

MAMMAL SURVEY REPORT IN RESTORASI EKOSISTEM RIAU

Mammal Report



MAMMAL SURVEY REPORT IN RIAU ECOSYSTEM RESTORATION

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APRIL 2016

Fauna Flora International



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OVERVIEW

Peat swamp forest is one of a unique type of forest in Sumatra. In fulfilling the basic data related to mammal diversity in Restorasi Ekosistem Riau (RER) in Kampar Peninsula, a survey had been conducted to identify and describe the latest condition of mammal diversity, its potentials, and its threats. The existence of key animal, especially mammals can be used as the benchmark of ecosystem health within the landscape. Data collection initiated based on observations with line transect, recce walk methods, and an additional list of mammals obtained using camera trap. It is known that there are 70 mammal species. Order rodentia is the order with the most number of species. From all observed species, commonly insectivores and omnivores have the ability to live on trees (arboreal). There need to be a facility to do monitoring and further research to do a study of the role of mammals in particular a frugivorous in a forest restoration process in order to maximize the role of forest regeneration in mammals.



1.1 Background

Peat swamp forest is a unique and fragile ecosystem which under threat by human disturbance. Sumatra had the largest peat swamp forest with 7,151,887 ha. However, due to illegal logging, habitat changes into agriculture, plantation and also due to forest fire caused loss of peatland of Sumatra, which suffered the greatest compared to Kalimantan and Papua. Sumatra lost about 78% from its previous initial area (Purba et al., 2014). Riau Province has the largest peatland area which had 4,004,434 ha in Sumatra and about 671,125 ha exist in Kampar peninsula (Tropenbos International Indonesia Program, 2010).

The Kampar peninsula is part of the largest peatland forest for Riau, which is an important area for biodiversity conservation. This area also an important habitat for Sumatran Tiger and other endangered species. Birdlife International also found that this landscape met the criteria as an Important Bird Area (IBA). 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).

Riau ecosystem Restoration Riau (RER) is a non-profit organization formed by APRIL in 2013 with an area of about 150,000 hectare. 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 the supports of the RER in the Kampar peninsula had obtained a license of IUPHHK-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 is very important as RER concession is about 29% of coverage of the Tasik Besar Serkap-Forest Management Unit. RER had been collaborated with Fauna & 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.

This assessment will help RER in restoring 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 become 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

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

1.2 Aim

In order to meet the need for basic data to diversity of mammals in Kampar Peninsula, FFI-IP carried out a dedicated survey to identify and describe the current state of biodiversity and its potential population and threats.



II. METHODS

2.1 Study Site

The area of Riau Ecosystem Restoration (RER) consists of PT. Gemilang Cipta Nusantara (GCN), PT. Sinar Mutiara Nusantara (SMN), and PT. The Best One UniTimber (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% and annual rainfall ranges between 1.949-2.951mm/ year. Monthly average for air temperature ranged from 26.1 until 27.5 °C with annual average 26.7°C (PT. GCN, 2012).

In general, there are three main types of ecosystems in Kampar Peninsula which are mangrove forest, peat swamp forest and riparian forest. For RER area, main ecosystem is in the form of peat swamp forest 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 have a high economic value such as Ramin (*Gonystylus* sp.), other dipterocarp species (*Shorea* spp.), durian (*Durio* sp.), kempas (*Kompassia malacensis*) 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 reptiles like False Gharial (*Tomistoma schlegelii*) and Box Turtle (*Batagur borneoensis*) can also be found in this area (Tropenbos International Indonesia Program, 2010).

a. Survey in PT. Gemilang Cipta Nusantara

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 the surrounding of PT. GCN. Survey was conducted from May to June 2015 with approximately effective time of the sampling of data for 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.).

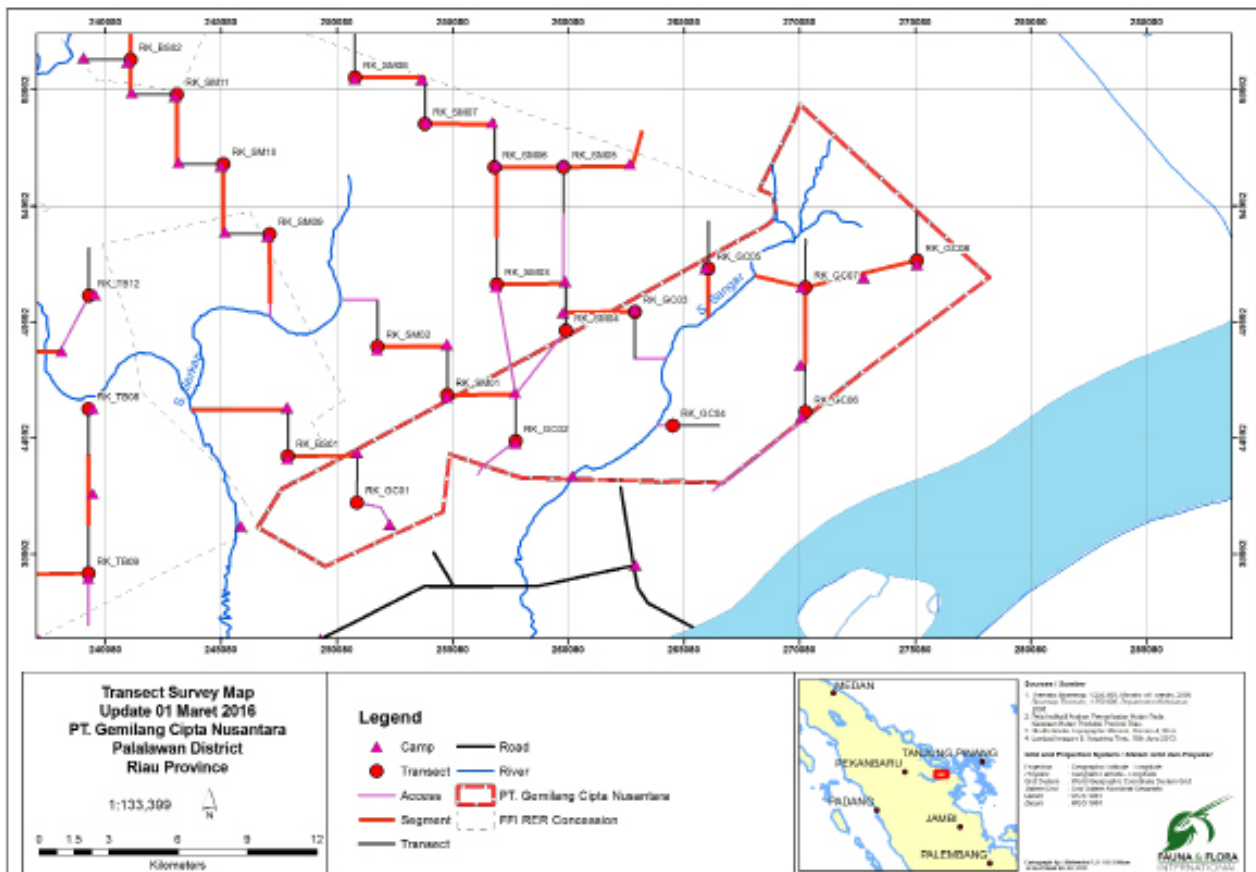


Figure 1 Distribution of nine transects in PT. GCN and one transect RK_BS01 are outside the concession area.

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 dan GC_04. The condition of the forest floor is largely inundated to a depth at least 30-40 cm in transects RK_GC03 dan GC_04, while other transect remained dry.

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 transects RK_GC02, RK_GC04, RK_GC06, RK_GC07 dan 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 parallel 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

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 lake Tasik Besar. The survey was conducted during August-October 2015 by the effective time for 26 days.

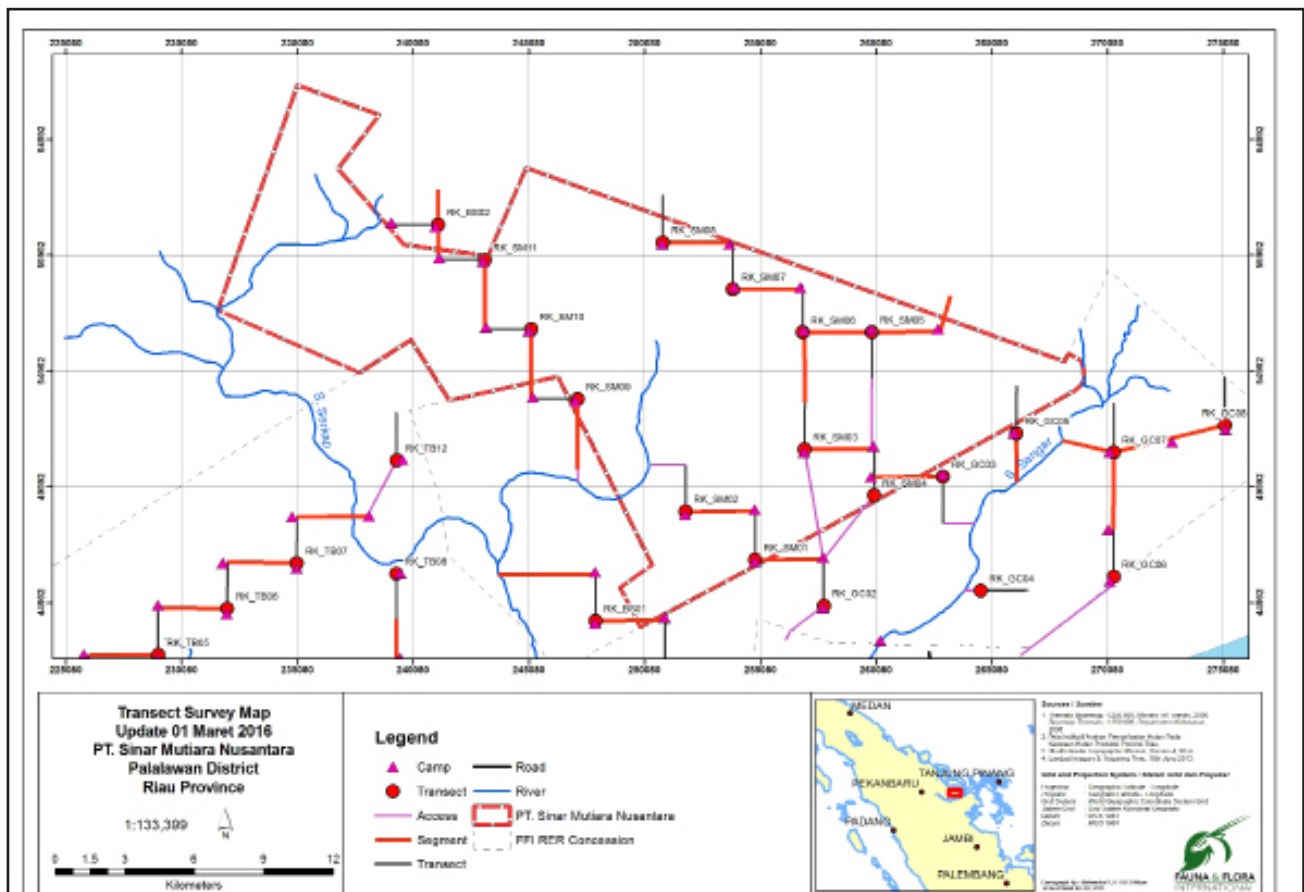


Figure 3 Distribution of transects in the area of PT. SMN.

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 locations, 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 *Shorea teysmanniana* (Meranti), *Tetramerista glabra* (Punak), and *Calophyllum ferrugineum* (Bintangur) with shrubs such as *Pandanus* sp.

The dominant vegetation in the form of *Pandanus* sp in PT. SMN found in transects of RK_SM04, RK_SM06, RK_SM07. Transect of RK_SM05 dominated with smaller pandan while others like in RK_SM11 and RK_BS02 had vegetation ranging from shrubs, pandan and salak trees. *Nepenthes* sp. also found in S



Figure 4 Condition of a transect with several small stands of trees with its diameters between 5 to 10 cm and water puddle as a habitat for amphibians and reptiles.

c. Survey in PT. The Best One Unitimber

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 the transects, except for transects of RK_TB08, RK_TB09, RK_TB10, RK_TB11 dan RK_TB12.

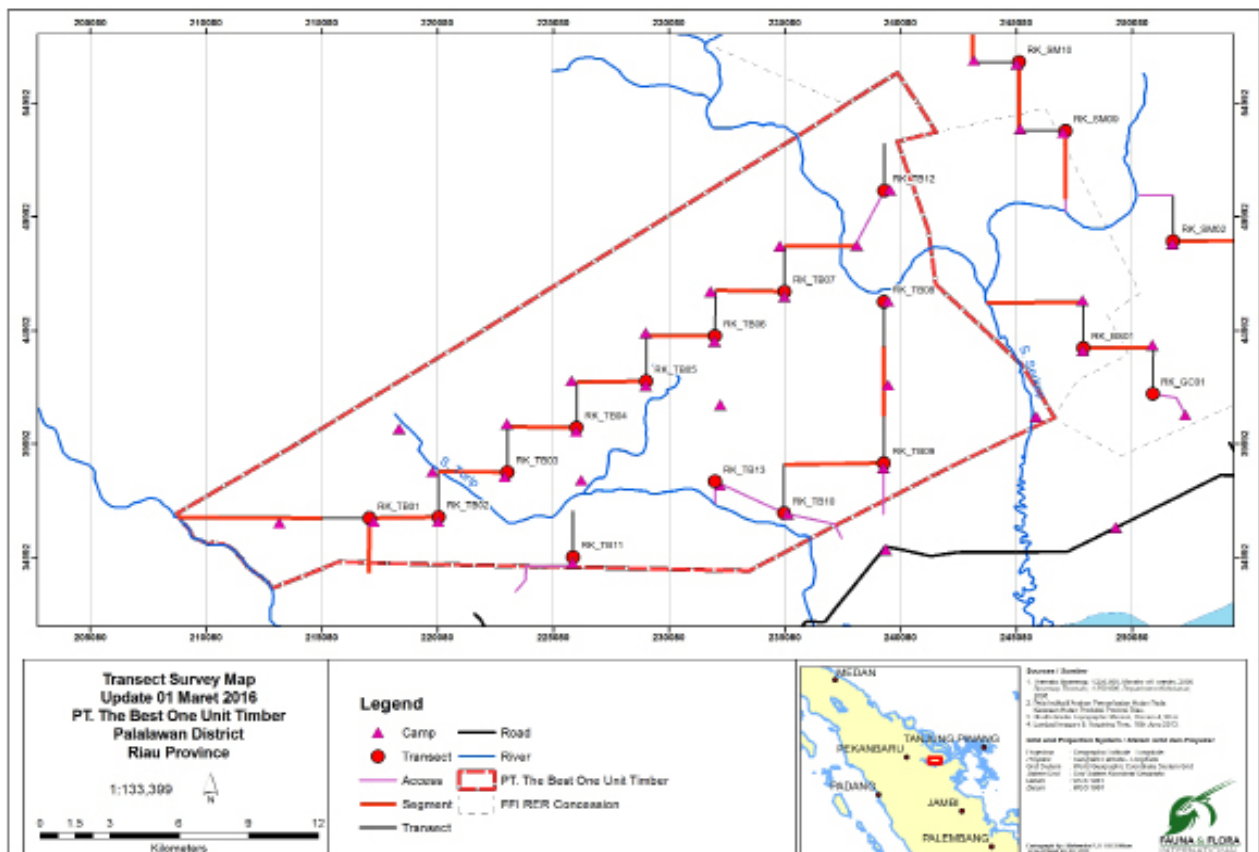


Figure 5 Distribution of transects in the area of PT. TBOT.

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



Figure 6 Dominations 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

Data collection for fauna and flora refers to the line transect method. A total of 32 transects with 2km 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.

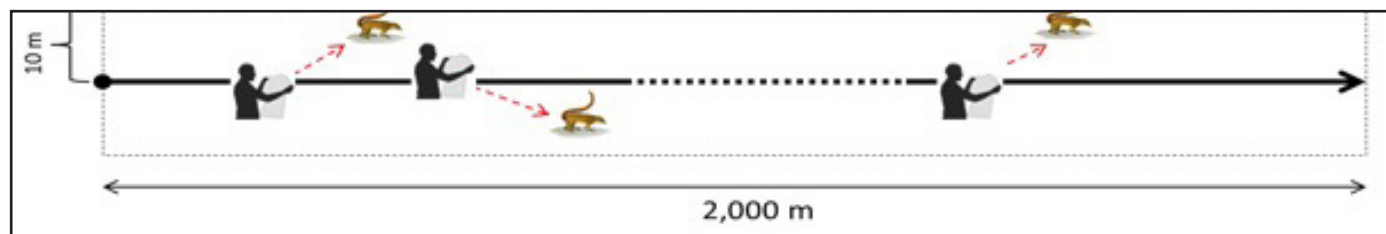


Figure 7 the line transect survey Method.

Kasmin and Harp trap is used to help locate small mammals that are on the path of observation. Kasmin used to trap small terrestrial mammals. Kasmin traps are placed with a distance of 20-30 m between traps, and alternately on each side of the line (Aplin et al., 2003). Distance of the Kasmin traps with about 10 meters. The number of Kasmin trap used 30 pieces in line transect. The bait used in trap alternately between each trap, are salted fish and peanuts that have been fried. Every 24 hours, the bait in the trap is replaced with a new one. Mammals that are caught will be conducted measurements of body, such as the length of the tail, legs, body, back and ears.

For the installation of the trap of harp, performed with a distance of 50 to 100 metres for each installation. The number of traps used for each line as much as one or two traps. Harp trap used to trap bats. Bats that are caught will be measured to known species. The measurement is done on the lower arm, tail, ears, and the lapet (leaf nose) (Suyanto & Kartikasari, 2001; Huang *et al.*, 2001). To know the bat species that is caught using a bat identification book "Kelelawar di Indonesia" as well as scientific journals about the diversity of bats on the Bukit Barisan region by Huang *et al* (2014).



Figure 8 the traps and pitfalls of harp group.

2.3 Data Analysis

To examine the level of diversity of mammal species on site surveys, existing data will be analyzed using multiple indexes. The indexes are the indices of diversity, dominance index, and the similarity index. The indexes are described below.

a. Shannon-Wiener (H') Diversity Index

Shannon-Wiener index used to measure the level of biodiversity a community taking into account the number of species (species richness), evenness and the number or proportion of individuals of each species (Harper, 2000). This index can be calculated with

$$H' = -\sum_{i=1}^n p_i \cdot \ln p_i$$

- H' : diversity index Shannon- Wiener
- ni : number of individuals-i
- N : the total number of individuals

The value of H' is numeric and no specific range, but from the previous study of biodiversity to date, no value of H' above 5. The lower the value of H' (close to 0), then the diversity becoming lower too.

b. Simpson Dominance Index (D)

This index is used to provide information about the existence of dominance by one or a few species in a community or ecosystem. The value of D has a range of 0 to 1. Getting closer to the value 1, then it indicates the existence of dominance by one or a few species in a community or ecosystem (Harper, 2000).

$$D = \sum_{s=1}^S (P_i^2)$$

D = Simpson Dominance Index

S = Number of species in the community

P_i = Proportion of individu per sampel within community

c. Similarity of Community (Jaccard Index)

Similarity index can provide information on the degree of similarity between the communities of species constituting (Harper, 2000). One similarity index used is the Jaccard similarity Index (SC_j). Jaccard similarity index (SC_j) can be calculated with the formula:

$$SC_j = (c/A+B-c) \times 100$$

A: the number of species that are at a first location

B: the number of species reported s at second location

c: the number of species that are in two or more locations

d. Cluster analysis

Analysis of clustering is used to see the similarity between communities that are present on site surveys. The classification of this community can be based on similarity of mammal species that existed on some transect on site surveys. Analysis of the simple grouping was making a graph tree (dendrogram) (Harper, 2000). To make a dendrogram based on Jaccard's index, we use a PAST 3 software.

e. Accumulation curve

Accumulation curve is the graph of the number of species observed on the basis of survey effort undertaken which can be a multitude of time observation (Colwell & Coddington, 1994; Hsieh & Li, 1998; Harper, 2000). The species accumulation curve will assess the number of the observed wildlife species added to the day of observation. For seeing the curve, we use the PAST 3 Software.



III. RESULTS AND DISCUSSIONS

3.1 Result

a. Mammal Diversity in Riau Ecosystem Restoration Region

Based on the survey being conducted in three company areas within different RERs, we identified 70 mammal species from 8 different orders, four species of which are found only from the photo of camera trap. The number of species is known based on observations with line transect, recce walk methods, and an additional list of mammals obtained using camera trap. Kasmin trap and harp trap were utilized to observe small mammals species that existed in the transect. Meanwhile, some big mammals such as Sumatran Tiger and other types of wild cats tend to be avoiding human, and hence made it more difficult to be observed directly. In order to be able to observe these species, it will be easier to use camera traps (Seidensticker, 1999; Karanth et al., 2002).

In the report the data are analyzed only data derived line transect method. The data retrieved from the camera trap and recce walk method only contains list of mammal species (appendix 1 list species of mammals found in RER). From the three surveyed RER areas it was known that TBOT area has the most number of mammals with 44 mammal species. Meanwhile in GCN and SMN areas 40 and 37 mammal species had been sighted respectively. The order of Rodentia is an order with the most species number with 18 species. Mammals that belong to order Rodentia are known to be found a lot in logged areas such as in RER area (Meijaard et al., 2005).

There are 35 mammal species in RER area that is categorized as threatened animal, protected and or animals with limited dispersion (endemic) (Appendix 1). Animals that belong to this category are animals with the status of Vulnerable, Endangered, and Critically Endangered on the International Union for the Conservation of Nature (IUCN). Protected animals are mammal species that is listed in the attachment of government regulation no 7 year 1999 and or included in the list of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Consortium to Revise the HCV Toolkit for Indonesia, 2008). Within these three regions it is known that there are 2 mammal species that are categorized as Critically Endangered. Meanwhile, there are 26 animals that belong to categories of threatened, protected, or endemic (animals with limited dispersion) in the TBOT region, and in GCN and SMN there are 25 and 22 species respectively.

The number of mammal species in each region are different, and so are the species that inhabited every regions. This can be seen from the value of Jaccard Similarity Index that can be seen at dendrogram on figure 6. Based on Jaccard Similarity Index, TBOT region has a more diverse mammal species than those in GCN and SMN regions. This is because TBOT is a region which location is furthest to community activity. Mammals tend to live in areas that are far from human activity (Laurance et al., 2008, 2009).

Based on the historical data from Landsat Imagery, it was recorded that SMN region had been logged until early years of 2000. On the other hand in GCN and TBOT regions, the logging activity has been previously terminated. When the survey was being conducted it was found that there were illegal loggings in GCN region. The disturbances on the two regions of GCN and SMN had caused these regions to have lower species richness compared to TBOT region. Brodie et al in year 2015 stated that new mammal species richness could come back to its original state after 10 years since the logging. Based on the calculation with Jaccard

Similarity Index it is known that mammal species in GCN region tend to be different than the other two regions, this can be seen on figure 9.

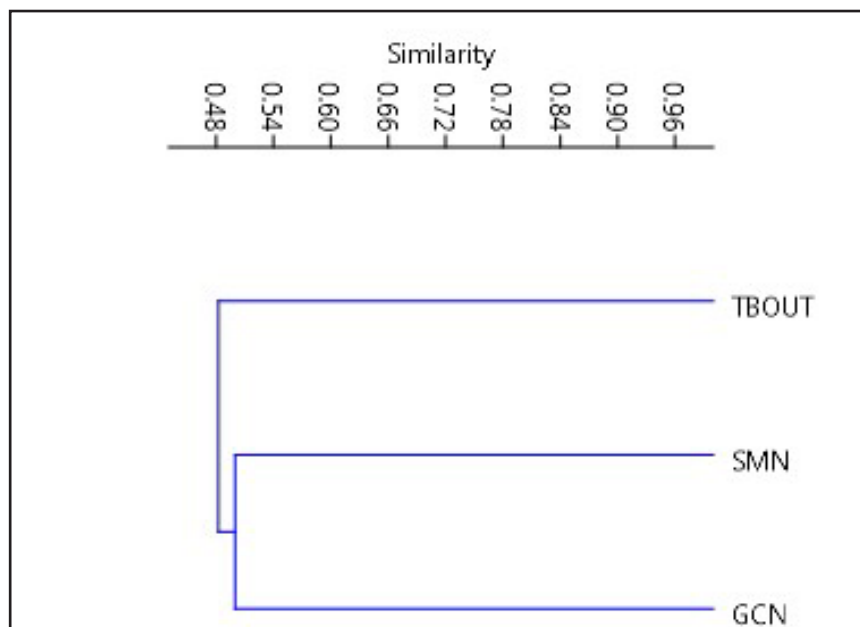


Figure 9 Dendrogram of Jaccard Similarity Index on three regions of RER.

b. Mammal Diversity in PT. Gemilang Cipta Nusantara (GCN) Region

Based on the survey that has been performed, it is known that GCN has 40 mammal species and 25 species that is categorized as threatened, protected and or animals with limited dispersion (endemic). The survey was conducted on eight transects in GCN region, and one transect in the skirt of GCN region. The number of species and individual mammals in each transek can be seen in table 1.

Table 1 The number of species that existed on each transects in GCN region.

	RK_BS01	RK_GC01	RK_GC02	RK_GC03	RK_GC04
N	2	2	2	2	2
Σ Species	12	7	10	10	8
Σ Total Individuals	32	19	18	17	12
The Average Individual	16.00	9.50	9.00	8.50	6.00
SD Individuals	2.29	1.34	1.11	1.17	0.72

Tabel 1 (cont.)

	RK_GC05	RK_GC06	RK_GC07	RK_GC08
N	2	2	2	2
Σ Species	14	14	20	15
Σ Total Individuals	35	23	47	46
The Average Individual	17.50	11.50	23.50	23.00
SD Individuals	1.95	1.01	2.12	3.14

From the total of nine transects observed, it is known that transect RK_GC07 has the highest species richness with 20 species. The highest mammal abundance is located on transect RK_GC07 with 47 individual. Transect RK_GC01 is a region with the lowest mammal species richness. The lowest mammal abundance is on RK_GC04 region where there were only 12 mammal individuals being sighted.

The number of species is increasing until the last days of the survey, which can be seen on the accumulation curve graph. The increase of number of species kept on occurring until the last day of observation. It is estimated that there are mammal species in GCN region that has not been found yet.

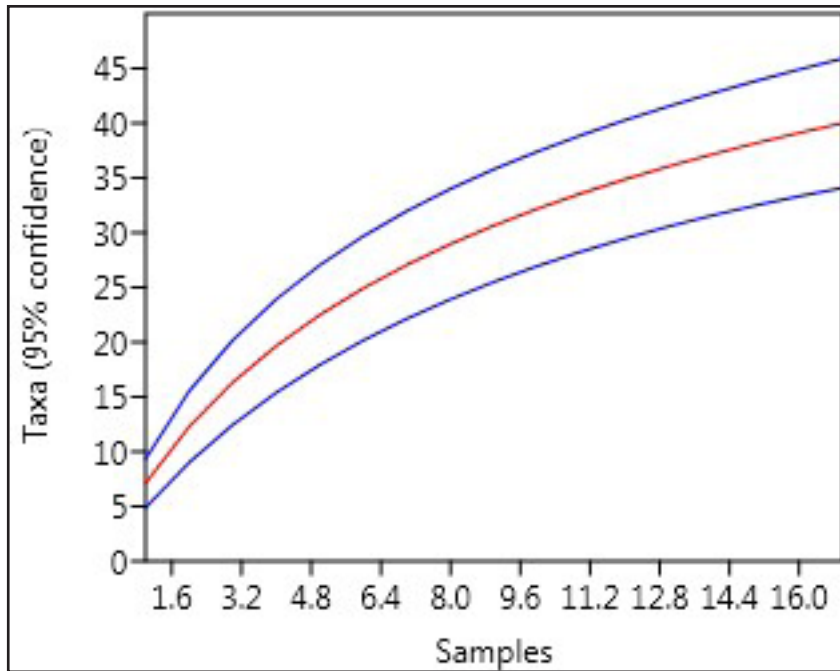


Figure 10 Curve of mammal species accumulation in GCN region.

On each observatory transects, whether those that are located in the GCN region or transect that is located on the skirt area, the species are found to be quite different. RK_GC07 is transect with the highest diversity index value with Shannon-Wiener index value as much as 2.63. Region with the lowest diversity index value is RK_GC01 transect, with 1.71. There are dominating species on RK_GC06, and RK_GC07 transects, they are *Sus barbatus* and *Hylobates agilis*.

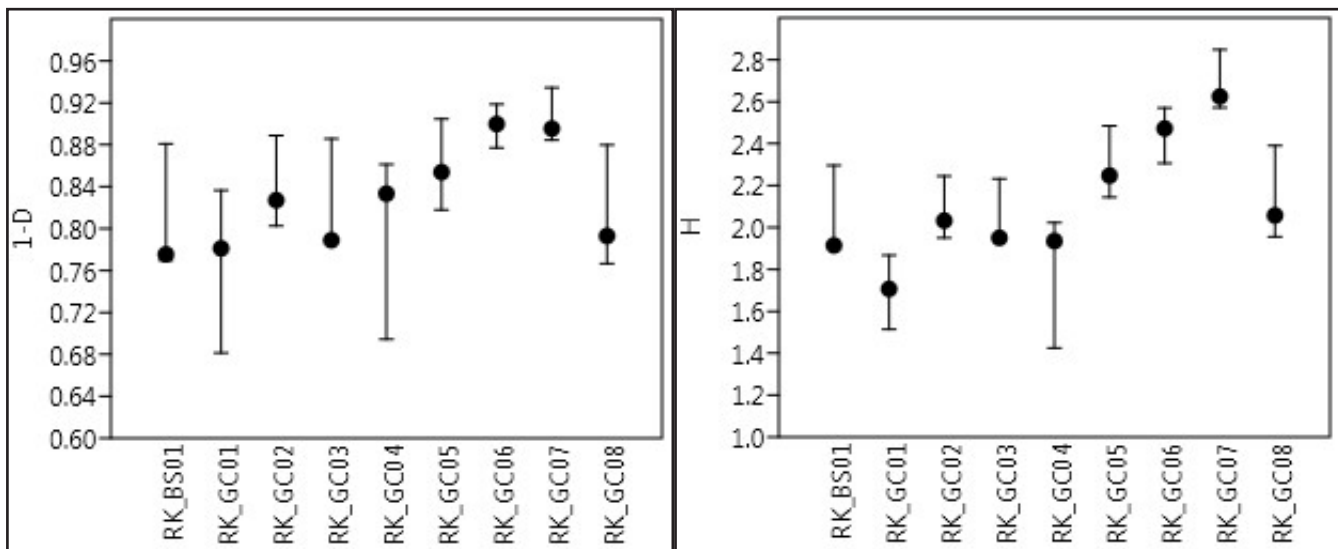


Figure 11 Simpson's Dominance Index (1-D) and Shannon-Wiener Diversity Index (H) in GCN region.

Mammals in GCN region consist of seven orders from variable species. Mammals that belong to order rodentia have the highest number of species. Family of Muridae and Sciuridae from order rodentia is commonly found. There are 15 mammal species that belong to order rodentia. Based on the amount of individuals, mammals from order primates are dominant.

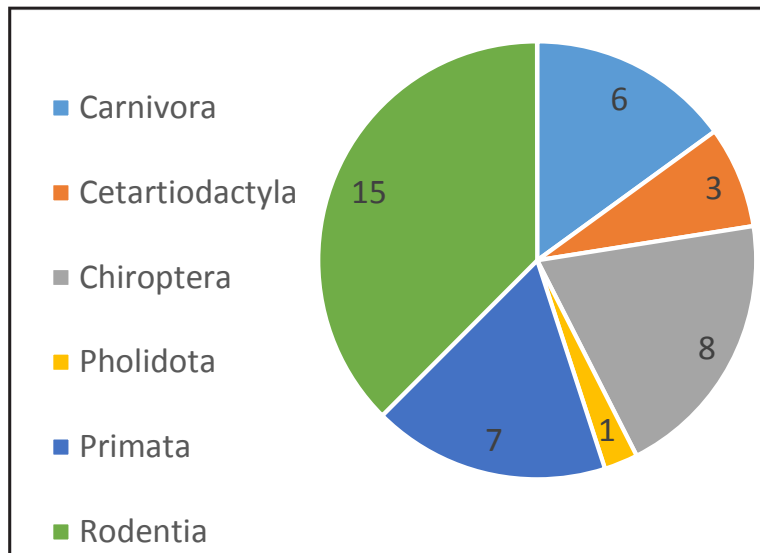


Figure 12 Number of order comparison of mammals found on GCN region.

The mammal diversity on each transects are not very different, as can be seen in the dendrogram. The dendrogram was arranged based on Jaccard Similarity Index. The values of Jaccard Similarity Index in some transects of GCN regions are less than 0.5. This means that the mammal species on each transects are not different. But based on the dendrogram, the transects that are located in the upstream of Sangar river have a higher similarity, such as those of RK_GC05, RK_GC07, and RK_GC08. When the transect locations are put into view, it can be known that transects that are located further from human access have a higher similarity of inhabiting species.

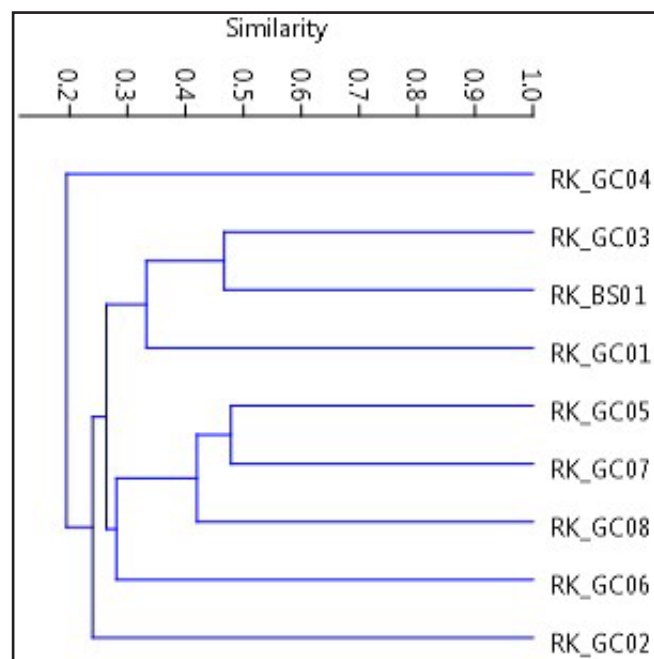


Figure 13 Jaccard Similarity Index on GCN region.

c. Mammal Diversity in PT. Sinar Mutiara Nusantara (SMN) Region

According to the survey, SMN region has 37 mammal species in which 22 species are categorized as threatened animal, protected animal, or animals with limited dispersion (endemic). The survey was conducted in 10 transects inside SMN region and 1 transect (RK_BS02) on the skirt area of SMN. Since there are animals in this region that are categorized as threatened, protected or endemic, this region are considered to have the potentials as a habitat for valuable mammals for restoration and conservation purposes.

In SMN region, the highest mammal species richness is found on RK_SM10 transect with 16 species. The highest mammal abundance is detected on RK_SM10 transect where 40 mammal individuals were record-

ed. RK_SM09 is the transect with the least mammal species richness and the least mammal abundance. Based on the site observation that was conducted in RK_SM09, trees with diameter less than 30 cm were hardly found. The plant dominating the area was at the level of stakes and poles. The number of species and individual mammals in each transek can be seen in table 2.

Table 2 The number of species that existed on each transects in SMN region.

	RK_SM01	RK_SM02	RK_SM03	RK_SM04	RK_SM05	RK_SM06
N	2	2	2	2	2	2
Σ Species	12	12	13	12	9	7
Σ Total Individuals	34	24	23	17	25	32
The Average Individual	17.00	12.00	11.50	8.50	12.50	16.00
SD Individuals	2.14	1.38	1.67	0.73	1.43	2.25

Table 2 (cont.)

	RK_SM07	RK_SM09	RK_SM10	RK_BS02	RK_SM11
N	2	2	2	2	2
Σ Species	9	7	16	10	11
Σ Total Individuals	24	33	40	15	39
The Average Individual	12.00	16.50	20.00	7.50	19.50
SD Individuals	1.58	2.65	1.79	0.86	2.69

On the accumulation curve, there seem to be an increasing movement until the last days of observation. This means that it can be predicted that the number of mammal species that was found on SMN region was kept on accumulating. The reason behind this was that many mammal species have the tendencies to avoid encountering human.

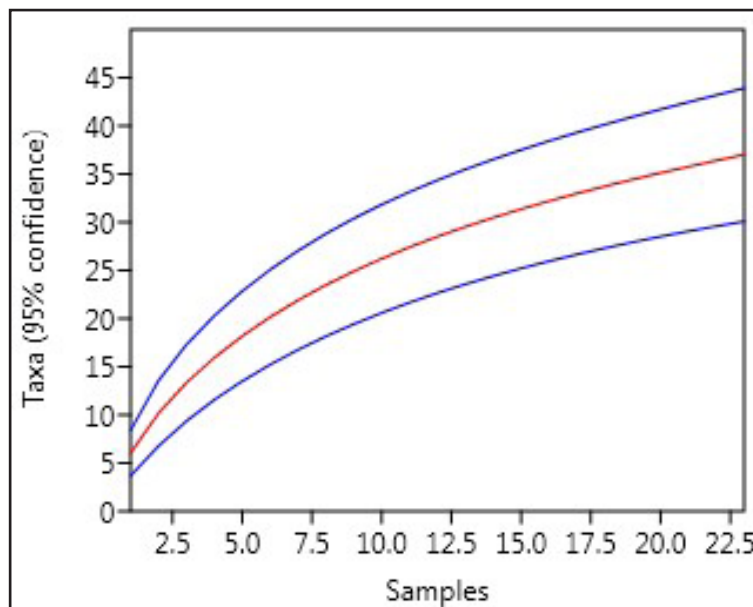


Figure 14 Curve of accumulation of mammal species in SMN region.

The diversity on each transects of SMN region differs. This can be seen from the graph above. RK_SM09 transect has the highest diversity index value with 2.51. The lowest diversity index value is 1.71 on RK_SM07 transect.

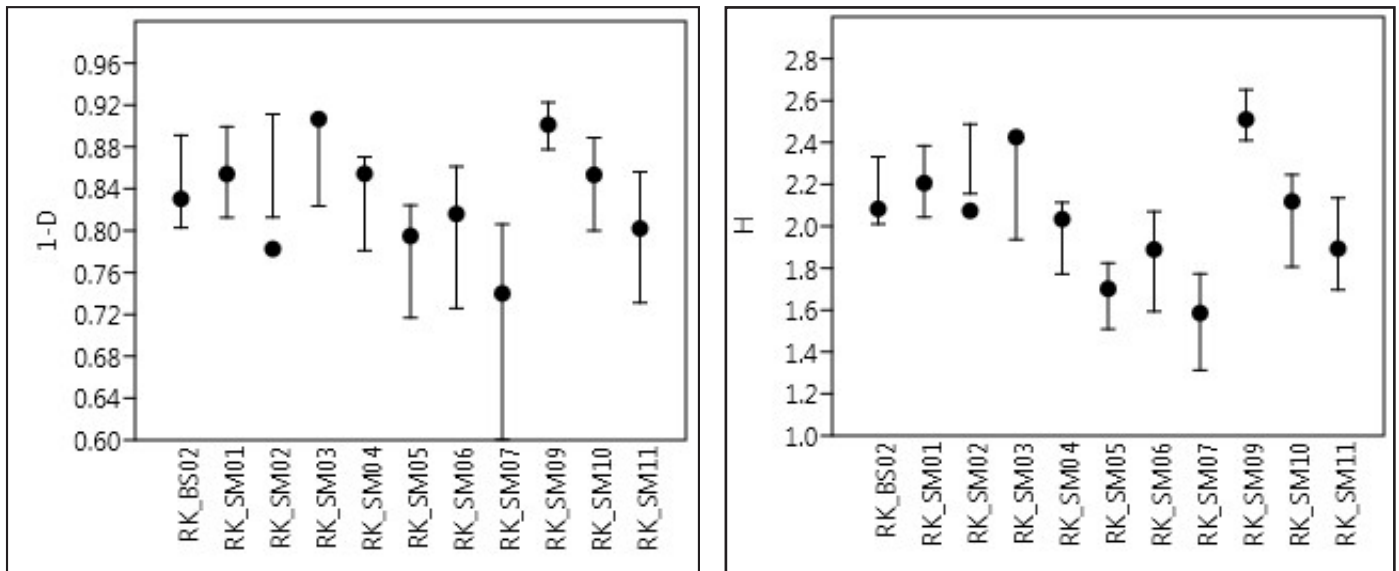


Figure 15 Simpson's Dominance Index (1-D) and Shannon-Wiener Diversity Index (H) in SMN region.

Mammals from order of rodentia are found the most in SMN region with 10 species. Order of rodentia has the capability to survive in peatland forest.

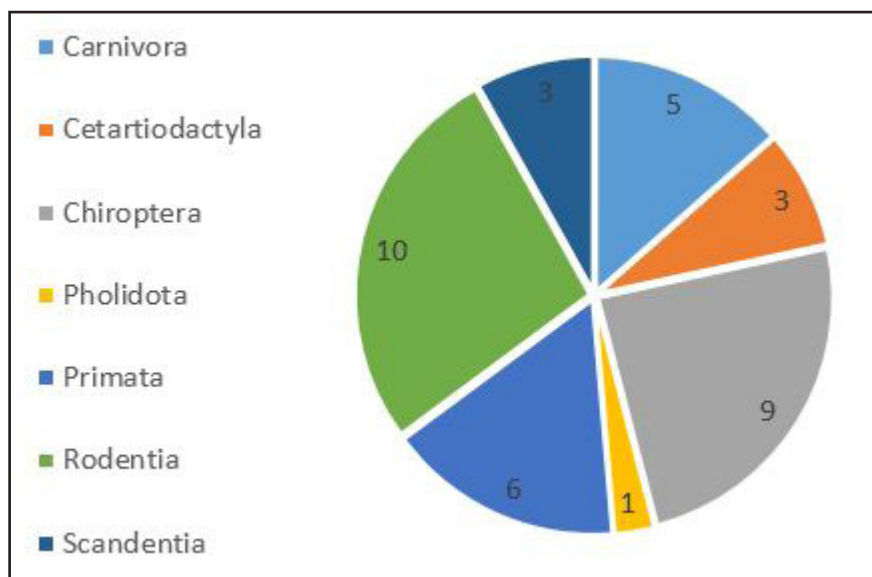


Figure 16 Comparison of number of mammal orders that were found on SMN region.

Mammal species on each transects of SMN regions is not very different with each other. This is suggested based on dendrogram that was made based on value of Jaccard Similarity Index. Based on the calculation it is known that value of Jaccard Similarity Index on each transects is less than 0.5. Only the transek RK_SM03 have different mammals community at transek which is in the other.

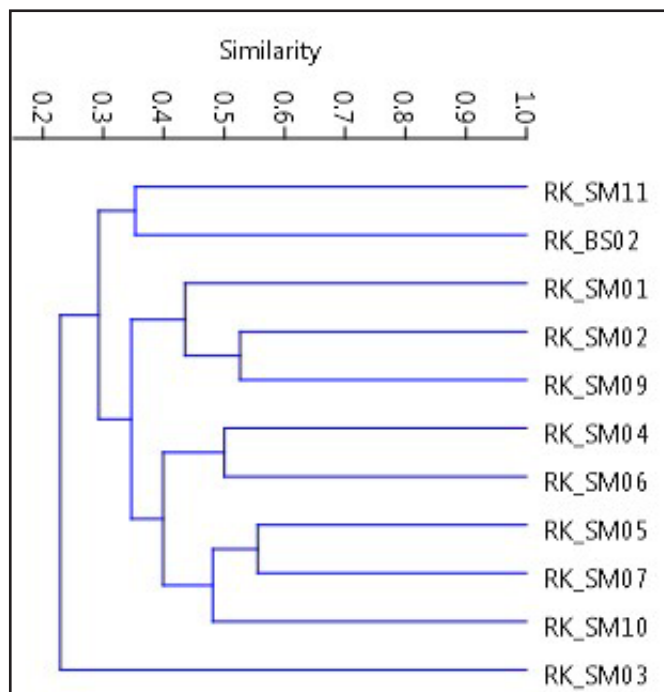


Figure 17 Dendrogram of Jaccard Index on SMN region.

d. Diversity of Mammals in PT. The Best One Uni Timber Region

From 12 transects in TBOT region, there are 44 mammal species. This is the region with the highest number of mammal species. Including within the category endangered, protected and or have limited the spread (endemic), that as many as 26 species.

In TBOT region, the highest mammal species richness came from transect RK_TB01 and RK_TB-07 with 16 mammal species. The highest species abundance is on RK_TB03 with 55 mammal individuals. RK_TB09 transect is an area with the least species richness and RK_TB09 transect is an area with the least abundance. Based on the observation it is discovered that the species richness in Turip River area is higher than transects in Serkap River area. The number of species and individual mammals in each transek can be seen in table 1.

Table 3. The number of species that existed on each transects in TBOT region.

	RK_TB01	RKTB02	RK_TB03	RK_TB04	RK_TB05	RK_TB06
N	2	2	2	2	2	2
Σ Species	16	12	12	14	11	15
Σ Total Individuals	54	43	55	35	22	50
The Average Individual	8.00	6.00	6.00	7.00	5.50	7.50
SD Individuals	3.18	2.73	3.21	1.91	1.15	2.68

Table 3 (cont.)

	RK_TB07	RK_TB08	RK_TB09	RK_TB10	RK_TB11	RK_TB12
N	2	2	2	2	2	2
Σ Species	16	6	1	7	9	10
Σ Total Individuals	51	13	7	13	14	19
The Average Individual	8.00	3.00	0.50	3.50	4.50	5.00
SD Individuals	2.79	0.85	1.06	0.76	0.74	0.97

The same trend also happened during survey. It can be seen from the Accumulation Curve that shows an increase until the last days of observation (figure 18).

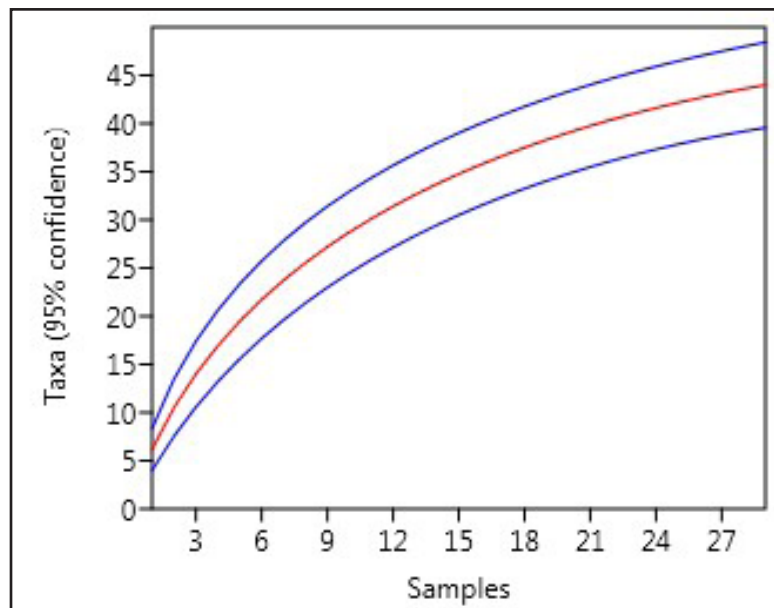


Figure 18 Accumulation curve of mammal species in TBOT region.

The highest diversity is found on RK_TB01 transect with diversity index value 2.26. RK_TB09 transect has the lowest diversity index value with 0. In transect RK_TB09 found only one mammal species. Based on Simpson Dominance Index at each transek in TBOT known there are several species of mammals that dominate, it is visible from the Simpson dominance index value that approximates the value of one. Several species of mammals in this region is found in a number of quite a lot.

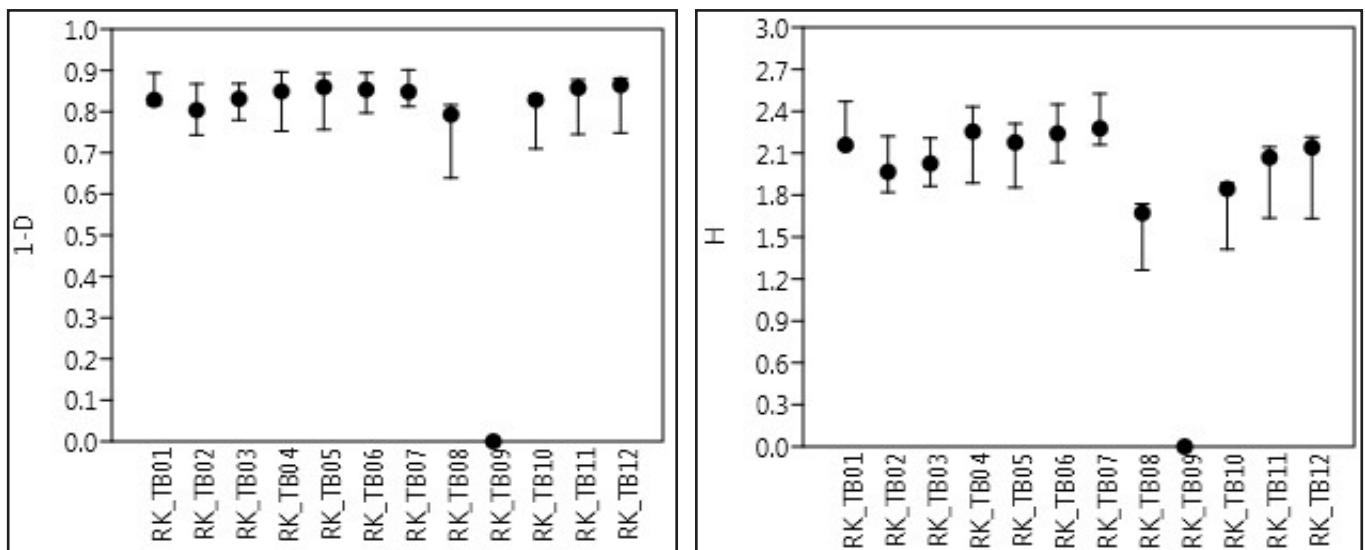


Figure 19 Simpson's Dominance Index (1-D) and Shannon-Wiener Diversity Index (H) in TBOT region.

The mammal species on each transects in TBOT region is quite different between one another. It can be seen from the dendrogram that was made based on Jaccard Similarity Index. Only RK_TB05 and RK_TB06 transects have high level of similarities. The difference between species is also observed on the transect locations. Transects that are located on Turip River area has a higher similarities when compared to transects in other areas. Transects that are located in Turip River area are RK_TB03, RK_TB07, RK_TB05, RK_TB06, RK_TB01, RK_TB02, and RK_TB04.

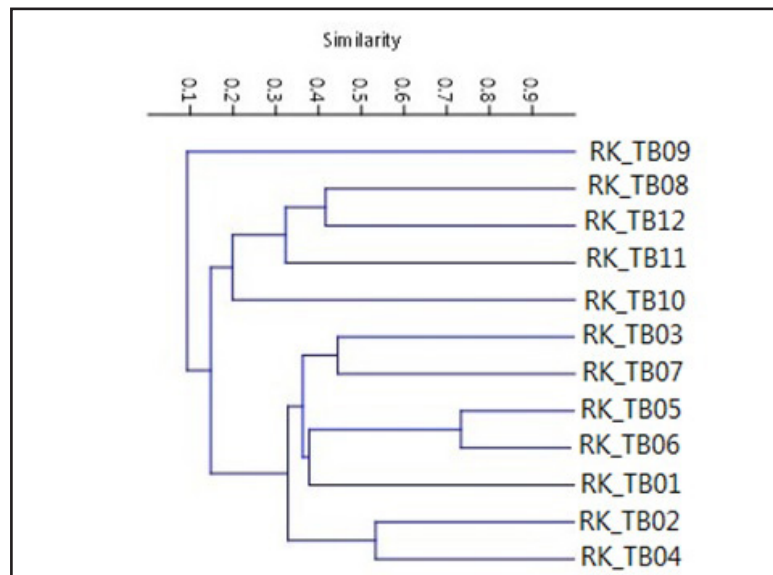


Figure 20 Dendrogram of Jaccard Similarity Index on TBOT region.

The highest number of species on TBOT is the order of rodentia with 15 species. The second highest number of species comes from order carnivora with 10 species. Many species of carnivore and species of rodentia have their own relations. Order carnivora usually belongs to family of viverridae, and mustelidae. Mammals from that family are arboreal.

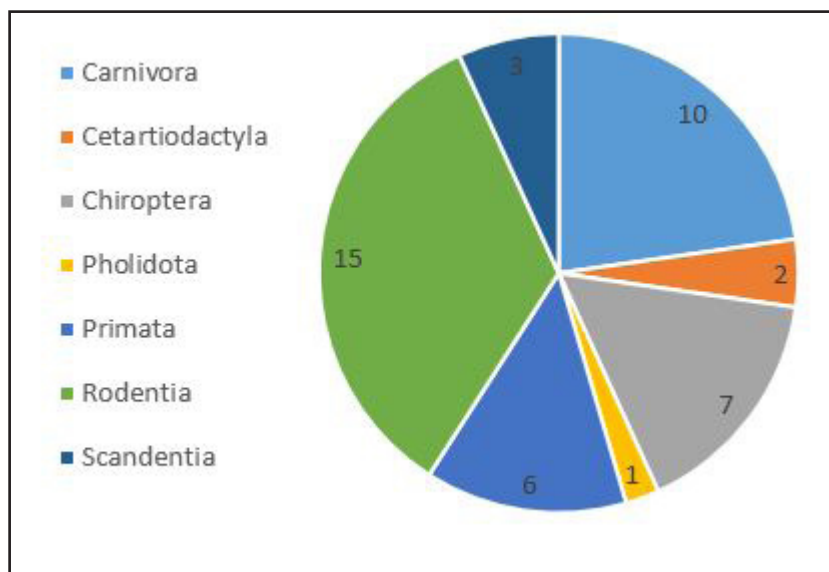


Figure 21 The number of mammal species based on the orders in TBOT region.

e. Threats

In some survey locations there are some threats for the existence of mammal population. One of the threat is the illegal logging activity that was found on RK_GC06 transect. Illegal logging was found around the community settlements. The illegal logging perpetrators have access to enter the forest through a canal that was not in use anymore.

Based on the information from local people, the perpetrators entered through Pulau Muda Village. The illegal loggers usually came from the outside of Pelalawan district. Another threat to mammals is hunting. Animals that are hunted are pangolin, deer, mouse deer, tiger, and some species of primates such as long-tailed monkey and ape. Some animals are hunted to be traded or to be pets.



Figure 22 Trails of illegal logging route and canal that were used for transporting logs.

Primates such as sunda pig-tailed Macaque (*Macaca nemestrina*) and long-tailed macaque (*Macaca fascicularis*) are hunted to be pets. A long-tailed monkey was found to be a pet of a shop owner near a bridge of Serkap River. Based on the information from the shop owner, the monkey was captured near Serkap River. The long-tailed macaque is categorized as a juvenile.

Mouse-deer (*Tragulus* sp.) and sambar deer (*Rusa unicolor*) hunting are rapidly occurring in accessible areas by the community. By the end of December 2015, it was known that villagers of Puskopol had caught a deer. The residents who live nearby the location caught a deer that crossed the area. The deer was then being consumed by the residents of the area. Puskopol village is one of the settlements close to SMN and GVN regions.



Figure 23 Mouse-deer that was caught near Serkap River by fisherman.

Pangolin (*Manis javanica*) and Sumatran Tiger (*Panthera tigris sumatrae*) hunting were indeed rarely conducted in the survey area. But based on information of some residents, there had been some residents that

caught those two animals and traded their body parts to the city of Pangkalan Kerinci and Pekanbaru. The hunting generally took place near the forest around the village area. The threat of hunting on these two animals can be happening in the restoration area because there are accesses through rivers and old canals which had not been guarded well.

3.2 DISCUSSION

a. Comparison of mammal species diversity in Peatland Ecosystem

Based on the survey that has been done on three company regions within different RERs, it is studied that there are 70 mammal species in which 35 of it are categorized as threatened animal, protected, and or animals with limited dispersion (endemic) (attachment 1). Four species of mammals are derived from the results of a photo camera trap In all three survey areas, TBOT company region has the highest diversity with 44 mammal species. Region of GCN and SMN companies have 40 and 37 mammal species respectively. Compared to TBOT region, the other two regions (GCN and SMN) has less species richness. All three regions in RER are former areas of logging that occurred until early 2000. The mammal species richness in the former logging area will decrease to 11% compared to areas that has not been logged before (Brodie et al., 2015).

Mammal species that was recorded in the Tropenbos International survey is a little different from the survey that we conducted. On that survey it was known that there are as much as 45 mammal species (Tropenbos International Indonesia Programme, 2007). If compared to other regions with the same ecosystem in Sumatera, the number of species data that shall be obtained from the survey shall be a lot more. As a comparison, in region of Suaka Margasatwa Giam Siak there were 32 mammal species found (Fujita et al., 2012). And the same condition such as in Berbak Sembilang National Park region where only 29 mammal species had been found (Panjaitan et al., 2012). Different result of collected number of species is generally caused by different methods that are used in data collection. Mammal is one of the organisms which have a great variability either in its dispersion or its activity patterns. In that case the methods used for mammal survey would differ. Until now there have only been a number of publications about mammal diversity as a whole, especially on peatlands ecosystem. (Surendra-Varman & Sukumar, 1995; Aplin et al., 2003; Gowda & Kumara, 2009).

Based on the existing mammal orders, rodentia is the order with the most number with 20 species. Followed by order of chiroptera and carnivora, mammals from that order have a special adaptation in order to survive living in peatlands ecosystem that existed in RER regions (Cheyne et al., 2010). List of number of mammal orders in RER regions can be seen on Figure 24. Characteristics of habitat RER causes types of rodentia are more dominant than on the type of frugivora.

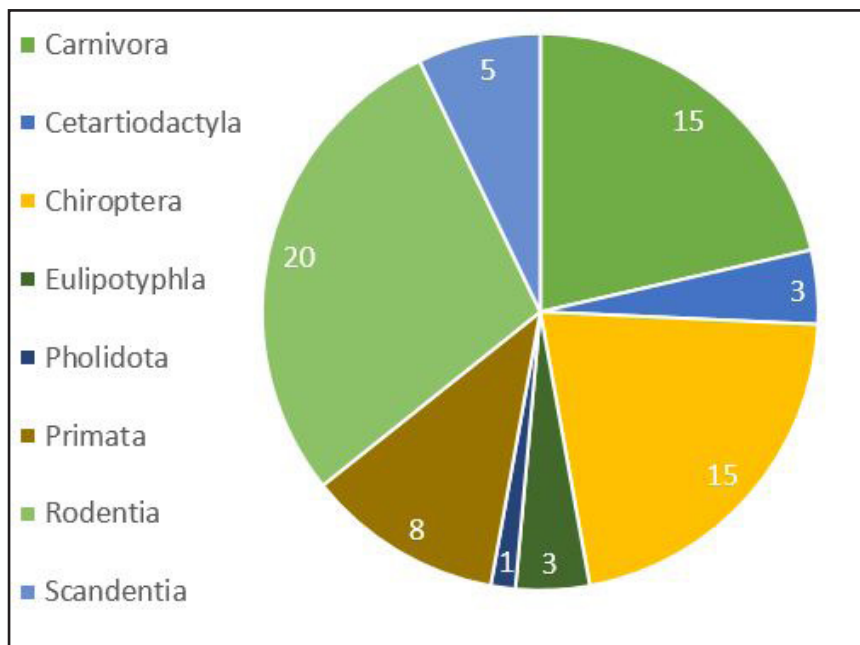


Figure 24 Comparison of mammal order in RER region

Bat species found is dominated by the bat microchiroptera. A total of bat species found are 15 species, and 13 of them was bat microchiroptera. Only 3 bat species from megachiroptera group are sighted. This number is very low compared to the number of other bat species in other parts of Sumatera Island. For example in the forest area around Bukit Barisan Selatan which is not a peatland ecosystem forest. On that area 53 bat species was found (Huang et al., 2014). Meanwhile for bats in peatlands in Sumatera there have only been a few publications until now.

b. Species Diversity and Habitat Quality

Small mammals such as *Maxomys whiteheadi*, *Sundamys muelleri*, and *Callosciurus notatus* are proved to adapt well in peatland forests. Peat swamp forests have changing water tables. In the purpose of adapting to peat forests that are continuously waterlogged, those mammals adapt by keeping grains (Van de Meer et al., 2008). Rats such as *Sundamys muelleri*, *Niviventer cremoriventer* are usually found on tree branches (arboreal) (Payne & Françis, 1997). Therefore, those species are able to adapt well on wet peatland conditions. That is also the case with other mammals where it is common to find them with the ability to live as arboreal. One of the mammals that are able to survive and not using forest floor are bats.



Figure 25 *Callosciurus notatus* consumes insects that are on the bark and *Sundamys muelleri* uses tree branching to move.

Mammals from the family of tupaidae and sciuridae can be found in almost every RER regions. Mammals from both families have the ability to live on tress (arboreal). Eleven species from the family sciuridae was found in RER region, this is one of the families with the highest number of species. Five species from family of tupaidae were found. Generally the mammal species from those two families are omnivores that can consume fruits and little insects (Duckworth & Hedges, 2003; Han, 2015; Han & Maryanto, 2015; Han & Stuebing, 2015a, 2015b). *Callosciurus notatus* was found to consume insects on the tree parts. *Callosciurus notatus* was indeed known to consume small insects such as ants (payne & Françis, 1997; Duckworth, Lee, et al., 2008).

Most of the bats that are found from the survey belong to microchiroptera group. There are only three bat species from megachiroptera, they are *Balionycteris maculate*, *Pteropus vampyrus*, and *Megaerops ecaudatus*. Microchiptera is generally insectivorous bats, while megachiroptera consumes fruits. Other than the species of megachiroptera that was found less, the number of individuals of megachiroptera were limited. Seeing the size dimension, microchiptera is generally smaller than megachiroptera (Payne & Françis, 1997; Suyanto & Kartikasari, 2001; Huang et al., 2014). At the previously logged forest in Peninsular Malaysia, the percentage of microchiptera is higher than megachiroptera where a 3 km² area can support 51 species of microchiroptera bats and 11 species of megachiroptera (Kingston et al., 2003).

Balionycteris maculata and *Megaerops ecaudatus* are examples of bat species from megachiroptera group that are found under the tree canopy. *Balionycteris maculata* has smaller body size which allows it to be found under high tree canopies. *Megaerops ecaudatus* is found to have fallen to the forest floor. The bottom arm length of *Balionycteris maculata* is only 41 mm (Huang et al., 2014), which allows the species to fly under the tree canopies.

The number of fruit bats that has been observed is not much because the number of fruit trees in the forest area is low. Based on personal communication with Hamidi and Kurnia on the survey analysis of vegetation and peat swamp community trees in the region of the RER, where an abundance of tribes in the region of RER myrtaceae known low. Plants from family myrtaceae are edible plants to be consumed by fruit bats. Besides, there is a factor of highly dense vegetation on survey location which would make it difficult for the fruit bats to move under the tree canopies since they generally are large in size.

Species that was found the most are bats with skin membrane between the thighs (interfemoral membrane). Bats from family vespertilonidae which is found a lot in RER region have this characteristic. The skin membrane is located at the bottom part of the body, and to be precise, it is located between both feet of the bat. The function of interfemoral membrane is to aid the bat to prey on insects, that is by holding them using its feet and putting them in the interfemoral membrane (Webster & Griffin, 1962).

Primates found on the RER region has adapted to peat swamp forest areas. All mammals are found in the RER area has the ability of arboreal. *Macaca fascicularis*, *Presbytis femoralis percura* and *Trachypithecus cristatus* are some primates that have been found. The ability of primates to move on trees makes it easy for them to move when water level on peatlands that they live in is rising. Other than that, the feeding variety of primates is highly ranged (Boonratana et al., 2014).

c. Important Species and Its Threat

Based on the existing data it is known that 35 species belong to animal category that have high conservation values. Some species of those mammals belong to threatened category of International Union for Conservation of Nature (IUCN), the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), and animals that are protected by the government regulation. Animals such as Sunda slow loris (*Nycticebus coucang*), Siamang (*Symphalangus syndactylus*), and Sumatran Tiger (*Panthera tigris sumatrae*) are animals with limited dispersion which can only be found in Sumatra Island (Boonratana et al., 2014; J. M. Goodrich et al., 2015; nekaris, 2015; Nijman & Geissman, 2015).

Based on the IUCN status there are two species that are categorized as Critically Endangered, they are *Panthera tigris sumatrae* and *Manis javanica*. These two animals are categorized to Critically Endangered because of their high rate of being hunted. These two animals were detected due to their trails that were left on site. The reason behind this is because both animals are the type of animals that are difficult to be found directly, because they tend to avoid encounters with human. Especially *Manis javanica* which is more active in the night (Sawitri et al., 2012; Challender et al., 2015; J. M. Goodrich et al., 2015).

Sumatran Tiger and Pangolin are Flagship species that have high values as important animals for conservation area purposes (Ducarme et al., 2013). The exploration range of Sumatran Tiger is considered wide. The wide range of exploration depends on the location of the preys. As there is less number of preys, the tiger will explore wider range of forest area. Due to its wide exploration range, the Sumatran Tiger is considered as an umbrella species for other mammals with smaller exploration range (Seidensticker, 1999; J. M. Goodrich et al., 2015).

Some mammals have the tendencies to avoid encountering humans. One of the animals that tend to avoid humans is mammals from the cats species (felidae) (Sanderson et al., 2008, Hearn et al., 2015; J. Goodrich et al., 2015). It will be easier to observe animals with this behavior by using trap camera. During the observation on three RER regions, direct sightings of animals from felidae are hardly occurred. There were only two mammal species from felidae that has been directly sighted; they were *Prionailurus bengalensis*, and *Neofelis diardi*.

The encounter with both of these animals only took place in SMN and TBOT regions. Other than that, large carnivores from felidae are very dependent to their prey location as food source. For example Sumatran Tiger that is used to feed on animals with the same body size as itself or smaller (Karanth et al., 2002).

Tragulus sp., *Sus barbatus* and *Rusa unicolor* the most potential prey for *Panthera tigris sumatrae*. The existence of these three species will be very important to *Panthera tigris sumatrae* (Kawanishi, K., Gumal, M. & Oliver, 2008; Timmins et al., 2015). *Tragulus sp.*, *Sus barbatus*, and *Rusa unicolor* are included to animal category that will avoid humans. Direct sighting only occurred with *tragulus sp.*, and *Sus barbatus*, meanwhile for *Rusa unicolor* only its trails were sighted. Based on information from the community in the Puskopol area which location is not far from GCN region, this species tend to inhabit the skirt area of the forest. When the survey was conducted there is information of the animal being successfully captured by the community of Puskopol.

One of the carnivores with large sizes that are often found in RER region is *Helarctos malayanus*. Direct encounter with this animal rarely happens. The location of *Helarctos malayanus* was known based on its trails and claws on trees. Direct encounter with these two animals was rare because both animals tend to avoid human and they tend to search places with less noise. Although *Helarctos malayanus* belong to the order carnivora, they tend to consume everything (omnivore). The fact that *Helarctos malayanus* is categorized to threatened animal is due to the changing use of habitat, and that the animal is being hunted for its body parts. (Augeri, 2005; Fredriksson et al., 2008).

Besides large carnivores, there are also small carnivores in RER region. Mammals that are categorized into small carnivores are mammals from viverrida, and mustelidae. The small carnivores are also able to adapt to peatlands. *Paradoxurus hermaphroditus*, *Hemigalus derbyanus*, *Paguma larvata*, *Martes flavigula*, *Viverra zibetha* and *Arctogalidia trivirgata* are animals that can adapt to peat wetlands (Duckwoth, P., et al., 2008; Cheyne et al., 2010; Azlan et al., 2015; Duckwoth, C. Wozencraft, & Kanchanasaka, 2015; Duckwoth, R.J. Timmins, et al., 2015; Hon et al., 2015). Other than that, some species of viverridae and mustelidae do not have difficulties to adapt to peatlands due to its arboreal capabilities (Payne & Francis, 1997).

Mammal group that are listed the most as threatened species are primates. Five mammal species from order primate that are categorized as threatened are *Nycticebus coucang*, *Presbytis melalophos*, *Macaca nemestrina*, *Hylobates agilis*, and *Symphalangus syndactylus*. The biggest threat to primates is hunting. The primates are usually hunted to be domesticated as pets. The population of *Nycticebus coucang*, *Macaca nemestrina*, *Hylobates agilis* are found in all area of survey concession, while *Symphalangus syndactylus* and *Presbytis melalophos* are only found in TBOT region. Primates such as *Macaca nemestrina*, *Hylobates agilis*, *Symphalangus syndactylus*, and *Presbytis melalophos* are usually found in group (Geissman & Nijman, 2008; Boonratana et al., 2014; Nekaris, 2015).

Hylobates agilis is indeed known to be able to survive in peat forest ecosystem. Based on the previous survey that was conducted in the Sebangau peat forest ecosystem, it is known that the number of individuals per group is around 3 or 4 (Buckley et al., 2006). Almost all primates that are found in the RER region are fruit eaters (Frugivore) except for *Nycticebus coucang*. Frugivorous mammal species such as primates, viverridae, and bats *Pteropus vampyrus* are key species that have a role to disperse good seeds in forest ecosystem. As seed dispersers, these animals are able to increase the rehabilitation process of a disturbed forest ecosystem (Meijaard et al., 2005).

Bats that feed on fruits are one of good seed dispersers. *Pteropus vampyrus* is one of frugivore that is categorized as protected species. This is because the species is being consumed in several areas. These bats which wing size reach 1.5 meter are commonly found around small islands or coastal areas until 1,370 m above the sea. Their long wings allow them to have a great range of exploration, which makes them excellent seed dispersers. Usually *Pteropus vampyrus* will perch on trees with height 30.5-45.7 m (Kunz & Jones, 2000; Bates et al., 2015). Trees with that range of height are scarce in the RER region, which will limit the movement of the population. In the RER region, this species is found between transect RK_SM06 and great Lake of Serkap.

Some small mammals are also categorized as threatened animals. Mammals such as *Tupaia tana*, *Maxomys whiteheadi*, *Maxomys rajah*, *Ratufa affinis*, *Ratufa bicolor*, *Iomys horsfieldii*, and *Hystrix brachyura* belong to threatened category because they are being hunted and consumed which causes a decrease on their population number (Aplin & Lunde, 2015; Aplin, Frost, et al., 2015; Aplin, Lunde et al., 2015; Duckworth, E. Meijaard, Gimán, et al., 2015; Walston et al., 2015). Besides, there are many forest areas that are experiencing land conversion, causing the condition of the animals to be categorized as threatened. Those mammal species usually can live in areas that have been recently logged. So these species are able to help forest rehabilitation process (Meijaard et al., 2005).

On this survey there are a mammal species that belong to family tragulidae, it's *Tragulus* sp.. This mammal species are herbivores and at times also found to consume insects (Payne & Francis, 1997; Duckworth, R. Timmins, et al., 2015; Timmins & Duckworth, 2015). *Tragulus* sp. were found in each area of RER, both GCN, SMN, and TBOT. These species are often caught by the community around RER area.



IV. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

There are 70 mammal species in peat swamp forest managed by the RER, and four of which are found only in a Camera Trap. PT. TBOT area has the largest number of species than any other region in the RER (PT. GCN, and PT. SMN). When compared with other areas of peat swamp forest in Sumatra, the number of species of mammals that exist come within the RER a lot more. There are three order of mammals that dominate the order Rodentia, Chiroptera, and Carnivora. Mammal species that are found are generally Insectivores and omnivores. Generally the mammals found in has the ability to move above the trees (arboreal). Mammal species found in the RER area is the usual species are on forest after logging. This means peat swamp forest ecosystems in the RER area has not returned as the beginning when prior to logging.

The area of peat swamp forest in the management of RER is a habitat for protected wildlife and endangered species. There are 35 species of mammals included as threatened animal, protected and or animals with limited dispersion (endemic). Among these 35 species, Sumatran Tiger (*Panthera tigris sumatrae*) and Sunda Pangolin (*Manis javanica*) are the species which need more attention due to its Critically Endangered species. Both of these species are found in every area of the concession in the area of the RER. PT. GCN area has the largest number of protected and endangered species, compared to other regions in the RER. area. In the PT. TBOT area there are 26 species as threatened animal, protected and or animals with limited dispersion (endemic) . While the area of PT. GCN and PT. SMN there are 25 and 22 species. The existence of threatened species indicates the need for surveillance against potential interference. In the RER area found some potential threat to the existence of a mammalian wildlife like poaching of animals and illegal logging.

4.2 Recommendation

Some recommendation can be implemented by RER for area restoration purposes, such as:

1. RER should do an intensive patrols to avoid threats from outsiders, especially to threatened mammals, in particular with a mammal which stated as threatened species.
2. RER should do a socialization of the importance of peat swamp forest ecosystems and buidling several warning sign for not hunting the mammals in RER area.
3. RER should do monitoring and conduct an additional research about study population of mammalian communities especially endangered wildlife such as the Sumatran tiger and its prey. A research station and permanent observation route on each concession areas in RER can be used as monitoring purposes and for further researches.
4. RER should do a study of the role of mammals in particular a frugivorous in a forest restoration process in order to maximize the role of forest regeneration in mammals. It can be followed up by having a regular biodiversity inventORIZATION (once every two years) at the same location to observe biodiversity pattern in RER areas for all taxa.



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VI. APPENDICES

Appendix 1 List species of mammals found in RER

No.	Family	Scientific Name	English Name	IUCN	CITES	GOI	Endemic	Konsesi		
								GCN	SMN	TBOT
1	Lorisidae	<i>Nycticebus coucang</i>	Sunda Slow Loris	VU	I	√	√	√	√	√
2	Cercopithecidae	<i>Presbytis femoralis percura</i>	Banded langur	NT	II	-	-	√	√	√
3	Cercopithecidae	<i>Trachypithecus cristatus</i>	Silvered Langur	NT	II	-	-	√	-	-
4	Cercopithecidae	<i>Presbytis melalophos</i>	Sumatran surili	EN	II	-	-	√	√	-
5	Cercopithecidae	<i>Macaca fascicularis</i>	Long-tailed Macaque	LC	II	-	-	√	√	√
6	Cercopithecidae	<i>Macaca nemestrina</i>	Sunda Pig-tailed Macaque	VU	II	-	-	√	√	√
7	Hylobatidae	<i>Hylobates agilis</i>	Agile gibbon	EN	I	√	-	√	√	√
8	Hylobatidae	<i>Symphalangus syndactylus</i>	Siamang	EN	I	√	√	-	-	√
9	Sciuridae	<i>Sundasciurus hippurus</i>	Horse-tailed Squirrel	NT	-	-	-	√	-	-
10	Sciuridae	<i>Sundasciurus lowii</i>	Lows's Squirrel	LC	-	-	-	√	√	√
11	Sciuridae	<i>Sundasciurus tenuis</i>	Slender squirrel	LC	-	-	-	-	√	-
12	Sciuridae	<i>Ratufa affinis</i>	Giant squirrel	NT	II	-	-	√	√	√
13	Sciuridae	<i>Ratufa bicolor</i>	Black Giant squirrel	NT	II	√	-	√	-	√
14	Sciuridae	<i>Callosciurus notatus</i>	Plantain squirrel	LC	-	-	-	√	√	√
15	Sciuridae	<i>Callosciurus prevostii</i>	Prevost squirrel	LC	-	-	-	√	√	√
16	Sciuridae	<i>Iomys horsfieldii</i>	Horsfield's Flying Squirrel	LC	-	√	-	√	-	√
17	Sciuridae	<i>Exilicurus exilis</i>	Least Pygmy Squirrel	DD	-	-	-	-	-	√
18	Sciuridae	<i>Petaurista elegans</i>	Spotted Giant Flying Squirrel	LC	-	√	-	√	-	-
19	Sciuridae	<i>Lariscus insignis</i>	Three-striped Ground Squirrel	LC	-	√	-	√	-	√

20	Tupaidae	<i>Tupaia minor</i>	Lesser Treeshrew	LC	II	-	-	√	√	√
21	Tupaidae	<i>Tupaia splendidula</i>	Ruddy Treeshrew	LC	II	-	-	-	√	-
22	Tupaidae	<i>Tupaia glis</i>	Common Treeshrew	LC	II	-	-	-	√	√
23	Tupaidae	<i>Tupaia picta</i>	Painted Treeshrew	LC	II	-	-	-	√	-
24	Tupaidae	<i>Tupaia tana</i>	Large treeshrew	LC	II	-	-	√	√	√
25	Muridae	<i>Maxomys whiteheadi</i>	Whiteheads Rat	VU	-	-	-	√	√	√
26	Muridae	<i>Maxomys rajah</i>	Rajah Spiny Rat	VU	-	-	-	√	√	-
27	Muridae	<i>Niviventer cremoriventer</i>	Dark-tailed Tree Rat	VU	-	-	-	√	-	√
28	Muridae	<i>Rattus argentiventer</i>	Rice-field Rat	LC	-	-	-	√	√	√
29	Muridae	<i>Rattus tanezumi</i>	Oriental house rat	LC	-	-	-	-	-	√
30	Muridae	<i>Rattus tiomanicus sabae</i>	Malaysian Field rat	LC	-	-	-	-	-	√
31	Muridae	<i>Rattus exulans</i>	Polynesian Rats	LC	-	-	-	-	-	√
32	Muridae	<i>Sundamys muelleri</i>	Muller's Giant Sunda Rat	LC	-	-	-	√	√	√
33	Soricidae	<i>Chimarrogale himalayica</i>	Elegant Water Shrew	LC	-	-	-	√	-	-
34	Soricidae	<i>Crocidura fuliginosa</i>	Southeast Asian White-toothed Shrew	LC	-	-	-	-	√	√
35	Erinaceidae	<i>Echinosorex gymnurus</i>	Moonrat	LC	-	-	-	√	-	-
36	Manidae	<i>Manis javanica</i>	Sunda pangolin	CR	II	√	-	√	√	√
37	Hystricidae	<i>Hystrix brachyura</i>	Common Porcupine	LC	-	√	-	√	√	√
38	Vespertilionidae	<i>Kerivoula intermedia</i>	Small Woolly Bat	NT	-	-	-	√	√	-
39	Vespertilionidae	<i>Kerivoula pellucida</i>	Clear-winged Woolly Bat	NT	-	-	-	√	√	-
40	Vespertilionidae	<i>Kerivoula minuta</i>	Least Woolly Bat	NT	-	-	-	-	√	√
41	Vespertilionidae	<i>Kerivoula hardwickii</i>	Common Wolly Bat	LC	-	-	-	√	√	√
42	Vespertilionidae	<i>Kerivoula papilosa</i>	Papillose Wolly Bat	LC	-	-	-	-	√	√
43	Vespertilionidae	<i>Murina suilla</i>	Lesser Tube-noosed Bat	LC	-	-	-	-	√	-
44	Vespertilionidae	<i>Phoniscus atrox</i>	Gilded Groove-toothed Bat	NT	-	-	-	√	-	-
45	Emballonuridae	<i>Emballonura alecto</i>	Greater Sheath-tailed Bat	LC	-	-	-	√	-	-
46	Emballonuridae	<i>Emballonura monticola</i>	Lesser Sheath-tailed Bat	LC	-	-	-	√	-	√
47	Rhinolophidae	<i>Rhinolophus borneensis</i>	Bornean Horseshoe Bat	LC	-	-	-	√	-	-
48	Rhinolophidae	<i>Rhinolophus trifolius</i>	Trefoil Horseshoe Bat	LC	-	-	-	-	√	√
49	Rhinolophidae	<i>Rhinolophus sedulus</i>	Lesser Woolly Horseshoe Bats	NT	-	-	-	-	√	√
50	Pteropodidae	<i>Pteropus vampyrus</i>	Large Flying-Fox	NT	II	-	-	-	√	-
51	Pteropodidae	<i>Megaerops ecaudatus</i>	Tailed-Less Fruit Bat	LC	-	-	-	-	-	√

52	Pteropodidae	<i>Balionycteris maculata</i>	Spotted-Winged Fruit Bat	LC	-	-	-	√	-	√
53	Tragulidae	<i>Tragulus</i> sp.	Mouse-Deer	DD/LC	-	√	-	√	√	√
54	Cervidae	<i>Rusa unicolor</i>	Sambar Deer	VU	-	√	-	√	√	-
55	Suidae	<i>Sus barbatus</i>	Bearded Pig	VU	-	-	-	√	√	√
56	Viveridae	<i>Arctogladia trivirgata</i>	Small-toothed Palm Civet	LC	-	-	-	√	√	√
57	Viveridae	<i>Hemigalus derbyanus</i>	Banded Civet	NT	II	-	-	√	√	√
58	Viveridae	<i>Paradoxurus hermaphroditus</i>	Common Palm Civet	LC	III	-	-	√	√	√
59	Mustelidae	<i>Martes flavigula</i>	Yellow-Throated Marten	LC	III	-	-	√	√	√
60	Viveridae	<i>Viverra zangalunga</i>	Malay civet	LC	-	-	-	√	√	√
61	Viveridae	<i>Paguma larvata</i>	Masked Palm Civet	LC	III	-	-	-	√	√
62	Herpestidae	<i>Herpestes brachyurus</i>	Short-tailed Mongoose	LC	-	-	-	-	√	-
63	Ursidae	<i>Helarctos malayanus</i>	Malayan Sun Bear	VU	I	√	-	√	√	√
64	Felidae	<i>Neofelis diardi</i>	Sunda clouded leopard	VU	II	√	-	√	√	√
65	Felidae	<i>Prionailurus bengalensis</i>	Leopard Cat	LC	II	√	-	√	√	√
66	Felidae	<i>Panthera tigris sumatrae</i>	Sumatran Tiger	CR	I	√	√	√	√	√
67	Felidae	<i>Pardofelis marmorata</i> *	Marbled cat	NT	I	√	-	√	√	√
68	Felidae	<i>Prionailurus planiceps</i> *	Flat-headed cat	EN	I	√	-	√	√	√
69	Prionodontidae	<i>Prionodon linsang</i> *	Banded linsang	LC	II	√	-	-	√	-
70	Viveridae	<i>Arctistic binturong</i> *	Binturong	VU	III	√	-	-	-	√

Note : IUCN (CR= Critically Endangered, EN= Endangered, U= Vulnerable, NT= Near Threatened, LC= Least Concern, DD= Data Deficient), CITES (I= Appendix I, II= Appendix II), GOI (Government of Indonesia)= Lampiran PP no 7 Tahun 1999, * = only photographed by camera trap

Appendix 2 Photos of mammals found in RER region



Black Giant Squirrel (*Ratufa bicolor*)



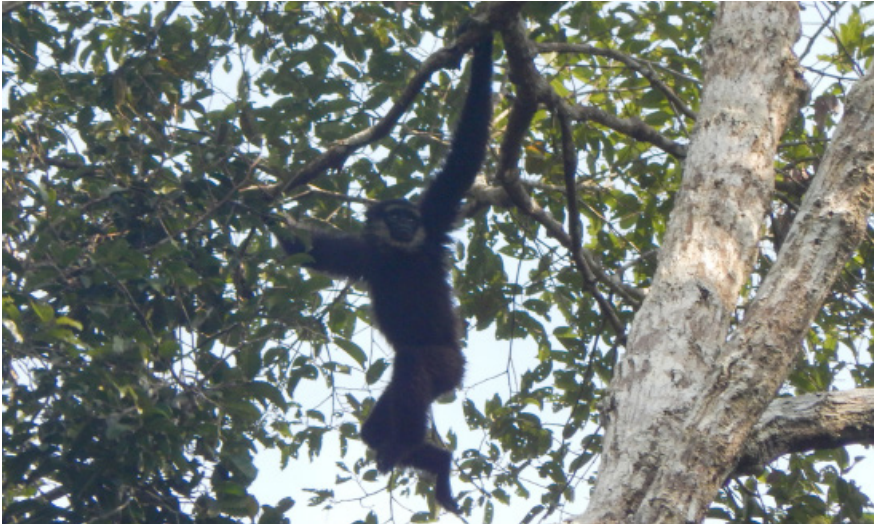
Common Treeshrew (*Tupaia glis*)



Low's Squirrel (*Sundasciurus lowii*)



Whiteheads Rat (*Maxomys whiteheadi*)



Agile Gibbon (*Hylobates agilis*)



Sunda Slow Loris (*Nycticebus coucang*)



Spotted-Winged Fruit Bat (*Balionycteris maculata*)



Long-tailed Macaque (*Macaca fascicularis*)