THE 1999 SURVEY OF JAVAN RHINOCEROS,

Rhinoceros sondaicus annamiticus,

IN CAT TIEN NATIONAL PARK, VIETNAM

By

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1 INTRODUCTION

In April 1998, financially supported by the US Fish and Wildlife Service, the Institute of Ecology and Biology Resources (IEBR) in Hanoi collaborated with the Cat Tien National Park in order to execute a survey. The survey aimed at establishing the number and dry-season range of Javan rhinoceros, *Rhinoceros sondaicus annamiticus*, in Cat Tien National Park (Cat Loc sector). In January 1999, financed by the Cat Tien National Park Conservation Project, the Cat Tien National Park organised a survey of Rhinoceros in the Cat Loc sector at the end of the rainy season, aiming at:

- Monitoring the number of rhino individuals presently remaining in Cat Tien National Park.
- Finding out the range of the rhino population during the wet season.
- Collecting basic information on the present situation of the rhino population, their habitat, and human inhabitants' influence to Cat Tien National Park to build up and carry out more effective solutions for preserving the rhinos and biological diversity in Cat Tien National Park.

This report presents the results of analysed data of the situation and activity zone of the rhino population of Cat Tien National Park during the rainy season. The data and information on the habitat and human impacts will be presented in another report.

2 THE METHODOLOGY OF CHECKING THE NUMBER AND ACTIVITY ZONE OF RHINOCEROS

This survey used the method of analysing the footprints left behind by passing rhinos, a standard method widely applied over the world and also during the survey of April 1998. This is also the most suitable method to the purpose put forward and specific circumstances of Cat Tien National Park. The method consists of three basic steps as below:

- Carrying out the investigation of all the possible activity zones of rhinos to collect every activity trace of rhinos (footprints, dung, wallows, body's rub trace against tree trunks, trace of plants broken and eaten, etc.) for defining the range of rhinos.
- Measuring width and length of the discovered footprints, making plaster casts of the whole footprint or the front hoof to define the minimum number of the rhino's in the area.

- Considering the elements which had an effect on the process of survey and the size of the areas not yet investigated to define the maximum number of the local rhino population.

The survey team consists of 10 members of the Cat Tien National Park's staff, Dr. Nguyen Xuan Dang (IEBR-Hanoi), who was invited to direct and to technically supervise the study. Most members of the survey team had been technically trained and had taken part in the survey of April 1998. However, before the beginning of the survey of January 1999, the whole team received a weeklong training in rhino census techniques. This training took place in the classroom and in the field.

The survey team was divided into two groups, each of five members. Group A was under the charge of Eng. Pham Huu Khanh, while group B was led by Eng. Tran Van Dat. The two groups simultaneously investigated in different areas of Cat Loc zone (Cat Tien National Park). Geographical co-ordinates of action traces and investigation lines were located by GPS, compass and topographical maps with a scale of 1:50,000.

3 THE SURVEY RESULT

3.1 The Collected Data

Over a month of intensive investigation, the survey team covered nearly all the possible activity zones of rhinoceros. The total length of investigation lines was around 218 km., with some lines repeated several times. The investigation lines concentrated in the South part of Cat Loc zone (11° 37'N – 11°43'N, 107°15'E – 107°23'E) – the place where most rhino activity traces were gathered. Some investigation lines were carried out near Village N°. 5, the upper Suoi Lon (Big Stream) (11°45'N, 107°23'E), Thung Co (Valley of Co) in Bu Quat zone, Bor Dang (17°46'N, 107°34'E) – the places with terrain and habitat rather suitable for rhinos to live and where rhino signs have been reported before.

The Survey Team collected data on the following:

- 12 wallows,
- 6 heaps of excrement (including one in a new location),
- two salt licks (Table 1),
- 241 rhino footprints (Table 2),
- 55 casts of footprints and front hoof prints (Table 3),
- recognised many footpaths, body's rub traces on tree trunks, traces of eaten and broken plants and trees.

Of special interest was the discovery of a tree with many cuts on the bark, which might be inflicted either by a rhino's horn or by a rhino's incisors. If it could be established that these marks were caused by a rhino's horn indeed, than that would be the first evidence that an adult male is present in the population. These marks were found on a hill near Bau Chim (Birds' Swamp) (11°38'17''N, 107°18'29''E).

This is the richest source of data ever obtained on the rhinoceros population in the Cat Tien National Park. The plaster cards and other raw data are kept at the headquarters of Cat Tien National Park, Tan Phu District, Dong Nai Province.

3.2 The Number of Rhinoceroses

The total of the rhinos' footprint casts included in the analysis was 144, including 137 casts made during the survey of January 1999 plus 7 casts from December 1998 (from Bau Chim (Birds' Swamp) (11°37'55''N, 107°18'18''E)). Of the 144 casts, 33 could not be analysed because of poor quality; the other 111 were carefully analysed in the laboratory. The width and length of all the footprints and front hooves were recorded. Based on dimensions of the casts, the measurements of footprints in the field (of which not always casts were made), the footprints were divided into many groups, each group with the same characteristics in form and size. In this manner individual rhino's were recognised. The dimensions and analytic results are shown in Table 3 and summarised in Table 4. From Table 3 and 4, it is observed that the widths of the feet measured from casts and in the field are comparable, but the lengths of the feet measured in the field are nearly 1 cm larger than those measured from casts. The analysis shows that there are 6 rhino individuals, which can be identified clearly by the differences and dimensions and the form of their front hooves, as following:

Rhino 1: Front hoof rim rather regularly round, wide and high; the front hoof's average width is 106.0 mm., its average height (length) is 46.9 mm. Foot average width 191.2 mm, length 217.9 mm.

Rhino 2: Front hoof rim rather regularly round, similar to Rhino 1's, but wider and lower, average width 111.9 mm. (Rhino1: 106mm), height (length) 33.7 mm. (Rhino 1: 46.9 mm.). Foot average width 202.1 mm., length 222.9 mm.

Rhino 3: Front hoof width and height similar to Rhino 1, but a little slanting, not regularly round, average width 107.6 mm., height (length) 47.4 mm. Foot average width 136.6 mm., length 219.7 mm.

Rhino 4: Front hoof relatively regularly round but low and narrow, average width 101.0 mm., height (length) 33.4 mm. Foot average width 185.8 mm., length 220.8 mm.

Rhino 5: Front hoof narrow, slanting a little on the right and the hoof rim still sharp; average width 93.4 mm., height (length) 47.1 mm. Foot average width 187.0 mm., length 207.4 mm.

Rhino 6: Front hoof slanting on the left; hoof rim sharp, wider and lower than Rhino 5; average width 96.4 mm., height (length) 44.4 mm. Foot average width 191.1 mm., length 187.5 mm.

Thus, from the analytic result, which compares the front hoof's size and form of the footprint, the plaster casts allow the definition of 6 different rhino individuals.

The analysis and comparing of the dimensions of 241 footprint sizes measured in the field (no casts made), show that the dimensions' range of variation is rather large. From 157 mm. to 240 mm. wide, and 187 mm. to 258 mm. long. The smallest footprint is 157 mm. wide and 197 mm. long (11°40'35''N – 107°18'37''E), and the largest footprint is 240 mm. wide and 248 mm. long (11°18'43''N – 107°18'37''E). It is concluded that these are the footprints of many different individuals. Nearly all the footprints' widths are within the range from 176 mm. to 215 mm. (including 217 footprints, 90% of the total number of footprints). There are 19 footprints shorter than 176 mm. and 5 wider than 215 mm.

The width of the footprint plaster casts analysed above oscillates within the range from 166 mm. to 215 mm. (Table 3). Of 241 footprints being measured in the field, 231 are within and 10 outside the above range of 166 mm. to 215 mm.

Among the footprints which are wider than 216 mm. there are 3 particularly large, recognised at 3 different locations:

- Footprint 1: 240 mm. wide, 248 mm. long;
  co-ordinates 11°38'43''N, 107°18'31''E
- Footprint 2: 243 mm. wide, 366 mm. long;
  co-ordinates 11°38'41''N, 107°18'30''E
- Footprint 3: 223 mm. wide, 234 mm. long;
  co-ordinates 11°39'48''N, 107°19'42''E

At the same time there is also a very large hoof plaster cast: The cast H6A made on 24 January 1999 at 11°39'42''N, 107°20'06''E, 135 mm. wide, 46 mm. long. All the

3.4 The Rhinoceros' Range of Activities

In the survey of January 1999, the Survey Team investigated rather carefully all the rhinos' possible activity zones belonging to Cat Loc area (Cat Tien National Park) and an area out of the National Park, belonging to Dac Lac district (11°45'N – 11°47'N, 107°23'E – 107°24'E), and areas of Bor Dang hamlet, Bao Loc district, Lam Dong province (17°46'N, 107°34'E).

In the whole area of Cat Loc is to the west of longitude 107°23'E and in the investigated areas outside Cat Loc sector of the National Park, no signs of rhino were found. Interviews with local inhabitants also show that no one has seen the traces of rhinos coming and going there since the last five years. In the areas of Bu Quat – Bor Dang, rhino footprints were last seen in 1993.

At present the rhinos' are concentrating their activities in the west part of Cat Loc area (West of longitude 107°23'E) belonging to the areas of Village N°. 3, Village N°. 4, Phuoc Son, Phuoc Thai, Hamlet K' Lo, Dang Peo, as presented in detail below:

Around Da Dinh Vu Stream and Lanh Stream (Cold Stream) belonging to the areas of Village N°. 3 and Village N°. 4 (11°40'30''N – 11°42'30''N, 107°18'E – 107°21'E) the Survey Team saw many footprints new and old, two heaps of dung and three wallows together with many traces of body rubbing against tree-trunks, and branches and leaves eaten by rhinos. This is the place where the rhinos frequently come for activities: by the sides of Da Dinh Vu Stream, on the hillsides and especially around the marshes. Among these marshes, near Dinh Giang Marsh (11°41'01''N, 107°19'25''E), Dinh Har Marsh (11°41'47''N, 107°19'43''E), and Da Dinh De Stream (11°40'50''N, 107°19'12''E) there are many new footprints and new wallows of rhinos. However, around some marshes such as Dinh Rat Marsh (11°41/30''N, 107°18'59''E) and Dinh Tria (11°40'12''N, 107°19'00''E) there were many footprints in April 1998 (dry season) but no new footprints were seen during this survey.

At the area of Quarter 512 (11°39'00''N – 11°40'30''N, 107°18'00''E – 107°19'30''E), the Survey Team also discovered many new footprints, two wallows and many plants eaten by rhinos. Particularly, the Sinh Marsh (Marsh of Mud) (11°40'03''N, 107°18'55''E) is rather large where the rhinos frequently come and go, with two wallows which were recently used. From the past until now, the area of Quarters 512, 513 have been considered the main residence of rhinos because of relatively flat terrain, with large marshes and many food plants. This is also the place where the last rhino hunt happened in 1989; the shot rhino's skeleton was

restored and is displayed at the Institute of Ecology and Biological Resources, Hanoi.

The area of Hamlet K' Lo, Hamlet K' Ich, and Hamlet Dang Peo (17°38'50''N – 17°41'00''N, 107°19'00''E – 107°21'30''E) is the place where the rhinos frequently come and go. Here many new footprints were encountered, three new wallows and many traces of rhinos' eating branches and leaves. Two marshes with many new footprints and new wallows: Trau Marsh (Marsh of Water Buffaloes) (11°39'42''N, 107°20'06''E) and Marsh Dac Lo (11°39'48''N, 107°19'42''E). Especially at the Marsh Dac Lo a site was found where underground water is pushed up and rhinos usually come to drink. This is very possibly a mineral source of rhinos. In the survey of April 1998, a mineral source had been found at the side of Lon Stream (Large Stream) (11°41'20''N, 108°21'10''E) but during this (rainy) season survey, the stream rose high and covered this mineral lick.

In the area of Phuoc Son (11°37'30''N – 11°39'30''N, 107°18'00''E – 107°19'00''E) there is a very important mineral source for rhinos and thus this is the place where they frequently come and go, particularly in the rainy season. During the dry season, the mineral lick and its neighbourhood are severely influenced by the local inhabitants and cattle. This obstructs the rhino routes and threaten the rhino's coming to the salt lick. During the rainy season, these effects decrease and the rhino's frequent the salt lick more often. In the survey of January 1999, many new footprints and new wallows were found around Bau Chim (Birds' Marsh) (11°37'55''N, 107°18'18''E), Suoi Tre (Stream of Bamboo) (11°38'52''N, 107°18'35''E), three dung piles, four new body-dipping puddles, many rubbing traces of body against tree-trunks and traces of eating branches and leaves left by the rhinos.

In brief, the above investigations' result shows that the rhinoceros' present range of activities in Cat Tien National Park is the west part of Cat Loc, over a region of nearly 6,000 hectares, at the geographical co-ordinates 11°37'50''N–11°43'00''N, 107°17'30''E–107°22'30''E.

In comparison to the result of the survey in April 1998, it is observed that the rhino's activity zone in dry season and rainy season are the same, except that in rainy season the frequency of rhinos' appearance in the area of Bau Chim (Phuoc Son) is much higher because of less disturbing activities by local inhabitants and their cattle. However, this fact does not mean that the area of 6,000 hectares is enough for rhinos' activities all the year round but that the neighbouring areas have been so strongly affected that the rhinos dare not go out of that limit. In fact, to the East of the Hamlet K' Lo and Hamlet K' Ich the rhino's route leading to the areas

of Thung Co (Valley of Palm-trees) and farther have been blocked by human activities. The inhabitants here have never met with rhino's in the cashew gardens behind their houses and this is the evidence that the rhino's want to enlarge their zone of activities but this is impossible. To the North, Village N°. 4 is a barrier; to the South and West are the Village N°. 3, Hamlet Phuoc Son, Hamlet Phuoc Thai of which the chain of cultivated areas, high population, and disturbance builds up a belt stopping the rhino's from expanding their activity zone. The limitation of the range leads to the shortage of food sources for rhino's, and inhibits the normal reproduction and development of the local rhinoceros population.

The salt lick of Bau Chim – Phuoc Son (Birds' Marsh – Hamlet Phuoc Son) is of special significance to the local rhinos' activities. This is a wet and large piece of land of about 300 m^2 (15m. x 20m.) close to the foot of the hill in the South East of Phuoc Son Valley. The vegetation cover at the salt lick consists of various kinds of water grass, water-taro and some small bushes. The underground mineral water pushes up on to the ground, flowing into a small spring (Tak Ke Spring) which moves through the salt lick, skirting the South-East foot of the hill. Connected with the mineral point is the Phuoc Son Valley (Bau Chim), the place has been cleared by local inhabitants for growing agricultural plants (rice, bean, maize, etc.) (Table 5). In addition, the local cattle are also let go freely in and out of the mineral point and the hill feet of the valley. The Phuoc Son salt lick, therefore, suffered greatly from human and cattle's activities and the rhino's passage to the mineral point is blocked. However, the rhino's need of mineral forces them to arrive rather frequently at this mineral point (once or twice per month) during the rainy season (from May to October), and sometimes they also return to the salt lick in dry season (the season of very strong effects from humans and cattle). The range of rhino's in Phuoc Son Valley has been much diminished, just within an area of about 0.5 hectare (the area of Bau Chim or Birds' Marsh is about 10 hectares), i.e. from the mineral point at the south-east hillfoot through the valley and up to the hillfoot in the North-West of the valley.

From Dang Peo or Suoi Lon (Large Stream), the rhino route follows a range of hills North-West of the valley and skirting the hillside down to Phuoc Son salt lick. Their activities occur there, and then they return to the North-West hillside to move to other regions.

On the range of hills to the North-West of Phuoc Son Valley there are many routes of rhinos, together with many other activity traces of rhinos, such as their body's and horn's rubbing traces against the tree-trunks, four wallows with many traces of mud on the branches and leaves around, three dung piles and many traces of eaten

plants. This is the evidence that in this period the rhino's activities are rather intensive here.

The forest quality on these ranges of hills is very poor, mainly including rattan and bamboo, not many food plants. Bamboo and rattan build up safe shelters for rhino's but are not principal foods for them. Rattan and bamboo hinder the development of rhino food plants. Therefore, there must be a solution to overcome this situation. In addition, the local inhabitants are clearing these forests for growing cashew and other food plants, destroying the rhino's habitat. The area of the cashew plantation on the North-West top of Phuoc Son Valley is up to 30 hectares, blocking the rhinos' passage from this place to and back from the area of Suoi Lon.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

- The survey of January 1999 covered nearly all the possible zones of rhino activities, and the total length of investigation lines is 218 km. with some lines repeated several times. The survey builds up the richest collection of data ever obtained on the present situation of the rhinoceros population in the area of Cat Loc (Cat Tien National Park), including the dimensions of 241 footprints, 55 foot plaster casts, 82 front hoof plaster casts, 12 wallows, 6 dung piles, 2 salt licks and many body's rubbing traces and horn / incisors goring traces, and traces of breaking and pressing plants down to eat branches and leaves.

- The present number of rhinoceroses in Cat Tien National Park is minimally 7 individuals, maximally 8 individuals, and includes male, female, young and adult individuals.

- The rhino's present range is to the South-West of Cat Loc (Cat Tien National Park), over a tract of about 6,000 hectares, geographical co-ordinates 11°37'55''N – 11°43'00''N, 107°17'30''E – 107°22'30''E, coinciding with the dry-season range of the rhino's.

- The locations with most traces of rhino's are: Bau Chim, Phuoc Son (11°37'55''N, 107°18'18''E), Bau Sinh (Muddy Marsh) (11°40'03''N, 107°18'55''E), Bau Dinh Giang (Dinh Giang Marsh) (11°40'01''N, 107°19'25''E), Bau Trau (Water-Buffalo Marsh) (11°39'42''N, 107°20'06''E), and Suoi Da Dinh De (Da Dinh De Stream) (11°40'50''N, 107°19'12''E).

- The local inhabitants' effect is so strong that the rhino's range has contracted and is now limited to a tract of nearly 6,000 hectares; a too small area for the normal activities and living requirements of this large mammal.

4.2 Recommendations

- Mobilising all abilities and increasing the patrol and checking to protect these last Vietnamese rhinoceroses.

- Moving the hamlets and villages which are within or close to the rhino's present activity zone (Village N°. 4, Village N°. 3, Hamlet K' Lo, Phuoc Son, Phuoc Thai) out of the boundary of Cat Tien National Park to guarantee the rhino's safety and to provide favourable conditions for them to expand their range and thus their daily need of food can be satisfied.

- Placing automatic cameras (camera-trapping method) at the locations where the rhino's frequently come and go (Bau Chim, Bau Sinh, Bau Dinh Giang, Suoi Da Dinh De, Bau Dac Lo) to take photographs of rhino's, and define the number of individuals and the number of male, female, young and adult members of the rhino population, in order to help the Cat Tien National Park find a solution for more suitable control.

- Inquiring into the ingredients of rhino's food, estimate the reserve of local food plants, trying the methods of restoring the habitat, establishing rich food sources for rhino's.

- Studying the big herbivorous animals' competition with rhino's for food within the range (such as Gaur, Banteng, Buffalo, deer, etc.) in order to have suitable treatments.

- Ending the agricultural cultivation, the grazing cattle and the local inhabitants' trespassing on the area of Bau Chim–Phuoc Son salt lick; restoring the natural vegetation cover and guaranteeing the safety of the rhino's when approaching the salt lick over an area of which the minimum radius is 400 m.

- Another survey should be carried out in the year 2000 to monitor the change of the number of rhinos and especially the expansion or contraction of rhinos' range in order to have more suitable and effective solutions.

TABLE 1: RHINO SIGNS FOUND IN JANUARY 1999

No.	Place names	Co-ordinates	Size (meter)	Traits
	WALLOWS			
1.	Bau Chim	11 37 55N, 107 18 18E	1 x 3 x 0.5	New
2.	K' Lang Ai	11 38 09N, 107 18 29E	1.1 x 3 x 0.25	New
3.	K' Lang Ai	11 38 09N, 107 18 29E	1.5 x 0.8 x 0.3	New
4.	K' Lang Ai	11 38 77N, 107 18 29E	6 x 2 x 0.25	New
5.	Tung K' La Hill	11 38 45N, 107 18 26E	5 x 7 x 1	New
6.	Suoi Tre (Tung K' La)	11 38 52N, 107 18 35E	5 x 7 x 0.5	New
7.	Da Dinh Giang	11 41 01N, 107 19 25E	2.5 x 2 x 0.5	New
8.	Dac Lo	11 39 48N, 107 19 42E	2.5 x 3 x 0.5	New
9.	Dac Lo	11 39 48N, 107 19 42E	2.5 x 4 x 0.5	New
10.	Bau Trau	11 39 54N, 107 20 06E	5 x 7 x 1	New
11.	Bau Trau	11 39 54N, 107 20 06E	3 x 4 x 0.5	New
12.	Bau Sinh	11 40 35N, 107 18 39E	1.5 x 2 x 0.5	Old
	DUNG PILES			
1.	Tung K' La Hill	11 38 52N, 107 18 35E		New
2.	Suoi Tre (Tung K' La)	11 38 43N, 107 18 31E		Old
3.	Ba Ro Hill	11 39 00N, 107 19 00E		Old
4.	Ba Ro Hill	11 39 00N, 107 18 42E		Old
5.	Da Dinh Giang	11 41 50N, 107 19 18E		Old
6.	Bau Da Giang	11 41 22N, 107 20 00E		Old
	SALT LICKS			
1.	Bau Chim	11 37 55N, 107 18 18E	$400m^2$	New
2.	Bau Dac Lo	11 39 48N, 107 19 48E	$100m^2$	New

TABLE 2: DIMENSIONS OF RHINO FOOTPRINTS FOUND IN JAN. 1999

Date	No.	Dimensions (mm)		Co-ordinates	Plaster Cast
		Width	Length		
07 Jan. 1999					
	1.	181	224	11 37 55, 107 18 18	F1A
	2.	185	266	11 37 59, 107 18 22	
	3.	201	222		F2A
	4.	202	231		F3A
	5.	201	187		F4A
	6.	200	214		F5A
	7.	199	231		F6A
	8.	201	221		
	9.	187	220		
	10.	192	223		F7A
	11.	202	234		
	12.	204	242	11 37 55, 107 18 18	F1B
	13	198	204		
	14.	190	246		
	15.	195	256		F5B
	16.	185	222		
	17.	191	221		
	18.	190	230		
	19.	185	222	11 37 59, 107 18 23	
	20.	183	216		
	21.	180	223		
	22.	170	197		
	23.	183	227		
	24.	188	206		
	25.	172	210		
	26.	176	215		
	27.	193	236		
	28.	184	217		
	29.	170	209		
	30.	180	211		
	31.	166	208		F14B
	32.	179	204		F15B
	33.	166	190		F16B
	34.	198	231		
	35.	190	235		
	36.	194	211		
	37.	181	200		
	38.	185	221		
	39.	178	220		

	40.	187	222		
08 Jan. 1999					
	41.	201	207	11 37 55, 107 18 20	
	42.	190	224		H1A
	43.	203	235		F2A
	44.	183	214		H3A
	45.	184	236		F4A
	46.	195	239		H5A
	47.	205	214		H6A
	48.	184	228		H7A
	49.	194	238		H8A
	50.	188	218		
	51.	187	206	11 38 01, 107 18 26	
	52	189	228	11 38 08, 107 18 29	
	53.	212	240	11 38 17, 107 18 29	F9A
	54.	185	219	11 37 59, 107 18 20	F1B
	55.	185	214		F2B
	56.	185	218		
	57.	173	219		
	58.	185	213		
	59.	188	229		F6B
	60.	175	203		
	61.	184	225	11 38 01, 107 18 26	
	62.	189	228	11 38 09, 107 18 29	
	63.	212	240	11 38 17, 107 18 29	
09 Jan. 1999					
	64.	234	236	11 38 41, 107 18 30	
	65.	218			
	66.	205	248	11 38 43, 107 18 31	
	67.	205	223	11 38 52, 107 18 35	
	68.	196	258		
	69.	194	230		
	70.	207	237		F1A
	71.	197	218		H2A
	72.	192	237		F4A
	73.	197	219		H3A
	74.	193	240		
	75.	213	222		
	76.	203	231		H5A
	77.	205	225		
	78.	197	232		F6A
	79.	197	235		F7A
	80.	182	224	11 38 43, 107 18 31	
	81.	240	248		

	82.	181	203		
	83.	181	219		
	84.	184	219		
	85.	205	223		
	86.	208	226		
	87.	210	235		
	88.	189	225		
	89.	172	201		
	90.	188	229		
	91.	188	223	11 38 52, 107 18 35	
	92.	184	215		
	93.	184	223		
	94.	195	211		
	95.	186	228		F1B
	96.	190	212		F2B
	97.	198	241		
	98.	173	218		
	99.	180	219		
	100.	188	227		
	101.	180	218		
	102.	194	239	11 38 43, 107 18 56	
	103.	198	250		
10 Jan. 1999					
	104.	177	205	11 39 00, 107 19 00	
	105.	197	213		
	106.	190			
	107.	182			H1A
	108.	185			H2A
	109.	203	243		H3A
	110.	189	234		H4A
	111.		244		H5A
	112.	195	225		
	113.	195	239		
	114.	187	245		
	115.	212	259		
	116	210	240	11 39 00, 107 19 00	
	117.	198	219		
	118.	195	237		
	119.	188	238		
14 Jan. 1999					
	120.	214	231	11 41 36, 107 18 24	
	121.	200	223	11 41 30, 107 18 59	
	122.	191	223		
	123.	176			

	124.	194	227	11 42 51, 107 19 36	
	125.	192	234		
	126.	195	231		
	127.	182	222		
	128.	195	238		
	129.	196	244		
	130.	200	217		
	131.	194	232		
	132.	174	213		
	133.	205	238		
	134.	195	228	11 41 39, 107 19 36	H4B
	135.	189	223		
	136.	189	230		
15 Jan. 1999					
	137.	203	247	11 41 35, 107 19 33	
	138.	190	221		
	139.	205	249		
	140.	190	223	11 41 01, 107 19 25	F1B
	141.	185	225		
	142.	193	239		
	143.	195	223		
	144.	206	232		F3B
	145.	195	233		
	146.	189	228		
	147.	205	234		F5B
	148.	205	239		
	149.	204	239		
	150.	175	219		
	151.	195	236		F9B
	152.	195	226		
	153.	195	247		
	154.	195	232		
	155.	200	230		H13B
	156.	185	223		
	157.	185	234		
	158.	190	200		
16 Jan 1999					
	159.	193	235	11 40 45, 107 19 12	F1B
	160.	200	232		
	161.	180	224		F2B
	162.	190	226		
	163.	190	233		F3B
	164.	175	226		F4B
	165.	178	227		

	166.	178	217		
	167.	178	228		
	168.	165	220		
	169.	167	200		
	170.	164	205		F9B
	171.	163	227		
17 Jan. 1999					
	172.	197	237	11 41 45, 107 19 36	
	173.	205	234	11 41 47, 107 19 43	F1B
	174.	187	226		F2B
	175.	186	223		F8B
	176.	197	219		
	177.	197	230		
	178.	192	238		F3B
	179.	187	234		
	180.	182	217		
	181.	187	226		
	182.	180	213		
	183.	182	216		
22 Jan. 1999					
	184.	200	242	11 39 48, 107 19 42	F1A
	185.	223	234		
	186.	197	266		H3A
	187.	202	240		H4A
	188.	212	263		H5A
	189.	200	243		H6A
	190.	204	208		
	191.	212	224		
	192.	206	238		F9A
23 Jan. 1999					
	193.	212	228	11 39 48, 107 19 48	F1A
	194.	199	235		H3A
	195.	185	216		H4A
	196.	210	244		H5A
	197.	192	231		F6A
	198.	204	229		F8A
	199.	216	258	11 39 36, 107 19 54	F9A
	200.	196	253		
	201.	201	267		
	202.	200	237		
	203.	212	237		
	204.	195	228		
24 Jan. 1999					
	205.	189	230	11 39 42, 107 20 06	F1A

	206.	182			H2A
	207.	207	236		H3A
	208.	195	235		F5A
	209.	211	238		F7A
	210.	200	238		
	211.	215	247		H8A
	212.	185	230		F9A
	213.	171		11 39 45, 107 20 06	H16A
	214.	198			H17A
	215.	185			H19A
	216.	171			H24A
	217.	183			H25A
	218.	158	208	11 40 35, 107 18 39	
	219.	180	218		
	220.	157	197		
	221.	165	196		
	222.	181	199		
	223.	180	217		
	224.	193	212		
	225.	180	228	11 40 03, 107 18 55	
	226.	180	225		
	227.	190	230		
	228.	194	228		
	229.	192	238		
	230.	190	227		
	231.	202	229		
	232.	215	237		
	233.	195	248		
	234.	204	237		
	235.	202	235		
	236.	204	240		
	237.	200	215		F6B
	238.	210	240		
	239.	202	225		
	240.	197	230		
	241.	205	240		

TABLE 3: DIMENSIONS OF RHINO FOOTPRINTS, JANUARY 1999

Date	Quality	Locations	Symbol	Foot Plaster Casts		Footprints		Front Hoof Plaster Casts	
		Latitude, Longitude		Width (mm)	Length (mm)	Width (mm)	Length (mm)	Width (mm)	Length (mm)
RHINO 1									
08 Jan 99	G	11 38 17, 107 18 29	F9A	195	230	212	240	110	52
16 Jan 99	G	11 40 45, 107 19 12	F9B	175	212	164	205	111	42
16 Jan 99	G	11 40 45, 107 19 12	F2B	.181	201	180	224	112	46
07 Jan 99	G	11 37 59, 107 18 22	F6A	196	215	199	231	106	45
08 Jan 99	F	11 37 55, 107 18 20	F2A	202	232	203	235	108	50
24 Jan 99	P	11 39 42, 107 20 06	F1A	196	214	189	230	107	44
22 Jan 99	P	11 39 48, 107 19 42	F1A	190	223	200	242	105	48
23 Jan 99	F	11 39 48, 107 19 48	F8A	194	220	204	229	110	54
08 Jan 99	P	11 37 55, 107 18 20	F4A	192	200	184	236	105	58
09 Jan 99	P	11 38 52, 107 18 35	F4A	191	232	192	237	100	41
15 Jan 99	G	11 41 01, 107 19 25	H11B					104	49
10 Jan 99	F	11 39 00, 107 19 00	H2A			185		105	42
14 Jan 99	G	11 41 39, 107 19 36	H4B			195	228	110	55
14 Jan 99	G	11 42 51, 107 19 36	H2B			182	222	107	52
14 Jan 99	F	11 42 51, 107 19 36	H3B					106	44
08 Jan 99	F	11 37 55, 107 18 20	H3A			183	214	100	42
08 Jan 99	F	11 37 55, 107 18 20	H8A			194	238	103	47
10 Dec 98	G	11 37 55, 107 18 18	H.0					108	42
16 Jan 99	F	11 40 45, 107 19 12	H5B					101	46
08 Jan 99	P	11 37 55, 107 18 20	H6A			205	214	102	42
24 Jan 99	P	11 39 54, 107 20 06	H18A					106	45
			Average:	191.2	217.9	191.9	228.3	106.0	46.9
RHINO 2									
24 Jan 99	F	11 40 35, 107 18 39	F2B	181	230	180	227	104	30
22 Jan 99	F	11 39 48, 107 19 42	H2A					110	38
08 Jan 99	F	11 37 55, 107 18 20	H5A			195	239	110	35
10 Jan 99	F	11 39 00, 107 19 00	H5A				244	110	31
14 Jan 99	F	11 42 51, 107 19 36	H1B					110	38

15 Jan 99	F	11 41 01, 107 19 25	F5B	214	222	205	234	114	31
24 Jan 99	P	11 39 42, 107 20 06	F9A	181	220	185	230	114	34
22 Jan 99	P	11 39 48, 107 19 42	F9A	204		206	238	113	35
15 Jan 99	G	11 41 01, 107 19 25	F3B	219	220	206	232	110	24
15 Jan 99	F	11 41 01, 107 19 25	F9B	205	225	195	236	116	30
17 Jan 99	G	11 44 47, 107 19 43	F8B	206	220	186	223	113	33
17 Jan 99	F	11 44 47, 107 19 43	F1B	213	223	205	234	112	30
07 Jan 99	P	11 37 59, 107 18 22	F5A	196		200	214	113	32
24 Jan 99	P	11 39 54, 107 20 06	H25A					116	35
15 Jan 99	F	11 41 01, 107 19 25	H10B					116	33
22 Jan 99	P	11 39 48, 107 19 42	H3A			197		110	38
24 Jan 99	F	11 39 54, 107 20 06	H26A					117	28
15 Jan 99	F	11 41 01, 107 19 25	H2B					108	34
10 Jan 99	F	11 39 00, 107 19 00	H4A			189	234	110	33
			Average:	202.1	222.9	195.8	234.7	111.9	33.7
RHINO 3									
24 Jan 99	G	11 40 03, 107 18 55	F3B	186	237	180	228	105	
24 Jan 99	G	11 40 03, 107 18 55	F5B	200	217	190	230	110	43
09 Jan 99	G	11 38 52, 107 18 35	F1A	202	230	207	237	111	50
07 Jan 99	F	11 37 59, 107 18 22	F7A	172	194	192	223	100	42
10 Jan 99	G	11 37 55, 107 18 18	F.0	210	224			100	49
07 Jan 99	P	11 37 55, 107 18 18	F1B	204		204	242	103	55
10 Jan 99	F	11 37 55, 107 18 18	F.0	202	216			106	44
07 Jan 99	F	11 37 55, 107 18 18	H4B					121	51
15 Jan 99	F	11 41 01, 107 19 25	H4B					112	45
15 Jan 99	G	11 41 01, 107 19 25	H8B					108	53
			Average:	196.6	219.7	194.6	232.0	107.6	47.4
RHINO 4									
16 Jan 99	F	11 40 45, 107 19 12	F10B	166	233	163	227	100	32
17 Jan 99	F	11 44 47, 107 19 43	F2B	190	220	187	226	98	35
16 Jan 99	F	11 40 45, 107 19 12	F3B	193	226	190	233	100	32
10 Dec 98	G	11 37 55, 107 18 18	F.0	192	207			98	30
09 Jan 99	P	11 38 52, 107 18 35	F6A	188	218	197	232	100	38
24 Jan 99	F	11 39 54, 107 20 06	H21A					100	37

10 Jan 99	F	11 39 00, 107 19 00	H1A			182		105	32
24 Jan 99	F	11 39 42, 107 10 06	H13A					107	35
15 Jan 99	G	11 40 45, 107 19 12	HB7					95	28
10 Dec 98	F	11 37 55, 107 18 28	H.0					88	30
09 Jan 99	F	11 38 52, 107 18 35	H2A			197	218	94	34
24 Jan 99	P	11 39 54, 107 20 06	H23A					103	
24 Jan 99	P	11 39 54, 107 20 06	H25A			183		98	34
15 Jan 99	F	11 41 01, 107 19 25	H12B					103	32
22 Jan 99	P	11 39 48, 107 19 42	H2A					102	22
23 Jan 99	F	11 39 48, 107 19 48	H5A			210	244	102	34
16 Jan 99	F	11 40 45, 107 19 12	H8B					103	35
24 Jan 99	P	11 39 42, 107 20 06	H14A					98	32
16 Jan 99	P	11 40 45, 107 19 12	H7B					103	38
16 Jan 99	P	11 41 01, 107 19 25	H13B			200	230	102	32
10 Jan 99	F	11 39 00, 107 19 00	H6A					102	33
16 Jan 99	F	11 40 45, 107 19 12	H11B					103	33
09 Jan 99	F	11 38 52, 107 18 35	H3A			197	219	102	37
24 Jan 99	P	11 39 42, 107 20 06	H15A					95	38
08 Jan 99	F	11 37 59, 107 18 20	H4B					108	39
09 Jan 99	F	11 38 52, 107 18 35	H5A			203	231	100	38
23 Jan 99	P	11 39 48, 107 19 48	H2A					100	30
15 Jan 99	G	11 41 01, 107 19 25	H6B					108	30
24 Jan 99	F	11 39 54, 107 20 06	H17A			171		106	36
			Average:	185.8	220.8	190.0	228.9	101.0	33.4
RHINO 5									
08 Jan 99	F	11 37 59, 107 18 20	F2B	198	210	185	214	95	50
07 Jan 99	F	11 37 59, 107 18 22	F3A	200	219	202	231	94	62
10 Dec 98	P	11 37 55, 107 18 18	F.0	195	208			92	53
24 Jan 99	F	11 40 03, 107 18 55	F6B	185	203	200	215	87	40
07 Jan 99	F	11 37 59, 107 18 23	F16B	172	189	166	190	93	49
15 Jan 99	F	11 41 01, 107 19 25	F1B	185	223	190	223	73	46
10 Dec 98	F	11 37 55, 107 18 18	F.0	175	191			87	43
16 Jan 99	F	11 40 45, 107 19 12	F4B	182	209	175	226	93	45
10 Dec 98	F	11 37 55, 107 18 18	F.0	188	215			95	45

08 Jan 99	G	11 37 59, 107 18 20	H5B					102	40
07 Jan 99	G	11 37 59, 107 18 23	H9B					93	52
09 Jan 99	G	11 38 52, 107 18 35	H3B					95	47
08 Jan 99	F	11 37 55, 107 18 20	H1A			201	207	99	46
08 Jan 99	G	11 37 59, 107 18 20	H3B					93	46
07 Jan 99	P	11 37 55, 107 18 18	H7B					94	53
16 Jan 99	F	11 40 45, 107 19 12	H6B					102	42
10 Jan 99	F	11 39 00, 107 19 00	H3A			203	243	100	43
			Average:	187.0	207.4	190.3	218.6	93.4	47.1
RHINO 6									
07 Jan 99	G	11 37 55, 107 18 18	F1A	180	210	181	224	97	43
24 Jan 99	F	11 40 35, 107 18 39	F1B	193	216	180	218	94	46
09 Jan 99	F	11 38 52, 107 18 35	F7A	196	217	197	235	107	50
07 Jan 99	F	11 37 59, 107 18 22	F2A	195	210	201	222	99	50
08 Jan 99	F	11 37 59, 107 18 20	F1B	190	206	185	219	94	44
07 Jan 99	F	11 37 59, 107 18 23	F11B	187	226			102	53
07 Jan 99	G	11 37 55, 107 18 18	F5B	203	226	195	256	94	54
09 Jan 99	P	11 38 52, 107 18 35	F2B	195	208	190	212	103	45
07 Jan 99	G	11 37 59, 107 18 23	F14B	177	199	166	208	88	48
07 Jan 99	F	11 37 59, 107 18 22	F4A	193	187	201	187	98	43
07 Jan 99	G	11 37 59, 107 18 23	F15B	193	214	179	204	95	48
07 Jan 99	F	11 37 55, 107 18 18	H6B					90	47
17 Jan 99	F	11 44 47, 107 19 43	H7B					98	40
24 Jan 99	G	11 40 03, 107 18 55	H4B					97	43
07 Jan 99	G	11 37 55, 107 18 18	H2B					90	48
			Average:	191.1	210.1	187.5	218.5	96.4	44.4
UNIDENTIFIED FOOTPRINTS									
24 Jan 99	P	11 39 42, 107 20 06	F5A			189	230		
16 Jan 99	P	11 40 45, 107 19 12	F1B			193	235		
23 Jan 99	P	11 39 36, 107 19 54	F9A			216	258		
09 Jan 99	P	11 38 52, 107 18 35	F1B			186	228		
24 Jan 99	P	11 39 42, 107 20 06	F7A			211	238		
17 Jan 99	P	11 44 47, 107 19 43	F3B			192	238		

23 Jan 99	P	11 39 48, 107 19 48	F1A			212	228		
22 Jan 99	P	11 39 48, 107 19 42	F10A						
23 Jan 99	P	11 39 48, 107 19 48	F6A			192	231		
08 Jan 99	P	11 37 59, 107 18 20	F6B			188	229		
24 Jan 99	P	11 39 54, 107 20 06	H16A			171			
24 Jan 99	P	11 39 54, 107 20 06	H24A			171			
22 Jan 99	P	11 39 48, 107 19 42	H6A			200	243		
23 Jan 99	P	11 39 48, 107 19 48	H4A			185	216		
24 Jan 99	P	11 39 42, 107 20 06	H2A			182			
17 Jan 99	P	11 44 47, 107 19 43	H5B						
23 Jan 99	P	11 39 48, 107 19 48	H7A						
24 Jan 99	P	11 39 54, 107 20 06	H20A						
22 Jan 99	P	11 39 48, 107 19 42	H4A			202	240		
24 Jan 99	P	11 39 42, 107 20 06	H11A						
23 Jan 99	P	11 39 48, 107 19 48	H3A			199	235		
22 Jan 99	P	11 39 48, 107 19 42	H5A			212	263		
24 Jan 99	P	11 49 54, 107 20 06	H19A			185			
10 Jan 99	P	11 39 00, 107 19 00	H7A						
14 Jan 99	P	11 39 42, 107 20 06	H8A			215	247		
07 Jan 99	P	11 37 59, 107 18 23	H10B						
24 Jan 99	P	11 39 42, 107 20 06	H4A						
24 Jan 99	P	11 39 54, 107 20 06	H22A						
22 Jan 99	P	11 39 48, 107 19 06	H11A						
24 Jan 99	P	11 39 42, 107 20 06	H3A			207	236		
17 Jan 99	P	11 44 47, 107 19 43	H4B						
22 Jan 99	P	11 39 48, 107 19 42	H8A						
08 Jan 99	P	11 37 55, 107 18 20	H7A			184	228		

Notes:

Quality: G (Good), F (Fair), P (Poor)

Symbol: F5A, F1B, etc. (Foot Plaster Cast 5A, 1B, ...)

H16A, H24A, etc. (Front Hoof Plaster Cast 16A, 24A, ...)

Table 4: Comparison of rhino footprint characteristics for identification
(Dimensions' average value of footprint plaster casts and footprints on the spot

Characteristics	Foot Plaster Casts (mm)		Footprints (mm)		Front Hoof Plaster Casts (mm)	
	Width	Length	Width	Length	Width	Length
Rhino 1 Front hoof regularly round, wide, high (number of casts n=21)	191.2	217.9	191.1	228.3	106.0	46.9
Rhino 2 Front hoof regularly round, wider than Rhino 1's (n=19)	202.1	222.9	195.8	234.7	111.9	33.7
Rhino 3 Front hoof slanting a little, wide, high (n=10)	196.6	219.7	194.6	232.0	107.6	47.4
Rhino 4 Front hoof regularly round, low, narrow (n=29)	185.8	220.8	190.0	228.9	101.1	33.4
Rhino 5 Front hoof slanting on the right, high, narrow, hoof rim sharp (n=17)	187.0	207.4	190.0	218.6	93.4	47.1
Rhino 6 Front hoof slanting on the left, high, narrow, hoof rim sharp (n=15)	191.1	210.1	187.5	218.5	96.4	44.4

TABLE 5: LIST OF THE HOUSEHOLDS AGRICULTURALLY CULTIVATING IN THE AREA OF BAU CHIM, PHUOC SON HAMLET, PHUOC CAT 2 VILLAGE (supplemented through three investigations) Note sizes of land in m^2

No.	Householder's Name	Born	Total members	Ethnicity	Native Place	Arrival Year	Size of cultivated land	Total size of cultivated land	Two-crop rice growing land	Auxiliary crop land	Land in Conservation Area	Remarks
1.	Duong Van Phong	1963	5	Nung	Lang sơn	1992	4,300	**14,096**	4,193	1,330	5,523	
2.	Ly Tien Dung	1969	4	Tay	Lang son	1992	3,992	**8,095**	4,422		4,422	Very poor
3.	Pham Chua	1940	9	Kinh	Binh dinh	1987	9,534	**45,939**	6,701		6,701	
4.	Nguyen Van Hoa	1968	6	Kinh	Binh dinh	1987	1,000	**9,775**	2,335		6,740	
5.	Doan Ngoc Nam		5	Kinh	Binh dinh	1987	5,000	**39,288**	5,600		5,600	
6.	Nguyen Ngoc Hoang		?	Kinh	Binh dinh	1987	6,740	**6,740**	6,740		6,740	Absent
7.	Pham van Dang	1962	5	Tay	Bac thai	1991	5,181	**8,300**	5,181		5,181	
8.	Nguyen Van Len	1950	8	King	Binh dinh	1989	4,180	**15,225**	3,975		3,975	Thuy's Father
9.	Nguyen Van Thuy	1979	3	Kinh	Binh dinh	1989	2,080	**2,082**	2,082		2,082	
10.	Nguyen Le Cung	1970	5	Kinh	Binh dinh	1986	1,064	**10,642**	1,882		1,882	Cung, Chuc, Dong are brothers
11.	Nguyen Le Chuc	1973	3	Kinh	Binh dinh	1986	1,060	**10,600**	970		970	
12.	Nguyen Van Dong	1949	7	Kinh	Binh dinh	1986	2,000	**22,930**	1,992		1,992	
13.	Diep Duy Tan	1966	5	Kinh	Binh dinh	1986	4,140	**19,254**	3,944		3,944	
14.	Be Thi Lien	1951	4	Tay	Bac can	1992	6,000	**7,942**		5,962	5,962	
15.	Nguyen Van Son	1960	6	Kinh	Binh dinh	1996	7,000	**17,570**		7,200	7,200	
16.	Ly Tien Van		7	Nung	Lang son	1992	1,200	**13,554**	3,180	1,200	4,380	

LIST OF RHINOCEROS SURVEY TEAM MEMBERS IN THE CAT TIEN NATIONAL PARK, JANUARY 1999

In general charge: Eng. Pham Huu Khanh
Technical adviser: Dr. Nguyen Xuan Dang

Survey Team:

1. Pham Huu Khanh - Group A leader
2. Hoang Dinh Trang
3. Hoang Van Gao
4. K' Giang
5. Vo Thanh Binh
6. Do Van Dat - Group B leader
7. K' Minh
8. Le Duy Binh
9. Vu Ba Ngoc
10. Duong Van Thuong

Guides:

1. K' Mot - Village N°. 3
2. K' Lia - Hamlet K' Lo
3. K' Lot - Village N°. 5
4. K' Zen - Village N°. 5
5. K' Bam - Village N°. 4
6. K' Thanh - Village N°. 5
7. Trieu Van Tu - Hamlet Phuoc Thai

1. Mr. Tran Van Mui, Director of Cat Tien National Park, entrusting the task to the Rhinoceros Survey Team – January 1999

2. Dr. Nguyen Xuan Dang, from The Institute of Ecology and Biological Resources, training the Survey Team in techniques of rhino investigation

3. Mr. Gert Polet, chief technical adviser of the WWF - Cat Tien National Park Conservation Project, discussing with the Rhino Survey Team

4. The Rhinoceros Survey Team – January 1999

5. Rhinos' path found in the area of Bau Chim (Birds' Marsh). Phuoc Son

6. Measuring rhino footprints

7. Salt lick at Bau Chim, Phuoc Son

8. Rhinos' wallow used 1 or 2 days before the Survey Team's arrival

9. Measuring rhinos' wallow

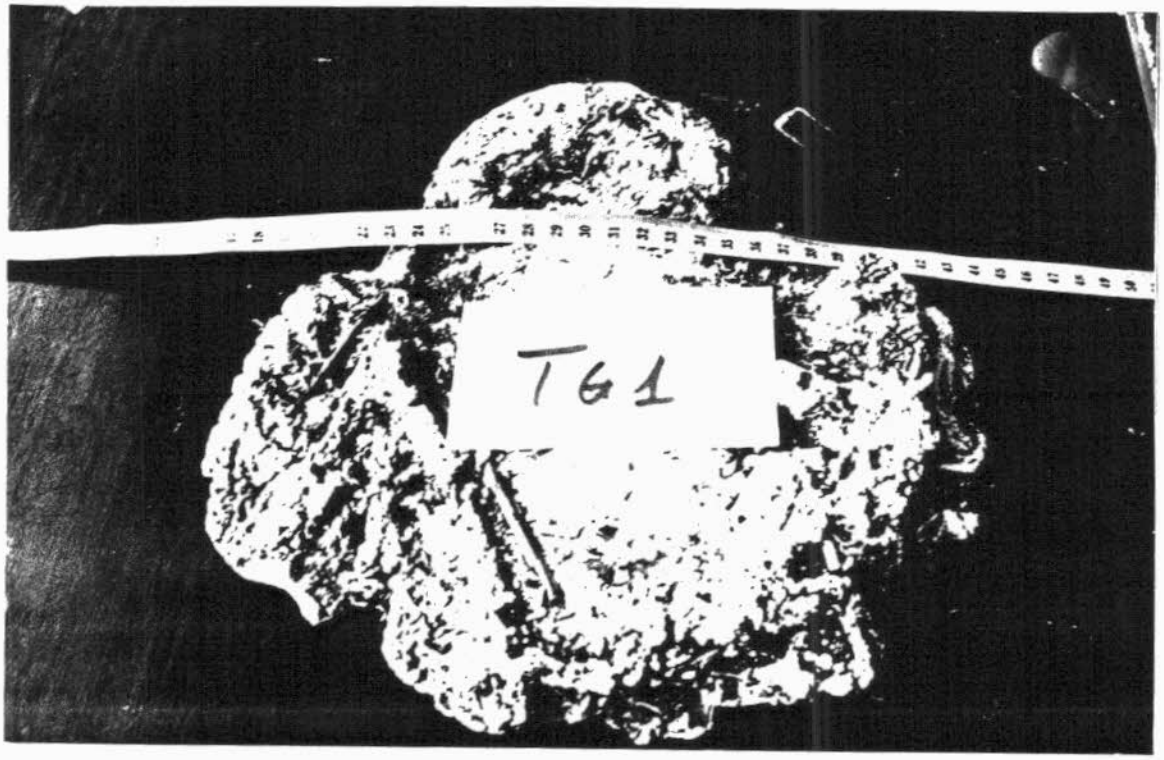
10. Analysing rhinos' excrements

11. Mud traces from rhinos' rubbing body against tree trunk and traces of rhinos' horn or incisors goring into the tree base

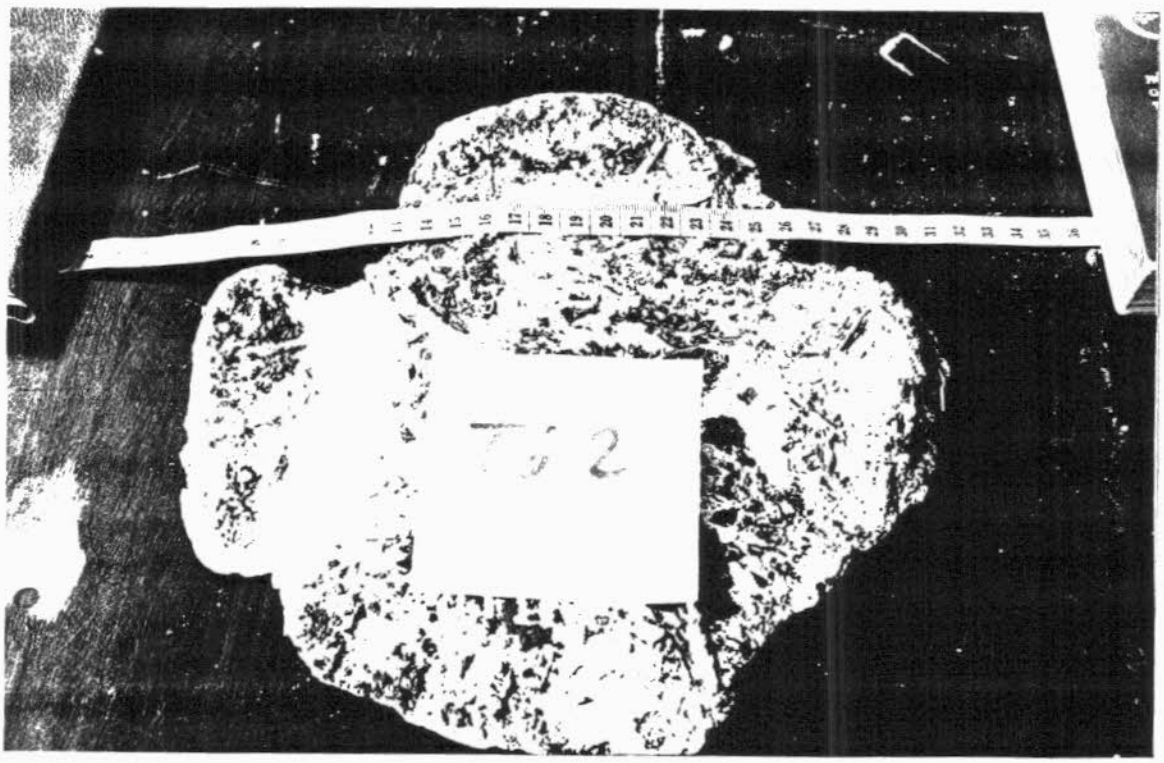
12. Traces of rhinos' teeth on tree trunk

13. Tree pressed down by rhinos to eat its leaves

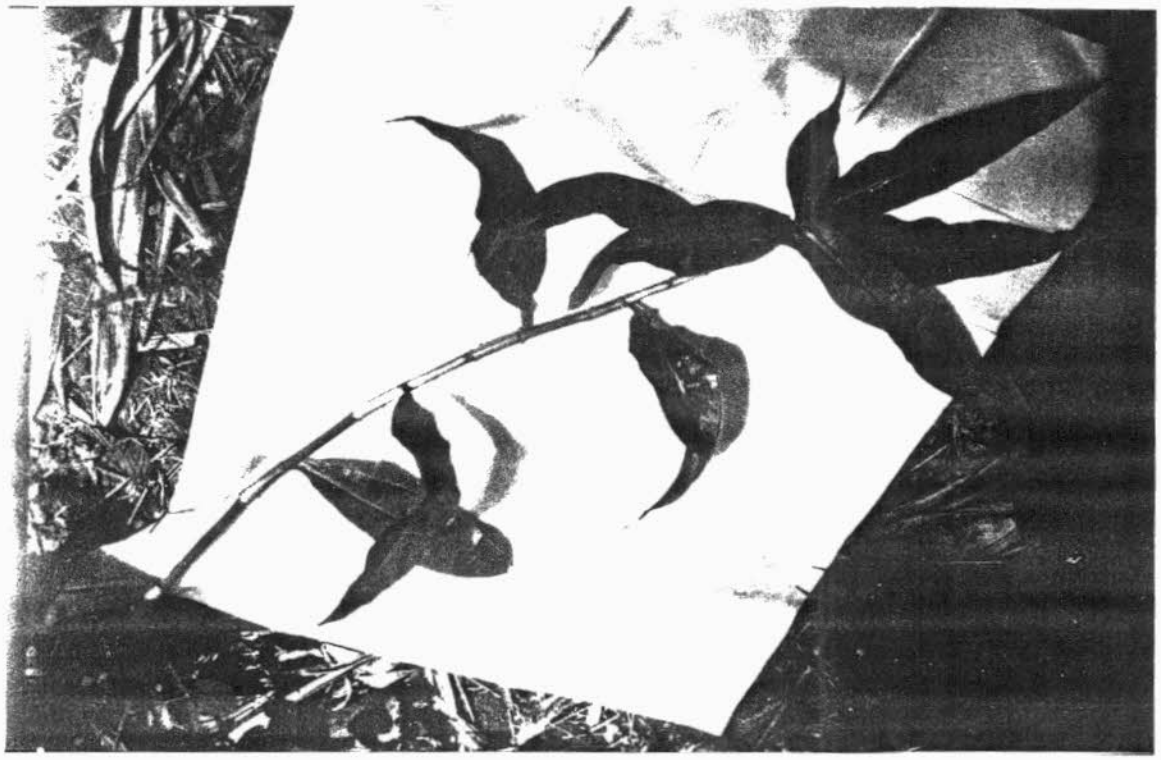
14. Rhinos' food plants



19. Footprint plaster cast of Rhino 1

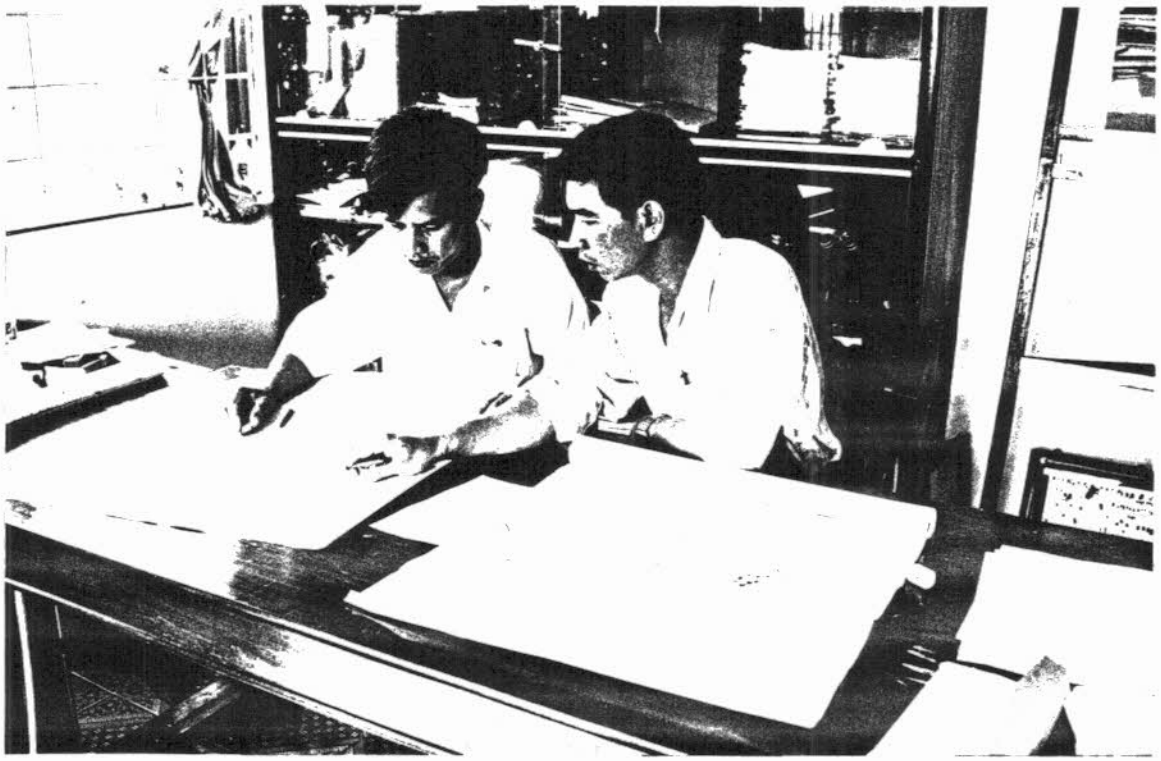


20. Footprint plaster cast of Rhino 2



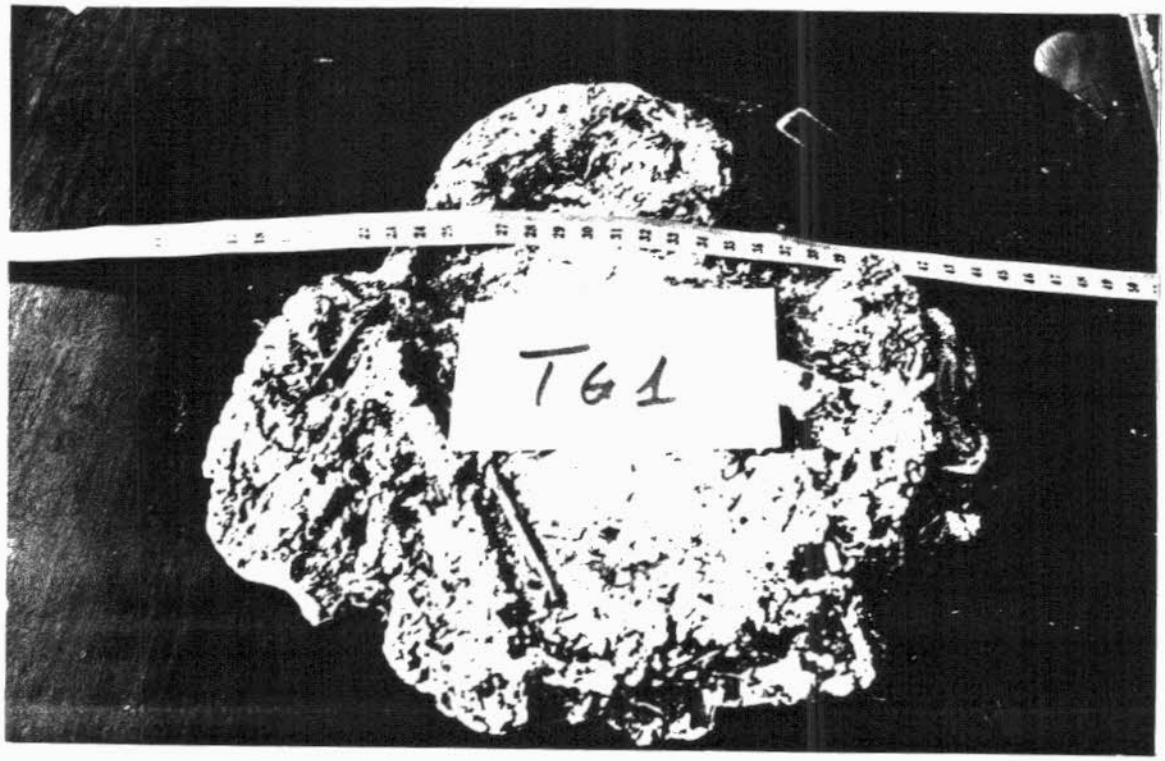
15. Rhinos' food plant

16. Rhinos' food plants

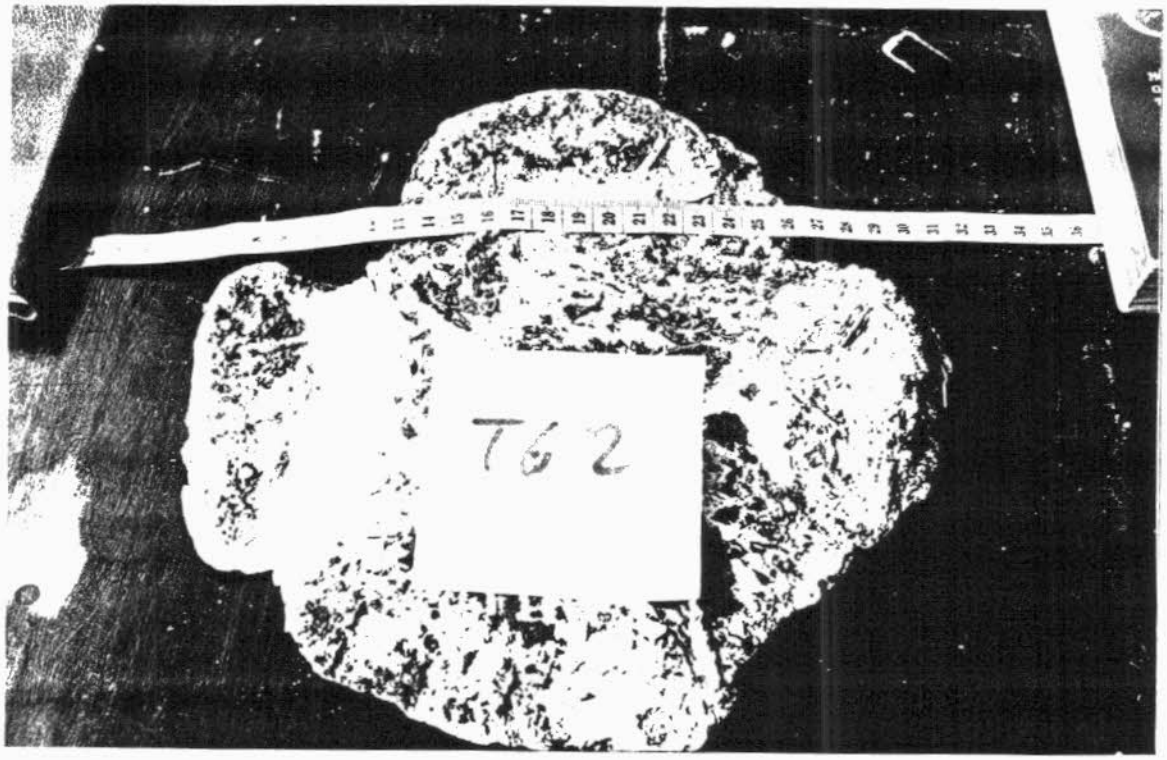


17. Mr. Pham Huu Khanh, Group A leader and Mr. Do Van Dat, Group B leader exchanging investigation data

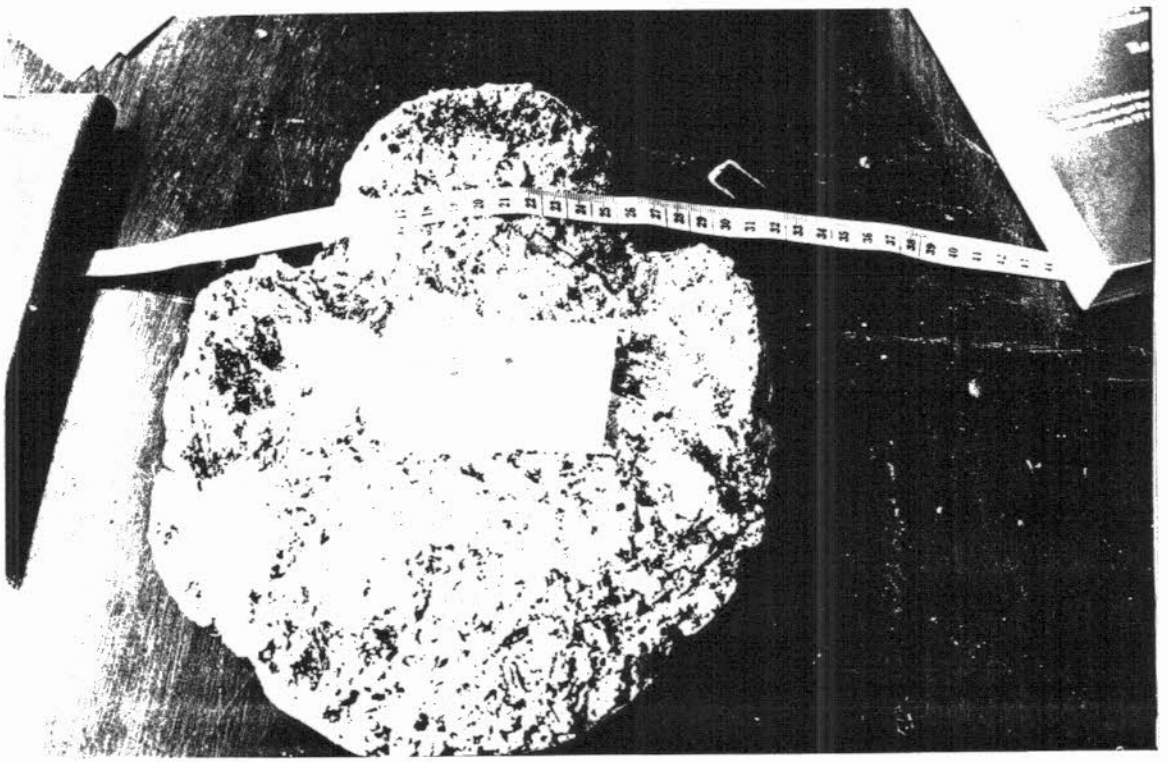
18. Classifying rhino footprint plaster casts



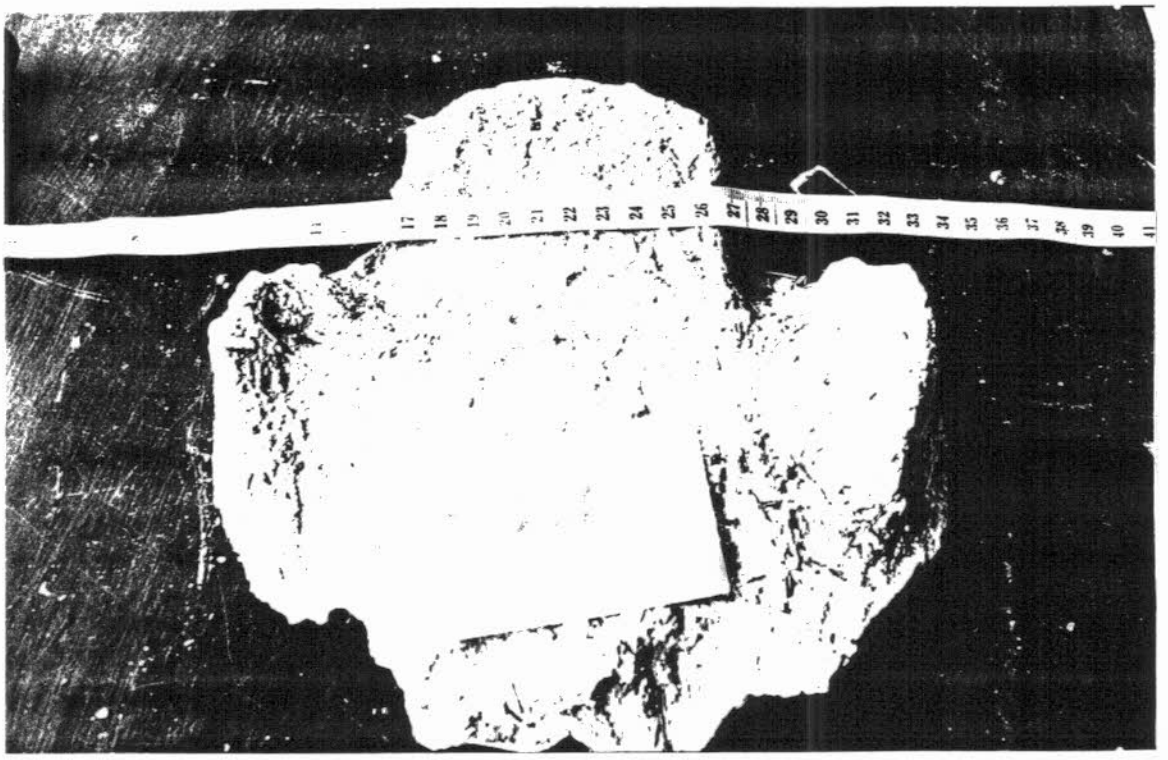
19. Footprint plaster cast of Rhino 1



20. Footprint plaster cast of Rhino 2



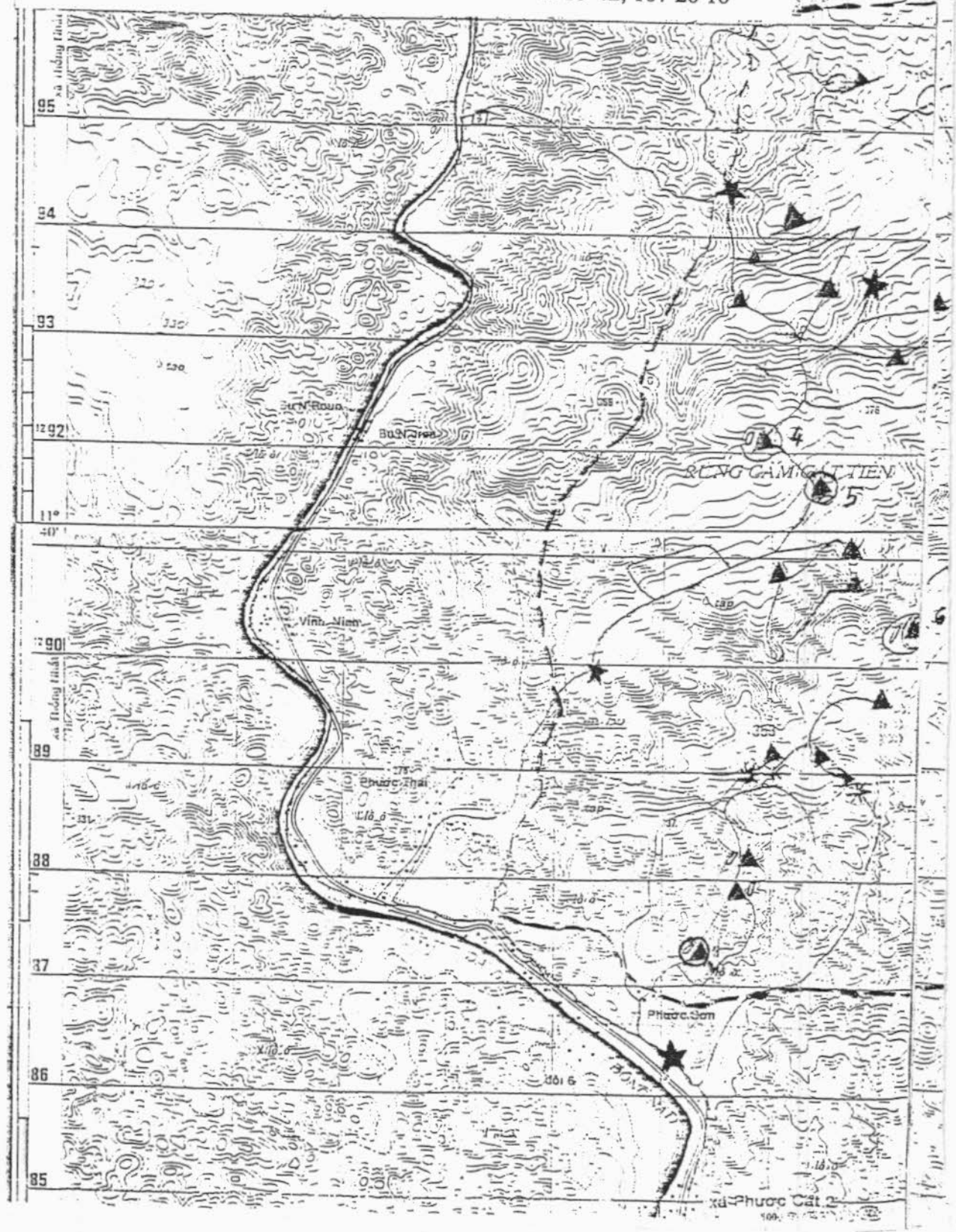
21. Footprint plaster cast of Rhino 3



22. Footprint plaster cast of Rhino 4

THE MARSHES WITH RHINOS' NEW FOOTPRINTS DISPLAYED ON THE MAP

N.1: Bau Chim–Phuoc Son	Co-ordinate:	11 37 55, 107 18 18
N.2: Bau Dinh Har		11 41 47, 107 19 43
N.3: Bau Dinh Giang		11 41 01, 107 19 25
N.4: Bau Dinh Tria		11 40 11, 107 19 00
N.5: Bau Sinh		11 40 03, 107 18 55
N.6: Bau Dac Lo		11 39 48, 107 19 42
N.7: Bau Trau		11 39 42, 107 20 16



E RESULT OF JAN. 1999 SURVEY OF JAVAN RHINOCEROS