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SMALL CARNIVORES AND OTHER MAMMALS IN A SMALL PROTECTED AREA OF 50 KM^2 IN THONG PHA PHUM FOREST, WESTERN THAILAND

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ABSTRACT

The status of small carnivores and other mammals in a small reserve (50 km^2) called "PTT Forest Reserves" in western Thailand was studied in parallel with human activities in the area. At least 17 wild mammal species were present in this protected area (PA) including 10 carnivore species. The carnivore community in this area is dominated by viverrid species. The Large Indian Civet (*Viverra zibetha*) was the most abundant, followed by Small Indian Civet (*Viverricula malaccensis*) and Common Palm Civet (*Paradoxurus hermaphroditus*). Along forest edges, percent visitations of the Large Indian Civet indicate that it is the dominant species. Abundance of Large Indian Civets was negatively and significantly correlated with distance to the forest edge ($r = -0.682$, $p = 0.043$).

There is a variety of human activity in this small PA. Frequencies of signs of Non-Timber Forest Products (NTFPs) collecting and of domestic animals were significantly negatively correlated with distance from villages ($r = -0.831$, $p = 0.006$ and $r = -0.685$, $p = 0.042$, respectively). In contrast, the relation of distance from villages and hunting was not significant. Domestic dogs (*Canis familiaris*) were found in this forest, especially in areas less than 1 km from the forest edge.

The results of this study will be useful in motivating local participation in conservation. Cooperation among local agencies and local people for conservation is now needed to start co-conservation management in this small protected area. The experience will be useful for improving wildlife conservation of the Western Thong Pha Phum Ecosystem on the larger scale.

Key words: Small protected area, small carnivores, human activities, wildlife conservation, Thailand.

INTRODUCTION

Most studies about carnivores are aimed at increasing knowledge about the ecology of the carnivore communities in tropical forests (EMMONS, 1987; RAY & SUNQUIST, 2001; MUKHERJEE *ET AL.*, 2004). Some studies show important roles of carnivores in controlling prey populations, decreasing competition within the prey community, and reducing seed predation (GUTIÉRREZ, *ET AL*, 1997, TERBORGH *ET AL.*, 2001). However, there is little information about carnivore communities in disturbed forests and most studies come from temperate ecosystems (CROOKS, 2002; GEHRING & SWIHART, 2003).

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In Thailand, there are many factors threatening wildlife, especially carnivores. There is almost no knowledge about carnivores in relation with human activities in the forest. Most studies on carnivores have been conducted in undisturbed forest within national parks and wildlife sanctuaries (RABINOWITZ & WALKER, 1991; CONFORTI, 1996; GRASSMAN, 1999; GRASSMAN *ET AL.*, 2005). Small protected areas such as national forest reserves and other disturbed forests near human communities have been undervalued, although small carnivores can be found in such places. Information about such areas will increase our knowledge about wildlife and may also be useful as a pilot study for local participation in conservation, especially in situations outside parks and wildlife sanctuaries where conservation must depend more on community action than on inflexible laws (SRIKOSAMATARA & BROCKELMAN, 2002).

In this study, the status of small carnivores and other mammals was studied in the PTT Forest Reserves of Western Thailand for better understanding of the characteristics of the carnivore community in disturbed forest. At the same time, signs of human activities were also analyzed for assessing human disturbance and its effect on the wildlife community.

STUDY AREA

A forest reserve for conservation was proposed by the Petroleum Authority of Thailand (PTT) in 1999, in collaboration with the Royal Forest Department (at that time), through

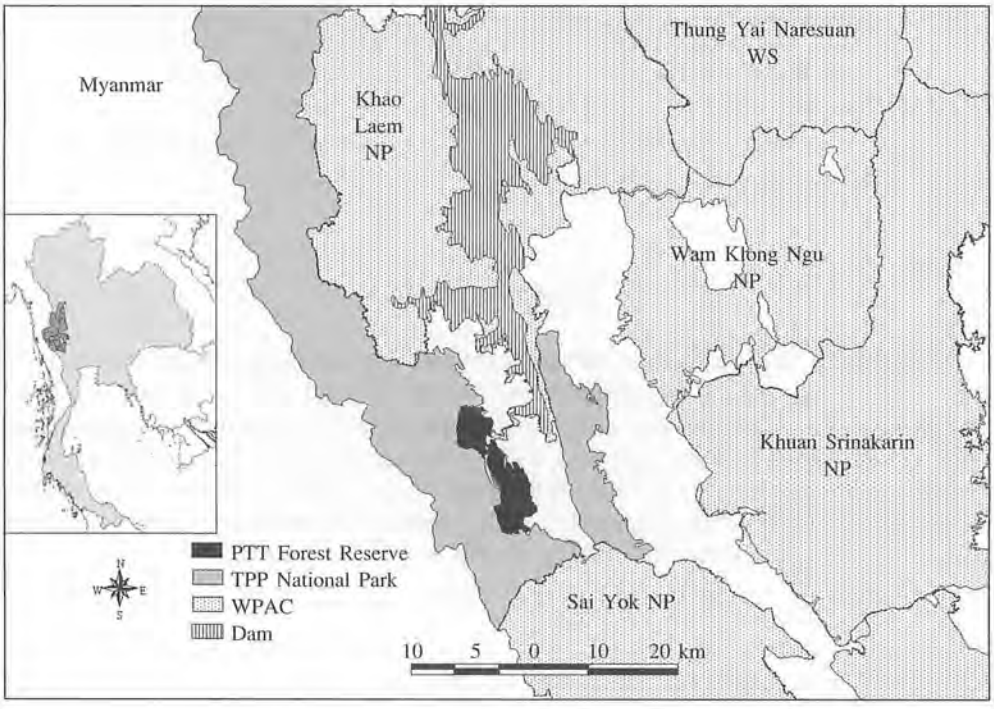

Figure 1. Location of PTT Forest Reserves (PTTF) in the Western Protected Area Complex.

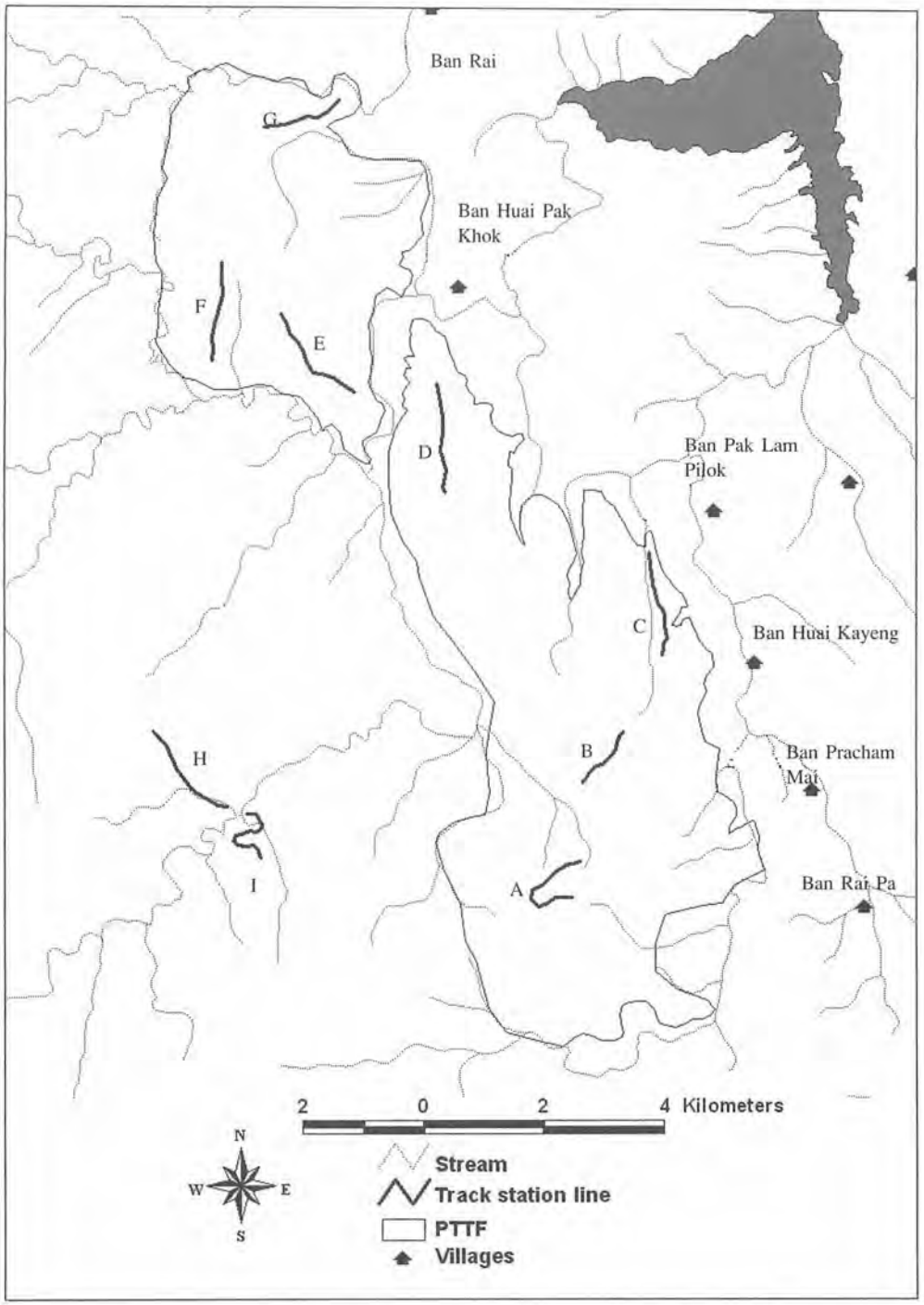

Figure 2. PTTF and Villages around the forest. There are 9 line surveys in the study (A–I), 7 in PTTF and 2 in TPPNP

the Regional Forest Authority. This was a part of the post- environmental impact assessment (EIA) responsibility of PTT after construction of the Yadana natural gas pipeline from Myanmar. Officially, it is now a forest reserve under the National Forest Reserve Act of 1964. It is a small protected area about 50 km^2 located inside the boundary of Western Thong Pha Phum Forest (WTPP), which is a part of the Western Forest Complex (Fig. 1). A temporary boundary has been demarcated by PTT to designate it as a protected area. PTT has an interest in conserving the forest and wildlife, and in developing the well-being of local villagers around the forest (Petroleum Authority of Thailand, 2002).

PTT Forest Reserves (PTTF) are located at the boundary of WTPP Forest. This PA is separated by a dirt road and some crop fields into two parts: about 30 km^2 of lower PTTF and 20 km^2 of upper PTTF (Fig. 2). The elevation range in this protected area is 160–945 m asl, the upper part being the steepest. About 50% of the upper part has a slope more than 30 degrees. The PTTF covers three watersheds: Huai Khayeng, Huai Pracham Mai, and Huai Ban Rai. The forest is mainly Mixed Deciduous Forest with some areas of Dry Dipterocarp and Tropical Dry Forest, most rather disturbed. The PTTF is close to six villages in Tambon Huai Kayeng (Fig. 2).

MATERIALS AND METHODS

Observation of Small Carnivores and Other Mammals

During March 2004–January 2005, wildlife surveys were conducted in 9 study sites, 7 sites in PTTF and 2 sites in TPPNP (A–I, Fig. 2). The study focused on small carnivores, but other mammals were also observed and noted. The methods used were relatively simple, and potentially useful by local agencies participating with local people in wildlife conservation management.

Track stations were the main method for assessing abundance and diversity of small carnivores. In this study, one 2-km line transect was set up in each of 9 study sites distributed in PTTF and some areas of TPPNP (Fig. 2). Track stations 1 m^2 in area and 100 m apart were made along the transects. The surface of each station was made smooth and soft by sieving the soil. Banana and freshly caught fish available in the area were baited on the stations. The stations were checked the following 2 mornings and then tracks in the soil surface were fixed. Species were identified from tracks using *The Mammal Tracks of Thailand* (GREEN WORLD FOUNDATION, 1997), and *Carnivores of Mainland South East Asia* (KANCHANASAKHA, *ET AL.*, 1998). Camera traps (Passive CamTrakker, CamTrack South, Inc., U.S.A.) were also set up at various stations to determine species that visited, using 360 station-nights (40 station-nights/site), 280 in PTTF and 80 in TPPNP. Relative abundance was calculated from trap success/ trap-night x 100. Trap success was derived from the number of track stations that animals visited.

Intensive surveys of wildlife were also carried out within PTT Forest Reserves. Signs of wildlife on human trails and wildlife trails within study areas were observed. The presence of carnivore and other mammal signs such as scats, scrapes and tracks etc. was recorded. Although this method is rough, the results can provide a general picture of the diversity and status of mammals in this PA. Six camera traps were also set up within PTTF. However, this method was not suitable in this study due to high human

disturbance. Camera traps could not be set up for long enough time. Moreover, some people tried to destroy cameras on two occasions. Camera traps were set for the total of 95 trap-nights.

Human Disturbance Survey

During the track station survey, signs of human disturbance were observed on 2-km line transects in each study site. Human signs in each site were classified into three main activities: hunting signs, domestic animals, and non-timber forest product (NTFP) collecting. Such signs were counted, and the frequencies of such activities among study sites were compared. Old signs of fire, camping sites, hunting points and gun sounds were classified as hunting signs. This study classified old signs of fire as hunting signs because most occurred in the dry season when there were few other resources available in the forest. For gun sounds, we counted the number of shots per day along each line transect. NTFP collecting was one of major activities occurring in this forest reserve (NARUCHAIKUSOL, unpublished). Most signs found in the survey were bamboo collecting, *Curcuma parviflora* collecting, and dipterocarp oils. We counted the number of signs every 100-m distance. There were two groups of domestic animals found in study area, domestic cattle and domestic dogs. For cattle, the presence of tracks was noted every 100 m distance. The number of dogs was counted in the line transects by camera traps, as individuals could be recognized.

Data on all species were analyzed using Microsoft Excel for presence of track station signs, species composition, and relative abundance of small carnivores. Habitat characteristics such as size of area, percent area in each slope category, elevation, and distance of study sites from villages and forest edges were analyzed using ArcView GIS 3.2a. SPSS version 7.5 was used for statistical analysis.

RESULTS

Status of Small Carnivores and Other Mammals in PTT Forest Reserves (PTTF)

Eighteen mammal species were observed in this study, including 10 carnivore species (Table 1). Ten mammal species were observed by walking on trails, 9 species from the track station survey and 2 from camera traps. However, other species were confirmed to be present by local people, such as Fea's Muntjac, Golden Cat, Banded Palm Civet, Banded Linsang, Ferret Badger and Yellow-Throated Marten.

Species Presence, Composition and Relative Abundance

Of 360 station-nights of track station survey, 85 track stations were visited by small carnivores and some mammals, indicating 23.6% trap success. Study sites D, G and C showed high trapping success as 42.5%, 35% and 32.5%, respectively. The 9 wild mammal species included 7 carnivores and 2 other mammals observed in 7 sites of PTTF and 2 sites of TPPNP (Table 2). From 9 study sites, 3 civet species including Small Indian Civet, Common Palm Civet, and Large Indian Civet were present at 8, 7 and 7 study sites,

Table 1. Species of Mammals were observed by 3 methods in study area

Species	Method*	Study Area**
Sun Bear, *Ursus malayanus*	1	A
Elephant, *Elephas maximus*	1	A,B,C
Sambar Deer, *Cervus unicolor*	1	A,C
Red Muntjac, *Muntiacus muntjak*	1	A
Wild pig, *Sus scrofa*	1	A,B,C
Serow, *Naemorhedus sumatraensis*	1,2	B
Asiatic Jackal, *Canis aureus*	2	B
Binturong, *Arctictis binturong*	1,2	B,C
Large Indian Civet, *Viverra zibetha*	2	A,B,C
Small Indian Civet, *Viverricula indica*	1,2	A,B,C
Common Palm Civet, *Paradoxurus hermaphroditus*	2	A,B,C
Masked Palm Civet, *Paguma larvata*	2	A
Leopard Cat, *Prionailurus bengalensis*	2	A,B,C
Small-Clawed Otter, *Aonyx cinerea*	1	C
Hog Badger, *Arctonyx collaris*	3	A
Lesser Mouse Deer, *Tragulus javanicus*	1	B
Porcupine, *Hystrix brachyura*	2,3	A,C
Domestic Dog, *Canis familiaris*	1,2,3	A,B

*1 = Walking Survey, 2 = Track Station, 3 = Camera traps
**A = Upper PTTF, B = Lower PTTF, C = Thong Pha Phum NP

respectively. Masked Palm Civet, Binturong and Asiatic Jackal were rare species that only visited only one site each.

The small carnivore community in this area consisted mainly of civet species, including 5 species out of 9 wild mammals. Overall, percent visitation of Large Indian Civet were highest (27%) followed by Small Indian Civet, Common Palm Civet and Leopard Cat (19%, 14% and 8%, respectively) (Fig. 3). In this study, percent visitation of domestic dogs was very high, about 24% of station visits. The table also indicates that Common Palm Civet visited 7 of 9 study sites, but had a low percent visitation overall. In contrast, percent visitation of Large Indian civet and Small Indian Civet was high in some study sites. Large Indian Civet visitation in site C was 46% and in site G, 43%. Small Indian Civet visitation in site E was 50% and site I, 50%.

Comparison of relative abundance of small carnivores shows that the Large Indian Civet is the most abundant small carnivore, with relative abundance of 6.39, followed by Small Indian Civet (4.44) and Common Palm Civet (3.33). Other species with lower abundance were Masked Palm Civet, Binturong and Asiatic Jackal, with relative abundances of 0.28. Domestic dogs had relative abundance of 5.56.

Table 2. Species composition, percent trap success and percent visitation of small carnivores and other mammals in 9 track station line surveys.

Line name	Distance from forest edge	% Trap success	Percent Visitation of small carnivores and other mammals in 9 sites (N = 85)									
			Common Palm Civet	Small Indian Civet	Masked Palm Civet	Large Indian Civet	Binturong	Leopard Cat	Asiantic Jackal	Serow	Porcupine	Domestic Dog
A*	1.92	10 (n = 4)	25	0	0	0	0	50	0	0	0	25
B*	1.13	25 (n = 10)	30	30	0	30	0	10	0	0	0	0
C*	0.27	32.5 (n = 13)	15	8	0	46	0	0	0	0	0	31
D*	0.87	42.5 (n = 17)	12	12	0	12	0	0	6	6	0	52
E**	0.48	15 (n = 6)	0	50	0	33	0	0	0	0	0	17
F**	2.23	17.5 (n = 7)	30	14	14	14	0	14	0	0	14	0
G**	0.57	35 (n = 14)	0	14	0	43	0	0	0	0	7	36
H***	2.49	25 (n = 10)	10	20	0	30	0	30	0	0	10	0
I***	3.85	10 (n = 4)	25	50	0	0	25	0	0	0	0	0
Average		**23.61**	**14**	**19**	**1**	**27**	**1**	**8**	**1**	**1**	**4**	**24**

* line surveys in Lower PTT Forest Reserve
* line surveys in Upper PTT Forest Reserve
*** line surveys in Thong Pha Phum National Park

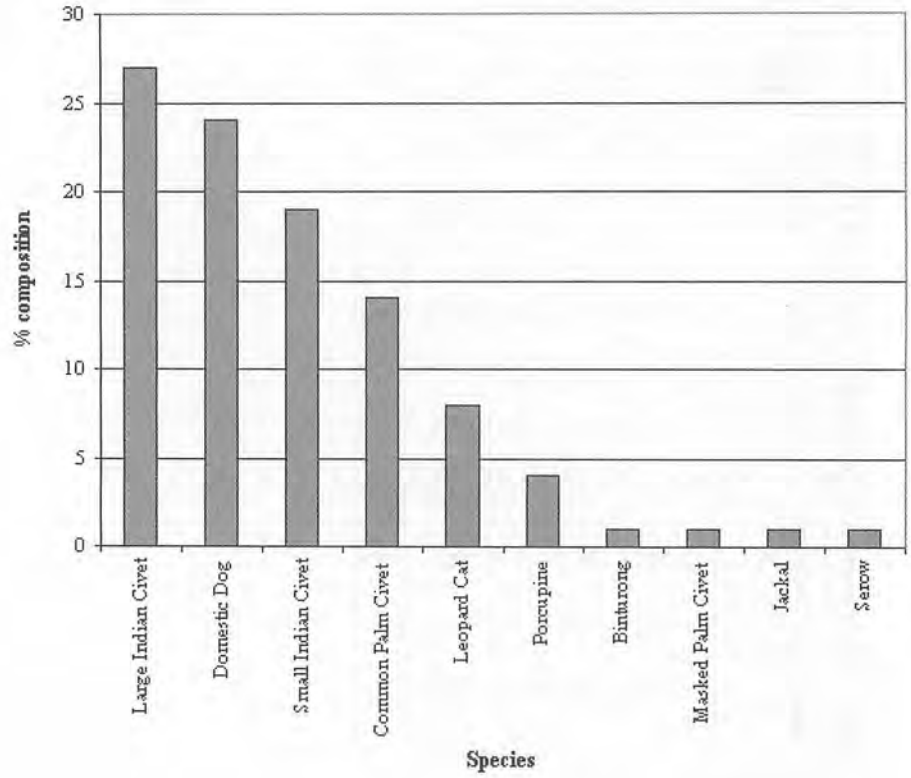

Figure 3. Species composition of small carnivores and some mammals in PTTF and some area of TPPNP based on track station visits (N = 85).

Pattern of Human Activities and Some Disturbance Factors in PTTF

Overall, the frequency of disturbance signs was not significantly correlated with distance from villages ($R = -0.295$, $P = 0.441$). However, different types of human activity showed different correlations with distance from villages. The results indicate that the dominant activities in each site were different. The negative correlation of NTFP collecting and domestic animals with distance indicated that they tended to be highest in forest close to villages ($R = -0.831$, $P = 0.006$, and $R = -0.685$, $P = 0.042$, respectively) (Figs. 4, 5). In contrast, hunting activities tended to be highest in areas far from villages ($R = 0.552$, $P = 0.124$), but this correlation was nonsignificant.

Domestic Dogs

Domestic dogs were found in 5 of 9 track station line surveys. Most sites were located in PTT forest reserves. Camera traps set in track station lines identified 9 individual dogs. Moreover, other camera traps set in Upper PTTF also detected dogs, and identified 3

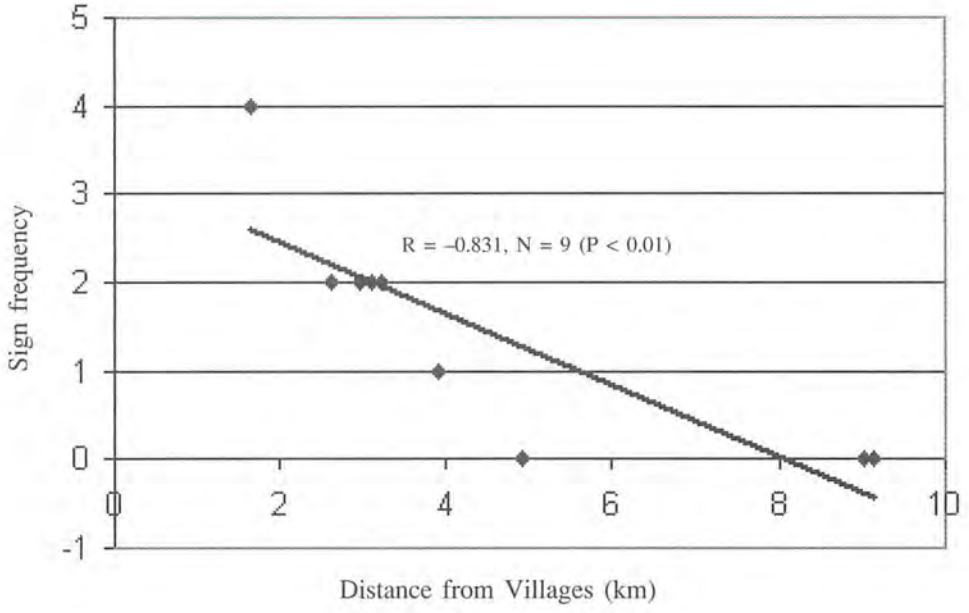

Figure 4. Relation between NTFP collecting signs and distance from villages.

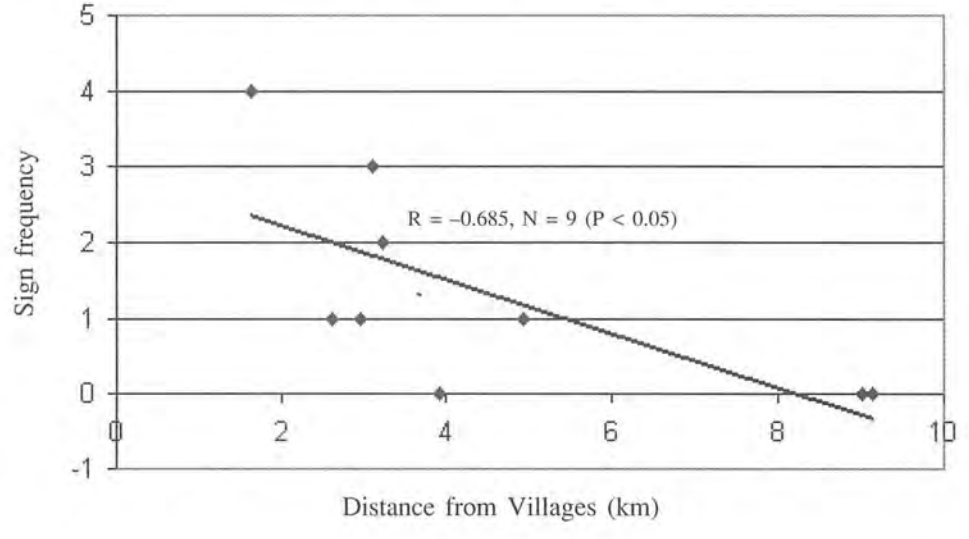

Figure 5. Relationship between signs of domestic animals (dogs and cattle) and distance from village.

individuals. In site A only one dog was detected, while in other sites at least 2 dogs traveled together. Most domestic dogs were detected in study sites less than 1 km from the forest edge. Domestic dogs tended to be less abundant in areas far from the forest edge. Relative abundance was 11.9 in areas less than 1 km from forest edge, but 1.25 in areas 1–2 km from the edge. They were not detected in areas more than 2 km from the edge.

Relationships between Human Activities and Abundance of Small Carnivores

Overall, the study indicated that human activities as a whole in the forest and carnivore abundance were not significantly correlated due to the similarly of disturbance levels among study sites ($R = -0.128$, $P = 0.743$). However, some factors and human activities showed significant relations with specific small carnivores. For example, forest edge was a preferred habitat of Large Indian Civet; the abundance of this species increased closer to the forest edge ($R = -0.682$, $P < 0.05$) (Fig. 6). Hunting is an activity that affected the presence of some small carnivores. This activity was negatively but insignificantly related to overall mammal abundance in this study ($R = -0.511$, $P = 0.160$). However, hunting level significantly affected abundance of Small Indian Civet, which tended to be lower in areas with more numerous hunting signs ($R = -0.726$, $P < 0.05$). Small Indian Civet was also negatively related to disturbance level, and tended to be less abundant in study sites with high levels of human disturbance ($R = -0.852$, $P < 0.01$) (Fig. 7). There was no significant correlation between disturbance level and other small carnivores.

DISCUSSION

Characteristics of the Small Carnivore Community

The 10 carnivores found in this small PA are half of the carnivores documented for the larger forest area in nearby Huai Kha Khaeng (HKK) and Thung Yai (TY) (CONFORTI, 1996). Our list may underestimate the true species diversity because other species stated to be present by hunters were not included. However, the low diversity in this area reflects mostly the influence of human disturbances. Most large carnivores were absent in this small forest reserve. The Malayan Sun Bear was the only large carnivore present in this area. Large cats such as Tiger (*Panthera tigris*) and Leopard (*Panthera pardus*) were absent, although these carnivores were confirmed present inside Thong Pha Phum National Park by hunters. Although PTTF is connected to the national park, it had few prey of large carnivores such as sambar deer, primates and muntjac (RABINOWITZ, 1989, GRASSMAN, 1997). The low density of such prey is a result of past hunting, which continues within TPPNP to the present day.

Overall, the small carnivore community in this PA consists mainly of generalized carnivores, primarily viverrid species. This result confirms the adaptability of these species in disturbed forest (LEKAGUL & MCNEELY, 1977, HEYDON & BULLOH, 1996). The very high abundance of Large Indian Civet in this forest indicates the adaptability of this species, while, other more specialized predators such as some felids were less abundant.

Microhabitat may also influence the small carnivore community in this area. In edge areas where the habitat is dominated by bamboos with fewer trees, the dominant carnivores

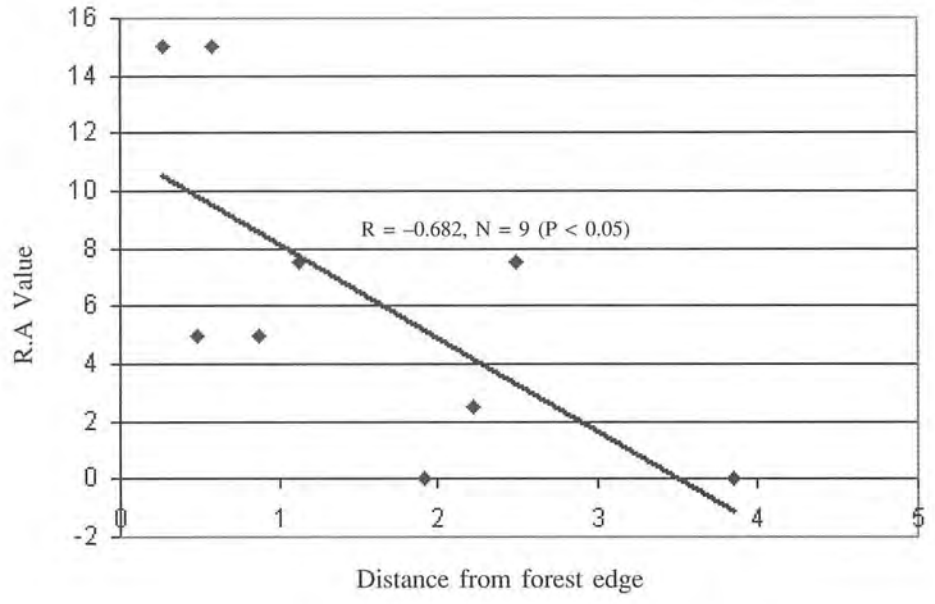

Figure 6. Relation between relative abundance of Lange Indian Civet and distance from forest edge.

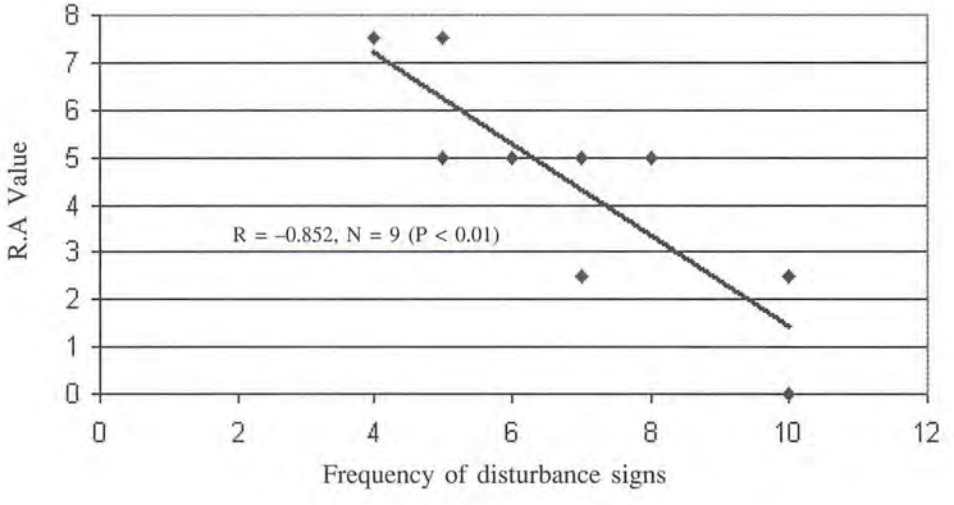

Figure 7. Relationship between relative abundance of Small Indian Civet and frequency of disturbance signs.

are Large Indian Civets, whereas Common Palm Civets and Masked Palm Civet show low abundance due to the lower availability of fruits, the main food of palm civets (GRASSMAN, 1997). Palm civets are very common species in some areas (RABINNOWITZ & WALKER, 1991, CONFORTI, 1996, HEYDON & BULLOH, 1996, GRASSMAN, 1997). In more mature and complex forest, these species is likely to be nearly equal in abundance. In two study sites, A and E, where deciduous dipterocarp forest grow on narrow ridges, only two species of carnivores were found. The result indicates lower preference of small carnivores for this habitat type, consistent with previous studies in HKK (RABINNOWITZ, 1990) and HKK/TY (CONFORTI, 1996). The lower usage of small carnivores of this area may due to fewer prey. In HKK, deciduous dipterocarp forest has low abundance and biomass of small mammals, the main prey of small carnivores, as compared with other habitat types (WALKER & RABINOWITZ, 1992). In addition, the steepness of the terrain in both dipterocarp habitats in this study may also be a factor in the very low diversity of small carnivores.

Pattern of Human Activities

Rather diverse human activities occur in PTTF. This was not surprising when considering the number and characteristic of local communities around the forest. There are six villages around this forest reserve, three villages located within 1 km from forest edges and six villages located within 1–2 km from forest edges. Local people within these villages used forest resources both directly and indirectly. A previous study of non-timber forest product use in this area listed more than 40 bird species, about 30 mammal species and 10 amphibian or reptile species used by villagers as food (NARUCHAIKUSOL, unpublished).

We found no significant relation between distance of forest from villages and hunting frequency. The level of hunting was high in areas far from villages. Other studies in tropical forest, for example, in an Amazonian community, have found that hunting is most intense near human settlements (SIRÉN, *ET AL.*, 2004), and snare density decreased with distance from the village (MUCHAAL, 1999). The difference in the hunting patterns may be due differences in the density of wildlife in the protected area system.

It is more difficult for us to determine the effects of NTFP collecting on the small carnivore community. Most signs of NTFP collection were of bamboo product collecting. The collection of other resources left fewer signs in the field. However, the strong relation between distance from villages and frequency of signs indicates that such activities occur mostly near villages. These activities may indirectly affect small carnivores in this forest, especially when local people travel to collect NTFP farther from villages and need to camp in the forest. Most collectors have guns and hunt wildlife at night, especially civet species.

The Problem of Domestic Dogs

The high relative abundance of domestic dogs (*Canis familiaris*) in the forest indicates that this animal is a threat to wildlife in small forest reserves. Although most dogs were recorded within 1 km from the forest edge, they were capable of traveling farther. In Africa, domestic dogs have been found up to 6 km from edges of forest reserves (BUTLER, *ET AL.*, 2004). In our study, there were no signs of owners in the line survey and they were not detected by camera traps. It is possible that they were feral. In any event, they could still endanger wildlife. If they traveled with owners, they could increase their owners'

ability to hunt wildlife. If they traveled as free-ranging or feral dogs, they could become predators or competitors of wildlife, especially with carnivores. Recent research confirmed these threats posed by domestic dogs in Africa (BUTLER & DU TOIT, 2002; BUTLER *ET AL.*, 2004) and Asia (DAHMER, 2002). From camera traps it was shown that dogs often traveled in packs of 2 or 3. Dog packs are a greater threat to wildlife than are individual dogs. The effect of domestic dogs on wildlife should be studied more in Thai forest. In some places, domestic dogs could compete with wild dogs, or dholes (Cuon alpinus).

Wildlife Conservation in Local Context: Beginning in a Small-Scale Protected Area

The results show that there is a low density and low diversity of carnivores in the forest. However, there is still some hope for restoration of wildlife in this forest, since the forest is still connected to the larger forest of TPP National Park which is a good source area. Wildlife in the forest may increase if local people can be encouraged to conserve wildlife and its habitat, even is some degree of forest use occurs.

Six villages were involved in this small protected area (see Study Area). To implement conservation planning, all person involved in wildlife use or collection and other persons who have some capacity to help in wildlife conservation must be identified. Information from local people and local agencies revealed that most people that travel in or use the forest belong to ethnic groups such as Karen, Mon and Burmese. Most earn income as laborers or temporary workers, and such insecure livelihoods result in having more free time. Some are hired only during holidays, with 5 days a week free. They usually use their free time to travel in the forest for hunting and NFTP collecting both for sale and for consumption. These people should be focused on because they comprise a high proportion of the community. For example half of the households in Ban Huai Kayeng are of minority groups such as Mon, Karen and Burmese.

However, "co-conservation management" with local people should consider local benefits because this will increase their willingness to cooperate in conservation. Communication activities about benefits of biodiversity conservation should be designed and local accumulated knowledge should be used in this area, for example, the value of NTFP and the potential or actual effects of overharvest on them, the importance of wildlife to forest resources and the effects on their livelihood if wildlife is absent, etc. Although this practice is accepted worldwide (LEISHER & PETERS, 2004), co-conservation may be difficult in practice on the ground because each area has different characteristics, according to the local people and local problems. However, gaining experience and understanding of people is important in designing adaptive conservation practices. This is the major challenge for agencies and conservationists in overcoming the problems and burdens, and succeeding in wildlife conservation.

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