

**PARC NATIONAL DE LA GARAMBA
et
DOMAINES DE CHASSE**

**GENERAL AERIAL COUNT 1995
AND EVALUATION OF THE STATUS AND TRENDS OF THE ECOSYSTEM**

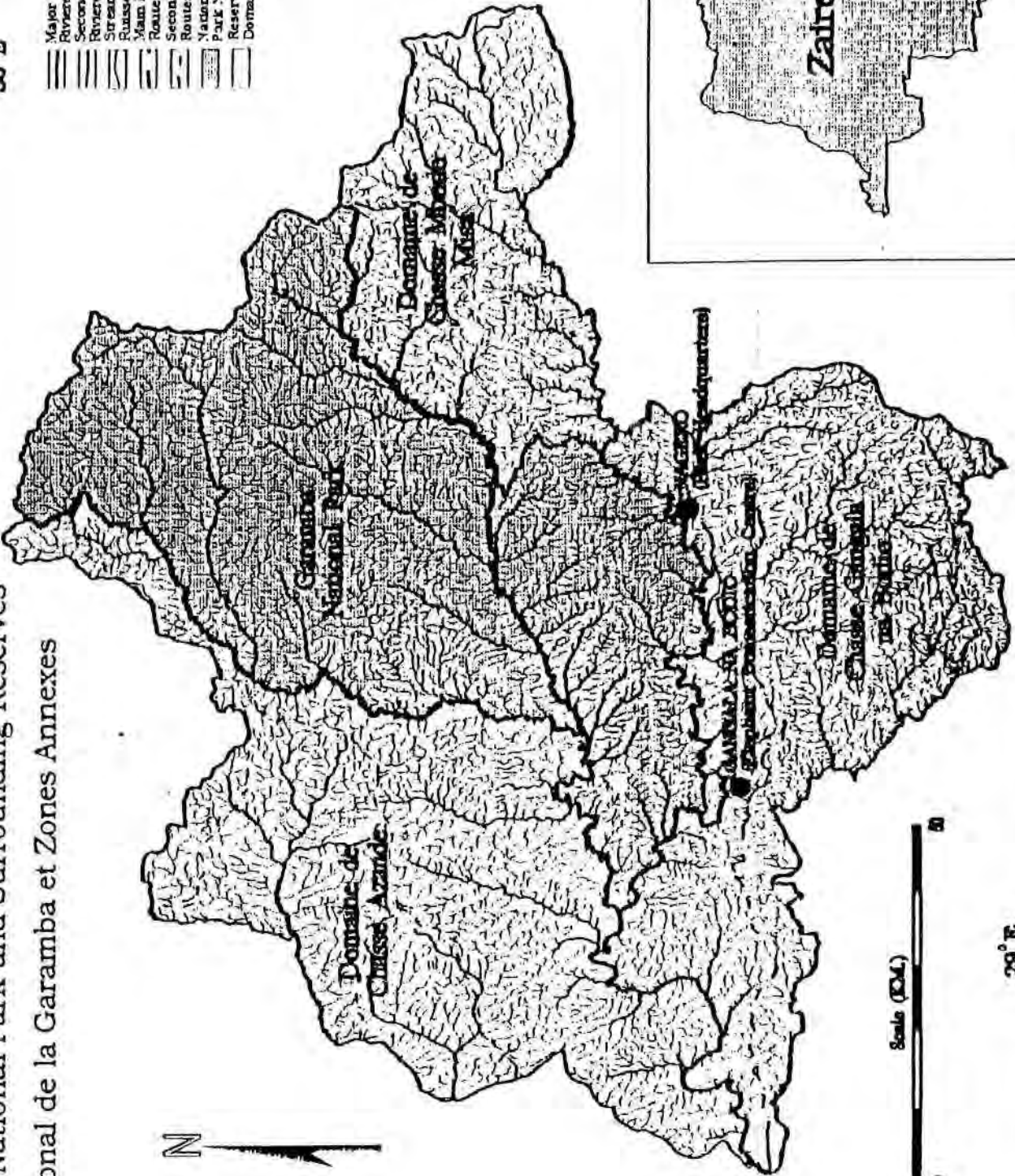
**RECENSEMENT GENERAL 1995
ET EVALUATION DU STATUT ET TENDANCES DE L'ECOSYSTEME**

**Kes Hillman Smith, Mbayma Atalia, Monungu Likango, Fraser Smith, Amube Ndey
& Giningayo Panzama**

Version français par Monungu Likango et Mbayma Atalia

Garamba National Park and Surrounding Reserves
 Park National de la Garamba et Zones Annexes

- Major Rivers
- Rivieres Principales
- Secondary Rivers
- Rivieres Secondaires
- Streams
- Ruisseaux
- Main Roads
- Routes Principales
- Secondary Roads
- Routes Secondaires
- National Park
- Park National
- Reserves
- Domaines de Chasse



30° E

3° N

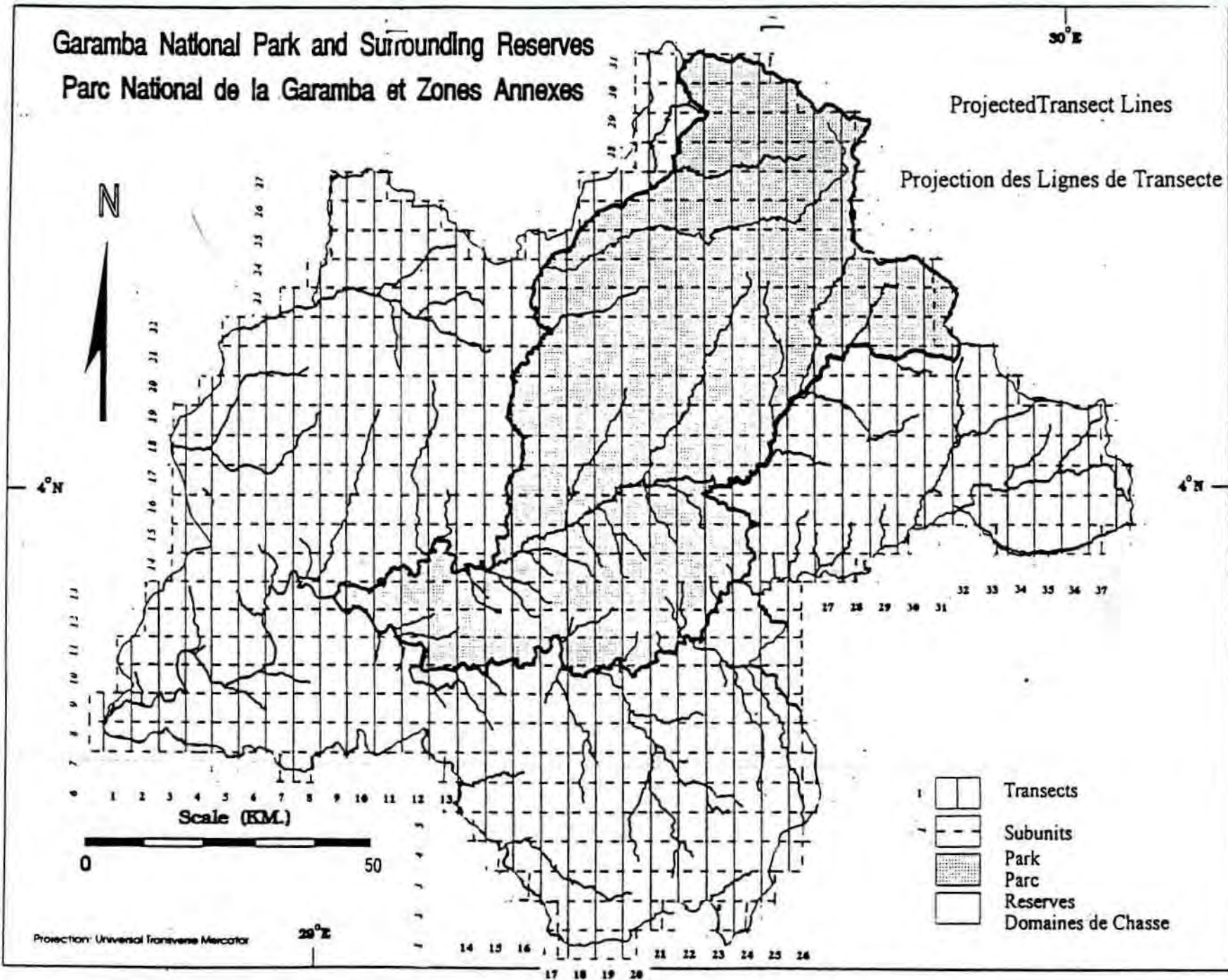


4° N



28° E

Garamba National Park and Surrounding Reserves
 Parc National de la Garamba et Zones Annexes



COUNTING METHOD

The counting method is the standard aerial systematic reconnaissance flight (SRF) using parallel transect sampling as described by Norton Griffiths (1978) and widely used for aerial counting of wildlife and livestock. Heights, strip widths and general application of the method have been relatively standard throughout the series of counts. Analysis is carried out using Jolly's method II (Norton Griffiths 1978) in the spreadsheet programme Quattro Pro, and shaded vegetation mapping uses the GIS programme Idrisi.

Aircraft: Cessna 206, 9Q-CBR

Pilot: Fraser Smith

Front Seat Obs.: Kes Smith

Middle Seat Obs.: Mbayma Atalia
Monungu Likango

Rear Seat Obs.: Amube Ndey
Giningayo Panziama

Analysis design: John Watkin

Analysis: Kes Smith, Mbayma Atalia, Monungu Likango & Amube Ndey,
based on Hillman Smith et al (1995) and Watkin et al (1995)

Census zone: Garamba National Park and Domaines de Chasse Azande, Gangala-na-Bodio and
Mondo-Misa
Total area 15,125 km²

Timing:

For greatest accuracy in population estimation the period April to mid June, just after the start of the long wet season offers best visibility. The grass is short and the air is cleared by the rain. The preparation, calibrations and count were carried out from 25th May to 7th June 1995. This was delayed from the planned date in late April due to other commitments of Dr Mbayma.

Stratification:

The count was flown at the same sampling intensity through out the area in order to obtain standard information and stratification was applied to the analysis to minimise confidence limits. For this purpose the area is divided into Park and Domaines de Chasse and the park was stratified as high, medium and low density areas, on the basis of elephant density as an indicator species. The stratification that has been adopted is based on the elephant distribution observed in 1993, which is known to reflect the elephant distribution over the preceding ten years, is as follows. The count boundaries are based on sub-unit boundaries rather than those of the park and reserves. Hence they are slightly larger than the actual boundaries:

PARK:	5,500 km ²
Low density:	1,400 km ² 14 Transects, 55 sub-units
Medium density:	1,925 km ² 12 transects, 77 sub-units
High density:	2,200 km ² 16 transects, 88 sub-units
DOMAINES DE CHASSE:	9,600 km ² 37 transects, 384 sub-units

Equipment:

King Radar altimeter, Garmin Global Positioning System (GPS) , marker rods, tape recorder per observer, tapes and batteries, stopwatch, data sheets, computer for analysis.

GARAMBA NATIONAL PARK
AND RESERVES

GENERAL AERIAL COUNT 1995

INTRODUCTION

General all species aerial censuses of the Garamba National Park and surrounding Domaines de Chasse are carried out as part of the ecosystem monitoring programme. This is a report of the count carried out from 15th May to 7th June 1995, with discussion on the status of the ecosystem.

The Garamba National Park (4,900 km²) is situated between 4° and 3° North and 29° and 30° East in the north east of Zaïre. It is surrounded on three sides by Reserves, the Domaines de Chasse Azande, 2,892 km² to the west, Gangala na Bodio, 2,652 km² to the south, and Mondo Misa, 1,983 km² to the east. All these areas were counted. On the north east, within Sudan, the park is bordered by the Lantoto Game Reserve. This area was not included, due to the political situation.

The park is situated within the sudano-guinean savanna biome. The southern two thirds of the park comprises long grass savanna dominated by *Loudetia arundinacea* with *Hyparrhenia* species. The Reserves are dominated by a complex of deciduous *Combretum* woodland and gallery forest. Within them is limited human settlement and gold mining.

The first aerial census of the area was carried out in 1976 (Savidge et al 1976) by an FAO project. Since then the ecosystem has been censused in 1983 during a survey of northern white rhinos (*Ceratotherium simum cottoni*) (Hillman et al 1983) and since 1984 as part of the Garamba National Park Project. (Hillman Smith 1990, Smith et al 1993).

The counting technique has remained standard throughout, based on the systematic aerial sample count method described by Norton Griffiths (1978), but the process of analysis has varied. Analysis is now based on a system developed using the commercial software programme Quattro Pro 4 (Borland 1992) for the 1993 count (Watkin et al 1995). The method of counting and analysis as applied at Garamba has been written up as a Handbook (Hillman Smith et al 1995) to guide long term standard application of the technique in the monitoring programme at Garamba. We hope it may also contribute a few guidelines for easy analysis of aerial counts elsewhere.

A UTM (universal Transverse Mercator) compatible system of coordinates, which was based on the transect lines used since the 1983 count has been used to locate all animal observations since 1983. In conjunction with the establishment of a Geographic Information System (GIS) at Garamba in 1993, this has now been expanded to cover the surrounding Reserves and is maintained as the basis for the positioning of the flown transects. A Garmin Global Positioning System (GPS) was used to navigate the transects and sub-units. The GIS programme IDRISI has been used in mapping the vegetation cover.

Parc National de la Garamba

CODES DES ESPECES

<i>CODE</i>	<i>NOM FRANCAIS</i>	<i>ENGLISH NAME</i>
ELE	Elephant	Elephant
RHI	Rhinoceros	Rhino
HIP	Hippopotame	Hippo
COB	Cobe de Buffon	Kob
BUF	Buffle	Buffalo
GIR	Girafe	Giraffe
BUB	Bubale	Hartebeeste
WAT	Waterbuck	Waterbuck
ROA	Antelope rouane	Roan antelope
RED	Redunca	Reedbuck
ORI	Oribi	Oribi
GUI	Guib harnache	Bushbuck
CEG	Cephalophe Grimm	Grey duiker
CEJ	Cephalophe à dos jaune	Yellow-backed duiker
CER	Cephalophe à flancs roux	Red-flanked duiker
ELA	Eland de Derby	Eland
SIT	Sitatunga	Sitatunga
PHA	Phacochere	Warthog
HYL	Hylochere	Giant forest hog
POT	Potamochere	Bushpig
LIO	Lion	Lion
HYE	Hyene	Hyena
LEO	Leopard	Leopard
BAB	Babouin	Baboon
SIC	Singe Colobe	Black and White Colobus
SIP	Singe Patas	Patas monkey
SIB	Singe de Brazza	de Brazza's monkey
SIV	Singe vervet	Vervet monkey
CRO	Crocodile	Crocodile

Carcases ou des os d'éléphant, ou d'autres espèces

Registrez l'espèce comme ES:Squellète d'éléphant, BS:Squellète de buffle

US:Squellète non identifié etc

1	Carcasse fraîche	Fresh carcass
2	Os récent avec aire de pourriture	Recent bones with rot patch
3	Os blanc sans pourriture	White bones without rot patch
4	Os gris.	Grey bones

Signes humains

VAC	Vaches	Cattle
SHO	Chevres/moutons	Shoats
MAH	Maison d'habit'n	Living hut

MAA	Maison abandonnée	Abandoned hut
ASH	Ancien site d'habitation	Old living site
Sous notes classifiez tous les trois au-dessus comme partie du village ou famille, et en route ou en sentier.		
RTE	Route	Road
SEN	Sentier	Footpath
CBO	Campement braconniers occupé	Poachers'camp, occupied
CBR	Campement braconniers, recent	Poachers' camp, recent
CBA	Campement braconniers ancien	Old poachers camp
PEC	Peche	Fishing
MIN	Mine	Mine
MIA	Mine abandonné	Abandoned mine

SPECIES NAMES/NOMS LATIN

<i>NOM FRANCAIS</i>	<i>ENGLISH NAME</i>	<i>SPECIES/ESPECES</i>
Elephant	Elephant	<i>Loxodonta africana</i>
Rhinoceros	Rhino	<i>Ceratotherium simum cottoni</i>
Hippopotame	Hippo	<i>Hippopotamus amphibius</i>
Cobe de Buffon	Kob	<i>Kobus kob thomasi</i>
Buffle	Buffalo	<i>Synceros caffer brachyceros</i>
Girafe	Giraffe	<i>Giraffa camelopardalis congoensis</i>
Bubale	Hartebeeste	<i>Alcelaphus buselaphus lelweli</i>
Waterbuck	Waterbuck	<i>Kobus defassa harnieri</i>
Antelope rouane	Roan antelope	<i>Hippotragus equinus bakeri</i>
Redunca	Reedbuck	<i>Redunca redunca diana</i>
Ouribi	Oribi	<i>Ourebia ourebi</i>
Guib harnache	Bushbuck	<i>Tragelaphus scriptus diana</i>
Cephalophe Grimm	Grey duiker	<i>Cephalophus grimmia roosevelti</i>
Cephalophe à dos jaune	Yellow-backed duiker	<i>Cephalophus silvicultor</i>
Cephalophe à flancs roux	Red-flanked duiker	<i>Cephalophus rufilatus</i>
Eland de Derby	Eland	<i>Taurotragus derbianus</i>
Sitatunga	Sitatunga	<i>Tragelaphus spekii</i>
Phacochere	Warthog	<i>Phacoceus aethiopicus</i>
Hylochere	Giant forest hog	<i>Potamochoerus porcus ubangensis</i>
Potamochere	Bushpig	<i>Hylochoerus meinertzhageni ituriensis</i>
Lion	Lion	<i>Panthera leo</i>
Hyene	Hyena	<i>Crocuta crocuta</i>
Leopard	Leopard	<i>Panthera pardus</i>
Babouin	Baboon	<i>Papio anubis</i>
Singe Colobe	Black & White Colobus	<i>Colobus polykomos uellensis</i>
Singe Patas	Patas monkey	<i>Erythrocebus patas pyrrhonotus</i>
Singe de Brazza	de Brazza's monkey	<i>Cercopithecus neglectus</i>
Singe vervet	Vervet monkey	<i>Cercopithecus aethiops</i>
Crocodile	Crocodile	<i>Crocodylus niloticus</i>

Fibreglass fishing rod blanks mounted on a support fitting designed for the wing strut were used as marker rods.

Duties of Crew

Pilot:

Piloting the aircraft, navigating to the ends of transects and along transects using GPS, calling out transects and sub-units at 5km intervals based on the data sheet Subunits. The GPS was pre-programmed with the beginning and end waypoints of the transects, which are listed in the table GPS Waypoints.

Front Seat Observer:

Recording the time and speed of each transect and maintaining the Transect Summary sheet (in Annex). Within each sub-unit recording height a.g.l. from the radar altimeter and habitat factors as defined below. (FSO Data sheet in Hillman Smith et al 1995)

Middle Seat Observers:

Counting and recording into the tape-recorders all animal species and signs of human occupancy, as listed on the table: Code des Espèces, that are seen within the strips. On return from each flight the observations are transcribed onto RSO data sheets (example in Hillman Smith et al 1995). The middle seat observers also noted the habitat in which the animals were seen. Cameras were available, but were only used on two occasions for large groups of buffaloes and of houses.

Rear Seat Observers:

The rear seat observers made the same observations as the middle seat observers. There were three main values to the second row of animal observers: comparison of the two data sets to verify and improve the data and to enable other methods of analysis to be applied, back-up if a tape-recorder fails and training. To make the first two objectives valid, the strip widths were adjusted to be as near as possible to covering the same strip on the ground as seen by the middle observers. Their strip markers were cords stretched from the wing struts to the tail.

Sample Intensity:

Sample intensity:	7.5 %
Transect spacing:	5 km
Sub-unit spacing:	5 km
Target flying height:	350' a.g.l.
Overall mean actual flying height	347' a.g.l.
Target strip width:	400m total (200 metres each side)

Strip widths were preset according to Norton Griffiths (op.cit.) and calibrated by flying at different heights over markers spaced at 20 metre and 100 metre intervals on the airstrip, simultaneous with radar altimeter readings. Observers counted the numbers of spaces between markers included within the strip widths, to calculate the observed widths. These passes were carried out both during training, before counting began and at the beginning and end of each counting flight. The results, analysed and plotted in Quattro Pro 4.0 are shown in the graph Calibrations, and were used combined with measured altitudes per sub-unit to calculate strip widths for each transect and sub-unit. On the basis of this the average combined strip widths for middle seat observers were:

Overall actual strip width 377m.

Mean strip width per stratum for middle seat observers:

Low:	382m.
Medium:	371m.
High:	376m.
Domaines:	361m.

Transects:

Transects were spaced at 5 km intervals and flown North/South as shown on the map **Projected Transect Lines**. The co-ordinates for the start and end points of each transect flown alternately north and south are given on the **Table GPS Waypoints**. Subunit were at 5 km intervals as measured using the GPS and is used, sub-unit boundaries are located in multiples of 5 km from the end waypoint, using the **tables Subunits**. (Hillman Smith et al 1995)

Species:

Animal species were counted by both middle and rear seat observers, as listed on the **Table: Codes des Espèces**. Signs of human habitation and land use were also counted. Elephant and other species carcasses are classified as:

1. Fresh, with flesh present
2. Recent bones, with rot patch present
3. Bones white, no rot patch
4. Bones grey old

(Douglas-Hamilton & Hillman 1981)

In this high rainfall, high scavenger density environment, fresh recognisable rot patches remain for a considerably shorter time than in east Africa. Carcasses monitored have usually remained at stage 2. less than two months.

Habitat factors :

Within each sub-unit the front seat observer recorded the height a.g.l. as measured by the radar altimeter and estimates percentages of the following habitat parameters in units of 10% intervals:

- Tree cover, as percent of sub-unit
- Tree greenness as percent of trees present
- Bush cover, as above
- Bush greenness, as above
- Grass cover, as above
- Grass greenness, as above
- Long old grass, as percent of grass present
- Burn, as percent in sub-unit
- Water availability,
 - 0 = none
 - 1 = available to humans and livestock
 - 2 = limited availability
 - 3 = unlimited availability
 - 4 = running water
 - 5 = floods

Agriculture, as percent in sub-unit

Vegetation zones are classified within each sub-unit.

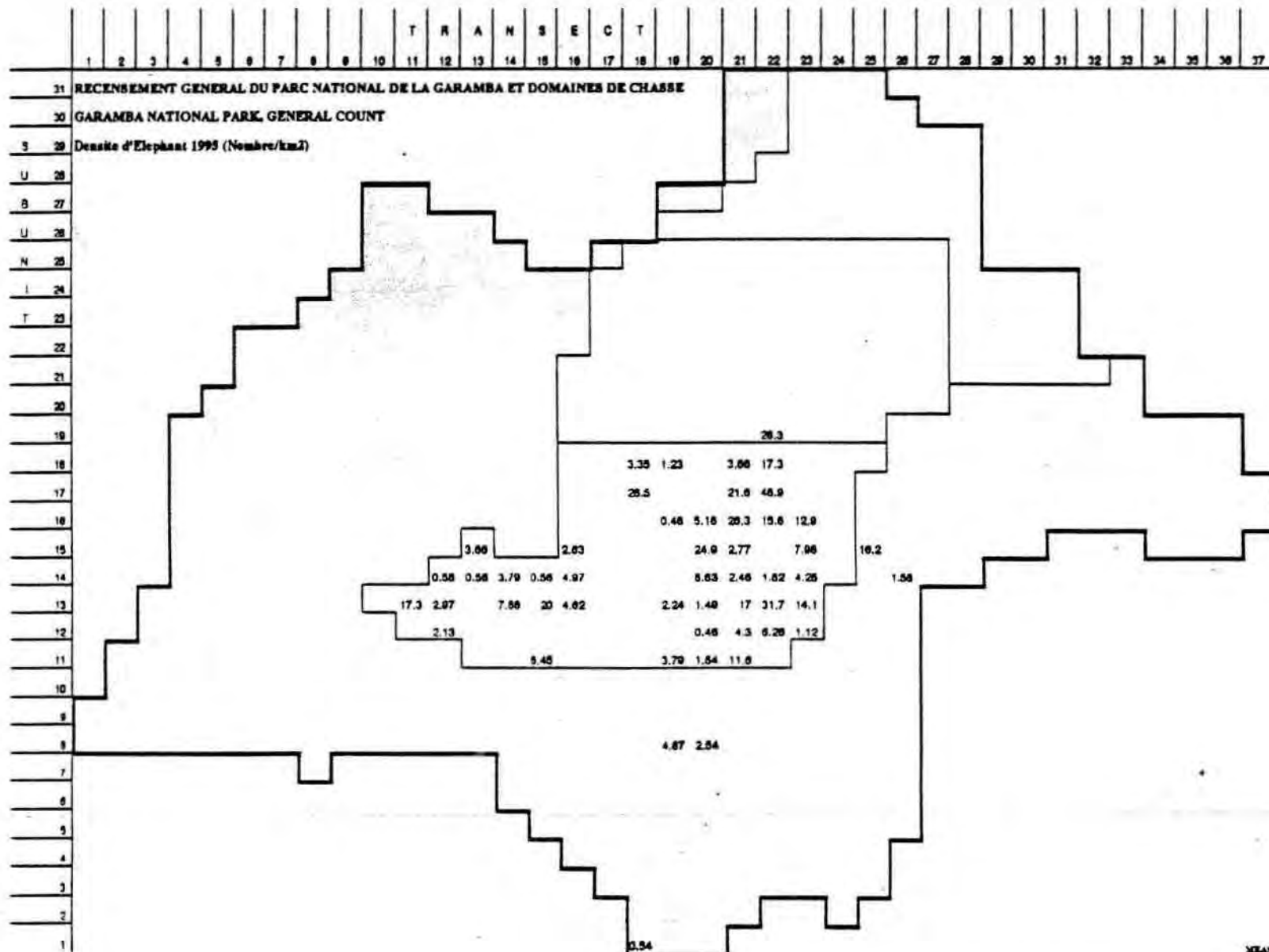
PARC NATIONAL DE LA GARAMBA, RECENSEMENT GENERAL, JUIN 1995
GARAMBA NATIONAL PARK, GENERAL CENSUS JUNE 1995

SOMMAIRE DE TOTAUX, DENSITES ET BIOMASSES DES POPULATIONS
SUMMARY OF POPULATION TOTALS DENSITIES AND BIOMASSES

ESPECES/SPECIES	POPULATIONS	STRAT.TOT	PARC/PARK	HIGH D	MEDIUM D	LOW D	DOMAINES
ELEPHANT	TOTAUX/TOTALS	11,752	11,175	10,501	6,737	0	577
	DENSITES/Km2	0.77	1.90	4.68	0.34	0.00	0.07
	BIOMASSES/Km2	1,917.50	4,750.00	11,697.50	785.00	0.00	149.12
BUFFLES/BUFFALO	TOTAUX/TOTALS	25,713	25,241	18,141	7,100	0	472
	DENSITES/Km2	1.14	2.71	4.25	3.87	0.00	0.05
	BIOMASSES/Km2	587.10	1,395.65	2,188.75	1,993.05	0.00	25.75
BUBALE/ HARTEBEESTE	TOTAUX/TOTALS	2,865	2,819	1,259	1,293	268	65
	DENSITES/Km2	0.25	0.70	0.58	0.68	0.83	0.01
	BIOMASSES/Km2	38.75	108.50	89.90	105.40	128.65	1.55
COBE DE THOMAS/ KOB	TOTAUX/TOTALS	7,128	6,601	5,189	1,239	173	524
	DENSITES/Km2	0.44	1.48	2.17	0.63	0.13	0.08
	BIOMASSES/Km2	39.60	901.48	195.30	58.70	11.70	5.40
COBE DEFASSA/ WATERBUCK	TOTAUX/TOTALS	2,100	1,680	725	821	133	419
	DENSITES/Km2	0.15	0.30	0.34	0.46	0.10	0.05
	BIOMASSES/Km2	30.00	60.00	68.00	92.00	20.00	10.00
PHACOCHERE/ WARTHOG	TOTAUX/TOTALS	8,248	5,808	4,353	1,172	80	642
	DENSITES/Km2	0.42	0.88	1.95	0.68	0.08	0.08
	BIOMASSES/km2	29.40	81.60	138.50	44.10	4.20	5.80
HIPPOPOTAME/ HIPPO	TOTAUX/TOTALS	3,839	3,600	2,725	876	0	39
	DENSITES/Km2	0.22	0.53	1.14	0.44	0.00	0.00
	BIOMASSES/km2	242.00	583.00	1,254.00	484.00	0.00	0.00
REDUNCA/ REEDBUCK	TOTAUX/TOTALS	271	271	151	67	53	0
	DENSITES/km2	0.03	0.09	0.07	0.04	0.15	0.00
	BIOMASSES/Km2	1.80	5.40	4.20	2.40	9.00	0.00
GUIB HARNACHE/ BUSHBUCK	TOTAUX/TOTALS	133	68	27	27	13	66
	DENSITES/km2	0.01	0.01	0.01	0.01	0.01	0.01
	BIOMASSES/km2	0.70	0.70	0.70	0.70	0.70	0.70
CEPHALOPHE GRIMM/ GREY DUIKER	TOTAUX/TOTALS	133	94	27	53	13	39
	DENSITES/km2	0.01	0.04	0.01	0.03	0.01	0.00
	BIOMASSES/km2	0.15	0.60	0.15	0.45	0.15	0.00
CEPH.FLANCS ROUX/ RED FL.DUIKER	TOTAUX/TOTALS	215	107	13	13	79	104
	DENSITES/km2	0.02	0.03	0.01	0.01	0.07	0.01
	BIOMASSES/km2	0.20	0.30	0.10	0.10	0.70	0.10
RHINOCEROS Figures from monitoring Chiffres de monitoring	TOTAUX/TOTALS	28	28	28	0	0	0
	DENSITES/km2	0.002	0.008	0.010	0.000	0.000	0.000
	BIOMASSES/km2	3.000	9.000	15.000	0.000	0.000	0.000
ANTILOPE ROUANE/ ROAN	TOTAUX/TOTALS	80	80	0	80	0	0
	DENSITES/km2	0.01	0.01	0.00	0.04	0.00	0.00
	BIOMASSES/km2	1.50	1.50	0.00	8.00	0.00	0.00
HYLOCHERE/ GIANT FOREST HOG	TOTAUX/TOTALS	40	40	0	0	40	0
	DENSITES/km2	0.003	0.010	0.000	0.000	0.030	0.000
	BIOMASSES/km2	0.000	1.300	0.000	0.000	3.900	0.000
GIRAFE/ GIRAFFE	TOTAUX/TOTALS	230	177	150	28	0	52
	DENSITES/km2	0.02	0.03	0.07	0.01	0.00	0.01
	BIOMASSES/km2	18.00	24.00	58.00	8.00	0.00	8.00
BABOUIN/ BABOON	TOTAUX/TOTALS	342	342	342	0	0	0
	DENSITES/km2	0.02	0.05	0.18	0.00	0.00	0.00
	BIOMASSES/km2	0.50	1.25	4.00	0.00	0.00	0.00
SINGE VERVET/ VERVET MONKEY	TOTAUX/TOTALS	13	0	0	0	0	13
	DENSITES/km2	0.00	0.00	0.00	0.00	0.00	0.00
	BIOMASSES/km2	0.00	0.00	0.00	0.00	0.00	0.00
LION	TOTAUX/TOTALS	13	13	13	0	0	0
	DENSITES/km2	0.00	0.00	0.01	0.00	0.00	0.00
	BIOMASSES/km2	0.00	0.00	1.50	0.00	0.00	0.00
HYENE/HYENA	TOTAUX/TOTALS	13	13	13	0	0	0
	DENSITES/km2	0.00	0.00	0.01	0.00	0.00	0.00
	BIOMASSE/km2	0.00	0.00	0.50	0.00	0.00	0.00
CROCODILE	TOTAUX/TOTALS	13	13	0	13	0	0
	DENSITES/km2	0.00	0.00	0.00	0.01	0.00	0.00
	BIOMASSES/km2	-	-	-	-	-	-

	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	26	27	28	29	30	31	32	33	34	35	36	37
31	RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE 1995																																				
30	GARAMBA NATIONAL PARK. GENERAL COUNT 1995																																				
5	Elephants 1995																																				
U	Observateurs du milieu																																				
B	(Mbeyma & Monungu)																																				
U																																					
K																																					
I																																					
T																																					
22																																					
21																																					
20																																					
19																																					
18																																					
17																																					
16																																					
15																																					
14																																					
13																																					
12																																					
11																																					
10																																					
9																																					
8																																					
7																																					
6																																					
5																																					
4																																					
3																																					
2																																					
1																																					

Low D	0 0																																				
Med D	0 0																																				
High D	0 33 10 7 21 56 23 0 52 14 81 157 344 89 0 0																																				
Dom	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 8 4 0																																				
Total	0 0 0 0 0 0 0 0 0 0 0 33 10 7 21 56 23 0 53 22 85 157 294 89 0 28 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0																																				



31 RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE

30 GARAMBA NATIONAL PARK, GENERAL COUNT

3 Densité d'Elephant 1995 (Nombre/km²)

U 28
B 27
U 26
N 25
I 24
T 23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1

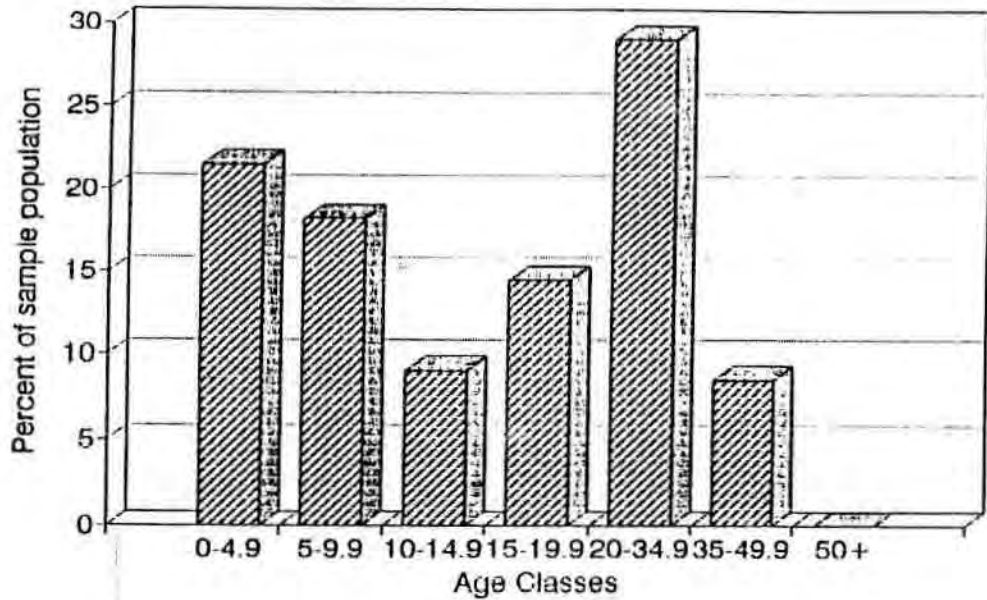
Low D	0																														MEAN DENSITY							
Med D	0																														PER STRATUM							
High D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.341	
Dom	0	0	0	0	0	0	0	0	0	0	0	17.3	5.87	4.21	11.7	28	12.2	0	28.5	7.74	42.5	88.8	122	40.4	0	0	0	0	0	0	0	0	0	0	0	0	4.878	
Total	0	0	0	0	0	0	0	0	0	0	0	17.3	5.87	4.21	11.7	28	12.2	0	30.4	12.8	48	89.6	148	40.4	0	16.2	1.58	0	0	0	0	0	0	0	0	0	0	0.787

MEAN DENSITY

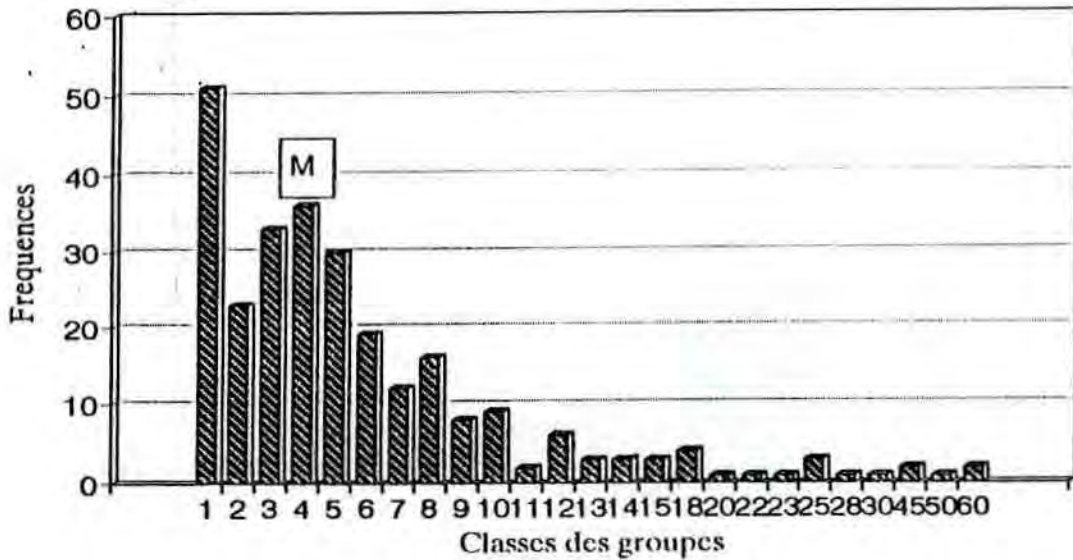
PER STRATUM

Parc National de la Garamba

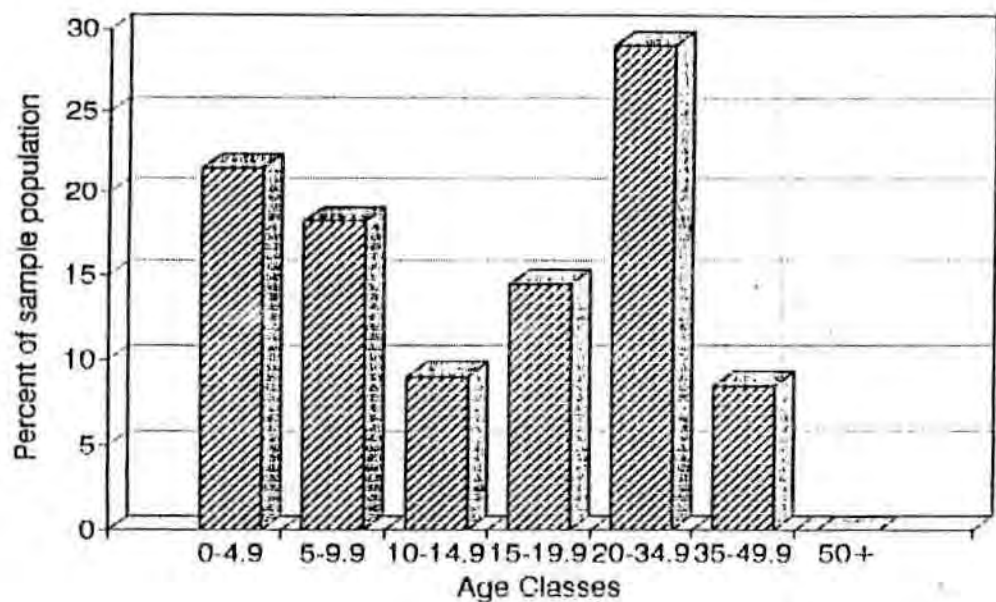
ELEPHANT AGE STRUCTURE 1990 (C. Moss)



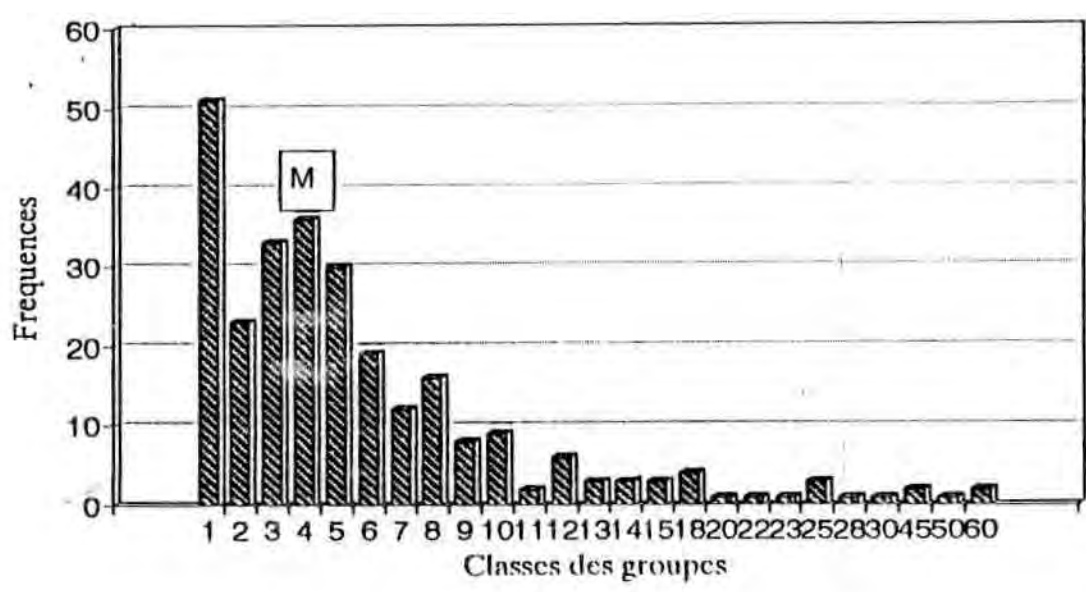
PARC NATIONAL DE LA GARAMBA DISTRIBUTION GROUPES ELEPHANTS 1995



Parc National de la Garamba ELEPHANT AGE STRUCTURE 1990 (C.Moss)



PARC NATIONAL DE LA GARAMBA DISTRIBUTION GROUPES ELEPHANTS 1995



DISCUSSION OF RESULTS AND EVALUATION OF TRENDS AND THE STATUS OF THE ECOSYSTEM

Methods

The draft counting manual which has been written up based on the standard methods developed during the 1993 census was applied throughout as a training manual. This ironed out any inadequacies in it before a final copy. It proved a very useful guideline for all observers to understand the methods and for everyone to participate in analysis.

The two middle seat observers have been the same for the 1991, 1993 and 1995 counts. The FSO has been standard since 1983. This therefore minimises errors due to observer bias.

Animal numbers

Elephant numbers have continued to rise, despite a small increase in elephant poaching having been noted from patrol reporting and ivory recovery. Buffalo numbers have fallen and there has been heavy and increasing poaching of buffaloes for meat in the north of the park, which is associated with the Sudanese civil war across the border. There has been no significant change in numbers of other species except warthog, which have risen.

Dead to live ratios from carcase counts are very low, but they are not strictly comparable with those from 1983 for example, since the grass was already half a metre tall when it was possible to do the count. In addition carcasses disappear extremely quickly. Rainfall is over 1300 mm per year, aiding rapid breakdown and hyena and vulture densities are high. Even elephant carcasses can sometimes be so scattered as to be unrecognisable from the air a week after death. The 12% cover of termitaria clearings and the tendency of animals to use them and therefore die in them, together with the rapid rate of grass growth also makes it difficult to distinguish all rot patches for as long as in East Africa.

Tables and graphs of population estimates over time, from aerial census, for the main mammal species within the park, are given to examine trends. These are discussed below by species.

Current figures for large mammal numbers and biomasses are expressed as pie charts. The biomass contribution of elephants to the ecosystem is very striking. The relative sizes of the populations of elephants and buffaloes are now the same as those found in 1976 (Savidge et al 1976).

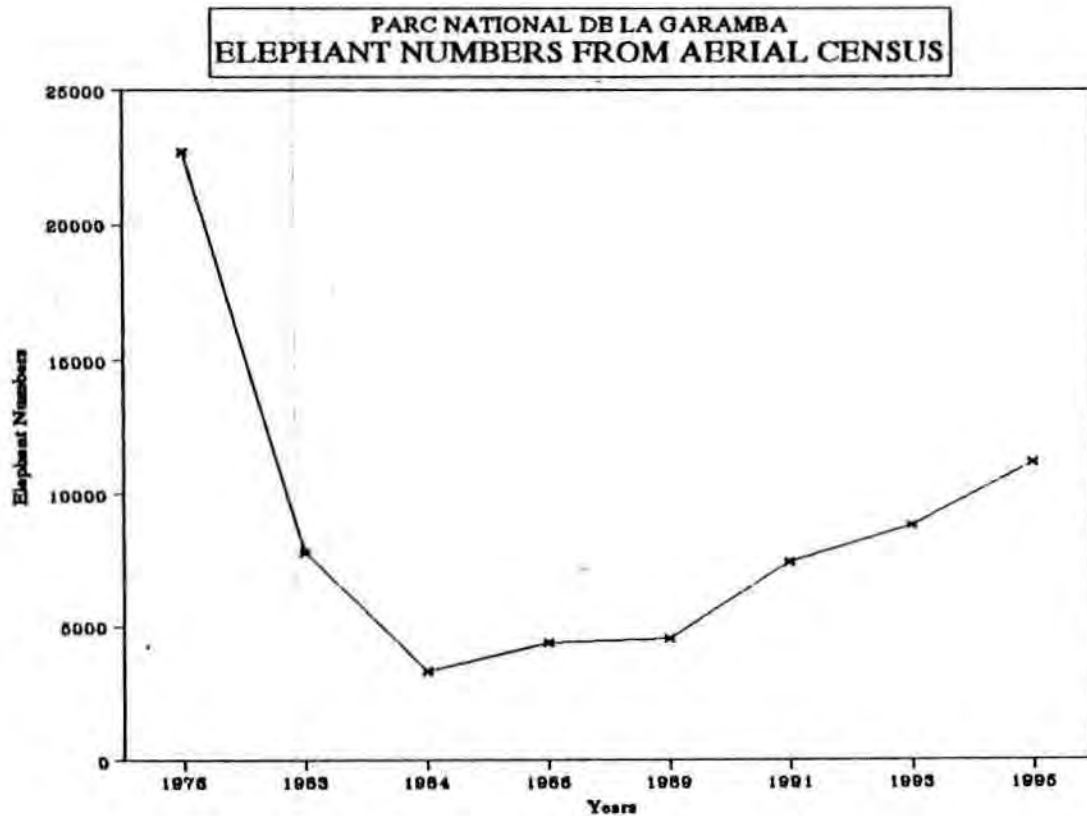
Elephants:

The table and graph of elephant numbers since 1976 show the precipitous decline between 1976 and 1984. Numbers then gradually began to rise again, until they have apparently more than doubled. Despite the broad confidence limits inherent in sample counting, the difference is significant at the 5% level (Anal. of variance, Cochran in Norton Griffiths 1978). The graph of elephant and buffalo populations, plotted with equally spaced years and lines of best fit calculated from the regression, show that the actual slopes of decline and increase were similar. ($r=0.18$) Both were of the order of 10% per annum. However, the minimum number in 1984 may have been lower than the actual number of elephants, since it was a count done in December, when over 50% of the park is still covered by long old grass. It has been shown, both from the results of that count and from aerial total counts over fire experiment blocks that elephants favour long old grass for cover, and the results were probably an undercount. If the minimum number was higher the rate of increase would be slower, while the current population estimate within its confidence limits could be high. The measured rate of increase is therefore between 7 and 10%.

The overall increase in the elephant population since the project started is largely due to the elimination of most of the commercial poaching of internal and external origin. Further evidence for this reduction in poaching

**PARC NATIONAL DE LA GARAMBA
ELEPHANT NUMBERS FROM AERIAL SAMPLE CENSUSES**

DATE	EST.PAR	+ - S.E.	EST.DOM	METHOD	SOURCE
1976	22,670	11,790		Aer.syst.sample	Savidge et al 76
1983	7,742	3,690	2,066	Aer.syst.sample	Hillman et al 83
1984	3,300	509		Aer.syst.sample	Hillman Smith 89
1986	4,339	1,648	0	Aer.syst.sample	Hillman Smith 89
1989	4,500			Aer.block count	Hillman Smith 89
1991	7,389	2,922	231	Aer.syst.sample	Own data
1993	8,768	1,584	178	Aer.syst.sample	Smith et al 93
1995	11,175	3,660	577	Aer.syst.sample	This report



comes from the changing carcass ratios since 1983, from 1 dead:8 live elephants in 1983, through 1:23 in 1984, 1:86 in 1986 and 1:576 in 1991. No elephant carcasses were seen in 1993 and only 2 in 1995, at a ratio of 1:431. One of the elephant carcasses seen in 1995 was in the Domaines, which would give a stratified ratio of 1:44. However, the timing of this count was not ideal for maximising the chance of seeing carcasses. The grass was already over 50cm high throughout.

The population increase has continued exponentially despite some increase in elephant poaching associated with the current increase in meat poaching and the arms availability from Sudan. This is indicated by the results of patrol reports and recovered ivory, which show a rise from a low of 21 tusks in 1990 to a high of 76 in 1993 and a fall again to 59 in 1994. The latter followed a major onslaught on poaching with the cooperation of the army.

271 elephant groups were seen in the transects or partly out. Note was also made apart from the transect figures of parts of groups seen outside. Combining these with the number seen within the transect enabled an assessment of groups size. As shown in the accompanying graph, mean group size was 6.38 (range 1-60), with median and modal sizes of 4. During a ground based survey of the age structure of the elephant population in 1989, the mean group size was 5.25 with a modal size of 4 (n=119 groups) (Moss 1990). Moss found that 89 (86%) of the groups categorized were cow calf groups and 14 (14%) were bull groups, of which 10 (10%) were single bulls. Each year during April and May large aggregations of several hundred elephants are noted. This is during the early wet season, a time of plentiful food availability and this year, through radio telemetry, it has also been found that these groups are the ones that are moving out into the Domaines at night. The age structure showed a growing population, with a high proportion of young animals, but with two dips. The first of these in the 10 to 14 class corresponded with the heavy poaching between 1978 and 1993. The second in the over 35 year old groups corresponded to the heavy poaching associated with the Simba rebellion in the 1960s.

The distribution map shows how the elephants are concentrated into the south of the park. The comparative distribution maps from 1976, 1983 and 1993, show how in 1976 when there were double the current number of elephants, they were distributed throughout the park. In 1983 the overall density was very much reduced and the core of the population had moved south. In 1993 it was still to the south and centre of the park, but the density was increasing. In 1995 the elephant population shows an even greater concentration south. This may be related to a movement south of some of the poaching.

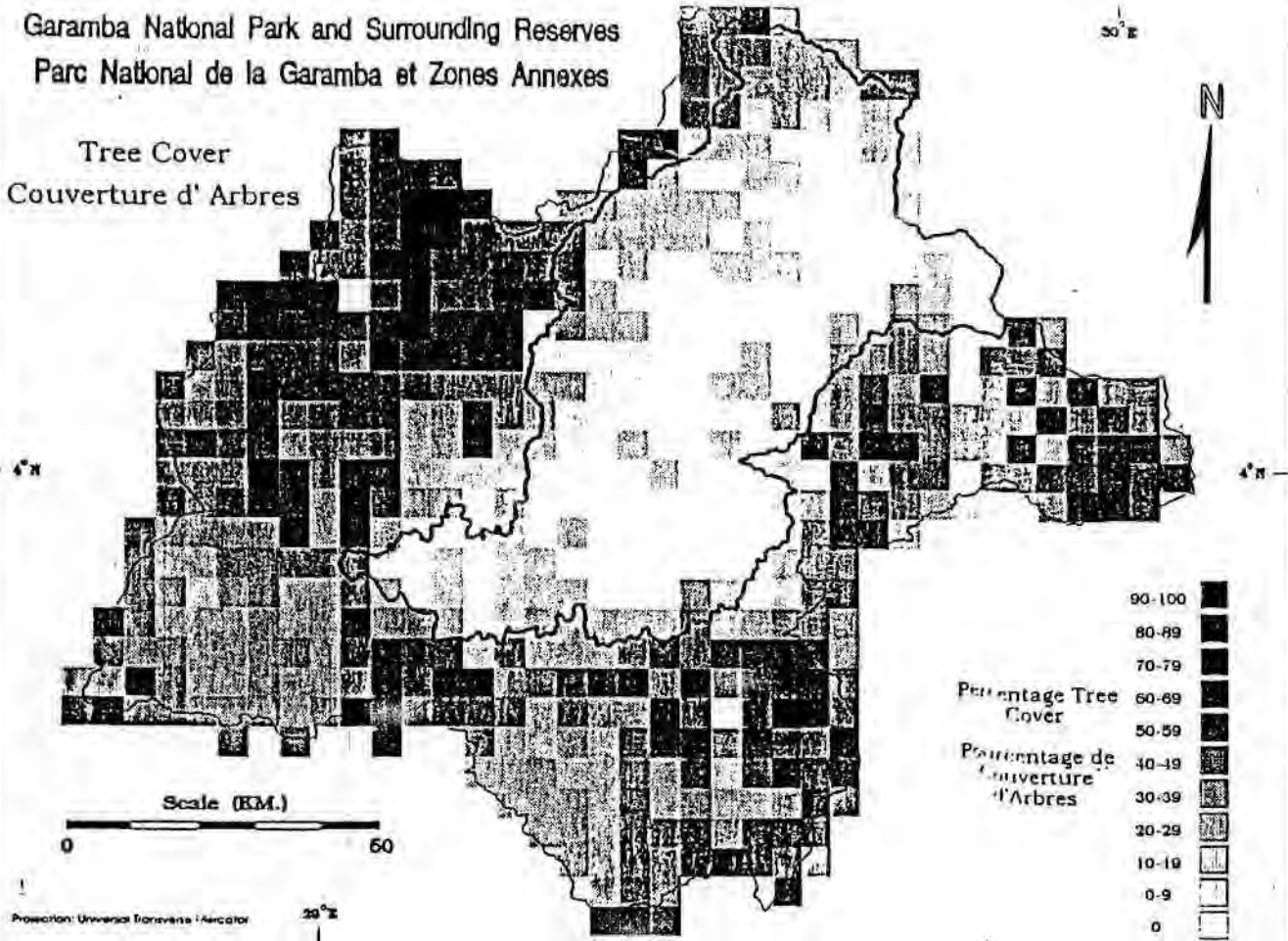
An examination of the tree and bush cover from 1995, and 1993 reflects both the overall reduction in mature trees within the park compared with the surrounding Domaines and the increasing bush regeneration in the north of the park, as the elephants have to a large extent been absent from this area for over twelve years. This is borne out by reports of guards, who say there used to be many elephants in the north of the park, and that much of the poaching between 1978 and 1984 was done by guards themselves. Much of the poaching therefore came from the south and the elephants responded accordingly. Even during the count in 1993 we found fresh elephant carcasses appearing in the south in areas that we were covering twice at different sample intensities. Now they say that the bush is much thicker towards the north than it was 15 years ago.

The reduction of woody vegetation is compounded by the effects of fire. The action of the elephants and the hot fires is to damage smaller trees. The elephants further prevent regeneration from old rootstocks by selection for these plants. This leads to dominance by rapidly growing coarse perennial grasses (*Loudetia arundinacea* and *Hyparrhenia spp.*) that grow over 2 metres tall. In addition to competing with the woody regrowth amongst them, they provide a huge combustible biomass for the hot fires that sweep through, further destroying that year's regrowth of woody plants that might remain.

The concentration of elephants in the south of the park and the contrast in distribution of woody plant biomass, together with a better control of poaching even in the reserves south of the park has led to an increasing nightly movement of elephants out of the park. These nightly movements do not show up on aerial counts, which are inevitably limited to daytime, except as groups of elephants moving back into the park in early mornings or

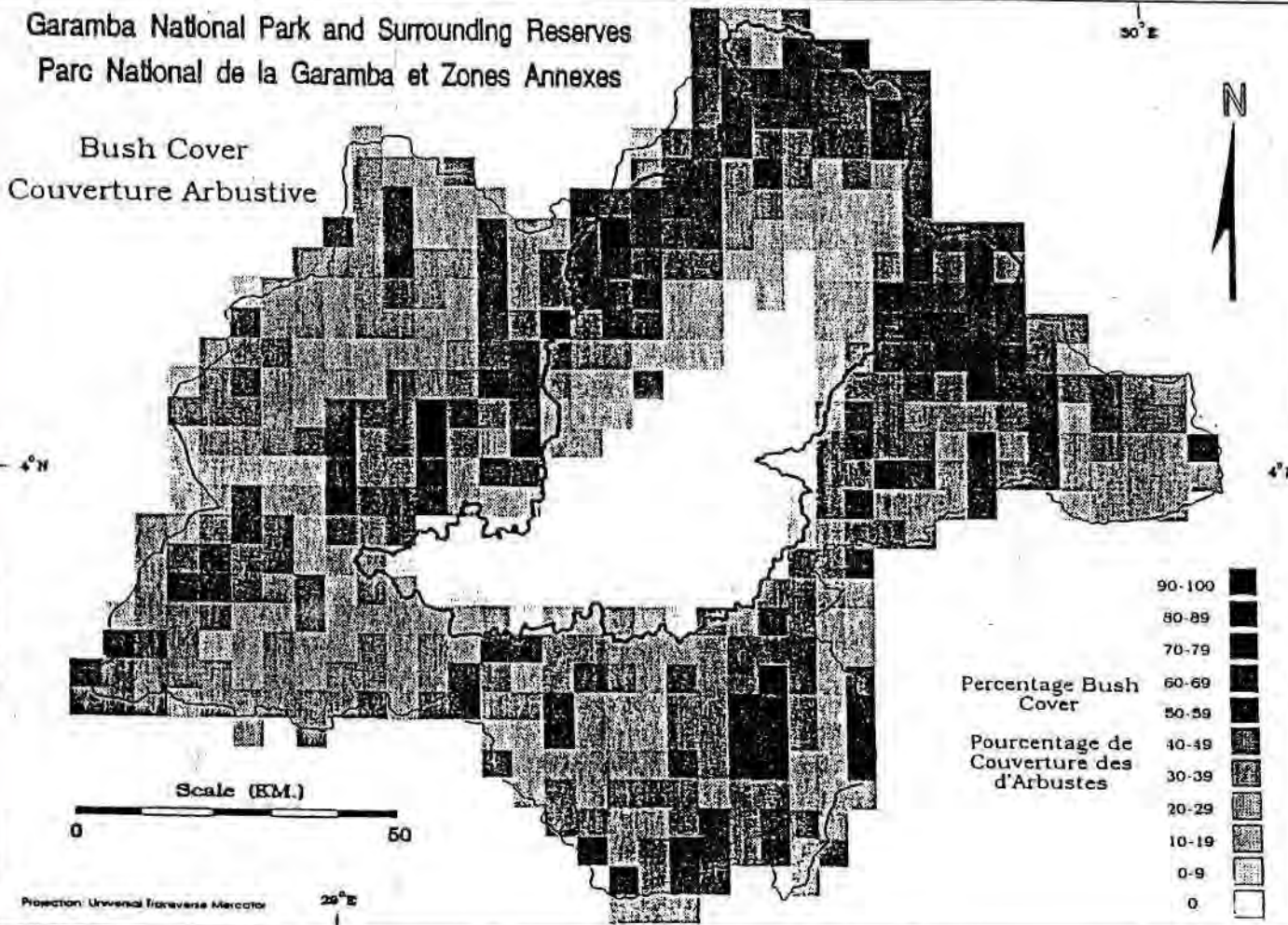
Garamba National Park and Surrounding Reserves
Parc National de la Garamba et Zones Annexes

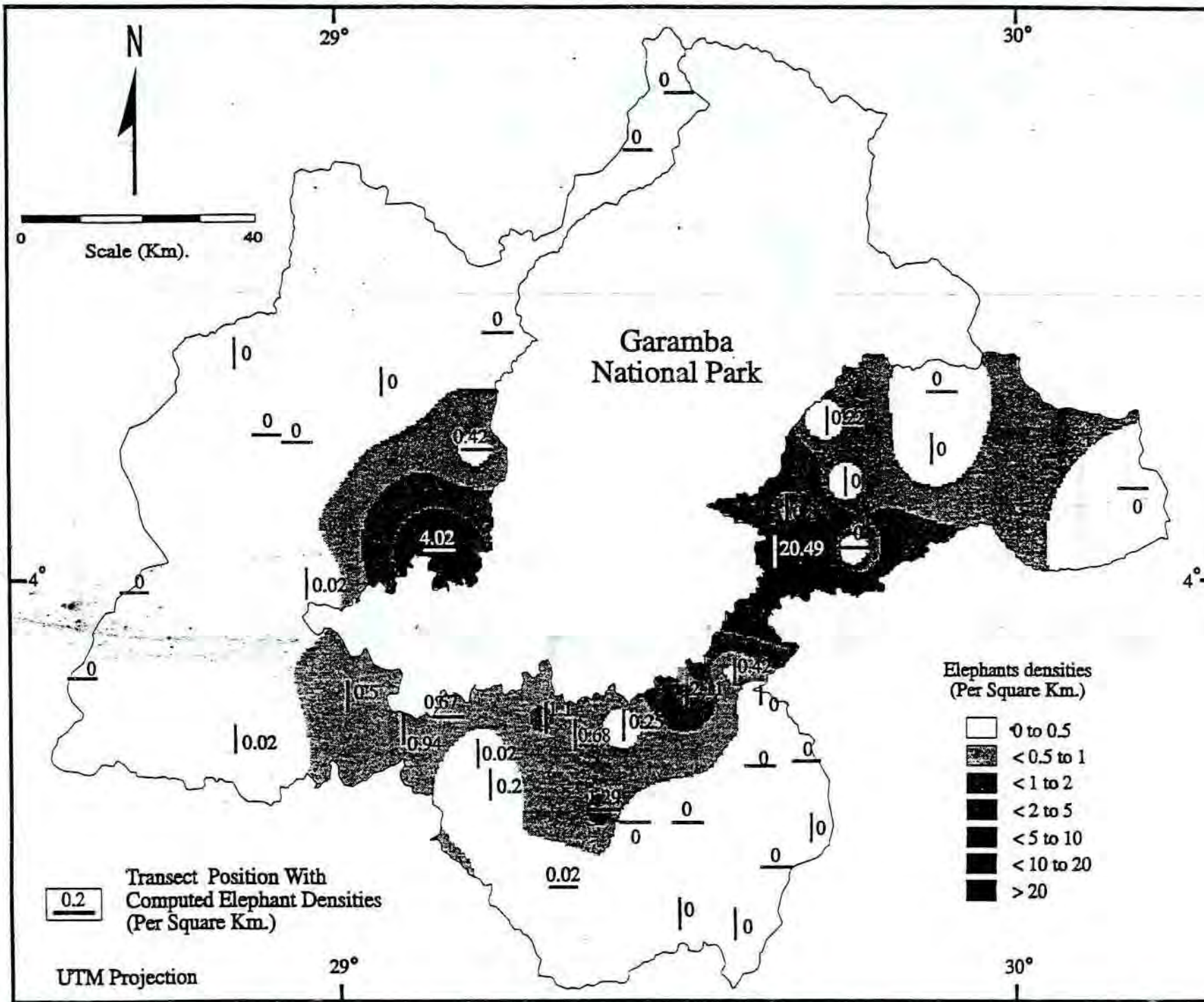
Tree Cover
Couverture d' Arbres

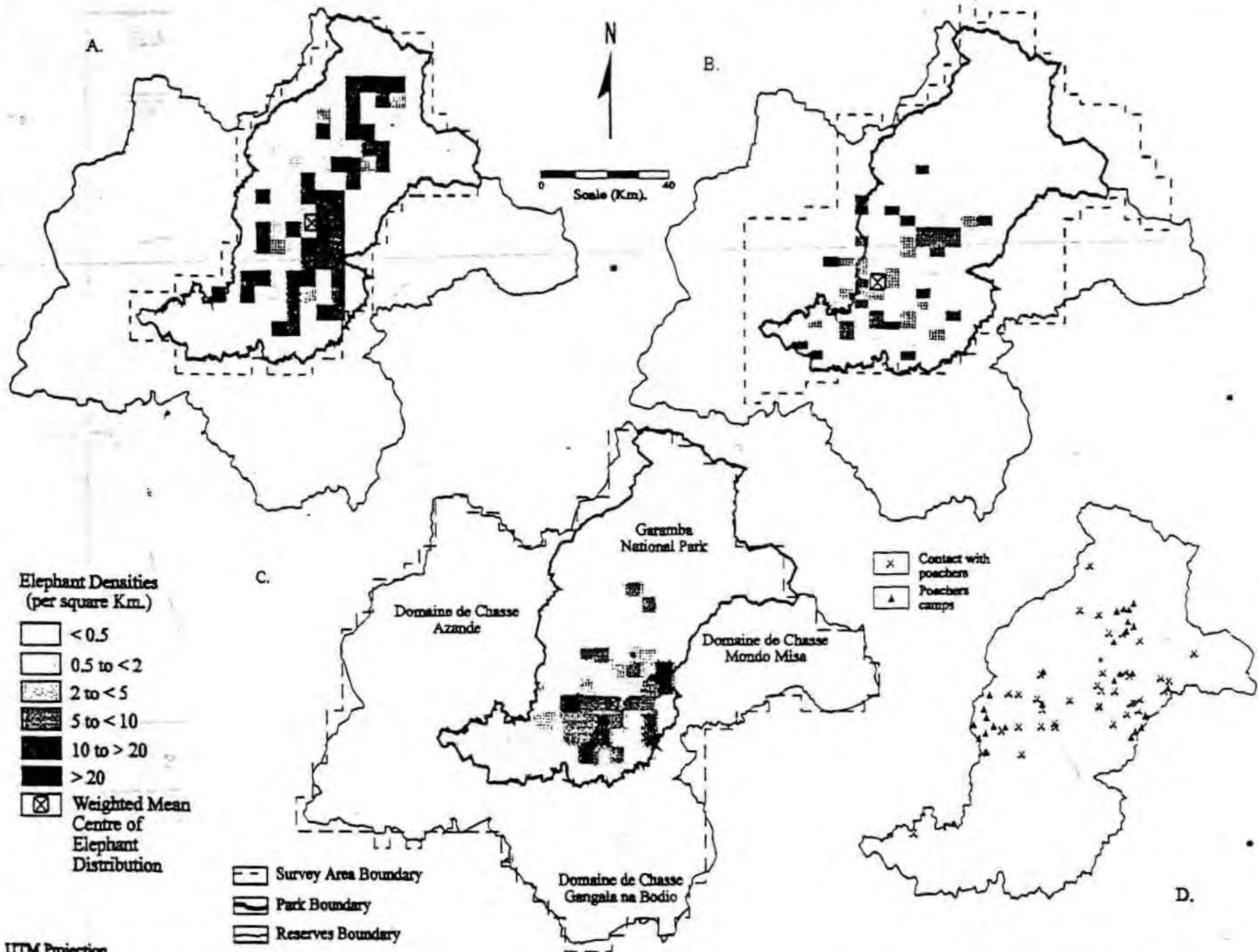


Garamba National Park and Surrounding Reserves
Parc National de la Garamba et Zones Annexes

Bush Cover
Couverture Arbustive



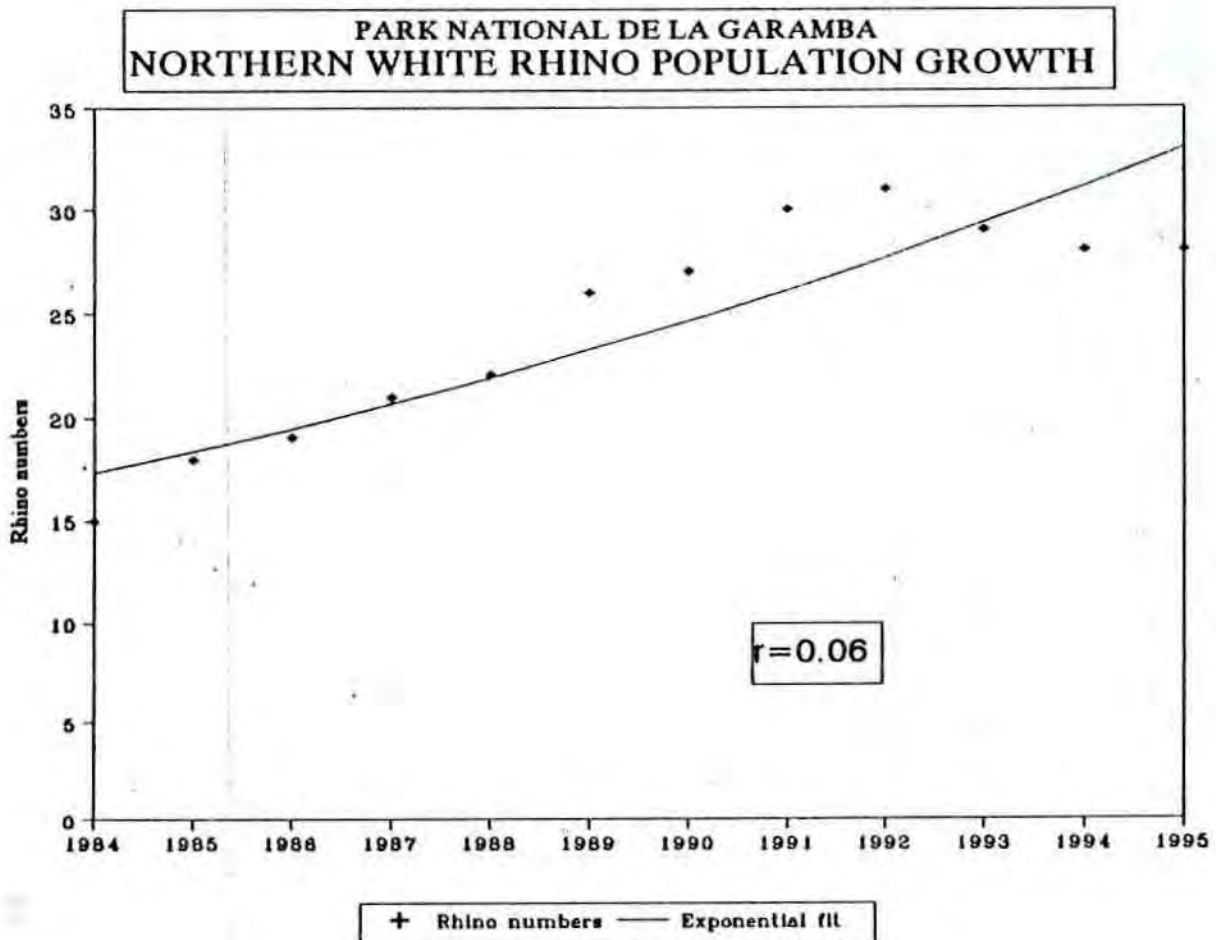




Parc National de la Garamba

NORTHERN WHITE RHINO POPULATION 1984-1993

YEAR	TOTAL	MA	FA	MSA	FSA	MJ	FJ
1984	15	5	5	2	0	2	1
1985	18	5	5	3	0	2	3
1986	19	5	5	4	1	1	3
1987	21	5	5	5	2	0	4
1988	22	7	5	3	4	1	2
1989	26	7	5	3	4	4	3
1990	27	7	6	3	5	5	1
1991	30	7	6	5	5	4	3
1992	31	7	6	7	6	2	3
1993	29	7	5	5	7	2	3
1994	28	7	5	5	8	1	2
1995	28	8	4	5	8	1	2



waiting to move out in the evenings. Elephant use of the surrounding reserves has therefore been investigated by Nicholas and Amube (1995) using ground line transect methods and counting dung and tree damage. They found indications of local densities of elephants of up to 21 elephants per km² within a stratum 5 km from the southern boundary of the park. These results are mapped using GIS interpolation (Hillman Smith et al 1995). This shows intensive elephant use of areas close to the park boundary, opposite the elephant core area, which is demonstrated by the aerial counts. Elephant use of the reserves appears to be largely limited to the distance they can travel in a night and return to the safety of the park during the day, but groups of elephants have been seen in the reserves during at least the last two aerial counts. This is mainly to the south and south east of the park.

Elephant distribution and use of natural woody vegetation in the Domaines de Chasse was found to be positively correlated with proximity to their daytime core distribution, and negatively with distance from human settlement in the dry season. (Hillman Smith et al 1995). This shows that they are not moving out solely to raid crops, though this would appear to be the human perception of the situation. There is crop damage reported and this is particularly a problem in the area of Nagero station, the park head-quarters, which is closer to the park boundary than any other centres of human settlement. Here elephants have been found to be the most important culprits, though hippos are also a major problem up to 2 km from the river that forms the boundary of the park (Buls 1993). The GIS modelling done by de Merode in Hillman Smith et al 1995, overlaying human and elephant distribution, shows that the extent of this same level of human elephant conflict is very limited elsewhere in the Domaines.

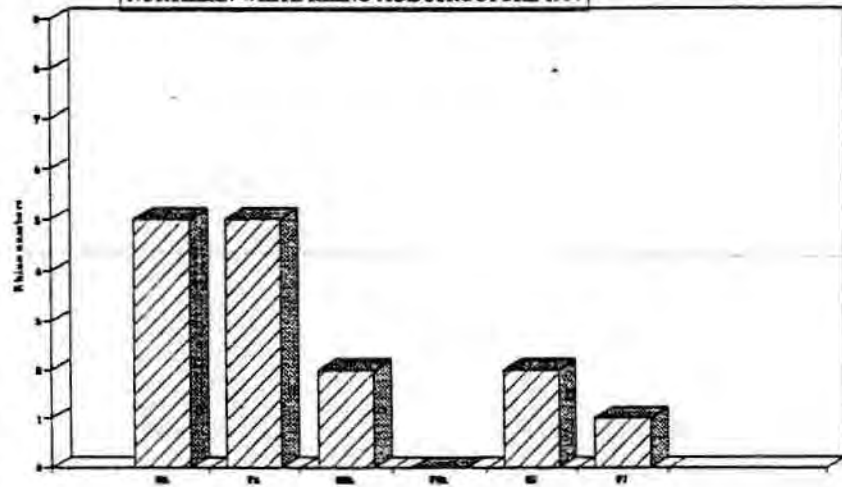
It would seem, therefore that poaching in the north of the park is confining the elephants to the south. As the population increases there is some response by the elephant population to seek the higher protein rich woody vegetation outside the park. There they are modifying the woody vegetation and some human elephant conflicts have been noted, which may be locally serious, but not widespread. Management implications are discussed under conclusions.

Rhinos

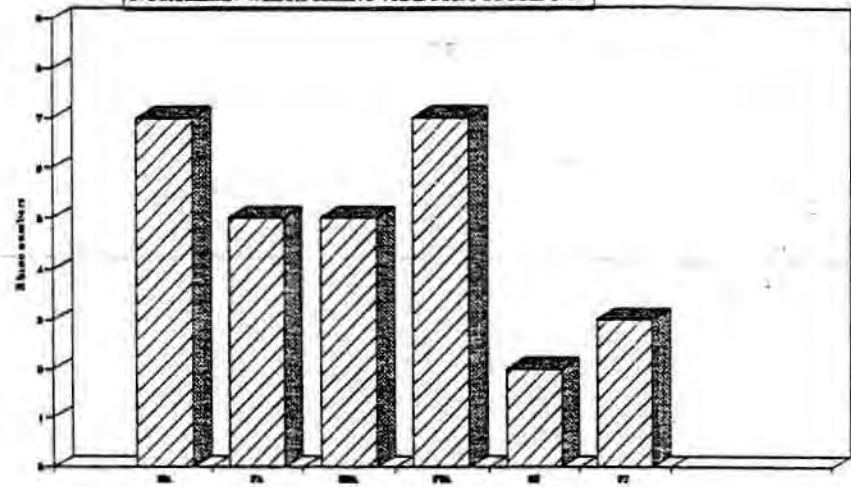
A sample count of 7.5% sampling intensity is not adequate for accurate estimation of so small a rhino population. The difference between seeing 2 or 4 means the difference between population estimates of 27 or 53. We have been monitoring the rhino population through individual recognition over the years, and on this basis we consider the current population to be 28 animals. Under the IUCN Red List Categories of endangered species (IUCN/SSC,1995), they are classed as Critically Endangered by reason of their low numbers, though the population is increasing. The population dynamics of the rhinos are shown here as tables and graphs.

The initial rate of increase based on known births and deaths was 9.7% per annum, but in recent years this growth rate appears to have slowed. The current overall rate since 1984 is 6%, as shown on the graphs. There is no evidence of poaching to date, and all four known deaths have been from natural causes. However, some animals have not been seen for a time and after two years and an intensive and widespread search in 1994, it was decided that a further four must be assumed to be dead. Two of the natural deaths were new born calves, and one was of a sub-adult male at the vulnerable time of just having left his mother on the birth of her next offspring. We have not discovered any births so far in 1995, although it is possible that an adult female that died in January was in the process of giving birth. There is no evidence that this is more than just a temporary slowing in the rate of increase. The longer term picture has shown population parameters the same as or better than those found for southern white rhinos (*Ceratotherium simum*). The current sex ratio is 1:1 and the adult to sub-adult and juvenile ratio is 1: 1.3 and at least five of the adult males are contributing to the breeding pool. The graphs of age and sex structure of the population over time show that currently there is a very large sub-adult female cohort. As soon as these females begin to reproduce there should be a rapid growth in the population again.

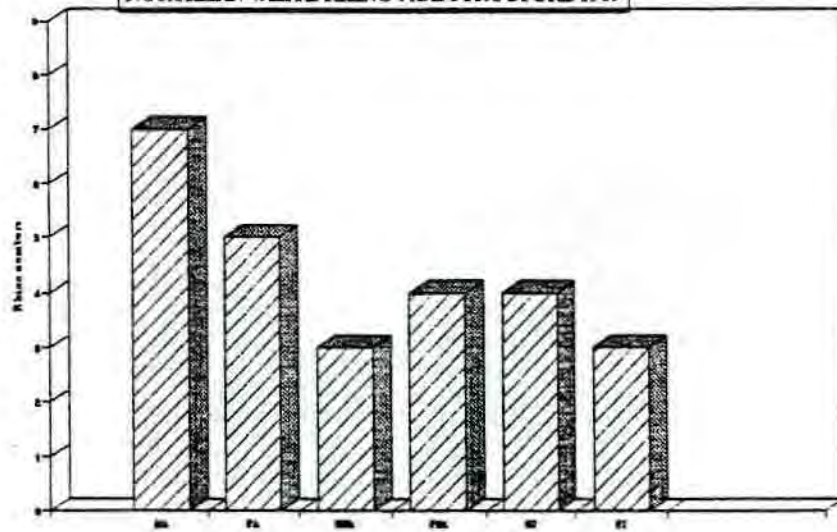
PARK NATIONAL DE LA GARAMBA
NORTHERN WHITE RHINO AGE STRUCTURE 1984



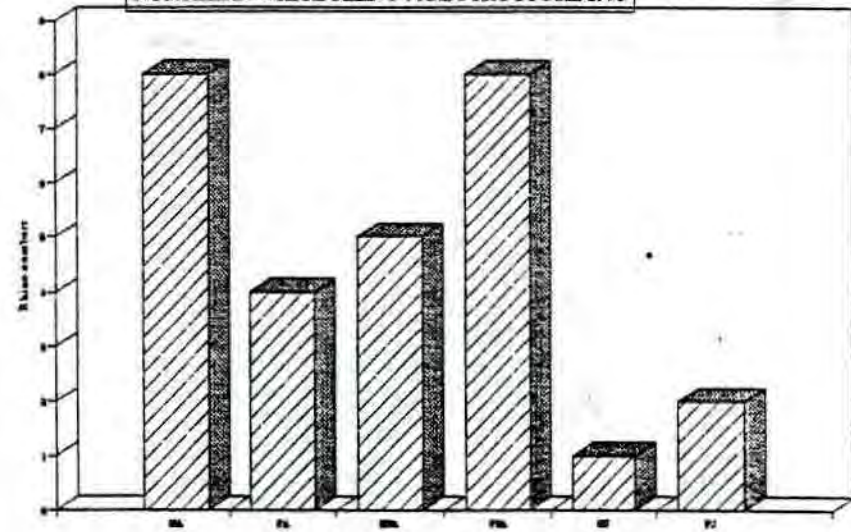
PARK NATIONAL DE LA GARAMBA
NORTHERN WHITE RHINO AGE STRUCTURE 1993

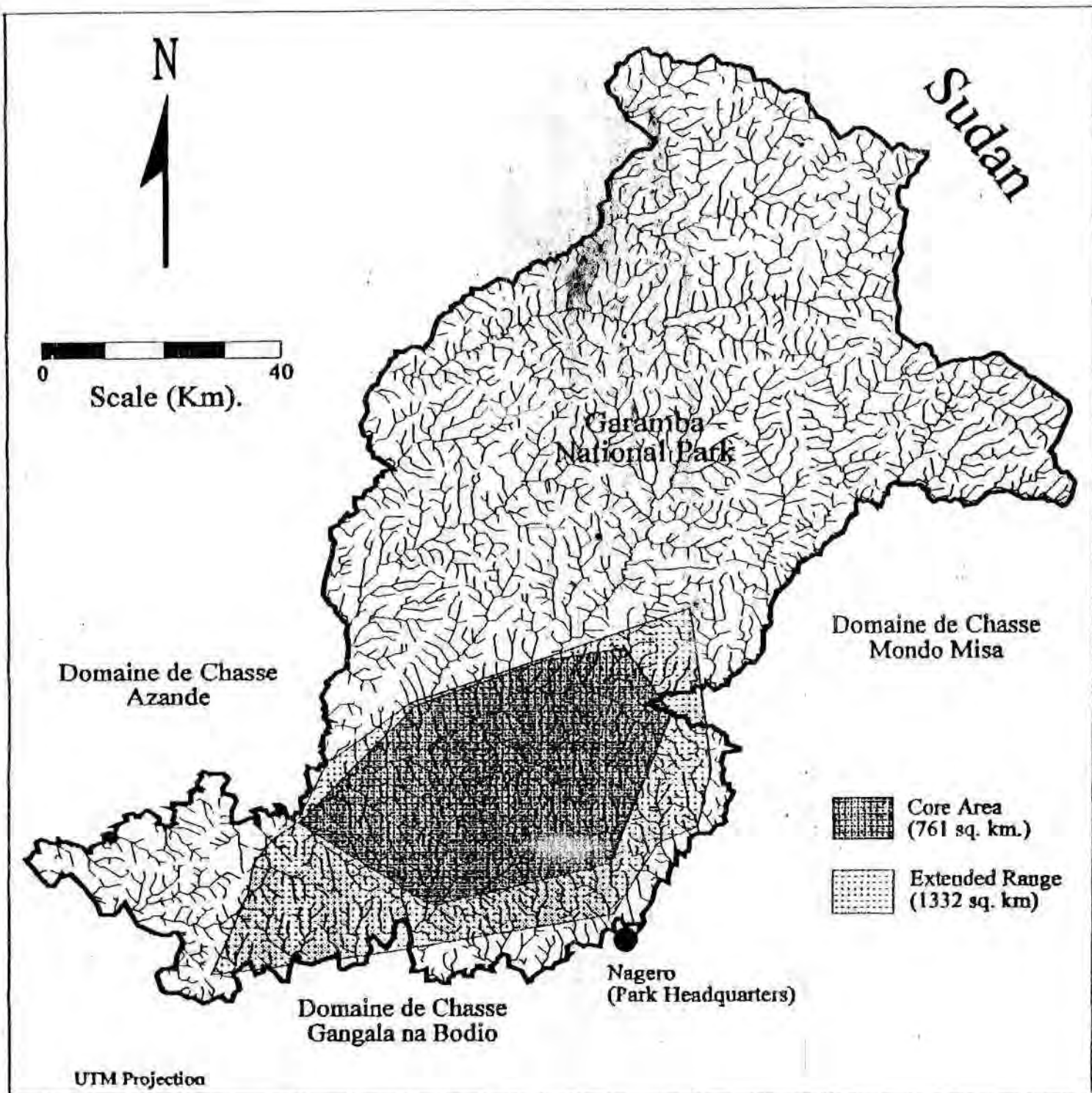


PARK NATIONAL DE LA GARAMBA
NORTHERN WHITE RHINO AGE STRUCTURE 1989



PARK NATIONAL DE LA GARAMBA
NORTHERN WHITE RHINO AGE STRUCTURE 1995





Outer convex polygons delimiting total known rhino range in Garamba National Park since 1983

The rhinos, like the elephants, are also found only in the south of the park. They are at an over all density of 0.003/km², but a local density of 0.03/km². In recent years, however, as the population has been expanding and sub-adults in particular have been dispersing, there has been more movement north of the Garamba river. Home ranges for dominant males average 188.6km² (124-228). For females the mean is 345km² (185-492), and for sub-adults 534 km² (up to 786). These ranges are of the order of 100 time larger than those recorded for southern white rhinos. Their size may be related to the very low density of rhinos, which places little restriction on their movement, but may also be related to the dispersal of available food resources at certain times of the year. The extensive movements of the animals, however maximise the chances of encounters between different individuals for breeding.

It is essential for the long term conservation of the rhinos and their ecosystem, that there is adequate control of the poaching in the north of the park and prevention of its spread, together with intensive monitoring of the rhinos for their protection.

Buffaloes

Buffalo are the most numerous large mammals, but contribute less than a third of the biomass of elephants. Their effect on the vegetation is therefore less than that of elephants. It would appear from reports (Verschuren and Cornet d'Elzius, pers.comm) that buffalo are far more numerous now than in the 1950s. Their increase was probably related to the increasing proportion of coarse grass biomass.

However buffalo numbers in 1995 are approximately half what they were in 1976 and even 1983. The difference is significant at the 5% level ($d=2.07$, Anal. of Variance, Cochran in Norton Griffiths 1978). The graph of buffalo numbers shows no significant change between 1976 and 1983, followed by a gradual decline, which has steepened in recent years. During the period of the project, buffalo have been the species most poached for meat. This meat poaching increased in 1994, with large, well-armed groups of Sudanese causing the majority of it. It has been necessary at times to combat this with the help of the Zairian army. Buffalo are also the favoured prey of lions.

The distribution map shows that buffalo have not responded as strongly as elephants to the poaching in the north of the park. However all the maps show that very few, except cryptic and woodland species occur in the low density stratum. Poaching is concentrated in the medium density stratum, where a prey is available, but surveillance is less than in the south.

Giraffe

This giraffe population is the only one extant in Zaire and probably the only representative of the sub-species (*Giraffa camelopardalis congolensis*). It is classified as **Endangered** by the IUCN Red List Categories (IUCN/SSC 1995). The northern white rhinos and the giraffes were the main reason for the creation of the park in 1938 and for its World Heritage Status in 1981.

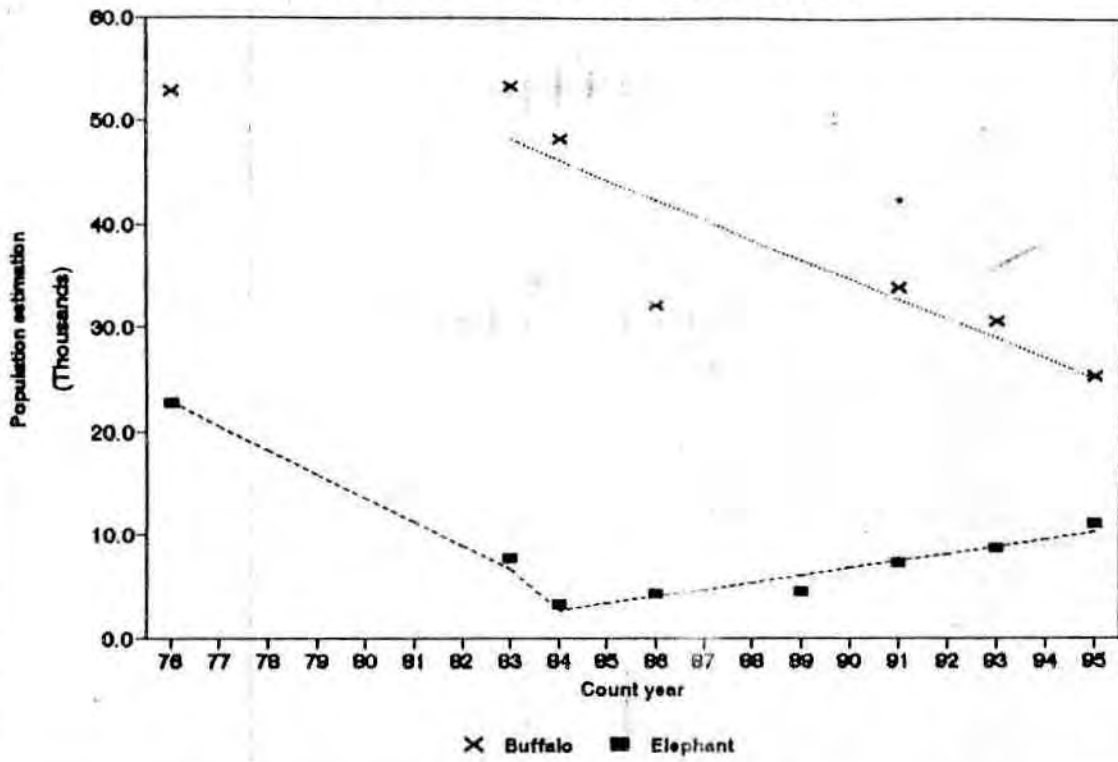
The population, however is very small. This year's estimate is only 240 ± 210 . It has not shown much change since 1976. The fluctuations in the estimates are not significant. However, there would appear to have been a reduction since the 1950s. On one road count reported in de Saeger (1952) 40 giraffes were seen between Nagero and Bac Garamba, an area where it is extremely rare to see any these days. The reduction is probably due to loss of the woody habitat in the park, and the distribution map shows how giraffe tend to be found along the peripheries of the park and in the Domaines. A preliminary study showed their selection for *Acacias* which are very poorly represented in this ecosystem.

Giraffe are not widely poached, because the Azande believe that eating their meat confers leprosy, but their tails are used by local chiefs, and one was found poached during ground transects (Nicholas 1995). Greater security in the north of the park, and more secure use of the Domaines de Chasse would also benefit the giraffe by making a higher diversity of browse habitat available.

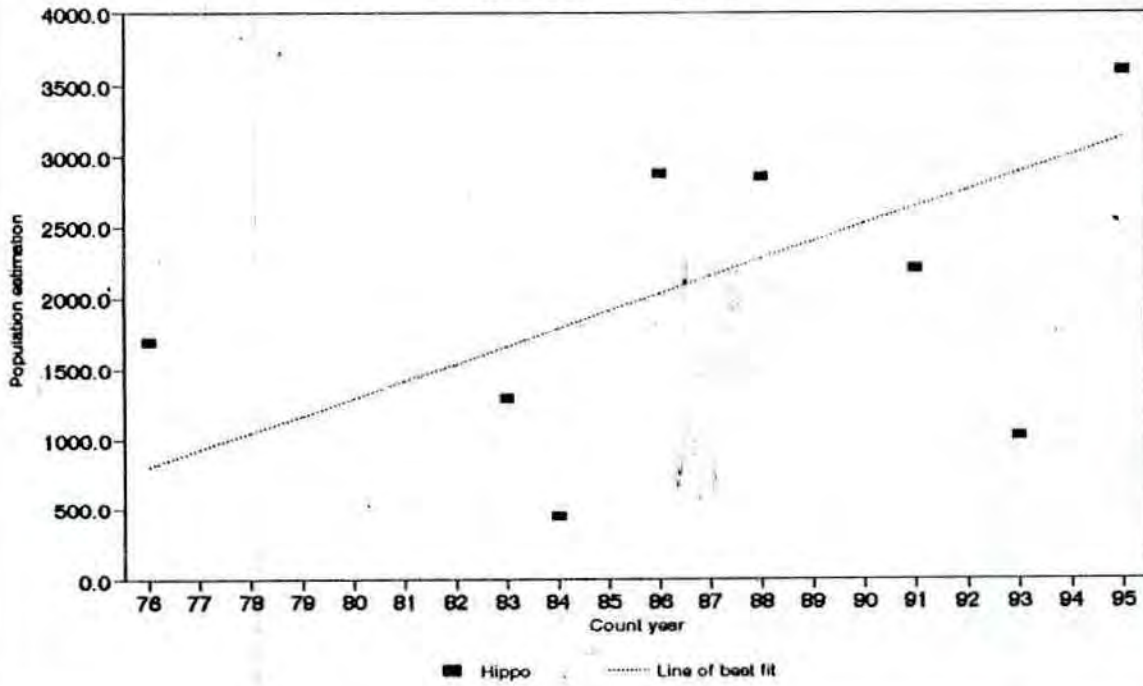
PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE
WILDLIFE NUMBERS/ NOMBRES DES ANIMAUX 1976 - 1995

YEAR	BUFFALO	GIRAFFE	HIPPO	KOB	HARTEBEESTE	WATERBUCK	REEDBUCK	ROAN	WARTHOG	GR.DUIKER	RF DUIKER	ORIBI	LION	HYENA	BUSHBUCK
1978															
PARC	53000	350	1700	7180	7750	3680	640	360	3340	140		380	35	35	420
DC															
95% cl	42380	250		2300	1470	1330	310	530	1440	100		150	40	50	130
1983															
PARC	53312	175	1290	3878	1932	2215	183	91	1117	91		234	15	87	51
DC	2864	20		766	146	455	181	0	241	169	36	17			121
95% cl	16060	163	1781	2321	812	1420	107	124	244	72	31	152	15	14	127
1984															
PARC	48284	273	448	3792	1224	568	175	0	404	109		153	33	44	131
DC	76	0	0	0	0	218	0		0	11		0	0	0	
95% cl	5982	144	442	214	442	293	101		162	126		103	69	36	57
1985															
PARC	29419	153	2874	7222	1706	1322	328	34	943	12		230	63	157	149
DC	341	13	0	490	75	869	93	0	86	23	25	15	0	0	93
95% cl	3485	140	1668	2601	589	456	136	25	344	12	26	90	46	121	121
1986/1988															
PARC	32163		2851												
1991															
PARC	33910	346	2205	3423	967	716	35	13		13	51	39			90
DC															
95% cl	19706	422	2002	2045	675	440	42	26		26	60	56			94
1993															
PARC	30555	347	1023	6738	3444	1113	75	150	2692	75	120	90			75
DC	549	0	0	564	89	356	0	0	183	15	45	0			104
95% cl	18798	419	817	3347	2114	623	91	255	1524	83	57	67			53
1995															
PARC	28242	178	3601	6601	2819	1680	271	81	5806	98	107	0	14	14	67
DC	472	52	39	524	66	420	0	0	643	39	105		0	0	66
95% cl	16820	210	2638	3033	1199	1340	180	159	2546	74	52		27	26	43

PARC NATIONAL DE LA GARAMBA ELEPHANT & BUFFALO POPULATIONS



PARC NATIONAL DE LA GARAMBA HIPPO POPULATIONS



Hippos

Sample counting is not ideal for hippos, whose distribution tends to be in local concentrations, leading to large variations in estimates, and for whom correction factors are needed to allow for those underwater. However the specialised hippo count carried out in 1988 yielded figures very similar to the preceding sample count. The graph of the results from all the counts shows a gradual trend of increase since 1976. This is borne out by personal observation that the hippos appear to have been increasing, and by reports from Nagero and Faradje of increasing problems of crop-raiding by hippos. If the correction factor calculated in 1988 was applied to the current estimate, it would be over 6,000 hippos. Another specific hippo count is required to verify the numbers.

It would appear from local reports that hippos were a favoured species to be shot for meat in the past. One reason is their availability along the rivers which form the boundaries of the park. During the hippo count in 1988, their distribution was very indicative. Hippos were almost non-existent along the Dungu and Aka rivers, which form the park boundaries, except for at the station of Nagero where a hippo concentration is protected. They were, however widely distributed along the Garamba river which is bounded by park on both sides. The currently well enforced ban on hunting and even on control shooting for crop protection appears to have enabled them to increase and new concentration areas are known to have been colonised at three locations near Nagero, near Namalombia and at Faradje.

Kob

Apart from an apparent high in 1986, kob appear to have followed a similar pattern to other antelope species, with a decrease between 1976 and 1983, continuation at a similar level, and an increase again in 1993 and 1995. They are distributed mainly in the high density stratum, but with several in the medium density and even the low. They were also seen in parts of the Domaines de Chasse. Kob tend to show a certain fidelity to areas where the grass is generally shorter all year round, for example on the shallow soils near the Nauloloko/Eleti confluence and at Bac Garamba. Their social organisation shows large harem groups, smaller, less coherent female and calf groups, male groups and "leks", with birth peaks in early dry season and breeding peaks in early wet.

Hartebeeste

Hartebeeste were 7750 ± 1470 in 1983, and down to 1932 ± 146 in 1983. They stayed at a similar level until a major increase in 1993 and 1995. The difference between the 1991 and 1995 figures is significant ($d=4.9$, $>5\%$). They are distributed throughout the park, even in the low density stratum, except in the thickly wooded zone. It would appear therefore that they are not selectively poached, and they are rarely reported as poached. They tend to be relatively sedentary and their preferred habitat is on ridge tops of the savanna grassland (HP).

Waterbuck

Waterbuck are widely distributed throughout the park and Domaines, in association with water courses. They like most species showed an apparent drop from the 1976 figures. Since then the minor fluctuations in populations have been insignificant.

Reedbuck

Reedbuck are not numerous. Like most of the antelopes they show a decrease from the 1976 figures and an apparent, but insignificant rise in 1995. They are fairly cryptic and not easily seen unless they move. Their distribution was apparently towards the south and east of the park, but they may have been more difficult to see in the more bushed north and west.

Roan

Roan antelope are represented by a very small population, which was apparently larger in 1976 (360 ± 530). There usually tends to be group south of Mt Kpaza, near the Kasi, where this year's observations were made.

Water is not a limiting factor anywhere in the park and reserves, but more surface water appears to be available in the park. In the reserves more of it is tied up in transpiration through trees.

Human Influences

Poaching

Twenty nine poaching huts were seen in transect. However the majority were either old abandoned camps or fishing huts. Two camps in the medium density stratum of the park were occupied, which implies a possible population of 26 occupied camps, a figure for considerable concern. Anti-poaching has been stepped up and directed to the region.

The camps are temporary shelters or merely smoking racks, built near the site of a kill in order to smoke the meat. Thus they would probably only be occupied for one or two days.

Occupied huts

Where groups of huts were at a low density it was possible to differentiate between living huts and granaries or chicken coops. In denser areas, however, there was only time to count all buildings. In this case they had to be separated by applying the ratios of living huts to annexes that was found elsewhere. The hut count was further stratified for analysis to allow for a human population estimate based on observed hut occupancy. A preliminary socio-economic survey in 1991 (Monungu, unpub.) found a mean hut occupancy of 4 people in semi-urban areas and 2 in villages or family units. This will be refined with more detailed ground work, but the current population estimate for the Domaines de Chasse is 97,706 .

Abandoned huts

A large proportion of huts were abandoned. there appear to be several reasons for this:

- 1) People who have abandoned homes close to the Sudanese military camps,
- 2) Refugees who have moved out of the reserves again, either to refugee camps to the west of Dungu or back to Sudan,
- 3) Temporary accommodation built by young men involved in gold exploration, who have moved on,
- 4) The shifting system of agriculture.
- 5) Movement of family members out of a house following the death of one of the occupants.

Agriculture

The surface area covered by active agriculture is very small, but the clearing of new areas, as mentioned above is concentrated most often on the richest and most wooded areas.

Gold mining

The map of active and recently (possibly seasonally) abandoned mines shows the extent of gold mining in the reserves. Much of it centres on Sambia in the south of D.C. Gangala na Bodio, with another focus to the east of the park. These are centres of potential poaching pressures, in that the people do not have much time for agriculture or hunting, but do have the money to pay someone else to do it. However these people do not appear to be such an influence for poaching as are the Sudanese military. The areas where elephants have been seen in the Domaines in 1993 and the present count are close to Sambia. This does not indicate a high degree of direct harrassment of the wildlife.

CONCLUSIONS

There was some loss of most species except buffalo between 1976 and 1983. However the focus of poaching during that time appears to have been for the commercially valuable elephants and rhinos. Both species provided plenty of meat in addition to the trophies, if it was required. The main drive for poaching now is for meat, and this has been hitting the buffalo population. The combined effects of elephants and fires have perpetuated a striking contrast in woody vegetation between outside and inside the park in the south, though in the north, bush composed of small savanna trees of limited species diversity is regenerating. The distribution of meat poaching in the north of the park continues to concentrate the elephants in the south, and as a result of their increasing population density, many are moving into the reserves at night, as mapped from line transect work.

The implications for management planning, based on this and the situation of other species are that a) If poaching could be eliminated in the north of the park, the higher diversity of habitat types and higher density of woody vegetation would become available as safe habitat for elephants and other species, and b) the Domaines de Chasse need to be considered for long term management of the ecosystem. These areas contain complementary and necessary habitats for the wildlife and species which do not exist in the park itself. There is limited, but serious as perceived by the human population, and potentially increasing human-wildlife conflict. This same population and immigrants and refugees, who do not have the traditional rights are also a source of poaching pressure in the park. Ways need to be found to improve the relationship between the park and the people, reducing poaching pressure at source and to develop means of improving the sustainable long term use of the natural resources of the whole ecosystem, comprising park and reserves. The floral resources also need management for sustainable use. The tree felling focused on the limited relict forest patches and the species rich dense woodlands should be stopped and alternatives found.

It is important for the sake of the park and its wildlife that sufficient resources and political negotiations are mobilised to stop the trans-border poaching, and that the poaching is tackled on all fronts, including positive integration of local people in resource conservation. For the sake of faunal and floral biodiversity and for long term conservation of the ecosystem and its particularly valuable components, it is important that the park and reserves are considered as a whole in an integrated plan backed with the resources to implement it.

REFERENCES

- Burril A., Kalliskl K & Douglas- Hamilton I.(1984) Aerocount, aerial survey analysis program manual
Typescript
- Campbell K (199..)
- Douglas-Hamilton I. & Hillman A.K.K. (1981) Elephant carcasses and skeletons as indicators of population trends. Low Level Aerial Survey Techniques ILCA Monograph, 113-129
- Haltenorth Th. & Diller H (1977) Mammifères d'Afrique et de Madagascar. Delachaux & Niestlé.
- Hillman K., Borner M., Mankoto ma Oyisenzoo, Rogers P., Smith F.(1983) Aerial census of the Garamba National park, Zaire, March 1983
- Hillman Smith K. (1989) Ecosystem Resource Inventory, Garamba National park. Internal document. IUCN/WWF/FZS/IZCN
- d'Huart J.P. (1978) Ecologie de l'Hylochère (*Hylochoerus meinertzhageni* Thomas) au Parc National des

Virunga. L'Academie Roy.des Sci.d'Outre-mer. FFRSA

IUCN/SSC (1995) IUCN Red List Categories. IUCN Publication.

Nicholas A. (1995) A report on the results of line transect work undertaken during the dry and wet seasons in the Domaines de Chasse of Garamba National Park, north eastern Zaire. 2. Large Mammal abundance and distribution in the Domaines de Chasse.

" & Amube N.(1995) A report on the results of line transect work undertaken during the dry and wet seasons in the Domaines de Chasse of Garamba National Park, north eastern Zaire. 1. Elephant distribution, density and feeding preferences in the Domaines de Chasse.

Norton Griffiths M. (1978) Counting animals, AWF handbook 1.

Savidge, J.M. Woodford M.II. and Croze H. (1976) Report on a mission to Zaire, FAO W/K1593 KEN/71/526 - ZAI/70/001

Smith K, Smith F., Mbayma A. Monungu L.,Watkin J. de Merode E., Amube N. Eza K. (1993)
Garamba National Park, General Aerial Count 1993 WWF/FZS/IZCN/IUCN/UNESCO Report

Watkin J.,de Merode E. & Hillman Smith K. (1995) A simple method for analysis of aerial sample count data using widely available commercial software. (In press, Pachyderm)

Western D (1976) An aerial method of monitoring large mammals and their environment. FAO KEN/71/526 Project Working Document 9.

ACKNOWLEDGEMENTS

We are extremely grateful to the World Wide Fund for Nature (WWF) for support to ourselves and the running costs of the project, to Frankfurt Zoological Society (FZS) for the aircraft, to International Rhino Foundation for guards' salaries, to the Global Resource Information Database (GRID) of UNEP for use of equipment and facilities, to the Wildlife Conservation Fund for the aircraft used for monitoring the rhinos and Save the Rhino International for a vehicle, and in particular to the Institut Zaïrois pour la Conservation de la Nature (IZCN) for the chance to work in Garamba National Park.

Place: NAGERO, Alt: 740 m. Lat: 03°46'N Long: 29°32'E

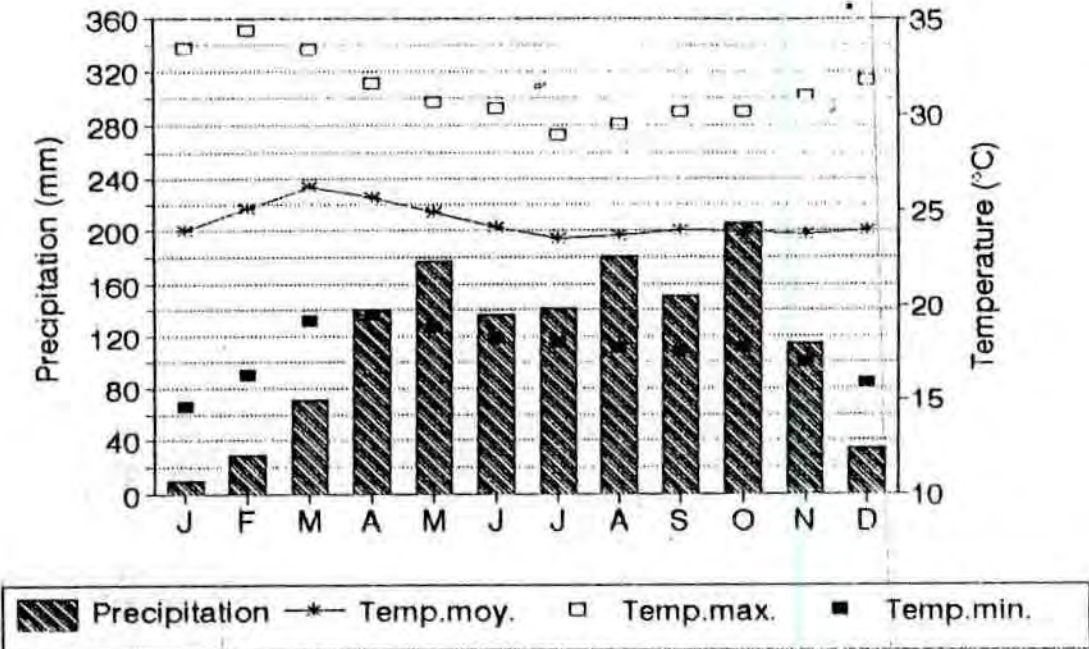
Années: (1980-1994)

Mois	PRECIP'N Moyen (mm)	TEMPERATURE			HUMIDITE REL. (%)			EVAP'N (cm'3) Moyen
		Moyen (C)	Max moy (C)	Min moy (C)	6:00	15:00	18:00	
J	9.5	23.9	33.4	14.6	95.5	41.0	63.0	242.4
F	29.1	25.1	34.4	16.2	93.9	43.4	57.1	234.1
M	71.7	26.2	33.4	19.2	93.4	51.4	65.8	215.8
A	140.4	25.7	31.6	19.5	94.9	60.8	68.6	122.6
M	176.2	24.9	30.6	18.9	97.0	69.0	84.5	84.1
J	136.7	24.1	30.3	18.2	97.9	71.4	87.2	77.7
J	141.2	23.5	29.0	18.0	97.1	70.9	86.5	62.9
A	180.5	23.6	29.5	17.7	97.8	77.6	88.2	66.0
S	150.9	23.9	30.1	17.5	98.0	72.3	87.7	69.7
O	206.6	23.9	30.2	17.7	97.2	68.2	84.6	71.6
N	114.4	23.7	31.0	17.0	97.5	66.4	86.8	94.6
D	34.1	23.9	31.8	15.9	96.9	57.3	80.9	136.1
Ann.tot.	1391.3	24.4	31.3	17.5	96.4	62.5	78.4	1477.6
Sais sech	144.4	24.9	33.4	16.5	95.0	48.3	67.0	828.4
Sais.pluie	1246.9	24.2	30.5	18.1	96.1	69.6	84.3	649.2

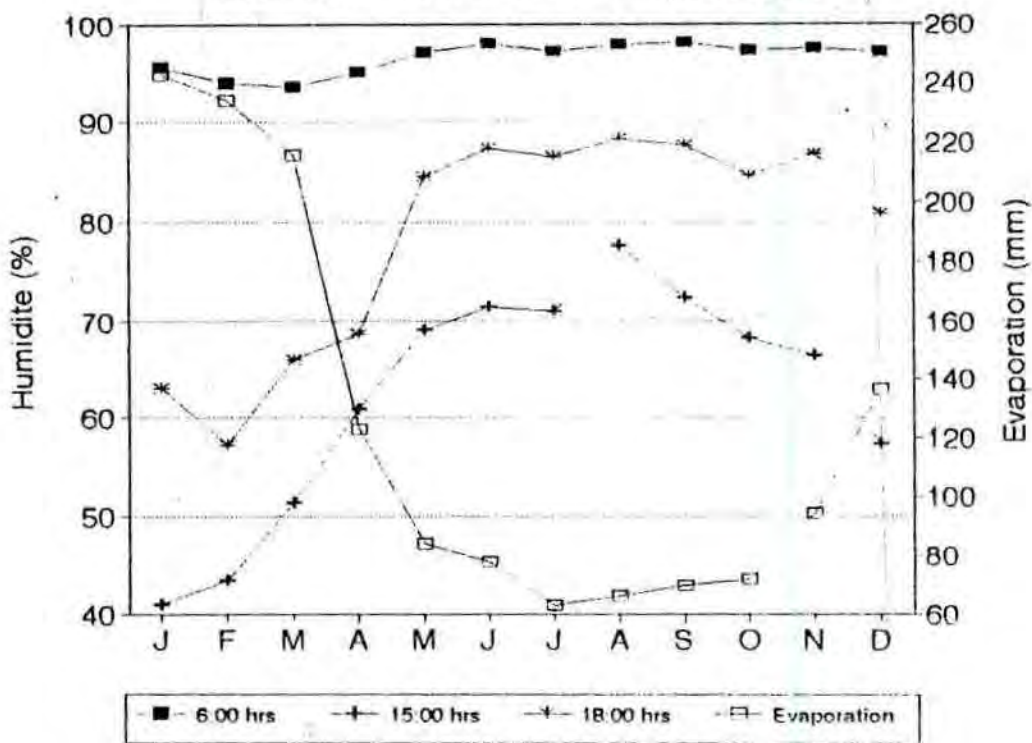
Saison Seche : Jan,Fev,Dec; Saison de Pluie : Mar-Nov.

Precipitation et Evaporation en totaux; Humidite et Temperature en moyennes par mois

PARAMETRES DU CLIMAT: NAGERO (1980-94)
 Temperature et Precipitation



PARAMETRES DU CLIMAT: NAGERO (1980-94)
 Humidite Relative et Evaporation

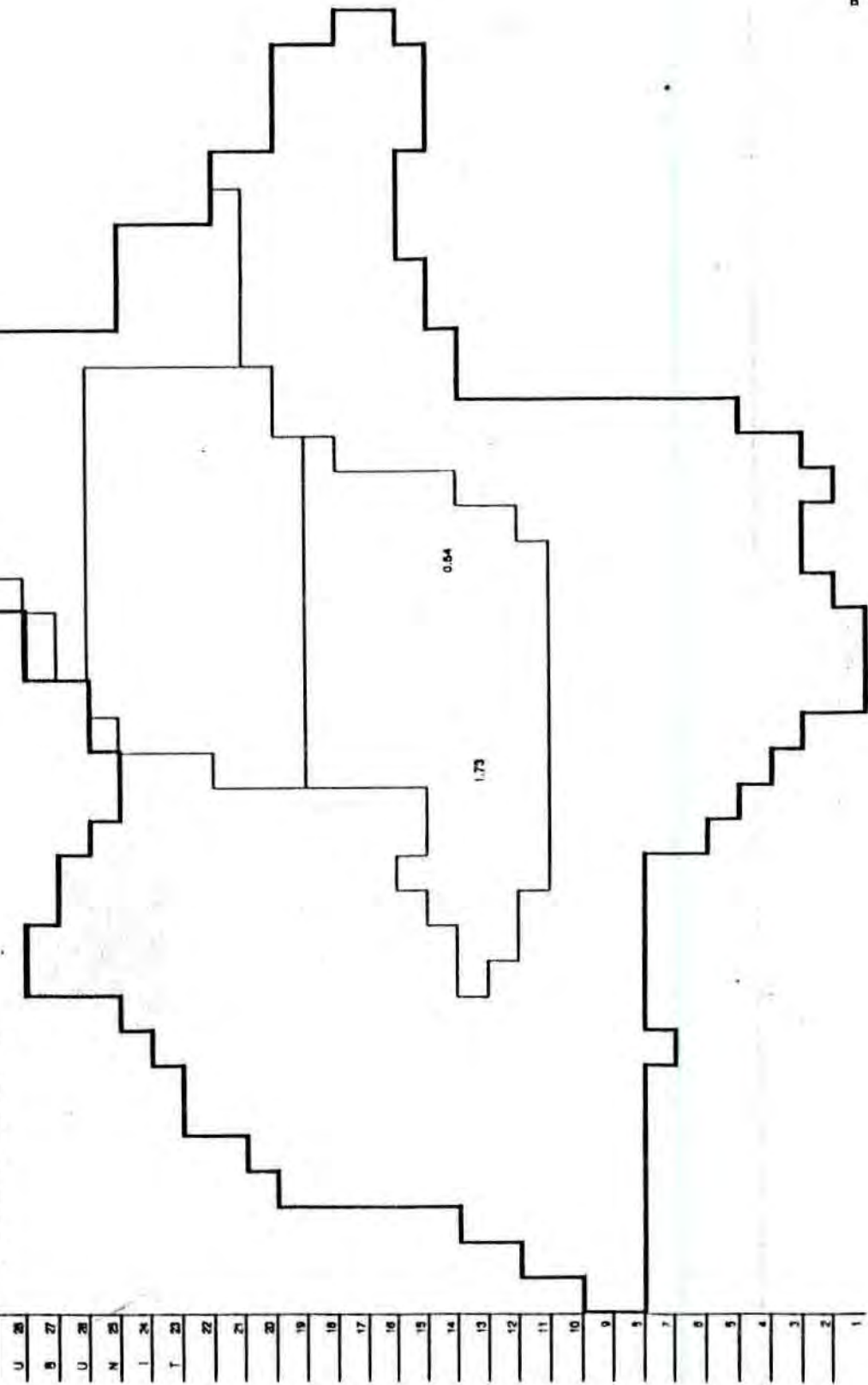


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37

RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE

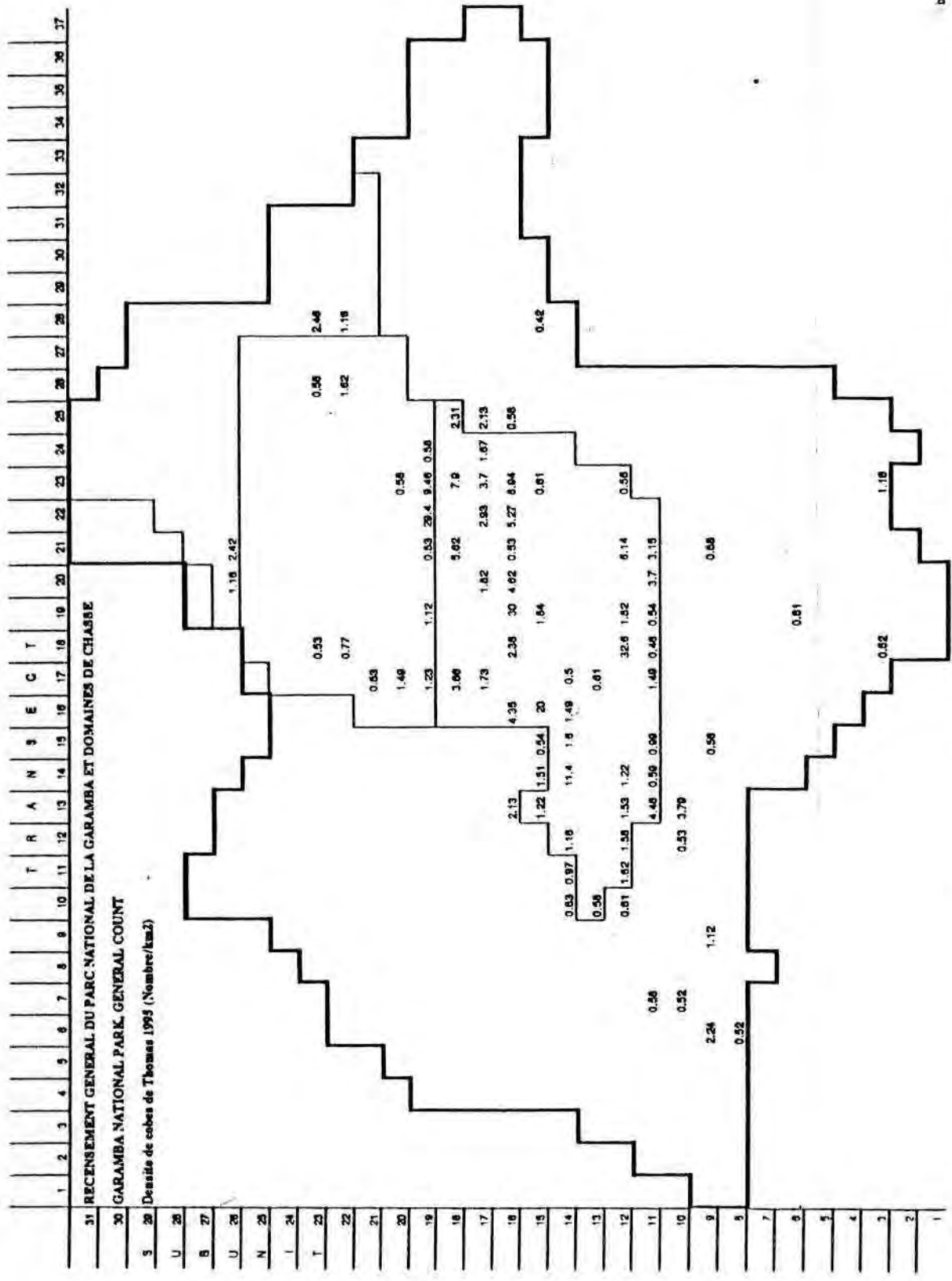
GARAMBA NATIONAL PARK, GENERAL COUNT

Devisé de Rhinoceros 1995 (Nombre/km²)



DEBITE MOYENNE
PAR PLATE
0.00
0.00
0.03
0.00
0.00

Low 0
Med 0
High 0
Doom 0
Total 0



	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	26	27	28	29	30	31	32	33	34	35	36	37			
Low D																																								
Med D																																								
High D																																								
Dom																																								
Total																																								

DEVIANTS MOYENNES

PAS DEVIANTS
 0.13
 0.83
 2.17
 0.06
 0.44

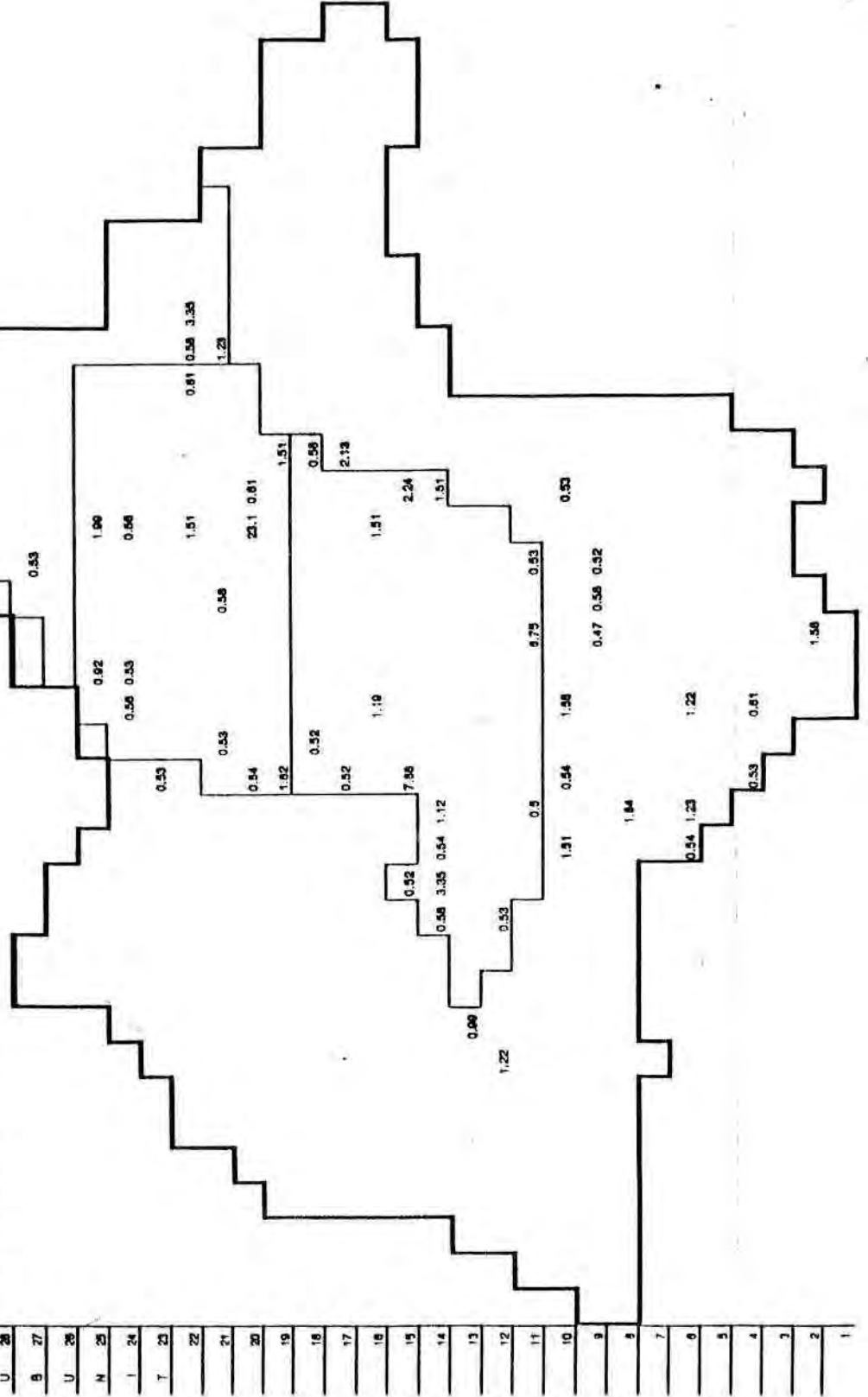
T R A N S E C T

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 26 27 28 29 30 31 32 33 34 35 36 37

RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE

GARAMBA NATIONAL PARK, GENERAL COUNT

Deutshe de Waterbucks 1995 (Nombre/Km2)



Category	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	26	27	28	29	30	31	32	33	34	35	36	37		
Low 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Med 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

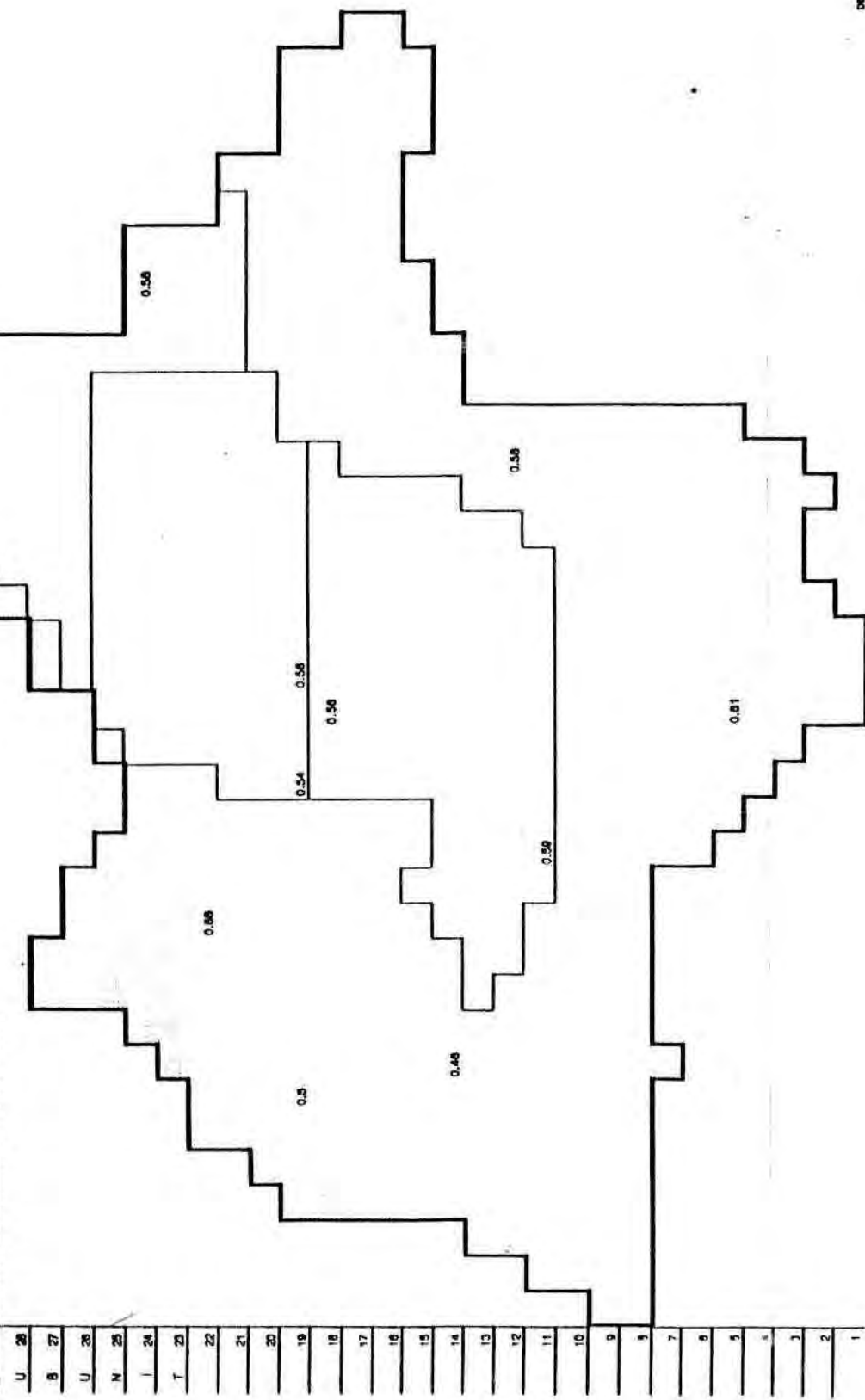
MOYENS MOYENS
PAR STRATE 0.10
0.48
0.34
0.08
0.15

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 26 27 28 29 30 31 32 33 34 35 36 37

RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE

GARAMBA NATIONAL PARK, GENERAL COUNT

Densité de Grés Harasché 1995 (Nombre/Km2)



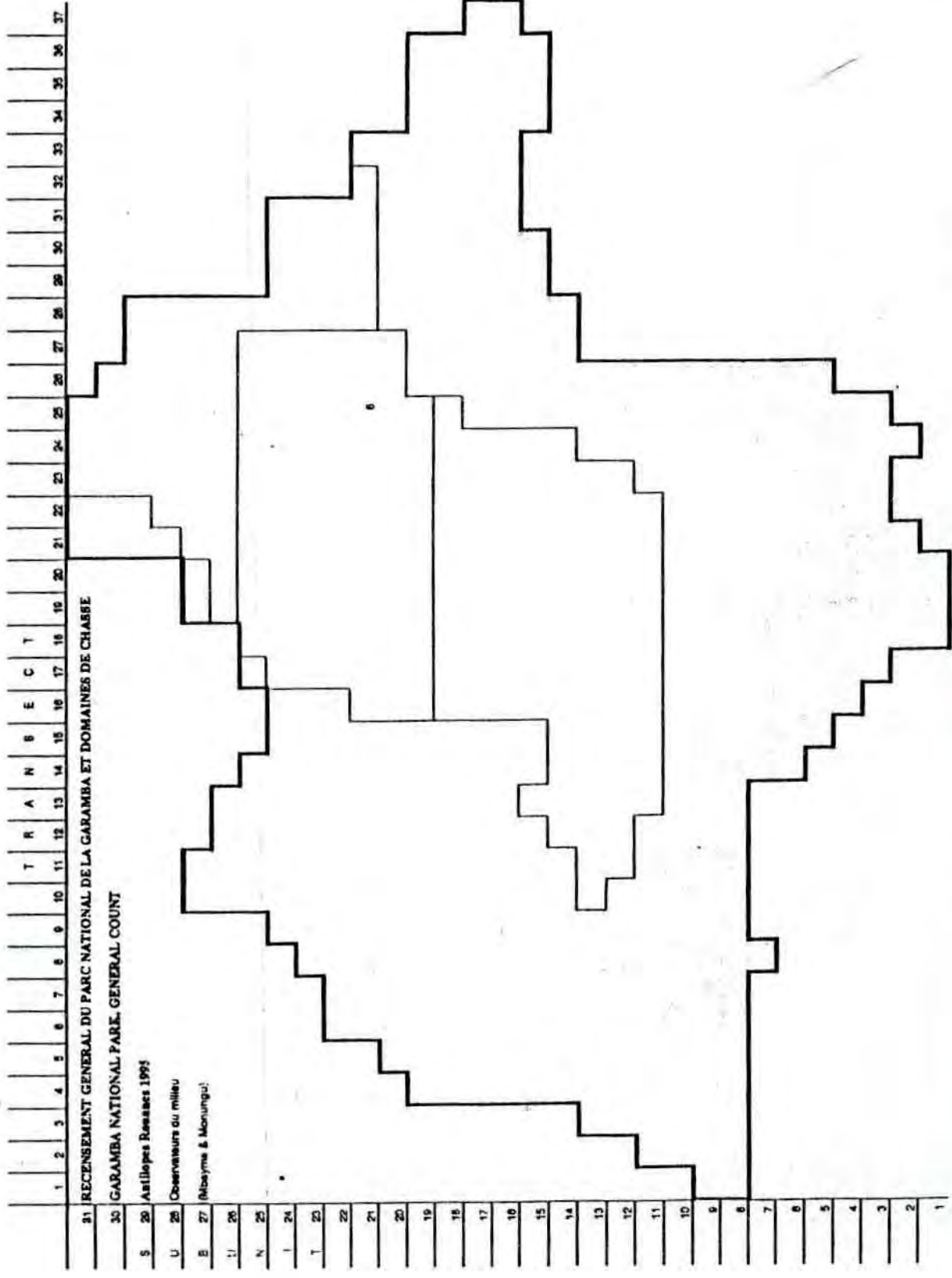
Low D
Med D
High D
Doom
Total

	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	26	27	28	29	30	31	32	33	34	35	36	37	
Low D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Med D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Doom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

DEBITES MOYENNE

PAR STRATE

0.01
0.01
0.01
0.01



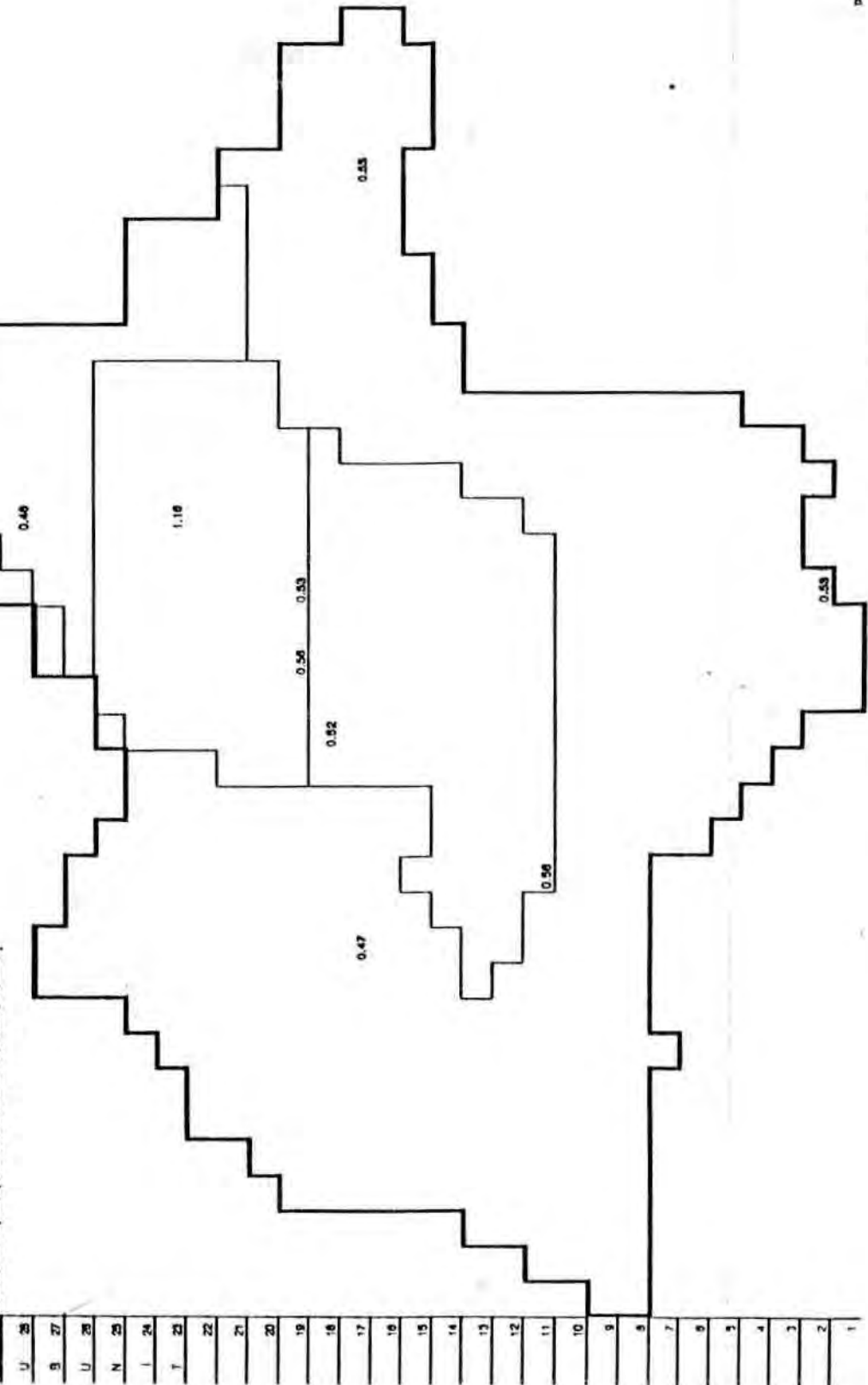
Category	Low D	Med D	High D	Dom	Total
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
18	0	0	0	0	0
19	0	0	0	0	0
20	0	0	0	0	0
21	0	0	0	0	6
22	0	0	0	0	0
23	0	0	0	0	0
24	0	0	0	0	0
25	0	0	0	0	0
26	0	0	0	0	0
27	0	0	0	0	0
28	0	0	0	0	0
29	0	0	0	0	0
30	0	0	0	0	0
31	0	0	0	0	37

	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	26	27	28	29	30	31	32	33	34	35	36	37
--	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE

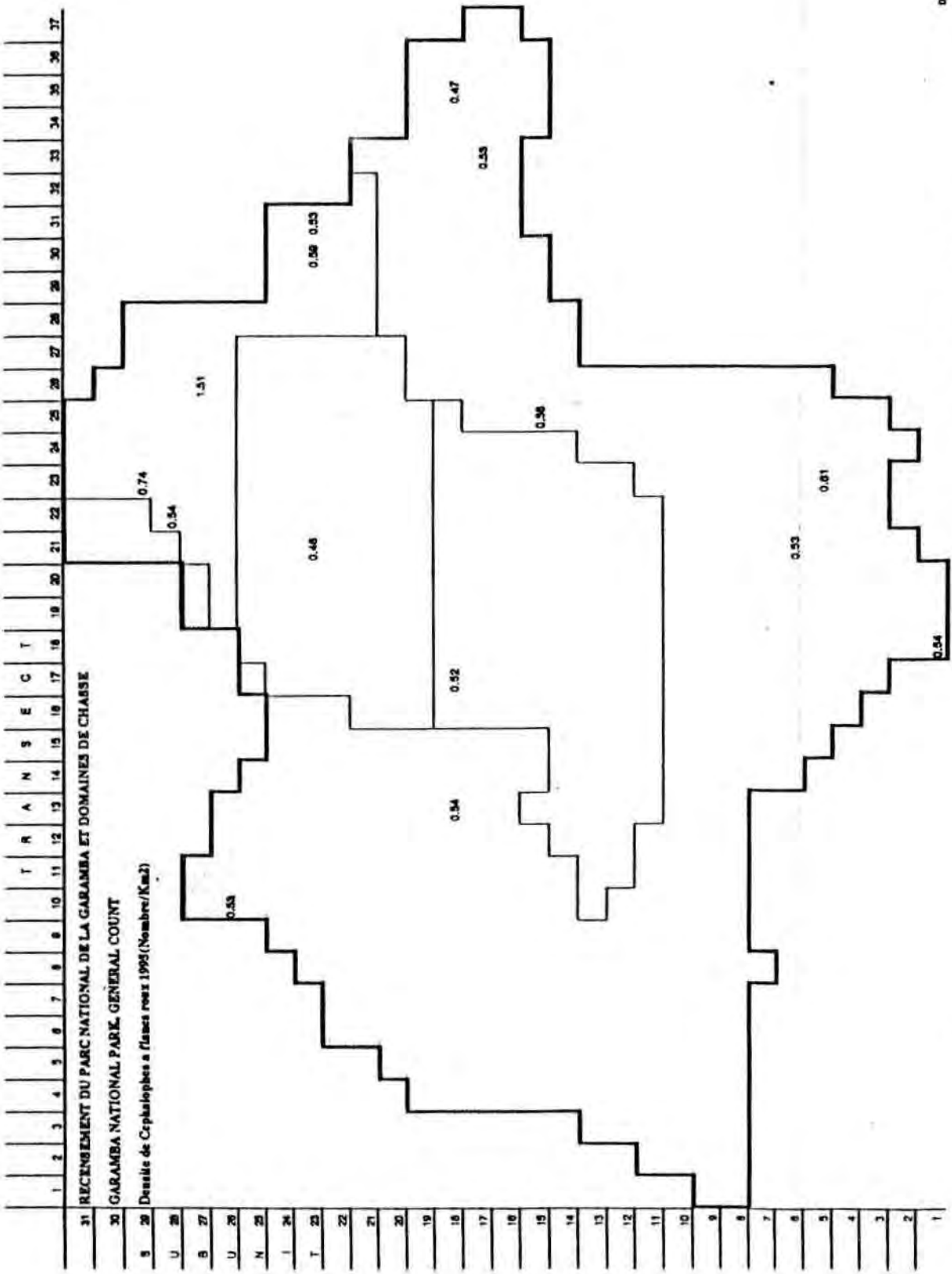
GARAMBA NATIONAL PARK, GENERAL COUNT

3 28 Densité de Cephalopbes de Grimm 1993 (Nombre/Km2).



	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	26	27	28	29	30	31	32	33	34	35	36	37		
Low D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Med D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

INDICATE MOYENNE
PAR STRATE



RECENSEMENT DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE

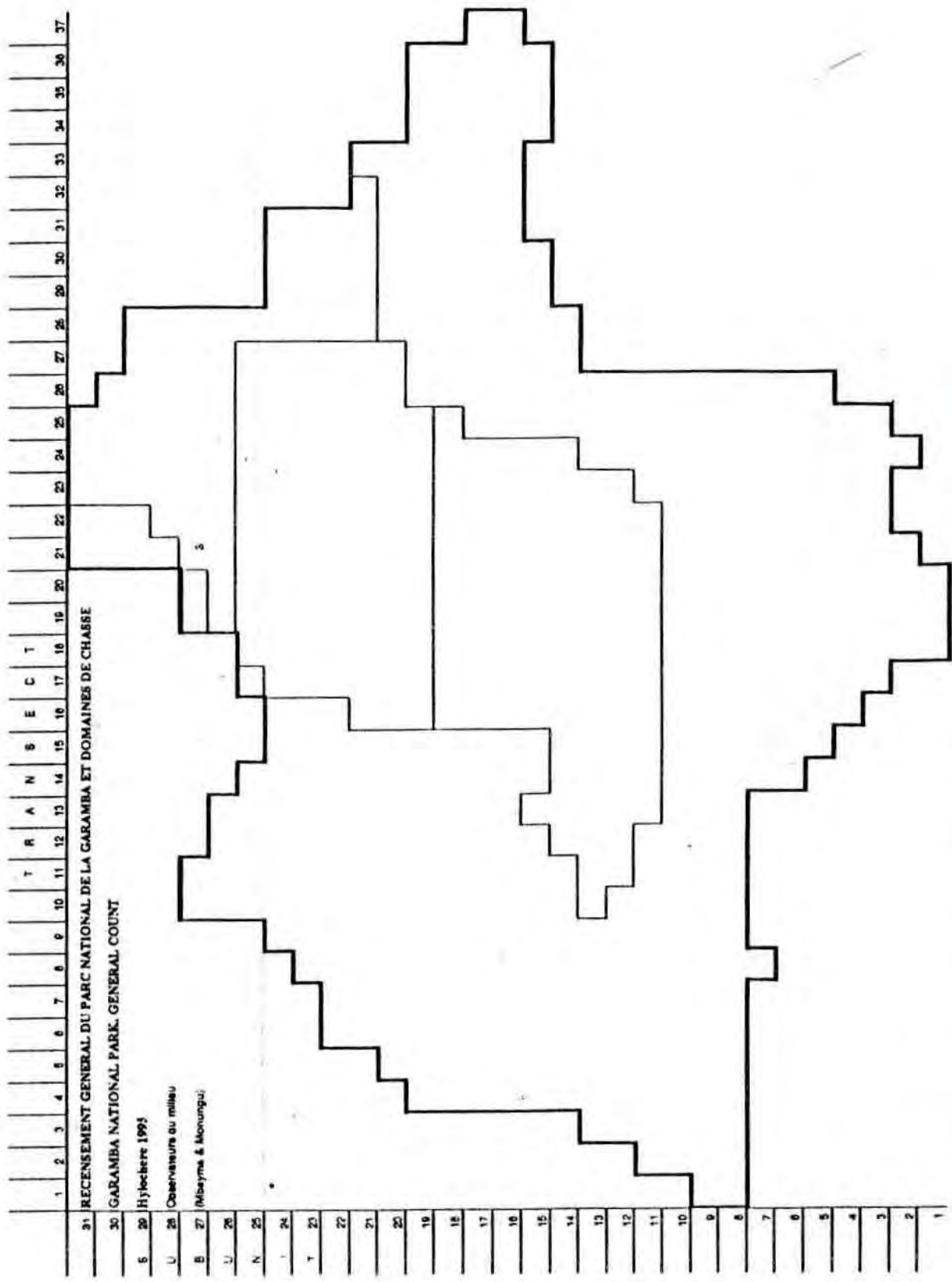
GARAMBA NATIONAL PARK, GENERAL COUNT

Densité de Céphalopodes à flancs rochers 1995 (Nombre/Km²)

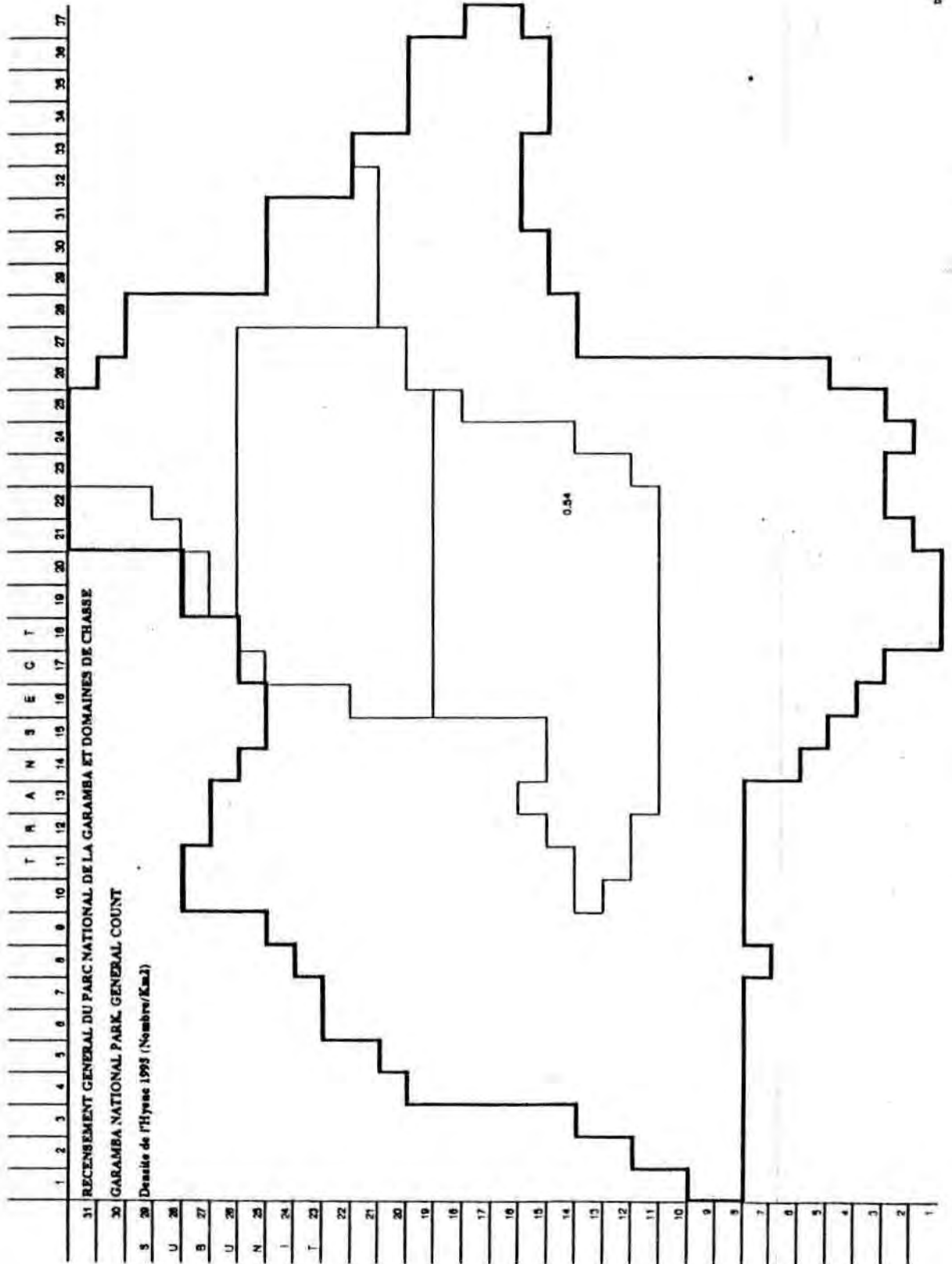
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37		
Low D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Med D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

DENSITE MOYENNE

PAR STRATE
0.07
0.01
0.01
0.01
0.02



Low D
 Med D
 High D
 Dem
 Total



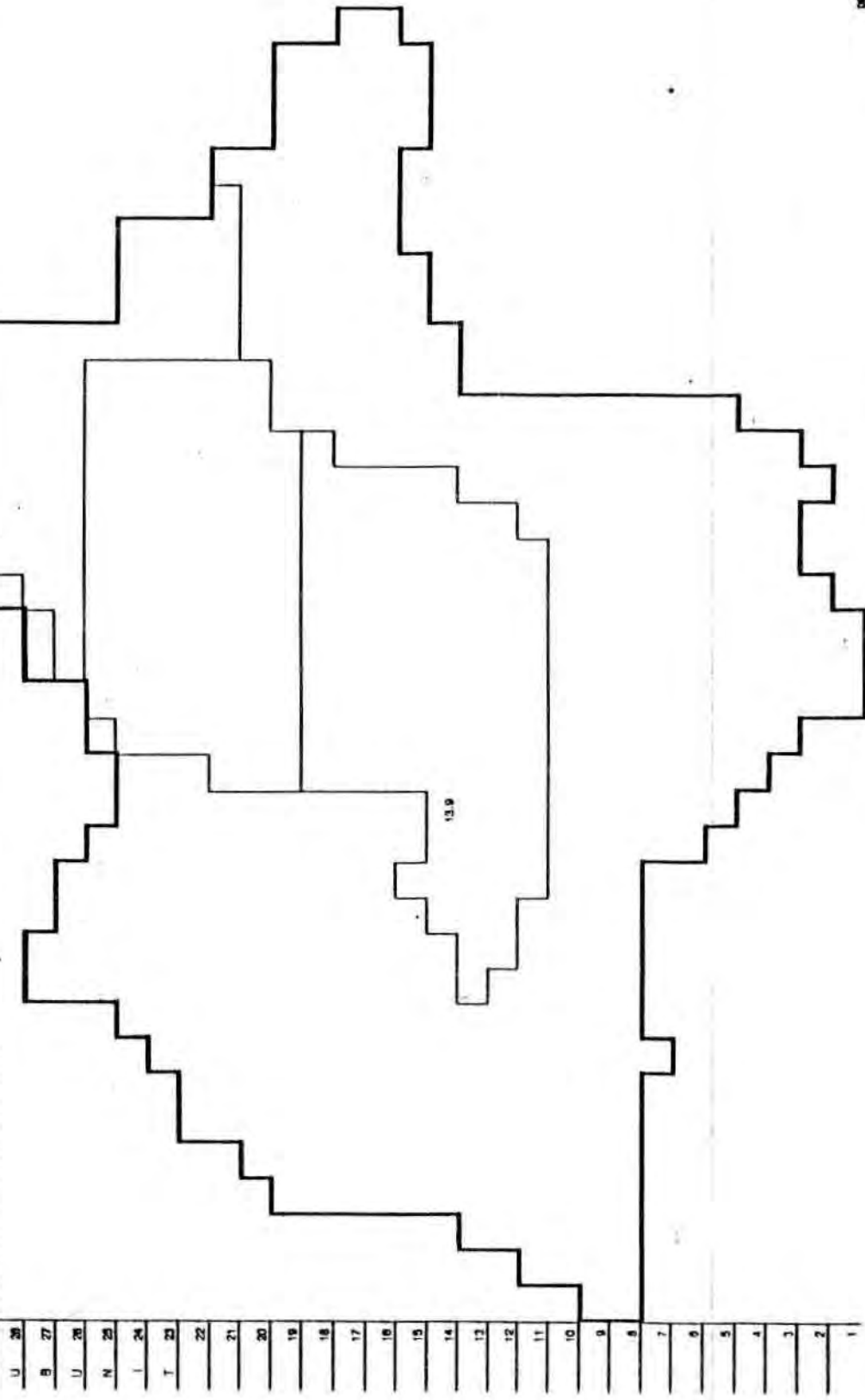
DENSITE MOYENNE			
	PAR STRATE		
Low D	0.00	0.00	0.00
Med D	0.00	0.00	0.00
High D	0.01	0.01	0.01
Dom	0.00	0.00	0.00
Total	0.00	0.00	0.00

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 26 27 28 29 30 31 32 33 34 35 36 37

RECENSEMENT GENERAL DU PARC NATIONAL DE LA CARAMBA ET DOMAINES DE CHASSE
GARAMBA NATIONAL PARK GENERAL COUNT

31 GARAMBA NATIONAL PARK GENERAL COUNT

3 26 Densité de Babouilles 1993/(Nombre/Km2)



	0	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	26	27	28	29	30	31	32	33	34	35	36	37		
Low D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Med D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

DENSITE MOYENNE
 PAR ETAPPE
 0.00
 0.00
 0.18
 0.00
 0.02

	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	26	27	28	29	30	31	32	33	34	35	36	37
--	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

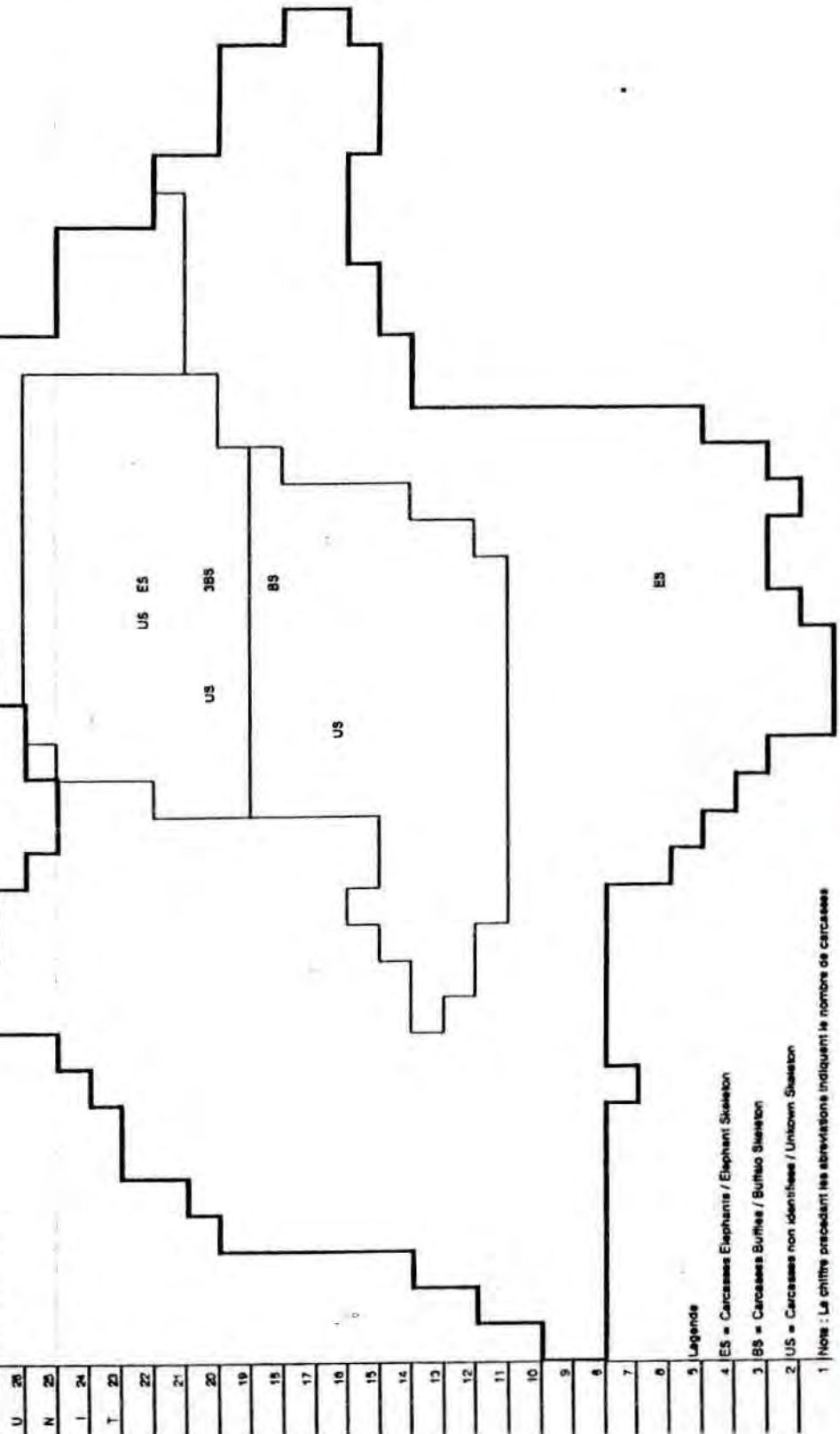
RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE

GARAMBA NATIONAL PARK, GENERAL COUNT

Types de Carcasses elephants, boeuf et non identifiés 1995

Observateurs du milieu

(Mbayna & Monungu)



1 Note : Le chiffre précédant les abréviations indiquent le nombre de carcasses

Low D
Med D
High D
Dom
Total

Low D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Med D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Legende

4 ES = Carcasses Elephants / Elephant Skeleton

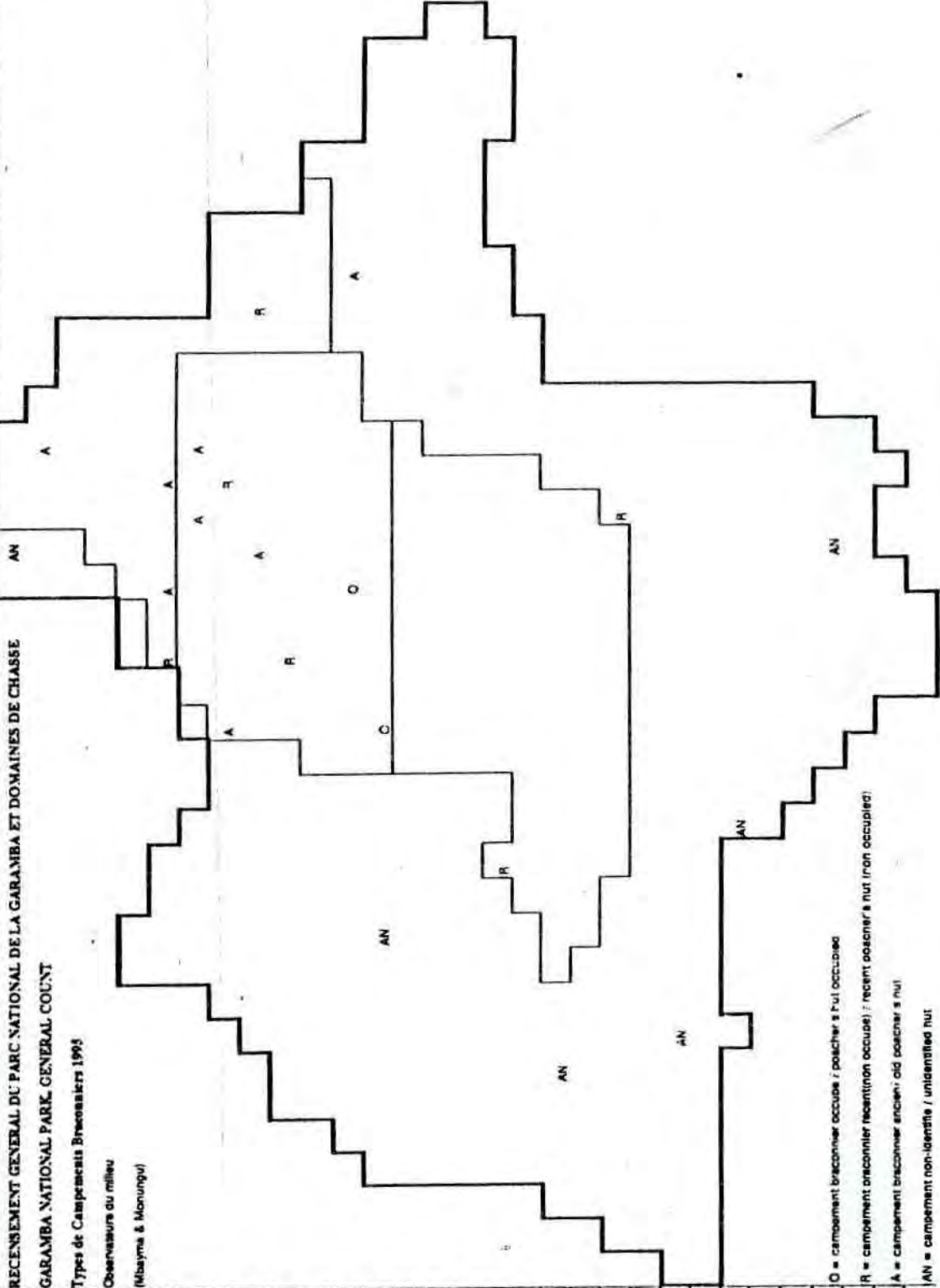
3 BS = Carcasses Buffalo / Buffalo Skeleton

2 US = Carcasses non identifiées / Unknown Skeleton

	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	26	27	28	29	30	31	32	33	34	35	36	37
--	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE
 GARAMBA NATIONAL PARK GENERAL COUNT

Types de Campements Broussiers 1995
 Observateurs du milieu
 (Mbayma & Monungu)



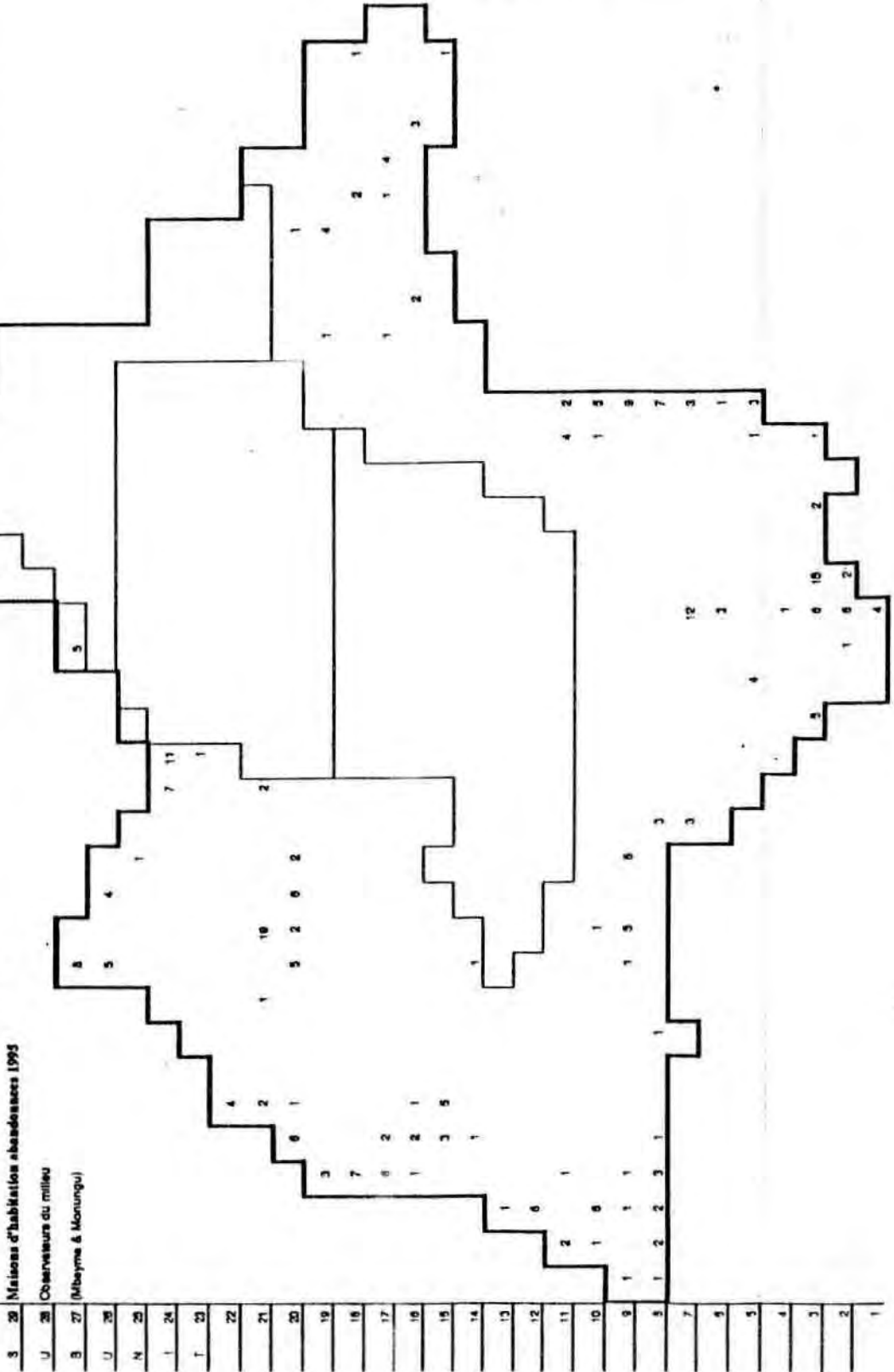
31	AN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
30	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
29	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	AN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	AN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	AN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	AN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	AN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	AN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	AN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	AN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	AN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	AN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Low D
 Med D
 High D
 Dam
 Total

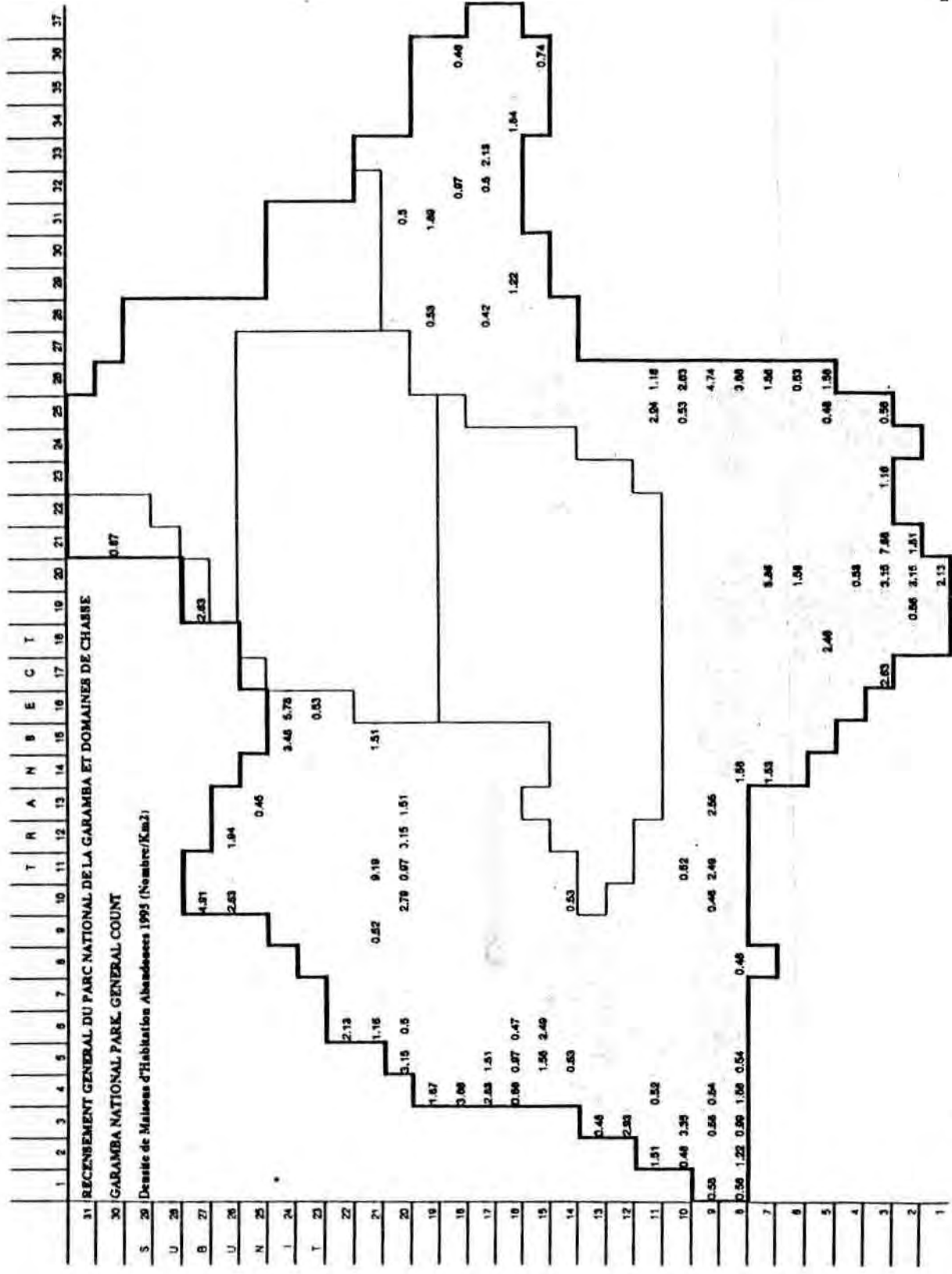
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
--	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE

GARAMBA NATIONAL PARK, GENERAL COUNT



	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	26	27	28	29	30	31	32	33	34	35	36	37	
Low D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Med D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dem	2	5	16	22	15	13	0	1	1	20	27	10	6	6	9	12	5	4	6	32	16	0	2	0	7	30	0	2	2	0	3	3	4	3	0	2	0	
Total	2	5	16	22	15	13	0	1	1	20	27	10	6	6	9	12	5	4	6	32	16	0	2	0	7	30	0	2	2	0	3	3	4	3	0	2	0	



STATISTICS

Stat	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995																
Low D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0															
Med D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0															
High D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0															
Dom	1.13	3.21	8.33	11.4	8.26	6.74	0	0.48	0.52	11.3	13.2	8.08	4.82	3.11	4.88	8.31	2.83	2.48	3.18	18.4	10.3	0	1.18	0	3.81	15.8	0	0.84	1.22	0	2.38	1.47	2.13	1.84	0	1.2	0	0.40
Total	1.13	3.21	8.33	11.4	8.26	6.74	0	0.48	0.52	11.3	13.2	8.08	4.82	3.11	4.88	8.31	2.83	2.48	3.18	18.4	10.3	0	1.16	0	3.81	15.8	0	0.84	1.22	0	2.38	1.47	2.13	1.84	0	1.2	0	0.38

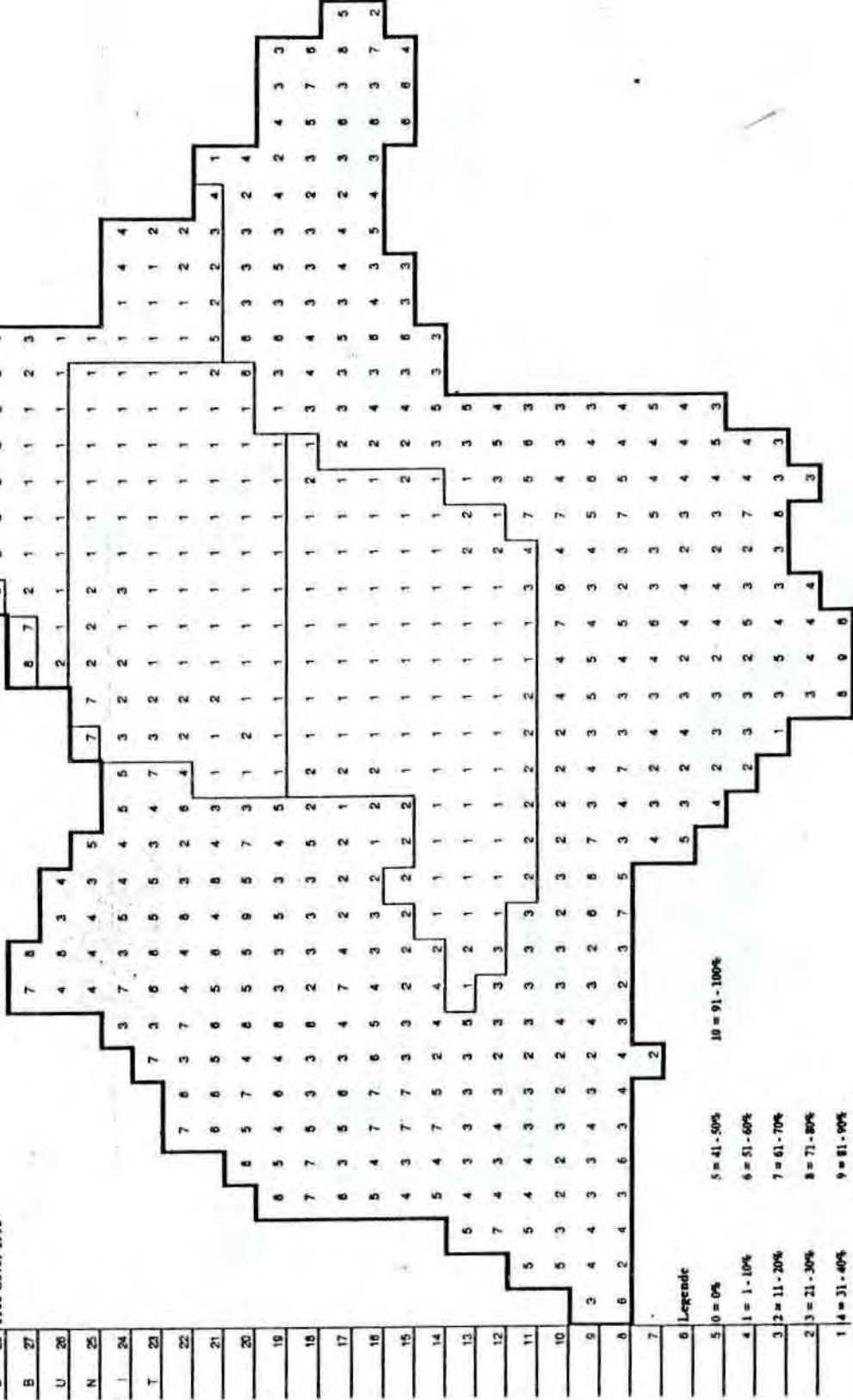
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE

GARAMBA NATIONAL PARK, GENERAL COUNT

Couverture d'Arbres 1995

Tree Cover 1995



- 5 = 41 - 50%
- 6 = 51 - 60%
- 7 = 61 - 70%
- 8 = 71 - 80%
- 9 = 81 - 90%
- 10 = 91 - 100%

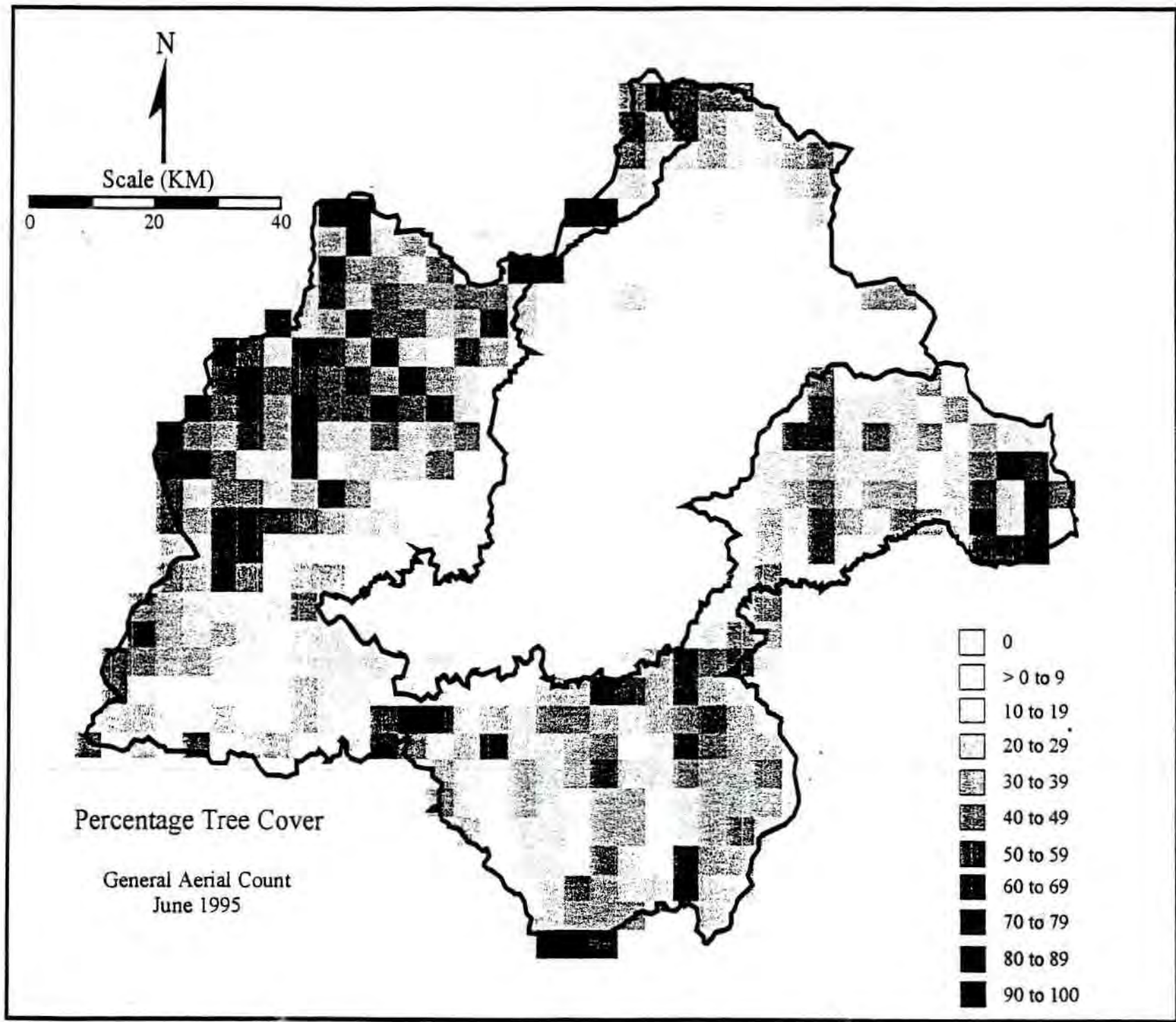
Legende

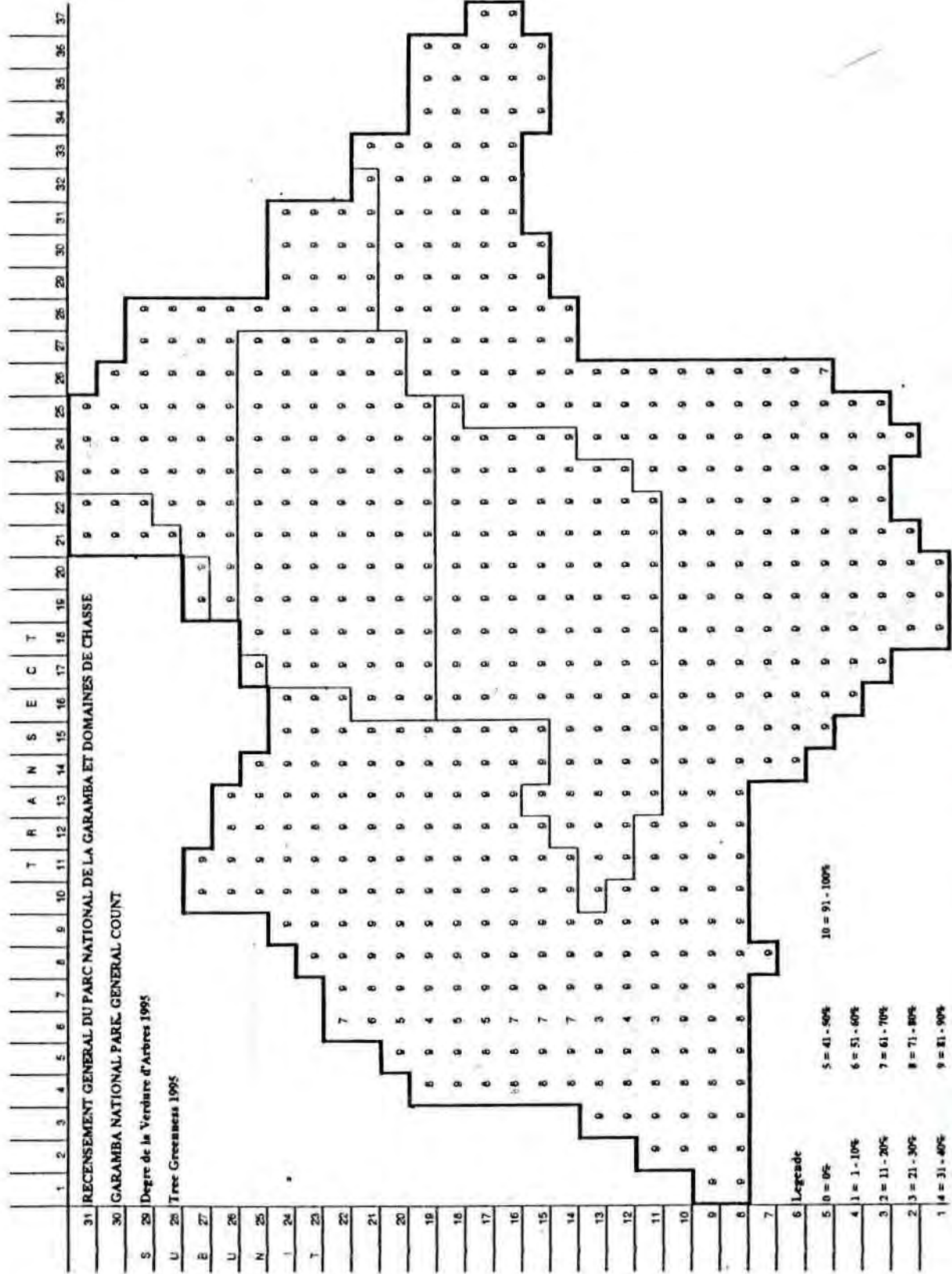
- 5 0 = 0%
- 4 1 = 1 - 10%
- 3 2 = 11 - 20%
- 2 3 = 21 - 30%
- 1 4 = 31 - 40%

Low D
Med D
High D

Dom
Total

Low D	2	1	3	4	18	17	15	11	10	22	5	9	11	4																					
Med D	9	16	28	55	73	73	57	81	78	74	71	58	60	52	37	30	38	48	58	51	37	52	46	54	19	38	18	21	18	14	16	28	22	28	7
High D	9	16	28	55	73	73	57	81	78	74	71	58	60	52	37	30	38	48	58	51	37	52	46	54	19	38	18	21	18	14	16	28	22	28	7
Dom	9	16	28	55	73	73	57	81	78	74	71	58	60	52	37	30	38	48	58	51	37	52	46	54	19	38	18	21	18	14	16	28	22	28	7
Total	9	16	28	55	73	73	57	81	78	74	71	58	60	52	37	30	38	48	58	51	37	52	46	54	19	38	18	21	18	14	16	28	22	28	7





Category	18	34	54	86	115	89	133	153	153	180	179	167	196	160	179	169	207	225	242	243	270	281	256	270	281	228	144	142	89	89	61	54	45	45	18		
Low D																																					
Med D																																					
High D																																					
Dom	18	34	54	86	115	89	133	153	153	180	179	167	196	160	179	169	207	225	242	243	270	281	256	270	281	228	144	142	89	89	61	54	45	45	18		
Total	18	34	54	86	115	89	133	153	153	180	179	167	196	160	179	169	207	225	242	243	270	281	256	270	281	228	144	142	89	89	61	54	45	45	18		

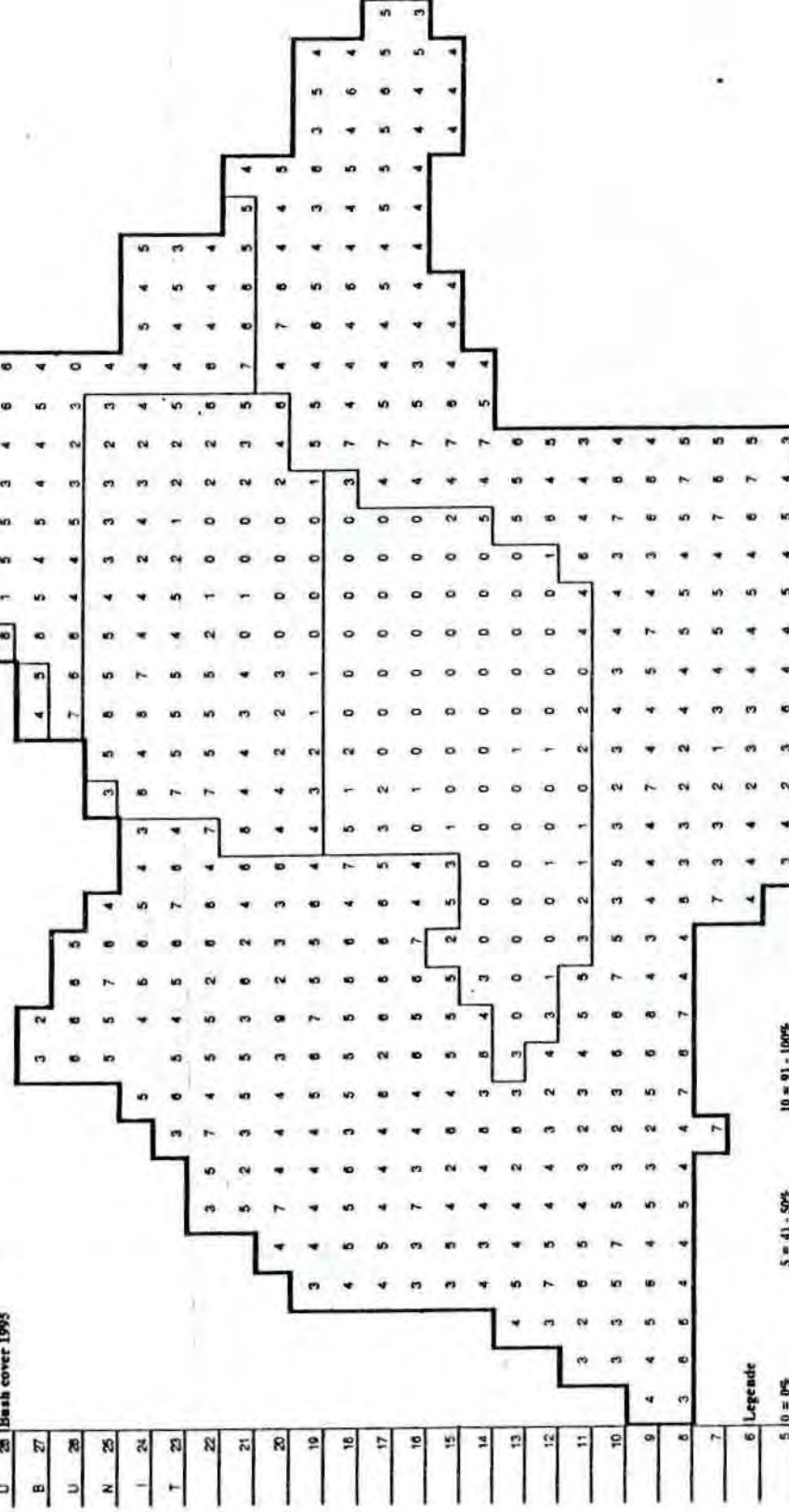
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
--	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE

GARAMBA NATIONAL PARK. GENERAL COUNT

Couverture d'Arbustes 1995

Bush cover 1995

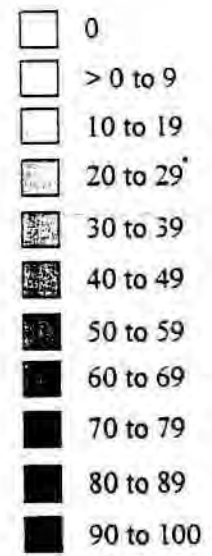
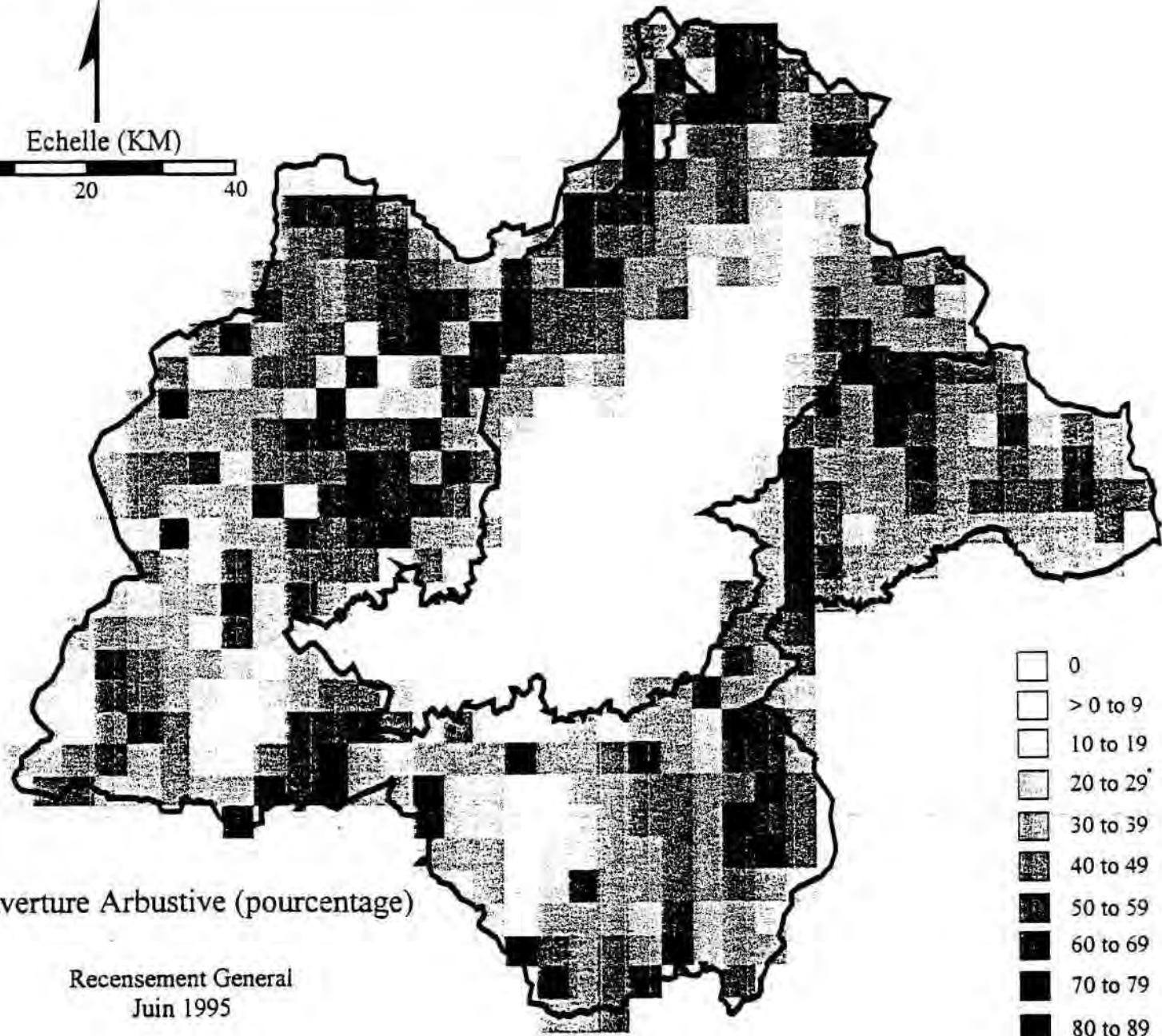
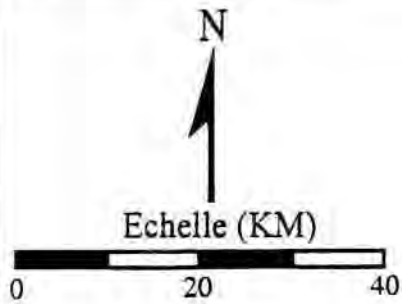


Legende

- 5 = 41 - 50%
- 10 = 91 - 100%
- 4 = 1 - 10%
- 6 = 51 - 60%
- 3 = 11 - 20%
- 7 = 61 - 70%
- 2 = 21 - 30%
- 8 = 71 - 80%
- 1 = 31 - 40%
- 9 = 81 - 90%

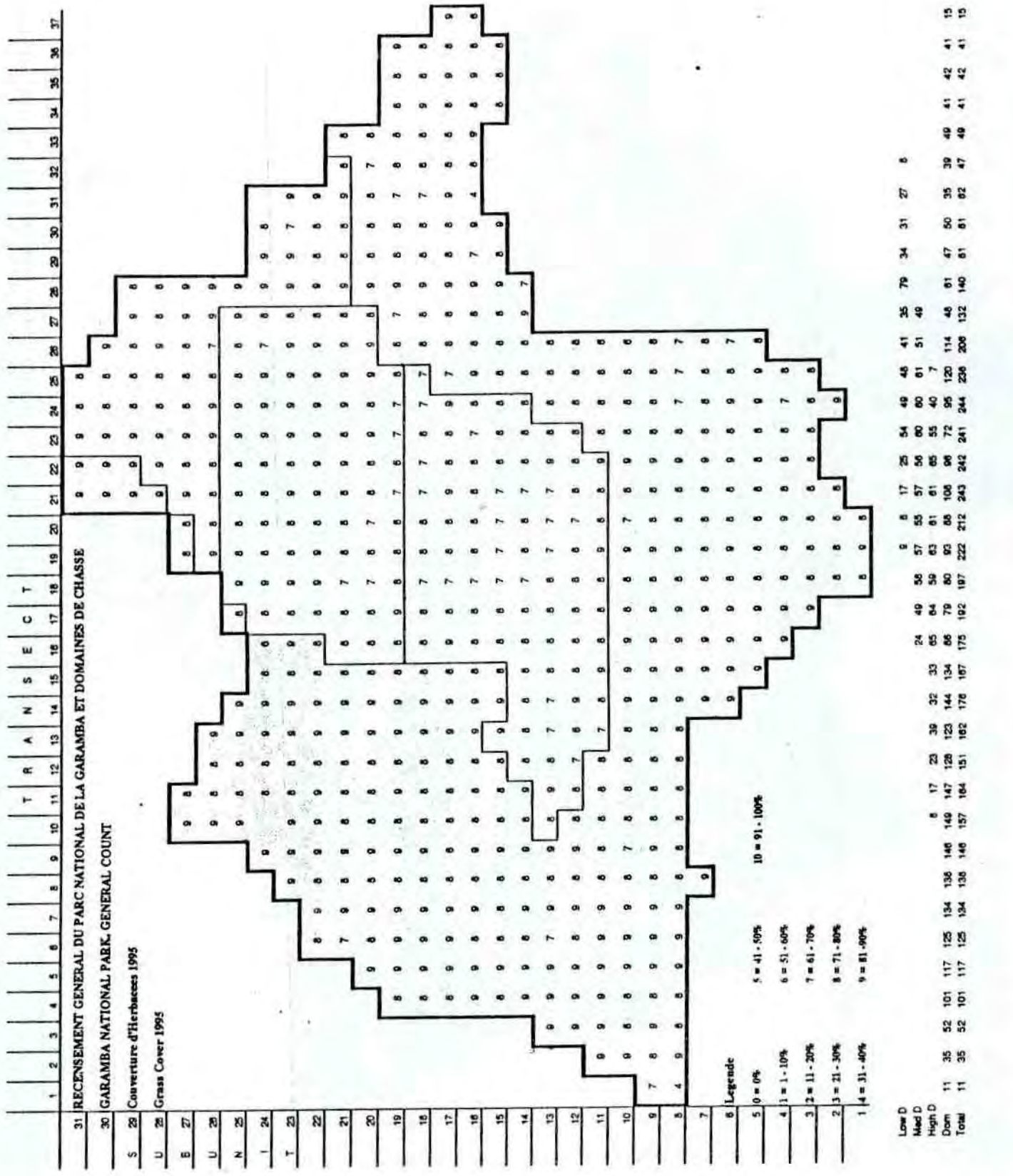
Low D
Med D
High D

7	16	23	54	58	70	53	72	76	86	96	65	70	82	71	36	30	36	44	46	66	56	34	64	72	80	30	27	28	30	20	20	29	20	25	22	6
7	16	23	54	58	70	53	72	76	91	99	86	75	84	73	64	85	69	78	84	96	85	70	116	118	114	76	87	48	40	37	25	20	20	25	22	8



Couverture Arbustive (pourcentage)

Recensement General
Juin 1995



RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE

GARAMBA NATIONAL PARK GENERAL COUNT

Couverture d'Herbaces 1995

Grass Cover 1995

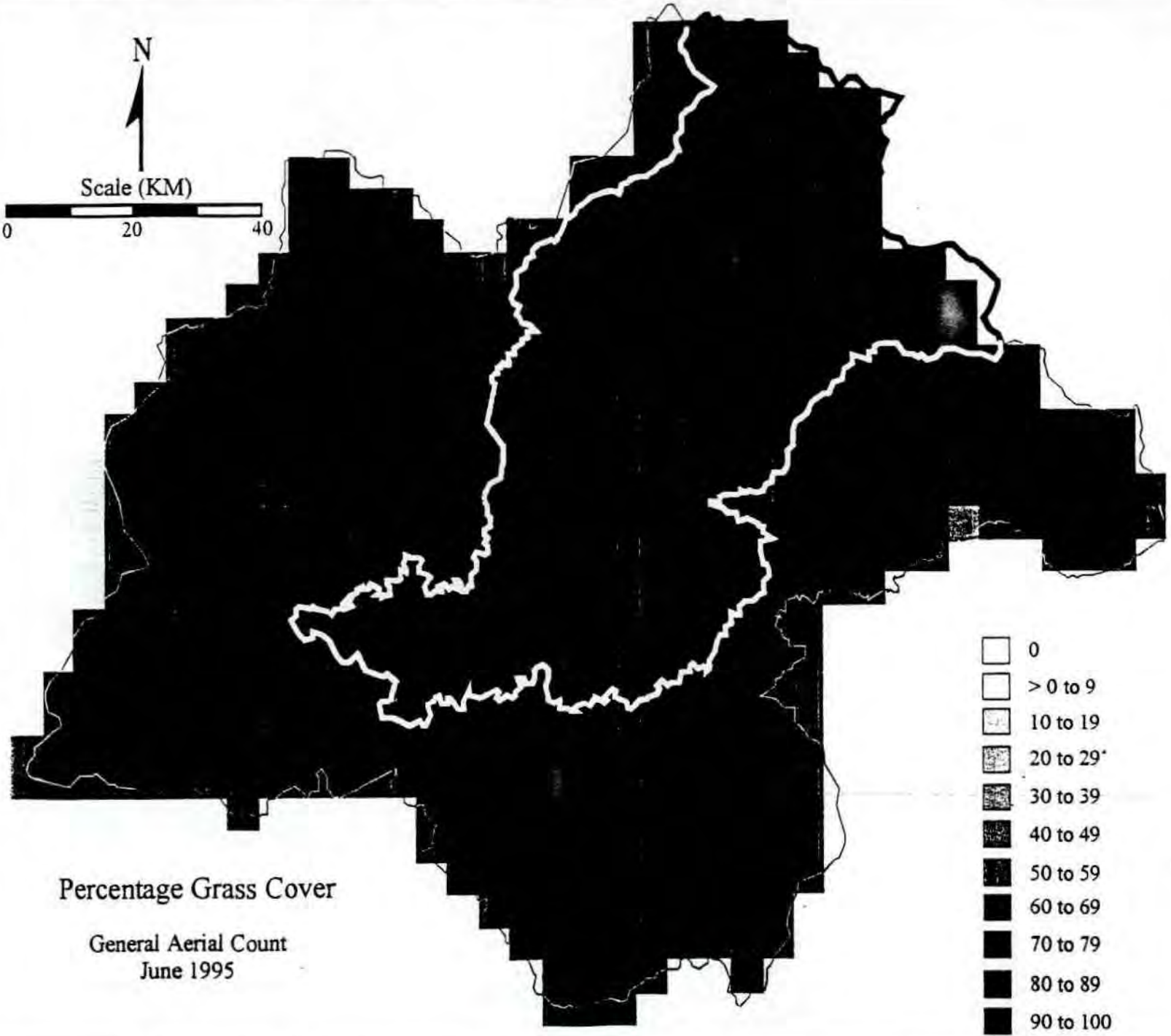
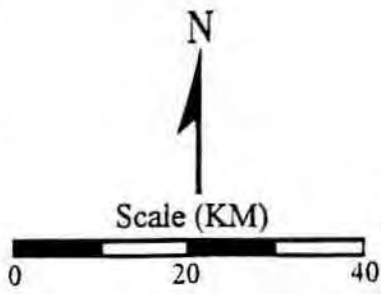
- 5 = 41 - 50%
- 6 = 51 - 60%
- 7 = 61 - 70%
- 8 = 71 - 80%
- 9 = 81 - 90%
- 10 = 91 - 100%

Legend

5	0 = 0%
4	1 = 1 - 10%
3	2 = 11 - 20%
2	3 = 21 - 30%
1	4 = 31 - 40%

Low D
Med D
High D
Dom
Total

11	35	52	101	117	125	134	136	140	140	147	128	123	144	134	66	79	80	93	86	100	96	72	95	120	114	46	61	47	50	35	39	49	41	42	41	15
11	35	52	101	117	125	134	136	140	140	157	164	151	162	176	167	175	192	187	222	212	243	242	241	244	208	132	140	61	61	62	47	49	41	42	41	15

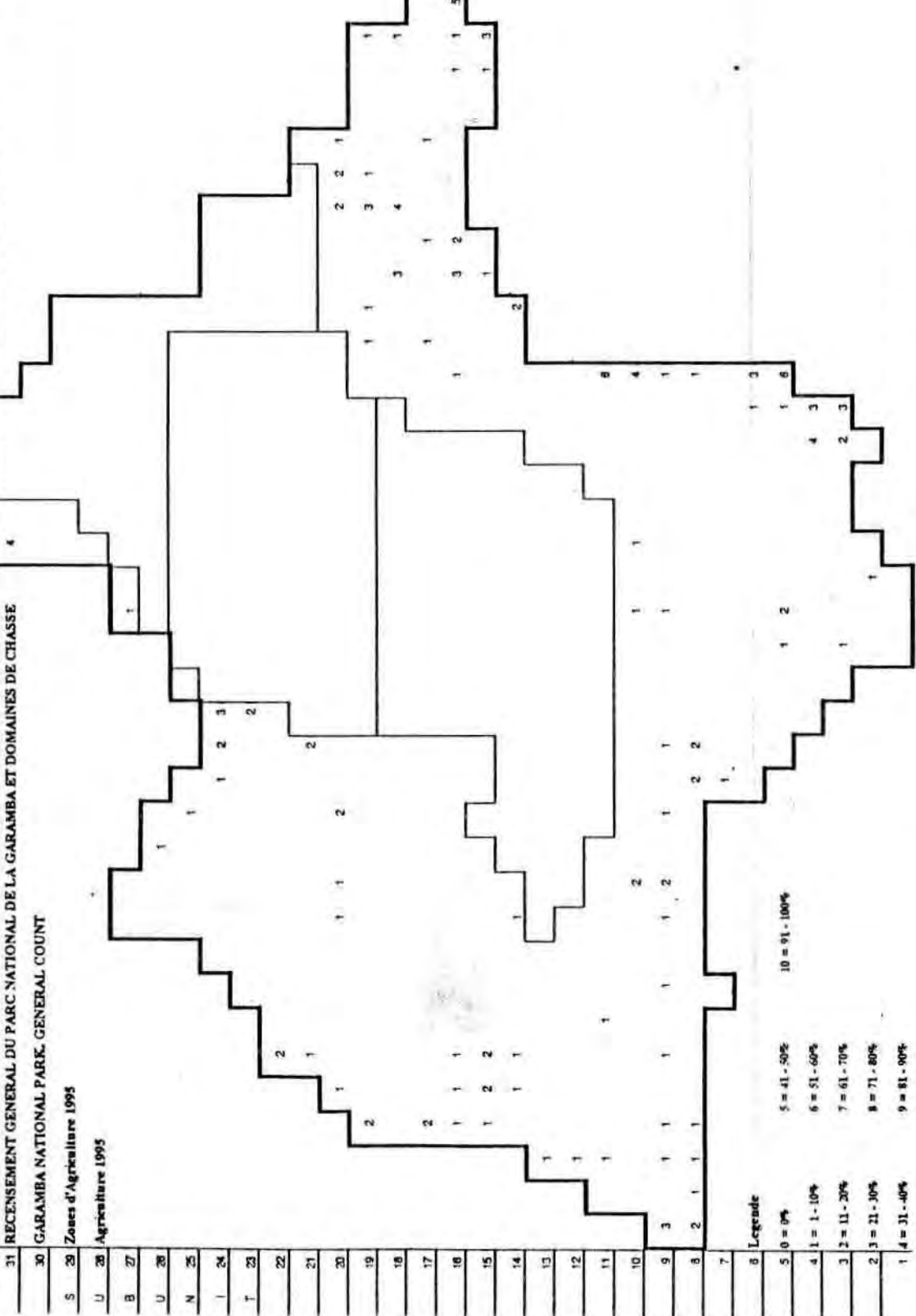


- 0
- > 0 to 9
- 10 to 19
- 20 to 29
- 30 to 39
- 40 to 49
- 50 to 59
- 60 to 69
- 70 to 79
- 80 to 89
- 90 to 100

Percentage Grass Cover

General Aerial Count
June 1995

	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	26	27	28	29	30	31	32	33	34	35	36	37
--	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----



RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE
 GARAMBA NATIONAL PARK GENERAL COUNT

S 28 Zones d'Agriculture 1995
 U 26 Agriculture 1995

- 5 = 41 - 50%
- 6 = 51 - 60%
- 7 = 61 - 70%
- 8 = 71 - 80%
- 9 = 81 - 90%
- 10 = 91 - 100%

Low D
 Med D
 High D
 Dom
 Total

Low D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Med D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
High D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dom	5	1	5	8	5	8	1	1	0	3	5	1	4	4	7	5	0	2	5	1	5	0	0	8	8	22	2	3	7	3	9	3	2	0	2	8	5	5		
Total	5	1	5	8	5	8	1	1	0	3	5	1	4	4	7	5	0	2	5	1	5	0	0	8	8	22	2	3	7	3	9	3	2	0	2	8	5	5		

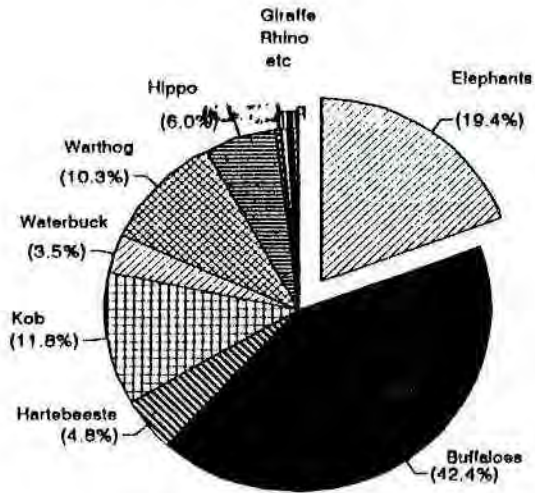
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37			
31	RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE																																							
30	GARAMBA NATIONAL PARK GENERAL COUNT																																							
S	Disponibilité en cas 1995																																							
U	Water availability 1995																																							
B	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2			
U	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		
N	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		
I	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4		
T	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4		
22	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		
21	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
20	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
19	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
18	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
17	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
16	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
15	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
14	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
13	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
12	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
11	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
10	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
9	3	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
8	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
7	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
6	4	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

Low D	2	2	4	7	14	15	16	12	8	21	6	9	8	2																							
Med D	7	14	21	16	22	19	20	22	23	14	15	21																									
High D	4	7	9	14	13	14	27	26	27	26	24	20	15	2																							
Dem	5	12	14	30	30	37	40	46	40	34	30	40	36	20	32	26	25	16	27	35	36	15	17	12	14	9	10	12	10	10	10	10	10	10	10	10	4
Total	5	12	14	30	30	36	37	40	46	50	47	43	44	53	52	56	60	60	71	79	83	76	77	60	67	65	44	36	20	23	17	12	12	10	10	10	4

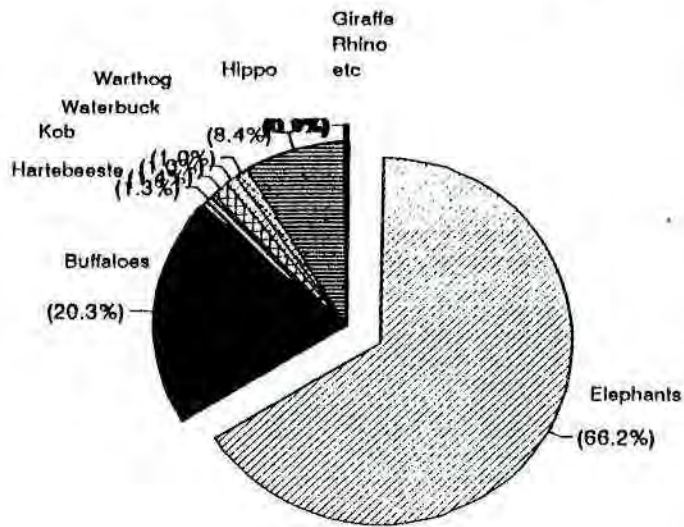
RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBIA ET DOMAINES DE CHASSE ,JUN 1995

SINGE VERVET				CROCODILE				MAISONS D'HABITATION				MAISONS D'HABITATION ABAN				
LOW	MID	HIGH	DOM	LOW	MID	HIGH	DOM	LOW	MID	HIGH	DOM	LOW	MID	HIGH	DOM	TOTAL
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	385
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	104
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	140
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	151
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	134
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	181
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	51
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	440
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	88
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44
0.0	0.0	0.0	1.0	1.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2847.0
0.0	0.0	0.0	1.0	1.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	487983.0
0.0	0.0	0.0	24.8	56.6	0.0	11.8	0.0	0.0	0.0	43.0	0.0	0.0	0.0	0.0	0.0	50429.9
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8
0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8294.9
0.0	0.0	0.0	0.1	0.7	0.0	-0.0	0.0	0.0	0.0	0.34	0.0	0.0	0.0	0.0	0.0	-108.57
SINGE VERVET				CROCODILE				MAISONS D'HABITATION				MAISONS D'HABITATION ABANDONNEES				
0	0	0	13	13	0	13	0	0	0	13	13	0	0	0	0	34.718
0.0	0.0	0.0	12.7	12.4	0.0	13.16	0.0	0.0	0.0	13.16	13.16	0.0	0.0	0.0	0.0	8501.42
0.0	0.0	0.0	25.4	24.8	0.0	28.72	0.0	0.0	0.0	25.72	25.86	0.0	0.0	0.0	0.0	17342.91
ERR	ERR	ERR	186.9	181.5	ERR	188.35	ERR	ERR	ERR	183.87	180.57	ERR	ERR	ERR	ERR	48.86
TOTAL				TOTAL				TOTAL				TOTAL				
0	0	0	13	13	0	13	0	0	0	13	13	0	0	0	0	34.718
0.0	0.0	0.0	12.7	12.4	0.0	13.16	0.0	0.0	0.0	13.16	13.16	0.0	0.0	0.0	0.0	8501.42
0.0	0.0	0.0	25.4	24.8	0.0	28.72	0.0	0.0	0.0	25.72	25.86	0.0	0.0	0.0	0.0	17342.91
ERR	ERR	ERR	186.9	181.5	ERR	188.35	ERR	ERR	ERR	183.87	180.57	ERR	ERR	ERR	ERR	48.86
0.0	0.0	0.0	13	13	0	13	0	0	0	13	13	0	0	0	0	34.718
0.0	0.0	0.0	12.7	12.4	0.0	13.16	0.0	0.0	0.0	13.16	13.16	0.0	0.0	0.0	0.0	8501.42
0.0	0.0	0.0	25.4	24.8	0.0	28.72	0.0	0.0	0.0	25.72	25.86	0.0	0.0	0.0	0.0	17342.91
ERR	ERR	ERR	186.9	181.5	ERR	188.35	ERR	ERR	ERR	183.87	180.57	ERR	ERR	ERR	ERR	48.86
0.0	0.0	0.0	13	13	0	13	0	0	0	13	13	0	0	0	0	34.718
0.0	0.0	0.0	12.7	12.4	0.0	13.16	0.0	0.0	0.0	13.16	13.16	0.0	0.0	0.0	0.0	8501.42
0.0	0.0	0.0	25.4	24.8	0.0	28.72	0.0	0.0	0.0	25.72	25.86	0.0	0.0	0.0	0.0	17342.91
ERR	ERR	ERR	186.9	181.5	ERR	188.35	ERR	ERR	ERR	183.87	180.57	ERR	ERR	ERR	ERR	48.86
0.0	0.0	0.0	13	13	0	13	0	0	0	13	13	0	0	0	0	34.718
0.0	0.0	0.0	12.7	12.4	0.0	13.16	0.0	0.0	0.0	13.16	13.16	0.0	0.0	0.0	0.0	8501.42
0.0	0.0	0.0	25.4	24.8	0.0	28.72	0.0	0.0	0.0	25.72	25.86	0.0	0.0	0.0	0.0	17342.91
ERR	ERR	ERR	186.9	181.5	ERR	188.35	ERR	ERR	ERR	183.87	180.57	ERR	ERR	ERR	ERR	48.86

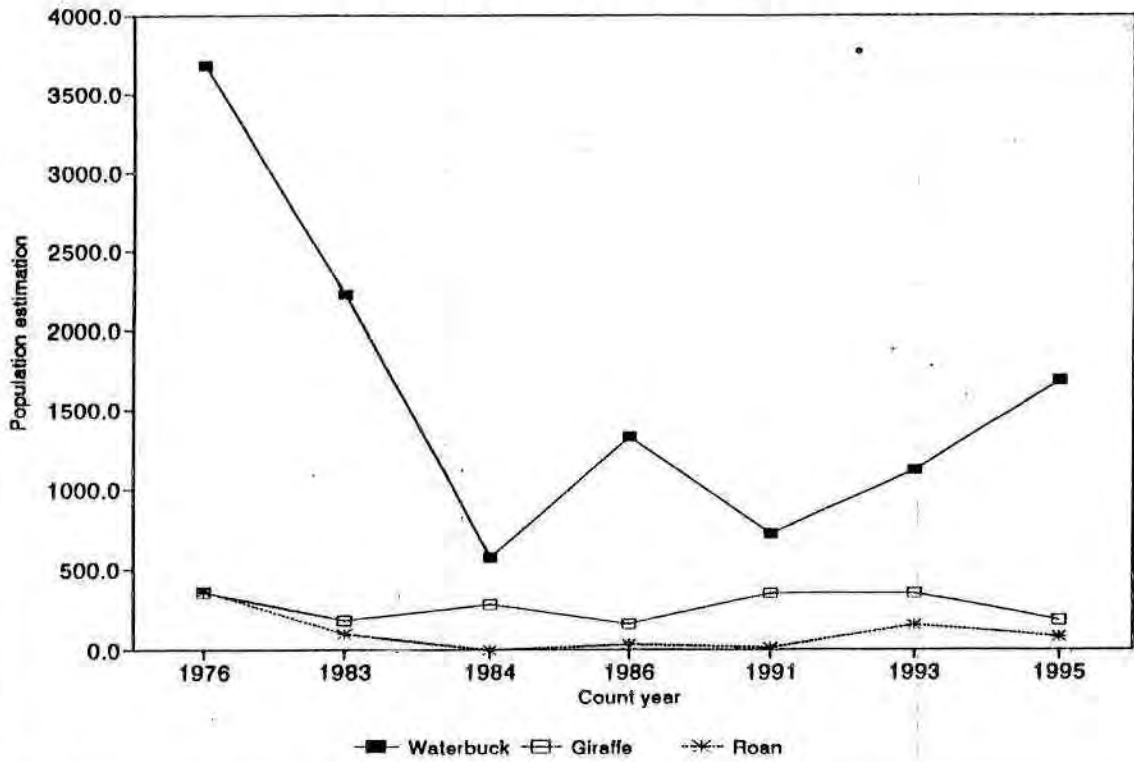
**PARC NATIONAL DE LA GARAMBA
LARGE MAMMAL NUMBERS 1995**



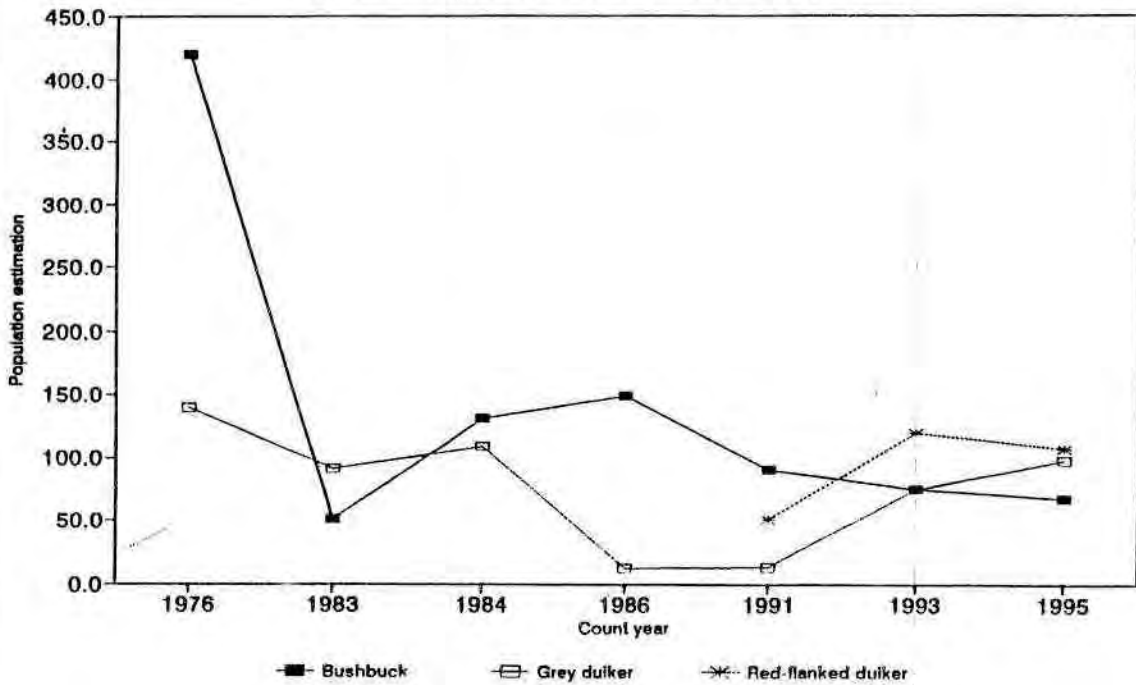
**PARC NATIONAL DE LA GARAMBA
LARGE MAMMAL BIOMASSES 1995**



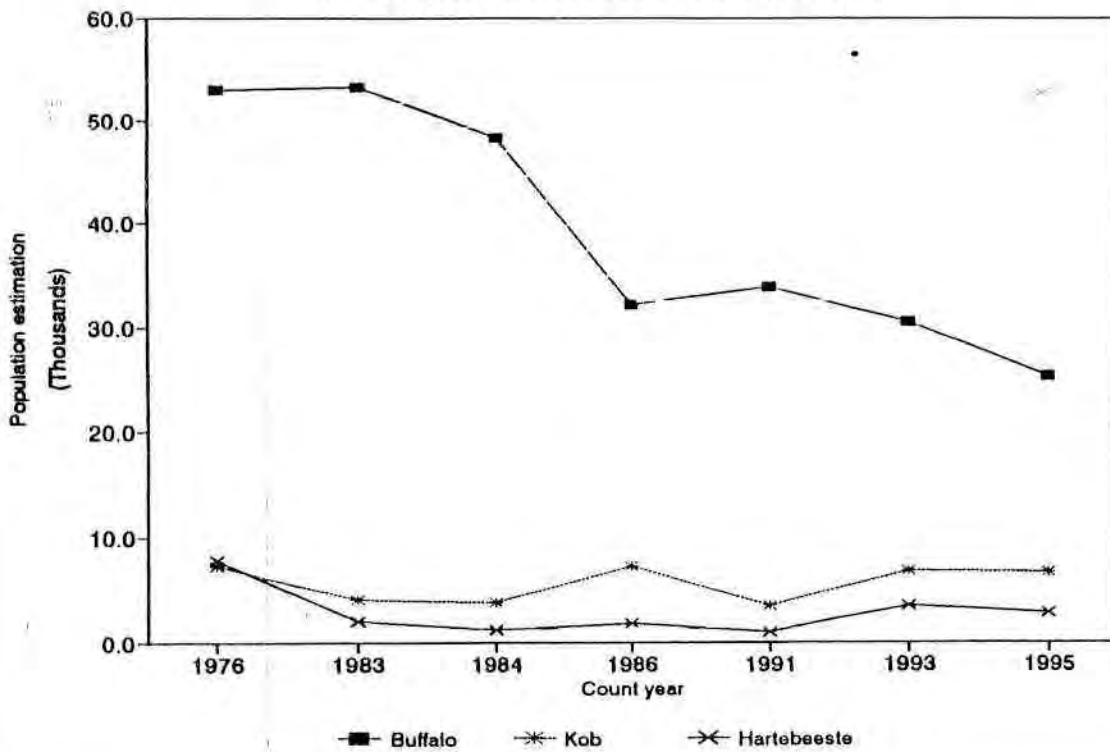
PARC NATIONAL DE LA GARAMBA
WATERBUCK, GIRAFFE, ROAN



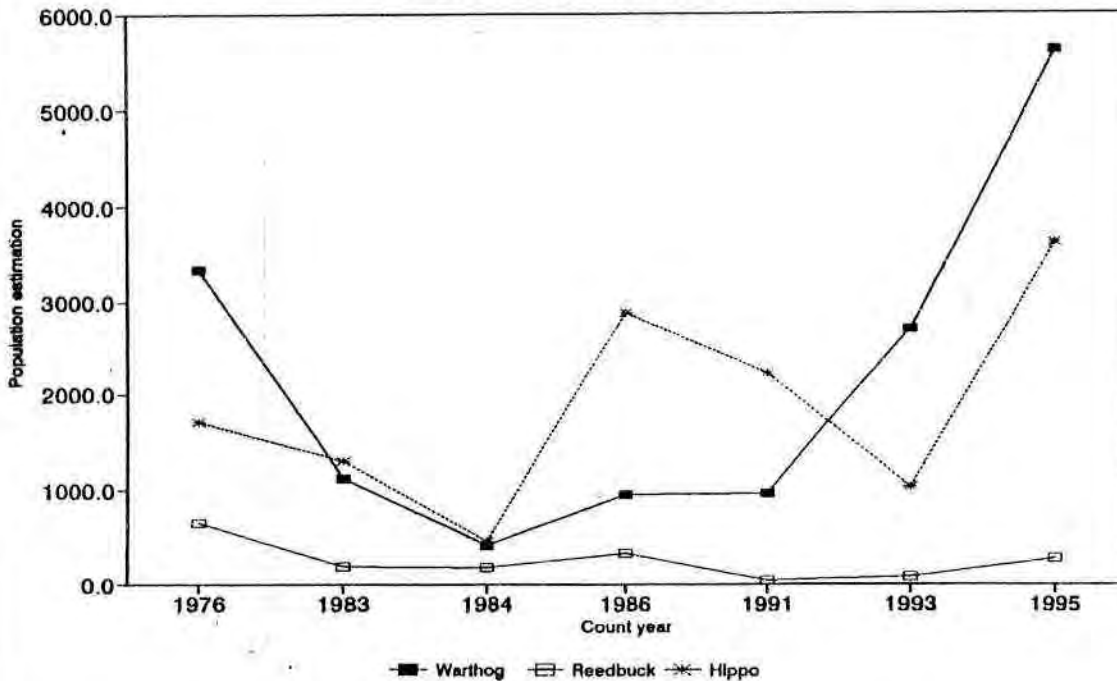
PARC NATIONAL DE LA GARAMBA
BUSHBUCK, GREY & RED-FLANKED DUIKERS



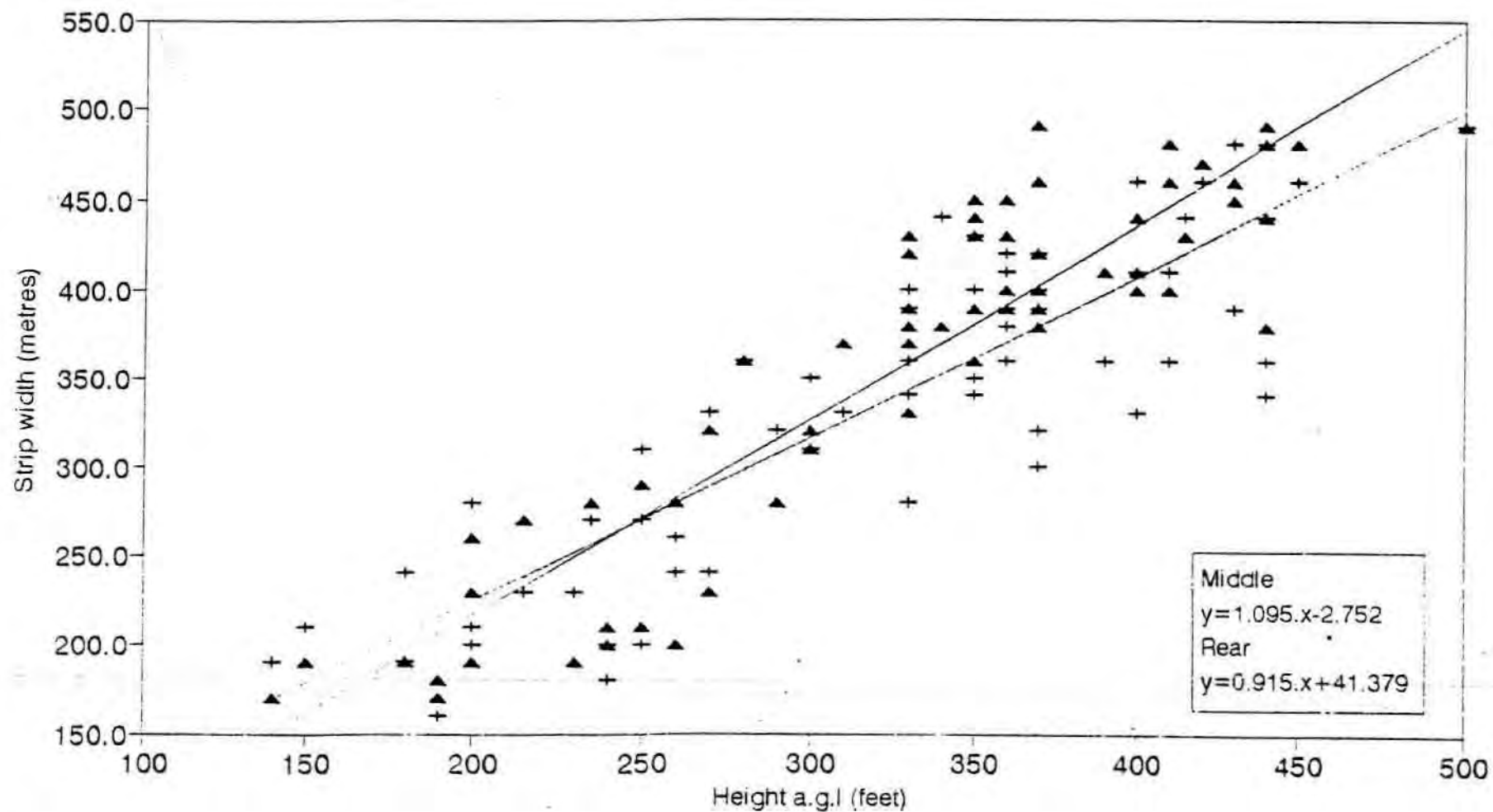
PARC NATIONAL DE LA GARAMBA
BUFFALO, KOB & HARTEBEESTE POPULATIONS



PARC NATIONAL DE LA GARAMBA
WARTHOG, HIPPO & REEDBUCK POPULATIONS



P.N.G. RECENSEMENT GENERAL 1995 CALIBRATIONS



Middle
 $y=1.095.x-2.752$
Rear
 $y=0.915.x+41.379$

▲ Middle seat (L+R) + Rear seat (L+R) — Regression middle - - - Regression rear

	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	26	27	28	29	30	31	32	33	34	35	36	37																															
31	RECEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE																				2.18	2.01	2.01	2.07	1.9																																											
30	GARAMBA NATIONAL PARK, GENERAL COUNT																				2.23	2.16	1.79	1.9	1.85	1.9																																										
5	Arree per sub-unit 1995																				2.07	1.9	1.35	1.96	1.9	1.62	2.07	2.18																																								
U																					1.9	1.65	2.18	1.9	1.62	1.79	2.29	2.07																																								
B																					1.62	2.12															1.9	2.01	2.18	1.9	1.9	1.9	1.74	2.01																								
U																					1.9	2.01	2.07	2.23															1.9	1.74	2.07	1.9	2.07	1.9	2.01	1.74	1.9	1.9																				
M																					1.9	2.01	1.8	2.23	1.98															1.79	1.79	2.18	1.79	1.9	1.96	2.01	1.9	1.74	1.92	1.63	1.9																	
1																					1.79	1.79	2.23	2.12	1.74	1.74	2.01	1.9	1.96	1.79	1.9	1.62	1.9	1.9	1.79	1.62	1.74	2.01	1.79	1.9	1.65	1.74	2.18																									
7																					1.9	2.07	1.62	1.9	1.9	2.07	1.9	1.96	1.9	1.74	1.9	1.9	1.85	2.07	1.79	1.74	1.85	1.96	1.74	2.01	1.62	0.15	1.68	1.9																								
22																					1.9	1.9	1.74	1.98	1.74	1.76	1.92	1.9	1.85	1.96	1.79	2.24	2.01	1.79	2.07	2.18	1.62	1.9	1.79	1.9	1.69	1.62	1.74	1.79	1.9																							
21																					1.74	1.79	2.01	1.96	1.72	2.07	1.98	1.9	1.9	1.9	1.69	1.9	1.85	2.07	1.9	1.74	1.19	1.62	1.9	1.9	2.01	1.74	1.62	1.79	1.96	2.07	2.41	1.79																				
20																					1.9	2.01	1.9	1.96	1.9	1.79	2.07	1.9	1.9	1.9	1.62	2.01	1.85	1.74	1.9	1.74	1.65	1.74	1.62	1.74	1.68	1.79	2.01	2.07	1.74	2.01	1.9	1.62																				
14																					1.78	1.78	1.96	2.01	1.62	1.74	1.85	1.79	1.9	2.4	1.9	1.62	1.65	1.62	1.74	1.79	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	2.01	2.01	2.12	1.79	1.9	1.96	2.16	2.07																
18																					1.9	1.85	1.9	1.9	1.96	2.01	2.01	1.79	1.9	1.85	1.79	1.68	1.9	1.96	1.79	1.62	2.01	1.96	1.74	1.92	1.9	1.74	1.9	1.9	1.78	1.9	1.96	2.01	2.07	1.96	1.78	2.12	2.18															
17																					2.12	1.9	1.96	1.9	1.9	1.96	2.07	2.12	2.07	1.62	2.01	1.96	1.96	1.74	1.74	1.99	1.99	1.99	2.07	1.62	1.79	1.9	1.96	1.79	2.4	1.96	1.9	2.23	2.01	1.9	2.16	1.96	2.01	1.68														
16																					1.79	2.07	2.12	1.9	1.79	1.74	1.85	1.9	1.92	1.9	2.01	1.9	2.07	1.62	1.68	2.07	1.74	1.9	1.92	1.9	1.74	1.74	1.99	1.79	1.62	1.96	1.79	1.65	1.9	2.18	1.62	1.96	1.9	1.74														
15																					1.62	1.9	2.01	1.9	1.9	1.9	2.07	1.74	1.74	1.96	1.9	1.62	1.9	1.96	1.62	2.01	1.96	1.96	1.62	1.79	1.74	1.99	1.62	2.4	1.74	1.9																						
14																					1.9	1.9	1.9	1.74	2.07	1.74	1.9	2.07	1.74	1.79	1.85	1.79	2.01	2.01	1.9	1.62	1.74	1.62	1.65	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9										
13																					2.07	1.9	2.12	1.79	2.07	1.65	2.01	1.74	1.9	1.96	1.65	1.79	1.9	1.74	1.62	1.9	1.79	2.01	1.25	1.74	1.62	1.74	1.9	1.62																								
12																					2.07	1.96	2.18	1.48	1.96	1.96	1.9	1.62	1.19	1.9	1.92	1.96	1.79	2.18	1.79	1.9	1.85	2.18	1.62	2.4	1.79	2.01	1.74	2.16																								
11																					1.9	2.01	1.96	1.96	2.07	1.74	2.18	2.07	1.96	1.96	1.95	1.79	1.68	2.01	2.07	2.01	2.07	1.96	1.62	1.9	1.9	1.74	1.99	1.74																								
10																					2.07	1.79	1.9	1.96	1.9	1.96	1.62	2.01	2.23	1.96	1.9	1.85	1.9	2.07	1.62	1.62	1.96	1.79	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9											
9	1.74	1.9	1.74	1.85	1.9	1.79	1.9	1.74	1.72	2.18	2.01	2.29	1.96	1.65	1.72	1.9	1.9	2.24	1.9	2.12	1.74	1.96	2.01	1.9	2.58	1.9																																										
8	1.78	1.96	2.01	1.9	1.85	1.96	1.9	2.07	1.79	2.18	2.12	1.9	1.62	1.9	1.62	1.62	1.9	1.96	1.96	1.97	1.62	1.62	2.12	1.48	1.79	1.9																																										
7																					1.96	1.9	2.12	1.9	1.96	1.9	2.07	1.62	1.9	2.12	1.9	2.18	1.9	1.96	1.92	1.9	1.96	1.92	1.9	1.96	1.92	1.9	2.18	1.9	1.96	1.92	1.9																					
6																					1.74	1.74	1.9	1.62	1.9	2.07	2.01	1.9	1.96	1.9	2.07	1.9	1.96	1.92	1.9	1.96	1.92	1.9	1.96	1.92	1.9	2.07	1.9																									
5																					1.9	1.96	1.9	1.9	1.9	2.01	1.74	1.65	1.79																																							
4																					1.62	1.19	1.9																																													
3																					1.85	1.19	1.9																																													

ARE TOTALE ECHANTILLONNEE

TOTAL AREA SAMPLED

342 km2

Low																						1.9	1.74	2.12	1.96	1.92	1.94	1.87	1.79	2	1.88	1.4	1.79	2.01	2.45		
Med																							1.65	1.92	1.92	1.91	1.97	1.92	1.94	1.82	1.78	1.94	1.9	1.77			
High																							1.74	1.79	1.92	1.91	1.75	1.9	1.8	1.4	1.9	1.4	1.9	2	1.74		
Sum	3.92	3.88	11.7	22.4	25.2	29.9	18.5	12.2	22.3	26.1	19.9	27.1	20.1	29.6	18.5	17.2	18.8	19.9	21.2	14.8	21.2	17.3	22.4	18.7	28	10.6	14.1	11.6	12.2	10.2	9.08	11.4	7.48	10.1	9.51	2.42	
Mean	3.92	3.88	11.7	22.4	25.2	29.9	18.5	12.2	22.3	26.1	19.9	27.1	20.1	29.6	18.5	17.2	18.8	19.9	21.2	14.8	21.2	17.3	22.4	18.7	28	10.6	14.1	11.6	12.2	10.2	9.08	11.4	7.48	10.1	9.51	2.42	

ANALYSIS

Outline

Analysis was carried out in QuattroPro according to the method described in detail in Watkin et al (1995) and Hillman Smith et al (1995). The method is based on entering the animal and habitat observations and the altitudes per sub-unit onto separate versions of a spreadsheet, which is laid out like a map of the census zone, in which each cell represents a subunit. This was printed directly, to map the distribution of animal observations, and with conversion, to map density distributions. Habitat data was entered in the same way. To produce the shaded mapping it was transferred to Idrisi. The overlay map of the park and reserves was created in ArcInfo and they were combined in Coreldraw.

A graph of strip width calibrations was created in Quattro and the resulting regression applied to the map of altitudes per sub-unit. This enables transect width correction per sub-unit, as opposed to an average applied to whole transects as previously. Superimposition of this on the map of animal observations calculates the densities. Within the map spreadsheet the transect and strata totals are summed and these data were transposed to a second spreadsheet, which was laid out with the formulae from Jolly (1969) and Norton Griffiths (1978) for calculating population estimates and confidence limits. This is printed directly with the details of the observed numbers, stratified population estimates and confidence limits.

RESULTS

The **Summary Table** gives population totals and stratified totals, densities and biomasses. The weights used to calculate the biomasses were those used by Savidge et al (1976), Haltenorth & Diller (1977) and d'Huart (1978).

The following maps and tables show the distribution and density distributions of the parameters measured, and the stratified estimated populations with confidence limits.

A small group usually occupies the region near to Source Nauloko each short grass season, and apart from that scattered observations are made from time to time.

Bushbuck

The population estimate for bushbuck is undoubtedly lower than the true population. They are very cryptic, preferring relatively thick bush near to water courses. The apparent reduction or lack of increase in numbers in the last two counts may be associated with lower visibility from a count later in the year than previously. From the ground, however they are fairly frequently seen and Nicholas (1995) found that they were the most numerous small antelope in the Domaines.

Oribi

No oribi were seen on this count and only 90 were estimated in 1993, but this is probably due to the fact that both counts were made slightly later than others, when the grass was over half a metre tall. Their population estimate will probably always be lower than the actual, since they are small and not easily seen. Verschuren in 1989 (pers.comm) had a strong impression that Oribi had increased since the 1950s, but he conceded that it might have been the effect of more open vegetation.

Duikers

Population estimates for duikers will be minimal, since they are small and not easily seen. Grey duikers are mainly found within the park, but two were seen outside. Their population estimates do not show significant change over time. Red-flanked duikers are found more in the wooded areas to the north of the park and in the Domaines. No Yellow-backed duikers were seen on this count, but they have previously been seen from the air in wooded areas to the north and in the Domaines de Chasse. Figures within the park were apparently higher in the 1993 and 1995 counts despite lower visibility overall. This could be associated with the increasing woody vegetation in the north.

Warthog

The warthog population was estimated at 3340 ± 1440 in 1976. By 1983 it was 1348 ± 244 . It apparently dropped below 1000 in the period between 1983 and 1993, when it had again risen to over 3000. This year it was estimated at 6249 ± 2546 .

These major changes are supported by personal observation. When the first author visited Garamba in 1980, the apparent warthog density was the highest seen anywhere. When the project started in 1984, there was hardly a warthog to be seen, a fact that was remarked on by many long term residents of the region. One suggestion mooted for the decline was lion predation, but it was more likely to be an epidemic. Warthog probably go into their burrows to die and carcasses would not often be noted. This year, in the course of field work we had been remarking on the huge numbers of warthog everywhere, and this observations was thoroughly vindicated by the count results. What it means in terms of population cycles will have to be assessed in the longer term.

Lion and Hyena

Lion and Hyena are both relatively plentiful predators, but are not easily counted by aerial sample counts and their population estimates are definitely lower than true values. Only a few days ago we watched 7 hyenas on a single kill, and I have seen 13 lions together in one group from the air. Other means will have to be found to estimate their populations if it is sufficient priority to do so.

Monkeys, baboons and crocodiles

No reliance is placed on these population estimates that were based on chance sightings. Crocodiles are very plentiful.

Other species

Some species occur only or more commonly in the Domaines or the very north of the park, such as the chimpanzee (*Pan troglodytes*), giant forest hog, bushpig, leopard and two of the duiker species. Other valuable species, like Bongo (*Tragelaphus euryceros*) have been reported only from the Domaines de Chasse (Nicholas 1995) and a Derby's Eland was once observed walking through the park from the Domaines. These differences are largely due to habitat differences as can be seen from the vegetation maps. However, they add weight to the fact that the Domaines and Park support complementary and different habitats and both need to be considered to maintain maximum biodiversity of the ecosystem as a whole.

Vegetation

The vegetation maps show the clear differentiation between the wooded reserves and the grassland savanna of the south of the park. The southern half of the park is long grass savanna dominated by *Loudetia arundinacea* and *Hyparrhenia* species, with scattered *Kigelia africana* and *Vitex doniana* trees. Relict gallery forest and riverine trees add further to the sparse tree cover in the south. A few areas of sparse tree savanna usually dominated by *Crossopteryx febrifuga* exist. They appear to be relicts of a more wooded savanna in the past. They are not favoured by elephants and are usually on patches of shallow soil, where the effect of fire may be less due to reduced grass cover. *Crossopteryx* has also been found in Lope Reserve in Gabon to be the relict species remaining in savanna that has in the past been forested (White L. pers.comm). Areas of regenerating bush in the centre of the park are usually dominated by *Piliostigma thonningii*, which is relatively fire resistant. The interactions of elephants and fire as controlling factors in the maintenance of the open savannas of the park are discussed in the section under Elephants. Because the count was done at the early wet season, the greenness factor was high throughout.

Towards the north of the park the ground rises with rocky kopjes and increasing woodland and gallery forest. Monodominant patches of *Lophira lanceolata* are noted and other areas dominated by *Terminalia mollis*, *Isobertinia* or *Anogeissus leocarpus* occur. The domaines support a variety of degrees and types of woodland and tree/bush savanna. In some areas particularly towards the west, these are interspersed with dense gallery forest along the water courses. In other areas, particularly to the east and in the north of the park, many of the rivers are bounded by papyrus swamp or grassy plains. Over 104 tree species were recorded by Nicholas and Ndey (1995) on their ground transects in the Domaines.

In the south of the Domaines de Chasse Gangala na Bodio are limited areas of secondary forest, and in areas. To the east, just outside the Domaines, are some conserved forest patches, which indicate the climax type of vegetation of the area when protected. Rainfall averages 1400mm per annum. Most of the region, however shows the effects of human clearing at some stage in the past. In every case where the bush was being cleared for new agriculture it was in areas of secondary forest or dense tree bush savanna, the most species rich stage of this habitat type, or in woodland. There is a positive correlation between tree density and human tree destruction. The people choose these areas because the soil is more fertile in the forest or woodland. The selection for these regions of highest biodiversity and very limited extent is having a destructive effect on the reserves, which would be probably be irrecoverable for several hundred years. Agriculture is not prohibited in the Domaines de Chasse, but its current method of slash and burn practice is not compatible with sustainable use of natural resources. A proper crop rotation system and the use of fertilizers, with prohibition of tree felling in specified areas is needed if the few remaining forest patches are to be protected to maintain plant and animal biodiversity.

Water availability