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[Strengthening The Resort Based Management and Partnership With The Buffer Village for The Mitigation of Wildlife Hunting and Forest Fire in Way Kambas National Park]

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Chair of Way Kambas National Park,

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ECOLOGICAL STUDY OF WILDLIFE DISTRIBUTION POINT FOR POTENTIAL HUNTING AND INVENTORY OF WILDLIFE IN AREA AFFECTED BY FIRE IN SUSUKAN BARU AND KUALA PENET RESORT AND BUFFER VILLAGES OF WAY KAMBAS NATIONAL PARK LAMPUNG PROVINCE

BY:

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1. Introduction

1.1 Background

Sumatra, the third largest island in Indonesia with an area of 443,065 km^2, has a diversity of mammals as much as 257 (37%) of the total 720 species of mammals in Indonesia. The 44 species of which are endemics, such as the Sumatran tiger (*Panthera tigris sumatrae*), Sumatran elephant (*Elephas maximus sumatranus*), Sumatran rhino (*Dicerohinus sumatranus*), gibbon (*Symphalangus syndactylus*), etc. (LIPI, 2014).

Way Kambas National Park was designated as a National Park Area (WKNP) through the Decree of the Minister of Forestry No. 670/Kpts-II/1999 on 26 August 1999 with an area of approximately 125,631.31 ha. The efforts to conserve the Way Kambas nature have been started since 1936 by the resident of Lampung which was later determined by the Dutch Governor's Letter dated January 26th, 1937. WKNP is located at 4^0 37'-$5^0$16' South Latitude and $105^0$33'-$105^0$54 East Longitude.

Way Kambas National Park is an important habitat for tapirs (*Tapirus indicus*), Sumatran elephants (*Elephant maximus sumatranus*), Sumatran tigers (*Panthera tigris*), Sumatran rhinos (*Dicerohinus sumatranus*), and sun bears (*Helarctos malayanus*). Several types of ecosystems in WKNP include lowland rain forest ecosystems, riparian ecosystems, coastal forest ecosystems, mangrove ecosystems, and freshwater swamp forest ecosystems. The various types of ecosystems above serve as habitats for various kinds of animals such as mammals, avifauna, herpetofauna, insects, and fish. In the WKNP area, there are 50 mammal species which are included in the endangered species such as the Sumatran rhino (*Dicerorhinus sumatrensis sumatrensis*), Sumatran elephant (*Elephas maximus sumatranus*), and

Sumatran tiger (*Panthera tigris sumatrae*). As much 314 species of avifauna were recorded. The jungle stick (*Cairina scutulata*), lawe stork (*Ciconia episcopus stormi*), and tong tong stork (*Leptoptilos javanicu*), noted as endangered. Then, the amphibians and reptiles recorded 17 species and 13 species respectively. As for freshwater fish and butterflies, there were 48 species and 77 species (Evi et al., 2018).

Although this area has been designated as a conservation area since 1937, habitat destruction continues to occur mainly due to logging activities when the area was opened for Forest Concession Rights in 1968-1974. Moreover, illegal settlements sprung up which had an impact on wild plants and animals in WKNP due to the impact of illegal hunting that accompanied these activities.

The history of land and forest fires in Indonesia has occurred since the pre-independence era. In the post-independence period, several periods of large-scale forest fires were recorded, including 1982-1983, 1987, 1991, 1994, 1997-1998 which were the effects of the El-Nino heatwave (Bowen et al., 2001) and 2015. On a smaller scale, land and forest fires almost occur every year. Based on tracing data from Landsat 5 (USGS) satellite imagery, land and forest fires in WKNP have occurred since 1994 on a small scale and 1997/1998 in a larger period and most recently experienced land and forest fires in 2019.

Land and forest fires have a very significant impact on the existence of biodiversity. This study was conducted to determine the impact of land and forest fires on biodiversity, especially mammals in WKNP.

1.2 Objective

a. Knowing the forest fire occurrence at Susukan Baru and Kuala Penet Resort
b. Knowing about poaching event at Susukan Baru and Kuala Penet Resort
c. Knowing the diversity of avifauna in two buffer villages, namely Rantau Jaya Udik 2 and Braja Harjosari Village

2. Methodology

2.1 Time and Location

The hunting and forest fire event assessment survey was conducted in the ex-burned areas of Kuala Penet Resort and Susukan Baru Resort, Way Kambas National Park, Lampung. The survey was conducted on the 8th-13th of June 2020. The location selection was determined based on the objective of this study, namely knowing the forest fires and hunting spots in two resorts. Selected survey locations are the sites that have experienced forest fires for the last 4 years, from 2015 to 2019 based on existing data.

2.2 Data Collecting Method

The data collecting method is a set of procedures for collecting the data field as complete as possible. The choice of method is adjusted to the availability of time and resources of researchers and personnel.

2.2.1 Mammalian data collecting method

The sampling method used in data collection on mammals is:

a) Strip Transect Method

Strip transect is one of the most frequently used methods in data collecting, both in types and numbers of individual wildlife. The length of the path used was 1.5-2.5 km. The data collected is based on direct encounters with mammals that are in the width of the observation path

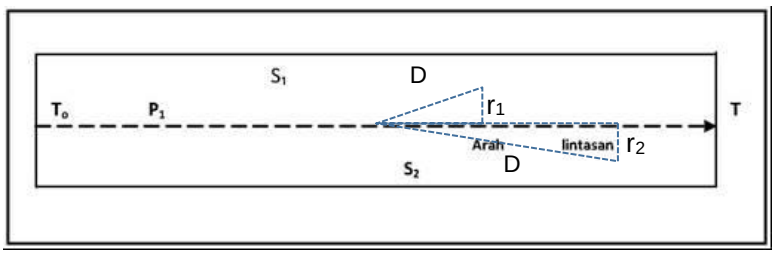


Figure 1 Inventory of mammals by path method

Note:

To = the starting point of the line of observation, T = the endpoint of the line of observation, P1 = the position of the observer, r = the distance between the observer and the place where wild animals were detected, S1 = the position of the wild animal. D = distance of observer to the animal; r = distance of animal to the transect line

b) Focus area (Concentration count)

Observations were made concentrated at a point that is thought to be a place with a high probability of encountering animals. For example, places were the source of food and water are available, and so on. Recording data through direct or indirect contact includes recording encounters of footprints, nesting sites, and feces. Observations were made in the morning, evening, and night.

c) Indirect observation

This method is applied to types of mammals that are difficult to find directly. The data taken can be in the form of traces such as footprints, hair, feces, nests, and other traces that can be used as data.

d) Camera trap

This method is applied to types of mammals that are difficult to find directly. The data taken is in the form of wild animals passing in front of the camera trap. This method is quite effective and efficient. However, it has a high-cost risk as well as special human resources to manage it.

2.2.2 Avifauna Data Collecting Method

The method used to analyze birds is the line transect with a length of 1 km. This method is carried out by observing a radius of about 50 meters by walking along the transect line and recording was conducted with intervals of 10 minutes each for 2 hours at 6-8 a.m and 4-6 p.m. During that time, the number of individuals and bird species found was counted and recorded. Observations were made in two WKNP buffer villages, namely Braja Harjosari Village and Rantau Jaya Udik II Village.

Birds are observed by writing down their characteristics such as the shape and color of the

beak, the color of the wings, legs, flight patterns, and then visualized with pictures. The identification of bird species was carried out manually using the bird's identification book, McKinnon, until the species was found.

Figure 2. Bird Observation Locations using the Line Transect Method

2.2.3. Herpetofauna Data Collection Method

Data of herpetofauna was collected by searching for herpetofauna in their habitats, namely terrestrial habitats and aquatic (water) habitats (Heyer et al., 1994). The method used is the Visual Encounter Survey (VES) which is carried out on the specified paths. The path used in this survey is the aquatic route following the river flow. Species from the Herpetofauna group usually use twigs, leaves, logs, holes in trees, wooden buttresses, litter, rocks, and streams to hide, so searches are focused on these places. Observations were made at 6-8 p.m. The data recorded included species, number of individuals, substrate, time of encounter, and activity. Each species found is immortalized using a digital camera and geo-tagging is done using GPS.

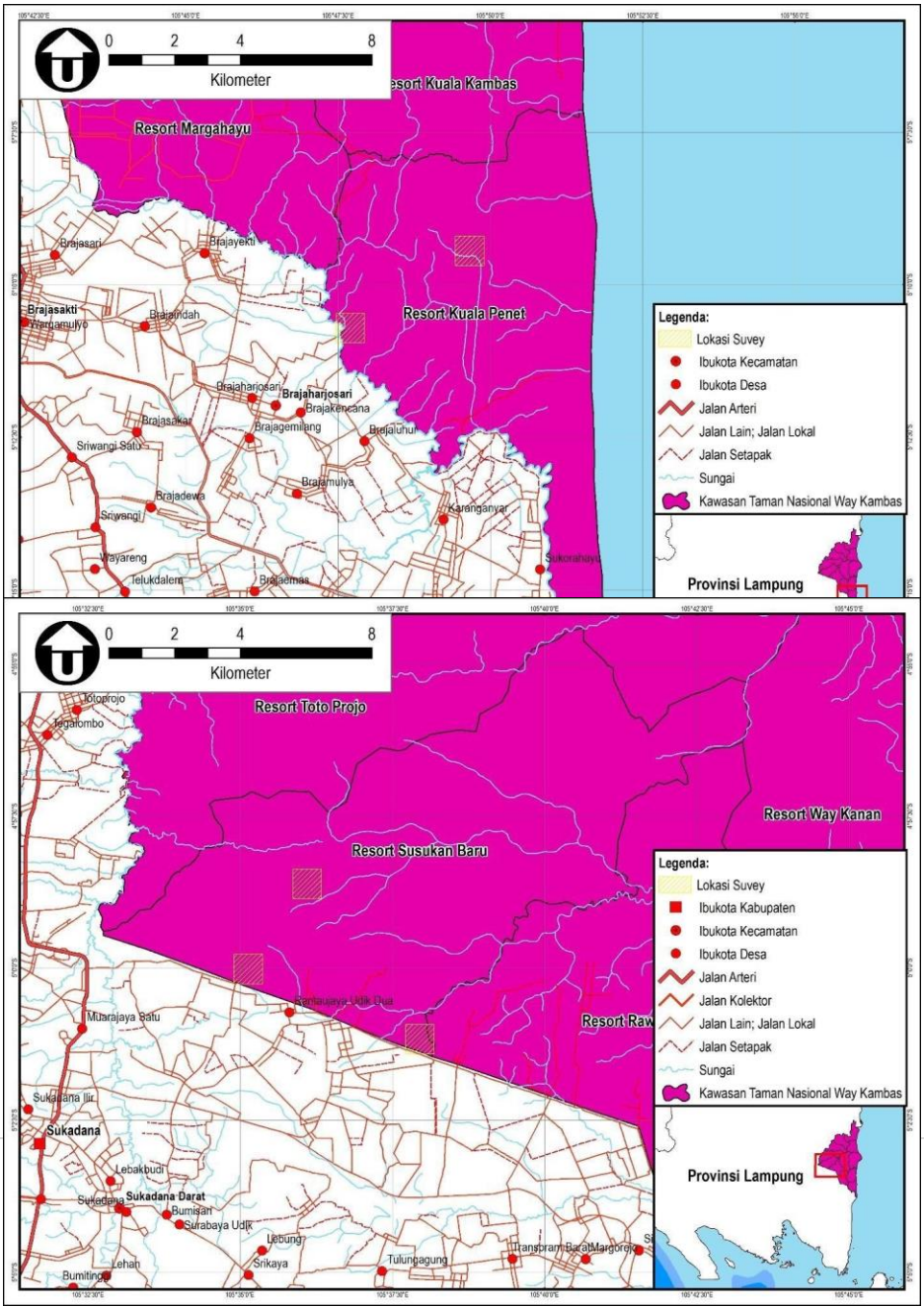


Figure 3. Location of Mammals and Herpetofauna Survey at the Kuala Penet Resort

Figure 4. Location of Mammals and Herpetofauna Survey at Resort Susukan Baru Resort

2.3. Data Analysis

Index of Diversity (H')

Species diversity is one of the community-level characteristics according to the biology hierarchy. Species diversity can be used to represent community structure. Species diversity can indicate community stability, and state community ability to protect and keep the parts stable, although a few of the components may have a stressor (Soegianto, 1994 in Indriyanto, 2006). The higher the value, the higher the species diversity, ecosystem productivity, and stability. Species diversity can be calculated using the Index of Shannon-Wiener formula (Krebs, 1989).

$$H' = \sum_{i=1}^{s} (Pi \times ln.\, Pi) \text{ where } Pi = \frac{n_i}{N}$$

Note:

H’ = Shannon-Wiener diversity Index

n_i = The number of individuals in species-i

N = The total number of individuals of all species

The criteria for the Shannon-Wiener Diversity Index are:

H’ < 1 = low diversity, an indication of heavy ecological pressure and an unstable ecosystem

1<*H’*≤3 = moderate diversity, sufficient productivity, fairly balanced ecosystem conditions, moderate ecological pressure

H’> 3 = high diversity, very stable ecosystem with high productivity

Index of Evenness (E)

The index of evenness can be used to calculate evenness and the distribution of every species in the community. Index of evenness counted using the following formula:

$$E = \frac{H'}{Ln.\, S}$$

Note:

E = Index of Evenness (0-1)

H’ = Shannon-Wiener diversity index

S = Number of species

List of Bird Species

The data obtained were individual bird encounters with 12 intervals for 2 hours of observation. The data was processed by classifying and comparing the types of species found in Braja Harjosari and Rantau Jaya Udik II Village. The species list was also completed with the conservation status and feeding guilds based on the latest information from IUCN.

Relative Abundance of Birds

Relative abundance is the number of individuals found in each species as a percentage. Abundance is also defined as the number of individuals per unit area or volume.

Index of Diversity

The Index of diversity expresses the combined total number of species and relative abundance between species. Quantitatively, the species diversity can be expressed using the Shannon-Wiener Diversity Index. The Shannon-Wiener index is often expressed in symbols H '. The diversity index value (H ') <1.0 then the diversity is categorized as low, if the value of H' is 1.0 - 3.0, then the diversity is categorized as moderate, whereas if the value of H ' > 3.0, then the diversity is categorized as high (Komi, Toana, & Yunus, 2015).

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

Note:

H '= index of diversity

pi = the ratio of the number of individuals of one species to the total number of individuals in the plot sample.

Simpson's Dominance Index

Index of dominance (D) is used to determine the presence or absence of dominance of a species. The dominance index which is close to zero means that there are no dominant species whereas if it is close to one, there are dominant species (Maya et al, 2016).

$$D = \sum pi^2$$

Note :

D = Simpson's Dominance Index

S = total number of species in the sample

Pi = proportion

The criteria for the index of dominance range from 0-1. If D approaches 0 then there are no dominant species, while if D approaches 1 then there are dominant species.

Sorensen Similarity Index (Is)

The Sorensen similarity index (Is) is used to find out the level of similarity between communiti located at different sampling locations.

$$Is = \frac{2C}{A + B} \; x \; 100\ \%$$

Note :

Is = Sorensen Similarity Index

A = Number of species presence at station I

B = Number of species presence at station II

C = The number of species present at stations I and II

Based on the value of Is, it can be concluded whether the two locations have the same or different community by the following criteria:

IS <50%: Two stations are considered to be different communities

IS> 50%: Two stations are considered the same community

3. Results and Discussion

3.1 Mammals

Based on field study results that were conducted for 6 days at Susukan Baru dan Kuala Penet Resort, there were 97 species of mammals encountered (43 species in Susukan Baru, 54 species in Kuala Penet). The total number of 13 species of mammals invented consists of 5 ordos and 10 families **(Table 1, Figure 4).** Sumatran elephant (*Elephas maximus sumatranus*) commonly encounter, which is 48 times (49.5%), the second is Sambar deer, and Sumatran wild boar 12 times (12.37%). The highest encounter times in the family is Elephantidae, which is 48 times (49.5%) and the lowest is Tragulidae, represented by greater mouse-deer (1 time, 1.03%) **(Figure 2).**

Table 1. Mammals encounter in Susukan Baru and Kuala Penet Resort

Family	Species	Susukan Baru					Kuala Penet				Total
		SB-01	SB-02	SB-03	SB-04	SB-05	KP-01	KP-02	KP-03	KP-04	
Elephantidae	Sumatran Elephant	3	1	2	2	10	4	10	3	13	48
Cervidae	Sambar Deer	0	6	0	3	0	1	0	2	0	12
Suidae	Wild Boar	1	1	0	2	4	0	0	1	3	12
Cervidae	Deer	1	1	0	0	0	0	0	0	5	7
Hylobatidae	Gibbon	2	0	0	0	0	0	0	0	0	2
Felidae	Sumatran Elephant	0	0	0	0	2	0	0	0	0	2
Cerophytecidae	Long-tailed Monkey	1	0	0	0	0	0	0	0	0	1
Felidae	Wildcat	0	1	0	0	0	0	0	0	0	1
Viverridae	Civet	0	0	0	0	0	1	2	0	1	4
Cerophytecidae	Silvery Lutung	0	0	0	0	0	3	0	0	0	3
Tapiridae	Tapir	0	0	0	0	0	0	0	2	0	2
Ursidae	Sun Bear	0	0	0	0	0	0	0	0	2	2
Tragulidae	Greater Mouse-deer	0	0	0	0	0	0	0	1	0	1
Total number of encounter		**8**	**10**	**2**	**7**	**16**	**9**	**12**	**9**	**24**	**97**
Total type of species		**5**	**5**	**1**	**3**	**3**	**4**	**2**	**5**	**5**	**13**

Of the 13 species found at the two resorts, 10 are protected species based on Permen LHK No. P.106 except for long-tailed monkeys, wild boar, and Viverridae. Based on the IUCN Red List, there are two types of mammals in the Critically Endangered (CR) category, namely the Sumatran tiger and elephant, two threatened species (Endangered/EN), gibbon and tapir, as well as sun bears and sambar deer that are vulnerable (Vulnerable/Vu).). When referring to the CITES category, there are six species included in the appendix I class, 2 types of appendix 2, and 3 types of non-appendix.

Figure 5. A herd of Sumatran elephants in the Susukan Baru Resort Area in the Critical Endangered (CR) category

Figure 6. Traces of Sumatran tigers were found in the area of the Susukan Baru Resort in the Critical category Endangered

Figure 7. Silvery Lutung in the Kuala Penet Resort area

Figure 8. Greater Mouse-deer in the Kuala Penet Resort

3.2. Herpetofauna

The total herpetofauna species identified in the survey locations are 22 species, consist of 13 amphibian species and 9 reptilian species. Encountered amphibian families are a member of Bufonidae, Dicroglossidae, Microhylidae, Ranidae, and Rhacophoridae. Encountered reptilian families are a member of Colubridae, Homalopsidae, Lacertidae, Phytonidae, Scincidae, and Geoemydidae (**Table 2**).

Table 2. Encountered species in the survey location

Family/Species	Status			Kuala Penet Resort			Susukan Baru Resort		
	P.106	IUCN	CITES	KP_01	KP_02	Misc.	SB_01	SB_02	SB_03
Amphibian									
Bufonidae									
Ingerophrynus quadriporcatus	-	LC	-			1			
Dicroglossidae									
Fejervarya limnocharis	-	LC	-	1	1	7	4	3	3
Limnonectes blythii	-	NT	-	1					
Limnonectes kuhlii	-	LC	-	1		1			
Limnonectes malesianus	-	NT	-	1					1
Limnonectes microdiscus	-	LC	-					1	
Limnonectes paramacrodon	-	NT	-	1				2	1
Occidozyga lima	-	LC	-					1	
Microhylidae									
Kaloula baleata	-	LC	-					1	
Ranidae									
Hylarana erythraea	-	LC	-			2	1	1	
Hylarana raniceps	-	LC	-			1	1		
Rhacophoridae									
Polypedates leucomystax	-	LC	-	1	1				
Reptilian									
Colubridae									
Ahaetulla prasina	-	LC	-			1			
Dendrelaphis	-	LC	-		1				

cauolineatus									
Homalopsidae									
Homalopsis buccata	-	LC	-			2			
Phytolopsis punctata	-	DD	-			1			
Lacertidae									
Takydromus sexlineatus	-	LC	-			1			
Pythonidae									
Malayopython reticulatus	-	LC	II			1			
Scincidae									
Eutropis multifasciata	-	LC	-		1				
Eutropis rugifera	-	LC	-			1			
Geoemydidae									
Cuora amboinensis	-	ED	II				1		

Phytolopsis punctata	-	DD	-			1			
Lacertidae									
Takydromus sexlineatus	-	LC	-			1			
Pythonidae									
Malayopython reticulatus	-	LC	II			1			
Scincidae									
Eutropis multifasciata	-	LC	-		1				
Eutropis rugifera	-	LC	-			1			
Geoemydidae									
Cuora amboinensis	-	ED	II				1		

Status:

P.106 : Regulation of the Minister of Environment and Forestry No. P.106/MenLHK/Setjen/Kum.1/12/2018 concerning the second amendment to Regulation of the Minister of Environment and Forestry No. P.20/MenLHK/Setjen/Kum.1/6/2018 concerning protected plant and animal species.

IUCN : IUCN Redlist of Threatened Species, version 2020-2; ED: *endangered,* NT: *near threatened,* LC: *least concern,* DD: *data deficient*

CITES : CITES Appendices I, II and III (26 November 2019)

Tabel 3. Index of Diversity and Index of Evenness of herpetofauna in the survey locations

No	Number path	Location	Habitat Type	H'	S	E
1	KP_01	Kuala Penet Resort	Intermediate habitat between ex-burned and vegetated area	1.79	6	1.00
2	KP_02	Kuala Penet Resort	Ex-burned area	1.39	4	1.00
3	SB_01	Susukan Baru Resort	Ex-burned area	1.15	4	0.83
4	SB_02	Susukan Baru Resort	Ex-burned area	1.68	6	0.93
5	SB_03	Susukan Baru Resort	Ex-burned area	0.95	3	0.86
6	KP_Outside the path	Kuala Penet Resort	-	-	11	-

Of all the species found during the survey, no species are protected species under the Regulation of the Minister of Environment and Forestry No. P.106. Based on the IUCN Red List, there are one (1) species which is included in the Endangered category, namely shell turtle (*Cuora amboinensis*) and three (3) species included in the Near Threatened category, namely *Limnonectes blythii, L. malesianus* and *L. paramacrodon*. Meanwhile, based on CITES trading status, there are two (2) species included in the list of Appendix II, namely *Malayophyton reticulatus* and *Cuora amboinensis*. Near threatened is defined as a species that is not classified as Threatened, but is near threatened or can be classified as threatened in the future based on IUCN's evaluation and assessment. Meanwhile, the Endangered criteria indicate that the species has experienced a significant population decline and is considered to be facing a high threat to extinction (IUCN, 2000). *Cuora amboinensis* is included in the Endangered A2d category, which indicates that the species has experienced a population decline of 50% in the last 10 years due to current and future exploitation.

Figure 9. *Limnonectes blythii* categorized as *Near Threatened*

Figure10. *Limnonectes Malesianus* categorized as *Near Threatened*

Figure 11. Shell Turtle categorized as *endangered*

Figure 12 *Limnonectes paramacrodon* categorized as *Near Threatened*

3.3 Avifauna

Table 4. Species List, Conservation Status, and *Feeding Guild* Bird Community Encounters in Braja Harjosari and Rantau Jaya Udik II VIllage

No	Nama Lokal	Nama Latin	Daerah Perjumpaan		Status konservasi	*Feeding guilds*	Famili
			Desa Rantau Jaya Udik II	Desa Braja Harjosari			
1	Punai Siam	*Treron bicincta*	✓	✓	LC	Frugivor	Columbidae
2	Cabai Jawa	*Dicaeum trochileum*	✓		LC	Frugivor	Dicaeidae
3	Cabai Bunga Api	*Dicaeum trigonostigma*	✓		LC	Frugivor	Dicaeidae
4	Cucak Kutilang	*Pycnonotus aurigaster*	✓	✓	LC	Frugivor	Pycnonotidae
5	Merbah cerukcuk	*Pycnonotus goiavier*	✓	✓	LC	Frugivor	Pycnonotidae
6	Kacamata Laut	*Zosterops chloris*		✓	LC	Frugivor	Zosteropidae
7	Merpati	*Streptopelia chinensis*	✓		LC	Granivor	Columbidae
8	Bondol Peking	*Lonchura punctulata*	✓	✓	LC	Granivor	Estrildidae
9	Burung Gereja	*Passer montanus*	✓	✓	LC	Granivor	Passeridae
10	Walet Sapi	*Collocalia esculenta*	✓	✓	LC	Insektivor	Apodidae
11	Walet Sarang Putih	*Aerodramus fuciphagus*	✓		LC	Insektivor	Apodidae
12	Kuntul Kerbau	*Bubulcus ibis*	✓	✓	LC	Insektivor	Ardeidae
13	Sepah Padang	*Pericrocotus cinnamomeus*	✓		LC	Insektivor	Campephagidae
14	Bubut Besar	*Centropus sinensis*	✓		LC	Insektivor	Cuculidae
15	Wiwik Uncuing	*Cacomantis sepulcralis*	✓	✓	LC	Insektivor	Cuculidae
16	Bentet Kelabu	*Lanius schach*		✓	LC	Insektivor	Laniidae
17	Apung Tanah	*Anthus novaeseelandiae*		✓	LC	Insektivor	Motacillidae
18	Sikatan Dada Merah	*Ficedula dumetoria*	✓	✓	LC	Insektivor	Muscicapidae
19	Sikatan Biru Muda	*Cyornis unicolor*	✓		LC	Insektivor	Muscicapidae
20	Kucica Kampung	*Copsychus saularis*		✓	LC	Insektivor	Muscicapidae
21	Tukik Belang	*Picumnus innominatus*		✓	LC	Insektivor	Picidae
22	Caladi Tilik	*Picoides mollucensis*		✓	LC	Insektivor	Picidae
23	Kedidi Jari Panjang	*Calidris subminuta*		✓	LC	Insektivor	Scolopacidae
24	Prenjak Lumut	*Orthotomus sutorius*	✓	✓	LC	Insektivor-Frugivor	Sylviidae
25	Elang Bondol	*Haliastur indus*		✓	LC	Karnivor	Accipitrinae
26	Elang Laut Perut Putih	*Haliaeetus leucogaster*		✓	LC	Karnivor	Accipitrinae
27	Cekakak Belukar	*Halcyon smyrnensis*		✓	LC	Karnivor	Alcedinidae
28	Raja Udang Meninting	*Alcedo meninting*		✓	LC	Karnivor	Alcedinidae
29	Kuntul Besar	*Egretta alba*	✓	✓	LC	Karnivor	Ardeidae
30	Cangak Laut	*Ardea sumatrana*		✓	LC	Karnivor	Ardeidae
31	Kuntul Kecil	*Egretta garzetta*		✓	LC	Karnivor	Ardeidae
32	Bambangan Merah	*Ixobrychus cinnamomeus*		✓	LC	Karnivor	Ardeidae
33	Cangak Merah	*Ardea purpurea*		✓	LC	Karnivor	Ardeidae
34	Cekakak Sungai	*Todiramphus chloris*	✓	✓	LC	Karnivor/Piscivor	Alcedinidae
35	Raja Udang Erasia	*Alcedo atthis*		✓	LC	Karnivor/Piscivor	Alcedinidae
36	Burung Madu Sriganti	*Nectarinia jugularis*	✓	✓	LC	Nektarivor	Nectariniidae
37	Pelatuk Kundang	*Reinwardtipicus validus*	✓		LC	Omnivor	Picidae
38	Betet Biasa	*Psittacula alexandri*	✓	✓	NT	Granivor	Psittacidae
39	Undan paruh totol	*Pelecanus philippensis*		✓	NT	Karnivor	Pelecanidae
40	Alap-alap dahi putih	*Microhierax latifrons*	✓		NT	Karnivor	Falconidae
41	Kerak Kerbau	*Acridotheres javanicus*	✓	✓	VU	Insektivor-Frugivor	Sturnidae
42	Bangau Tongtong	*Leptoptilos javanicus*		✓	VU	Karnivor	Ciconiidae
43	Bangau sandang lawe	*Ciconia episcopus*		✓	VU	Karnivor	Ciconiidae
44	Raja Udang Kalung Biru	*Alcedo euryzona*		✓	CR	Karnivor/Piscivor	Alcedinidae

*Note: LC (*Least Concern*) = Species with low risk of extinction; NT (*Near Threatened*) = Almost endangered species; VU (*Vulnerable*) = Species that vulnerable to extinct; CR (*Critically Endangered*) = Species that critically endangered

In Braja Harjosari Village **(Table 4)**, 35 bird species are found with two species having the largest relative abundance, namely the Glossy Swiftlet (*Collocalia esculenta*) and the Cattle Egret (*Bubulcus ibis*). Then, the lowest relative abundances were found, namely Purple Heron (*Ardea purpurea*) and Lemon-bellied White-eye (*Zostrerops chloris*). Meanwhile, in Rantau Jaya Udik II Village, 24 bird species were found with two species having the largest relative abundance, namely Glossy Swiftlet (*Collocalia esculenta*) and Sooty-headed Bulbul (*Pycnonotus aurigaster*). Then, the lowest relative abundances were found, namely the Orange-breasted Green-pigeon (*Treron bicincta*) and the Greater Egret (*Egretta alba*).

Figure 13. Lesser adjutant categorized as *vulnerable*

Figure 14. Javan myna categorized as vulnerable

Figure 15. White-bellied sea-eagle categorized as Least Concern

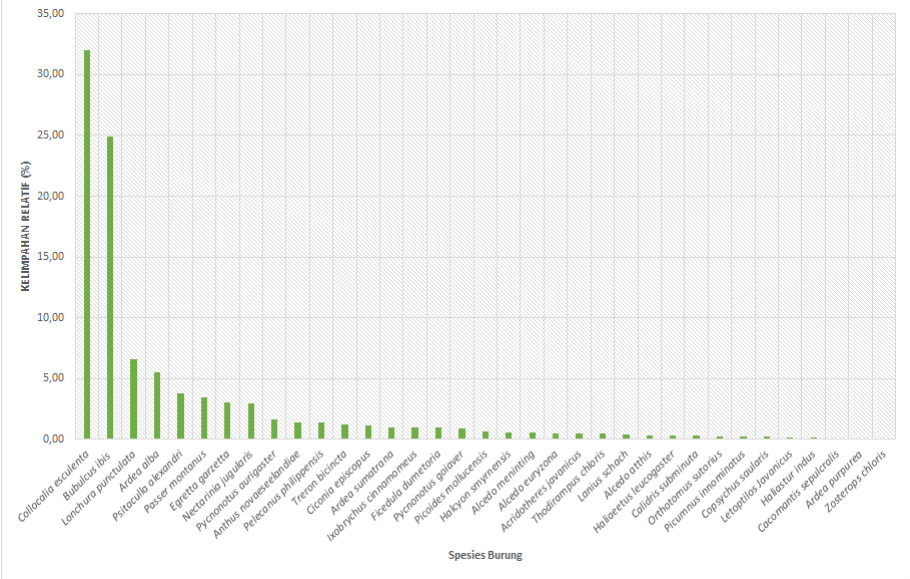


Figure 16. Relative Abundance of Birds in Braja Harjosari Village

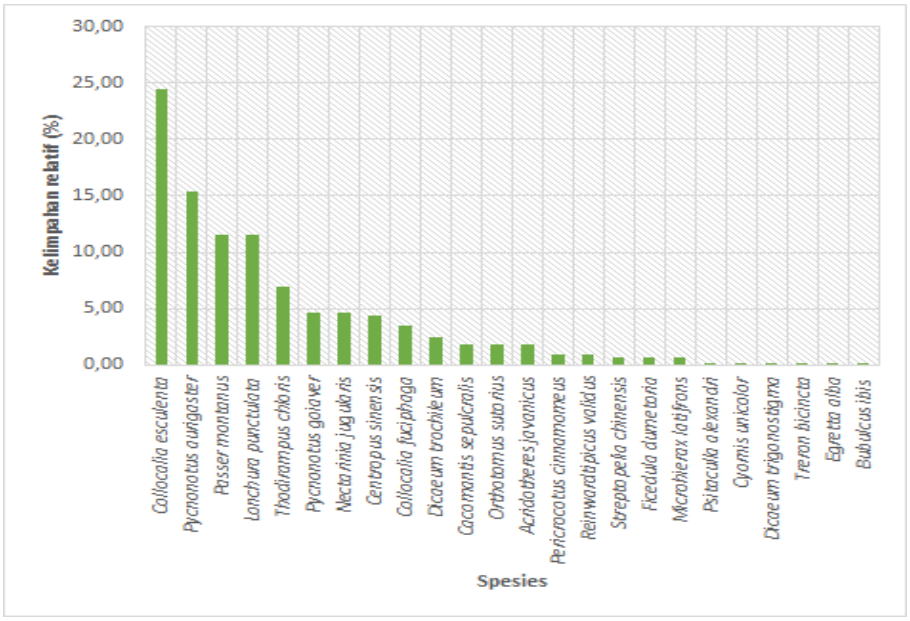


Figure 17. Relative Abundance of Birds in Rantau Jaya Udik II Village

	Desa Braja Harjosari	Desa Rantau Jaya Udik II
Indeks Kekayaan Spesies (S)	35	24
Indeks Keanekaragaman Spesies (H')	2,28	2,43
Indeks Kemerataan Spesies (E)	0,64	0,76
Indeks Dominansi Simpson (D)	0,19	0,12
Indeks Sorensen	50,85%	

Figure 18. Indexes Result in Two Buffer Villages, Braja Harjosari and Rantau Jaya Udik II

In the two buffer villages of Braja Harjosari and Rantau Jaya Udik II, the value of the Shannon-Wiener diversity index are 2.28, and 2.43 indicates that the diversity in the two buffer villages is moderate which was supported by the results of observations in those two villages. A total of 44 species with details of 16 species can be found in the two buffer villages, most of which are carnivorous and insectivorous. Based on the number of similarities, the Sorensens Index (Is) of the two villages was 50.85%, indicates that the two buffer villages have almost the same bird species community. Then, the index of evenness (E) is 0.64 and 0.76, which indicates that the bird community in the two buffer villages can be said to be evenly distributed and none is dominant because the species dominance index (D) value is 0.19 and 0.12. From the species encounter in Table 4., Braja Harjosari Village is dominated by 15 species of carnivorous birds, especially fish-eating birds/piscivores, while Rantau Jaya Udik II Village is dominated by 8 species of insectivorous birds.

The different types of species inhabiting the two villages are influenced by the ecosystem in the two villages. Braja Harjosari Village has a vast Savana and borders with the national park area, this ecosystem has a dominant type of grassy vegetation in which only a few large trees are spread unevenly. In some locations, savanna occurs due to repeated fires and dry soil conditions. This savanna can also be said to be a transitional ecosystem between forests and grasslands. The threat that exists in this ecosystem is less threatened than forests, such as livestock grazing (Walker & Gillison, 1982; Djufri, 2012).

In this ecosystem, there is a swamp ecosystem which is also the boundary between the Way Kambas National Park area and Braja Harjosari Village. The observation time was carried out during the rainy season so that the Savana was inundated by water. As a result, there has been a change in the characteristics of the Savana into a Wetland. This supports the presence of fish-eating waterbird communities.

Observations in the Village of Rantau Jaya Udik II took place in the wetland ecosystem, namely swamp. This ecosystem is located between terrestrial and aquatic areas, characterized by shallow to very deep groundwater levels. Swamp in this village is included in the tidal swampland which is influenced by the tidal river water which is also the boundary between the Way Kambas National Park area or it can also be called the forest edge and the buffer village. Slightly different from the characteristics of the location in the previous village, the swamp ecosystem in this village is very close to the residents' settlements and rice fields. Bird communities were found to be predominantly

insectivorous or insectivorous, such as the Greater Coucal (*Centropus sinensis*) and the Rofous-chested Flycatcher (*Ficedula dumetoria*).

Based on Table 4, almost all bird species founded are Least Concern (LC). However, 7 species were found with an alarming conservation status including the Red-breasted Parakeet (*Psittacula alexandri*), Spot-billed Pelican (*Pelecanus philippensis*), White-fronted Falconet (*Microhierax latifrons*) with Near Threatened (NT) conservation status. Javan Myna (Acridotheres javanicus), Lesser Adjutant (*Leptoptilos javanicus*), and Wooly-necked Stork (*Ciconia episcopus*) with conservation status Vulnerable (VU). Blue-banded Kingfisher (*Alcedo euryzona*) with Critically Endangered (CR) status (IUCN, 2018). Red-breasted Parakeet and Javan Myna were found in the two buffer villages, while the White-fronted Falconet, Spot-billed Pelican, Lesser Adjutant, Wooly-necked Stork, and Blue-banded Kingfisher were only found in savanna, Braja Harjosari Village.

Red-breasted Parakeet (*Psittacula alexandri*) and Javan Myna (*Acridotheres javanicus*) experienced a downward trend in the number of individuals around the world starting in 2013 due to illegal trade and habitat loss so that they fall into the Near Threatened (NT) and Vulnerable (VU) categories on the IUCN Red List. The distribution of these two species is mostly in East Asia, South Asia, and Southeast Asia. The encounter of the two can be found around wetland ecosystems or in close-knit trees. The suitability of this habitat is the reason the two species were found in two buffer villages (BirdLife International, 2017; BirdLife International, 2016; Eaton et al, 2015).

4. Conclusions and Suggestions

The conclusions from the ecological study are:

a. The number of mammal species found at the survey location was 13 species consisting of 10 families.
b. The diversity of mammal species in the two resorts has a moderate and low index.
c. The number of species found at the survey location was 22 species, consist of 13 species of amphibians and 9 species of reptiles.
d. Fires have a significant impact on the existence of herpetofauna, namely habitat and shelter loss and reduced sources of food.
e. From the observation, it was found that the species richness index was 35 species in Braja Harjosari Village and 24 species in Rantau Jaya Udik II Village. The index of diversity (H ') is 2.28 in Braja Harjosari Village and 2.43 species in Rantau Jaya Udik II Village, which indicates that the diversity in the two buffer villages is moderate. Also obtained an index of evenness (E) species (E) is 0.64 in Braja Harjosari Village and 0.76 in Rantau Jaya Udik II Village, which indicates that the bird community in the two buffer villages can be said evenly distributed and none of them are dominant because the dominance index (D) are 0.19 in Braja Harjosari Village and 0.12 in Desa Rantau Jaya Udik II.
f. The Sorensens Index (Is) obtained from the two villages is 50.85% which indicates that the two buffer villages have almost the same bird species community but have different habitat characteristics, that is the savanna which has turned into a swamp in Braja Harjosari Village and swamp ecosystem in Rantau Jaya Udik II Village.
g. There were 15 carnivore, 10 insectivors, 4 granivores, 3 frugivores, 2 insectivores/frugivores, and 1 nektarivor species in Braja Harjosari Village. Then, 3 carnivores, 8 insectivores, 5 granivores, 4 frugivores, 2 insectivores/frugivores, 1 omnivore, and 1 nectarivor species were found in Rantau Jaya Udik II Village.

Suggestion:

In the implementation of this ecological study during the corona 19 pandemic, the mobility of researchers at the study sites was not possible. This team was strengthened by a data-collecting team and an analysis team that compiled the results of this study. Therefore, the suggestions can be given are:

1. There needs to be further research related to this study and routine to obtain data series that can complement the analysis
2. It needs a more comprehensive point with complete camera trap data, especially for mammals because the camera trap data was not optimal.
3. The need for routine inventory activities carried out by resorts or the WKNP management team as comparative data so that it can complete the distribution analysis for potential hunting of animals and also the distribution of animals related to ex-encroached areas.

Bibliography

AKBAR, A., SUMARDI, S., HADI, R., PURWANTO, P. & SABARUDIN, M.S. (2011) STUDI SUMBER PENYEBAB TERJADINYA KEBAKARAN DAN RESPON MASYARAKAT DALAM RANGKA PENGENDALIAN KEBAKARAN HUTAN GAMBUT DI AREAL MAWAS KALIMANTAN TENGAH. *Jurnal Penelitian Hutan Tanaman*, 8, 287–300. Research, Development and Innovation Agency, Ministry of Environment and Forestry.

AMALINA, P., PRASETYO, L.B. & RUSHAYATI, S.B. (2016) Forest Fire Vulnerability Mapping in Way Kambas National Park. *Procedia Environmental Sciences*, 33, 239–252. Elsevier BV.

Bailey, L. L., Simons, T. R., and Pollock, K. H. (2004). Estimating site occupancy and species detection probability parameters for terrestrial salamanders. Ecological Applications, 14, 692–702.

BirdLife International. 2016. *Acridotheres javanicus*. The IUCN Red List of Threatened Species 2016: e. T103871334A104349008. Available at: http://dx.doi.org/10.2305/IUCN.UK.20163.RLTS.T103871334A104349008.en

BirdLife International. 2017. *Ciconia episcopus*. The IUCN Red List of Threatened Species 2017 : e. T22727255A110064997. Available at : http://dx.doi.org/10.2305/IUCN.UK.2017-1.RLTS.T22727255A110064997.en

BirdLife International. 2017. *Leptoptilos javanicus*. The IUCN Red List of Threatened Species 2017: e.T22697713A110481858. Available at : http://dx.doi.org/10.2305/IUCN.UK.2017-1.RLTS.T22697713A110481858.en

BirdLife International. 2017. *Microhierax latifrons*. The IUCN Red List of Threatened Species 2017: e.T22696330A117282429. Available at : http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22696330A117282429.en

BirdLife International. 2017. *Pelecanus philippensis*. The IUCN Red List of Threatened Species 2017: e.T22697604A117970266. Available at : http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22697604A117970266.en

BirdLife International. 2017. *Psittacula alexandri*. The IUCN Red List of Threatened Species 2017: e.T22685505A111371703. Available at : http://dx.doi.org/10.2305/IUCN.UK.2017-1.RLTS.T22685505A111371703.en

BirdLife International. 2018. *Alcedo euryzona* (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2018: e.T22726971A125574893. http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22726971A125574893.en

Bowen MR, Bompard JM, Anderson IP, Guizol P, Gouyon A. 2001. Anthropogenic fires in Indonesia, a viem from Sumatra. Di dalam: radojevic M & Eaton P, editor. EU & Departemen Kehutanan dan Perkebunan Republik Indonesia.

BOWEN, M.R., BOMPARD, J.M., ANDERSON, I.P., GUIZOL, P. & GUYON, A. (2001) Anthropogenic fires in Indonesia: a view from Sumatra. In 'Forest Fires and Regional Haze in South-East Asia'. (Eds P Eaton, M Radojevic) pp. 41–66. Nova Science Publishers: Huntington, NY.

Crump, M. L. and Scott, Jr, N. J. (1994). Visual encounter surveys. In W. R. Heyer, M. A. Donnelly, R. W. McDiarmid, L. A. C. Hayek, and M. S. Foster (eds), Measuring and Monitoring Biological Diversity, Standard Methods for Amphibians, pp. 84–92. Smithsonian Institution

Press, Washington DC.

Desa Rantaujaya Udik 2. (2020). *Desa RANTAUJAYA UDIK 2*. Retrieved from http://rantaujayaudik2-lampungtimur.desa.id/in9July.Availableat:http://rantaujayaudik2lampungtimur.desa.id/potensi/Pertanahan

Devung, Eki, A. R. 2018. Keanekaragaman Hayati Amfibi pada berbagai tipe habitat terrestrial di Hutan Harapan, Sumatera. Skripsi. Departemen Konservasi Sumberdaya Hutan dan Ekowisata, Fakultas Kehutanan, Intitut Pertanian Bogor.

DIMA, D. (1999) Studi Keanekaragaman Jenis Satwa liar pada Areal Bekas Kebakaran Taman Nasional Way Kambas Provinsi Lampung. *Sumberdaya Hutan. Institut Pertanian Bogor. 1999, Undefined*.

ELLENBERG, D. & MUELLER-DOMBOIS, D. (1974) Aims and methods of vegetation ecology. Wiley New York.

FORMAN, R.T.T. & GODRON, M. (1986) Landscape ecology. John Willey & Sons, tORONTO.

GRIFFITHS, M. & SCHAIK, C.P. (1993) The Impact of Human Traffic on the Abundance and Activity Periods of Sumatran Rain Forest Wildlife. *Conservation Biology*, 7, 623–626. Wiley-Blackwell.

HEYER, W.R., DONNELLY, M.A., MCDIARMID, R.W., HAYEK, L.A.C. & FOSTER, M.S. (1994) Measuring and monitoring biological diversity: standard methods for amphibians.

Indriyanto, 2006. *Ekologi Hutan*. Jakarta: Penerbit PT Bumi Aksara.

Inger, R.F. and D.T. Iskandar. 2005. A collection of amphibians from West Sumatra, with description of a new species of Megophrys (Amphibia:Anura). The Raffles Bulletin of Zoology 53 (1):133-142.

Iskandar, D.T. 2000. Turtles and Crocodiles of insular Southeast Asia and New Guinea. PALMedia Citra. Bandung.

Iskandar, D.T. and E. Colijn. 2002. A checklist of southeast asian and new guinean reptiles. Part I. Serpentes. Binamitra. Jakarta.

IUCN. 2012. IUCN Red List Categories and Criteria: Version 3.1. Second edition. Gland, Switzerland and Cambridge, UK: IUCN. iv + 32pp.

Indraswati, E., Muchtar, M., Veriasa, T. O., Muzakkir, A., & Putri, A. M. (2018). *Rencana Pengelolaan Kolaboratif Taman Nasional Way Kambas, Provinsi Lampung Tahun 2018- 2023.* Lampung: YOSL/OIC-PILI.

KREBS, C.J. (1999) Ecological Methodology. Addison. Welsey Educational Publishers, Inc., Menlo Park, CA.

Krebs, Charles. J. 1989. Ecological Methodology. Harper Collins Publisher: USA.

Kurniati, H. 2009. Herpetofauna diversity in Kerinci Seblat National Park, Sumatra,Indonesia. Zoo Indonesia 18(2): 45-68.

Kusrini MD, LF Skerratt, S Garland, L Berger, W Endarwin. 2008. Chytridiomucosis in frog Mount Gede Pangrangro Indonesia. Diseases of Aquatic Organism: 187-194

LIPI (2014) Kekinian Keanekaragaman Hayati Indonesia 2014. LIPI Pers.

MAGURRAN, A.E. (1988) Ecological Diversity and Its Measurement. In *Ecological Diversity and Its Measurement* p. . Springer Netherlands.

Profil Desa Braja Harjosari. (2020). Profil Desa Desa Braja Harjosari. *Data Monografi Desa Braja Harjosari*.

SILVEIRA, L., JÁCOMO, A.T.A. & DINIZ-FILHO, J.A.F. (2003) Camera trap, line transect census and track surveys: A comparative evaluation. *Biological Conservation*, 114, 351–355. Elsevier BV.

SUBAGYO, A., YUNUS, M., SUMIANTO, SUPRIATNA, J., ANDAYANI, N., MARDIASTUTI, A., ETAL. (2013) Survei dan monitoring kucing liar (Carnivora:Felidae) di Taman Nasional Way Kambas, Lampung, Indonesia. In *Seminar Nasional Sains & Teknologi V Lembaga Penelitian Universitas Lampung 19-20 November 2013* pp. 84–95.

TNWK (undated) Sejarah Taman Nasional Way Kambas | My CMS. Http://waykambas.org/sejarah- taman-nasional-way-kambas/ [accessed 16 August 2020].

Turvey, N.D. 1994. Afforestation and rehabilitation of Imperata grasslands in Southeast Asia: identification of priorities for research, education, training and extension. Canberra, Australia, Australian Centre for International Agricultural Research (ACIAR) and Center for International Forestry Research (CIFOR).

Wanger TC, Saro A, Iskandar DT, Brook BW, Sodhi NS, Clough Y, Tscharntke T. 2009. Conservation value of cacao agroforestry for amphibians and reptiles in South-east Asia: combining correlative models with follow-up field experiments. Journal of Applied Ecology. 46:823– 832.

WALSH, P.D., WHITE, L.J.T., MBINA, C., IDIATA, D., MIHINDOU, Y., MAISELS, F. & THIBAULT, M. (undated) Estimates of Forest Elephant Abundance: Projecting the Relationship between Precision and Effort. British Ecological Society. *Journal of Applied Ecology*. Https://www.jstor.org/stable/2655746 [accessed 16 August 2020].

WHITTEN, A., DAMANIK, S.J., ANWAR, J. & HISYAM, N. (2000) Ecology of Sumatra, 1st edition. Periplus, Hongkong.

WIBISONO, H.T., LINKIE, M., GUILLERA-ARROITA, G., SMITH, J.A., PUSPARINI, W., BAROTO, P., ETAL. (2011) Population status of a cryptic top predator: an island-wide assessment of tigers in Sumatran rainforests. *PLoS One*, 6, e25931. Public Library of Science.

Appendix

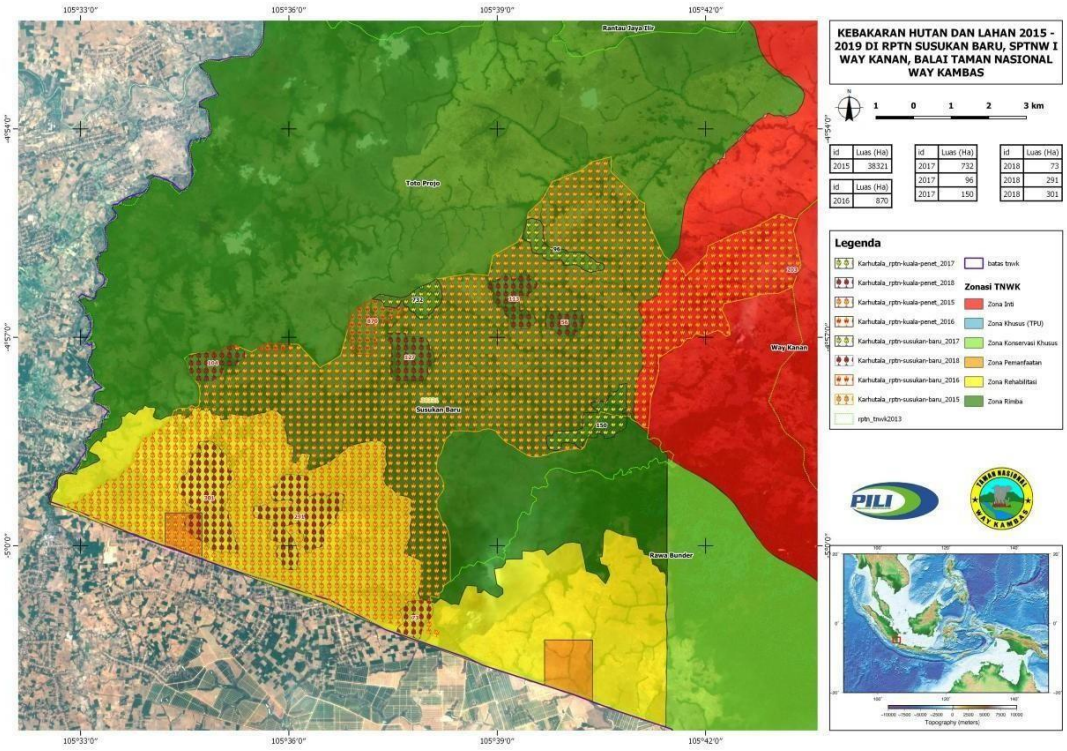


Figure 19. Land and Foret Fires in 2015-2019 at Susukan Baru Resort

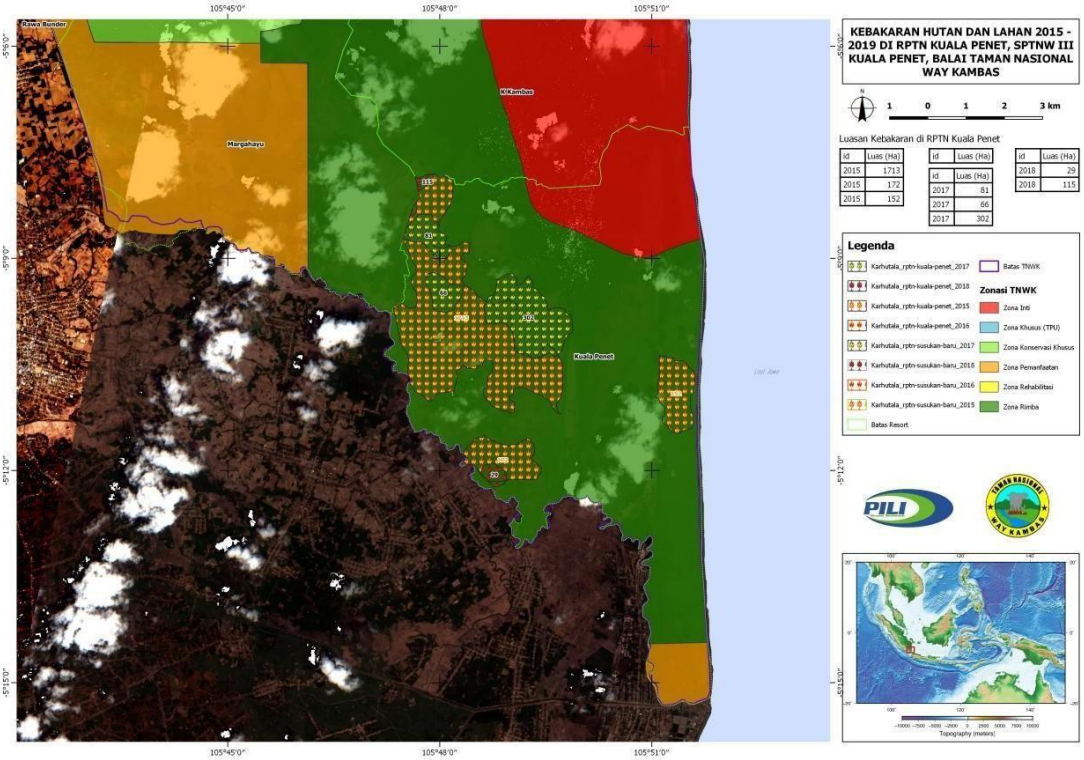


Figure 20. Land and Forest Fires in 2015-2019 at Kuala Penet Resort

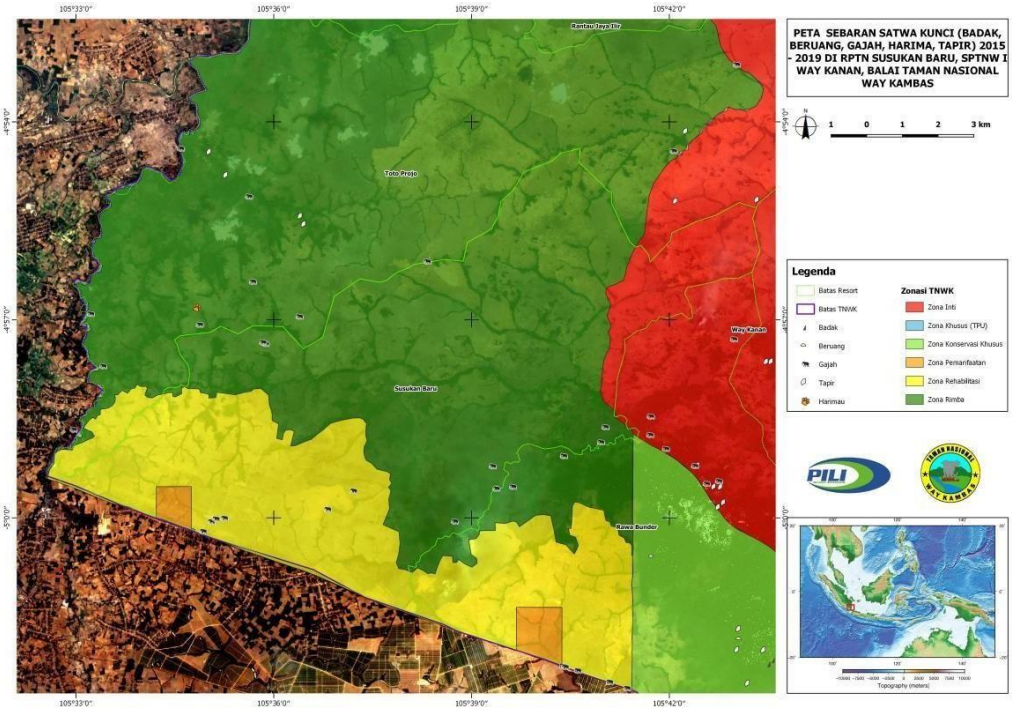


Figure 21. Map of Key Species Distribution in 2015-2019 at Susukan Baru Resort

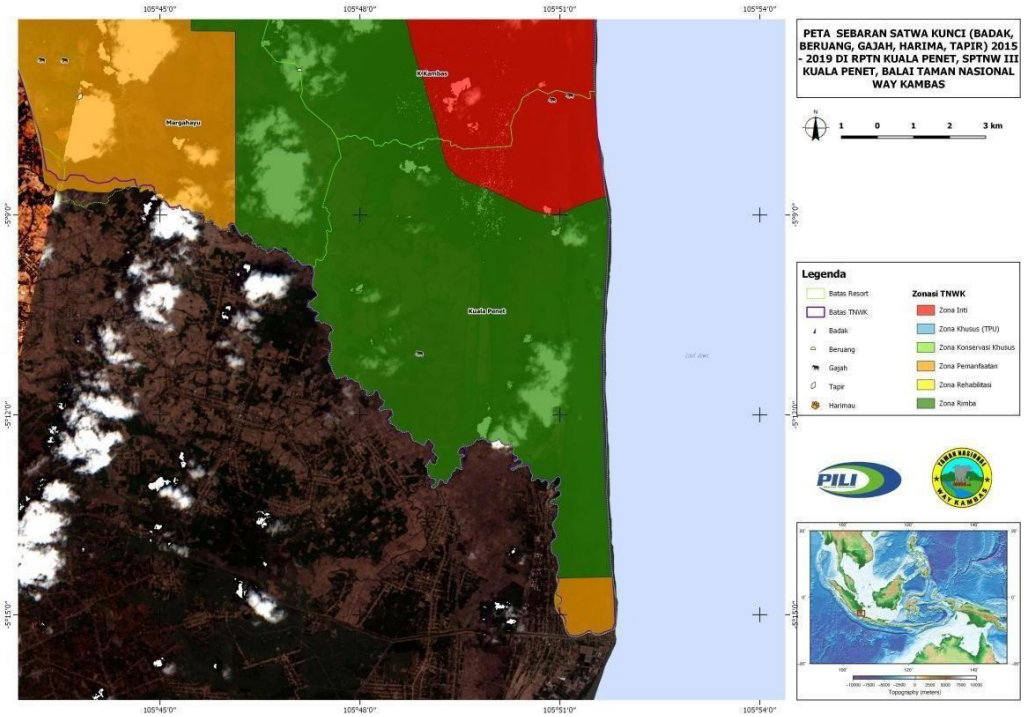
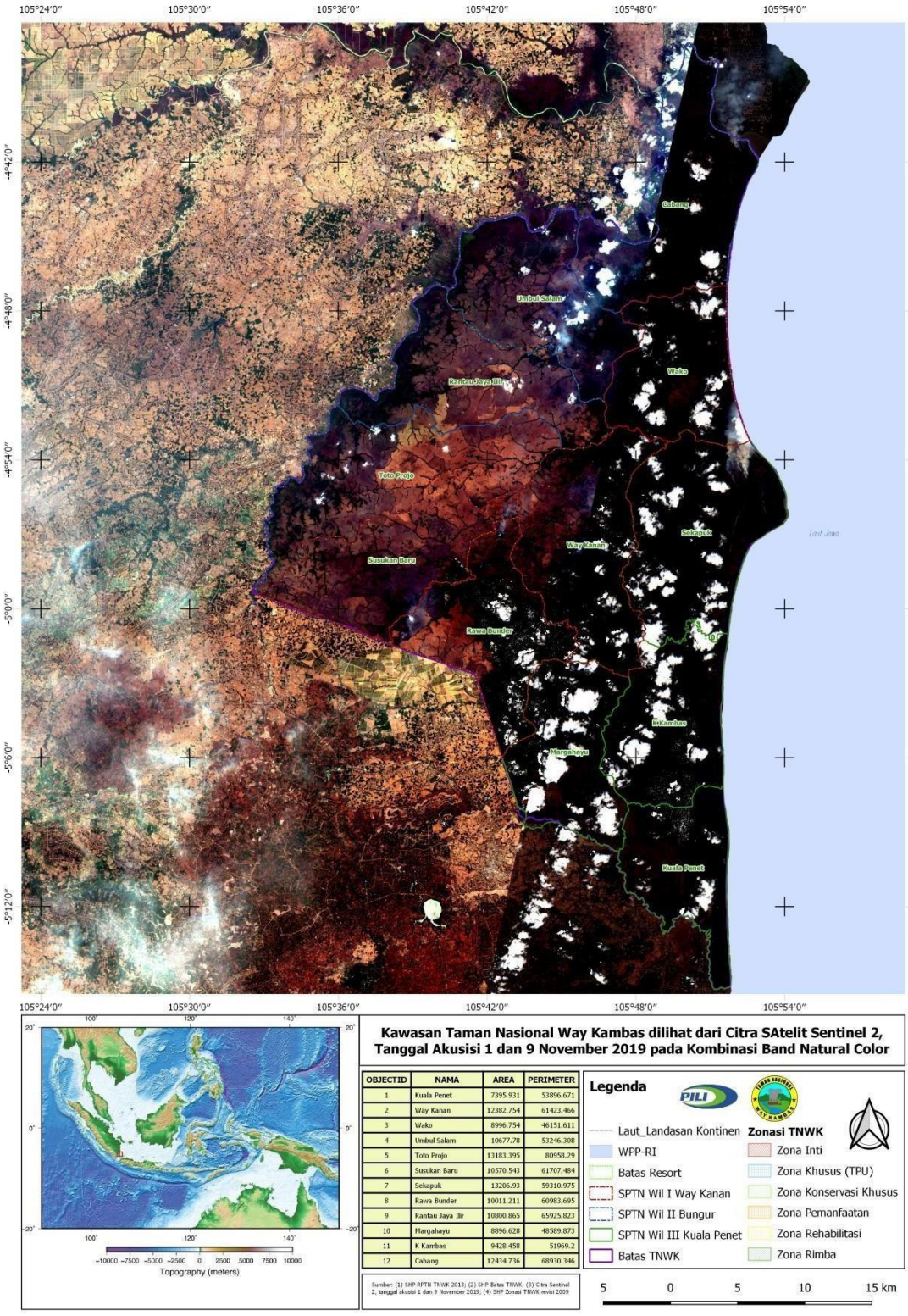


Figure 22. Map of Key Species Distribution in 2015-2019 at Kuala Penet Resort



OBJECTID	NAMA	AREA	PERIMETER
1	Kuala Penet	7395.931	53896.671
2	Way Kanan	12382.754	61423.466
3	Wako	8996.754	46151.611
4	Umbul Salam	10677.78	53246.308
5	Toto Projo	13183.395	80958.29
6	Susukan Baru	10570.543	61707.484
7	Sekapuk	13206.93	59310.975
8	Rawa Bunder	10011.211	60983.695
9	Rantau Jaya Ilir	10800.865	65925.823
10	Margahayu	8896.628	48589.873
11	K Kambas	9428.458	51969.2
12	Cabang	12434.736	68930.346

Figure 23. Map of WKNP Area at The Time of Fire in November 2019

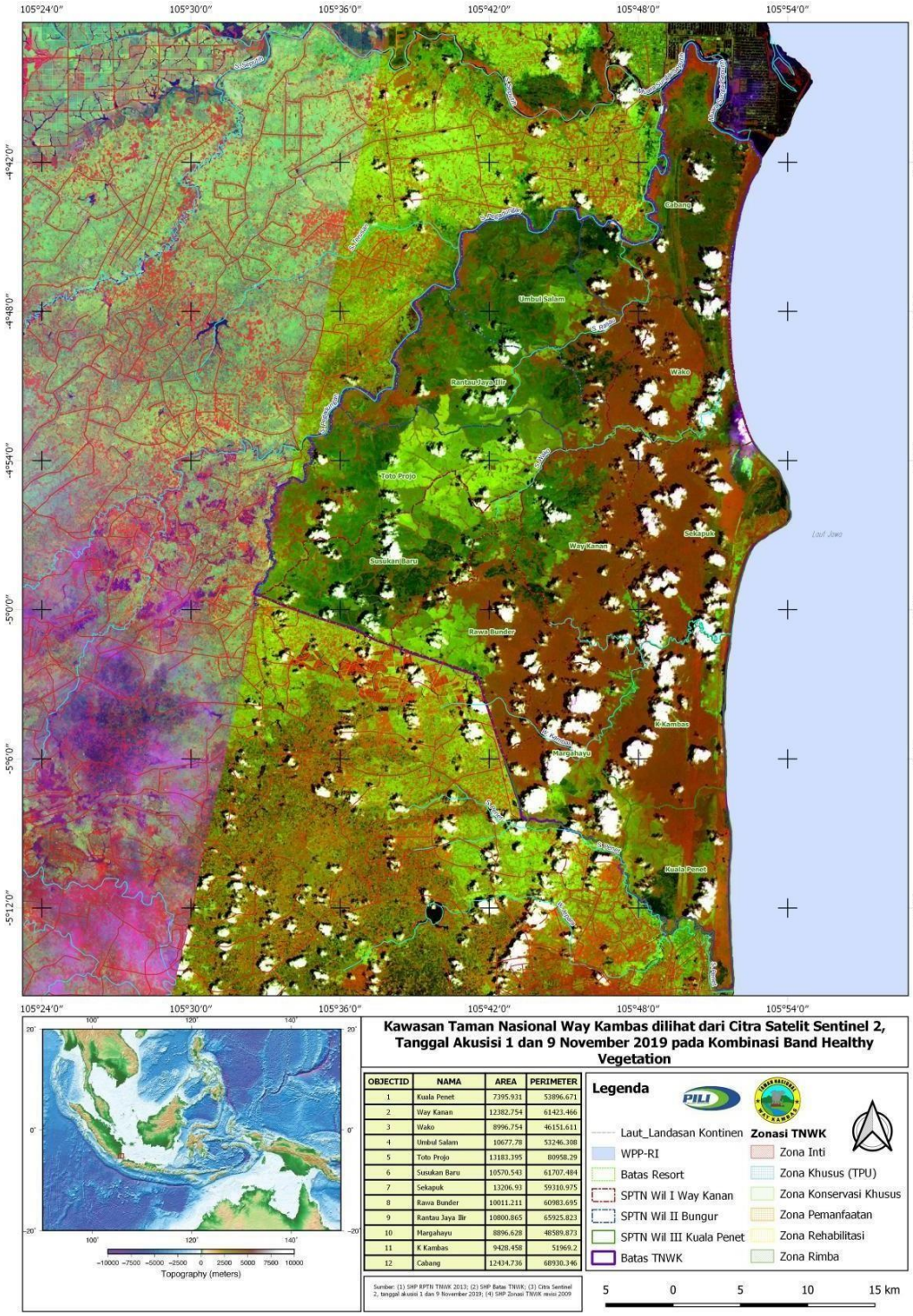


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Figure 24. Map of WKNP Area at The Time of Fire in November 2019