

Habitat destruction and threat on the large- and medium-sized mammals in Sumatra, Indonesia (Continuation)

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SUMMARY

Habitat destruction was being occurred in many places of Sumatra which might cause local extinction of some mammal species. We studied how large- and medium-sized mammal species responded to various intensities of habitat alteration in three provinces of Central Sumatra (West Sumatra, Riau and Jambi), Indonesia. Our goals are to evaluate the current status of 26 subject mammal species, to predict those population changes and to find key factors for sustaining each species in their habitat. Data on the distribution of each species and relating ecological factor were collected through direct interviewing to the local people and observation on those species traveling around whole areas with a car. We also conducted intensive surveys at some selected areas to assess more precisely the current status of subject species. Intensive surveys covered four main habitat types; natural forest, agro-forestry and/or rubber forest as mixed plantations, palm oil plantation as monoculture plantations and human settlement or rice fields as artificial habitats. Analyses were made in term of species existence by different habitat types and their responses to the habitat degradation. We found many mammal species can survive in traditionally managed agro-forestry areas and mixed forests mainly composed of rubber plantations. The large scaled palm oil plantation was the most serious threat for most subject species. They cannot survive in the newly established monoculture ecosystem where oil palm trees dominate and the under-storey vegetation is very poor. The distribution pattern of each species in various habitat types revealed that habitat degradation could have threatened those subject species in different levels (i.e. no influence, low, moderate, high, and extreme influence). Wild boars and common palm civets, for instance, appeared not to be influenced by habitat degradation while Malayan tapirs, bear cats, flying lemurs, Sumatran tigers, siamangs and elephants extremely suffered from habitat degradation. We further discussed the possibility on sustainability and/or local extinction of those subject species as a consequence of habitat alteration. We suggested the importance of retaining mixture vegetation within appropriate locations even when habitat alteration was inevitably,

1. INTRODUCTION

Sumatra Island is a biodiversity hotspot for conservation priorities (Myers et al. 2000). It is home to many large- and medium-sized mammals including the Sumatran elephant, Sumatran tiger, rhino, tapir, primates and others. Most of these mammal species are threatened (Kinnaird et al. 2002, Donald 2004). It is, therefore, very important to prepare the exact data sets on the distribution and biology of these species for establishing conservation measures. At present, the deforestation in Sumatra occur very rapidly and appropriate actions should be taken immediately to prevent the local extinction of these species (Jepson et al. 2001, Myers et al. 2000).

During 2004 to 2006, we conducted studies on the distribution of 26 mammal species and their populations in various habitats, together with land use trends, in the central landmass of the island covering about 130,780 km². The study has

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enabled the preparation of distribution maps for each species. In particular, for both Sumatran tigers and elephants, we have been able to retrace the historical changes in their populations. We found that local extinctions had already occurred for some of the species studied. Threats to these species became increasingly serious, especially in lowland habitats. On the other hand, our data suggested that some of the species, for instance, wild boar and crab-eating monkeys might adapt to habitats with various degrees of disturbances. These species may increase in number because they could tolerate the disturbed habitats that created by humans, where their natural predators no longer survive. Human interference was found to have increased the vulnerability of certain species but could be tolerated by some others (Bakar et al. 2007).

However, these findings were based on general questionnaire surveys of local inhabitants across a very wide area. Detailed studies are still required to evaluate how these species survive in or disappear from particular habitats and what the critical demands for their survival are. Moreover, we need to clarify what essential resources each habitat type provides for these mammal species and what degree of habitat disturbance can be tolerated. To obtain such data, we have continued with intensive investigations in some representative habitats. Our goals are to explain the current status and to predict population changes of the 26 subject mammal species. Most importantly, we need to identify key factors necessary for the conservation of these mammal species.

2. METHODS

(1) Study Sites

Based on data from our previous studies, in West Sumatra, Riau and Jambi Provinces, of the current distribution of the subject species, we conducted intensive field studies in selected sampling areas to assess the current situation. The study areas covered four main habitat types; namely, natural forest, agroforestry and/or rubber forest as mixed plantations, palm oil plantation as monoculture plantations, and human settlement or rice fields as artificial habitats. Natural forest was represented by that being managed by the Andalas University in West Sumatra, Taman Hutan Raya Sultan Syarif Hasyim in Riau, and Kebun Raya Bukit Sari in Jambi. Mixed plantation was represented by agroforestry areas (a complex of fruit trees and other utilised species with some natural vegetation) in West Sumatra, and rubber forest in Jambi. Monoculture plantation was represented by palm oil plantations in Riau and Jambi. Artificial habitat was represented by human settlements and rice fields in West Sumatra.

(2) Species Existence and Species Richness in the Different Habitats

Data was mainly collected using questionnaire surveys of the local people. Direct and indirect observations (visual, footprint, faeces, auditory census, and other evidence referring to the existence the species) were employed when possible. Interviews were carried out at random at 26 locations with 75 respondents in West Sumatra, 36 locations with 78 respondents in Riau and 50 locations with 94 respondents in Jambi. The preferred respondent was male, old, a permanent resident (at least 2 years or more) and a farmer. In those representative habitats where the initial respondents suggested the existence of most of the subject species, additional respondents were surveyed to confirm the information through direct observation. Data collected included, the location of each species found, the existence of the target species, species richness and historical changes of those mammal species in the habitats. In particular, effects of the habitat changes were estimated, to examine what changes may lead to species extinction in the near future.

(3) Habitat Use and Survival of Mammal Species

To clarify the relationship between the subject species and habitat changes we collected information on habitat use by the subject species, rate and history of deforestation, habitat utilization by human beings, land ownership, general vegetation, and species response to altered habitats, using questionnaire surveys and direct observations in the relevant habitats. We also asked respondents about the occurrence and/or degree of forest logging, animal poaching, animal trade and animal utilization for medicine, human-animal conflict, animal extinction or population decrease from the 1940s to the present time (using 10 years intervals). The information provided us insightful estimations on the current status of the subject species and predictions of population changes or possible extinctions.

We categorized the effect of habitat degradation into five levels (i.e. No influence, Low, Moderate, High and Extreme influences) and classified each species into an appropriate level. The levels are evaluated by decreasing numbers of locations they existed when habitat altered from forest reserve to monoculture plantation, i.e. No influence (<15% decreased), Low (16-40% decreased), Moderate (41-60% decreased), High (61-85% decreased) and Extreme (>85% decreased). Here, we assume that forest reserve is the best habitat form comparing to traditional land use and monoculture plantation regarding variation of trees availability and intensity of human interferences.

3. RESULTS AND DISCUSSION

(1) Habitat Condition

Agroforestry is a prominent component of farming systems in Sumatra as a whole (Thiollay 1995). The most prominent farming system in Riau is a palm oil plantation, while in Jambi rubber plantations or rubber mixed forests dominate, and agro-forestry dominates in West Sumatra. Logging and habitat alteration in Riau started in the 1970s, and rapid and large-scaled habitat changes occurred after the 1990s. The predominant change was to palm oil and acacia (for pulp) plantations. The predominant land-use in Jambi is old rubber forest. Logging and habitat alteration in Jambi started in the 1970s, and rapid habitat changes occurred after the 1990s, predominantly to traditional-type rubber plantations. The land use in West Sumatra has not changed much from the 1970's through the 1990's, with the exception of some specific areas. This is because West Sumatra has a larger human population compared to the other two provinces and traditional agro-forestry is being carried out in most areas. Land ownerships by the resident population in these small and subdivided areas could be a factor that has prevented the introduction of large-scale plantations.

(2) Effect of Habitat Quality

The most evident findings are that traditional land use, mainly composed of agroforestry, can sustain populations of most subject species even though their abundance or population density may decrease (Table 1). In the agroforestry areas in West Sumatra many subject species still exist and the species richness does not differ from that in the natural forest. Some species, reported in the agroforestry areas but not in the natural forests, can be the unavoidable consequences of the study methods, since information on some species were quite difficult to collect and confirm in the natural forest habitats, especially in West Sumatra. Such species are tiger, serow, clouded leopard, binturong and flying lemur. We are convinced that all of these species exist in the area although no information in the natural forest could be acquired. As would be expected, many subject species did not live in the artificial habitats.

It was apparent that oil palm plantations did not harbour many of the subject species (Table 1). This was especially true in Riau, where more large-scaled and well organized oil palm plantations managed by big companies exist. It is interesting that some species, like wild boar, leopard cat, otter, civet, porcupine and pangolin, adapt well to this newly

established habitat and could be found in many sites. In the oil palm plantation areas of Jambi the species richness was higher than that in Riau. Some primate and ungulate species could be found in the oil palm plantations in Jambi, although their numbers were markedly depleted. Their persistence may be due to the relatively small-size of plantations and variation in management practices; such that some were well-managed, while others were left relatively untouched. These different types were mixed within the area. However, oil palm plantations need to be managed intensively to make a profit. The use of chemical fertilizers, mowing and herbicides are common. For this reason, areas of oil palm plantation usually become very homogenous and many species cannot live there. Land use alteration into palm oil plantations in Riau increased rapidly after the late 1990s. This has caused local extinctions or population decreases of many primate and ungulate species.

In the rubber forests of Jambi many mammal species still exist (Table 1). Most species living in natural forests can also be found in the rubber forests. The species richness in the rubber forests is higher than in the agroforestry areas in West Sumatra. The traditional rubber forests surveyed varied notably due to different management practices. In some rubber forests, understorey vegetation was very dense and ordinarily the areas surveyed included many scattered small forest patches being differently managed. Thus, in general, understorey vegetation was more abundant in rubber plantations compared to agroforestry areas. This may be the reason why rubber plantations still harbour so many mammal species.

Elephant and tiger were the easiest targets for evaluation of current status and/or local extinction. As these species are involved in serious conflict with humans, precise and detailed information is available. At the survey location in

Table 1. Comparison of species existence from specific habitat types in three study sites, indicated by the number of existing per number of sampling locations (%)

No	Common name	Local name	Scientific name	West Sumatra			Riau		Jambi		
				Natural forest	Agroforest	Human settlement	Natural forest	Palm oil plantation	Natural forest	Rubber forest	Palm oil plantation
1	Slowloris	Pikang	<i>Mylodoncus couang</i>	90	75	15	75	0	100	100	20
2	Long-tailed macaque	Manis	<i>Macaca fascicularis</i>	100	100	25	100	11.1	0	100	20
3	Pig-tailed macaque	Bantik	<i>M. nemestrina</i>	100	100	5	100	0	100	66.7	20
4	Mixed leaf monkey	Simpai	<i>Presbytis melalophos</i>	100	100	10	50	0	100	100	20
5	Banded leaf monkey	Koloh	<i>P. femoralis</i>	0	0	0	50	22.2	0	0	0
6	Silvered langur	Cinabun	<i>Presbytis entellus</i>	0	0	0	75	0	0	66.7	0
7	Agile gibbon	Ukoko	<i>Haplorhina agilis</i>	90	75	0	100	0	100	33.3	0
8	Sumatran gibbon	Simang	<i>H. syndactylus</i>	0	0	0	50	0	0	0	0
9	Wild boar	Babi	<i>Sus scrofa</i>	100	100	25	100	100	100	100	100
10	Sambar deer	Rusa	<i>Cervus unicolor</i>	90	75	0	100	0	100	66.7	40
11	Barking deer	Kijang	<i>Moschus moschifer</i>	90	75	0	100	0	100	66.7	40
12	Moose deer	Kancil	<i>Tragulus sp.</i>	0	50	0	75	0	100	66.7	40
13	Sumatran serow	Kambing Hutan	<i>Capreolus sumatrensis</i>	0	50	0	0	0	0	0	0
14	Sumatran tiger	Hirinau	<i>Panthera tigris</i>	0	50	0	100	0	100	33.3	0
15	Asian golden cat	Hirinau Buluh	<i>P. bengalensis</i>	90	75	50	75	66.7	100	66.7	80
16	Clouded leopard	Hirinau Dahan	<i>Nimfela nebulosa</i>	0	50	0	75	0	100	33.3	40
17	Sun bears	Beruangmadu	<i>Helarctos malayanus</i>	100	100	5	100	0	100	66.7	20
18	Common palm civet	Musang	<i>Paracynus hermaphroditus</i>	90	75	90	100	100	100	100	100
19	Binturong	Binturong	<i>Arctictis binturong</i>	0	50	0	25	0	100	33.3	60
20	Malay weasel	Muntia	<i>Mustela nudipes</i>	90	75	40	25	22.2	100	100	60
21	Otter	Berang-berang	<i>Lutra lutra</i>	90	75	70	50	55.6	100	100	80
22	Flying lemur	Kibang	<i>Glyptodactylus variegatus</i>	0	50	0	25	0	100	33.3	0
23	Sunda pangolin	Tenaxilin	<i>Manis javanica</i>	90	75	40	100	77.8	100	66.7	100
24	Porcupine	Landak	<i>Eupomys sp.</i>	100	100	30	50	44.4	100	66.7	100
25	Malayan tapir	Totoi	<i>Tapirus indicus</i>	90	25	0	100	0	100	66.7	20
26	Asian elephant	Gajah	<i>Elephas maximus</i>	0	0	0	50	0	0	0	0

Riau, most conflict between humans and mammal species (human-attacks by animals, disturbance on plantations) happened in the 1990s and some have occurred in the 2000s. The same was reported for Jambi. In the study sites of Jambi many species still survived. One reason for this may be that the area is near to the Barisan Mountains and so remnant populations of some species still occur.

West Sumatra typically has old villages in most areas, where human settlement has occurred for more than 100 years and the traditional land use of rice fields and agroforestry is maintained. In comparison to Riau and Jambi, land use or habitat alterations occurred a long time ago in West Sumatra, which has contributed to the significant difference found in patterns of local extinction of the subject species, which is restricted only in a few lowland areas. In particular, in artificial habitats in West Sumatra, civets and otters are widely distributed. We might conclude from this that these species can endure habitat changes if they are restricted to these traditional human usages. Changes from natural forests to secondary habitats mainly composed of agroforestry fields did not cause local extinction of civet or otter, which indicates that they might be able to adapt to habitat disturbances of various intensity as long as a food source for them remains available. The Minang (West Sumatra) ethnic group, habitually plant a variety of fruiting plants surrounding their communities. This may sustain some mammals near human settlement. For instances, common palm civet could eat various fruits and sometimes they may prey farm chickens. Although otters could persist near human settlement, they actually live away from villages but come at night to prey on pond fishes as it is common in West Sumatra. We assume that this tradition also provides opportunities for these species to survive in this area.

In general, many species could not be longer existing after habitat degradation although some species are found

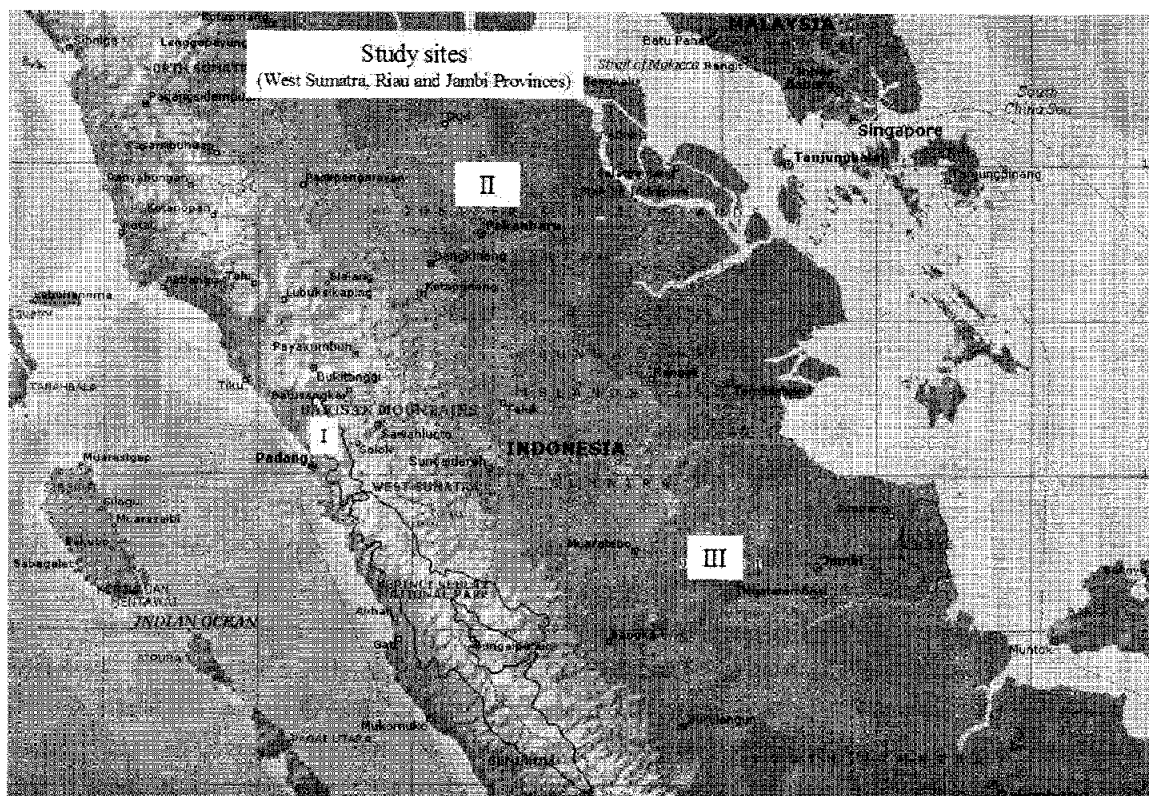


Fig.1 Study sites within three provinces in Sumatra

tolerant to some degree of the degradation (Fig 2). Wild pig and common palm civet are the most tolerant mammal species to the habitat degradation. They showed a similar trend of existences in all habitat types (Fig. 2a). This is because they could feed on various resources, active during the night even near human settlements. Although wild pig hunting is a common practice in West Sumatra and some adjacent areas but the hunting has no significant influence on their populations since the number of pigs killed is very few (Rizaldi et al. 2007).

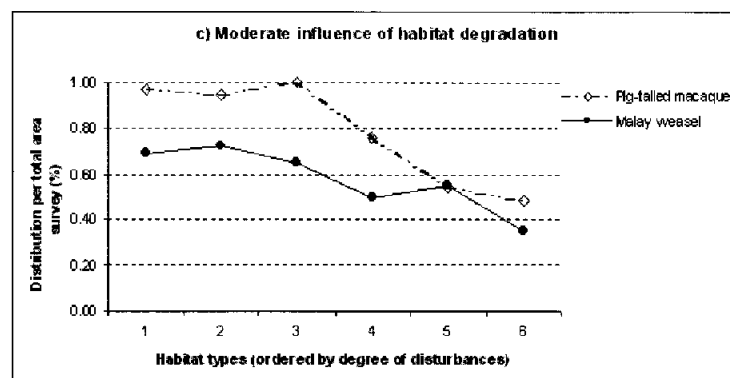
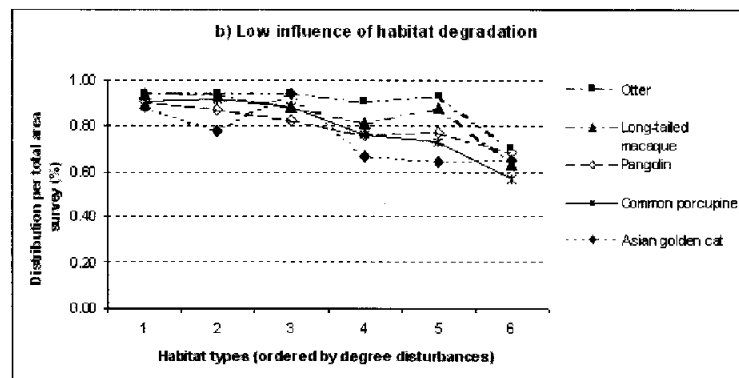
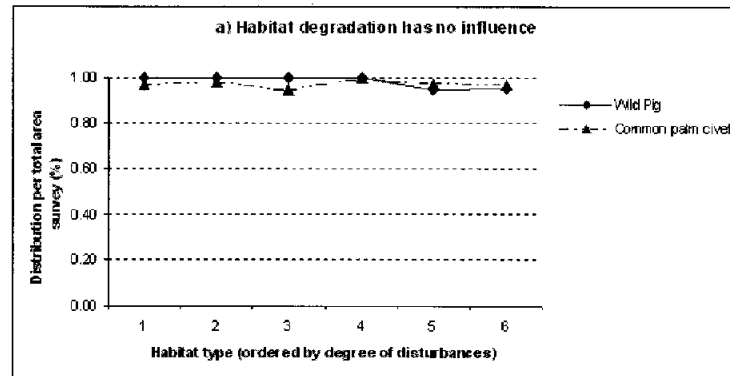
Otter, long-tailed macaques, pangolin, common porcupine and Asian golden cat are the species, which showed low influence of habitat degradation (Fig. 2b). All of these species are nocturnal except long-tailed macaques. They are found in all level of habitat degradation although most of them decreased at monoculture plantation. In large palm oil plantation usually some water canals and swampy water streams, that could provide fish for otters, still remain. Pangolin feed on insect especially ants which are available even in palm oil plantations. However, such low diversity vegetation may not fulfil their need for shelter and breeding. Porcupine are reported to feed on various fruits that usually found on the ground. They also eat fruits of palm oil so that they could survive in wide plantations although their population could be small. Asian golden cat is the only carnivore that may suffer low influence of habitat degradation. They were often reported to exist in large palm oil plantation. This is possible because they could prey on rats that are reported very common in palm oil plantation. During this study we found at least three cases of traffic accidents that kill the cats on the road along palm oil plantations (Fig. 3). Long-tailed macaques appear to be the most tolerant among primate species. Habitat degradation has a low influence although population density may be small in monoculture plantation. Actually, palm oil itself could support their need but some natural vegetation usually remains in some plots with slope areas, near water stream or border area.

In this analyses we could not classified leaf monkeys (e.g. silver langur, Mitered and banded leaf monkeys) only based on the influence of habitat degradation. Those species showed more geographical distribution separated by main rivers in Sumatra (Aimi & Bakar 1992) and elevation. However, all of them are still found in the all types of habitats. They were also found in large plantations but depending much on scattered natural vegetations, which was true especially in the newly established plantation areas. They could live in rubber forest because such vegetation provide them food and shelter although conflict with local farmers occurred sometimes.

Pig-tailed macaques and Malay weasel are diurnal and appeared to depend on forest vegetations (Fig. 2c). Distribution per total area surveyed decrease in traditional land use and plantation where the vegetation is far different from a forest form. These two species could be found near villages of human beings but natural vegetation is important to provide them with variety of foods and shelters. Pig-tailed macaques sometimes enter plantations and gardens from the adjacent forest habitats and they can cause considerable damage to grain and fruit crops (Payne et al. 1985). Their encounter in traditional land use and plantation can be due to the widely foraging habits of the species, but they may not use those areas for their core habitats.

Many species could be categorized into species with high influence of habitat degradation (Fig. 2d). All of ungulate species (barking deer, mouse deer, Sambar deer), two primate species (agile gibbon, slow loris) and two large carnivores (sun bear, clouded leopard) are in this category. Although habitat alteration from forest form to plantation could provide ungulate with more grazing area but hunting and trapping may cause serious threat since it become easy to detect them whenever they get close to plantation. We found that deer was the most favourite bush meat in the area, and most of the people in this study area did not eat pork. Agile gibbons cannot survive in plantation unless some fragmented natural vegetation support them. The fragmental natural vegetation may not sustain gibbon populations for longer to next generations. During field surveys we could find some fragmental forests remaining in large plantations that still harbour

animal flocks in them. Local people sometimes reported that clouded leopards and sun bears might come close into traditional land use and plantation. Crop damage by sun bear on coconuts are also reported but we noticed those areas were usually close to the forest that heavily disturbed.



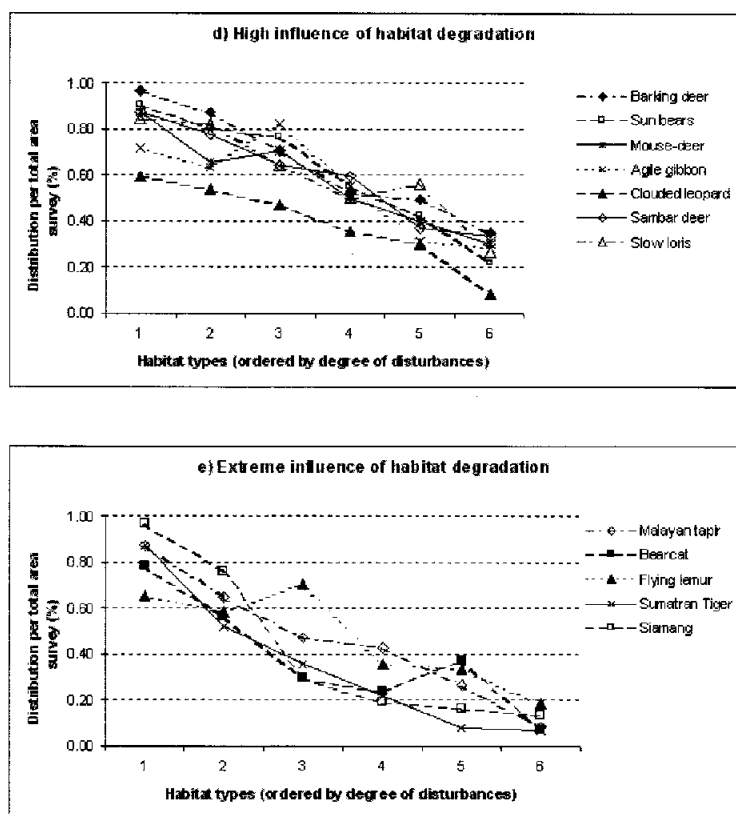


Fig.2 a-e: Influence of habitat degradation to each species of mammals

Habitat types are ordered from low to high degree of disturbances: 1= forest reserve (n=32 locations), 2= forest form adjacent to traditional land use (n=168 locations), 3= forest form adjacent to monoculture plantation (n=17 locations), 4= traditional land use adjacent to plantation (n=42 locations), 5= traditional land use (n=170 locations), and 6 = monoculture plantation (n=60 locations).

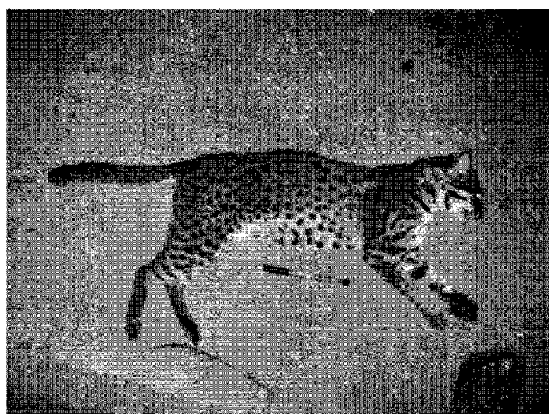


Fig.3 An Asian golden cat was killed by traffic accident



Fig.4 An interview with a preferred respondent Fig

Existence of at least six mammal species (including elephant) is extremely influenced by habitat degradation. All those species demand natural forest and they are very sensitive to the habitat disturbances (Payne et al. 1985). Many serious threats are facing them; those are habitat loss, hunting pressure, illegal trading, trapping, poisoning and human-animal conflict. Therefore, it is understandable why these species disappear faster than others. Elephant and Sumatran tiger has experienced local extinction in Riau and Jambi Provinces since last five decades (Bakar et al. 2007). Bear cat and flying lemur are nocturnal species that found extremely influenced habitats. However, these two species were also reported to enter traditional agricultural lands and to feed on fruit and flowers. They may not enter monoculture plantation unless fragmented forest form was still remained. Malayan tapir is also depended much on forest habitat. This species were sometimes reported to be accidentally trapped and killed in hunting for wild pigs near the forest edge. Siamang is an arboreal primate that could survive only in the forest habitat. Actually, most of the siamang populations were reported from higher elevation and mountain slopes in West Sumatra Province but few in Riau and Jambi. Siamang is also reported existing near traditional agricultural lands and plantations where fragmented forests still remained.

4. TENTATIVE CONCLUSIONS

- (1) Many mammal species can survive in traditionally managed agroforestry areas and mixed forests mainly composed of rubber plantations.
- (2) The most serious threat for most of the subject species is large-scale and monoculture plantations, intensively managed by large companies. Most species cannot survive in the newly established monoculture ecosystem where oil palm trees dominate and the understorey vegetation is very poor.
- (3) The natural forest should be protected for the conservation of mammal species. When habitat alteration is inevitable, the key factor is to retain a mixture of many kinds of habitat with understorey vegetation and some natural vegetation within some appropriate areas.
- (4) Habitat degradation influences different species in different ways. Some species may disappear very rapidly while others endure. Some species, like wild boars, may increase in population size. When habitat alterations occur rapidly, management of species must be carried out carefully, considering the different needs of the relevant species.

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要約

スマトラ島における現生中大型哺乳類の生息地破壊と その影響に関する調査研究(継続)

リザルディ、サンティ・ヌーラル・カミラー

インドネシアのスマトラ島では大規模な環境破壊が進んでおり、いくつかの哺乳類種の地域的な絶滅が危惧されている。中部スマトラの3つの州(西スマトラ州、リアウ州、ジャンビ州)で、生息する中大型哺乳類種がどのようにこうした生息地破壊に対応しているのかについての調査を行った。

調査の目的は、1. 対象とした26種の中大型哺乳類種の生息実態を明らかにすること、2. これらの種の個体数変動を予測すること、3. これらの種が将来生息していく上での鍵となる要因を見いだすことである。車を用いてほぼこれらの州全域をまわりながら、それぞれの土地の住民に対する聞き取り調査を行い、さらに直接観察を行って対象種の分布実態と関連する生態要因に関するデータ収集を行った。またより正確に分布実態を把握するために、いくつかの重点調査区をもうけて調査を行った。重点調査区では、4つの生息環境、すなわち自然林、さまざまな種の混交林となるアグロ・フォレストリー地域もしくは伝統農法によるゴム林、アブラヤシのみが生育する集約的なプランテーション地域、人間の生活する集落やその周辺の田園地帯を区分けして、それぞれ生息環境の違いにより、どのように種の生息

状況が変わっていくのか、またそれぞれの種の生息地破壊に対する影響の受け方を分析した。調査の結果、伝統的なやりかたで維持されてきたアグロ・フォレストリー地域や主としてゴム林からなる混交林では、個体数は少なくともまだ多くの種が生息していることが明らかになった。アブラヤシの大規模農園はほとんどの種にとって重大な脅威となっている。新しく作られたアブラヤシだけが生育し下生えが非常に貧困な単純生態系の中では、彼らは生息していくことはできない。種の分布パターンにより、生息地の環境変化に対してそれぞれ少しずつ異なった対応があることが認められ、影響の大きさによって5段階に分類した。イノシシやジャコウネコは環境変化に対してもっとも影響を受けない種であり、ゾウ、トラ、フクロテナガザル、タピル、マレーグマ、ヒョケザルなどがもっとも影響を受ける種である。こうした結果に基づいて、それぞれの種の存続可能性、あるいは地域的絶滅の可能性について検討した。また環境破壊が避けられないとしても、混交林地域を適切に残していくことが多くの種の存続のために重要であることを論じた。

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