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IMPACT OF KAREN VILLAGES ON THE FAUNA OF THUNG YAI NARESUAN WILDLIFE SANCTUARY: A PARTICIPATORY RESEARCH PROJECT

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ABSTRACT

Between February and December 1994, Karen villagers and Royal Forestry Department (RFD) guards in Thung Yai Naresuan Wildlife Sanctuary were trained in line transect techniques for wildlife censuses, and collected data over a total transect length of 363 km in four survey areas, three near Karen villages, and one near the sanctuary headquarters. The results show the area has great conservation significance for primates and carnivores, especially large cats and bears, but is of minimal importance for large herbivores such as gaur and elephant. Possible impacts of Karen villages on wildlife populations are analysed and discussed. The project as a whole reveals the tremendous potential of participatory wildlife surveys, and the possibility of establishing a community-based wildlife monitoring process.

INTRODUCTION

It is widely recognised that lack of accurate data on the status and trends of wildlife populations is an obstacle to proper effective management and conservation (KARANTH & SUNQUIST, 1992; MACKINNON ET AL., 1986; RABINOWITZ, 1993), but this is usually seen as being a problem only for official wildlife managers. In reality, local people are often wildlife managers, intentionally or not, through their presence and activities in protected areas.

Quantitative assessments of the distribution, abundance, and status of the fauna of Thung Yai Naresuan Wildlife Sanctuary, part of Thailand's only Natural World Heritage Site, are sparse and fragmentary. This lack of knowledge prevents informed management decisions on the part of the legal protector of the sanctuary, the Royal Forest Department (RFD). It also prevents a clear understanding of impacts caused by the presence and activities of the "de facto" historical managers of the sanctuary, the Pwo Karen people. They have resided in western Thung Yai for at least 200 years (KEYES, 1979), and have developed numerous traditions and beliefs which affect their behaviour towards wildlife. Although possessing generations of knowledge and experience regarding forest ecology and wildlife, any claims they make asserting the benign nature of their presence remain unsupported by scientific data.

Since 1990, the Karen have been threatened with eviction from the sanctuary because of their suspected impact on the wildlife of Thung Yai. In light of the above, this project was carried out with the following objectives:

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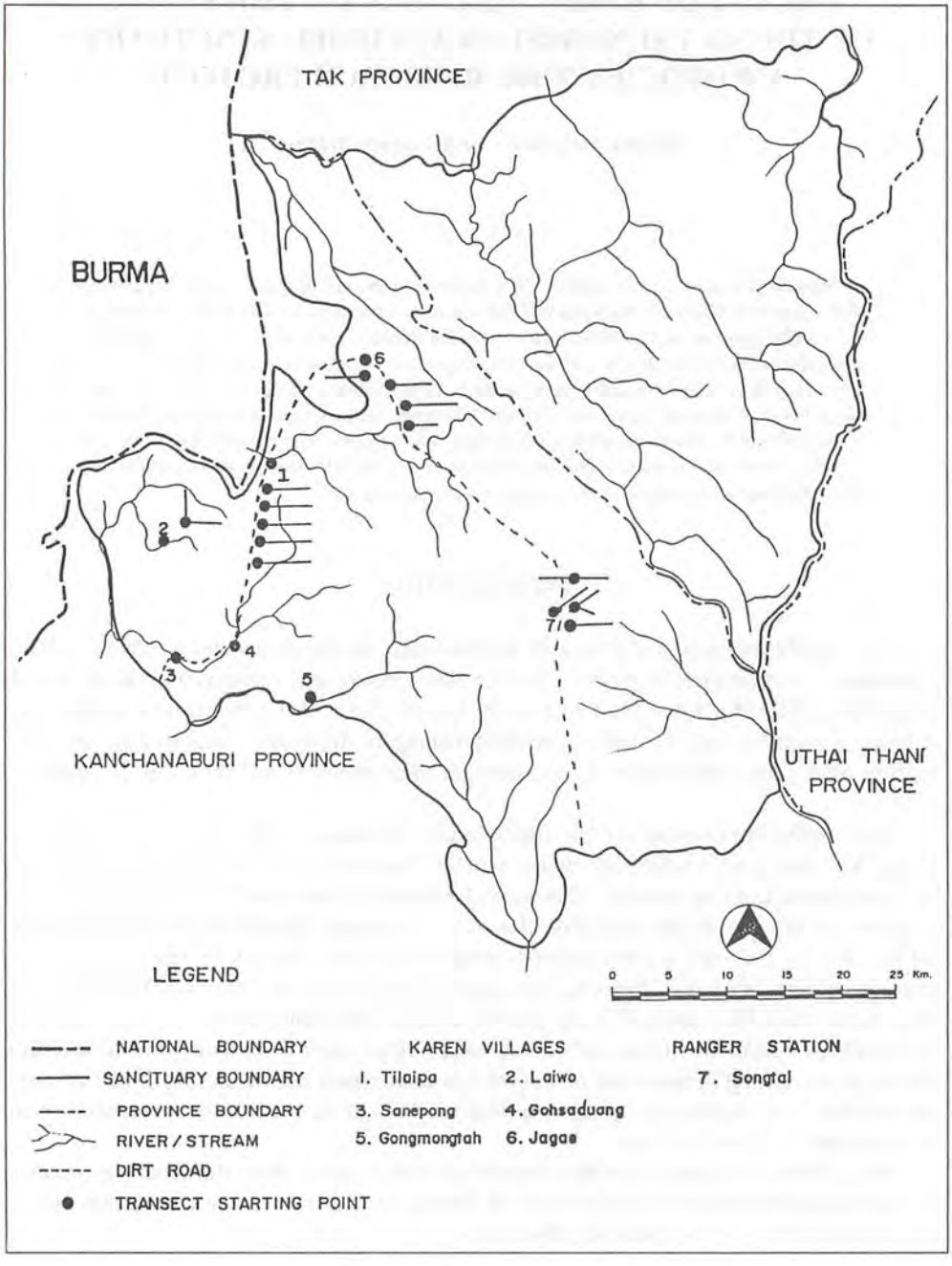

Figure 1. Map of transect locations in Thung Yai Naresuan Wildlife Sanctuary.

1) To enable both forest guards and Karen villagers to develop the skills of basic wildlife census and inventory.

2) To collect baseline data defining the biodiversity significance and conservation importance of the southwestern part of Thung Yai, in the area of six Karen villages of Laiwo sub-district.

3) To assess the impact of these villages, and activities of villagers, on the fauna of Thung Yai.

The fundamental principle guiding this project was that the research be participatory, the participants being the RFD rangers and the Karen villagers. Experience has shown that it is the protected area which suffers when local villagers and guards are at odds. This fact alone was sufficient reason for designing a project which incorporated both locals and guards in the objective study and analysis of the forest in which they live and work. By being trained together and undertaking research, and participating in the subsequent interpretation of the results as a group, these persons have initiated a system of problem diagnosis based on a common understanding of the facts, rather than on partisan distrust.

Participatory research of this kind has few precedents. The importance of local participation in agricultural research has been recognised and utilised in Thailand (FARRINGTON & MARTIN, 1988) and the value of indigenous ecological knowledge has been accepted and incorporated into the management plans of protected areas elsewhere in Asia and Africa (JACOBSON, 1993; JOHNSON, 1992; WELLINGS, 1994). Capacity building of protected area staff in research and monitoring has recently become an integral part of the long range plans of forestry departments in Malaysia, Indonesia and Thailand (NYZS, 1992; RABINOWITZ, 1993). However, examples of joint scientific research relating to biodiversity, in which indigenous people carry out the actual research are rare.

In the past, where local people have had a role, it has generally been to supply information or labour, or act as guides. This project has aimed to train them as research partners working for the benefit of their communities and the forest, who will become the owners of the data and knowledge that result.

STUDY SITE

The 3,200 km2 Thung Yai Naresuan Wildlife Sanctuary (TYN) is located in Tak and Kanchanaburi Provinces of western Thailand, adjacent to the Burmese border. Together with the contiguous Huai Kha Khaeng Wildlife Sanctuary, it constitutes Thailand's only Natural World Heritage Site.

TYN contains a variety of forest types, including mixed deciduous (45%), dry evergreen (31%) and hill evergreen (15%). Secondary forest of varying stages of regeneration covers 4% of the sanctuary, and the remaining 5% consists of savanna, deciduous dipterocarp forest, and grassland (NAKHASATHIEN & STEWART-COX, 1990).

All of the surveys in the present study were carried out in western TYN, which is characterised by rugged mountainous terrain, with elevations of up to 1811 m, accounting for about 1,500 km2 of mostly dry evergreen and mixed deciduous forests.

The mean annual rainfall recorded in Sangklaburi District, Kanchanaburi Province, over the past 10 years was 1970 mm, ranging from a minimum of 1297 mm in 1993 to

a maximum of 2714 mm in 1991 (AMBROSINO, 1993). There is a 4 to 5 month dry season from November to March, with temperatures ranging from a mean monthly minimum of 16.2° Celsius in December, to a maximum of 35.8° in April.

Within TYN there are 12 Karen villages. Six are located in Laiwo Sub-district of Sangklaburi, and wildlife surveys were conducted in the vicinity of three of these villages: Tilaipa, Jagae, and Laiwo. A fourth survey site was near the sanctuary headquarters at Songtai, in Thong Pha Phum District of Kanchanaburi Province (Figure 1).

There are notable habitat differences between the Songtai and the Karen area study sites. The Songtai study site was dominated by mixed deciduous (MD) forest which appeared drier than the less abundant MD forest in the Karen area study sites, with fewer water sources, and some floral characteristics of deciduous dipterocarp (DD) forest. *Shorea siamensis,* indicative of very dry conditions, was common in the Songtai study area, but was not present in the Karen study areas.

Mineral licks were common in the Songtai study area, but were not encountered in the Karen study area. While mineral licks are important for many large mammals, they are also indicative of soil features which in turn affect the type and quality of food sources which determine the distribution and abundance of many other species of wildlife (MARSH & WILSON, 1981; PAYNE, 1990).

The Karen living in Laiwo sub-district number about 2000 people in six villages. They practice subsistence rotational rice farming, and some wet rice cultivation. Vegetables are grown, and also collected from the forest. Fishing is an important activity, and is the main source of protein. Hunting and trapping are not important or widespread activities, although it is sometimes deemed exigent in the case of wild pigs and porcupines raiding their rice crop before harvest.

METHODS

Survey Techniques

Six surveys were conducted using standard line transect methodology (BURNHAM ET AL. 1980). Direct observations and indirect signs of wildlife were recorded in Thai on purpose-designed data sheets. Indirect signs included tracks, scat, dens, nests, markings, animal remains, trails, and vocalizations.

For direct sightings of each species, the following information was recorded: distance along transect, time, species, number of individuals, sex, distance from observer to animal, behavior, and forest type.

Transects were established and their length measured prior to the start of the surveys. They intentionally bisected terrain and topographic features.

In addition, a general survey was made of the Mae Jan valley in Tak Province to collect preliminary information relating to large mammal movements.

The line transect methodology has many characteristics which make it appropriate for such a participatory research project:

1) It requires relatively few resources and equipment.
2) The concepts involved are straightforward and training can be accomplished in a

short period. Previous knowledge or specialised education is not a prerequisite.

3) It is widely applicable to a variety of species and habitats.

4) It can easily be replicated for long-term monitoring.

5) It is widely accepted, and commonly used by researchers (BROCKELMAN & ALI, 1987; MARSH & WILSON, 1981; NRC, 1981).

6) Indigenous ecological knowledge and forest skills augment data collection, and are easily incorporated into the survey method.

There are numerous statistical methods for determining animal densities from line transect data. King's method (see BROCKELMAN & ALI, 1987 for description) was chosen because its relatively simple and straightforward mathematical procedure make it most suitable where the researchers have little formal education and no access to computers. Mean sighting distances (MSD) were used for density calculations. In King's method, density = total number of individuals sighted / total transect length x 2 x MSD. The survey area contained different forest types, so the sampling was stratified to reflect those differences.

Training

Prior to each survey, a training session was held for the participants. The training included detailed discussion of the following topics:

—The distinction between casual observation and documented data
—How data can be used to understand trends and make comparisons
—Concepts of averages, and densities
—Concept of baseline data and the value of long-term monitoring
—Line transect methodology
—Habitat types and local ecological knowledge
—Animal species identification

Practical exercises were conducted on the following:

—Distance estimation techniques
—Use of a compass
—Use of data collection forms
—Track identification and measurement

Surveys

Each transect was walked by two or three people. Walks began at 0700 h and finished around 1100 h. On some transects, a return walk was done between 1500 and 1830 h. Each transect was walked on 3–5 consecutive days. Individual transect length varied from 1.5 to 5 km, depending on topography and habitat type. Transects were located at varying distances from the following five villages:

Tilaipa village: Two sets of surveys were conducted along five transects, spaced 2 km apart. The transects were located between 2 and 11 km from the village, and ran from west to east from a dirt road which was used as a baseline. The transect lengths were 3.3, 3, 4, 1.5, and 5 km, respectively.

The first survey was conducted in the dry season. A training session was held for 14

villagers and 7 RFD rangers from 6–9 February, 1994. Transects were prepared during the training session. Data were collected during 19–23 February, and the total length of transects walked was 118 km.

The second survey on the same transects was conducted in the rainy season, during 16–20 July, 1994. A training refresher session was held beforehand for 6 villagers and 3 guards. Total transect length walked was 46 km.

Jagae village: Two sets of surveys were conducted along four transects. One of these transects started 3 km southwest of the village, and ran east to west. The other three were spaced 2–3 km apart and ran west to east, using a dirt road as a baseline. The first of these started near the RFD guard station, 2 km south-east of the village, and the last started 7 km from the village. The transect lengths were 3, 5, 2.6, and 2.5 km, respectively

The first set of surveys was conducted in the dry season. Training and transect preparation were completed 21–23 March, 1994. Data were collected 25–29 March. Participants included 9 villagers and 8 guards. Total transect length walked was 80 km.

The second survey was completed in the rainy season between 24 and 28 July. A training refresher course was held beforehand for 4 villagers and 2 guards who participated. Three of the four transects were used, and the total length walked was 42 km.

Laiwo village: One small survey was completed between 28 April and 1 May, 1994. Two villagers participated, and total length of transects walked was 19 km.

Songtai (TYN West Headquarters): One set of surveys was conducted along six transects, using a dirt road running north-south as a baseline. The first transect started 1 km from the HQ, and the last transect started 6 km from the HQ. Transects 1 and 5 ran west to east, transect 2 ran southeast, transects 3 and 4 ran northeast and transect 6 ran east to west. The transect lengths were 4.5, 2.6, 4, 2.2, 2.4, and 2.5 km, respectively.

A training session was held on 2 Dec, 1994, transects were prepared on 3 Dec., and data collected during 4–6 December. The total length of transects walked was 58 km. Participants included 11 guards and 4 villagers, about half of whom had previous experience from the surveys around the villages.

In Mae Jan Valley a general assessment of factors influencing large mammal distribution and abundance was conducted in and around two Karen villages during 14–23 November, 1994. This involved discussions with village elders, leaders, and others in Greungbor and Dalacla. Preliminary information was gathered on historical and present large mammal distribution, movement patterns, use of different forest types and the availability of critical resources such as mineral licks.

Human impacts were also investigated, and data were collected on village history, demographics, land use patterns, and traditional resource management.

GENERAL SUMMARY OF RESULTS

The total transect length walked was 363 km, covering four main habitat types. Of this, 305 km was walked in the Karen study area, amd 58 km at Songtai. The Karen study area comprised 54% mixed deciduous forest, 41% dry evergreen, 3% grassland, and 2% agricultural fallow, closely resembling the overall stratification of HKK/TYN which is made up of 51% mixed deciduous, 40% evergreen, 3% savanna/grassland, and 3%

agricultural fallow. The survey area at Songtai was 97% mixed deciduous forest and 3% grassland.

A total of 26 mammal species were documented. Of these, 10 are listed as endangered in Thailand, and another seven as vulnerable or threatened (NAKHASATHIEN & STEWART-COX, 1990). Frequencies of direct sightings and indirect observations are shown in Table 1.

In addition to mammals, two species of hornbills (Oriental Pied and Great), jungle fowl, and two species of pheasant (Silver and Kalij) were commonly encountered. As observers did not always distinguish between the pheasants, the two species were grouped to calculate pheasant density.

Langurs, gibbons, macaques and barking deer were the species most frequently encountered. Densities for these species (and pheasant) calculated from direct sightings, are shown in Table 2, both as overall density for all forest types, and as ecological density stratified according to mixed deciduous (MD) and dry evergreen (DE) forest types.

The three primate species all have higher densities in dry evergreen forest, whereas the density of barking deer is twice as high in mixed deciduous as in dry evergreen forest, and the density of pheasant is similar in both forest types.

RESULTS AND DISCUSSION

In order to assess the impact of Karen villages on wildlife, the data were analysed in a number of ways. Firstly, the data set from the Karen study areas was divided into two sub-sets "near" and "far" from the road which served as the baseline for all the transects. The "near" sub-set contains all data collected from the start to the mid-point of all transects; and the "far" sub-set contains all data collected from the mid-point to the end of all transects. The frequencies of direct and indirect observations in the two sub-sets are shown in Table 4.

Assuming that hunters would be opportunistic, starting their search for prey from the road or trail leading from their village, and that other human-created disturbances such as fire and noise would start from, or be of greater magnitude, closer to the road, we might expect to see differences in animal densities between the two data sub-sets.

Secondly, an attempt was made to assess impact by comparing data in this study to that from elsewhere in Thailand and the region where appropriate. For many species, direct sightings were too few to calculate densities, but indirect signs were numerous. In such cases comparisons were made for some species using a relative index of frequency of indirect signs, by dividing the total transect length walked by the total number of times indirect sign were encountered. The resulting index is the average number of km walked before encountering one sign. Index values are presented in Table 3. If monitored systematically over time, such data can be useful to elucidate trends in wildlife status (CAUGHLEY, 1977; RODGERS, 1991; SALE & BERKMULLER, 1988; VAN LAVIEREN, Pt.1, 1982).

Lastly, the data from the Karen study areas were compared with the data from Songtai which is devoid of villagers and presumably should be subject to lower levels of human disturbance, either from hunting, agriculture, or other activities. Unfortunately the sample

Table 1. Species inventory from all transects, and total numbers of direct sightings and indirect observations, for Karen and Songtai study areas. Indirect observations include: tracks, scat, dens, nests, markings, animal remains, trails, and vocalizations.

Species	Karen Study Areas		Songtai	
	Direct	Indirect	Direct	Indirect
Tragulus sp. (Mouse deer)	4	3	0	0
Muntiacus sp. (Barking deer)	16	169	7	20
Cervus unicolor (Sambar deer)	0	48	0	21
Sus scrofa (Boar)	3	64	0	1
Bos gaurus (Gaur)	0	47	0	19
Capricornus sumatraensis (Serow)	0	5	0	0
Macaca spp.[1]	13	7	0	0
Trathypithecus phayrei (Phayre's langur)	47	7	1	0
Hylobates lar (Lar gibbon)	19	47	2	24
Helarctos malayanus (Malayan Sun Bear)	2	40[2]	0	1
Selenarctos tibetanus (Asiatic Black Bear)	0		0	
Panthera pardus (Leopard)	1	0	0	0
Panthera tigris (Tiger)	0	1	1	5
Felid spp. (med.-sm. cats)	0	7	0	4
Cuon alpinus (Dhole)	0	1	0	1
Canis aureus (Jackal)	0	0	0	1
Lutra sp. (Otter)	0	1	0	0
Viverrid sp. (Civet)	1	19	2	4
Arctonyx collaris (Hog Badger)	1	3	0	2
Hystrix and *Atherurus* sp. (Porcupine)	0	36	1	9
Canomys badius (Bamboo rat)	1	–[3]	0	–
Ratufa bicolor (Giant squirrel)	15	2[4]	6	0
Manis javanicus (Pangolin)	0	1	0	0
Tapirus indicus (Tapir)	0	0	0	1

[1] *Macaca* spp. represents *M. nemestrina* and *M. arctoides.*
[2] Indirect signs of these bear species are combined.
[3] Data incomplete — Observers did not consistently record signs of Bamboo rats.
[4] Data incomplete — Observers did not consistently record squirrel sightings or signs.

Table 2. Total number of sightings, density, and mean sighting distances, from all transects, for barking deer, gibbon, langur, macaque, and pheasant. "Overall" refers to density in all forest types combined. "DE" and "MD" refer to densities stratified according to Dry Evergreen and Mixed Deciduous forest types, respectively.

Species	No. of Sightings	Density (groups/km^2)			Mean Sighting Distance
		Overall	DE	MD	
Barking Deer	16	1.0	–[1]	2.1	28.6m
Lar Gibbon	19	.72	1.4	–	43.2m
Phayre's Langur	47	1.8	3.1	.84	43.2m
Macaca spp.	13	.92	1.9	–	23.1m
Pheasant	31	2.7	2.6	3.0	19.7m

[1] No value (indicated by "–") indicates number of sightings in that forest type not sufficient to calculate density.

Table 3. Relative index of number of km walked along transects in Karen study areas and Song Tai study area before encountering one indirect sign. Total transect length is divided by total number of signs for each species to determine these figures.

Species	Karen Study Areas	Songtai
Sambar Deer	6.6	2.8
Gaur	6.6	3.1
Wild Pig	4.8	58.0
Porcupine	8.5	6.4
Bear spp.	7.6	58.0
Elephant	71.7	0

Table 4. Number of direct sightings and indirect observations from all transects in " Karen study areas", near and far from road. Road served as baseline from which transects started.

Species	Direct Sightings		Indirect Observations	
	Near	Far	Near	Far
Gibbon	9	10	26	23
Langur	23	23	3	5
Macaque	2	10	3	4
Barking Deer	9	7	122	47
Sambar Deer	0	0	33	15
Bear spp.	2	0	18	22
Gaur	0	0	26	21
Wild Pig	0	3	37	27

effort at Songtai was much less than in the Karen study areas, and time did not permit further surveys around Songtai.

Primates

Most of the data collected in this study concerned primates. Gibbons, langurs and macaques were all found to have the highest densities in dry evergreen forest, which can be expected from the known food and habitat preferences of these species. The "near/far" sub-set values are almost identical for gibbons and langurs, while macaques show a tendency to be seen more often farther from the baseline.

White-handed Gibbons

This study found a population density of 2.1/km^2 overall and 4.1/km^2 in DE forest, with a mean group size of 2.9 (N=21). These values are lower than than found in a line transect survey around Khao Nang Rum (KNR) Research Station in HKK, in a study area which also included deciduous dipterocarp forest (SRIKOSAMATARA, 1993). The calculated densities are not significantly different. SRIKOSAMATARA (1993) found a gibbon population density of 5.4/km^2, with a range of 0–11.2. The apparent disparity in density values could be the result of different statistical methods. The KNR values were determined by Fourier Series Analysis. Our study used the King's method, which tends to give lower density values compared to the Fourier method (MARSH & WILSON, 1981). Also significant is the fact that the KNR density was calculated using an average group density of 3.5, while our average was 2.9. The lower average group sizes in our study were probably due to more hurried and incomplete counts.

In two separate studies in lowland evergreen forest in Malaysia, gibbon group densities of between 1.0 and 1.6/km^2 (CHIVERS, 1977), and 1.9–3.7/km^2 (MARSH & WILSON, 1981), have been found. The Karen study areas showed a density in DE forest of 1.4 groups/km2. Although the survey methods used were similar to the Karen survey, comparisons must be made with the awareness that the Malaysian forest types differ from the Karen areas in terms of climate, rainfall, forest structure, and flora. However, the Malaysian sites were relatively pristine, therefore comparisons are still instructive.

Although vocalisations were commonly heard around Songtai, only one group was seen, and no density estimate was made.

Gibbons are regarded as animals with many similarities to humans, and tend to be awarded much respect by Karen people. This survey found no reason to contradict Karen claims about never harming gibbons.

Phayre's Langurs

Langurs were sighted almost three times as often (N=34) in DE forest as in MD (N=12), and one group was encountered in fallow fields. Overall density was 1.8 groups/km^2, with the highest density of 6.1 groups/km^2 found at the Tilaipa survey site in the rainy season.

There are very little data on densities of Phayre's Langur at other sites. A study in a wildlife sanctuary in India, in habitat classified as moist mixed deciduous forest, revealed

a density of 0.5 groups/km^2 (BHATTACHARYA & CHAKRABORTI, 1992). In this study, density of Phayre's Langurs in mixed deciduous forests in the Karen study area was 0.84 groups/km^2

No published estimate of langur density for HKK could be found. However in the line transect survey around KNR, one group of langurs was encountered for every 32 km of transect walked (SRIKOSAMATARA,1993). In our study, in Karen areas, one group was encountered for every 6.5 km walked.

At Songtai, only one group was seen in 56 km of transect through MD forest. Near the Karen villages, one group was seen for every 13 km of MD forest walked. One possible reason for the lower frequency of encounters at Songtai, is that the MD forest there is notably drier, as discussed above.

A study in the Khwae Yai River valley, approximately 25 km north of Songtai, encountered no langurs in two weeks of surveying in deciduous dipterocarp forest (Kanchanasaka, 1994). The study noted the presence of a nearby Karen village as a possible cause, but suboptimal habitat is the more likely explanation. If the Karen village was really the reason, then we would expect to see much greater langur densities at Songtai where there are no villages.

The same study had one encounter with langurs for every 3.5 days (total number of days = 15) of study in MD forest far from human habitation. In our study langurs were encountered once every 1.5 days (total number of days = 23) in MD forest in Karen study areas. Although this form of comparison is crude, there is no evidence to suggest that forests near Karen villages support lower densities of langurs than areas further from Karen villages.

The "near/far" data sub-sets both contain 23 direct sightings of langurs. No langur carcass or meat was ever observed in a village throughout a year of fieldwork. Lack of evidence of hunting, coupled with data from the line transects, implies a negligible impact on langurs from the activities of Karen villagers.

Macaques

Two species of macaques were observed. The pig-tailed *(Macaca nemestrina),* listed as vulnerable in Thailand, was seen most often, and the stump-tailed *(M. arctoides),* endangered in Thailand, was encountered less frequently. Sometimes observers did not distinguish between the two, so observations have been grouped for analysis.

Macaques were seen 11 times in DE forest and only twice in MD forest. There were five times as many observations in the "far" sub-set as in the "near" sub-set. Macaques were found to be unpredictable and difficult to locate. This is manifested in a small number of observations but a short sighting distance-observers had to get much closer to the macaques than to other primates before they were detected.

Overall density in Karen survey areas was found to be 0.92 groups/km^2, similar to densities of pig-tails found in Malaysia (MARSH & WILSON, 1981), while very little is known about stump-tail densities (TREESUCON, 1988).

Line transect walks in HKK (SRIKOSAMATARA, 1993) encountered macaques twice in 32 km, or once every 16 km. In Karen survey areas in this study, one group was encountered per 23 km walked. The Songtai survey area revealed no sightings or signs of macaques,

and the Khwae Yai study (KANCHANASAKA, 1994) also found an absence of macaques in deciduous forests.

Overall, the number of sightings of macaques is too small to draw any firm conclusions, and the impact of Karen villages on macaque populations remains unclear.

Ungulates

Barking Deer

Overall, barking deer density in Karen survey areas was one individual/km^2, lower than the density of 3.1/km^2 found in HKK (SRIKOSAMATARA, 1993), but not significantly so. Sightings in our study were three times higher in MD forest than in DE. Density in MD forest in both the Karen survey areas, and Songtai, were found to be identical, at 2.1 individuals/km^2. Besides the presence of Karen villages, possible explanations for a lower density in our study as compared with the HKK study are the lack of mineral licks, and the higher proportion of DE forest in our study. DE forest is not a preferred habitat of barking deer.

The Khwae Yai study found five times as many barking deer signs at a study site near to a Karen village, than at another site far from any village. In our study, indirect signs were three times higher in the "near" than in the "far" sub-set. Overall, there is no evidence to suggest that the Karen have a negative impact on barking deer populations.

Sambar Deer

Sambar were never seen directly either near the villages or at Songtai, and no density estimate could be calculated. Indirect signs were noted 48 times in the Karen areas, or once every 6 km walked, and the number of indirect signs in the "near" sub-set was twice as many as in the "far" sub-set. Tracks were commonly seen near the agricultural areas of Tilaipa village, even those fields within 100 m of Karen homes, and some villagers experienced Sambar feeding on ripening rice and vegetables. The Karen maintain that regenerating fallow forest provides both shelter from predators and food for Sambar, at different times of the year. This behaviour has also been recorded in India, where it has been noted that secondary forest and regenerating fallow benefit browsers like Sambar by providing favoured foods (KARANTH & SUNQUIST, 1992). These factors could influence distribution such that more signs were observed in the "near" subset. This tolerance for human activity could potentially result in situations were Sambar are killed as pests, although evidence of this has not been observed.

Indirect signs of Sambar were twice as common at Songtai where there are many more salt-licks, which have been documented as a requirement for Sambar (LEKAGUL & MCNEELY, 1977). In a mineral-lick survey in HKK, 90% of licks were found in MD forest (NAKSATIT, 1986) and the Khwae Yai study found Sambar signs three times more often in MD forest far from Karen villages than in DD forest close to a Karen village (KANCHANASAKA, 1994). Although fairly common both near and far from Karen vilages, Karen impact on this species remains unclear.

Gaur

Gaur were not seen during the surveys, although tracks and dung were common. Although indirect signs in Karen areas were evenly partitioned between the "near" and "far" sub-sets, indirect signs were twice as common around Songtai, where dung and tracks were concentrated around the three mineral licks found on the transects. SRIKOSAMATARA (1993) reports densities in HKK in areas with abundant salt-licks of 1.8 gaur/km^2, and SRIKOSAMATARA & SUTEETHORN (1994) report that density of gaur dung there increases with proximity to mineral licks.

Abundance of salt-licks is a major limiting factor for large herbivores like gaur because they require regular consumption of minerals not usually supplied in their food (LEKAGUL & MCNEELY, 1977; PAYNE, 1990). The scarcity of salt-licks in the western part of TYN near the Karen villages illustrated in the SRIKOSAMATARA & SUTEETHORN (1994) study is confirmed by our own findings, and would seem to be sufficient explanation for the low frequency of gaur sign in this area.

Indeed, Karen villagers assert that there have never been resident populations of gaur near the villages, but that transient groups pass through in the rainy season, feeding on seasonal foods such as bamboo shoots. The location and age of tracks and feeding signs in the Karen study areas seem to confirm this. One Karen participant asserted that gaur are not as dependent on salt-licks during the rainy season, which enables them to travel to seasonal feeding grounds near the Karen villages without being constrained by the lack of mineral licks there. Possible explanations could be that mineral requirements are lower in the rainy season (less loss from evaporative cooling from their bodies?) or are met in their rainy season foods.

Serow

Indirect signs of serow were encountered on five occasions during the surveys. One animal was seen outside of a survey period, a few km northeast of Jakae village (RS). Villagers maintain that they are fairly common.

Wild Pig

Due to low numbers of sightings (pigs tend to be nocturnal) densities could not be calculated at any of the sites. Indirect signs were, however, much more common in the Karen study areas than at Songtai or HKK. Both this study, and the Khwae Yai study (KANCHANASAKA, 1994) found relatively equal distribution of pig sign "near" and "far" from Karen habitations. The overall implication is that wild pigs are suffering no negative impact from the Karen presence and activities.

Elephants

In the Karen study areas, only four old dung piles and one old trail were seen, and there were no signs of elephant at Songtai. In contrast, at HKK an elephant density of 0.08/ km^2 was calculated from 29 dung piles (SRIKOSAMATARA, 1993). There is strong evidence that Asian Elephant distribution and abundance is limited by the availability of mineral

licks (PAYNE, 1990; SEIDENSTICKER & MCNEELY, 1975). In addition to the lack of salt-licks and grasslands, western Thung Yai may be unsuitable for elephants because of the extremely rugged terrain. It seems that western TYN has never been favoured by elephants.

From villager interviews in the Mae Jan valley, a picture of elephant decline there was gleaned. The general perception of villagers is that elephant populations have gradually been declining for about 30 years, or since the construction of the mining roads to the south, and the subsequent increase in organized poaching. Another cause identified is the long-standing ethnic conflict in Burma, which has severely limited the options for elephants in their movements across the border. The Mae Jan valley in central northern TYN should be surveyed to determine its importance to present day elephant populations.

Carnivores

Sightings of all carnivores were rare. In a line transect survey, however, this is not unusual, because most carnivores are secretive, solitary, and usually active at night. Studies of carnivores require the use of specialised methods of detection. However, our data provide some information about the prey base on which carnivores depend, which tells us something about the distribution and abundance of the predators themselves.

Felids

Research on carnivores in HKK has shown that the prey most frequently encountered in both tiger and leopard faeces is barking deer. Next most frequent are porcupines for tigers, and macaques for leopards, followed by sambar, wild pig, hog badger and langurs (RABINOWITZ, 1991).

Our survey indicates that the most favored prey of tigers and leopards are abundant in the forests surrounding the Karen villages. The leopard sighted in our study was hiding in ambush at the time, seemingly interested in a group of langurs overhead.

In July 1994, two cows were killed and eaten by a tiger within 3 km of Tilaipa village. At Songtai, fresh tiger tracks were commonly seen within 1 km of the RFD Headquarters. Apparently tigers will approach habitations readily. No evidence or news of large cats being hunted by Karens was encountered in a year of fieldwork. Karen disturbance appears to be minimal, both to cats and to their prey. In fact the forests near Karen villages may be important for the conservation of tigers and leopards.

Indirect signs of medium and small cats were also encountered, but it was often impossible to determine the species. A jungle cat *(Felis chaus)* was seen in the Karen survey area, but not during a transect walk. Medium and small cats should benefit from the range of habitats and abundance of prey species near the Karen villages. Rodents and birds are the most common prey found in dung of medium and small carnivores (RABINOWITZ, 1991) and this study found large ground birds like junglefowl and pheasant to be common, with 2.7 groups of pheasants/km^2 near to villages.

Canids

Evidence of dholes was seen once in the Karen study areas, and once at Songtai. They probably exist naturally at low densities, and should be able to maintain a stable population

given the diversity and health of the prey base.

Vivverids

Evidence of civets was common, but these nocturnal and solitary animals are difficult to assess without trapping.

Ursids

Bears were observed relatively often near Karen villages, and their indirect signs were common, being seen once every 7.6 km walked. Malayan Sun-Bears *(Helarctos malayanus)* were seen twice during the surveys, and an Asiatic Black Bear *(Selenarctos tibetanus)* mother and cub were seen once, outside the survey period. Evidence of bears was noted only once at Songtai. They were rare at HKK (RABINOWITZ, 1991; SRIKOSAMATARA, 1993). Given the scarcity of data regarding bear abundance in Thailand, it appears that the forests of western TYN, including areas near Karen settlements, may be important for the conservation of these endangered bears.

It has been speculated that seasonal burning of forests in HKK keeps bear densities low (RABINOWITZ, 1991) but forest areas near Karen villages are also subject to seasonal or irregular burning, and evidence of bears is high there. Karen villages in western Thung Yai do not appear to have an impact on bear populations.

Rodents

Porcupines

Direct and indirect signs were slightly more common in the Karen survey areas and Songtai than reported for HKK. Two species were found to be present, *Atherurus macrourus* and *Hystrix brachyura,* although only one individual was ever seen, at Songtai. The species were not always distinguishable from their indirect signs, and so were grouped together for analysis. It appears that viable porcupine populations exist both near and far from Karen villages.

CONCLUSIONS

1) Western TYN, including areas near Karen settlements and activities, supports viable populations of gibbons, langurs, and macaques.

2) The highest densities of these primates occur in dry evergreen forest. Mixed deciduous forest and other types support low densities.

3) Bears are relatively common, but more data are neccessary to determine their abundance.

4) Western TYN has not historically been an important area for gaur. Their numbers are low, mainly due to the scarcity of mineral licks and grasslands. However, some herds do take advantage of rainy season food sources in certain areas, including nearby Tilaiba and Jagae villages.

5) Scarcity of mineral and grass resources, plus the extremely rugged terrain, seem to seriously limit elephant populations in western TYN, but also, perhaps, because they are shy of human activities.

6) The data collected so far represent baseline information, and will become truly useful for assessing impacts if surveys are repeated. In this way trends in wildlife status can be tracked and timely responses implemented.

7) The project has initiated a very important process, strengthening the base of understanding and cooperation between TYN guards and Karen villagers. A powerful precedent now exists to seek the facts of a perceived problem, whether it be impact on wildlife or another issue, then work together to understand the implications. In such a climate, long-standing prejudices concerning the Karen may start to be dispelled.

8) It has been shown that local people and state forest protectors are capable of collecting meaningful research data for the benefits of conservation. However, they did not plan the research or analyze the data for publication. Further input from outside wildlife researchers would still be necessary for a few years to launch a monitoring program.

9) The potentially far-reaching applications of participatory wildlife research have been demonstrated. It can be the starting point for a process of community-based ecological monitoring. It is also a mindset and methodology for the objective analysis of other contentious or misunderstood issues.

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