THE STATUS AND CONSERVATION OF ASIAN ELEPHANTS IN CAT TIEN NATIONAL PARK, VIETNAM

BY

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Project profile

The Status and Conservation of Asian Elephants in Cat Tien National Park, Vietnam

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1. INTRODUCTION

Elephant conservation in Vietnam is a very challenging task. The country has under 0.5 % of the global population of the Asian elephant (Santiapillai & Jackson, 1990; Tuoc & Santiapillai, 1991; Tuoc, 1991; Khoi & Tuoc, 1992; Dawson 1996; Osborn & Vinton, 1999). It is also difficult to study elephants in Vietnam as they are scattered and remain only as small, disturbed herds approaching extinction (Duckworth & Hedges, 1998). Elephants in Vietnam suffered heavily due to loss and modification of forest cover during the American-Vietnam War. There was extensive spraying of herbicides during the War followed by clearing of forests for agriculture (Khoi & Tuoc, 1992; Tuoc, 1992). During 1943–83, nearly 50% of the country's forests was lost due to various reasons. This resulted in habitat fragmentation and also rendered elephants vulnerable to hunting. The high commercial value of animal products, including of elephants, places many wildlife species in the region under high risk of extinction. Prior to the Second Indo-China war, central Vietnam was the biggest elephant market in southeastern Asia (Pjerffer, 1984).

The number of elephants in Vietnam was estimated to be 1500-2000 in 1984 (Tuoc 1991) and 300-600 in 1997 (S. Dawson and P.M. Giao in Lair 1997). However, the general opinion is that these numbers were overestimates, even for these earlier periods, and that there may be fewer than 150 elephants left in the country, however, Walston (verbally 1998) estimated only 70–150 elephants (Duckworth & Hedges, 1998). The country has no single medium-sized population (more than 100 individuals), but only fragmented herds comprising 10 to 15 individuals each. The dispersed nature of elephants has led to poor conservation planning. There are few reports on the number of elephants and their ranges in southern Vietnam (Duckworth & Hedges, 1998) and two small groups were believed to exist in the northern and southern part of Cat Tien National Park and La Nga Forestry Enterprise (Polet & Khanh, 1999). The current elephant survey (February to December 2001) was carried out in Cat Tien National Park and its environs.

2. OBJECTIVES OF THE SURVEY

The aims of the current survey were to study the status and distribution of elephants in the Cat Tien National Park and its environs through estimating their population numbers and to understand their basic ecology. This would form the basis for management decisions for the elephants in this region. The project aimed for two-fold benefits, one to provide training on elephant survey, research and conservation techniques to the Park staff, and the second to begin a systematic survey of elephants in Cat Tien National Park. The data collected are then used together with those of earlier surveys to understand the status of elephants and to formulate recommendations for their future conservation.

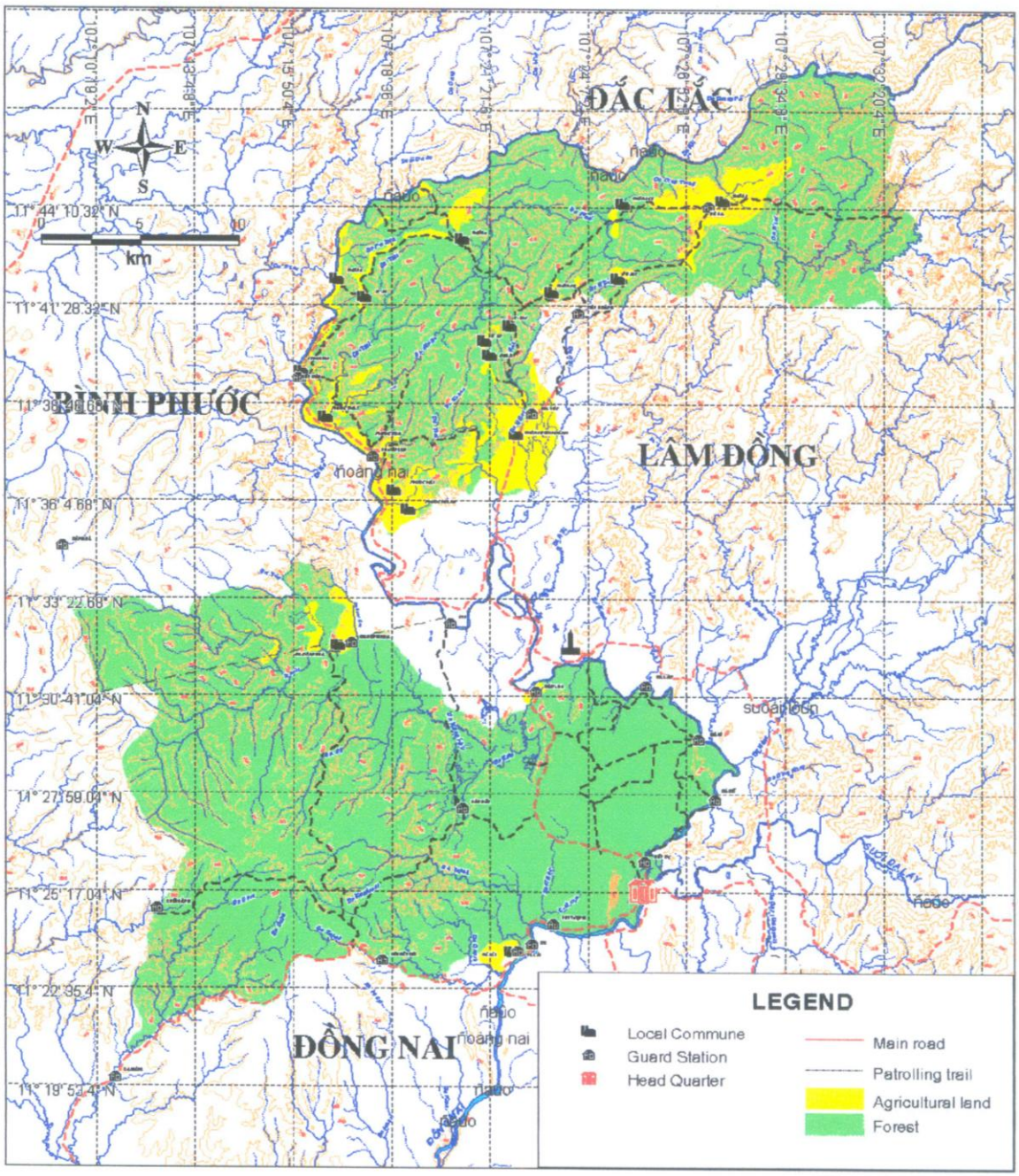
The specific objectives were:

- To estimate number of individuals, sex and age structure of the elephant population.
- To determine their distribution, home range, activity and feeding behaviour
- To identify current threats to the elephant population and conservation problems.
- To develop an appropriate action plan for conservation of the elephant population.

The specific terms of reference for the project are listed in Appendix 1.

3. THE STUDY AREA

Cat Tien National Park is located in southern Vietnam, about 130km northeast of Ho Chi Minh City. The park covers an area of over 74,000 hectares. The park consists of three sectors, Nam Cat Tien (38,302 ha) in Dong Nai province, Tay Cat Tien (5,382 ha) in Binh Phuoc Province and Cat Loc (30,635 ha) in Lam Dong province (Map 1). Cat Loc is separated geographically from the Nam Cat Tien and Tay Cat Tien sectors. The protected area received the status of a national park in 1992. Asian Elephants (*Elephas maximus*) only occur in the southern section of the park (Nam Cat Tien), located in Dong Nai Province (Map 1). The Dong Nai River forms the natural boundary of Nam Cat Tien in the east and the southeast. To the north the reserve borders on the Lam Dong province, and to the west Binh Phuoc Province.



Map 1. Cat Tien National Park.

Both hills and flat areas characterise the Park's topography, with altitudes ranging from 200 to 600 meters above sea level with relatively steep slopes. There are two distinct seasons, a dry season from December to April and a wet season from May to November. Average annual rainfall is approximately 2,300 mm (range 2175–2975mm).

The park has an extensive area of lowland forest with many bamboo stands. The three distinct forest types found here are *Lagerstroemia*, *Dipterocarpus* and gallery forests. About 70% of the area consists of *Lagerstroemia* forest degraded due to spraying of defoliants, commercial logging and shifting cultivation. Here the vegetation is dominated by *Lagerstroemia angustifolia* mixed with Dipterocarpaceae and Leguminosae. One observation is that there is no regeneration of *Lagerstroemia* and the old trees are slowly disappearing, to be replaced by other species of the deciduous forest (Wolf, 1998). The *Dipterocarpus* forest is characterised by a strong dominance of Dipterocarpaceae, especially *Dipterocarpus costatus* and covers about 10% of the park. The gallery forest' or 'corridor forest' is found as narrow forest strips along rivers and these are currently in a degraded state (Wolf, 1998).

The park suffered from the spraying of defoliants during the American-Vietnam War and by subsequent exploitation and uncontrolled immigration of people. The large-scale influx of people resulted in rapid transformation of the area's natural vegetation into lowland rice fields and agriculture on sloping terrain. A combination of warfare, commercial logging and conversion of wild lands into farmland by immigrants resulted in the degradation of the natural habitats on an extensive scale.

4. PAST ELEPHANTS RECORDS

Prior to our survey, Dawson (1996) and Polet & Khanh (1999) had carried out preliminary surveys on elephants in Cat Tien National Park. Dawson (1996) found elephant signs in the central and western regions of the Park. Polet & Khanh (1999) documented chronological details of elephant observations for the park. In early 1992 a herd of 20 elephants was sighted in the southwest of the park. In 1993 the forest staff estimated 12 to 17 individuals in the park. Polet & Khanh (1999) also speculated that about 21 individuals inhabit the park but that elephant movement

was restricted to a portion of the park. Elephants did not move into the east and southeast of the park, which had large trees; the elephants presumably had difficulty finding enough food in the primary vegetation. The Cat Loc part of the park, home to the highly endangered Javan rhino (*Rhinoceros sondaicus annamiticus)*, had a sizeable elephant population in the past but this population has been exterminated by hunters in the 1960s and 1970s (G. Polet, personal comment based on discussions with former hunters). Elephants have not been reported from this area in recent times. The northern part of the park (area between Da Bong Cua village, Hill 102 and the Bau Sau wetland) was estimated to have 5 animals in 1993. The northern part has many permanent water bodies (streams and lakes) and grasslands, mixed forest of Dipterocarpaceae and *Lagerstroemia,* and bamboo thickets (*Bambusa procera*). They provide an ideal habitat for elephants; surprisingly hardly any elephant sightings or signs are now reported from this area. The few individuals reported from this region seemed to occasionally range outside the Park (near the C10 guard post to the north).

The number of elephants in the southern part of Cat Tien National Park and La Nga Forestry Enterprise was estimated to be 7 to 12 animals in 1993; frequently encountered footprints suggested some juveniles in the group. According to Polet & Khanh (1999), the elephants restrict themselves to the La Nga Forestry Enterprise during the wet season and move further east into the area of Thanh Son commune (Dinh Quan district) but do not cross the Dong Nai River. In the dry season, they are located within the park (bordering with Vinh An Forestry Enterprise). From here they moved to Sa Mach stream (southwest of the park), passing the Sa Mach forest guard station.

In 1997, 5-6 elephants, including a big male were reported to visit the Ta Lai region at intervals of 2-3 months. In October 1998 elephant signs were noticed in Hill 102 by forest staff. In July 1999, a male elephant was sighted at night near the park headquarters. The height of the animal was estimated to be 2.5 meters (Polet & Khanh 1999). This is possibly the eastern most limit of elephant sighting in the park in recent years. In March 2000 at Sa Mach guard station adjoining La Nga Forest Enterprise, 9 elephants were seen. South of Cat Tien National Park (east of Ta Lai

village) during the rainy season, 5 elephants including a male were sighted in March 2000. During the eleven-year tenure of Ta Laii village, elephants have occasionally come to the village and in 2001,3 elephants were reported from here. The village was set up in 1988 by logging the natural forest and converting the land into plantations. People grow food crops while the department grows teak (*Tectona grandis*). Elephants do not cause much damage to the cultivated crops and the plantation, but they seem to come mainly for stored rice and salt (Polet & Khanh 1999).

Tan Phu Forestry Enterprise, Dang Nai province, had a herd of about 12 elephants in 1997 (Giao *et al*., 1997). This was a remnant of a larger population of elephants that had been in severe conflict with people and had been reduced through capture in 1993. In 1999 the remnant herd that had continued to be in serious conflict moved out of the enterprise area. The elephants of Tan Phu and CTNP did not interact in spite of close geographical proximity because Highway 20 with its human settlements and agricultural lands formed a barrier for elephants to move between these two forested areas (Giao *et al*., 1997). In November-December 2001 a plan to translocate these elephants to Yok Don National Park (along the border with Cambodia) was implemented with the loss of two elephants post capture.

5. SURVEY METHODS

In the initial stages of the project, a study tour cum field training programmes on elephant research, conservation and management (Appendix 2) was imparted to four personnel from Vietnam. This included three forest staff from Cat Tien NP and one scientist, who were invited to southern India to expose them to elephants and their conservation status in two wildlife reserves in southern India. After this two resource persons from India and one from Hanoi visited Cat Tien NP and conducted another training program for the entire survey team. Along with the survey team, the resource persons had discussions with many local people, visited a number of guard posts in the park and a conducted a pilot survey of elephants. The actual survey was then designed based on the experience gained during this exercise. As visibility in the forest is very poor due to dense vegetation, direct methods of surveying elephants were not possible and indirect methods were followed (Varman *et al.,*

1995). Surveys were carried out during the dry and wet seasons (see Appendix 3 for survey itinerary and team composition).

5.1. Dry Season Survey

The following survey methods were used during the dry season (February-April 2001) elephant survey at Cat Tien National Park and environs.

5.1.1. Transects to quantify elephant signs and dung abundance

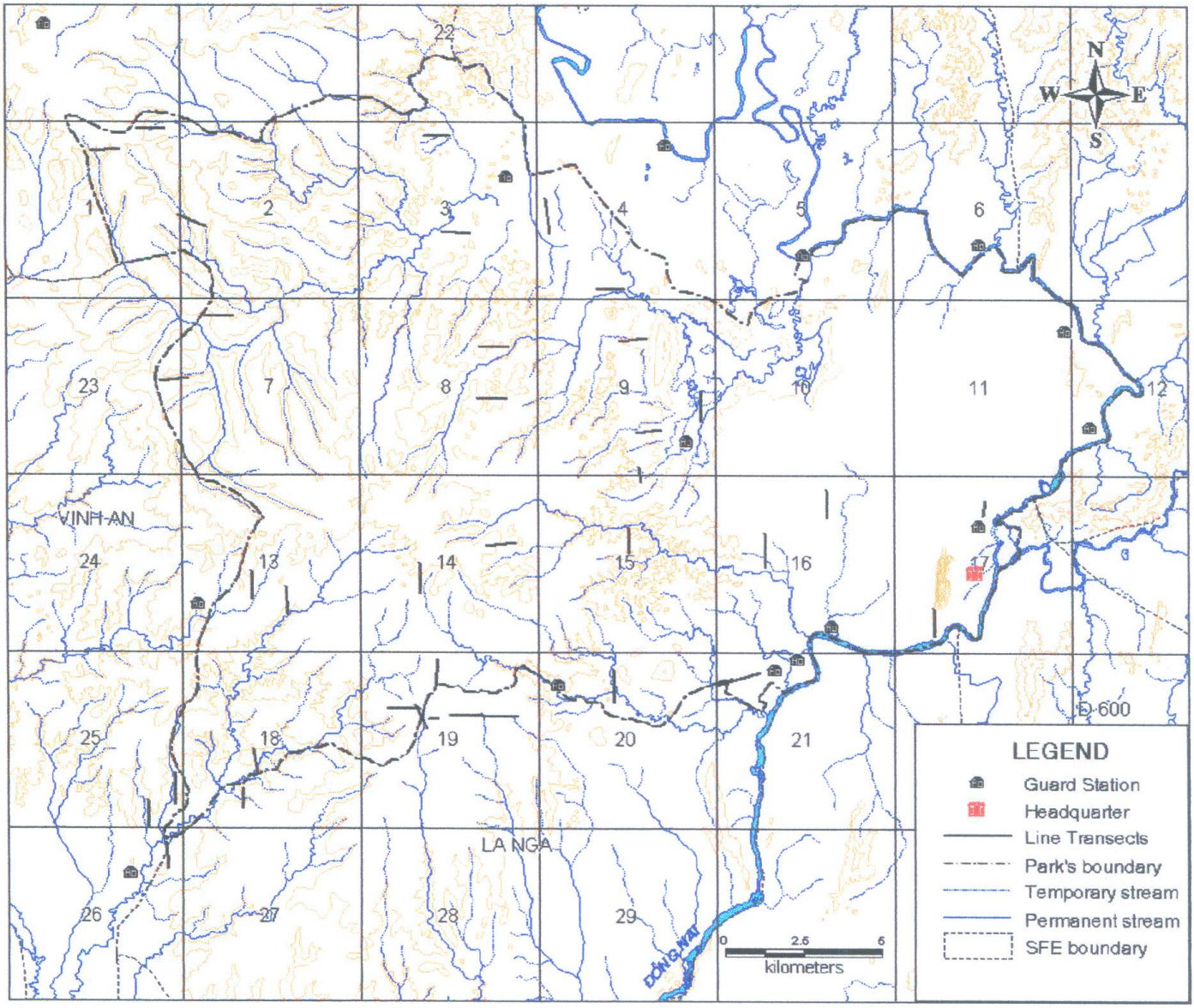
Based on latitudinal and longitudinal grids, 19 blocks, each of about 6 km^2 were identified for the survey in Cat Tien NP (Map 2). Out of 27 blocks, 8 extended partially outside or were located entirely outside the park. Two or three transects of 1 km each were laid in a north-south or east-west direction within each block (Map 2). Two teams (5 to 6 forest staff in each) were constituted to cover one transect each per day. The existing trails within the blocks were used for the starting point of the lines and the GPS locations of starting and ending points of transects lines were recorded. Every 50 m segment of the transect was marked and observations were made on either side of the transect for 2 meters. Information collected included habitat type, signs such as elephant footprints, feeding and dung.

5.1.2. Block Survey

The blocks were also surveyed for elephant signs, including dung, track, and feeding, through perambulation. During the block survey, a small team of observers identified a trail within the block and scanned it thoroughly for signs of elephants. When an elephant track was identified, the circumference of the front foot, width and length of the track along with the GPS locations were recorded. When elephant dung was encountered, the location and the circumference of the boli (for approximate size of the animal) were taken.

5.1.3. Village Surveys

Villages located within and outside the Cat Tien NP and forestry enterprise area were visited and a questionnaire used for obtaining information on elephants. The questionnaire focused on elephant numbers and distribution (based on the location of the villages and forest regions). Additional information on human-elephant conflict



Map 2. The location of transects (1 km in length), within the survey blocks (6 km^2), in Cat Tien National Park.

was also collected, on the number of animal visits to a given village. The information on elephant visits was supplemented with data on crop and household damage, human injury and death, and elephant deaths.

5.1.4. Guard post survey of past records

Cat Tien National Park has 19 guard posts for staff patrolling the park. Most of these posts are located along the boundary (with the sole exception of Bau Sau located within). Considering the location of these posts and work responsibilities of the staff posted here, we felt it would be very useful to visit these posts and interview the staff in order to understand the past and current elephant numbers and their movements. We also initiated the collection of information by staff through maintaining a daily log of patrol.

5.1.5. Survey of elephant food plants

During this survey, specimens of plants eaten or plants with feeding signs by elephants were collected. Both fresh and dry elephant dung piles found (n = 20) in the field were examined for its components and samples were collected for further study of plant content in the laboratory (samples have also been preserved for possible genetic studies). The samples were carefully washed to remove the fine contents while the remaining coarser remains were dried and analyzed under a microscope for identifying plant species and parts. The identification of plant remains in the dung was not easy due to their morphological changes (structure and color) during digestion and also due to the analysis several days after defecation. There is obviously a need for a systematic survey of the density and distribution of elephant food plants as this could be an important factor in determining elephant distribution in the region, but this was beyond the scope of this study.

5.2. Wet Season Survey

The following survey methods were used during the wet season (May –December 2001).

The dry season survey indicated that the elephants mainly used the southwest of the park and the Forestry Enterprise (La Nga and a part of Vinh An) areas. It was also

seen that the transect method did not provide any information on either elephant density or its habitat usage pattern. Time and manpower required for laying transects were very high and the returns very low. Survey through line transect method was abandoned. During the wet season survey, therefore more emphasis was given to blocks along the southwestern boundary with the La Nga Forestry Enterprise as well as blocks outside the park in the enterprise area (with some effort within the park areas where elephant signs were encountered during the dry season survey). The block survey followed a similar method as during dry season survey (tracks, dung, feeding and other signs of elephants were recorded along with GPS locations of the signs). However, survey of elephant food plants and plant components in dung was not carried out during the wet season because the dry season foraging was much more likely to be important to the animal and relevant to management. More effort was spent on information through village survey. Apart from the more regular monitoring of elephant visits through village surveys, a rapid, vehicle-based village survey was also carried out. Villages and smaller settlements located in the La Nga and Vinh An Forestry Enterprise areas were visited with a specific questionnaire and information on only recent visits of elephants were recorded.

The dry season survey had provided a fairly clear picture of the status of elephant and the issue of human–elephant conflict. This underscored the importance of understanding and mitigating this problem with the involvement of local people and enterprise area administrators. Thus, a one-day workshop on elephant conservation was arranged with the participation of these stakeholders (see Appendix 4 for notes on elephant conservation workshop and 5 for data sheet formats).

6. SURVEY RESULTS

6.1. Line Transect Survey

Thirty-seven transects (total distance of 35 km) covering the entire park were laid (Map 2), each taking an average of 49 man-hours to lay. Out of these, 30 (82%) of the transects went through bamboo and mixed forest habitats (see appendix 6 for summary of the data collected and 7 for photographs). No dung piles were encountered in any of the transects (only elephant signs were encountered along a few transects) and thus the

density of dung piles could not be estimated (Table 1). However, other information from the transects was useful for understanding the habitat usage pattern of elephants. During the transect survey elephant signs were encountered only in blocks 7, 9, 18, 19 and 20 (Table 1), which were located in the southwestern part of the park and in the forestry enterprise areas (Map 3). The frequency of occurrence of signs was highest in block 19, which included the cashew plantation (Map 3)

Table 1: Summary of elephant signs encountered along line transects within survey blocks (each 6 km^2) in Cat Tien National Park and its environs.

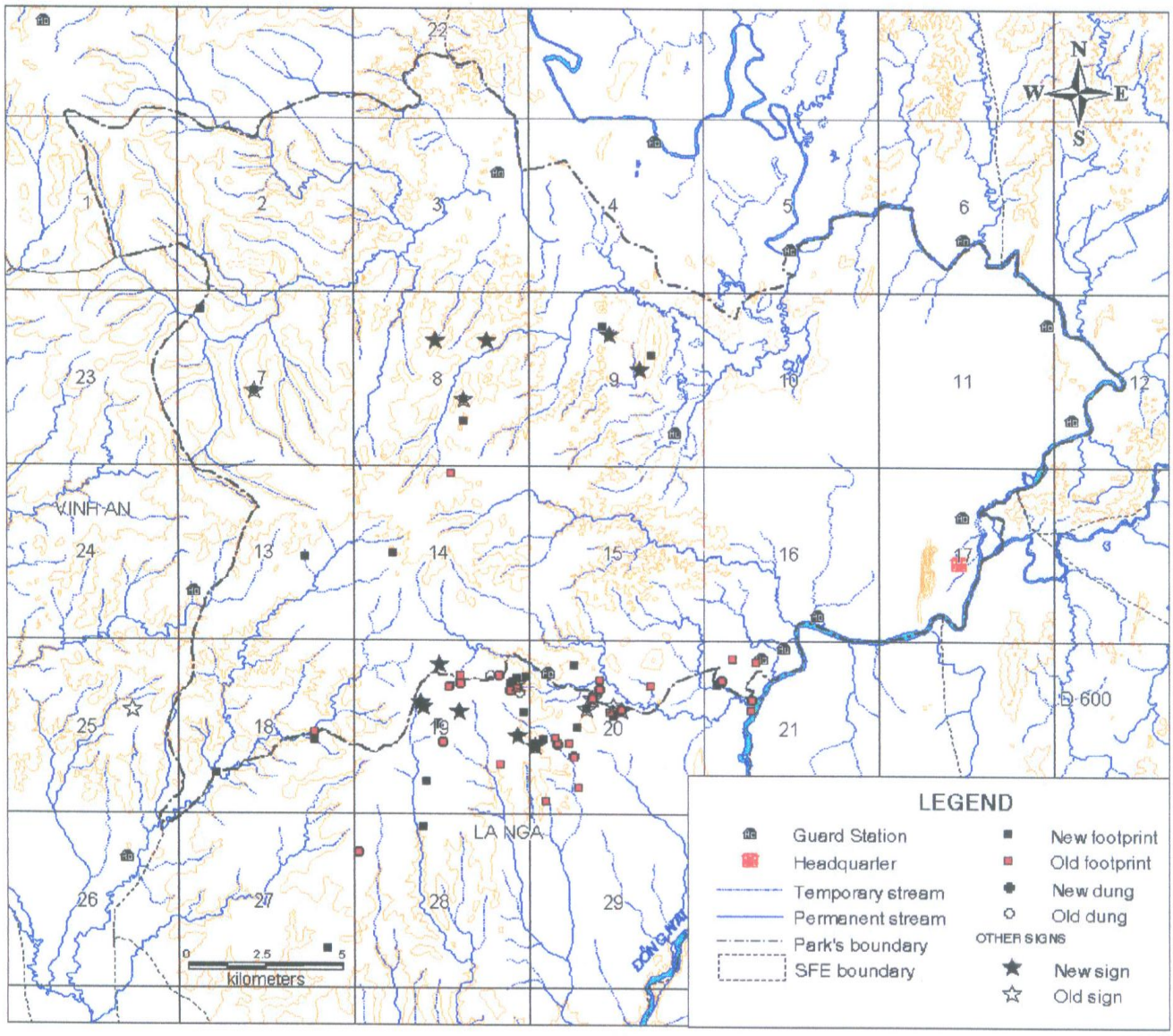
Block No.	**Distance covered (km)**	**No. of transects**	**Dung piles encountered**	**Elephant signs encountered**	**Signs encountered / km**
1	1.00	1	0	0	0.00
2	1.92	2	0	0	0.00
3	2.00	2	0	0	0.00
4	1.00	1	0	0	0.00
7	2.00	1	0	1	0.50
8	1.92	2	0	0	0.00
9	3.00	3	0	1	0.33
10	0.96	1	0	0	0.00
13	2.00	2	0	0	0.00
14	2.00	2	0	0	0.00
15	1.84	2	0	0	0.00
16	2.00	2	0	0	0.00
17	1.56	2	0	0	0.00
18	2.68	3	0	1	0.37
19	4.16	5	0	5	1.20
20	2.00	2	0	1	0.50
21	1.00	1	0	0	0.00
25	1.00	1	0	0	0.00
27	1.00	1	0	0	0.00

No of blocks	Total distance covered (km)	Number of transects	Number of dung encountered	Number of signs encountered	Signs encountered / km
19	35.04	37	0	9	0.25

6.2. Block Survey

A total distance of 854 km was surveyed during both seasons. Block numbers 7, 8, 9, 13, 14, 16, 18, 19, 20, 21, 25, 26 27 and 28 had elephant signs (Map 3). The frequency of encountering elephant signs was high in blocks 19, 20 and 21 and signs per km was highest in block 19, followed by block 20. The survey also indicated that elephants do not use areas to the north (block no 3), east (10, 11, 12 & 17), northwest (1 & 2),

northeast (5 & 6) and southeast (17) of the park, but that they only use the western and southwestern areas of the park. Overall, the results of both seasons show that



Map 3. Elephant sign recorded in Cat Tien National Park and its environs.

elephants generally use areas to the southwest of the park, as well as the La Nga and Vinh An Enterprises areas. During the dry season, the elephants seem more confined to the proximity of cashew plantation along the park boundary. Elephant did not use blocks such as 8 and 16 during this season, but only use these blocks during the wet season.

Table 2: Elephant signs encountered in general survey of blocks during dry and wet seasons

Block No	Dry season			Wet season			Both seasons		
	Distance (km)	Signs (No)	Signs / km	Distance (km)	Signs (No)	Signs / km	Distance (km)	Signs (No)	Signs / km
1	8.0	0	0.00	8.0	0	0.00	16.0	0	0.00
2	6.0	0	0.00	6.5	0	0.00	12.5	0	0.00
3	8.0	0	0.00	5.3	0	0.00	13.3	0	0.00
4	7.0	0	0.00	3.0	0	0.00	10.0	0	0.00
5	6.0	0	0.00	0.0	0	0.00	6.0	0	0.00
6	7.0	0	0.00	0.0	0	0.00	7.0	0	0.00
7	13.0	1	0.08	46.6	3	0.06	59.6	4	0.06
8	8.0	0	0.00	9.2	1	0.11	17.2	1	0.05
9	13.5	1	0.07	29.0	3	0.10	42.5	4	0.09
10	9.0	0	0.00	10.0	0	0.00	19.0	0	0.00
11	15.0	0	0.00	0.0	0	0.00	15.0	0	0.00
12	7.0	0	0.00	0.0	0	0.00	7.0	0	0.00
13	5.0	1	0.20	48.5	1	0.02	53.5	2	0.03
14	9.0	1	0.00	31.0	1	0.03	40.0	1	0.02
15	7.0	0	0.00	32.0	0	0.00	39.0	0	0.00
16	5.5	0	0.00	29.0	1	0.03	34.5	1	0.02
17	6.4	0	0.00	0.0	0	0.00	6.4	0	0.00
18	6.0	1	0.16	103.5	1	0.01	109.5	2	0.01
19	18.0	6	0.33	139.5	14	0.10	157.5	20	0.12
20	1.0	1	1.00	82.6	14	0.17	83.6	15	0.17
21	16.0	1	0.06	14.0	4	0.29	30.0	5	0.16
23	0.0	0	0.00	7.0	0	0.00	7.0	0	0.00
24	5.0	0	0.00	5.0	1	0.20	10.0	0	0.00
25	6.0	1	0.16	5.5	0	0.00	11.5	1	0.08
26	5.0	0	0.00	15.0	1	0.07	20.0	1	0.05
27	0.0	0	0.00	5.0	0	0.00	5.0	0	0.00
28	0.0	0	0.00	16.0	3	0.19	16.0	3	0.18
26/27	6.0	1	0.16	0.0	0	0.00	6.0	1	0.16
	194			651			854.6	61	0.07

6.3. Dung Survey and Elephant Numbers

When both the seasons are combined, a total of 58 dung piles were encountered. Dung piles were found in blocks 11,19, 20, 21 and 28 with the majority of these being found in block 19 (68%) followed by block 20 (22%). When only fresh dung piles are considered, these occurred mainly in block 19 during the dry season and in block 20 during the wet season. As these are adjacent blocks, it is again clear that elephants restrict themselves

to the southwest of the park, while other areas of the park are used to a much lesser extent. However, during the dry season fresh dung piles were encountered only in block number 19, while during the wet season they were found in other blocks too such as 7, 14, 16, 19, 20, 21 and 28. This suggests that during the dry season elephants restrict themselves to a much smaller area of the park, close to cashew plantation, and in the wet season disperse over a wider area.

A total of 46 dung piles was measured for size and this varied from 15 cm to 49 cm (circumference), suggesting these came from at least 6 to 7 elephants (Table 3). Among the size classes, the most frequently encountered class was the 34-36 cm (20%) class; there is a distinct possibility that more than one individual in the population may be of similar body size and have similar dung boli size and hence the estimated number should be treated as the minimum number.

Table 3: Dung circumference, frequency of occurrence and expected number of elephants for both seasons.

S.No		Dry Season		Wet season		Both seasons	
	Dung circumference (cm)	Frequency of occurrence	Minimum number of distinct elephants	Frequency of occurrence	Minimum number of distinct elephants	Frequency of occurrence	Minimum number of distinct elephants
1	15	1	1	O	1	1	1
2	30-33	6	1	2	1	9	1
3	34-36	8	1	4	1	12	1
4	37-39	7	1	2	1	8	1
5	40-43	6	1	2	1	9	1
6	44-47	2	1	3	1	5	1
7	48-50	1	1	1	1	2	1

6.4. Track Survey and Elephant Numbers

A total of 142 elephant tracks were encountered during the surveys in blocks 4, 7, 8, 9, 13, 14, 16, 18, 19, 20, 21, 24, 25 26 and 28. Most tracks were seen in block 19 followed by blocks 20 and 21. The presence of tracks thus also indicated that the distribution of elephants was mostly towards the southwest and to some extent the south-central of the park. For both seasons, fresh tracks were found in blocks 7, 16, 19, 20, 21 and 28. During the dry season, only in block 19 fresh tracks were found, during the wet season, including block 19, in all other blocks were also fresh tracks were reported. When data

from both seasons are pooled the measurements of the total of 80 tracks encountered varied from 49 cm to 142 cm (Table 4). It should be noted that it is difficult to precisely differentiate track measurements between 105 cm to 142 cm (Table 4). However, it is reasonable to interpret the track measurements as representing about 9 distinct elephants.

Table 4: Measurements of elephant footprints encountered in Cat Tien NP and enterprise areas for both seasons.

S.No	Circumference (cm)	Height of the animal (cm)	No of observations	Status		Number of elephants
				New	Old	
1	49-58	98-116	4	4	0	1
2	67-69	134-138	2	2	0	1
3	77-83	154-166	6	4	2	1
4	87-93	174-186	2	1	1	1
5	98	196	1	1	0	1
6	105-112	210-224	11	6	5	1?
7	113-120	226-240	17	10	5	1?
8	121-130	242-260	23	15	7	1?
9	132-142	264-284	14	10	1	1?

6.5. Village Surveys

6.5.1. Systematic Village Survey

In total 80 visits were made to various villages (with some of them being visited multiple times) for obtaining information on raids by elephants. The villages visited were located along the park boundary, within the La Nga and Vinh An Enterprise areas as well as along their periphery. During the dry season survey both past and current elephant visits were recorded while during the wet season survey the information was restricted only to recent (2000 and 2001) visits. The villagers were able to recall visits by elephants since about 1988. From 1988 to 1992 the biggest group sighted by the villagers was one of 12 individuals. Since 1997, groups of only 8-9 elephants, but more frequently 6-7 elephants, were reported. The wet season survey suggested that the number of elephants visiting in the past two years ranged from solitary to a group of 7 animals. A solitary male elephant seemed to be the most frequent visitor.

There are two distinct periods of elephant visits to villages. One period is from February to May, mainly for cashew, maize, stored rice and salt, with a peak during February-March (25% of visits recorded). The second is from June to December with a peak in November (30% of visits). Every year, from February to May, elephants regularly visit a cashew plantation located in the southwest of the park. There are no permanent human settlements within the plantation; elephants have demolished several huts and thus people do not stay overnight in the plantation due to fear of elephant attack. Although elephants visit most of the villages in the vicinity and there are reports of damage to huts, the frequency of visits and damage to cultivated crops are not high. There are no reports of human deaths due to elephants and the villagers use only very primitive methods of mitigating the problem.

6.5.2. Vehicle- based rapid village survey

This survey provided very useful information on the number of elephants in this area. During a 4-day (11-14 December 2001) visit to villages situated in La Nga enterprise area, the team encountered an adult male elephant, which had come to Ta Lai village (located south west of the park) on the very first day. The same day a village located 7 km from Ta Lai reported a group of 4-5 elephants. None of the other villages visited by the team reported any elephants. To this can be added an adult female and her calf that had been sighted by villagers near the boundary of the park, and signs of which were located by the team. Thus, a minimum of 7-8 elephants is found in this region. If survey team visits all villages located in the region within a short period during the peak crop-raiding season, a fairly good estimate of the number of elephants here could be obtained.

6.6. Guard Station Survey

The guard station survey again indicated that elephants mostly use the southwest of the park and the forestry enterprise area. The guards reported no elephants for several years from the southeastern and northeastern portions of the park. Elephants were reported only rarely in the northern and northwestern parts. In the southwest of the park, elephants were reported up to Ta Lai village. There were reports of direct sightings during February and March 2001, while in 2000 a group of 9 elephants were reported here. Towards the south, only a solitary male has been

sighted near Nui Tuong Guard Station and the park headquarters during 1999. Da Bong Kua in the northwest and Bau Sau in the central region reported elephant tracks in March 2001.

6.7. Elephant Food Plants

On 10 March 2001, one of the survey teams sighted a group of 5 elephants in Enterprise II of La Nga Forestry Enterprise (Block 19: 11°22'48", 107°16'06"), very close to the park boundary. The team collected specimens of all plants with fresh feeding signs by the elephants. Apart from this instance elephant feeding signs were also found in several other localities (Block 9; Block 8). A list of plant species with fresh feeding signs by elephants is presented in Table 5.

Table 5: List of elephant food plants recorded during dry season survey

No	Local name	Scientific name	Parts eaten
1	Ba gac	*Euodia lepta*	Bark
2	Lùöi ùôi	*Seaphium macropodimu*	Root
3	Mây nöùc	*Calamus dongnaiensis*	Stem
4	Dây vu sa	*Indororouchera contestiana*	Stem
5	Chiéc ít hoa	*Barringtonia pauciflora*	Stem
6	Ngâi gùng	*Alpinia sp.*	Root
7	Gôi	*Dysoxylum sp.*	Bark
8	Cö lac ba canh	*Cyperus trialatus*	All
9	Trâ rùng	*Adinandra dongnaiensis*	Root
10	Lö ö	*Bambusa procera*	Young shoots, leaves
11	Mây giâ	*Calamus dioicus*	Stem
12	Quán dáu sông lu	*Polyalthia luensis*	Young branches, leaves
13	Thàu Táu	*Aporusa tetrapleura*	Root
14	Nhoc long	*Polyalthia sp.*	Root
15	Diéu	*Anacardium occidentale*	Fruits, leaves
16	Mít nhâ	*Artocarpus heterophylla*	Fruits, leaves
17	Chuöi rùng	*Musa acuminata*	Stem
18	Duoi voi nhiéàu gié	*Penisctum polystachyon*	Stem
19	Thôm (khôm)	*Ananas comosus*	Fruits
20	Miá	*Saccharum officinarum*	Stem
21	Báp (Ngô)	*Zea mays*	Stem, leaves, fruits
22	Lùa	*Oryza sativa*	Stem, leaves, fruits
23		*Sp1 – Unidentified*	Root
24		*Sp2 – Unidentified*	Root
25		*Sp3 – Unidentified*	Stem
26		*Sp4 – Unidentified*	Stem

Elephants feed on at least 26 species of plants, which include both wild and cultivated varieties. Of these species, stems of 11 plants, roots of 7 plants, fruits of 4 plants, and bark

of 2 plants were eaten. It is interesting to note that elephants did not exclusively consume the leaves of any plant species, but these were consumed along with the stem, shoots or fruits.

The analysis of dung samples gave an approximate idea of the relative quantities of plant species in the diet. In all samples, grass dominated (57.7%) the diet, followed by cashew fruits (32.3%), rattan (5.8%) and bamboo (4.1%) (Table 6). Both bamboo and rattan were found in all the dung samples collected. It was also noted that not many forest plant species (as food) were found in the dung samples. Only bamboo and rattan are eaten, which may indicate that not many elephant food species are found in the forest as many of these plants are unpalatable (due to plant secondary compounds) to the elephants.

Table 6: Percentage composition of elephant dung with respect to the plant parts

Components	**Percent occurrence (Range)**	**Percent occurrence (Mean)**	**Frequency of encounter (%)**
Grasses	19.2 - 87.7	57.7	100
Bamboo	1.2 - 8.8	4.1	100
Rattan	1.0– 14.8	5.8	100
Bark	0.0 – 0.4	-	5
Stem/root	0.0 – 4.1	1.8	95
Leaves	0.0 – 3.0	0.8	70
Cashew fruit & nut	0.0– 73.7	32.3	85
Cloth piece	0.0 – 0.8	-	10

The cashew plantation located in southwest of the park is a major attraction for elephants during the dry season. They visit the plantation mainly for feeding on cashew fruits, and the undigested fruits and nuts are expelled in the dung. Each dung pile contained an average of 15.4 (S.E. 4.48) seeds (34 piles sampled out of which20 had seeds, range 6-117 seeds in those that contained seeds). We further estimated that 140 seeds weighed a kilo and further those 20 cashew fruits also weighed about a kilo. If an elephant defecated 15 times/day and 4 to 5 them have cashew seeds in it (assuming passage rate of 24 hours and that elephants do not feed on cashew during the day in the forest), about 6 to 7.5 kg of fruit may be consumed by an elephant/day. If there are 5 to 6 elephants operating in this region

about 30 to 40 kg of fruits are eaten daily by the elephants. There may be little loss to the farmers as 40 kg is only 2% of the total harvest/day (2000kg harvested/day) and the farmers also collect seeds from the dung piles making the collection of cashew nuts actually easier for the farmers. This is a good example of conflict avoidance over this resource.

Elephants spent up to 9 hours/day (20.00 hr to 05.00 hr) in the morning in the plantation, feeding also on grass available within and outside the plantation. This assumption is validated by grass being the principal component in all dung samples examined. Domination of grasses and cashew fruits in the diet could be due to sampling bias as most samples were from within and around the cashew plantation. However, during the survey period few dung piles were encountered in other areas.

7. Elephant Conservation Workshop

As a part of the study, a one-day workshop on elephant conservation was organized on 7th December 2001 at Cat Tien National Park. The main agenda of the workshop was to invite the personnels from the Forestry Enterprises and local community to discuss the survey findings with them. To expose the participants to the current status of the elephant, the conservation issues and develop a close coordination among Park and Enterprise authorities and local communities for conserving the species. The participants (Appendix 4) discussed the issue of human-elephant conflict and the need to evolve appropriate measures to solve the problem in collaboration with local people and Forestry Enterprises authorities. Forestry Enterprise authorities and the heads of the villages requested the Cat Tien NP authorities and other experts to train the villagers on methods of mitigating elephant-human conflicts. The need for installing an electric fence along the outer boundary of elephant usage area, its maintenance by local communities, transferring forested areas of Forestry Enterprise to Cat Tien NP and establishing salt licks inside the Park to attract elephants deeper into the Park were also discussed in this workshop.

8. CONCLUSIONS

8.1. Elephant Status and Population Structure in Cat Tien National Park

It is clear that the elephant population in Cat Tien National Park and adjoining areas has declined, perhaps by half or more, during the 1990s. Our surveys showed that the there are presently at least 2 adult or sub-adult males from the direct sighting of the team, the indirect evidence as well as sightings by the cashew collectors. Two more of the elephants are juveniles as seen from the size of tracks and dung boli. The rest of the elephants seem to be sub-adult or adult females. There was also a reliable sighting of an adult female and her newborn calf in April 2001 near the cashew plantation and it is entirely possible that this mother-calf pair may simply be part of the larger herd. We therefore estimate a minimum of 10 elephants in the park, including two adult bulls plus a herd of eight comprising 3-4 adult females, 2-3 sub-adults/juvenile, one juvenile (age 2 years in Feb 2001) and a young calf (born April 2001). It is possible that another small herd could exist, but there is no firm evidence at present. An upper limit of 15-17 elephants can be taken as speculative for the present.

The redeeming feature of the small elephant population is the presence of breeding males and females, thus offering some hope for recovery. Our present estimate of 10 elephants in the park is below the carrying capacity we can anticipate (at least 40 elephants if we assume that 0.1 elephant/km^2 are the minimum densities that can be supported in this forest type). The carrying capacity of the larger area used by elephants would be higher; the forestry enterprise areas could actually support higher densities because of the secondary nature of the forest and grasses available.

8.2. Elephant Distribution and Habitat Use

The elephants are largely concentrated along the southwestern boundary of Nam Cat Tien both during the dry and the wet seasons. They also make extensive use of the La Nga State Forest Enterprise (LNSFE) area to the south of this boundary. The data indicate the highest density of indirect signs (tracks, dung, etc.) in Blocks 19 and 20, which can be considered as “core area” of the home range of the elephants.

During the dry months (February-May) the elephants frequent the cashew plantations, just south of the park boundary, to feed on the cashew fruits. While the herd members seem to be largely confined to the plantation and the secondary vegetation in the park, at least one bull makes larger forays south through the LNSFE to enter agricultural areas. The elephants also use the western and central part of the park occasionally as seen from sporadic, old signs in Blocks 7, 8, 9, 13, 14, 15, 16, 18 and 21. It is surprising that elephants rarely visit the large lake area at Bau Sau (Block 9), where a guard post is located, though old signs in the block indicate very occasional use of the grassland.

During the wet season (June-November) blocks 19 and 20 still remain the "core area". But now the elephants, both the herd and the bulls, seem to use the LNSFE area more intensively, possibly because of the growth of grasses in the plantation areas and the added attraction of agricultural fields with maize and paddy beyond to the south. In November 2001 we found clear evidence of an adult female elephant and her calf visiting the forest-cultivation boundary of Khu 91 of Thanh Son Commune. The southern forested blocks of LNSFE (Nos 27, 28 & 29) will therefore have to be more carefully surveyed for elephant usage. Fresh sign of elephant was also seen in Blocks 21, 14, and 7.

To the west of the park, elephants also move into the secondary forests of the Vinh An Forest Enterprise. The odd signs of elephants here indicate sporadic usage, but also calls for a more detailed survey. Elephants never move to the northern boundary of the park, nor have they been recorded in recent years in the northeastern part of the park (Blocks 5, 6, 10, 11, 12) where primary evergreen forest is seen. There has been only a single sighting of a bull near the park headquarters in Block 17 on June 1999. There was a report of elephant prior to the arrival of settlers in the northwest of the park (Da Bong Cua area) but at present there are no reports of elephant sightings in this region. However, there are sporadic incidents of elephant observations and visits to human habitation in this region.

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8. 3. Dry Season Feeding Ecology

During the dry season, elephants seem to depend substantially on grasses found in and around the cashew plantation for their forage. They restrict themselves close to the plantation and each sub-adult/adult individual feeds on about 30-40 kg of cashew fruits everyday. Feeding signs on wild plants indicated that they feed on at least 26 species of both wild and cultivated varieties found within the park, cashew plantation and Forestry Enterprise areas. A crucial factor for elephant distribution would be the availability of food plants and their distribution. It appears that both wild and cultivated forage species have clumped distribution. However, it is not clear how the elephants' feeding behavior, food species availability and distribution would really determine the elephant numbers, distribution and the carrying capacity of the park and its environs.

8.4. Elephant-Human Conflict

Although the focus of the village survey was for estimating the number of elephant found in the region, it provided useful information on the status of human-elephant conflict. Most of the villages (91%) visited by the survey team reported visits by elephants, a majority of these being a solitary adult male. It also appears that males cover larger distance to raid crops while the family group/s restrict themselves to a few villages. Elephants visit villages for stored and cultivated rice, salt, maize, sugar cane, cashew, banana, tapioca, bean and other crops. In the process of looking for stored food, the elephants damaged houses; the adult males even enter houses in search of stored food. Although there is damage to crop and huts, the human–elephant conflict is fortunately not severe (as compared to the nearby Tan Phu forest) because the elephants have not killed any people and only primitive methods of mitigating the problem are currently in use. However there is a distinct possibility that a bull entering a house for stored rice and salt may attack or kill people in future, even if this by accident. Developing a strategy to mitigate the conflict is of crucial importance, as any human death due to elephant attack would result in antagonism towards conservation. If a reproductive bull is killed in the ensuing conflict this may virtually seal the demographic fate of this population.

9. RECOMMENDATIONS FOR CONSERVATION

9.1 Monitoring the elephant population:

The dense vegetation and low elephant density in Cat Tien National Park preclude the use of line transect methods, either direct or indirect (dung), for estimating elephant numbers. These methods are neither feasible nor economical. The most practical way of estimating the elephant population number and structure is to question villagers and examine fresh evidence such as track and dung in localized areas (such as the cashew plantation) where the elephants spend much of their time. It appears that the winter and early dry season (November to February) is the ideal periods for estimating elephant numbers in this region. Rapid village survey in November through visiting all the villages within a few days would provide information on the total number of crop raiding elephants. The cashew plantation to the west of Doi Dat Do guard station is also an ideal place to look for fresh signs of elephant during February when the cashew fruit attracts them almost every night.

Two other methods would be feasible and rewarding for this small population with a restricted range. Molecular genetic (DNA) analyses of dung for sexing as well as individual identification are now feasible (Fernando et al. 2001 & Kumar, 2001) Because of problems with sample preservation we were unable to resolve these in the samples we had collected; however, this could be overcome in future. The cashew plantation is also a good location for camera trapping of elephants.

9.2 Elephant population viability:

The small population of 10-15 elephants here has very low viability in demographic terms. Population viability analyses for Asian elephants (Sukumar 1995) show that such a population may have as high as a 70% probability of extinction from chance alone (if the deterministic population growth rate is zero). The presence of breeding males and females, and the availability of sufficient habitat area and resources, however, offer some hope for population recovery. This is possible only if the elephants are strictly protected from any mortality due to extraneous causes such as poaching or conflict with humans. Intensive management of the population and its habitat would be needed to ensure a lower risk of extinction.

The short-term (2-5 years) goal of management should be to stabilize the elephant population at present levels, the medium-term (20-25 years) goal to increase the population to about 25-30 animals, if necessary through supplementing the population with animals from elsewhere, and the longer-term (75-100 years) goal to further increase it to about 100+ elephants.

9.3 Habitat management:

The habitat of the Nam Cat Tien sector of the park can be manipulated in a selective manner to make it more attractive for the elephants, with the objective of gradually luring the elephants away from the La Nga SFE to a certain extent. This could include the development of salt licks, a water reservoir and perhaps a small area under grassland in Block 14 and/or 15. Even the planting of cashew trees could be tried on an experimental basis. Recognizing that Cat Tien has the status of a national park, such manipulation should be only on an experimental, small scale. It would also be prudent to carry out the manipulation initially at sites not more than 1-3 km to the north of the southern boundary of the park, as otherwise the elephants may never actually venture into these areas.

9.4 Mitigation of elephant-human conflicts:

Elephant-human conflict is not intense at present, mainly because the elephants have not killed any people. There is however a distinct possibility that the adult bull that boldly ventures into houses in search of stored food grains and salt could easily kill a person. This would antagonise local people against the elephants. Conflict could also escalate with an increasing elephant population. To prevent any conflict-related deaths of people and of elephants, the feasibility of putting up a high-voltage electric fence along the forest-cultivation boundary of the La Nga SFE, from Sa Mach to Ta Lai, should be seriously explored. This fence would keep elephants away from the dense settlements as well as maize and paddy fields in the lowlands, but allow them the use of about 100 km^2 of secondary forest area and cashew plantations in the La Nga SFE (within Blocks 18, 19, 20, 27, 28, 29).

9.5 Education programmes:

In the meantime, an education programme among the communes of the La Nga SFE about the elephants should be continued, building upon the elephant conservation campaign being executed under this (USFWS) project. This should emphasise the need to avoid harming the elephants as well as provide training to the people on simple methods to discourage elephants. Special teams of farmers should be established to monitor movement and activities of elephants and inform villagers to take necessary preventive measures.

9.6 Land-use survey of the enterprise areas:

A survey of land-use within the 100 km^2 forested area of the LNSFE and Vinh An SFE has to be carried out. At present there are several small patches of cashew plantation, sometimes supplemented with banana and coffee. The peripheral areas also have plantations of *Acacia auriculiformis, Acacia magnum* and *Tectona grandis*. Although there are permanent human settlements inside this area, several people live in temporary shelters, either permanently or seasonally when the cashew fruit is ready for harvest. Bamboo is also regularly extracted from this area. These activities can continue, but at the same time there should be a serious attempt to wean people away to a non-elephant area for more permanent settlement by offering an attractive relocation package. The few people we met here expressed their willingness to move to another region free of elephants. Land-use regulation in the enterprise area should take place. For example, in the areas close to CTNP should not grow plants palatable to elephants to discourage the elephants from going out.

9.7 Buffer area for Cat Tien NP:

The Vinh An Forestry Enterprise (VAFE) together with Ma Da and Hieu Liem Forestry Enterprises to the west of the park provides an ideal buffer with about 200 km^2 of secondary vegetation. Every effort should be made to maintain this buffer in the present state. There is already a proposal to designate the VAFE as a nature reserve; this should be encouraged, as it will contribute to the long-term planning for the conservation of elephants in the greater Cat Tien region.

9.8 Regulation of development:

A road (number 323) is currently being enlarged and improved along the southwestern boundary of Nam Cat Tien, extending the existing road from Doi Dat Do to the Sa Mach guard post. About 4 km of the road from Doi Dat Do to a cashew plantation has already been developed during 2001 replacing a track used by people from Ta Lai to reach the plantation. The road when completed has the potential to encourage the influx of a large number of people along the park boundary and increase vehicular traffic. *This should be avoided at all costs* as it could cut off the access/movement of elephants between La Nga SFE and Nam Cat Tien. A gate has to be located along the road near the junction of the Ta Lai – Doi Dat Do road and the Ta Lai – Ap 7 road to regulate vehicular traffic and the movement of people. Only the park staff and people going on legitimate work should strictly use the road. The existing road between Sa Mach and Ta Lai, through the La Nga SFE, could be strengthened for the general use of the public. This would also discourage elephants from moving across the road, which would be a desirable goal.

9.9 Establishment of Mobile Elephant Protection and Monitoring Unit (MEPMU):

As future action plan or follow up action, two mobile elephant protection and monitoring units could be established with a manpower consisting of 2 park rangers, 1 La Nga Forest Enterprise staff and 4 local villagers for each unit. Responsibilities such as patrolling elephant areas, collecting records of elephant signs and human-elephant conflict problems, etc, could be assigned to the units.

For effective functioning of the units, establishment of elephant monitoring network in 12 locations within and out side Cat Tien NP and enterprises area is highly desirable. Locations such as Tal Lai guard station, Dat Do guard station, Nga Ba Xuong Cua hamlet (Ap 7, Thanh Son Commune), Khu 91 hamlet (Ap 7, Thanh Son Commune), Cho Doi Hamlet (Ap 7, Thanh Son Commune), Cau Go near Nga Ba to Nga ba Tang bo (LN Forest Enterprise II), Cashew plantation near Nga Ba Tang Bo, Doi Truong/Suoi Duc Hamlet (LN Enterprises I), Ten Lua hamlet (LN Forest Enterprise I), Suoi Ty village, Sa Mach guard station and Thung Phi grassland (Vinh An Forest Enterprise) have been identified for these units.

Training MEPMU on techniques of elephant survey and monitoring, hiring one ranger or villager at each point for monitoring and recording elephant activities and informing MEPMUs in his area, supplying necessary equipment to MEPMUs (motorbikes, GPS, binoculars, compasses, measuring tapes, field notebooks, pens, data-sheets, etc) could also advance the quality of functioning of the units.

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Appendix 1:

Terms of Reference for the project:

Major Function: Assist Cat Tien National Park in surveying and assessing its Asian Elephant *Elephas maximus* population with the purpose to formulate an Asian Elephant Management Plan.

Duties and Responsibilities.

In Coordination with Dr. Nguyen Xuan Dang, train Cat Tien National Park staff in Asian Elephant survey techniques (including line transects, interviewing villagers, camera trapping).

In collaboration with Dr. Nguyen Xuan Dang, conduct a baseline inventory of Cat Tein National Park's Asian Elephant population within CTNP and the surrounding State Forest Enterprises including an estimation of the number of elephants present, their ranges and assessment of possible elephant-human conflicts and advise on mitigating measures to be taken thereof.

Formulate a work schedule for Cat Tien National Park staff to conduct a year round routine Asian Elephant monitoring program, including monthly field surveys.

In coordination with Dr. Nguyen Xuan Dang, train on staff CTNP's Technical Department in setting-up a computerized data and compiling field data into this data base.

Together with Dr. Nguyen Xuan Dang (and CTNP staff where suitable and feasible), compile the reports mentioned under "deliverables" above.

Appendix 2:

Report on Study Tour

Elephant Research, Conservation and Management Study Tour for the Personnel from Cat Tien National Park, Vietnam.

Date: 3rd to 14th February 2001

Venue: Bangalore, Mudumalai and Bandipur National Park (India)

Participants: Mr. Tran Van Thanh - Chief of Forest Protection Department of Cat Tien NP (Vietnam)
Mr. Phan Quoc Tuan - Staff of FPD Cat Tien NP (Vietnam)
Mr. Vuong Duy Lap - Technical officer of Cat Tien NP (Vietnam)
Dr. Nguyen Xuan Dang - Head of department of Zoology, Institute of Ecology and Biological resources, Hanoi, Vietnam.

Study tour instructor and coordinator

Mr. Surendra Varma, Asian Elephant Research and Conservation Centre, CES, IISc, Bangalore

Resource Persons:

Prof. Sukumar, Asian Elephant Research and Conservation Centre, CES, IISc, Bangalore
Mr. Surendra Varma, Asian Elephant Research and Conservation Centre, CES, IISc, Bangalore
Mr. R. Arumugam, Centre for Ecological Sciences, IISc Field Research Station, Masinagudi, Nilgiris, South India.
Mr. Wildemann, Bokkapuram Village, Nilgiris, South India
Mr. Pooviah, Range Forest Officer, Bandipur National Park, Karnataka, South India.

Organised by:

ASIAN ELEPHANT RESEARCH AND CONSERVATION CENTRE
(A division of the Asian Nature Conservation Foundation)
Centre for Ecological Sciences,
Indian Institute of Science,
Bangalore – 560 012, Karnataka, INDIA
Phone: 91-80- 3092786/3600382. Fax: 91- 80 -3602280
Email: aercc@ces.iisc.ernet.in

Itinerary

3rd February 2001.

Participants travel from Ho Chi Minh City (Vietnam) to Madras (India). Stay overnight at Madras.

4th February 2001.

Travel from Madras to Bangalore - Meeting with Prof. R. Sukumar, Mr. Surendra Varma and other staff of Asian Elephant Research and Conservation Centre (AERCC) - Halt at Bangalore (Ashraya International Hotel).

5th February 2001.

10.00 AM Participants along with Prof. Sukumar and Mr. Surendra Varma travel from Bangalore to Mudumalai Sanctuary and National Park (by car), halt at Jungle Trails guest house Masinagudi, Nilgiris.

19.00- 21.00 Discussion about the study tour and work plan.

6th February 2001.

08.00 AM Field visit to Mudumalai Sanctuary and National Park (MSNP).

10.00–11.00 Introductory talk about the park by Mr. R. Arumugam.

11.30–12.30 Introductory talk by Mr. Surendra Varma on study methods of estimating population densities of large mammals, by total count, line transect (direct), walking transect and road count using vehicle.

13.00–14.00 Field demonstration of line transect method of counting large mammals by direct method.

15.30-18.00 Introductory talks and fields demonstration of estimating elephant density by indirect methods by Mr. Surendra Varma & Mr. Arumugam.

7th February 2001.

09.00–10.00 Lecture by Porf. R. Sukumar on methods of elephant census. Discussion on total count, direct count, indirect count, camera-trap method, and estimating elephant numbers through DNA method and procedure for dung sample collection for DNA study.

10.30–12.00 Preparation for elephant survey in Cat Tien NP Vietnam. Discussion on methods to be adopted, manpower, equipment, logistics and other issues, proposed visit of Prof. R. Sukumar and Mr. Surendra Varma to Vietnam.

12.30–14.00 Training on use of Computer Programs TRANSECT – DISTANCE and GAJAHA to analyze elephant census (direct and indirect) methods.

16.00–18.00 Visit to private farm, discussion with Mr. Wildemann on elephant barriers, electric fence and elephant proof trench (EPT).

19.00–21.00 Talk and field demonstration of camera - trap by Mr. Arumugam.

8th February 2001.

08.00 Visit to Bandipur National Park (BNP).

10.00-11.00 Introductory talk on BNP by Mr. Surendra Varma.

11.30-13.00 Visit to Gopalswami Betta (1400 meters) for an aerial view of the park, and discuss the park boundary, human settlements, human-elephant conflict and other management problems.

13.30-4.30 Visit to EPT and Hosahalli village to asses the status of elephant barrier and to interview the villagers about elephant invasion and crop damage, human death, house-hold damage by elephants, etc.

15.00-16.00 Meeting and discussion about the BNP management problem and solution, elephants and their habitat with Mr. Poovaiah.

17.00–18.30 Talk on elephant corridors by Mr. Surendra Varma and visit to Kanyanpura elephant corridor.

9th February 2001.

10.00-12.00 Group discussion about the topics covered and report preparation.

14.00–15.00 Visit to Mudumalai Sanctuary for elephant age classification, study the problem of elephant poaching by visiting anti-poaching camp (APC) and wildlife sighting.

16.00 Travel to Mysore City, overnight stay at Mysore

10th February 2001.

Travel to Bangalore. 11.30-12.30 Meeting with Prof. R. Sukumar and discussion about the study tour.

11th February 2001.

Travel to Ho Chi Minh City.

Main topics covered by the participants and their feedback and suggestions:

I. Study Tour Sites:

Bandipur and Mudumalai National Parks:

Brief introduction about Mudumalai Sanctuary and National Park (MSNP) and Bandipur National Park was provided by Mr. Surendra Varma, Mr. Arumugam and park's staff provided us very good understanding of the parks. Both the reserves are famous for elephant and tiger conservation. MSNP has an area of about 321 km^2 and BNP 870 km^2. There are 3 main forest types found within the reserve. They are dry deciduous, moist deciduous and scrub forests. Flora and fauna of the parks are varied and diverse. During our visit, we have seen several species of wildlife which include, elephant (*Elephas maximus*), spotted deer (*Axis axis*), gaur (*Bos gaurus*), sambar (Cervus unicolor), muntjac (*Muntiacus muntjak*), bonnet macaque (*Macaca radiata*) and common langur (*Semnopithecus entellus*). In general, MSNP and BNP are very ideal place to study and understand the conservation issues of elephants and other large mammals. Both these parks have several conservation problems, however they are managed relatively well.

II. Methodology of Elephant census:

The participants understood, that through several methods elephant density and number could be estimated and they were introduced to methods such as

1. Total count method:

By establishing several compartments or blocks within the census area and using a large manpower, this method estimates total number of animals in a given area. This method was used in Mudumalai in the past and was found to under-estimate and the reliability of the animal numbers are questionable and this method therefore cannot be applied in Cat Tien NP Vietnam.

2. Line transect direct count method:

Stratification of the habitat based on vegetation or density of animals, establishment of line transects by cutting and marking them. After establishing transect, walking, detecting the animals, measuring the sighting distance from transect to the animal, taking sighting angles, number, group size, and sex of the animal sighted were undertaken. However, this method cannot be applied in Cat Tien NP because of poor visibility and very low density of elephants in the area.

3. Line transect dropping/dung count method:

The following procedures were involved in estimating the number of elephants.

a) Estimating dung density:

- Like direct count, habitat stratification based on vegetation or density of elephants
- Establishment of line transects
- Estimating dung density
- Detecting elephant dung piles, taking perpendicular distance from dung pile to transect
- In overall, the data collection includes, date, place, weather, observers, time of sighting, starting and closing time of transect, perpendicular distance from the line to the dung, habitat status and remarks.
- Estimating dung density by Computer Program Gajaha.

b) Estimating defecation rate of elephant:

- Following elephants of different age and sex classes for 24 hours/day in different season and habitat to study the of defecation rate.
- Estimating defecation rate by Computer Program Gajaha.

It is very difficult to estimate defecation rate in Cat Tien NP because it is impossible to follow wild elephants for 24 hours. One may have to observe captive elephants or use the defecation rate data available from India and Myanmar.

c) Estimating decay rate:

- Locating and monitoring, 30-100 fresh elephant dung piles in different habitat for different season until they decay completely.
- Estimating decay rate by Computer Program.

Estimation of Decay rate cannot be carried out in Cat Tien NP because it is impossible to locate enough number of fresh dung piles in the park. We may need to carry out the observation on captive elephants or use available decay rate of India or Myanmar.

d) Estimating Elephant Density:

Elephant density can be estimated by a computer program developed by Indian scientists and copy of the program GAJAHA is given to the participants to be used in Cat Tien NP elephant survey by Mr. Surendra Varma.

III. Management of elephants in Mudumalai S & NP and Bandipur NP:

In general, elephants in MSNP and BNP are well protected. However, some problems still occur. The major elephant problems in these areas are as follows.

Human-elephant conflict: It's understood that, elephants regularly come to villages close to the park, particularly northwest and northeast of Bandipur National Park and southeast, southwest and central regions of Mudumalai Sanctuary and destroy crops, houses and sometimes kill people. The following methods are adopted to mitigate the problem.

- Chasing the elephants: local residents chase elephants away by making sound (mainly fire crackers are used) and it was understood that this method is not very effective and has the risk of irritating the animals and people getting injured or killed subsequently by the elephants.
- Erection of electric fence: through the field demonstration it was felt this method is the most effective to prevent elephants. However, it's very costly and is estimated that for the erection of a km of such fence, 2500 US $ is needed. Apart from being very costly, it's found that high manpower and maintenance is required.
- Construction of elephant proof trenches (EPT): A trench of 3m wide X 2m deep X 2m bottom wide appears to be effective in preventing elephant incursion to human habitation. However, if a park has a very long boundary with human habitations, it involves a lot of resources and manpower to maintain it. The construction cost of the EPT is about 5000 USD/km. Local people do not co-operate in maintaining the trenches.

Suggestions: Trench may be dug only in some critical areas. Local people should bear the responsibility for maintenance of the trench because they are directly benefited from having an effective elephant barrier. In some areas, it appears that electric fence is more practical and should be developed there. Encouraging local people not to grow plants that are palatable for elephants and other wildlife close to the park boundary would also solve the problem.

Elephant poaching: It's estimated that, a total of seven to eight elephants are killed each year by poachers in Bandipur National Park. It's understood that there are 22 anti-poaching stations established in critical points of the park and each station has 6 forest staff patrolling the forest regularly. However, if the park authorities are empowered to kill the poachers if they are encountered in the forest and they can bring the case directly to the court without participation of the local police, which would help in tackling the problem.

Habitat destruction: Habitat destruction exists in some park areas in the following patterns; woodcutting, collection of fuel wood and secondary forest products and forest fire. Solutions to these problems are similar to those of Vietnam. Increasing the manpower, regular patrol of forest, establishment of fire observation (watch) towers and carrying out various community programs would help in minimizing the problems.

IV. Elephant corridor:

Elephants are known to move seasonally in search of food, water and other resources. However, natural barriers such as ridges and steep slopes, man-made barriers such as, villages, cultivated lands are known to prevent elephant movements. Visit to Kanyanpura corridor located on the eastern side of Bandipur National Park, provided a picture of both natural and man made barriers preventing the elephant movement in this region. It was also felt that, the approach to purchase the land from the local people and digging trenches to prevent habitat encroachment problem and elephant visit to village in Kanyanpura region is a very effective

conservation measure, jointly undertaken by forest department, local NGO's and elephant research organizations.

Conclusion:

Despite the short duration of the study tour, the participants completed their mission successfully. They learned much about nature and wildlife of two famous Indian national parks, Mudumalai and Bandipur. The participants felt, in general, the study tour was very useful and enjoyable; however the duration of the study tour should last for 10 - 14 days to allow them to learn in more detail.

Appendix 3:

Manpower and Survey itinerary – Dry and Wet Seasons.

Dry Season:

Survey team:

Group 1:

Mr. Tran Van Thanh	– Chief ranger, Cat Tien National Park
Mr. Hoang Dinh Trang	– Deputy Chief ranger, Cat Tien National Park
Mr. Pham Quoc Tuan	– Ranger, Cat Tien National Park
Mr. Nguyen Thanh Liem	– Ranger, Cat Tien National Park
Mr. Nguyen Van Em	– Ranger, Cat Tien National Park
Mr. Nguyen Tien Dung	– Botanist, Sub-Institute of Forest Inventory and Forestry Planning in Ho Chi Minh City

Group 2:

Mr. Nguyen Thanh Son	– Ranger, Cat Tien National Park
Mr. Nguyen Van Bo	– Ranger, Cat Tien National Park.
Mr. Quach Anh Minh	– Ranger, Cat Tien National Park
Mr. Vuong Duy Lap	– Technical officer, Cat Tien National Park

Group 3:

Prof. R. Sukumar	– Asian Elephant Research & Conservation Centre, Indian Institute of Science, India
Dr. Nguyen Xuan Dang	– Institute of Ecology and Biological Resources, Hanoi, Vietnam.
Mr. Surendra Varma	– Asian Elephant Research & Conservation Centre, Indian Institute of Science, India.
Mr. Bui Huu Manh	– (Map design) Cat Tien National park
Mr. Pham Minh Tien	– Cat Tien National Park

Survey itinerary (dry season):

22 February:	Prof. R. Sukumar arrived at Ho Chi Minh City
24 February:	Mr. Surendra Varma arrived at Ho Chi Minh City, Prof. R. Sukumar and Mr. Surendra Varma traveled to Cat Tien National Park
24-25 February:	Prof. R. Sukumar and Mr. Surendra Varma along with Mr. Tran van Thanh conducted field visit to key areas of Cat Tien NP
26 Feb. 2001:	Dr. Nguyen Xuan Dang arrived at Cat Tien NP. Planning of methodology, preparation of data sheet, identification of survey work plan.
27 February:	Elephant survey training programme for survey team by Prof. R.Sukumar, Dr. Nguyen Xuan Dang and Mr. Surendra Varma. After the program visit Doi Dat Do for field survey.
28 Feb – 2 March:	Field survey: Line-transect and Block trail survey
3-4 March:	Survey team return to Park Headquarter for discussion on data collection and work plan. Arrival at Doi Dat Do Guard post for further field survey.
5-19 March:	Field work continued: Line transect and block survey, Guard post and village interview
20 March:	Mr. Surendra Varma's departure for India
20-28 March:	Field work continued: Line transect and block survey, Guard post and village interview
29 March:	Dr. Nguyen Xuan Dang's departure for Hanoi
29 March - 10 April:	Field work continued: Line transect and block survey, Guard post and village interview

WET SEASON

Survey team:

Prof. R. Sukumar	Asian Elephant Research & Conservation Centre, Indian Institute of Science
Dr. Nguyen Xuan Dang	Senior Biologist, Institute of Ecology and Biological Resources, Hanoi.
Mr. Surendra Varma	Asian Elephant Research & Conservation Centre, Indian Institute of Science.
Mr. Tran Van Thanh	Chief ranger, Cat Tien National Park
Mr. Hoang Dinh Trang	Deputy chief ranger, Cat Tien National Park
Mr. Pham Quoc Tuan	Ranger, Cat Tien National Park
Mr. Nguyen Thanh Liem	Ranger, Cat Tien National Park
Mr. Nguyen Van Em	Ranger, Cat Tien National Park
Mr. Nguyen Thanh Son	Ranger, Cat Tien National Park
Mr. Nguyen Van Bo	Ranger, Cat Tien National Park
Mr. Quach Anh Minh	Ranger, Cat Tien National Park
Mr. Pham Minh Tien	Ranger, Cat Tien National Park
Mr. Vuong Duy Lap	Technical officer, Cat Tien National Park

Survey Itinerary (wet season)

Date	Activities
13. Nov.2001	Dr. Nguyen Xuan Dang arrived at HCM City
14. Nov. 2001	Dr. Nguyen Xuan Dang arrived at Cat Tien NP headquarter, working with Mr. Tran Van Thanh for preparation of survey equipment, manpower, data-sheets, etc.
15-18 Nov.2001	Dr. Nguyen Xuan Dang: Visiting Doi Dat Do area; Summarizing results of June survey and monitoring materials.
19. Nov.2001	Prof. R. Sukumar & Mr SurendraVarma arrived Cat Tien NP
20. Nov. 2001	- Visiting Mr. Tran Van Mui – Director to inform the results of previous survey and objectives of November survey. - Meeting with survey team for revising survey techniques and developing survey plan for 21 and 21 November. Survey team temporarily divided into 3 group: • Group I: Prof. R. Sukumar, Dr Nguyen Xuan Dang, Mr. Surendra Varma, Mr. Son and Mr. Trang (Group head) • Group II: Mr. Lap, Mr. Em, Mr. Liem and Mr. Tuan (Group head) • Group III: Mr. Bo, Mr. Tien and Mr. Minh (Group head)
21-22 Nov.2001	- Group I conducted overview survey along Park boundaries with Vinh An Enterprise on the west and La Nga Enterprises I, II, III on the south. - Group II and III conducted survey on blocks 21, 16 and 10.
23 Nov. 2001	- Meeting with Mr. Gert Polet for discussing on human – elephant conflict and preventive measures and objectives of this survey. - Transport to Doi Dat Do Guard Station.
24 Nov.2001	- Group I conducted survey in Doi Dat Do area - Group II &III conducted village survey in La Nga Enterprises area close to southern boundary of the park.
25 Nov. 2001	- Group I conducted survey in Enterp.I,II,and III along road from Ta Lai to Nga ba Tang bo. - Group II&III conducted village survey in La Nga Enterprises area close to southern boundary of the park
26 Nov.2001	- Prof. R. Sukumar, Mr. SurendraVarma, Dr Nguyen Xuan Dang: data analysis - Group I,II conducted trail survey in block 27 (Road to Nga Ba Tang Bo) - Group III conducted village survey in Enterprise I, II.
27 Nov. 2001	- Prof. R. Sukumar, Mr. Surendra Varma, and Dr. Nguyen Xuan Dang: discussing with Mr. Gert Polet about the survey finding; working with socioeconomic specialists (Mr. Tien and Mr. Toan). - Group I,II conducted trail survey in block 27 (Road to Nga Ba Tang Bo) - Group III conducted village survey in Enterprise I, II.
28 Nov.2001	- Group meeting to discussing about survey finding and work plan for next days. - Group I and II moved to Khu 91 (Ap 7, Thanh Son commune), overnight there with expectation of watching elephants coming to

	the areas at night. - Group III moved to Cashew plantations near Nga ba Tang bo and overnight stay to watch elephants coming to the areas at night. - Prof. R. Sukumar left Cat Tien NP
29 Nov. 2001	- Group I and group II conducted trail survey in La Nga Enterprise III (block 20) - Group III conducted survey in La Nga Enterprise II (Blocks 19, 28)
30 Nov. 2001	- All team moved to Sa Mach Guard Station. - Village survey in Phu Ly commune
1 Nov. 2001	Groups I, II and III conducted trail survey in Block 24 (Vinh An Enterprise)
2 Nov. 2001	Groups I, II and III conducted trail survey in Block 25 (Vinh An Enterprise)
3 Nov. 2001	- Mr. Surendra Varma and other members conducted trail survey in block 26 (Vinh An enterprise) - Dr Dang and 4 members returned to Park Headquarter for Park Meeting
4 Nov. 2001	- 3 Groups conducted trail survey in Block 27 (La Nga Enterprise I) and Suoi Ty area - Dr. Nguyen Xuan Dang conducted data analysis.
5 Nov. 2001	- 3 groups conducted trail surveys and village survey in La Nga Enterprise I, II) - Dr Nguyen Xuan Dang conducted data analysis
6 Nov. 2001	All team returned to Park Head quarter for preparation of Elephant conservation workshop
7 Nov. 2001	Elephant Conservation Workshop with participation of Representatives of La Nga Enterprises, Vinh An Enterprise and local communities
8 Nov. 2001	- Dr. Dang, Mr. Surendra Varma conducted data analysis and development of follow-up actions - Day off for other members
9 Nov. 2001	- Dr Nguyen Xuan Dang left for Hanoi, Mr. Surendra Varma worked on recommendations. - Day off for other members
10 –16 Nov.	- Village survey in La Nga Enterprises I, II, III - Identification of boundary and status of natural forest of La Nga Enterprises I, II, III. - Preliminary identification of location of possible electric fence.
17 Nov. 2001	Survey teams returned to Park Headquarter Rounding up survey materials
18 Nov. 2001	Mr. Surendra Varma returned to India.

Appendix 4:

Notes on Elephant Conservation Workshop

Workshop agenda:

Date:	07-12-2001
8:30 – 9:00:	Introduction of delegates (Mr. Tran Van Thanh – Head of Forest Protection Unit of Cat Tien NP). Opening welcome speech (Mr. Tran Van Mui – Director of Cat Tien NP).
9:00 – 9:30:	Report " Status of elephant population in Cat Tien National Park and recommendations for its conservation" (Dr. Nguyen Xuan Dang and Mr. Surendra Varma).
9:30 – 11:15:	Discussion and presentation of delegates
11:15 – 11:45:	Conclusion of workshop (Mr. Tran Van Mui).
11:15 – 12:00:	Watching videotape of Cat Tien elephants taken in 1995.
12:00 – 13:00:	Lunch

Workshop Participants:

Mr. Tran Van Mui	– Director, Cat Tien NP)
Mr. Tran Van Thanh	– Head of Forest Protection Unit of Cat Tien NP
Mr. Surendra Varma	– Oversea export
Dr Nguyen Xuan Dang	– National export
Mr. Gert Polet	– Adviser of Cat Tien NP Conservation Project
Mr. Cong	– La Nga Forestry Company
Mr. Quy	– Director of La Nga Forestry Enterprise I
Mr. Hiep	– Head of Ta Lai village
Mr. My	– Deputy Chief of Forest Protection Department of Dinh Quan District
Mr. Giang	– Head of Ap 3, Thanh Son commune
Mr. Nam	– Head of Ap 7, Thanh Son Commune

Workshop notes:

Mr. Tran Van Thanh introduced delegates and workshop agenda, Mr. Tran Van Mui gave opening speech, pointed out Cat Tien NP authority's interest in conservation of elephant population, understanding and mitigating current human-elephant conflict problem in areas of La Nga (I, II, III) and Vinh An Forestry Enterprise. He felt the need of having appropriate measures to solve the problem in collaboration local people and enterprises authorities. As a part of the workshop agenda, in consultation with Mr. Surendra Varma, Dr. Nguyen Xuan Dang presented a report " *Status of elephant population in Cat Tien National Park and recommendations for its conservation*" as the preliminary results of 2001 elephant survey in Cat Tien NP. The talk provided basic information on elephant number, status and conservation issues and brought into a long discussion on the subject among the participants of the workshop.

Mr. Cong, Mr. Quy, Mr. Giang, Mr. Nam and Mr. Hiep appreciated the Cat Tien NP authorities for carrying out elephant survey and organizing the workshop. They felt the workshop is basis for information exchange and discussion on measures of elephant protection and human – elephant conflict mitigation. According to them, in La Nga Forestry Company area, elephants were often seen since 1980 but more often after 1990. During 1995, there was a group of 6 elephants including 1 male and 1 young often came in the area (the incident was recorded on videotape on 19 October 1995 in Ap 4, Thanh Son Commune by the company). All requested the Cat Tien NP authorities to inform the movement of elephants and train villagers on methods of mitigation human – elephant conflict. They felt at present, the elephants do not cause much damage to local villages and people chase elephants away by making fire torches, shouting and making noises. Currently La Nga company has appointed forest guards to monitor and inform people about activity of elephants, but need more close cooperation with Cat Tien NP.

Mr. Gert Polet – Adviser of Cat Tien NP Conservation Project, felt survey and protection of Cat Tien elephants would not be possible without the help and cooperation of local authorities and enterprises. According to him at present, the human- elephant conflict is not a serious problem, however there is an urgent need of understanding and mitigating it, otherwise the situation will be more complicated. In the long run, the best way to mitigate it is erecting an electric fence along the outer boundary of elephant usage area. The park could install the electric fence, but its maintenance is very time consuming and needs dedication from Park staff and collaboration of enterprises and local authorities. He also felt the natural forests in La Nga and Vin enterprises are favorite habitat of elephants, so these forests should be turned into protected areas for elephants and wildlife conservation. To maintain elephants within the forest, Cat Tien NP authorities should establish saltlicks inside the Park, if a similar approach is followed by enterprises authorities within the enterprise area this could be also of some help for the management of elephants in this region. Need of establishing Elephant Protection and Monitoring Units comprised of enterprises and villages personal was also advised by Mr. Polet.

Responding to the various questions from the workshop participants, Mr. Cong (La Nga Forestry Company) agreed to provide La Nga Forestry Company's support in erecting electric fence following outer boundary of natural forests of the enterprise. He assured that, no damage to the natural forests within the enterprise area would be done, however, emphasized the difficulty of stopping of harvesting bamboo immediately by the enterprises. He expected that after the installation of electric fence appropriate regulations of bamboo harvesting would be practicable.

Mr. Tran Van Mui – Director of Cat Tien NP made conclusion remarks of the workshop, felt the need of carrying out more study on erecting a fence and recommended discussion on the issue at various levels. As future action, Cat Tien NP will collaborate with La Nga Enterprises to organize a Commune meeting to discuss on elephant protection and establish Elephant Conservation Steering Committee by including members from Cat Tien NP, La Nga enterprises and local Communes. The Steering Committee meeting possibly will hold at headquarters of La Nga enterprises with financial support from Cat Tien NP. To mitigate of human - elephant conflict problem, the change of the composition of cultivated crops was also

discussed in the workshop and the need of enterprises and communes to discuss the implementation of such suggestion was also felt. A promise also made to apply all possible methods of attracting elephants back to Cat Tien NP, however it was felt this solution will be effective only when change of cultivated crops composition takes place. The director of the Park mentioned that the Park would carry out feasibility study of electric fence construction and submit Vietnam Government for funding.

End of the workshop, the participants watched a video tape of elephants observed in Ap 4, Thanh Son Commune, recorded on 19 October 1995 by La Nga Forest Enterprise.

Appendix 5: Data Sheet Formats:

Cat Tien National Park - Dong Nai – Vietnam
Elephant Survey - Indirect method - Line transect- dung count

Date Observer/Team Block No
Compass bearing Transect No:
GPS: Starting Closing
Lat: N Lat: N
Long: E Long: E
Time: Starting Closing
Distance Covered (km)

Rope No.	Habitat	Type of Sign	Dung perp. dist (cm)	State of dung	Remarks
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Type of sign: Elephant dung, track, feeding, sound (of elephant) and others
State of dung: 1) Moist 2) Dry outside 3) Very dry
Habitat: 1) Closed forest (CF) 2) Open forest (OF) 3) Grassland (GL) 4) Other type (OT)

Elephant front foot measurements:

S.No	Location	Circumference (cm)	Length (cm)	Width (cm)	Remarks

Elephant feeding signs:

S.No	Location	Plant Species	Remarks

Cat Tien National Park - Elephant Survey Project WWF/FD/AERCC 2001.

Cat Tien National Park - Dong Nai - Vietnam
Elephant Survey - Block and Trail survey

Date _____ Group no _____

Block No _____ Observer/s name _____

Location surveyed _____

_____

_____

Time: Starting _____ Closing _____

Distance Covered (km) _____

S.No	Time	Type of Sign	Number	State of Sign	Direct sightings or Remarks

State of sign :- **Dung:** moist, dry outside, very dry. **Track:** Fresh, old, very old.

Elephant front foot measurements:

S.No	Location	Circumference (cm)	Length (cm)	Width (cm)	Remarks

Type of sign: Elephant dung, track, feeding, sound (of elephant) and others

Cat Tien National Park – Dong Nai – Vietnam
Elephant Survey - Indirect method - Village Survey

Date: **Observer/s**

Village Name Commune

District Province

GPS Location

Direction of Village (from the forest)

Distance of Village (from the forest)

Forest type

Elephant visit Yes No

S.No	Date/Month	Adult Male	Adult female	Sub adult	Calf	others	Remarks

Reasons for elephant visit

Name of the nearest village elephant reported

Distance of the village

Direction of the village

Name of the farthest village elephant reported

Distance of the village

Direction of the village

Human death due to elephants

S.No	Date/Month	Sex of the person	Age	Remarks

Household damage

S.No	Date/Month	Remarks

Crops Cultivated

S.No	Name	Months	Remarks

Crops damaged

S.No	Name	Month/yr	Remarks

Elephant death

S.no	Month/yr	Sex	Cause	Remarks

Remarks

Cat Tien National Park - Dong Nai – Vietnam
Elephant Survey - Feeding habits (from elephant dung)

Date: **Observer/s**

Sample no/code

Location surveyed/name/ GPS

State of dung (moist/dry outside/very dry)

Size of dung (diameter in cm)

Details of the elephant

Sex

Height

Track size

S.no	Circumference (cm)	Length (cm)	Width (cm)	Remarks

Other details

Remarks

Cat Tien National Park – Dong Nai – Vietnam
Elephant Survey - Feeding habits (from elephant dung)

Date: **Observer/s**

Sample no/code

Location surveyed/name/ GPS

State of dung (moist/dry outside/very dry)

Size of dung (diameter in cm)

Details of the elephant

Sex

Height

Track size

S.no	Circumference (cm)	Length (cm)	Width (cm)

Other details

S.No	Plant name	Plant part	Remarks

S.No	Plant part	Dry weight (gm)	Remarks
1	Grasses		
2	Bamboos		
3	Bark		
4	Stem		
5	Leaves		
6	Seeds/fruits		
7	Others		

Cat Tien National Park - Elephant Survey Project -WWF/FPD/AERCC 2001.

Cat Tien National Park - Dong Nai – Vietnam
Elephant Survey - Guard post survey of past records

Name of the post

Elephant records Yes No

Direct Sightings:

S.No	Date/Month	Location	Male	Female	Calf	others	Remarks

Indirect signs:

S.No	Date/month	Location	Type of sign	Remarks

Type of Sign: Elephant dung, track, feeding, sound (of elephant) and others.

Remarks

Cat Tien National Park - Dong Nai – Vietnam

Elephant Survey - Guard post - Daily log of patrols:

Name of guard post		Month/year	
Guard names:			

Date	Starting time	Closing time	Areas visited/ Trail used	Distance Covered (km)	Remarks

Date	Time	Location	Direct	Indirect	Remarks

Type of sign: Elephant dung, track, feeding, sound (of elephants) and others

Cat Tien National Park - Elephant Survey Project -WWF/FD/AERCC 2001

Cat Tien National Park - Dong Nai – Vietnam				
Elephant Survey -Vehicle based rapid village survey				
Date Observer				
Village Name				
GPS				
Distance to forest				
Elephant visit during 2000-01				
No Since when				
Yes				
Date	Total	Male	Female	Young
Details of male 1				
Height				
Tusk Length				
Details of male 2				
Height				
Tusk Length				
Details of Female and Young				
No.	Height		Details	
Reasons for Elephant Visit				
Crop damage No Yes				
Name	Date		Remarks	
House damages	No			Yes
Date	Item (Hut/House)		Number	Damage
Human Injury/Death			No	Yes
Date	Details of Death		Details of Injury	Remarks

Elephant Death/Injury		No	Yes
Date	Details of Death	Details of Injury	Remarks
Methods of chasing elephants			
Name of the Method	Effective		Not effective
Remarks			
Cat Tien National Park - Elephant Survey Project -WWF/FD/AERCC 2001.			

Appendix 6: Summary of the data collected

Elephant Survey in Cat Tien National Park,Vietnam
Line transect dung count

S.no	Transect No	Date	GPS location		GPS location		Distance covered (km)	Habitat	Elephant Signs
			Starting - N	E	End - N	E			
1	1a	22.3.01	11°32'35"	107°10'13"	11°32'38"	107°10'43"	1	Bamboo forest with scattered big trees	None
2	2a	21.3.01	11°32'59"	107°11'00"	11°32'59"	107°11'30"	1	Bamboo forest Mixed bamboo-wood forest and swamp.	None
3	2b	21.3.01	11°31'29"	107°11'44"	11°31'17"	107°12'12"	0.92	Bamboo forest, rattan and scrub land.	None
4	3a	12.3.01	11°32'51"	107°16'29"	11°32'51"	107°16'01"	1	Crop fields, mixed bamboo-wood forest.	None
5	3b	13.3.01	11°31'10"	107°16'50"	11°31'12"	107°16'20"	1	Fields Mixed bamboo-wood forest.	None
6	4a	12.3.01	11°31'46"	107°18'08"	11°31'1o"	107°18'13"	1	Scrub land, crop fields and regenerating forest.	None
7	7a	25.3.01	11°29'44"	107°12'10"	11°29'45"	107°12'41"	1	Bamboo forest with scattered big trees.	Old tracks
8	7b	24.3.01	11°28'37"	107°11'23"	11°28'41"	107°11'54"	1	Mixed bamboo-wood forest and rattans.	None
9	8a	13.3.01	11°29'14"	107°16'58"			0.92	Bamboo forest with scattered big trees and rattans.	None
10	8b	14.3.01	11°28'21"	107°16'56"	11°28'19"	107°17'27"	1	Mixed bamboo-wood forest, rattans and swamp.	None
11	9a	15.3.01	11°27'47"	107°20'09"	11°27'44"	107°19'43"	1	Mixed bamboo-wood forest and grassland	None
12	9b	6.4.01	11°29'19"	107°19'25"	11°29'23"	107°19'54"	1	Scrub land and grassland	Old tracks
13	9g	14.3.01	11°30'13"	107°19'02"	11°30'14"	107°19'30"	1	Grassland and regenerating bamboo	None
14	10g	1.3.01	11°27'56"	107°20'51"	11°28'28"	107°20'51"	0.96	Seasonal grassland	None
15	13b	24.3.01	11°25'05"	107°13'34"	11°24'36"	107°13'37"	1	Bamboo forests and mixed bamboo-wood forest.	None
16	13a	25.3.01	11°24'52"	107°12'59"	11°25'21"	107°12'58"	1	Bamboo forests and mixed bamboo - wood forest.	None
17	14a	9.3.01	11°25'47"	107°17'05"	11°25'50"	107°17'35"	1	Mixed bamboo-wood forest, dense scrubs and rattan.	None
18	14b	9.3.01	11°25'30"	107°15'55"	11°24'58"	107°15'56"	1	Bamboo forests and mixed bamboo-wood forest.	None

S.no	Transect No	Date	GPS location Starting - N	E	GPS location End - N	E	Distance covered (km)	Habitat	Elephant signs
19	15a	2.3.01	11°26'53"	107°19'47"	11°27'09"	107°19'45"	1	Wood forest, rattan, scrub and Grassland.	None
20	15b	2.3.01	11°26'o6"	107°19'34"			0.84	Wood forest with bamboo and dense scrubs.	None
21	16a	7.3.01	11°26'oo"	107°21'57"	11°25'25"	107°21'58"	1	Tall tree forest.	None
22	16b	7.3.01	11°26'45"	107°23'02"	11°26'16"	107°23'03"	1	Tall tree forest.	None
23	17a	16.3.01	11°24'14"	107°24'55"	11°24'43"	107°24'54"	1	Grassland and swamp	None
24	17b	16.3.01	11°26'18"	107°25'46"	11°26'34"	107°25'48"	0.56	Wood forest and bamboo forests.	None
25	18a	28.3.01	11°21'5o"	107°13'04"	11°22'17"	107°12'59"	1	Mixed bamboo and wood forest.	None
26	18b	26.3.01	11°21'19"	107°11'39"	11°21'51"	107°11'39"	1	Mixed bamboo and wood forest	None
27	18c	28.3.01	11°21'35"	107°12'50"	11°21'15"	107°12'49"	0.68	Mixed bamboo and wood forest with dense undergrowth.	Old tracks
28	19a	10.3.01	11°22'59"	107°15'55"	11°22'58"	107°15'20"	1	Bamboo forests and mixed bamboo-wood forest.	Old tracks
29	19b	6.3.01	11°23'20"	107°16'11"	11°23'50"	107°16'13"	1	Bamboo forests with scattered big trees.	New and old tracks
30	19c	15.3.01	11°23'02"	107°15'50"	11°22'38"	107°16'02"	0.8	Bamboo forests with scattered tall trees and a stream.	Many old track
31	19d	10.3.01	11°22'48"	107°16'04"	11°22'48"	107°16'14"	0.36	Bamboo forests with scattered tall trees and dense ground floor.	Fresh dungs, tracks, feeding signs, Elephant sighting
32	19e	6.3.01	11°22'53"	107°16'26"	11°22'50"	107°17'37"	1	Mixed bamboo wood forest with dense ground floor.	New and old tracks
33	20a	28.3.01					1	Mixed bamboo wood forest and grassland.	Many old track
34	20b	28.3.01	11°23'o5"	107°19'19"	11°23'40"	107°19'18"	1	Grassland and young mixed bamboo wood forest	None
35	21a	6.4.01	11°23'36"	107°21'52"	11°23'23"	107°21'06"	1	*Dipterocarp* forest and grassland.	None
36	25a	26.3.01	11°20'55"	107°11'11"	11°21'24"	107°11'10"	1	Mixed bamboo wood forests.	None
37	27a	29.3.01	11°20'39"	107°11'29"	11°20'13"	107°11'31"	1	Mixed wood-bamboo forests.	None

Elephant Survey Cat Tien National Park, Vietnam
Block Survey

Dry Season

No	Block	Date	GPS location Beginning of the survey route N	E	GPS location End of the survey route N	E	Distance covered (km)	Elephant signs
1	1	21.3.01	11°30'50"	107°10'43"	11°33'17"	107°09'44"	8	None
2	2	21.3.01	11°30'50"	107°11'54"	11°33'02"	107°10'55"	6	None
3	3	13.3.01	11°32'01"	107°17'40"	11°28'41"	107°18'48"	8	None
4	4	14.3.01	11°32'40"	107°20'23"	11°27'44"	107°19'43"	7	None
5	5	2.4.01	11°31'12"	107°22'43"	11°32'03"	107°24'10"	6	None
6	6	8.4.01	11°30'58"	107°26'02"	11°29'56"	107°24'19"	7	None
7	7	25.3.01	11°29'44"	107°12'10"	11°28'37"	107°11'23"	6	None
8	7	26.3.01	11°26'26"	107°12'26"	11°27'25"	107°12'53"	7	Old tracks
9	8	14.3.01	11°28'41"	107°18'48"	11°23'48"	107°17'54"	8	None
10	9	7.4.01	11°29'24"	107°19'59"	11°30'43"	107°21'25"	5.5	Old tracks
11	9	14.3.01	11°31'57"	107°17'45"	11°27'47"	107°20'09"	8	None
12	10	4.4.01	11°27'56"	107°23'16"	11°30'38"	107°23'03"	9	None
13	11	3.4.01	11°29'05"	107°24'47"	11°28'30"	107°26'21"	8	None
14	11	5.4.01	11°24'12"	107°26'03"	11°26'16"	107°26'35"	7	None
15	12	5.4.01	11°30'10"	107°28'20"	11°27'44"	107°27'50"	7	None
16	13	25.3.01	11°24'31"	107°12'30"	11°25'41"	107°13'21"	5	None
17	14	14.3.01	11°28'41"	107°18'40"	11°23'48"	107°17'54"	9	Old tracks
18	15	30.3.01	11°25'15"	107°17'46"	11°26'56"	107°19'58"	7	None
19	16	31.3.01	11°24'26"	107°23'09"	11°26'13"	107°22'20"	5.5	None
20	17	6.4.01	11°25'19"	107°25'58"	11°24'11"	107°23'24"	6.4	None
21	18	28.3.01	11°20'03"	107°11'15"	11°21'50"	107°13'04"	6	Old tracks
22	19	10.3.01	11°23'10"	107°16'35"				Fresh dung and tracks

No	Block	Date	GPS location Beginning of the survey route N	E	GPS location End of the survey route N	E	Distance covered (km)	Elephant signs
23	19	10.3.01	11°22'48"	107°16'03"				New and old track, noise of elephant movement
24	19	9.3.01	11°23'10"	107°16'35"			3	Fresh dung, old tracks
25	19	6.3.01	11°23'10"	107°16'35"				17 dung piles
26	19	5.3.01	11°23'33"	107°16'23"	11°23'31"	107°16'12"	1	1 fresh dung, many tracks
27	19	5.3.01	11°23'37"	107°11'57"	11°23'09"	107°16'44"	5	Old dung, new tracks
28	20	9.3.01	11°23'05"	107°18'37"	11°23'15"	107°18'09"	1	Old tracks
29	21	8.3.01	11°23'24"	107°22'20"	11°23'31"	107°21'34"	4	None
30	21	8.3.01	11°22'47"	107°20'37"	Near Ta La village		5	Old tracks
31	21	7.4.01	11°22'37"	107°21'48"	11°23'58"	107°21'27"	7	None
32	24	24.3.01	11°28'36"	107°11'23"	11°29'01"	107°09'12"	5	Old tracks
33	25	26.3.01	11°19'55"	107°10'55"	11°22'26"	107°11'40"	6	Old tracks
34	26	23.3.01	11°18'27"	107°10'10"	Near Sa mach guard post		2	None
35	26	23.3.01	11°19'50"	107°10'55"	Near Sa mach guard post		3	None
36	26/27	29.3.01	11°20'13"	107°11'26"	11°18'24"	107°10'17"	6	Old track

Wet Season

No	Block	Date	GPS location Beginning of the survey route N	E	GPS location End of the survey route N	E	Distance covered (km)	Elephant signs
1	1	21.6.2001	11°34'27"	107°09'37"			8	None
2	2	21.6.2001	11°34'26"	107°09'36"	11°24'39"	107°12'21"	6.5	None
3	3	14.6.2001	11°32'01"	107°17'41"	11°30'36"	107°17'05"	5.3	None
4	4	12.6.2001	11°32'00"	107°17'40"	11°31'02"	107°18'23"	3	None
5	7	24.5.2001	11°28'19"	107°13'07"			1	Old tracks of about 9months old of 5 elephants
6	7	22.6.2001	11°30'28"	107°11'58"	11°26'40"	107°12'11"	8.6	Very old track
7	7	26.7.2001	11°27'18"	107°03'13"			4	Of 1 elephant and old tracks about 3 month of 2 elephants
8	7	30.7.2001	11°30'13"	107°12'51"			9	None
9	7	30.7.2001	11°30'13"	107°12'51"			8	None
10	7	24.10.2001	11°30'13"	107°12'51"			8	None
11	7	25.10.2001	11°24'39"	107°12'21"			4	None
12	7	1.12.2001	11°28'36"	107°11'23"	11°29'38"	107°12'05"	4	None
13	8	15.6.2001	11°30'36"	107°17'05"	11°28'42"	107°16'48"	6	None
14	8	16.6.2001	11°28'42"	107°16'48"	11°27'13"	107°16'38"	3.2	Old tracks of 1 elephant; body rubbing on tree at 2m high.
15	9	8.5.2001	11°8'42"	107°19'57"			8	Many old tracks of about 1 year ago
16	9	15.5.2001	11°27'47"	107°20'09"			6	None
17	9	20.5.2001	11°28'57"	107°20'10"			3	Old track
18	9	13.6.2001	11°31'04"	107°15'31"	11°27'25"	107°20'58"	12	Old tracks

No	Block	Date	GPS location Beginning of the survey route N	E	GPS location End of the survey route N	E	Distance covered (km)	Elephant signs
19	10	12.6.2001	11°26'31"	107°24'13"	11°30'28"	107°22'50"	10	None
20	13	13.5.2001	11°24'39"	107°12'21"	11°23'37"	107°11'57"	3	None
21	13	23.6.2001	11°24'29"	107°12'31"	11°25'28"	107°15'34"	7	Very old track
22	13	11.8.2001	13°25'05"	107°13'34"			8	None
23	13	4.9.2001	11°30'13"	107°12'51"			4.5	None
24	13	6.10.2001	11°24'39"	107°12'21"			6	None
25	13	8.11.2001	11°24'39"	107°12'21"	11°23'37"	107°11'57	5	None
26	13	8.11.2001	11°24'52"	107°12'59"			4	None
27	13	10.11.2001	11°24'39"	107°12'21"			5	None
28	13	2.12.2001	11°24'58"	107°12'11"			2	None
29	14	16.6.2001	11°27'13"	107°16'38"	11°23'28"	107°18'12"	8	New tracks of 2 elephants
30	14	10.9.2001	11°25'30"	107°15'55"			9	None
31	15	14.5.2001	11°27'33"	107°20'46"	11°23'37"	107°11'57"	12	None
32	15	21.5.2001	11°27'04"	107°20'07"			8	None
33	15	14.6.2001	11°27'25"	107°20'58"	11°23'28"	107°18'12"	12	None
34	16	1.10.2001	11°23'35"	107°22'00"			12	Many new footprints
35	16	22.11.2001	11°27'02"	107°22'06"	11°28'29"	107°22'05"	7	None
36	16	22.11.2001	11°26'00	107°21'57"			10	None
37	18	6.5.2001	11°22'50"	107°13'04"			5	None
38	18	11.5.2001	11°22'50"	107°13'04"			4	None
39	18	23.5.2001	11°21'19"	107°11'39"			6	None
40	18	6.6.2001	11°24'39"	107°12'21"	11°19'56"	107°10'55"	8	None
41	18	12.6.2001	11°19'55"	107°10'55"	11°22'12"	107°14'10"	7	Old tracks
42	18	14.8.2001	11°21'50"	107°13'04"			3.5	None
43	18	8.9.2001	11°24'39"	107°12'21"	11°19'56"	107°10'55"	6	None
44	18	12.9.2001	11°24'39"	107°12'21"			8	None
45	18	16.9.2001	11°24'39"	107°12'21"			7	None

No	Block	Date	GPS location Beginning of the survey route N	E	GPS location End of the survey route N	E	Distance covered (km)	Elephant signs
46	18	22.9.2001	11°19'56"	107°10'55"			5	None
47	18	25.9.2001	11°19'56"	107°10'55"			3	None
48	18	8.10.2001	11°24'39"	107°12'21"	11°23'12"	107°16'46"	9	None
49	18	8.10.2001	11°24'39"	107°12'21"			4	None
50	18	22.10.2001	11°19'56"	107°10'55"			4	None
51	18	27.10.2001	11°24'39"	107°12'21"	11°23'37"	107°11'57"	5	None
52	18	9.11.2001	11°21'50"	107°13'04"	11°24'39"	107°12'21"	4	None
53	18	16.11.2001	11°21'50"	107°13'04"			6	None
54	18	2.12.2001	11°23'14"	107°11'36"	11°23'19"	107°10'25"	4	None
55	19	11.5.2001	11°23'10"	107°16'35"			7.5	New tracks in cashew plantation
56	19	13.5.2001	11°22'08"	107°18'42"			9	None
57	19	14.5.2001	11°23'21"	107°16'46"			11	Many new tracks close to stream
58	19	17.5.2001	11°23'10"	107°17'47"			6	New track
59	19	31.5.2001	11°23'12"	107°16'46"			8	New tracks
60	19	17.6.2001	11°23'28"	107°18'12"	11°21'54"	107°15'27"	7	New tracks
61	19	29.8.2001	11°15'42"	107°15'04"			7	New track
62	19	28.9.2001	11°23'12"	107°16'46"			7	2 old dung piles
63	19	11.10.2001	11°23'12"	107°16'46"			8	New footprints
64	19	14.10.2001	11°22'21"	107°14'10"			6	New tracks of about 2 elephants
65	19	16.10.2001	11°22'21"	107°14'10"			15	New track
66	19	19.10.2001	11°22'21"	107°14'10"			14	New track
67	19	26.10.2001	11°23'16"	107°19'14"			7	New tracks
68	19	27.10.2001	11°23'37"	107°11'57"	11°27'33"	107°20'43"	11	None
69	19	24.11.2001	11°23'19"	107°17'55"	11°222'42"	107°17'53"	3	Old tracks, old dung, signs of eating banana leaves

No	Block	Date	GPS location Beginning of the survey route N	E	GPS location End of the survey route N	E	Distance covered (km)	Elephant signs
70	19	29.11.2001	11°23'14"	107°16'13"	11°21'28"	107°16'10"	7	Many new and old tracks
71	20	26.5.2001	11°22'17"	107°17'47"			9	New & old tracks
72	20	19.6.2001	11°23'28"	107°18'12"	11°16'38"	107°12'27"	10	Track and rubbing sign on field shelter
73	20	24.8.2001	11°22'07"	107°18'29"			3	Many fresh food prints
74	20	7.9.2001	11°22'07"	107°18'29"			7	New footprints
75	20	12.9.2001	11°22'08"	107°18'42"			6.2	New tracks
76	20	17.9.2001	11°23'06"	107°19'14"			5.4	Many new footprints, 2 dung piles
77	20	20.9.2001	11°23'16"	107°19'14"			5	Many new tracks
78	20	28.10.2001	11°21'47"	107°17'28"			13	New track
79	20	22.11.2001	11°22'04"	107°18'06"	11°22'08"	107°18'17"	2	Old dung
80	20	24.11.2001	11°22'44"	107°19'38"	11°22'42"	107°19'25"	4	New tracks
81	20	25.11.2001	11°22'08"	107°18'29"	11°21'54"	107°18'46"	5	New footprints, old dung
82	20	29.11. 2001	11°21'25"	107°18'47"	11°22'07"	107°18'05"	4	New and old tracks & dung
83	20	29.11. 2001	11°22'23"	107°18'48"	11°22'56"	107°19'06"	4	Many new and old tracks
84	20	29.11.2001	11°22'08"	107°18'29"	11°21'22"	107°18'51"	5	New dung
85	21	11.6.2001	11°23'28"	107°22'33"	11°22'22"	107°21'29"	5.4	None
86	21	9.9.2001	11°23'14"	107°21'24"			6	New track
87	21	21.11.2001	11°23'43"	107°21'31"			6	Old signs of eating rice plant
88	21	10.12.2001	11°23'16"	107°21'24"			1	New tracks and dung
89	21	10.12.01	11°23'38"	107°21'36"	11°23'39"	107°21'36"	1	New track
90	23	1.12.2001	11°29'13"	107°09'50"	11°28'50"	107°08'29"	4	None
91	23	1.12.2001	11°29'04"	107°10'18"			3	None

No	Block	Date	GPS location Beginning of the survey route N	E	GPS location End of the survey route N	E	Distance covered (km)	Elephant signs
92	24	2.12.2001	11°25'29"	107°12'15"	11°25'34"	107°11'33"	5	None
93	25	19.5.2001	11°21'42"	107°10'13"			5.5	None
94	26	3.12.2001	11°19'52"	107°10'43"	11°21'19"	107°11'39"	5	Old rubbing sign
95	26	4.12.2001	11°19'58"	107°11'03"	11°20'19"	107°12'12"	5	None
96	26	4.12.2001	11°19'58"	107°11'00"	11°21'37"	107°12'32"	5	None
97	27	3.12.2001	11°20'32"	107°10'52"	11°20'44"	107°10'57"	5	None
98	28	26.11.2001	11°18'07"	107°15'01"	11°18'21"	107°15'00"	1	None
99	28	26.11.2001	11°18'46"	107°14'58"	11°17'24"	107°19'05"	6	Old track
100	28	27.11.2001	11°19'59"	107°15'04"	11°20'19"	107°15'48"	5	Old dung, old track
101	28	27.11.2001	11°22'09"	107°14'58"			4	New dung, new and old tracks
102	13, 14	16.9.2001	11°24'39"	107°12'21"	11°23'37"	107°11'57"	7	None
103	14, 18	17.9.2001	11°25'47"	107°17'05"	11°24'39"	107°12'21"	11	None
104	19,14	15.9.2001	11°23'37"	107°11'57"			11	None

Elephant Survey in Cat Tien National Park, Vietnam

Elephant Dung survey

Dry Season

No	Block	GPS N	GPS E	Circumference (cm)	Content
1	19	11°23'18"	107°16'12"		
2	19	11°22'48"	107°16'06"	35	
3	19	11°22'48"	107°16'04"	43	
4	19	11°22'48"	107°16'04"	37	
5	19	11°23'05"	107°16'44"	41	Cashew fruit + nut, grass, etc (76 cashew nuts).
6	19	11°23'18"	107°16'12"	31	Grass, old clothes.
7	19	11°23'11"	107°16'50"	33	Cashew fruit + nut and leave, grass, etc.
8	19	11°23'1o"	107°16'33"	44	Cashew leaves + fruit + nut, grass and old clothes, etc. 70 cashew nuts =0.5kg
9	19	11°23'03"	107°16'37"	46	Cashew fruit + nut, etc.
10	19	11°22'48"	107°16'06"		
11	19	11°22'48"	107°16'06"	43	
12	19	11°22'48"	107°16'06"	48	Cashew fruit + nut, bamboo leave, grass, etc.
13	19	11°22'58"	107°16'05"	31	Bamboo leaves rattan, grass, etc.
14	19	11°23'15"	107°16'14"	34	
15	19	11°23'1o"	107°16'35"	33	
16	19	11°23'1o"	107°16'35"		
17	19	11°23'1o"	107°16'35"	31	
18	19	11°23'1o"	107°16'35"	37.5	41 cashew nuts
19	19	11°23'1o"	107°16'35"	41	
20	19	11°23'1o"	107°16'35"	35,36	11 cashew nuts
21	19	11°23'1o"	107°16'35"	37	20 cashew nuts
22	19	11°23'1o"	107°16'35"	44,41,42	117 cashew nuts

No	Block	GPS		Circumference	Content
		N	E	(cm)	
23	19	11°23’1o”	107°16’35”	38,40,38	16 cashew nuts
24	19	11°23’1o”	107°16’35”	38,39	6 cashew nuts
25	19	11°23’1o”	107°16’35”	35,36,35	10 cashew nuts
26	19	11°23’1o”	107°16’35”	38,39	31 cashew nuts
27	19	11°23’1o”	107°16’35”	39,39,40	41 cashew nuts
28	19	11°23’1o”	107°16’35”	33,34,35	8 cashew nuts
29	19	11°23’1o”	107°16’35”	32,33,34	17 cashew nuts
30	19	11°23’1o”	107°16’35”	34,35	10 cashew nuts
31	19	11°23’1o”	107°16’35”	40,41,41	7 cashew nuts
32	19	11°23’1o”	107°16’35”	35,36,36	14 cashew nuts
33	19	11°23’31”	107°16’12”		
34	11	11°23’22”	107°17’33”		

Wet Season

No	Block	GPS		Circumference	Content
		N	E	(cm)	
1	20	11°23’06”	107°19’14”		2 piles
2	19	11°23’12”	107°16’46”		2 piles
3	20	11°22’04”	107°18’06”		
4	20	11°22’44”	107°19’38”		2 piles
5	19	11°23’21”	107°17’18”	33, 38, 37	
6	19	11°23’21”	107°17’18”	37.5, 43,38	
7	19	11°23’1o”	107°17’46”		
8	19	11°23’02”	107°17’49”	35, 34, 31	
9	19	11°22’29”	107°16’22”	41,43	
10	19	11°22’1o”	107°16’27”	48, 50	
11	20	11°22’07”	107°18’29”	46, 47, 48	

No	Block	GPS		Circumference	Content
		N	E	(cm)	
12	28	11°20’16”	107°21’18”	36, 33, 38	
13	28	11°20’14”	107°14’57”		
14	20	11°22’07”	107°18’05”	44, 44, 43	
15	20	11°22’56”	107°19’06”	34, 35, 34	Several piles on resting site
16	20	11°21’25”	107°18’47”		Corn, grass
17	20	11°23’13”	107°17’41”	45, 42.5, 45	Grass, young bamboo leaves
18	21	11°23’16”	107°21’24”		Grass, corn seed
19	20	11°23’12”	107°17’41”	43.5, 36, 42	Grass, young bamboo leaves
20	20	11°23’12”	107°17’41”	39.5	
21	20	11°23’05”	107°17’39”	34.5, 35.5, 32.4	Grass, bamboo leaves
22	20	11°23’05”	107°17’39”	44.5	
23	21	11°22’55”	107°21’57”	33, 30.5	
24	20	11°23’20”	107°17’27”		Grass, bamboo

Elephant survey in Cat Tien National Park, Vietnam
Foot print records

Dry Season

No	Block	GPS N	E	Circumference (cm)	Length (cm)	Width (cm)	Status
1	14	11°23'48''	107°17'54''				Old
2	18	11°21'07''	107°12'09''	124	40	35	Old
3	18	11°21'35''	107°12'50''	93	30	27	Old
4	19	11°23'20''	107°15'55''		37	30	Old
5	19	11°23'28''	107°16'11''		28	27	New
6	19	11°23'32''	107°16'11''				Old
7	19	11°23'45''	107°16'13''				Old
8	19	11°23'05''	107°16'20''	123	38	38	New
9	19	11°22'57''	107°16'05''				Old
10	19	11°22'50''	107°16'10''				Old
11	19	11°22'48''	107°16'06''	130	42	40	New
12	19	11°22'48''	107°16'06''	69	21	20	New
13	19	11°22'53''	107°16'45''	105	34	32	Old
14	19	11°22'53''	107°16'55''	109	34	31	New
15	19	11°22'50''	107°17'37''				Old
16	19	11°23'05''	107°16'44''	120	38	32	New
17	19	11°22'48''	107°16'06''				New
18	19	11°22'44''	107°15'55''	117	38	33	Old
19	19	11°22'48''	107°16'03''	125	40	40	Old
20	19	11°22'55''	107°16'19''		35	35	Old
21	19	11°23'33''	107°16'23''		33	31	
22	19	11°23'33''	107°16'11''		32	30	Old
23	19	11°23'33''	107°16'11''	112	33	32	
No	**Block**	**GPS**		**Circumference**	**Length**	**Width**	**Status**

		N	E	(cm)	(cm)	(cm)	
24	19	11°23’22’’	107°17’33’’	115	40	32	New
25	19	11°22’53’’	107°16’37’’	117	35	34	New
26	19	11°23’09’’	107°16’44’’	118	39	34	New
27	20	11°23’02’’	107°18’30’’				Old
28	20	11°23’14’’	107°18’09’’	127	42	36	Old
29	21	11°22’47’’	107°20’37’’				Old
30	24	11°29’13’’	107°09’29’’				Old
31	25	11°20’44’’	107°10’57’’	114	38	36	
32	25	11°20’44’’	107°10’57’’		38	34	
33	26/27	11°20’13”	107°11’20”				Old
34	26/27	11°18’24”	107°10’17”				Old
35	5	11°52’44”	107°34’02				Old
36	7	11°27’25’’	107°12’53’’				Old
37	7	11°29’45’’	107°12’14’’	116	36	34	Old
38	7	11°29’44’’	107°12’25’’				Old
39	7	11°29’45’’	107°12’33’’				Old
40	8	11°28’20’’	107°17’10’’				Old
41	8	11°29’13’’	107°17’14’’				Old
42	9	11°29’19”	107°19’26”	77	24	22	Old
43	9	11°29’19”	107°19’26”	110	34	31	Old
44	9	11°29’23”	107°19’35”	80	25	23	Old
45	9	11°29’24”	107°19’59”	80	25	23	Old
46	9	11°29’23”	107°19’35”	83	27	25	Old
47	9	11°29’24”	107°19’59”	115	36	34	Old
48				121	43	40	Old
49				122	41	34.5	Old

Wet Season

No	Block	GPS N	GPS E	Circumference (cm)	Length (cm)	Width (cm)	Status
1	18	11°28'42"	107°19'57"	142	50	40	Old
				120	40	31	
				125	40	36	
2	19	11°23'10"	107°16'35"	136	42	38	New
3	19	11°23'21"	107°16'46"				New
4	19	11°23'10"	107°20'09"	135	43	37	New
5	9	11°28'57"	107°20'10"				Old
6	7	11°28'19"	107°13'07"				Old
7	20	11°22'17"	107°17'47"	136	42	38	New
8	19	11°23'12"	107°16'46"	140	42	40	New
9	18	11°21'37"	107°12'26"				Old
10	18	11°22'12"	107°14'10"				Old
11	9	11°29'27"	107°19'17"				Old
12	14	11°26'53"	107°16'36"				New
13	8	11°28'11"	107°16'49"				Old
14	8	11°27'48"	107°16'49"				0ld
15	19	11°23'08"	107°16'34"	109	36	35	
				115	39	34	New
16	20	11°22'38"	107°19'29"	122	40	38	Old
17	7	11°29'44"	107°12'10"				Old
18	13	11°25'25"	107°14'00"				Old
19	13	11°25'28"	107°15'34"				Old
20	7	11°27'18"	107°03'13"	113	36.5	33.5	Old
				112	36	33	New
21	20	11°22'07"	107°18'29"	128	40	36	New
22	19	11°15'42"	107°15'04"	115	39	32	New
23	20	11°22'07"	107°18'29"	132	41	37	New
				130	40	37	New
24	21	11°23'14"	107°21'24"	120	40	35	New

No	Block	GPS N	E	Circumference (cm)	Length (cm)	Width (cm)	Status
25	20	11°22'08"	107°18'42"	136	40	38	New
				136	41	39	
				136	40	37	
26	20	11°23'06"	107°19'14"	136	40	38	New
27	20	11°23'16"	107°19'14"	135	40	37	New
				135	40	37	
28	19	11°23'12"	107°16'46"				New
29	16	11°23'35"	107°22'00"	124	46	40.5	New
				78	29	24	New
30	19	11°23'12"	107°16'46"	120	39	34	New
31	19	11°22'21"	107°14'10"	114	38	34	New
				98	32	30	New
32	19	11°22'21"	107°14'10"	120	39	34	New
33	19	11°22'21"	107°14'10"	123	43	39	New
34	19	11°23'16"	107°19'14"	132	44	39	New
35	20	11°21'47"	107°17'28"	122	42	37	New
36	21	11°23'11"	107°21'20"				Old
37	20	11°21'08"	107°18'17"				New
38	20	11°22'42"	107°19'25"	125	42	36	New
39	20	11°22'44"	107°19'38"	129	41	38	New
				129	41	36	New
40	19	11°23'19"	107°17'55"				Old
41	19	11°23'18"	107°17'45"				Old
42	19	11°22'42"	107°17'53"				Old
43	19	11°23'07"	107°17'46"	126	42	39	New
44	20	11°21'54"	107°18'46"	-	42	39	New
				124	41	37	New
45	20	11°22'08"	107°18'29"	55	18	17	New
46	28	11°18'33"	107°14'24"				Old
47	28	11°20'41"	107°16'06"	105	32	30	Old
				128	41	38	Old

No	Block	GPS N	E	Circumference (cm)	Length (cm)	Width (cm)	Status
48	28	11°20’14”	107°14’57”	120	40	37	New
				130	43	38	New
49	20	11°22’08”	107°18’29”				New
50	20	11°22’15”	107°18’27”	49	15	14	New
				67	22.5	17.5	New
					19.5	18.5	New
51	20	11°22’09”	107°18’06’				New
52	20	11°22’13”	107°18’14”				Old
53	20	11°22’07”	107°18’05”				New
54	20	11°22’58”	107°19’07”		37	29	New
					37	34	
55	20	11°22’26”	107°18’50”				Old
56	20	11°23’32”	107°18’47”				Old
57	20	11°22’45”	107°19’00”				Old
58	20	11°22’56”	107°19’07”				New
59	20	11°21’22”	107°18’51”	127	43	38	New
				78	25	22	New
60	19	11°22’46”	107°16’07”				Old
61	19	11°22’31”	107°16’22”				Old
62	19	11°22’29”	107°16’22”	110	35	33	Old
63	19	11°22’10”	107°16’27”	112	37	33	New
64	19	11°21’28”	107°16’10”				Old
65	21	11°23’16”	107°21’24”	87	26	24	New
				132	48	39	New
				126	41	39	New
66	21	11°23’38”	107°21’36”	107	38.5	28	New
67	21	11°23’39”	107°21’36”	109	39	28	New
68	21	11°22’44”	107°21’56”		39	35.5	New
					40	36	New
					38	36	New

No	Block	GPS N	E	Circumference (cm)	Length (cm)	Width (cm)	Status
69	20	11°23'05"	107°17'39"	57.8	20	17.4	New
70	21	11°22'55"	107°21'57"		40	36	New
71	20	11°23'20"	107°17'27"	56	22	19	New
72	20	11°23'20"	107°17'27"	123	38	36	New

Summary of the villages visited, status of elephant visit and human - elephant conflict.

S.No	Village Name	GPS		No. of elephants visited in different years			Status of Conflict	Remarks
				Before 2000	After 2000			
1	Ap 1	11°19'48"	107°10'47"	1983	No report			
2	Ap 1	11°27'42"	107°28'05"			6-7	Not serious	Visit the village for salt and rice.
3	Ap 1 (Da Bong Cua)	11°30'36"	107°17'05"	1992-98				Elephant lower jaw was found near village.
4	Ap 3	11°17'17"	107°17'47"		2001	5	Not serious	Visit the village for salt and rice.
5	Ap 3	11°32'28"	107°23'07"		2001	Group		
6	Ap 4	11°16'42"	107°15'27"		March to December 2001	1 to 7	Not serious	Damage to huts reported.
7	Ap 5	11°34'53"	107°10'41"		February to December 2001	1 to 6	Not serious	Before 1994, conflict was more and has become less.
8	Ap 5	11°16'38"	107°12'23"		February to December 2001	1to 6	Not serious	Damage to huts reported.
9	Ap 6	11°19'03"	107°18'31"		May to November 2001	1to 2	Not serious	Elephants were reported before 1994.
10	Ap 6 (Nghia Trung Ent.)	11°34'26"	107°09'36"				Not serious	Elephants were reported before 1992.
11	Ap 7	11°22'37"	107°19'01"		August to December 2001	1 to 5	Not serious	Damage to huts reported.
12	Ap 8	11°15'52"	107°13'53"		March 2000	Group		
13	Ap Bau Dia	11°34'44"	107°14'13"					No elephants for 10 yr.
14	Ap Tram Dang Ha	11°34'26"	107°09'36"					Before 1990, elephants were reported not now.
15	Ap2 (Ln ent.II, IV)	11°15'58"	107°16'34"					After 1999 occasionally

S.No	Village Name	GPS		No. of elephants visited in different years				Status of Conflict	Remarks
				Before 2000		After 2000			
16	Ap3 (Ln enter.III)	11°16'59"	107°18'42"	1997	8to9			Not serious	Since 1998 only 5 elephants reported
17	Bu Chap 2	11°23'09"	107°16'44"			February to May 2001	1 to 5	Not serious	Damage to huts reported.
18	Dat Do Station, Enterp.II	11°17'02"	107°15'08"			March- April 2001	1 to 7	Not serious	Damage to crops.
19	Enterp.II	11°20'17"	107°15'13"			November 2001	Group	Not serious	Damage to crops.
20	Enterpr. I	11°17'41"	107°10'43"			Feb, May & August 2001	1 to 5	Not serious	Damage to huts and crops reported.
21	Forest Guard Station	11°20'44"	107°10'57"			February 2001	7 to 9	Not serious	Damage to huts and crops reported.
22	Forest Planting Station, LN Enterp.II	11°15'57"	107°13'19"			November 2001	1	Not serious	Damage to huts and crops reported.
23	Guard station of Vinh An Enterp.	11°20'40"	107°10'57"			December 2000	Group	Not serious	
24	Khu 91 (Ap 7)	11°22'13"	107°19'26"			February & November 2001	5 to 6	Not serious	
25	Nga 3 xuong cua	11°22'38"	107°19'29"			May 2001	1	Not serious	For salt and rice
26	Sub-Enterp. II Headquarter of Vinh An Enterp.	11°24'39"	107°12'21"						Occasionally reported
27	Tieu Khu 18, La Nga Enterp.II	11°16'53"	107°15'17"			November 2001	Group	Not serious	
28	To 11, Ap 6	11°15'37"	107°17'34"						Since 1998, no elephants
29	To 2, Ap 6	11°18'52"	107°18'44"						Before 1999, elephants were reported
30	To 4, Ap 4	11°15'55"	107°16'22"			November 2001	1	Not serious	Damage to crops.
31	To 6, Ap 4	11°16'14"	107°15'44"			May 2001	5	Not serious	Damage to crops.
32	To 6, Ap 6	11°20'02"	107°18'45"			Feb &November 2001	2	Not serious	Mother &Calf
33	To 7, Ap 4	11°16'26"	107°15'30"			November 2001	1		
34	To 9, Ap 6	11°19'46"	107°18'54"						Before 2000, no report of elephants in 2001
35	To1, Ap 6	11°19'07"	107°18'14"			November 2001	1	Not serious	
36	Xom Tram Suoi Ty (LN Enterp.I)	11°18'33"	107°09'42"			March & May 2000 & March 2001	Group	Not serious	

Elephant Survey in Cat Tien National Park - Vietnam
Food plant survey

Code of Samples	Component	Dry weight (mg)	Percentage (%)
1	Grass	66400	38.7
	Cashew nuts	72000	42
	Cashew fruit	19000	11.2
	Rattan stem	8900	5.2
	Bamboo shoot	3100	1.8
	Bamboo leaves	800	0.5
	Leaves of jack fruit trees	700	0.4
	Un-identified leaves	500	0.3
2	Grass	55300	84.2
	Cashew leaves	500	0.8
	Rattan stem	3000	4.6
	Bamboo leaves	800	1.2
	Bamboo stem	1600	2.4
	Stem of Yen Bach* tree	1300	2
	Cover of bamboo shoot	900	1.4
	Stem of *Cyperus trialatus*	1700	2.6
	Old clothes	500	0.8
3	Grass	28900	77.3
	Rattan stem	4400	11.8
	Bamboo stem	2800	7.5
	Bamboo leaves	500	1.3
	Leaves of Jack fruit tree and Cashew	800	2.1
4	Grass	87000	84.3
	Rattan stem	5600	5.4
	Liane stem	2500	2.4
	Bamboo shoot	2200	2.1
	Bamboo leaves	500	0.5
	Tree stem	1600	1.6

Code of Samples	Component	Dry weight (mg)	Percentage (%)
	Leaves of jack fruit tree	700	0.7
	Cashew fruits	3100	3
5	Grass	64500	46.8
	Rattan stem	7500	5.4
	Cashew nuts	44900	32.6
	Cashew fruits	15900	11.6
	Cashew leaves	500	0.4
	Bamboo leaves	600	0.4
	Bamboo shoots	1600	1.2
	Tree stem	1700	1.2
	Bark of bamboo shoots	600	0.4
6	Grass	22800	35.3
	Cashew fruits	28300	43.9
	Cashew nuts	5900	9.2
	Cashew leaves	600	0.9
	Bamboo stem	1600	2.5
	Bamboo leaves	500	0.8
	Rattan stem	3500	5.4
	Stem of Yen bach* tree	1300	2
7	Grass	49700	66
	Rattan stem	2400	3.2
	Stem of *Cyperus trialatus*	1500	2
	Bamboo stem	2300	3.1
	Bamboo leaves	700	0.9
	Stem of tree	1600	2.1
	Cashew fruits	8000	10.6
	Cashew nuts	8000	10.6
	Leaves of jack fruit tree	500	0.7
	Old cloth	600	0.8
8	Grass	77200	48.6
	Rattan stem	7000	4.4
	Cashew nuts	64800	40.8

Code of Samples	Component	Dry weight (mg)	Percentage (%)
	Cashew leaves	500	0.3
	Cashew fruits	5300	3.4
	Stem of trees	800	0.5
	Bamboo leaves	800	0.5
	Bamboo stem	1600	1
	Bark of bamboo shoot	800	0.5
9	Grass	62500	53.8
	Rattan	5800	5
	Cashew nuts	34700	29.8
	Cashew fruits	8200	3.1
	Bamboo stem and bark	3700	7
	Bamboo leaves	700	0.6
	Tree roots	800	0.7
10	Grass	85200	53.3
	Bamboo stem	1800	1.1
	Cashew nuts	55700	43.8
	Cashew fruits	6200	3.9
	Cashew leaves	500	0.3
	Rattan stem	1900	1.2
	Tree stem	5700	3.6
	Stem of *Cyperus trialatus*	2100	1.3
	Bamboo leaves	800	0.5
11	Grass	10500	19.1
	Cashew nuts	26400	48.2
	Cashew fruits	14000	25.5
	Bamboo leaves	700	1.3
	Bamboo stem	1000	1.8
	Rattan stem	1400	2.6
	Liana stem	800	1.5
12	Grass	27900	26.6
	Cashew nuts	43900	41.9
	Cashew fruits	24900	23.7

Code of Samples	Component	Dry weight (mg)	Percentage (%)
	Rattan stem	4300	4.1
	Bamboo leaves	1200	1.1
	Bamboo stem	1200	1.1
	Bark of bamboo shoots	600	0.6
	Tree stem	900	0.9
13	Grass	18700	70
	Bamboo leaves	700	2.6
	Bamboo stem	800	3
	Rattan stem	1200	4.5
	Cashew leaves	800	3
	Cashew fruits	3400	12.8
	Tree roots	1100	4.1
14	Grass	20000	27.5
	Cashew fruits	9600	13.2
	Cashew nuts	38100	52.3
	Tree stem	1900	2.6
	Bamboo stem	700	1
	Bark of bamboo shoots	700	1
	Bamboo leaves	500	0.7
	Rattan stem	700	1
	Liana stem	500	0.7
15	Grass	59000	87.6
	Rattan stem	5900	8.8
	Bamboo stem	1000	1.5
	Tree roots	1400	2.1
16	Grass	38000	66.2
	Rattan stem	8500	14.8
	Bamboo stem, root and bark	6900	12.9
	Bamboo leaves	5000	8.8
	Cashew fruits	1600	2.8
	Tree roots	1000	1.7
	Leaves of cashew and jack fruit trees	1000	1.7

Code of Samples	Component	Dry weight (mg)	Percentage (%)
17	Grass	30000	57.7
	Rattan stem	5900	11.3
	Bamboo stem	2800	5.4
	Cashew nuts	12000	23.1
	Cashew leaves	700	1.3
	Leaves of jack fruit tree	600	1.2
18	Grass	40400	63.7
	Rattan stem	7900	12.5
	Bamboo stem	4900	7.7
	Bamboo leaves	700	1.1
	Cashew fruits	7400	11.7
	Leaves of cashew and jack fruit trees	1200	1.9
	Liana stem	900	1.4
19	Grass	56700	43.5
	Rattan stem	6900	5.3
	Cashew nuts	31400	24.1
	Cashew fruits	29000	22.2
	Cashew leaves	500	0.4
	Penisetum polystachyon	500	0.4
	Bamboo stem	800	0.6
	Bamboo leaves	500	0.4
	Bamboo shoot	2300	1.8
	Tree barks	500	0.4
	Tree roots	800	0.6
	Leaves *Seaphium macropodium*	500	0.4
20	Grass	26200	43.3
	Cashew nuts	20300	33.7
	Cashew fruits	10500	17.5
	Rattan stem	1600	2.7
	Stem of Yen Bach* tree	700	1.2
	Bamboo stem	700	1.2

Elephant Survey in Cat Tien National Park, Vietnam
Guard Post survey

Locations and elephant records

Suoi Rang (11°24'39", 107°12'21")
Located southwest of the park within survey block 13, adjoining blocks 7 and 18 (north and south respectively). According to the staff, sometimes, tracks of elephants were reported in the forest near the post. In the first week of March 2001, old tracks of elephants were seen in block 7 by the forest guards and the survey team confirmed the elephant sign.

Sa Mach (11°19'56", 107°10'55")
This post is located in the extreme southwest of the park and within La Nga Forestry company. Every year, elephants are reported in block 18 and the areas of Enterprise I of La Nga Forestry Company (blocks 26 and 27) and Vinh An Enterprise (block 25). There is also a report of human–elephant conflict in the villages around the post. Sometimes elephants destroy field houses of farmers and feed on crops. In 2000, local farmers saw a group of 9 elephants in this area. In February 2001, one big male came to the field just 300m behind the guard post. On 14th March 2001, local people reported a group of elephants came to Suoi Ty stream area (Village 5, Thanh Son Commune, Enterprise 1) and destroyed some farmers' houses.

Doi Dat Do (11°23'37", 107°11'57")
This post is located in block 20. Elephants often frequent blocks 14, 15, 19 and 20 and come to the areas of Enterprises I and II of La Nga Forestry Company. On 19th February 2001, at 20 hours, when staff of the guard post were staying in a hut in cashew plantation (3 km west of the guard post, block 19:11°23'10", 107°16'33"), a group of 5 elephants (2 males, 3 females) came close to their hut. The elephants were chased away by fire torches. They visited the place again the next night and destroyed the hut.

Ta Lai (11°22'40", 107°21'54")
Located near Ta Lai village in the southeast of the park and block 21. Before 1995, elephants often came to this area. They are rarely reported in this area (blocks 15, 16). However, there is a report of elephants visiting the village in January 2001.

Nui Tuong (0760754, 1261535)
Located southeast of the park and in block 16, elephants often came to this area before 1994. In June 1999, one male elephant was reported. After 1999, no reports of elephants in this area. This elephant was reported to have come close to the Park's headquarters then followed the main road north to Nui Tuong guard post then moved to Doi Dat Do area.

Da Ko (CC or MI)
Local farmer reported that during 1979 – 1983 elephants were reported in this area. Since then no elephant signs have been reported.

Da Lac
Located extreme northeast of the park within block 6. Since 1995, no signs of elephants have been reported from here.

Dak Lua
Located northeast and in block 5, no elephants have been recorded since a long time.

Bau Sau (11°27'33", 107°20'43")
Located in block 9 and in the middle of the park. Elephant tracks, usually of one elephant, were observed sometimes in an area near Hill 102 and Hill 105.

C10
Located outside the park (towards extreme north), elephant tracks were reported in December 2000 and March 2001 in grassland near Hill 105. There is also a report of an old elephant track by staff of the Department of Techniques and Science on 17th April, near the post.

Da Bong Cua (11°32'01", 107°17'40")
Located northwest of the park within block 4, tracks of possibly 1 elephant were observed in July and September 1998 in block 4 (near hill 102) by the staff. No signs of elephants have been found in the area since 1999.

Dang Ha (11°34'26", 107°09'36")
This post is located extreme northwest, outside the park and was established only in May 2000. However no signs of elephants.

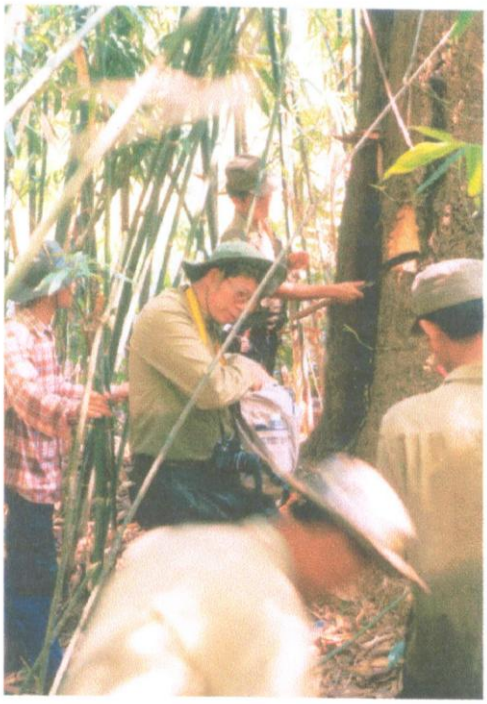
Appendix 7: Photographs

Elephant survey training program & the survey team

Survey in the field

Survey planning

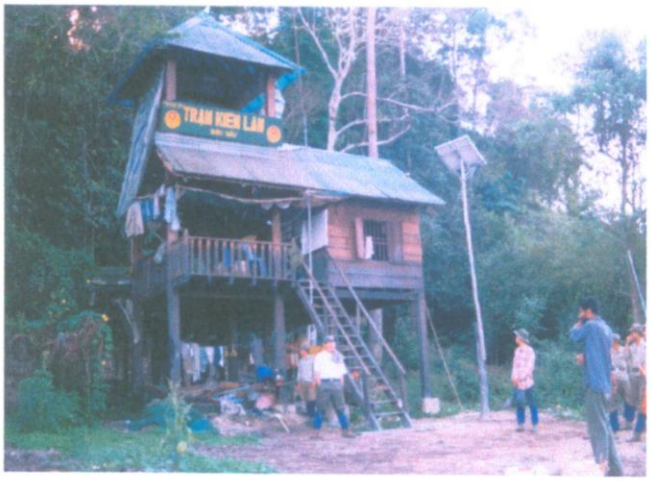
Line transect dung survey



Vegetation survey along the transect

Dung measurement & food component survey

Elephant track mark measurement



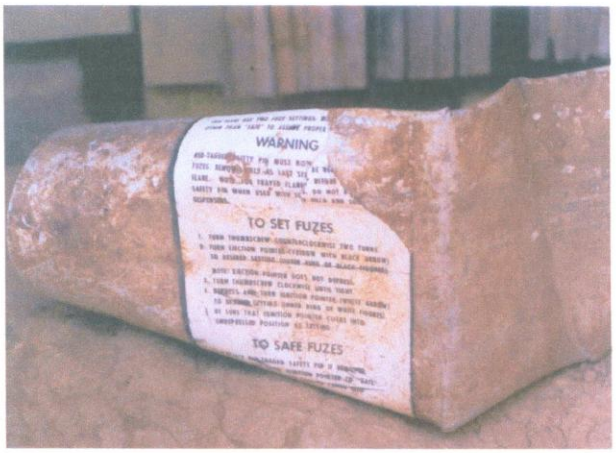
Guard station survey

Elephant food species with feeding signs

Nut being separated from cashew fruit

A view of settlement in La Nga Forestry Enterprises area

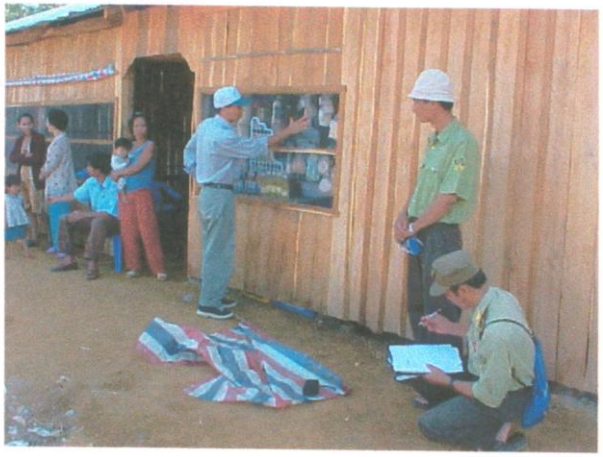
Paddy fields and bamboo forests of the north west of Cat Tien NP



Remnants of the war found in the north west of Cat Tien NP

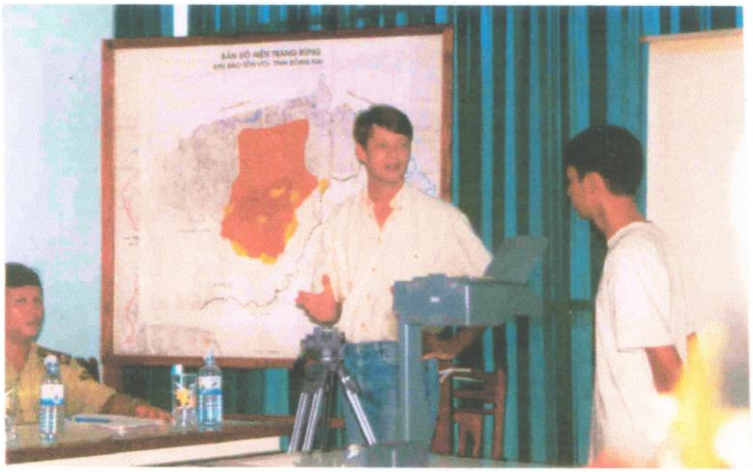
Elephant damage to paddy field

Elephant damage to a banana plant



Elephant damage to a shop in Ta Lai village

Huts damaged by elephants in cashew plantation



Elephant conservation workshop

Human – Elephant Conflict: Mitigation measures

Wooden fence & fire torches

Noise through beating vessels

Noise generating "bamboo gun"