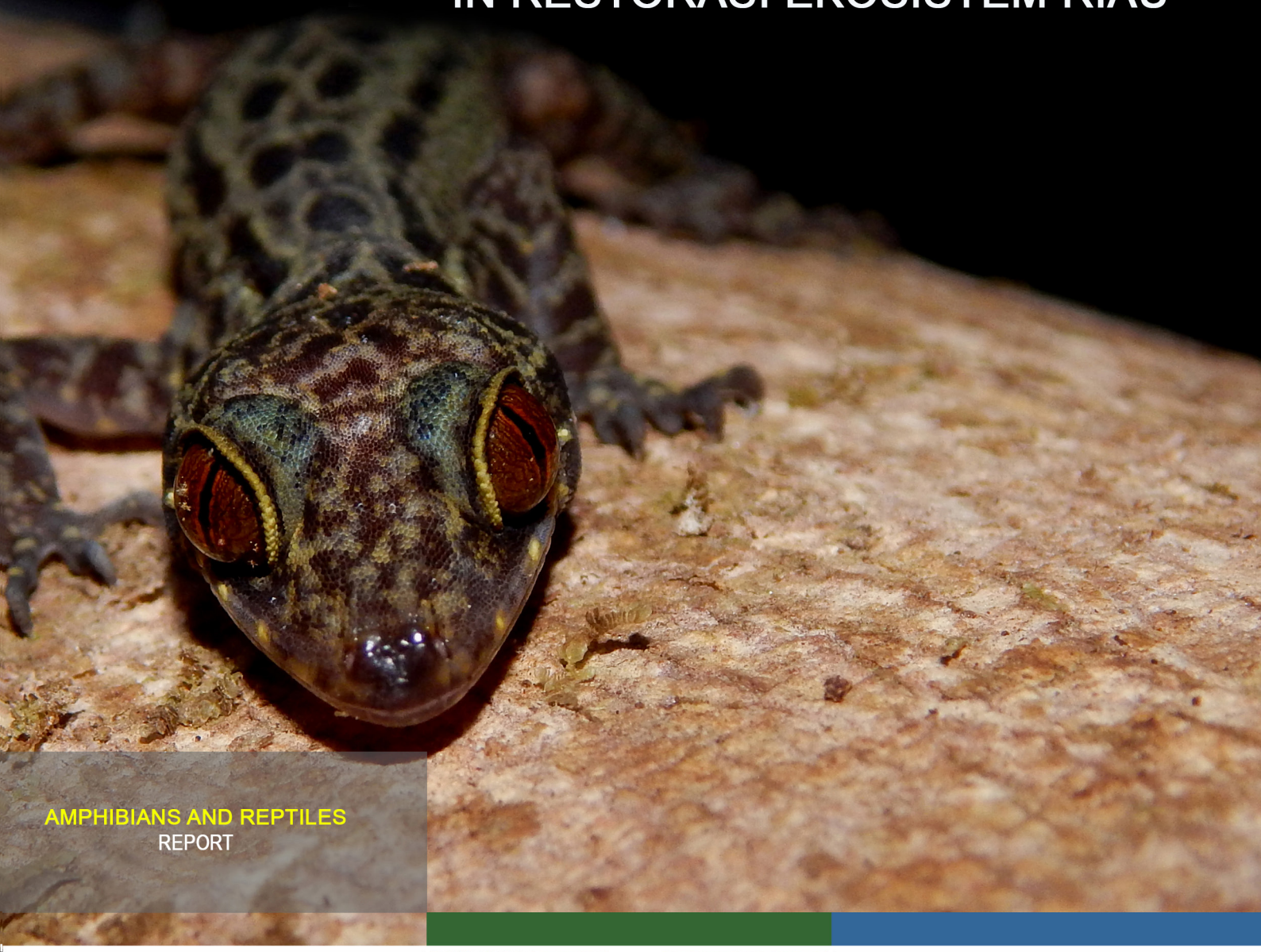
AMPHIBIANS AND REPTILES SURVEY REPORT IN RESTORASI EKOSISTEM RIAU



AMPHIBIANS AND REPTILES
REPORT

FAUNA & FLORA INTERNATIONAL

RESTORASI EKOSISTEM RIAU

APRIL

Amphibians and Reptiles Survey Report in Restorasi Ekosistem Riau

Andri Irawan
Ganjar Cahyadi

APRIL **2016**

FAUNA & FLORA INTERNATIONAL

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

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

FFI-IP has a broader its approach in the conservation efforts, mainly focused in the landscape level. Currently, FFI-is doing several conservation efforts at various locations in Indonesia like Sumatra, Kalimantan, Papua (Waigeo), Java (Nusakambangan) and Lombok. Through the assessment of High Conservation Value (HCV), FFI-IP has helped community to protect forests with a high potential for carbon reserves as well as the important habitats of the various endangered species (Sumatran elephant, Sumatran tiger, Orangutan) since 2007.

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Slug-eating snake - ***Pareas carinatus***

Overview

Extensive amphibians and reptiles survey were conducted in three concessions under the Restorasi Ekosistem Riau (RER) which are PT. CGN (20.265 ha), PT. SMN (32.830 ha) and PT. TBOT (39.412 ha) from May to December 2015. The objective of this survey was to identify and describe amphibians and reptiles diversity as well as the threat they are facing. 45 species were recorded in PT. GCN (12 amphibians, 33 reptiles), 46 species in PT. SMN (11 amphibians, 35 reptiles) and 52 species in PT. TBOT (11 amphibians, 41 reptiles), making up a total of 75 species for the RER area (14 amphibians and 61 reptiles). This number represented around 22% of Sumatran amphibians and reptiles and possibly will increase since the species accumulation curve was still not reaching asymptote phase for the reptile. Turtles and crocodiles were the threatened species found within the RER area. Among them, the Bornean river turtle and the false gharial are endangered (EN) and are protected by law. We identified hunting and illegal logging as a direct and indirect threat to the amphibians and reptiles in RER. Threats control both direct and indirect and protection of watershed areas in RER are urgently needed as they are important habitats for threatened species especially turtles and crocodiles.

Collett's tree frog - *Polypedates colletti*

I. PREFACE

Earless lizard - *Aphaniotis fusca*

1.1 Background

Peat swamp forest is a unique and fragile ecosystem which under threat of 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 peat swamp forest 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 provides 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).

Restorasi Ekosistem Riau (RER) is a non-profit organization formed by APRIL in 2013 with an area of about 150,000 hectares. 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 the 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 are 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. The management plan resulted from this assessment will restore its ecological for the Kampar Peninsula landscape. This initiative will ensure the ecosystem services from the peat swamp forest to many people, especially the communities that coexist with this landscape(Restorasi Ekosistem Riau, 2015). If successful, the restoration and conservation program can 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 are 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. To fulfill those needs, several studies of the diversity of fauna and flora in the region is an important part of managing the landscape properly.

Amphibians and reptiles are very sensitive to the changes in the environment, so the diversity and its population size can be used as the indicators of environmental changes (Thompson et al., 2008). Non-scale protected skin on amphibians making it highly threatened to pollutants and drought (Stebbins & Cohen, 1995). Amphibians were more easily observed, its richness and abundance of species can be calculated more accurately than the other taxa by considering the level of the encounter and the extent of home range area (Mazaris et al., 2008; Das & van Dijk, 2013). However, information on the amphibians and reptiles in the peat swamp forest is still very limited (Inger et al., 2005; Yule, 2010; Posa et al., 2011). Inger et al. (2005) found that species richness and its endemism levels of amphibians, in the peat swamp forest of Borneo is much lower than in its lowland forests. In Sumatra, the basic data on the amphibians and reptiles diversity in the peat swamp forests has not been reported.

1.2 Aim

To meet the need for basic data which related to the diversity of herpetofauna 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. METHOD

2.1 Study SIte

The area of Restorasi Ekosistem Riau (RER) consists of PT. Gemilang Cipta Nusantara. PT. Sinar Mutiara Nusantara and PT. The Best One Unitimber in the stretch of the Kampar Peninsula which its topography ranges from 2-16 m. This area classified as a tropical wet 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 26.1-27.5 ^{o}C with annual average 26.7 ^{o}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, the 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 flows into PT. TBOT, Serkap River in PT. SMN and Sangar River inside PT. GCN. During the highest tide, a wide puddle of these rivers may reach 1-1.5 km. The peat depth on RER reaches 15m 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 ahigh 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 (*Helarctos malayanus*). Some species of hornbills and raptors such as hawks and falcons, and also reptiles like false gharial (*Tomistoma schlegelii*) and painted terrapin (*Batagur borneoensis*) can also be found in this area (Tropenbos International Indonesia Program, 2010).

a. Survey in PT. Gemilang Cipta Nusantara

In PT. GCN, nine transects were conducted within concession area and one additional transect in Tasik Besar Serkap forest management unit which is the surrounding of PT. GCN (Figure 1). Survey was conducted from May to June 2015 with an 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.).

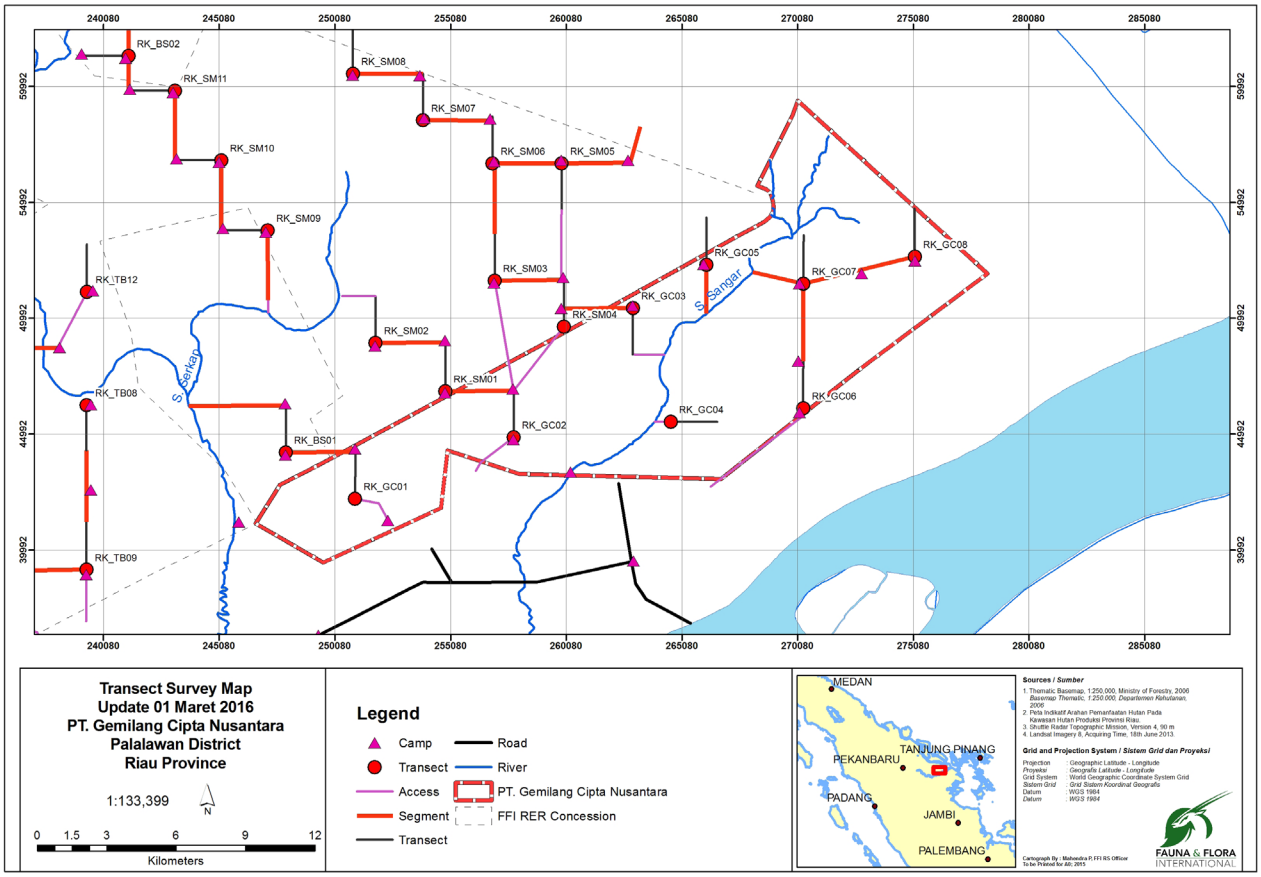

Figure 1 Distribution of nine transects in PT. GCN. RK_BS01 transects are outside the concession area.

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 and 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 (Figure 2). Pandan dominance conditions and shrubs was found in transects RK_GC02, RK_GC04, RK_GC06, RK_GC07 and RK_GC08. In opening area, we found several *Nepenthes* sp.

In transect of RK_GC01 and RK_BS01, have relatively different vegetation conditions with other transects with pandan dominance compared to other transects. A 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 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 oflake Tasik Besar (Figure 3).The survey was conducted during August-October 2015 by the effective time for 26 days.

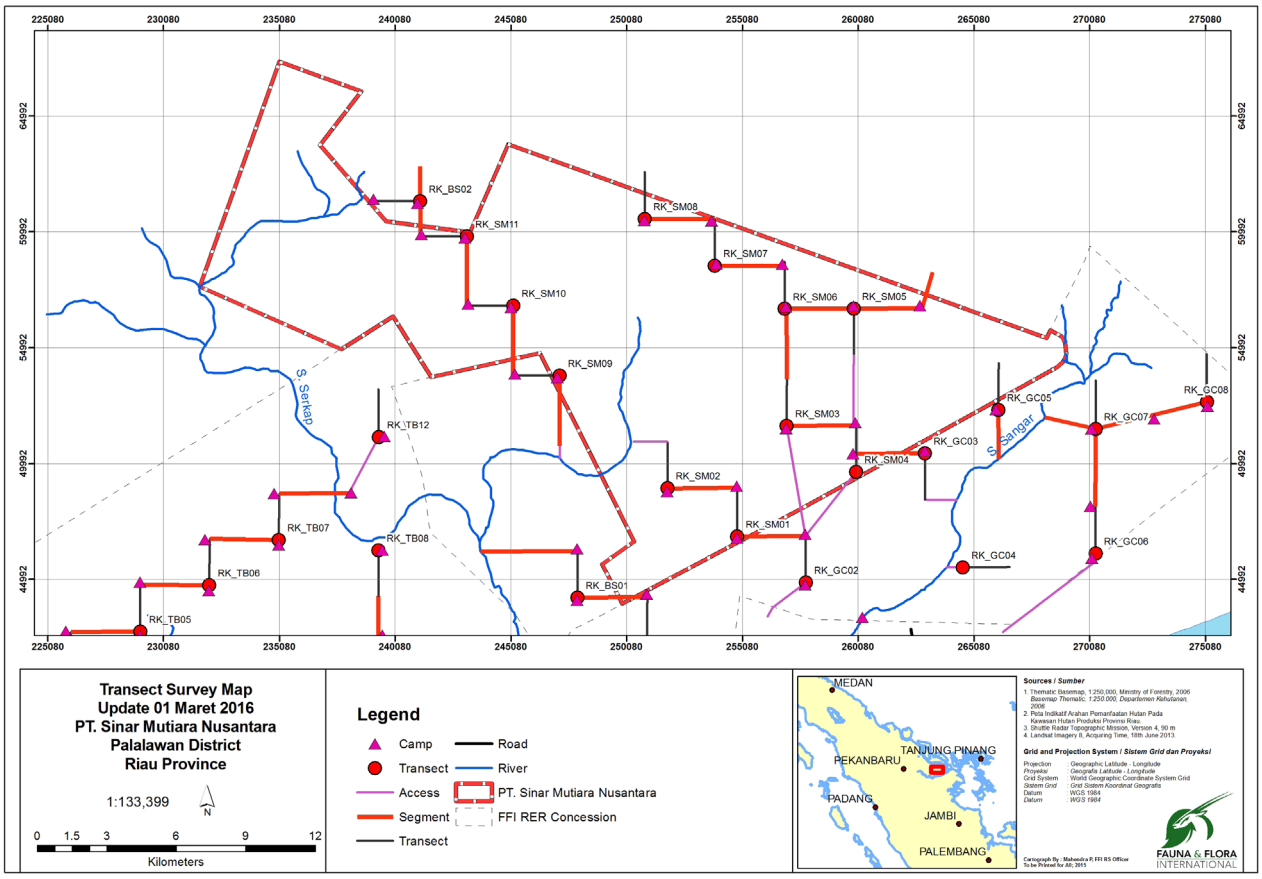

Figure 3 Distribution of transects in the area of PT. SMN. RK_BS02 transect was outside the concession boundariesof PT.SMN and approaching Lake Tasik Besar Serkap.

In general, the location of data collection was secondary peat swamp ecosystem. The habitat is a terrestrial patch 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 (Figure 4). The dominant tree vegetation that can be found throughout the concession such as meranti (*Shorea teysmanniana*) , punak (*Tetramerista glabra*) and bintangur (*Calophyllum ferrugineum*) with shrubs such as *Pandanus* sp.

The dominant vegetation in the form of Pandanus sp in PT. SMN found in transects of RK_SM04, RK_SM06, RK_SM07. A transect of RK_SM05 dominated with smaller pandan while others like RK_SM11 and RK_BS02 had vegetation ranging from shrubs, pandan and peatswamp salak (*Eleiodoxa conferta*). *Nepenthes* sp. also found in significant amounts in almost all transects.

Figure 4 Condition of the transect with several small stands of trees with its diameters between 5 to10 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 and RK_TB12.

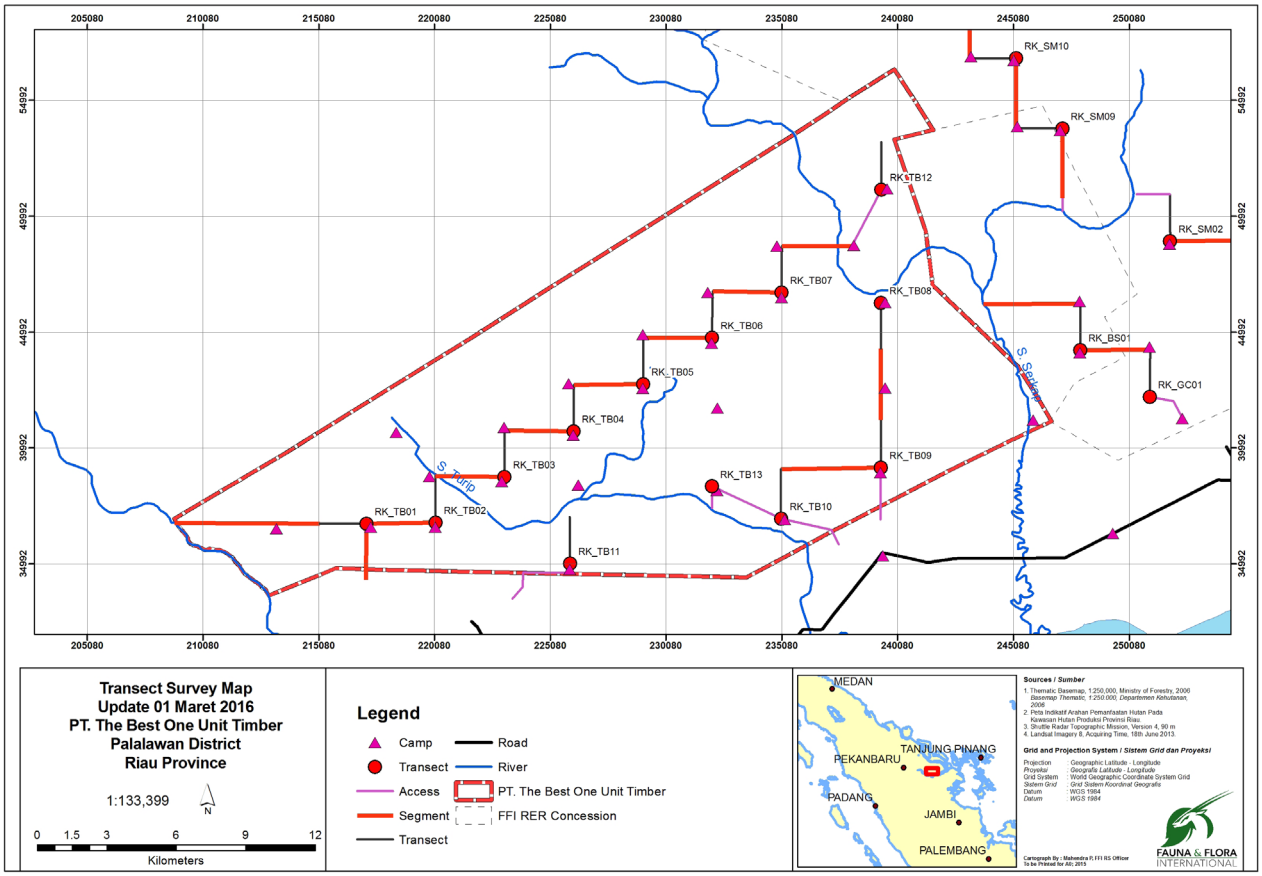

Figure 5 Distribution of transects in the area of PT. TBOT.

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 (Figure 6). 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, and RK_TB12. *Nepenthes* sp. was rarely being found in this area.

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

a. General Research Design

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

b. Data Collection

Data collection was conducted using Visual Encounter Survey (VES) (Heyer et al., 1994), only in 1.5 km transect line. Each transect observation is divided into ten plots, which is 100 m long and 10 m wide, with a distance between the plot per 50 m apart. Observation time is differed into two parts: the morning phase started at 9:00 to 12:00 pm and evening phase started at 19:00 to 22:00 pm. Information will be recorded when individuals encountered. The data collection will include: species name, time and number of the segment being found, a length from snout to cloaca (or snout vent length) and tail length (for reptiles), horizontal and vertical positions of the transects and water sources, a substrate that is occupied and the activities of individuals. The duration of observation ranged from 2 to 3 hours. Sampling used a hand-collecting method or catch directly by hand and only be applied to individuals who could not be identified directly in the field.

c. Preservation dan Identification

Preservation being made to species that can not be identified in the field. Preservation of specimens was performed using 70% alcohol which injected into the nape of the specimen obtained. Specimens were labeled and positioned for the identification process to see morphological characters if needed. Amphibians and reptiles species identification refers to field identification guide book based on Inger & Stuebing 2005; Iskandar 2000; Manthey & Grossmann 1997; Stuebing & Inger 1999; Grismer 2011. Status of conservation and protection of encountered species will refer to the Redlist of International Union for Conservation of Nature and Natural Resources (IUCN), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and Government of Indonesia species protection act No. 7 year 1999.

2.3 Data Analysis

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

a. Amphibians and reptiles diversity

Amphibians and reptiles diversity in each transect was measured using the Shannon - Wiener diversity index (H') and Pielou evenness index (J). Shannon - Wiener diversity index calculates the relative abundance and species richness. The index value will increase along with the addition of species richness and species evenness (Brower et al., 1998).

$$H' = -\sum_i \frac{n_i}{N} ln \frac{n_i}{N}$$

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

For comparing the diversity of amphibians and reptiles between transects, t-test on the value of the index Shannon- Wiener will be conducted (Hutcheson, 1970 in Hammer, 2015) with hypothetical state as follows:

H0: there is no difference in the value of Shannon - Wiener diversity index between the two transects were compared.
H1: here are differences in the value of the Shannon - Wiener diversity index between the two transects were compared.
H' variance will be calculated using this formula:

$$Var\ H' = \frac{\Sigma pi\ (\ln pi)^2 - [\Sigma(pi \ln pi)]^2}{N} + \frac{S-1}{2N^2}$$

S is the total number of species
To calculate the T value, the formulation is:

$$t = \frac{H'_1 - H'_2}{\sqrt{Var\ H'_1 + Var\ H'_2}}$$

Degrees of freedom from the T-test will be calculated using:

$$df = \frac{(Var\ H'_1 + var\ H'_2)^2}{\frac{(Var\ H'_1)^2}{N_1} + \frac{(Var\ H'_2)^2}{N_2}}$$

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

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

E : Pielou Evenness Index
H' : Shannon diversity index
S : Number of total species

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

b. Rarefaction and extrapolated species richness

This method will be used to see a trend of increasing number of species to the number of sampling units. For this study, the trend will overview on the number of days of transect observations using EstimateS 9.0 (Colwell, 2013). The results of this analysis are the curve of additional of species per sampling unit. The more oblique form of the curve to the left and tend to not showing the flat shape of the curve on the right, will indicate that the findings are still potential for the study area. It would be most likely a record of increasing number of species if the number of sampling units added.

c. *Cluster analysis*

This analysis was conducted to see the similarities of amphibians and reptiles community within the transects surveyed. Transect with similar amphibians and reptiles communities will tend to be clustered with the value of a certain degree of similarity or resemblance. The transect with different communities or nothing will form different groups. The group's analysis was conducted using PAST 3 software (Hammer, 2015).

Bray - Curtis index will be used to create a similarity tree community (dendogram) with the data forms i.e. the proportion of individuals, the index value ranging from 0 to 1. The closer to 1, the two communities that than have a high similarity in species composition.

III. RESULTS AND DISCUSSIONS

3.1 Result

a. Amphibians and reptiles diversity in Restorasi Ekosistem Riau

A total of 75 amphibians and reptiles species were recorded from Restorasi Ekosistem Riau(Table 1). From that total, 14 species were composed of amphibians belonging to five families with Ranidae being the most represented family (five species). For reptile, Colubridae was the most represented family (16 species) compared to the other sixteen families (Appendix 1).

Table 1. Summary of amphibians and reptiles species richness recorded from the area of Restorasi Ekosistem Riau. The total number of species was compiled from the record within and outside of observation transects.

	PT. GCN	PT. SMN	PT. TBOT	Total RER
Species				
· *Amphibians*	12	11	11	14
· *Reptiles*				
o Crocodiles	-	-	2	2
o Snakes	18	19	22	34
o Monitor lizard	2	1	3	3
o Freshwater turtles	3	5	2	6
o Lizards	6	7	7	9
o Geckoes	4	3	5	7
Total	45	46	52	75
IUCN				
Amphibians				
· Near threatened (NT)	1	2	2	2
Reptiles				
· Near threatened (NT)	1	1	1	1
· Vulnerable (VU)	1	4	-	4
· Endangered (EN)	1	1	2	2
CITES				
Reptiles				
· Appendix I	-	-	1	1
· Appendix II	7	8	7	13

Protected				
· Reptiles	1	1	1	3
Sumatra Endemic				
· Amphibians	2	2	2	2

According to the IUCN categories, there are two near threatened (NT) species from among the amphibian recorded; the painted Indonesian tree frog (*Nictyxalus pictus*) and the lesser swamp frog (*Limnonectes paramacrodon*). Meanwhile, seven reptile species (11.48%) are in the threatened categories of which five are vulnerable (VU) the king cobra (*Ophiophagus hannah*), the amboina box turtle (*Cuora amboinensis*), the smiling terrapin (*Siebenrockiella crassicollis*) the asiatic softshell turtle (*Amyda cartilaginea*) and false gharial (*Tomistoma schlegelii*). Three are two endangered (EN) the bornean river turtle (*Orlitia borneensis*) and the spiny turtle (*Heosemys spinosa*). Most of the threatened turtles were recorded from Serkap and Sangar River (outside of transect), trapped in fisherman fish traps and hook. The false gharial (*T. schlegelii*) is confirmed present at Serkap River. The record of *T. schlegelii* was reported by peat survey team in Serkap River on their way headed to transect surveys in SMN area. They clearly saw this crocodile was basking at the river bank of Serkap and easily recognized this as *T. schlegelii* (senyulong or panjang palung the in local name) from its elongated and slender shaped of the snout. Frogs are not protected by the Indonesian government, only the false gharial (*T. schlegelii*), salt water crocodile (*Crocodylus porosus*) and the bornean river turtle (*O. borneensis*) are. Two amphibian species from our record (*Hylarana rawa* and *H. parvaccola*) were endemic to Sumatra.

The variation of the mean value of amphibians and reptiles diversity index score for each concession was shown in Figure 7. Based on the one-way ANOVA test, the diversity index scores (H') between the three concessions were not significantly different ($F(2.29)= 3.281$; $p>0.05$). However, their evenness index scores were significantly different. Based on the one way ANOVA and the post-hoc Games-Howell test, PT. SMN had the highest evenness index (0.82±0.02; pSMN-GCN< 0.05; pSMN-TBOT<0,01) compared to PT. GCN (0.62±0.61) and PT. TBOT (0.51±0.05). Meanwhile evenness index between PT. GCN and PT. TBOT were not different (pGCN-TBOT> 0.05).

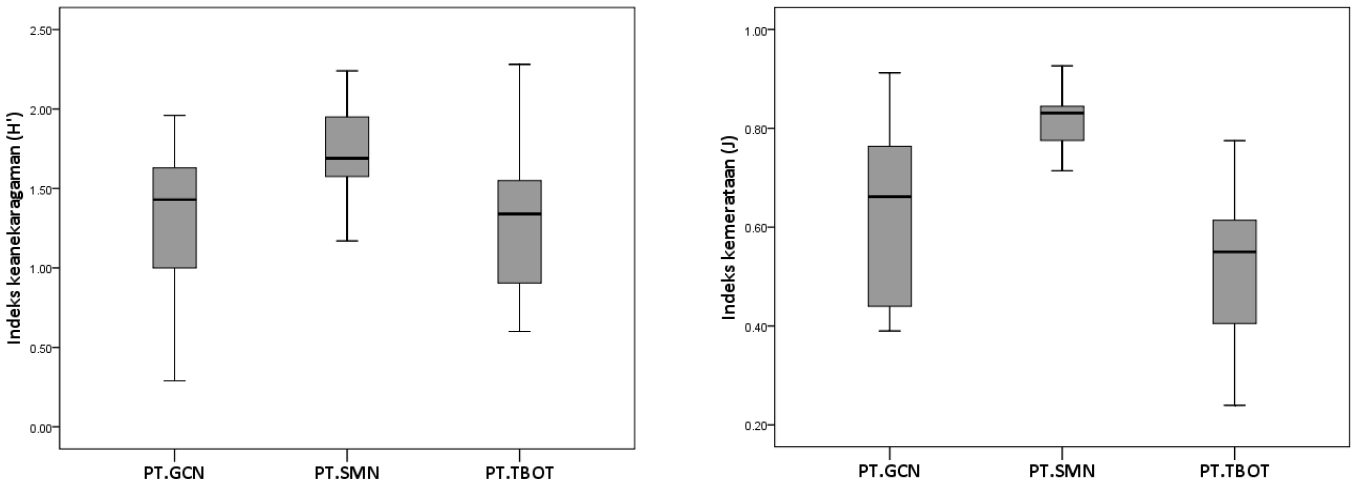

Figure 7 The score of diversity index (H') and evenness index (J) with 95% Confidence Interval for the three concessions under RER.

The amphibians had higher relative abundance than the reptiles; about three to four out of five species with the highest relative abundance were amphibians (Table 2). In each concession, the collet's treefrog's (*Polypedates colletti*) relative abundance always came in first place. It even showed very high dominance in PT. GCN and PT. TBOT with a relative abundance of 0.58 and 0.72 respectively. Only two out of the 61 reptile species recorded belonged in the top five species with the highest relative abundance; common sun skink (*Eutropis multifasciata*) and the bent-toed forest gecko (*Cyrtodactylus* sp.).

Table2. The top five species with the highest relative abundance (Kr) in each concession area.

PT. GCN	Kr	PT. SMN	Kr	PT. TBOT	Kr
Polypedates colletti	0.58	*Polypedates colletti*	0.28	*Polypedates colletti*	0.72
Cyrtodactylus sp.	0.12	*Eutropis multifasciata*	0.23	*Hylarana baramica*	0.06
Hylarana rawa	0.08	*Hylarana rawa*	0.09	*Hylarana rawa*	0.05
Ingerophrynus quadriporcatus	0.04	*Ingerophrynus quadriporcatus*	0.08	*Cyrtodactylus* sp.	0.03
Eutropis multifasciata	0.03	*Hylarana baramica*	0.06	*Phrynella pulchra*	0.03

b. Amphibians and reptiles diversity in PT. Gemilang Cipta Nusantara

Based on the record within and outside of the observation transects, a total of 45 species of amphibians and reptiles were obtained which consisted of 33 reptile species and 12 amphibian species. The recorded reptile species belonged to 12 families with Colubridae being the most represented family (six species). For amphibians, we encountered species belonging to 5 families with Ranidae being the most represented family (four species) (appendix 1).

Several of the species recorded were found to be species of global conservation concern because they met one or more status based on the IUCN red list category, CITES or are protected by the Indonesian government law (Table 3, Appendix 3).

Tabel 3 Species of global conservation concern within the area of PT. GCN was dominated by reptiles.

Local Name	Species	IUCN	CITES	Protected	End	Location
Kuo-kuo	*Cuora amboinensis*	VU	App. II	-	-	8
Kuo-kuo	*Cyclemys dentata*	NT	App. II	-	-	5
Biuku	*Orlitia borneensis*	EN	App. II	√	-	*
Ular kobra	*Naja sumatrana*	LC	App. II	-	-	6
Ular sawah	*Malayopython reticulatus*	NE	App. II	-	-	1,*
Biawak punggu	*Varanus rudicollis*	NE	App. II	-	-	6
Biawak	*Varanus salvator*	LC	App. II	-	-	*
-	*Hylarana parvaccola*	NE	-	-	√	1,4,5,6
Katak rawa kecil	*Hylarana rawa*	NE	-	-	√	1,2,4,5,6,8

**recorded in Sangar River*
Status: NE = not evaluated, LC = least concern, VU = vulnerable, EN = endangered, PP RI = PP No. 7 tahun 1999, End = Endemic Sumatera.
Transect: 1 = RK_GC05, 2 = RK_BS01, 3 = RK_GC01, 4 = RK_GC02, 5 = RK_GC03, 6 = RK_GC04, 7 = RK_GC06, 8 = RK_GC07, 9 = RK_GC08

Until the 18th day or the last day of data collection in PT. GCN, amphibians and reptiles species accumulation curve was still increasing and had not yet reached the stationary phase (Figure 8). Based on the extrapolation result, it is still very possible to obtain additional species in the case of reptile since the curve had not begun to plateau even after fitting more observation days. In contrast, the curve for amphibian showed that most species had probably been encountered. Thus, the chance is high to get more species, especially reptile, if more observation days are added.

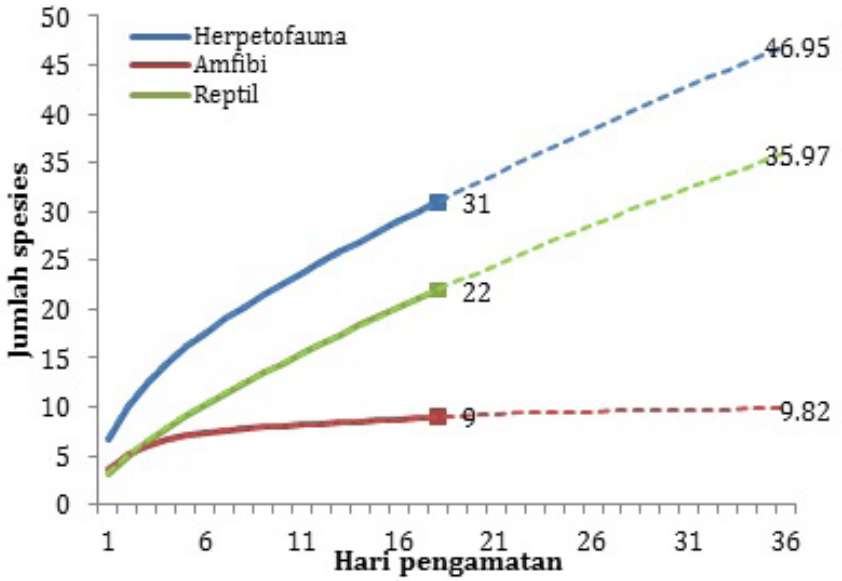

Figure 8 The species accumulation curve was still increasing for reptile group but not for the amphibian group.

The highest species richness (14 species) was found in transect RK_GC01 and RK_GC04, while the lowest species richness (only five species) was found in transect RK_GC06 and RK_GC08. The highest abundance (142 individuals) was found in transect RK_GC03 and the lowest abundance (16 individuals) was found in transect RK_GC06 (table 4).

Table 4 Comparison of species richness and abundance in nine observation transects.

	RK_BS01	RK_GC01	RK_GC02	RK_GC03	RK_GC04
Amphibians	n=3	n=3	n=3	n=3	n=2
Σ species	4	3	**7**	**7**	**7**
Σ individuals	105	104	71	**132**	31
Mean individu	35	34.67	23.67	**44**	15.5
SD individuals	5.29	4.04	**12.66**	5.57	-
Reptiles	n=3	n=3	n=3	n=3	n=2
Σ species	5	**11**	3	6	7
Σ individuals	18	24	6	10	33
Mean individuals	6	8	2	3.33	16.5
SD individuals	3	4.58	1	2.52	-
Σ spesies amphibians and reptiles	9	**14**	10	13	**14**
Σ individuals	123	128	77	**142**	64

Table 4 cont.

	RK_GC05	RK_GC06	RK_GC07	RK_GC08
Amphibians	n=3	n=3	n=3	n=3
Σ species	**7**	2	5	2
Σ individuals	40	2	14	4

Mean individuals	13.33	0.67	4.67	1.33
SD individuals	3.06	0.58	1.53	0.58
Reptiles	n=3	n=3	n=3	n=3
Σ species	4	3	5	3
Σ individuals	9	14	13	14
Mean individuals	3	4.67	4.33	4.67
SD individuals	1.73	3.51	0.58	1.53
Σ spesies amphibians and reptiles	11	5	10	5
Σ individuals	49	16	27	18

**Highest value indicated by bold dan n is survey days number.*

Transect RK_GC01 had the highest reptile richness (11 species) while the other eight transectshad relatively low richness with only three to seven species. The highest abundance of the reptile was found in transect RK_GC04 with 33 individuals while the lowest was found in RK_GC02 with 6 individuals. Transect RK_GC02, RK_GC03, RK_GC04 and RKGC_05 had the highest amphibian richness with seven species while transect RK_GC06 and RK_GC08 had the lowest richness with only two species. The highest abundance of amphibian was found in transect RK_GC03 with 132 individuals, while the lowest in transect RK_GC06 with two individuals (Table 4).For the amphibians, *Polypedates colletti* had the highest relative abundance (0.58). As for the reptiles, *Cyrtodactylus* sp. had the highest relative abundance (0.11). Other species of amphibians or reptiles had a relative abundance of less than 0.10.

The score of Shannon-Wiener diversity index (H') ranged from 0.29 to 1.96 with the highest score found in RK_GC04. Based on a test on the H' score, the score of diversity index for transect RK_GC06 was significantly the lowest compared to the other transects ($p<0.01$). As for the Pielou evenness index, these three transects had the lowest score: RK_BS01 (0.44), RK_GC01 (0.39) and RK_GC06 (0.4) (Figure 9).Alow score of Pielou evenness index that was near 0 implied that there were a few species that dominated those obsevation transects. As mentioned before, the treefrog, *Polypedates coletti* was the species with the highest relative abundance.

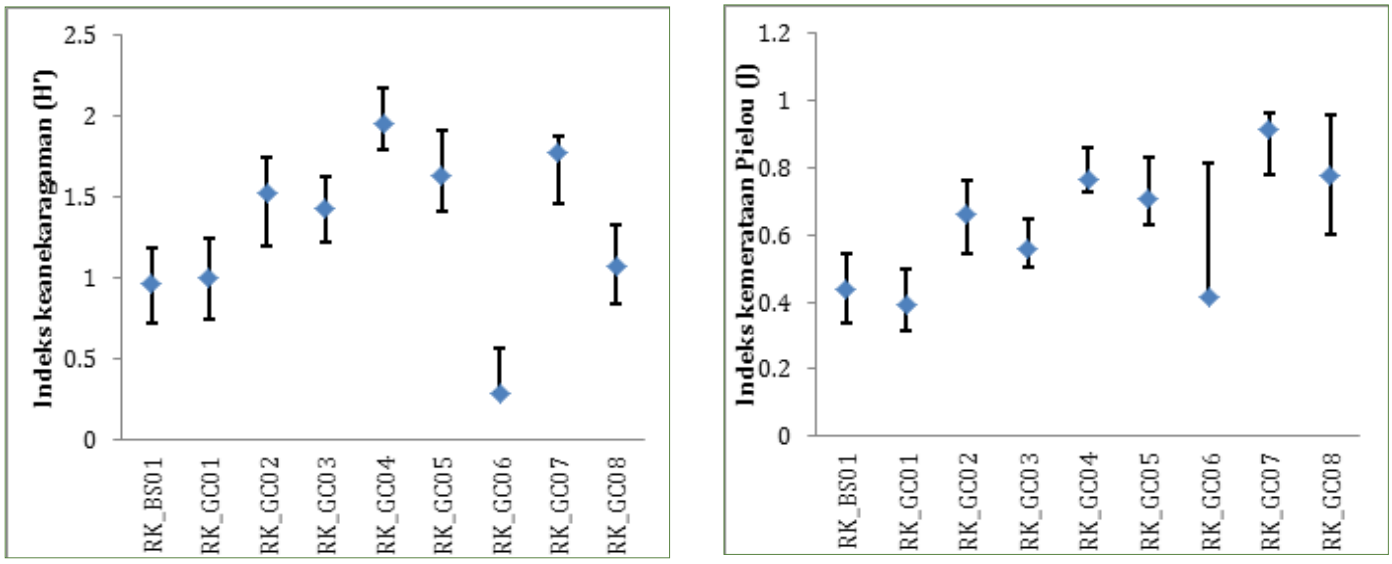

Figure 9 Shannon-Wiener diversity index (H') score and Pielou evenness index (J) score with 95% confidence interval for transects within the area of PT. GCN

Based on the cluster analysis result, there were four amphibian communities in the area of PT. GCN (Figure 10). Group A was composed of RK_BS01, RK_GC01 and RK_GC08 with similarity score of 74%. Group B was composed of RK_GC02, RK_GC03, RK_GC04 and RK_GC05 with a similarity score of 70%. Group

A-B and C were two relatively different communities with a similarity score of 0.48. RK_GC06 and transects group (A-B-C) had the lowest similarity score. This implied that RK_GC06 was a very different community compared to the other.
Transects in group A, especially transect RK_GC01 and RK_BS01, tend to have better habitat condition compared to the other transects groups. These transects had more big standing trees and denser canopy cover as well as the low dominance of *Pandanus* sp. bush. Meanwhile, transect RK_GC06 and RK_GC07 had low canopy cover and their vegetation was dominated by shrubs and bushes, especially Pandanus sp. In addition, the practice of illegal logging was present at the time of observation (especially in transect RK_GC06). Group B consisted of transects that were relatively close to streams with maximum distance ranging from 0.5-3km.

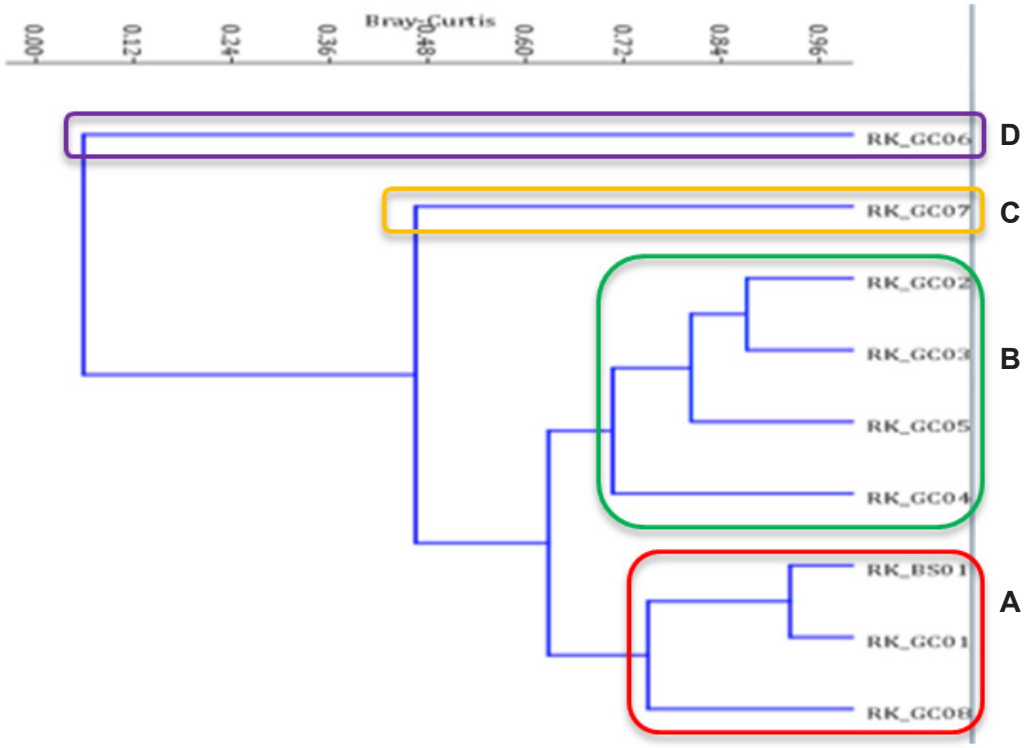

Figure 10 Similarity tree between amphibian communities in the area of PT. GCN. The highest similarity score was between RK_BS01 and RK_GC01.

c. Amphibians and reptiles diversity in PT Sinar Mutiara Nusantara

Based on the record within and outside of the observation transects, a total of 46 species of amphibians and reptiles were obtained which consisted of 35 reptile species and 11 amphibian species. The recorded reptile species belonged to 11 families with Colubridae being the most represented family (10 species). For amphibians, we encountered species belonging to 5 families with Ranidae being the most represented family (four species) (appendix 1).

Several of the species recorded were found to be species of global conservation concern because they are listed as threatened according to the IUCN Red List, are listed in one of the Appendixes of the Convention on Trade in Endangered Species (CITES), or are protected by the Indonesian government law (Table 5, Appendix 3).

Table 5 Species of global conservation concern within the area of PT. SMN.

Local Name	Species	IUCN	CITES	Protected	End	Locations
Kuo-kuo	Cuora amboinensis	VU	App. II	-	-	4
Kuo-kuo	*Cyclemys dentata*	NT	App. II	-	-	6,8
Biuku	*Orlitia borneensis*	EN	App. II	√	-	5,*,**
Kuo-Kuo	*Siebenrockiella crassicollis*	VU	App. II	-	-	*
Ular kobra	*Naja sumatrana*	LC	App. II	-	-	1
Ular upe	*Ophiophagus hannah*	VU	App. II	-	-	1,**
Biawak	*Varanus salvator*	LC	App. II	-	-	*
-	*Hylarana parvaccola*	NE	-	-	√	2,3,6,8
Katak rawa kecil	*Hylarana rawa*	NE	-	-	√	2,3,4,5,7

**Recorded in Serkap River*
***Recorded outside of transect*
NE = not evaluated, LC = least concern, VU = vulnerable, NT = near threatened, EN = endangered, PP RI = PP No. 7 tahun 1999, End = Endemik Sumatera, 1 = RK¬_SM01, 2 = RK_SM03, 3 = RK_SM04, 4 = RK_SM05, 5 = RK_SM06, 6 = RK_SM07, 7 = RK_SM10, 8 = RK_BS02

Most of the amphibian species that are commonly found in peat swamp forest, especially in SMN area, had possibly been collected. This was indicated by the species accumulation curve which had reached stationary phase (Figure 11).As for reptiles, additional species could still be obtained if observation day is prolonged (the species accumulation curve had not plateaued).

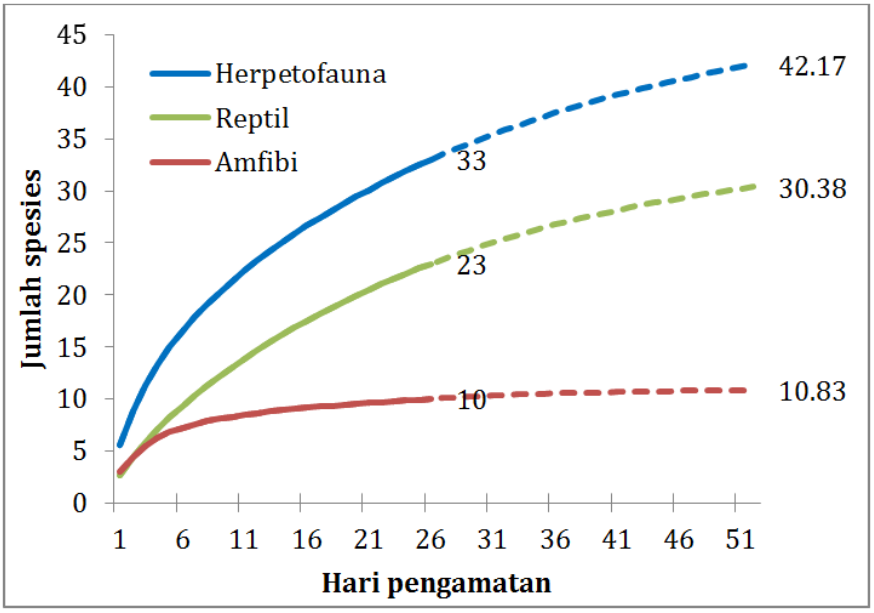

Figure 11 Species accumulation curve and the estimated number of species addition for the 11 observation transects.

The highest species richness and abundance (15 species; 74 individuals) were found in transect RK_SM04, while the lowest species richness and abundance (4 species; 14 individuals) was found in transect RK_SM02 (Table 6).

Transect RK_SM01 and RK_SM04 had the highest reptile richness (eight species) while the other nine transects ranged from two to seven species. The highest abundance of the reptile was found in transect RK_SM03 with 23 individuals while the lowest was found in RK_SM10 with three individuals. Transect RK_SM04 had the highest amphibian richness and abundance with seven species and 60 individuals while transect RK_SM11 had only one species (*Polypedates colletti*) with only three individuals.

Table 6 Comparison of species richness and abundance in eleven observations transects.

	RK_BS02	RK_SM01	RK_SM02	RK_SM03	RK_SM04	RK_SM05
Amphibians	n=3	n=3	n=3	n=2	n=2	n=3
Σ species	4	2	2	6	**7**	3
Σ individuals	22	9	8	33	**60**	18
Mean individu	7,33	3	2,67	11	20	6
SD individuals	4,51	1,73	0,58	4,36	**10,58**	0
Reptiles	n=3	n=3	n=3	n=2	n=2	n=3
Σ species	5	8	2	3	**8**	7
Σ individuals	16	16	6	**23**	14	12
Mean individu	5,33	5,33	3,00	11,50	4,67	4,00
SD individuals	1,53	4,04	0,00	2,12	4,73	1,73
Σ species amphibians and reptiles	9	10	4	9	**15**	10
Σ individuals	38	25	14	56	**74**	30

Table 6 cont.

	RK_SM06	RK_SM07	RK_SM09	RK_SM10	RK_SM11
Amphibians	n=3	n=2	n=2	n=2	n=3
Σ species	5	4	4	4	1
Σ individuals	16	7	26	12	3
Mean individu	5,33	2,33	8,67	4	1
SD individuals	1,53	1,15	2,08	3,61	0,71
Reptiles	n=3	n=3	n=3	n=3	n=3
Σ species	2	2	5	2	4
Σ individuals	5	7	21	3	17
Mean individu	1,67	2,33	7,00	1,00	5,67
SD individuals	2,08	0,58	5,29	0,00	4,51
Σ species amphibians and reptiles	7	6	9	6	5
Σ individuals	21	14	47	15	20

**Highest value indicated by bold dan n is survey days number.*

The score of Shannon-Wiener diversity index (H') ranged from 1.19 to 2.10 with the highest score found in RK_SM04. Based on a t test on the H' score, the score of diversity index for transect RK_SM02 was significantly the lowest compared to the other transects ($p<0.01$). As for the Pielou evenness index, these three transects had the lowest score: RK_SM09 (0.71), RK_BS02 (0.76) and RK_SM04 (0.77) (Figure 12). However, all transects in SMN area had a Pielou evenness index score of near one. This implied that no species dominated these transects.

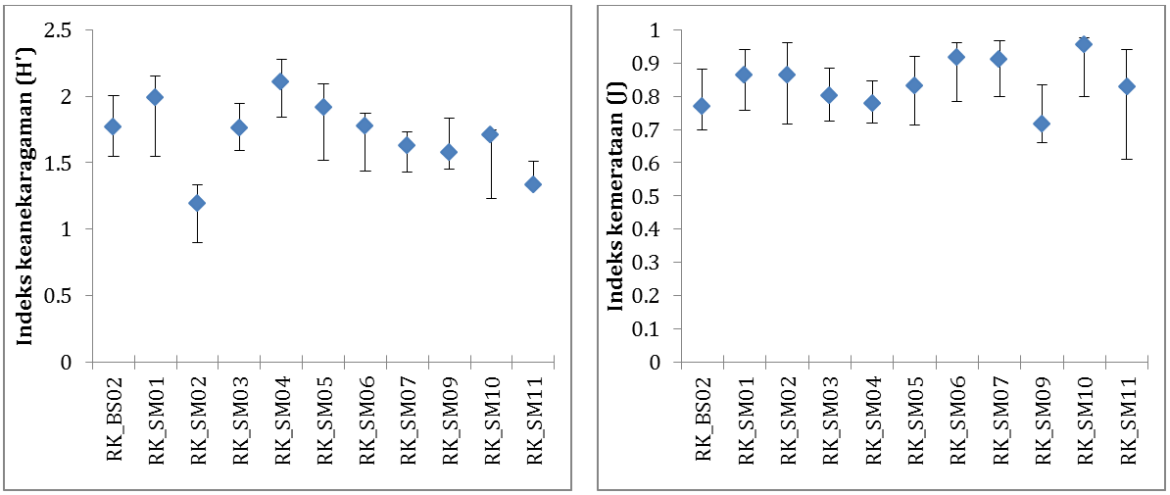

Figure 12 Shannon-Wiener diversity index (H') score and Pielou evenness index (J) score with 95% Confidence Interval for transects within the area of PT. SMN

The cluster analysis using Bray-Curtis index resulted in three groups of transects with different amphibian species composition(Figure 13).The first group consisted of transect RK_SM05, RK_SM02, RK_SM09, RK_BS02, RK_SM07 and RK_SM01 with similarity score around 52%. This group consisted of transects that were relatively close to streams (about 2-5 km). The second group consisted of transect RK_SM06, RK_SM03, RK_SM04 and RK_SM10 with a similarity index of 50%. This group consisted of transect with denser canopy cover compared to the other groups. Besides that, no dominance of pandan plant was observed. Transect RK_SM11 was separated from group one and two and formed its own group. This transect was probably located at a peat dome which was characterized by vegetation with smaller size plants, lots of bushes and pandan plant as well as fewer water sources.

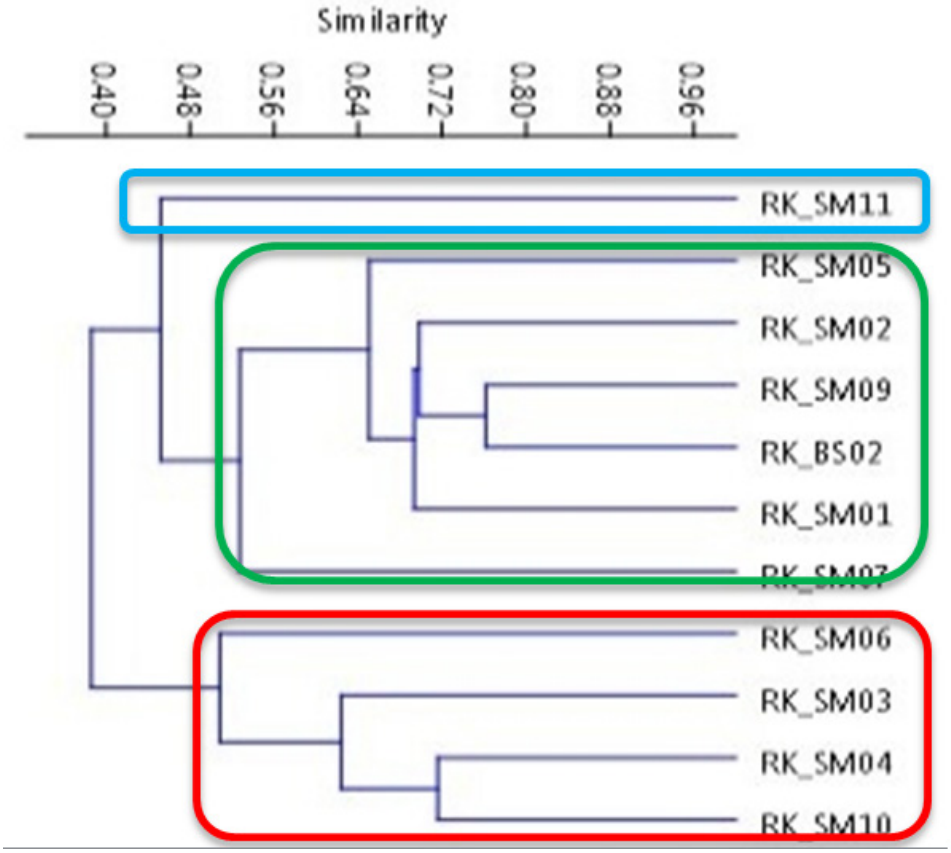

Figure 13 Similarity tree between amphibian communities in the area of PT. SMN.

d. Amphibians and reptiles in PT. The Best One Unitimber

Based on the record within and outside of the observation transects, a total of 52 species of amphibians and reptiles were obtained. Fourty one species were reptiles belonging to 16 families with Colubridae being the most represented family (12 species). Eleven species were amphibians with Ranidae being the most represented family (four species) (appendix 1).

Eleven species recorded were found to be species of global conservation concern because they met one or more status based on the IUCN red list category, CITES or are protected by the Indonesian government law (Table 7, Appendix 3).

Table 7 Species of global conservation concern within the area of PT. TBOT was dominated by reptiles.

Local name	Species	IUCN	CITES	Protected	End	Locations
Kuo-kuo	*Cyclemys dentata*	NT	App. II	-	-	2,4,5,6,7,11,12
Kuo-kuo	*Heosemys spinosa*	EN	App. II	-	-	**
Ular kobra	*Naja sumatrana*	LC	App. II	-	-	12
Ular sawah	*Malayopython reticulatus*	NE	App. II	-	-	**
Biawak punggu	*Varanus dumerilii*	NE	App. II	-	-	2,4
Biawak punggu	*Varanus rudicollis*	NE	App. II	-	-	1
Biawak	Varanus salvator	LC	App. II	-	-	**
-	*Hylarana parvaccola*	NE	-	-	√	1-6, 8-11
Katak rawa kecil	*Hylarana rawa*	NE	-	-	√	3-11
Buaya muara	*Crocodylus porosus*	LC	App. II	-	-	*
Senyulong	*Tomistoma schlegelii*	VU	App. I	√	-	*

**Recorded in Serkap River*
***Recorded outside of ransect*
NE = not evaluated, LC = least concern, NT = near threatened, EN = endangered, PP RI = PP No. 7 tahun 1999 End = Endemik Sumatera, 1 = RK_TB01, 2 = RK_TB02, 3 = RK_TB03, 4 = RK_TB04, 5 = RK_TB05, 6 = RK_TB06, 7 = RK_TB07, 8 = RK_TB08, 9 = RK_TB09, 10 = RK_TB10, 11 = RK_TB11, 12 = RK_TB12.

The species accumulation curve in PT. TBOT had the same pattern with PT. GCN and SMN. Reptile species number was still increasing and had not yet reached the stationary phase at the last survey day (Figure 14). Even based on extrapolation result up to 60 days survey, it still had not yet reaching the stationary phase.

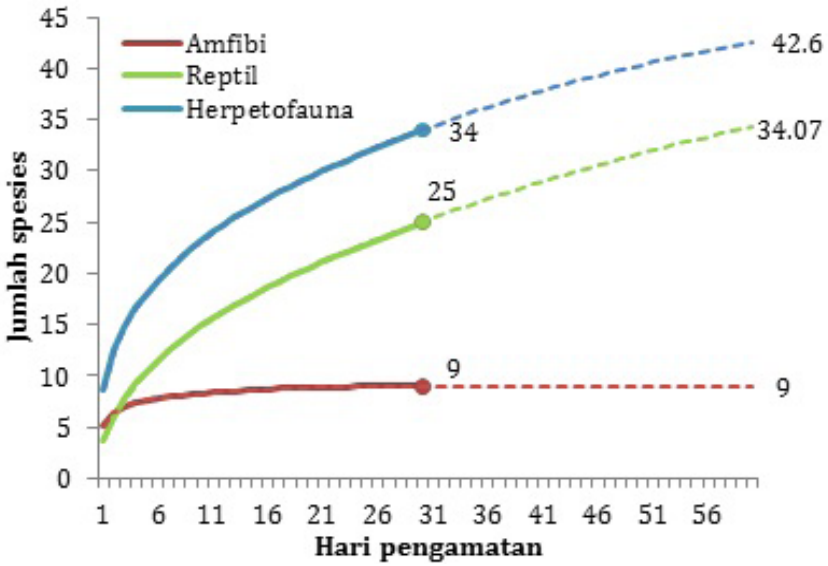

Figure 14 The species accumulation curve was still increasing for reptile group but not for amphibian group.

The highest species richness 19 species was found in transect RK_TB01, while the lowest species richness (9 species) was found in transect RK_TB12. The highest abudance (524 individuals) was found in transect RK_TB09 and the lowest abundance (94 individuals) was found in transect RK_TB04 (table 8). Transect RK_TB01 had the highest reptile richness (12 species) while RK_TB12 had the lowest richness (three species).

The highest abundance of the reptile was found in transect RK_TB01 with 43 individuals while the lowest was found in RK_TB12 with 6 individuals. Transect RK_TB01; RK_TB04; RK_TB05 and RK_TB09 had the highest amphibian richness with seven species while transect RK_TB02 and RK_TB07 had the lowest richness with five species.The highest abundance of amphibian was found in transect RK_TB09 with 504 individuals, while the lowest in transect RK_TB01 with 56 individuals (Table 8). The Collet's treefrog *Polypedates colletti*, had the highest relative abundance (0.72) compared to the other species which had relative abundance of no more than 0.05.

Table 8 Comparison of species richness and abundance in eleven observations transects.

	RK_TB01	RK_TB02	RK_TB03	RK_TB04	RK_TB05	RK_TB06
Amphibians	n=3	n=2	n=3	n=2	n=2	n=3
Σ species	**7**	5	6	**7**	**7**	6
Σ individuals	56	89	164	85	129	188
Mean individu	18.67	43	54.67	42	43	62.33
SD individuals	7.64	-	10.02	-	8.54	5.13
Reptiles	n=3	n=3	n=3	n=2	n=2	n=3
Σ species	**12**	6	6	5	8	5
Σ individuals	43	19	17	7	14	17
Mean individu	14.33	6,33	5.67	2.33	4.67	5.67
SD individuals	2.89	1,15	3.79	-	1.53	1.53
Σ species amphibians and reptiles	**19**	11	12	12	15	11
Σ individuals	109	105	171	92	143	205

Table 8 cont.

	RK_TB07	RK_TB08	RK_TB09	RK_TB10	RK_TB11	RK_TB12
Amphibians	n=3	n=3	n=3	n=3	n=2	n=3
Σ species	5	6	**7**	6	6	6
Σ individuals	297	193	504	110	173	161
Mean individu	99	64.33	168	36.67	57.67	53.67
SD individuals	20.52	14.05	10.58	6.66	**31.09**	7.02
Reptiles	n=3	n=3	n=3	n=3	n=2	n=3
Σ species	**8**	7	6	5	6	3
Σ individuals	15	24	20	18	11	6
Mean individu	5	8	6.67	6	3.67	2
SD individuals	1	2.65	5.51	2.65	4.62	1
Σ species amphibians and reptiles	13	13	13	11	12	9
Σ individuals	312	217	**524**	128	184	167

Note: n is survey days number

Highest value indicated by bold.

The score of Shannon-Wiener diversity index (H') ranged from 0.60 to 2.28 with the highest score found in RK_TB01 (2.28) meanwhile the lowest one found in RK_TB09. Two transects with the lowest evenness index were RK_TB09 (0.24) and RK_TB07 (0.26) (Figure 15).

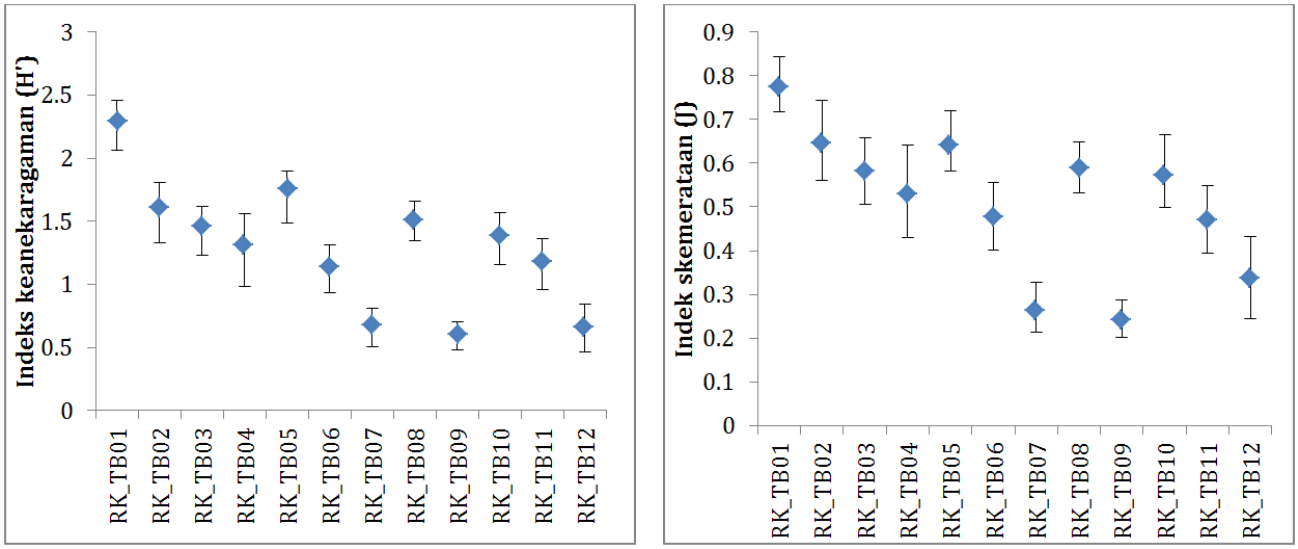

Figure 15 Shannon wiener diversity index (H') score and Pielou evenness index (J) score with 95% Confidence Interval for transects within the area of PT. TBOT.

In regards to their amphibian communities composition, the transects within the area of PT. TBOT were very similar to each other (similarity index = 0.74)(Figure 16).

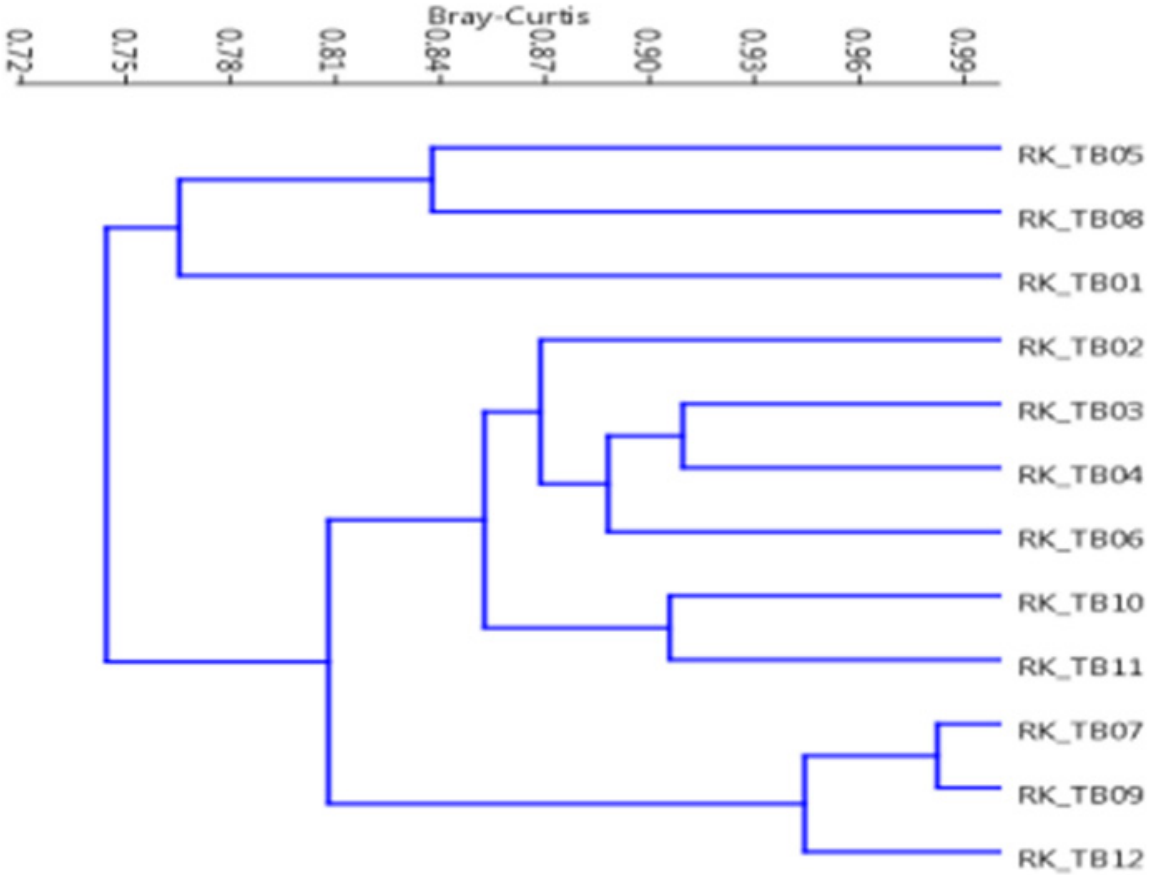

Figure 16 Similarity tree between amphibian communities in the area of PT. TBOT. All transect formed one cluster with high similarity score of 0.74.

e. Threats

Based on the field observation results, the amphibians and reptiles population in RER is facing two types of threat; a direct threat which affects individuals directly such as hunting and indirect threat which affect their habitat such as illegal logging.Direct observation and interview with several field assistants from Teluk Meranti village showed that reptiles such as turtles, snakes and monitor lizards becomeshunting target because they have economic values (table 9).

Table 9 Some reptiles species that are threatened by illegal hunting activities.

No	Species	Local Name	Uses
1	*Malayopython reticulatus*	Piton/ular sawah	skin and meat
2	*Orlitia borneensis*	Biuku	meat
3	*Amyda cartilaginea*	Lalabi/Labi Labi	meat
4	*Varanus rudicollis*	Biawak punggu	meat
5	*Varanus dumerilii*	Biawak punggu	meat
6	*Varanus salvator*	Biawak	meat

During the survey in PT. GCN, about 1.5 km upstream from RK_GC05 towards the head of Sangar Stream, we identified bornean river turtles (*Orlitia borneensis*) being hunted. Their legs and lower part of the shells were bound to prevent them from escaping when left by their hunters (Figure 17). The largest turtle had a shell length and width of 525 mm and 400 mm respectively. At the same time, we also encountered a reticulated python (*Malayopython reticulatus*) with a length of 3 m and a body diameter around 15 cm in a tightly knotted plastic bag. Based on the information from the field assistant, those capture would usually be sold to collectors in Pulau Muda district.

The threat to the bornean river turtles was also present in Serkap watershed. There we found large bamboo fish traps (bubu) and hooks (tajur). The fishermen used them to catch big fishes but the bornean river turtle could also get caught accidentally (Figure 18).The river turtles were lured by the bait put by fishermen and in some cases, 10 to 18 river turtles could get trapped in one large fish trap. Some fisherman would sell those river turtles to get additional income even if the selling price are lower than of the reticulated python and the asiatic soft shell turtle (*Amyda cartilaginea*). Sometimes, some bornean river turtle drowned and died inside the bamboo trap due to its position which is completely submerged in water. In other cases, some fishermen would release the trapped river turtles back to the stream. Besides the bornean river turtle, other species that could get trapped and died inside the fish trap were the gold-ringed cat snake (*Boiga dendrophila*), the elephant trunk snake (*Acrochordus javanicus*), the sunbeam snake (*Xenopeltis unicolor*) and the reticulated python (*M. reticulatus*).

Figure 17 The bornean river turtles (*Orlitia borneensis*) collected by native tribe. The plastron was bound with ropes to prevent escape.

Figure 18 Left: a bornean river turtle trapped inside a fishermen's bamboo fish trap; right: size comparison between the river turtle and the trap.

Apart from the bamboo fish trap, some reptiles species were also found to be caught by fishermen's hooks (Figure 19) such as the masked water snake (*Homalopsis buccata*), the orange-necked keelback (*Macropisthodon flaviceps*), the Asiatic soft shell turtle (*A. cartilaginea*), the bornean river turtle (*O. borneensis*), the smiling terrapin (*Siebenrockiella crassicollis*) and the monitor lizard (*Varanus salvator*). When crossing the Serkap stream, we saw two monitor lizard (*V. salvator*) got caught on a hook. One was dead while the other was managed to be released with a damaged eye. Besides that, one hooked smilling terrapin (*Siebenrockiella crassicollis*) was also released to the stream.

Figure 19 Upper left: the hook got caught in the monitor lizard's eye; upper right: releasing the monitor lizard back into its natural habitat; lower left: removing hook from a smiling terrapin's mouth; lower right: damage on the smiling terrapin's mouth caused by the hook.

Another potential direct threat revealed from the interview is the practice of electro fishing in Sangar stream. It was said that this activity had caused fish catchment in Sangar stream to be decrease rapidly.

The practice of illegal logging which is an indirect threat to amphibians and reptiles occurred in transect RK _GC06. The logging area was opened to provide access for getting and transporting the timber. At this location, we found some nicely cut logs with names written on them to mark ownership (Figure 20).

Figure 20 Threat from illegal logging in transect RK_GC06.

f. Taxonomic Notes

From the survey in RER area, we collected seven pit viper snake specimes belonging to the genus *Trimeresurus*. This snake has short and plump body (not more than 100 cm), triangular head, a vertical pupil with red-orange iris and thermal sensors (loreal pit). Its dorsal is generally brown with a green net pattern which is bordered by a row of black scales. These scales create a distinct border between the green net pattern and the brown dorsal (figure 21).

We have checked and compared our specimens with several identification books, included David and Vogel, 1996 (Snakes of Sumatra) and also compared with other specimens of *Trimeresurus* from School of Life Sciences and Technology-ITB collections which were also collected from Sumatra. Kampar pit viper has distinct body pattern and coloration from all known Sumatran *Trimeresurus*. Not only its body pattern and coloration several meristics characters (scale count) combinations are also not matched. We consulted a herpetology expert from Bandung Institute of Technology, Prof. Djoko T. iskandar, and he verified that there is a high chance that this snake specimens are new to science. Currently, a manuscript is being prepared to publish this snake as new species.

Figure 21 The morphology of *Trimeresurus sp.* encountered around the area of RK_TB07.

3.2 DISCUSSION

a. Comparison of species diversity in peat ecosystem

A total of 75 species of amphibians and reptiles (14 amphibians and 61 reptiles) recorded from the RER area represented about 22% of the total 343 species known from Sumatra Island (Teynié et al., 2010; Amphibiaweb, 2016; Reptile Database, 2016). PT. GCN and PT. SMN covered 13% while PT. TBOT represented 15% of Sumatran amphibians and reptiles.

From this number, 42 species or about 74% of our findings added new records to the list of amphibians and reptiles species of the Kampar Peninsula which is based on the list from the HCV assessment study result of PT Riau Andal Pulp and Paper (RAPP) by LPPM IPB (2015) (Appendix 2). The addition of a significant number of species to the latest list showed that the study of amphibians and reptiles in the area of Kampar Peninsula is still very minimal. Perhaps the result of our study provides the most current information about amphibians and reptiles species richness of the Kampar Peninsula.

In general, the amphibian species accumulation curve from each concession had reached the stationary phase implies that most of the common amphibian species in the RER area had all been encountered (Umilaela, 2008). Additional observation day would not result in significant addition to the record of amphibian species. Contrary to that, the reptile species accumulation curve had not reached the stationary phase implying that the possibility of encountering more species is high if observation days are added. So far, the number of reptile species encountered was more than the amphibians and it is still possible to get an additional number of species. Although the number of reptile species recorded was more than the amphibians, their abundance was lower. As predator, reptiles are relatively hard to spot because they move very smoothly, making them hard to detect (Beebee, 2013). Their move also covers a wide range (Barve et al., 2013). Most reptiles do not depend on water for reproducing and they play the role as predators in the food webs which make their abundance or density in nature lower than their preys (Gibbons & Dorcas, 2005; Brown & Shine, 2007).

The RER is dominated by peat swamp forest ecosystem and our study revealed that it has a low amphibian species richness of only 14 species, three of which are commonly found in man-made habitat (*Polypedates leucomystax*, *Fejervarya limnocharis* and *Hylarana erythraea*). The study of several researchers in peat swamp forests of Kalimantan also showed a similar result (Inger et al., 2005; Harrison et al., 2010; Waddell, 2010; Klys, 2011). From a study of amphibian species richness around a particular area in Giam Siak Kecil Nature Reserves, Riau, Sumatra, at least nine species was recorded, three of which are species highly associated with man made habitat (Matsui et al., 2012).

The low amphibian species richness in peat swamp forest might be caused by three ecological factors characterizing the peat swamp (Inger et al., 2005): 1) No streams with rocky bottom and relatively medium to fast current. In Kalimantan Island, most Ranids species are found in that kind of stream; about 33% of the total species known are found only in that particular stream type. 2) Water in peat ecosystem has low pH (acid) 3) Puddles as potential breeding sites are often inhabited by predatory fishes (which eat on amphibian larvae). During observation, we often found *Betta sp.* and *Channa sp.* in puddles within the observation transects.

b. Amphibians and reptiles diversity and habitat quality

Amphibians and reptiles are a taxa that is very sensitive to environmental changes (Inger and Stuebing, 2005; Zug et al., 2001). Richnes, species composition and abundance can be used as an indicator of habitat quality (Herrmann et al., 2005; Thompson et al., 2008; Browne et al., 2009). The Shannon-Wiener diversity index determined the diversity of a habitat by considering the richness and evenness of the species found within (Browner et al., 1998). However, it might not be wise to rely solely on the score of Shannon-Wiener diversity index to assess the relationship between amphibians and reptiles diversity and habitat quality in transects around RER area.

RK_BS01, RK_GC01, RK_TB07, RK_TB09, and RK_TB12 had the lowest diversity index ranging from 0.60-0.99. However, when considering the species richness alone, these transects had relatively high number of species compared to the other transects. They also had better forest condition with more big trees and denser canopy cover as well as less dominance of *Pandanus* sp. bushes. *Pandanus* sp. is said to have an association with disturbed habitat as seen in abandoned logging areas in the peat swamp forest of Kalimantan where this plant has very high density (Wibisono et al., 2005; Klys, 2011).

A study of amphibian diversity in primary dipterocarp forest in the Malaysian Peninsula showed low diversity index of 0.75. This low score was caused by the big population size of *Amolops larutensis* with more than 50% proportion (Ibrahim et al., 2012). Many studies have been conducted to show that amphibian abundance is directly proportional to habitat quality (Herrmann et al., 2005; Browne et al., 2009). In an extreme case, amphibian abundance decrease until 70% from its original population in an extensively abandoned logging area which was previously an old secondary forest (Dupuis et al., 1995). *Amolops larutensis* is commonly found only in streams with big rocks, fast current and clear water in primary forest with relatively low disturbance level (Ibrahim et al., 2012; IUCN SSC Amphibian Specialist Group, 2014). Its presence and abundance might be used as an indicator of good quality forest.

The collet's treefrog *P. colletti*, in RER area had a relative abundance of more than 80% especially in transect RK_BS01, RK_GC01 (PT. GCN), and RK_TB07, RK_TB09, RK_TB12 (PT. TBOT). This treefrog is commonly found in primary and old secondary forest habitat (Inger and Stuebing, 2005). This frog was not found in transect RK_GC06 where human activities were relatively high. Logging was present, so there was quite a big road opening probably used for transporting timber. Its location was also close to a canal and the area was dominated by *Pandanus* sp. bushes which might affect the presence and abundance of *P. colletti*. Some studies in the peat swamp forest of Kalimantan have shown that *P. colletti* tend to have very low abundance in the disturbed area (habitat) such as recently burnt forest area, opened forest area caused by logging activity, forest edge and canal. On the other hand, in peat swamp forest areas where disturbance are relatively low, these species tend to have a higher abundance (Waddell, 2010; Klys, 2011).

The presence of amphibian species that are commonly found around human settlements (human bound species) and man-made habitats such as pond, garden and rice field could be used as an indicator of habitat quality. *Fejervarya limnocharis* which is commonly found in rice fields was frequently seen in trenches and grasses around the area of Meranti main campas well as in transect RK_GC06. Besides that, *Hylarana erythraea* that is also commonly found in rice fields was also seen in recently burnt areas along the bank of Serkap Stream. Thus, *P. coletti* abundance, amphibians and reptiles species number as well as the presence/absence of human bound species couldbe used to indicate the quality of a peat swamp forest.

c. Important species and the threat they are facing

Sangar, Serkap and Turip watershed within the RER area are important for most of the threatened reptile species especially turtles and crocodiles. The presence of the false gharial in Serkap stream has been confirmed by the peat survey team who came across it when this species was basking at a distance of around 1 km downstream from the ranger post. Besides that, another species of the crocodile was reported to be seen around the area of a fisherman's hut at the left and right branch of Serkap Stream. Based on the witness's description, that crocodile has relatively short and widened snout which pointed towards the characteristic of the estuarine crocodile (*Crocodylus porosus*).

Cyclemis dentata is a land turtle that was relatively easy to find while *Cuora amboinensis* and *Heosemys spinosa* were spotted once in a while. These three species of turtle were encountered in terrestrial habitat near water puddles with in the forest which was relatively far from the stream. Three other turtle species which are *Batagur borneoensis*, *Pelochelys cantorii* and *Manouria emys* were not recorded in this survey. However, based on the RKU PHHK-RE document of PT. GCN, these species were reported to be found in the vicinity of PT. GCN (specific locations of findings are not mentioned).

Batagur borneoensis was reportedly found in the lake and river of Serkap (Tropenbos International Indonesia Program, 2010) and Sangar river of PT. GCN area (PT. GCN, 2012). However, our survey could not confirm this species occurence in those area. The adult of *Batagur borneonesis* is usually found in brackish water around the estuary of a big river (Iskandar, 2000) and tidal areas of a mangrove forest (Liat and Das, 1999). Since *B. borneoensis* is Critically Endangered, the specific locations where it was found as well as the sexes of each individual encountered are important for the conservation management of this species. Female individuals are reported to have the ability to migrate as much as 3 km away from the estuary to lay eggs (Liat and Das, 1999). Besides that, the young of this species is known to live in the freshwater part of a stream which is far away from the estuary (Asian turtle trade working group, 2000). However, information on how far young individuals travel away from the estuary is not mentioned. The information about where this species was found within the area of PT. GCN becomes very important considering its distance from the big River Kampar exceeds 3 km. This area might play an important role as breeding site or nursery ground for young individuals.

Similar to *B. borneoensis*, *P. cantorii* and *Manouria emys* are recorded as thretened reptiles in PT. GCN area (PT. GCN, 2012). *Pelochelys cantorii* known to live near the estuary of a big river and is reported to have been fished in the sea (Iskandar, 2000). If the record of *P. cantorii* can be confirmed inside the area of PT. GCN it will provides new information that this species could move more than 5 km away from the river estuary to the only stream that flows within the area of PT. GCN which is the Sangar River.

Manouria emys is a terrestrial turtle commonly found inside the forest at mid elevation to 1000 m (Liat and Das, 1999; Iskandar, 2000). We have found some individuals of this species in a hilly forest area at the elevation of 600-700 m in Sarolangun District, Jambi. If the record of *M. emys* can be confirmed inside the area of PT. GCN it will provides new information about this species's altitudinal distribution (near sea level) as well as its presence in peat swamp forest.

Several reptiles have economic values. Hunting (intentionally or accidentally) becomes a direct threat to them. Intentional hunting is when hunters deliberately hunt them for their values while accidental hunting occured when fishermen caught them at times when they got trapped in a fishtrap intended for fish. This might happen for turtles which spend most of their lives in streams such as *Orlitia borneensis, Amyda cartilaginea* and *Siebenrockiella crassicollis*.

Turtles are likely the most vulnerable group to hunting because of their relatively slow movement as well as the high mortality rate of the young individuals in nature (even when still at the egg phase). It takes a long time (years or even dozen of years) for them to reach sexual maturity and be ready to mate. This low rate of reproduction success in nature caused the recovery rate of turtle populations tend to be very slow. Even without human intervention, a dozen of years are needed (TRAFFIC Southeast Asia, 2001). Thus, if not controlled, the hunting of species from this group most likely will increase the risk of their manyfold extinction.

IV. CONCLUSIONS AND RECOMMENDATIONS

Asian leaf turtle - *Cyclemys dentata*

4.1 CONCLUSIONS

The peat swamp forest managed by RER is of a typical structure and composition for this forest type in Sumatra after it has been logged lightly some years ago. This area comprised as much as 75 species amphibians and reptiles which represented around 22% of species known from Sumatra. Generally, amphibian species richness was low which normally found in peat swamp habitat. Its relative abundance and also richness seems to be low in disturbed habitat where shrub of mengkuang (*Pandanus* sp.) dominated. Among all amphibians and reptiles are at least 16 threatened species according to the IUCN Red Lists, CITES and Indonesian Law. Watersheds within RER (Turip, Serkap, and Sangar River) are important areas and proposed to be protected and well managed where many threatened reptiles species including bornean river turtle (*Orlitia borneensis*) and the false gharial (*Tomistoma schlegelii*) using these areas as habitat. Poaching is potential direct threat for freshwater turtles, snakes, and monitor lizards found within RER area.

4.2 RECOMMENDATIONS

Based on this study, here are some recommendations we propose:

1. RER should do socialization or raise awareness program which related to important and threatened reptiles within RER area. It can be through counceling session, information board, book or poster. Information boards and posters should be placed in public areas in each estate. It should also be put in area around the bridges of Turip, Serkap and Sangar streams which function as entrance for fishermen when fishing in RER area.
2. RER could do a skill upgrade for rangers' capacities i.e. ability to identify threatened reptiles species in RER area. It might also be necessary to equip them with identification guide book.
3. RER should increase their security conducted by rangers in their ranger posts for filtering hunting (through thorough check and search) to minimize and eliminate this activity.
4. RER should make management plans to protect riparian areas that flow through RER area because they are important habitats for many threatened reptiles.
5. RER should enforce the establishment of some permanent transects in each concession for monitoring purpose; not only for amphibians and reptiles but also for other taxa. These transects should represent all variation of disturbance level (high, medium, low). The periodic survey should be done every 6 months so that it can represent seasonal variations (rainy and dry season).
6. RER should do a monitoring activity for their biodiversity every 2 to 3 years in the same location within PT. GCN, PT. SMN and PT. TBOT to see the biodiversity pattern and get more accurate information of threatened amphibians and reptiles species and also other taxa.
7. RER should conduct a population study for threatened flora and fauna especially for crocodiles and

turtles. This study should be intended to monitor the population health of these taxa. With healthy population size it is expected that ecological process which supports the increase of environment service would go well. The study about diversity and population of turtles could also be used to confirm the presence of the painted terrapin (Batagur borneoensis) which has the critically endangered (CR) status.

8. RER should stop the practice of fishermans's unsustainable fishing by using electrocution, in order to maintain the river ecosystem. Also, reptiles species trapped in fish traps (bubu and tajur) should be released back into the wild.

Puff-faced water snake - *Homalopsis buccata*

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VI. APPPENDICES

Appendix1 Amphibians and reptiles species list in each concession and their state of conservation. (GOI = protected under Regulation No. 7 of 1999, End : endemic of Sumatra).

No	Family	Species	IUCN	CITES	GOI	END	PT. GCN	PT. SMN	PT. TBOT
1	Acrochordidae	*Acrochordus javanicus*	LC	-	-	-	√	√	√
2	Agamidae	*Aphaniotis fusca*	LC	-	-	-	√	√	√
3	Agamidae	*Bronchocela cristatella*	NE	-	-	-	√	-	√
4	Agamidae	*Draco quinquefasciatus*	NE	-	-	-	-	√	√
5	Agamidae	*Draco sumatranus*	NE	-	-	-	√	√	√
6	Agamidae	*Gonocephalus liogaster*	NE	-	-	-	-	-	√
7	Bufonidae	*Ingerophrynus quadriporcatus*	LC	-	-	-	√	√	√
8	Bufonidae	*Pseudobufo subasper*	LC	-	-	-	√	√	√
9	Colubridae	*Ahaetulla prasina*	LC	-	-	-	-	√	√
10	Colubridae	*Boiga dendrophila*	NE	-	-	-	-	√	√
11	Colubridae	*Boiga drapiezii*	LC	-	-	-	-	√	√
12	Colubridae	*Boiga jaspidea*	LC	-	-	-	-	-	√
13	Colubridae	*Boiga nigriceps*	NE	-	-	-	√	-	√
14	Colubridae	*Chrysopelea paradisi*	NE	-	-	-	-	-	√
15	Colubridae	*Coelognathus flavolineatus*	LC	-	-	-	-	√	-
16	Colubridae	*Dendrelaphis caudolineatus*	NE	-	-	-	√	√	√
17	Colubridae	*Dendrelaphis formosus*	LC	-	-	-	-	-	√
18	Colubridae	*Dendrelaphis pictus*	NE	-	-	-	-	-	√
19	Colubridae	*Dryocalamus subannulatus*	LC	-	-	-	√	√	√

20	Colubridae	*Gongylosoma baliodeirus*	LC	-	-	-	-	√	√
21	Colubridae	*Lepturophis albofuscus*	LC	-	-	-	√	√	√
22	Colubridae	*Lycodon effraensis*	LC	-	-	-	-	√	-
23	Colubridae	*Lycodon subcinctus*	LC	-	-	-	√	-	-
24	Colubridae	*Xenelaphis hexagonotus*	LC	-	-	-	√	√	-
25	Crocodylidae	*Crocodylus porosus*	LC	II	-	-	-	-	√
26	Crocodylidae	*Tomistoma schlegelii*	VU	I	√	-	-	-	√
27	Dicroglossidae	*Fejervarya limnocharis*	LC	-	-	-	√	-	-
28	Dicroglossidae	*Limnonectes paramacrodon*	NT	-	-	-	√	√	√
29	Elapidae	*Bungarus flaviceps*	LC	-	-	-	√	-	-
30	Elapidae	*Naja sumatrana*	LC	II	-	-	√	√	√
31	Elapidae	*Ophiophagus hannah*	VU	II	-	-	-	√	-
32	Gekkonidae	*Cnemaspis* sp.	-	-	-	-	-	-	√
33	Gekkonidae	*Cyrtodactylus* sp.*1*	NE	-	-	-	√	√	√
34	Gekkonidae	*Gehyra mutilata*	NE	-	-	-	√	-	√
35	Gekkonidae	*Gekko smithii*	LC	-	-	-	-	√	√
36	Gekkonidae	*Hemidactylus frenatus*	LC	-	-	-	-	√	√
37	Gekkonidae	*Hemiphyllodactylus typus*	NE	-	-	-	√	-	-
38	Gekkonidae	*Ptychozoon kuhlii*	NE	-	-	-	√	-	-
39	Geoemydidae	*Heosemys spinosa*	EN	II	-	-	-	-	√
40	Geoemydidae	*Orlitia borneensis*	EN	II	√	-	√	√	-
41	Geoemydidae	*Cuora amboinensis*	VU	II	-	-	√	√	-
42	Geoemydidae	*Cyclemys dentata*	NT	II	-	-	√	√	√
43	Geoemydidae	*Siebenrockiella crassicollis*	VU	II	-	-	-	√	-
44	Homalopsidae	*Homalopsis buccata*	LC	-	-	-	√	√	√
45	Lamprophiidae	*Psammodynastes pictus*	NE	-	-	-	-	√	√
46	Lamprophiidae	*Psammodynastes pulverulentus*	NE	-	-	-	√	-	-
47	Microhylidae	*Phrynella pulchra*	LC	-	-	-	√	√	√
48	Natricidae	*Macropisthodon flaviceps*	LC	-	-	-	√	-	-
49	Natricidae	*Macropisthodon rhodomelas*	LC	-	-	-	√	-	-
50	Natricidae	*Rhabdophis subminiatus*	LC	-	-	-	-	√	-
51	Natricidae	*Xenochrophis maculatus*	LC	-	-	-	-	-	√
52	Pareatidae	*Aplopeltura boa*	LC	-	-	-	√	-	√

53	Pareatidae	*Asthenodipsas malaccanus*	LC	-	-	-	√	-	-
54	Pareatidae	*Pareas carinatus*	LC	-	-	-	√	-	-
55	Pythonidae	*Malayopython reticulatus*	NE	II	-	-	√	-	√
56	Ranidae	*Hylarana baramica*	LC	-	-	-	√	√	√
57	Ranidae	*Hylarana erythraea*	LC	-	-	-	-	√	√
58	Ranidae	*Hylarana glandulosa*	LC	-	-	-	√	-	-
59	Ranidae	*Hylarana parvaccola*	NE	-	-	√	√	√	√
60	Ranidae	*Hylarana rawa*	NE	-	-	√	√	√	√
61	Rhacophoridae	*Nyctixalus pictus*	NT	-	-	-	-	√	√
62	Rhacophoridae	*Polypedates colletti*	LC	-	-	-	√	√	√
63	Rhacophoridae	*Polypedates leucomystax*	LC	-	-	-	√	-	-
64	Rhacophoridae	*Polypedates macrotis*	LC	-	-	-	√	√	√
65	Scincidae	*Dasia olivacea*	LC	-	-	-	-	√	-
66	Scincidae	*Eutropis multifasciata*	NE	-	-	-	√	√	√
67	Scincidae	*Eutropis rudis*	NE	-	-	-	√	√	-
68	Scincidae	*Eutropis rugifera*	NE	-	-	-	√	√	√
69	Trionychidae	*Amyda cartilaginea*	VU	II	-	-	-	√	-
70	Varanidae	*Varanus dumerilii*	NE	II	-	-	-	-	√
71	Varanidae	*Varanus rudicollis*	NE	II	-	-	√	-	√
72	Varanidae	*Varanus salvator*	LC	II	-	-	√	√	√
73	Viperidae	*Trimeresurus* sp.*1*	-	-	-	-	-	√	√
74	Viperidae	*Tropidolaemus wagleri*	LC	-	-	-	√	√	√
75	Xenopeltidae	*Xenopeltis unicolor*	LC	-	-	-	-	√	√
Total							**45**	**46**	**52**

Appendix2 Comparison of the amphibians and reptiles species in RER with the results of other studies. (GOI = protected under Regulation No. 7 of 1999 , End = endemic)

No	Family	Spesies	IUCN	CITES	GOI	END	Estate RAPP[1]	RER[2]	Kampar Peninsula[1]
1	Acrochordidae	*Acrochordus javanicus*	LC	-	-	-	√	√	√
2	Agamidae	*Aphaniotis fusca*	LC	-	-	-	-	√	√
3	Agamidae	*Bronchocela cristatella*	NE	-	-	-	-	√	√
4	Agamidae	*Draco quinquefasciatus*	NE	-	-	-	-	√	-
5	Agamidae	*Draco* sp.	NE	-	-	-	-	-	√
6	Agamidae	*Draco sumatranus*	NE	-	-	-	-	√	-
7	Agamidae	*Gonocephalus liogaster*	NE	-	-	-	-	√	-
8	Bufonidae	*Duttaphrynus melanostictus*	LC	-	-	-	√	-	√
9	Bufonidae	*Ingerophrynus biporcatus*	LC	-	-	-	√	-	√
10	Bufonidae	*Ingerophrynus divergens*	LC	-	-	-	-	-	√
11	Bufonidae	*Ingerophrynus quadriporcatus*	LC	-	-	-	√	√	√
12	Bufonidae	*Phrynoidis aspera*	LC	-	-	-	-	-	√
13	Bufonidae	*Pseudobufo subasper*	LC	-	-	-	√	√	√
14	Colubridae	*Ahaetulla prasina*	LC	-	-	-	√	√	√
15	Colubridae	*Boiga dendrophila*	NE	-	-	-	-	√	√
16	Colubridae	*Boiga drapiezii*	LC	-	-	-	-	√	-
17	Colubridae	*Boiga jaspidea*	LC	-	-	-	-	√	-
18	Colubridae	*Boiga nigriceps*	NE	-	-	-	-	√	-
19	Colubridae	*Chrysopelea paradisi*	NE	-	-	-	-	√	-
20	Colubridae	*Coelognathus flavolineatus*	LC	-	-	-	-	√	-
21	Colubridae	*Coelognathus radiatus*	LC	-	-	-	√	-	-
22	Colubridae	*Dendrelaphis caudolineatus*	NE	-	-	-	√	√	√
23	Colubridae	*Dendrelaphis formosus*	LC	-	-	-	-	√	-
24	Colubridae	*Dendrelaphis pictus*	NE	-	-	-	√	√	√
25	Colubridae	*Dryocalamus subannulatus*	LC	-	-	-	-	√	-
26	Colubridae	*Gongylosoma baliodeirus*	LC	-	-	-	-	√	-
27	Colubridae	*Lepturophis albofuscus*	LC	-	-	-	-	√	-
28	Colubridae	*Lycodon effraensis*	LC	-	-	-	-	√	-
29	Colubridae	*Lycodon subcinctus*	LC	-	-	-	√	√	-

30	Colubridae	*Ptyas korros*	NE	-	-	-	√	-	√
31	Colubridae	*Xenelaphis hexagonotus*	LC	-	-	-	-	√	-
32	Crocodylidae	*Crocodylus porosus*	LC	II	-	-	-	√	√
33	Crocodylidae	*Tomistoma schlegelii*	VU	I	√	-	-	√	√
34	Dicroglossidae	*Fejervarya cancrivora*	LC	-	-	-	√	-	√
35	Dicroglossidae	*Fejervarya limnocharis*	LC	-	-	-	-	√	-
36	Dicroglossidae	*Limnonectes paramacrodon*	NT	-	-	-	-	√	√
37	Elapidae	*Bungarus flaviceps*	LC	-	-	-	-	√	-
38	Elapidae	*Naja sumatrana*	LC	II	-	-	√	√	√
39	Elapidae	*Ophiophagus hannah*	VU	II	-	-	√	√	-
40	Gekkonidae	*Cnemaspis* sp.	-	-	-	-	-	√	-
41	Gekkonidae	*Cyrtodactylus marmoratus*	NE	-	-	-	-	-	√
42	Gekkonidae	*Cyrtodactylus* sp.*1*	NE	-	-	-	-	√	-
43	Gekkonidae	*Cyrtodactylus* sp.*2*	NE	-	-	-	-	-	√
44	Gekkonidae	*Gehyra mutilata*	NE	-	-	-	-	√	√
45	Gekkonidae	*Gekko gecko*	NE	-	-	-	√	-	√
46	Gekkonidae	*Gekko smithii*	LC	-	-	-	-	√	-
47	Gekkonidae	*Gekko* sp.	LC	-	-	-	-	-	√
48	Gekkonidae	*Hemidactylus frenatus*	LC	-	-	-	√	√	√
49	Gekkonidae	*Hemidactylus platyurus*	NE	-	-	-	-	-	√
50	Gekkonidae	*Hemiphyllodactylus typus*	NE	-	-	-	-	√	-
51	Gekkonidae	*Ptychozoon kuhlii*	NE	-	-	-	-	√	-
52	Gekkonidae	*Ptychozoon* sp.	NE	-	-	-	-	-	√
53	Geoemydidae	*Batagur borneensis*	CR	I	√	-	-	-	√
54	Geoemydidae	*Heosemys spinosa*	EN	II	-	-	√	√	√
55	Geoemydidae	*Orlitia borneensis*	EN	II	√	-	-	√	√
56	Geoemydidae	*Cuora amboinensis*	VU	II	-	-	√	√	√
57	Geoemydidae	*Cyclemys dentata*	NT	II	-	-	-	√	-
58	Geoemydidae	*Siebenrockiella crassicollis*	VU	II	-	-	-	√	-
59	Homalopsidae	*Enhydris enhydris*	LC	-	-	-	√	-	-
60	Homalopsidae	*Homalopsis buccata*	LC	-	-	-	√	√	√
61	Lacertidae	*Takydromus sexlineatus*	LC	-	-	-	-	-	√
62	Lamprophiidae	*Psammodynastes pictus*	NE	-	-	-	-	√	√

63	Lamprophiidae	*Psammodynastes pulverulentus*	NE	-	-	-	-	√	-
64	Microhylidae	*Phrynella pulchra*	LC	-	-	-	-	√	-
65	Natricidae	*Macropisthodon flaviceps*	LC	-	-	-	-	√	√
66	Natricidae	*Macropisthodon rhodomelas*	LC	-	-	-	-	√	-
67	Natricidae	*Rhabdophis subminiatus*	LC	-	-	-	-	√	-
68	Natricidae	*Xenochrophis maculatus*	LC	-	-	-	√	√	√
69	Pareatidae	*Aplopeltura boa*	LC	-	-	-	-	√	√
70	Pareatidae	*Asthenodipsas malaccanus*	LC	-	-	-	-	√	-
71	Pareatidae	*Pareas carinatus*	LC	-	-	-	-	√	-
72	Pythonidae	*Malayopython reticulatus*	NE	II	-	-	√	√	√
73	Pythonidae	*Python curtus?*	LC	II	-	S	√	-	-
74	Pythonidae	*Python molurus?*	NE	II	-	-	√	-	-
75	Ranidae	*Hylarana baramica*	LC	-	-	-	-	√	√
76	Ranidae	*Hylarana chalconota*	LC	-	-	-	-	√	√
77	Ranidae	*Hylarana erythraea*	LC	-	-	-	√	√	√
78	Ranidae	*Hylarana glandulosa*	LC	-	-	-	-	√	-
79	Ranidae	*Hylarana parvaccola*				S	-	-	-
80	Ranidae	*Hylarana raniceps*	LC	-	-	B	-	-	-
81	Ranidae	*Hylarana rawa*	NE	-	-	S	-	√	-
82	Ranidae	*Hylarana* sp*1.*	-	-	-	-	-	-	√
83	Rhacophoridae	*Nyctixalus pictus*	NT	-	-	-	-	√	-
84	Rhacophoridae	*Polypedates colletti*	LC	-	-	-	-	√	√
85	Rhacophoridae	*Polypedates leucomystax*	LC	-	-	-	√	√	√
86	Rhacophoridae	*Polypedates macrotis*	LC	-	-	-	-	√	-
87	Scincidae	*Dasia olivacea*	LC	-	-	-	-	√	-
88	Scincidae	*Eutropis multifasciata*	NE	-	-	-	√	√	√
89	Scincidae	*Eutropis rudis*	NE	-	-	-	-	√	-
90	Scincidae	*Eutropis rugifera*	NE	-	-	-	-	√	-
91	Scincidae	*Eutropis* sp.	NE	-	-	-	-	-	√
92	Scincidae	*Lygosoma bowringii*	NE	-	-	-	√	-	√
93	Scincidae	*Sphenomorphus bowringii*	NE	-	-	-	-	-	√
94	Testudinidae	*Manouria emys*	EN	II	-	-	-	-	√
95	Trionychidae	*Amyda cartilaginea*	VU	II	-	-	√	√	√

96	Trionychidae	*Pelochelys cantorii*	EN	II	-	-	-	-	√
97	Trionychidae	*Trionychidae (unidentified)*	DD	-	-	-	-	-	√
98	Varanidae	*Varanus bengalensis*	LC	-	-	-	-	-	√
99	Varanidae	*Varanus dumerilii*	NE	II	-	-	-	√	-
100	Varanidae	*Varanus rudicollis*	NE	II	-	-	-	√	-
101	Varanidae	*Varanus salvator*	LC	II	-	-	√	√	√
102	Viperidae	*Calloselasma rhodostoma*	LC	-	-	-	√	-	-
103	Viperidae	*Popeia nebularis*	LC	-	-	-	√	-	-
104	Viperidae	*Trimeresurus sp.1*	-	-	-	-	-	√	-
105	Viperidae	*Trimeresurus* sp.*2*	-	-	-	-	-	-	√
106	Viperidae	*Tropidolaemus wagleri*	LC	-	-	-	-	√	√
107	Xenopeltidae	*Xenopeltis unicolor*	LC	-	-	-	-	√	-
Total							**32**	**75**	**57**

1 .Based on LPPM IPB HCV report (LPPM IPB, 2015)
2. Compiling from three concessions, which are PT. GCN, SMN dan TBOT

Confirmation required for distribution presence in the peat swamp area in eastern part of Sumatra or the east side of Bukit Barisan.

Calloselasma rhodostoma : In Indonesia, reported only in Java (Grismer & Chan-Ard, 2012).
Hylarana raniceps : Endemic to Borneo (Inger et al., 2009).
Manouria emys : Known only found in the forest plains to a height of 1000 m (Liat & Das, 1999; Iskandar, 2000).
Popeia nebularis : Known endemic to the highlands Cameron (Cameron Highlands) , Pahang , Peninsular Malaysia (Vogel et al., 2004).
Python curtus : Not distributed to the west of the Bukit Barisan Mountains area (Keogh et al., 2001). Possibly identified as *P. brongersmai*.
Python molurus : In Indonesia listed as *P. bivittatus* and only distributed in Java , Bali and Sulawesi (Stuart et al., 2012).
Varanus bengalensis : Formerly known there are two sub-species, namely V. b. bengalensis and V. b. nebulosus respective current status was raised as a distinct species. Distribution V. bengalensis up to Southeast Asia only to Myanmar. For V. nebulosus in Indonesia is recorded in Sumatra and Java (Kochet al., 2013).

Appendix 3. Description of some threatened reptiles in RER.

Varanus salvator
Biawak
Monitor lizard
Varanidae
Conservation status: LC, CITES App. II

Short description: total size of an average of 142 cm (males) and 149 cm (female). Have a black line with a yellow edge that extends to the rear of the direction of the eye. The body color is usually black with yellow spots that fade when more mature. Neck and a long snout. The nostrils are oval or rounded. Scales on a hump or back of the head relative to the body scales of the same size.

Distribution : Indonesia (Sumatera, Jawa, Kalimantan, and widespread distribution in Indonesia). Bangladesh, Cambodia, China, Hong Kong, India, Lao,Malaysia Peninsula, Myanmar, Singapore, Sri Lanka, Thailand, Vietnam.

Varanus dumerilii
Biawak
Dumeril's monitor
Varanidae
Conservation status: NE, CITES App. II

Short description: Slender, monitor lizards, total lengths between 120 and 135 cm. head short and broad, a blunt, flat snout, neck shorter than head. Juveniles with more contrasting pattern; head and nape often orange-red; cross lines of the body correspondingly coluured or whitish yellow.

Distribution; Indonesia (Sumatera, Borneo, Bangka, Billiton, Natuna). Southern Myanmar, Thailand, Malaysian Penisula.

Varanus rudicollis
Biawak
Roughneck monitor lizard
Varanidae
Conservation status: NE, CITES App. II

Short description: The total size between 130-150 cm. It has a dark gray body color with yellow stripes wrapped around the body and yellow spots on the neck and legs. Has a long neck. Have a long snout with nostrils slit-shaped line Scales enlarged and as lifted up on a hump or back of the head is formed as a clear horizontal line.

Distribution: Indonesia (Sumatera, Kepulauan Riau, Bangka, Kalimantan). Myanmar,Thailand, Malaysia, Filipina.

Cyclemys dentata
Kuo-kuo
Asian leaf terrapin
Geoemydidae
Conservation status: NT, CITES App. II.

Short description: Adult carapace length reaches 21 cm. Has a blackish brown shell color as the leaves die and there are parts lifted horizontally in the center of the shell. The bottom shell (plastron) is yellow with black stripes. There is a sort of hinge in adult individuals in the middle plastron. Head brownish or reddish brown stripe on the neck.

Distribution: Indonesia (Sumatera, Jawa, Kalimantan, Bali). India, Bangladesh, Myanmar, Thailand, Kamboja, Vietnam, Peninsula Malaysia; Filipina, China.

Orlitia borneensis
Biuku
Bornean river turtle
Geoemydidae
Consrvation status: EN, CITES App. II, Protected by law

Short description: Adult carapace length reaches about 80 cm, with a smooth oval shape which is flatter than that tiller tends to be convex with a rough carapace margin. Carapace color black with pale yellow or white plastron. There is no kind of hinge on the plastron, webbed feet like paddles with thick and long claws.

Distribution: Indonesia (Sumatera, Kalimantan). Peninsula Malaysia.

Cuora amboinensis
Kuo-kuo
Amboina box turtle
Geoemydidae
Conservation status: VU, CITES App. II

Short description: Carapace length reaches 25 cm smooth convex blackish color. Plastron pale yellow or white. Have a kind of hinge on the plastron that allows the entire body into the shell. Head black with yellow stripes clear.

Distribusi: Indonesia. India, Bhutan, Bangladesh, Myanmar, Thailand, Kamboja, Vietnam, Semenanjung Malaysia, Singapura, Filipina.

Heosemys spinosa
Kuo-kuo
Spiny turtle
Conservation Status: EN, CITES App. II

Short description: Carapace length of about 22 cm with a convex shape brownish color. Head brown with red spots on the snout and behind the eyes. The shell of the tillers formed like spines on the edges. Has a section lifted horizontally in the center of the shell.

Distribution: Indonesia (Sumatera, Kalimantan). Singapura, Malaysia, Myanmar, Filipina,Thailand.

Siebenrockiella crassicollis
Kuo-kuo
White cheeck terrapin
Conservation status: VU, CITES App. II

Short description: Carapace length of about 20 cm with a convex shape in black. Plastron black-colored or pale yellow, the legs and the head blackish color. In juvemile and female individuals are white section above the eye, near the cheek, below the lower jaw, and at the side of the head. The shape of the jaw line lifted up like the shape of a smile.

Distribution: Indonesia (Sumatera, Jawa, Kalimantan). Singapura, Malaysia Vietnam. Kamboja, Thailand, Myanmar.

Amyda cartilaginea
Labi-labi atau Lalabi
Asiatic softshell turtle
Conservation status: VU, CITES App. II

Short description: Carapace length of about 75 cm. Soft shell and not be separated like a turtle. Flat shell shape and rounded with a smooth periphery. There are yellow spots all over the body that disappears with age. Elongated snout or nose like a pig.

Distribution: Indonesia (Jawa, Sumatera, Kalimantan, Sulawesi). Singapura, Malaysia, Vietnam, Laos, Kamboja, Thailand, Myanmar, India, Bangladesh.

Crocodylus porosus
Buaya Muara/ Buaya Katak
Salt water crocodile
Conservation status: LC, CITES App. II, Protected by law.

Short description: The total size could reach 9 m. Has a yellowish body color with black spots along the body to tail. Snout width.

Distribution: Indonesia (widespread distribution). Australia, Bangladesh, Brunei, Myanmar, Kamboja, China, India, Malaysia, Palau, Papua Nugini, Filipina, Singapura, Sri Lanka, Pulau Solomon, Thailand, Vanuatu, Nauru, Micronesia, Vietnam.

Tomistoma schlegelii
Buaya Senyulong
False gharial
Conservation status: EN, CITES App. I, Protected bt law

Short description: The size can be up to 6 m. Reddish brown body color with black spots. Muzzle narrows towards the front.

Distribution: Indonesia (Sumatera, Kalimantan, Jawa, Sulawesi). Peninsula Malaysia, Thailand, Vietnam.

Malayopython reticulatus
Piton/Ular sawah
Reticulated python
Conservation status: NE, CITES App. II

Short description: Total size can reaches 10 m. Has a body color grayish brown with a zig - zag pattern black and yellow interspersed brown or dark brown and there is a white area. An elongated head with a black stripe on the back of the eye. Orange eyes with vertical pupils Body relatively plump with relatively long tail.

Distribution: Indonesia (widespread). Timor-Leste, Bangladesh, Brunei Darussalam, Kamboja, India, Laos, Malaysia, Myanmar, Filipina, Singapura, Thailand, Vietnam.

Naja sumatrana
Ular Kobra Sumatra
Sumatran cobra
Conservation status: LC, CITES App. II

Short description: The total size of about 1.5 m. Black or brown body. The neck can be developed to form a hood. The lower part of the body is black with pale white area on the neck.

Distribution: Indonesia (Sumatera, Kalimantan). Malaysia, Thailand, Singapura, Filipina.

Ophiophagus hannah
Ular raja kobra/ Ular Upe
King cobra
Conservation status: VU, CITES App.II

Short description: The total size can reach 6 m. Body yellowish brown, pale brown , dark brown or black. Some have a white stripe. The neck can be developed to form a hood. Head can be distinguished from the neck and have large scales with black side. The lower part of the body (neck) are cream-colored and black lines.

Distribution: Indonesia (widespread). Bangladesh, Myanmar, Kamboja, China, India, Nepal, Bhutan, Singapura, Laos, Thailand, Vietnam, Peninsula Malaysia, Filipina.

Hylarana rawa
Katak rawa
-
Conservation status : Not evaluated (NE) , endemic to Sumatra (currently limited distribution in the peat swamp forests of Riau)

Short description: Small body size of approximately 26 mm. Body dark brown, the bottom is white with flecks of gray. Humeral glands in the hands of individual males. Feet and hands do not have a swimming membranes.

Distribution: Endemic Sumatra (Indonesia)

Hylarana parvaccola
-
Conservation status : Not evaluated (NE) , endemic to Sumatra

Short description: Mean body size of 45 mm (females) and 40 mm (male). The upper body is yellow to greenish. Tunica full foot except on the fourth finger.

Distribution: Endemic Sumatra (Indonesia)

Photo resources:

1. *Amyda cartilaginea*: (c) Tim McCormack (sumber: http://www.arkive.org/southeast-asian-soft-terrapin/amyda-cartilaginea)
2. *Cuora amboinensis*: (c) Ganjar Cahyadi
3. *Siebenrockiella crassicollis*: (c) Ganjar Cahyadi
4. *Crocodylus porosus*: (c) Ganjar Cahyadi
5. *Tomistoma schlegelii*: (c) Ganjar cahyadi
6. *Naja sumatrana*:(c) FFI Jambi Sarolangun - Andri Irawan
7. *Ophiophagus hannah*: (c) Rob Valentic (sumber: https://www.flickr.com/photos/gondwanareptileproductions/16337208082)