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FINAL REPORT

RAPID ASSESSMENT OF MAMMALS IN THE TAM DAO NATIONAL PARK

for
GTZ OFFICE VIETNAM
Hanoi, Vietnam

and

FOREST PROTECTION DEPARTMENT (FPD)
MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT (MARD)
Hanoi, Vietnam

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LIST OF ABBREVIATIONS:

FIPI - Forest Investigation and Planning Institute
IEBR – Institute of Ecology and Biological Resources
NTFPs – Non-timber forest products
NP – National park
NR – Nature reserve
TDNP – Tam Dao National Park, Vinh Phu Province

IUCN Red List categories:

VU- Vulnerable,
LRnt- Low risk/near threatened,
DD- Data deficient for evaluation.

Red data book of Vietnam (2000) categories:

E- Endangered,
V- Vulnerable,
R- Rare.

Decree 48/2002/NDCP:

Group IB- strict ban of hunting and use,
Group IIB- limited and controlled hunting and use.

EXECUTIVE SUMMARY

This rapid assessment of mammals in TDNP consists of 3 phases: Village interview to determine target area and focus of the assessment conducted in December 2004; Dry season extensive field survey in 4 target areas conducted in December 2004-January 2005; and Wet season extensive field survey in 4 target areas conducted in May 2005. Totally, about 250 local people from 11 communes and 5 forest guard stations were interviewed; survey effort of large mammal survey is 290 hours daytime survey, 72 hour night spotlighting survey and about 417 km of survey transect distance covered. Survey effort of small mammals survey is 2,826 night.trap and survey effort of bat survey is 2,159 hour.metre.net and 300 hour.harptrap.

Eight (8) large mammal species which were included in mammal checklists of previous studies (FIPI, 1993; Cao Van Sung et al., 1998) are reported to be extirpated from TDNP. They are Black crested gibbon *Nomascus concolor*, Tonkin snub-nosed monkey *Rhinopithecus avunculus*, Indochinese tiger *Panthera tigris*, Spotted leopard *Panthera pardus*, Clouded leopard *Pardofelis nebulosa*, Red dog *Cuon alpinus*, Binturong *Artictis binturong*, and Common otter *Lutra lutra*.

Thirty one (31) species of large mammals are reported to be existing in TDNP, of which 19 species were recorded during extensive field survey and other 12 species could not recorded, possibly because of very low density. Through 173 specimens collected and direct field observation, 21 species of small mammals were identified including 1 species of Insectivore (*Insectivora*), 2 species of Tree-shrews (*Scandentia*) and 18 species of Rodents (*Rodentia*). With 73 specimens collected, 22 bat species, belonging to 5 families and 2 sub-orders were identified. Totally, a checklist of 77 mammal species belonging to 24 families and 8 orders was complied for TDNP, including 3 bat species recently recorded by other authors but not recorded by this survey. Order Bats *Chiroptera* has highest species diversity (25 species), then follow Rodents *Rodentia* (18 species), Primates *Primates* (5 species), Even-toed ungulates *Artiodactyla* (5 species), Insectivore *Insectivora* (2 species), Tree-shrews *Scandentia* and Pangolin *Pholidota* (1 species each).

Though being degraded, mammal fauna in TDNP still has high conservation value. Out of 77 species recorded to be existing in TDNP, 21 species are of high conservation concern, including 17 species of large mammals, 2 species of rodents and 2 species of bats. Out of them, 16 species are nationally threatened, 17 species are globally threatened species and 16 species enlisted in Governmental Decree 48/2002/NDCP..

Within 21 high conservation concern, 7 species (Stump-tailed macaques, Rhesus macaque, Assamese macaque, francois's langur, Asiatic black bear, Malaysian sun bear, Small-clawed otter, Chinese pangolin, Lesser mouse deer) have extremely low number, while existing in much better status in other protected areas of Vietnam, therefore, TDNP should not pay important role in their conservation. Other species may remain in more or less viable population, however, their population size should be further estimated, hunting and habitat disturbance should be mitigated as soon as possible. Back-striped weasel have been found in few areas in Vietnam (Yen Bai, Bac Kan, Vinh Phuc), its occurrence in TDNP give more hope to its conservation, further study needs to determine population size of this species in TDNP.

No direct sighting or confirmable activity signs of Primates can be found during this field survey, but 5 species mentioned above are reported to be existing in TDNP, they are still observed and killed by local hunters in 2004-2005. No fresh signs of Asiatic black bear, Malayan sun bear and Lesser mouse deer could be found during this survey. Existence of Southern serow, Chines pangolin and Sambar is confirmed by observation of their fresh signs (droppings and tracks).

The importance of TDNP in conservation of the country's bat fauna is reduced due to their low abundance and severe habitat disturbance remained. However, species number is relatively high and comparable with other protected areas in Vietnam, and 2 threatened species are recorded (Harlequin bat – a globally threatened and Himalayan wiskered bat – a nationally threatened). This gives opportunity for recovery of the fauna when habitat disturbance will be mitigated. TDNP may have few large caves for roosting of large bat populations, however, the forests can support good refuge and food sources for other species, especially, fruit-eating bats. Rodents shown high abundance in TDNP indicating high habitat disturbance and possibly, low abundance of rodent-prey small carnivores. Within rodents, only one globally threatened species is recorded – Malayan porcupine (Vu). This species has been seriously reduced in number, but can recover if illegal hunting mitigated.

At present, though having been over-exploited for many years, TDNP still support one of the most extensive, contigurous tracts of lowland, lower montane and bamboo forests in Northern Vietnam. This makes the TDNP as an important place for maintaining a diverse mammal fauna in Northern Vietnam. Five (5) areas should be taken for conservation priority, including Suoi Tram- Suoi Tien up-stream, Tay Thien- Thach Ban-Ao Dua, Ngoi Lanh up-stream- peak 1590m, Xa Huong up-stream and Tam Dao Town surrounding (for bat conservation). These areas contains the best forest cover of TDNP and habour most of its key mammal species.

With about 150,000 people living in buffer zone, TDNP has to face with great pressure on its natural resources. Current threats to mammal fauna in TDNP are illegal hunting, illegal wildlife trade, illegal extraction of forest products, forest fire and domestic cattle raising.

One day workshop for introduction of village interview results, designing of follow-up extensive field investigation and introduction survey techniques was held at Headquarter of Tam Dao NP on 6 December 2004. About 15 staff members attended this workshop. Two staff members of TDNP Forest Protection Department, joined survey team for on-job training.

Following actions are recommended for enhancement of biodiversity conservation in TDNP:

- Strengthening law enforcement and increase public awareness.
- Initiating biodiversity monitoring programme (establishment of faunal database, development of forest rangers mammal field records gathering system, initiating operation of Animal Monitoring Units (AMU), using camera-trapping technique for further inventory and monitoring status of small carnivores and further study of bats and small mammals, etc.)
- Capacity building training for park staff members on wildlife survey and monitoring techniques (technique of field identification of key species of TDNP; use of field equipment; techniques of mammal surveys; techniques camera trapping; technique of data analysis,

management activities development and report writing; and identification of problems and designing mammal survey/monitoring project)

- Producing and distribution of awareness education material: posters, fact sheets with conseration messages and book on mammals of TDNP.

I. INTRODUCTION

Tam Dao Nature Reserve was gazetted in 1977 by Decision No. 41/TTg, dated 24 January 1977 of Prime-Minister and up-graded into Tam Dao National Park (TDNP) in March 1996, by Decision No. 136/TTg, dated 6 March 1996 of Prime-Minister. Total area of TDNP is 36,883 ha. Management board of Tam Dao NP was established in May 1996 (Tordoff et al. 2004).

Richness of mammal fauna in Tam Dao area has early attracted attention of foreign scientists with first mammal study carried by R. Bourret in 1942. However, severe warfare did not allow foreign scientists to continue their studies and only after the war stopped, the studies of mammals in Tam Dao area could be continued by Vietnamese scientists. Mammal surveys in this area were initiated by National Committee for Science and Technics in April 1962; then, followed by Hanoi University during 1966-1969 and Institute of Biology in 1974. In 1992, Forest Investigation and Planning Institute (FIPI) in development of Management plan for TDNP has complied a list of 58 mammal species (FIPI, 1993). During 1997 –1998, Forestry University and Institute of Ecology and Biological Resources (IEBR) carried out faunal inventory in TDNP and a list of 69 mammal species was compiled for TDNP (Cao Van Sung et al., 1998). In 2000, Nguyen Quang Truong, in framework of GTZ Project has made a literature overview of faunal studies of TDNP and compiled a checklist of 643 animal species, including 64 species of mammals (Nguyen Quang Truong, 2004). After 2000, there are several short surveys, such as for bats (Borissenko, 2003), for rodents (Joint IEBR- Japan team 2003, 2004), etc. Results of these studies are only partly published.

The checklist of 69 species by Cao Van Sung et al., (1998) is the latest full checklist of mammal fauna in TDNP. The checklist consists of 36 species of large mammals, 21 species of rodents, 8 species of bats, 1 species of Insectivore and 1 species on Tree-shrews. Out of 21 species of Rodents, 14 species were based on un-confirmable dada sources, i.e. recorded through village interview, un-verified student report or by field observation without specimens, only 7 species were based on specimen analysis. This checklist is, obviously, un-completed because some mammal groups with species diversity such as rodents, bats and small carnivores were still poorly studied. The checklist also contains large mammal species which possibly no longer occur in the TDNP (GTZ Office Vietnam - Wildlife trade report, 2004).

A lack of comprehensive and up-to-date information about the status of important species does not allow TDNP to develop appropriate strategies and measures for effective conservation of its remaining mammal fauna. The aim of this study is to assess the current status of mammal fauna in TDNP with special focus on primates, small carnivores, bats and rodents; to determine species of conservation importance and requirements for monitoring their valuable populations. The specific objectives are:

1. Assess the species composition of poorly studied groups: primates, small carnivores, bats and rodents.
2. Determine the occurrence or probable occurrence of species of high conservation value (endemic, nationally threatened and globally threatened species, species listed in Governmental Decree No 48/2002/NDCP).
3. Identify distribution and habitats of key populations of valuable species.
4. Determine specific follow-up actions required to monitor populations of valuable species
5. Train technical staffs of TDNP on rapid assessment techniques.

II. METHODOLOGY

The Rapid Assessment was carried out in three phases:

- Village interviews to determine target areas and focus of the assessment, in December 2004.
- Dry season field survey in target areas, in December 2004-January 2005.
- Wet season field survey in target areas, in May 2005.

2.1. Village interviews

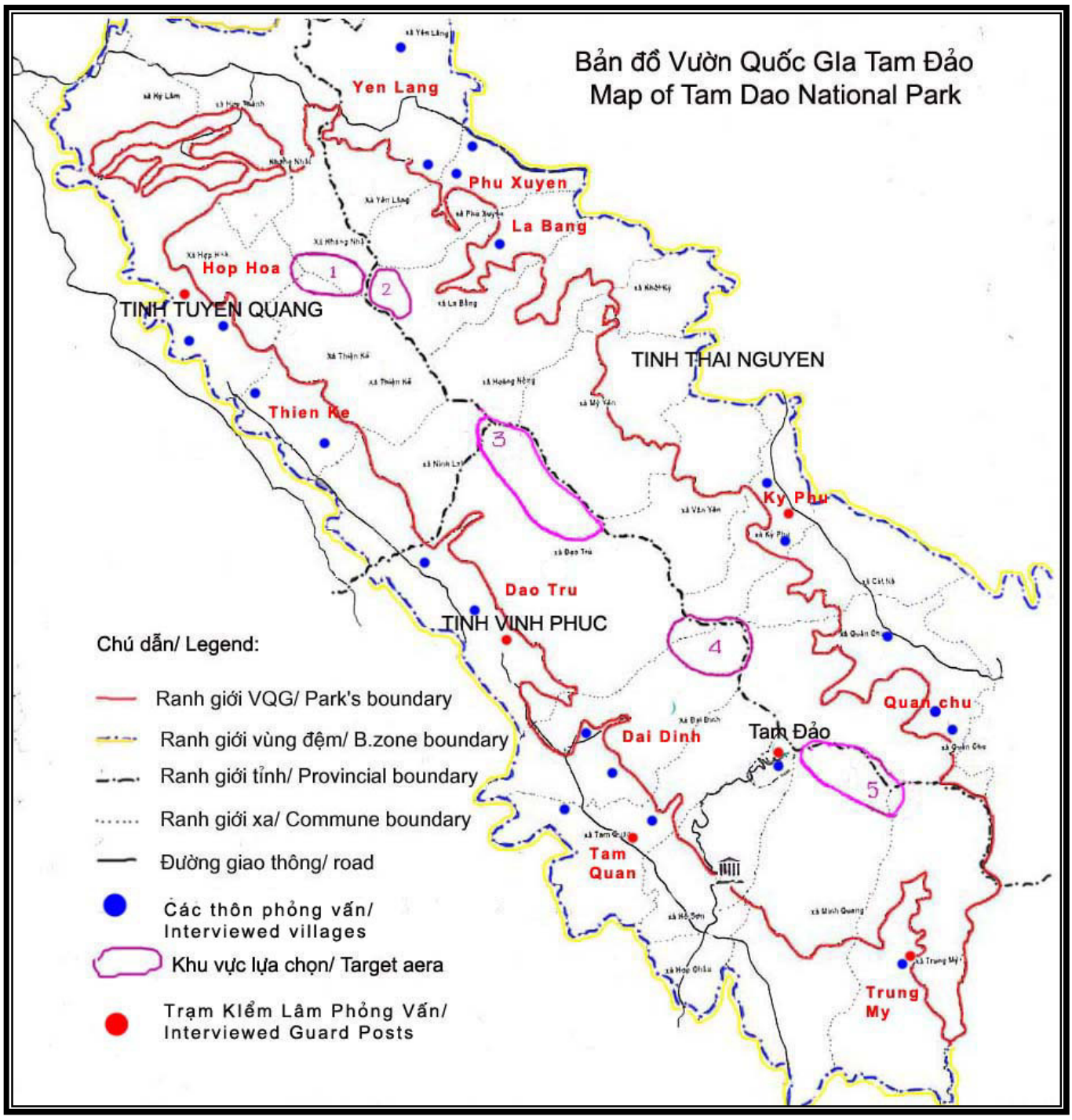
TDNP guards and staff and records of the TDM Project were consulted to identify villages known to be harvesting resources from the TDNP.

Two types of interview was employed: group meetings conducted as participatory fauna assessments and focused interviews with single or small groups of people identified as having expert knowledge of the TDNP (particularly knowledgeable elders who may have hunted in the area in the past). These meetings were aimed at obtaining up-to-date information on the status of mammals in the TDNP, trends in abundance of mammals and local exploitation of mammals for food or for sale.

The village interview was carried from 29 November to 5 December 2004 in 11 communes, Tam Dao Town and 5 forest protection stations of TDNP (Map 1).. Eleven interviewed communes are:

- Thai Nguyen Province: Quan Chu (Hoa Binh II, Chiem villages and Quan Chu Townlet), Ky Phu (Xom Chuoi, Xom Gio villages) , La Bang (Kem village), Phu Xuyen (Xom Say and Xom Man villages), Yen Lang (Khuan Nanh and Dong Ao Villages).
- Tuyen Quang Province: Hop Hoa (Dong Phai, Cau Da villages), Thien Ke (Tan Dan, Thien Tan).
- Vinh Phuc Province: Dao Tru (Vinh Ninh and Phan Lan villages), Dai Dinh (Dong Thong, Long Sau villages), Tam Quan (Dong Bua, Yen Trung villages), Trung My (Thanh Lanh village), Tam Dao town.

Five interviewed forest protection stations are Ky Phu, Hop Hoa, Dao Tru, Tam Quan and Tam Dao Town Stations. During the interview, the informants were requested to answer question about the status of mammals in TDNP from general to more detail with showing as many evidences as possible, such as skin, bone, new tracks, number of persons know the same information, date and place of the information occurrence. Color pictures of animals were used to help clarify taxonomic identification of target species in the end of discussion. The selection of target areas and species to be surveyed during the rapid biodiversity assessment was based on information received from village interviews.



Map 1: Interviewed villages and target areas

See text for names of interviewed villages and guard posts

Target area: 1- Suoi Tram-Suoi Tien up-stream; 2- Ba Luong up-stream
3- Ngoi Lanh up-stream –Tam Dao North peak 1590; 4- Tay Thien-Thach Ban- Ao Dua Area;
5- Xa Huong up-stream - Qua Ha peak.

Totally, about 250 people have been interviewed including local villagers and 13 TDNP forest rangers. All villagers were once extensive exploitators of forest products: wildlife hunting, timber extraction, NTFPs harvesting, etc. Out of them, about 200 people are still occasionally encroaching TDNP for NTFP harvesting and hunting; about 70 people have good knowledge on mammals of Tam Dao area. They were extensive hunters in the past and half of them still occasionally go hunting now. Besides, 12 hunters were met and interviewed in the forest during our fieldwork. In general, village interview provides good information about large mammals of TDNP, especially their status before 2000. Contrarily, most of interviewed forest rangers show poor knowledge about mammals of TDNP. The reasons are: 1) They are young and from other locations far away from TDNP with poor experience of forest life before they were employed by the Park, 2) Some of them have no biological background, and 3) During their patrolling, they do not pay much attention to wildlife, they deal mostly with violations on forest clearing, timber extraction and NTFP harvesting.

2.2. Survey areas

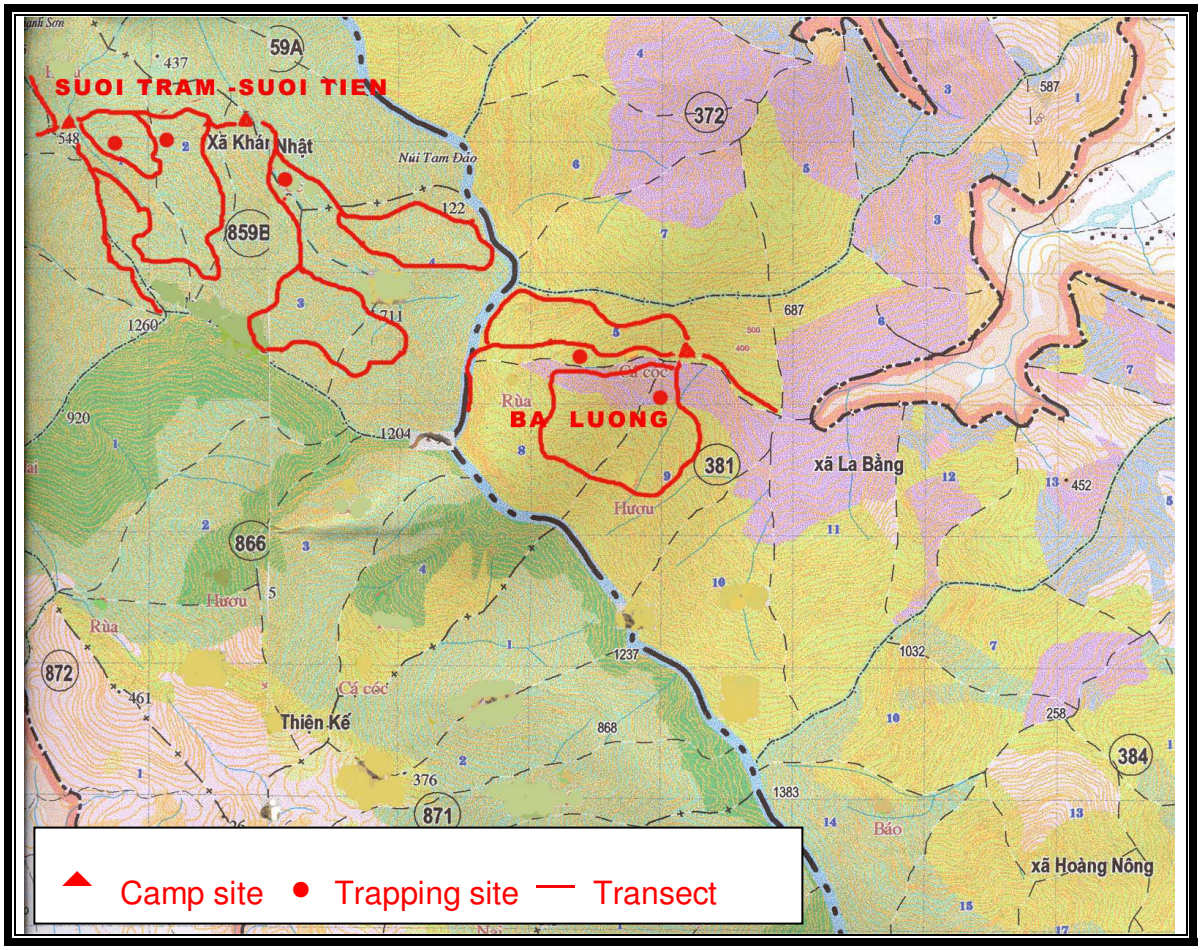
During village interview, 5 following areas were reported to contain better forests and consequently, the most abundant and diverse mammal fauna of TDNP (Map 1):

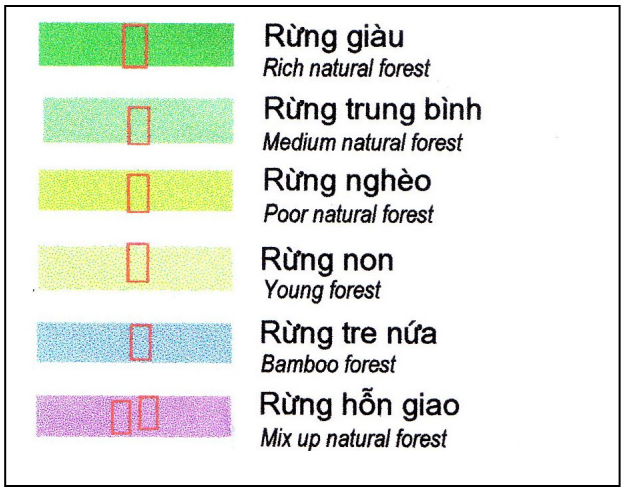
1. Up-stream area of Suoi Tram and Suoi Tien area, including peak 1260 (Khang Nhat Commune, Tuyen Quang Province).
2. Up-stream area of Ba Luong stream (La Bang Commune, Thai Nguyen Province).
3. Up-stream area of Ngoi Lanh stream, including peak 1590 (Dao Tru Commune, Vinh Phuc Province and Ninh Lai Commune, Tuyen Quang Province)
4. Tay Thien – Thach Ban – Ao Dua area (Dai Dinh and Dao Tru Communes, Vinh Phuc Province), including Phu Nghia and Thien Thi peaks (Hoa Binh Commune, Thai Nguyen Province).
5. Up-stream area of Xa Huong reservoir (Minh Quang Commune, Vinh Phuc Province), including Qua Ha peak (Trung My Commune, Vinh Phuc Province).

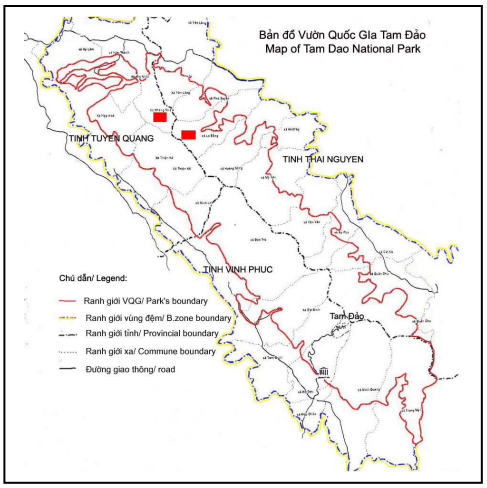
These areas were selected for extensive field surveys.

2.2.1. Suoi Tram and Suoi Tien Up-stream (Khang Nhat Commune)

This area is located in forest compartment 859B, belonging to Khang Nhat Commune, Tuyen Quang Province (Map 2). The area consists of steep slopes of high mountains including highest peak of 1260m a.s.l. in the area. The survey area was accessed from Hop Hoa Commune following Ngoi Chau Stream. It takes about 4h to get from village to the survey area. Elevation of the survey area ranges from 400 to 1200m a.s.l. The forest cover has been affected by illegal timber extraction but still in relatively good status. Main forest types are tall broadleaf evergreen forests, mixed wood-bamboo forests and some patches of bamboo forest mixed with scattered trees. Bamboo forests are usually found in mountain summits with elevations of more than 800m a.s.l. Stream water is available all round year in the survey area. This area can provide favorable habitat for diverse fauna, however, wildlife hunting and collecting NTFPs area still extensive in the area.







<u>Map 2</u>: Location of Suoi Tram-Suoi Tien up-stream (Khang Nhat Com.) and Ba Luong (La Bang Com.) survey areas

Survey camp sites were located within tall forest, at coordinates (48Q) 0550025/ 2392978, altitude of 430m a.s.l. for dry season survey and at 0548230/ 2393323, altitude of 450m a.s.l. for wet season survey. Survey transects began from the camp sites and went to different directions. Rodent and bat trapping was taken place within 0.5 to 2 km away from the camps.

2.2.2. Ba Luong up-stream (La Bang Commune)

The area is located in forest compartment 381, western slope of main Tam Dao range, La Bang Commune, Thai Nguyen Province (Map 2). The area is accessed from Kem village of La Bang Commune following Ba Luong stream up to its up-stream area. It takes about 2.5 h to get from Kem village to survey area. The area has complicated terrain with steep slopes, several mountain peaks, the highest peak is of 1,000m a.s.l. Elevation of the area ranges from 200-1000m. The dense broadleaf evergreen forests in the past have been severely affected by human impacts and changed into mixed bamboo-wood forest, bamboo forests and scrublands. Only some patches of tall wood forests remain in high elevations (>400m). In high mountain summits (900-1000m) there is a forest of small bamboo with very scattered trees. Water is available all round year in Ba Luong stream system.

Forests in Ba Luong up-stream are degraded, but connected with tall forests in high elevations of Suoi Tram – Suoi Tien up-stream area, therefore, can maintain many mammal species, however, wildlife hunting and collecting of NTFPs are still extensive in this area.

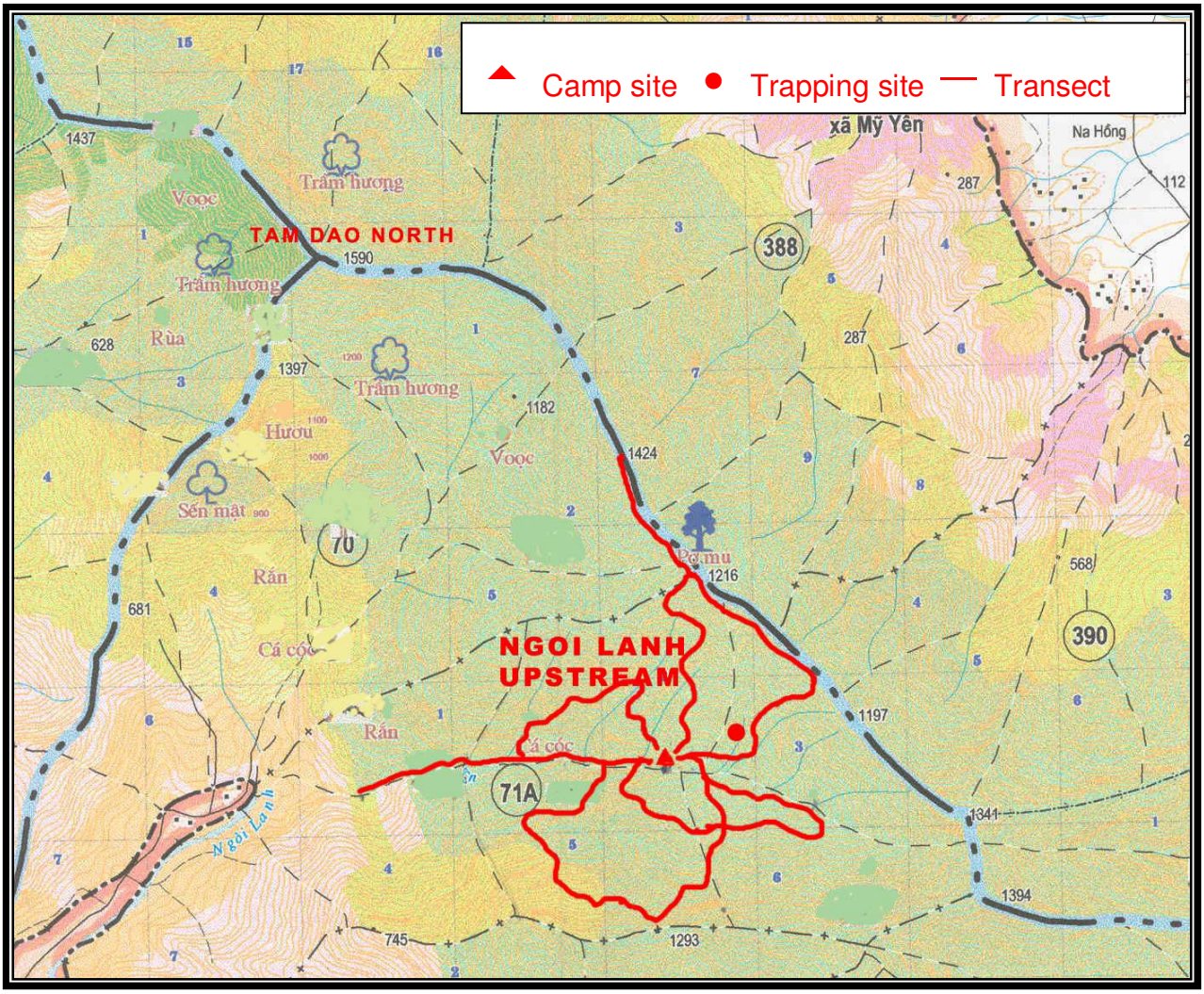
Only dry season survey was carried in this area, camp site is close to La Bang stream, at coordinates: 0553233/ 2391404, altitude of about 300m a.s.l. From the campsite the survey transects took place to different directions as far as 4 km away from the camp. Rodent and bat traps were laid in 0.5 to 2 km away from the camp.

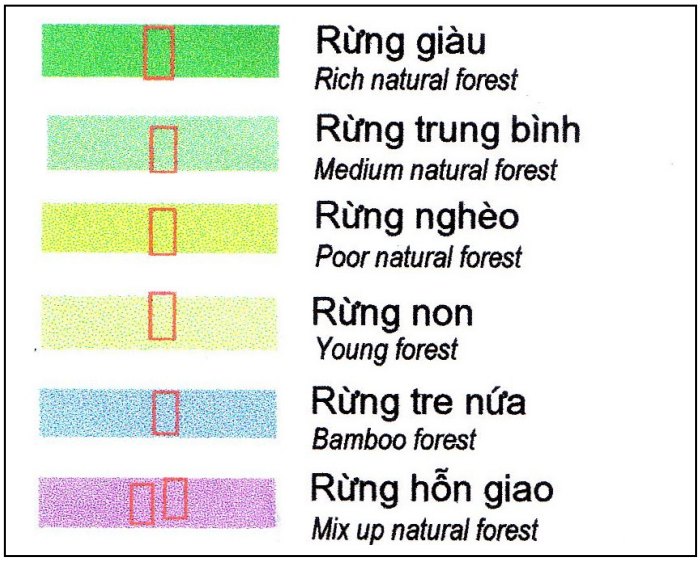
2.2.3. Ngoi Lanh up-stream (Dao Tru Commune)

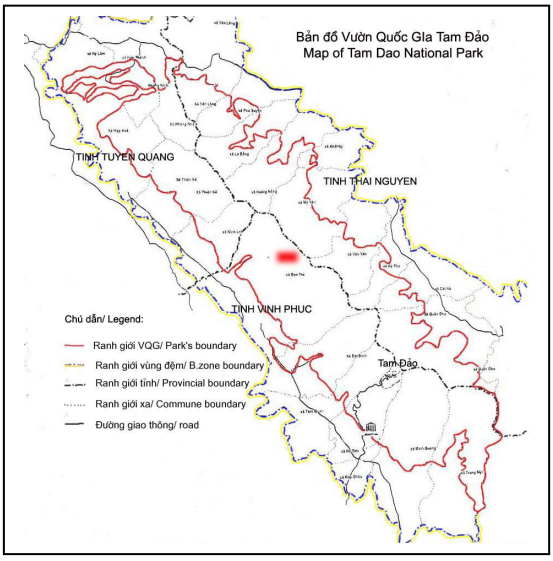
The area is located in forest compartment 71A, Dao Tru Commune, Vinh Phuc Province (Map 3). The area is accessed from Vinh Ninh village of Dao Tru Commune, following Ngoi Lanh stream. It takes about 3 h to get from Vinh Ninh village to campsite. The area has complicated terrain with steep slopes and several mountain peaks of above 1200m, the highest peak is of 1,394m a.s.l. Elevation of the area ranges from 500-1300m.

The forests in this area have been affected by illegal timber extraction, however, remain as tall multi-layers forests with dense ground layer. The forest represent quite good refuge and food resources for diverse fauna. The area has large Ngoi Lanh stream and a complicated network of stream branches. Main human impacts in this area is illegal hunting, several old hunting shelters and old trap-sites were observed during this survey.

Only wet-season survey was conducted in this area, campsite is within tall forest, at coordinates: 0558644/ 2382316, altitude of about 660m a.s.l. From the campsite the survey transects took place to different directions as far as 4-5 km away from the camp. Rodent and bat traps were laid in 0.5 to 2 km away from the camp.







Map 3: Location of Ngoi Lanh up-stream survey area (Dao Tru Commune)

2.2.4. Tay Thien-Thach Ban- Ao Dua (Dai Dinh & Dao Tru Commune)

This area is located in forest compartment 95, in eastern slope of main Tam Dao Range, up-stream of Tay Thien Stream, Dai Dinh and Dao Tru Commune, Vinh Phuc Province (Map 4). The survey area is accessed from Son Dinh Village of Dai Dinh Commune following Tay Thien stream. It takes about 4.5h to get the campsite. Included to this area is also Phu Nghia peak where survey was conducted at elevation above 500 m a.s.l. This site was accessed from Tam Dao Town for about 4 hour walk.

This area is characterized by system of high mountains with very steep slopes. Elevation ranges from 400-1400m a.s.l. Water is available all round year due to dense stream system. The forests in this area are little affected by human activities. Dominant forest types are mixed wood-bamboo forest with tall trees. There are also several patches of pure small bamboo forest or tall wood forests. In mountain summits (above 900m a.s.l.) there are usually forests of small bamboo mixed with scattered big trees. The forests in this area can provide good refuge and food sources for diverse mammal fauna. The forest surrounding Tay Thien temples are more affected by cutting and collecting of NTFPs, however, still remain as tall multi-layers forests.

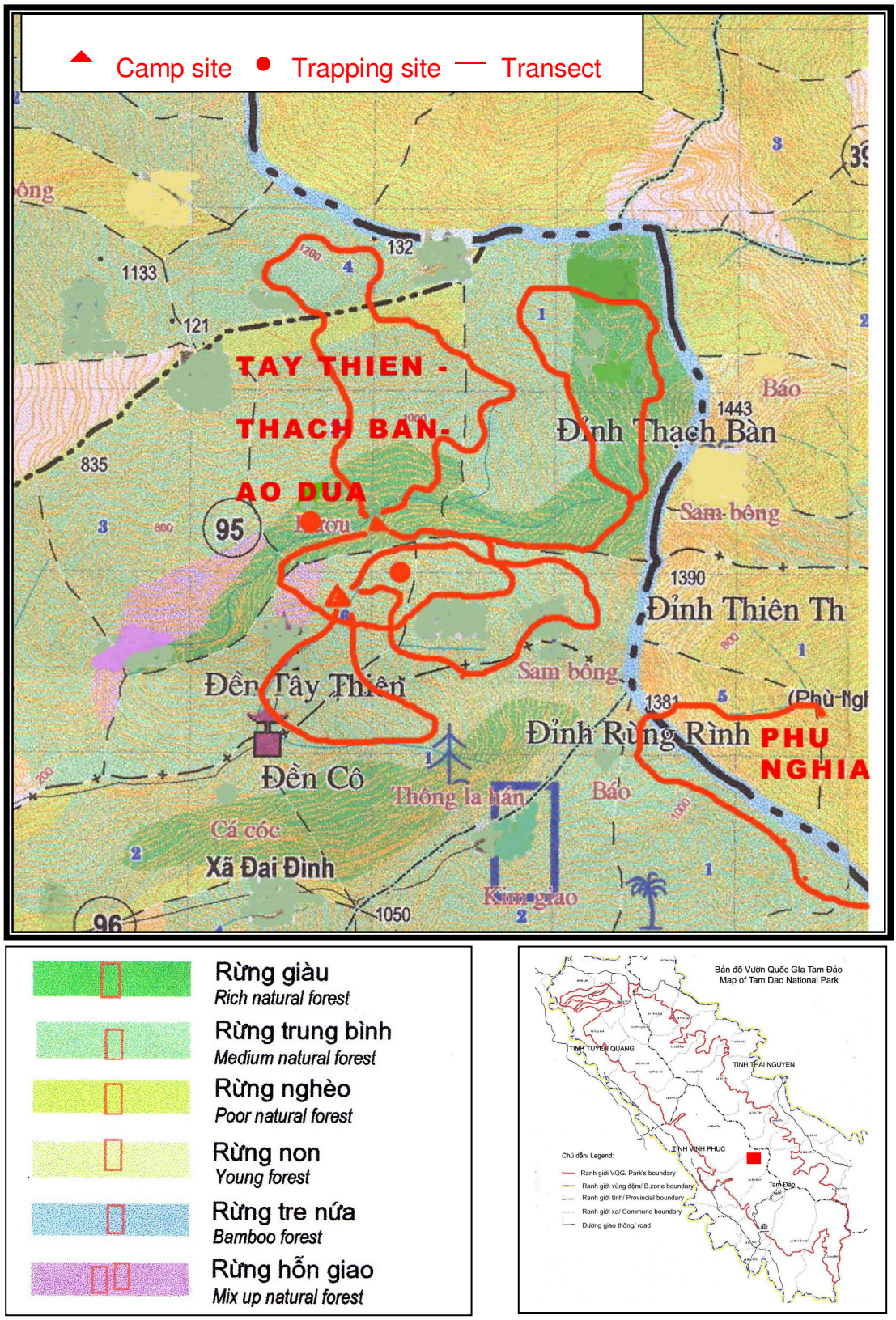
Hunting and collecting forest products still occur in this area, several hunters' shelters and old traplines were found during the survey time.

Survey camp sites were located within tall mixed wood-bamboo forest at coordinates 05635554/ 2375583, altitude: 550m a.s.l for dry season survey and at 0563885/ 2376244, altitude: 860m a.s.l for wet season survey. Survey transects began from the camp sites and went to different directions. Rodent and bat trapping was taken place within 0.5 to 2 km away from the camp.

2.2.5. Xa Huong up-stream (Minh Quang commune)

The area is located in forest compartments 100a and 101, in the Southern end of TDNP (Map 5). The survey site was accessed from Tam Dao Town, following trail running along top of main Tam Dao mountain range, then down slope to elevation of about 600m a.s.l. It takes about 3.5 hours to get from Tam Dao Town to campsite. The survey area consists of high mountain summits and very steep slope. Elevation range from 500-1020m a.s.l. Forests in this area have been affected by intensive illegal timber extraction in the past. At present, dominant forest types are mixed bamboo-wood forests in lower elevation and bamboo forests with scattered tree in mountain summit. There is also some patches of tall tree forests in the area. Water in this area is not abundant as in other survey areas, most streams are dried up during dry season. The forests in this area can provide relatively good habitat for many mammal species. However, illegal wildlife hunting, collecting NTFPs and domestic cattle raising are still occur in the area.

Survey camp site was located within tall mixed wood-bamboo forest at coordinates 0568201/ 2372747, altitude of about 600m a.s.l. Survey transects began from the camp sites and went to different directions. Rodent and bat trapping was taken place within 0.5 to 2 km away from the camp. Some bat captures also took place near Tam Dao Town.



Map 4: Location of Tay Thien-Thach Ban-Ao Dua (Dai Dinh Com.) and Phu Nghia (Quan Chu Com.) survey areas

2.2.6. Surrounding area of Tam Dao Town

This area was taken for small mammal and bat surveys due to its easy accessibility in cold season and containing several bat-roosting caves. The area has elevation ranging from 700- 1000m a.s.l. The vegetation cover is degraded by human activities, consisting of regenerating mixed bamboo-wood forests, bamboo forests and scrublands. Rodent survey was carried out in mixed bamboo-wood forest in distance of about 1km away from Tam Dao Town centre. Bat investigation was conducted both inside and outside the town, but mostly outside, up to 2km away from the town centre.

2.3. Methods of large mammal survey

- *Transect survey*

Transect techniques were used to record direct observation of wildlife and indirect observation through wildlife activity signs (tracks, dropping, dens, vocalization, etc.). Survey transects passed through various habitat types of each survey sites and with distance of 5-10 km each. Because of complicated terrain and thick forest in survey sites, some existing small trails running through various habitat types were used as the survey transects, but most of survey effort was spent in off-trail areas as far as possible. Extensive surveys used the rapid assessment technique (various different extensive surveys from a camp, rather than repeated walks of the same transect) to cover a lot of ground quickly. Equipment for wildlife observation and recording include binoculars, cameras, pens, field books and pre-prepared data sheets.

- *Spot-lighting survey*

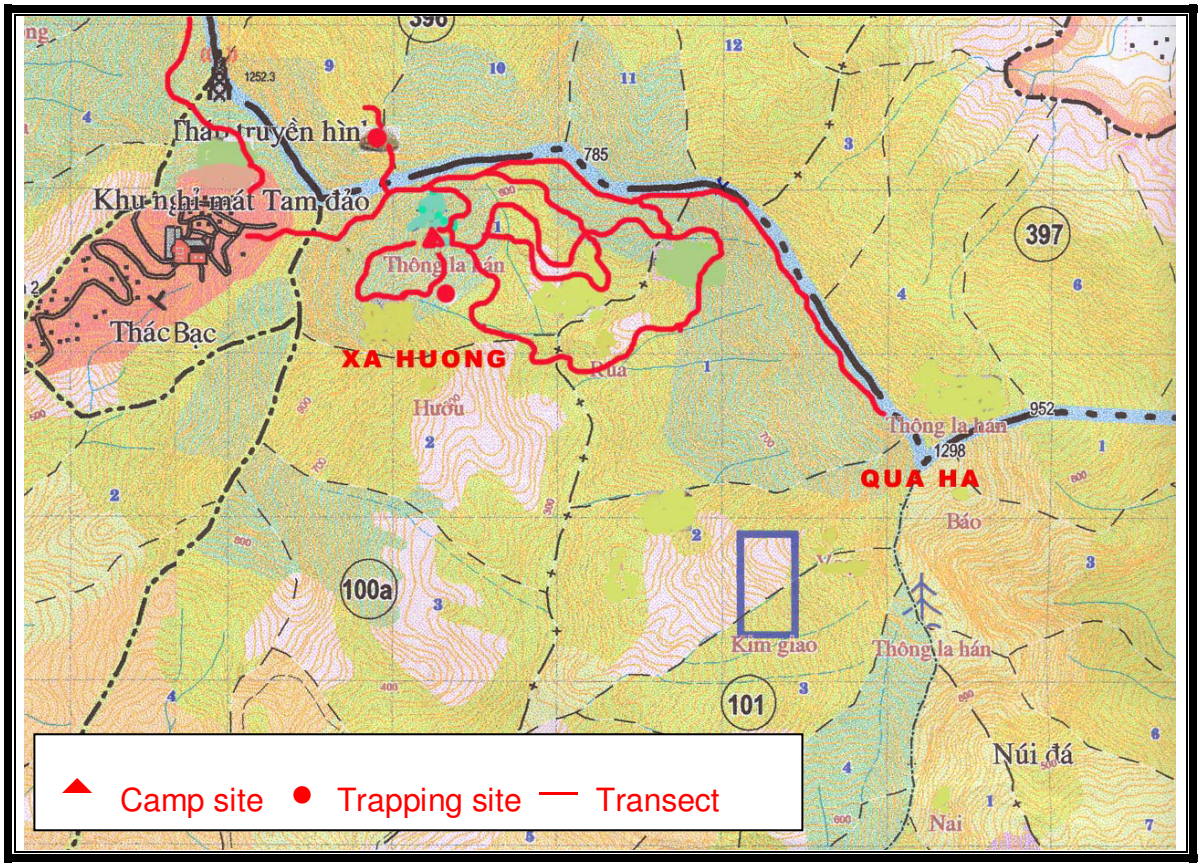
Since most target species (loris and small carnivores) are nocturnal, night spotlighting techniques were used during rapid assessments. Head-lamps with a low light beam were used to search for animal eye-shine along the same survey routes defined for diurnal surveys. Once the animal was detected, spotlights (using 4 D-sized batteries) with a strong light beam was turned on to get better observations of the animal.

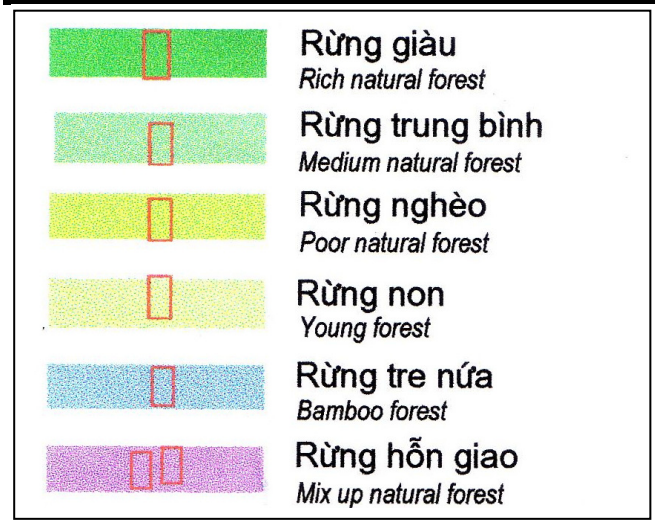
- *Field note taking*

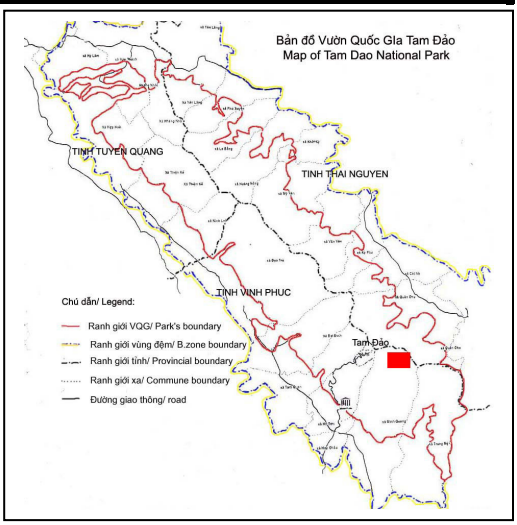
For each encounter (direct or indirect) with a target species (or any other species of interest), the following information were recorded: date and time, GPS location, altitude, local habitat type (bamboo forest, secondary evergreen forest, primary evergreen forest, primary forest on limestone, sub-montane forest, riverine forest, open water, etc.), species encountered, means of identification (direct sighting, tracks, claw marks of bears, feathers and other remains, food remains, etc.).

The majority of large mammal records are by observation of tracks. Tracks were quantified as far as possible. The age of tracks were estimated as:

+ New: clearly defined tracks probably made within 24 hours.
+ Recent: remained clear but probably over 24 hours old.
+ Old: difficult to age but tracks faded and many individual prints no longer visible.







<u>Map 5</u>: Location of Tam Dao Town and Xa Huong up-stream (Minh Quang Com.) survey areas

- *Species identification manuals*

Following manuals were used for species identification of large mammals:

- Lekagul et al., 1977: Mammals of Thailand. Bangkok.
- Corbet G.B., et al., 1992: The Mammals of the Indomalayan Region: A Systematic Review. Oxford Univ. Press.
- Nguyen Xuan Dang, Pham Trong Anh, 2004: Carnivore mammals (*Carnivora*) of Vietnam. A preparation for publication series "The Fauna of Vietnam".
- Pham Nhat and Nguyen Xuan Dang, 2000: Field Guide to the Key Mammal Species of Phong Nha-Ke Bang. Hanoi.

Identification though mammal tracks is based on author own experience and "The mammal tracks of Thailand" by Oy, Kanjanaavanit, 1997. Bangkok. Systematics follows Corbet G.B., et al., 1992; except for *Primates* follows Nadler et al. 2003.

- *Survey effort*

Dry season survey was from 6-13 December 2004 and from 2-12 January 2005 and conducted in 4 target areas. Wet season survey was from 9 - 30 May 2005 and conducted in 4 target areas (Table 1, Map 2,3,4,5).

Very steep terrain in all survey sites considerably limited the effort of the night spotlighting survey. Heavy foggy weather during dry season survey also reduced the effectiveness of survey effort. Wet season survey held in good weather and, therefore, covered larger area. The campsite of wet season survey is based far away from those of the dry season survey.

Totally, about 290 hours of daytime extensive survey, about 72 hours of night survey were made and about 417 km of survey transect distance were covered (Table 1).

Table 1: Effort of large mammal survey in Tam Dao National Park

Survey site	**Season**	**Camp site**	**Survey duration**	**Survey effort** (Total searching hours & transect distance)
Suoi Tram-Suoi Tien up-stream (Khanh Nhat Commune)	Dry	0550025/ 2392978 Altitude: 427m	4 days (6-9/12/2004)	34h & 58 km & 12h night survey
	Wet	0548230/ 2393323 Altitude: 450m	5 days (20-24/5/2005)	40 h & 60 km & 10h night survey
Ba Luong up-stream (La Bang Commune)	Dry	0553233/ 2391404 Altitude: 253m	4 days (10-13/12/2004)	36h & 57 km & 8h night survey
Ngoi Lanh Up-stream (Dao Tru Commune)	Wet	0558644/ 2382316 Altitude: 663 m	5 days (25-29/5/2005)	30 h & 45 km & 6h night survey
Tay Thien-Thach Ban- Ao Dua (Dai	Dry	0563833/ 2375853 Altitude: 520m	5 days (2-6/1/2005)	32h & 54 km

Dinh & Dao Tru Commune)	Wet	0563885/ 2376244 Altitude: 860 m	6 days (9- 14/5/2005)	50 h & 65 km & 20h night survey
Xa Huong up-stream (Minh Quang Commune) & Tam Dao Town	Dry	0569536/ 2372686 Altitude: 710	5 days (7-11/1/2005)	32h & 50 km
	Wet	0569536/ 2372686 Altitude: 710	5 days (15–19/5/2005)	40 h & 50 km & 16h night survey
		Total:	**39 days**	**290 hours & 417 km & 72h night survey**

2.4. Methods of bat survey

- *Capture by mist-nets and harp traps*

Four mist-nets were used to survey bats (3 x 3m, 6 x 3m, 9 x 3m and 12 x 3m). The nets were set across the flight ways of bats from their roosting sites such as in front of bat roosting caves, across forested trails, close to or across forested streams, etc. Depending on terrain conditions, the nets may set separately from each other and connectedly to increase the catching efficiency. The nets open from 18:00 – 23:00h and from 4:00-5:00h next morning, when bats fly out from their roosting for feeding. The nets are close for the rest time to avoid bird capture.

Only one harp trap (4 bank design, 1.2m wide x 1.5m high) was used in this study. The trap was set at forest trail or forest dry stream. Harp traps are generally more effective for capturing insectivorous bats.

- *Cave exploration*

Location of caves with bat roosting were determined through village interview. The caves were explored in daytime to check if there are bats inside. Hand net was used to catch the bats inside the cave. In the evening harp trap and/or mist-nets were set in front of cave entrance to catch the bats.

- *Information recording*

All bats captured were measured for forearm length, identified, sexed and the time of capture recorded. For voucher specimens, additional measurements including head-body, tail, ear, hind-foot, third finger part A (combined length of metacarpal and 1st phalanx), third finger part B (2nd phalanx) and fourth and fifth finger length were recorded to the nearest 0.1mm using a calipers. Weight measurements were taken of live bats using cloth bags of known weight. After completion of information recording live bats were either promptly released at the point of capture, or, kept overnight in cotton draw-string bags for release the following morning.

- *Specimen preservation*

Some captured bats which can not species identified in the field are preserved for later identification at museums (IEBR or Hanoi University). Usually, two voucher specimens were collected for each species, preferably one of each sex. All specimens were humanely killed using

diethyl ether and subsequently soaked, and, in the case of larger specimens also injected, with 10% formaline, prior to storage in 70% ethanol solution. Pregnant or lactating bats were not collected as voucher specimens. Voucher specimens collected during the survey are retained at the Institute of Ecology and Biological Resources (IEBR), Hanoi (Annex 3).

- *Identification manuals*

Following manuals are used for bat identification:

- Lekagul et al., 1977: Mammals of Thailand. Bangkok.
- Corbet G.B., et al., 1992: The Mammals of the Indomalayan Region: A Systematic Review. Oxford Univ. Press.
- Bate P., et al., 1997: Bats of the Indian subcontinent. Harrison Zool. Museum Publ.
- Borissenko A.V., et al., 2003: Bats of Vietnam and Adjacent Territories. An identification Manual. Zool. Museum of Moscow. Russia.

- *Survey effort*

Dry season survey was from 6-13 December 2004 and from 2-12 January 2005, in 4 target areas and wet season survey was from 9 - 30 May 2005, in 4 target areas (Table 2, Map 2,3,4,5).

Very cold weather during dry season survey may reduce the bat activity, consequently, reduce trapping effectiveness. Totally, about 2,159 hour.metre.nets and 300 hour.traps (harp trap) were made (Table 2).

Table 2: Effort of bat survey in Tam Dao National Park

Survey site	Season & Habitat	Trapping site	Survey duration	Effort (h.m.net & h.trap)
Suoi Tram-Suoi Tien up-stream (Khanh Nhat Commune)	**Dry**. Cross little water side stream, and cross trail (harp-trap), tall wood forest, dense ground layer.	0548984/ 2393148 Altitude: 454m	4 days (6-9/12/2004)	180 h.m.net & 36 h.trap
	Wet. Cross water streams, tall wood forest, dense ground layer with bamboo and tree seedling.	0548394/ 2393236 Altitude: 500m 0548334/2393106 Altitude: 450m	5 days (20-24/5/2005)	216 h.m.net & 48h. trap
Ba Luong up-stream (La Bang Commune)	**Dry**. Cross trail. Degraded forest with many of bamboo and scattered tall trees	0552564/ 2391454 Altitude: 260m	4 days (10-13/12/2004)	174 h.m.net & 36 h.trap

Ngoi Lanh Up-stream (Dao Tru Commune)	**Wet**. Cross water stream, tall wood forest, dense ground layer.	0558779/ 2382374 Altitude: 660m	5 days (25-29 May)	126 h.m.net & 48h.trap
Tay Thien-Thach Ban- Ao Dua (Dai Dinh & Dao Tru Commune)	**Dry.** Cross water stream and trail. Mixed wood-bamboo forest, dense ground layer.	0564217/ 2376923 Altitude: 932m 0566837/2372888 Altitude: 850m	5 days (2-6/1/2005)	324 h.m.net & 36 h.trap
	Wet. Cross water stream and trail, tall wood forest, dense ground layer.	0563743/ 2376349 Altitude: 850m 0566249/2374793	6 days (9- 14 May)	636 h.m.net &48h. trap
Tam Dao Town & Surrounding	**Dry.** Degraded forest with many bamboo and scattered trees.	0567955/ 2373279 Altitude: 920m 0566778/2372958 Altitude: 1014m	5 days (7-11/1/2005)	324 h.m.net
	Wet. Cross small water stream, wood forests with dense ground layer.	056332/ 2372632 Altitude: 720m	5 days (15–19/5/2005)	179 h.m.net 48h.trap
	Total:		**2,159 h.m.net & 300 h.trap**	

2.5. Methods of small mammal survey (Rodents and Insectivores)

- *Capture by live traps*

Small mammals were sampled through the use of 100 live traps (dimension of 20x10x10 cm). From each survey sites (Map 2,3,4,5) transects were established within various vegetation types. Each transects included 20-50 traps interspersed at about 10-m intervals. Some traps were set on trees of 5-10m above ground for capture of squirrels. Traps were set at each transect for 4-6 days and checked on subsequent mornings (for specimens) and evening (for bait replacement). Baits included fresh manioc or sweet potato. In Xa Huong and Suoi Tram-Suoi Tien areas, 15 bamboo traps set by local hunters were also used to collected specimens and test the capture efficiency of the local hunters' traps.

The following information were collected from surveyed sites: date, weather, and number of night.traps, habitats, GPS location, altitude, level of human disturbance. For each rodent captured following information were collected: trap location (ground, trees, etc.), brief description of the specimen (general appearance; coloration; measurement of head-body length, tail length and weight; reproduction status; species identification). After the examining, captured rodents were released immediately at capture point. Those specimens which cannot be identified in the field were preserved in 70% ethanol for latter identification using museum mammal collections of IEBR and Hanoi University. Collected specimens are kept at IEBR Zoological museum (Annex 3).

- *Search for insectivores*

Live traps were used for capture of insectivore species. However, moles can be sampled only by special mole traps or digging their dens. In this study we used second techniques. Ground surface, especially moist slopes were checked to detect new dens or movement routes of moles. Then, digging the new dens or new movement routes to catch the animals. Caught specimens after taking relevant measurement and description were released immediately at catching point.

- *Identification manuals*

Following manuals are used for species identification of Rodents and Insectivores:

- Cao Van Sung et al., 1980: Rodent species in Vietnam. Hanoi. (in Vietnamese).
- Lunde D. et al., 2001: An Identification Guide to the Rodents of Vietnam. AMNH.
- Lekagul et al., 1977: Mammals of Thailand. Bangkok.
- Corbet G.B., et al., 1992: The Mammals of the Indomalayan Region: A Systematic Review. Oxford Univ. Press.

Systematics and sequence follow Corbet G.B., et al., 1992.

- *Survey effort*

Dry season survey was from 6-13 December 2004 and from 2-12 January 2005, in 4 target areas and wet season survey was from 9 - 30 May 2005, in 4 target areas (Table 3, Map 2,3,4,5).

Very cold weather during dry season survey may reduce the animal activity, consequently, reduce capture effectiveness. With the aim to get as much as possible information of the faunal composition, the trapping sites of wet season survey is located far away from those of the dry season survey. Totally, 90-100 live traps were used daily and about 2,826 night.traps were made (Table 3).

Table 3: Effort of small mammal survey in Tam Dao National Park

Survey site	Season & Habitat	Trapping site	Survey duration	Effort (night.trap)
Suoi Tram-Suoi Tien up-stream (Khang Nhat Commune)	**Dry**. Near dry stream, tall wood forest, clear ground layer.	0548984/ 2393148 Altitude: 454m	4 days (6-9/12/2004)	310
	Wet. Near water stream, tall wood forest, dense ground layer with bamboo and tree seedling, surface ground with many stones.	0548837/ 2390236 Altitude: 500m	5 days (20-4/5/2005)	360

Ba Luong up-stream (La Bang Commune)	**Dry**. Near large stream. Degraded forest with many of bamboos and bananas.	0552564/ 2391454 Altitude: 260m	4 days (10-13/12/2004)	320
Ngoi Lanh Up-stream (Dao Tru Commune)	**Wet**. Near large stream, tall wood forest, dense ground layer with tree seedlings.	0558938/ 2382467 Altitude: 740m	5 days (25-29/5/2005)	360
Tay Thien-Thach Ban- Ao Dua (Dai Dinh & Dao Tru Commune)	**Dry.** Mixed wood-bamboo forest, dense ground layer with many bamboo.	0564217/ 2376923 Altitude: 932m	5 days (2-6/1/2005)	346
	Wet. Near large stream, tall wood forest, dense ground layer, surface ground with many stones	0563703/ 2376349 Altitude: 850 m	6 days (9-14/5/2005)	450
Tam Dao Town	**Dry.** Degraded forest with many bamboos and scattered trees, surface ground with many stones.	0567955/ 2373279 Altitude: 920m	5 days (7-11/1/2005)	320
Xa Huong up-stream (Minh Quang Commune)	**Wet**. Near water stream, wood forests with most of small trees and bananas, surface ground with many stones.	0568332/ 2372342 Altitude: 720 m	5 days (15–19/2005)	360
	Total:		**39 days**	**2,826 night.trap**

2.6. Training for technical staff members

After the village interview stage and before the fieldwork, a one-day training workshop was organized in Headquarter of TDNP with participation of staff members of TDNP. In this workshop the participants were acquainted with survey planning, main survey techniques and means of data analysis. Survey site selection and detailed survey planning for this survey were also discussed in this workshop.

After the workshop, 2 staff members of TDNP (Mr. Dang Van Thuan and Mr. Nguyen Duc Toan from TDNP Forest Protection Department) were selected to join the survey team to obtain field experience of rapid assessment techniques. Mr. Dang Van Thuan joined field survey for 39 days, during this period he participated in activities of all 3 groups: large mammal survey led by Dr. Nguyen Xuan Dang, Small mammal survey led by Mr. Nguyen Xuan Nghia and Bat survey led by Mr. Nguyen Truong Son. Mr. Nguyen Duc Toan joined the field survey for 31 days, during this period he participate in activities of 2 groups: Small mammal study and Bat study.

III. RESULTS

3.1. Species inventory of mammal fauna

- ***Large mammals***

Eight (8) species of large mammals were reported to be extirpated from TDNP (Table 4). They are reported to be quite abundant in the past, but no evidence of their survival have been found for more than 15 recent years. All these species were included in mammal checklist in 1993 (FIPI, 1993) and 6 of them (except Tonkin snub-nosed monkey and Indochinese tiger) were still enlisted in checklist in 1998 (Cao Van Sung et al., 1998). However, no sign of their existence could not found during our extensive field investigation.

Table 4: Mammal species reported to be extirpated from Tam Dao NP

No.	English name	Scientific name
1	Black crested gibbon	*Nomascus concolor*
2	Tonkin snub-nosed monkey	*Rhinopithecus avunculus*
3	Indochinese tiger	*Panthera tigris*
4	Spotted leopard	*Panthera pardus*
5	Clouded leopard	*Pardofelis nebulosa*
6	Red dog	*Cuon alpinus*
7	Binturong	*Artictis binturong*
8	Common otter	*Lutra lutra*

Thirty one (31) species of large mammals are reported to be existing in TDNP, including 5 species of Primates (*Primates*), 20 species of Carnivores (*Carnivora*), 5 species of Even-toed ungulates (*Artiodactyla*) and 1 species of Pangolins (*Pholidota*) (Annex 2).

During our field survey , 290 hours of daytime extensive search with about 417km of total transect length (resulted in 120,930 h.km) and 72 hours of night spotlight search were made. Majority of mammal records were obtained by daytime survey; night survey could get animal sighting only in 3 cases: Common palm civet in Ba Luong upstream and Tay Thien area, and Leopard cat in Suoi Tram upstream. Low encouter rate of night survey can be explained by low survey effort, difficult terrain to walk and mainly low density of large mammals in survey areas.. Out of 31 species reported to be existing, only 19 species were recorded during field investigation, including 4 species of direct observation or hunted specimens (Yellow-throated marten, Common palm civet, Small asian mongoose and Small-toothed ferret badger), and 15 species of their activity signs and hunting remains (Annex 2). Other 12 species could not be recorded, possibly because of their very low density in the wild.
Distribution of recorded species by survey areas is provided in Annex 2 and summarized in table 5. Total number of recorded species is highest in Tay Thien-Thach Ban-Ao Dua area and Suoi Tram-Suoi Tien up-stream; then follow Xa Huong up-stream, Ngoi Lanh up-stream, Ba Luong up-stream and Tam Dao Town. However, number of species with field records is highest in Tay Thien-Thach Ban-Ao Dua (16 species), then follow Xa Huong up-stream (13 species), Suoi Tram-Suoi Tien up-stream (12 species), Ngoi Lanh up-stream (11 species), Tam Dao Town surrounding (9 species) and Ba Luong up-stream (8 species). This relates with increase of survey

effort in areas with similar habitat status: Tay Thien-Thach Ban-Ao Dua (16 species, 9,758 h.km), Suoi Tram-Suoi Tien up-stream (12 species; 8,732) and Ngoi Lanh up-stream (11 species; 1,350 h.km); but relates mostly with habitat status in Xa Huong up-stream (better habitat; 2,880 h.km;13 species) and Ba Luong up-stream (worse habitat; 2,052 h.km; 8 species). Tam Dao Town surrounding has habitat better than Ba Luong up-stream but survey effort is much lower (960 and 2,052 h.km, respectively).

Table 5: Number of recorded large mammal species by survey areas

Area	Total (Species)	Recorded only by interview (Species)	Recorded by field records	
			Species	Survey effort* (h.km)
Suoi Tram-Suoi Tien up-stream	29	17	12	8,732
Ba Luong up-stream	15	7	8	2,052
Ngoi Lanh up-stream	20	9	11	1,350
Tay Thien-Thach Ban-Ao Dua	30	14	16	9,758
Tam Dao Town surrounding	15	6	9	960
Xa Huong up-stream	23	10	13	2,880

*Note: * - Survey effort is equal number of searching hours multiplied by transect distance covered*

- ***Small mammals***

During field surveys, 15 species of small mammals were recorded through 173 captured specimens, and other 6 species were recorded by direct observation Totally, 21 species are recorded, belonging to 3 orders: Insectivores *Insectivora* (1 species), Tree-shrews *Scandentia* (2 species) and Rodents *Rodentia* (18 species) (Annex 2). Four species observed in the wild are Common Tree-Shrew, Irrawaddy Squirrel, Hairy-Footed Flying Squirrel, Black Giant Squirrel. Two (2) species recorded by their signs and hunting remains are Malayan Porcupine and Hoary Bamboo Rat. Within small mammals, highest species diversity belongs to family Rats *Muridae* (9 species) and family Non-flying Squirrels *Sciuridae* (6 species), other families have only 1-2 species each.

Cao Van Sung et al. (1998) provided a list of 21 rodent species for TDNP, however, 8 species of them were recorded through village interview or un-verified student reports, that means these records are un-confirmed. Out 13 confirmed species, 2 species did not recorded during our surveys. They are *Rattus mulliculus* and *Bandicota savilei.* So, total number of small mammals recorded for TDNP could be 23 species.
Number of collected specimens and their distribution by survey areas are presented in table 6. Number of collected specimens and recorded species is higher in Suoi Tram-Suoi Tien upstream (43 specimens, 9 species) and Tay Thien-Thach Ban-Ao Dua (40 specimens, 9 species) because of higher number of survey effort (670 night.trap and 796 night.trap respectively). In Xa Huong up-stream area, high number of specimens (34) and species (11) while survey effort is low (360 night.trap) can be explained by additional specimens confiscated from local hunters which we met in forest. Ba Luong up-stream and Ngoi Lanh up-stream has lower number of specimens collected and species recorded (13 specimens, 6 species and 14 specimens, 4 species respectively) due to less survey effort (320 night.trap and 360 night.trap respectively).

Table 6: Number of small mammal specimens collected in Tam Dao NP

No.	English name	Scientific name	ST-ST	BL	NL	TT-TB-AD	TD	XH	Total
1.	Grey Shrew	*Crocidura attenuata*					9		**9**
2.	White-Tailed Shrew-Mole	*Talpa leucura*	1				4		**5**
3.	Pallas's Squirrel	*Callosciurus erythraeus*	5	2		8	6	2	**23**
4.	Perny's Long-Nosed Squirrel	*Dremomys pernyi*	2					3	**5**
5.	Red-Cheeked Squirrel	*Dremomys rufigenis*	4	3	2	4	4	3	**20**
6.	Hainan's Striped Tree Squirrel	*Tamiops maritimus*	2	1		2	2	2	**9**
7.	Noisy Rat	*Leopoldamys sabanus*	16	2	4	13	3	9	**47**
8.	House Mouse	*Mus musculus*					1		**1**
9.	Dark-Tailed Rat	*Niviventer tenaster*	5	3	3			4	**15**
10.	Chestnut Rat	*Niviventer fulvescens*	6	2		7		3	**18**
11.	Rice-Field Rat	*Rattus argentiventer*				2			**2**
12.	Sladen's Rat	*Rattus remotus*	2		5	1		1	**9**
13.	House Rat	*Rattus rattus*						5	**5**
14.	Large Bandicoot Rat	*Bandicota indica*				3		2	**5**
		Total:	**43 spe. 9 sp.**	**13 spe. 6 sp.**	**14 spe. 4 sp.**	**40 spe. 9 sp.**	**29 spe. 7 sp.**	**34 spe. 10 sp.**	**173 spe. 14 sp.**

Note:
ST-ST – Suoi Tram-Suoi Tien up-stream, **BL** – Ba Luong up-stream**, NL** – Ngoi Lanh up-stream, **TT-TB-AD** – Tay Thien –Thach Ban- Ao Dua area, **TD** – Tam Dao Town and its surrounding forests, **XH** – Xa Huong up-stream, **spe.** – specimens, **sp.** - species

Table 7: Number of bat specimens collected in TDNP

No.	English name	Scientific name	ST-ST	BL	NL	TT-TB-AD	PN	TD	Total
15.	Short-Nosed Fruit Bat	*Cynopterus sphinx*	2		4	1		1	**8**
16.	Bat	*Sphaerias blanfordi*						*	
17.	Bat	*Megaerops niphanae*						*	
18.	Cave Fruit Bat/ Dawn Fruit Bat	*Eonycteris spelaea*		2					**2**
19.	Black-Bearded Tomb Bat	*Taphozous melanopogon*						3	**3**
20.	Himalayan Leaf-Nosed Bat	*Hipposideros armiger*			1		1		**2**
21.	Large Roundleaf Horseshoe Bat	*Hipposideros larvatus*	2		1	6	1	2	**12**
22.	Bat	*Hipposideros pomona*						1	**1**
23.	Woolly Horseshoe Bat	*Rhinolophus luctus*						*	
24.	Intermediate Horseshoe Bat	*Rhinolophus affinis*		1	3	1		2	**7**
25.	Big-Eared Horseshoe Bat	*Rhinolophus macrotis*						3	**3**
26.	Pearson's Horseshoe Bat	*Rhinolophus pearsonii*				2			**2**
27.	Least Horseshoe Bat	*Rhinolophus pusillus*	1	1				12	**14**
28.	Hardwicke's Forest Bat	*Kerivoula hardwickii*		1					**1**
29.	Round-Eared Tube-Nosed Bat	*Murina cyclotis*		2					**2**
30.	Hairy-Footed Tube-Nosed Bat	*Murina tubinaris*	1	2		1			**4**
31.	Hairy-faced bat	*Myotis annectans*		1					**1**
32.	Himalayan Whiskered Bat	*Myotis siligorensis*	1						**1**
33.	Bat	*Myotis sp.*				1			**1**
34.	Indian Pipistrelle	*Pipistrellus coromandra*					2		**2**
35.	Least Pipistrelle	*Pipistrellus tenuis*				1			**1**
36.	Pipistrelle	***Pipistrellus sp.***			1				**1**
37.	Harlequin Bat	***Scotomanes ornatus***	1		1	1			**3**
38.	Asiantic Greater Yellow House Bat	*Scotophilus heathii*						2	**2**
39.	Collared Serotine	*Thainycterus aureocollaris*			1				**1**
	Total:		**8 spe. 6 sp.**	**10spe. 7 sp.**	**12 spe. 7 sp.**	**14spe. 8sp.**	**4spe. 3 sp.**	**26 spe. 11 sp.**	**74 spe. 22 sp.**

Note:

ST-ST – Suoi Tram-Suoi Tien up-stream,
BL – Ba Luong up-stream**,**
NL – Ngoi Lanh up-stream,
TT-TB-AD – Tay Thien –Thach Ban- Ao Dua area,
TD – Tam Dao Town and its surrounding forests,
PN – Phu Nghia Peak,
spe. – specimens,
sp. – species,
* - after Borissenko et al.,, 2003

- ***Bats***

With total 2,159 net.hours and 300 harp trap.hours, 74 specimens were collected, of which 22 species of bats were identified, belonging to 13 genera, 5 families, 2 sub-orders. 15 species were collected in dry season and 16 species were recorded in wet season. Besides, 3 other species (Woolly Horseshoe Bat *Rhinolophus luctus, Megaerops niphanae*, and *Megaerops niphanae*) has been recorded by other authors (Cao Van Sung et al., 1998; Dang Huy Huynh et al., 1994, Borrissenko et al., 2003), but not recorded in our survey. Totally, 26 species of bats have been recorded in TDNP so far (Annex 2).

Family *Vespertilionidae* contains highest species number (12 species, 48% of species total recorded in TDNP), then follow *Rhinolophidae* (5 species, 20%), *Pteropodidae* (4 species, 16%), *Hipposideridae* (3 species, 12%) and *Emballonuridae* (1 species 4%).

Number of collected specimens, species and their distribution by survey areas are presented in table 7. Tay Thien-Thach Ban-Ao Dua and Tam Dao Town has highest species number (10 and 11 species, respectively) while Tam Dao Town has less survey effort (503 h.m.net) than Tay Thien-Thach Ban-Ao Dua (960 h.m.net). Higher species number of Tam Dao Town is because of existence of many small caves for roosting. Ngoi Lanh up-stream and Ba Luong up-stream has similar low species number (6 or 7 species each) corresponding with similar low survey effort (126 h.m.net and 174 h.m.net respectively). However, habitat in Ngoi Lanh is much better indicates that further study can find more species in this area. Suoi Tram – Suoi Tien up-stream has lowest species number (6 species) while survey effort is not low (396 h.m.net) and habitat looks favorable for bats, at least better than in Ba Luong up-stream. This is difficult to explain why, further study should conduct to check the situation.

- ***Checklis of mammals in TDNP***

As mentioned above, 1993 mammal checklist of TDNP includes of 58 species (FIPI, 1993), and 1998 checklist includes 69 species (Cao Van Sung et al., 1998).

Table 8: Species number of mammals in TDNP and some other protected areas

Protected area	Area (ha)	Total species number	Threatened species*
Tam Dao NP	36,883	77	21
Xuan Son NP (Phu Tho)[1]	15,048	72	31
Huu Lien NR (Lang Son)[2]	10,500	68	28
Ba Be NP (Bac Kan)[3]	7,610	55	26
Na Hang NR (Tuyen Quang)[3]	40,500	89	32
Pu Luong NR (Thanh Hoa)[4]	17,662	65	14
Pu Huong NR (Nghe An)[5]	50,075	64	26
Vietnam[6]		288	116

*Note: 1 –Department of Zoology, 2004; 2 – Department of Zoology, 1998 ; 3 – Le Trong Trai et al., 2004; 4- Dang Ngoc Can, 2003, 5- Department of Zoology, 2001; 6- Nguyen Xuan Dang, 2005; * - species enlisted in Red data book of Vietnam (2000), IUCN Red List (2004) and Governmental Decree 48/2002/NDCP*

This survey allows to compile a new checklist of 77 mammal species including 3 bat species recently recorded by other author but not recorded in this survey (Annex 2). These 77 species belong to 24 families and 8 orders. Order Bats *Chiroptera* has highest species number (25 species), then follow order Carnivores *Carnivora* (20 species), Rodents *Rodentia* (18 species), Primates *Primates* (5 species), Even-toed ungulates *Artiodactyla* (5 species), Insectivores *Insectivora* (2 species), Tree-shrews *Scandentia* and Pangolin *Pholidota* (1 species each). Table 8 provides comparison of number of recorded mammal species between TDNP and some other protected areas with limestone landscape.

With 77 species recorded, TDNP harbors about 26.7% of total Vietnam's mammal species number and about 18,1% of its total threatened species. Comparison with 6 other limestone protected areas (Table 8) shows that TDNP still contains high mammal species diversity, but low number of threatened species (i.e., species of high conservation value). This indicates that, though still containing high species diversity, TDNP is loosing its importance for conservation of nationally and globally important biodiversity components.

Table 9 gives comparison of bat diversity between TDNP and some other protected areas which have relatively similar effort of bat survey.

Table 9. Species number of bats inTDNP and some other protected areas

Protected area	Area (ha)	No. family	No. genus	No. species	Threatened species*
Tam Dao NP (Vinh Phuc)	36,883	5	14	25	2
Xuan Son NP (Phu Tho)[2, 4]	15,048	5	16	25	3
Huu Lien NR (Lang Son)[1]	10,500	5	11	23	9
Ba Be NP (Bac Kan) [5]	7,610	5	16	27	5
Na Hang NR (Tuyen Quang)[5]	40,500	6	20	45	11
Pu Luong NR (Thanh Hoa)[3]	17,662	4	10	24	5

*Note: 1- Nguyen Truong Son, 2004; 5- Nguyen Truong Son, 2005; 2- Pham Duc Tien, 2004; 3- Vu Dinh Thong, 20044; Vu Dinh Thong, 2005. ; * - species enlisted in Red data book of Vietnam (2000), IUCN Red List (2004) and Governmental Decree 48/2002/NDCP.*

The bat species diversity of TDNP is equal to those of 4 other protected areas (Xuan Son NP, Huu Lien NR, Ba Be NP and Pu Luong NR), but much lower than those in Na Hang NR. The area of TDNP and Na Hang NR is almost equal. Less number of bat recorded in TDNP can be explained by more habitat destruction and disturbance in TDNP. Besides, TDNP also have no large caves like in Na Hang NR where many species come to roost.

3.2. Abundance

- ***Large mammals***

No specific abundance-estimating techniques were used during this survey, therefore, we use abundance of field records (mostly, mammals activity signs) as indirect index of mammal abundance and also refer to village interview information for some correction. One record is assumed as a locality where animal or its sign was seen. Many species (deer, wild pigs, civets,

etc.) may leave many signs (tracks) in one locality, then this locality with cluster of animal signs should be assumed as one record. Record rate is calculated as total number of records of species in concern divided by total transect distance (417 km, Table 1). Record rate of large mammal species are presented in table 10.

Table 10. Record rate (*record/km*) of large mammal species in TDNP

No	English name	Scientific name	No. of records	Record rate
1.	Slow Loris	*Nycticebus coucang*	0	0
2.	Stump-Tailed Macaque	*Macaca arctoides*	0	0
3.	Rhesus Macaque	*Macaca mulatta*	0	0
4.	Assamese Macaque	*Macaca assamensis*	0	0
5.	Francoi's Langur	*Trachypithecus francoisi*	0	0
6.	Raccoon Dog	*Nyctereutes procyonoides*	90	0.216
7.	Asiatic Black Bear	*Ursus thibetanus*	0	0
8.	Sun Bear	*Ursus malayanus*	0	0
9.	Hog Badger	*Arctonyx collaris*	120	0.288
10.	Small-Clawed Otter	*Aonyx cinerea*	1	0.002
11.	Yellow-Throated Marten	*Martes flavigula*	2	0.005
12.	Small-Toothed Ferret-Badger	*Melogale moschata*	200	0.480
13.	Yellow-Bellied Weasel	*Mustela kathiah*	0	0
14.	Back-Striped Weasel	*Mustela strigidorsa*	0	0
15.	Three-Striped Palm Civet	*Arctogalidia trivirgata*	0	0
16.	Owston's Banded Civet	*Hemigalus owstoni*	30	0.072
17.	Masked Palm Civet	*Paguma larvata*	80	0.192
18.	Common Palm Civet	*Paradoxurus hermaphroditus*	80	0.192
19.	Spotted Linsang	*Prionodon pardicolor*	0	0
20.	Large Indian Civet	*Viverra zibetha*	0	0
21.	Small Indian Civet	*Viverricula indica*	0	0
22.	Small Asian Mongoose	*Herpestes javanicus*	3	0.007
23.	Crab-Eating Mongoose	*Herpestes urva*	0	0
24.	Golden Cat	*Catopuma temminckii*	0	0
25.	Leopard Cat	*Prionailurus bengalensis*	12	0.029
26.	Wild Boar	*Sus scrofa*	200	0.480
27.	Lesser Malay Mouse Deer	*Tragulus javanicus*	0	0
28.	Sambar	*Cervus unicolor*	5	0.012
29.	Common Barking Deer	*Muntiacus muntjak*	75	0.180
30.	Southern Serow	*Naemorhedus sumatraensis*	11	0.026
31.	Chinese Pangolin	*Manis pentadactyla*	9	0.022

Record rates do not always reflect the real abundance of the species in the wild, especially species with cryptic life or not conspicuous signs. Within 16 species with 0 record/km, 11 species (Slow Loris, Stump-Tailed Macaque, Rhesus Macaque, Assamese Macaque, Francoi's Langur, Asiatic Black Bear, Sun Bear, Golden Cat, Large Indian Civet, Small Indian Civet and Lesser Malay Mouse Deer) could not record, mainly because of their very low density in the wild: primate

species are diurnal and signs of the large carnivores and Mouse deer are easy to recognize if they occur in the survey areas. Their low number is also reported during the village interview. Four (4) Small carnivore species (Yellow-Bellied Weasel, Back-Striped Weasel, Spotted Linsang, Crab-Eating Mongoose) could not record, possibly, because of their scryptic life within dense bushes. This record rate does not reflect their number in the wild.

Species with high record rate, indicating their commonness in the wild are Wild Boar (0.480), Small-Toothed Ferret-Badger (0.480), Hog Badger (0.288), Raccoon Dog (0.216), Common Barking Deer (0.180), Masked Palm Civet (0.192) and Common Palm Civet (0.192) . Species with low record rate, indicating their very low density in the wild are Small-Clawed Otter (0.002), Sambar (0.012), Chinese Pangolin (0.022), Southern Serow (0.026), Leopard Cat (0.029).

Totally, within 31 species of large mammals in TDNP, 15 species (35.5%) have very low number in the wild, only 7 species (22.6%) are common. This indicates fauna of large mammals in TDNP has been much degraded in abundance.

- ***Small mammals***

Capture rate of small mammal is presented in Table 11. Noisy rat appears to be the most abundant in the area (27.2% of specimen total and 0.0166 specimen/night.trap), then follows Pallas's Squirrel (13.3% & 0.0081 specimen/night.trap), Red-Cheeked Squirrel (11.6% & 0.0081 specimen/night.trap), Chestnut rat (10.8% & 0.0064 specimen/night.trap), Dark-tailed rat (8.7% & 0.0053 specimen/night.trap).

Table 11: Capture rate (*specimen per.trap. night*) of small mammals in TDNP

No.	English name	Scientific name	Total Spec.	% per Total	Capture rate
1.	Grey Shrew	*Crocidura attenuata*	9	5.2	0.0032
2.	White-Tailed Shrew-Mole	*Talpa leucura*	5	2.9	0.0018
3.	Pallas's Squirrel	*Callosciurus erythraeus*	23	13.3	0.0081
4.	Perny's Long-Nosed Squirrel	*Dremomys pernyi*	5	2.9	0.0018
5.	Red-Cheeked Squirrel	*Dremomys rufigenis*	20	11.6	0.0071
6.	Hainan's Striped Tree Squirrel	*Tamiops maritimus*	9	5.2	0.0032
7.	Noisy Rat	*Leopoldamys sabanus*	47	27.2	0.0166
8.	House Mouse	*Mus musculus*	1	0.6	0.0004
9.	Dark-Tailed Rat	*Niviventer tenaster*	15	8.7	0.0053
10.	Chestnut Rat	*Niviventer fulvescens*	18	10.4	0.0064
11.	Rice-Field Rat	*Rattus argentiventer*	2	1.2	0.0007
12.	Sladen's Rat	*Rattus remotus*	9	5.2	0.0032
13.	House Rat	*Rattus rattus*	5	2.9	0.0018
14.	Large Bandicoot Rat	*Bandicota indica*	5	2.9	0.0018
		Total:	**173**	**100**	**0.0612**

*Note: **Spec**.- Specimen, **% per total**: percentage of specimen number of each species per total species number, **Capture rate** – Specimen number of each species per total survey effort (2,826 .trap.night).*

These are typical species of limestone forests, their dominant percentage within collected specimens is reasonable. Other 2 species (Hainan's striped tree squirrel, Perny's long-nosed squirrel) are also common in TDNP. They were observed regularly in many localities of surveyed areas, though number of their captured specimens is low. Hoary bamboo rat and Asiatic brush-tailed porcupine are also wide-spread in TDNP. Their dens and tracks were found in many localities of survey areas.

Capture rate of total small mammal fauna is 0.0612 specimen/night.trap (Table 11), higher than those in Pu Mat NR (0.016; SFNC 2000) and Vu Quang NP (0.039; Kuznesov et al. 2001). This may relate to more habitat degradation and low density of small carnivores in TDNP.

- ***Bats***

Capture rate of bats in TDNP is 0.034 specimen/h.m.net (74 specimens per 2,159 h.m.net), much lower than those in some other protected areas such as Ba Be NP (0.125), Na Hang NR (0.123) and Huu Lien NR (0.121). This indicate low abundance of bat fauna in TDNP. This can be explained by low number of large caves where bats prefer to roost in survey area. Most of investigated caves are small and disturbed by local residents (overnight, cooking, resting, etc.).

Number of collected specimens is presented in table 7. Capture rates of all species are shown in Table 12. Dominant species are Least Horseshoe Bat *Rhinolophus pusillus* (19% of specimen total, 0.0065 specimen/h.m.net), Large Roundleaf Horseshoe Bat *Hipposideros larvatus* (16.2%, 0.0056), Greater Short nosed Fruit Bat *Cynopterus sphinx* (11%, 0.0037), Intermediate *Rhinolophus affinis* (9.5%, 0.0032) and Scully's Tube-nosed Bat *Murina tubinaris* (5.4%, 0.0032). These species were recorded from many localities in survey areas in both seasons.

The species with only one specimen collected during whole survey duration are Blanford's Fruit Bat *Sphaerias blanfordi*, Tail-less Fruit Bat *Megaerop niphanae*, Woolly Horseshoe Bat *Rhinolophus luctus*, Hairy-faced Bat *Myotis annectans*, Hardwickey's Woolly Bat *Kerivoula hardwicki*, Hymalayan Whiskered *Myotis siligorensis*, Least Pipitrelle *Pipistrellus tenuis*, *Thainycteris aureocollaris* and Indian Pipistrelle *Pipistrellus coromandra.*

Table 12: Capture rate (*specimen/h.m.net*) of bats in TDNP

No	English name	Scientific name	Total Spec.	% per Total	Capture rate
1.	Short-Nosed Fruit Bat	*Cynopterus sphinx*	8	10.8	0.0037
2.	Cave Fruit Bat/ Dawn Fruit Bat	*Eonycteris spelaea*	2	2.7	0.0009
3.	Black-Bearded Tomb Bat	*Taphozous melanopogon*	3	4.1	0.0014
4.	Himalayan Leaf-Nosed Bat	*Hipposideros armiger*	2	2.7	0.0009
5.	Large Roundleaf Horseshoe Bat	*Hipposideros larvatus*	12	16.2	0.0056
6.	Bat	*Hipposideros pomona*	1	1.4	0.0005
7.	Intermediate Horseshoe Bat	*Rhinolophus affinis*	7	9.5	0.0032
8.	Big-Eared Horseshoe Bat	*Rhinolophus macrotis*	3	4.1	0.0014
9.	Pearson's Horseshoe Bat	*Rhinolophus pearsonii*	2	2.7	0.0009
10.	Least Horseshoe Bat	*Rhinolophus pusillus*	14	18.9	0.0065
11.	Hardwicke's Forest Bat	*Kerivoula hardwickii*	1	1.4	0.0005

12.	Round-Eared Tube-Nosed Bat	*Murina cyclotis*	2	2.7	0.0009
13.	Hairy-Footed Tube-Nosed Bat	*Murina tubinaris*	4	5.4	0.0019
14.	Hairy-faced bat	*Myotis annectans*	1	1.4	0.0005
15.	Himalayan Whiskered Bat	*Myotis siligorensis*	1	1.4	0.0005
16.	Bat	*Myotis sp.*	1	1.4	0.0005
17.	Indian Pipistrelle	*Pipistrellus coromandra*	2	2.7	0.0009
18.	Least Pipistrelle	*Pipistrellus tenuis*	1	1.4	0.0005
19.	Pipistrelle	*Pipistrellus sp.*	1	1.4	0.0005
20.	Harlequin Bat	*Scotomanes ornatus*	3	4.1	0.0014
21.	Asiantic Greater Yellow House Bat	*Scotophilus heathii*	2	2.7	0.0009
22.	Collared Serotine	*Thainycterus aureocollaris*	1	1.4	0.0005
		Total:	**74**	**100**	**0.0343**

*Note: **Spec**.- Specimen, **% per total**: percentage of specimen number of each species per total species number, **Capture rate** – Specimen number of each species per total survey effort (2,159 h.m.net).*

3.3. Species of conservation concern

Species of conservation concern in TDNP include globally threatened (enlisted in 2004 IUCN Red List), nationally threatened (enlisted in Red Data Book of Vietnam (2000), and species enlisted in Governmental Decree 48/2002/NDCP (table 13) .

Table 13: Mammal species of conservation concern recorded in TDNP

No	English name	Scientific name	IUCN RL	VN RDB	Decree 48
1.	Slow loris	*Nycticebus coucang*	DD	V	IB
2.	Stump-tailed macaque	*Macaca arctoides*	VU	V	IIB
3.	Rhesus macaque	*Macaca mullata*	LRnt		IIB
4.	Assamese macaque	*Macaca assamensis*	VU	V	IIB
5.	Francois's Langur	*Trachypithecus francoisi*	VU	V	IB
6.	Asiatic black bear	*Ursus thibethanus*	VU	E	IB
7.	Malayan sun bear	*Ursus malayanus*	DD	E	IB
8.	Golden cat	*Catopuma temminckii*	VU	E	IB
9.	Leopard cat	*Prionailurus bengalensis*			IB
10.	Three-striped palm civet	*Arctogalidia trivirgata*		R	
11.	Owston's palm civet	*Chrotogale owstoni*	VU	V	IIB
12.	Spotted linsang	*Prionodon pardicolor*		R	IIB
13.	Small-clawed otter	*Aonyx cinerea*	LRnt	V	IB
14.	Back-striped weasel	*Mustela strigidorsa*	VU		IIB
15.	Lesser mouse deer	*Tragulus javanicus*		V	IIB
16.	Southern serow	*Naemorhedus sumatraensis*	VU	V	IB

17.	Chinese pangolin	*Manis pentadactyla*	LRnt	V	IB
18.	Malayan Porcupine	*Hystrix brachyura subcristata*	Vu		
19.	Hairy-Footed Flying Squirrel	*Trogopterus pearsonii*	LRnt	R	
20.	Harlequin Bat	*Scotomanes ornatus*	LRnt		
21.	Himalayan Whiskered Bat	*Myotis siligorensis*		R	
		Total (species):	**17**	**16**	**16**

Note: ***IUCN RL*** *(2004 IUCN Red List):* ***VU****- Vulnerable,* ***LRnt****- Low risk/near threatened,* ***DD****- Data deficient for evaluation.* ***VN RDB*** *(Red Book of Vietnam, 2000):* ***E****- Endangered,* ***V****- Vulnerable,* ***R****- Rare.* ***Decree 48*** *(Decree 48/2002/NDCP):* ***IB****- strict ban of hunting and use,* ***IIB****- limited and controlled hunting and use.*

Out of 77 species recorded to be existing in TDNP, 16 species are nationally threatened, 17 species are globally threatened species and 16 species enlisted in Governmental Decree 48/2002/NDCP. Totally, 21 species are of conservation concern, including 17 species of large mammals, 2 species of rodents and 2 species of bats. Out of 31 species of large mammals recorded, 17 species (54.8%) are of conservation concern. This indicates that large mammal fauna in TDNP has very high percentage of conservation concern species and would be very high conservation value.However, most of these species remain in TDNP in very low number and possibly will not survive in the long term due to high pressure of hunting and habitat disturbance remained.

3.4. Species account

GPS location of mammal field records are shown in Annex 4.

3.4.1. Account for species of conservation concern

- *Slow loris*

In spite of its wide distribution in Vietnam, Slow loris is threatened by extensively hunting, trade and habitat destruction. This species is reported to survive in all survey areas of TDNP. Most of interviewed hunters reported their observation or killing of this species during recent 3-4 years. However, no direct sighting of the species could be obtained during survey, possibly, because of their low density and low effort of night survey (due to very steep slopes). Fur of Slow loris was seen from a small shop in Tay Thien Temple, where in April 2005, the shop-keeper bought this animal from local hunter and killed for traditional medicinal treatment. Very likely, that small number of Slow loris still exist in tall forests of survey areas. The forests in these areas can still provide good refuge for them. Current threats to Slow loris population in TDNP are illegal hunting for food, trade and medicinal use. Slow loris is slow-moving nocturnal animal with big eyes, therefore, is easy to be detected and shot by hunters.

- *Stump-tailed macaques, Rhesus macaques and Assamese macaque*

These species have wide distribution in North and Central Vietnam, but they are threatened by extensive hunting for food, medicine and trade and by habitat loss. In TDNP, as reported by local villagers, a group of 10-15 individuals of Stump-tailed macaque was observed in January 2004

near Mo Qua mountain and another group of 7-10 individuals was observed also in January 2004 in Suoi Tram-Suoi Tien Up-stream area. In June 2004, a group of about 10-15 Assamese macaque was observed in Southern slope of peak 1260 and 3 of them was killed by hunters from Ninh Lai Commune. In February 2004, one group of 10-15 individuals of Assamese or Rhesus macaques was observed in Ba Luong area. A group of 4- 5 stump-tailed macaque was observed by hunters near Thien Thi Peak in March 2005 and one was killed by hunters from Quan Chu Commune. One of our local guide also reported one Rhesus macaques was hunted from North Tam Dao area by a hunter from Ninh Lai Commune (Tuyen Quang Province) in March 2005.

During our field surveys, no direct observation could be obtain. The short vocalization and moving noise of macaque was heard at mountain peak of Suoi Tram-Suoi Tien Up-stream area, at 9 December 2004. Freshly broken leaves and branches, possibly made by macaques were also found in mountain top of Tay Thien-Thach Ban- Ao Dua area at 9 December 2004. A small mountain corner with old sleeping site of macaques was checked, but no sign of their recent use could be found.

Possibly, very few macaques still exist in areas of Tay Thien-Thach Ban- Ao Dua, Suoi Tram-Suoi Tien and Ngoi Lanh up-stream. Forests in these areas can provide good habitat for them. Macaques are one of extensive hunting objects of local hunters. The animals are hunted by guns and leg-holding traps.

- *Francois's Langur*

In Vietnam, Francois langur occurs only in the North and is highly threatened by illegal hunting, trade and habitat loss. Very few local informants reported about existence of this species in TDNP. During our field surveys, neither direct sighting nor their signs could be found, however, 3 local hunters which we met in forest informed that in just March 2005, they saw a group of 3 individuals in Phu Nghia peak area (Quan Chu Commune). Their description of external features of Francois's langur is quite correct, that gives their information believable.

Considering the interview information and quality of forest cover, few (about 10) individuals of Francois's langur possible still survive in areas of Phu Nghia – Thach Ban peaks. The status of Francois's langur in TDNP is critical and illegal hunting is detrimental threat to their survival.

- *Asian Black Bear and Malayan Sun Bear*

Asian Black Bear and Malayan Sun Bear are wide spread in Vietnam, but both are seriously threatened by illegal hunting for meat, medicine, keeping for gall bladder, trader, and by habitat loss. Both species are reported to be existing in TDNP in very low number. Villagers from Quan Chu Commune reported to see an Asiatic black bear and their scratches in Mo Qua area., in November 2004. Another bear was reported to come close to Tay Thien Tempe (Den Co Temple) for feeding on fruits, in April 2004. During our field survey, no fresh sign of these species could be found, except old scratches on a tree near Tay Thien Temple. Some individuals of bears, possibly still exist in TDNP, however, high hunting may eliminate them from the Park soon.

- *Golden cat*

Golden cat is wide spread in Vietnam, but highly threatened by illegal hunting and habitat loss. The species is reported to be seen occasionally in TDNP. Especially, in September 2004, during his field work in TDNP, Dr. Dang Ngoc Can from IEBR has observed the fresh track of a Golden cat which come to Village 1 of Tam Dao Town for prey on domestic animals. The footprints are of about 4cm wide in diametre. No fresh signs of Golden cat were found during our field survey. Obviously, population of Golden cat in TDNP is small and threatened by illegal hunting pressure.

- *Owston's palm civet*

Owston's palm civet is threatened by illegal hunting for food, trade and by habitat loss. One dead individual was seen at an eating shop in Son Duong Town (Tuyen Quang Province), at 2 December 2004, and another fresh killed one was seen in Hop Hoa Commune at 9 December 2004. The animals are reported to killed in TDNP surrounding. As reported by local residents, at least 2 other individuals of Owston's palm civet were killed during February-April 2005. During our field investigation, signs of digging for earthworm, possibly made by owston's palm civet were found in several localities of Suoi Tram-Suoi Tien Up-stream area and Tay Thien-Thach Ban- Ao Dua area.

Owston's palm civet exists in TDNP, but under high threat of locally extinction. Most of humid valleys in low elevation – their favorable habitat – were much degraded or highly disturbed by human encroachment and cattle raising. In high elevation they are threatened by gun-hunting and trapping. As reported by local hunters, Owston's palm civet is easy to hunt because of their habit to walk along trail to search for earthworm dens.

- *Three-striped palm civet, Spotted linsang, Small-clawed otter, Back-striped weasel*

These 4 species are reported to be existing in TDNP. Some their hunting remains were shown during village interview survey: one stuff of Spotted lisang was seen in Hop Hoa commune which is reported to killed in TDNP in 2001, one stuff of Back-striped weasel was seen in Tam Dao Town which is reported to killed in TDNP in 2000. Small-clawed otter is reported recently seen in Tay Thien stream in November 2004 and in a small reservoir in Tam Quan commune in December 2004. During our field surveys, only one fresh dung pile of Small-clawed otter was found in May 2005, on side stream running to Tay Thien stream. In fact, with their low density, it is not easy to get sighting of these species by transect survey techniques, specific technique such as camera trapping is necessary. In TDNP, these species are threatened mostly by habitat degradation and trapping.

- *Lesser mouse deer*

Most of local informants reported extinction of Lesser mouse deer from Tam Dao NP. Only few villagers from Trung My Commune reported its existence in watershed area of Trung My lake. During field surveys, due to time limitation, we did not check this area, and no sign of this species was found in other surveyed areas. Lesser mouse deer, possibly, survives in TDNP in critical low number. They are threatened by habitat disturbance and illegal hunting by guns and traps.

- *Southern serow*

Limestone forests of TDNP are favorable habitat for Southern serow. As reported by local villagers, the species was once very abundant, however, intensive hunting for many years has seriously reduced its number. At present, Southern serow still exists in high elevations (mostly above 700m a.s.l.) of TDNP, in low density. During our field surveys, no direct sighting of the animals could be obtained, but their tracks and droppings were found only in several localities of Suoi Tram- Suoi Tien up-stream , Ngoi Lanh Up-stream, Tay Thien-Thach Ban- Ao Dua area and Tam Dao-Xa Huong area.

The habitat in TDNP can support large population of Southern serow, however, hunting by gun and snare remains considerable threat to the species survival. The animals are hunted for food, traditional medicine and illegal trade. At least, 3 serows was reported to be killed at La Bang Commune in 2004.

- *Chinese pangolin*

Chinese pangolin is threatened by extensive hunting for food, medicine and especially for illegal export. The species is reported to be almost extinct from TDNP. During our field surveys only few signs of their activity were recorded, namely, dens were found in 3 localities of Ngoi Lanh up-stream and Tay Thien-Ao Dua area , and signs of breaking decaying trees for insects were observed in 6 localities of Ngoi Lanh up-stream and Tay Thien-Thach Ban area.

Currently, main threat to Chinese pangolin in Tam Dao NP is hunting. Their dens are easy to recognize in the wild by conspicuous hill of new soil just in the den's entrance. Several old dens destroyed by hunters for pangolin were observed in the forests during this survey.

- *Malayan Porcupine, Hairy-Footed Flying Squirrel*

As reported by local villagers, Malayan Porcupine has been significantly reduced in number due to extensive hunting for food and medicine. During our field surveys fresh dens of Malayan porcupine were observed in a number of localities of all survey areas.

Hairy-footed flying squirrel is reported to be often seen in tall forest at night. In April 2005, a shop-keeper in Tay Thien Temple bought one alive individual and kept for several days before the animal dead. Fur of this animal still remains when we came to examine. Two individuals, possibly of this species were observed at night, one was close to our dry season camp in Suoi Tien up-stream and another was near to our camp in Ba Luong up-stream.

- *Hymalayan Whiskered bat and Harleequin bat*

Only 1 individual of Hymalayan Whiskered *Myotis siligorensis* was recorded in Suoi Tram stream area (Khang Nhat commune) at 21:35, when they were flying closely surface water to search for food. This species is also recorded in some other limestone mountains in Vietnam.

Four (4) individuals of Harleequin Bat *Scotomanes ornatus* were recorded in 3 different areas, 2 individuals were catch by net at 20:40 and 20:55 in the Tay Thien stream area , 1 individual was caught by net at 04:50 in the SuoiTram stream area and 1 individual was caught by net at 04:00

in the Ngoi Lanh stream area. These individuals were recorded when they flied along the stream to search for food.

3.4.2. Account for other species

- *Small carnivores*

Except threatened carnivore species described above, other 11 small carnivore species are recorded during these surveys. Of them, 1 species (Small-Toothed Ferret Badger) was recorded through confiscated specimen, 3 species (Yellow-throated Marten, Common palm civet and Small Asian Mongoose) were observed, 4 species (Hog badger, Yellow-belied weasel, Masked palm civet and leopard cats) were recorded by their activity signs or hunting remains, and 4 species (Raccon dog, Large indian civet, Small indian civet and Crab-eating mongoose) were recorded by village interview. All small carnivores are threatened by hunting (both by guns and traps) for food, medicine and illegal trade, and habitat disturbance.

Masked palm civet and Common palm civet are wide-spread in Tam Dao NP. One hunted individual of Common palm civet was observed in La Bang Communes in 3 January 2005. Direct observation of Common palm civet was also obtained by night survey in Ba Luong up-stream and Tay Thien area. Fresh signs of both species (tracks, eating fruit remains, and droppings) were found in many localities of all surveyed areas: in Suoi Tram-Suoi Tien Up-stream, Ba Luong area, Ngoi Lanh up-stream, Tay Thien -Thach Ban - Ao Dua and Tam Dao - Xa Huong
Small-tooth ferret is among the most common large animals in Tam Dao NP. Two individuals were found captured by snares in Xa Huong area and another individual was captured by rodent trap in Suoi Tram-Suoi Tien area. Fresh signs (digging for food and tracks) of Small-toothed ferret were wide-spread in all surveyed areas. Ground with many stone caves and humid wood forest provide good habitat for this species. Main threat for this species is trapping by local residents.
Leopard cat is reported to often come to prey on domestic chicken in Chiem and Yen Trung Villages of Quan Chu Commune (Thai Nguyen Province). During our field surveys, one individual was observed in tall forest at Ao Dua area. Another was seen when it came to prey on bird stuck in mist-net in Suoi Tram area. Their tracks and droppings were found in Suoi Tram-Suoi Tien area, Ba Luong area.Ngoi Lanh up-stream, Tay Thien-Thach Ban-Ao Dua area and Xa Huong up-stream.

- *Even-toed ungulates*

Wild pig is quite common and wide spread in TDNP. It is reported during village interview that the species got increased in number during recent 3 years due to better park management. During our surveys, no direct sighting could be obtained, however, their recent and fresh signs were found abundant in many localities of all survey areas.

Common barking deer is still common and wide-spread in Tam Dao NP. Their fresh signs (tracks, eating remains) were found in many localities of 4 survey areas, especially in Ba Luong up-stream. Barking vocalization of male was also heard at nights (18- 19 May) from our campsite in Xa Huong up-stream.

Most of local informants reported extinction of Sambar from TDNP, except some informants from Quan Chu and Tam Quan Communes. During our surveys, Sambar tracks were found in on few localities of Suoi Tram-Suoi Tien up-stream, Tay Thien- Ao Dua area and Xa Huong up-stream. Obviously, Sambar still exists in TDNP, but in critical low density.

The even-toed ungulates in TDNP are facing considerable hunting pressure (by guns and traps), and also habitat disturbance by human encroachment and domestic cattle raising.

- *Small mammals*

Four teen (14) species of small mammals were recorded by trapping during these surveys. Locations of trapping sites are given in Table 2 and number of species and specimens collected in each sites is given in Table 6. Totally, 9 species (43 specimens) are recorded in Suoi Tram-Suoi Tien up-stream; 6 species (13 specimens) recorded in Ba Luong up-stream (0552564/2391454), 4 species (14 specimen) recorded in Ngoi Lanh up-stream; 9 species (40 specimens) recorded in Tay Thien-Thach Ban-Ao Dua area (; 7 species (29 specimens) recorded in Tao Dao Town surrounding; and 10 species (34 specimens) recorded in Xa Huong up-stream.

- *Bats*

Twenty two (22) species of bats were recorded during these surveys. Number of specimen of each species and location of specimen collecting sites is presented in table 7. Totally, 6 species (7 specimens) are recorded in Suoi Tram-Suoi Tien up-stream, 7 species (10 specimens) recorded in Ba Luong up-stream, 7 species (12 specimens) recorded in Ngoi Lanh up-stream, 8 species (14 specimens) recorded in Tay Thien-Thach Ban-Ao Dua area, 3 species (4 specimens) recorded in Phu Nghia peak and 11 species (26 specimens) recorded in Tam Dao Town surrounding.

IV. DISCUSSION

4.1. Importance of TDNP for mammal conservation

TDNP is located in Global 200 ecoregion "Northern Indochina subtropical moist forest" which contains the second highest richness value for mammals in Asia (Olson D., M., et al, 2000). TDNP has been designated as Important Bird Area because it supports large number of bio-restricted species (Tordoff, 2002). TDNP also once supported rich mammal fauna (Cao Van Sung et al., 1998).

Forest cover in TDNP consists of two main types, lowland evergreen forest and lower montane evergreen forest with some elfin forest on high peaks (Tordoff, 2002). At present, though having been over-exploited for many years, TDNP still support one of the most extensive, contigurous tracts of lowland, lower montane and bamboo forests in Northern Vietnam. This makes the TDNP as an important place for maintaining a diverse mammal fauna in Northern Vietnam.

The mammal fauna in TDNP has been degraded due to long-term over-exploitation and forest destruction, however, 77 mammal species are recorded to exist in TDNP, indicating relatively

high mammal species diversity of the park. Population size of some large mammal species is small, but the park is supporting viable populations of many small carnivores and other small mammal species.

The importance of TDNP in conservation of the country's bat fauna is reduced due to their low abundance and severe habitat disturbance remained. However, species number is relatively high and comparable with other protected areas in Vietnam, and 2 threatened species are recorded (Harlequin bat – a globally threatened and Himalayan wiskered bat – a nationally threatened). This gives opportunity for recovery of the fauna when habitat disturbance will be mitigated. TDNP may have few large caves for roosting of large bat populations, however, the forests can support good refuge and food sources for other species, especially, fruit-eating bats. Rodents shown high abundance in TDNP indicating high habitat disturbance and possibly, low abundance of rodent-prey small carnivores. Within rodents, only one globally threatened species is recorded – Malayan porcupine (Vu). This species has been seriously reduced in number, but can recover if illegal hunting mitigated.

Seventeen (21) globally and nationally threatened species are recorded to exist in TDNP, but 9 of them (Stump-tailed macaques, Rhesus macaque, Assamese macaque, francois's langur, Asiatic black bear, Malaysian sun bear, Small-clawed otter, Chinese pangolin, Lesser mouse deer) have extremely low number, while existing in much better status in other protected areas of Vietnam, therefore, TDNP should not pay important role in their conservation. Other species possibly remain in more or less viable population, however, their population size should be further estimated, hunting and habitat disturbance should be mitigated as soon as possible. Back-striped weasel have been found in few areas in Vietnam (Yen Bai, Bac Kan, Vinh Phuc), its occurrence in TDNP give more hope to its conservation, further study needs to determine population size of this species in TDNP.

4.2. Conservation priority setting

4.2.1. Species and populations

Though being degraded, mammal fauna in TDNP still has high conservation value. This value will be rapidly reduced if TDNP will not improve their management, first of all, strengthening law enforcement to stop illegal wildlife hunting and habitat disturbance. First of all, the extensive enforcement activities should be focused on protection of 21 species of high conservation concern shown in Table 13. Moreover, considering their critical low abundance and existing extensive illegal hunting as the most serious immediate threat to their survival, out of above 21 species, following species must be treated as of *top conservation priority*: Slow loris, Stump-tailed macaque, Assamese macaque, Rhesus macaque, Francois's langur, Asiatic black bear, Malayan sun bear, Lesser mouse deer, Southern serow and Chines pangolin. Besides, Sambar is not nationally or globally threatened species, but in TDNP it remains only in critical low number and under high hunting pressure, therefore, must be taken for top priority. So totally, 22 species must be treated as of high conservation priority, of which 11 species must be treated of top conservation priority. Location of key populations of conservation priority species is shown in table 14.

Table 14: Location of key populations of conservation priority species

No	English name	Location of key populations
1.	Slow loris - *Nycticebus coucang*	Suoi Tram- Suoi Tien up-stream, Tay Thien –Thach Ban- Ao Dua area.
2.	Stump-tailed macaque - *Macaca arctoides*	Suoi Tram- Suoi Tien up-stream, Tay Thien –Thach Ban- Ao Dua area, Ngoi Lanh up-stream-Peak 1590m.
3.	Rhesus macaque - *Macaca mullata*	Suoi Tram- Suoi Tien up-stream, Tay Thien –Thach Ban- Ao Dua area , Ngoi Lanh up-stream-Peak 1590m.
4.	Assamese macaque - *Macaca assamensis*	Suoi Tram- Suoi Tien up-stream, Tay Thien –Thach Ban- Ao Dua area, Ngoi Lanh up-stream-Peak 1590m.
5.	Francois's Langur - *Trachypithecus francoisi*	Tay Thien –Thach Ban- Ao Dua area (Thach Ban, Thien Thi, Phu Nghia peak)
6.	Asiatic black bear - *Ursus thibethanus*	Tay Thien –Thach Ban- Ao Dua area
7.	Malayan sun bear - *Ursus malayanus*	Tay Thien –Thach Ban- Ao Dua area
8.	Sambar - *Cervus unicolor*	Xa Huong up-stream
9.	Lesser mouse deer - *Tragulus javanicus*	Trung My reservoir up-stream
10.	Southern serow - *Naemorhedus sumatraensis*	Suoi Tram- Suoi Tien up-stream, Tay Thien –Thach Ban- Ao Dua area, Ngoi Lanh up-stream-Peak 1590m, Xa Huong up-stream.
11.	Chinese pangolin - *Manis pentadactyla*	Tay Thien –Thach Ban- Ao Dua area

4.2.2. Habitat areas

Forest cover in TDNP is seriously degraded in lower elevations (below 500 m a.s.l.), however, remains in relative good status in higher elevation, especially, in 4 of five our survey areas (Suoi Tram- Suoi Tien up-stream, Ngoi Lanh up-stream- Peak 1590, Tay Thien –Thach Ban- Ao Dua area, Xa Huong up-stream, Map 1-5). These areas possibly maintain most of key mammal species of TDNP. Distribution of recorded species by the survey areas is presented in Annex 2 and summarized in table 15.

Table 15: Number of recorded species by each survey areas

Survey area	No. of recorded species	No. of conserv. priority species
Suoi Tram- Suoi Tien up-stream	52 (67.5%)	20 (95.2%)
Ba Luong up-stream	34 (44.2%)	6 (28.6%)
Ngoi Lanh up-stream	39 (50.6%)	11 (52.4%)
Tay Thien –Thach Ban- Ao Dua area	56 (72.7%)	20 (95.2%)
Tam Dao Town and its surrounding forests	37 (48.1%)	6 (28.6%)
Xa Huong up-stream	40 (56.6%)	13 (61.9%)
Total:	**77 (100%)**	**21 (100%)**

Suoi Tram- Suoi Tien up-stream and Tay Thien- Thach Ban-Ao Dua has the good forest cover with large area of tall wood forest. Highest number of mammal species (52 species; 67.5% and 56 species; 72.7%, respectively) and also highest number of conservation priority species (20 species; 95.2%) are found in these area. Almost all conservation priority species recorded to exist in TDNP inhabit these areas. Protection of Suoi Tram- Suoi Tien up-stream is under responsibility of Hiep Hoa Guard Station and protection of Tay Thien- Thach Ban-Ao Dua is under responsibility of Dai Dinh Guard Station.

Forests in Ngoi Lanh up-stream- Peak 1590m are almost as good as in Suoi Tram- Suoi Tien Up-stream and Tay Thien- Thach Ban-Ao Dua, however, the number species recorded is lower (39 species; 50.6%), possibly due high human disturbance pressure. This area is located close to one the most wildlife hunting active commune (Ninh Lai commune) and hunting pressure has been high for many years. If human disturbance will be controlled this area can provide quite good habitats for many wildlife species including threatened mammal species. 11 species of conservation priority were found in this area. Dao Tru Guard Station is responsible for protection of this area

Forests in Tam Dao Town surrounding are degraded, but can support large number of mammal species (37 species; 48.1%), however, human impacts are increasingly high due to increase of tourist number and tourism-service infrastructure constructions. A large car road to tourism complex Tam Dao II is under construction and more buildings will also be constructed here in near future. This obviously will lead to increase tourism number and their impacts on the nature resources of TDNP. This area is loosing its importance for maintaining high conservation priority species. This area is under protection responsibility of Tam Dao Town Guard Station.

Forest cover in Xa Huong up-stream area consists mainly of bamboo forest with scattered tall trees, bamboo forest and few small patches of tall wood forest. Forty (40) species of mammals are recorded in this area, including 13 species of high conservation value. However, most of large mammal species have very low density while human disturbance (hunting, NTFPs collecting, cattle raising) is high. If human disturbance will be controlled, this area can supported reasonable population of some conservation priority species such as Southern serow, Sambar, Stump-tailed macaques, Rhesus macaque, and Assamese macaque, etc. Protection of this area is under responsibility of Minh Quang Guard Station.

Ba Luong up-stream has much degraded forests. Forest cover consists mainly of bamboo forests and bamboo forest with scattered trees. Human disturbance in this area is very high, including wildlife hunting and NTFPs collecting. This area is located close to tea production villages which need large volume of firewood for tea processing. Every day about hundred of villagers encroaching this area for firewood collecting. Though, 34 species (6 species of high conservation priority) has been recorded in this area, but this area is loosing its biodiversity conservation value and should not consider as conservation priority area. Protection of this area in under responsibility of Hoang Nong Guard Station.

In term of bat conservation, 3 areas can be set for priority: Tam Dao Town and surrounding (11 species recorded, many small cave with bat roosting); Tay Thien-Thach Ban-Ao Dua area (8 species recorded, including one nationally threatened species, Hymalayan Whiskered *Myotis siligirensis*) and Ngoi Lanh up-stream area (7 species recorded, including 1 globally threatened species, Harlequin Bat *Scotomanes ornatus*).

In general, in term of supporting mammal conservation, following areas should be taken for priority: Suoi Tram- Suoi Tien up-stream, Tay Thien- Thach Ban-Ao Dua, Ngoi Lanh up-stream-Peak 1590m, Xa Huong up-stream and Tam Dao Town surrounding (for bat comservation).

4.3. Current threats to mammal fauna

With about 150,000 people living in buffer zone, TDNP has to face with great pressure on its natural resources. Poor management capacity and un-strict enforcement of forest protection regulations has led to level of timber extraction, firewood collecting, wildlife hunting and other illegal impacts in TDNP higher than those with other national parks in Vietnam (Tordoff et al., 2004). However, as reported by Head of TDNP Forest Protection Unit, the protection have been improved in the last tree years, timber extraction is almost under control, wildlife hunting has been reduced. Current direct threats to the mammal fauna are as following.

- ***Illegal animal hunting***

Wildlife hunting has been better controlled (or reduced), especially since 2001 (GTZ Office Vietnam - Wildlife trade report, 2004). Main reasons are: 1) Abundance of economic species is exhausted, abundance of other species is also significantly reduced, and 2) The patrolling and enforcement activities of Park's rangers is more effective, especially due to close cooperation between Park's Forest Guard stations and local contractees of forest protection in forest patrolling. However, illegal hunting still remains relatively extensive (Table 16). A fresh hunted common palm civet was seen in La Bang Commune (Thai Nguyen Province), in 3 January 2005 and a fresh hunted owston's palm civet was also seen in Hiep Hoa Commune in 9 November 2005. During our field survey, about 12 hunters were met in forests and about 20 hunting shelters (8 shelters are in use with wildlife remains) were seen in survey areas. Local hunters use both local-made guns and traps/snares to hunt animals. Trapping is more popular. There are several kind of traps. Bamboo traps are use to catch small mammals such rodents, but small civets also can be trapped. The traps are set in long line with fence between to guide animals to the traps to increase trapping efficiency. Each trapline varies from 50m to about 1,000m with about 10 – 100 traps.

Table 16: Some wildlife hunting indeces in TDNP during survey time

Survey areas	Hunters' shelters		Trapline*		Traps*	
	Number	Index	Number	Index	Number	Index
Suoi Tram-Suoi Tien upstream	6	0.0508	5	0.0424	300	2.5424
Ba Luong upstream	3	0.0526	2	0.0351	50	0.0877
Ngoi Lanh upstream	2	0.0444	3	0.0667	100	2.2222
Tay Thien-Thach Ban-Ao Dua	5	0.0420	5	0.0420	250	2.1008
Xa Huong upstream	4	0.0500	7	0.0700	300	3.0000
Total:	**20**	**0.0480**	**22**	**0.0528**	**1,000**	**2.3981**

*Note: Index is calculated as total number of shelters (traplines or traps) of each survey area divided by total transect distance covered in the survey area. Units: shelter/km, trapline/km and trap/km. *- Bamboo traps only.*

During our field surveys, about 22 recent traplines with about 1,000 traps were found. Metal traps are more dangerous, these traps can catch small animals to very large animals like muntjak, serow, etc. When setting, these traps are carefully covered by leaves and after trapping, the traps are taken back for next time use, therefore, it is difficult to observe them in the wild, however, these traps were seen in several hunters' shelters.

- ***Illegal wildlife trade***

As one of big tourism base in the country, demand for food from wild animals, as well as animal products and parts is high, that leads to development of illegal wildlife trade net around the TDNP. Restaurants serving dishes from wild animals can find in many places such as Tam Dao Town, Tay Thien Temple area, Dai Tu Town, Son Duong Town, etc. The illegal wildlife trade provides great incentives for development of illegal hunting in the Park's territory. More detailed information about wildlife trade can be found in Wildlife trade Report of GTZ Office Vietnam, 2004.

- ***Illegal forest products extraction***

Illegal timber extraction and non-timber products lead to disturbance and degradation of wildlife habitats. Illegal timber extraction was very extensive in past, but seems greatly reduced during recent years. In each of all survey areas, hundreds of old timber cutting sites were observed but very few new timber cutting can be found. Most of habitats in TDNP is bamboo forests with scattered trees or mixed bamboo-wood forests. Timber extraction is especially detrimental for these forests types due to removal of tall trees which are so few in these forests and represent as an important food source for many mammal species. Collecting NTFPs (firewood, bamboo shoots, mushroom, etc.) occurs extensively in TDNP. Many mushroom collector shelters were seen in all survey areas. Firewood collecting is especially extensive in communes of Thai Nguyen Province where people use the firewood for tea processing. In La Bang commune alone, during our survey time (January 2005) every day about hundred people encroach the forest for firewood collecting. Collecting NTFPs causes forest degradation, reduction of animals food source and disturbance for wildlife habitats.

- ***Forest fire***

As reported by the park rangers, TDNP stays in high risk of forest fire. During recent years, no large fires happen, but the fires can cause further degradation of mammal habitat and damage to mammal populations themselves, especially small mammals.

- ***Domestic cattle raising***

Domestic cattle raising occurs intensively in low elevation up to 500m a.s.l. of TDNP in some area (Xa Huong up-stream). Domestic cattle can cause degradation of park's vegetation cover, competition for food source with wild ungulates.

V. RECOMMENDATIONS

In order to effectively manage and conserve mammal fauna in TDNP, following actions must be taken:

1. *Strengthen law enforcement and increase public awareness:*

   As mentioned above, main current threats to mammal fauna in TDNP are illegal animal hunting, illegal wildlife trade, illegal forest products extraction, forest fire and domestic cattle raising. These threats must be mitigated and eliminated through strict enforcement of park management regulations and national forest protection laws, and public awareness-raising campaign. Detailed activities for control of illegal wildlife hunting and trade have been discussed in Wildlife trade report (GTZ Office Vietnam, 2004a) and Report on control of wild animals in captivity and orchid garden (GTZ Office Vietnam, 2004b)

   Except recommendations provided in Wildlife trade report and Report on control of wild animals in captivity and orchid garden (GTZ office Vietnam 2004) some more specific recommendations can be made as following:

   - Cooperation with local villagers for forest patrolling and violators detection appears an effective way for forest protection. The park authority should develop this cooperation, i.e., establishment of Commune Protection Teams which includes the park forest rangers and villagers (especially who signed the forest protection contract with the Park) and provide certain material incentives for communal team members. These teams are very necessary for following communes Yen Lang, Khang Nhat, Hop Hoa, Thien Ke, Ninh Lai, Dao Tru and Dai Dinh because Forest guards in these communes are responsible for the biodiversity-richest parts of the park.

   - Village meetings should be organized in buffer zone communes, especially Quan Chu, La Bang, Yen Lang, Khang Nhat, Hop Hoa and Dao Tru communes to explain the park's management regulations on ban of hunting and forest product collection and negotiate with the community to develop and sign commune agreement of not hunting and forest product collecting from the park.

   - Park should work with tea-producing communes of Thai Nguyen Province (La Bang, Ky Phu, Phu Xuyen, etc.) to control of fire-wood collecting from the park and encourage the communes to use alternative heating material (coal, ect.) for tea-processing and also fire-wood planting for commune use.

   - Park should work with Minh Quang Commune (Vinh Phuc Province) to control of free-ranging domestic cattle raising in Tam Dao NP: village meeting to explain the park regulation on ban of cattle raising inside the park boundary, negotiate and signing commune agreement on not keeping domestic catle inside the park's bounadry.

- There is still "underground" wildlife trade network arround Tam Dao NP. Tam Dao NP should reveal and stop this network. Wildlife-serving restaurants in Tay Thien area, Tam Dao Town and Son Duong Town should be closed.

2. *Biodiversity study and monitoring:*

Gathering more information on mammal fauna and monitor status tendency of key species, especially species of high conservation value will help to adjust the Park's management measures. In order to monitor status of mammal fauna following techniques can be used:

- A faunal database of TDNP fauna should be established and regularly updated to monitor status of animals in the park and to produce relevant conservation recommendations for the park. At present, TDNP has no software and personell to manage the database. TDMP project may help to develop/purchase the software, train personnel or Management Board of TDNP should contact with Information Centre of Forest Protection Department (MARD) for support, cooperation, and information sharing.
- A system of mammal/animal field records gathering by forest rangers should be developed: each forest ranger will receive a pocket notebook with animal field record form. When he goes patrolling in forest he should take note of all observed animals or their activity signs and also signs of human impacts into the notebook. Every month, staff member from Park's Scientific Centre will collect all the notes for updating the faunal database and producing relevant report to park director.
- In general, rangers can only help to gather information on easy-recognized species, in order to get appropriate information on wider species range and, especially, threatened species (species of high conservation priority) TDNP should have specific monitoring personnel who will receive proper training in wildlife monitoring techniques and dedicate their main duty on wildlife monitoring work. Three (3) Animal Monitoring Units (AMU) should be established. Each AMU consists of 3 persons: one (with proper training) from Technical or Research Units and 2 from local guard station.. One AMU will base in Hiep Hoa guard station and responsible for monitoring in Suoi Tram- Suoi Tien up-stream area, the second AMU will base at Dao Tru guard station and responsible for monitoring in Ngoi Lanh-upstream – Tan Dao North area, and the third AMU will base at Dai Dinh guard station and responsible for monitoring in Tay Thien-Thach Ban- Ao Dua area. The AMUs will regularly conduct field trip to collect information with focus on species of high conservation value. A network of monitoring routes to key habitat of conservation priority species should be established for regular frequency of AMUs. Information collected by AMUs will use to update the faunal database and produce monthly report with conservation recommendations to park's director.
- At present, one AMU should be established to conduct monitoring focused on Primate species and Northern serow. These species are chosen because they are globally endangered, under high hunting pressure and easier to recognize in forest in comparison with other species of high conservation priority. This group will consists of one well-trained staff member of Technical Unit and Mr. Dang Van Thuan from Tam Quan Guard Station who received training during this survey. The group will focus their field observation in 3 key areas (Suoi Tram – Suoi Tien up-stream, Ngoi Lanh upstream-Tam Dao North peak and Tay Thien-Thach Ban- Thien Thi- Ao Dua area) with fixed schedule.

- Camera-trapping technique should be used for further inventory and monitoring status of small carnivores and other nocturnal species. TDMP Project may help to purchase the equipment or TDNP should get fund from other sources to purchase about 10-15 camera sets. IEBR can help to train technical staff members of TDNP Techical Unit or Research Centre on techniques of camera-trapping. There is a risk of camera being stolen by local residents, therefore, the camera-trapping group should work with local guard station and forest protection contractees for keeping the cameras.
- Further study of bats on limstone slopes (Thai Nguyen and Tuyen Quang Provinces) should be conducted to get more complete species list and information on their abundance and distribution.
- Rapid mammal assessment should be repeat every 2-3 years to monitor change tendency of the mammal fauna.

3. Training

Training for building up capacity of park staff members on wildlife survey and monitoring techniques is necessary. The training should focus on following topics:

- Technique of field identification of key species of TDNP
- Use of field equipment (maps, compass, GPS, binoculars, camera, etc.).
- Techniques of mammal surveys (transect survey, trapping, netting, etc.)
- Techniques camera trapping
- Technique of transferring collected information into management activities and report writing.
- Identification of problems and designing mammal survey/monitoring project.

4. Production of education materials

- Posters and fact sheets which briefly describe the status of high conservation priority species, threats to their survival and with conservation messages should be produced and distributed to buffer zone households, schools, tourism bases in TDNP buffer zone for awareness education.

- A book describing overall status of mammal fauna in TDNP and its key species should be produced to increase knowledge and awareness of park staff members and also of tourists and other park visitors.

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ANNEX 2: A CHECKLIST OF MAMMAL SPECIES RECORDED IN TAM DAO NATIOANL PARK

No.	English name	Scientific name	Conservation status			Survey areas					
			IUCN RL	VN RDB	DEC. 48	ST-ST	BL	NL	TT-TB-AD	TD	XH
	I. Order INSECTIVORES	**I. Order INSECTIVORA**									
	1. Family Shrews	**1. Family Soricidae**									
1.	Grey Shrew	*Crocidura attenuata*								S	
	2. Family Moles	**2. Family Talpidae**									
2.	White-Tailed Shrew-Mole	*Talpa leucura*				S				S	
	II. Order Tree-Shrews	**II. Order SCANDENTIA**									
	3. Family Tree-Shrews	**3. Family Tupaiidae**									
3.	Common Tree-Shrew	*Tupaia belangeri*				O	O	O	O	O	O
	III. Order Bats	**III. Order CHIROPTERA**									
	4. Family Fruit Bats	**4. Family Pteropodidae**									
4.	Short-Nosed Fruit Bat	*Cynopterus sphinx*				S		S	S	S	
5.	Bat	*Sphaerias blanfordi*								L	
6.	Bat	*Megaerops niphanae*								L	
7.	Cave Fruit Bat/ Dawn Fruit Bat	*Eonycteris spelaea*					S				
	5. Family Sheath-Tailed Bats	**5. Family Emballonuridae**									
8.	Black-Bearded Tomb Bat	*Taphozous melanopogon*								S	
9.	Himalayan Leaf-Nosed Bat	*Hipposideros armiger*						S	S		
10.	Large Roundleaf Horseshoe Bat	*Hipposideros larvatus*				S		S	S	S	
11.	Bat	*Hipposideros pomona*								S	
	7. Family Horseshoe -Bats	**7. Family Rhinolophidae**									
12.	Woolly Horseshoe Bat	*Rhinolophus luctus*								L	
13.	Intermediate Horseshoe Bat	*Rhinolophus affinis*					S	S	S	S	
14.	Big-Eared Horseshoe Bat	*Rhinolophus macrotis*								S	
15.	Pearson's Horseshoe Bat	*Rhinolophus pearsonii*						S			
16.	Least Horseshoe Bat	*Rhinolophus pusillus*				S	S		S		

No.	English name	Scientific name	Conservation status			Survey areas					
			IUCN RL	VN RDB	DEC. 48	ST-ST	BL	NL	TT-TB-AD	TD	XH
	8. Family Evening Bats	**8. Family Vespertilionidae**									
17.	Hardwicke's Forest Bat	*Kerivoula hardwickii*					S				
18.	Round-Eared Tube-Nosed Bat	*Murina cyclotis*					S				
19.	Hairy-Footed Tube-Nosed Bat	*Murina tubinaris*				S	S		S		
20.	Hairy-faced bat	*Myotis annectans*					S				
21.	Himalayan Whiskered Bat	*Myotis siligorensis*		**R**		S					
22.	Bat	*Myotis sp.*							S		
23.	Indian Pipistrelle	*Pipistrellus coromandra*									
24.	Least Pipistrelle	*Pipistrellus tenuis*							S		
25.	Pipistrelle	*Pipistrellus sp.*						S			
26.	Harlequin Bat	*Scotomanes ornatus*	**LRnt**			S		S	S		
27.	Asiantic Greater Yellow House Bat	*Scotophilus heathii*								S	
28.	Collared Serotine	*Thainycterus aureocollaris*						S			
	IV. Order Primates	**IV. Order PRIMATES**									
	9. Family Lorises	**9. Family Loridae**									
29.	Slow Loris	*Nycticebus coucang*	**DD**	**V**	**IB**	Re		Re	Hu		Re
	10. Family Old-World Monkeys	**10. Family Cercopithecidae**									
30.	Stump-Tailed Macaque	*Macaca arctoides*	**VU**	**V**	**IIB**	Re		Re	Re		Re
31.	Rhesus Macaque	*Macaca mulatta*	**LRnt**		**IIB**	Re			Re		Re
32.	Assamese Macaque	*Macaca assamensis*	**VU**	**V**	**IIB**	Re			Re		
33.	Francoi's Langur	*Trachypithecus francoisi*	**VU**	**V**	**IB**				Re		
	V. Order CARNIVORES	**V. Order CARNIVORA**									
	11. Family Dogs, Foxes	**11. Family Canidae**									
34.	Raccoon Dog	*Nyctereutes procyonoides*				Sn	Sn	Sn	Sn		Sn
	12. Family Bears	**12. Family Ursidae**									
35.	Asiatic Black Bear	*Ursus thibetanus*	**VU**	**E**	**IB**	Re			Re		
36.	Sun Bear	*Ursus malayanus*	**DD**	**E**	**IB**	Re			Re		

No.	English name	Scientific name	Conservation status			Survey areas					
			IUCN RL	VN RDB	DEC. 48	ST-ST	BL	NL	TT-TB-AD	TD	XH
	13. Family Mustelids, Martens, Otters	**13. Family Mustelidae**									
37.	Hog Badger	*Arctonyx collaris*				Sn	Sn	Sn	Sn	Sn	Sn
38.	Small-Clawed Otter	*Aonyx cinerea*	**LRnt**	**V**	**IB**	Re			Sn		
39.	Yellow-Throated Marten	*Martes flavigula*				O		Re	O		Re
40.	Small-Toothed Ferret-Badger	*Melogale moschata*				S	Sn	Sn	Sn	Sn	S
41.	Yellow-Bellied Weasel	*Mustela kathiah*				Re			Re	Hu	
42.	Back-Striped Weasel	*Mustela strigidorsa*	**VU**			Re			Re	Hu	Hu
	14. Family Civets, Viverrids	**14. Family Viverridae**									
43.	Three-Striped Palm Civet	*Arctogalidia trivirgata*		**R**		Re			Re		
44.	Owston's Banded Civet	*Hemigalus owstoni*	**VU**	**V**	**IIB**	Hu, Sn	Hu, Sn	Sn	Sn		Re
45.	Masked Palm Civet	*Paguma larvata*				Sn	Re	Sn	Sn	Sn	Sn
46.	Common Palm Civet	*Paradoxurus hermaphroditus*				O, Sn	S, Sn	Sn	O	Sn	Hu, Sn
47.	Spotted Linsang	*Prionodon pardicolor*		**R**	**IIB**	Hu		Re	Re		Re
48.	Large Indian Civet	*Viverra zibetha*			**IIB**	Re	Re	Re	Re	Re	Re
49.	Small Indian Civet	*Viverricula indica*			**IIB**	Re	Re	Re	Re	Re	Re
	15. Family Mongooses	**15. Family Herpestidae**									
50.	Small Asian Mongoose	*Herpestes javanicus*				Re	Re	O	O	Re	O
51.	Crab-Eating Mongoose	*Herpestes urva*				Re	Re	Re	Re	Re	Re
	16. Family Cats	**16. Family Felidae**									
52.	Golden Cat	*Catopuma temminckii*	**VU**	**E**	**IB**	Re	Re	Re	Re	Sn	Re
53.	Leopard Cat	*Prionailurus bengalensis*			**IB**	Re	Sn	Sn	Sn	Re	Sn
	VI. Order EVEN-TOED UNGULATES	**VI. Order ARTIODACTYLA**									
	17. Family Pigs	**17. Family Suidae Gray,**									
54.	Wild Boar	*Sus scrofa*				Sn	Sn	Sn	Sn	Sn	Sn

No.	English name	Scientific name	Conservation status			Survey areas					
			IUCN RL	VN RDB	DEC. 48	ST-ST	BL	NL	TT-TB-AD	TD	XH
	18. Family Mouse Deer	**18. Family Tragulidae**									
55.	Lesser Malay Mouse Deer	*Tragulus javanicus*		**V**	IIB						Re
	19. Family Deer	**19. Family Cervidae**									
56.	Sambar	*Cervus unicolor*				Sn			Sn		Sn
57.	Common Barking Deer	*Muntiacus muntjak*				Sn	Sn	Sn	Sn	Sn	Sn
58.	Southern Serow	*Naemorhedus sumatraensis*	**VU**	**V**	**IB**	Sn	Re	Re	Sn	Re	Sn
	VII. Order PANGOLINS	**VII. Order PHOLIDOTA**									
	20. Family Pangolins	**20. Family Manidae**									
59.	Chinese Pangolin	*Manis pentadactyla*	**LRnt**	**V**	**IB**	Re		Sn	Sn		Re
	VIII. Order RODENTS	**VIII. Order RODENTIA**									
	21. Family Non-Flying Squirrels	**21. Family Sciuridae**									
60.	Black Giant Squirrel	*Ratufa bicolor*				O, Hu	O	O	O	O	Hu, O
61.	Pallas's Squirrel	*Callosciurus erythraeus*				S	S	O	S	S	S
62.	Irrawaddy Squirrel	*Callosciurus inornatus*				O		O	O	O	O
63.	Perny's Long-Nosed Squirrel	*Dremomys pernyi*				S		O	O	S	S
64.	Red-Cheeked Squirrel	*Dremomys rufigenis*				S	S	S	S	S	S
65.	Hainan's Striped Tree Squirrel	*Tamiops maritimus*				S	S	O	S	S	S
	22. Family Flying Squirrels	**22. Family Pteromyidae**									
66.	Hairy-Footed Flying Squirrel	*Trogopterus pearsonii*	**LRnt**	**R**		O	O	Re	Hu		Re
67.	23. Family Rats	23. Family Muridae									
68.	Noisy Rat	*Leopoldamys sabanus*				S	S	S	S	S	S
69.	House Mouse	*Mus musculus*								S	
70.	Dark-Tailed Rat	*Niviventer tenaster*				S			S		
71.	Chestnut Rat	*Niviventer fulvescens*				S	S		S	S	S
72.	Rice-Field Rat	*Rattus argentiventer*							S		
73.	Sladen's Rat	*Rattus remotus*				S	S		S		S
74.	House Rat	*Rattus rattus*									S

No.	English name	Scientific name	Conservation status			Survey areas					
			IUCN RL	VN RDB	DEC. 48	ST-ST	BL	NL	TT-TB-AD	TD	XH
75.	Large Bandicoot Rat	*Bandicota indica*				Hu			S		S
76.	Hoary Bamboo Rat	*Rhizomys pruinosus*				Hu, Sn	Hu, Sn	Hu, Sn	Hu, Sn	Sn	Sn
77.	24. Fam. Old-World Porcupines	24. Family Hystricidae									
78.	Asiatic Brush-Tailed Porcupine	*Atherurus macrourus*				Hu, Sn	Hu, Sn	S, Sn	Sn	Sn	Sn
79.	Malayan Porcupine	*Hystrix brachyura subcristata**	**VU**			Sn.	Sn	Sn	Sn		Re
	Total:		**17**	**16**	**18**		**34**	**39**	**56**	**40**	**40**

Note: Systematics and sequence follow Corbet G.B., J.E. Hill, 1992, exept Primates which follow recent review of Geissman et al., 2000 and Nadler et al. 2003

- **Conservation status:**

IUCN RL (2004 IUCN Red List): **VU**- Vulnerable, **LRnt**- Low risk/near threatened, **DD**- Data deficient for evaluation.
VN RDB (Red Book of Vietnam, 2000): **E**- Endangered, **V**- Vulnerable, **R**- Rare.
Decree 48 (Decree 48/2002/NDCP): **IB**- strict ban of hunting and use, **IIB**- limited and controlled hunting and use.

- **Survey areas:**

ST-ST – Suoi Tram-Suoi Tien up-stream, **BL** – Ba Luong up-stream**, NL** – Ngoi Lanh up-stream, **TT-TB-AD** – Tay Thien –Thach Ban- Ao Dua area,including Phu Nghia peak, **TD** – Tam Dao Town and its surrounding forests, **XH** – Xa Huong up-stream
S – Recorded by specimens captured by our traps, or confiscated from hunters, or examming hunted specimen
Sn – Recorded by animal's signs (track, den, dropping, vocalization, etc.)
O – Recorded by direct observation of the animal in the wild.
Hu – Recorded by remains of hunted animals
Re – Recorded by interview of local hunters/ residents.
L- Literature

Annex 3. List of voucher specimens collected in Tam Dao NP kept in IEBR

Sp. No.	*V. SPECIES*	Sex	Date	Trap site
TĐ 01-05	Rhinolophus pusillus	Male	8/12/2004	Tam Dao Town
TĐ 02-05	Scotophilus heathii	Male	8/12/2004	Tam Dao Town
TĐ 03-05	Myotis horsfieldii	Male	8/12/2004	Tam Dao Town
TĐ 04-05	Pipistrellus tenuis	Male	8/12/2004	Tam Dao Town
TĐ 05-05	Myotis horsfieldii	Male	8/12/2004	Tam Dao Town
TĐ 06-05	Cynopterus sphinx	Female	8/12/2004	Tam Dao Town
TĐ 07-05	Pipistrellus tenuis	Female	8/12/2004	Tam Dao Town
TĐ 17-05	Murina tubinaris	Female	9/12/2004	Khang Nhat
TĐ 18-05	Myotis horssfieldii	Male	9/12/2004	Khang Nhat
TĐ 19-05	Murina tubinaris	Male	9/12/2004	Khang Nhat
TĐ 20-05	Murina tubinaris	Female	12/12/2004	La Bang
TĐ 21-05	Murina cyclotis	Male	12/12/2004	La Bang
TĐ 22-05	Kerivoula hardwicki	Male	12/12/2004	La Bang
TĐ 23-05	Kerivoula hardwicki	Male	12/12/2004	La Bang
TĐ 24-05	Myotis annectans	Male	12/12/2004	La Bang
TĐ 26-05	Murina cyclotis	Male	13/12/2004	La Bang
TĐ 29-05	Rhinolophus pusillus	Male	13/12/2004	La Bang
TĐ 43-05	Rhinolophus affinis	Male	8/1/2005	Tay Thien
TĐ 44-05	Taphozous melanopogon	Male	8/1/2005	Tam Dao town
TĐ 46-05	Rhinolophus pusillus	Male	10/1/2005	Tam Dao town
TĐ 47-05	Rhinolophus macrotis	Female	10/1/2005	Tam Dao town
TĐ 48-05	Rhinolophus macrotis	Female	10/1/2005	Tam Dao town
TĐ 49-05	Rhinolophus pusillus	Female	10/1/2005	Tam Dao town
TĐ 52-05	Rhinolophus pearsoni	Female	12/5/2005	Tay Thien
TĐ 53-05	Rhinolophus pearsoni	Female	12/5/2005	Tay Thien
TĐ 54-05	Hipposideros larvatus	Male	12/5/2005	Tay Thien
TĐ 55-05	Hipposideros larvatus	Female	12/5/2005	Tay Thien
TĐ 56-05	Myotis horsfieldii	Male	13/5/2005	Tay Thien
TĐ 57-05	Scotomanes ornatus	Female	13/5/2005	Tay Thien
TĐ 58-05	Murina tubinaris	Female	17/5/2005	Xa Huong
TĐ 58-05	Rhinolophus pusillus	Male	17/5/2005	Tam Dao town
TĐ 60-05	Rhinolophus macrotis	Male	17/5/2005	Tam Dao town
TĐ 61-05	Rhinolophus pusillus	Female	17/5/2005	Tam Dao town
TĐ 62-05	Rhinolophus pusillus	Female	17/5/2005	Tam Dao town
TĐ 63-05	Rhinolophus pusillus	Female	17/5/2005	Tam Dao town
TĐ 64-05	Rhinolophus pusillus	Female	17/5/2005	Tam Dao town
TĐ 65-05	Rhinolophus pusillus	Male	17/5/2005	Tam Dao town
TĐ 66-05	Rhinolophus pusillus	Male	17/5/2005	Tam Dao town
TĐ 67-05	Rhinolophus pusillus	Female	17/5/2005	Tam Dao town
TĐ 68-05	Rhinolophus pusillus	Female	17/5/2005	Tam Dao town
TĐ 69-05	Rhinolophus pusillus	Female	17/5/2005	Tam Dao town
TĐ 70-05	Rhinolophus pusillus	Female	17/5/2005	Tam Dao town
TĐ 71-05	Hipposideros larvatus	Male	19/5/2005	Quan Chu

TĐ 72-05	Hipposideros larvatus	Male	19/5/2005	Quan Chu
TĐ 73-05	Hipposideros larvatus	Male	19/5/2005	Quan Chu
TĐ 74-05	Hipposideros larvatus	Male	19/5/2005	Quan Chu
TĐ 75-05	Pipistrellus coromandra	Male	19/5/2005	Quan Chu
TĐ 76-05	Pipistrellus coromandra	Female	19/5/2005	Quan Chu
TĐ 77-05	Myotis siligorensis	Female	22/5/2005	Khang Nhat
TĐ 78-05	Scotomanes ornatus	Male	22/5/2005	Khang Nhat
TĐ 79-05	Thainycteris aureocollaris	Male	27/5/2005	Dao Tru
TĐ 80-05	Rhinolophus affinis	Female	27/5/2005	Dao Tru
TĐ 81-05	Rhinolophus affinis	Female	27/5/2005	Dao Tru
TĐ 82-05	Rhinolophus affinis	Female	27/5/2005	Dao Tru
TĐ 83-05	Scotomanes ornatus	Male	27/5/2005	Dao Tru
TĐ 84-05	Hipposideros larvatus	Female	27/5/2005	Dao Tru
TĐ 85-05	Pipistrellus ceylonicus	Female	27/5/2005	Dao Tru
TĐ 86-05	Cynopterus sphinx	Male	27/5/2005	Dao Tru
TĐ 87-05	Cynopterus sphinx	Male	27/5/2005	Dao Tru
TĐ 88-05	Cynopterus sphinx	Male	27/5/2005	Dao Tru
TĐ 89-05	Cynopterus sphinx	Male	27/5/2005	Dao Tru
TĐ 90-05	Hipposideros armiger	Female	27/5/2005	Dao Tru
	Rodents			
TĐ 25-05	Leopoldamys sabanus	Male	12/12/2004	La Bang
TĐ 45-05	Mus musculus	Male	8/1/2005	Tam Dao town
TĐ 09-05	Leopoldamys sabanus	Female	8/12/2004	Khang Nhat
TĐ 50-05	Niviventer sp.	Male	12/5/2005	Tay Thien
TĐ 27-05	Niviventer sp.	Male	13/12/2004	La Bang
TĐ 28-05	Niviventer sp.	Male	13/12/2004	La Bang
TĐ 34-05	Niviventer sp.	Female	7/1/2005	Tay Thien
TĐ 31-05	Niviventer fulvescen	Female	6/1/2005	Tay Thien
TĐ 08-05	Niviventer fulvescen	Male	8/12/2004	Khang Nhat
TĐ 32-05	Leopoldamys sabanus	Female	6/1/2005	Tay Thien
TĐ 33-05	Leopoldamys sabanus	Male	7/1/2005	Tay Thien
TĐ 35-05	Leopoldamys sabanus	Female	7/1/2005	Tay Thien
TĐ 39-05	Rattus sp.	Male	7/1/2005	Tay Thien

Annex 4: GPS LOCATIONS OF MAMMAL RECORDS IN TDNP

Species	GPS location
Stump-Tailed Macaque - *Macaca arctoides* Rhesus Macaque- *Macaca mulatta* Rhesus Macaque- *Macaca assamensis*	Mo Qua (reported): ca.5720000/2371400 Suoi Tien area (reported): ca.5512000/2392500 Suoi Tien upstream (signs): 0550969/2392602 Slope of peak 1260 (reported): ca. 5490000/2391200 Ba Luong upstream (reported): ca.5525000/2391500 Tay Thien (signs): 0564202/2376180.
Raccoon Dog – *Nyctereutes procyonoides*	Signs found in many localities of survey areas
Asiatic Black Bear – *Ursus thibetanus* Sun Bear -*Ursus malayanus*	Mo Qua area (reported): ca.5720000/2372600 Tay Thien Temple(old sign): 0563313/2375017
Hog Badger- *Arctonyx collaris*	
Small-Clawed Otter – *Aonyx cinerea*	Tay Thien stream(sign): 0564593/2376452
Small-Toothed Ferret-Badger - *Melogale moschata*	Xa Huong area (captured specimen):0568306/2372676 Suoi Tram-Suoi Tien area (Capt. Specimen): 0548394/2393236
Owston's Banded Civet - *Hemigalus owstoni*	Suoi Tram-Suoi Tien Up-stream (signs): 0549418/2392062; 0549167/2392620, 05507391656, etc. Tay Thien-Thach Ban- Ao Dua (sign): (0563791/276096; 0564671/2376800; etc.).
Masked Palm Civet - *Paguma larvata* Common Palm Civet- *Paradoxurus hermaphroditus*	Ba Luong up-stream: (Sighting: 0553210/2391027). Signs: 0552211/2391518; 0551531/2391034; 0553210/2391027; 0553406/2390768, 0552526/2390158 etc. Ngoi Lanh up-stream: 0557565/2382858; 0558938/2382467; 0558943/2382250; 0558940/2381996; etc Suoi Tram-Suoi Tien Up-stream: 05548660/2393298; 05549289/ 2393387; 0549418/2392062; 0548479/2390633; 0549116/2391818; 0549875/2392528; 05500318/2392767; 0550295/ 2392564; 0550579/2391428; 0550519/239166; 0550343/2392510; 0550696/2392184; 0551285/2392788, etc. etc. Tay Thien -Thach Ban - Ao Dua: (Sighting: 0563822/2376214). Signs: 0563811/ 2377577; 0564666/ 2376995; 0563734/ 2376147; 0565493/2376452, 0566542/2375176, 0564951/2375814; 0563644/2375717; 0563881/2376121; 0563665/2376508, 0562793/2376285;; etc. Tam Dao - Xa Huong: 0567987/2372462; 0568091/2372485, 0569162/2372778, 0569536/2372686; 0569252/2373005, 0569015/2372598, 0570248/2372275, etc.
Golden Cat – *Catopuma temminckii*	Tracks in village 1 of Tam Dao Town

Leopard Cat – *Prionailurus bengalensis*	Suoi Tram-Suoi Tien area: 0549254/2392184, 0548190/2393150; 0550182/2392797; 0548942/2393236 Ba Luong area: 0553686/2390920, 0552508/2391293; 0552078/2390573 Ngoi Lanh up-stream: 0559325/2382137; 0558838/2381893 Tay Thien-Thach Ban-Ao Dua area: (Sighting: 0563874/2377175). Signs: 0564959/2376091; 0564446/ 2377182; 0563176/2377246; Xa Huong up-stream (signs): 0568901/2373034.
Wild Boar- *Sus scrofa*	Signs found at many localities of survey areas
Lesser Malay Mouse Deer **-** *Tragulus javanicus*	watershed area of Trung My lake: Reported ca. 5730000/2371000
Sambar -*Cervus unicolor*	Suoi Tram-Suoi Tien up-stream (signs): 0549159/2392063, 0550246/2391638 Tay Thien- Ao Dua area (signs): 0563744/2377271 Xa Huong up-stream (signs): 0569271/2372686, 0568737/2372891.
Common Barking Deer - *Muntiacus muntjak*	Ba Luong up-stream (signs): 0550496/2392372; 0553790/2391256; 0553270/2391057; 0553221/2390920; 0553420/2390692; 0563746/2375741; etc. Xa Huong up-stream (vocalozation): 0568201/2372747
Southern Serow - *Naemorhedus sumatraensis*	Suoi Tram- Suoi Tien up-stream: 0549644/2392525, 0550253/2391701, 0564281/2375404,0564244/2375284 Ngoi Lanh Up-stream: 05583063/2381328 Tay Thien-Thach Ban- Ao Dua: 0564274/2377632; 0565271/ 2370092, 0566420/2375155 Tam Dao-Xa Huong area (0566421/ 2374317, 0570354/2372319,0567955/2373279.
Chinese Pangolin**-** *Manis pentadactyla*	Ngoi Lanh up-stream: 0559075/2382655, 05587291/ 2382819; 05591576/ 2381799 Tay Thien-Ao Dua area (0564210/ 2376851; 0563486/ 2376398, 0565197/ 2376781, 0564348/ 2376716, 0565072/ 2378195, 0564733/ 2375665

Annex 5: Training for TDNP staff members

One day workshop for introduction of village interview results, designing of follow-up extensive field investigation and introduction survey techniques was held at Headquarter of Tam Dao NP on 6 December 2004. About 15 people attended this workshop, within them 10 persons are from Technical Unit, Research Centre and Forest Protection Unit of Tam Dao NP and head of Tam Dao Ranger Station of Tam Dao District.

Two staff members of TDNP Forest Protection Department, Mr. Dang Van Thuan and Mr. Nguyen Duc Toan, joined survey team for on-job training. Before starting the survey activities they received brief introduction of survey objectives and survey methods. They also learned to use some necessary field equipment such as binoculars, GPS and maps. Working together with specialists during survey activities they have directly involved in following survey techniques:

- Techniques of village interview on mammal fauna and human impacts on biodiversity
- Field identification of common Tam Dao mammal species
- Detailed mammal survey designing: selection of target areas, field study organization and transect designing for large mammal survey, etc.
- Techniques of field detection of large mammals for direct observation and their signs
- Techniques of small mammal trapping: how to use live traps and mist-net
- Taking basic measurements of rodent and bat specimens
- Techniques of preparation of museum bat specimens
- Taking field notes during mammal survey
- Techniques of preliminary data analysis: Data classification, making data tables, transferring data into maps

During wet season survey, except being involved in all survey activities, they received more intensive training on following skills:

- Handling and taking measurement of captured animals.
- Preparation and preservation of museum specimen of small mammals.
- Using guide books for species identification of observed/ captured animals and their indirect signs (tracks, dropping, etc.).
- Transferring collected data into tables and maps.
- Making management recommendations based on survey data.

Both trainees show their high interest in learning survey techniques. But Mr. Dang Van Thuan with better biological background (graduated Forestry University) and better field experience quickly learned survey skills and techniques. Mr. Nguyen Duc Toan has less biological background (graduated Forestry Vocational School) and less field-working experience. Consequently, it was difficult for him to learn some techniques such as mammal identification, taking specimen measurements and taking field notes.

After the surveys, the trainees show to obtain good progress during training. However, in order to properly conduct biodiversity monitoring activities they need more training on biodiversity conservation background, skill of species identification and report preparation.

ANNEX 6: ILLUSTRATION PICTURES


Forest in Tay Thien upstream

Forest in Ao Dua area

Regenerating forest in Ngoi Lanh upstream

Mixed wood-Bamboo forest in Peak 1260

Pure Bamboo forest in Tay Thien area

Survey team in Tay Thien Camp

Mist-net for bat capture

Live trap for small mammal capture

Interview at Hiep Hoa Guard station

Interview in Quan Chu Commune

Pre-field survey workshop at TDNP headquarter

Muntjak from Tam Dao NP is kept in Yen Lang Commune

Asiatic brush-tailed porcupine from TDNP kept in Dao Tru Commune

Small-toothed ferret badger confiscated from hunters

Common palm civet killed by La Bang hunter

Dropping of leopard cat found in Xa Huong area

Pangolin den found in Tay Thien area

Talpa leucura

Callosciurus erythraeus

Hipposideros larvatus

Kerivoula hardwickii

Murina tubirnaris

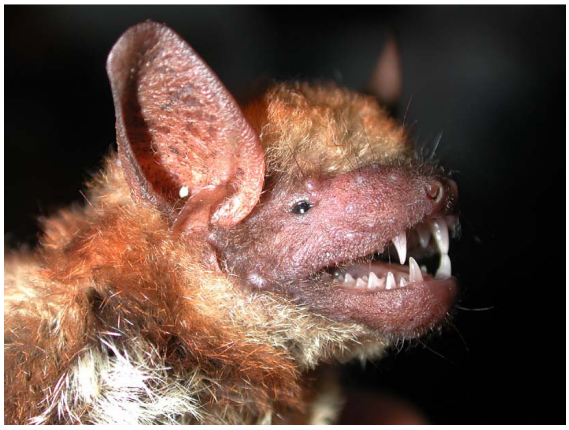
Myotis annectans

Myotis siligorensis

Pipistrellus coromandra

Rhinplophus macrotis

Rhinolophus pearsoni



Scotomanes ornatus

Thainycterus aureocollaris

Hunters' shelter in Suoi Tien upstream

Fur of hunted animals found in hunters' shelter in Suoi Tram upstream

Bamboo traps are found commonly in survey areas

Bamboo traps and metal leg-hold trap found in hunters'shelter in Xa Huong area

These animals are found in one trap line in Xa Huong area

Owston's palm civet in Son Duong Town restaurant