AERIAL CENSUS OF THE GARAMBA NATIONAL PARK, ZAIRE, MARCH 1983 WITH EMPHASIS ON THE NORTHERN WHITE RHINOS AND ELEPHANTS

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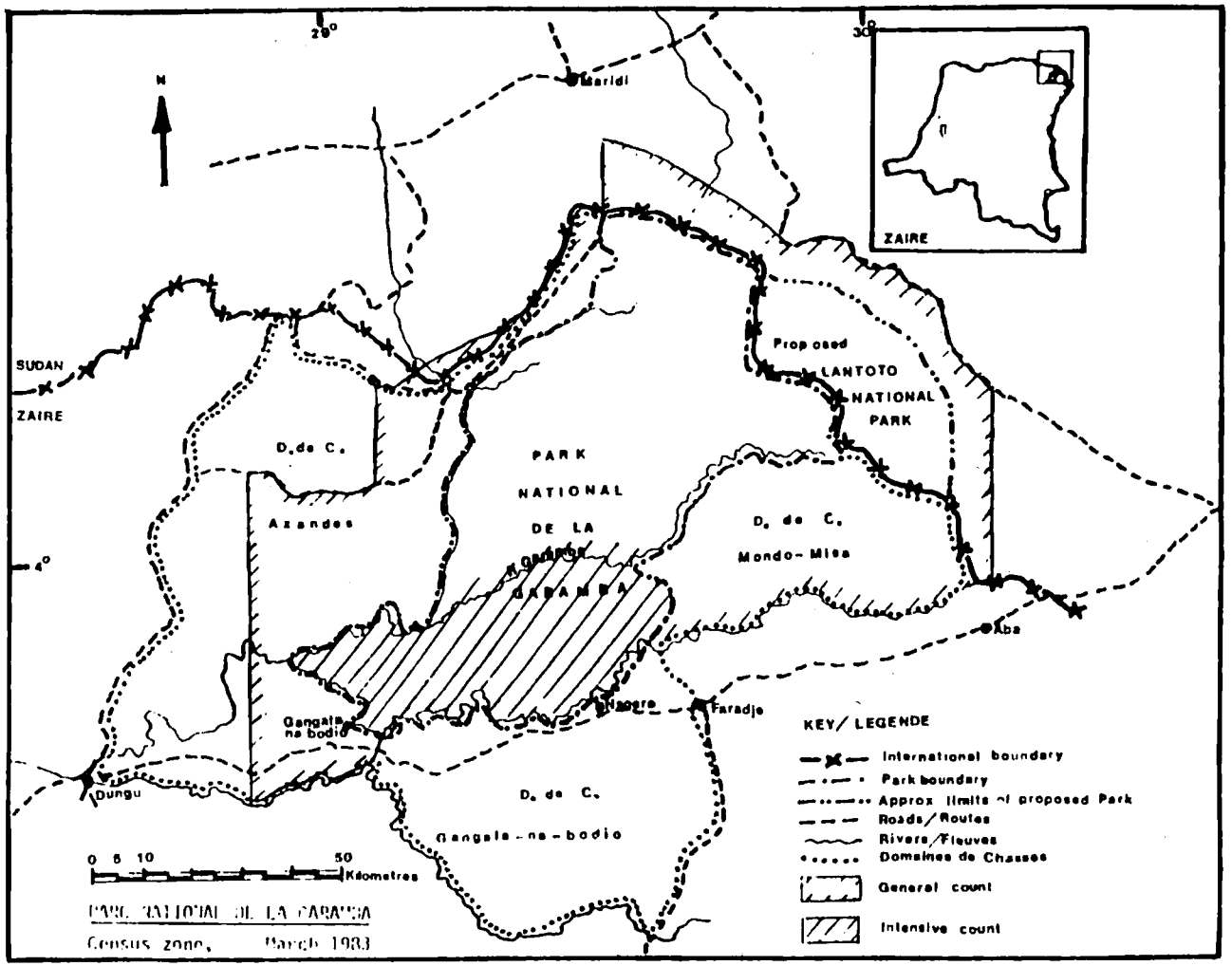


PARC NATIONAL DE LA GARAMBA

Census zone, March 1983

MAP 1

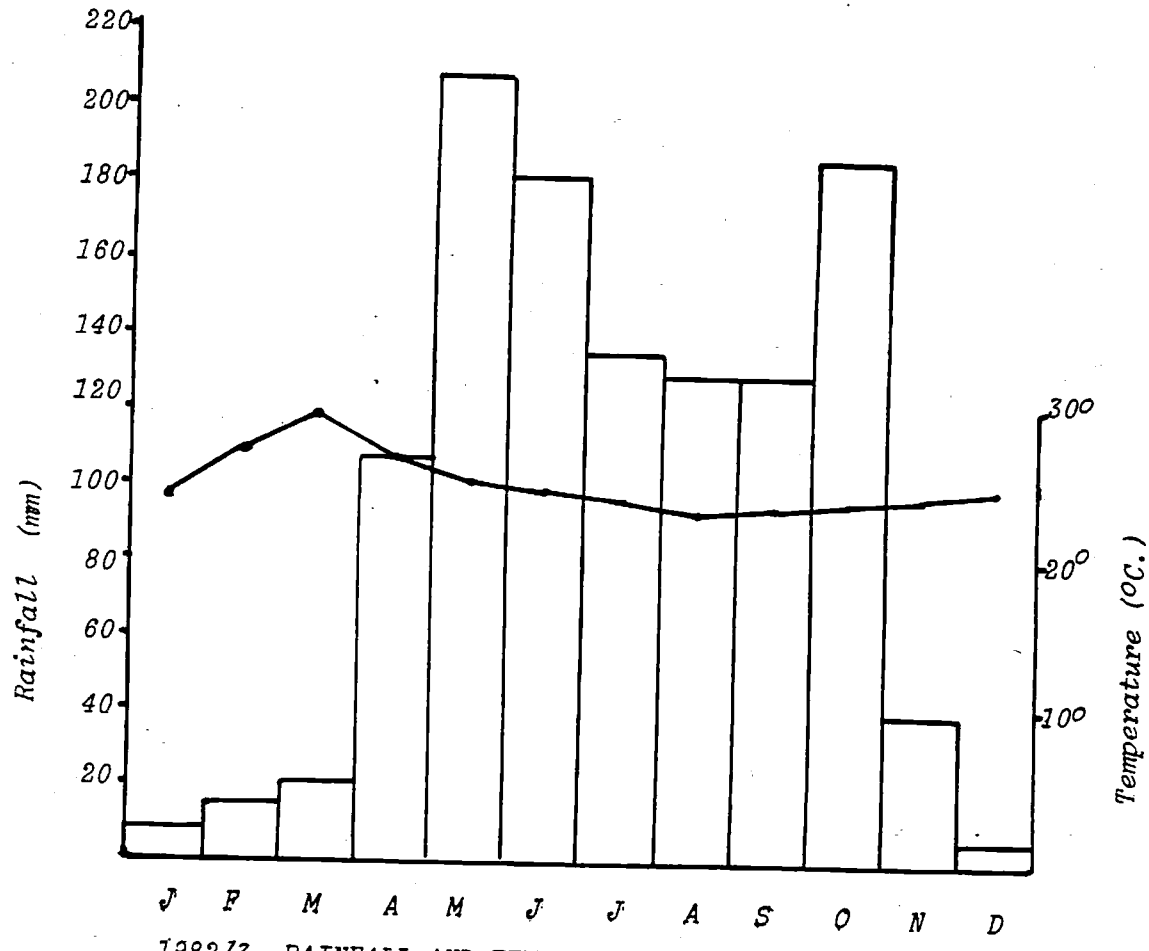
INTRODUCTION

DESCRIPTION OF THE AREA

Parc National de la Garamba (P.N.G.) is situated in the north east corner of Zaire, between 29 and 30°E and 3°40' and 4°35'N. Its northern boundary is the border with Southern Sudan. Abutting some of the north eastern boundary is an area in Sudan proposed as Lantoto South National Park. In Zaire the Park is completely surrounded by Domaines de Chasse: d'Azandes to the west, Mondo-Misa to the east and Gangala to the south, which total roughly twice the size of the Park. Limited settlement and subsistence hunting using traditional weapons are allowed within the Domaines de Chasse.

The Park covers 4,900km^2 and was gazetted in March 1938 as the third Park of the then Begian Congo, with the primary aim of protecting the white rhinoceros *(Ceratotherium simum cottoni)* and the giraffe *(Giraffa camelopardalis congoensis)* which occur nowhere else in Zaire. It appears that now this northern white rhino occurs in very few other places in the world. The Park also supports a substantial population of elephant *(Loxodonta africana)*, which appear to be an intergrade between the forest *(L.a.cyclotis)* and savanna *(L.a.africana)* types, with rather more forest characteristics. It holds a very large population of buffalo, with clearly distinct individuals of the Central African form of the Cape buffalo *(Syncerus caffer aequinoctialis)* and the Dwarf Red Forest buffalo *(S.c. nanus)* in mixed groups. There is a wide variety of other species, including Roan antelope *(Hippotragus equinus)*, Lelwel's hartebeeste *(Alcelaphus buselaphus lelweli)*, many Spotted hyaena *(Crocuta crocuta)*, lion *(Panthera leo)* and leopard *(Panthera pardus)*. Bird life is most spectacular and varied, particularly since the Park is on an interface between savanna and forest habitats, East, West and Central African species and on migration routes. The only African elephant Training School in Africa is situated there, at Gangala-na-Bodio, one of the Headquarters sites, where it moved in 1927. The Park is now internationally recognised as a World Heritage Site.

The Park has a tropical semi-humid climate with mean annual rainfall of 1,500mm (De Saeger, 1957). The majority of it falls from April through October, with a short dry season, with limited rainfall from November through March. The altitude is around 700m in the south, with inselbergs up to 1000m towards the north. The Sudan/Zaire border to the north is situated on the Nile/Zaire rivers watershed. The northern part of the Park is therefore dominated by rolling wooded hills and some rocky outcrops, dissected by water courses with gallery forest and patches of riverine grassland. The southern two thirds of the Park grades into savanna grasslands, with scattered trees and remnants of degraded gallery forest along the numerous water courses. Perennial rivers form most of the Park boundaries, with other major rivers, notably the Garamba, flowing through it. The predominant grasses in the savanna are *Loudetia arudinaceae, Hyparrhenia spp.* and *Panicum maximum*. The dominant sward grows as high as 2.5m by the end of the wet season. The scattered trees and open clumps throughout the savanna are predominantly *Kigelia*, *Vitex* and some *Combretum* and *Terminalia* particularly towards the north and with some *Erythrina* and *Dombeya* to the west. *Erythrophleum, Ficus, Kigelia, Spathodea, Vaukanga* and *Mitragyna* occur at springs and along the river courses. Fire and probably elephants have been dominant factors in the ecology of the Park.



1982/3 RAINFALL AND TEMPERATURE, PARC NATIONAL DE LA GARAMBA

FIGURE 1

All development of the Park, apart from tracks has been peripheral, with the two headquarters (Nagero and Gangala-na-Bodio) and the 23 guard posts situated around its border, in the Domaines de Chasse.There is a staff of roughly 200, with approximately 150 game guards.

THE CENSUSES AND INTERNATIONAL INVOLVEMENT

The aerial census reported here formed part of a survey of the status of northern white rhinos in Sudan and Zaire, carried out by Hillman and Smith for IUCN/WWF, under the auspices of the IUCN African Elephant and Rhino Specialist Group and supported also by the Global Ecological Monitoring System of UNEP under their involvement with the Species Conservation Monitoring Unit of IUCN. Within the brief from the latter was the need to examine methods and feasibility for census and monitoring of rare and endangered species. The aerial survey was also supported by Frankfurt Zoological Society, who have had a long term involvement in the area and who provided aircraft and pilot. It was done in conjunction with the Instutut Zairois pour la Conservation de le Nature, in particular Mankoto ma Oyisenzoo of 'Projet Rhino' and with the FAO project ZAI/80/002, and its project leader, Dr P.M.Rogers. The pilot, Dr M.Borner was seconded from FZS work in Tanzania.

The survey was related to the development by IUCN/WWF of conservation projects for the area, both past and future. The primary justification for aid to the area has been the existence there of a population of northern white rhinos, whose conservation has been given highest priority by the IUCN African Elephant and Rhino Groups and by the IZCN, who have requested help to achieve it. In recent years it has become the only known one with a reasonable chance of survival in the wild, if aid can be given. Rates of poaching have been so bad in the last few years, however that it was necessary to find out the current status of this and other species.

In 1976 an aerial census of the area was carried out by FAO (Savidge et al, 1976), and methods were therefore designed to be directly comparable to that one. Every 2 or 3 years staff of the Park carry out a count by walking 2 km spaced transects thrpugh the southern sector of the Park. The aerial census and related ground work were therefore timed to coincide with this. In view of their concern about the status of the rhinos in the Park, the IZCN had, in 1981, stationed a biologist at the Park, Mankoto ma Oyisenzoo, in charge of 'Projet Rhino', with the aim of improving their conservation. Information that he and the guards had gathered on individual rhino was therefore also used in assessing the population.

PAST NUMBERS

Methods of population estimation have varied considerably in the past and rhinos are not easy to census. However, the following summarises what is known of the populations in the past:

1938 At the establishment of the Park, Curry-Lindhal states that rhinos were rare there, with "probably not more than 100 animals"

1950 250-300 from De Saeger, quoted in Curry-Lindhal (1972).Method not known.

1956 730, from Micha (1958), in Curry-Lindhal (1972). Method not known.

1960 1190, from Ory, in Curry-Lindhal (1966).

1963 1202 " " " "

1963 1300, quoted by PNG staff as a result of census, method unspecified

1963-7 Until 1963, the rate of poaching had been low, but in that year the Park was occupied by "Simba " rebel forces and numbers fell rapidly, as rhinos were killed and horns or money exchanged for arms and amunition.

(Lusenge, pers. comm.) Verschuren states that almost all were exterminated by local rebels or Sudanese mercenaries in a few months. 77 rangers apparentely joined the rebels. The remainder fled and the abandoned Park was an open hunting area for local people (Curry-Lindhal,1972).

1966 Approximately 100 was a "rough and perhaps optimistic estimate" by Curry-Lindhal in May 1966. On the basis of numbers seen and reports of numbers of horns found at Faradje and being exported from Mombasa, he estimated that 900-1100 rhinos had been killed between 1963 and 1966.

1969 Control of the Park was regained and it became legal to shoot poachers not responding to orders to surrender. The situation improved.

1970 65 were counted on a preliminary foot survey (PNG Report)

1971 250 (Pierret 1976),30 (Verschuren in Pierret et al 1976)

1972 219 Ground survey, (PNG Report)

1972 "In April this year came news that the latest count showed 252 animals, but according to Verschuren this figure is far from being accurate"(Curry-Lindhal,1972)

1973 100-160, 1 aerial,3 ground detailed surveys,including individuals (Pierret et al 1976)

1974 176, from ground surveys (PNG Report)

1975 259, " " "

1975 150-200 animals, including many juveniles and sub-adults were recorded, mainly between the Garamba and Dungu rivers, and 15-20 were known to be living outside the Park (Verschuren,1975).

1976 318, ground survey (PNG report, Kabirizi & Lusenge pers. comm.)

1976 490 $\pm$ 270, estimated by aerial sample counting. (Savidge et al 1976). Aerial sample counts generally give higher estimates for many species than ground counts, but one of the authors reports that due to certain factors estimates for some species from this count were considered to be high. possibly over-estimates.

1977 395, ground survey (PNG report)

1978 426, " "

1977-8 was apparentely a period when Sudanese and probably Ugandan poachers using arms from the Ugandan war got the upper hand and numbers declined.

1979 203, ground count in April, using transects spaced 4km apart, covering the southern part of the Park in one day.

1980 202, ground count in April, same method.(Figures not officially confirmed)

1981 36, ground count with transects 2 km apart, in southern sector of Park (Dimoyele Ku-Gilima Buna, 1981)

METHODS

During March 1983 the following censuses were carried out in the Park and environs. March is in the end of the dry season and visibility is therefore at a maximum. 1/200,000 topographical maps N3/28&29,N4/28&9 were use

1. An intensive 46% systematic aerial sample count was made over the southern third of the Park, south of the Garamba river and to 3 km (1 minute flying time) north of it (total area 1609km^2; area south of the river only 1440km^2). Transects were spaced at 1 km intervals, flown north/south. Rhinos, elephants and large mammal skeletons were counted. Methods were as in Norton-Griffiths (1978). Details of count parameters are given on page 5.
2. A 10% aerial sample count was made over the whole Park (4900km^2), major areas of the surrounding Domaines de Chasse and parts of neighbouring Sudan, including the proposed Lantoto South National Park.(total area 8998km^2). Transects were spaced at 5 km intervals and parameters maintained comparable to the FAO count in 1976. Methods were as in Norton-Griffiths (1978). All species and skeletons were counted and habitat parameters measured. Details of count parameters are on page 6.
3. A ground count was carried out by the Park staff under the direction of the Conservateur-en-chef, Dimoyelele Ku-Gilima Buna. 170 men in 55 groups walked transects north/south, at 2 km intervals in the sector south of the Garamba river. They started from the central watershed between the Dungu and Garamba rivers and on 15th March, half the teams walked north to the Garamba, while the rest walked south to the Dungu. They spent the night at the rivers and returned next day, counting both days. In the analysis, correction was made for what was extrapolated as double counting of the same groups. All species were counted by most teams.
4. Simultaneous high intensity ground and aerial counts were carried out over and 84km^2 area that had been found to contain most rhinos, in order to test methods. Guards of 'Projet Rhino' walked 500m spaced north/south transects and the aerial count team flew a'total'count using parallel, adjacent,north/south transects and avoiding double counting by individual identification.
5. An estimate was made of the total number of rhinos that could be individually distinguished, by combining those known to Mankoto and the guards, and those seen from air or ground that were or were not known to Mankoto.
6. A total of 57km was walked in the Park counting rhinos signs over a measured distance to compare relative densities with other areas, in Sudan and in areas of known white rhino density, using a 'density index' method.

The intensive sample count was aimed at obtaining optimal aerial count information on the rhinos.Onekm spacing of transects was felt to be the closest that would allow for reasonable accuracy in navigation to avoid double counting. Using systematic sampling rather than an attempted total count gave confidence limits to the data, and high intensity systematic sample counting has been found to be more accurate for rhinos than total counting, especially within such a large area (Hillman 1981).

The 10% sample count was designed to be directly comparable with the FAO count to be able to assess trends and to provide data on all species of interest to the Park and on the Lantoto area in Sudan and the Domaines de Chasse.

The ground count was similar to those that had been carried out in past years by Park staff and timing enabled it to be directly compared with results from other methods. Individual recognition is the most accurate way to know how many rhinos are in an area,since they live at low densities.

The 'density index approach was aimed to get an idea of relative occurence in areas where there are almost none left.

COUNT PARAMETERS

Intensive count 8th-11th March 1983

AREA 1609km^2, south of Garamba River and to 3km north of it; 1440km^2, if analysis is carried out only on the area south of the river. Distance north of the river was measured by flying time, ie 1 minute.

SAMPLE INTENSITY 46%

TRANSECTS 75 transects, North/South at 1km spacing, sub-divided into 1 minute sub-units in flight.

STRIP Calibrated strip width: Left: 267m. Right:196m.Combined:463m @ 350f: Strip widths were demarcated by fibreglass rods on the wing struts. Initial spacing was set by calculation (Norton-Griffiths,1978). Then for each count calibrations were carried out to measure actual width counted, by flying across markers spaced at 20m intervals, which observers counted. Simultaneously aircraft height a.g.l. was measured. Passes were made at different heights, and a+ least 10 at count height of 350ft.Passes were made before and after each counting session to allow for position change as observers tired. Actual width per transect was calculated from measured height a.g.l.

SPECIES Rhinos, elephants and rhino,elephant and unidentified large mammal skeletons. Skeletons were classified according to the system of Douglas-Hamilton and Hillman (1981). Classes are given below. On every fifth transect all species were counted. These transects corresponded to the transects counted on the general count and this information therefore provided a back-up and a means of testing analyses.

HEIGHT 350 feet above ground level (a.g.l), measured by a radar altimeter.

SPEED Average speed 196km/hr(3.3km/min.)

AIRCRAFT Cessna 182 : 5H-FZS

PERSONNEL

Pilot	: Markus Borner	
Front seat observer	: Kes Hillman	
Rear seat observers	: Mankoto ma Oyisenzoo	Right
	: Fraser Smith	Left

HABITAT FACTORS

Each minute the FSO read the radar altimeter and estimated proportional representation of the same habitat parameters as outlined under 'General Count',p.6, in the same way. For the purposes of this report, however habitat factors have only been plotted for the General count.

SKELETON CLASSIFICATIONS

Large mammal skeletons were classified as follows:

- Category 1 - Fresh; soft tissue still present, body has a rounded appearance (up to 1 week since death)
- Category 2 - Rot patch present; the dark, vegetationless patch caused by the release of rotting body fluids is still present; the carcasse may or may not have skin and scattering of bones depends on scavenger influence. (Generally within 1 season)
- Category 3 - Rot patch absent, bones white; the rot patch has disappeared but the bones have not broken down muc (1-a number of years depending on local climate et
- Category 4 - Grey bones, scattered;the surface of the bones flaking off gives a grey appearance (up to 10 year

ANALYSIS Analysis, using Jolly,Method 2 (Norton-Griffiths 1978) on Hewlett Packard 97 calculator.Estimates were made both by analysing each side observer separately and combining, and by combining first.

General Count 11th-14th March 1983

AREA 8998 Km^2 , comprising the whole Park (4900km^2) and roughly half of Domaines de Chasses Azandes (to east) and Mondo-Misa (to west), and into Sudan to the Yei-Maridi road to include the area of the proposed Lantoto South National Park and a strip of Sudan bordering P.N.G.

SAMPLE INTENSITY 10%

TRANSECTS 28 transects, North/South at 5km spacing, sub-divided into 1 minute sub-units.

STRIP Calibrated strip widths: Left:267m. Right:266m. Combined:533m @ 350ft.

SPECIES All species counted

HEIGHT 350 feet a.g.l. (radar altimeter)

SPEED Average speed: 192km/hr (3.2km/min.)

AIRCRAFT Cessna 182 : 5H-FZS

PERSONNEL Pilot : Markus Borner
Front seat observer : Kes Hillman
Rear seat observers : Pat Rogers Right
: Fraser Smith Left

HABITAT FACTORS

Each minute the radar altimeter was read by the FSO and the following parameters estimated:

Tree cover	In units of 10% from 0-100,eg 1=0-10%,2=11-20%etc
Tree greenness	" as a percent of trees present
Bush cover	" as a percent of sub-unit
Bush greenness	" as a percent of bushes present
Grass cover	" as a percent of sub-unit
Grass greenness	" as a percent of grass present
Long grass	" proportion in sub-unit
Burn	" burned ground this season
Flush	" average throughout sub-unit

Water availability
0=none seen available in sub-unit
1=available only to people and domestic stock eg boreholes,protected points
2=limited availability
3=unlimited availability
4=running water
5=floods

Agriculture In units of 10% as a percent cover in sub-unit

Vegetation zones (Based on Yangambi System)

S	Savanna- grassland with scattered trees,especially at water courses
BS	Bush savanna- grassland with bushes
TS	Tree savanna- grassland with moderate tree cover
TBS	Moderate cover of trees, bushes and grassland
W	Woodland- Tree cover predominant
RF	Riverine forest

Other notes, eg soil colour, poaching,topographical features for navigation etc.

ANALYSIS Analysis using Jolly Method 2 (Norton Griffiths 1978) on HP 97 and 55 calculators.

RESULTS AND DISCUSSION OF RESULTS

INTENSIVE COUNT

Figures from the Intensive Count are given in Table 1.
Map 2 shows the Intensive Count area, flight lines and topography. Maps 3 - 7 plot the distributions of animals and skeletons seen on the count in transect. A grid of sub-units has not been used here, because of the close spacing of the transects, but the minute intervals have been used to locate sightings along the transects.

GENERAL COUNT

Figures from the General Count are given in Table 3.
Map 10 shows the count boundaries and transect lines. Maps 11 - 27 plot the distributions of animals seen in sub-units. Maps 28 - 35 and 37 - 39 plot the habitat parameters measured during the general count per sub-unit. Map 36 plots the burn measured on every fifth transect (comparable with the general count) during the intensive count. These measurements were taken on average 4 days before those on the general count and the change during that time can clearly be seen.

RHINOS

During the 46% count 6 rhinos were seen in transect and 3 out. This gives a population estimate of 15 or 13, depending on method of analysis. (Separate or combined strip widths).
During the 10% count no rhinos were seen, which further confirms the known innacuracy of low intensity counts for rhinos (Hillman 1981). During the 10% sub-sample of the high intensity count (every 5th transect) one rhino was seen. If that sub-sample was analysed as part of the general count replacing the section south of the river, it would give a population estimate of 10. The sighting has been used in plotting the distribution maps, simply to give a density distribution comparable to those of other species. 37 rhinos were seen on the FAO count in 1976.

10 different individuals were seen on the Ground Count and another 2 individuals were reported north of the river, out of the census zone just prior to it. A rhino sighting was also reported from the Domaines de Chasse d'Azandes shortly before. The preliminary population estimate from the ground count was 20 (Dimoyelele pers.comm.), but it was based on assumptions about unreturned results books, and the final result may be different.

11 individuals were known to Mankoto ma Oyisenzoo and others had been seen or reported that he did not know. A number of individuals not known to him were seen on the census and by combining these with those known, 17 individuals could be accounted for.

In all it was therefore felt that a reasonable population estimate was 13-20 rhinos within the southern sector of the Park. It is doubtful whether; many,if any,exist outside that region.

It is common to apply correction factors to aerial count results for rhinos, (of at least 2x for black rhinos).However the open terrain and their use of the grasslands makes the white rhinos easier to see in Garamba. They did tend to frequent patches of long grass, and when inside them were extremely difficult to see. The very high intensity count done simultaneously by ground and air was aimed to give an indication of correction factors for the aerial count and the standard ground count. However results from the ground were not certain enough to be able to do this.

6 animals were seen from the air. 24 sightings were reported from the ground, but from the information presented and the uncertainty of certain factors, it was not

possible to ascertain what number between 7 and 15 these sightings represented. From the reported sexes and groups, 11 seems a possibility. The single male, who was a known individual, may have entered the count zone after the aerial count. Use of only trained observers and a tighter control is required, with guards starting transects simultaneously, keeping occasional sight of each other, and counting only to one side, if good results are to be obtained through this method. This was aimed at but not achieved. It was observed that a 2km spacing between transects meant that part of the time (depending on terrain) observers were not covering all ground, however a 500m spacing means that animals may move from one transect to the next, hence the need for strict observational control.

Distribution

The rhinos were largely in the central section of the zone south of the Garamba river, although some movements north of the river were reported. It appears that they have always been more concentrated there, but until a few years ago also occurred elsewhere in the Park. The distribution map from the FAO count (Savidge et al 1976) shows that half the rhinos seen were in the 2/3 of the Park north of the Garamba.

The observed range of the rhinos was of the order of 500km^2 of fairly flat ground with reasonable visibility. Movements within that indicate that there could be enough contact for mating. It is not known how much movement there is in response to fires or other disturbances.

Group size

Sample size is not large, but group sizes have been extracted from sightings recorded since 1981:

Date	*Type of observations*	*Mean group size*	*Source*
May '81	Ground count	1.8	Dimoyelele Ku-Gilima Buna
1982	Sightings,first ½	3.6	Ipantua Ira Yung
1981/2	Patrols	2.2	Mankoto ma Oyisenzoo
Mar '83	Ground count	2.0	Dimoyelele Ku-Gilima Buna
Mar '83	Aerial count	2.3	This report.

These are similar to southern white rhinos *(C.s.simum)*,(Owen-Smith,1974)

Age and sex ratios

Definitions and classifications into age classes vary between observers and are not always accurate from the air. No test has been made of the accuracy of sex determination by the varying observers. However, the following gives some indication of age and sex ratios, with age class names normalised:

Date	*Male Ad.*	*Fem.Ad.*	*Unclass.Ad.*	*Sub-ad.*	*Juv.*	*Source*
May 1981	18	14		3	1	Dimoyelele
1981/2	4	3	3		1	Mankoto
June 1981	3	3				Mankoto
March 1983,Ground	3	3				Dimoyelele
March 1983,Aerial	1		9	6		This report

There appears to be an almost equal sex ratio, with a possible bias towards males, though this could be observer bias, based on the assumption that single animals are males and that pairs are males and females. The rhinos are not always easy to observe and the guards do not generally have binoculars. Van Gyseghem (northern) and Owen-Smith (southern) found that groups of white rhinos were usually females and juveniles, females and/or sub-adults. There were few juveniles. The youngest known was 2 years old (Mankoto pers.com

Reductions

There is no doubt that there has been a considerable reduction in the population in the years since 1977, and it is known that it is primarilly due to poaching. Other contributing factors, if any, are not yet known. The ages of the skeletons seen indicates that there has not been much rhino poaching recently, but protective measures are urgently needed, and are discussed later.

TABLE 1

Garamba National Park, Southern sector. Population estimates from Intensive Count (46%), March 1983

SPECIES	*NO.SEEN*	*POP.EST.* *Sep. strips*	*Comb.strips*	*± 95% C.L.*	*C.L.as %*	*DENSITY (km⁻1)*
Rhinos *(Ceratotherium simum cottoni)*	6	15	13	13	100.9%	0.008
Elephants *(Loxodonta africana)*	2290	4975	5219	865	16.6%	3.6
Rhino skeletons	9	22	15			0.009
Elephant skeletons	82	178	181			0.11
Unidentified skeletons	47	91	102			0.06

TABLE 2

Garamba National Park and Environs. Live:Dead ratios of Elephants and Rhinos. General and Intensive Counts

SPECIES	*REGION*	*LIVE SEEN*	*RATIO*	*ALL SKELS.*	*FRESH DEAD(Cats.1&2)*	*COUNT*
Elephants	Park overall	790	8:1	97		General
	Dom.de Chasse	224	37:1	6		"
	Park south of Garamba R.	429	19:1	23		"
	" " "	2290	28:1	82		Intensive
	" " "	2290	254:1		9	"
Rhinos	" " "	6	0.9:1	7		"
	" " "	6	6:0		0	"

TABLE 3

Garamba National Park, surrounding Domaines de Chasses and proposed Lantoto National Park

Estimates of population sizes and biomasses of species counted, General Count (10%), March 1983

SPECIES	IN PARK Pop.Est.	±95%CL	CLas%	(Km^{-1}) Density	(Kg) Wt.*	Kg(10^5) Biomass	IN WHOLE CENSUS ZONE Pop.Est	±95%CL	CLas%	(Km^{-1}) Density	OUT ONLY Density
Elephant *(Loxodonta africana)*	7742	3690	48%	1.6	2500	193.6	9808	5649	58%	1.09	0.5
**Buffalo *(Syncerus caffer aequinoctialis&nanus)*	53312	16960	32%	10.9	515	274.6	56176	21176	39%	6.2	0.7
***Rhino *(Ceratotherium simum cottoni)*	13	13	99%	0.008	1500	0.3	Seen in Park only				
Hippo *(Hippopotamus amphibius)*	1290	1781	138%	0.3	1100	14.2	Counted as in Park, though use outside				
Giraffe *(Giraffa camelopardalis congoensis)*	175	163	93%	0.03	800	1.4	195	172	88%	0.02	0.004
Hartebeeste *(Alcelaphus buselaphus lelweli)*	1932	812	42%	0.4	155	3.0	2078	1061	51%	0.23	0.04
Kob *(Kobus kob thomasi)*	3978	2321	58%	0.8	90	3.5	4744	3011	63%	0.5	0.2
Waterbuck *(Kobus defassa unctuosus)*	2215	1420	64%	0.5	200	4.4	2670	1619	61%	0.3	0.11
****Reedbuck *(Redunca redunca)*	183	107	58%	0.04	60	0.1	344	170	50%	0.04	0.04
Roan *(Hippotragus equinus)*	91	124	136%	0.02	150	0.1	Seen in Park only				
****Bushbuck *(Tragelaphus scriptus)*	51	45	88%	0.01	70	0.04	121	82	68%	0.01	0.02
****Duiker,Grey *(Sylvicapra grimmia)*	91	72	79%	0.02	20	0.02	260	137	53%	0.03	0.04
Yellow backed *(Cephalophus silvicultor)*	-						18	35	194%	0.002	0.004
Red flanked *(C. rufilatus)*	-						36	31	86%	0.004	0.008
****Oribi *(Ourebia ourebia)*	234	152	65%	0.05	16	0.04	251	146	58%	0.03	0.004
Warthog *(Phacochoerus aethiopicus)*	1117	244	22%	0.2	70	0.8	1358	357	26%	0.2	0.06
****Red river hog *(Potamochoerus porcus)*	-						74	148	200%	0.008	0.02
*****Lion *(Panthera leo)*	15	15	99%	0.003	150	0.02	Seen in Park only				
*****Hyaena *(Crocuta crocuta)*	87	14	16%	0.02	50	0.04	Seen in Park only				
*****Crocodile *(Crocodylus niloticus)*	20	25	114%	0.004			Seen in Park only				
*****Baboon *(Papio anubis)*	742	920	127%	0.2			760	937	156%	0.08	0.004
Shoats *(Domestic sheep & goats)*	-						90	196	218%	0.01	0.02
Houses	-						6495	1418	45%	0.7	1.58
Elephant skeletons	938	228	24%	0.2			991	343	35%	0.1	0.01
Rhino skeletons	10	16	165%	0.002			Seen in Park only				

TABLE 3 - Notes

* *Source: Savidge, et al (1976)*

** *Estimates of herds in transect too large to count were calibrated by subsequent estimates and counts from photographs*

*** *Rhino population estimate from 46% stratum*

**** *Minimum estimates only since they are small or cryptic species.*

***** *Aerial sample counts cannot give accurate estimates for such species, and these figures are indicative only.*

ELEPHANTS

The populations of elephants estimated from the counts were approximately 5,000 south of the Garamba river, 8,000 in the Park and 10,000 in the whole census zone. This compares with an estimate of 22,670 ± 52% in 1976 (Savidge et al) Although the earlier estimate may have been high, poaching, judging by evidence seen on the count has been one of the major factors in bringing about a considerable reduction in numbers. They do not yet, however show the characteristics of heavilly poached populations observed in the past in East Africa: low proportions of adults and juveniles, very high dead to live ratios etc.

Distribution

The distribution map shows the elephant population concentrated in the southern half of the Park in the savanna grasslands. There were 3.6/km^2 south of the Garamba river. The distribution shown in 1976 was rather more even throughout the grasslands, though with a greater concentration towards the centre of the Park. The count then was slightly later, in April, into the beginning of the wet season. However observations in the Park in May indicate that there is still a heavy concentration of elephants in the south, and the distribution may be linked more to poaching pressure than habitat factors.

Group size

The mean group size for a sample of 100 observations in the Intensive Count was 4.8 (range 1-31). Most of the few groups seen outside the Park were within the same range, but the only really large group seen, over 250 individuals, was outside the Park in the Domaines de Chasse d'Azandes.

Age structures

No accurate age classification of elephants could be made during the counts, but since there was a noticeably large number of very young calves, elephant groups were classified, where possible, into numbers of new born calves, juveniles, sub-adults and adults. Of 410 elephants classified, 21% were juveniles and a further 4% were new born calves. One quarter of the population was therefore young animals

SKELETONS

Table 2 gives the live to dead ratios for elephants and rhinos, and the maps show the distribution of skeletons observed. Skeletons were only classified as elephant or rhino if recognisable skulls were present. Unidentified skeletons may therefore be either, or buffalo, or other large mammals. Definite buffalo skeletons were kept in the unidentified category since they are not long lasting or characteristic enough to do a separate count of.

There was a high proportion of live elephants relative to dead, compared with similar counts in East Africa, where at times more dead than live were seen (Douglas-Hamilton and Hillman 1981). This is a reflection of the large elephant population. There is current and relatively heavy elephant poaching. We saw elephants that had been killed in the south west corner of the Park between the times that we covered the area in the Intensive and General Counts. However it is not (yet) of the extent or type that has devastated the elephant population. A fresh dead to live ratio of 1:254 indicates that 0.4% were killed in the season, while 4% were born.

It has, however devastated the rhino population. No recently dead rhino skeletons were seen indicating no recent poaching. This may be a reflection both of the increased awareness and surveillance by the Park staff and of the scarcity and central distribution of the rhinos. Either way it does give hope for possibilities of controlling the situation.

Both the distribution maps and the ratios indicate a proportionately higher degree of poaching of elephants north of the Garamba river. It has often been found elsewhere that the ratio of dead to live is much higher outside parks, because there are less live animals there and the poaching is easier. In this case it was the other way around, but it may be partly due to the far more wooded terrain in the Domaines de Chasse which would make any skeletons more difficult to see.

BUFFALO

Buffalo herds too large to count were estimated. Observers' estimations were calibrated for analysis, by estimations and counts from a series of aerial photographs of buffalo, to obtain correction factors for each observer.

The buffalo population is the same size and the distribution very similar to that in 1976. If these count figures are considered in the same light as the others,the buffalo population could, if anything, have increased slightly. Most recent poaching reported by the guards is of buffalo for meat. However it does not appear to be of a magnitude sufficient to have any significant effect onsuch a large population. Over the past decades there has been a decrease in the woody vegetation throughout most of the Park, which will have favoured the buffalo and probably elephants and been of disadvantage to the browsers and species requiring cover. The buffalo now constitute 55% of the mammal biomass of the Park.

Utilization of this and other large mammals in the form of small scale cropping for local consumption was suggested as a possibility in 1976. But it was also recommened that this should only be after and in conjunction with ecological monitoring . The same would apply now. If such an operation were considered it should only be after a more thorough investigation of the populations and a continuous monitoring, as well as a through investigation of markets. A large scale operation would be impractical under the circumstances. and for future considerations. Any such management would depend on the principles of the IZCN.

This population comprises a mixture of the savanna and forest sub-species of buffalo. Individuals that are distinctly recognisable as the Dwarf Red Forest buffalo*(S.c.nanus)* occur in mixed groups with the savanna type.

HIPPO

The hippo population estimate was only slightly smaller than that in 1976, though a count designed for hippo was not carried out this time, as it was then. It does not appear to be large enough or to be having any significant effect on its habitat as to require managmement and utilization, as was suggested in 1976. Since the major rivers form the Park boundaries, hippos are vulnerable to poaching.

GIRAFFE

The giraffe are of particular importance to the park since they occur nowhere else in Zaire, and are also, apparentely, a distinct race. Numbers are very low, however, especially as the sole national representatives of a species.

They were seen mainly towards the periphery of the Park, associated with the wooded areas (although they are also known to occur in the more wooded savanna close to Gangalaena Bodio). They have undoubtedly been affected by the reduction of woodland throughout the southern 2/3 of the Park. Apparentely (Dimoyelele pers.comm.) there are local beliefs against the killing of giraffe, which should at least be a protective measure in Zaire, though it is not known whether the same pertains in Sudan. Ecological and habitat monitoring are of obvious importance in the management and conservation of this apparentely declining species. The population estimate was half that made in 1976.

HARTEBEESTE

More hartebeeste were seen towards the centre of the Park than south of the Garamba river on this count. They were fairly evenly distributed on the count in 1976. The present estimate is about ½ of that made in 1976. There is no evidence of undue poaching of this species. Most of the 1976 estimates, apart from that for buffalo, were about twice the present estimates. However the difference here could also be affected by observer biases in identification. No cause could be pin-pointed at this stage for such a large decline if it is real. The hartebeeste, which are of the sub-species, Lelwel's, are fairly commonly observed from the ground.

KOB

The population estimate for the kob is roughly half that made in 1976, but as mentioned before, this made be an artefact of method rather than an actual decline. There is no evidence of poaching of this species. The distribution is similar and shows a marked association with major water sources, and apparentely with areas of greener grass and more patches of long grass.

WATERBUCK

The waterbuck population estimate was 2/3 that in 1976. The distribution was, as to be expected, associated with water sources, and they were also seen in the more wooded, hilly areas.

REEDBUCK

Reedbuck estimates will be minimum, since they are not an easily observed species from the air. They have a widespread distribution.

ROAN

The roan estimate is also ½ of that made in 1976, although that in 1976 would have been pushed up by one sighting of a group of 24. The distribution is similar, in the grasslands.

BUSHBUCK AND ORIBI

The oribi are widely distributed, mainly in the grasslands. The bushbuck, which favour wooded areas, were seen more in the Domaines de Chasse than in the Park. Both will be minimum estimates, but the bushbuck are a very cryptic species and far more must occur than the estimate indicates.

DUIKER

The Grey or Grimm's duiker are relatively common throughout the Park, but associated more with areas of bush and tree cover. Yellow-backed were seen in the Domaines de Chasse to the west, and Red-flanked in Sudan to the north-east. As small, cryptic species, estimates will be minumum.

WARTHOG AND RED RIVER HOG

The warthogs were quite widely distributed throughout the grasslands, though with less seen in the north of the Park than in 1976. Some were seen in the Domaines de Chasse. The Red River Hog or Bushpig are more cryptic species a and were seen in the woodland in Sudan.

LION AND HYAENA

A census of this kind cannot produce good results for carnivores, espcially nocturnal species like hyaenas. It is unusual to see any hyaena at all, and the fact that 9 were seen indicates that there must be a large population. The frequency of spoor on the ground and rate of breakdown of carcasses is further supporting evidence for what is reported to be a large hyaena population (guards, pers.comm.). Lions appear to be reasonably plentiful, and there is certainly an abundance of prey.

CROCODILES AND BABOONS

This census does not pretend to produce accurate results for crocodiles or baboons, but the sightings made are plotted for interest.

HOUSES, SHOATS AND POACHING CAMPS

Human density in the region is low compared with some areas. Although the Park is surrounded by Domaines de Chasse, however, there is settlement close to its borders in some places. There is considerable settlement in particular close to the north-western border, and this is the region where an occupied poaching camp was seen and evidence of current as well as past poaching. The only other current poaching seen was on the northern edge of the south-west tip. Old poaching camps were seen in the Domaines de Chasse near there, but the conservateur, when it was reported to him said that the nearby patrol post must be at least aware of the situation, possibly involved, and immediately dispatched a patrol to deal with the problem.

The south-western tip must be vulnerable to potential poaching from the considerable settlement there, while some poaching has also occurred across the eastern border. Lantoto proposed National Park only abuts half the Sudan border of the Park and it would be very difficult to protect or give conservation status to the rest, since a road runs close to the border, and there is settlement all along the road. The amount and distribution of settlement in the Domaines de Chasse should be examined in relation to what is legally allowed, and where possible control measures taken. The local people could, however be an asset in poacher control if they valued the Park.

Very little domestic stock was seen , with no cattle. The people live from agriculture and some subsistence hunting, which with traditional methods in legal places would not be a problem. It is the availability of arms and the pressures to make money, initiated probably by outsiders and traders, that has caused the problems with poaching for rhino horn and ivory. The return per unit effort for rhinos is probably now to low, especially if better control is kept. Traders have become interested in gold, which is mined locally and coffee is always of value. There is still poaching for ivory, however.

Efforts to obtain the support of the local chiefs and people would be a valuable part of re-developing conservation and protection for the Park.

The Park is surrounded by patrol posts, which provides excellent guard coverage if there is adequate supervision and support. If salaries are late, rations are non-existent and supervision cannot be given for lack of transport, the temptations for armed guards in remote wildlife regions must be enormous. These aspects are therefore also an important part of Park re-development, and must also be a priority if Lantoto National Park is developed. Systems need to be able to function in the long term at the lowest common denominator of resources.

HABITAT FACTORS

The maps of tree cover and bush cover clearly show how the Park stands out as open grassland savanna,surrounded by the tree/bush savanna and woodland of the Domaines de Chasse and Sudan. The relict forest along the water courses, old photographs and reports by those who have known the area a long time indicate that, at least over the past few decades, there has been a reduction of the woody vegetation within the Park.

The maps of burn show the extent of fire throughout the Park at that time, and a comparison of the map ofburn in the southern sector during the Intensive and General counts, spaced 4 days apart shows how rapidly the fires were being lit at that time and how much late burning there was. It was observed that during the subsequent ground count fresh fires blossomed in what was left of the old grass in the southern sector. It would appear that fires are be lit by both poachers and guards, with the aim of improving visibility and ease of travel. Animals are also likely to be attracted to areas of flush. Late burns will not only destroy woody vegetation, but also prevent regeneration and reduce heterogeneity by favouring fire resistant species. This season the IZ(researcher had planned a pattern of early burns and areas protected from burn. but to be successful this requires full co-operation from all who are in the field.

Elephants and probably other species have almost certainly contributed factors in the reduction of woody vegetation. Pellew in Serengeti showed giraffe and elephants affected regeneration, and it is well known that they can reduce mature woodlands. However, there are undoubtedly other factors as well and the southern part of the Park has probably been basically grassland savanna for a very long time. That is where the rhinos and other grazers were when the Park was created. The woodland to the north is associated with higher more broken terrain and a lower water table, as the ground rises to the Nile/Zaire watershed. The difference to the east and west is less obviously associated with topographic or soil factors, though there is less surface water. There are other places in the region where an area of rolling savanna grassland intersected by wooded river valleys is distinct from surrounding forest. There are a lot of ecological questions to be answered to help conservation and management of this ecosystem.

It can be seen from the map that water is not a limiting factor. Even in the late dry season it is available almost throughout. The maps of rhino distribution in the southern sector also show how regularly dissected by water courses the grassland is. Virtually all the water courses are fed by perrennial springs, and water is widely available from springs, swamps or rivers Patches of swamp in the middle of the grasslands also provide habitat for hippos away from the rivers and provide shorter green grass when most of the Park is covered by tall coarse grasses. Old termitaria clearings are also widely and regularly spaced throughout the grassland and make shorter, more palatable grasses available.

Proportions of patches of long grass still available as cover were estimated for each sub-unit, but on the scale of the general count it was not possible to draw any clear associations with animal distribution.

The broad vegetation zones given are based on the Yangambi system, with the cover estimates for refinement.

COMPARISON OF COUNT FIGURES

Although methods of the 1976 and 1983 counts were as similar as possible, some aspects varied. Observers were different, which is quite important. Strip widths were not calibrated in the 1976 count and this may have given rise to high estimates in analysis. Correction was also made for actual average height per transect in the 1983 count. Visibility may have been better on the 1976 count. In March the grass is mostly burnt but there is little flush, and there is a constant haze in the air from fires. In April it would have rained There would be some green flush to give contrast and the air was probably clearer. In May this year it was noticed how much the visibility had improved since March. It would be dangerous, therefore to draw too strict a conclusion from comparison of the figures. In general, figures for all species except buffalo were around half those estimated in 1976. Most of the species are not poached and it is difficult to find another cause for so considerable a difference, except those inherent in the methods. Systematic sample counts are designed to give maximum data on a wide spectrum of parameters in the most economical and practical way, with confidence limits on the population estimates. These may be quite large if the populations are at low density or have clumped distribution. The 1976 figures should therefore be considered as a maximum at the time and the 1983 ones as possibly a minimum. More weight should be placed on taking the present count as an assessment of the current situation.

It would appear, for example, that the buffalo numbers might have risen, but it would not be true to conclude that the elephant population is less than half that in 1976. There is poaching, and numbers probably are lower, but the indications are that it has not been on quite that scale.

The high intensity sample count, together with the other methods was aimed at getting a reasonably accurate picture of the rhino population, and it is felt that this was acheived, although low numbers and clumped distribution gave high confidence limits to the population estimates for rhinos.

DISCUSSION OF RHINO CONSERVATION

The rhino population is down to very low numbers and urgently needs effective protection. However, it is felt that it still stands a very reasonable chance of recovery if such protection can be acheived. The Park situation is such that, if international help is given, the chances of acheiving such protection are very good.

The rhino population has built up from low numbers before, and the southern white rhinos (*C.s.simum*) were once reported to be down as low as 10 (Sydney 1957). Whether or not that figure was strictly accurate, the sub-species now numbers over 3,500 and their problem is one of excess animals. Other species have also shown build ups from low numbers. Only 8 Himalayan Thar were introduced into New Zealand and now they are a national pest (Gwynne pers.comm.). Six black rhino were introduced into Rwanda in 1958. Now there are 20-40 (Monford pers.comm.) According to Frankel and Soulè (1981), if a population passes through a bottleneck of low numbers fast enough, there is little loss of genetic heterozygosity. An equal sex ratio (such as this one) allows for the maximum effective population (N_e) (population of animals contributing to reproduction out of the total population). For long term viability through many generations, however, an N_e of 50 is considered a minimum, although the majority of southern white populations are less than that (Hillman 1982).

There are 14 northern white rhino known to still be inraptivity, possibly more (considerably more have been caught but never got to the zoos). There are others in the wild in Sudan and Central African Republic, but there is little hope in Sudan for being able to do anything effective to conserve them in situ. With such a small world population, therefore it may be necessary to consider them as a whole gene pool, and develop and use, where possible, techniques for exchange of genetic material. For example, it might prove possible, in conjunction with

Dr Safarik of the Vychodeceska Zoo, and/or others, to collect and store sperm, if it was agreeable, when animals are tranquillised for other purposes (eg radio collaring), and later to use these on captive females. At a later stage some introductions of animals or material to the wild population could be considered, if necessary. If the world population of northern white rhinos is thus considered as a whole in conservation terms, it should improve the viability of both the whole and the parts.

The problem is how to give the best long term protection to the rhinos. Various possibilities could be considered, but the ultimate decision about the rhinos obviously rests with the IZCN. Three theoretical possibilities are discussed here:
a) A major project for their protection and management in Garamba and re-development of the Park, b) Capture and holding in a protected enclosure within the Park, c) Translocation to a protected captive situation elsewhere.

For pure protection of individuals, captive holding in a guaranteed safe place (c) could be one approach. But this is somewhat defeatist, when it has long been known that the rhinos and Garamba needed improved protection, and when aid is being given to the Park anyway (hence the reason for the survey). Catching and moving the rhinos would not be without risk and some could be lost. The logistics of such an operation there would be very difficult and time-consuming, and it is questionable whether the sub-species has the same distinct value if it exists only in a "zoo situation", not as part of an ecosystem. There certainly are obvious morphological and genetic differences between the 2 sub-species, but there are probably ecological and behavioural ones too, which would be lost out of context. The main reason the northern and southern white rhinos were considered separately and the northern ones given highest priority during the survey of rhinos for the IUCN African Rhino Group, was the difference in conservation status and needs. The northern whites were not only desparately in need of protection, but represented areas and ecosystems that were special and that were lacking sufficient protection.

Garamba is an existing, functional National Park, established originally on very sound principles, with good, well designed development structures. It still has sufficient manpower, many good. Lack of running resources, funds, motivation and active leadership, and delayed salaries have led to a deterioration of the functioning of the infrastructure. But the potentials for rehabilitating the Park and controlling poaching are excellent, with material and practical input. It is a productive area, with rich, and some unique, fauna and flora and is valued nationally, and internationally as a World Heritage Site. While there is, therefore, still a viable chance of conserving a population of this highly endangered sub-species in the wild and contributing to conservation of such an ecosystem, it would seem ethical to try to do so.

Within the Park, one could also consider (b), capturing and holding the rhinos in a fenced enclosure to improve their protection for a time. This, however, has inherent problems in so remote a place. If they were held in a small boma, the adult males would have to be kept separatelyfrom each other, the reproductive potentials of the whole population could be reduced by unnatural conditions and high density, and the latter could also lead to fighting. It would necessitate artificial feeding, which with the uncertainties of supplies and transport would be a dangerous situation to get in to, and overall it could lead to a deterioratio of the population.

If they were kept in an enclosure large enough to allow for natural feeding and reproduction and increase, the absolute minimum that might be necessary in that habitat could be around 100km^2. In an elephant density of 3.6/km^2, this would enatil extremely expensive fencing and constant maintainance. It would disrupt existing social systems and home ranges and could lead to domination of the reporoduction by a limited number of males. It would have to be extremely carefully managed for fire, to avoid complete burning or complete lack of burning of the area, or burning of the fence. There would still have to be a considerable development of the effectiveness of the guards or, the rhinos would be sitting duck

None of this would be impossible, but they are already in a fairly limited area and it is suggested that the initial approach should be (a), to develop the effectiveness of the guards and intensify patrolling with trusted guards and constantly manned field bases (which is currently being done by Mankoto), and to intensively monitor the rhinos and poaching threats, both from the air and the ground, by having the rhinos radio-collared. The presence of a prominant collar would probably also deter any poachers who got that far. To be successful, this obviously needs to be in the context of re-development of the whole Park and anti-poaching and a greater understanding of the dynamics of the ecosystem.

The population dynamics and ecology and behaviour of the rhinos, as well as the poaching threats would need to be very closely monitored in order to determine whether the action taken was successful, and if not, at what stage another approach, such as captive protection would be needed. The logistics of such a possibility would also need to be worked out in advance. Simultaneous monitoring of the whole ecosystem, particularly with reference to the elephants buffalo, giraffe, habitat and poaching, is also indicated as valuable by the results of this survey. If the rhino conservation can be made effective in situ now, there would be a far better chance for the long term future of a population of northern white rhinos in the wild, and the Park. Conservation of the rhinos within the Park is the policy of IZCN (Mankoto ma Mbaelele, in meeting).

THE ELEPHANT TRAINING SCHOOL

The only African elephant training school was started near Dungu in the then Belgian Congo, in 1901. It moved to Gangala-na-Bodio in 1927. At times there were over 100 elephants there, and it was run along military lines. There had been intentions of widespread use of the elephants for agriculture, until tractors took over. Ceylonese mahouts helped in the original establishement and training, but after that it was all done by the Belgians and local 'Cornacs'.

Four female elephants remain, one of which is a 'moniteur' (trainer elephant). They are apparentely of the sub-species *L.a cyclotis*. Two were caught in 1954 and one in 1957. The fourth was born at the station in 1954. There would appear to be immense potential for tourist and possibly even anti-poaching or research use of the elephants, while it would also be a great loss to let such an establishment die out completely. There are hopes to re-develop the school, and it is felt these should definitely be encouraged and supported. It is suggested that experts from one of the countries where they still train and use Asian elephants for work should be brought in to up-date local knowledge for catching and training more elephants. Officials in India have expressed interest.

LANTOTO PROPOSED NATIONAL PARK

The Wildlife Dept. of Southern Sudan has proposed two areas as Lantoto National Park: that south of the Yei-Maridi road, which was covered during this census, and an area north of the road, including the Yei river. The Project Development Unit of the Ministry of Agriculture in preparing a land-use plan for Yei district suggests that from the human point of view only the southern section is suitable as National Park. It is unsuitable as agricultural land and is uninhabited. The northern part is forestry area at present, and to make it National Park would invlove re-settling a whole tribe of people. Unfortunately we were unable to survey the area from the air, but reports from the ground indicate that there is very little wildlife left (Conn G.,Minga H. pers.comm.). In addition, there is settlement all along the road, between the two.It is proposed that a corridor be kept between the two, but corridors rarely work. Gazzetting of the northern section would therefore serve no buffer zone purpose to Garamba and would depend on whether the Department feels there is sufficient wildlife or sufficiently unique habitat to justify deploying their limited resources to protect it. (Information on Yei development plan kindly provided by D.Billing)

The survey showed that there is very little wildlife in the southern section, but that what there is is unusual and represents different species from those found in the savanna of Garamba National Park. They are probably however found

in Bangangai Forest Reserve further along the border in Sudan (J.C.Hillman pers.comm.) It is basically a woodland habitat and surface water is limited, and would probably therefore never hold high densities of animals. In the 1960s rhinos were often seen there by locals (Maswa S. pers. comm.) but those days are long gone. It is part of the Nile/Zaire watershed and it is always of value to protect a watershed. It can act as a valuable buffer zone to Garamba National Park, as long as guards are sufficiently supervised and supported so that they do not become a poaching threat themselves. At present there is good co-operation between the guards on both sides of the border. Two posts in Sudan are manned, and another will be shortly (Angutwa P. pers. comm.)

In all, therefore it seems valuable to give Lantoto South National Park,or other protected area status, but aid and supervision to the guards must be maintained. No informed recommendations can be made about Lantoto North here.

Unfortunately, Lantoto only borders half of the Garamba/Sudan border. The other half is in Maridi district, but the main problem with trying to give it any conserved status is the presence of a road and settlement close to the boundary. The Zairois guards have a problem along the border, because they are closest to human settlement and food sources in Sudan, but do not have Sudanese money. Systems for ensuring their support without the need to turn to any poaching should therefore be promoted and good co-operation between guards on both sides of the border encouraged.

DOMAINES DE CHASSE AND ASSOCIATED DEVELOPMENT

Only the eastern part of Domaine de Chasse d'Azandes contained substantial numbers of wildlife. It would be suitable as a hunting concession under the FAO/IZCN projec ZAI/80/002 to develop wildlife utilization in Haut Zaire, and such a concession could be of value to the Park in anti-poaching and logi tical support. Other aspec of the project, such as tourist development,logistical support and education exten- would be vital to the success of a project in Garamba.Its continuation is needed.

CONCLUSIONS AND RECOMMENDATIONS

1. The rhino population is estimated to be down to 13-20 individuals, possibly more, if reports of them elsewhere are true. Most seen were in the central area south of the Garamba river, within a total range of less than 500km^2, at a local density of 0.3/km^2. There were signs of old but no recent poaching.

2.The elephant population of the Park was estimated at 7742 ±3690, of which 5000 were south of the Garamba River at a density of 3.6/km^2. A further 2100 were estimated in the immediately surrounding Domaines de Chasse. There was evidence of old and current poaching of elephants within the Park. The minimum poaching to date this season was in the region of 0.4% of the population, while the proportion of young calves indicated a calf recruitment in the season of 4%. There has undoubtedly been a reduction of the elephant population,however,due, probably to poaching,

3. The buffalo population was estimated at 53312 ±=6960 in the Park, with a further 3000 in the immediate surrounds. It appears to be increasing, though poaching of buffalo is reported. As coarse grass grazers, their presence is probably of advantage to the ecosystem under present conditions, and the present grassland dominated conditions favour them.

4. There were good populations of other species, but roan and giraffe numbers are low and care should be taken in their conservation.

5. As the only known population of northern white rhinos that stands a reasonable chance of being conserved in the wild, and that is part of an ecosystem worthy of conservation, in a World Heritage National Park, the rhinos should be given urgent and intensive protection.

6. Such protection should be in the context of a re-development of all aspects of the functioning of the Park and its relationship with the surrounding areas, and of conservation of the ecosystem as a whole.

7. It should also be in the context of monitoring of the whole ecosystem to provide information for conservation and management, with concentration both on the needs of the rarer species and the effects of the more numerous, as well as habitat dynamics.

8. The protection and population dynamics of the rhinos should be closely monitored and methods changed if they are not effective. It is suggested that initially they should be protected in situ and monitored, using radio telemetry and intensive field work. Should the conservation action be unsuccessful, a failsafe back-up of more intensive protection for a while, for example in a captive or semi-captive situation as recommended by members of the IUCN/AERSG may be needed, and logistics and a minimum point should be worked out in advance. If in situ conservation can be made effective, there is a far better chance for the long term future of a wild population of northen white rhinos. It would probably also improve the chances of continued international aid.

9. It is also suggested that to improve genetic viability in the long term, the world population of northern white rhinos should be considered as a potential whole gene pool, and techniques of exchange of genetic material developed, and applied as feasible and required.

10. 66% of the Park is grassland savanna with scattered trees and relict forest along water courses. The north is more hilly and wooded, with less surface water. Water availability does not appear to be a limiting factor throughout at least the southern 2/3 of the Park. Reports indicate that there has been a reduction of woody vegetation in recent decades and the dynamic ecology of the system needs investigation. Fires and elephant have probably been contributing factors, though when the Park was created it was probably basically grassland savanna with wooded water courses.

11. It would appear to be valuable to give formal conserved (eg National Park) status to Lantoto south in Sudan, as long as there is back-up and supervision for the Game Scouts. Insufficient information is available to be able to make suggestions about Lantoto north.

12. Garamba National Park appears to warrant major international help to re-develop the conservation and protection of the ecosystem within a functional infrastructure and with primary emphasis on the rhinos. Some support should also be given to Lantoto south National Park, and the elephant training school is of value and should be re-habilitated. Re-habilitation of the Park stands more chance of success in the context of the development of tourism, wildlife utilization and education and extension work as promoted by the FAO/IZCN project ZAI/80/002. The project can also provide logistical back-up. It is important that it continues. Personnel and resources are needed to help re-develop the Park.

NB. This is a report to IUCN. It does not necessarilly express official IUCN or IUCN/AERSG view point. Recommendations are basically as discussed at Garamba by the authors, but some details may vary individually.

REFERENCES

Curry-Lindhal K.(1972) War and the White Rhinos. Oryx 11(4);263-267

Dimoyelele Ku-Gilima Buna (1981) Rapport de recensement des rhinoceros blancs *(Ceratotherium simum)* dans le Parc National de la Garamba

Douglas-Hamilton. I & Hillman A.K.K. (1981) Elephant carcasses and skeletons as indicators of population trends. Low level aerial survey techniques; ILCA 4;113-130

Hillman Kes (1981) Towards the interpretation of aerial sample census data for rhinos. IUCN AR&EG meeting, Wankie, Zimbabwe. In press.

" (1982) The status of rhinos in Africa. Bongo, Jnl.Berlin Zoo.Soc. In press.

Frankel O.H. & Soulé M.E. (1981) Conservation and evolution. University of Cambridge Press.

Norton-Griffiths M. (1978) Counting Animals. AWLF Handbook 1. SEMP.

Owen-Smith R.N. (1974) The behavioural ecology of the white rhinoceros. PhD thesis, University of Wisconsin.

Parc National de la Garamba ; Rapports annuelles et mensuelles.

Pierret P.V., Grimm M, Petit J.M. et Dimoyelele Ku-Gilima Buna (1976) Contribution à l'étude des grandes mammifères du Parc National de la Garamba et zones annexes. FAO Working Doc.4 ZAI/70/001

Saeger, Henri de (1954) Introduction à l'exploration du Parc National de la Garamba. Bruxelles .

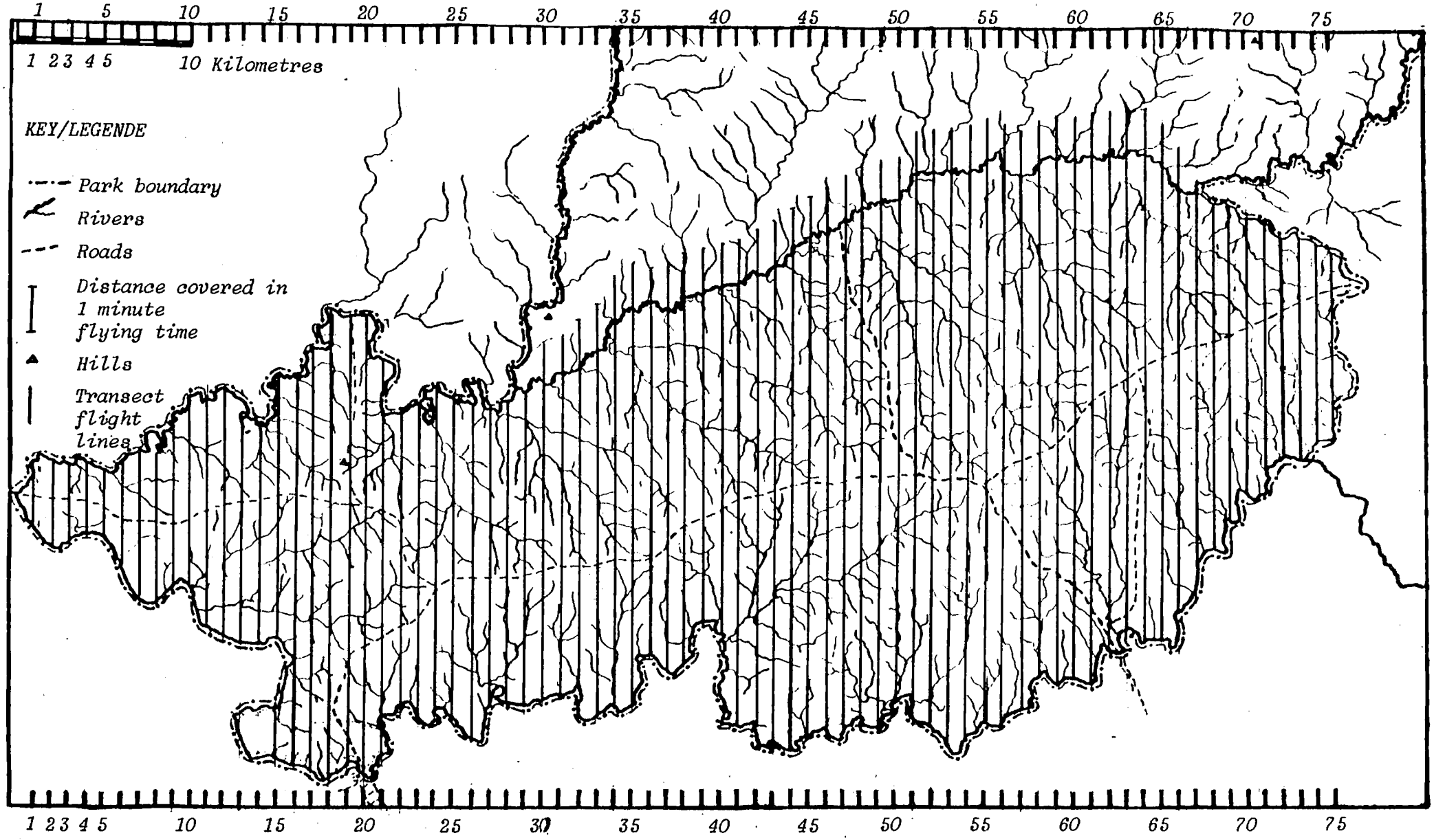
Savidge, J.M.,Woodford M.H.&Croze H.(1976) Report on a mission to Zaire FAO W/K1593 KEN/71/526 - ZAI/70/001

Schouteden H. (1927) Les rhinoceros congolais. Revue Zoologique Africaine 15 19-30.

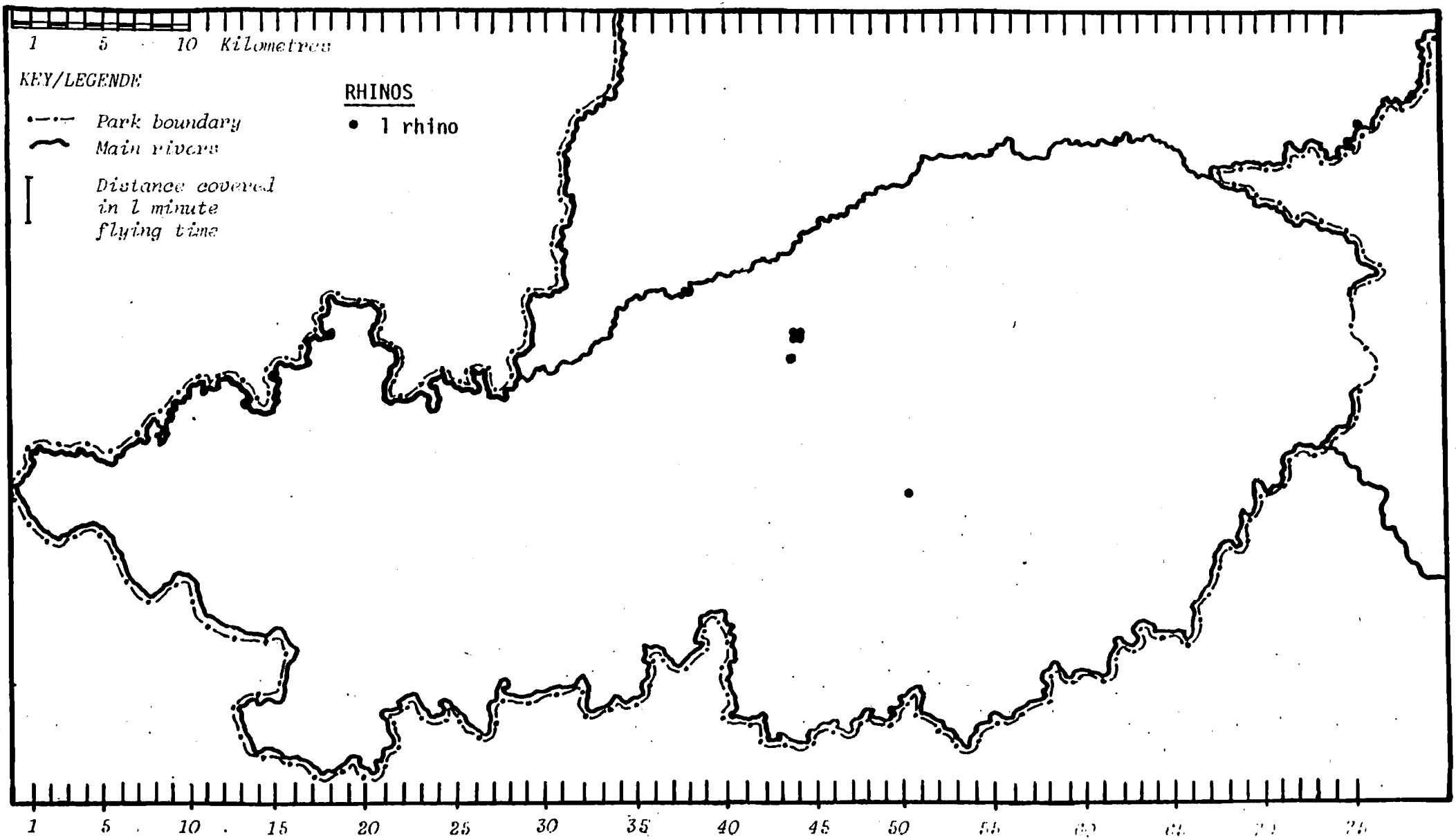
Van Gyseghem R.(1979) Zur Okologie des nordlichen Breitmaulnashorns *Ceratotherium simum cottoni* Lydekker 1908 (Freilanduntersuchungen in Uganda) Universitat Kaiserslautern, MSc thesis.

Verschuren J.(1975) Wildlife in Zaire. Oryx XIII(2)

Yangambi classification of vegetation types for tropical and sub-tropical Africa. Yangambi Agricultural College, Zaire. In Land Use Development Plan for Yei District. PDU.

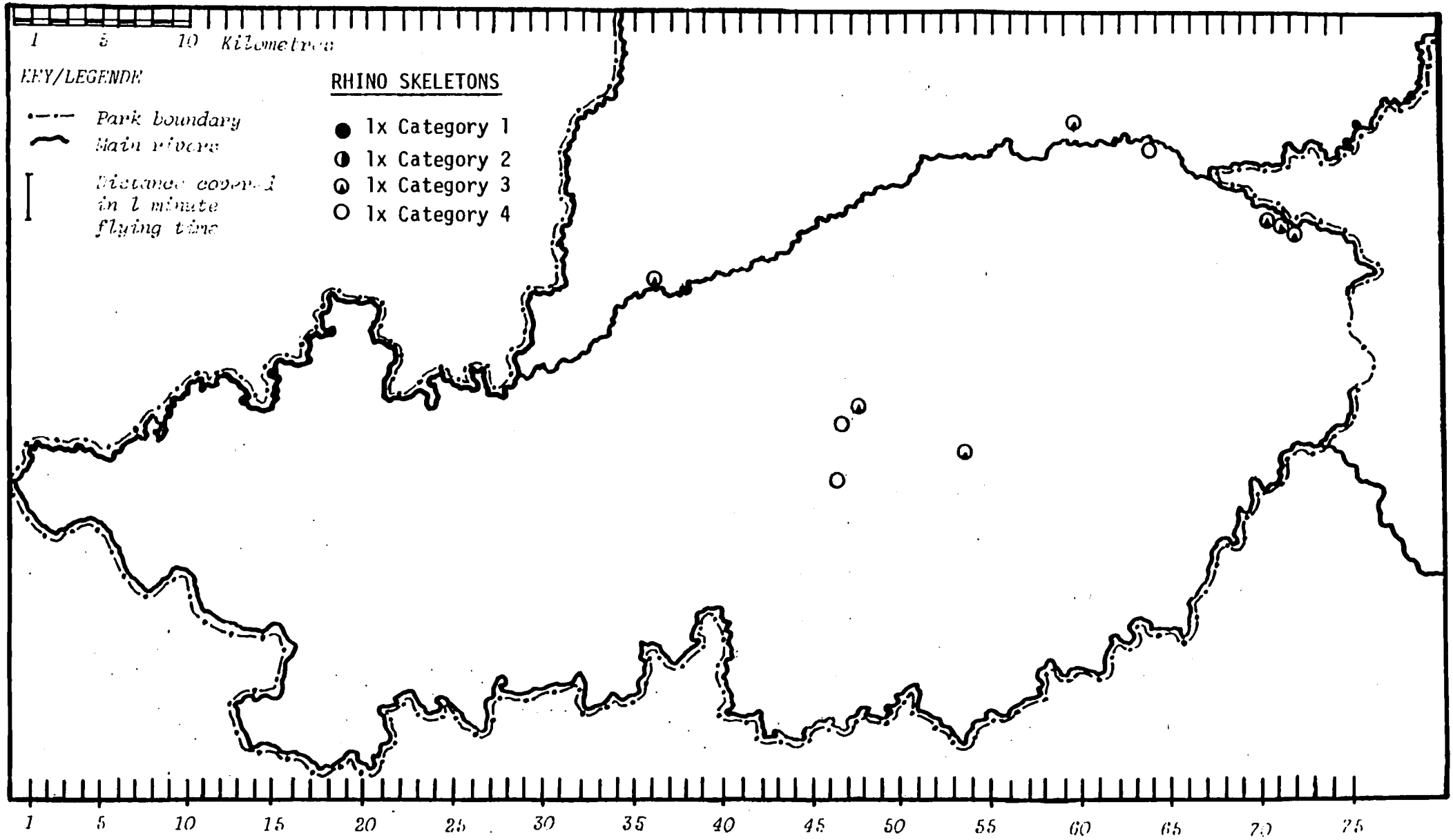


PARC NATIONAL DE LA GARAMBA (Southern sector) Intensive Count (46%), March 1983. Transect flight lines and topography.



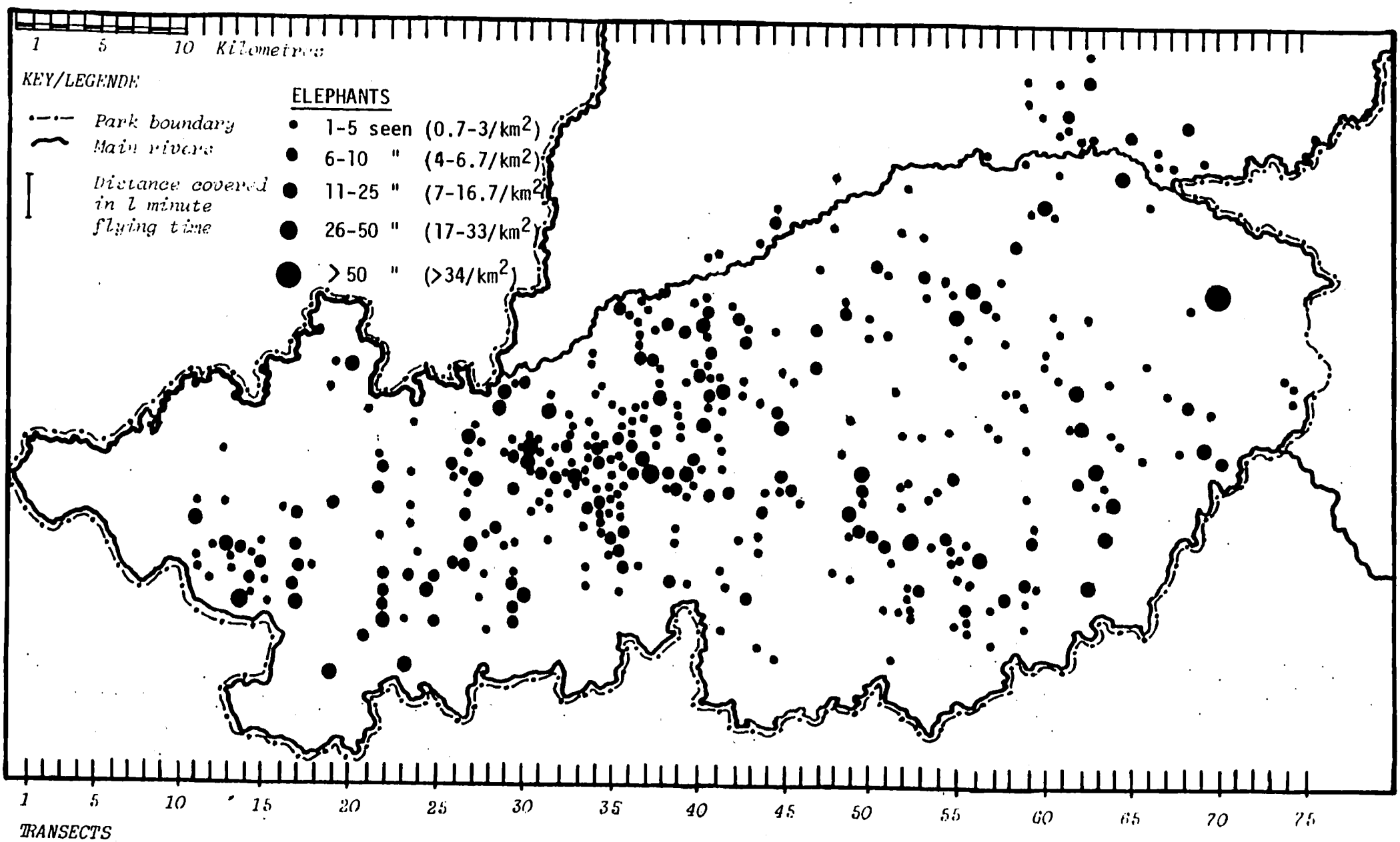
PARC NATIONAL DE LA GARAMBA (Southern sector) Intensive Count (46%), March 1983. Distribution of animals/skeletons seen.

RHINOS



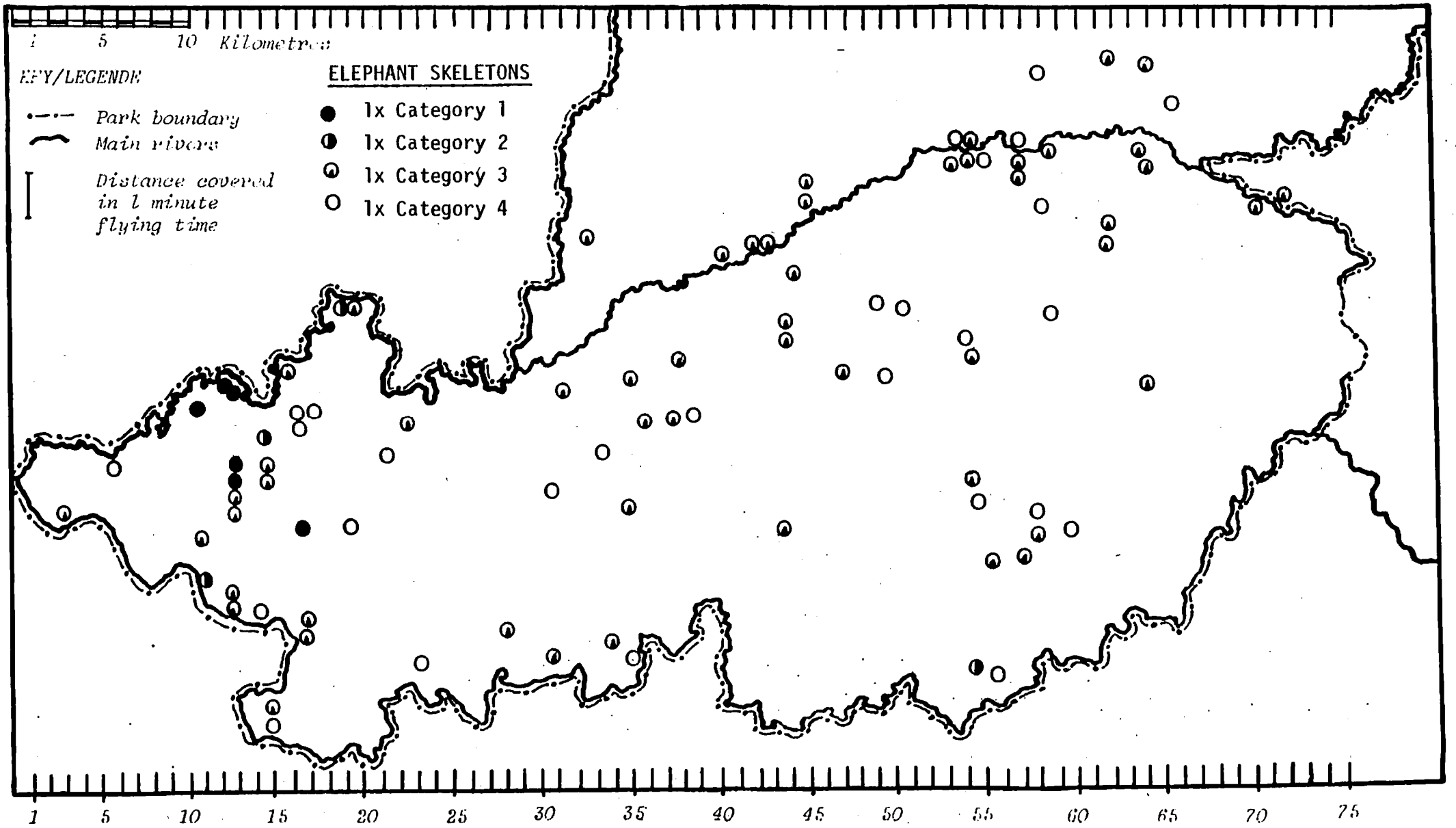
PARC NATIONAL DE LA GARAMBA (Southern sector) Intensive Count (46%), March 1983. Distribution of animals/skeletons seen.

RHINO SKELETONS



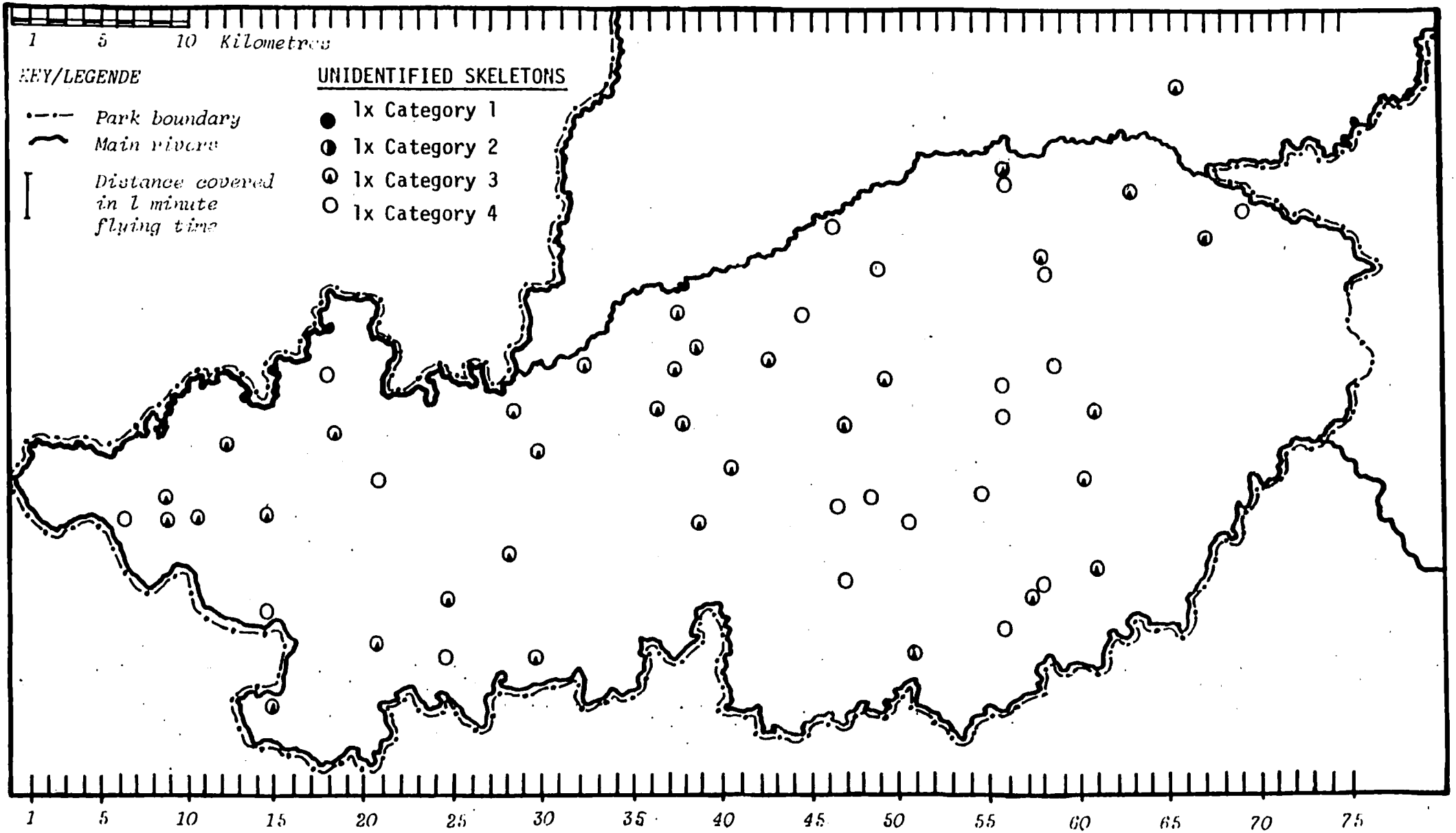
PARC NATIONAL DE LA GARAMBA (Southern sector) Intensive Count (46%), March 1983. Distribution of animals/skeletons seen.

ELEPHANTS



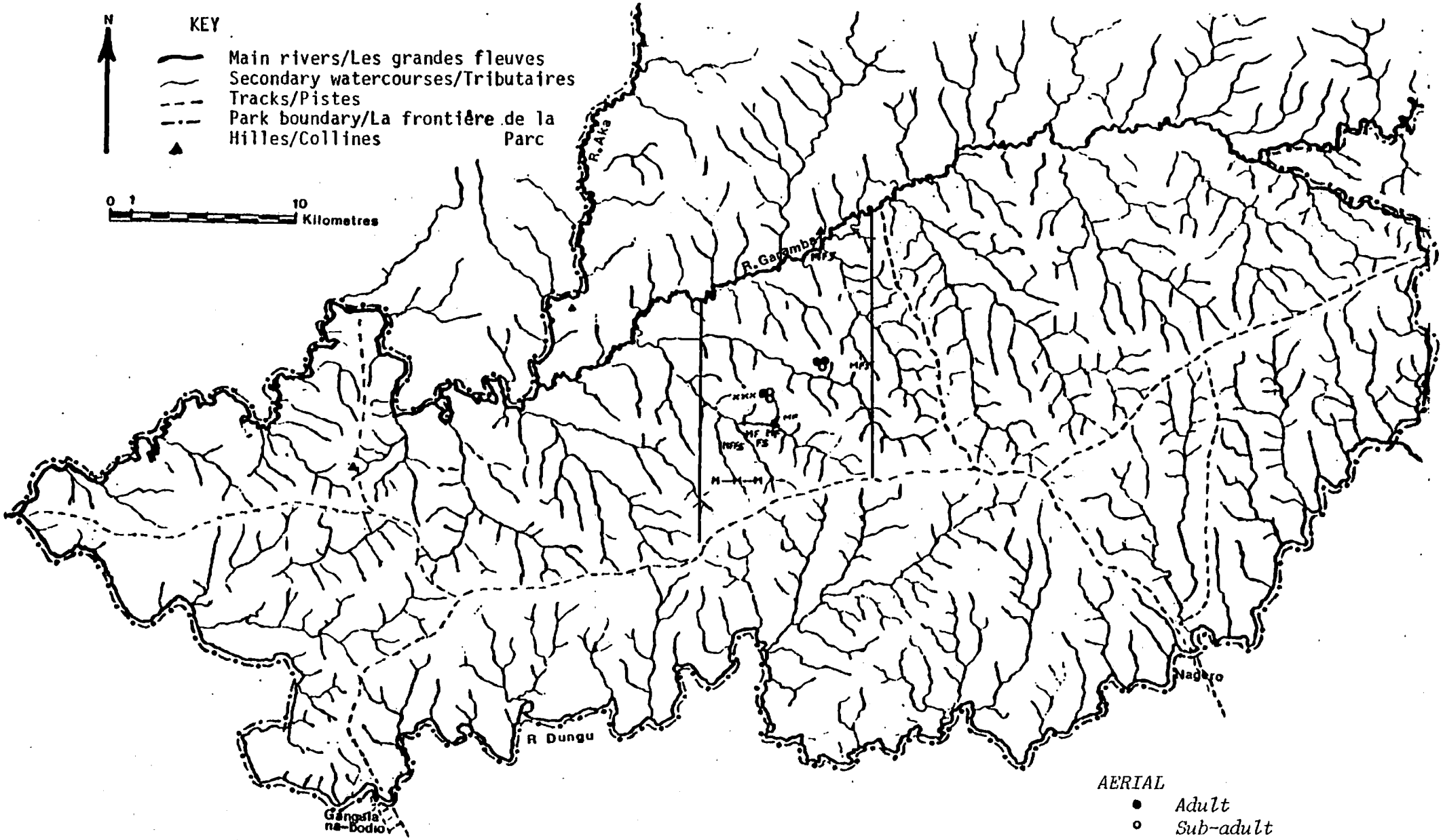
PARC NATIONAL DE LA GARAMBA (Southern sector) Intensive Count (46%), March 1983. Distribution of animals/skeletons seen.

ELEPHANT SKELETONS



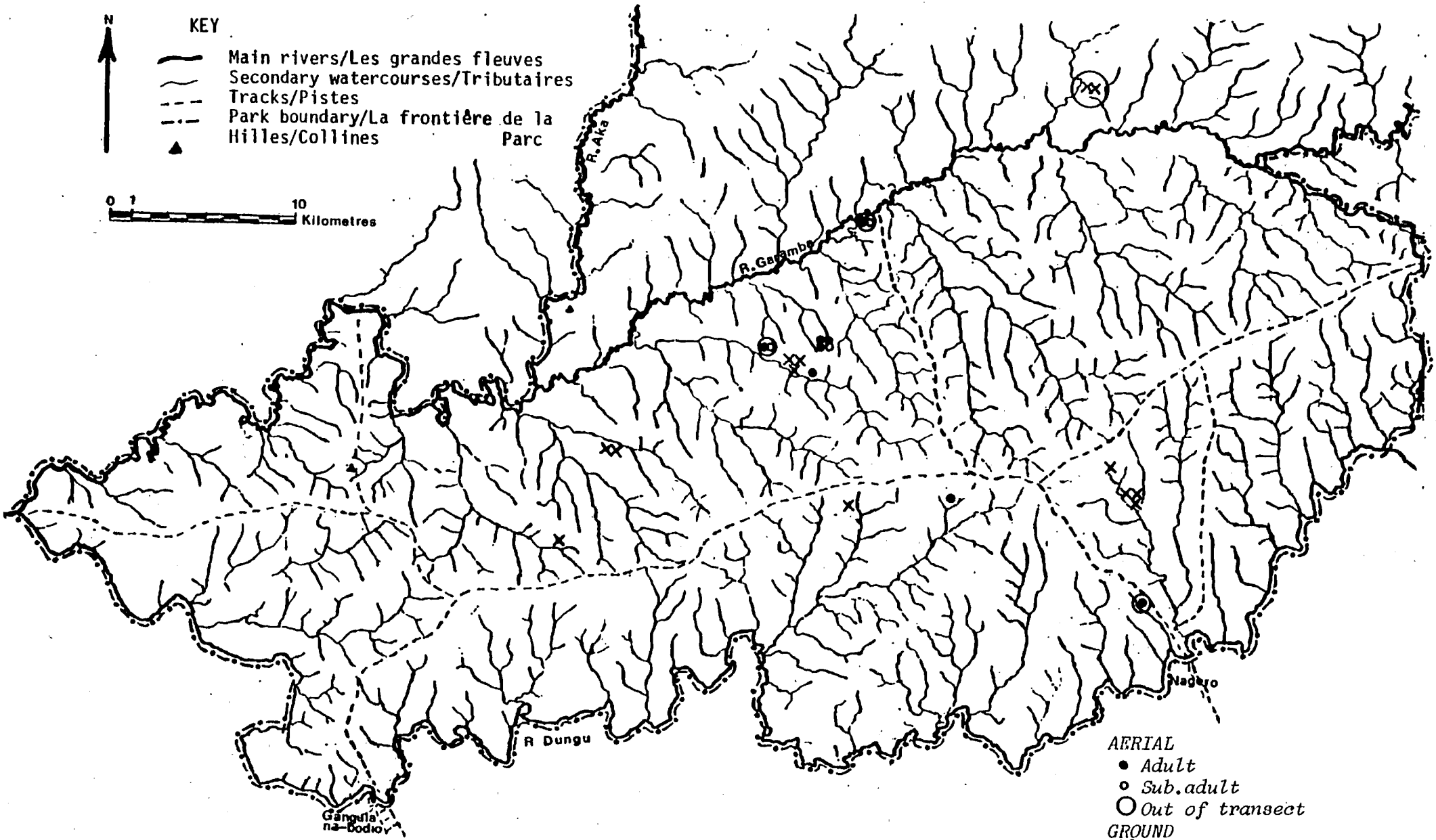
PARC NATIONAL DE LA GARAMBA (Southern sector) Intensive Count (46%), March 1983. Distribution of animals/skeletons seen.

UNIDENTIFIED SKELETONS



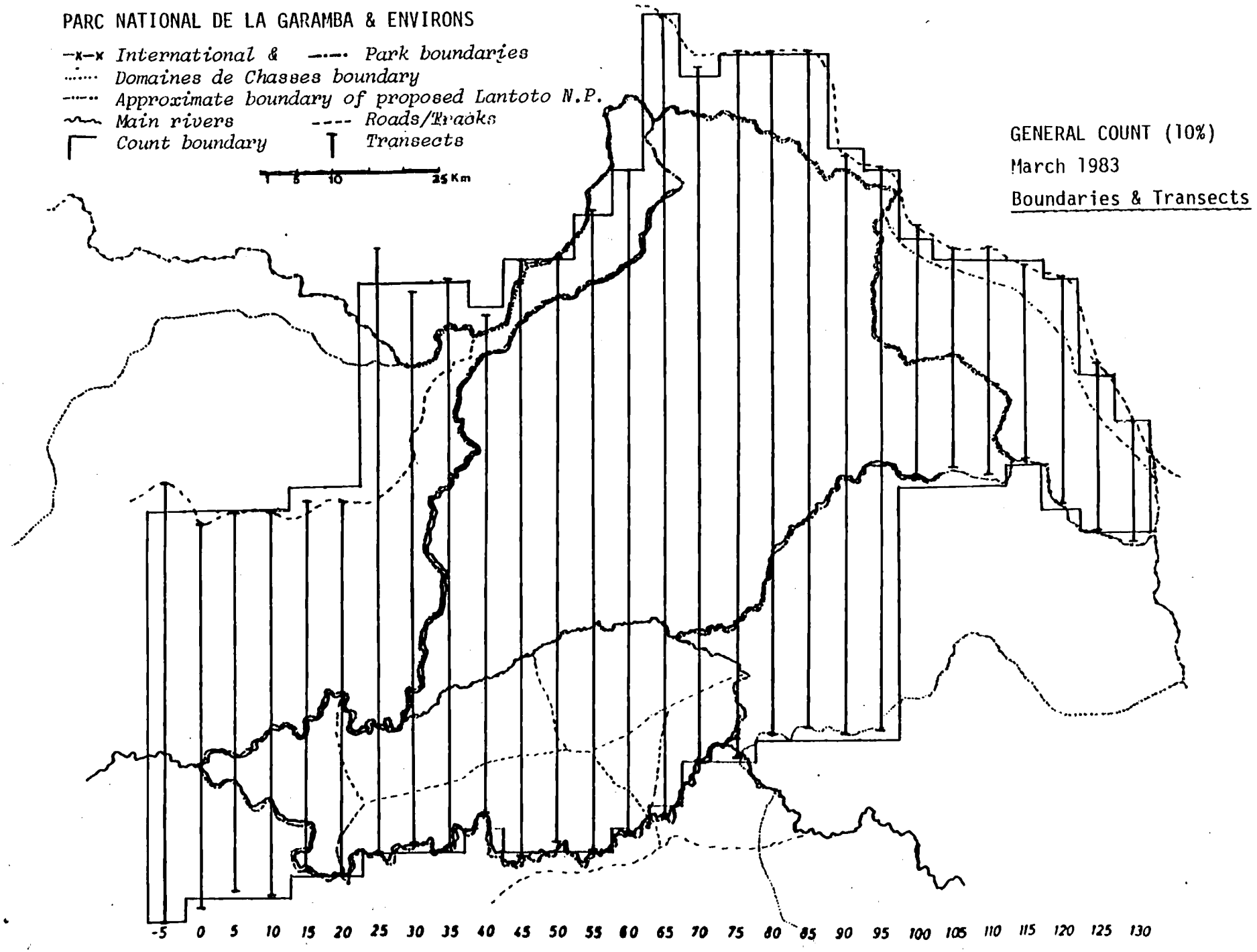
PARC NATIONAL DE LA GARAMBA Southern secter / Secteur sud

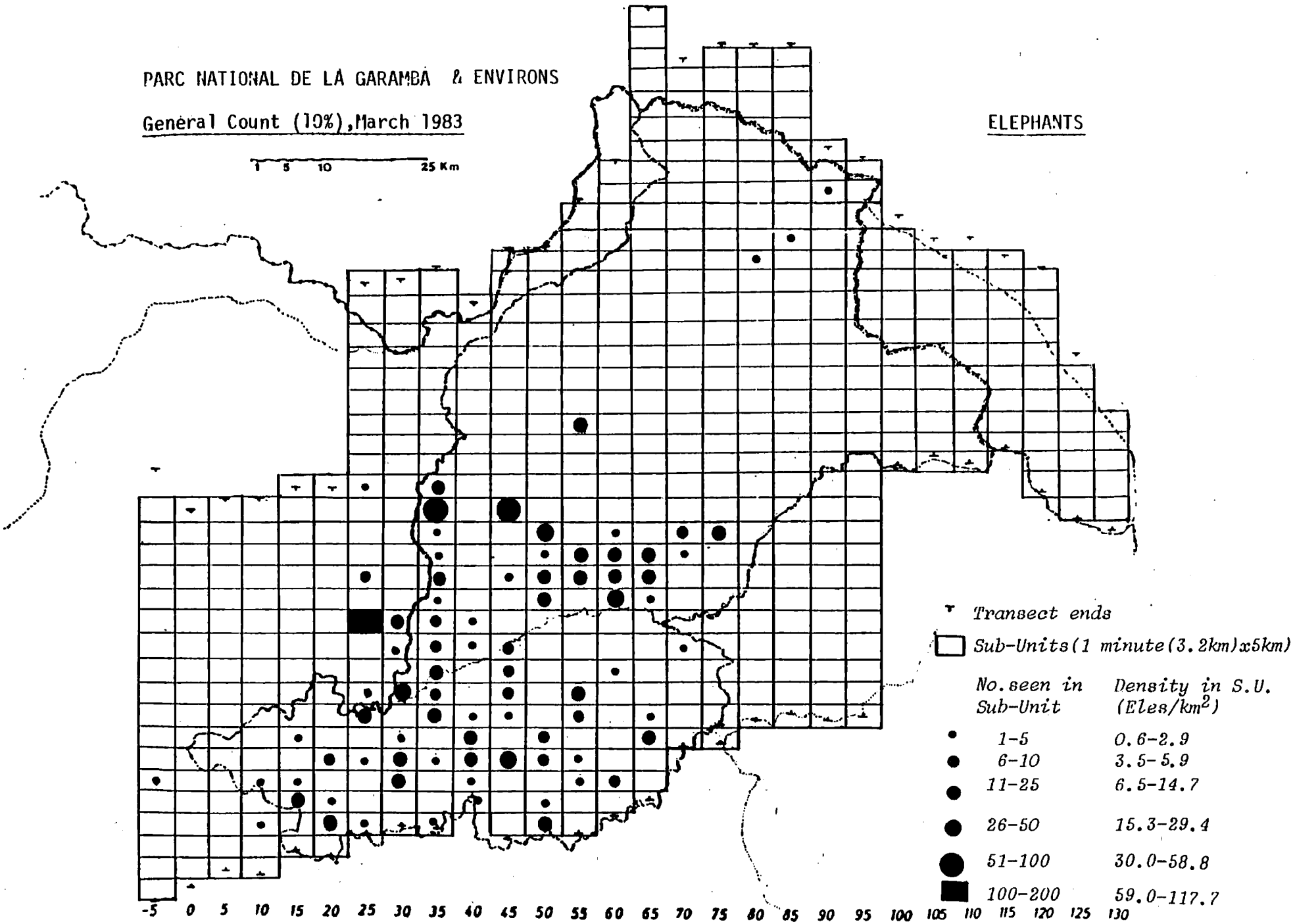
RHINO SIGHTINGS, VERY HIGH INTENSITY COUNT, 17 March 1983

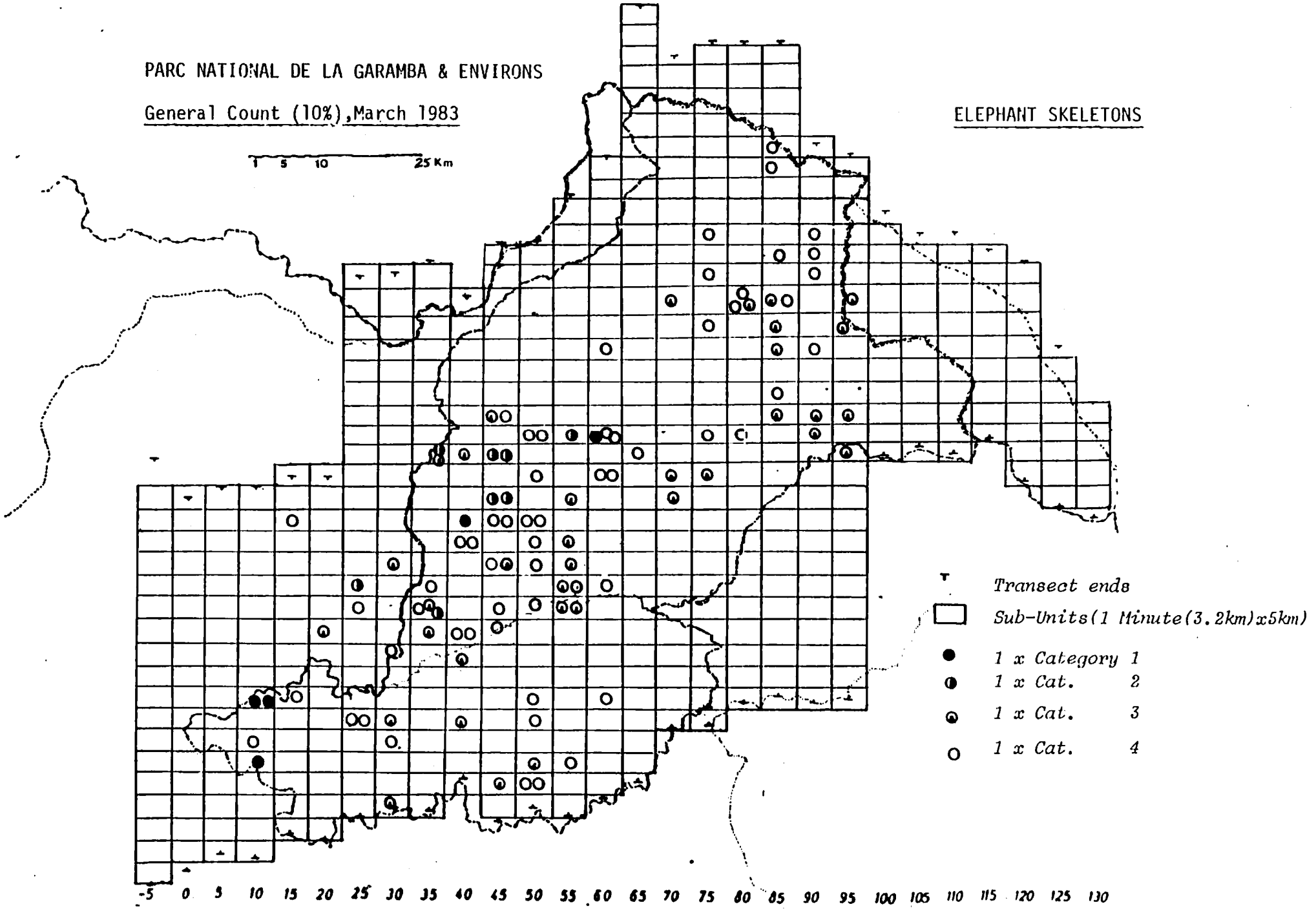


PARC NATIONAL DE LA GARAMBA Southern secter / Secteur sud

RHINO SIGHTINGS DURING CENSUS AND RECCE FLYING AND DURING PARK GROUND COUNT 7-16 March 1983


PARC NATIONAL DE LA GARAMBA & ENVIRONS
International &
Park boundaries
Domaines de Chasses boundary
Approximate boundary of proposed Lantoto N.P.
Main rivers
Roads/Tracks
Count boundary
Transects
1 5 10 25 Km
GENERAL COUNT (10%)
March 1983
Boundaries & Transects
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

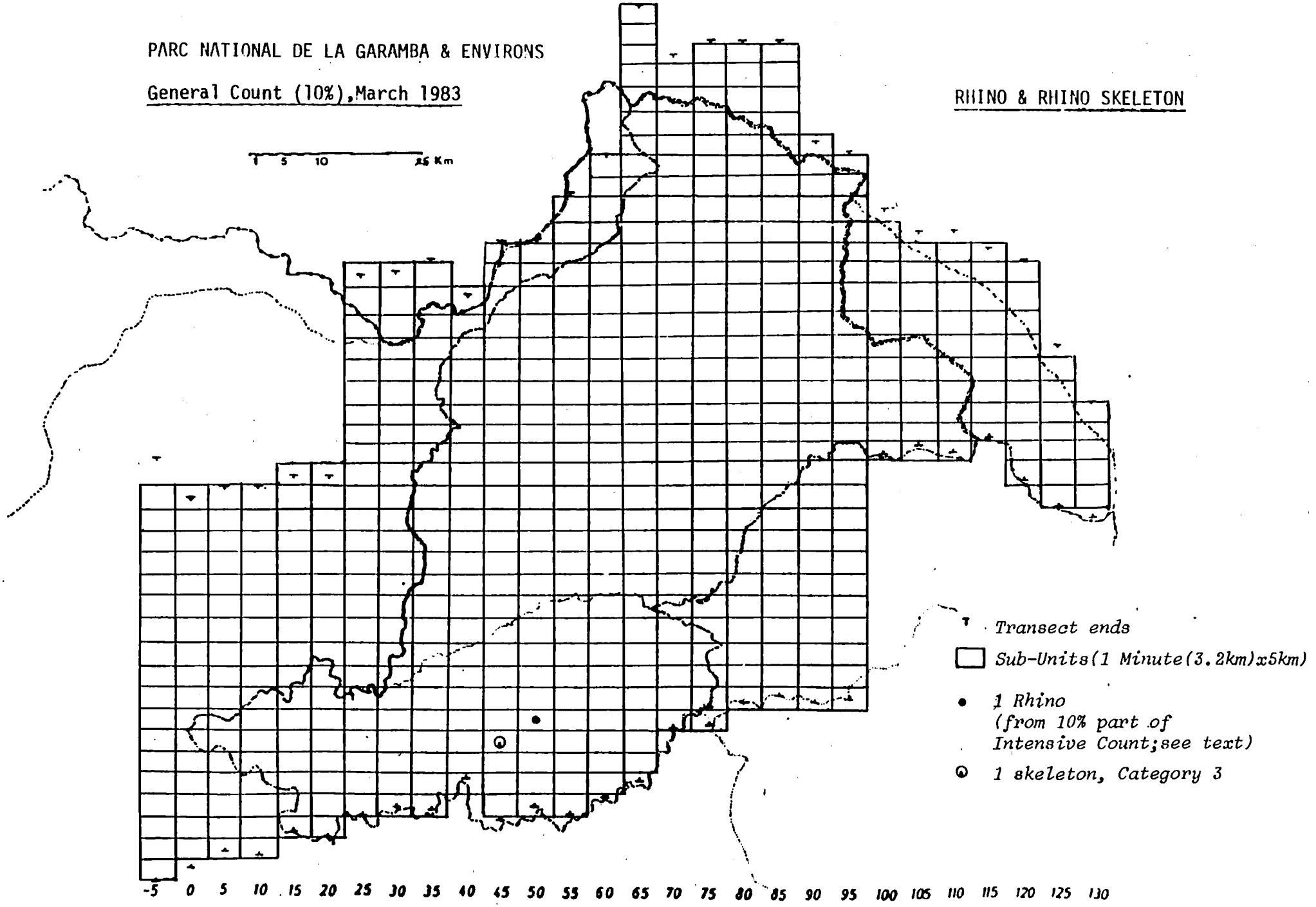

PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983
ELEPHANTS
1 5 10 25 Km
Transect ends
Sub-Units (1 minute (3.2km) x 5km)
No. seen in Sub-Unit
Density in S.U. (Eles/km²)
1-5 0.6-2.9
6-10 3.5-5.9
11-25 6.5-14.7
26-50 15.3-29.4
51-100 30.0-58.8
100-200 59.0-117.7
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

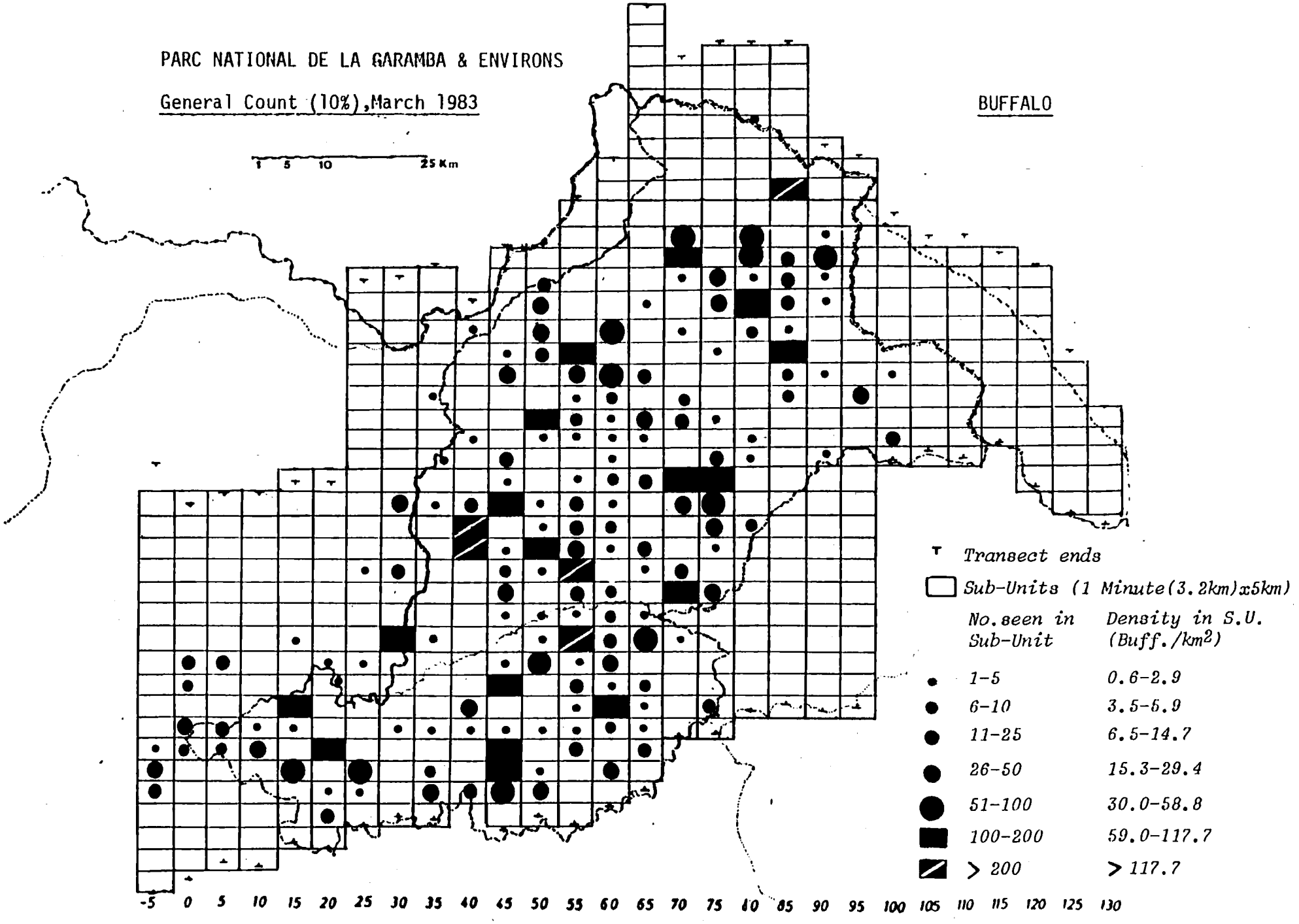

PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983
ELEPHANT SKELETONS
1 5 10 25 Km
Transect ends
Sub-Units (1 Minute (3.2km) x 5km)
1 x Category 1
1 x Cat. 2
1 x Cat. 3
1 x Cat. 4
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

PARC NATIONAL DE LA GARAMBA & ENVIRONS

General Count (10%), March 1983

RHINO & RHINO SKELETON

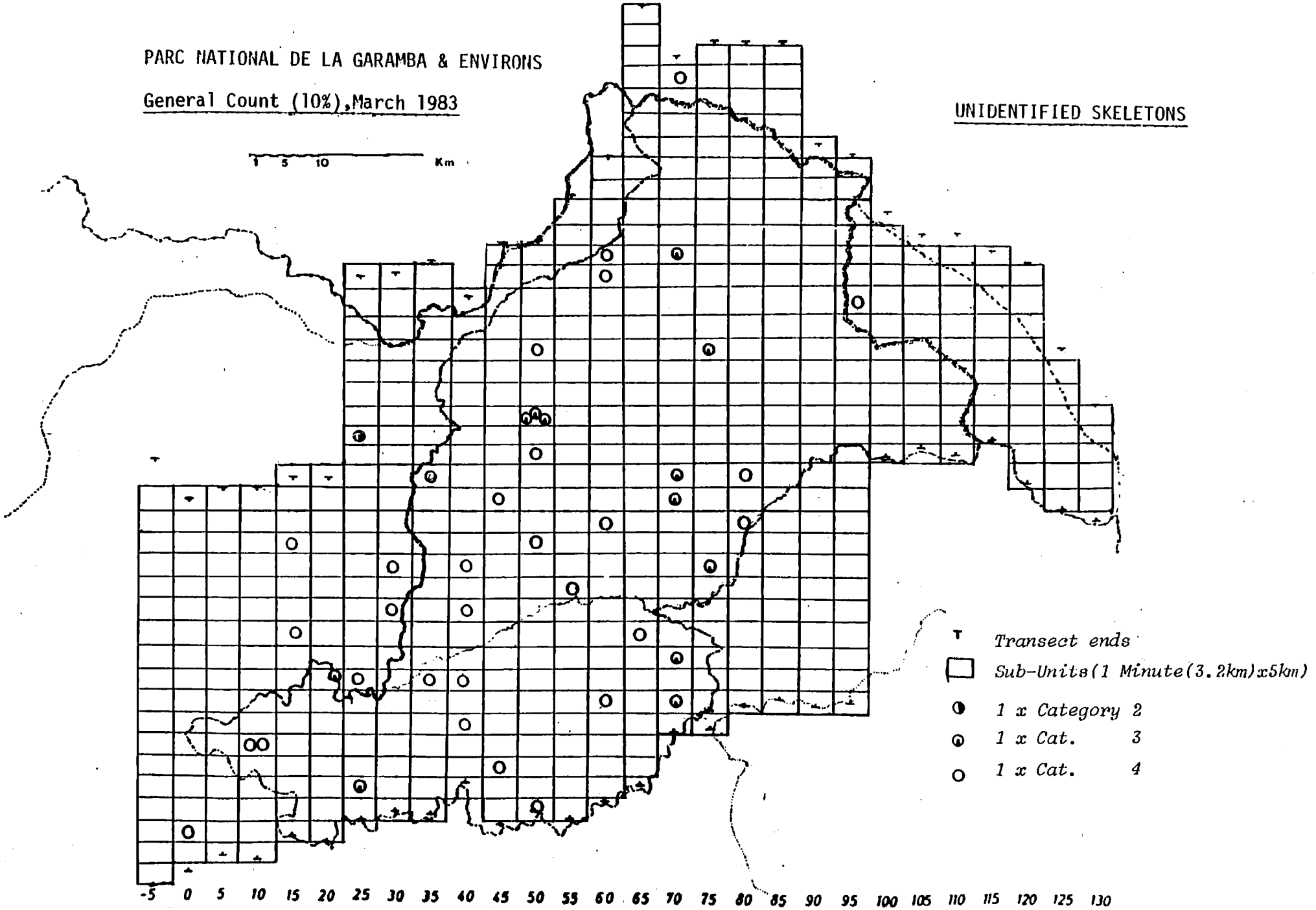


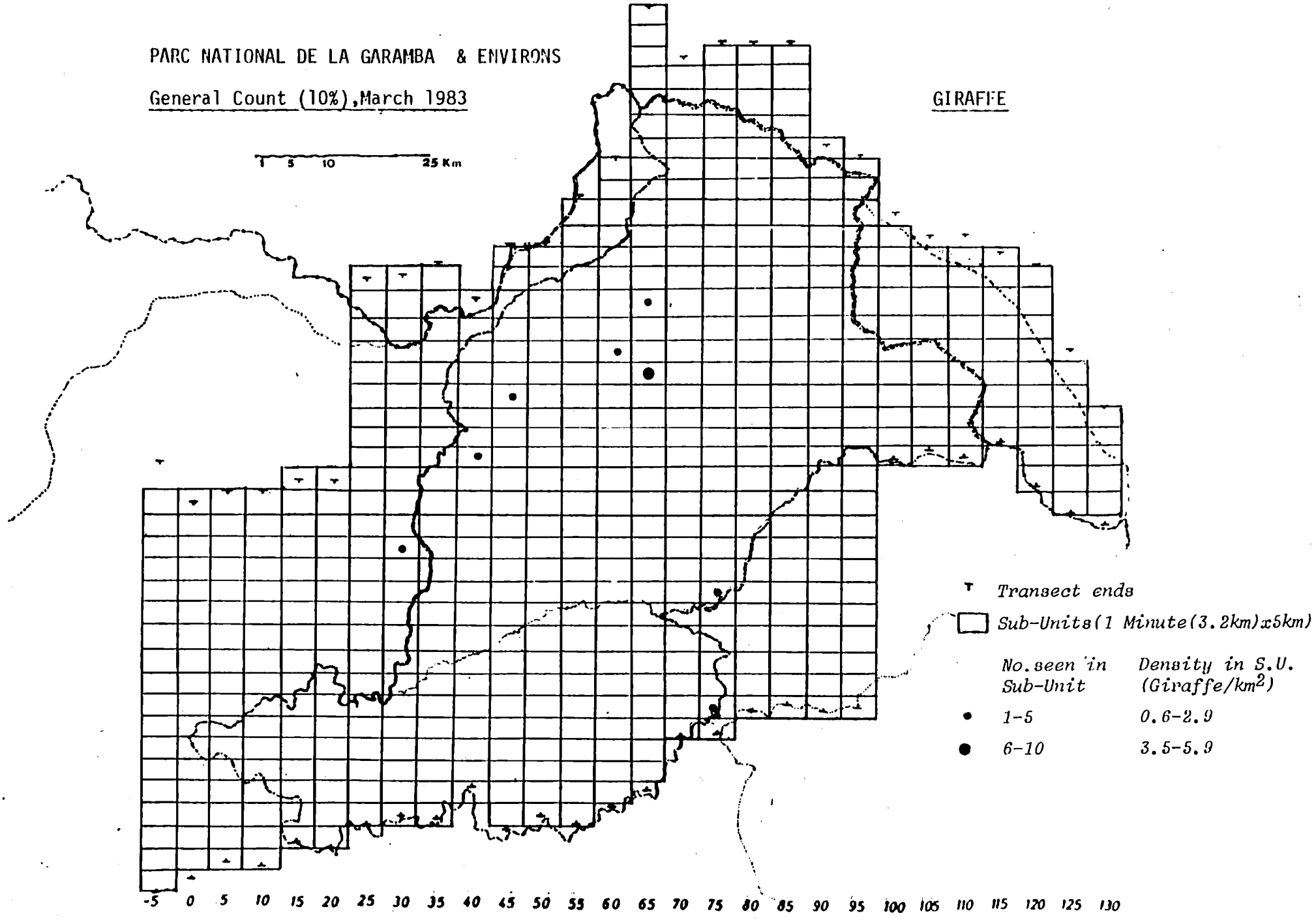

PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983
BUFFALO
1 5 10 25 Km
Transect ends
Sub-Units (1 Minute (3.2km) x 5km)
No. seen in Sub-Unit
Density in S.U. (Buff./km²)
1-5 0.6-2.9
6-10 3.5-5.9
11-25 6.5-14.7
26-50 15.3-29.4
51-100 30.0-58.8
100-200 59.0-117.7
> 200 > 117.7
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

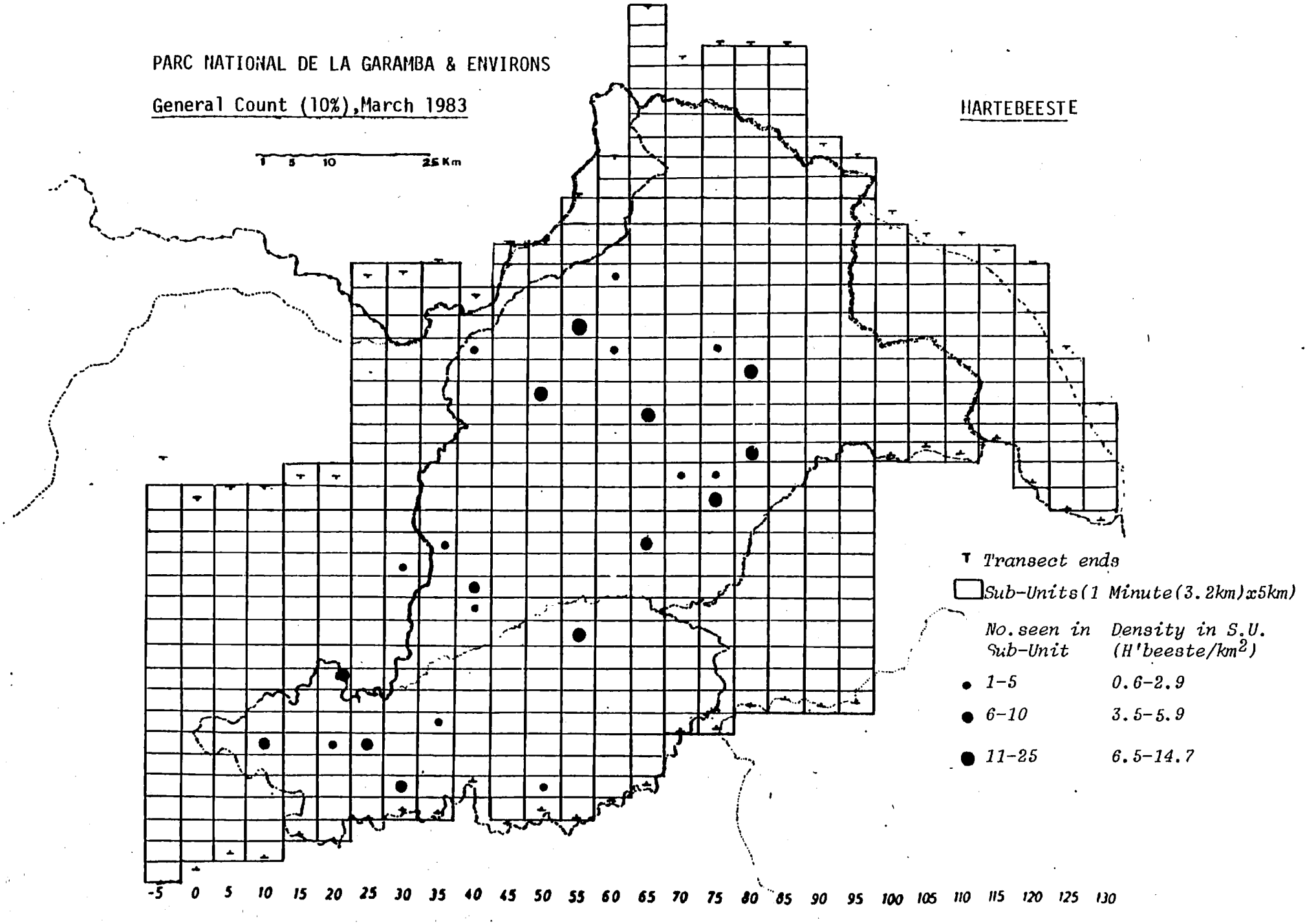
PARC NATIONAL DE LA GARAMBA & ENVIRONS

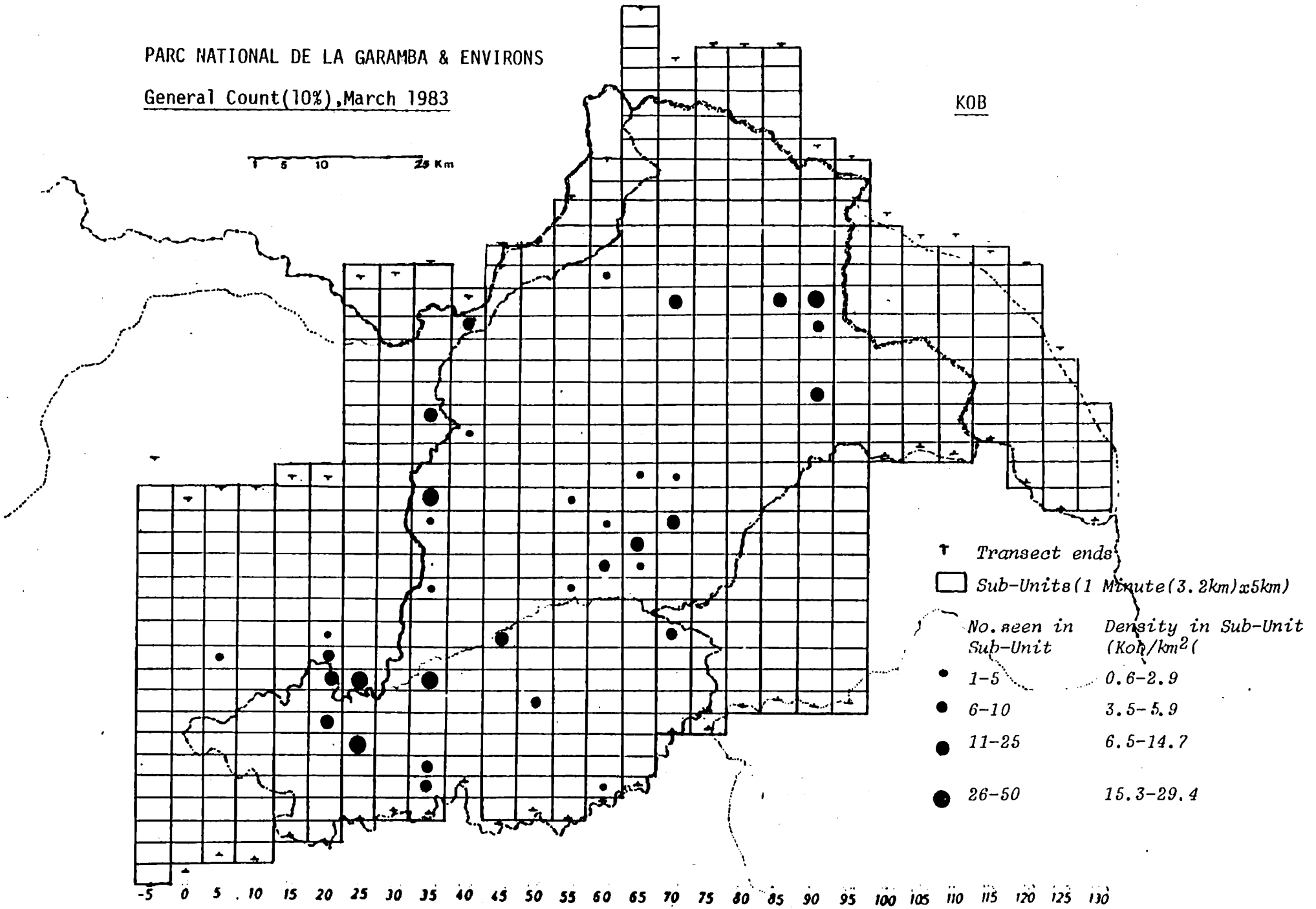
General Count (10%), March 1983

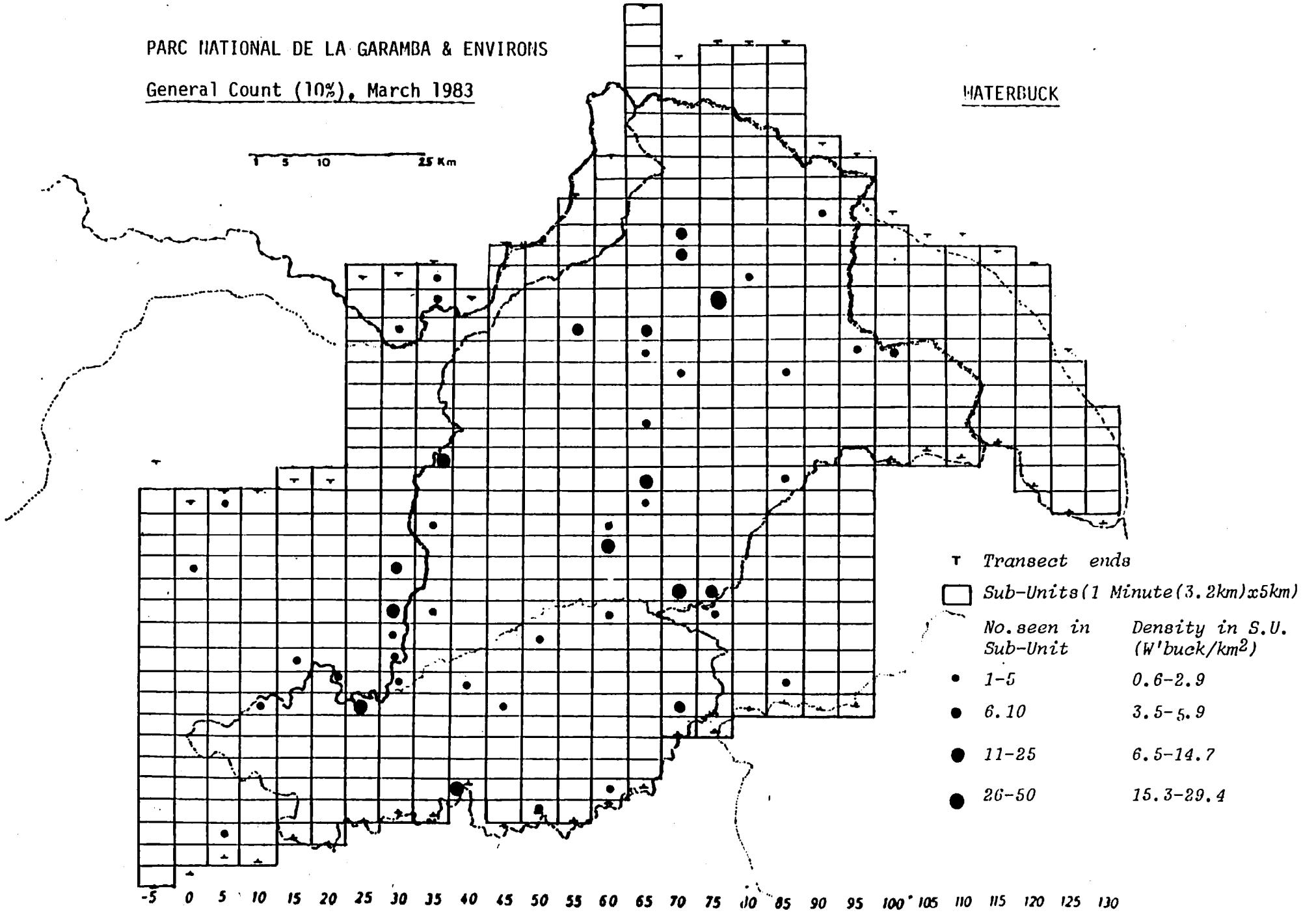
UNIDENTIFIED SKELETONS




PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983
GIRAFFE
1 5 10 25 Km
Transect ends
Sub-Units (1 Minute (3.2km) x 5km)
No. seen in Sub-Unit
Density in S.U. (Giraffe/km²)
1-5
0.6-2.9
6-10
3.5-5.9
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130


PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983
HARTEBEESTE
1 5 10 25 Km
Transect ends
Sub-Units (1 Minute (3.2km) x 5km)
No. seen in Sub-Unit
Density in S.U. (H'beeste/km²)
1-5
0.6-2.9
6-10
3.5-5.9
11-25
6.5-14.7
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

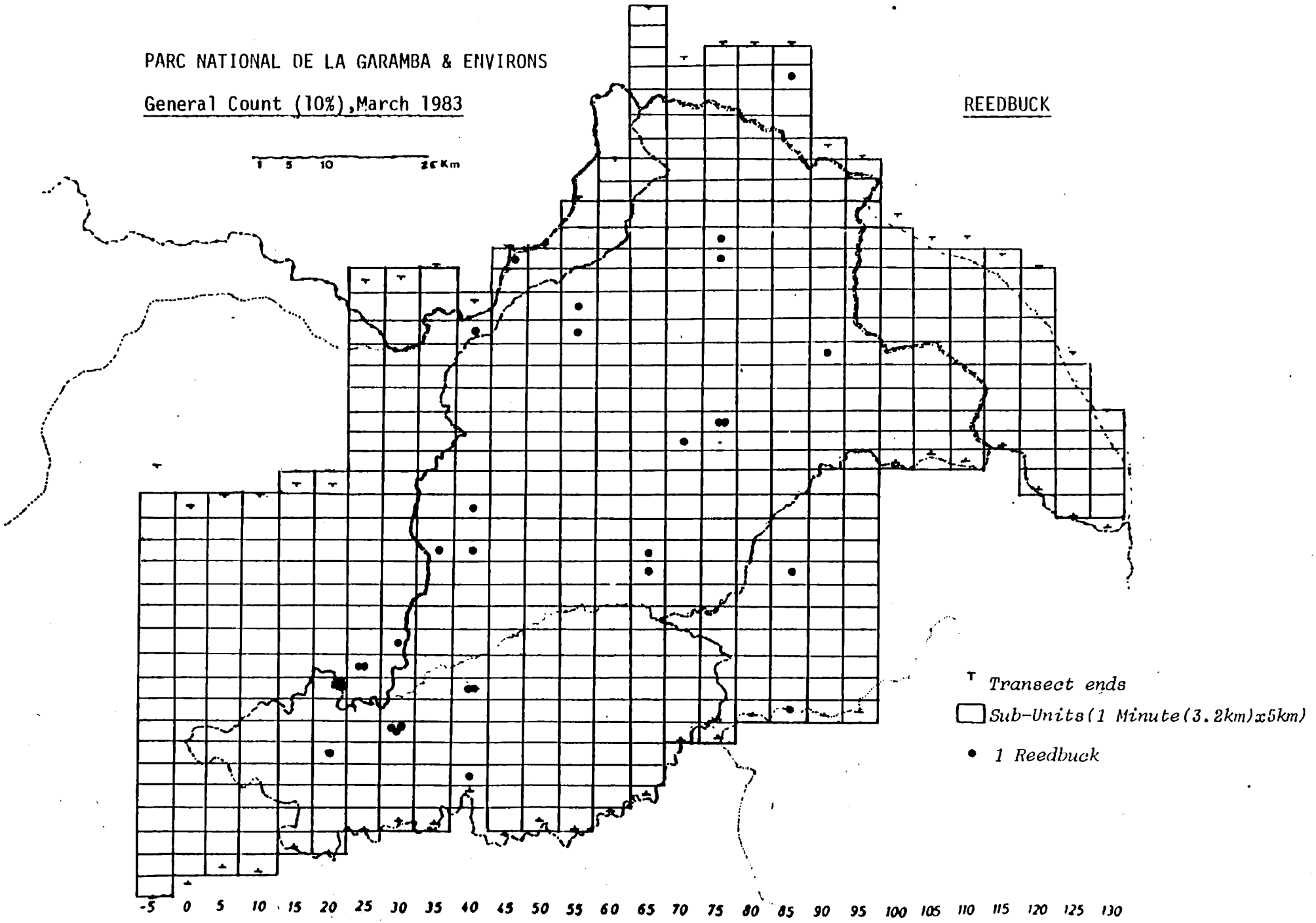

PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count(10%),March 1983
KOB
1 5 10 25 Km
Transect ends
Sub-Units(1 Minute(3.2km)x5km)
No.seen in Sub-Unit
Density in Sub-Unit (Kob/km2(
1-5
0.6-2.9
6-10
3.5-5.9
11-25
6.5-14.7
26-50
15.3-29.4
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

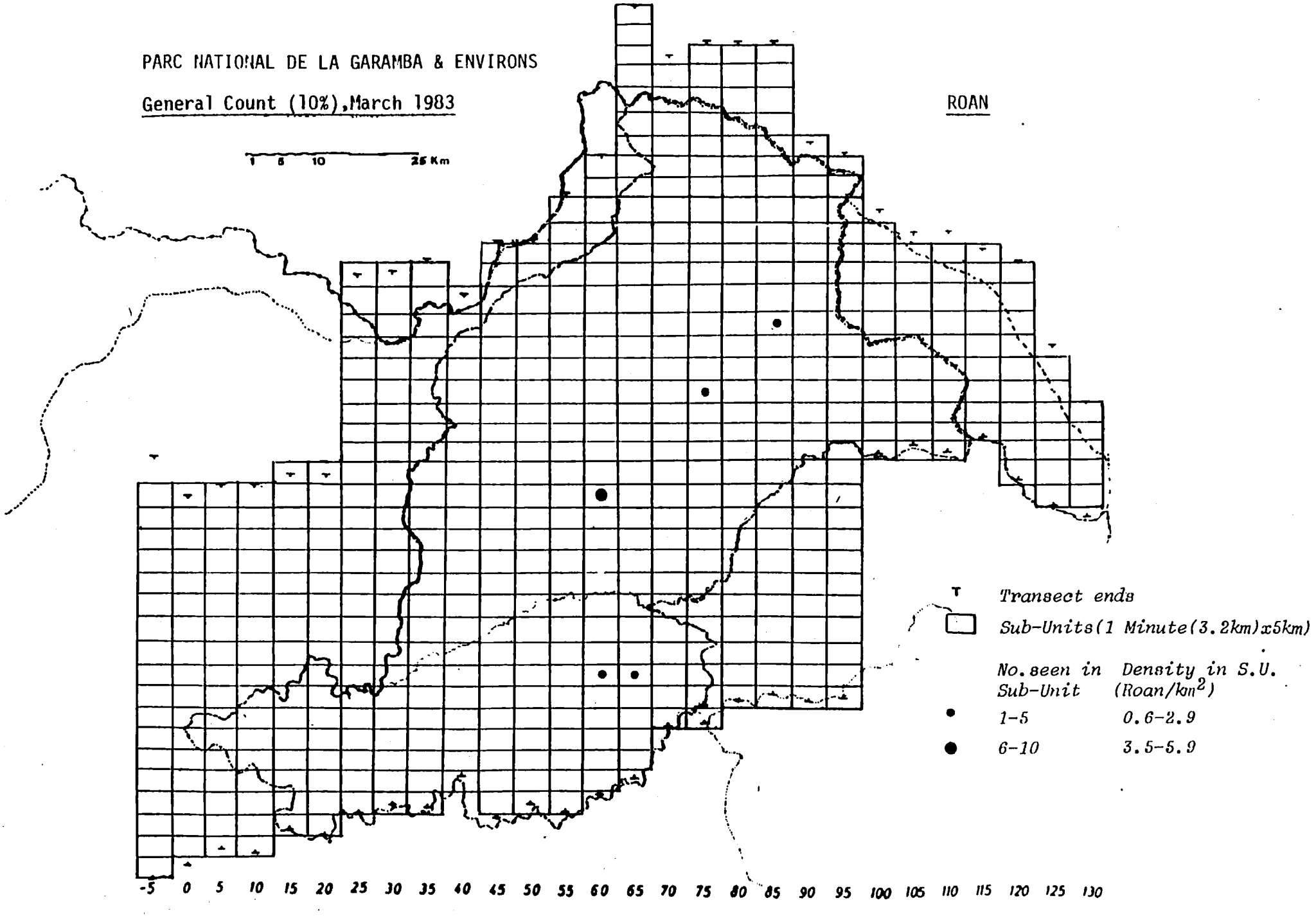

PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983
WATERBUCK
1 5 10 25 Km
T Transect ends
Sub-Units(1 Minute(3.2km)x5km)
No. seen in Sub-Unit
Density in S.U. (W'buck/km2)
1-5 0.6-2.9
6.10 3.5-5.9
11-25 6.5-14.7
26-50 15.3-29.4
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

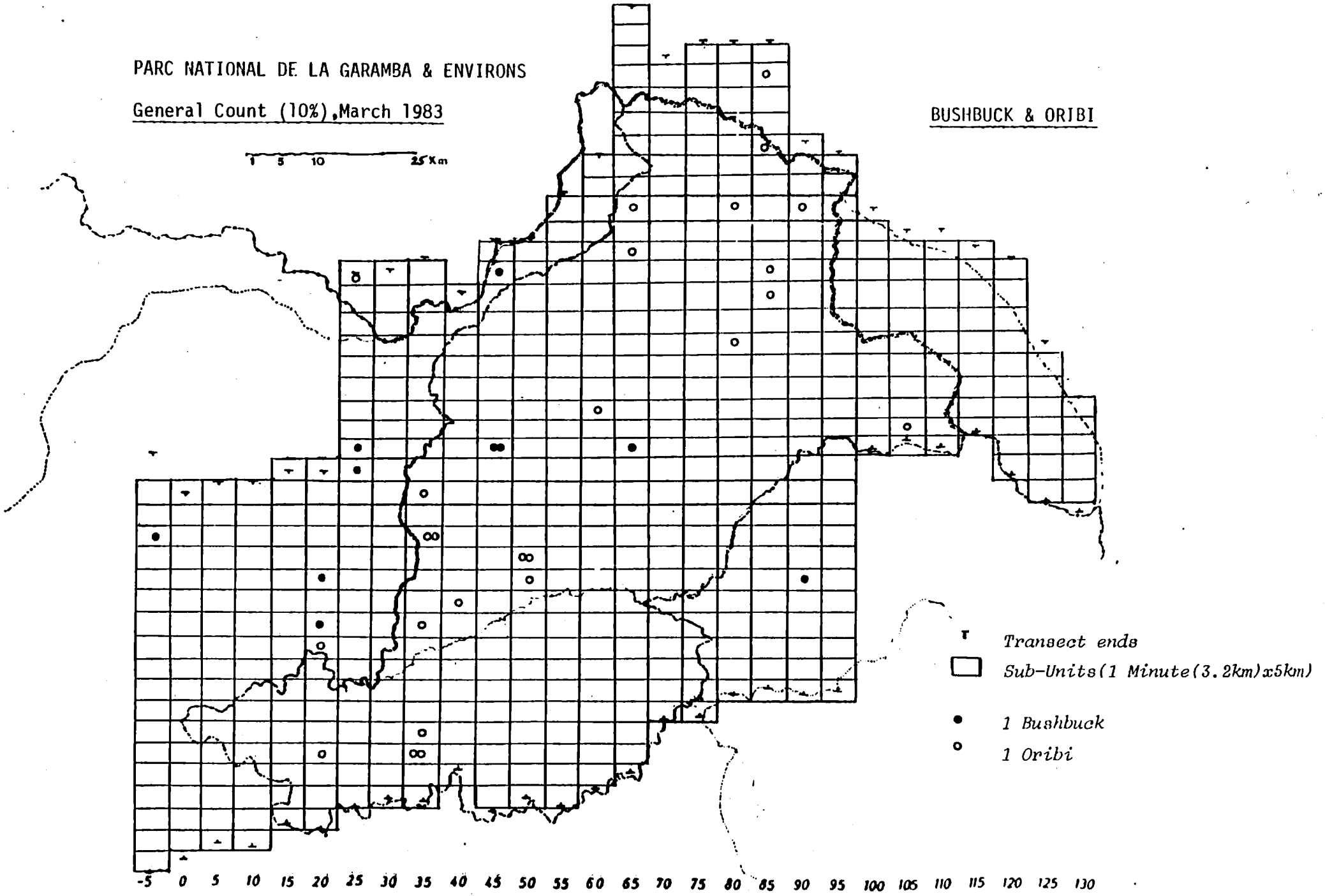
PARC NATIONAL DE LA GARAMBA & ENVIRONS

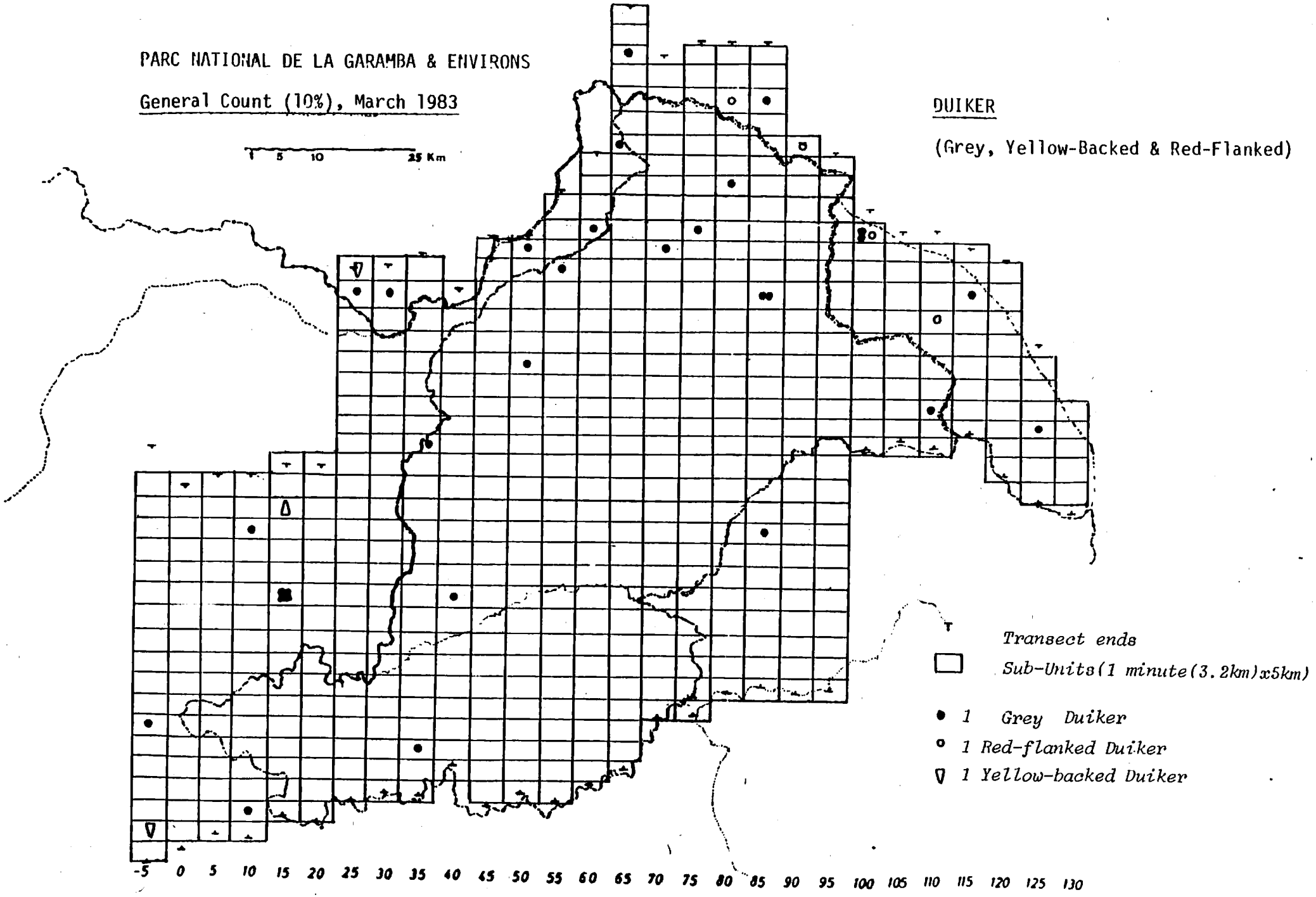
General Count (10%), March 1983

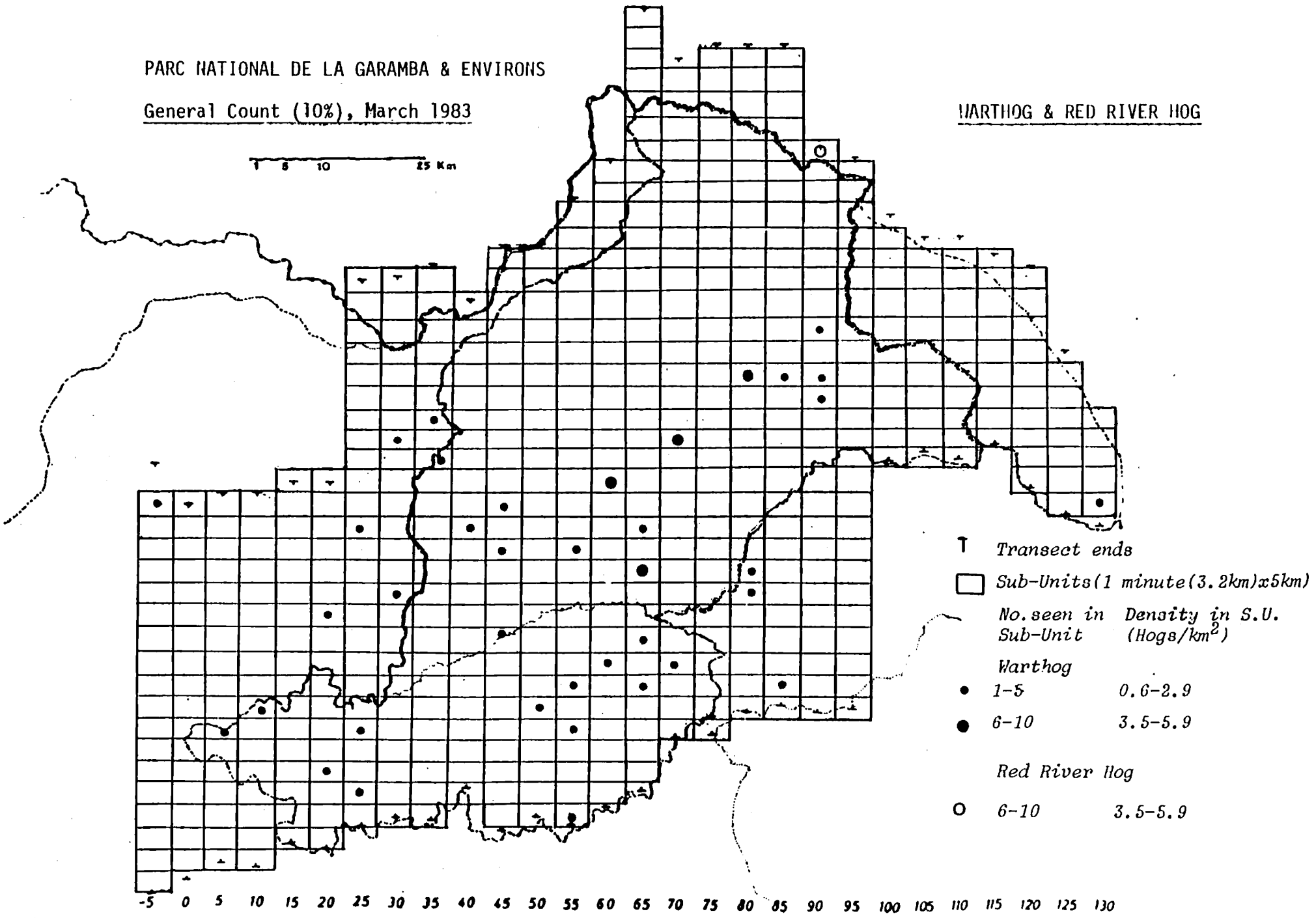
REEDBUCK

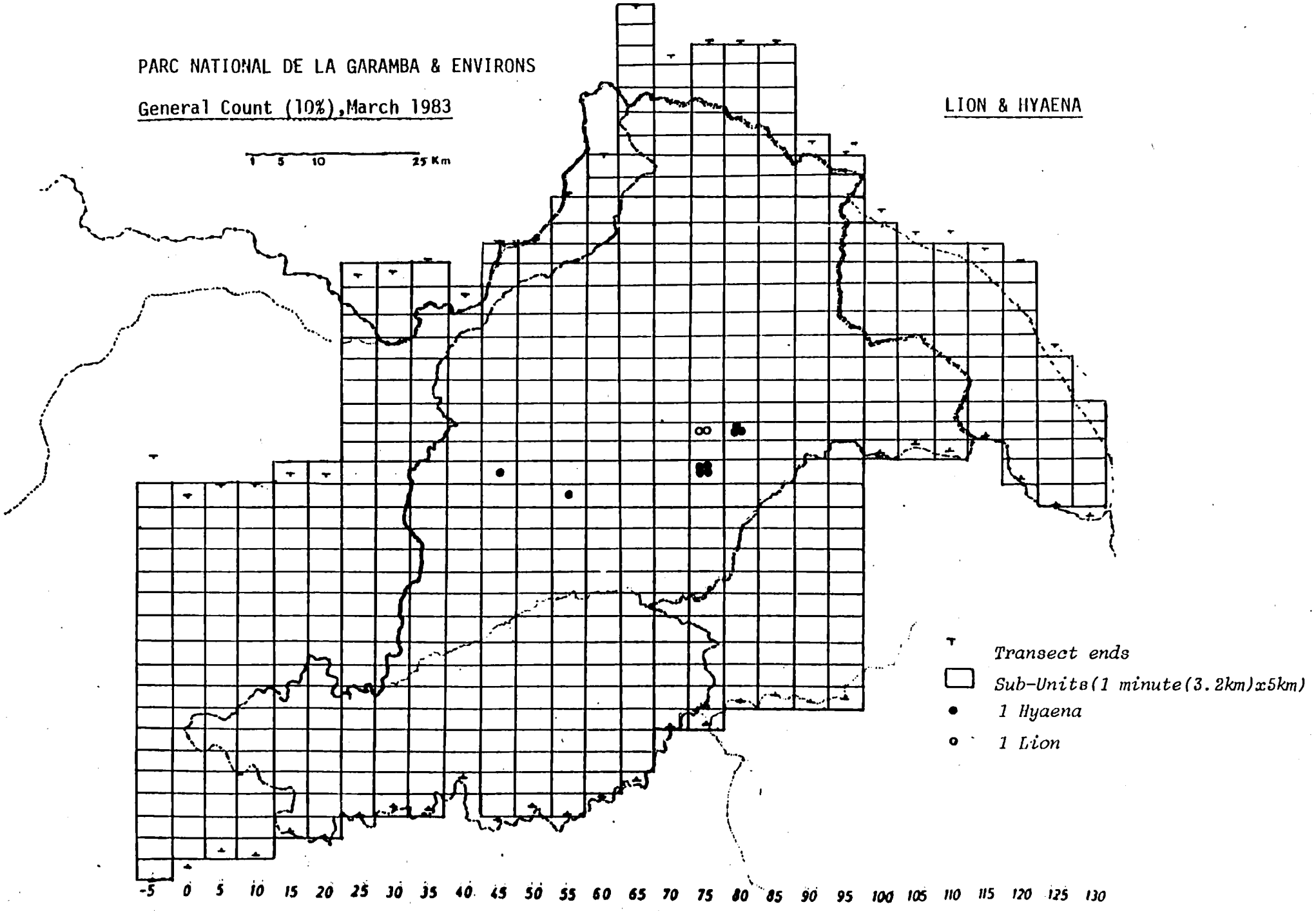


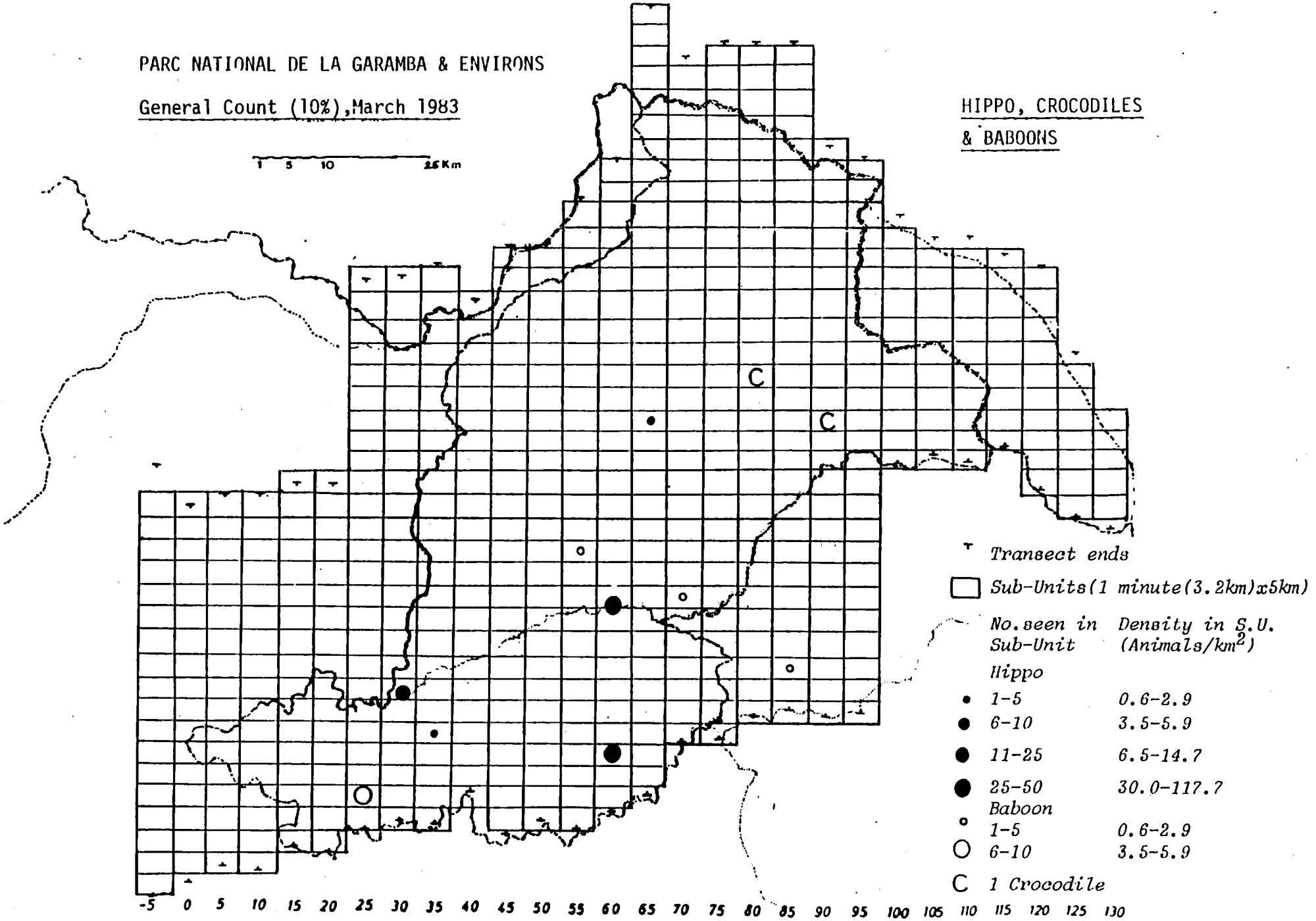

PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983
ROAN
1 5 10 25 Km
Transect ends
Sub-Units (1 Minute (3.2km) x 5km)
No. seen in Sub-Unit
Density in S.U. (Roan/km²)
1-5
0.6-2.9
6-10
3.5-5.9
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

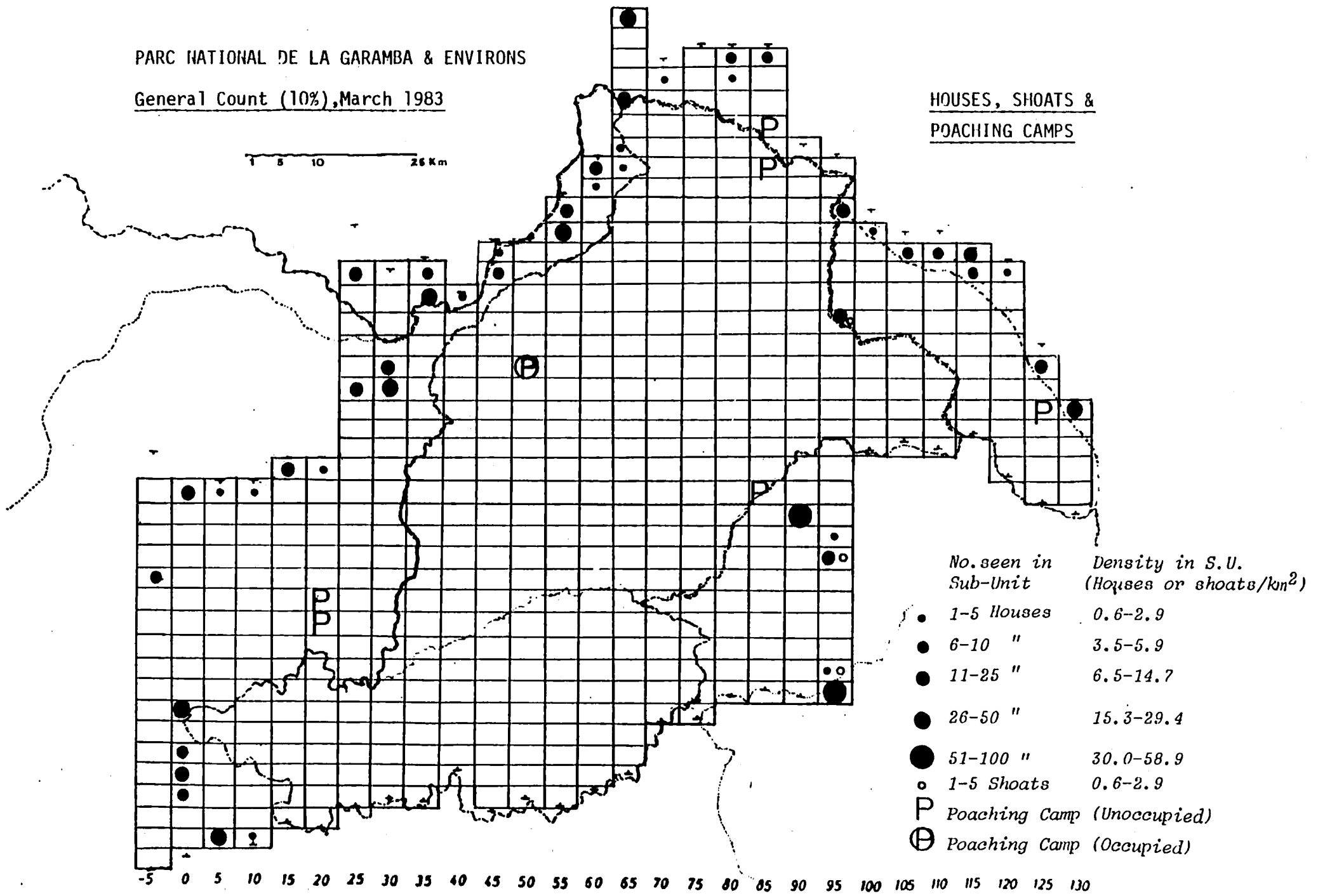

PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983
BUSHBUCK & ORIBI
1 5 10 25 Km
Transect ends
Sub-Units (1 Minute (3.2km) x 5km)
1 Bushbuck
1 Oribi
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

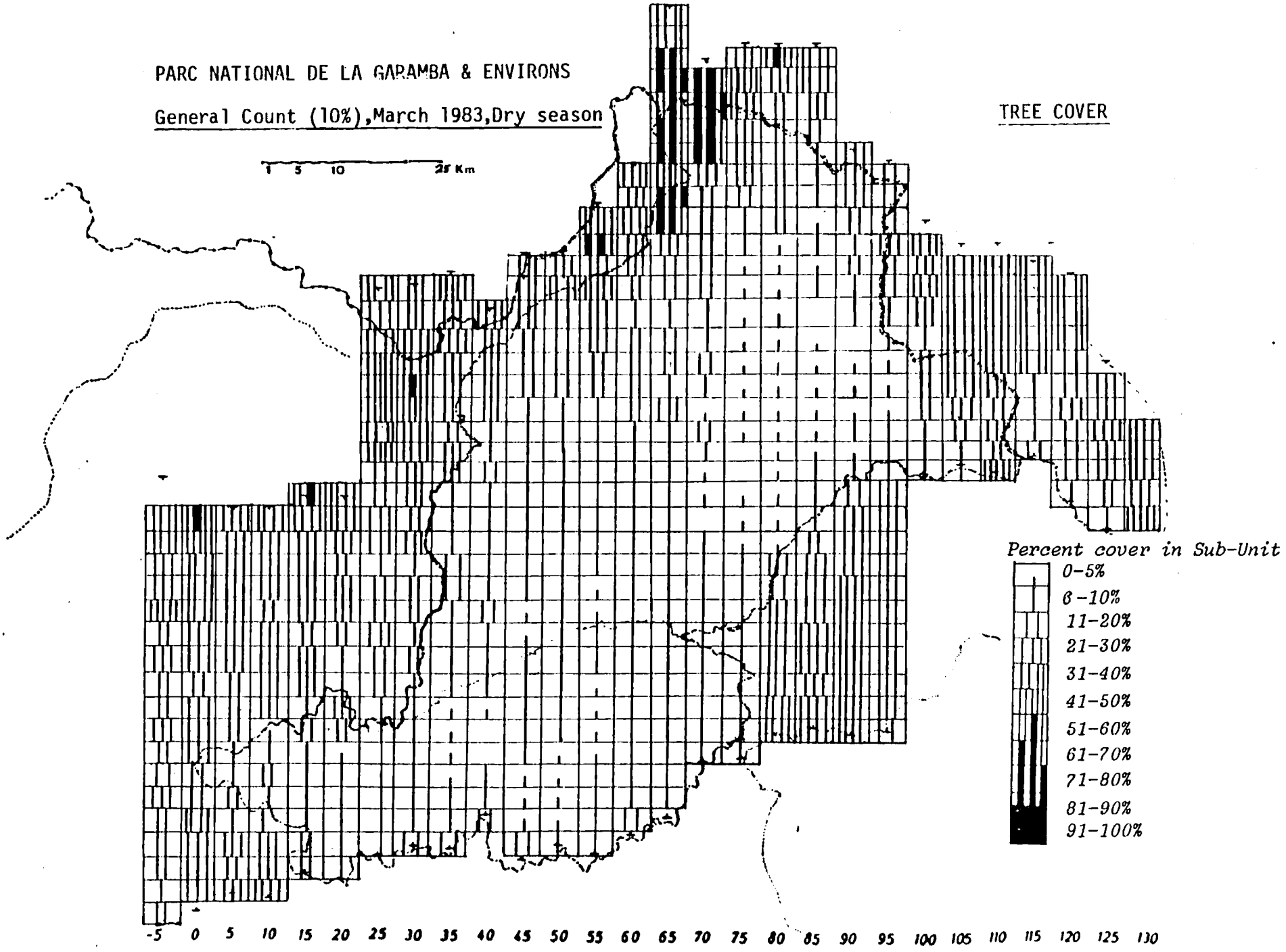

PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983
0 5 10 25 Km
DUIKER
(Grey, Yellow-Backed & Red-Flanked)
Transect ends
Sub-Units (1 minute (3.2km) x 5km)
1 Grey Duiker
1 Red-flanked Duiker
1 Yellow-backed Duiker
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

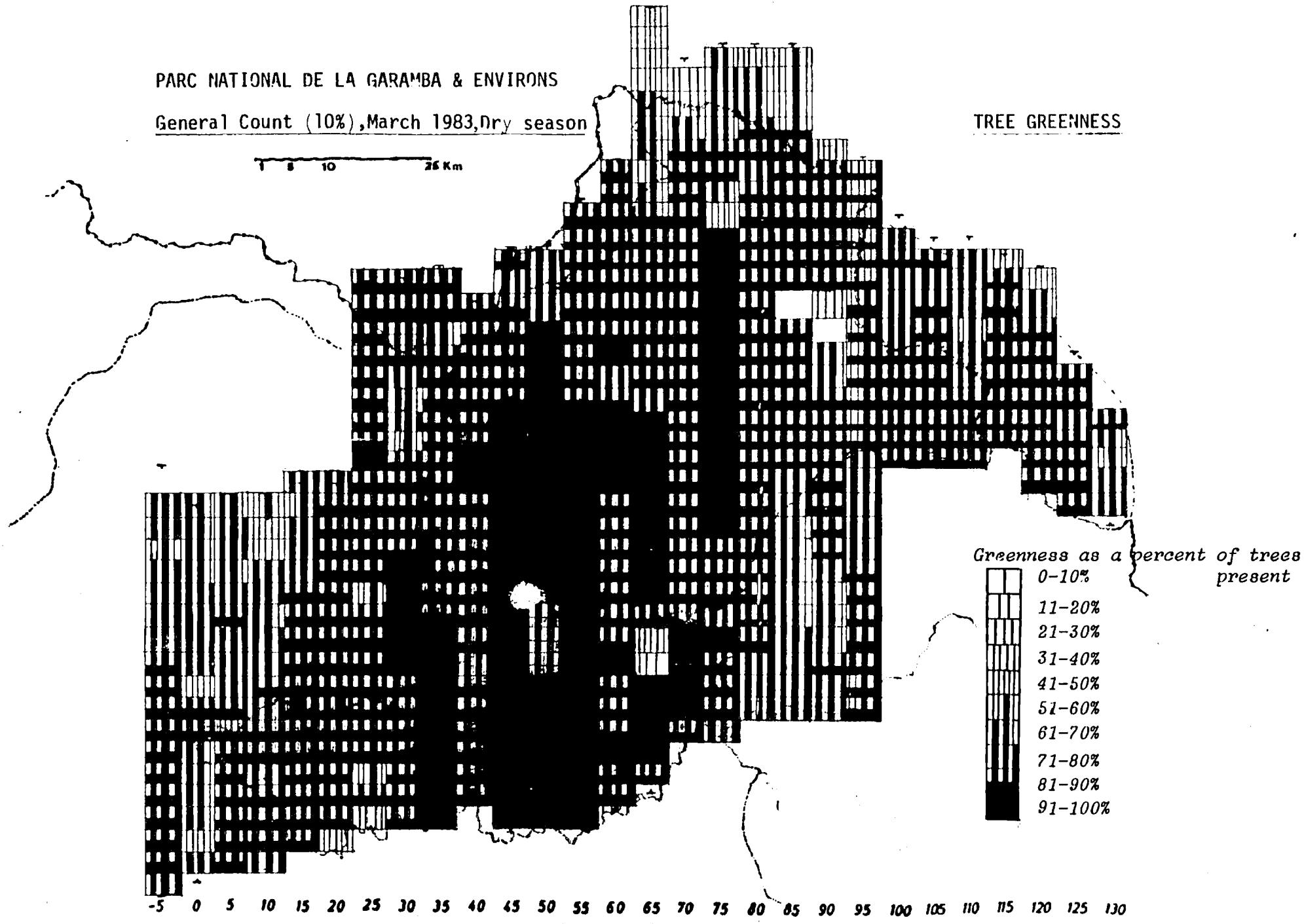

PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983
WARTHOG & RED RIVER HOG
0 5 10 15 Km
T Transect ends
Sub-Units (1 minute (3.2km) x 5km)
No. seen in Sub-Unit
Density in S.U. (Hogs/km²)
Warthog
1-5 0.6-2.9
6-10 3.5-5.9
Red River Hog
6-10 3.5-5.9
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

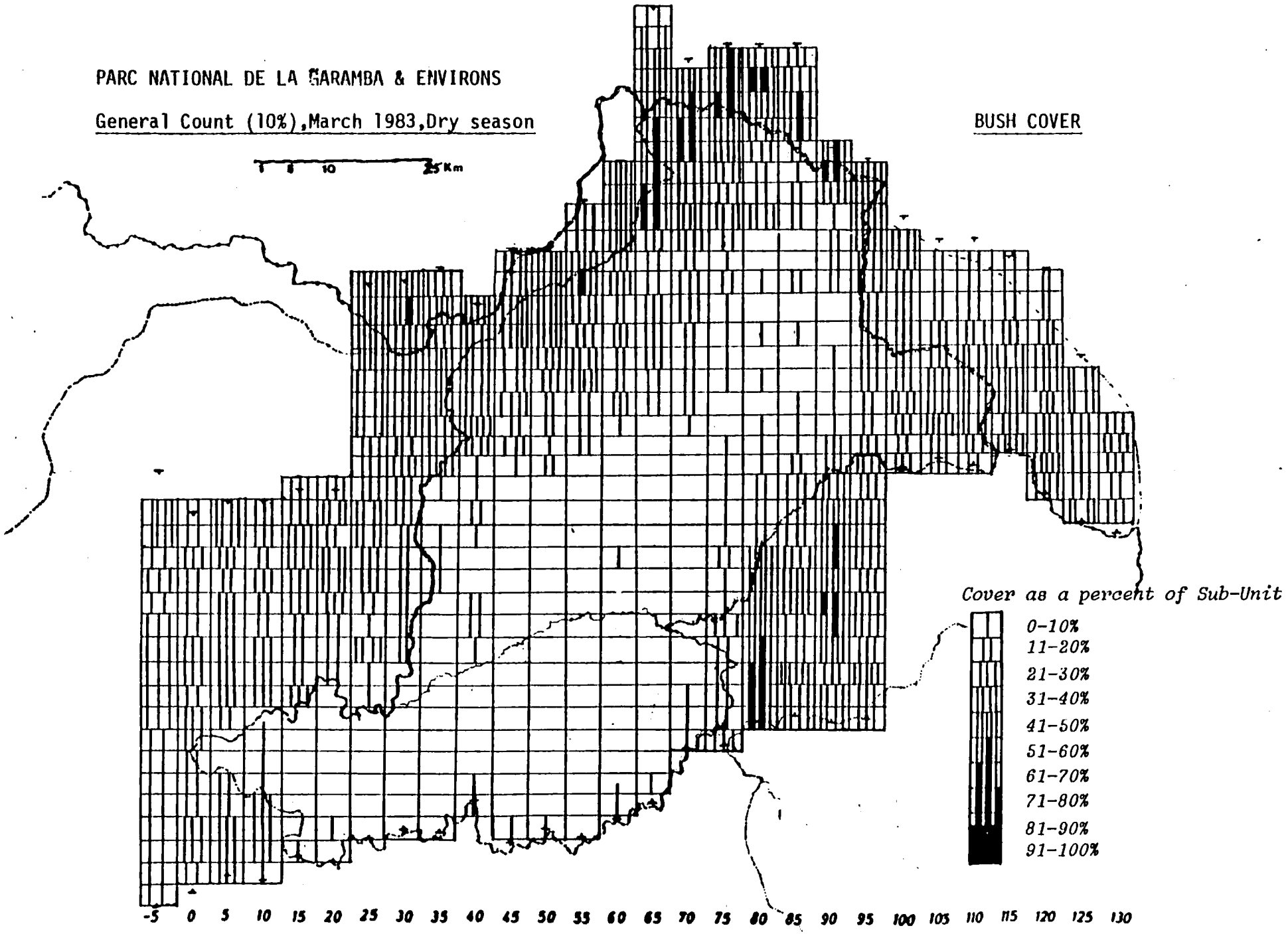

PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983
LION & HYAENA
1 5 10 25 Km
Transect ends
Sub-Units (1 minute (3.2km) x 5km)
1 Hyaena
1 Lion
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

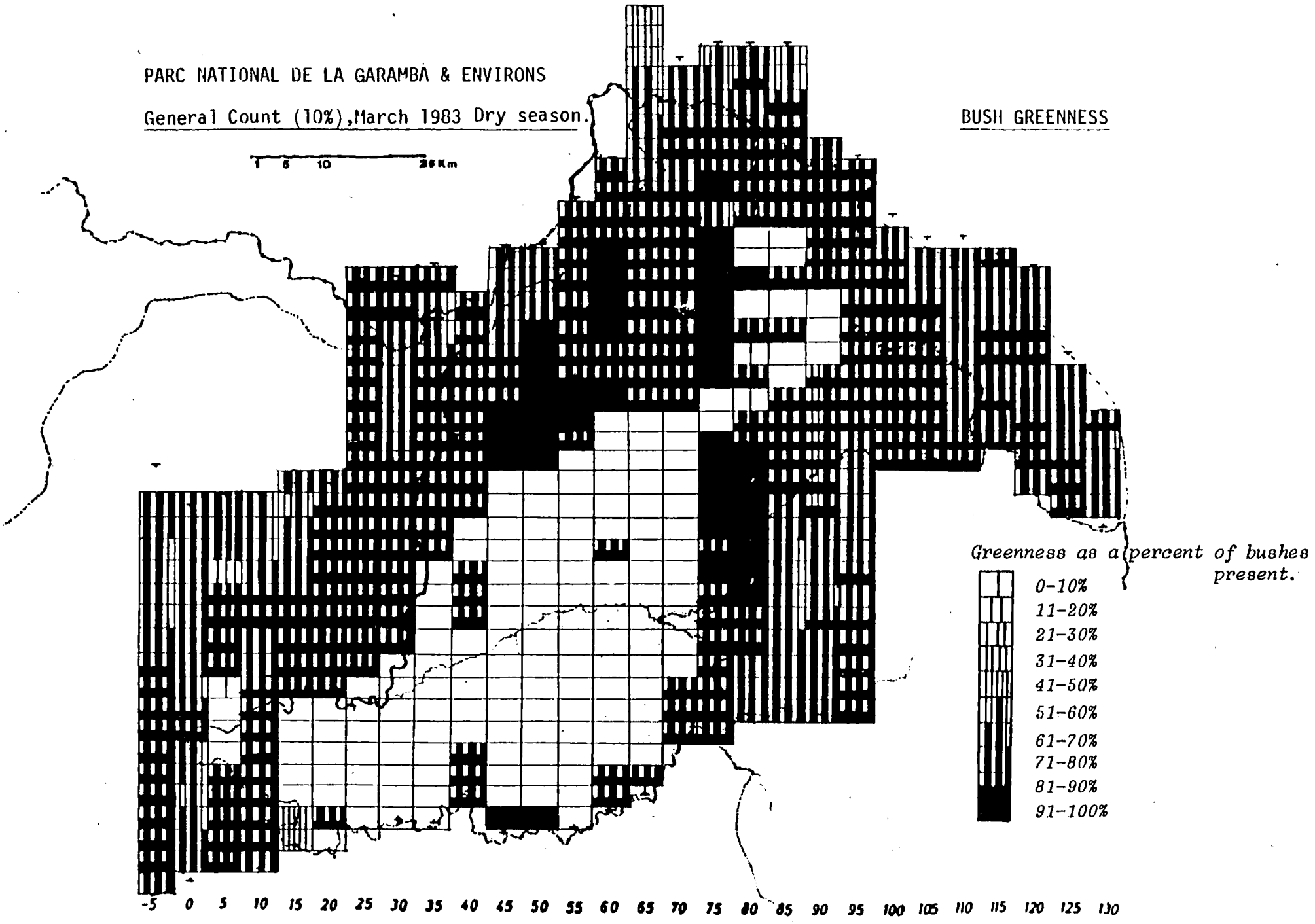

PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983
1 5 10 25 Km
HIPPO, CROCODILES & BABOONS
C
C
Transect ends
Sub-Units (1 minute (3.2km) x 5km)
No. seen in Sub-Unit
Density in S.U. (Animals/km²)
Hippo
1-5 0.6-2.9
6-10 3.5-5.9
11-25 6.5-14.7
25-50 30.0-117.7
Baboon
1-5 0.6-2.9
6-10 3.5-5.9
C 1 Crocodile
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130


PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983
HOUSES, SHOATS & POACHING CAMPS
1 5 10 25 Km
No. seen in Sub-Unit
Density in S.U. (Houses or shoats/km²)
1-5 Houses 0.6-2.9
6-10 " 3.5-5.9
11-25 " 6.5-14.7
26-50 " 15.3-29.4
51-100 " 30.0-58.9
1-5 Shoats 0.6-2.9
Poaching Camp (Unoccupied)
Poaching Camp (Occupied)
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130


PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983, Dry season
TREE COVER
1 5 10 25 Km
Percent cover in Sub-Unit
0-5%
6-10%
11-20%
21-30%
31-40%
41-50%
51-60%
61-70%
71-80%
81-90%
91-100%
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130


PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983, Dry season
0 5 10 25 Km
TREE GREENNESS
Greenness as a percent of trees present
0-10%
11-20%
21-30%
31-40%
41-50%
51-60%
61-70%
71-80%
81-90%
91-100%
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130


PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983, Dry season
BUSH COVER
5 0 10 25 Km
Cover as a percent of Sub-Unit
0-10%
11-20%
21-30%
31-40%
41-50%
51-60%
61-70%
71-80%
81-90%
91-100%
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

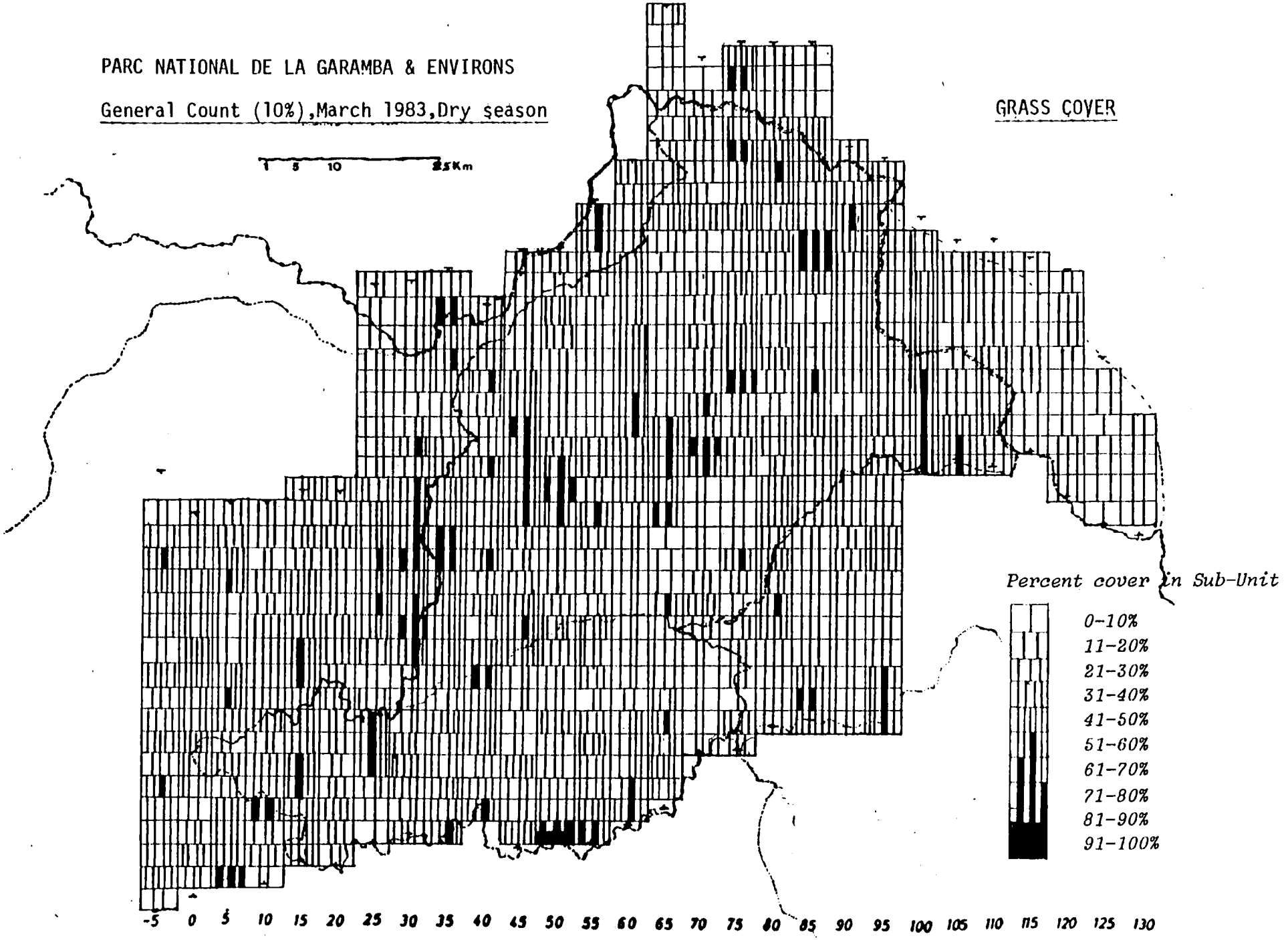

PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983 Dry season.
BUSH GREENNESS
1 5 10 25 Km
Greenness as a percent of bushes present.
0-10%
11-20%
21-30%
31-40%
41-50%
51-60%
61-70%
71-80%
81-90%
91-100%
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

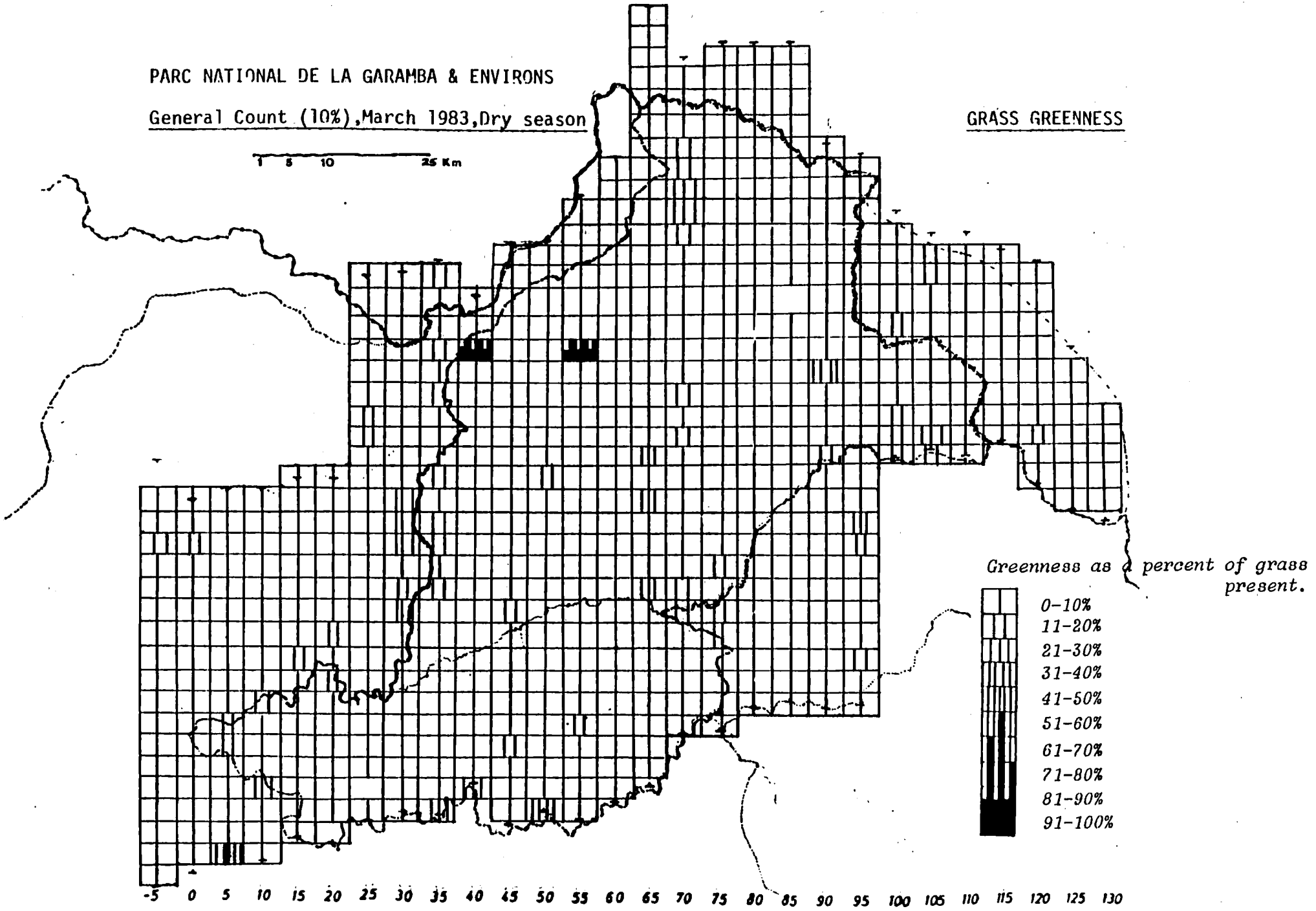
PARC NATIONAL DE LA GARAMBA & ENVIRONS

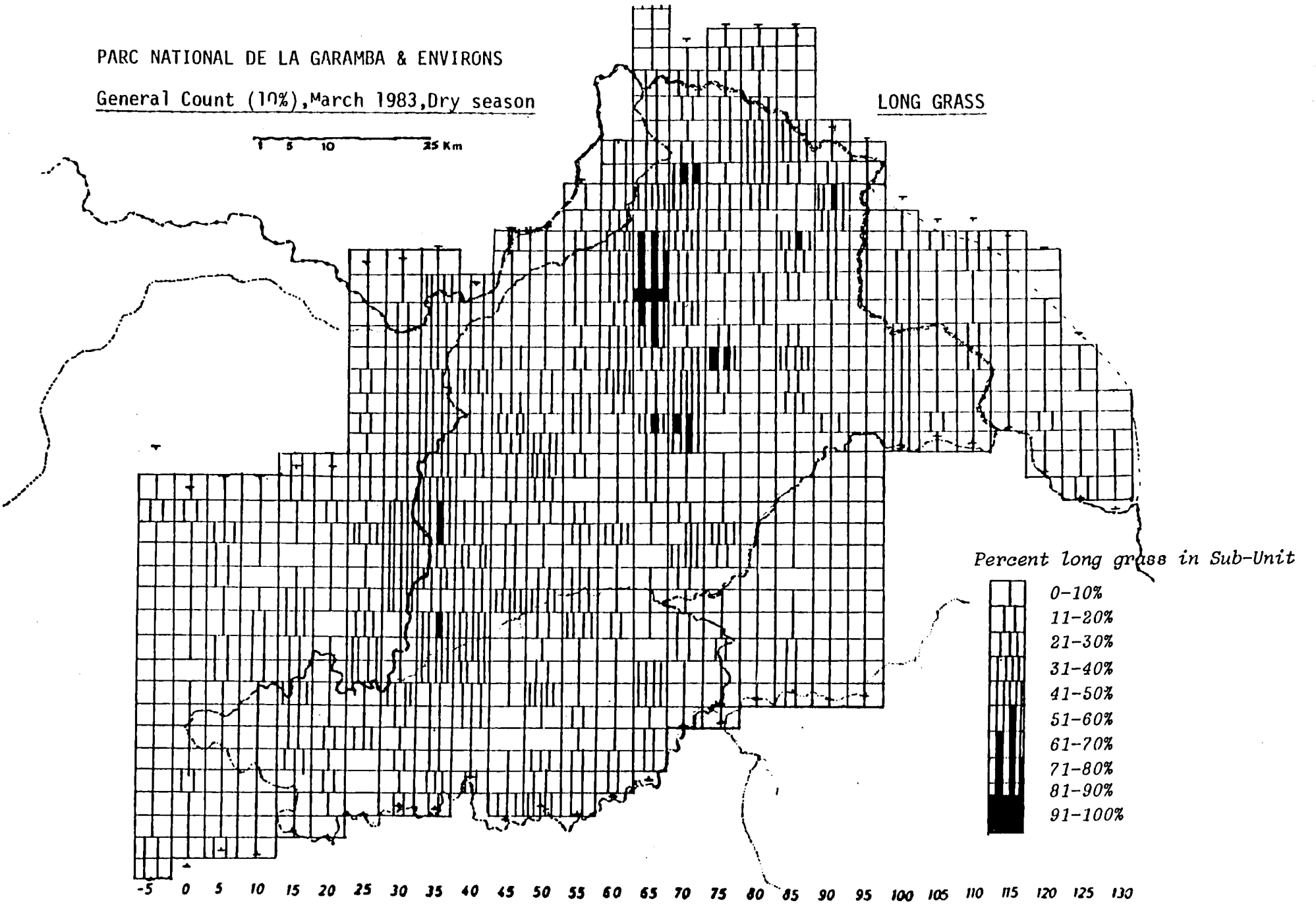
General Count (10%), March 1983, Dry season

GRASS COVER

1 5 10 25 Km



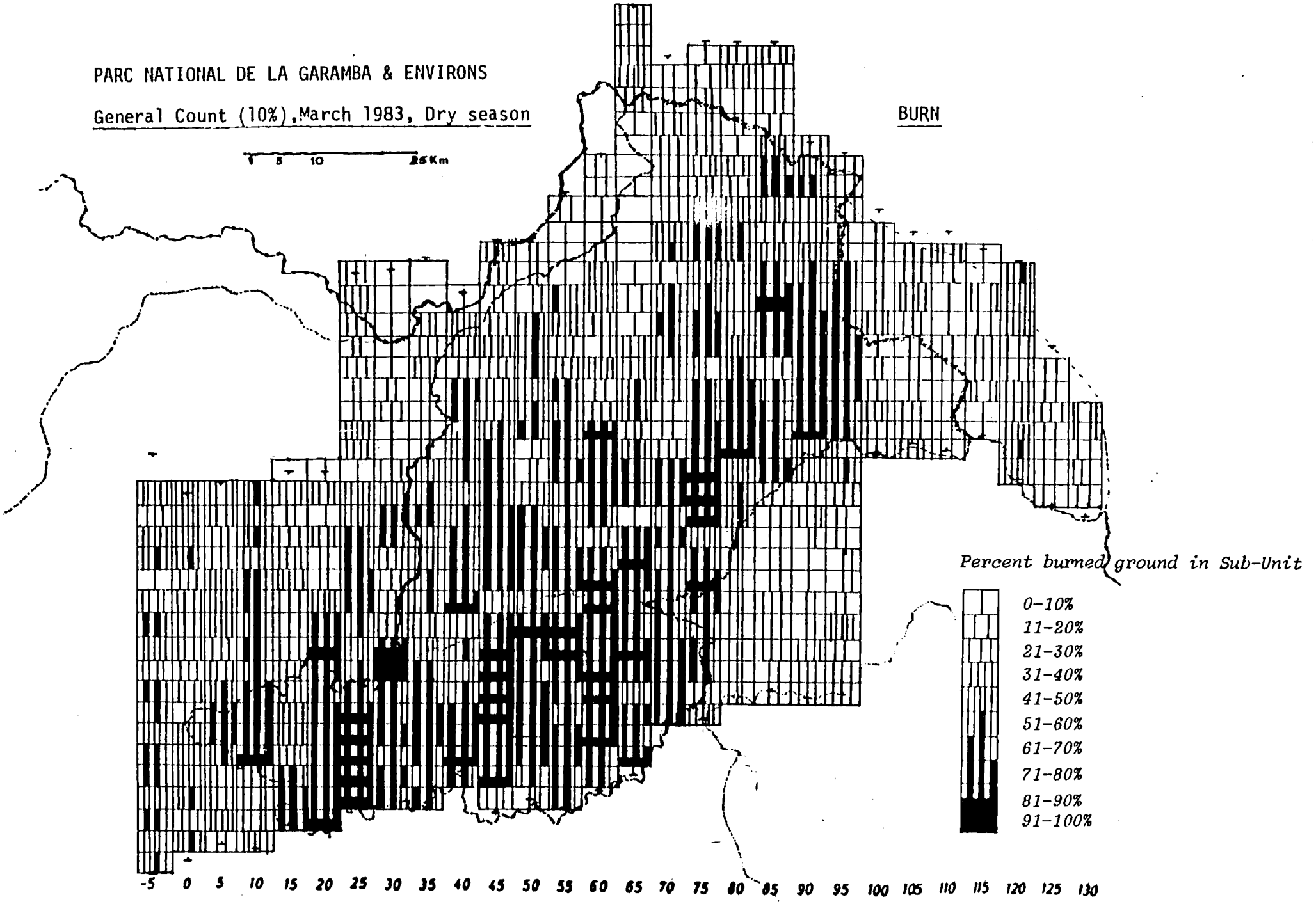

PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983, Dry season
GRASS GREENNESS
1 5 10 25 Km
Greenness as a percent of grass present.
0-10%
11-20%
21-30%
31-40%
41-50%
51-60%
61-70%
71-80%
81-90%
91-100%
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130


PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983, Dry season
LONG GRASS
1 5 10 25 Km
Percent long grass in Sub-Unit
0-10%
11-20%
21-30%
31-40%
41-50%
51-60%
61-70%
71-80%
81-90%
91-100%
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

PARC NATIONAL DE LA GARAMBA & ENVIRONS

General Count (10%), March 1983, Dry season

BURN

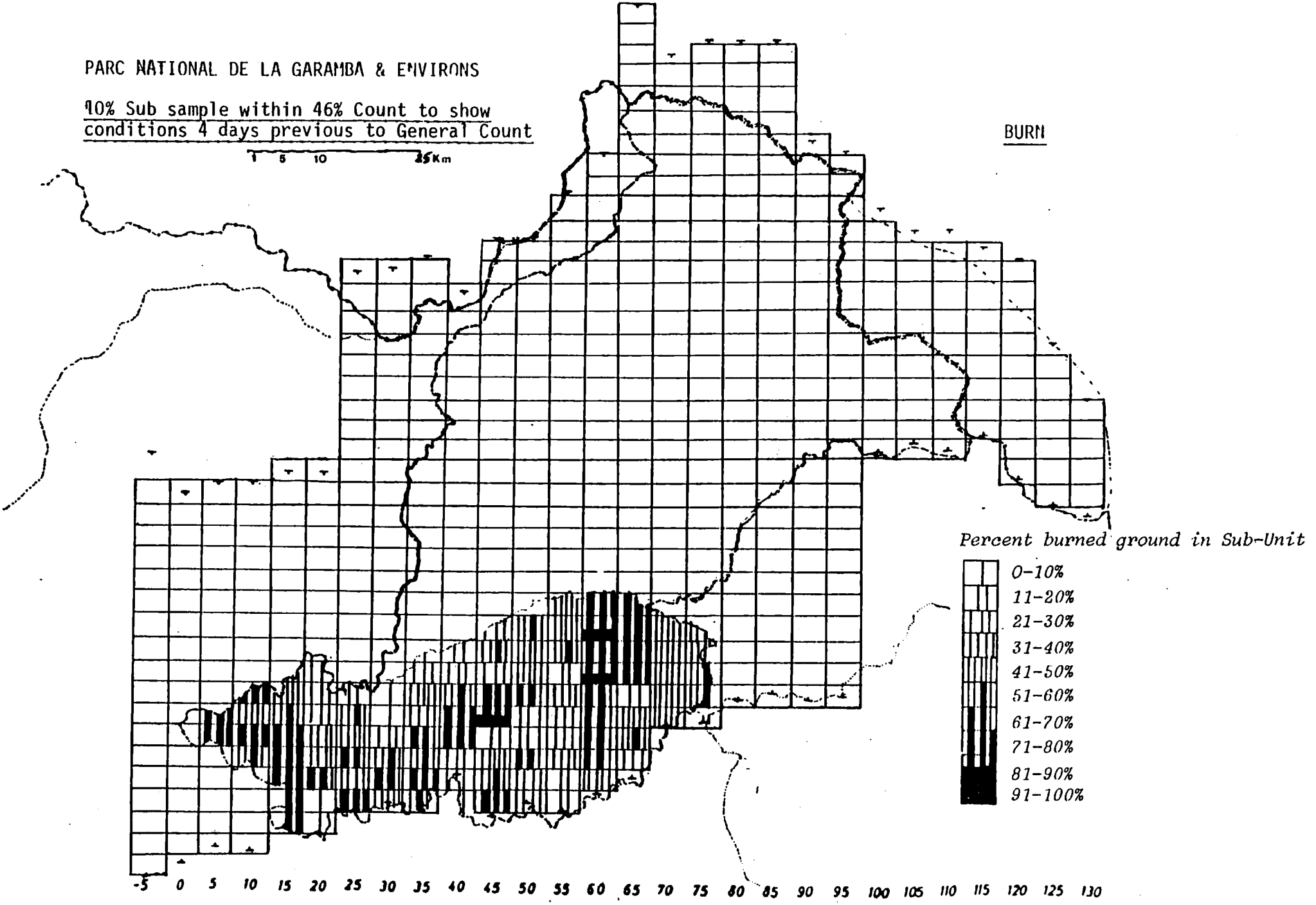


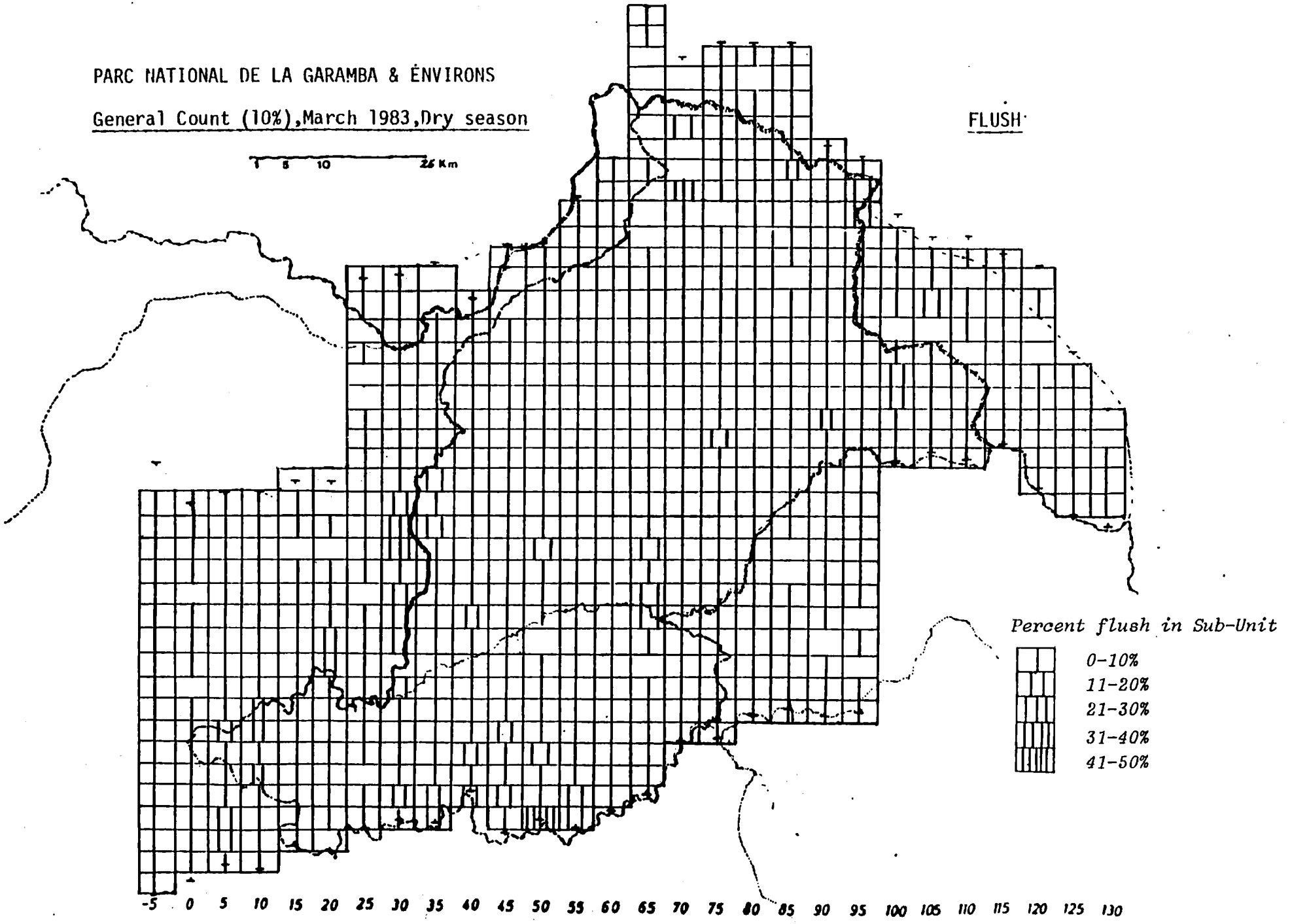
PARC NATIONAL DE LA GARAMBA & ENVIRONS

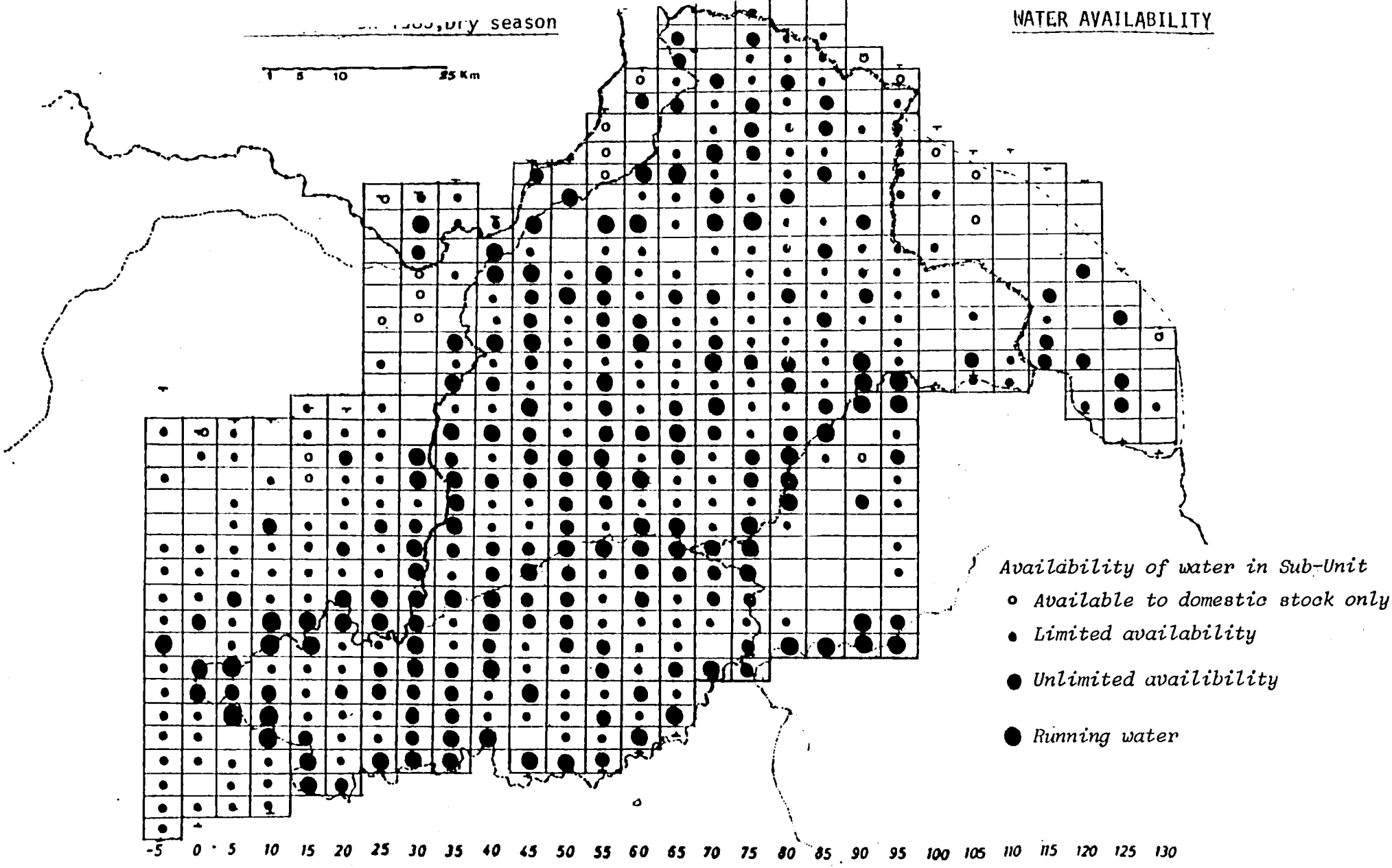
10% Sub sample within 46% Count to show conditions 4 days previous to General Count

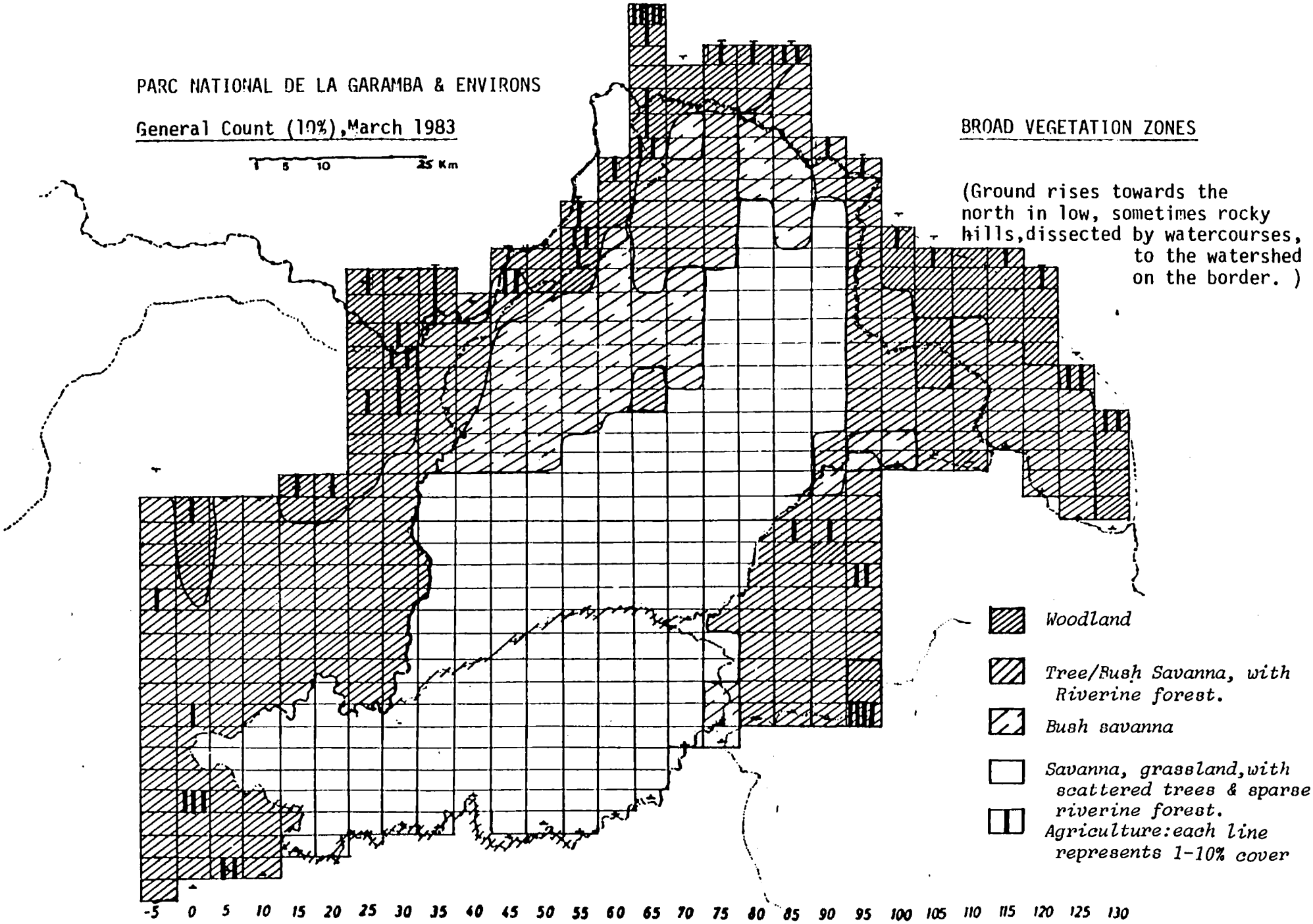
1 5 10 25 Km

BURN




PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%),March 1983,Dry season
FLUSH
1 5 10 26 Km
Percent flush in Sub-Unit
0-10%
11-20%
21-30%
31-40%
41-50%
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130


WATER AVAILABILITY
0 5 10 25 Km
Availability of water in Sub-Unit
Available to domestic stock only
Limited availability
Unlimited availibility
Running water
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130


PARC NATIONAL DE LA GARAMBA & ENVIRONS
General Count (10%), March 1983
0 5 10 25 Km
BROAD VEGETATION ZONES
(Ground rises towards the north in low, sometimes rocky hills, dissected by watercourses, to the watershed on the border.)
Woodland
Tree/Bush Savanna, with Riverine forest.
Bush savanna
Savanna, grassland, with scattered trees & sparse riverine forest.
Agriculture: each line represents 1-10% cover
-5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

APPENDIX 1

CHECKLIST OF BIRDS FOR GARAMBA NATIONAL PARK

(October 1982 - May 1983)

Compiled by: T.P.Dutton, A.K.K.Hillman, I.R.Grimwood, F.A.Smith & T.Wood

Ref: J.G.Williams & N.Arlott, *A Field Guide to the Birds of East Africa* Collins, London.

COMMON NAME	SPECIFIC NAME
Long-tailed Cormorant	*Phalacrocorax africanus*
African Darter	*Anhinga rufa*
Cattle Egret	*Ardeola ibis*
Grey Heron	*Ardea cinerea*
Great White Egret	*Egretta alba*
Little Egret	*Egretta garzetta*
Yellow-billed Egret	*Egretta intermedia*
Night Heron	*Nycticorax nycticorax*
Purple Heron	*Ardea purpurea*
Hammerkop	*Scopus umbretta*
Abdim's Stork	*Ciconia abdimii*
Yellow-billed Stork	*Ibis ibis*
Saddlebill Stork	*Ephippiorhynchus senegalensis*
Marabou Stork	*Leptoptilos crumeniferus*
European White Stork	*Ciconia ciconia*
Hadeda Ibis	*Hagedashia hagedash*
Sacred Ibis	*Threskiornis aethiopicus*
Egyptian Goose	*Alopochen aegyptiaca*
Knob-billed Duck	*Sarkidiornis melanotus*
Fish Eagle	*Haliaeetus vocifer*
Bateleur	*Terathopius ecaudatus*
Gymnogene	*Polybroides radiatus*
Black Kite	*Milvus migrans*
Yellow-billed Kite	*Milvus aegyptius*
Lizard Buzzard	*Kaupifalco monogrammicus*
White-backed Vulture	*Gyps bengalensis*
Long-crested Vulture	*Lophaetus occipitalis*
Palm Nut Vulture	*Gypohierax angolensis*
Grasshopper Buzzard	*Butastar rufipennis*
Auger Buzzard	*Buteo rufofuscus*
Red-necked Buzzard	*Buteo auguralis*
Black-shouldered Kite	*Elanus caeruleus*
Red-necked Falcon	*Falco chiquera*
Sooty Falcon	*Falco concolor*
Secretary Bird	*Sagitarius serpentarius*
Helmeted Guinea Fowl	*Numida meleagris*
Scaly Francolin	*Francolinus squamatus*
Heuglin's Francolin	*Francolinus icterorhynchus*
Button Quail	*Turnix sylvatica*

COMMON NAME	SPECIFIC NAME
Black Crake	*Limnocorax flavirostra*
Black-bellied Bustard	*Eupodotis ruficrista*
Kori Bustard	*Ardeotis kori*
Denham's Bustard	*Neotis denhami*
White-headed Plover	*Vanellus albiceps*
Wattled Plover	*Vanellus senegalus*
Caspian Plover	*Charadrius venustus*
Crowned Plover	*Vanellus coronatus*
Kittlitz's Plover	*Cahradrius pecuaris*
Spotted Stone Curlew	*Burhinus capensis*
Water Dikkop	*Burhinus vermicullatus*
Common Sandpiper	*Tringa hypoleucos*
African Jacana	*Actophilornis africanus*
Green Pigeon	*Treron australis*
Red-eyed Turtle Dove	*Streptopelia semitorquata*
Laughing Dove	*Streptopelia senegalensis*
Emerald-spotted Wood Dove	*Turtur chalcospilos*
Tambourine Dove	*Turtus tympanistria*
Black-billed Wood Dove	*Turtur abyssinicus*
Barred Long-tailed Cuckoo	*Cercoccyx montanus*
Didric Cuckoo	*Chrysococcyx caprius*
Black Coucal	*Centropus grillii*
Senegal Coucal	*Centropus senegalensis*
White-browed Coucal	*Centropus superciliosus*
Speckled Mousebird	*Colius striatus*
African Hoopoe	*Upupa epops africana*
Green Wood Hoopoe	*Phoeniculus africana*
Eastern Grey Plantain Eater	*Crinifer zonorus*
White-crested Turaco	*Tauraco leucolophus*
Red-headed Lovebird	*Agapornis pullaria*
Broad-billed Roller	*Eurystomus glaucurus*
Red-throated Bee-eater	*Merops bulocki*
Carmine Bee-eater	*Merops nubicus*
European Bee-eater	*Merops apiaster*
Little Bee-eater	*Merops pusillus*
Blue Breasted Bee-eater	*Merops variegatus*
Pied Kingfisher	*Ceryle rudis*
Woodland Kingfisher	*Halcyon senegalensis*
Malachite Kingfisher	*Alcedo cristata*
Pygmy Kingfisher	*Ispidina picta*
Giant Kingfisher	*Ceryle maxima*
Grey-headed Kingfisher	*Halcyon leucocephala*
Striped Kingfisher	*Halcyon chelicuti*
Shining Blue Kingfisher	*Alcedo quadribrachys*
Little Swift	*Apus affinus*
Palm Swift	*Cypsiurus parvus*
Grey Hornbill	*Tockus nasutus*
Abyssinian Ground Hornbill	*Bucorvus abyssinicus*
Barn Owl	*Tyto alba*
African Marsh Owl	*Asio capensis*

COMMON NAME	SPECIFIC NAME
Long-tailed Nightjar	*Caprimulgus climacurus*
Standard-winged Nightjar	*Macrodipteryx longipennis*
Cardinal Woodpecker	*Dendropicus fuscescens*
Grey Woodpecker	*Mesopicus goertae*
Green-backed Woodpecker	*Campethera taeniolaema*
Pied Wagtail	*Motacilla aguimp*
Golden Pipit	*Tmetothylacus tenellus*
Flappet Lark	*Mirafra rufocinnamonea*
Black-backed Puffback	*Dryoscotus cubla*
Fiscal Shrike	*Lanius collaris*
Black-headed Tchagra	*Tchagra australis*
Puffback Shrike	*Dryoscopus jambensis*
Sand Martin	*Riparia paludicola*
Black Roughwing Swallow	*Psalidopprocne holomelaena*
European Swallow	*Hirundo rustica*
Wire-tailed Swallow	*Hirundo smithii*
Mosque Swallow	*Hirundo senegalensis*
Yellow-vented Bulbul	*Pyconotus barabatus*
Northern Brownbul	*Phyllastrephus strepitans*
Sooty Chat	*Myrmecocichla nigra*
Capped Wheatear	*Oenanthe pileata*
Snowy-headed Robin Chat	*Cossypha niveicapilla*
Blue Flycatcher	*Erannornis longicauda*
Black-throated Wattle-eye	*Platysteira peltata*
Paradise Flycatcher (white & normal phases)	*Tersiphone viridis*
Wattle-eye Flycatcher	*Platysteira cyanea*
Tawny-flanked Prinia	*Prinia subflava*
White-chinned Prinia	*Prinia leucopogon*
Buff-bellied Warbler	*Phyllolais pulchella*
Red-winged Warbler	*Prinia erythroptera*
African Moustached Warbler	*Melochicla mentalis*
Grey-backed Camaroptera	*Camaroptera brevicaudata*
Yellow-bellied Hyliota	*Hyliota flavigasta*
Black-breasted Apalis	*Apalis flavida*
White-breasted Tit	*Parus albiventrus*
Black Tit	*Parus leucomelas*
Little Purple-banded Sunbird	*Nectarinia bifasciata*
Violet-backed Sunbird	*Anthreptes longuemarei*
Green-headed Sunbird	*Nectarinia verticalis*
Scarlet-chested Sunbird	*Nectarinia senegalensis*
Copper Sunbird	*Nectarinia cuprea*
Northern Double-collared Sunbird	*Nectarinia pruessi*
Yellow White-eye	*Zosterops senegalensis*
Bronze Mannikin	*Lonchura cucllata*
Black and White Mannikin	*Lonchura poensis*
Black-bellied Firefinch	*Lagonosticta rara*
Red-cheeked Cordon-bleu	*Uraeginthus bengalus*
Brown Twinspot	*Clytospra monteiri*
Fawn-breasted Waxbill	*Estrilda paudicola*
Grey-headed Olive-back	*Nesocharis capistrata*
Red-billed Firefinch	*Lagonosticta senegala*

COMMON NAME	SPECIFIC NAME
Double-toothed Barbet	*Lybius bidentata*
Black-billed Barbet	*Lybius guifsobalito*
Indigo Bird	*Hypochera chalybeata*
Pintailed Whydah	*Vidua macroura*
Yellow-mantled Widowbird	*Euplectes macrouras*
West Nile Red Bishop	*Euplectes franciscana*
Paradise Whydah	*Steganura paradisaea*
Chestnut Sparrow	*Passer eminibey*
Masked Weaver	*Ploceus intermedius*
Yellow Bishop	*Euplectes capensis*
Black-winged Bishop	*Euplectes hordeacea*
Grey-headed Sparrow	*Passer griseus*
Spectacled Weaver	*Ploceus ocularis*
Yellow-fronted Canary	*Serinus mozambicus*
Streaky Seed-eater	*Serinus striolatus*
Drongo	*Dicrurus adsimilis*
African Golden Oriole	*Oriolus auratus*
Yellow-billed Oxpecker	*Buphagus africanus*
Pied Crow	*Corvus albus*

APPENDIX II

LISTS OF TREES AND GRASSES IDENTIFIED SO FAR FROM GARAMBA NATIONAL PARK
(This is not comprehensive and represents only the start of a collection)

TREES AND BUSHES

Savanna grassland

SPECIFIC NAME	*FAMILY*	*LINGALA NAME (if known)*	*OCCURENCE*
Acacia siberiana	Mimosaceae;		Local
Annona senegalensis	Annonaceae		Locally common
Allophylus sp	Sapindaceae		Local
Bridelia scleroneura	Euphorbiaceae		Local
Cissus trothae	Vitaceae		Moderate
Combretum collinum loinderanum	Combretaceae		Common
Crotelaria sp.	Papilionaceae		Moderate
Crossopteryx febrifuga	Rubiaceae		Common,dominant
Dombeya quinquiseta	Sterculiaceae		Local
Kigelia africana	Bignoniacea	*Matapu*	Widespread,dominant
Lonchocarpus sp.	Papilionaceae		Locally common
Grewia mollis	Tiliaceae		Moderate
Nauclea latifolius	Rubiaceae		Locally common
Piliostigma thonningii	Ceasalpiniaceae		Locally common
Vaungaria apiculata ?	Rubiaceae	*Gbugari*	Common
Vitex doniana	Verbenaceae	*Guni*	Common,widespread
Ziziphus abyssinica	Rhamnaceae		Locally common

Springs, swamps and riverine associates

Dombeya quinquiseta	Sterculiaceae		Locally common
Erythrophleum sauveolens	Caesalpiniaceae	*Gero*	Common, indicator
Ficus spp.	Moraraceae		Common
Grewia mollis	Tiliaceae		Moderate
Kigelia africana	Bignoniaceae	*Matapu*	Common
Mitragyna stipulosa		*Kofo*	Common
Phoenix reclinata	Palmaceae		Common
Spathodea campanulata			
Teclea nobilis	Rutaceae		Moderate
Terminalia glaucescens	Combretaceae		Common
Uapaca sansibarica	Euphorbiaceae		Moderate
Vaukanga dregyii			Moderate
Vitex doniana	Verbenaceae	*Guni*	Moderate

Ref: East African Herbarium, Nairobi
Eggeling W.J. & Dale I.R. (1952) *The Indigenous trees of the Uganda Protectorate*. Government Printer, Entebbe
Coates Palgrave K. (1977) *Trees of Southern Africa* . C. Struik

GRASSES AND SEDGES

Long grass savanna

SPECIFIC NAME

Digitaria tenata
Loudetia arudinaceae
Hyparrhenia diplandra
H. rufa
H. neutonia
Pannicum maximum
Pennisetum polystachion;
P. unisetum
Rhynchelytrum repens
Setaria sphacelata
Sporobolus pyramidalis
Vepris glomerata

Shorter grasses in patches or a lower layer at edges within long grass savanna

Aplismenus barmanii
Brachiaria brizantha
B. jubata
Chloris lamproparia
C. sp.
Digitaria longiflora
D. tenata
Eragrostis patens
Hyparrhenia figariana
H. filipendula
Kyllinga sp.
Mariscus siberana
Paspalum scrobiculatum
Sacciolepis sp.
Schizachyrium sp.
Setaria barbata
Sporobolus uniglumis

River edge or swamp

Cynodon nlemfuensis
Cyperus difformis
Cyperus spp.
Heteranthera pontederiaceae
Hyparrhenia diplandra
Imperata cylindrica
Loudedia phragmatoides
Rhynchospora sp.
Andropogonaceae?

Ref: C.Gabuya, E.A. Herbarium.
Flora of Tropical East Africa - Graminae

Table 4 Garamba National Park: Estimates of population sizes and biomasses of principle species, April 1976

SPECIES	ESTIMATED POP. SIZE	95% CONFIDENCE LIMITS (C.L.)	C.L. AS %	VARIANCE	UNIT WEIGHT (KGS) 4/	BIOMASS (KG)
ELEPHANT	22,670 ±	11,790	52	$3.81(10^7)$	2,500	$5.67(10^7)$
BUFFALO 1/	53,000 ±	42,360	80	$4.07(10^8)$	515	$2.73(10^7)$
WHITE RHINO'	490 ±	270	54	$1.86(10^4)$	1,500	$7.35(10^5)$
HIPPO' 2/	1,700	-	-	-	1,100	$1.56(10^6)$
LELWEL	7,750 ±	1,470	19	$5.10(10^5)$	155	$1.20(10^6)$
KOB	7,180 ±	2,300	32	$1.22(10^6)$	90	$6.46(10^5)$
WATERBUCK	3,680 ±	1,330	36	$4.15(10^5)$	200	$7.36(10^5)$
WARTHOG	3,340 ±	1,440	27	$5.00(10^5)$	70	$3.73(10^5)$
GIRAFFE	350 ±	250	71	$1.42(10^5)$	800	$2.80(10^5)$
ROAN ANTELOPE	360 ±	530	147	$6.39(10^5)$	150	$5.40(10^5)$
ORIBI 3/	380 ±	150	39	$5.42(10^4)$	16	$6.08(10^3)$
BUSHBUCK 3/	420 ±	130	32	$4.11(10^4)$	70	$2.94(10^4)$
REEDBUCK 3/	640 ±	310	49	$2.25(10^5)$	60	$3.84(10^4)$
DUIKER 3/	140 ±	100	71	$2.50(10^4)$	20	$2.80(10^3)$
HYAENA	35 ±	50	140	$2.39(10^2)$	50	$1.75(10^3)$
LION	35 ±	40	120	$4.54(10^2)$	150	$5.25(10^3)$

Notes: 1/ Buffalo computed separately (see text)

2/ Hippo' were counted 100% at a different time; the population estimate is therefore given without confidence limits. The biomass is calculated on the basis of the estimate that only 5/6 of the hippo' use the Park.

3/ Small animals often in cover; therefore probably under-counted.

Sources: Casebeer & Petersen (1971), Western (1973), and Bindernagel (1968). The Lelwel weight actually refers to Jackson's Hartebeest.