SECTION 5: MAMMALS

SURVEY OF MAMMALS ON DIFFERENT LAND USE TYPES

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5.1 Introduction:

Not less than 620 species mammals are found in Indonesia. According to Krebs (1972), the distribution of animal species generally follows, or is commensurate with, changes in the physical environmental pattern. Medway (1972) believes that changes in animal diversity are congruent with elevation changes. Studies of bats from Kitchener *et al.,* (1990) suggest that populations vary inversely with elevation. Habitat type is the other factor which greatly influences animal diversity according to Kitchener *et al.,* (1997) from their study in Tembagapura, Irian Jaya, [see also Kitchener and Maryanto (1997) from the result study in P.Gag Irian Jaya].

To understand the degree to which mammal species vary across similar habitat types, we need to observe their diversity and distribution from primary forest to industrial forest plantation and jungle rubber as well as in areas that have been converted from forest to open areas such as alang-alang (*Imperata*) and/ or *Cassava* garden. This is a report on mammal diversity across six different land-use types : primary forest, secondary forest, jungle rubber jungle and rubber plantation, *Paraserianthes* plantation, and open areas under *Imperata* and *Cassava* (LUTs combined). Our observations were made just a week after a drought had broken and after forest fire and dense smoke affected all land-use types in Sumatra.

5.2 Site selection and methods:

5.2.1 *Sites:*

The sites were established at Pasir Mayang (01º 04’ 47’’ S, 102º 06’ 02’’ E), Pancuran Gading (01º 10’ 12’’ S, 102º 06’ 50’’ E), and Kuamang Kuning (01º 35’ 56’’ S, 102º 21’ 11’’ E), Muara Bungo, Jambi. There were 11 sample plots co-located with the vegetation survey team across six land use types as follows :

- Primary Forest : (BS1, BS2)
- Logged-over Forest : (BS3, BS4, and BS5)
- Industrial Forest Plantation (*Paraserianthes*) : (BS6 and BS7)
- Rubber Plantation : (BS8)
- Rubber Jungle ; (BS10)
- *Imperata* and *Cassava* (Open areas) : (BS12 and BS14)

5.2.2 *Data collection:*

We surveyed the diversity and ecological status of mammals during the period 19-29 November 1997. (Annex III Tables 5,6,7) We used two observer groups: the first group

observed bats and rats, and the second group observed other mammals, excluding bats and rats. The second group observed direct and indirect occurrences of mammals at the sample plot location.

5.2.2.1 Bats and Rats:

Collecting data for bat and rat diversity was implemented using mist nets and rat traps on six different land use types. We used a specific rat trap design known as "Trap Kasmin" (28x12x12cm) made from wire. In the field we used baits of coconut and peanut butter to attract the animals. We placed traps five metres apart along a transect on each land use type with 15-20 traps every night. From experience of Kitchener *et al.*, (1997) and from our own experience on small mammal research in Nusa Tenggara and Maluku during 1989-1995, traps should be left for three days, except in an open area such as alang-alang and *Cassava* (two days only). The total number of traps used for all land use type was 459 (Table 5.1). We trapped bats using a mist net placed to intercept bat flight paths. For each site, we used 2 9x12m mist nets, and left these for three days. We checked the traps every day and night at 08:00 and 20:00hrs (Table 5.1).

The maturity status of bats and rats is based on the basioccipital and basispenoid bone component (Kitchener and Maryanto 1993; Maryanto and Boeadi 1994). We determined the reproduction status for each bat and rat by direct examination of the position of the testes (abdominal, inguinal, or scrotal), virgin uterus form (nulliparous), the total number of foetuses, and the amount of scars that indicated whether or not an animal had been pregnant.

5.2.2.2 Small and large mammals (excluding bats and rats):

Observations of small and big mammals other than bats and rats were made twice daily; the first between 06.30-08.00 and second between 16:30-18:00. To complete the data, we included an additional observation at night between 20.00-22.00hrs. The types of data recorded were: a) animal species, b) total number of individuals, c) the contact distance between animals and the plot centre, d) contact direction, e) time of contact and f) direct and indirect track from foot, sound, and other tracks.

Table 5.1
The total number of traps and mist nets area for each land use type.

Habitat	Trap	Mist net (m^2)
Primary forest (BS1&2)	60	163,8
Log over (BS 3)	60	117
Log over 1983 (BS3,4 &5)	60	163,8
Paraseriantes (BS6)	60	156
Paraseriantes (BS7)	60	163,8
Rubber plantation (BS8&9)	60	132,6
Alang-alang (BS12&13)	30	31,2
Cassava plantation (BS14&15)	30	23,4
Rubber jungle (BS10&11)	39	109,2
Total	459	1060,8

5.3 Data Analysis:

For all taxa, we made comparisons between diversity from different land-use types and Simpson Index diversity (Simpson, 1949), Shannon-Wiener Index (Ludwig and Reynolds 1988) and cluster analysis using SPSS/PC software.

5.4 Discussion and Results:

5.4.1 *Bats:*

Mist nets were unsatisfactory. From the total mist net traps with size 9 and 12 meter that were used for three nights on each land use type, there were only a few species captured, which included frugivores such as *Rousettus amplexicaudatus* at the *Paraserianthes* site, *Cynopterus brachyotis* at rubber plantation and *Balionycteris maculata* at logged-over forest. Other species were *Pipistrellus javanicus* at a *Paraserianthes* plantation, *Rhinolophus lepidus* in logged-over forest (an insectivore). The total number of individual of bats per square meter during the survey was 0.0122 with 0.005 and for the total species. (Table 5.2). All female bats were pregnant. Also we found *Pteropus vampyrus* (kalong) that was observed on the flight line in logged-over forest. These animals can fly between islands 60 km apart (Marti Fujita, personal comunication).

Compared with our survey of bats in 1991 (before the El Niño smoke disaster in our study area), Maryanto (unpublished data) recorded 0.08 species m^{-2} and 0.39 individuals m^{-2} in logged-over forest. This figure was greatly reduced with the change to *Paraserianthes* plantation. In 1991 using the mist net with total area 140.4 m^2, we recorded *Balionycteris maculata, Megaerops wetmoreyi, Cynopterus brachyotis, Macroglotus sobrinus, Rousettus amplexicaudatus, Nycteris javanica, Tylonycteris pachypus, Tylonycteris robustula, Hipposideros cervinus, Megaderma spasma* and *Rhinolophus* sp. (cf. *lepidus*) (Table 5.3). Another comparison with data from logged-over forest at selection cutting in Serestra II, Bangko, Jambi Province, in January 1996 showed that the total number of individual and species for bats per square meter was 0.029 and 0.009 (Maryanto *et al.*, 1996) (Table 5.3). The differences between diversity and abundance may be because of the excessive smoke in the current survey area. The site location in this survey was particularly bad due to smoke that only disappeared one week prior to the survey. We were surprised not to find common species such as *Cynopterus brachyotis* or *Macroglossus sobrinus*. These species are usually very common in all areas of Sumatra with elevation less than 1000m (Kitchener *et al.*, 1990, Corbet and Hill 1992). We conclude that the widespread smoke may have had a negative impact on the bat populations.

Using mist nets should be much more efficient to catch frugivorous bats (Megachiroptera), but on this survey we were unsuccessful. On the other hand for a mist net that usually is not effective to catch Microchiroptera (insect eater), we recorded a higher than usual percentage of 27.27% (3 individuals from a total of 11 bats). The impact of smoke in these area is the main reason why the total population of frugivorous was less, but this did seem to affect insectivores. The high percentage of these bats is related to their feeding behaviour, as they can catch something small without using their eyes. Another possibility is the nature of their habitat. Insectivores usually stay in an enclosed close place such as roof or cave, but this is the opposite for the frugivores, who inhabit open spaces (Kitchener *et al.*,, 1990, Corbet and Hill, 1992).

From the total number of bats recored, *Megaerops wetmoreyi* was the only rare species (Micklenburh *et al.*, 1992). This is a common species in Riau and also in Pasir Mayang, particularly in primary forest and logged-over forest, but recently this forest has been converted to industrial forest plantation (*Paraserianthes* /BS7) (Maryanto, unpublished data). We suggest another study should be implemented to examine the impact of both smoke and habitat conversion from logged-over to industrial forest plantation.

The species *Balionycteris maculata* that we trapped in the field indicates that this species is distributed across all primary and secondary forests at elevations below 600m. This might be a new species because it is differs from the one recorded in Kalimantan (Maryanto, unpublished data). To confirm this, we need to compare it with the specimen original recorded in Malaya and now available in the Raffles Museum, Singapore.

Table 5.2
Trapping bats using a mist net for each land use type, individual, individual/trial 100m^{2*}

Land Use Type and plot	Effort	Species	Individual	Ind/effort	Diversity
Primary BS1 &BS2	163.8	-	-	-	-
Logged-over forest (BS 3,4,5)	280,8	2	2	0,7	0,3
Paraserianthes (BS6&7)	319,8	2	4	1,3	0,3
Jungle Rubber	241,8	1	5	2,1	0
Alang-alang	31,2	-	-	-	-
Cassava plantation	23,4	-	-	-	-
Diversity					0,6

* Values are Simpson's diversity index.

Table 5.3
Comparative effort in trapping bats at logged-over forest in Serestra, Bangko, Jambi, January 1996 (Maryanto *et al.* 1996), logged-over forest / primary October 1991 (before conversion to *Paraserianthes* / location BS7/ Maryanto, I. Data unpublished) and at Pasir Mayang research site, Kuamang Kuning, Pancuran Gading November 1997).

Species Name	Bangko (1996)	Logged-over (1991) (Now *Paraserianthes* /BS7)	Pasir Mayang, Kuamang kuning, Pancuran Gading,1997
Balionycteris maculata,	x	x	x (BS4,5)
Cynopterus brachyotis	x	x	x (BS8,9,10,11
Chironax melanocephalus,	x		
Dyacopterus spadiceus	x		
Megaerops wetmorei,		x	
Megaerops ecaudatus	x		
Penthetor lucasi	x		
Macroglosus sobrinus	x	x	
Eonycteris spelaea	x		
Rousettus amplexicaudatus		x	x (BS6)
Hipposideros cervinus,		x	
Nycteris javanica,		x	
Megaderma spasma		x	
Myotis muricola			x (BS 7)
Rhinolophus lepidus		x	x (BS4,5)
Tadarida mops	x		
Tylonycteris pachypus,		x	
Tylonycteris robustula,		x	

5.4.2 Rats:

This kind of animal can be found on different land use types and shows differences in degraded habitats. *Maxomys rajah* usually dominates primary forest and logged-over forest, while *Maxomys whiteheadi* is normally very common in open areas. But in our survey we found this species in the logged-over forest, *Paraserianthes*, and rubber plantation. It is very closely related to *Rattus exulans* that we found also in *Paraserianthes* and rubber plantations. Although rats occurred across all LUTs, abundance was greatest at the *Imperata* site (see Table 5.4).

The reproduction status and ecology for each rat species in different land uses can be explained by the following :

5.4.2.1 Microbiogeography of rats:

The dissimilarity distance between locations based on rat habitat show that there are two groups; primary and logged-over forest in the first group, and jungle rubber, *Paraserianthes* and *Imperata* in the second group. Results based on dissimilarity distances between rats show that *Rattus tanezumi* and *Rattus tiomanicu*s tend to share a similar habitat. This is different to

Maxomys rajah, that tends to live separately from other rats. The choice of habitat and associated breeding condition for each species can be explained by the following :

Rattus tanezumi (Indonesian black rats)

During the survey only one individual was found in the *Paraserianthes* plantation. This species is similar to *Rattus rattus*, but there are significant genetic differences between these species (Musser & Carleton, 1993). The reason it is found in *Paraserianthes* plantation is because there is a lot of human activity in that area. We predicted there would be a close relationship between rats at the *Paraserianthes* plantation and the level of human activity within the plantation forest.

Rattus exulans (Pacific rats**)**

Ecology:

This species has a wider range of distribution in South East Asia, Indonesia, New Zealand and Polynesia and has a specific habitat in Papua New Guinea and Solomon Islands. It is commensal with human activity and can survive up to 3000m above sea level. In paddy fields and gardens this species could become a pest (Maryanto, data unpublished). In this rapid survey the species was found in the *Paraserianthes* plantation, rubber plantation, *Imperata*, and jungle rubber. We did not find it in the *Cassava* plantation, and we suggest that this species might have moved to *Imperata*-dominated areas.

Reproduction***:***

We caught nine female rats in six different land use types during the survey and they were all pregnant . One female rat found at the *Paraserianthes* site was pregnant with two scars at both sides and uterine horn 1,48mm wide; another female rat found at the *Imperata* site was also pregnant with 5 foetuses in the left side and 1 at the other. Dwyer (1975) mentions that this species will breed during the wet season and produce a large litter.

Rattus tiomanicus (Malayan field rats)

Ecology:

This species was found at both the *Paraserianthes* plantation and *Imperata* and it prefers a bushy place (Payne *et al.*, 1985). From nine rats found during the survey, 8 occurred in *Imperata* , and one at a site similar to *Paraserianthes*. Corbet and Hill (1992) argue that this species is mutually incompatible with *Rattus tanezumi*.

Reproduction***:***

Six out of nine rats were male and ready for breeding. From 3 female rats, 2 were pregnant with one soon to be pregnant. About 5-7 babies will be born from each rat.

Maxomys rajah (Brown spiny rats)

Taxonomy:

Two sub-species of these rats are widespread in Sumatra (Van Strien 1986) : *M.r. pellax* and *M.r. similis*. At our site location we are not certain whether it is *M.r. similis*, so we need to repeat our effort by making a comparative sample from Aceh (Chasen 1940).

Ecology:
This species tends to live in secondary forest or primary forest with sandy soil (Payne 1985). In this survey, even though the soil type between *Paraserianthes* and rubber plantation was similar (ultisol) and the sites closer to each other, in this survey we did not find *Maxomys rajah* in both sites. It was predicted that besides soil type, the litter depth at primary and logged-over forest would exert a major influence over the presence of this species.

Reproduction:
Seven mature rats were found in the field from the total specimens. There were 4 male *Maxomys rajah* from both primary and secondary forest ready for breeding (Scrotal). One female rat had been pregnant twice with the six scars on the right and five on the left (on the logged-over area), and another 2 female rats were found in the primary forest , one pregnant and the other still young but ready for breeding.

Maxomys whiteheadi (Whitehead's rat)

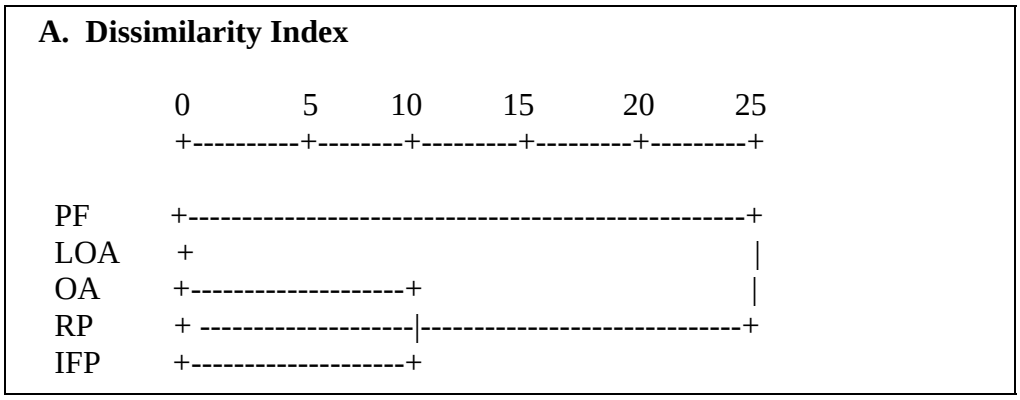
Ecology:
This species can be found near the forest. Payne *et al.*, (1985) mentions that this species can attack paddy rice, especially where paddy fields are surrounded by forest. It is associated with *Rattus argentiventer, Rattus exulans, Rattus tiomanicus, Rattus tanezumi* (Maryanto, data unpublished). In this survey, we found this species in *Paraserianthes*, logged-over forest, rubber plantation, and *Imperata.*

Reproduction:
We found 3 male rats in the field with imperfect testes (inguinal), only one showing perfect testes (scrotal). Another had just given birth and another 2 were pregnant.

Table 5.4
Records of rats for each land use type and each plot based on sexual status and reproduction.

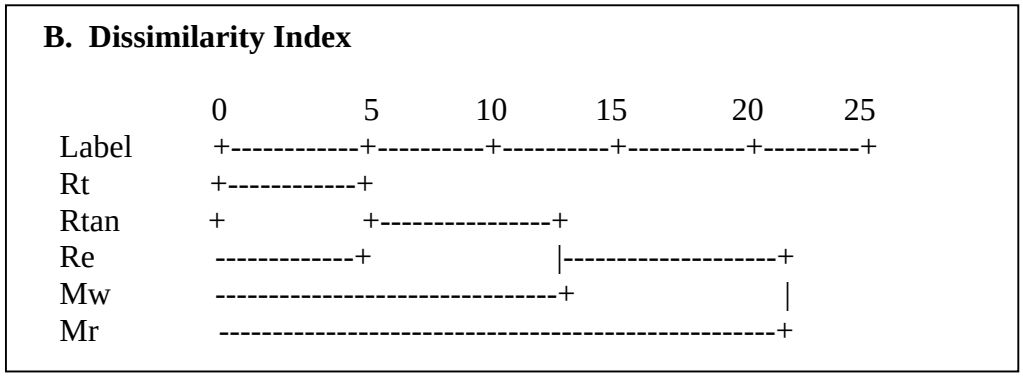
Habitat	Trap trial	Male mature	Male young	Female mature	Female young	Trapped	Trapping/ trial
Primary forest (BS1&2)	2	2		2		4	2
Logged-over (BS 3)	2	1		1		2	1
Logged-over 1983 (BS4 &5)	2	2	1	1		4	2
Parasarianthess (BS6)	2	4		2		6	3
Parasarianthes (BS7)	2	1		1		2	1
Rubber plantation (BS8&9)	2	2	-	1	-	3	1,5
Imperata (BS12&13)	1	6	3	2	2	13	13
Cassava (BS14&15)	1	-	-	-	-	-	-
Jungle Rubber (BS10&11)	1,3	-		1		1	0,76
Total		16	4	13	2	35	

Figure 5.1. Relationship between habitat type based on rats species



Note: PF = Primary forest, LOA = Logged-over area, OA = Open area *Imperata*, *Cassava*, RP = Rubber plantation, IFP = Industrial forest plantation

Figure 5.2. Relationship of rat species based on an ideal habitat



Note. Rt = *Rattus tiomanicus,* Rtan = *Rattus tanezumi,* Re = *Rattus exulans,* Mw = *Maxomys whiteheadii,* Mr= *Maxomys rajah*

5.4.3 *Other Mammals (excluding rats and bats):*

5.4.3.1 Species Richness:

From all land-use types sampled in this survey, the greatest richness of mammals, excluding rats and bat occurred in logged-over forest and jungle rubber. The total percentage of mammals in this area is 45%. If we compare to primary forest as baseline indicator (Alikodra 1990), the species richness in logged-over forest or rubber jungle is greater by 28.57%. This indicates that several mammals, excluding rats and bats, prefer an area with medium crown cover. Larger mammals such as pig (*Sus scrofa*; babi hutan) and deer (*Rusa sambar*) can be found at *Imperata* and *Cassava* plantation where the species richness has decreased to 71.43%. In the rubber plantation, the richness of big mammals is less than in industrial forest plantation or open area. This may be due to differences in food source and other habitat components (Table 5.5). Jungle rubber is a very good alternative habitat for large mammals because there is almost no treatment of plants and the vegetation is not homogeneous. This habitat will provide a wide variety of local habitats for different plant types. Hence, the component of the habitat is still complete. One mammal has been identified, *T. cristatus* (lutung budeng) with a black and white colour pattern that facilitates studying the social relationship between them. Using the Shannon Index of diversity (Ludwig and Reynold 1988), we see that the percentage of jungle rubber, 19.58% (Table 5.6), is higher than primary forest. The differences based on community

similarity index between two locations is about 23.53%. It seems that species diversity in jungle rubber is higher than primary forest. There would be changes of 60.45% if primary forest were to change to an open area such as alang-alang or *Cassava* (Figure 5.3).

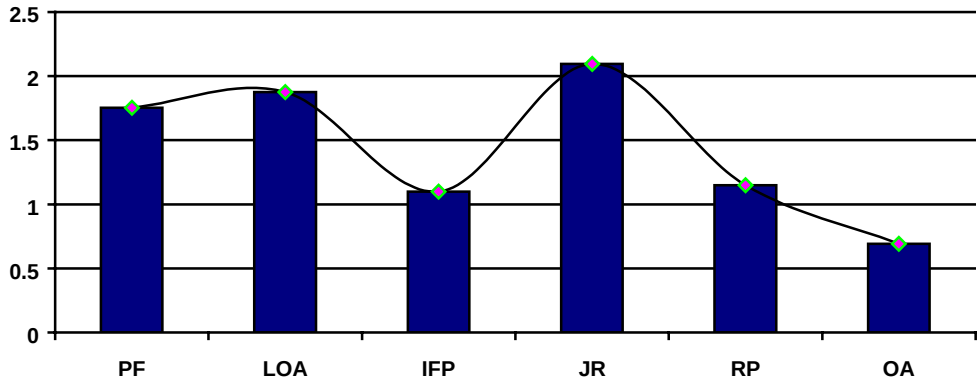


Figure 5.3 .Shannon similarity index changes base on habitat type

Community Similarity Index

The community similarity index tends to be high between primary forest and logged-over forest (about 55.56%). This index can show the effect of conversion from primary forest to logged-over forest and indicates an impact on dominant changes on mammals of about 44.44%.

Table 5.5
Mammals species excluding rats and bats in the study area

No.	English name	Species	PF	LOA	IFP	JR	RP	OA
1	Agile gibbon	*Hylobates lar agilis*	X	X				
2	Banded langur	*Presbytis melalophos*	X	X				
3	Banded palm civet	*Hemigalus derbyanus*	X					
4	Barking dear	*Muntiacus muntjak*		X				
5	Bearded pig	*Sus barbatus*	X	X	X	X	X	
6	Common treeshrew	*Tupaia glis*				X		
7	Domestic pig	*Sus scrofa*						X
8	Giant squirrel	*Ratufa affinis*			X			
9	Horse-tailed squirrel	*Sundasciurus hippurus*				X		
10	Large treeshrew	*Tupaia tana*				X		
11	Leopard cat	*Prionailurus bengalensis*					X	
12	Lesser mouse-deer	*Tragulus javanicus*		X				
13	Long-tailed macaques	*Macaca fascicularis*	X	X				
14	Low's squirrel	*Sundasciurus lowii*				X		
15	Plantain squirrel	*Callosciurus notatus*				X		
16	Prevost's squirrel	*Callosciurus prevostii*	X	X		X	X	
17	Sambar deer	*Cervus unicolor*				X		X
18	Silvered leaf monkey	*Trachypithecus cristatus*		X		X	X	
19	Sun bear	*Helarctos malayanus*	X		X			
20	Whiskered flying squirrel	*Petinomys genigarbis*		X				
	Total Individual (n)		32	63	3	12	9	4
	Total species (S)		7	9	3	9	4	2
	Percentage of species distribution (%)		35.00	45.00	15.00	45.00	20.00	10.00
	Conversion of primary forest (%)		-	28.57	-57.14	28.57	-42.86	-71.43

Microbiogeography:

A dissimilarity measure based on mammals species in six land-use types, suggests there are 3 groups of habitat from the identified 20 mammals that can be used as future indicators for mammals. The first group is *Paraserianthes*, alang-alang, *Cassava* plantation, and rubber plantation. The second group is jungle rubber, and the last group is primary forest and logged-over forest (Figure 5.4). Classification of habitat type is almost similar with microbiographical classification on habitat type of rats (see Figure 5.1 and 5.2).

Table 5.6
Species Diversity index on different land use types

No.	Species	PF		LOA		IFP		JR		RP		OA	
		n	H'	n	H'	n	H'	n	H'	n	H'	n	H'
1	*Hylobates lar agilis*	7	0.333	15	0.342								
2	*Presbytis melalophos*	5	0.290	10	0.292								
3	*Hemigalus derbyanus*	1	0.108										
4	*Muntiacus muntjak*			1	0.066								
5	*Sus barbatus*	2	0.173	2	0.110	1	0.366	1	0.207	1	0.244		
6	*Tupaia glis*							1	0.207				
7	*Sus scrofa*											2	0.347
8	*Ratufa affinis*					1	0.366						
9	*Sundasciurus hippurus*							1	0.207				
10	*Tupaia tana*							1	0.207				
11	*Prionailurus bengalens*									1	0.244		
12	*Tragulus javanicus*			1	0.066								
13	*Macaca fascicularis*	12	0.368	17	0.354								
14	*Sundasciurus lowii*							1	0.207				
15	*Callosciurus notatus*							1	0.207				
16	*Callosciurus prevostii*	3	0.222	3	0.145			3	0.347	2	0.334		
17	*Cervus unicolor*							1	0.207			2	0.347
18	*Trachypithecus cristatu*			13	0.326			2	0.299	5	0.326		
19	*Helarctos malayanus*	2	0.173			1	0.366						
20	*Petinomys genigarbis*			1	0.066								
	Total individual (n)	32		63		3		12		9		4	
	Total species (S)	7		9		3		9		4		2	
	Shannon Index (H')		1.667		1.765		1.099		2.095		1.149		0.694

The habitat type indicates the importance of the density of tree and crown cover, but the most important influence is availability of food. The first location, which includes alang-alang, *Cassava* plantation, *Paraserianthes*, and rubber plantation, tends to have more open habitat types. There are 4 group of animals which occupy 3 habitat types within and between which they interact. The 4 groups are as follows :

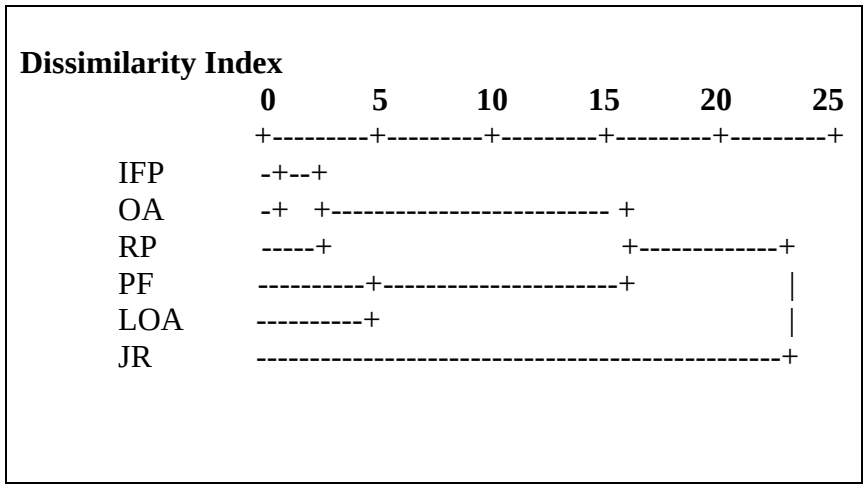
Group 1 : *Tragulus javanicus, Petinomys genigarbis, Muntiacus muntjak, Presbytis melalophos,*
Macaca fascicularis, Hylobates lar agilis.
Group 2 : *Ratufa affinis, Helarctos malayanus, Hemigalus derbyanus,*

Group 3 *: Sundasciurus lowii, Callociurus notatus, Tupai glis, Sundasciurus hippurus, Tupaia tana,*
Cervus unicolor, Sus scrova, Prionailurus bengalensis,
Group 4 : *Callociurus prevostii, Trachypithecus cristatus, Sus barbatus* (Figure 5.5).

5.5 Function of food:

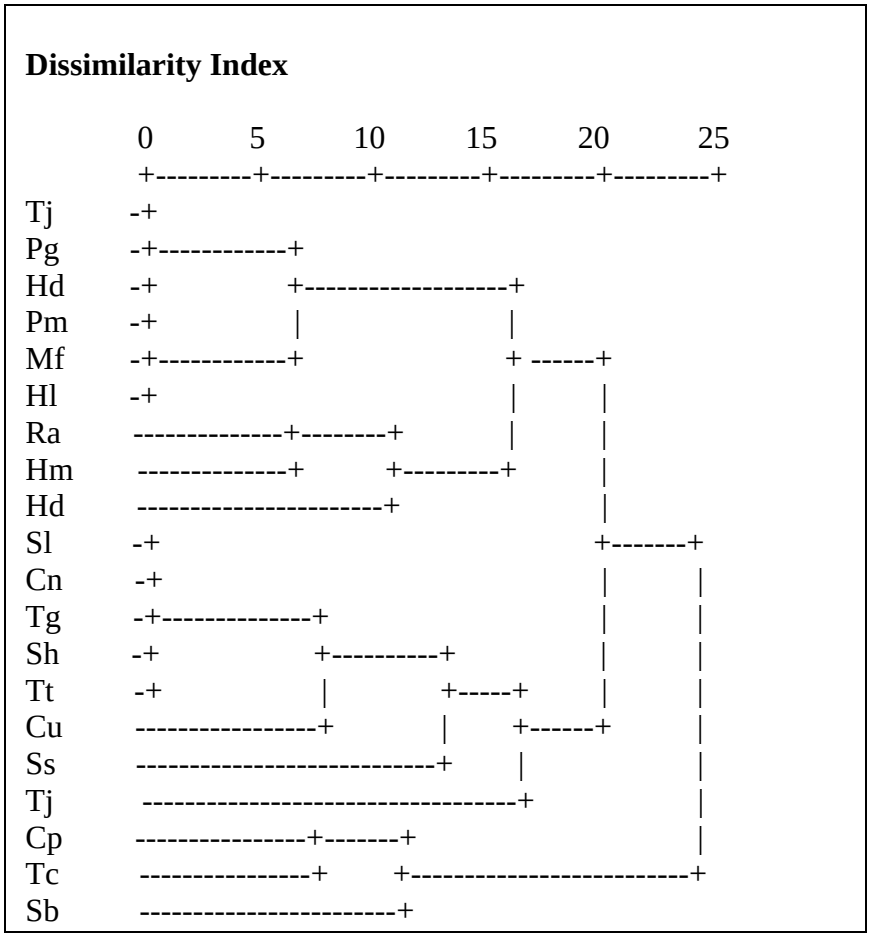
For the 4 groups of mammals above, each group can not necessarily live together on the same spatial distribution of food. Even if we find several mammal who live together at the same habitat, they do not necessarily compete for food because they have different spatial ranges. Mammals species identified in this survey were mostly from the group that eat fruits (38.10%), followed by seed-eaters (14.29%) and then grass or root tuber eaters (9.52%). The source of food consumption is outlined in Table 5.7. The food source can also be used to predict the *Hylobates lar* as an indicator of forest condition. There are 5 groups of animals, based on spatial distribution, that are dispersed across different elevations 0-1, 1-3, 3-15, 15-30, >30 meter (Table 5.8).

Figure 5.4
Relationship between type of habitat base on mammals species excluding rats and bats.



Note: IFP= *Paraserianthes* plantation, OA= Open Area / *Imperata*, *Cassava*, RP= Rubber Plantation, PF= Primary Forest, LOA= Logged-Over Forest, JR= Jungle Rubber

Figure 5.5
Relationship between species mammals based on an ideal habitat.



Note: Tj=*Tragulus javanicus*, Pg= *Petinomys genigarbis*, Mm= *Muntiacus muntjak*, Pm= *Presbytis melalophos*, Mf= *Macaca fascicularis*, Hl= *Hylobates lar agilis*, Ra= *Ratufa affinis*, Hm= *Helarctos malayanus*, Hd= *Hemigalus derbyanus*, Sl= *Sundasciurus lowii*, Cn= *Callociurus notatus*, Tg= *Tupai glis*, Sh= *Sundasciurus hippurus*, Tt= *Tupaia tana*, Cu= *Cervus unicolor*, Ss= *Sus scrova*, Pb= *Prionailurus bengalensis*, Cp= *Callociurus prevostii*, Tc= *Trachypithecus cristatus*,Sb= *Sus barbatus*.

Table 5.7

Potential sources of food for mammals

No	Species	Food source														
		Insect	Arthropoda	Warm	Bee nest	TerMites	Leave	Young leave	Fruit	Seed	Grass	Ground tree	Shrub	Mushroom	Small animals	Vegetables
1	*H. lar*	x					xx		xxx							
2	*P. melalophos*						xx		xx	xxx						
3	*H. derbyanus*	xx		xxx											x	
4	*M. muntjak*							xx	x	x	x	xxx				
5	*S. barbatus*			xx					xxx	xx		xx			x	
6	*T. glis*	xxx	xx						x							
7	*Sus scrofa*										xxx				xx	xx
8	*R. affinis*						x			xxx						
9	*S. hippurus*	x							xx	xxx						
10	*T. tana*		xxx	xx					x							
11	*P. bengalensis*	xx													xxx	
12	*T. javanicus*							xx	xxx					x		
13	*M. fascicularis*	x					xx	xx	xxx					x		
14	*S. lowii*	xx							xxx					x		
15	*C. notatus*	xx							xxx							
16	*C . prevostii*	xx				x			xxx							
17	*C. unicolor*						x		x		xxx	xx	xx			
18	*T. cristatus*						xxx	xx	x							
19	*H. malayanus*				xxx	xx			x						xx	
20	*P. genigarbis*	x														

Table 5.8

Spatial distribution of species according to food source

Elevation meter	No.	English Name	Species
0 - 1	1	Banded langur (BW)	*Presbytis melalophos*
	2	Banded palm civet	*Hemigalus derbyanus*
	3	Barking deer	*Muntiacus muntjak*
	4	Bearded pig	*Sus barbatus*
	5	Domestic pig	*Sus scrofa*
	6	Lesser mouse-deer	*Tragulus javanicus*
	7	Large treeshrew	*Tupaia tana*
	8	Low's squirrel	*Sundasciurus lowii*
	9	Leopard cat	*Prionailurus bengalensis*
	10	Sambar deer	*Cervus unicolor*
	11	Sun bear	*Helarctos malayanus*
1 - 3	1	Common treeshrew	*Tupaia glis*
	2	Horse-tailed squirrel	*Sundasciurus hippurus*
	3	Long-tailed macaques	*Macaca fascicularis*
3 - 15	1	Plantain squirrel	*Callosciurus notatus*
	2	Prevost's squirrel	*Callosciurus prevostii*
	3	Silvered leaf monkey	*Trachypithecus cristatus*
	4	Whiskered flying squirrel	*Petinomys genigarbis*
15 - 30	1	Banded langur	*Presbytis melalophos*
	2	Giant squirrel	*Ratufa affinis*
>30	1	Agile gibbon	*Hylobates lar*

5.6 Recommendations:

- Conversion to monoculture areas such as alang-alang, *Cassava*, industrial forest plantation (*Paraserianthes*), and rubber plantation will cause a decrease in species richness. Hence, it is important to maintain an area that includes natural mixed forest.
- *T. cristatus* found in the field has a different colour pattern; we need further study of its ecological status.
- Bats are potentially useful pollinators and agents for pest control. The smoke hazard may have caused several animals to either die or to migrate to alternative habitats. We need further research about this.
- We found one bat taxon that may represent a new species. To confirm this will require comparison with collected specimens from Malaya in the Raffles Museum, Univ. of Singapore.

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