COUR INTERNATIONALE DE JUSTICE

# AFFAIRE RELATIVE AUX ACTIVITÉS ARMÉES SUR LE TERRITOIRE DU CONGO

**(RÉPUBLIQUE DÉMOCRATIQUE DU CONGO c. OUGANDA)**

## DEUXIÈME PHASE
## QUESTION DES RÉPARATIONS

MÉMOIRE

DE

LA RÉPUBLIQUE DÉMOCRATIQUE DU CONGO

Volume 9 Annexes

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Septembre 2016

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

# GENERAL AERIAL COUNTS 1998, 2000, 2002 & 2003 AND EVALUATION OF THE EFFECTS OF THE CIVIL WARS ON THE ECOSYSTEM

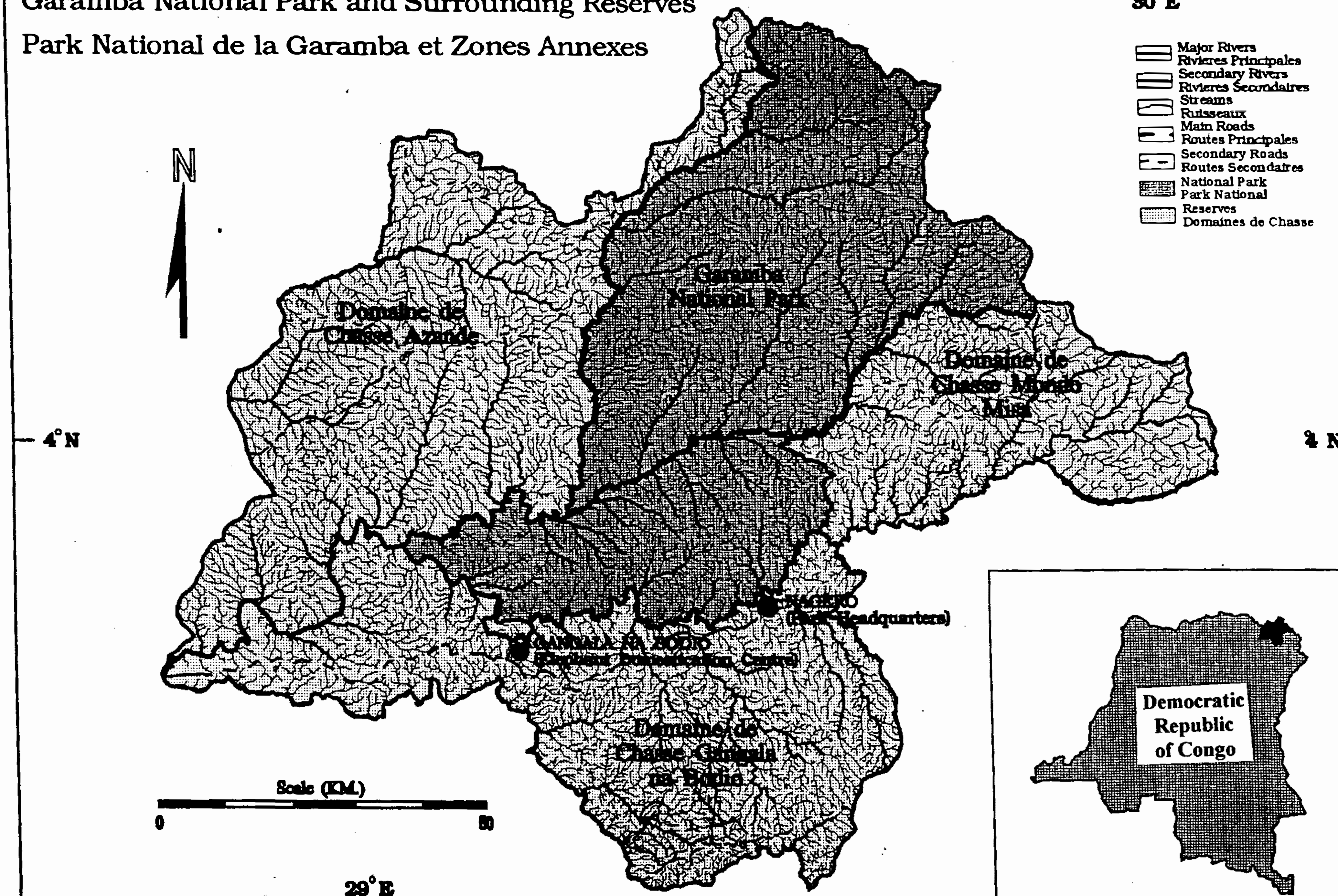
# RECENSEMENTS AERIENS GENERAUX DE 1998,2000, 2002 & 2003 ET EVALUATION DES EFFETS DES GUERRES CIVILES SUR L'ECOSYSTEME

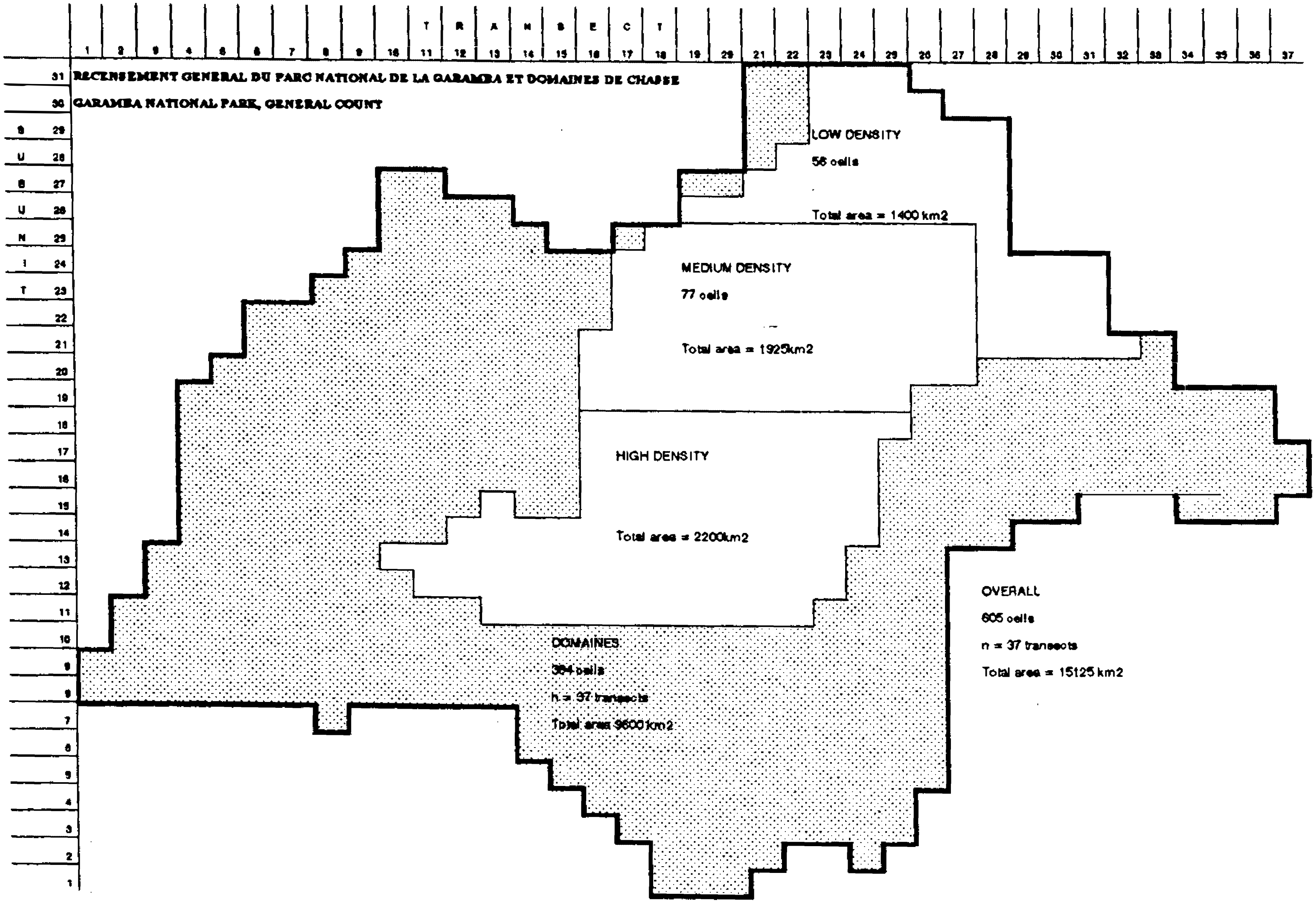
**Kes Hillman Smith, Fraser Smith, Amube Ndey, Mbayma Atalia**
**Jean Mafuko, Paulin Tshikaya, Giningayo Panziama & John Watkin**

**Version Française traduite par Jean Bigirimana Mugabushaka**

# Garamba National Park and Surrounding Reserves

# Park National de la Garamba et Zones Annexes




RECENSEMENT GENERAL DU PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE
GARAMBA NATIONAL PARK, GENERAL COUNT
TRANSECT
SUBUNIT
LOW DENSITY
56 cells
Total area = 1400 km2
MEDIUM DENSITY
77 cells
Total area = 1925km2
HIGH DENSITY
Total area = 2200km2
DOMAINES
384 cells
n = 37 transects
Total area 9600 km2
OVERALL
605 cells
n = 37 transects
Total area = 15125 km2

# GARAMBA NATIONAL PARK
# AND RESERVES

## GENERAL AERIAL COUNTS 1998, 2000, 2002 & 2003

### INTRODUCTION

General all species aerial censuses of the Garamba National Park and surrounding Domaines de Chasse are carried out as part of the ecosystem monitoring programme. This is a report of the counts carried out in May 1998, June 2000, May 2002 and May 2003, with discussion on the status of the ecosystem and the effects of the civil wars during this period.

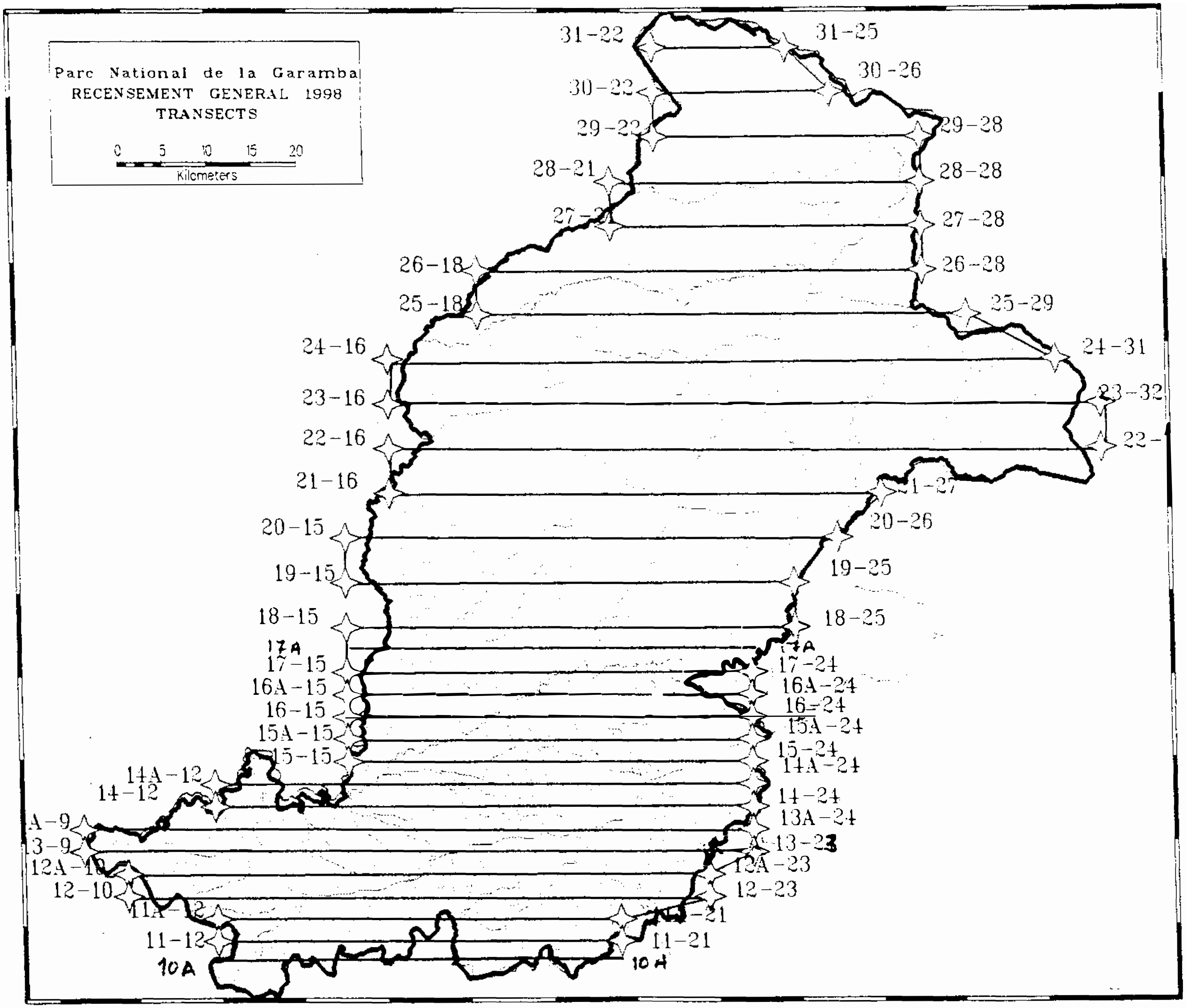
The Garamba National Park (4,900 km$^2$) is situated between 4° and 3° north and 29° and 30° east in the north east of the Democratic Republic of Congo (DRC). It is surrounded on three sides by reserves, the Domaines de Chasse Azande, 2,892 km$^2$ to the west, Gangala na bodio, 2,652 km$^2$ to the south, and Mondo Misa, 1,983 km$^2$ to the east. All these areas were counted. On the north east, within Sudan, the park is bordered by the Lantoto game reserve. This area was not included, due to the political situation.

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

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

The counting technique and basic analysis has remained standard throughout, based on the systematic aerial sample count method described by Norton Griffiths (1978) and Jolly Method 2 analysis (In Norton Griffiths 1978), but the process of analysis has varied. Analysis is now carried out with a system developed using the commercial software programme Quattro pro 4 (Borland 1992) for the 1993 count (Watkin et al 1995). The method of counting and analysis as applied at Garamba has been written up as a handbook (Hillman Smith et al 1995) to guide long term standard application of the technique in the monitoring programme at Garamba. We hope it may also contribute a few guidelines for easy analysis of aerial counts elsewhere.

A UTM (universal transverse mercator) compatible system of coordinates, which was based on the transect lines used since the 1983 count has been used to locate all animal and habitat observations since 1983 and all law enforcement monitoring observations since 1992. In conjunction with the establishment of a geographic information system (GIS) at Garamba in 1993, this has now been expanded to cover the surrounding reserves and is maintained as the basis for the positioning of the flown transects. A Garmin global positioning system (GPS) was used to navigate the transects and sub-units. The GIS programme Idrisi has been used in mapping the vegetation cover.



Parc National de la Garamba
RECENSEMENT GENERAL 1998
TRANSECTS
0 5 10 15 20
Kilometers
31-22
31-25
30-26
30-22
29-22
29-28
28-21
28-28
27-28
26-18
26-28
25-18
25-29
24-16
24-31
23-16
23-32
22-16
21-16
20-15
20-26
19-15
19-25
18-15
18-25
17A
17-15
17-24
16A-15
16A-24
16-15
16-24
15A-15
15A-24
15-15
15-24
14A-12
14A-24
14-12
14-24
13A-24
13-23
12A-23
12-10
12-23
11-12
11-21
10A
10A

**Counting method**

The counting method is the standard aerial systematic reconnaissance flight (srf) using parallel transect sampling as described by Norton Griffiths (1978) and widely used for aerial counting of wildlife and livestock. Heights, strip widths and general application of the method have been relatively standardthroughout the series of counts. Analysis is carried out using jolly's method ii (Norton Griffiths 1978) in the spreadsheet programme quattro pro, and shaded vegetation mapping uses the gis programme idrisi.

| | | | | |
|---|---|---|---|---|
| **Aircraft:** | Cessna 206, 9Q-CBR | | | |
| **Pilot:** | Fraser Smith | | | |
| **Front seat obs.:** | Kes Hillman Smith | | | |
| | **1998** | **2000** | **2002** | **2003** |
| **Middle seat obs.:** | Mbayma Atalia | Mbayma Atalia | Amube Ndey | Amube Ndey |
| | Mafuko Girineza | Giningayo Panziama | Giningayo Panziama | Paulin Tshikaya |
| **Rear seat obs.:** | Amube Ndey | Amube Ndey | | Serge Iliabo |
| Training & analysis | Giningayo Panziama | | | Mambo Marindo |

**Analysis design:** John Watkin & KHS,,
re-design for EW transect re-orientation K H.S & Kerin Adcock

**Analysis:** Amube Ndey, Kes H. Smith, Mbayma Atalia,
based on Hillman Smith et al (1995) and Watkin et al (1995)

**Census zone:** Garamba National Park
Total area 4,900 km$^2$

**Timing:**

For greatest accuracy in population estimation the period April to mid June, just after the start of the long wet season offers best visibility. The grass is short and the air is cleared by the rain. The preparation, calibrations and counts reported here were carried out in May or in one case June.

**Stratification:**

The count was stratified in relation to animal distribution. Very few anmials remain in the north and central sectors and these are flown at by transects spaced at 5 km apart. The southern sector is where over 90% of the animals are currently distributed. This was flown at 2.5 km spacing for greater accuracy. Sub-units are spaced at 5 km, as measured by GPS. The stratification that has been adopted since 1993 is based on the elephant distribution observed in 1993, which is known to reflect the elephant distribution over the preceding ten years, is as follows. The count boundaries are based on sub-unit boundaries rather than those of the park and reserves. Hence they are slightly larger than the actual boundaries:

park: 5,500 km$^2$

- Low density: 1,400 km$^2$
  14 transects, 55 sub-units
- Medium density: 1,925 km$^2$
  12 transects, 77 sub-units
- High density: 2,200 km$^2$
  16 transects, 88 sub-units

domaines de chasse: 9,600 km$^2$

37 transects, 384 sub-units

The counts reported here since the first war in DRC have included only the park as the objectives have been a rapid assessment of the status of the park, and fuel has always been a limiting factor.
At the start of the project transect used to be flown north south also with 5 km sub-units. In order to mare accurately and correctly analyse a stratified count, since 1998 the transects have been flown east-west with the sub-unit divisions east west. The grid system and method of analysis remain the same and the counts therefore continue to be comparable

**Equipment:**

King radar altimeter, Garmin global positioning system (gps) , marker rods, tape recorder per observer, tapes and batteries, stopwatch, data sheets, computer for analysis.

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

**Duties of crew**
**Pilot:**

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

**Front seat observer:**

recording the time and speed of each transect and maintaining the transect summary sheet (in annex). Within each sub-unit recording height a.g.l. from the radar altimeter and habitat factors as defined below. (Fso data sheet in hillman smith et al 1995)

**Middle seat observers:**

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

**Rear seat observers:**

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

**Sample intensity:**

sample intensity: 8-10% Low, 15-20% high
transect spacing - low 5km
high 2.5 km
sub-unit spacing: 5 km
target flying height: 350' a.g.l.
Overall mean actual flying height 347' a.g.l.
Target strip width: 400 -500 m total.(200-250 metres each side)

Strip widths are preset according to Norton Griffiths (op.cit.) and calibrated by flying at different heights over markers spaced at 20 metre and 100 metre intervals on the airstrip, simultaneous with radar altimeter readings. Observers count the numbers of spaces between markers included within the strip widths, to calculate the observed widths. These passes were carried out both during training, before counting began and at the beginning and end of each counting flight. The results, analyzed and plotted in quattro pro 4.0 are shown in the graph **calibrations**, and were used combined with measured altitudes per sub-unit to calculate strip widths for each transect and sub-unit. On the basis of this the combined strip widths for middle seat observers are calculated per sub-unit and the sample areas per sub-unit are calculated and used in the calculation of population estimates from animals of each species seen per sub-unit:

**Transects:**

Transects are spaced at 5 km intervals in the low and medium intensity zones and at 2.5 km in the high intensity southern zone. They are flown east/west as shown on the map **projected transect lines.** The co-ordinates for the start and end points of each transect flown alternately north and south are given on the table **gps waypoints in annex.** Subunit were at 5 km intervals as measured using the gps and is used, sub-unit boundaries are located in multiples of 5 km from the end waypoint, using the tables **of transect and subunits in Annex**.

**Species:**

Animal species were counted by both middle and rear seat observers, as listed on the table: **codes des espèces**. Signs of human habitation and land use were also counted. Elephant and other species carcases are classified as:

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

(Douglas-hamilton & hillman 1981)
in this high rainfall, high scavenger density environment, fresh recognisable rot patches remain for a considerably shorter time than in east africa. Carcases monitored have usually remained at stage 2. less than two months.

**Habitat factors** :

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

bush cover, as above
bush greenness, as above
grass cover, as above
grass greenness, as above
long old grass, as percent of grass present
burn, as percent in sub-unit
water availability,
- 0 = none
- 1 = available to humans and livestock
- 2 = limited availability
- 3 = unlimited availability
- 4 = running water
- 5 = floods

agriculture, as percent in sub-unit
Vegetation zones are classified within each sub-unit.

**Analysis**

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

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

**Results**

Distribution maps in the spreadsheet formats are given for each species for each of the count years. These are followed in each set by the tables calculating population estimates and Standard Errors and 95% Confidence limits for each species. Signs of threat, ie carcasses and poaching camps are mapped for each year.

Vegetation parameters are mapped for one year. Tree cover is dense in the north of the park and relatively dense in the Domaine de Chasse, but very sparse in the south of the park due to the effects of fire and elephants. Bush cover is increasing further and further south each year as the elephants and other large mammals are pushed down or poached out from the north and now even from the centre of the park.

**The summary table** gives population totals and stratified totals, densities and biomasses for the period 1976 until 1995, before the war. The weights used to calculate the biomasses were those used by savidge et al (1976), haltenorth & diller (1977) and d'huart (1978). A second summary table gives the situation since then.

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

## Methods

The aerial survey manual for Garamba National Park, based on the standard methods developed during the 1993 census was applied throughout as guidance and training manual. However since 1998 the transects have been flown east west instead of north south in order to make more accurate the stratified analysis. The sub-unit cells remain the same.

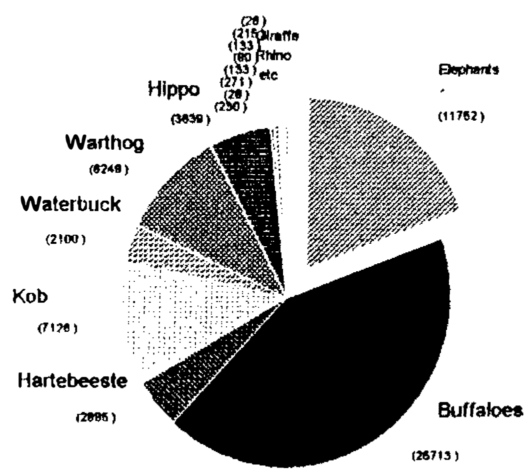
The front seat observer has been standard since 1983. This therefore minimises errors due to observer bias. However the two middle seat observers have varied over the four year period, and have included Guy Mbayma, the late Jean Mafuko, Jerome Amube, Giningayo Panziama and Paulin Tshikaya. The rear seat positions have been used for training. Practice and training was given by both estimating and counting from digital photos of buffalos, elephants and hippos, but the need to estimate large groups because the observers are not sufficiently practiced with cameras to use them, is a potential source of bias.

## Animal numbers and distribution over time in relation to external events

*Historical*

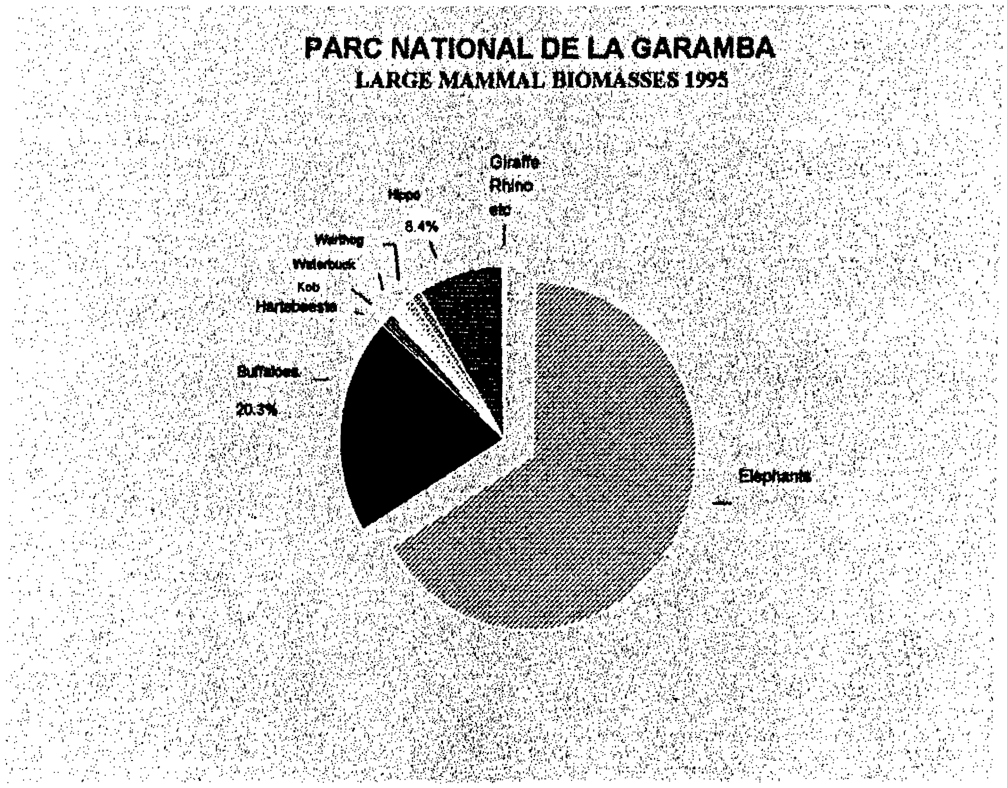
Table 1 gives the large mammal numbers from aerial census from 1976, when the FAO project ended through 1983 before the Garamba project started, to 1995, before the civil war. Table 2 gives numbers since the first war, from 1998 to 2003. The graphs Figs.3 and 4 summarise the trends of key species. Pie charts indicate the biomasses and relative species numbers for the two periods.

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

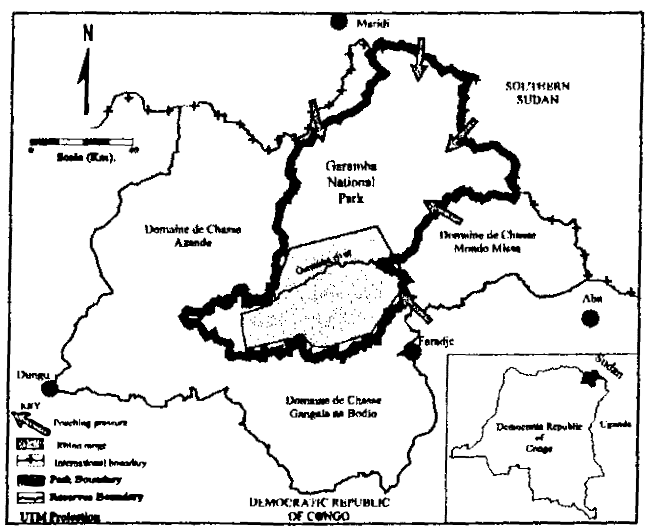


PARC NATIONAL DE LA GARAMBA ET DOMAINES DE CHASSE
WILDLIFE NUMBERS/ NOMBRES DES ANIMAUX 1976 - 1995

| YEAR | BUFFALO | GIRAFFE | HIPPO | KOB | HARTEBEESTE | WATERBUCK | REEDBUCK | ROAN | WARTHOG | GR.DUIKER | RF DUIKER | ORIBI | LION | HYENA | BUSHBUC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1976 | | | | | | | | | | | | | | | |
| PARC | 53000 | 350 | 1700 | 7180 | 7750 | 3680 | 640 | 360 | 3340 | 140 | | 380 | 35 | 35 | [illegible] |
| DC | | | | | | | | | | | | | | | |
| 95% cl | 42390 | 250 | | 2300 | 1470 | 1330 | 310 | 530 | 1440 | 100 | | 150 | 40 | 50 | [illegible] |
| 1983 | | | | | | | | | | | | | | | |
| PARC | 53312 | 175 | 1290 | 3978 | 1932 | 2215 | 183 | 91 | 1117 | 91 | | 234 | 15 | 87 | |
| DC | 2864 | 20 | | 765 | 146 | 455 | 151 | 0 | 241 | 169 | 36 | 17 | | | [illegible] |
| 95% cl | 16960 | 163 | 1781 | 2321 | 812 | 1420 | 107 | 124 | 244 | 72 | 31 | 152 | 15 | 14 | [illegible] |
| 1984 | | | | | | | | | | | | | | | |
| PARC | 48284 | 273 | 448 | 3792 | 1224 | 568 | 175 | 0 | 404 | 109 | | 153 | 33 | 44 | [illegible] |
| DC | 76 | 0 | 0 | 0 | 0 | 218 | 0 | | 0 | 11 | | 0 | 0 | 0 | |
| 95% cl | 5962 | 144 | 442 | 214 | 442 | 293 | 101 | | 182 | 126 | | 103 | 69 | 38 | |
| 1986 | | | | | | | | | | | | | | | |
| PARC | 29419 | 153 | 2874 | 7222 | 1705 | 1322 | 328 | 34 | 943 | 12 | | 230 | 63 | 157 | [illegible] |
| DC | 341 | 13 | 0 | 490 | 75 | 659 | 93 | 0 | 86 | 23 | 25 | 13 | 0 | 0 | |
| 95% cl | 3465 | 140 | 1658 | 2601 | 589 | 456 | 135 | 25 | 344 | 12 | 26 | 90 | 46 | 121 | |
| 1966 1968 | | | | | | | | | | | | | | | |
| PARC | 32163 | | 2851 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 1991 | | | | | | | | | | | | | | | |
| PARC | 33910 | 346 | 2205 | 3423 | 967 | 718 | 38 | 13 | | 13 | 51 | 39 | | | |
| DC | | | | | | | | | | | | | | | |
| 95% cl | 19705 | 422 | 2002 | 2045 | 675 | 440 | 42 | 25 | | 25 | 60 | 56 | | | |
| 1993 | | | | | | | | | | | | | | | |
| PARC | 30555 | 347 | 1023 | 6738 | 3444 | 1113 | 75 | 150 | 2692 | 75 | 120 | 90 | | | |
| DC | 549 | 0 | 0 | 564 | 89 | 355 | 0 | 0 | 163 | 15 | 45 | 0 | | | |
| 95% cl | 15798 | 419 | 617 | 3547 | 2114 | 623 | 91 | 255 | 1524 | 63 | 57 | 67 | | | |
| 1995 | | | | | | | | | | | | | | | |
| PARC | 25242 | 178 | 3601 | 6601 | 2819 | 1680 | 271 | 81 | 5606 | 98 | 107 | 0 | 14 | 14 | |
| DC | 472 | 52 | 39 | 524 | 56 | 420 | 0 | 0 | 643 | 39 | 105 | | 0 | 0 | |
| 95% cl | 16920 | 210 | 2636 | 3033 | 1192 | 1340 | 180 | 159 | 2546 | 74 | 52 | | 27 | 25 | |

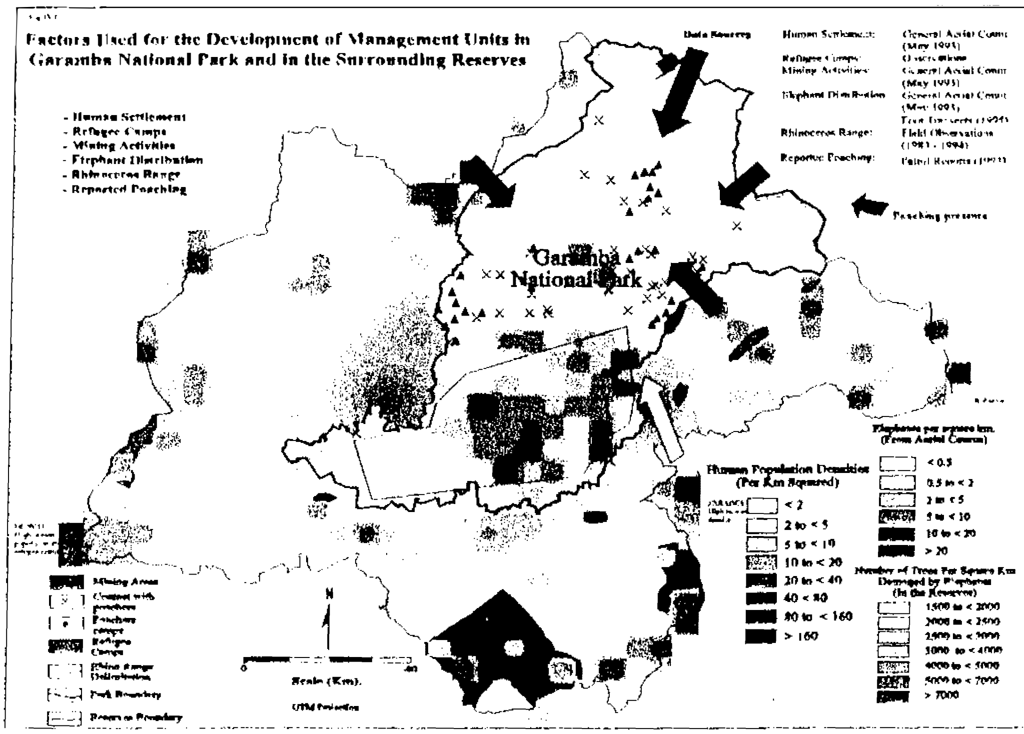



Between the FAO Project and the Garamba project most large mammal numbers dropped dramatically with heavy poaching. This also changed the distribution of the most valuable species, elephants and rhinos, who were eliminated from the north and remained concentrated in the better protected south of the park. The Garamba Project/IZCN partnership was able to eliminate the commercial poaching of elephants and rhinos but a continuation of poaching in the north of the park for meat maintained their unequal distribution and they did not move back to re-populate the centre or north. As the elephants increased they tended to move out more into the wooded Domaine de Chasse at night (Hillman Smith et al)




GARAMBA NATIONAL PARK AND RESERVES

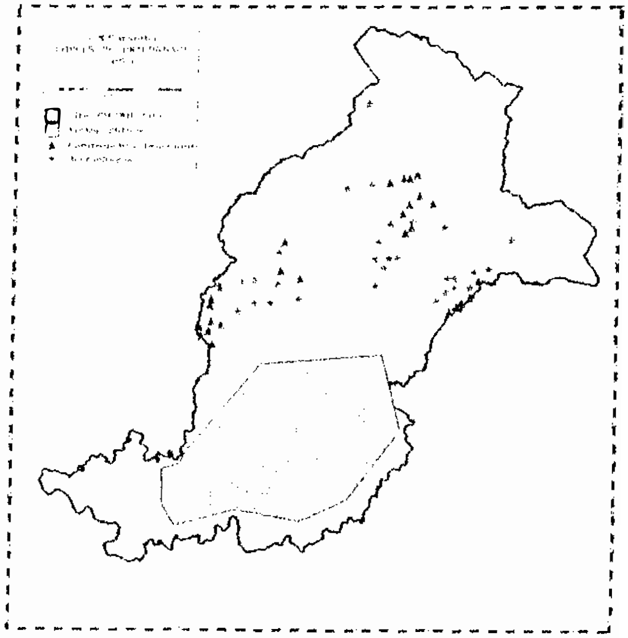
The north of the park is on the Sudan border and it is easy for poachers to cross. Elephant and rhino numbers rose through the first few years of the project, doubling in eight years, (Fig & Table 1), but buffaloes which remained widely distributed throughout the park became the main meat prey species in the north and centre of the park.. Because of this, buffalo numbers have declined steadily throughout the project, but they acted as a buffer to the more valuable species.



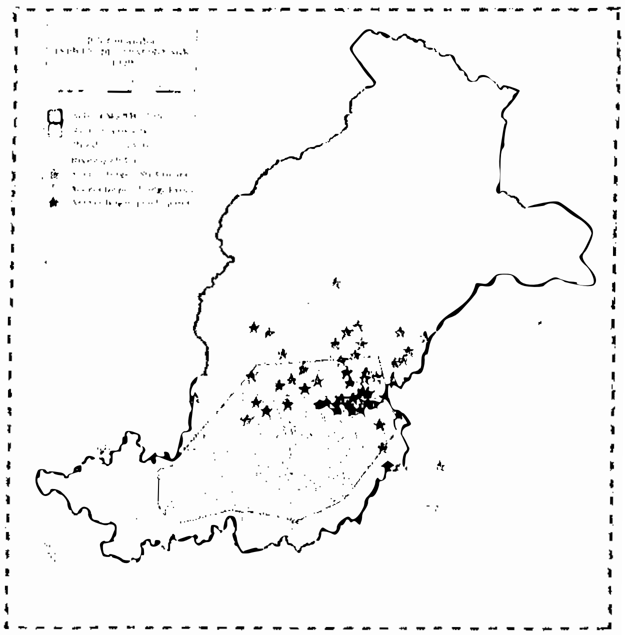

*The effects of wars*

In 1991 the Sudanese civil war moved south, as the town of Maridi, just across the border from Garamba, was taken by the Sudan Peoples' Liberation army. Arms and ammunition became widely available and about 80,000 refugees were settled east and west of the reserves surrounding the park. SPLA camps were set up adjacent to the border and well armed and trained militia or ex-militia became the main source of poaching pressure, as evidenced by the law enforcement monitoring (LEM) results (Fig.4).

Commercial meat poaching was the main driving force. Most active anti-poaching effort was concentrated in the centre of the park, where the prey species and the poachers were concentrated. In the south, where the elephants and rhinos were concentrated, there was very little poaching before the civil wars. Most patrulling focused on monitoring and on seeking any signs of incursions and on research. However the strength and arms of the SPLA militia, their long periods of inaction away from the Sudanese front line and the market for meat in the area, meant that meat poaching increased in intensity, with poacher groups increasing in size and operating with heavier weapons, including grenades and rocket launchers. Despite extreme efforts, the guards could not completely stop this poaching and the front line of poaching gradually moved south through the park, as the LEM maps show. Major efforts were being made to raise higher levels of funds, ammunition and to bring in training and support, but in 1996 the first two rhinos were lost to poaching. Towards the end of 1996, the civil Liberation war began in the then Zaire.

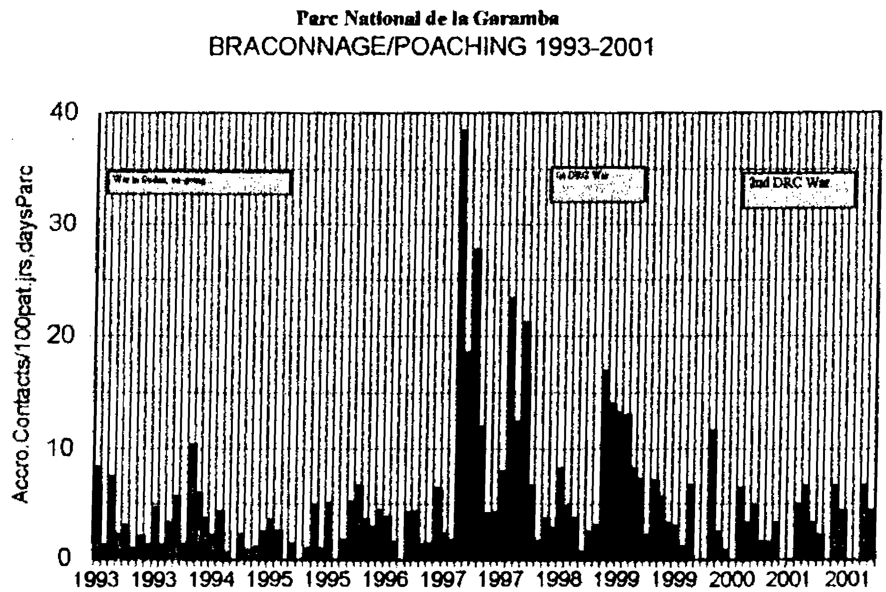


**Poaching Camps & armed contacts 1993**



**Armed contacts 1998**

In 1997 the Liberation war forces reached Garamba, the guards were disarmed and anti-poaching was forced to stop for several months. The poachers took advantage of the situation and moved into the high concentration southern sector. The figures of poaching per unit search effort (per 100 patrol days) show how the intensity of poaching increased significantly in the first war (Fig.5).




As Table 2 shows, over half the elephants, buffaloes and hippos were killed at this time and an aerial survey of the southern sector in 1997 showed fresh carcases and occupied poaching camps widely distributed. Major efforts by the ICCN and project personnel in Garamba, Kinshasa and internationally re-established anti-poaching, evaluated the situation, obtained clearance for training and back-up and began re-equipping and re-activating the conservation operations.

**Table 2 Impact of the wars 1996/97 and 1998 to present**

| Espèces | 1995 Population calculation | SE | 1998 Pop calc. | SE | 2000 Pop. Calc. | SE | 2002 Pop. Calc. | SE | 2003 Pop. Calc | SE |
|---|---|---|---|---|---|---|---|---|---|---|
| Elephant | **11,175** | 3,670 | **5,874** | 1,339 | **6,022** | 1,046 | **5,963** | 1,184 | **6,948** | 1995 |
| Buffalo | **25,242** | 8,299 | **7,772** | 2,063 | **13,115** | 3,066 | **13,281** | 3,930 | **14,480** | 4231 |
| Hippopotamus | **3,601** | 1,299 | **786** | 207 | **967** | 485 | **948** | 787 | **3,036** | 1191 |
| Giraffe | **178** | 108 | **144** | 73 | **118** | 64 | **62** | 13 | **62** | 75.4 |
| Waterbuck | **1,680** | 669 | **1,382** | 433 | **1,058** | 363 | **797** | 316 | **421** | 210 |
| Hartebeest | **2,819** | 590 | **1,685** | 398 | **1,065** | 218 | **1,139** | 232 | **1,224** | 260 |
| Kob | **6,601** | 1,495 | **6,505** | 1,558 | **3,902** | 984 | **3,587** | 991 | **6,235** | 2121 |
| Warthog | **5,606** | 1,261 | **4,765** | 668 | **1,075** | 213 | **990** | 254 | **789** | 155 |
| Roan Antelope | **81** | 78 | **8** | 7 | | | | | **57** | 67 |

Annexe 5.15

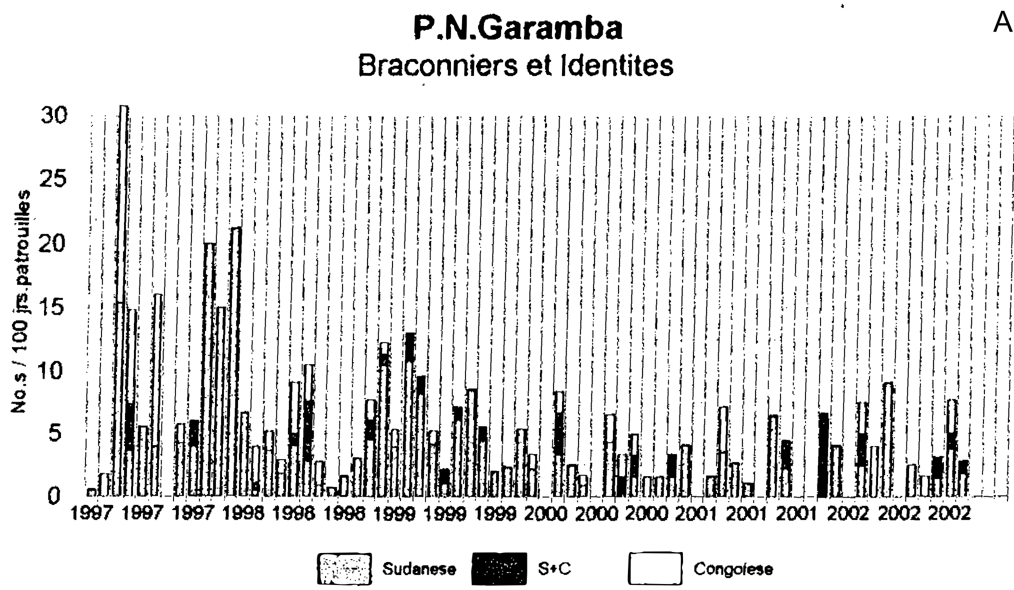
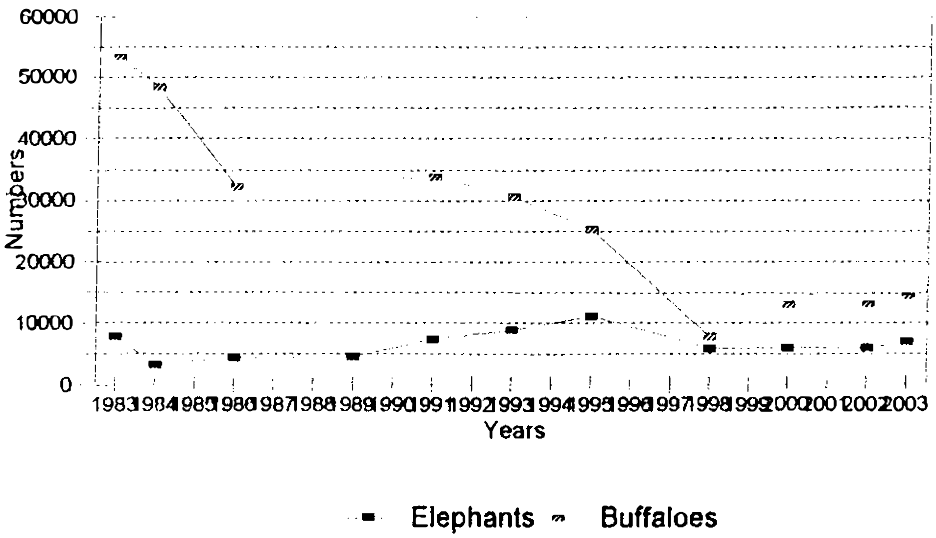



*Fig.: Identities of poachers*

In August 1998, the second civil war began. This time guards were not disarmed and although the senior staff and project personnel had to leave, the guards themselves continued patrolling and law enforcement monitoring and as soon as possible the project back paid them in relation to this. However, with Uganda being linked to the rebel forces holding the area, and the Ugandan links with the SPLA, it became very much easier for the Sudanese to move across the border semi-officially. The refugee camps were raided. In August 1999 a group of SPLA came across into the Domaine de Chasse Mondo Missa to the east of the park and began recovering weapons and "deserters". At first this had a positive effect on reducing poaching and in December park forces and local authorities joined them for a mixed operation supported by the project to recover more weapons. Agreement was given for a second two month operation in 2000. It delayed for several months and in the meantime, according to patrol reports, the local people were harrassed for food by the SPLA in the area and many moved away from their homes and fields. The official mixed operation involved support from the project in terms of vehicles, fuel and rations and although it was only for an agreed period of two months, at the end of which they were supposed to return to Sudan and continue a more limited trans border collaboration, the park warden at the time built houses for them close to the park border in the Domaine de Chasse in DRC to the east. They therefore did not want to move back to their side of the border even though the project was unable to support this kind of activity in the long term, in one area out of the park, to the detriment of the conservation activities within the park. The SPLA have remained there ever since, demanding support from the park or threatening to wipe out the animals if this is not given. Representation has been made to all the concerned authorities and the park's position has been made officially clear, but the threat remains and has in 2003 become extremely serious.

# P.N.Garamba

Large Mammal Populations 1983-2003

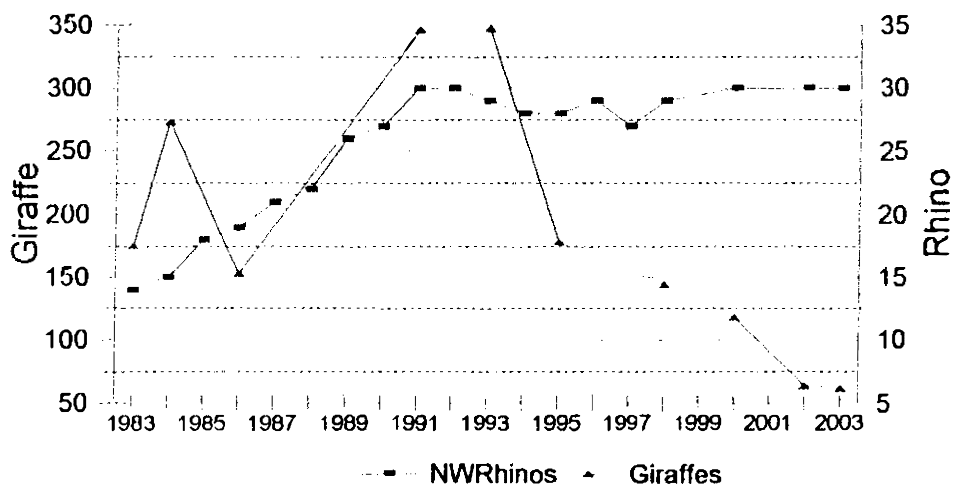



***Current trends***

As noted above, although the poaching front line had been moving south through the park under pressure from Sudan, while it was still largely for meat and while buffaloes and other species were available in the centre of the park, the rhinos and elephants in the south were relatively secure. During the most active phases of the wars, in early 1997 and late 1998, the poachers were able to penetrate the southern sector, but at times that the guards were able to operate more effectively, they were able to push them back. The most

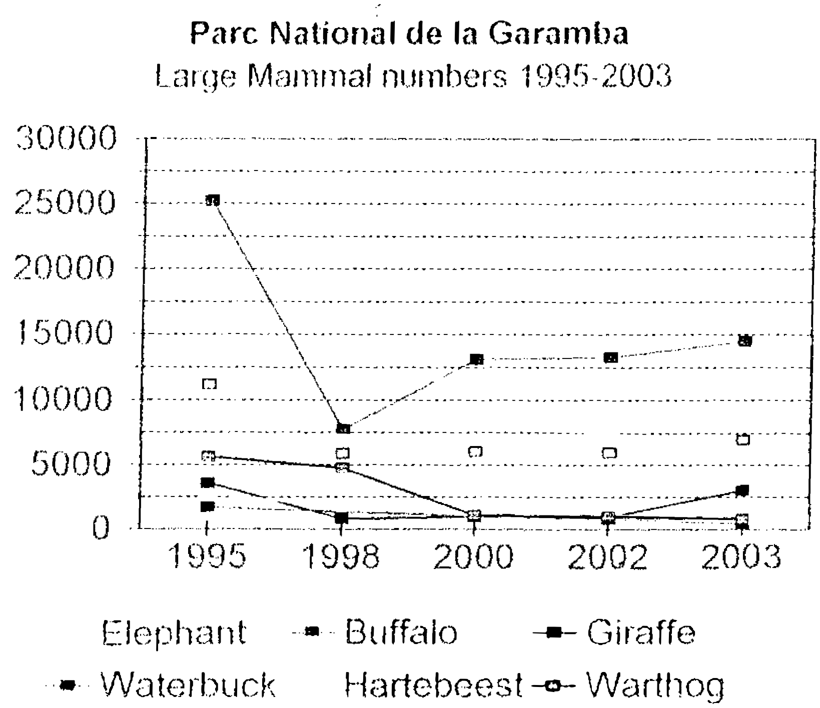
**PARC NATIONAL DE LA GARAMBA**

Rhino & Giraffe 1983-2003

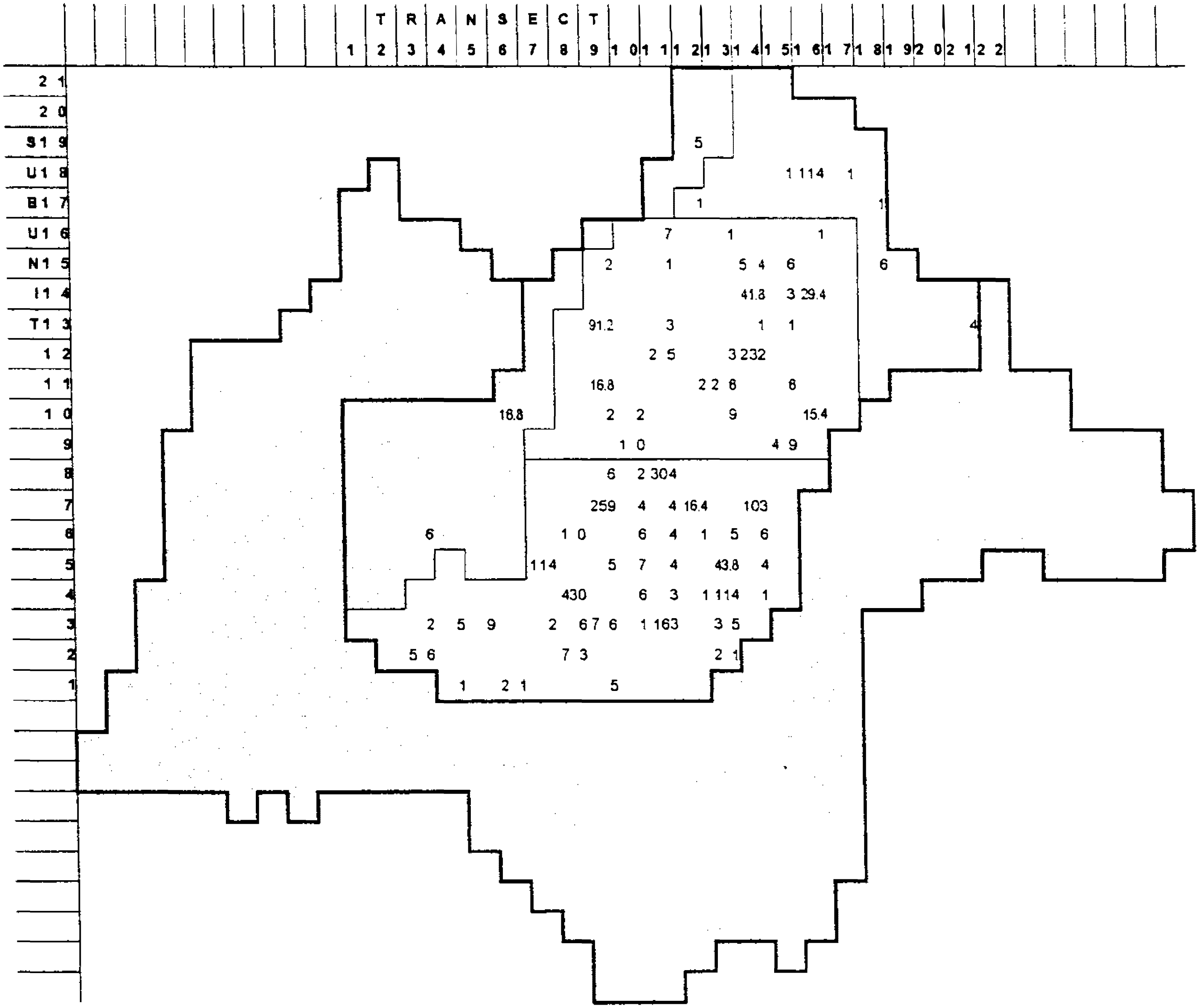



striking result of recent aerial surveys has been the almost complete lack of large mammals in the central and northern sectors of the park . The series of maps of buffalo distribution over time demonstrate this effectively. As these have been the main prey species for meat poaching, all the attraction for poachers for either meat or rhino horn and ivory is focussed in the southern sector. The pressure is serious. In response the guards prefer to go on patrol in very large groups, which halves or quarters the cover of the area and makes them easy to detect. In addition, with the key poachers now established close to the park in the Domaine de Chasse, they no longer have to make camps to smoke meat before travelling 100km back to Sudan, but can move in and out in a day

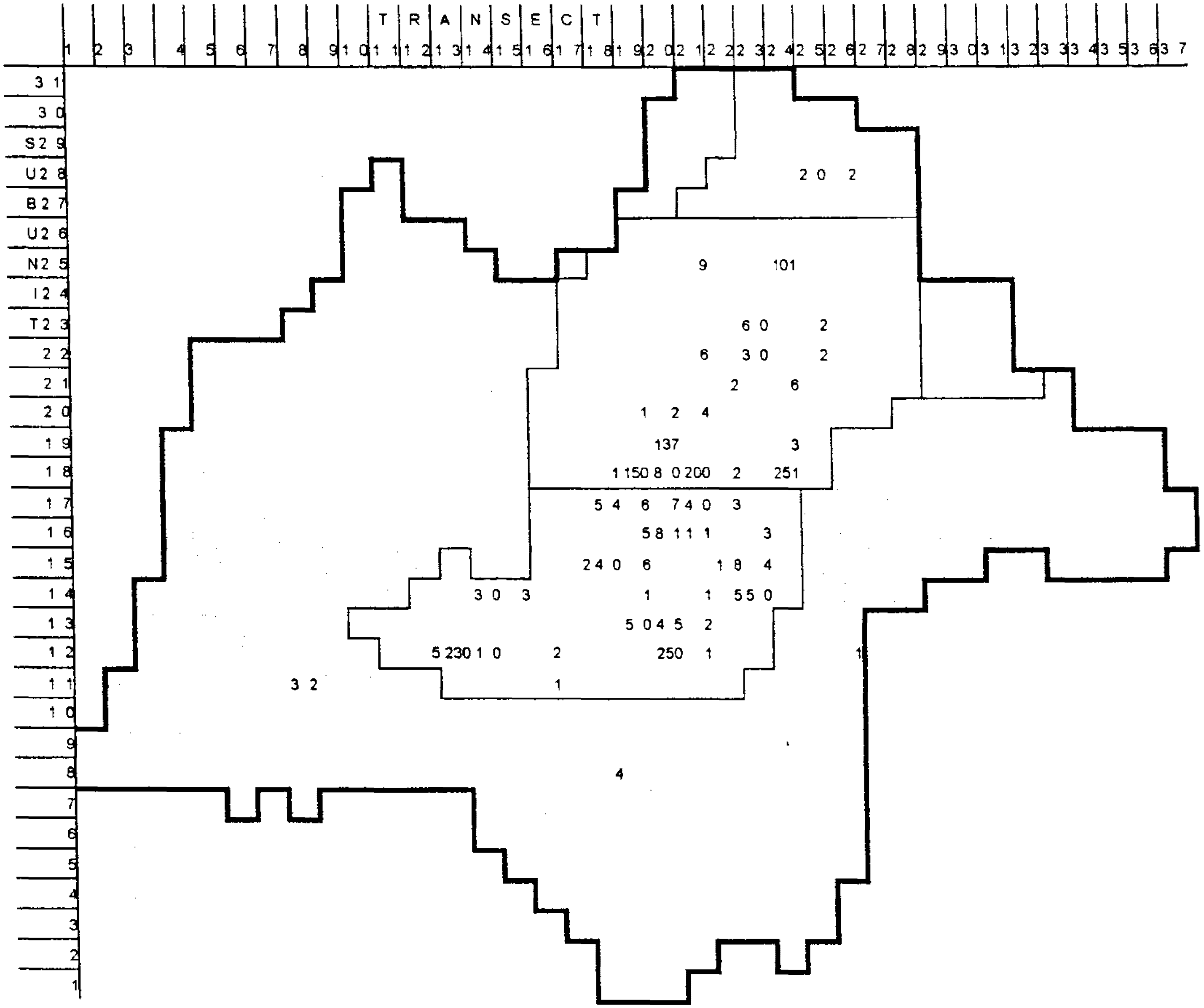
Recent patrol reports indicate that the trend since May has been to kill elephants for ivory and leave the meat, which also means that many more elephants can be killed in a short space of time. In June and July there have been three instances of guards being attacked in their camps, including the new radio relay station which is at Km 15 the very centre of the southern sector and only 15 km from Nagero, the park head-quarters. It is urgent that guards receive effective training, back up and leadership, that more young guards are recruited and trained and that an effective strategy is developed and followed. A rhino and poaching recce survey of the southern sector will be carried out in August.



**Buffalo Distribution in Garamba National Park in 1986**

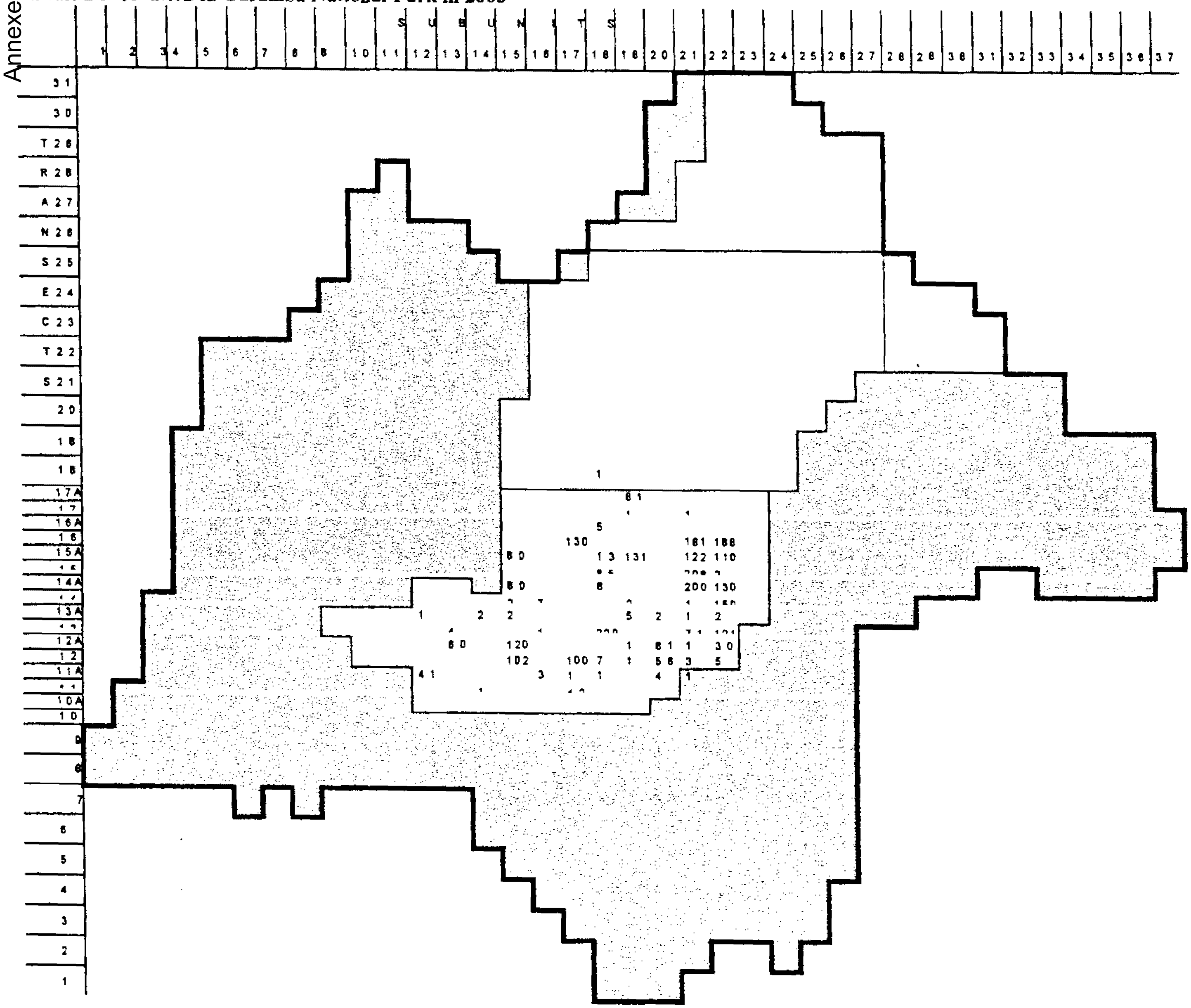


**Buffalo distribution in Garamba National Park 1993**



Annexe 5.15

**Buffalo Distribution in Garamba National Park in 2003**



***Elephants***

The table and graph of elephant numbers since 1976 show the precipitous decline between 1976 and 1984, with a low of about 4,500 and a time lag in increase as such a slow reproducing species. Numbers then rose exponentially, until they had more than doubled with over 11,000 in 1995. Despite the broad confidence limits inherent in sample counting, the difference was significant at the 5% level (anal. of variance, Cochran in Norton Griffiths 1978). The graph of elephant and buffalo populations, plotted with equally spaced years and lines of best fit calculated from the regression, show that the actual slopes of decline and increase were similar. (r=0.18) both were of the order of 10% per annum. The overall increase in the elephant population since the project started was largely due to the elimination of most of the commercial poaching of internal and external origin. However, the pressure from the war across the border in Sudan, exacerbated by the civil war preventing anti-poaching in early 1997 resulted in a loss of some 5,000 elephants between the counts of 1995 and 1998. Since then elephant numbers have remained relatively stable to slightly increasing, but the recent trends are of considerable concern and the aerial recces and next large mammal survey will be needed to assess the degree of effect.

Although the elephant population remained largely concentrated in the better protected south of the park, as their numbers increased, they increasingly used the woody vegetation in the Domaines de Chasse at night (Hillman Smith et al 1995 and Nicholas & Amube 1995) often forming into large groups near the periphery of the park during the day. In 2003 a large aggregation of some 800 was seen in May, concentrated in long grass patches during the day and moving out into the Domaine in the evening. However no elephants are now found north of the Garamba river in their previous concentration areas. It has been shown, from the results of counts, general observation and from aerial total counts over fire experiment blocks that elephants and rhinos favour long old grass for cover. During the war periods a management effort has been made to maintain mosaics of long old grass with patches of short palatable grass. Their distribution favouring these areas indicates the value of the long grass in helping to protect the more vulnerable species.

Dead to live ratios from carcase counts were relatively low during these surveys compared with the 1 dead to 8 live ratio found in 1983 before the project started. During the recce flight in 1997 carcase numbers had been very high, but by the time of the 1998 sample count reported here, many of those carcases had disappeared and the lack of new ones indicated how the guards were pushing back the poaching. Carcases disappear extremely quickly. Rainfall is over 1300 mm per year, aiding rapid breakdown and hyena and vulture densities are high. Even elephant carcases can sometimes be so scattered as to be unrecognisable from the air a week after death. The 12% cover of termitaria clearings and the tendency of animals to use them and therefore die in them, together with the rapid rate of grass growth also makes it difficult to distinguish all rot patches for as long as in east africa.

Figures for large mammal numbers and biomasses are expressed as pie charts. The biomass contribution of elephants to the ecosystem is very striking. The relative sizes of the populations of elephants and buffaloes in 1995 were the same as those found in 1976 (savidge et al 1976).

An examination of the tree and bush cover from aerial surveys throughout the project reflects both the overall reduction in mature trees within the park compared with the surrounding domaines and the advancing bush regeneration in the north and centre of the park, as the elephant have to a large extent been absent from this area for over twenty years. This is borne out by the 1976 distribution of elephants throughout the park compared with the present and by reports of guards, who say there used to be many elephants in the north of the park, and that much of the poaching between 1978 and 1984 was done by guards themselves. The reduction of woody vegetation is compounded by the effects of fire. The action of the elephants and the hot fires is to damage smaller trees. The elephants further prevent regeneration from old rootstocks by selection for these plants. This leads to dominance by rapidly growing coarse perennial grasses (*loudetia arundinacea and hyparrhennia spp.)* that grow over 2 metres tall. In addition to competing with the woody regrowth amongst them, they provide a huge combustible biomass for the hot fires that sweep through, further destroying that year's regrowth of woody plants that might remain. The management activity of maintaining mosaics of long and old grass is therefore doubly important

Elephant distribution and use of natural woody vegetation in the domaines de chasse was found to be positively correlated with proximity to their daytime core distribution, and negatively with distance from human settlement in the dry season. (Hillman smith et al 1995). This showed that they were not moving out solely to raid crops, though this appeared to be the human perception of the situation. More recent comments by guards are that elephants are escaping from the poaching dangers in the park!

***Rhinos***

A sample count is not adequate for accurate estimation of so small a rhino population. The difference between seeing 2 or 4 means the difference between population estimates of 27 or 53. We have been monitoring the rhino population through individual recognition over the years, and a rhino total block count using individual recognition was done in April each year, with further observations from recce flights. A minimum of 28 were accounted for in April and on the basis of earlier observations at least 30 were almost certainly present. With the recent poaching pressure in the southern sector, however, several may have been lost.

Rhino numbers increased exponentially before the wars, doubling in eight years. The known population dynamics through the war periods are given in the table. Throughout the wars the population has remained relatively stable and over 12 births were recorded. However according to the rate of reproduction and the previously demonstrated rate of increase, the population should be over 60 individuals now, double current numbers. We cannot be complacent about relative stability and must do all possible to improve protection combined with back up measures to avoid loss of this, the most endangered large mammal sub-species. Under the IUCN red list categories of endangered species (IUCN/SSC,1995), they are classed as **critically endangered** by reason of their low numbers.

The rhinos, like the elephants, are also found only in the south of the park. They are at an over all density of 0.003/km$^2$, but a local density of 0.03/km$^2$. Prior to the war, as the population had been expanding and sub-adults in particular had been dispersing, there was more movement north of the Garamba river. Since 1996, however, most rhinos venturing north of the river have been eliminated.
Home ranges for dominant males average 188.6km$^2$ (124-228). For females the mean is 345km$^2$ (185-492), and for sub-adults 534 km$^2$ ( up to 786). These ranges are of the order of 100 time larger than those recorded for southern white rhinos. Their size may be related to the very low density of rhinos, which places little restriction on their movement, but may also be related to the dispersal of available food resources at certain times of the year. The extensive movements of the animals, however maximise the chances of encounters between different individuals for breeding. The ecosystem has been shown to be ideal for them as demonstrated by rate of breeding. However adequate protection and monitoring is essential if they are to survive.

***Buffalo***

Buffalo numbers have fallen steadily throughout and the change in their distribution has been significant. Buffalo are the most numerous large mammals, but contribute less than a third of the biomass of elephants.
However buffalo numbers in 1995 were approximately half what they were in 1976 and are closer to one quarter in 2003. The difference is significant at the 5% level (d=2.07,anal.of variance, Cochran in Norton Griffiths 1978). The graph of buffalo numbers shows no significant change between 1976 and 1983, followed by a gradual decline, which has steepened in recent years. During the period of the project, buffalo have been the species most poached for meat. This meat poaching increased in 1994, with large, well-armed groups of sudanese causing the majority of it. Buffaloes have now been completely eliminated from the north and central sectors of the park. This insidious offtake over the years, while decreasing a once extremely numerous population, had a buffering effect on the protection of the more commercially valuable species, rhinos and elephants. Now, with all species concentrated in the south, all poaching is also concentrated there.

***Giraffe***

This giraffe population is the only one extant in DRC and probably the only representative of the sub-species (*Giraffa camelopardalis congoensis*). It is classified as **endangered** by the IUCN red list categories

(IUCN/SSC 1995). The northern white rhinos and the giraffes were the main reason for the creation of the park in 1938 and for its world heritage status in 1981.

The population, however is very small and has been decreasing. This estimate in 2●03 is only 62 ± 75. The woody habitat needed by the giraffe is only found in the north of the park or around the peripheries of the south or in the Domaines de Chasse, all areas which are very vulnerable now. A preliminary study showed their selection for *acacias* which are very poorly represented in this ecosystem.

Giraffe were not widely poached, because the Azande believe that eating their meat confers leprosy, although their tails are used by local chiefs. However these beliefs are not shared by the Sudanese, who form the majority of the poachers now.

***Hippos***

Sample counting is not ideal for hippos, whose distribution tends to be in local concentrations, leading to large variations in estimates, and for whom correction factors are needed to allow for those underwater. However the specialised hippo count carried out in 1988 yeilded figures very similar to the preceding sample count. The graph of the results from all the counts shows a gradual trend of increase from 1976 to 1995. This is borne out by personal observation that the hippos appear to have been increasing, and by reports from nagero and faradje of increasing problems of crop-raiding by hippos. If the correction factor calculated in 1988 was applied to the 1995 there would have beeen over 6,0●● hippos. However, as figures since the wars show, hippos were hard hit by the poaching during the 1997 war. The aerial survey we carried out in July 1997 of the southern sector confirms the reality of this, since the Garamba river was full of dead hippos floating belly up. Clearly when poachers penetrated as far as the river, they fired fairly indescriminantly at the hippos, but were unable to recover all the bodies.

The 1998 figures are lower than the subsequent figures. There are possibly at least three contributing factors to this: Some hippos may have moved out along the rivers during the major killing of 1997, the other two reasons may be linked to count biases. After training and discussion and practice with photos, I suspect that observers were making some allowances for the up:down ratio in their own counting or estimating of very large dense concentrations. The third factor is the shift in count transects from north south to east west. Transects north south cross the Garamba and Dungu rivers at near right angles. However east west transects, that are only spaced 2.5 km apart fly along relatively parallel to the river and slight drifts in course could easily lead to duplicate counting of some of the large groups. We have tried to check for any obvious duplications here and to control for observer bias in counting, but a spcific hippo count would give more precise figures.

***Kob***

Apart from an apparent high in 1986, kob appear to have followed a similar pattern to other antelope species, with a decrease between 1976 and 1983, continuation at a similar level, and an increase again in 1993 and 1995 and a decrease then relative stability since the wars. Observer bias may be one factor in their apparent fluctuations, and it will be important to try to standardise on observers for several years. They are distributed mainly in the high density stratum, but with several in the medium density and even the low. They were also seen in parts of the domaines de chasse. Kob tend to show a certain fidelity to areas where the grass is generally shorter all year round, for example on the shallow soils near the nauloloko/eleti confluence and at bac garamba. Their social organisation shows large harem groups, smaller, less coherent female and calf groups, male groups and "leks", with birth peaks in early dry season and breeding peaks in early wet.

***Hartebeeste***

Hartebeeste were 7750 ± 147● in 1983, and down to 1932 ± 146 in 1993. They stayed at a similar level until a major increase in 1993 and 1995. The difference between the 1991 and 1995 figures was significant (d=4.9, >5%). They were reduced by about half during the first war of 1997, but since then have remained relatively stable. They tend to be relatively sedentary and their prefered habitat is on ridge tops of the savanna grassland (hp).

*Waterbuck*
Waterbuck are widely distributed throughout the park and domaines, in association with water courses. They did not show a major drop during the first war, but numbers have shown a steady decline since then.

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

*Roan*
Roan antelope are represented by a very small population, which was apparentely larger in 1976 (360± 530). There used to be group south of mt kpaza, near the kasi, but any that remain are now only found south of the Garamba river. A small group usually occupies the region near to source Nauloko each short grass season, and apart from that scattered observations are made from time to time. 57+- 67 were estimated in 2003, but this could be on the high side from chance sightings of several individuals.

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

*Oribi*
Oribi are also difficult to see and are in low numbers and only 58 were estimated in 2003, though this was higher than the population estimated of two preceding years. Their population estimate will probably always be lower than the actual, since they are small and not easily seen. Verschuren in 1989 (pers.comm) had a strong impression that oribi had increased since the 1950s, but he conceded that it might have been the effect of more open vegetation.

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

*Warthog*
The warthog population has shown a rapid decline since 1995. This may be partly due to poaching but is probably largely due to some other factor like disease. Their populations have always fluctuated widely over the years. One suggestion mooted by guards for the previous decline was lion predation, but it was more likely to be an epidemic. Warthog probably go into their burrows to die and carcases would not often be noted.

*Lion and hyena*
Lion and hyena are both relatively plentiful predators, but are not easily counted by aerial sample counts and their population estimates are definitely lower than true values.

*Monkeys, baboons and crocodiles*
No reliance is placed on these population estimates that were based on chance sightings. Crocodiles are very plentiful.

*Other species*

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

*Vegetation*

The vegetation maps plotted in 1995 (Hillman Smith et al 1995a) and recorded but not necessarily plotted every year on the counts, show the clear differentiation between the wooded reserves and the grassland savanna of the south of the park. The southern half of the park is long grass savanna dominated by *loudetia arundinacea* and *hyparrhenia species*, with scattered *kigelia africana* and *vitex doniana* trees. Relict gallery forest and riverine trees add further to the sparse tree cover in the south. A few areas of sparse tree savanna usually dominated by *crossopteryx febrifuga* exist. They appear to be relicts of a more wooded savanna in the past. They are not favoured by elephants and are usually on patches of shallow soil, where the effect of fire may be less due to reduced grass cover. *Crossopteryx* has also been found in Lope reserve in Gabon to be the relict species remaining in savanna that has in the past been forested (White L. pers.comm). Areas of regenerating bush in the centre of the park are usually dominated by *piliostigma thoningii*, which is relatively fire resistant. The interactions of elephants and fire as controlling factors in the maintenance of the open savannas of the park are dsicussed in the section under elephants. Because the count was done at the early wet season, the greenness factor was high throughout.

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

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

***Water availability***

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

***Human influences***

*Poaching*
There was a widespread distribution of poaching camps in 1998, but decreasing numbers since then. A few camps were seen in the north and central sectors on the last count, but as noted previously there is less need for poachers to make meat smoking camps now that they are based so close to the remaining wildlife. On the 2002 count a small group of poachers in military uniform were found close to the eastern border of the park drying manioc on the rocks, and they fired at the aircraft.

Poaching is currently extremely brazen, but far more difficult to detect. The effects of the wars and instability has been most marked where it led to disarming of the guards and reduction of their ability to combat the poaching. As the graphs show, the majority of poaching groups are largely Sudanese and in the current situation in the region weapons and ammunition are readily available. It is urgent that really major effective training and leadership is given to the guards, with development of a new strategy of anti-poaching and recruitment and training of an adequate numbers of guards that can be fully supported and effective in their work. Numbers alone are not the answer.

## CONCLUSIONS

There was some loss of most species except buffalo between 1976 and 1983. However the focus of poaching during that time appears to have been for the commercially valuable elephants and rhinos. Both species provided plenty of meat in addition to the trophies, if it was required. Since 1984 most species increased with the better protection, notably the rhinos and elephants, which have shown high rates of increase, and warthog, which showed a recent spectacular rise prior to 1995. The exceptions are buffalo and girafe. Both have declined steadily. The buffalo population has dropped overall since 1983, probably as a result of meat poaching. Although carcase ratios and patrol reports show how poaching was brought down to minimal levels by the combined action of the project and IZCN, prior to 1991, after this time the effect of the war in adjacent Sudan has been the major influence on loss of animals and of the protected area of the park. The main drive for poaching has been for meat, and was hitting the buffalo population.

However the reduction in anti-poaching during the first war led to major wildlife losses in 1997. Since then major efforts by the guards and by the project personnel, principally in developing the UNF/UNESCO project to provide both financial and political support and in keeping up support on the ground, has enabled conservation work to continue as far as possible and has held many of the populations relatively stable. However there have been almost complete losses of wildlife in the northern and central sectors of the park. The combined effects of this is that all poaching focuses on the south, the proximity of well armed poachers to this area and the trands towards ivory and rhino horn poaching put the park in extreme danger, that must be tackled by extreme measures, now that peace is on the horizon in the DRC.

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

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2
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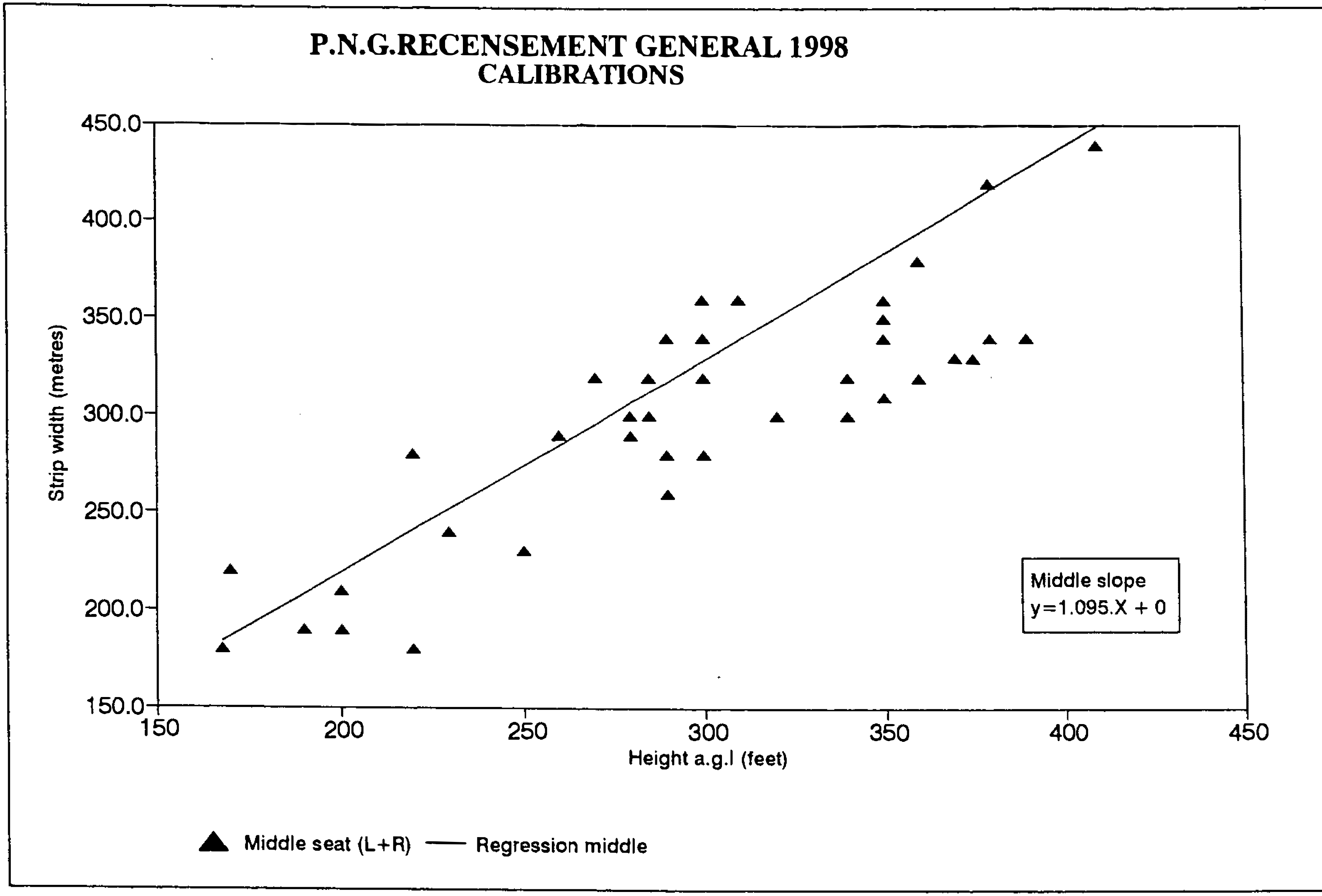
# PARC NATIONAL DE LA GARAMBA
# GARAMBA NATIONAL PARK

## RECENSEMENT GENERAL SYSTEMATIQUE
## GENERAL AERIAL SYSTEMATIC SAMPLE COUNT

**Calibration Graphs, Distribution Maps and Population Estimate Calculations**

**May / Mai 1998**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200.0
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300
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400
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Height a.g.l (feet)
Middle slope
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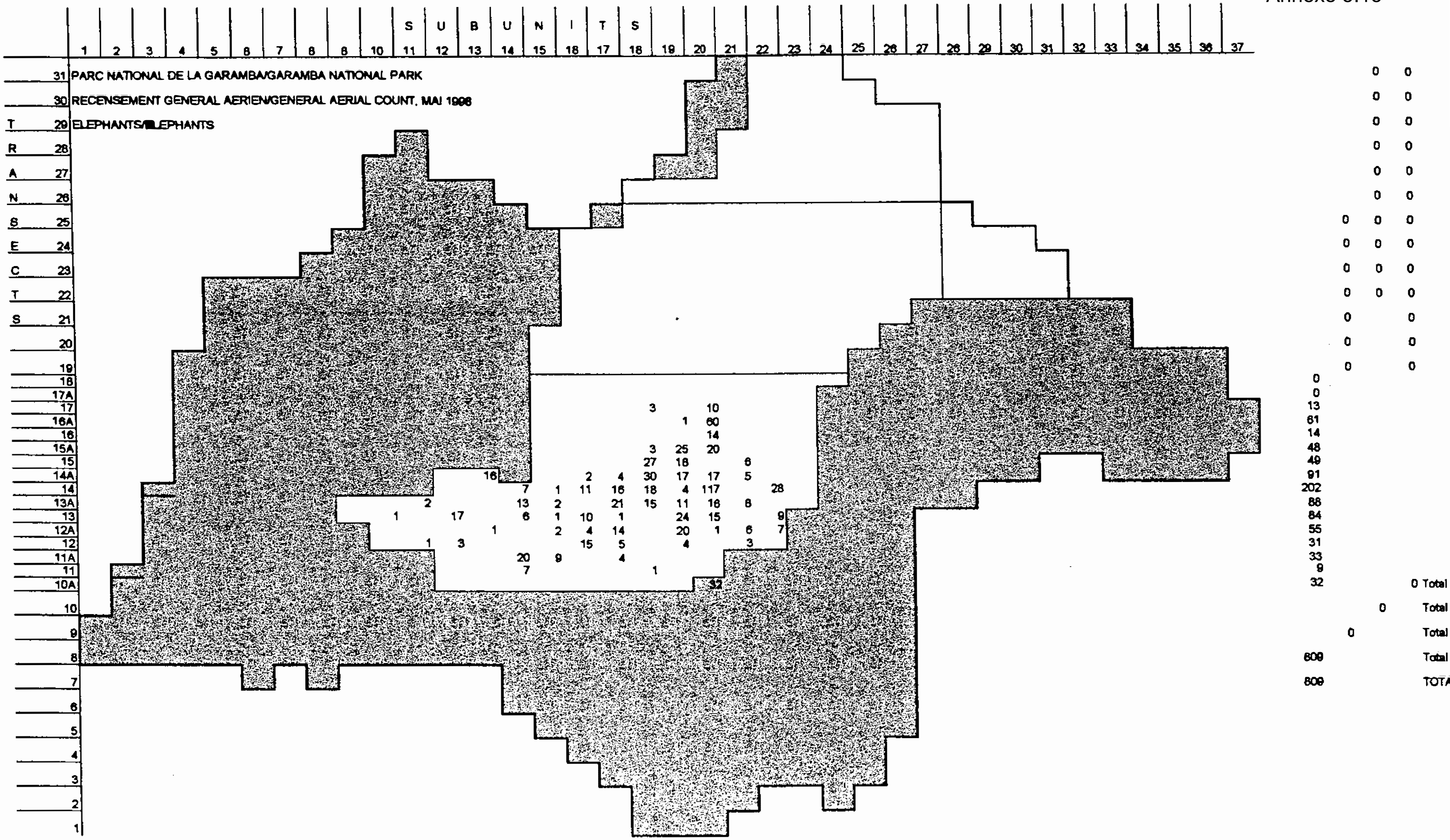
Middle seat (L+R)
Regression middle


PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998
ELEPHANTS/ELEPHANTS
SUBUNITS
TRANSECTS
0 Total
0 Total
0 Total
609 Total
609 TOTAL

PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK

RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998

ALTITUDE DE VOL/FLYING ALTITUDE

| | | | | | | | | | | | S | U | B | U | N | I | T | S | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 8 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | | | | | |
| | 31 | | | | | | | | | | | | | | | | | | | | | | 350 | 350 | 350 | 300 | | | | | | | | | | | | | | | 1350 | 350 | |
| | 30 | | | | | | | | | | | | | | | | | | | | | | 300 | 250 | 300 | 350 | 400 | | | | | | | | | | | | | | 1200 | 300 | |
| T | 29 | | | | | | | | | | | | | | | | | | | | | | 350 | 350 | 300 | 300 | 350 | 280 | | | | | | | | | | | | | 1930 | 322 | |
| R | 28 | | | | | | | | | | | | | | | | | | | | | 300 | 300 | 280 | 310 | 300 | 280 | 300 | | | | | | | | | | | | | 2070 | 296 | |
| A | 27 | | | | | | | | | | | | | | | | | | | | | 320 | 300 | 300 | 340 | 300 | 300 | 300 | | | | | | | | | | | | | 2160 | 309 | |
| N | 26 | | | | | | | | | | | | | | | | | | 330 | 280 | 300 | 300 | 300 | 280 | 300 | 300 | 300 | 300 | | | | | | | | | | | | | 2990 | 299 | |
| S | 25 | | | | | | | | | | | | | | | | | | 320 | 340 | 320 | 350 | 280 | 280 | 300 | 310 | 260 | 250 | 300 | | | | | | | | | | | 3010 | 300 | 301 | |
| E | 24 | | | | | | | | | | | | | | | | 300 | 300 | 300 | 260 | 350 | 300 | 300 | 280 | 280 | 300 | 300 | 350 | 280 | 310 | 320 | | | | | | | | | 3620 | 910 | 302 | |
| C | 23 | | | | | | | | | | | | | | | | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 280 | 200 | 270 | 300 | 250 | 300 | 280 | 340 | 300 | | | | | | | | 3400 | 2430 | 289 | |
| T | 22 | | | | | | | | | | | | | | | | | 320 | 300 | 300 | 300 | 300 | 280 | 280 | 300 | 300 | 320 | 300 | 300 | 280 | 300 | 330 | | | | | | | | 3300 | 1210 | 301 | |
| S | 21 | | | | | | | | | | | | | | | | 360 | 300 | 300 | 300 | 220 | 300 | 320 | 300 | 310 | 320 | 320 | | | | | | | | | | | | | 3350 | | 305 | |
| | 20 | | | | | | | | | | | | | | | 380 | 350 | 350 | 350 | 350 | 320 | 320 | 300 | 300 | 300 | 320 | | | | | | | | | | | | | | 3640 | | 331 | |
| | 19 | | | | | | | | | | | | | | | 300 | 350 | 350 | 270 | 250 | 200 | 250 | 300 | 320 | 300 | | | | | | | | | | | | | | | 2890 | | 289 | |
| | 18 | | | | | | | | | | | | | | | 350 | 350 | 350 | 370 | 320 | 350 | 350 | 300 | 320 | 300 | | | | | | | | | | | | | | 3360 | | | 336 | |
| | 17A | | | | | | | | | | | | | | | 350 | 320 | 340 | 350 | 300 | 320 | 360 | 360 | 440 | | | | | | | | | | | | | | | 3140 | | | 349 | |
| | 17 | | | | | | | | | | | | | | | 400 | 350 | 380 | 300 | 450 | 340 | 300 | 400 | 380 | | | | | | | | | | | | | | | 3280 | | | 364 | |
| | 16A | | | | | | | | | | | | | | | 300 | 210 | 280 | 300 | 300 | 300 | 330 | 320 | 310 | | | | | | | | | | | | | | | 2650 | | | 294 | |
| | 16 | | | | | | | | | | | | | | | 300 | 320 | 340 | 320 | 300 | 300 | 270 | 300 | 300 | | | | | | | | | | | | | | | 2750 | | | 306 | |
| | 15A | | | | | | | | | | | | | | | 250 | 300 | 320 | 300 | 350 | 240 | 300 | 300 | 400 | | | | | | | | | | | | | | | 2760 | | | 307 | |
| | 15 | | | | | | | | | | | | | | | 350 | 280 | 300 | 300 | 300 | 280 | 300 | 300 | 300 | | | | | | | | | | | | | | | 2710 | | | 301 | |
| | 14A | | | | | | | | | | | | 280 | 300 | 280 | 300 | 280 | 250 | 280 | 300 | 280 | 350 | 320 | 290 | | | | | | | | | | | | | | | 3520 | | | 293 | |
| | 14 | | | | | | | | | | | | 300 | 350 | 300 | 300 | 300 | 300 | 300 | 280 | 290 | 360 | 320 | 320 | | | | | | | | | | | | | | | 3720 | | | 310 | |
| | 13A | | | | | | | | | 380 | 300 | 300 | 300 | 330 | 320 | 310 | 300 | 320 | 280 | 350 | 300 | 300 | 300 | 320 | | | | | | | | | | | | | | | 4710 | | | 314 | |
| | 13 | | | | | | | | | 320 | 350 | 300 | 320 | 320 | 360 | 300 | 300 | 330 | 250 | 330 | 320 | 320 | 350 | | | | | | | | | | | | | | | | 4470 | | | 319 | |
| | 12A | | | | | | | | | | 350 | 330 | 350 | 320 | 340 | 320 | 350 | 300 | 300 | 350 | 300 | 250 | 400 | | | | | | | | | | | | | | | | 4260 | | | 328 | |
| | 12 | | | | | | | | | | | 350 | 280 | 300 | 270 | 300 | 300 | 350 | 300 | 250 | 300 | 300 | 330 | | | | | | | | | | | | | | | | 3630 | | | 303 | |
| | 11A | | | | | | | | | | | | 350 | 300 | 300 | 300 | 330 | 310 | 300 | 290 | 380 | | | | | | | | | | | | | | | | | | 2860 | | | 318 | |
| | 11 | | | | | | | | | | | | 280 | 300 | 320 | 320 | 280 | 280 | 300 | 300 | 320 | | | | | | | | | | | | | | | | | | 2700 | | | 300 | |
| | 10A | | | | | | | | | | | | 250 | 270 | 300 | 300 | 280 | 330 | 300 | 300 | 220 | | | | | | | | | | | | | | | | | | 2330 | | | 291 | |
| | 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 11700 | 312 | To |
| | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 23210 | 23210 | 4850 | 302 | To |
| | 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 52850 | 0 | 0 | 315 | To |
| | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 52850 | 23210 | 16550 | 311 | TC |
| | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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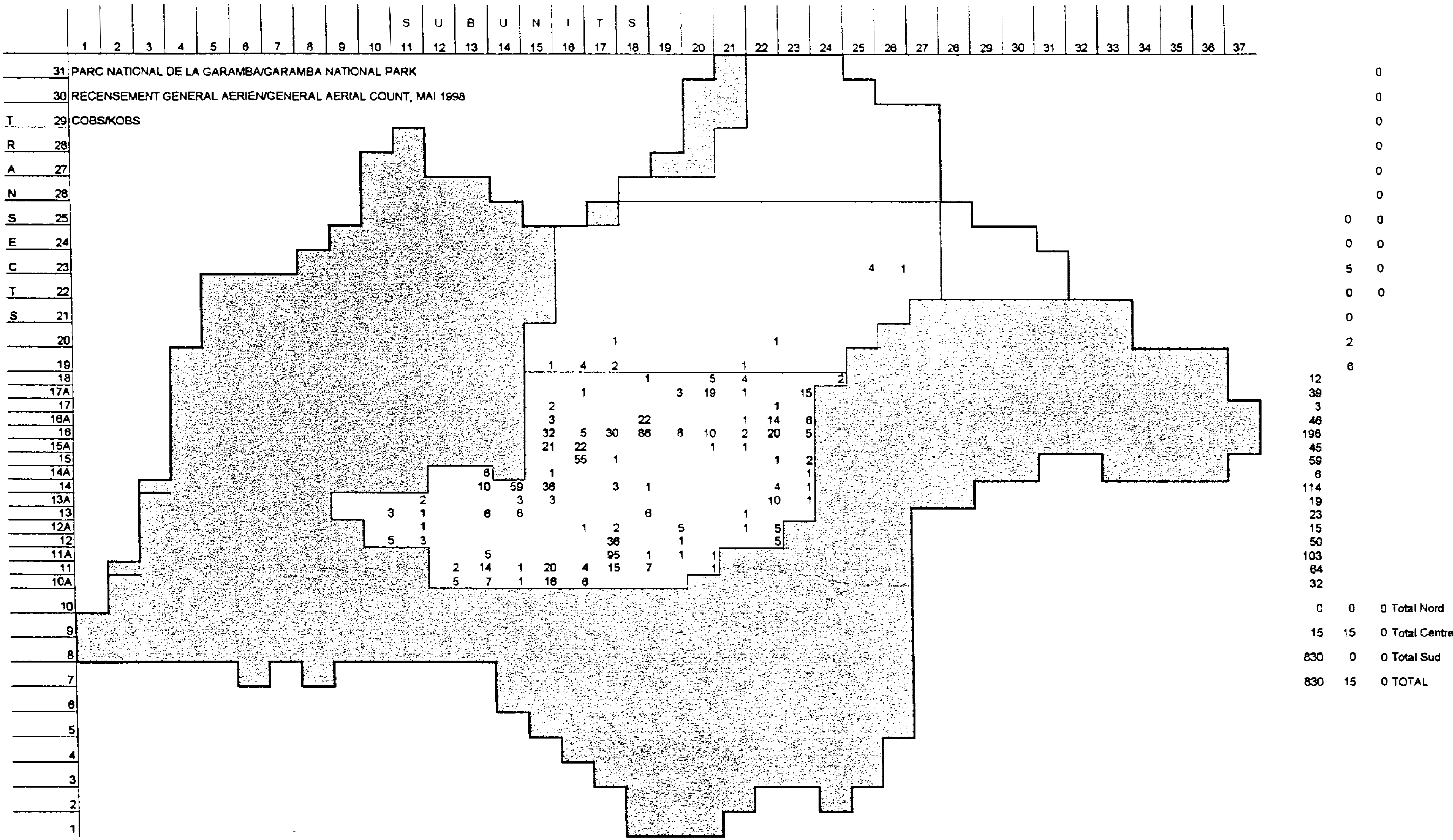
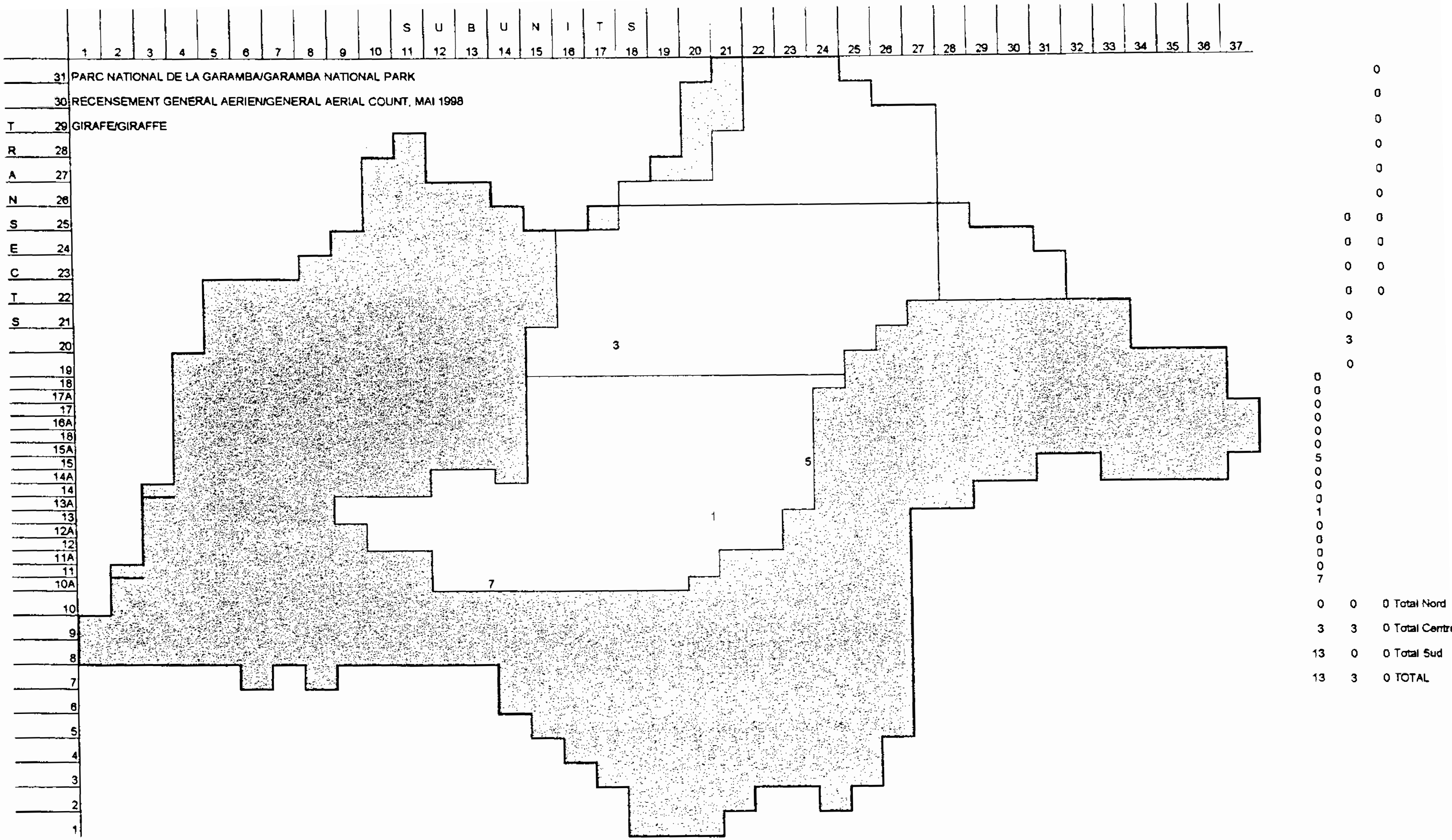
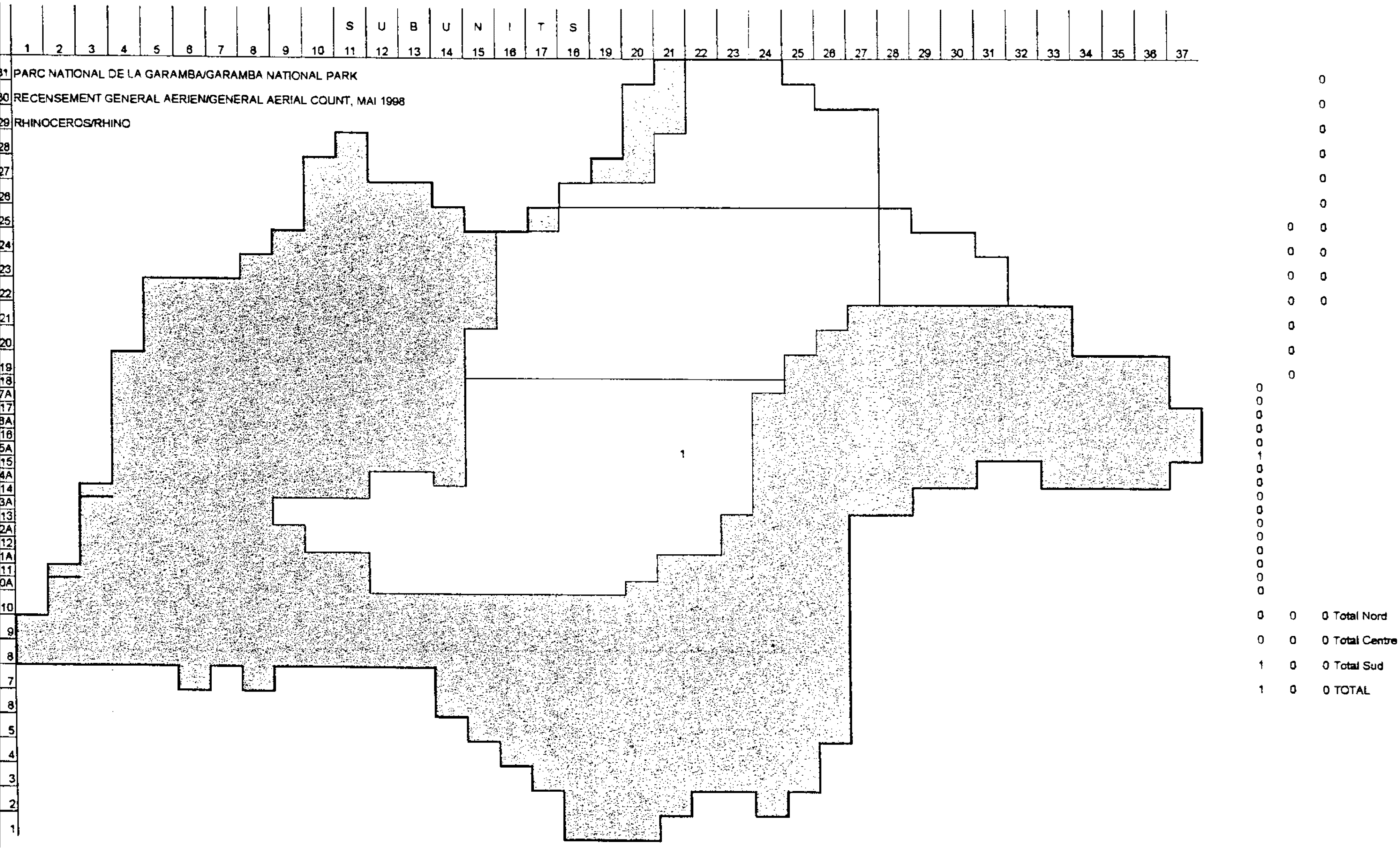
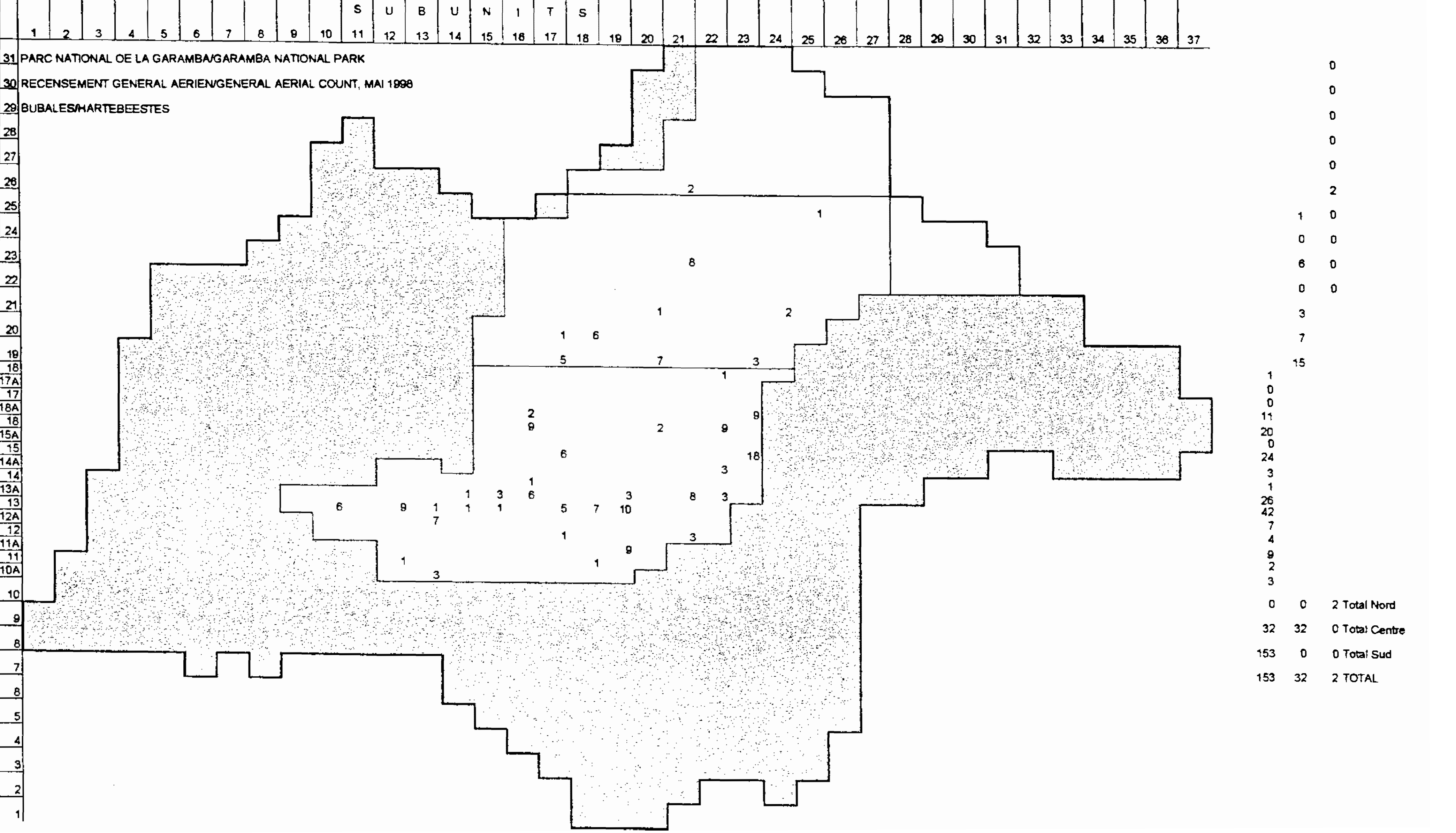

PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998
COBS/KOBS
SUBUNITS
TRANSECTS
0 0 0 Total Nord
15 15 0 Total Centre
830 0 0 Total Sud
830 15 0 TOTAL

Annexe 5.15

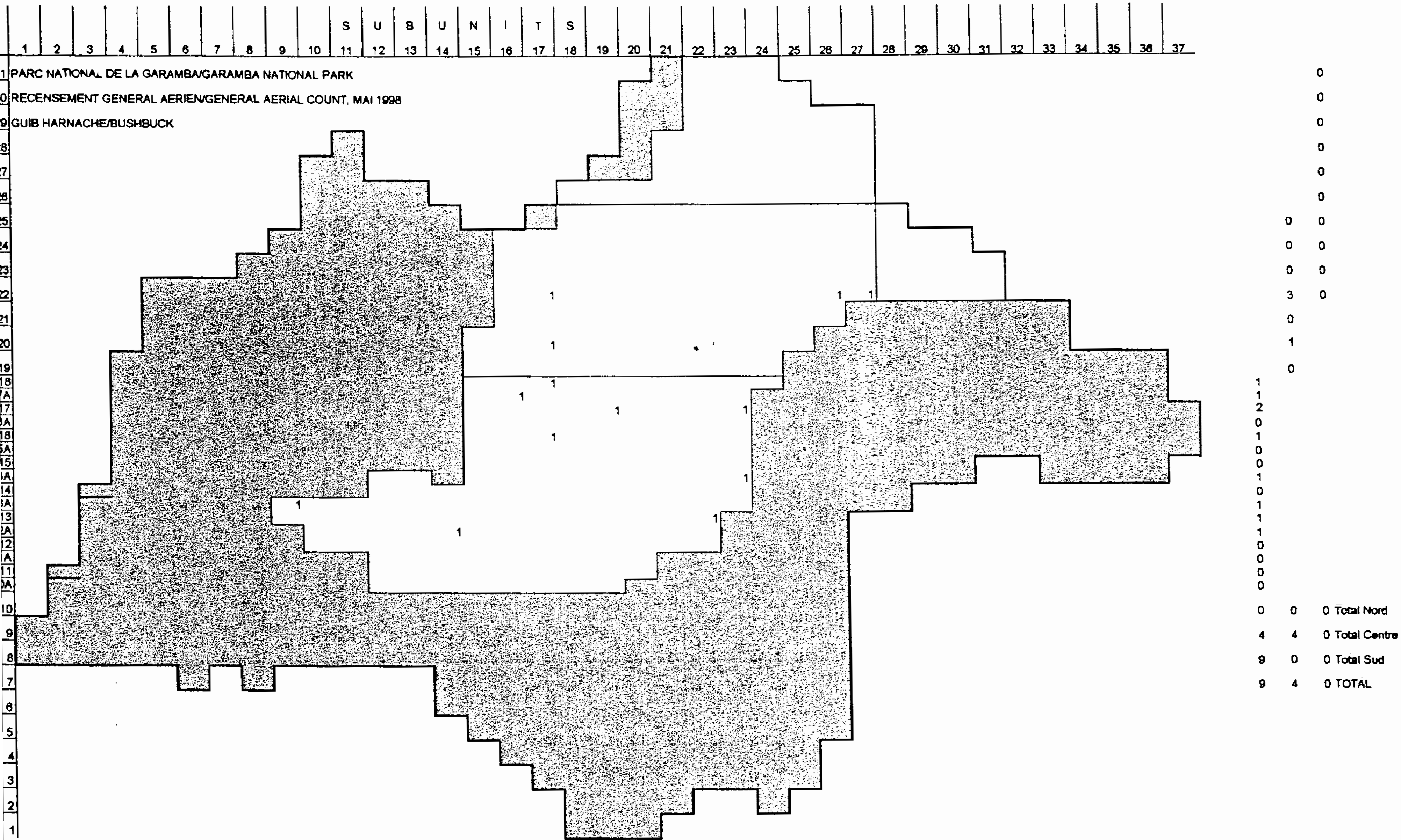


PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998
GIRAFE/GIRAFFE
SUBUNITS
TRANSECTS
0 0 0 Total Nord
3 3 0 Total Centr
13 0 0 Total Sud
13 3 0 TOTAL


SUBUNITS
PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998
RHINOCEROS/RHINO
1
0 0 0 Total Nord
0 0 0 Total Centre
1 0 0 Total Sud
1 0 0 TOTAL

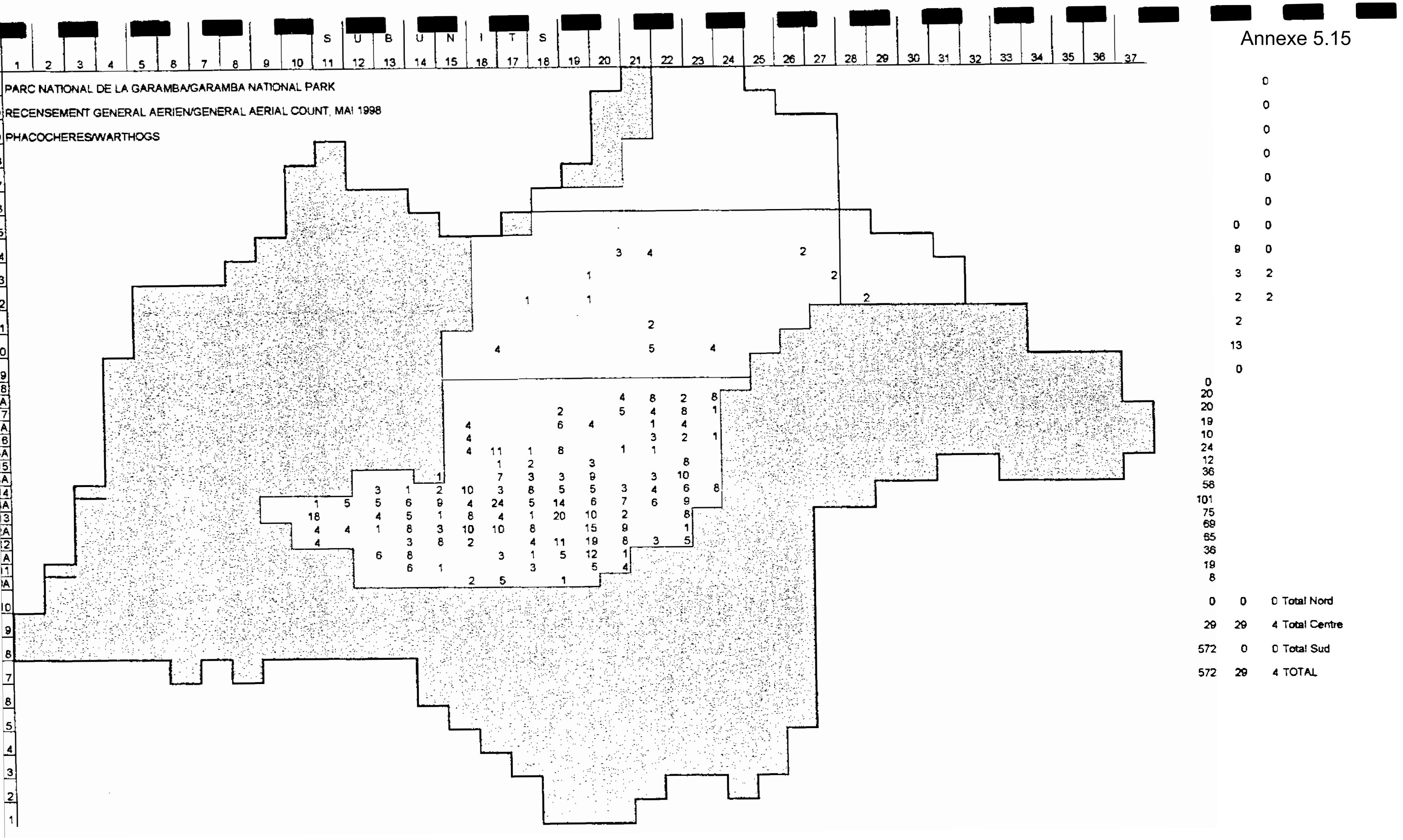

PARC NATIONAL OE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998
BUBALES/HARTEBEESTES
S U B U N I T S
0 0 2 Total Nord
32 32 0 Total Centre
153 0 0 Total Sud
153 32 2 TOTAL

Annexe 5.15

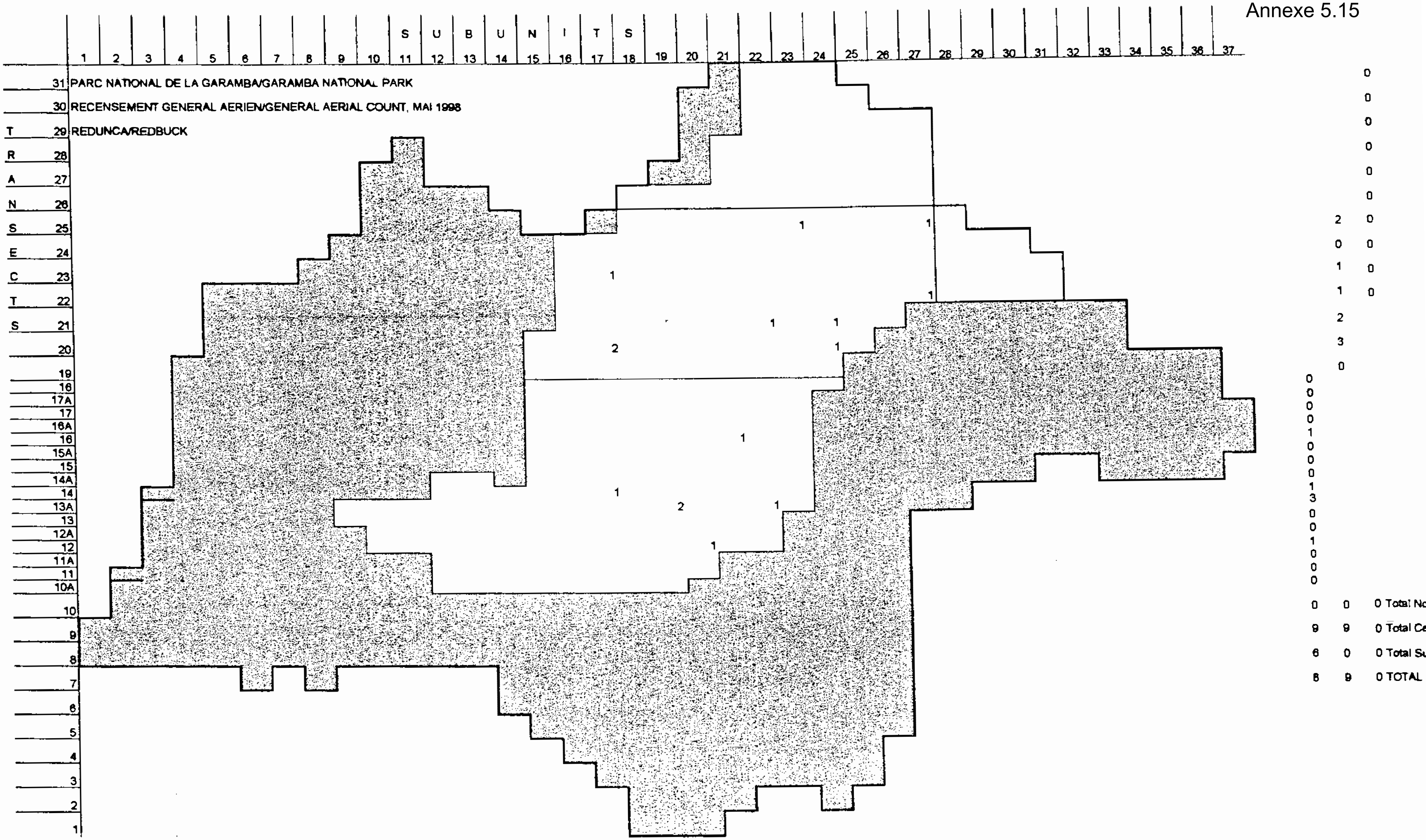


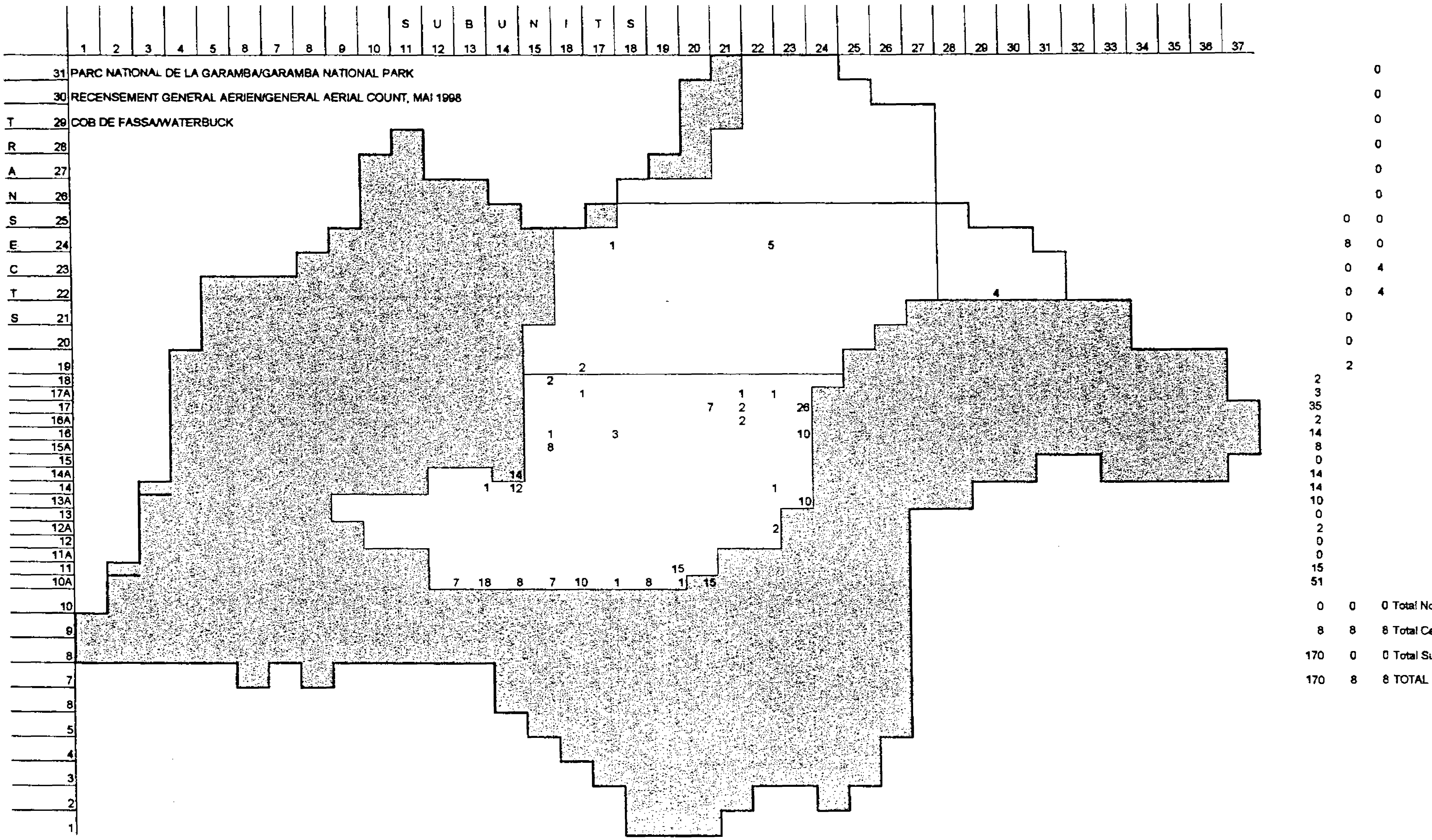
SUBUNITS
PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998
GUIB HARNACHE/BUSHBUCK
0 0 0 Total Nord
4 4 0 Total Centre
9 0 0 Total Sud
9 4 0 TOTAL

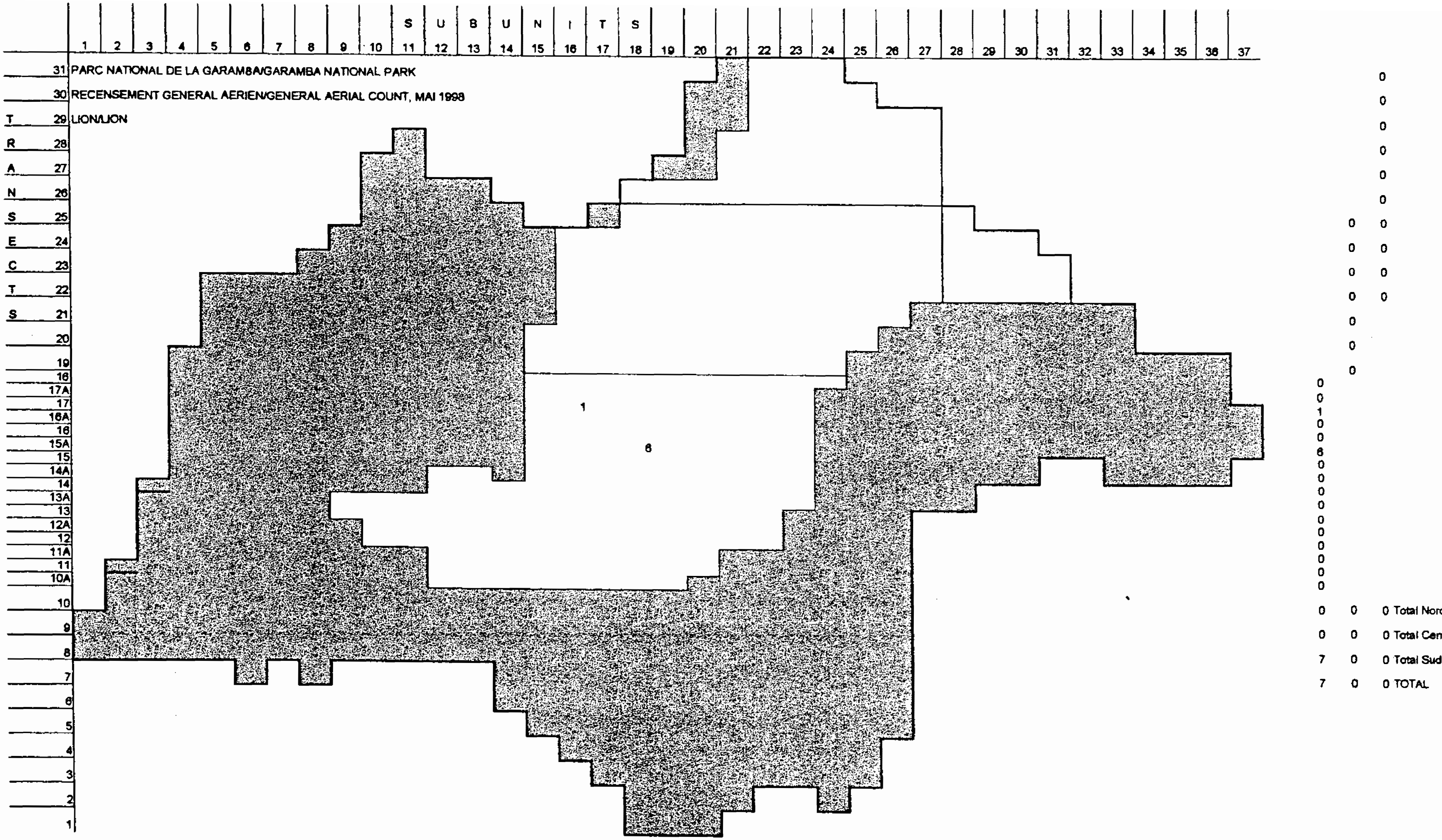
Annexe 5.15



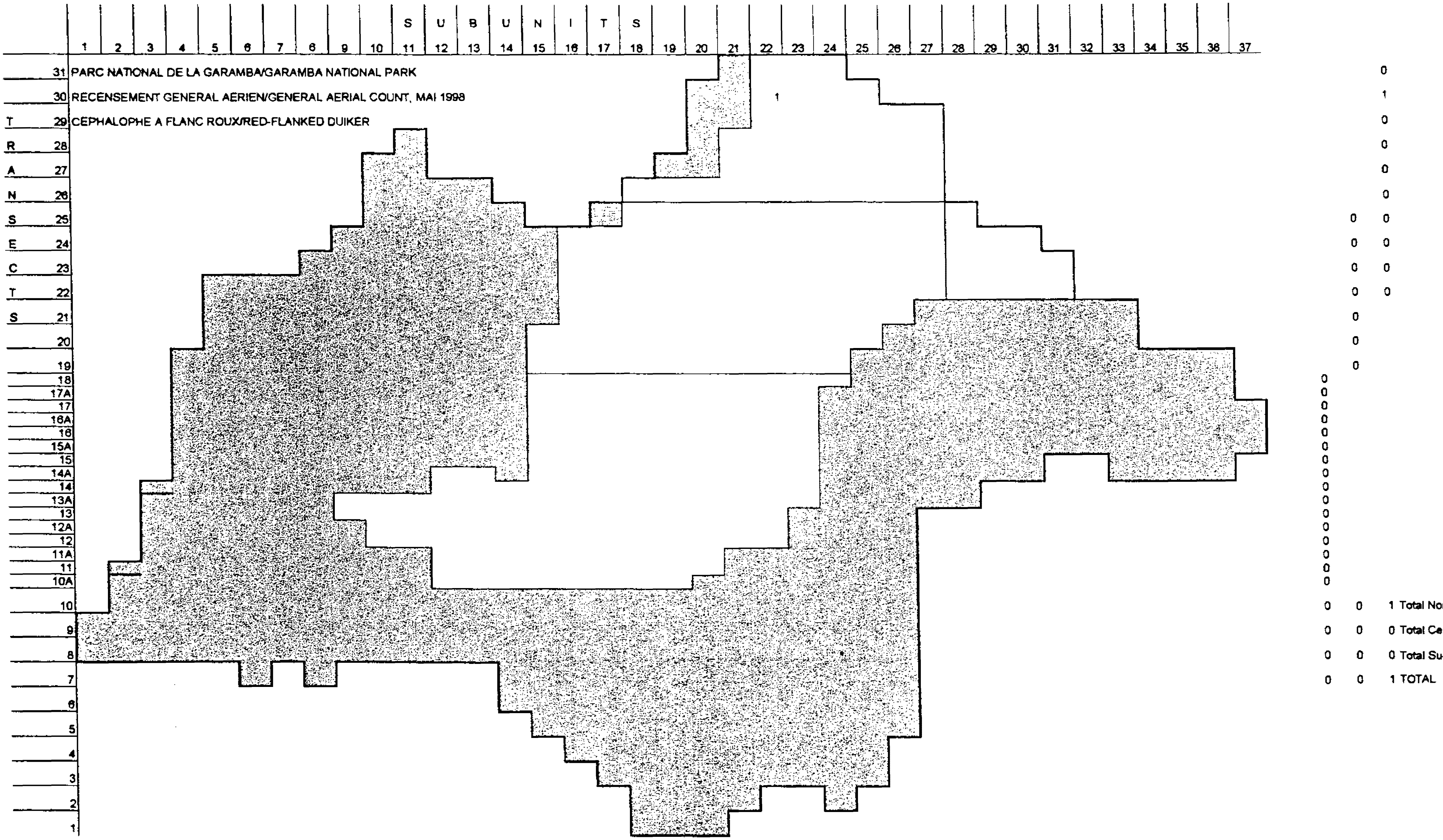
PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998
PHACOCHERES/WARTHOGS
S U B U N I T S
0 0 0 Total Nord
29 29 4 Total Centre
572 0 0 Total Sud
572 29 4 TOTAL


PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998
REDUNCA/REDBUCK
S U B U N I T S
T R A N S E C T S
0 Total No
9 9 0 Total Ce
6 0 0 Total Su
8 9 0 TOTAL

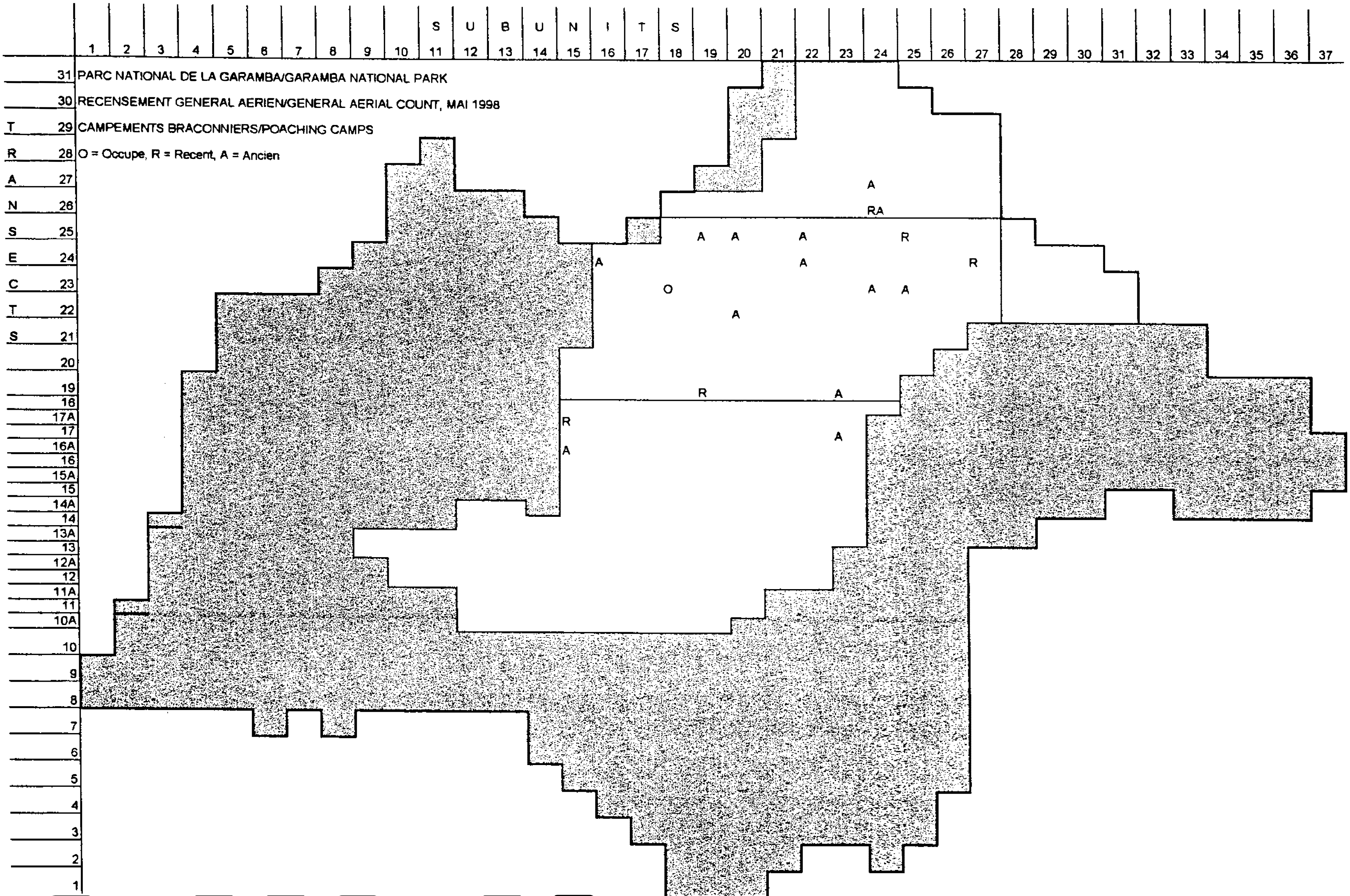

PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998
COB DE FASSA/WATERBUCK
SUBUNITS
TRANSECTS
0 0 0 Total Nc
8 8 8 Total Ce
170 0 0 Total Su
170 8 8 TOTAL



PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998
LION/LION
SUBUNITS
TRANSECTS
1
6
0 0 0 Total Nor
0 0 0 Total Cen
7 0 0 Total Sud
7 0 0 TOTAL


SUBUNITS
TRANSECTS
PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998
CEPHALOPHE A FLANC ROUX/RED-FLANKED DUIKER
1 Total No
0 Total Ce
0 Total Su
1 TOTAL

Annexe 5.15



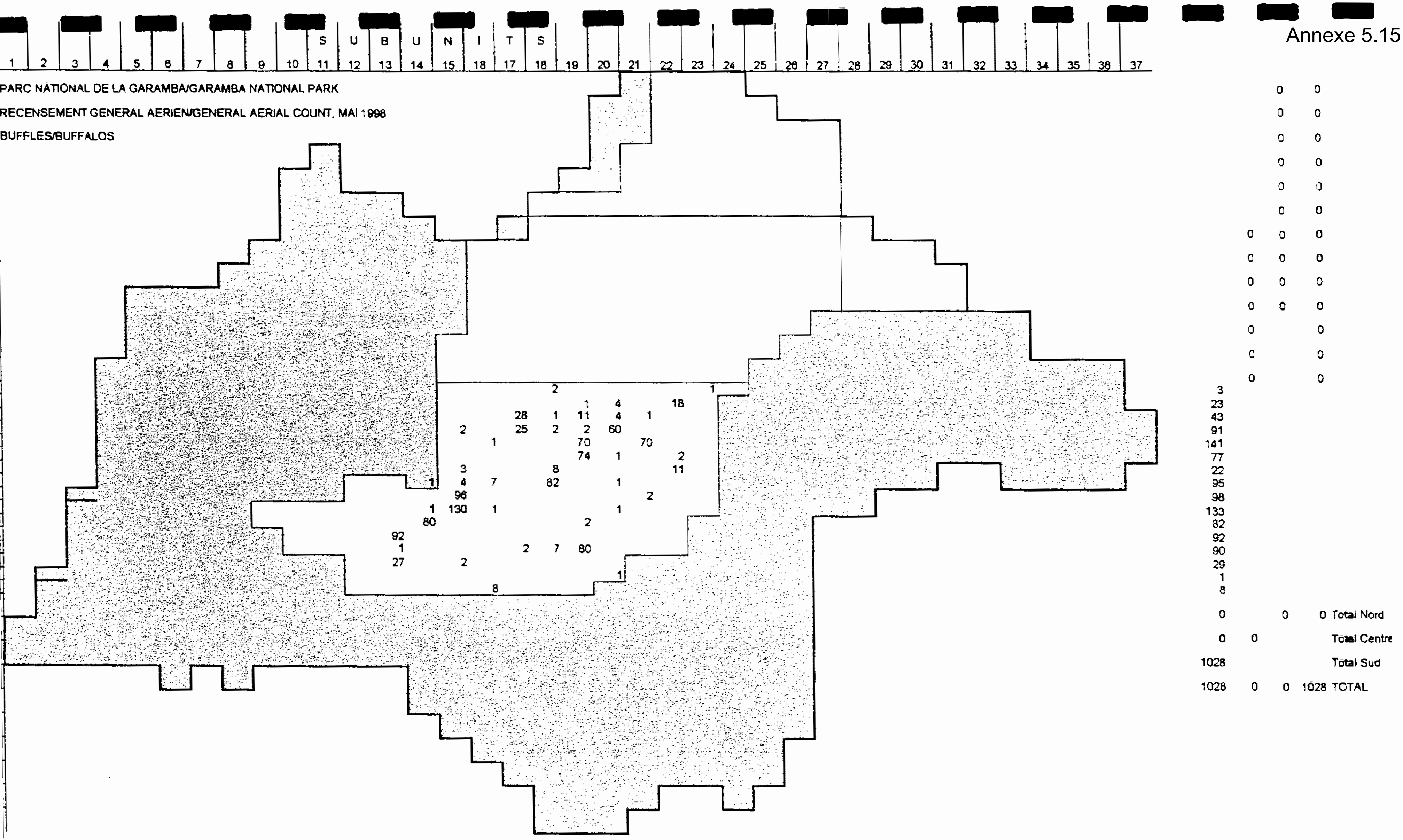
S U B U N I T S
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37
T R A N S E C T S
31 30 29 28 27 26 25 24 23 22 21 20 19 18 17A 17 16A 16 15A 15 14A 14 13A 13 12A 12 11A 11 10A 10 9 8 7 6 5 4 3 2 1
PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998
CAMPEMENTS BRACONNIERS/POACHING CAMPS
O = Occupe, R = Recent, A = Ancien

Annexe 5.15

PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK

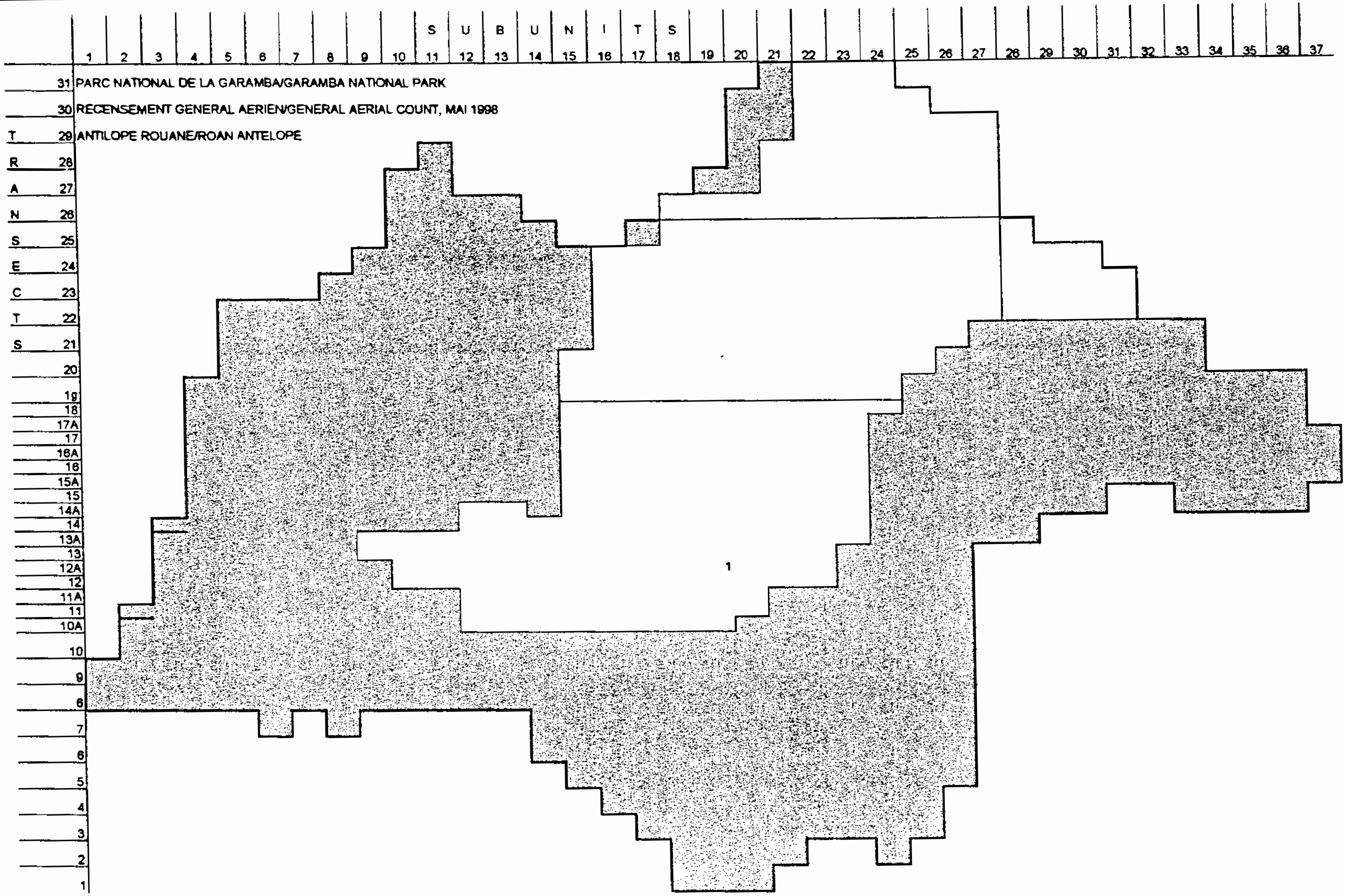
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998

BUFFLES/BUFFALOS




| | | | | |
|---|---|---|---|---|
| 0 | | 0 | 0 | Total Nord |
| 0 | 0 | | | Total Centre |
| 1028 | | | | Total Sud |
| 1028 | 0 | 0 | 1028 | TOTAL |

Annexe 5.15




| | | | | |
|---|---|---|---|---|
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
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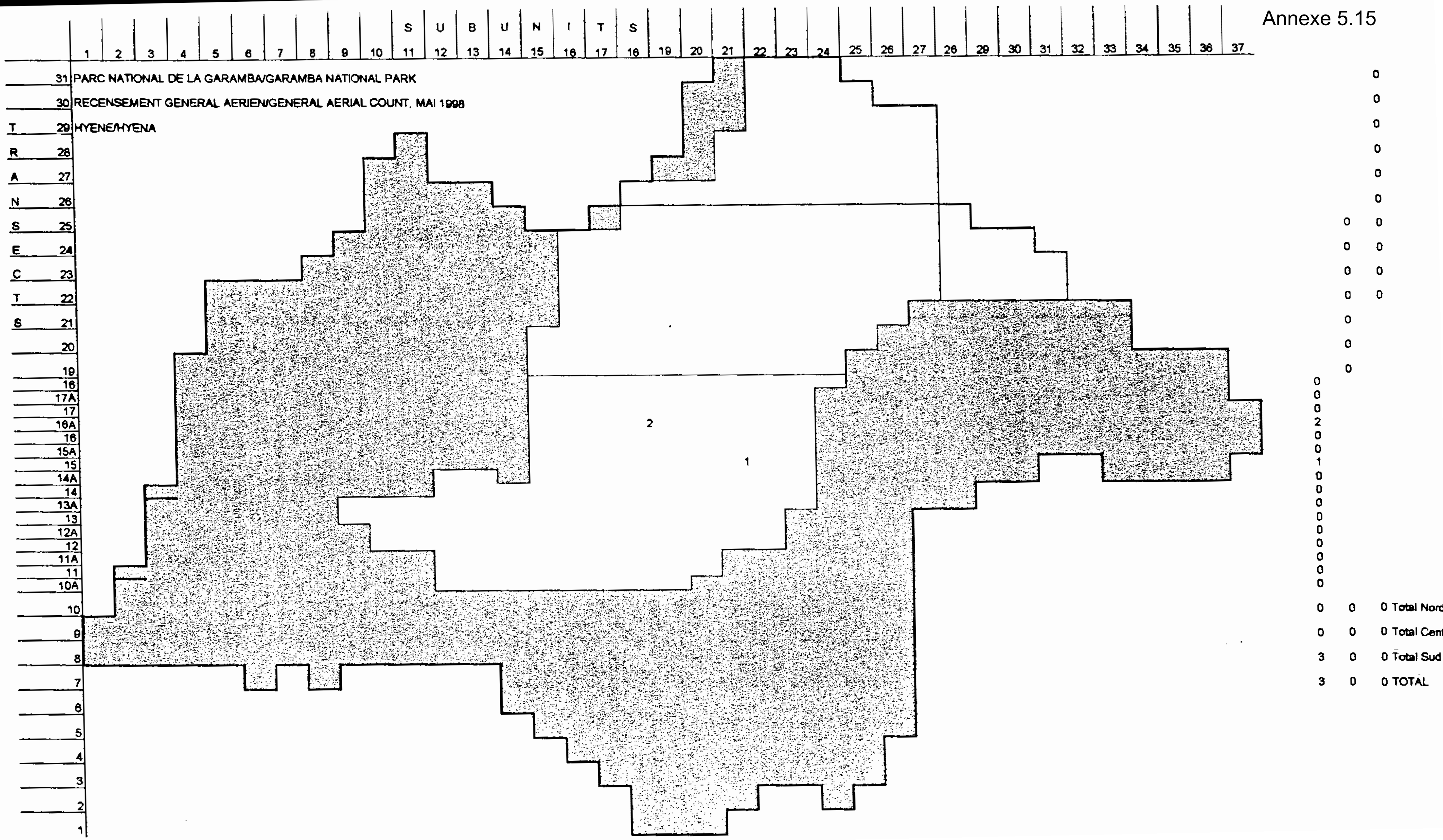
| 1 | | | | |
| 0 | | | | |
| 0 | | | | |
| 0 | | | | |
| 0 | | | | |
| 0 | | 0 | 0 | Total |
| 0 | 0 | | | Total |
| 1 | | | | Total |
| 1 | 0 | 0 | 1 | TOTA |

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

| | 1998 | AREA | | | GIRAFES | | | | | HIPPOPOTHAMES | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MID NTH | LO | | | MID NTH | LOW N | | TOTAL | HIGH STI | MID NTH | LOW NTH | TOT NTH | TOTAL |
| 31 | | | 7.39 | 7.39 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 6.57 | 6.57 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 10.57 | 10.57 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 11.33 | 11.33 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 11.83 | 11.83 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 16.37 | 16.37 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 16.48 | 1.64 | 18.12 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 19.82 | 4.98 | 24.80 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 18.62 | 13.30 | 31.92 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 18.07 | 6.62 | 24.69 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 18.34 | | 18.34 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 19.93 | | 19.93 | | 3 | | 3 | | | 0 | | 0 | |
| 19 | | 15.82 | | 15.82 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 18.40 | | | | 0 | | | | | 0 | | | | |
| 17a | 17.19 | | | | 0 | | | | | 0 | | | | |
| 17 | 17.96 | | | | 0 | | | | | 4 | | | | |
| 16a | 14.51 | | | | 0 | | | | | 1 | | | | |
| 16 | 15.06 | | | | 0 | | | | | 0 | | | | |
| 15a | 15.11 | | | | 0 | | | | | 11 | | | | |
| 15 | 14.84 | | | | 5 | | | | | 4 | | | | |
| 14a | 19.27 | | | | 0 | | | | | 18 | | | | |
| 14 | 20.37 | | | | 0 | | | | | 10 | | | | |
| 13a | 25.79 | | | | 0 | | | | | 1 | | | | |
| 13 | 24.47 | | | | 1 | | | | | 2 | | | | |
| 12a | 23.32 | | | | 0 | | | | | 28 | | | | |
| 12 | 19.87 | | | | 0 | | | | | 7 | | | | |
| 11a | 15.66 | | | | 0 | | | | | 8 | | | | |
| 11 | 14.78 | | | | 0 | | | | | 7 | | | | |
| 10a | 12.76 | | | | 7 | | | | | 3 | | | | |
| Total | 289.4 | 127.1 | 64.1 | 217.7 | 13.0 | 3.0 | 0.0 | 3.0 | . | 104.0 | 0.0 | 0.0 | 0.0 | |
| Sum squ | 5457.7 | 2321.3 | 745.7 | 4301.7 | 75.0 | 9.0 | 0.0 | 9.0 | | 1538.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Sum (Z*y) | 188.0 | 59.8 | 0.0 | 59.8 | | 1996.4 | 0.0 | 0.0 | 0.0 | |
| | | | | R=δy/δz | 0.0 | 0.0 | 0.0 | 0.0 | | 0.4 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 4.3 | 1.3 | 0.0 | 0.7 | | 57.5 | 0.0 | 0.0 | 0.0 | |
| Var z | 15.0 | 2.4 | 12.4 | 54.7 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | -3.1 | -0.8 | 0.0 | 0.5 | TOTAL | 7.7 | 0.0 | 0.0 | 0.0 | TOTAL |
| | | | | | **GIRAFES** | | | | | **HIPPOPOTHAMES** | | | | |
| | | | | **Pop.est.(Y)** | **98.3** | **46.0** | **0.0** | **43.4** | **144.3** | **786.2** | **0.0** | **0.0** | **0.0** | **786.2** |
| | | | | SE(Y) | 60.5 | 41.3 | 0.0 | 43.5 | 73.2 | 206.8 | 0.0 | 0.0 | 0.0 | 206.8 |
| | | | | 95% C.L. | 123.4 | 84.2 | 0.0 | 88.8 | 143.6 | 421.9 | 0.0 | 0.0 | 0.0 | 405.3 |
| | | | | 95% C.L.as % | 125.6 | 183.0 | ERR | 204.5 | 99.5 | 53.7 | ERR | ERR | ERR | 51.6 |

Annexe 5.15


PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 1998
HYENE/HYENA
SUBUNITS
TRANSECTS
2
1
0 0 0 Total Nord
0 0 0 Total Cent
3 0 0 Total Sud
3 0 0 TOTAL

| TRANS | 1998 AREA HIGH STH | MID NTH | LOW NTH | TOT.NORTH | COBES DE THOMAS HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL | PHACOCHERES HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | | | 7.39 | 7.39 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 6.57 | 6.57 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 10.57 | 10.57 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 11.33 | 11.33 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 11.83 | 11.83 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 16.37 | 16.37 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 16.48 | 1.64 | 18.12 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 19.82 | 4.98 | 24.80 | | 0 | 0 | 0 | | | 9 | 0 | 9 | |
| 23 | | 18.62 | 13.30 | 31.92 | | 5 | 0 | 5 | | | 3 | 2 | 5 | |
| 22 | | 18.07 | 6.62 | 24.69 | | 0 | 0 | 0 | | | 2 | 2 | 4 | |
| 21 | | 18.34 | | 18.34 | | 0 | | 0 | | | 2 | | 2 | |
| 20 | | 19.93 | | 19.93 | | 2 | | 2 | | | 13 | | 13 | |
| 19 | | 15.82 | | 15.82 | | 8 | | 8 | | | 0 | | 0 | |
| | 18.40 | | | | 12 | | | | | 0 | | | | |
| | 17.19 | | | | 39 | | | | | 20 | | | | |
| 17 | 17.96 | | | | 3 | | | | | 20 | | | | |
| 16a | 14.51 | | | | 46 | | | | | 19 | | | | |
| 16 | 15.06 | | | | 198 | | | | | 10 | | | | |
| 15a | 15.11 | | | | 45 | | | | | 24 | | | | |
| 15 | 14.84 | | | | 59 | | | | | 12 | | | | |
| 14a | 19.27 | | | | 8 | | | | | 36 | | | | |
| 14 | 20.37 | | | | 114 | | | | | 58 | | | | |
| 13a | 25.79 | | | | 19 | | | | | 101 | | | | |
| 13 | 24.47 | | | | 23 | | | | | 75 | | | | |
| 12a | 23.32 | | | | 15 | | | | | 69 | | | | |
| 12 | 19.87 | | | | 50 | | | | | 65 | | | | |
| 11a | 15.66 | | | | 103 | | | | | 36 | | | | |
| 11 | 14.78 | | | | 64 | | | | | 19 | | | | |
| 10a | 12.76 | | | | 32 | | | | | 8 | | | | |
| Total | 289.4 | 127.1 | 64.1 | 217.7 | 830.0 | 15.0 | 0.0 | 15.0 | | 572.0 | 29.0 | 0.0 | 33.0 | |
| Sum squ | 5457.7 | 2321.3 | 745.7 | 4301.7 | 80904.0 | 93.0 | 0.0 | 93.0 | | 33174.0 | 267.0 | 0.0 | 295.0 | |
| | | | | Sum (Z*y) | 13988.6 | 259.5 | 0.0 | 326.0 | | 11832.8 | 566.1 | 0.0 | 777.3 | |
| | | | | R=õy/õz | 2.9 | 0.1 | 0.0 | 0.1 | | 2.0 | 0.2 | 0.0 | 0.2 | |
| | | | | Var y | 2523.2 | 10.1 | 0.0 | 6.3 | | 848.3 | 24.5 | 0.0 | 17.6 | |
| Var z | 15.0 | 2.4 | 12.4 | 54.7 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | -68.1 | -11.6 | 0.0 | 4.9 | TOTAL | 99.2 | -9.6 | 0.0 | 16.2 | TOTAL |
| | | | | | COBES DE THOMAS | | | | | PHACOCHERES | | | | |
| | | | | **Pop.est.(Y)** | **6275** | **230** | **0** | **217** | **6505** | **4324** | **445** | **0** | **478** | **4769** |
| | | | | SE(Y) | 1553 | 129 | 0 | 125 | 1558 | 639 | 193 | 0 | 188 | 668 |
| | | | | 95% C.L. | 3168 | 263 | 0 | 256 | 3054 | 1304 | 394 | 0 | 384 | 1309 |
| | | | | 95% C.L.as % | 50 | 114 | ERR | 118 | 47 | 30 | 89 | ERR | 80 | 27 |

| | AREA | | | | ELEPHANTS | | | | | BUFFLES | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STI | MID NTH | LOW NTH | TOT NORTH | HIGH STI | MID NTH | LOW NTH | TOT NTH | TOTAL | HIGH STI | MID NTH | LOW NTH | TOT NTH | TOTAL |
| 31 | | | 7.39 | 7.39 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 6.57 | 6.57 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 10.57 | 10.57 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 11.33 | 11.33 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 11.83 | 11.83 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 16.37 | 16.37 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 16.48 | 1.64 | 18.12 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 19.82 | 4.98 | 24.80 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 18.62 | 13.30 | 31.92 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 18.07 | 6.62 | 24.69 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 18.34 | | 18.34 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 19.93 | | 19.93 | | 0 | | 0 | | | 0 | | 0 | |
| 19 | | 15.82 | | 15.82 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 18.40 | | | | 0 | | | | | 3 | | | | |
| 17a | 17.19 | | | | 0 | | | | | 23 | | | | |
| 17 | 17.96 | | | | 13 | | | | | 43 | | | | |
| 16a | 14.51 | | | | 61 | | | | | 91 | | | | |
| 16 | 15.06 | | | | 14 | | | | | 141 | | | | |
| 15a | 15.11 | | | | 48 | | | | | 77 | | | | |
| 15 | 14.84 | | | | 49 | | | | | 22 | | | | |
| 14a | 19.27 | | | | 91 | | | | | 95 | | | | |
| 14 | 20.37 | | | | 202 | | | | | 98 | | | | |
| 13a | 25.79 | | | | 88 | | | | | 133 | | | | |
| 13 | 24.47 | | | | 84 | | | | | 82 | | | | |
| 12a | 23.32 | | | | 55 | | | | | 92 | | | | |
| 12 | 19.87 | | | | 31 | | | | | 90 | | | | |
| 11a | 15.66 | | | | 33 | | | | | 29 | | | | |
| 11 | 14.78 | | | | 8 | | | | | 1 | | | | |
| 10a | 12.76 | | | | 0 | | | | | 8 | | | | |
| Total | 289.4 | 127.1 | 64.1 | 217.7 | 777.0 | 0.0 | 0.0 | 0.0 | | 1028.0 | 0.0 | 0.0 | 0.0 | |
| Sum squ | 5457.7 | 2321.3 | 745.7 | 4301.7 | 77815.0 | 0.0 | 0.0 | 0.0 | | 97474.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Sum (Z*y) | 15508.4 | 0.0 | 0.0 | 0.0 | | 19924.7 | 0.0 | 0.0 | 0.0 | |
| | | | | R=Sy/Sz | 2.7 | 0.0 | 0.0 | 0.0 | | 3.6 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 2672.1 | 0.0 | 0.0 | 0.0 | | 2095.0 | 0.0 | 0.0 | 0.0 | |
| Var z | 15.0 | 2.4 | 12.4 | 54.7 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | 97.1 | 0.0 | 0.0 | 0.0 | TOTAL | 88.9 | 0.0 | 0.0 | 0.0 | TOTAL |
| | | | | | ELEPHANTS | | | | | BUFFLES | | | | |
| | | | | Pop.est.(Y) | **5,874** | **0** | **0** | **0** | **5,874** | **7,772** | **0** | **0** | **0** | **7,772** |
| | | | | SE(Y) | 1339.2 | 0.0 | 0.0 | 0.0 | 1339.2 | 2062.8 | 0.0 | 0.0 | 0.0 | 2062.85 |
| | | | | 95% C.L. | 2732.0 | 0.0 | 0.0 | 0.0 | 2624.9 | 4208.2 | 0.0 | 0.0 | 0.0 | 4043.18 |
| | | | | 95% C.L.as % | 46.5 | 0.0 | 0.0 | 0.0 | 44.7 | 54.1 | ERR | ERR | ERR | 52.02 |

| | 1998 | AREA | | | ANTILOPE ROANNE | | | | | GUIB HARNACHE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH ST | MID NTH | LOW NTH | TOT.NORTH | HIGH ST | MID NTH | LOW NTH | TOT.NTH | TOTAL | HIGH ST | MID NTH | LOW NTH | TOT.NTH | TOTAL |
| 31 | | | 7.39 | 7.39 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 6.57 | 6.57 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 10.57 | 10.57 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 11.33 | 11.33 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 11.83 | 11.83 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 16.37 | 16.37 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 16.48 | 1.64 | 18.12 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 19.82 | 4.98 | 24.80 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 18.62 | 13.30 | 31.92 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 18.07 | 6.62 | 24.69 | | 0 | 0 | 0 | | | 3 | 0 | 3 | |
| 21 | | 18.34 | | 18.34 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 19.93 | | 19.93 | | 0 | | 0 | | | 1 | | 1 | |
| 19 | | 15.82 | | 15.82 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 18.40 | | | | 0 | | | | | 1 | | | | |
| 17a | 17.19 | | | | 0 | | | | | 1 | | | | |
| 17 | 17.96 | | | | 0 | | | | | 2 | | | | |
| 16a | 14.51 | | | | 0 | | | | | 0 | | | | |
| 16 | 15.06 | | | | 0 | | | | | 1 | | | | |
| 15a | 15.11 | | | | 0 | | | | | 0 | | | | |
| 15 | 14.84 | | | | 0 | | | | | 0 | | | | |
| 14a | 19.27 | | | | 0 | | | | | 1 | | | | |
| 14 | 20.37 | | | | 0 | | | | | 0 | | | | |
| 13a | 25.79 | | | | 0 | | | | | 1 | | | | |
| 13 | 24.47 | | | | 0 | | | | | 1 | | | | |
| 12a | 23.32 | | | | 1 | | | | | 1 | | | | |
| 12 | 19.87 | | | | 0 | | | | | 0 | | | | |
| 11a | 15.66 | | | | 0 | | | | | 0 | | | | |
| 11 | 14.78 | | | | 0 | | | | | 0 | | | | |
| 10a | 12.76 | | | | 0 | | | | | 0 | | | | |
| Total | 289.4 | 127.1 | 64.1 | 217.7 | 1.0 | 0.0 | 0.0 | 0.0 | | 9.0 | 4.0 | 0.0 | 4.0 | |
| Sum squ | 5457.7 | 2321.3 | 745.7 | 4301.7 | 1.0 | 0.0 | 0.0 | 0.0 | | 11.0 | 10.0 | 0.0 | 10.0 | |
| | | | | Sum (Z*y) | 23.3 | 0.0 | 0.0 | 0.0 | | 179.4 | 74.1 | 0.0 | 94.0 | |
| | | | | R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 0.1 | 0.0 | 0.0 | 0.0 | | 0.4 | 1.3 | 0.0 | 0.7 | |
| Var z | 15.0 | 2.4 | 12.4 | 54.7 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | 0.3 | 0.0 | 0.0 | 0.0 | TOTAL | 1.1 | -2.1 | 0.0 | 1.9 | TOTAL |
| | | | | | **ANTILOPPE ROANNE** | | | | | **GUIB HARNACHE** | | | | |
| | | | | **Pop.est.(Y)** | **8** | **0** | **0** | **0** | **8** | **68** | **61** | **0** | **58** | **187** |
| | | | | SE(Y) | 7 | 0 | 0 | 0 | 7 | 16 | 43 | 0 | 43 | 46 |
| | | | | 95% C.L. | 14 | 0 | 0 | 0 | 14 | 34 | 87 | 0 | 87 | 90 |
| | | | | 95% C.L.as % | 187 | ERR | ERR | ERR | 179 | 49 | 142 | ERR | 151 | 48 |

Annexe 5.15

| | AREA | | | | BUBALES | | | | | WATERBUCK | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | IGH ST | MID [illegible] | [illegible] | [illegible] | [illegible] | MID NTH | LOW NT | TOT NTH | TOTAL | HIGH ST | MID NTH | LOW NTH | TOT [illegible] | TOTAL |
| 31 | | | 7.39 | 7.39 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 6.57 | 6.57 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 10.57 | 10.57 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 11.33 | 11.33 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 11.83 | 11.83 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 16.37 | 16.37 | | | 2 | 2 | | | | 0 | 0 | |
| 25 | | 16.48 | 1.64 | 18.12 | | 1 | 0 | 1 | | | 0 | 0 | 0 | |
| 24 | | 19.82 | 4.98 | 24.80 | | 0 | 0 | 0 | | | 6 | 0 | 6 | |
| 23 | | 18.62 | 13.30 | 31.92 | | 6 | 0 | 6 | | | 0 | 4 | 4 | |
| 22 | | 18.07 | 6.62 | 24.69 | | 0 | 0 | 0 | | | 0 | 4 | 4 | |
| 21 | | 18.34 | | 18.34 | | 3 | | 3 | | | 0 | | 0 | |
| 20 | | 19.93 | | 19.93 | | 7 | | 7 | | | 0 | | 0 | |
| 19 | | 15.82 | | 15.82 | | 15 | | 15 | | | 2 | | 2 | |
| 18 | 18.40 | | | | 1 | | | | | 2 | | | | |
| 17a | 17.19 | | | | 0 | | | | | 3 | | | | |
| 17 | 17.96 | | | | 0 | | | | | 35 | | | | |
| 16a | 14.51 | | | | 11 | | | | | 2 | | | | |
| 16 | 15.06 | | | | 20 | | | | | 14 | | | | |
| 15a | 15.11 | | | | 0 | | | | | 8 | | | | |
| 15 | 14.84 | | | | 24 | | | | | 0 | | | | |
| 14a | 19.27 | | | | 3 | | | | | 14 | | | | |
| 14 | 20.37 | | | | 1 | | | | | 8 | | | | |
| 13a | 25.79 | | | | 26 | | | | | 10 | | | | |
| 13 | 24.47 | | | | 42 | | | | | 0 | | | | |
| 12a | 23.32 | | | | 7 | | | | | 2 | | | | |
| 12 | 19.87 | | | | 4 | | | | | 0 | | | | |
| 11a | 15.66 | | | | 9 | | | | | 0 | | | | |
| 11 | 14.78 | | | | 2 | | | | | 15 | | | | |
| 10a | 12.76 | | | | 3 | | | | | 51 | | | | |
| Total | 289.4 | 127.1 | 64.1 | 217.7 | 153.0 | 32.0 | 2.0 | 34.0 | | 164.0 | 8.0 | 0.0 | 16.0 | |
| Sum squ | 5457.7 | 2321.3 | 745.7 | 4301.7 | 3707.0 | 320.0 | 4.0 | 324.0 | | 4692.0 | 40.0 | 0.0 | 72.0 | |
| | | | | Sum (Z*y) | 3063.3 | 560.0 | 32.7 | 674.2 | | 2687.2 | 150.6 | 0.0 | 406.9 | |
| | | | | R=δy/δz | 0.5 | 0.3 | 0.0 | 0.2 | | 0.6 | 0.1 | 0.0 | 0.1 | |
| | | | | Var y | 149.6 | 29.0 | 0.7 | 19.6 | | 200.7 | 5.1 | 0.0 | 4.4 | |
| Var z | 15.0 | 2.4 | 12.4 | 54.7 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | 19.8 | -23.5 | 2.2 | 5.2 | TOTAL | -18.6 | -3.8 | 0.0 | 10.6 | TOTAL |
| | | | | | **BUBALES** | | | | | **WATERBUCK** | | | | |
| | | | | **Pop.est.(Y)** | **1,156.7** | **491.0** | **37.5** | **492.0** | **1,685.2** | **1,239.8** | **122.8** | **0.0** | **231.5** | **1,362.6** |
| | | | | SE(Y) | 324.9 | 229.8 | 18.0 | 223.8 | 398.3 | 424.2 | 85.2 | 0.0 | 88.4 | 432.7 |
| | | | | 95% C.L. | 662.7 | 468.8 | 36.7 | 456.5 | 780.7 | 865.4 | 173.8 | 0.0 | 180.3 | 848.0 |
| | | | | 95% C.L.as % | 57.3 | 95.5 | 98.0 | 92.8 | 46.3 | 69.8 | 141.5 | ERR | 77.9 | 62.2 |

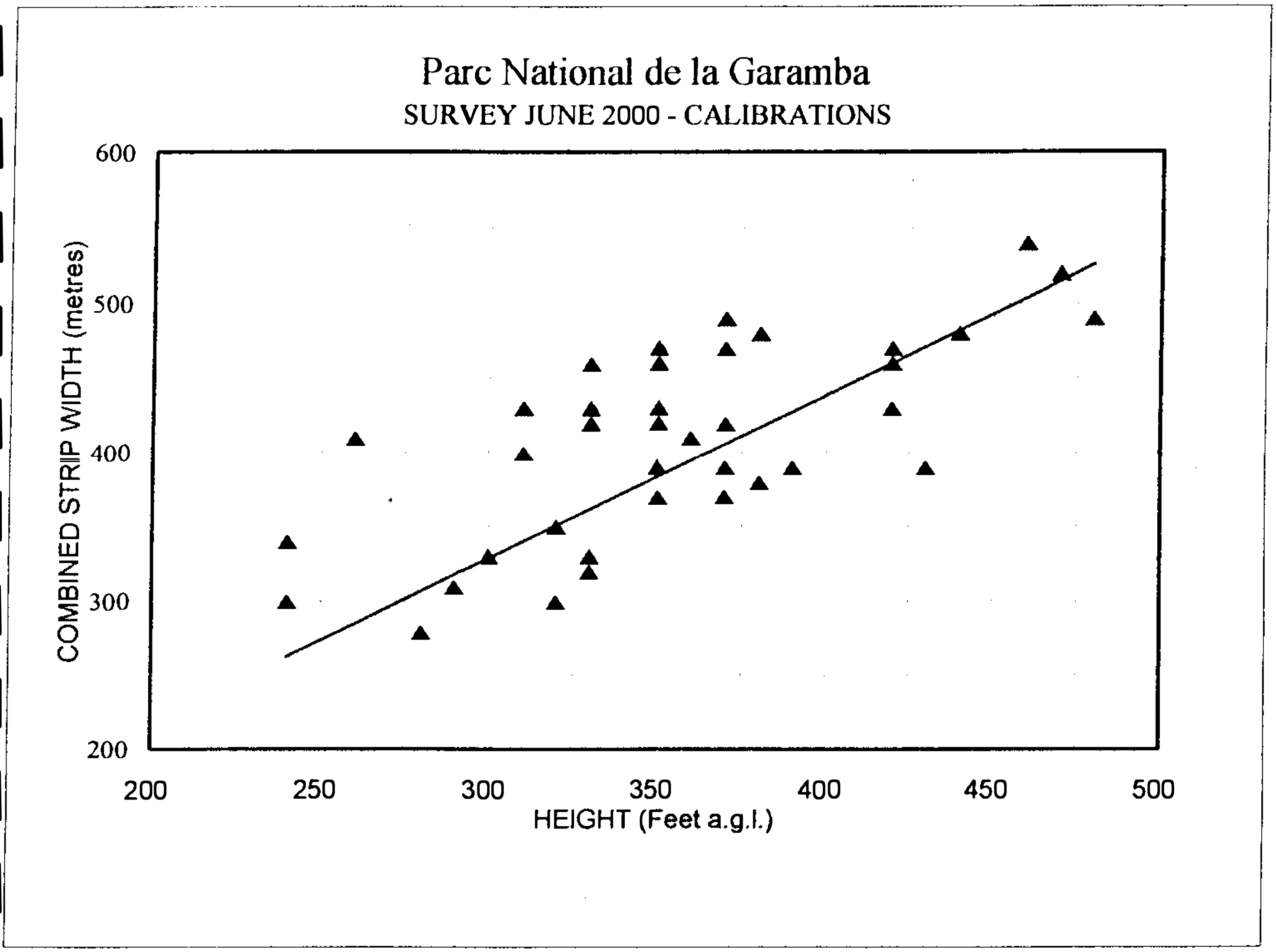
Annexe 5.15

# PARC NATIONAL DE LA GARAMBA
# GARAMBA NATIONAL PARK

## RECENSEMENT GENERAL SYSTEMATIQUE
## GENERAL AERIAL SYSTEMATIC SAMPLE COUNT

**Calibration Graphs, Distribution Maps and Population Estimate Calculations**

**June / Juin 2000**


Parc National de la Garamba
SURVEY JUNE 2000 - CALIBRATIONS
COMBINED STRIP WIDTH (metres)
600
500
400
300
200
200
250
300
350
400
450
500
HEIGHT (Feet a.g.l.)

PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK

RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT. JUIN 2000

SUPERFICIE ECHANTILLONNEE / SAMPLING AREA

TRANSECTS / SUBUNITS

| | 9 | 10 | S 11 | U 12 | B 13 | U 14 | N 15 | I 16 | T 17 | S 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | | | | | | | | | | | | | | 1.92 | 1.92 | 1.92 | | | | | | | |
| 30 | | | | | | | | | | | | | | 2.26 | 1.92 | 1.92 | 2.53 | | | | | | |
| 29 | | | | | | | | | | | | | | 1.92 | 1.94 | 1.92 | 2.85 | 1.92 | 1.83 | | | | |
| 28 | | | | | | | | | | | | | 2 | 2 | 1.92 | 1.92 | 1.89 | 1.92 | 1.86 | | | | |
| 27 | | | | | | | | | | | | | 1.89 | 1.92 | 1.92 | 1.92 | 1.94 | 1.92 | 1.94 | | | | |
| 26 | | | | | | | | | | 1.97 | 1.92 | 1.94 | 1.92 | 1.86 | 1.87 | 1.86 | 1.92 | 1.87 | 1.78 | | | | |
| 25 | | | | | | | | | | 1.97 | 1.94 | 1.97 | 1.92 | 1.92 | 1.92 | 1.97 | 1.94 | 1.89 | 2.53 | 2.19 | | | |
| 24 | | | | | | | | 1.75 | 1.92 | 1.89 | 1.83 | 1.64 | 1.92 | 1.72 | 1.92 | 1.7 | 1.78 | 1.89 | 1.89 | 2.85 | 1.87 | 1.94 | |
| 23 | | | | | | | | 1.92 | 1.92 | 1.78 | 1.92 | 1.86 | 1.94 | 1.94 | 2 | 2.14 | 1.92 | 1.92 | 2.26 | 2 | 1.97 | 1.97 | 1.92 |
| 22 | | | | | | | | 1.92 | 1.83 | 1.89 | 1.92 | 1.97 | 1.86 | 1.97 | 1.89 | 1.89 | 1.87 | 1.89 | 1.86 | 1.92 | 1.92 | 1.78 | 1.83 |
| 21 | | | | | | | | 1.94 | 1.89 | 1.92 | 1.92 | 1.92 | 1.83 | 1.92 | 1.97 | 1.97 | 1.89 | 2.26 | | | | | |
| 20 | | | | | | | 1.83 | 1.75 | 1.83 | 1.86 | 1.89 | 1.92 | 1.94 | 1.92 | 1.86 | 2 | 1.94 | | | | | | |
| 19 | | | | | | | 2.26 | 1.78 | 1.94 | 1.97 | 1.94 | 1.89 | 1.86 | 2.53 | 2.19 | 2.53 | | | | | | | |
| 18 | | | | | | | 1.92 | 1.89 | 1.92 | 1.94 | 1.87 | 1.89 | 1.92 | 2 | 1.89 | 1.78 | | | | | | | |
| 17A | | | | | | | 1.92 | 1.92 | 1.92 | 1.78 | 1.89 | 1.78 | 1.86 | 1.89 | 1.92 | | | | | | | | |
| 17 | | | | | | | 1.89 | 1.92 | 1.94 | 1.92 | 1.87 | 1.97 | 1.94 | 1.89 | 2.53 | | | | | | | | |
| 16A | | | | | | | 2.26 | 2 | 1.97 | 1.94 | 1.92 | 1.94 | 1.92 | 1.83 | 1.83 | | | | | | | | |
| 16 | | | | | | | 1.89 | 1.94 | 1.92 | 1.94 | 1.94 | 2.53 | 1.78 | 1.94 | 1.94 | | | | | | | | |
| 15A | | | | | | | 1.89 | 2.26 | 1.92 | 1.92 | 1.94 | 1.92 | 1.87 | 1.86 | 2.53 | | | | | | | | |
| 15 | | | | | | | 1.89 | 2 | 1.89 | 1.92 | 1.94 | 1.83 | 1.97 | 1.78 | 1.92 | | | | | | | | |
| 14A | | | | 1.92 | 1.94 | 1.94 | 1.92 | 1.86 | 1.86 | 1.92 | 1.92 | 1.92 | 2.26 | 2.85 | 1.97 | | | | | | | | |
| 14 | | | | 1.86 | 1.97 | 1.92 | 1.86 | 1.94 | 1.89 | 1.72 | 1.92 | 1.94 | 1.92 | 1.83 | 1.92 | | | | | | | | |
| 13A | 2.33 | 1.97 | 1.83 | 1.92 | 1.92 | 1.92 | 1.94 | 1.83 | 1.97 | 2 | 1.89 | 1.97 | 1.89 | 1.92 | 2 | | | | | | | | |
| 13 | 2.26 | 2.18 | 1.78 | 1.97 | 1.97 | 1.97 | 1.92 | 1.92 | 1.92 | 2.85 | 2 | 1.87 | 1.94 | 1.97 | | | | | | | | | |
| 12A | | 1.87 | 1.92 | 1.83 | 2.26 | 2 | 1.94 | 1.87 | 1.94 | 1.86 | 1.87 | 1.92 | 1.94 | 1.97 | 2.33 | | | | | | | | |
| 12 | | 1.86 | 1.97 | 1.92 | 1.86 | 1.86 | 1.78 | 1.92 | 1.92 | 1.94 | 1.92 | 2.26 | 1.97 | 2.33 | | | | | | | | | |
| 11A | | | | 1.37 | 1.92 | 2.85 | 2.53 | 2 | 1.94 | 1.89 | 1.97 | 2.16 | | | | | | | | | | | |
| 11 | | | | 1.87 | 2.19 | 1.86 | 1.75 | 1.64 | 1.75 | 1.92 | 2.85 | 1.92 | | | | | | | | | | | |
| 10A | | | | 1.87 | 1.94 | 1.92 | 2.53 | 1.92 | 2.26 | 1.92 | 1.89 | 1.59 | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | | | | | |

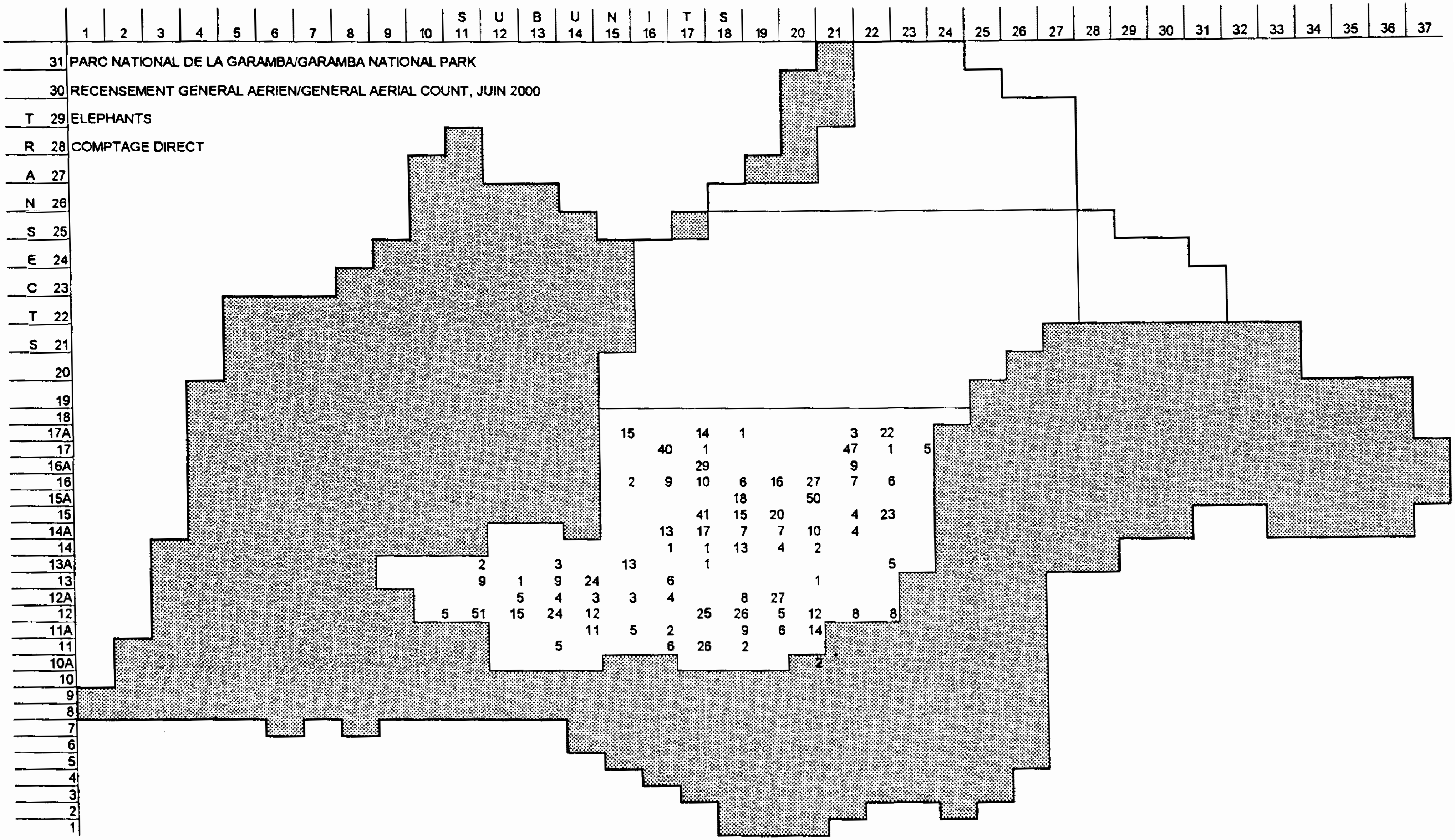
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | 1.97 | 1.92 | 1.94 | 5.8 | 11.9 | 11.5 | 11.4 | 11.1 | 7.62 | 7.42 | 8.95 | 5.75 | 5.69 | 3.75 | | | | | |
| Med D | | | | | | | | | | | | | | | 4.09 | 11.1 | 11.3 | 13.3 | 13.4 | 13.2 | 13.3 | 13.9 | 13.7 | 14.2 | 11.3 | 9.84 | 8.54 | | | | | | | | | |
| High D | | | | | | | | | 4.58 | 7.88 | 7.5 | 16.5 | 18 | 16.3 | 29.3 | 28.9 | 30.9 | 31.4 | 31.6 | 29.8 | 25.2 | 26.1 | 20.4 | 1.78 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.94 | 2.53 | 1.92 | 0 | 0 | 0 | 1.59 | 0 | 0 | 2.33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.58 | 7.88 | 7.5 | 16.5 | 18 | 18.2 | 35.9 | 41.9 | 42.3 | 46.6 | 46.9 | 46.5 | 44.3 | 51.8 | 48 | 27.4 | 22.5 | 17.5 | 16 | 8.95 | 5.75 | 5.69 | 3.75 | 0 | 0 | 0 | 0 | 0 |

PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK

RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, JUIN 2000

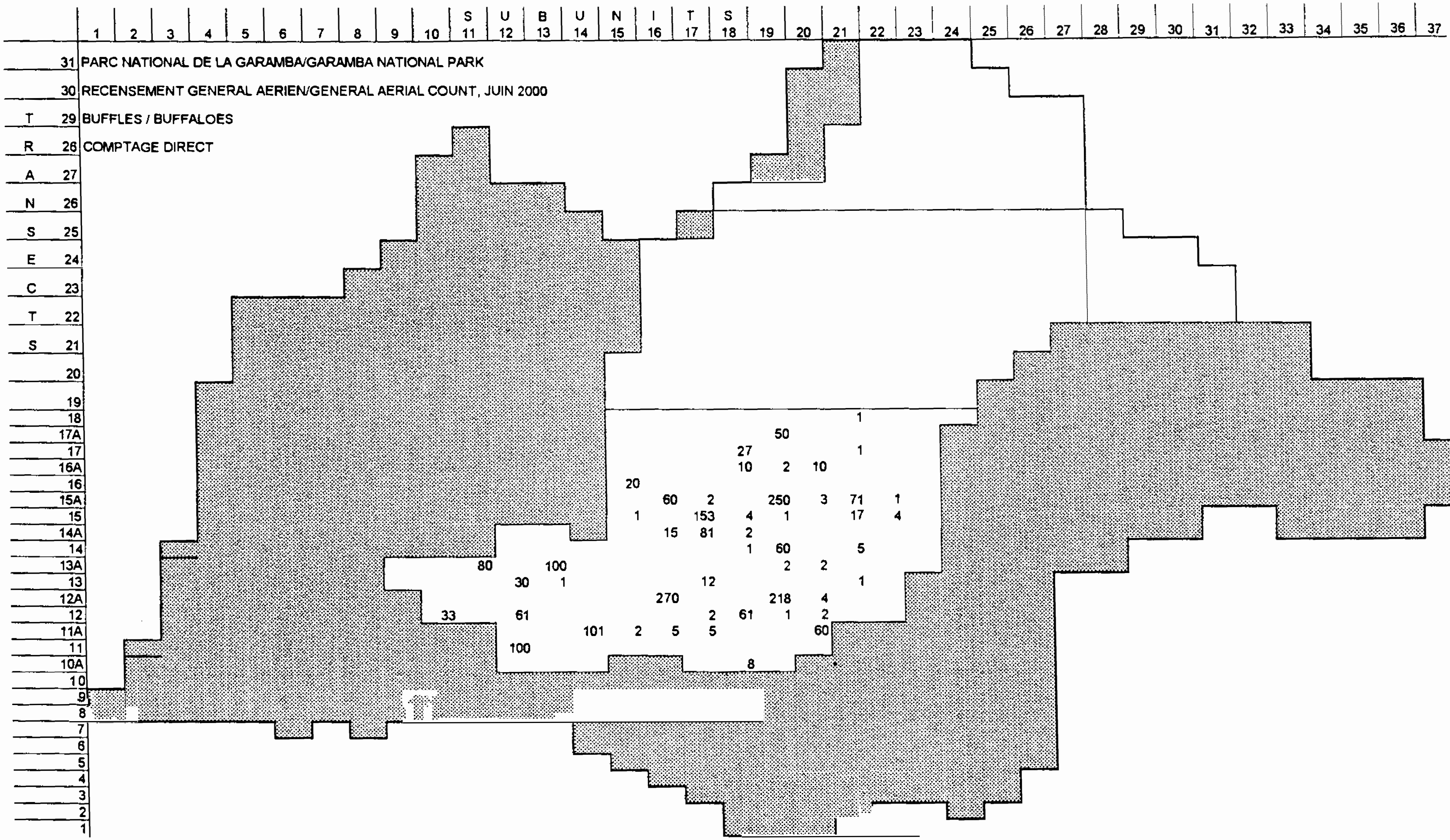
ALTITUDE MOYEN AU DESSUS DU NIVEAU DE LA TERRE/MEAN ALTITUDE ABOVE THE GROUND LEVEL (AGL)

| TRANSECTS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | S 11 | U 12 | B 13 | U 14 | N 15 | I 16 | T 17 | S 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | | | | | | | | | | | | | | | | | | | | | | 350 | 350 | 350 | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | | | | | | | 370 | 350 | 350 | 375 | | | | | | | | | | | | |
| T 29 | | | | | | | | | | | | | | | | | | | | | | 350 | 355 | 350 | 380 | 350 | 335 | | | | | | | | | | |
| R 28 | | | | | | | | | | | | | | | | | | | | | 365 | 365 | 350 | 350 | 345 | 350 | 340 | | | | | | | | | | |
| A 27 | | | | | | | | | | | | | | | | | | | | | 345 | 350 | 350 | 350 | 355 | 350 | 355 | | | | | | | | | | |
| N 26 | | | | | | | | | | | | | | | | | | 360 | 350 | 355 | 350 | 340 | 330 | 340 | 350 | 330 | 325 | | | | | | | | | | |
| S 25 | | | | | | | | | | | | | | | | | | 360 | 355 | 360 | 350 | 350 | 350 | 360 | 355 | 345 | 375 | 400 | | | | | | | | | |
| E 24 | | | | | | | | | | | | | | | | 320 | 350 | 345 | 335 | 300 | 350 | 315 | 350 | 310 | 325 | 345 | 345 | 380 | 330 | 355 | | | | | | | |
| C 23 | | | | | | | | | | | | | | | | 350 | 350 | 325 | 350 | 340 | 355 | 355 | 365 | 390 | 350 | 350 | 370 | 365 | 360 | 360 | 350 | | | | | | |
| T 22 | | | | | | | | | | | | | | | | 350 | 335 | 345 | 350 | 360 | 340 | 360 | 345 | 345 | 330 | 345 | 340 | 350 | 350 | 325 | 335 | | | | | | |
| S 21 | | | | | | | | | | | | | | | | 355 | 345 | 350 | 350 | 350 | 335 | 350 | 360 | 360 | 345 | 370 | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | 335 | 320 | 335 | 340 | 345 | 350 | 355 | 350 | 340 | 365 | 355 | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | | | | 370 | 325 | 355 | 360 | 355 | 345 | 340 | 375 | 400 | 375 | | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | | | | 350 | 345 | 350 | 355 | 330 | 345 | 350 | 365 | 345 | 325 | | | | | | | | | | | | | |
| 17A | | | | | | | | | | | | | | | 350 | 350 | 350 | 325 | 345 | 325 | 340 | 345 | 350 | | | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | | | | 345 | 350 | 355 | 350 | 330 | 360 | 355 | 345 | 375 | | | | | | | | | | | | | | |
| 16A | | | | | | | | | | | | | | | 370 | 365 | 360 | 355 | 350 | 355 | 350 | 335 | 335 | | | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | | | | 345 | 355 | 350 | 355 | 355 | 375 | 325 | 355 | 355 | | | | | | | | | | | | | | |
| 15A | | | | | | | | | | | | | | | 345 | 370 | 350 | 350 | 355 | 350 | 330 | 340 | 375 | | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | | | 345 | 365 | 345 | 350 | 355 | 335 | 360 | 325 | 350 | | | | | | | | | | | | | | |
| 14A | | | | | | | | | | | | 350 | 355 | 355 | 350 | 340 | 340 | 350 | 350 | 350 | 370 | 380 | 360 | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | 340 | 360 | 350 | 340 | 355 | 345 | 315 | 350 | 355 | 350 | 335 | 350 | | | | | | | | | | | | | | |
| 13A | | | | | | | | | 425 | 360 | 335 | 350 | 350 | 350 | 355 | 335 | 360 | 365 | 345 | 360 | 345 | 350 | 365 | | | | | | | | | | | | | | |
| 13 | | | | | | | | | 370 | 385 | 325 | 360 | 360 | 360 | 350 | 350 | 350 | 380 | 365 | 330 | 355 | 360 | | | | | | | | | | | | | | | |
| 12A | | | | | | | | | | 330 | 350 | 335 | 370 | 365 | 355 | 330 | 355 | 340 | 330 | 350 | 355 | 360 | 425 | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | 340 | 360 | 350 | 340 | 340 | 325 | 350 | 350 | 355 | 350 | 370 | 360 | 425 | | | | | | | | | | | | | | | |
| 11A | | | | | | | | | | | | 250 | 350 | 360 | 375 | 365 | 355 | 345 | 360 | 395 | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | 330 | 400 | 340 | 320 | 300 | 320 | 350 | 380 | 350 | | | | | | | | | | | | | | | | | |
| 10A | | | | | | | | | | | | 330 | 355 | 350 | 375 | 350 | 370 | 350 | 345 | 290 | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Low D | | | | | | | | | | | | | | | | | | 360 | 350 | 355 | 1060 | 2125 | 2085 | 2090 | 1805 | 1380 | 1355 | 1495 | 1040 | 1040 | 685 | | | | | | |
| Med D | | | | | | | | | | | | | | | 705 | 2020 | 2070 | 2425 | 2440 | 2405 | 2425 | 2455 | 2510 | 2505 | 2060 | 1755 | 1430 | | | | | | | | | | |
| High D | | | | | | | | | 795 | 1415 | 1370 | 2995 | 3240 | 2835 | 5220 | 5225 | 5605 | 5590 | 5595 | 5305 | 4545 | 4620 | 3560 | 325 | | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 355 | 375 | 350 | 0 | 0 | 0 | 290 | 0 | 0 | 425 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 795 | 1415 | 1370 | 2995 | 3240 | 3190 | 6300 | 7595 | 7675 | 8375 | 8385 | 8355 | 8030 | 9200 | 8580 | 4920 | 3865 | 3135 | 2785 | 1495 | 1040 | 1040 | 685 | 0 | 0 | 0 | 0 | 0 | 0 |

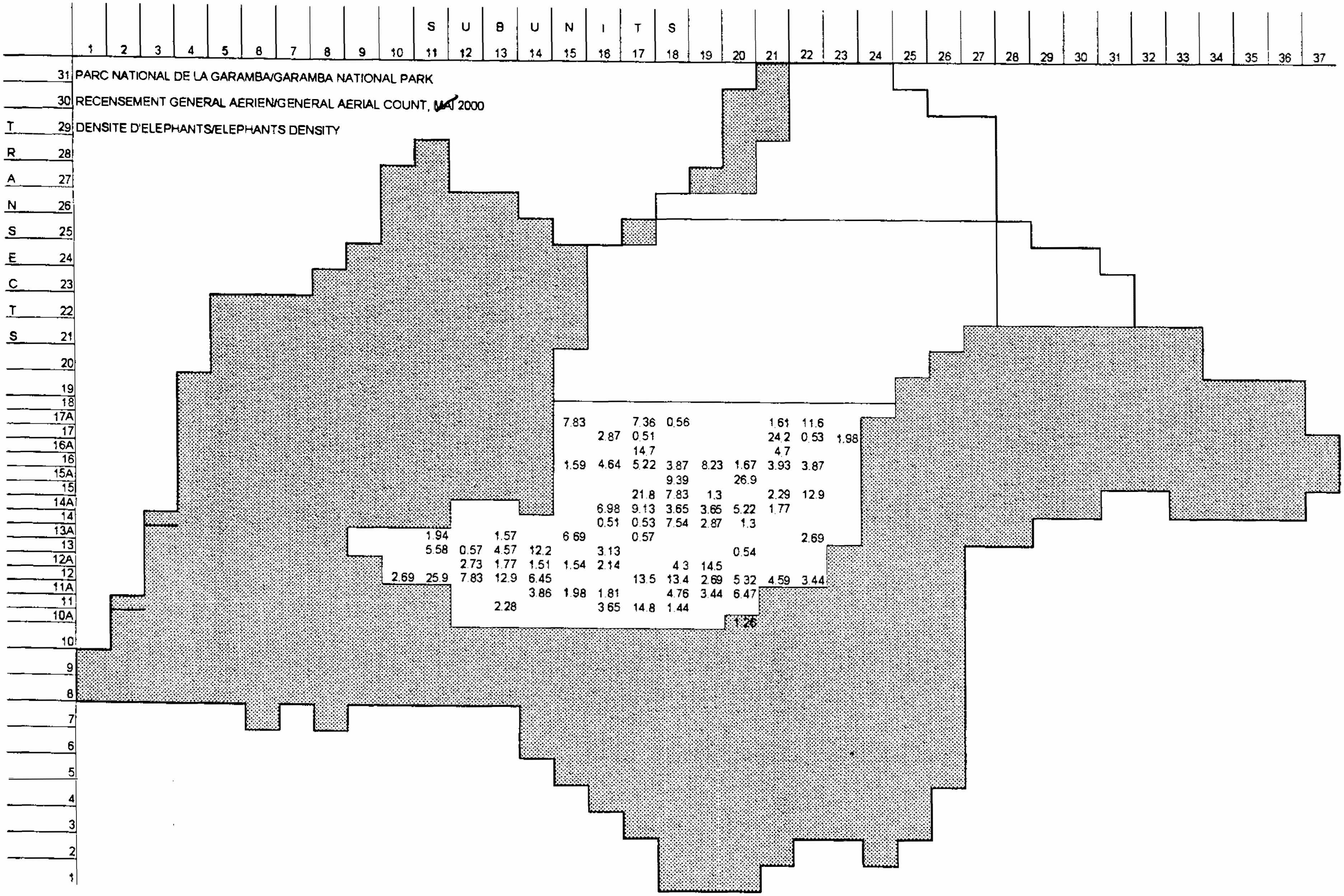



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| Med D | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |
| High D | | | | | | | | | 0 | 5 | 62 | 21 | 45 | 50 | 38 | 81 | 165 | 105 | 85 | 116 | 82 | 65 | 5 | 0 | | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tota | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 62 | 21 | 45 | 50 | 38 | 81 | 165 | 105 | 85 | 118 | 82 | 65 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Annexe 5.15

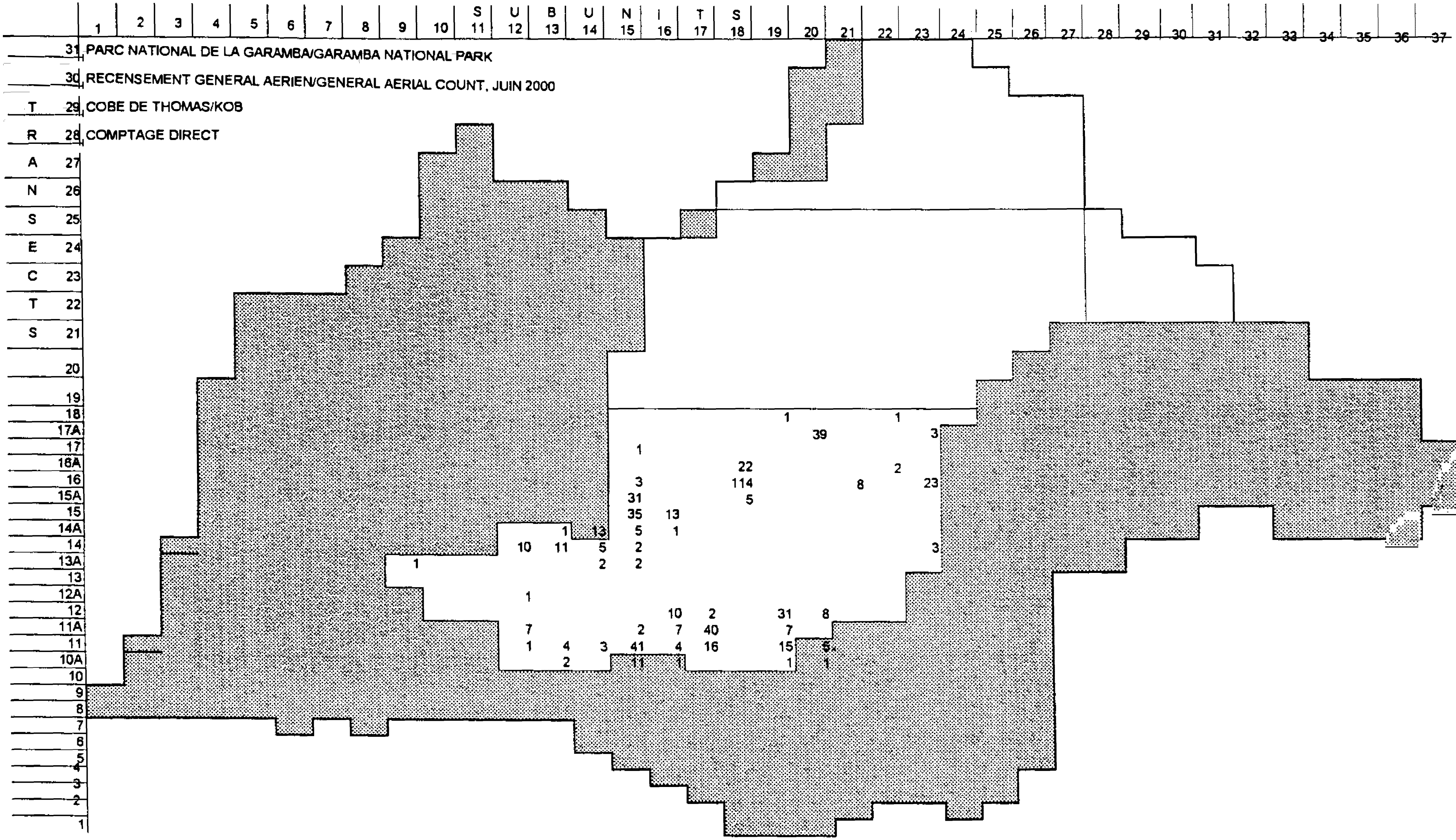



| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |
| High D | | | | | | | | | | ERR | 33 | ERR | 292 | 202 | 103 | 350 | 255 | 105 | 584 | 81 | 96 | 5 | 0 | 0 | 0 | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ERR | 0 | ERR | 0 | 0 | ERR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ERR | 33 | ERR | 292 | 202 | ERR | 350 | 255 | 105 | 584 | 81 | 96 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 |
| High D | | | | | | | | | | 0 | 31.5 | 11.1 | 23.1 | 24 | 10.2 | 25.7 | 88.1 | 56.7 | 36.6 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.69 | 0 | 0 | 0 | 0 | 9.42 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.69 | 31.5 | 11.1 | 23.1 | 24 | 19.6 | 25.7 | 88.1 | 56.7 | 36.6 |

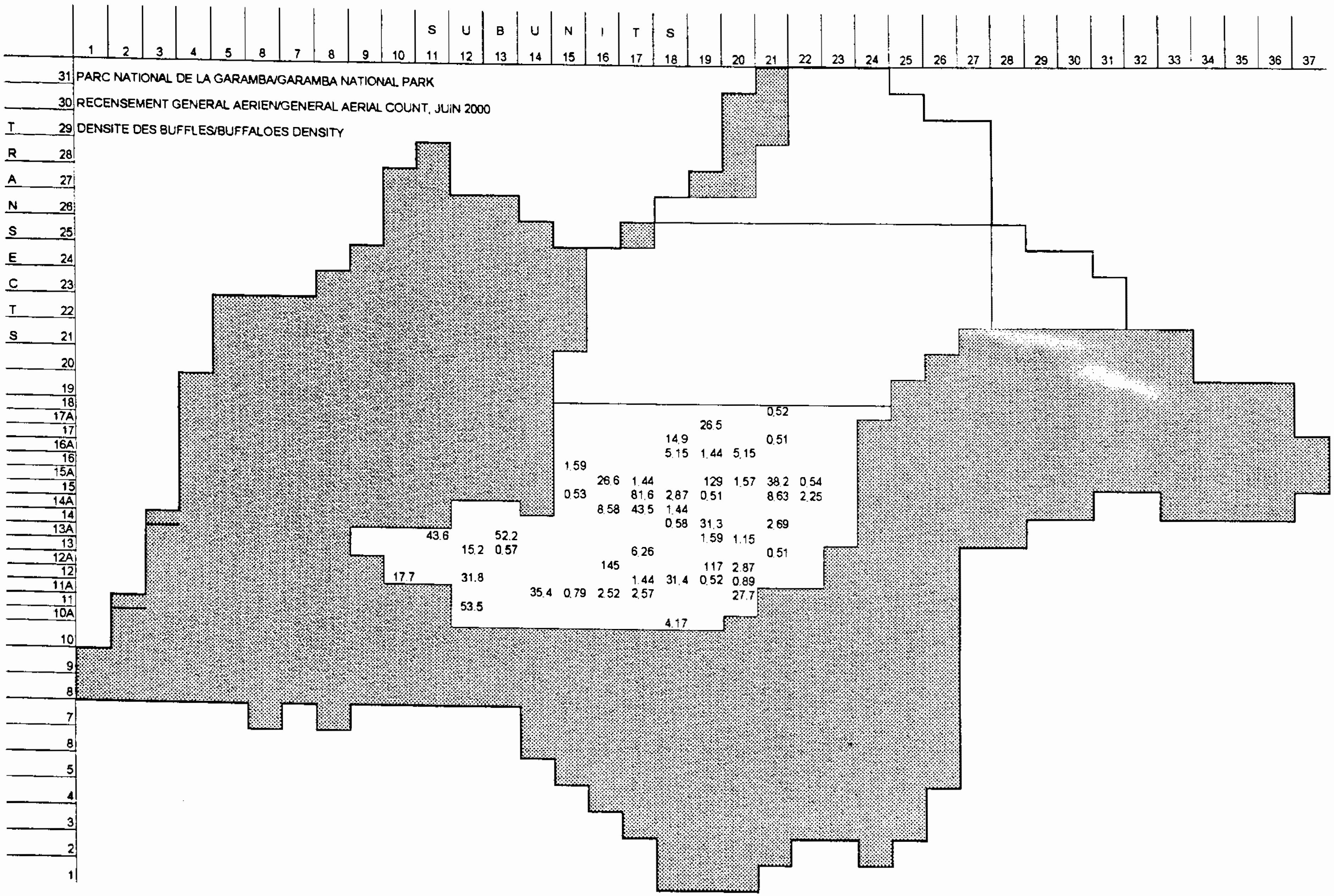
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 47.4 | 43.1 | 35.1 | 1.98 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 47.4 | 43.1 | 35.1 | 1.98 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 |
| High D | | | | | | | | | | 0 | 0 | ERR | 35 | 15 | 10 | 157 | 93 | 199 | 195 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | ERR | 0 | ERR | 0 | 0 | 70 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | ERR | 0 | ERR | 35 | 15 | 80 | 157 | 93 | 199 | 195 |

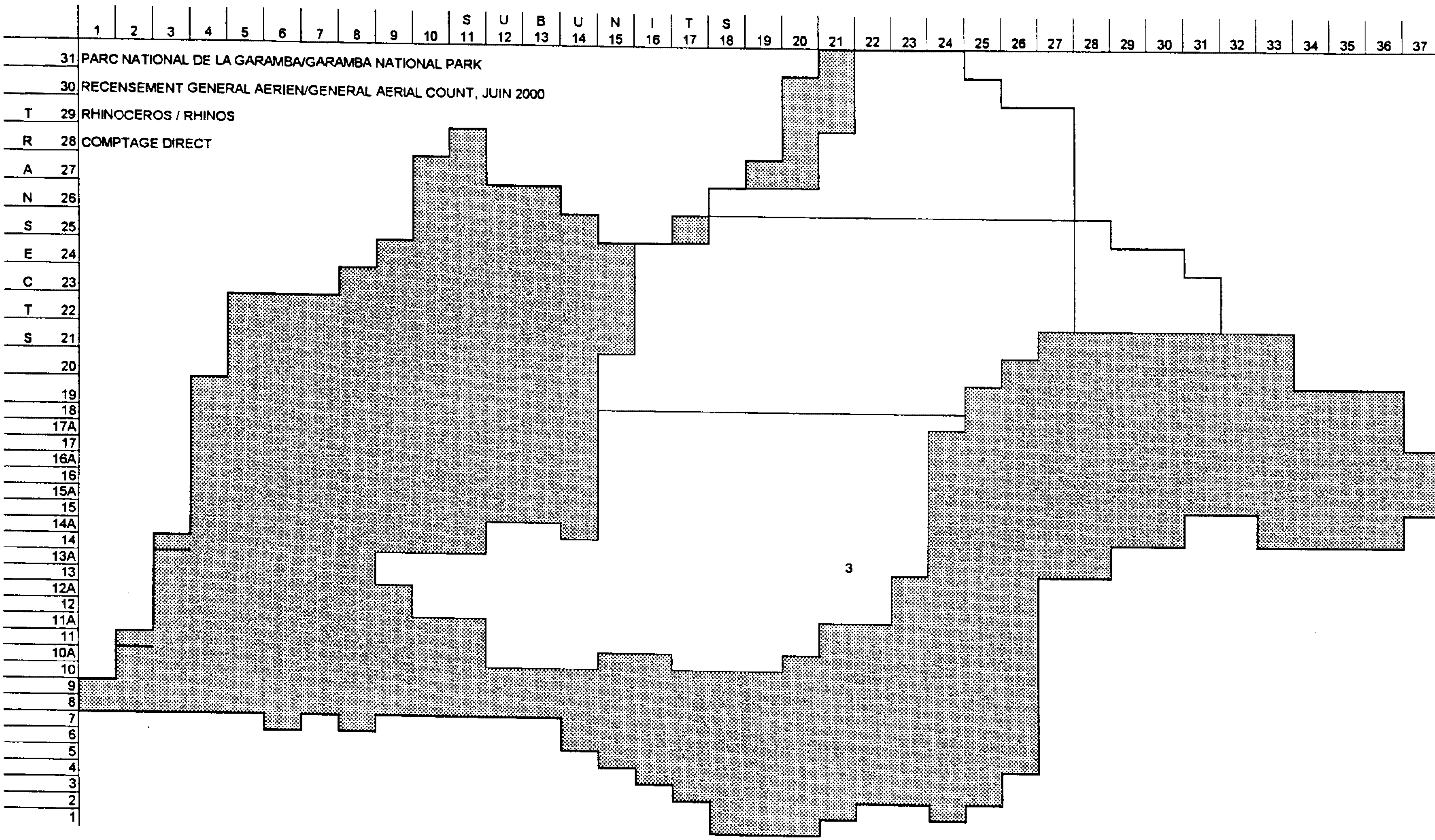
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 106 | 60 | 3 | 32 | 29 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 106 | 60 | 3 | 32 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Annexe 5.15

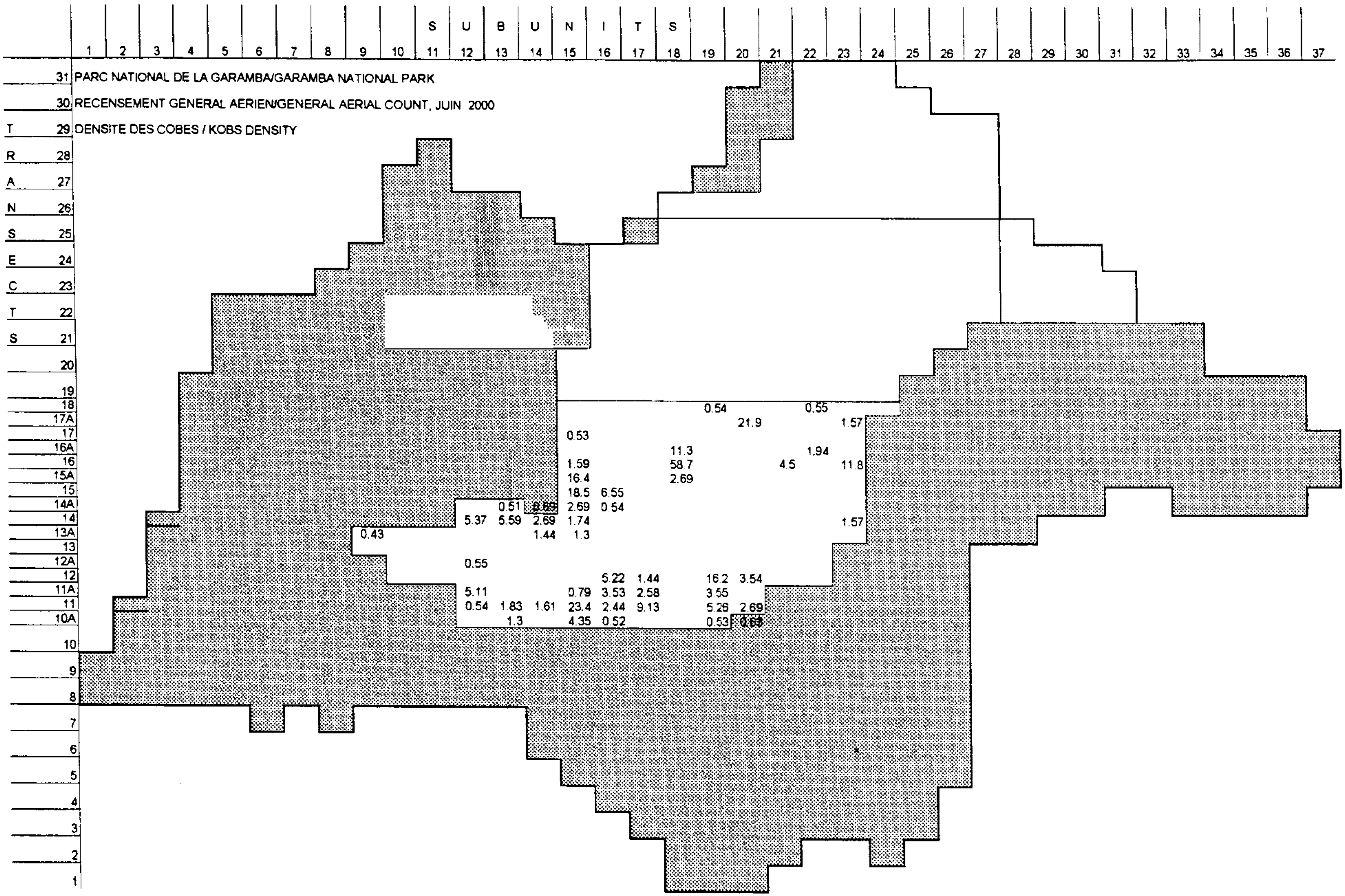



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 |
| High D | | | | | | | | | | 0 | 0 | 47.1 | 52.8 | 35.4 | 0.79 | 182 | 137 | 56.3 | 307 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17.7 | 0 | 53.5 | 0 | 0 | 2.12 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17.7 | 0 | 101 | 52.8 | 35.4 | 2.91 | 182 | 137 | 56.3 | 307 |

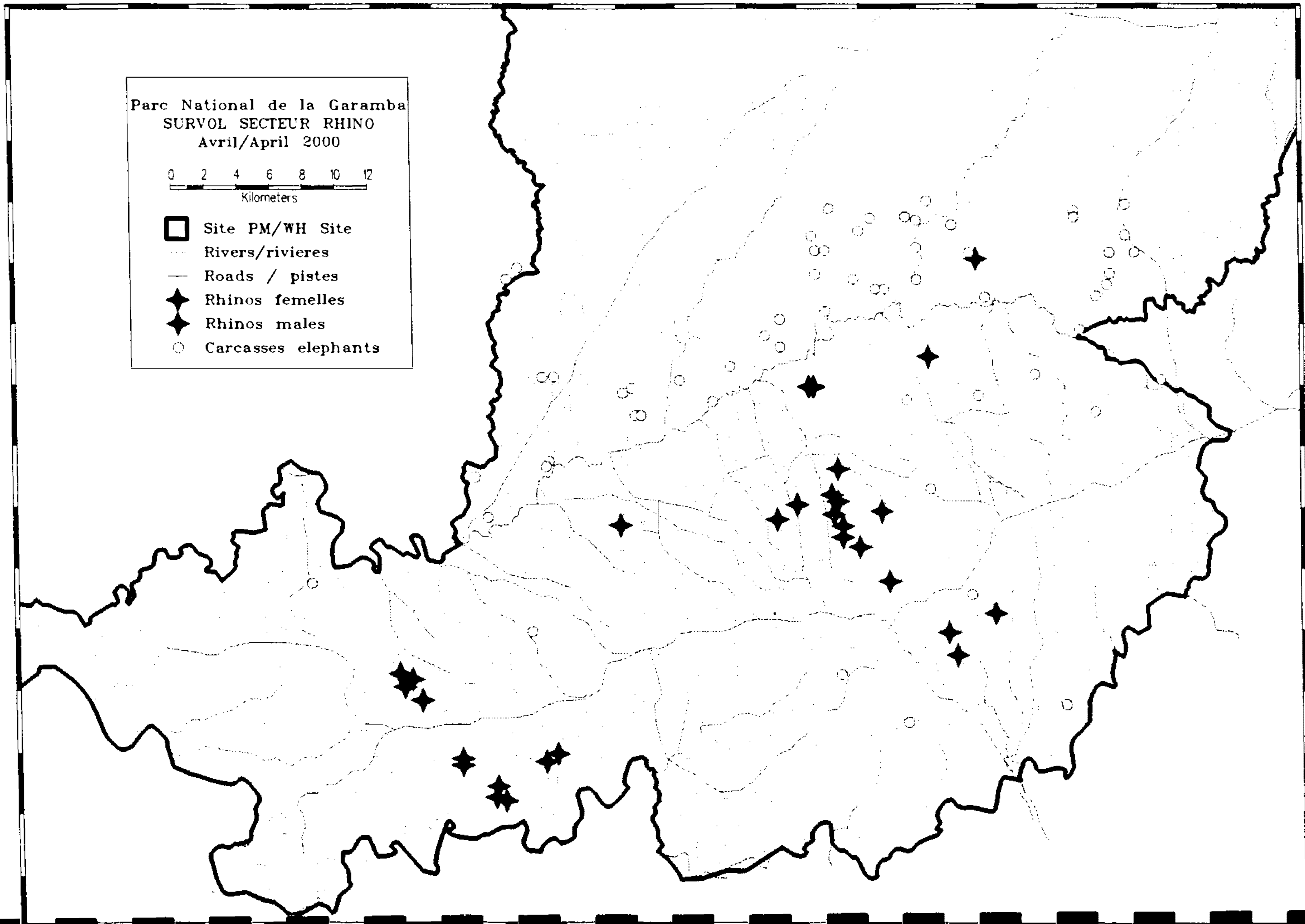
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 39.4 | 51.1 | 2.79 | 0 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 39.4 | 51.1 | 2.79 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



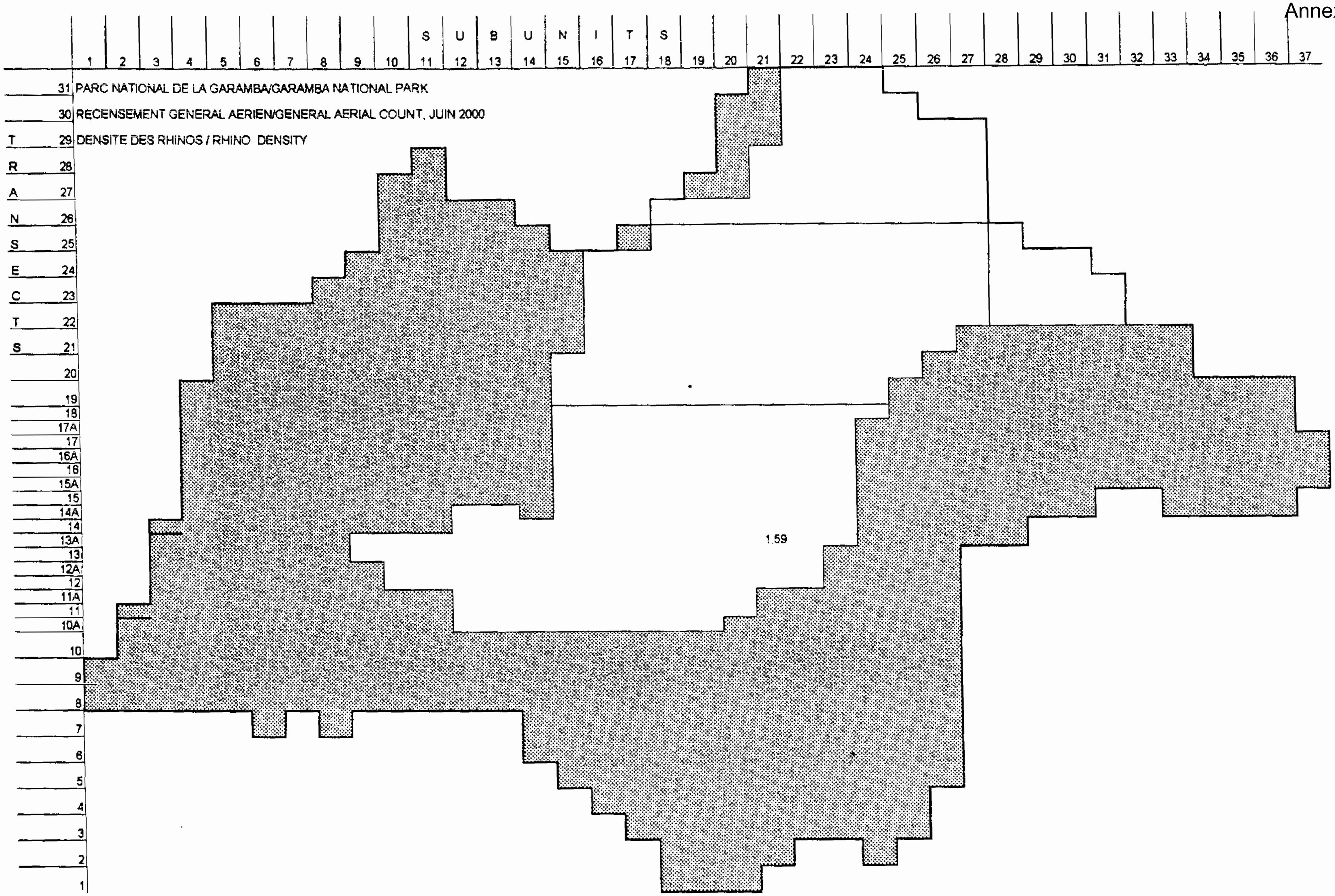

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|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




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | | | | | | | | | | 0 | 0 | 5.92 | 7.93 | 5.74 | 27.2 | 18.3 | 13.2 | 72.7 | 25.5 | 28.2 | 4.5 | 2.49 | 15 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.43 | 0 | 0 | 0.54 | 0 | 0 | 37 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.43 | 0 | 0 | 6.45 | 7.93 | 5.74 | 64.3 | 18.3 | 13.2 | 72.7 | 25.5 | 28.2 | 4.5 | 2.49 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

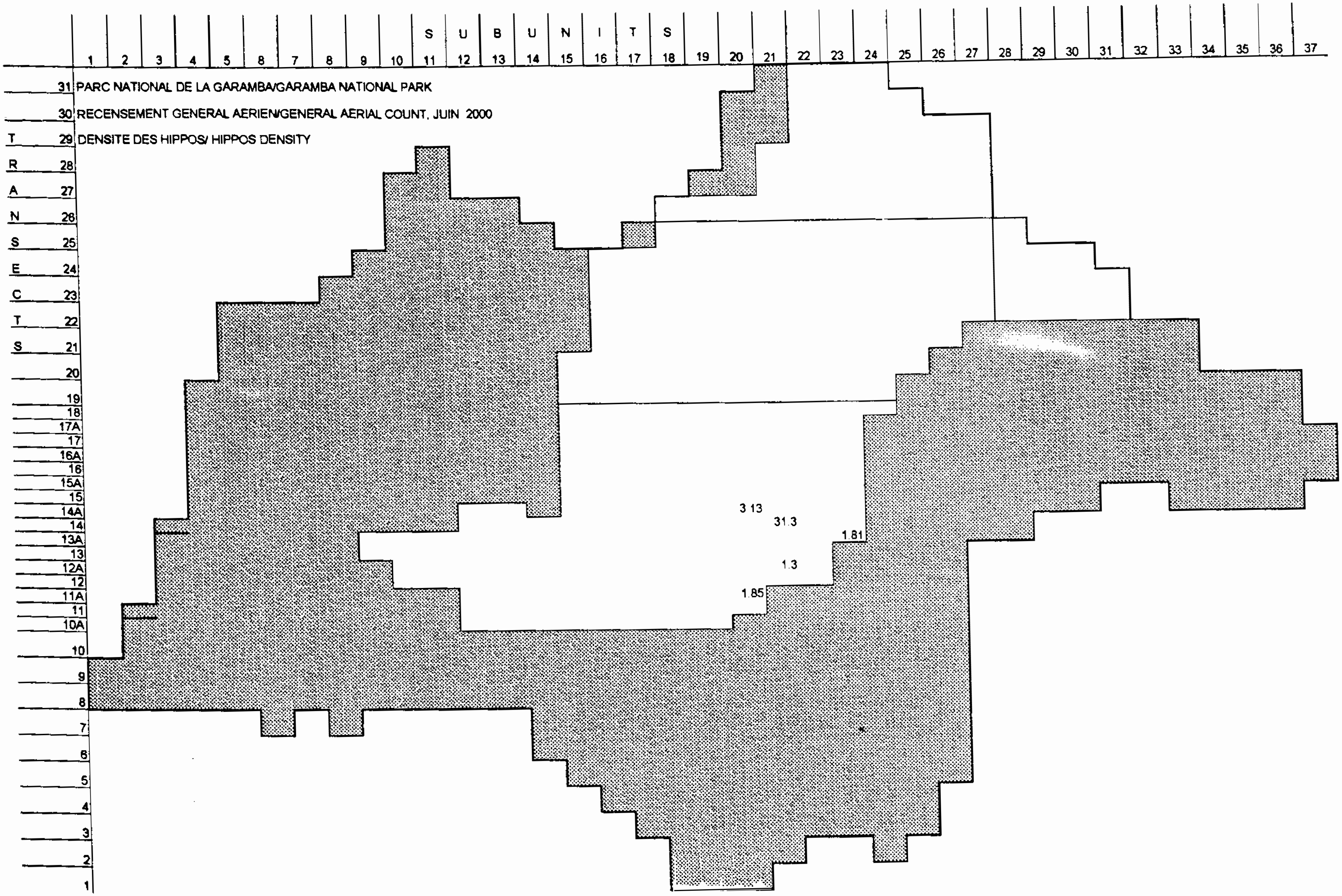

Parc National de la Garamba
SURVOL SECTEUR RHINO
Avril/April 2000
0 2 4 6 8 10 12
Kilometers
Site PM/WH Site
Rivers/rivieres
Roads / pistes
Rhinos femelles
Rhinos males
Carcasses elephants

Annexe 5.15



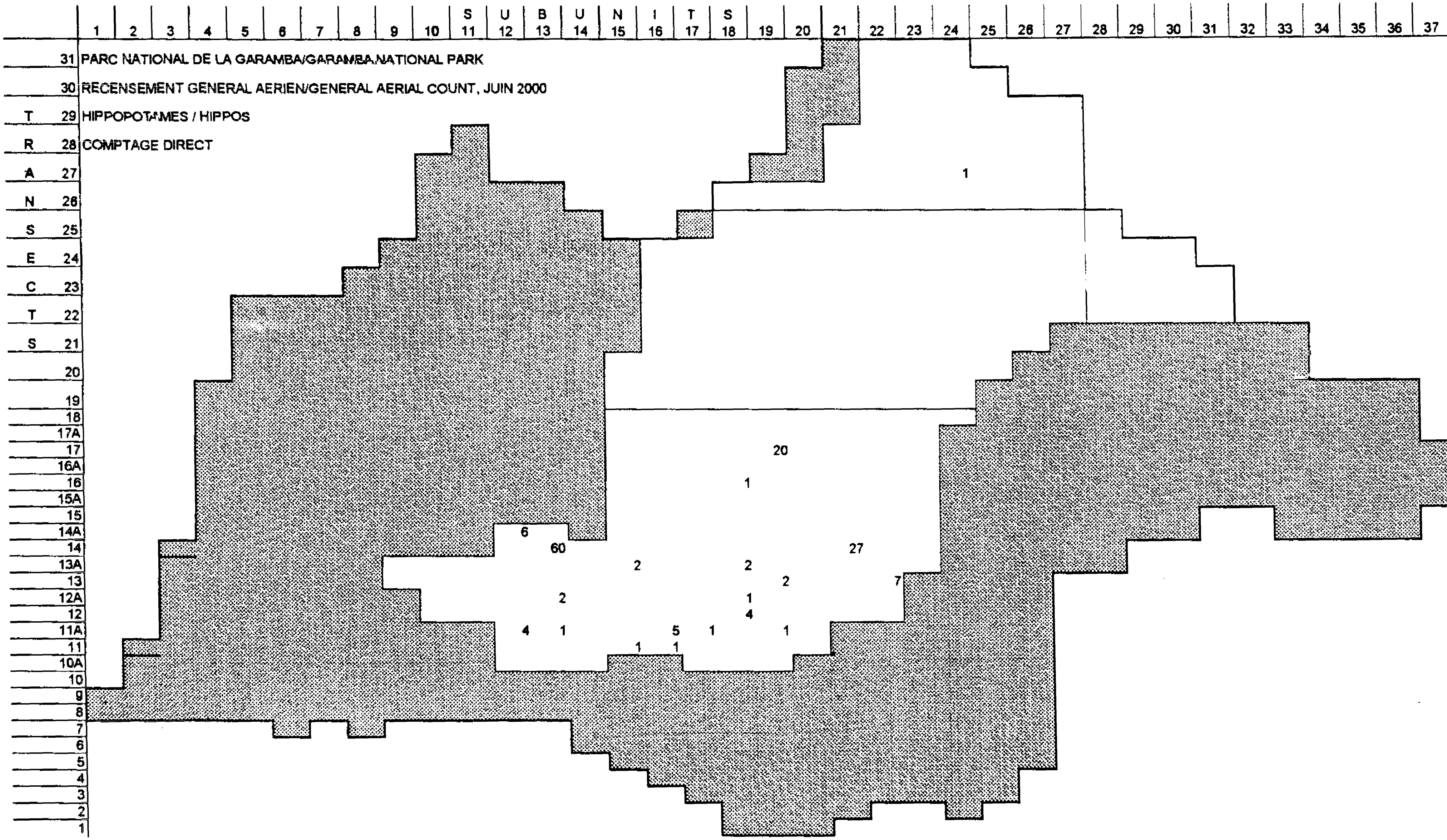

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.59 | 0 | 0 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.59 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Annexe 5.15

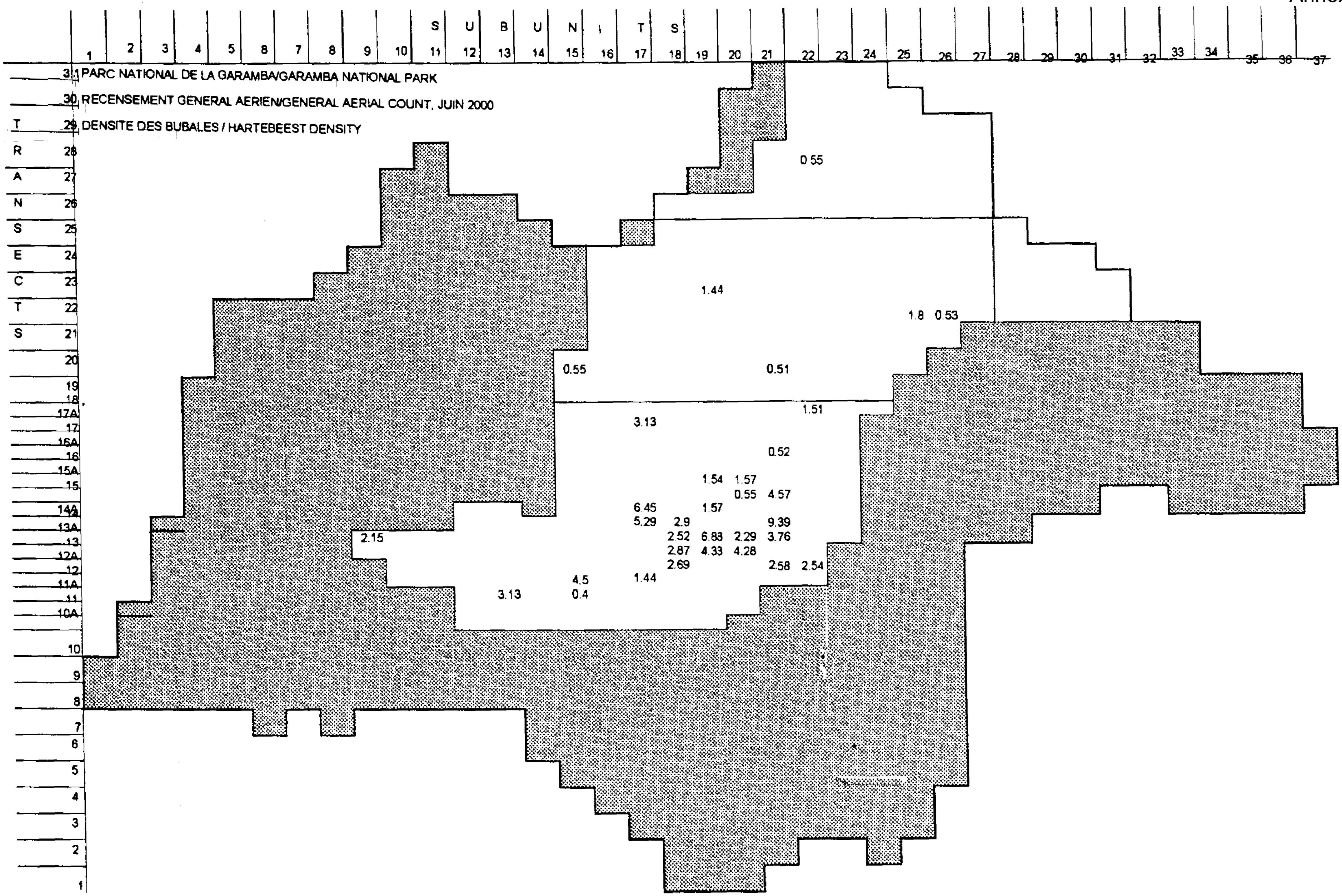



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 |
| High D | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 4.98 | 32.6 | 0 | 1.81 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 4.98 | 32.6 | 0 | 1.81 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

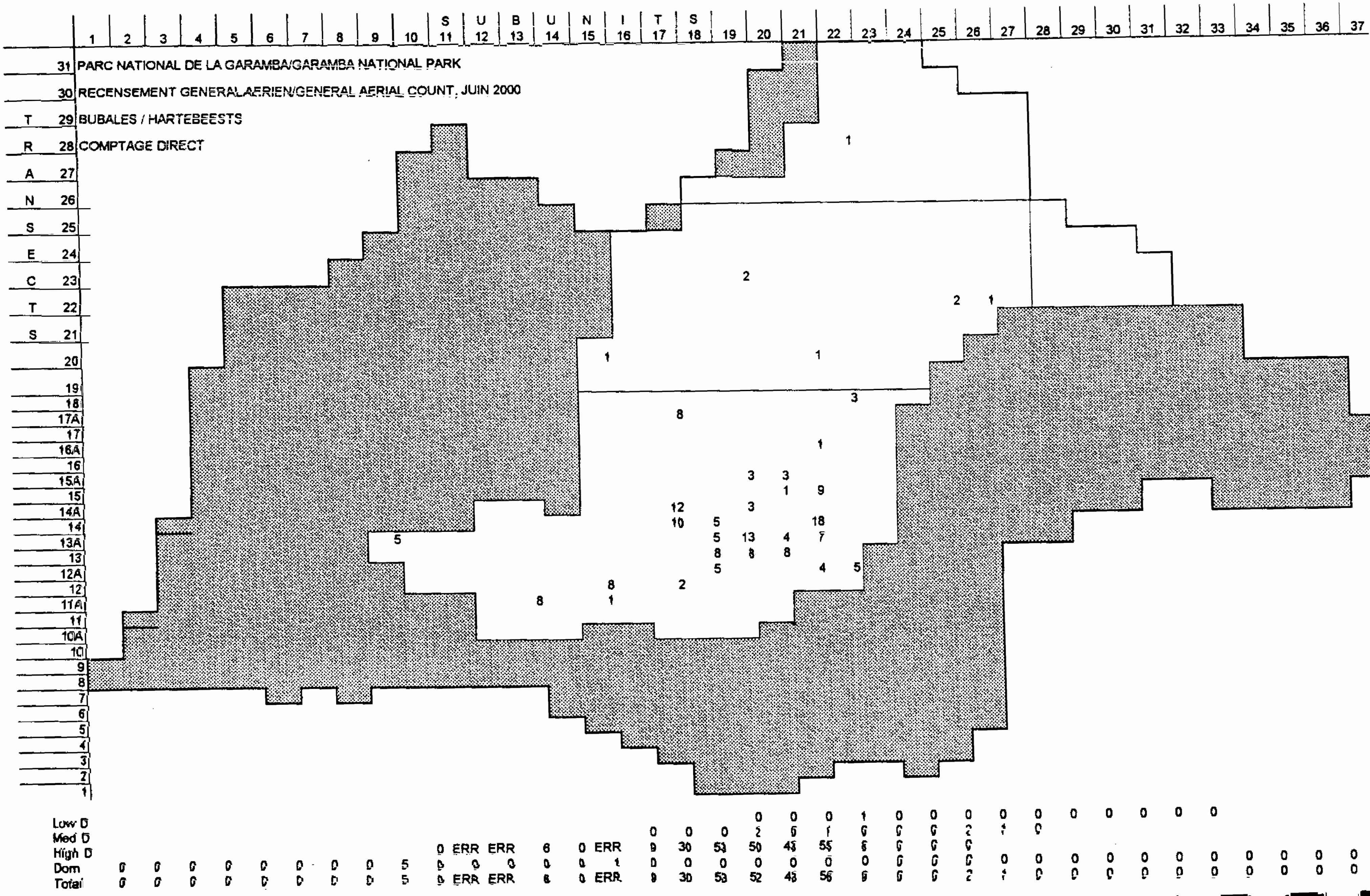


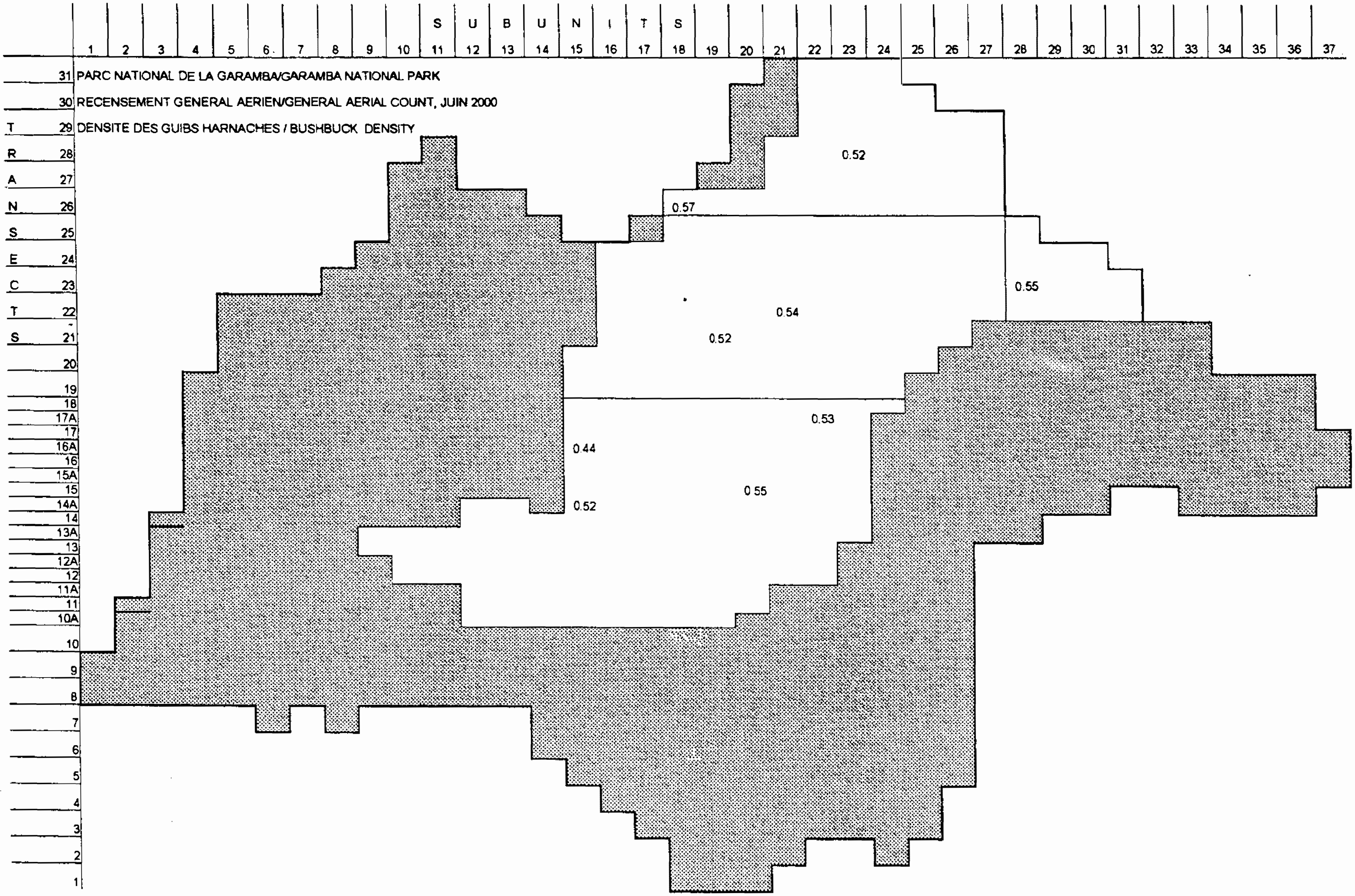

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| Med D | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |
| High D | | | | | | | | | | | 0 | ERR | ERR | 63 | 0 | ERR | 7 | 8 | 9 | 31 | 23 | 27 | 7 | 0 | 0 | 0 | | | | | | | | | | | |
| Dom | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ERR | ERR | 63 | 0 | ERR | 7 | 8 | 9 | 31 | 23 | 27 | 7 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



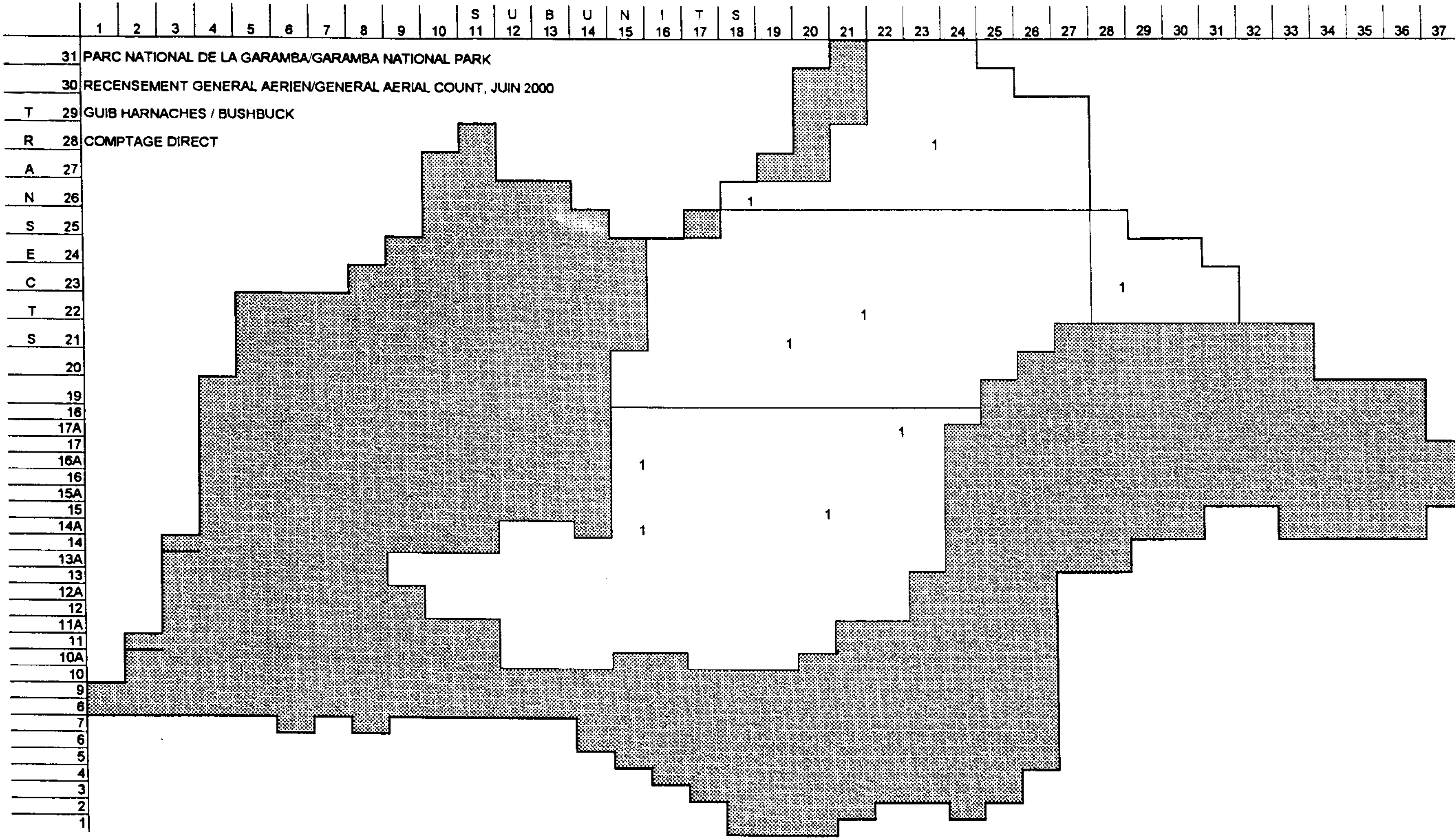

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0.55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 1.44 | 0 | 0.51 | 0 | 0 | 0 | 1.8 | 0.53 | 0 | | | | | | | | | | |
| High D | | | | | | | | | | 0 | 0 | 0 | 3.13 | 0 | 4.89 | 0 | 16.3 | 11 | 14.3 | 8.69 | 20.8 | 4.05 | 0 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.15 | 0 | 0 | 0 | 0 | 0 | 0.55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.15 | 0 | 0 | 0 | 3.13 | 0 | 5.44 | 0 | 16.3 | 11 | 15.8 | 8.69 | 21.3 | 4.6 | 0 | 0 | 1.8 | 0.53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Annexe 5.15


PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, JUIN 2000
BUBALES / HARTEBEESTS
COMPTAGE DIRECT
SUBUNITS
TRANSECTS
Low D
Med D
High D
Dom
Total



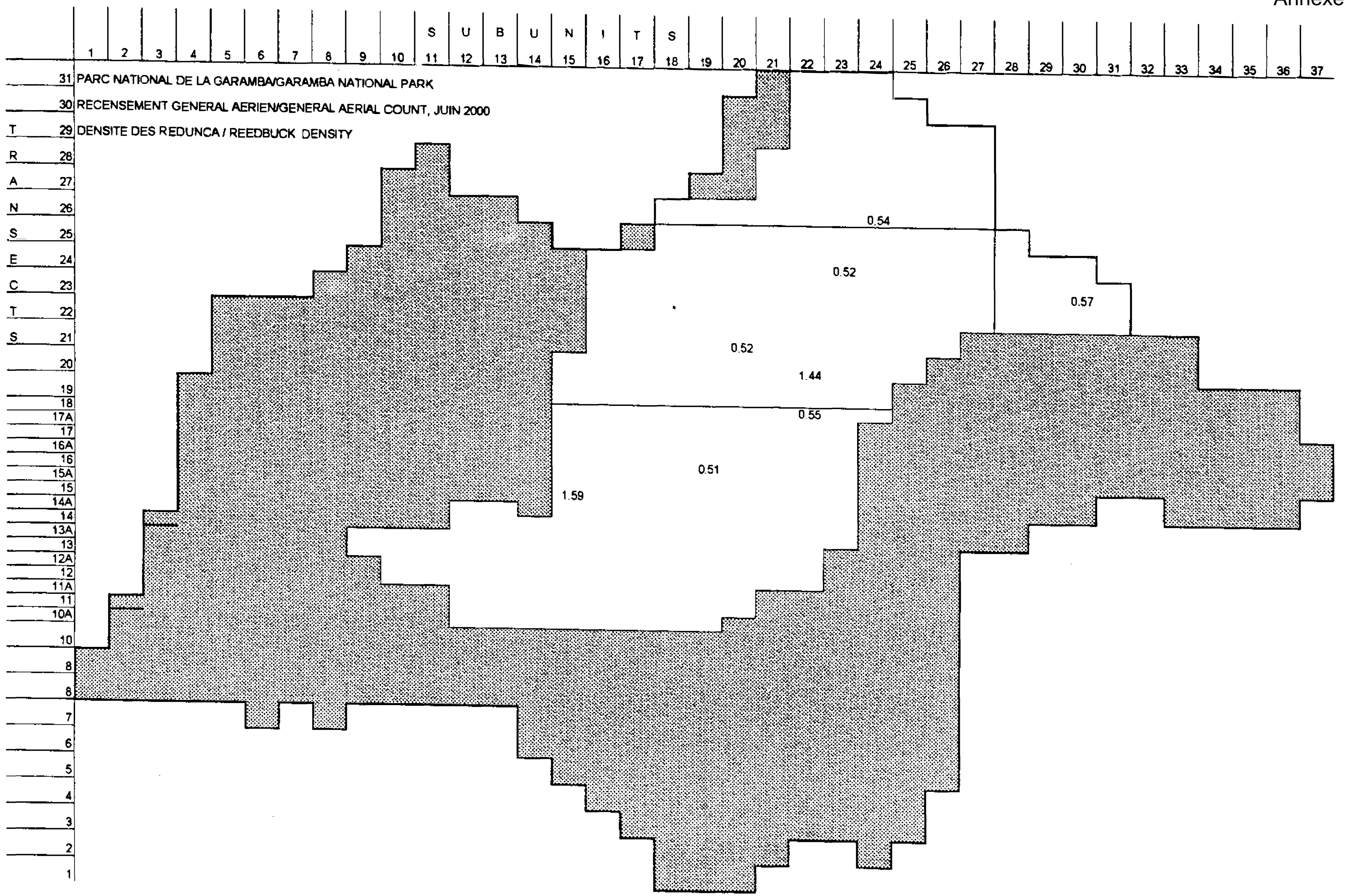

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0.52 | 0 | 0 | 0 | 0 | 0.55 | 0 | 0 | 0 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0.52 | 0 | 0.54 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.55 | 0 | 0.53 | 0 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.44 | 0 | 0 | 0 | 0.52 | 0.55 | 0.54 | 0.53 | 0.52 | 0 | 0 | 0 | 0 | 0.55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 |
| High D | | | | | | | | | | 0 | ERR | ERR | 0 | 0 | ERR | 2 | 0 | 0 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ERR | ERR | 0 | 0 | ERR | 2 | 0 | 0 |

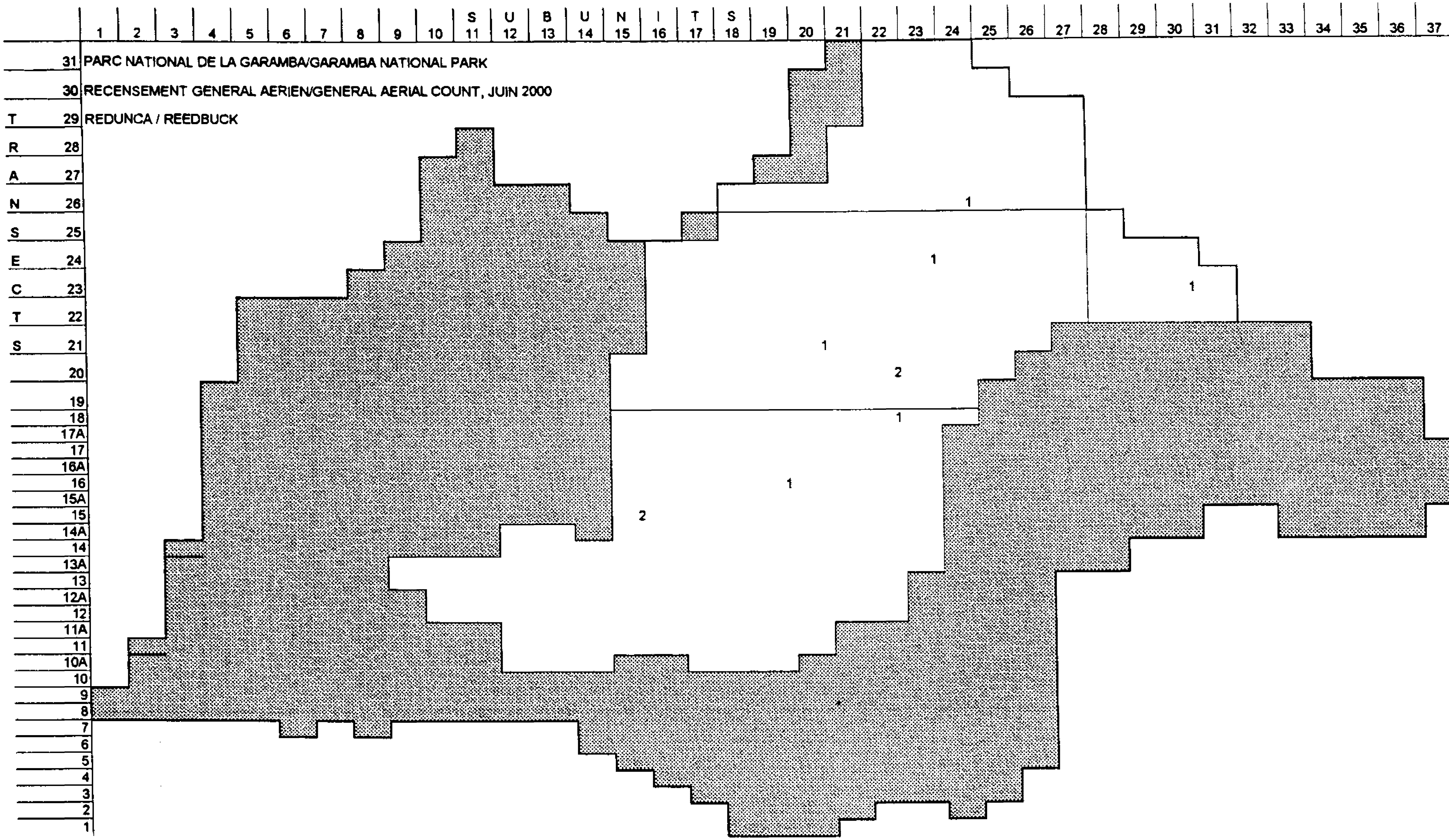
| | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | | | | |
| Med D | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |
| High D | 0 | 1 | 1 | 1 | 0 | 0 | 0 | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 1 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Annexe 5.15

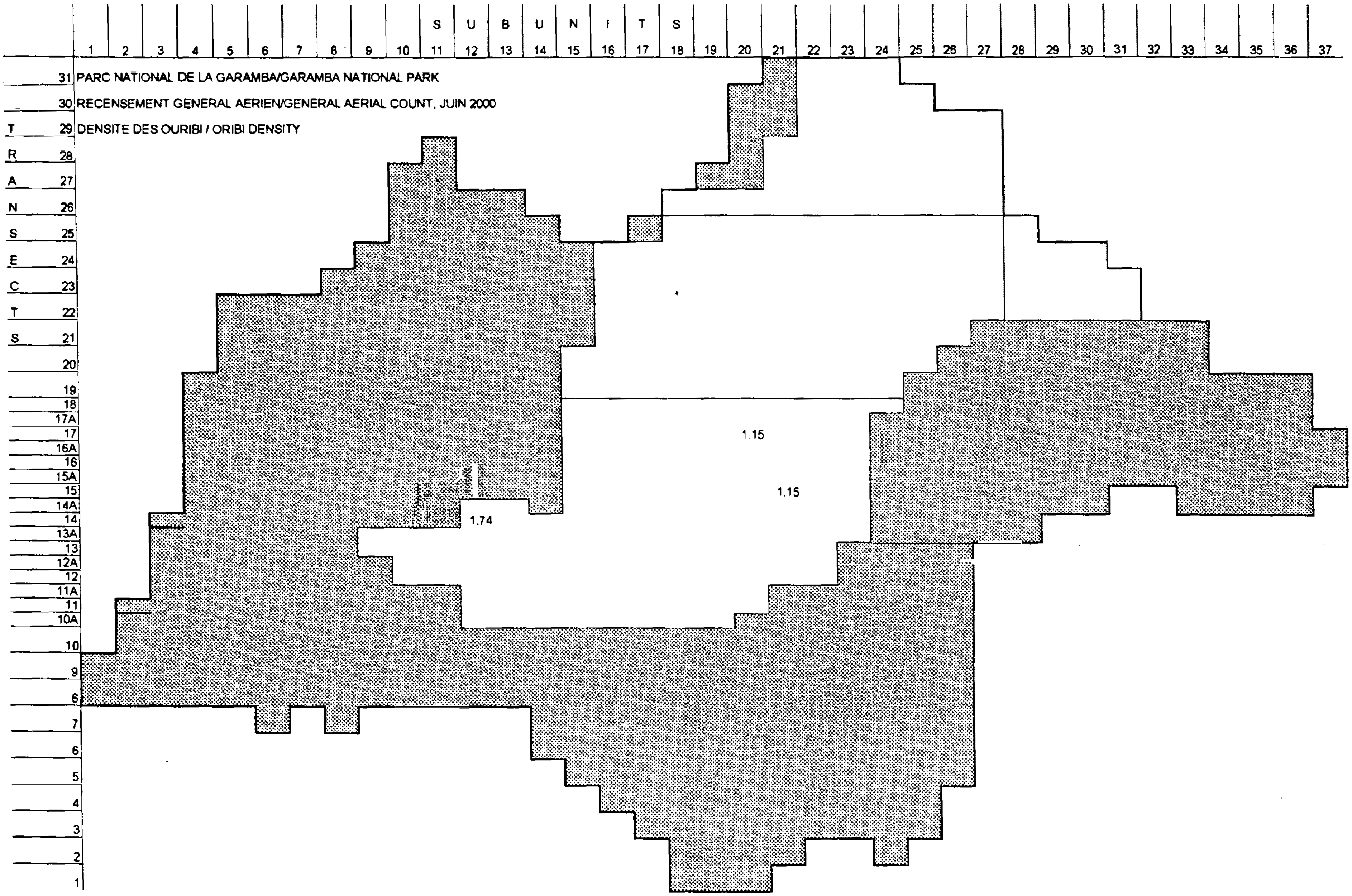



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 |
| High D | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.59 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.59 | 0 | 0 | 0 |

| | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0.54 | 0 | 0 | 0 | 0 | 0 | 0.57 | 0 | 0 | | | | | |
| Med D | 0 | 0.52 | 0 | 1.44 | 0.52 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 0.51 | 0 | 0 | 0.55 | 0 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0.51 | 0.52 | 0 | 1.98 | 0.52 | 0.54 | 0 | 0 | 0 | 0 | 0 | 0.57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



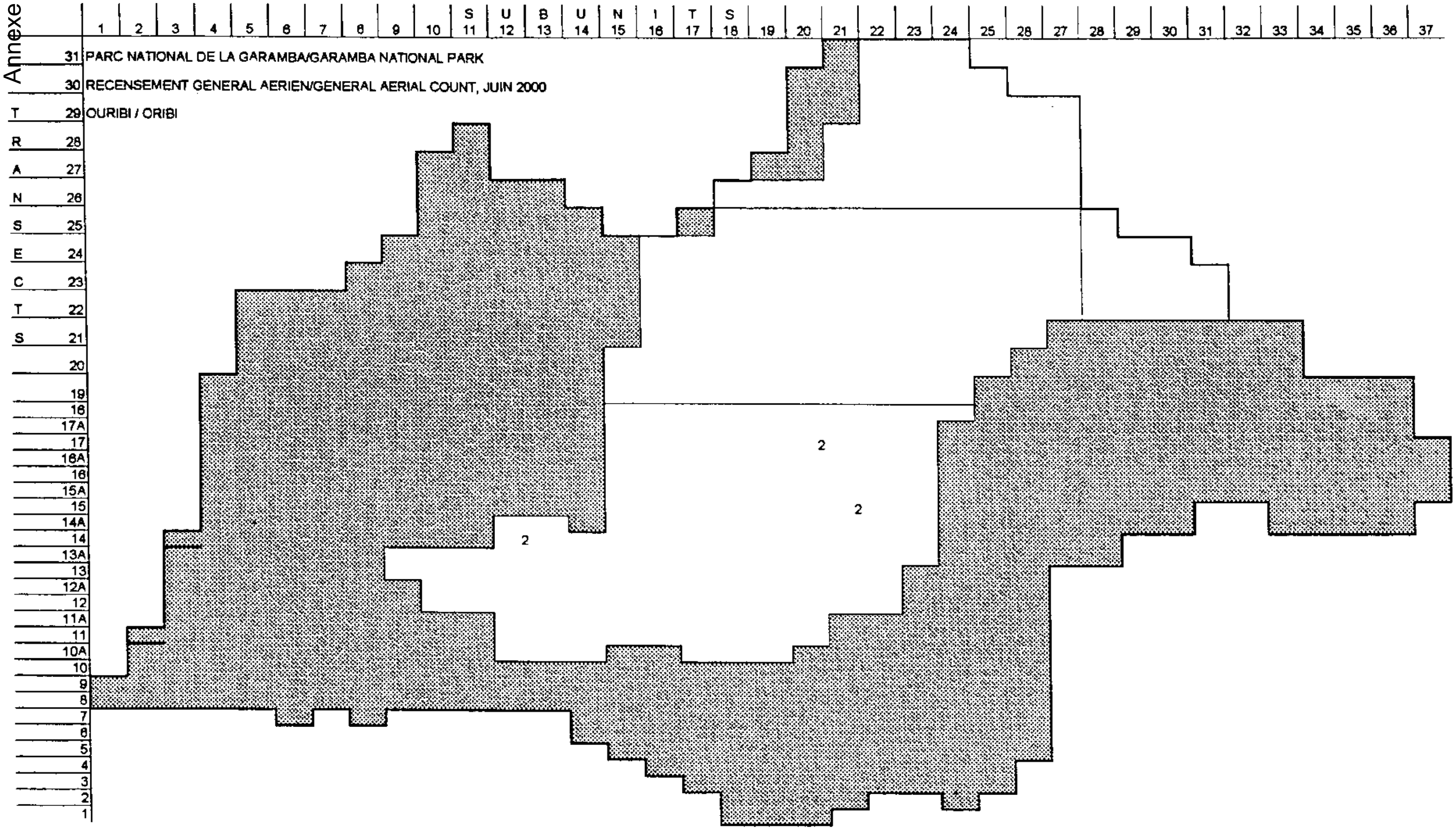

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | | | | | | | | | |
| High D | | | | | | | | | | 0 | ERR | ERR | 0 | 0 | ERR | 2 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ERR | ERR | 0 | 0 | ERR | 2 | 0 | 0 | 1 | 2 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 |
| High D | | | | | | | | | | 0 | 0 | 1.74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 1.15 | 1.15 | 0 | 0 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 1.15 | 1.15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

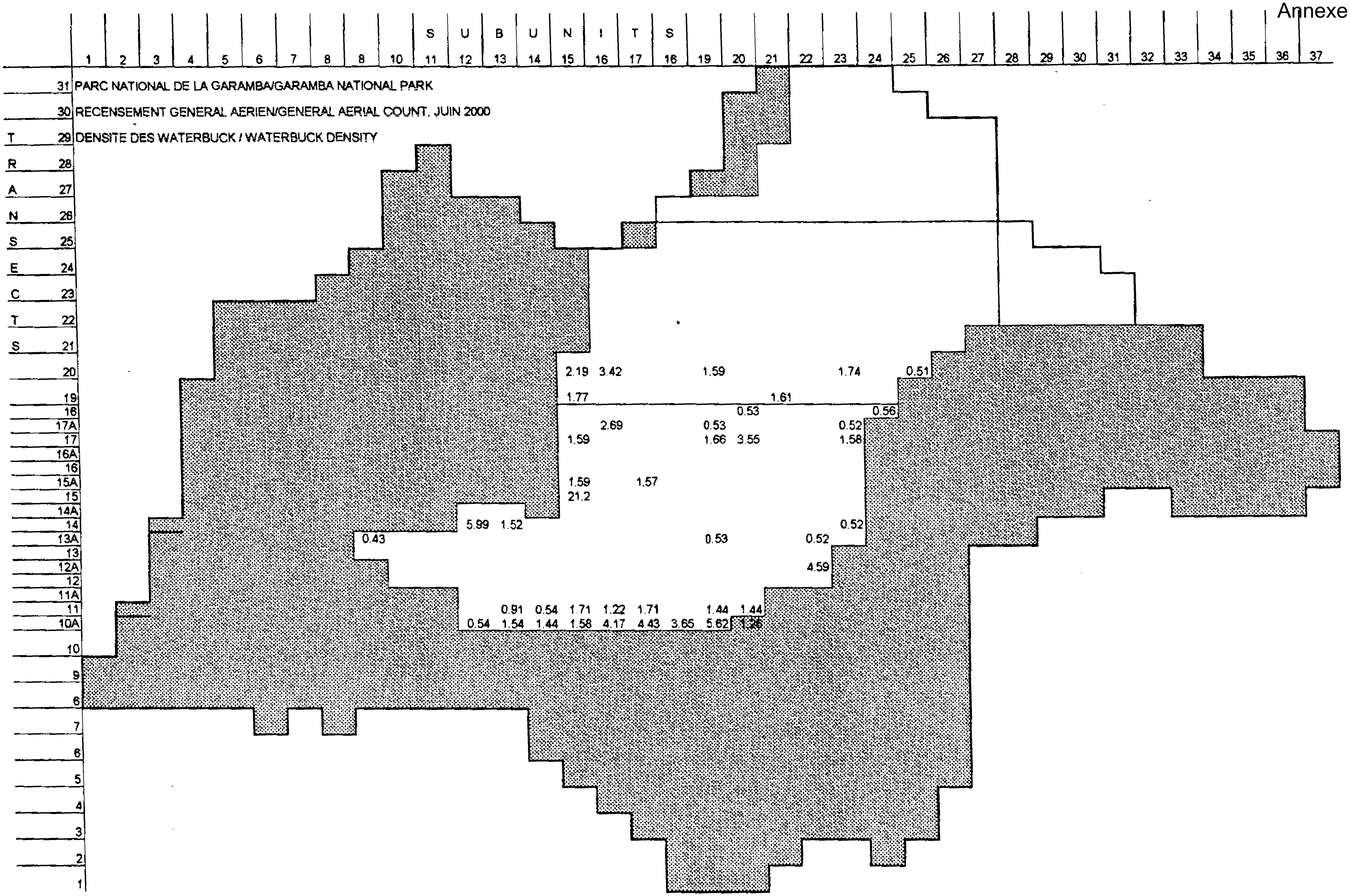
Annexe 5.15




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

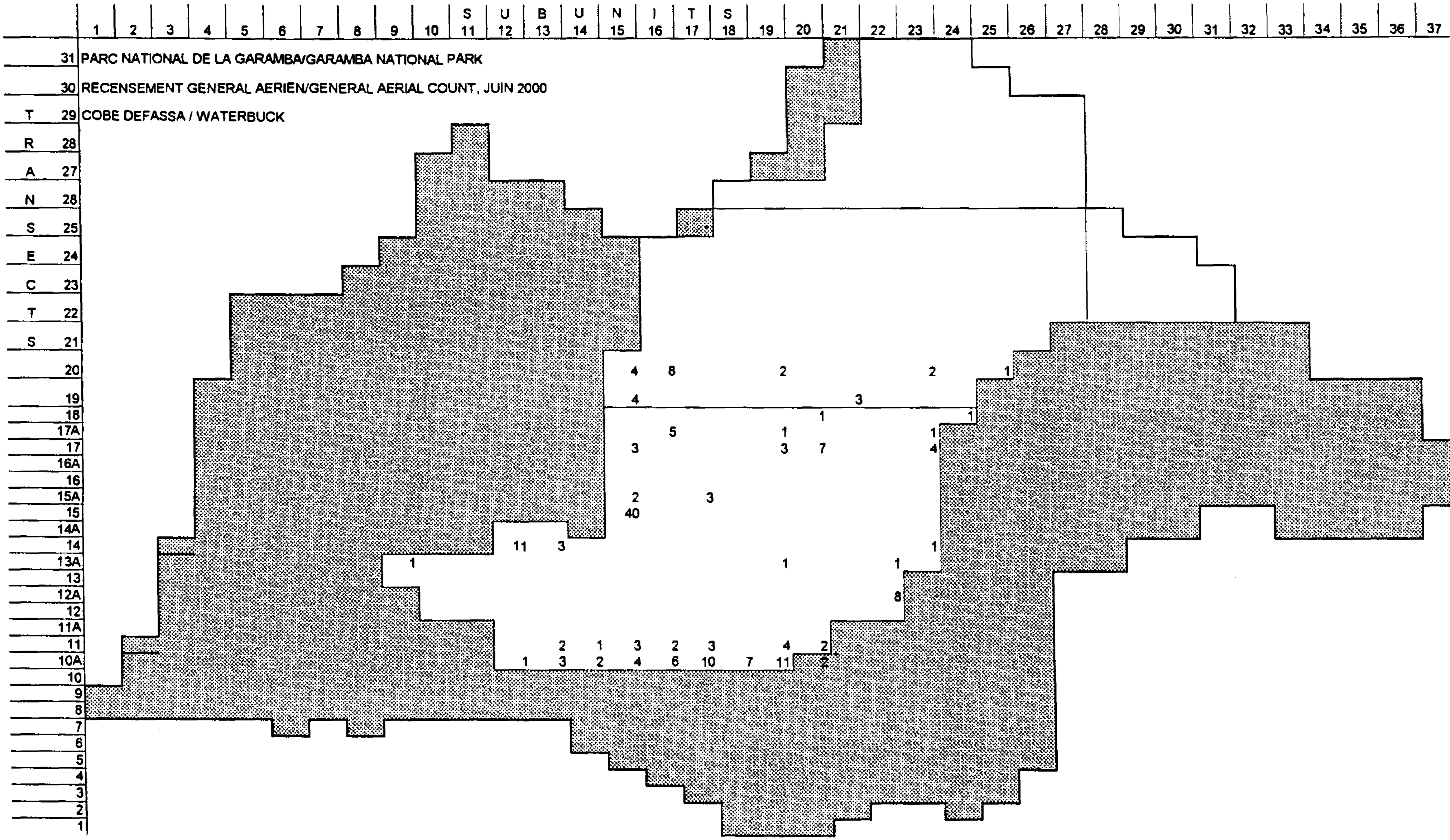
| | | | | | |
|---|---|---|---|---|---|
| 31 | | | 0 | 0 | |
| 30 | | | 0 | 0 | |
| 29 | | | 0 | 0 | |
| 28 | | | 0 | 0 | |
| 27 | | | 0 | 0 | |
| 26 | | | 0 | 0 | |
| 25 | | 0 | 0 | 0 | |
| 24 | | 0 | 0 | 0 | |
| 23 | | 0 | 0 | 0 | |
| 22 | | 0 | 0 | 0 | |
| 21 | | 0 | | 0 | |
| 20 | | 0 | | 0 | |
| 19 | | 0 | | 0 | |
| 18 | 0 | | | | |
| 17A | 0 | | | | |
| 17 | 2 | | | | |
| 16A | 0 | | | | |
| 16 | 0 | | | | |
| 15A | 0 | | | | |
| 15 | 2 | | | | |
| 14A | 0 | | | | |
| 14 | 2 | | | | |
| 13A | 0 | | | | |
| 13 | 0 | | | | |
| 12A | 0 | | | | |
| 12 | 0 | | | | |
| 11A | 0 | | | | |
| 11 | 0 | | | | |
| 10A | 0 | | | | |
| 10 | 0 | | 0 | 0 | Tota |
| 9 | 0 | 0 | | | Tota |
| 8 | 8 | | | | Tota |
| | 8 | 0 | 0 | 8 | TOT |

Annexe 5.15




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 8 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 16 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 3.42 | 0 | 0 | 1.59 |
| High D | | | | | | | | | | 0 | 0 | 5.99 | 2.44 | 0.54 | 1.71 | 3.91 | 3.28 | 0 | 4.16 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.43 | 0 | 0 | 0.54 | 0 | 0 | 28.3 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.43 | 0 | 0 | 6.53 | 2.44 | 0.54 | 30 | 7.33 | 3.28 | 0 | 5.75 |

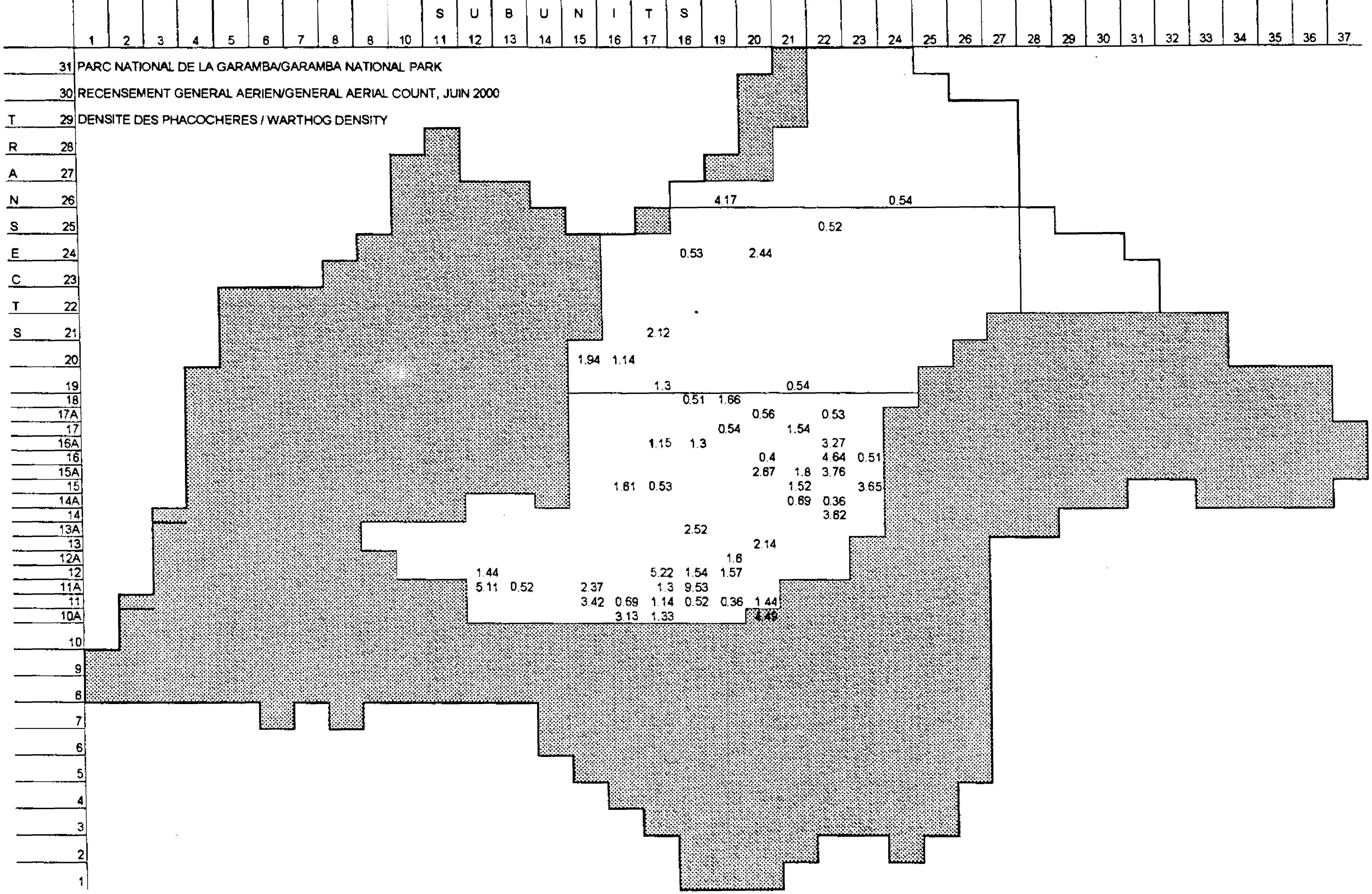
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 1.61 | 0 | 1.74 | 0 | 0.51 | 0 | 0 | | | | | | | | | | |
| High D | 5.52 | 0 | 5.11 | 2.63 | 0.56 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 5.52 | 1.61 | 5.11 | 4.37 | 0.56 | 0.51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 6 | 0 | 0 | 2 |
| High D | | | | | | | | | | 0 | ERR | ERR | 5 | 1 | ERR | 55 | 13 | 8 | 9 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 53 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | ERR | ERR | 5 | 1 | ERR | 61 | 13 | 6 | 11 |

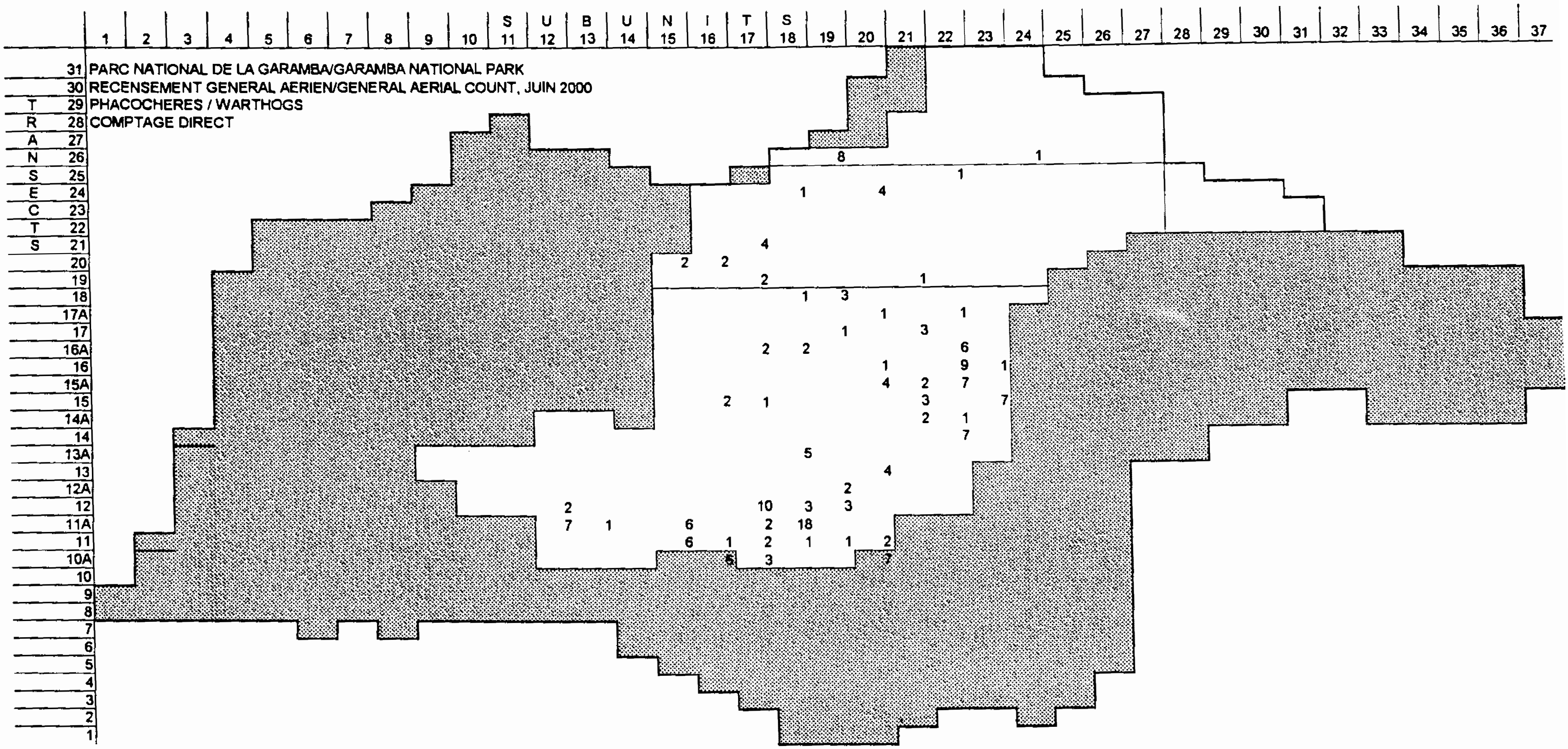
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 3 | 0 | 2 | 0 | 1 | 0 | 0 | | | | | | | | | | |
| High D | 19 | 10 | 9 | 6 | 1 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 19 | 13 | 9 | 8 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Annexe 5.15

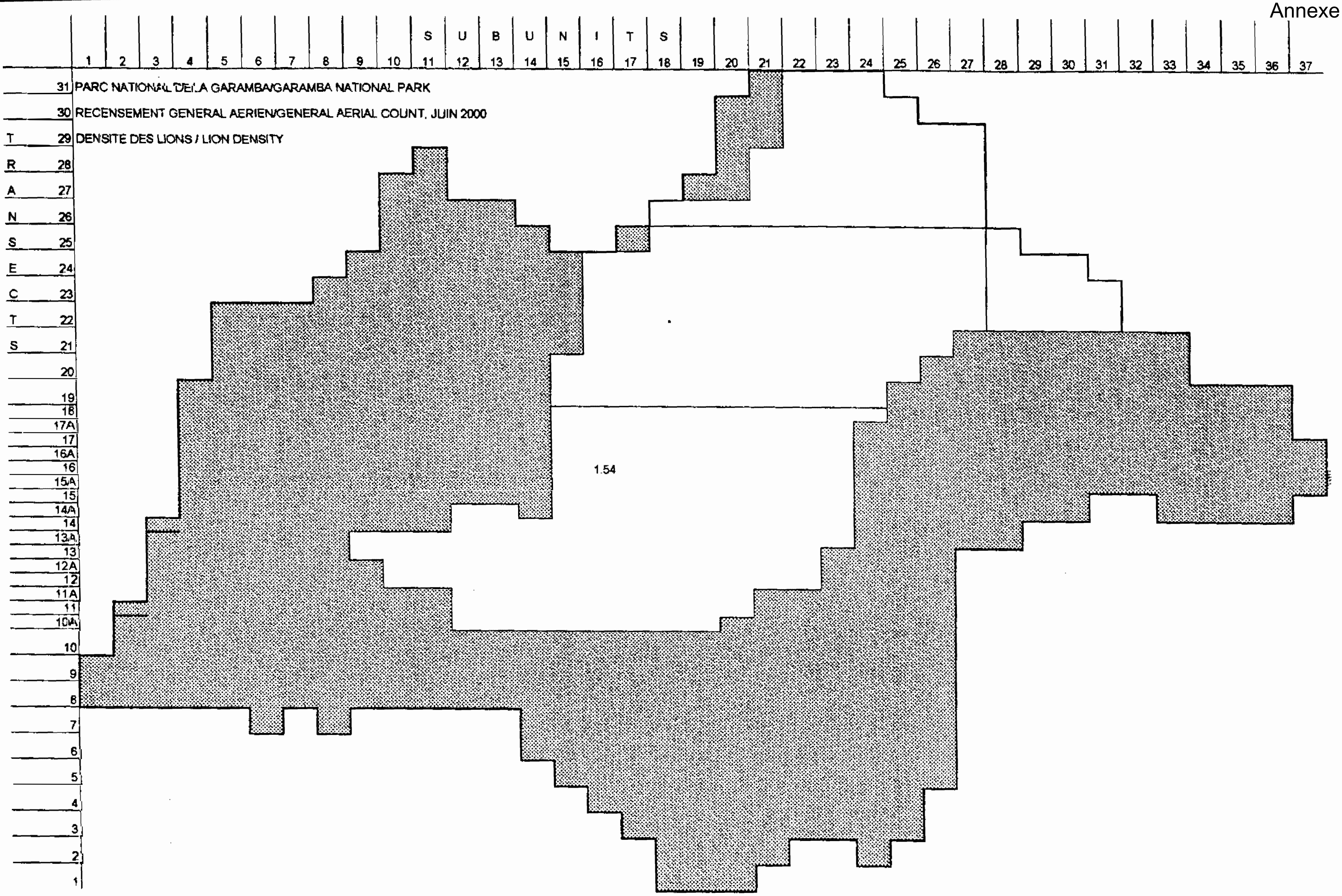



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 8 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 4.17 |
| Med D | | | | | | | | | | | | | | | | 1.14 | 3.41 | 0.53 | 0 |
| High D | | | | | | | | | | 0 | 0 | 1.44 | 0.52 | 0 | 5.6 | 2.5 | 9.33 | 15.9 | 5.92 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.94 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.44 | 0.52 | 0 | 7.74 | 3.64 | 12.7 | 16.5 | 10.1 |

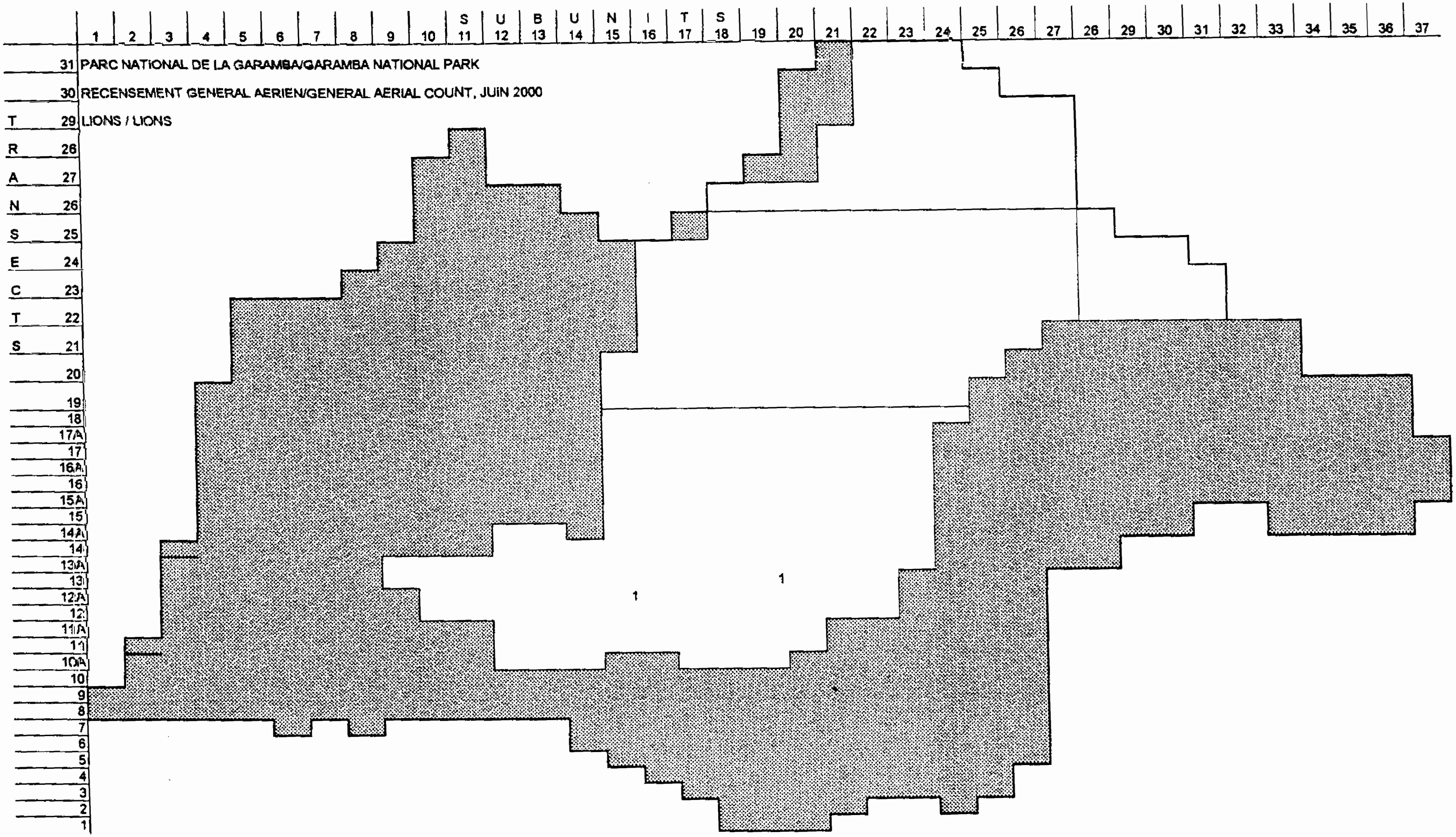
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0.54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 2.44 | 0.54 | 0.52 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 7.41 | 5.75 | 16.4 | 4.17 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 9.85 | 6.26 | 16.9 | 4.17 | 0.54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |




| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 6 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 2 | 6 | 1 | 0 | 4 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |
| High D | | | | | | | | | | 0 | ERR | ERR | 1 | 0 | ERR | 15 | 20 | 47 | 40 | 22 | 22 | 31 | 8 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ERR | ERR | 1 | 0 | ERR | 17 | 26 | 48 | 48 | 26 | 23 | 32 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



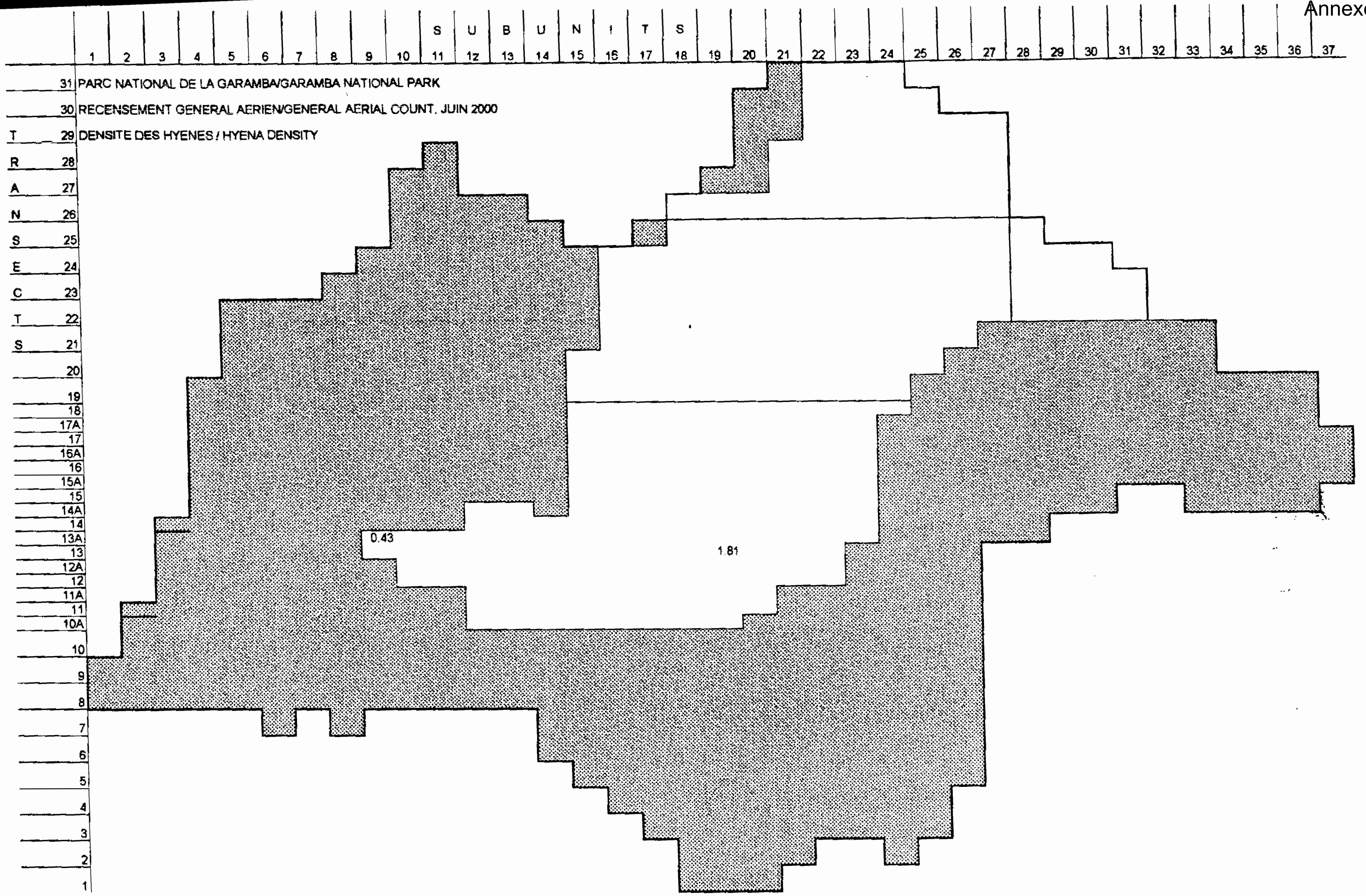

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 1.54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 |
| High D | | | | | | | | | | 0 | ERR | ERR | 0 | 0 | ERR | 1 | 0 | 0 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ERR | ERR | 0 | 0 | ERR | 1 | 0 | 0 |

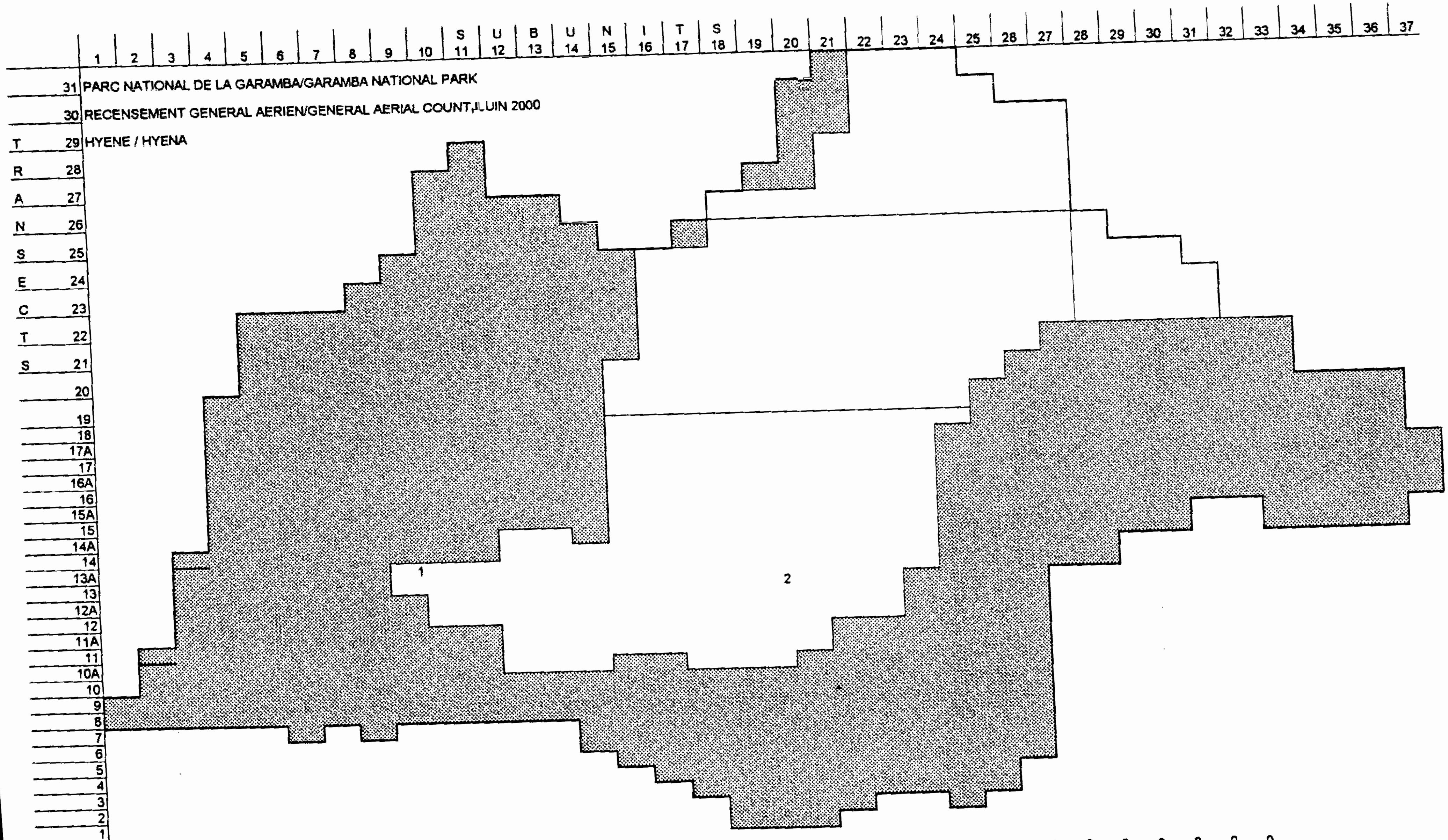
| | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 1 | 1 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Annexe 5.15



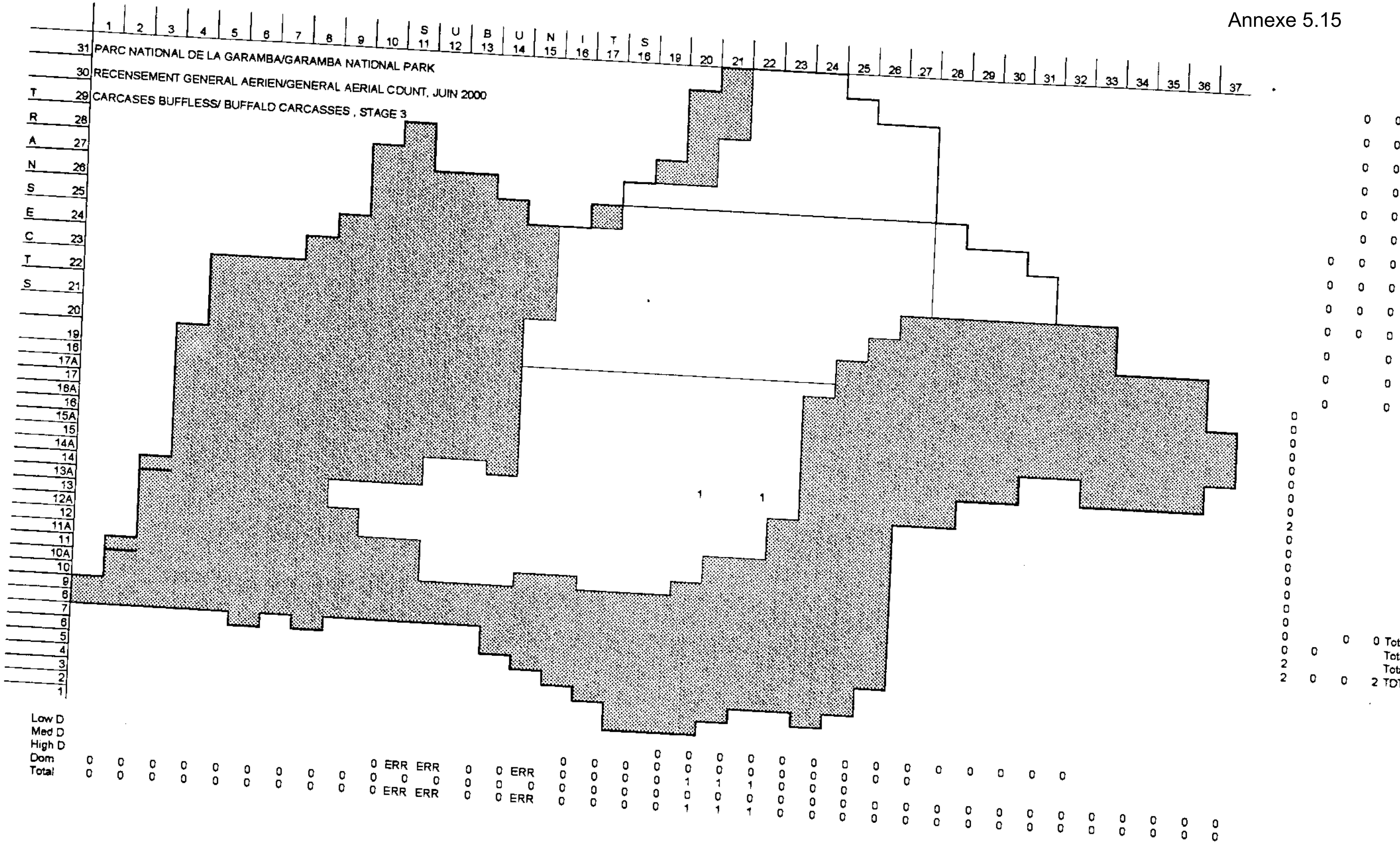

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.81 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.81 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Annexe 5.15




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

Annexe 5.15



PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, JUIN 2000
CARCASES BUFFLESS/ BUFFALO CARCASSES , STAGE 3
SUBUNITS
TRANSECTS
Low D
Med D
High D
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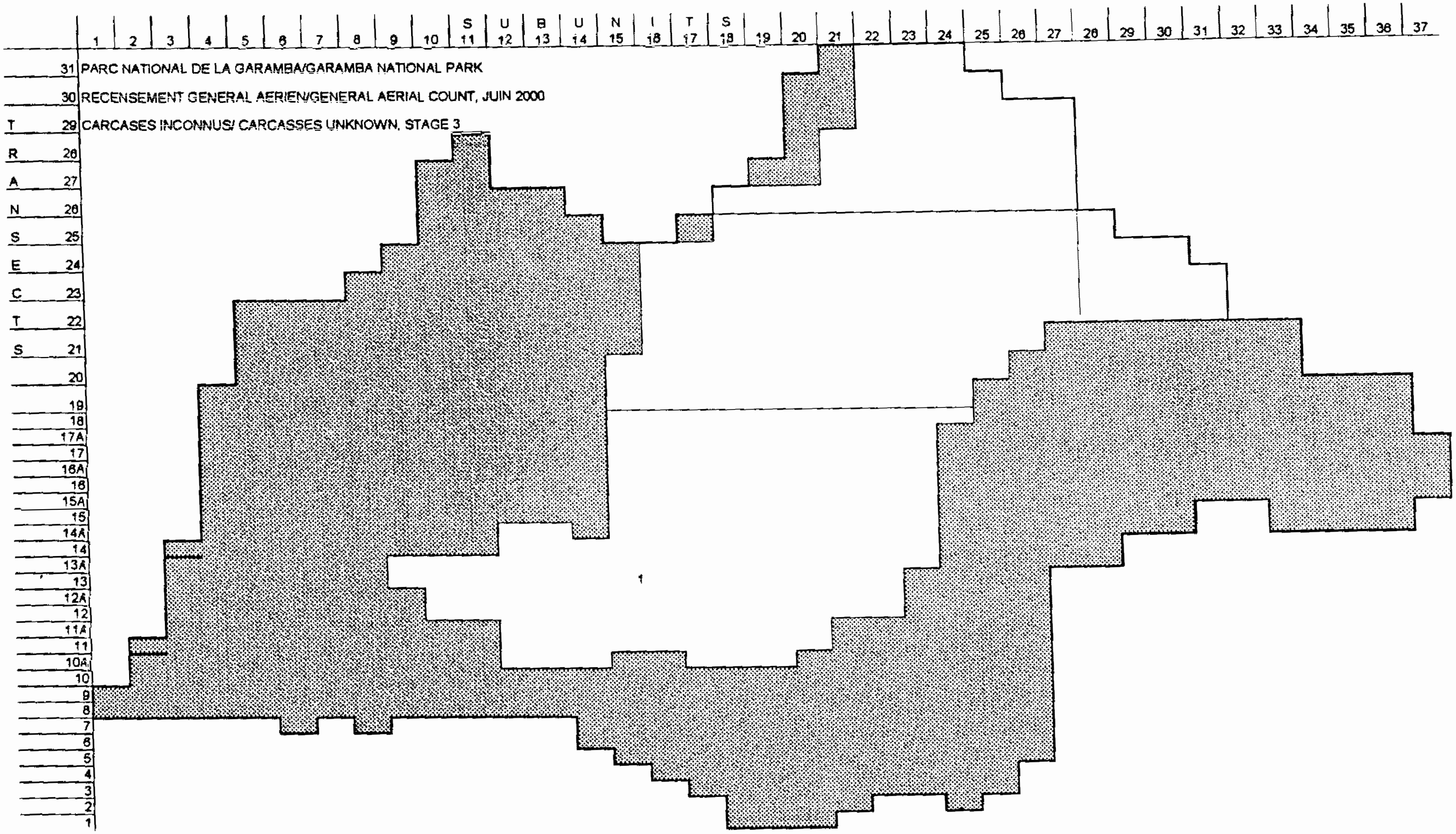
Total




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

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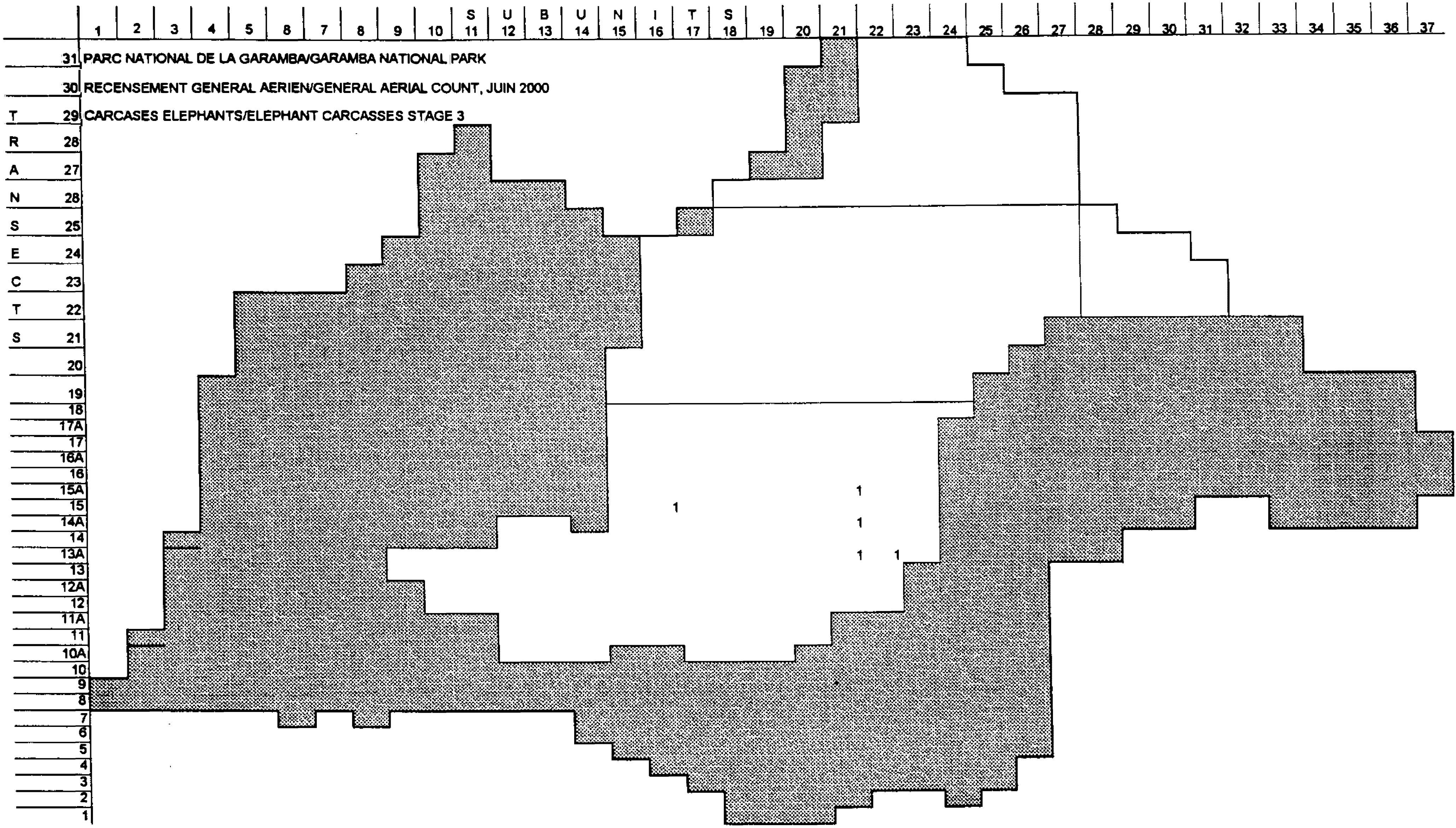
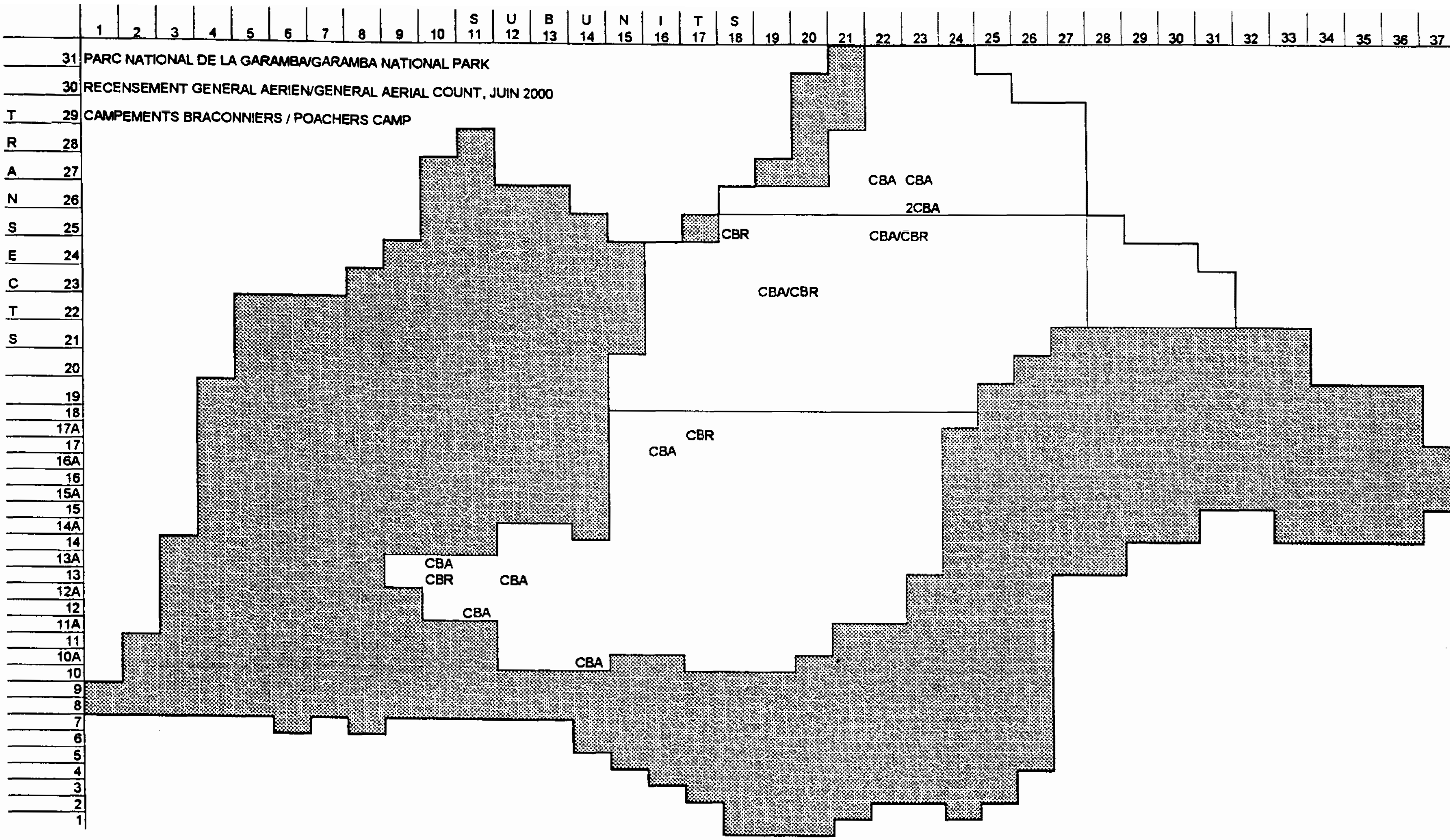
| 0 | 0 | | | Total |
| 1 | | | | Total |
| 1 | 0 | 0 | 1 | TOTAL |

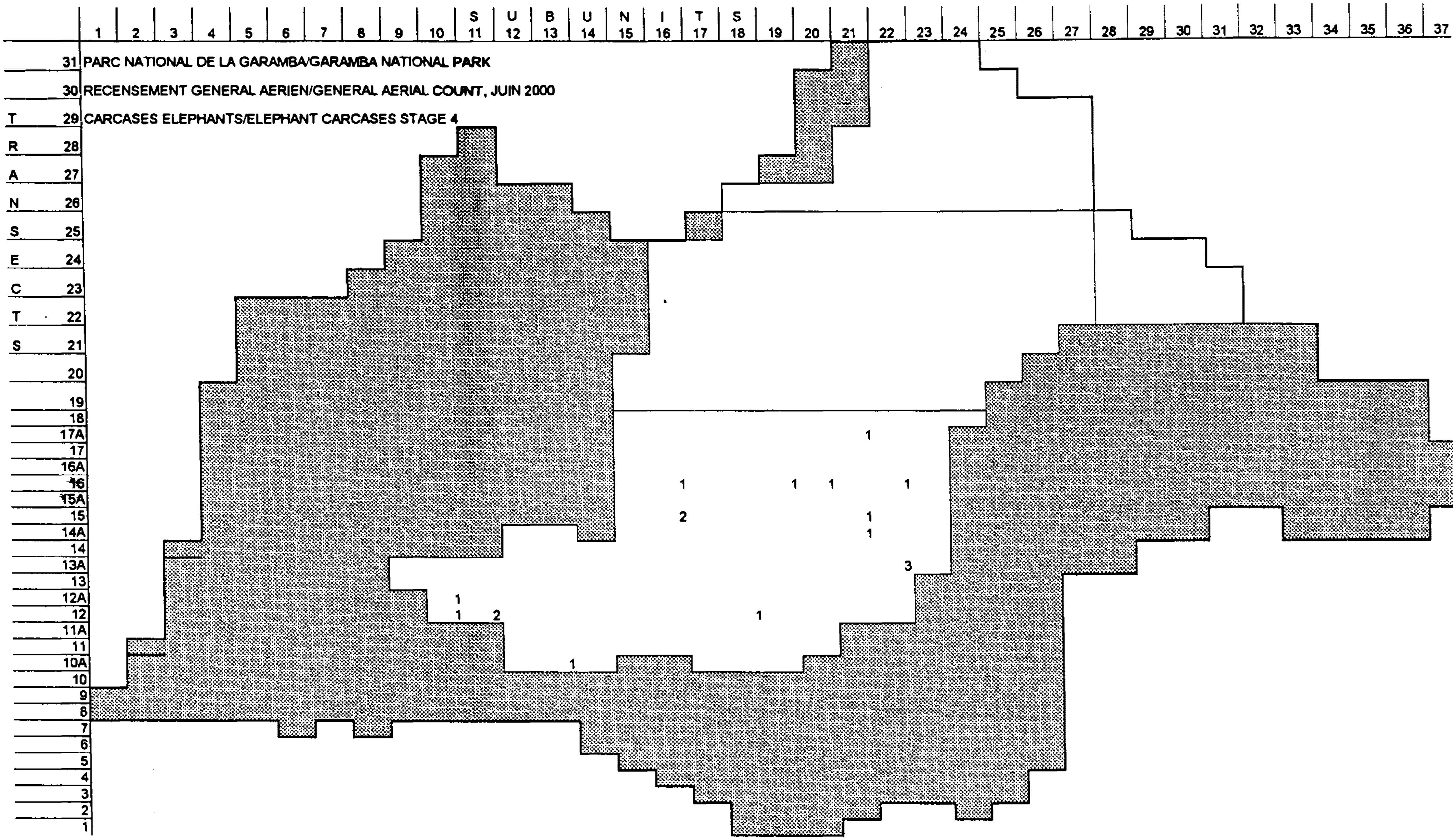



| | 1 | 2 | 3 | 4 | 5 | 8 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|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




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

Annexe 5.15




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | |
| Med D | | | | | | | | | | | | | | | | | 0 | 0 | 0 |
| High D | | | | | | | | | | | 0 | ERR | ERR | 0 | 0 | ERR | 3 | 3 | 1 |
| Dom | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | ERR | ERR | 0 | 0 | ERR | 3 | 3 | 1 |

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| Med D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |
| High D | 2 | 2 | 4 | 4 | 0 | 0 | 0 | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 2 | 2 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | PNG 2000 | AREA | | | ELEPHANTS | | | | | BUFFALOS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STH | MID NTH | LOW NTH | TOT NORTH | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL |
| 31 | | | 5.75 | 5.75 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 8.62 | 8.62 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 12.38 | 12.38 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 13.50 | 13.50 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 13.44 | 13.44 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 18.90 | 18.90 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 19.97 | 2.19 | 22.16 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 21.85 | 6.66 | 28.51 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 23.50 | 15.30 | 38.80 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 22.75 | 7.45 | 30.20 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 21.42 | | 21.42 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 20.75 | | 20.75 | | 0 | | 0 | | | 0 | | 0 | |
| 19 | | 20.90 | | 20.90 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 19.00 | | | | 0 | | | | | 1 | | | | |
| 17a | 16.86 | | | | 55 | | | | | 50 | | | | |
| 17 | 17.87 | | | | 94 | | | | | 28 | | | | |
| 16a | 17.61 | | | | 38 | | | | | 22 | | | | |
| 16 | 17.83 | | | | 83 | | | | | 20 | | | | |
| 15a | 18.10 | | | | 68 | | | | | 387 | | | | |
| 15 | 17.14 | | | | 103 | | | | | 180 | | | | |
| 14a | 22.33 | | | | 58 | | | | | 98 | | | | |
| 14 | 22.69 | | | | 21 | | | | | 66 | | | | |
| 13a | 29.29 | | | | 24 | | | | | 184 | | | | |
| 13 | 28.51 | | | | 50 | | | | | 44 | | | | |
| 12a | 25.19 | | | | 54 | | | | | 492 | | | | |
| 12 | 25.50 | | | | 191 | | | | | 160 | | | | |
| 11a | 18.63 | | | | 47 | | | | | 173 | | | | |
| 11 | 17.75 | | | | 39 | | | | | 100 | | | | |
| 10a | 17.83 | | | | 2 | | | | | 8 | | | | |
| Total | 332.1 | 151.1 | 104.2 | 255.3 | 927.0 | 0.0 | 0.0 | 0.0 | | 2013.0 | 0.0 | 0.0 | 0.0 | |
| Sum squ | 7163.0 | 3272.1 | 980.6 | 6028.1 | 85439.0 | 0.0 | 0.0 | 0.0 | | 543747.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Sum (Z*y) | 19486.2 | 0.0 | 0.0 | 0.0 | | 44138.3 | 0.0 | 0.0 | 0.0 | |
| | | | | R=Sy/Sz | 2.8 | 0.0 | 0.0 | 0.0 | | 6.1 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 2115.4 | 0.0 | 0.0 | 0.0 | | 19365.8 | 0.0 | 0.0 | 0.0 | |
| Var z | 17.9 | 1.5 | 20.5 | 84.5 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | 16.2 | 0.0 | 0.0 | 0.0 | TOTAL | 156.8 | 0.0 | 0.0 | 0.0 | TOTAL |
| | | | | | ELEPHANTS | | | | | BUFFALOS | | | | |
| | | | | Pop.est.(Y) | **5,896** | **0** | **0** | **0** | **5,896** | **12,804** | **0** | **0** | **0** | **12,804** |
| | | | | SE(Y) | 1066.0 | 0.0 | 0.0 | 0.0 | 1066.0 | 3084.5 | 0.0 | 0.0 | 0.0 | 3084.54 |
| | | | | 95% C.L. | 2174.5 | 0.0 | 0.0 | 0.0 | 2089.3 | 6292.5 | 0.0 | 0.0 | 0.0 | 6045.70 |
| | | | | 95% C.L.as % | 36.9 | 0.0 | 0.0 | 0.0 | 35.4 | 49.1 | ERR | ERR | ERR | 47.22 |

| | PNG 2000 | AREA | | | COBS | | | | | HARTBEEST | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STH | MID NTH | LOW NTH | TOT NORTH | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL |
| 31 | | | 5.75 | 5.75 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 8.62 | 8.62 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 12.38 | 12.38 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 13.50 | 13.50 | | | 0 | 0 | | | | 1 | 1 | |
| 27 | | | 13.44 | 13.44 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 18.90 | 18.90 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 19.97 | 2.19 | 22.16 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 21.85 | 6.66 | 28.51 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 23.50 | 15.30 | 38.80 | | 0 | 0 | 0 | | | 2 | 0 | 2 | |
| 22 | | 22.75 | 7.45 | 30.20 | | 0 | 0 | 0 | | | 3 | 0 | 3 | |
| 21 | | 21.42 | | 21.42 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 20.75 | | 20.75 | | 0 | | 0 | | | 2 | | 2 | |
| 19 | | 20.90 | | 20.90 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 19.00 | | | | 2 | | | | | 3 | | | | |
| 17a | 16.86 | | | | 42 | | | | | 6 | | | | |
| 17 | 17.87 | | | | 1 | | | | | 0 | | | | |
| 16a | 17.61 | | | | 24 | | | | | 1 | | | | |
| 16 | 17.83 | | | | 148 | | | | | 0 | | | | |
| 15a | 18.10 | | | | 36 | | | | | 6 | | | | |
| 15 | 17.14 | | | | 48 | | | | | 10 | | | | |
| 14a | 22.33 | | | | 7 | | | | | 15 | | | | |
| 14 | 22.69 | | | | 31 | | | | | 33 | | | | |
| 13a | 29.29 | | | | 5 | | | | | 34 | | | | |
| 13 | 28.51 | | | | 0 | | | | | 24 | | | | |
| 12a | 25.19 | | | | 1 | | | | | 14 | | | | |
| 12 | 25.50 | | | | 51 | | | | | 10 | | | | |
| 11a | 18.63 | | | | 63 | | | | | 7 | | | | |
| 11 | 17.75 | | | | 89 | | | | | 0 | | | | |
| 10a | 17.83 | | | | 16 | | | | | 0 | | | | |
| Total | 332.1 | 151.1 | 104.2 | 255.3 | 564.0 | 0.0 | 0.0 | 0.0 | | 163.0 | 7.0 | 1.0 | 8.0 | |
| Sum squ | 7163.0 | 3272.1 | 980.6 | 6028.1 | 43632.0 | 0.0 | 0.0 | 0.0 | | 3573.0 | 17.0 | 1.0 | 18.0 | |
| | | | | Sum (Z*y) | 10670.8 | 0.0 | 0.0 | 0.0 | | 3957.7 | 156.8 | 13.5 | 223.2 | |
| | | | | R=Sy/Sz | 1.7 | 0.0 | 0.0 | 0.0 | | 0.5 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 1583.4 | 0.0 | 0.0 | 0.0 | | 127.5 | 1.7 | 0.2 | 1.1 | |
| Var z | 17.9 | 1.5 | 20.5 | 84.5 | | | | | STRAT. | | | | | STRAT |
| Covar zy | | | | | -69.1 | 0.0 | 0.0 | 0.0 | TOTAL | 38.3 | -3.9 | 0.3 | 4.8 | TOTAL |
| | | | | | COBS | | | | | HARTBEEST | | | | |
| | | | | Pop.est.(Y) | **3,587** | **0** | **0** | **0** | **3,587** | **1,037** | **90** | **12** | **99** | **1,139** |
| | | | | SE(Y) | 990.8 | 0.0 | 0.0 | 0.0 | 990.8 | 222.4 | 51.2 | 9.9 | 38.4 | 231.6 |
| | | | | 95% C.L. | 2021.2 | 0.0 | 0.0 | 0.0 | 1941.9 | 453.8 | 104.4 | 20.1 | 78.3 | 454.0 |
| | | | | 95% C.L.as % | 56.3 | 0.0 | 0.0 | 0.0 | 54.1 | 43.8 | 115.6 | 170.9 | 78.7 | 39.8 |

| TRANS | PNG 2000 AREA HIGH STH | MID NTH | LOW NTH | TOT NORTH | WARTHOGS HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL | WATERBUCK HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | | | 5.75 | 5.75 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 8.62 | 8.62 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 12.38 | 12.38 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 13.50 | 13.50 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 13.44 | 13.44 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 18.90 | 18.90 | | | 9 | 9 | | | | 0 | 0 | |
| 25 | | 19.97 | 2.19 | 22.16 | | 1 | 0 | 1 | | | 0 | 0 | 0 | |
| 24 | | 21.85 | 6.66 | 28.51 | | 5 | 0 | 5 | | | 0 | 0 | 0 | |
| 23 | | 23.50 | 15.30 | 38.80 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 22.75 | 7.45 | 30.20 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 21.42 | | 21.42 | | 4 | | 4 | | | 0 | | 0 | |
| 20 | | 20.75 | | 20.75 | | 4 | | 4 | | | 15 | | 15 | |
| 19 | | 20.90 | | 20.90 | | 3 | | 3 | | | 7 | | 7 | |
| 18 | 19.00 | | | | 4 | | | | | 2 | | | | |
| 17a | 16.86 | | | | 2 | | | | | 7 | | | | |
| 17 | 17.87 | | | | 4 | | | | | 17 | | | | |
| 16a | 17.61 | | | | 10 | | | | | 0 | | | | |
| 16 | 17.83 | | | | 10 | | | | | 0 | | | | |
| 15a | 18.10 | | | | 13 | | | | | 5 | | | | |
| 15 | 17.14 | | | | 6 | | | | | 40 | | | | |
| 14a | 22.33 | | | | 3 | | | | | 0 | | | | |
| 14 | 22.69 | | | | 7 | | | | | 15 | | | | |
| 13a | 29.29 | | | | 5 | | | | | 3 | | | | |
| 13 | 28.51 | | | | 4 | | | | | 0 | | | | |
| 12a | 25.19 | | | | 2 | | | | | 8 | | | | |
| 12 | 25.50 | | | | 18 | | | | | 0 | | | | |
| 11a | 18.63 | | | | 34 | | | | | 0 | | | | |
| 11 | 17.75 | | | | 11 | | | | | 17 | | | | |
| 10a | 17.83 | | | | 9 | | | | | 48 | | | | |
| Total | 332.1 | 151.1 | 104.2 | 255.3 | 142.0 | 17.0 | 9.0 | 26.0 | | 162.0 | 22.0 | 0.0 | 22.0 | |
| Sum squ | 7163.0 | 3272.1 | 980.6 | 6028.1 | 2226.0 | 67.0 | 81.0 | 148.0 | | 4858.0 | 274.0 | 0.0 | 274.0 | |
| | | | | Sum (Z*y) | 2858.6 | 360.6 | 170.1 | 566.2 | | 3022.9 | 457.5 | 0.0 | 457.5 | |
| | | | | R=Sy/Sz | 0.4 | 0.1 | 0.1 | 0.1 | | 0.5 | 0.1 | 0.0 | 0.1 | |
| | | | | Var y | 64.4 | 4.3 | 13.5 | 8.0 | | 214.5 | 34.1 | 0.0 | 19.7 | |
| Var z | 17.9 | 1.5 | 20.5 | 84.5 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | -5.9 | -13.5 | 8.5 | 1.2 | TOTAL | -22.7 | -19.3 | 0.0 | -1.0 | TOTAL |
| | | | | | WARTHOG | | | | | WATERBUCK | | | | |
| | | | | **Pop.est.(Y)** | **903** | **219** | **106** | **323** | **1,228** | **1,030** | **284** | **0** | **274** | **1,314** |
| | | | | SE(Y) | 195.4 | 97.3 | 85.4 | 120.4 | 234.4 | 355.6 | 226.5 | 0.0 | 192.8 | 463.63 |
| | | | | 95% C.L. | 398.6 | 198.6 | 174.3 | 245.7 | 459.5 | 725.5 | 462.1 | 0.0 | 393.4 | 908.72 |
| | | | | 95% C.L.as % | 44.1 | 0.0 | 0.0 | 0.0 | 37.4 | 70.4 | 162.8 | ERR | 143.8 | 69.14 |

| TRANS | PNG 2000 AREA HIGH STH | MID NTH | LOW NTH | TOT NORTH | RHINOS HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL | HIPPOS HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | | | 5.75 | 5.75 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 8.62 | 8.62 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 12.38 | 12.38 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 13.50 | 13.50 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 13.44 | 13.44 | | | 0 | 0 | | | | 1 | 1 | |
| 26 | | | 18.90 | 18.90 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 19.97 | 2.19 | 22.16 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 21.85 | 6.66 | 28.51 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 23.50 | 15.30 | 38.80 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 22.75 | 7.45 | 30.20 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 21.42 | | 21.42 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 20.75 | | 20.75 | | 0 | | 0 | | | 0 | | 0 | |
| 19 | | 20.90 | | 20.90 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 19.00 | | | | 0 | | | | | 0 | | | | |
| 17a | 16.86 | | | | 0 | | | | | 0 | | | | |
| 17 | 17.87 | | | | 0 | | | | | 20 | | | | |
| 16a | 17.61 | | | | 0 | | | | | 0 | | | | |
| 16 | 17.83 | | | | 0 | | | | | 1 | | | | |
| 15a | 18.10 | | | | 0 | | | | | 0 | | | | |
| 15 | 17.14 | | | | 0 | | | | | 0 | | | | |
| 14a | 22.33 | | | | 0 | | | | | 6 | | | | |
| 14 | 22.69 | | | | 0 | | | | | 87 | | | | |
| 13a | 29.29 | | | | 3 | | | | | 4 | | | | |
| 13 | 28.51 | | | | 0 | | | | | 9 | | | | |
| 12a | 25.19 | | | | 0 | | | | | 3 | | | | |
| 12 | 25.50 | | | | 0 | | | | | 4 | | | | |
| 11a | 18.63 | | | | 0 | | | | | 12 | | | | |
| 11 | 17.75 | | | | 0 | | | | | 2 | | | | |
| 10a | 17.83 | | | | 0 | | | | | 0 | | | | |
| Total | 332.1 | 151.1 | 104.2 | 255.3 | 3.0 | 0.0 | 0.0 | 0.0 | | 148.0 | 0.0 | 1.0 | 1.0 | |
| Sum squ | 7163.0 | 3272.1 | 980.6 | 6028.1 | 9.0 | 0.0 | 0.0 | 0.0 | | 8276.0 | 0.0 | 1.0 | 1.0 | |
| | | | | Sum (Z*y) | 87.9 | 0.0 | 0.0 | 0.0 | | 3293.9 | 0.0 | 13.4 | 13.4 | |
| | | | | R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 0.4 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 0.6 | 0.0 | 0.0 | 0.0 | | 460.5 | 0.0 | 0.2 | 0.1 | |
| Var z | 17.9 | 1.5 | 20.5 | 84.5 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | 1.7 | 0.0 | 0.0 | 0.0 | TOTAL | 14.8 | 0.0 | 0.3 | -0.7 | TOTAL |
| | | | | | RHINOS | | | | | HIPPOS | | | | |
| | | | | **Pop.est.(Y)** | **19** | **0** | **0** | **0** | **19** | **941** | **0** | **12** | **12** | **953** |
| | | | | SE(Y) | 16.7 | 0.0 | 0.0 | 0.0 | 16.7 | 486.5 | 0.0 | 9.9 | 12.4 | 486.77 |
| | | | | 95% C.L. | 34.1 | 0.0 | 0.0 | 0.0 | 32.8 | 992.5 | 0.0 | 20.1 | 25.3 | 954.08 |
| | | | | 95% C.L.as % | 178.9 | 0.0 | 0.0 | 0.0 | 171.8 | 105.4 | ERR | 171.0 | 203.7 | 100.10 |

| | PNG 2000 | AREA | | | BUSHBUCK | | | | | REEDBUCK | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [illegible] | NTH | LOW NTI | TOT NORTH | HIGH STH | MID NTH | LOW N | TOT NTH | TOTAL | [illegible]TH | MID NTH | LOW NTH | TOT NTH | TOTAL |
| 31 | | | 5.75 | 5.75 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 8.62 | 8.62 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 12.38 | 12.38 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 13.50 | 13.50 | | | 1 | 1 | | | | 0 | 0 | |
| 27 | | | 13.44 | 13.44 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 18.90 | 18.90 | | | 1 | 1 | | | | 1 | 1 | |
| 25 | | 19.97 | 2.19 | 22.16 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 21.85 | 6.66 | 28.51 | | 0 | 0 | 0 | | | 1 | 0 | 1 | |
| 23 | | 23.50 | 15.30 | 38.80 | | 0 | 1 | 1 | | | 0 | 1 | 1 | |
| 22 | | 22.75 | 7.45 | 30.20 | | 1 | 0 | 1 | | | 0 | 0 | 0 | |
| 21 | | 21.42 | | 21.42 | | 1 | | 1 | | | 1 | | 1 | |
| 20 | | 20.75 | | 20.75 | | 0 | | 0 | | | 2 | | 2 | |
| 19 | | 20.90 | | 20.90 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 19.00 | | | | 0 | | | | | 1 | | | | |
| 17a | 16.86 | | | | 1 | | | | | 0 | | | | |
| 17 | 17.87 | | | | 0 | | | | | 0 | | | | |
| 16a | 17.61 | | | | 1 | | | | | 0 | | | | |
| 16 | 17.83 | | | | 0 | | | | | 1 | | | | |
| 15a | 18.10 | | | | 0 | | | | | 0 | | | | |
| 15 | 17.14 | | | | 1 | | | | | 2 | | | | |
| 14a | 22.33 | | | | 1 | | | | | 0 | | | | |
| 14 | 22.69 | | | | 0 | | | | | 0 | | | | |
| 13a | 29.29 | | | | 0 | | | | | 0 | | | | |
| 13 | 28.51 | | | | 0 | | | | | 0 | | | | |
| 12a | 25.19 | | | | 0 | | | | | 0 | | | | |
| 12 | 25.50 | | | | 0 | | | | | 0 | | | | |
| 11a | 18.63 | | | | 0 | | | | | 0 | | | | |
| 11 | 17.75 | | | | 0 | | | | | 0 | | | | |
| 10a | 17.83 | | | | 0 | | | | | 0 | | | | |
| Total | 332.1 | 151.1 | 104.2 | 255.3 | 4.0 | 2.0 | 3.0 | 5.0 | | 4.0 | 4.0 | 2.0 | 6.0 | |
| Sum squ | 7163.0 | 3272.1 | 980.6 | 6028.1 | 4.0 | 2.0 | 2.0 | 5.0 | | 6.0 | 6.0 | 1.0 | 8.0 | |
| | | | | Sum (Z*y) | 73.9 | 44.2 | 32.4 | 122.8 | | 71.1 | 84.8 | 18.9 | 149.1 | |
| | | | | R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 0.2 | 0.2 | 0.3 | 0.3 | | 0.3 | 0.6 | 0.2 | 0.4 | |
| Var z | 17.9 | 1.5 | 20.5 | 84.5 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | -0.6 | -1.2 | 0.1 | 1.5 | TOTAL | -0.8 | -3.2 | -0.2 | 2.0 | TOTAL |
| | | | | | **BUSHBUCK** | | | | | **REEDBUCK** | | | | |
| | | | | **Pop.est.(Y)** | **25** | **26** | **35** | **62** | **87** | **25** | **52** | **24** | **75** | **101** |
| | | | | SE(Y) | 10.7 | 18.7 | 12.9 | 19.2 | 25.1 | 13.7 | 31.9 | 10.5 | 25.4 | 44.23 |
| | | | | 95% C.L. | 21.8 | 38.1 | 26.2 | 39.2 | 49.2 | 27.9 | 65.1 | 21.3 | 51.7 | 86.70 |
| | | | | 95% C.L.as % | 85.6 | 0.0 | 0.0 | 0.0 | 56.8 | 109.5 | 126.1 | 90.7 | 69.3 | 86.21 |

| TRANS | PNG 2000 HIGH STH | AREA MID NTH | LOW NTH | TOT NORTH | LION HIGH STH | MID NTH | LOW NT | TOT NTH | TOTAL | HYENA HIGH STH | [illegible] | LOW NTH | TOT NTH | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | | | 5.75 | 5.75 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 8.62 | 8.62 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 12.38 | 12.38 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 13.50 | 13.50 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 13.44 | 13.44 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 18.90 | 18.90 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 19.97 | 2.19 | 22.16 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 21.85 | 6.66 | 28.51 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 23.50 | 15.30 | 38.80 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 22.75 | 7.45 | 30.20 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 21.42 | | 21.42 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 20.75 | | 20.75 | | 0 | | 0 | | | 0 | | 0 | |
| 19 | | 20.90 | | 20.90 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 19.00 | | | | 0 | | | | | 0 | | | | |
| 17a | 16.86 | | | | 0 | | | | | 0 | | | | |
| 17 | 17.87 | | | | 0 | | | | | 0 | | | | |
| 16a | 17.61 | | | | 0 | | | | | 0 | | | | |
| 16 | 17.83 | | | | 3 | | | | | 0 | | | | |
| 15a | 18.10 | | | | 0 | | | | | 0 | | | | |
| 15 | 17.14 | | | | 0 | | | | | 0 | | | | |
| 14a | 22.33 | | | | 0 | | | | | 0 | | | | |
| 14 | 22.69 | | | | 0 | | | | | 0 | | | | |
| 13a | 29.29 | | | | 0 | | | | | 1 | | | | |
| 13 | 28.51 | | | | 0 | | | | | 2 | | | | |
| 12a | 25.19 | | | | 0 | | | | | 0 | | | | |
| 12 | 25.50 | | | | 0 | | | | | 0 | | | | |
| 11a | 18.63 | | | | 0 | | | | | 0 | | | | |
| 11 | 17.75 | | | | 0 | | | | | 0 | | | | |
| 10a | 17.83 | | | | 0 | | | | | 0 | | | | |
| Total | 332.1 | 151.1 | 104.2 | 255.3 | 3.0 | 0.0 | 0.0 | 0.0 | | 3.0 | 0.0 | 0.0 | 0.0 | |
| Sum squ | 7163.0 | 3272.1 | 980.6 | 6028.1 | 9.0 | 0.0 | 0.0 | 0.0 | | 5.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Sum (Z*y) | 53.5 | 0.0 | 0.0 | 0.0 | | 86.3 | 0.0 | 0.0 | 0.0 | |
| | | | | R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 0.6 | 0.0 | 0.0 | 0.0 | | 0.3 | 0.0 | 0.0 | 0.0 | |
| Var z | 17.9 | 1.5 | 20.5 | 84.5 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | -0.6 | 0.0 | 0.0 | 0.0 | TOTAL | 1.6 | 0.0 | 0.0 | 0.0 | TOTAL |
| | | | | | LION | | | | | HYENA | | | | |
| | | | | **Pop.est.(Y)** | **19** | **0** | **0** | **0** | **19** | **19** | **0** | **0** | **0** | **19** |
| | | | | SE(Y) | 17.4 | 0.0 | 0.0 | 0.0 | 17.4 | 11.9 | 0.0 | 0.0 | 0.0 | 11.87 |
| | | | | 95% C.L. | 35.4 | 0.0 | 0.0 | 0.0 | 34.0 | 24.2 | 0.0 | 0.0 | 0.0 | 23.26 |
| | | | | 95% C.L.as % | 185.7 | 0.0 | 0.0 | 0.0 | 178.4 | 126.9 | ERR | ERR | ERR | 121.92 |

| | PNG 2000 | AREA | | | ORIBI | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | H STH | MID NTH | LOW NTI | TOT NTH | TOTAL |
| 31 | | | 5.75 | 5.75 | | | 0 | 0 | |
| 30 | | | 8.62 | 6.62 | | | 0 | 0 | |
| 29 | | | 12.38 | 12.38 | | | 0 | 0 | |
| 28 | | | 13.50 | 13.50 | | | 0 | 0 | |
| 27 | | | 13.44 | 13.44 | | | 0 | 0 | |
| 26 | | | 18.90 | 18.90 | | | 0 | 0 | |
| 25 | | 19.97 | 2.19 | 22.16 | | 0 | 0 | 0 | |
| 24 | | 21.85 | 6.66 | 28.51 | | 0 | 0 | 0 | |
| 23 | | 23.50 | 15.30 | 38.80 | | 0 | 0 | 0 | |
| 22 | | 22.75 | 7.45 | 30.20 | | 0 | 0 | 0 | |
| 21 | | 21.42 | | 21.42 | | 0 | | 0 | |
| 20 | | 20.75 | | 20.75 | | 0 | | 0 | |
| 19 | | 20.90 | | 20.90 | | 0 | | 0 | |
| 18 | 19.00 | | | | 0 | | | | |
| 17a | 16.86 | | | | 0 | | | | |
| 17 | 17.87 | | | | 2 | | | | |
| 16a | 17.61 | | | | 0 | | | | |
| 16 | 17.83 | | | | 0 | | | | |
| 15a | 18.10 | | | | 0 | | | | |
| 15 | 17.14 | | | | 2 | | | | |
| 14a | 22.33 | | | | 0 | | | | |
| 14 | 22.69 | | | | 2 | | | | |
| 13a | 29.29 | | | | 0 | | | | |
| 13 | 28.51 | | | | 0 | | | | |
| 12a | 25.19 | | | | 0 | | | | |
| 12 | 25.50 | | | | 0 | | | | |
| 11a | 18.63 | | | | 0 | | | | |
| 11 | 17.75 | | | | 0 | | | | |
| 10a | 17.83 | | | | 0 | | | | |
| Total | 332.1 | 151.1 | 104.2 | 255.3 | 6.0 | 0.0 | 0.0 | 0.0 | |
| Sum squ | 7163.0 | 3272.1 | 980.6 | 6028.1 | 12.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Sum (Z*y) | 115.4 | 0.0 | 0.0 | 0.0 | |
| | | | | R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 0.7 | 0.0 | 0.0 | 0.0 | |
| Var z | 17.9 | 1.5 | 20.5 | 84.5 | | | | | STRAT. |
| Covar zy | | | | | -0.6 | 0.0 | 0.0 | 0.0 | TOTAL |
| | | | | | ORIBI | | | | |
| | | | | Pop.est.(Y) | 38 | 0 | 0 | 0 | 38 |
| | | | | SE(Y) | 18.9 | 0.0 | 0.0 | 0.0 | 18.9 |
| | | | | 95% C.L. | 38.5 | 0.0 | 0.0 | 0.0 | 37.0 |
| | | | | 95% C.L.as % | 100.8 | 0.0 | 0.0 | 0.0 | 96.9 |

| | ELEPHANTS CARCASES, STAGE 3 | | | | | ELEPHANTS CARCASES, STAGE 4 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | HIGH STH | NTH | LOW NTH | TOT | | TI | MID NTH | LOW NTI | TOT NTH | TOTAL |
| 31 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 0 | | 0 | | | 0 | | 0 | |
| 19 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 0 | | | | | 0 | | | | |
| 17a | 0 | | | | | 1 | | | | |
| 17 | 0 | | | | | 0 | | | | |
| 16a | 0 | | | | | 0 | | | | |
| 16 | 0 | | | | | 4 | | | | |
| 15a | 1 | | | | | 0 | | | | |
| 15 | 1 | | | | | 3 | | | | |
| 14a | 1 | | | | | 1 | | | | |
| 14 | 0 | | | | | 0 | | | | |
| 13a | 2 | | | | | 3 | | | | |
| 13 | 0 | | | | | 0 | | | | |
| 12a | 0 | | | | | 1 | | | | |
| 12 | 0 | | | | | 4 | | | | |
| 11a | 0 | | | | | 0 | | | | |
| 11 | 0 | | | | | 0 | | | | |
| 10a | 0 | | | | | 1 | | | | |
| Total | 5.0 | 0.0 | 0.0 | 0.0 | | 18.0 | 0.0 | 0.0 | 0.0 | |
| Sum squ | 7.0 | 0.0 | 0.0 | 0.0 | | 54.0 | 0.0 | 0.0 | 0.0 | |
| Sum (Z*y) | 116.1 | 0.0 | 0.0 | 0.0 | | 394.8 | 0.0 | 0.0 | 0.0 | |
| R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 0.1 | 0.0 | 0.0 | 0.0 | |
| Var y | 0.4 | 0.0 | 0.0 | 0.0 | | 2.3 | 0.0 | 0.0 | 0.0 | |
| Var z | | | | | STRAT. | | | | | STRAT. |
| Covar zy | 0.8 | 0.0 | 0.0 | 0.0 | TOTAL | 1.4 | 0.0 | 0.0 | 0.0 | TOTAL |
| | ELEPHANTS CARCASES, STAGE 3 | | | | | ELEPHANTS CARCASES, STAGE 4 | | | | |
| Pop.est.(Y) | 32 | 0 | 0 | 0 | 32 | 114 | 0 | 0 | 0 | 114 |
| SE(Y) | 13.4 | 0.0 | 0.0 | 0.0 | 13.39 | 33.6 | 0.0 | 0.0 | 0.0 | 33.59 |
| 95% C.L. | 27.3 | 0.0 | 0.0 | 0.0 | 26.25 | 68.5 | 0.0 | 0.0 | 0.0 | 65.84 |
| 95% C.L.as % | 85.9 | ERR | ERR | ERR | 82.55 | 59.9 | ERR | ERR | ERR | 57.51 |

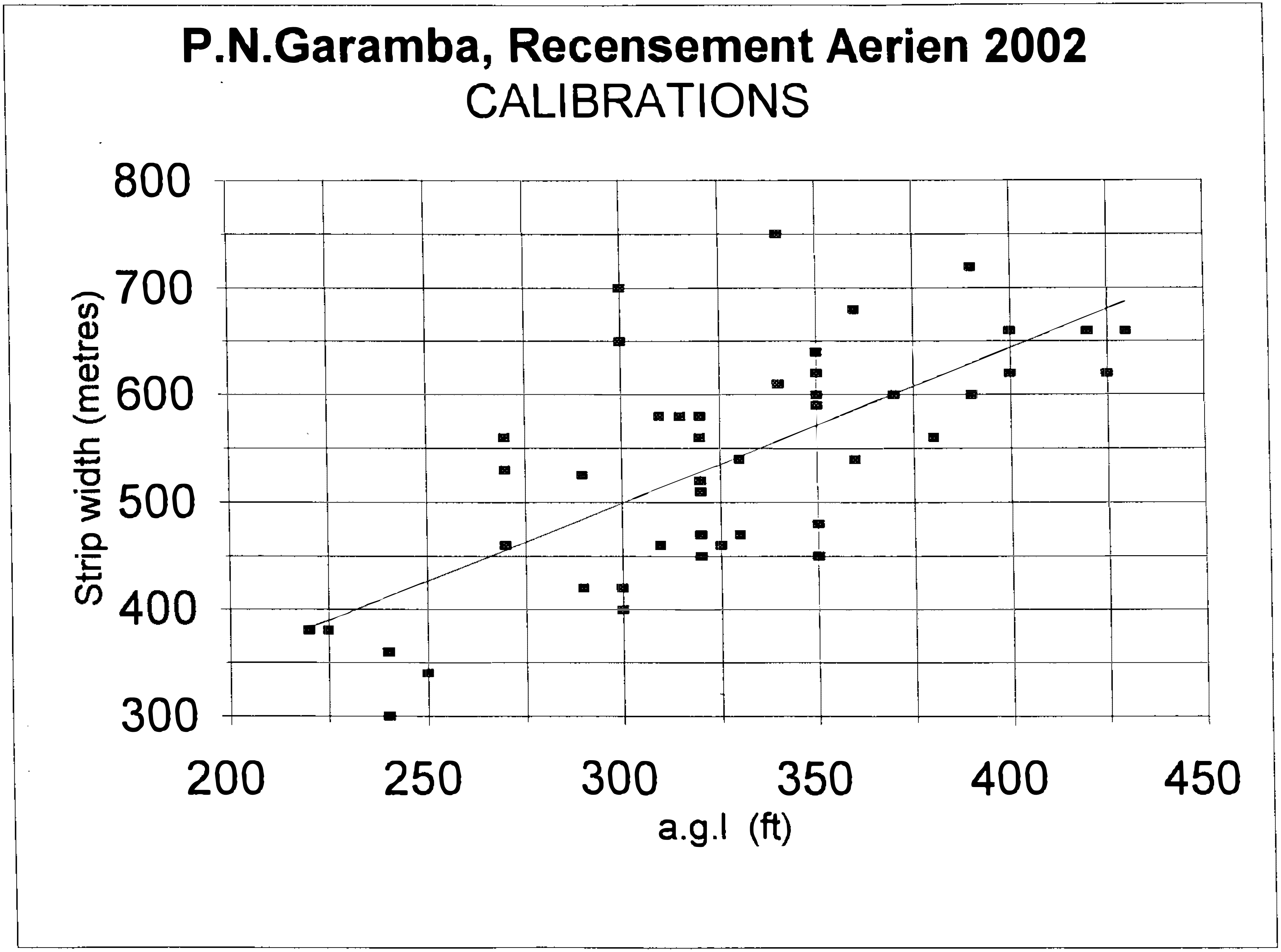
Annexe 5.15

# PARC NATIONAL DE LA GARAMBA
# GARAMBA NATIONAL PARK

## RECENSEMENT GENERAL SYSTEMATIQUE
## GENERAL AERIAL SYSTEMATIC SAMPLE COUNT

### Calibration Graphs, Distribution Maps and Population Estimate Calculations

**May / Mai 2002**


P.N.Garamba, Recensement Aerien 2002
CALIBRATIONS
Strip width (metres)
800
700
600
500
400
300
200
250
300
350
400
450
a.g.l (ft)

**CALIBRATION , May 2002**

| No | Alt agl | Strip Width |
|---|---|---|
| 1 | 330 | 470 |
| 2 | 315 | 580 |
| 3 | 370 | 600 |
| 4 | 290 | 525 |
| 5 | 270 | 460 |
| 6 | 270 | 530 |
| 7 | 320 | 560 |
| 8 | 350 | 450 |
| 9 | 350 | 590 |
| 10 | 320 | 450 |
| 11 | 270 | 560 |
| 12 | 350 | 480 |
| 13 | 320 | 470 |
| 14 | 390 | 720 |
| 15 | 310 | 460 |
| 16 | 300 | 400 |
| 17 | 300 | 420 |
| 18 | 380 | 560 |
| 19 | 425 | 620 |
| 20 | 390 | 600 |
| 21 | 300 | 700 |
| 22 | 300 | 650 |
| 23 | 330 | 540 |
| 24 | 360 | 680 |
| 25 | 420 | 660 |
| 26 | 320 | 520 |
| 27 | 400 | 660 |
| 28 | 400 | 620 |
| 29 | 340 | 750 |
| 30 | 220 | 380 |
| 31 | 320 | 510 |
| 32 | 360 | 540 |
| 33 | 340 | 610 |
| 34 | 350 | 640 |
| 35 | 430 | 660 |
| 36 | 350 | 600 |
| 37 | 360 | 540 |
| 38 | 225 | 380 |
| 39 | 250 | 340 |
| 40 | 240 | 300 |
| 41 | 240 | 360 |
| 42 | 290 | 420 |
| 43 | 310 | 580 |
| 44 | 325 | 460 |
| 45 | 320 | 580 |
| 46 | 350 | 620 |

**Regression Output:**

| | | |
|---|---|---|
| **Constant** | | **131.8018** |
| **Std Err of Y Est** | | **80.24209** |
| **R Squared** | | **0.436305** |
| **No. of Observations** | | **47** |
| **Degrees of Freedom** | | **45** |
| | | |
| **X Coefficient(s)** | **1.23E+00** | |
| **Std Err of Coef.** | **0.2090577828** | |

Y = M.X + C

**Y = 1.23380318303919 X + 131.801796597442**

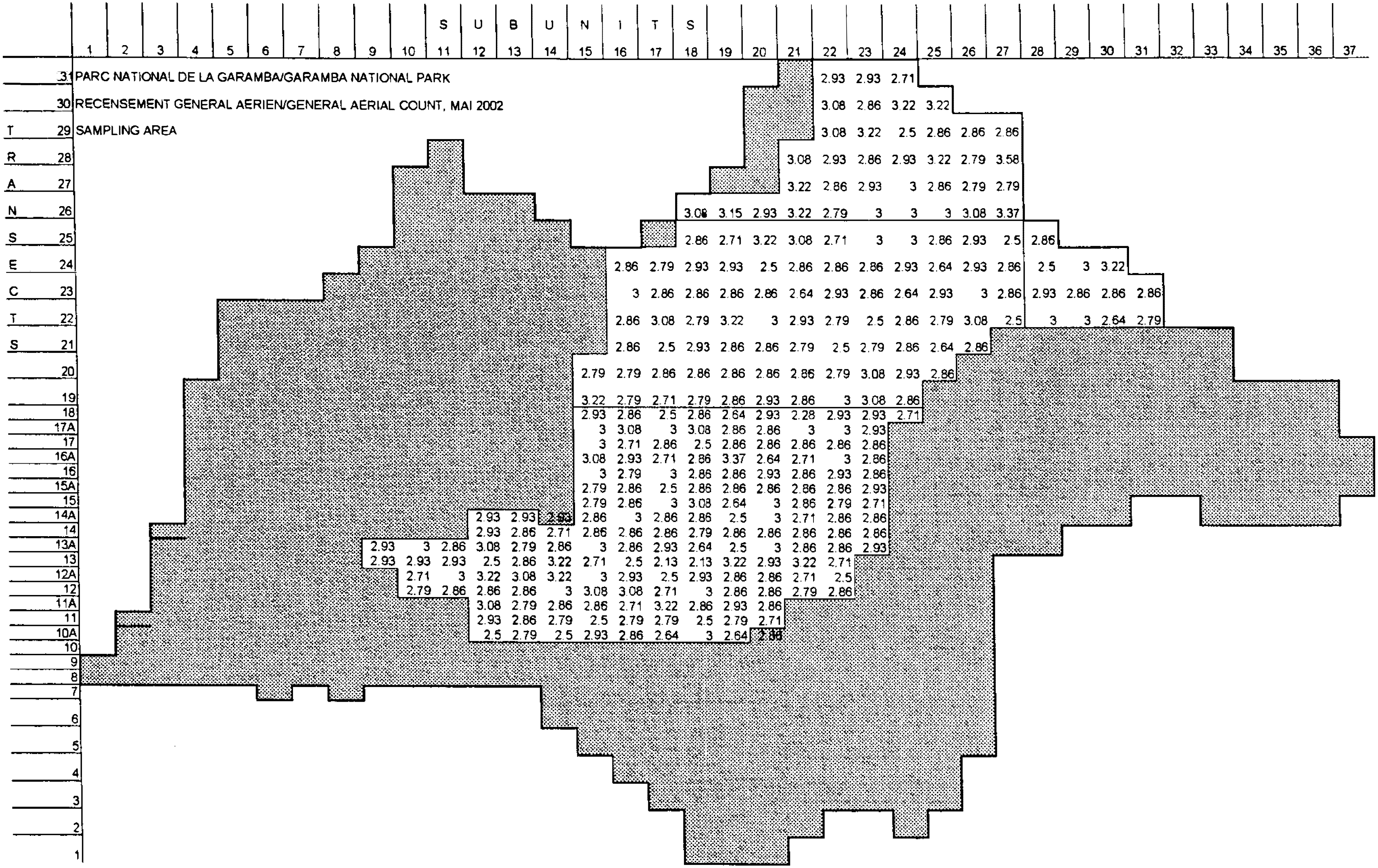
not used - eliminated 500/600 anomolous reading

Regression Output:

| | | |
|---|---|---|
| Constant | | 64.00504 |
| Std Err of Y Est | | 77.10593 |
| R Squared | | 0.48747 |
| No. of Observations | | 46 |
| Degrees of Freedom | | 44 |
| | | |
| X Coefficient(s) | 1.4506150141 | |
| Std Err of Coef. | 0.2242389917 | |

**Y= 1.4506 . X + 64.005**

| | | |
|---|---|---|
| 220 | 380 | 383.137 |
| 225 | 380 | 390.39 |
| 240 | 360 | 412.149 |
| 240 | 300 | 412.149 |
| 250 | 340 | 426.655 |
| 270 | 560 | 455.667 |
| 270 | 460 | 455.667 |
| 270 | 530 | 455.667 |
| 290 | 525 | 484.679 |
| 290 | 420 | 484.679 |
| 300 | 400 | 499.185 |
| 300 | 420 | 499.185 |
| 300 | 700 | 499.185 |
| 300 | 650 | 499.185 |
| 310 | 580 | 513.691 |
| 310 | 460 | 513.691 |
| 315 | 580 | 520.944 |
| 320 | 580 | 528.197 |
| 320 | 510 | 528.197 |
| 320 | 450 | 528.197 |
| 320 | 560 | 528.197 |
| 320 | 520 | 528.197 |
| 320 | 470 | 528.197 |
| 325 | 460 | 535.45 |
| 330 | 540 | 542.703 |
| 330 | 470 | 542.703 |
| 340 | 750 | 557.209 |
| 340 | 610 | 557.209 |
| 350 | 640 | 571.715 |
| 350 | 590 | 571.715 |
| 350 | 450 | 571.715 |
| 350 | 600 | 571.715 |
| 350 | 480 | 571.715 |
| 350 | 620 | 571.715 |
| 360 | 540 | 586.221 |
| 360 | 540 | 586.221 |
| 360 | 680 | 586.221 |
| 370 | 600 | 600.727 |
| 380 | 560 | 615.233 |
| 390 | 600 | 629.739 |
| 390 | 720 | 629.739 |
| 400 | 620 | 644.245 |
| 400 | 660 | 644.245 |
| 420 | 660 | 673.257 |
| 425 | 620 | 680.51 |
| 430 | 660 | 687.763 |




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 3.15 | 2.93 | 6.44 | 8.58 | 17.8 | 17.4 | 15.2 | 11.5 | 12.6 | 11.3 | 8.87 | 8.72 | 5.64 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 8.43 | 16.8 | 20 | 20.3 | 20.2 | 20 | 19.6 | 20.2 | 20.1 | 16.7 | 14.8 | 10.7 | | | | | | | | | | |
| High D | | | | | | | | | | 2.93 | 8.79 | 14.6 | 23 | 20.7 | 20 | 42.8 | 41.6 | 41.8 | 42.6 | 43.2 | 36.6 | 37 | 28.7 | 2.71 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.86 | 2.79 | 0 | 5.43 | 0 | 0 | 26.6 | 8.72 | 0 | 0 | 0 | 0 | 3.08 | 9.08 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.86 | 5.72 | 8.79 | 20 | 23 | 20.7 | 46.6 | 60 | 58.4 | 61.8 | 66 | 66.3 | 66.1 | 74.3 | 66.7 | 40.2 | 31.9 | 26.3 | 23.3 | 11.3 | 8.87 | 8.72 | 5.64 | 0 | 0 | 0 | 0 | 0 | 0 |

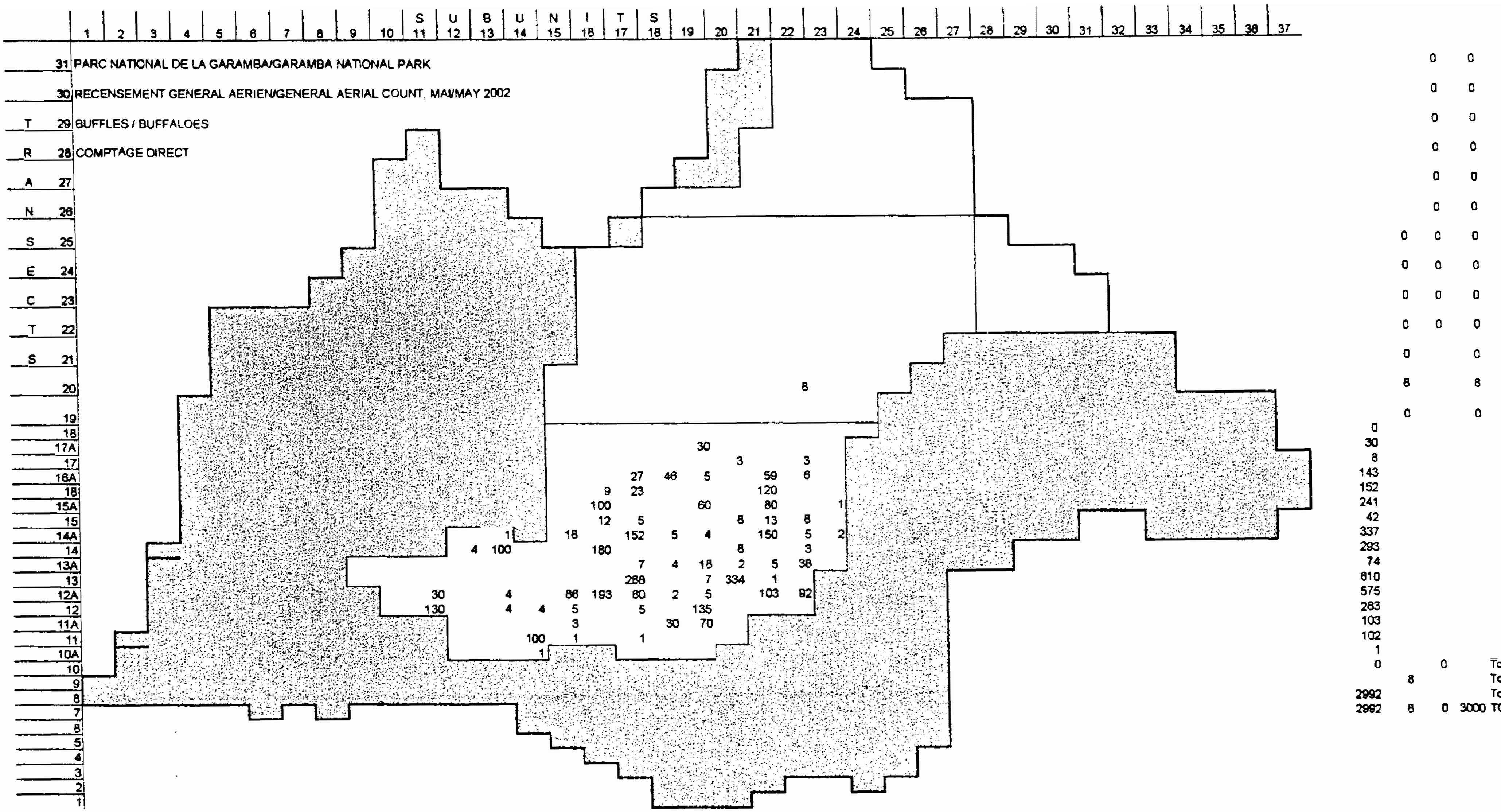
PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK

RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI/MAY 2002

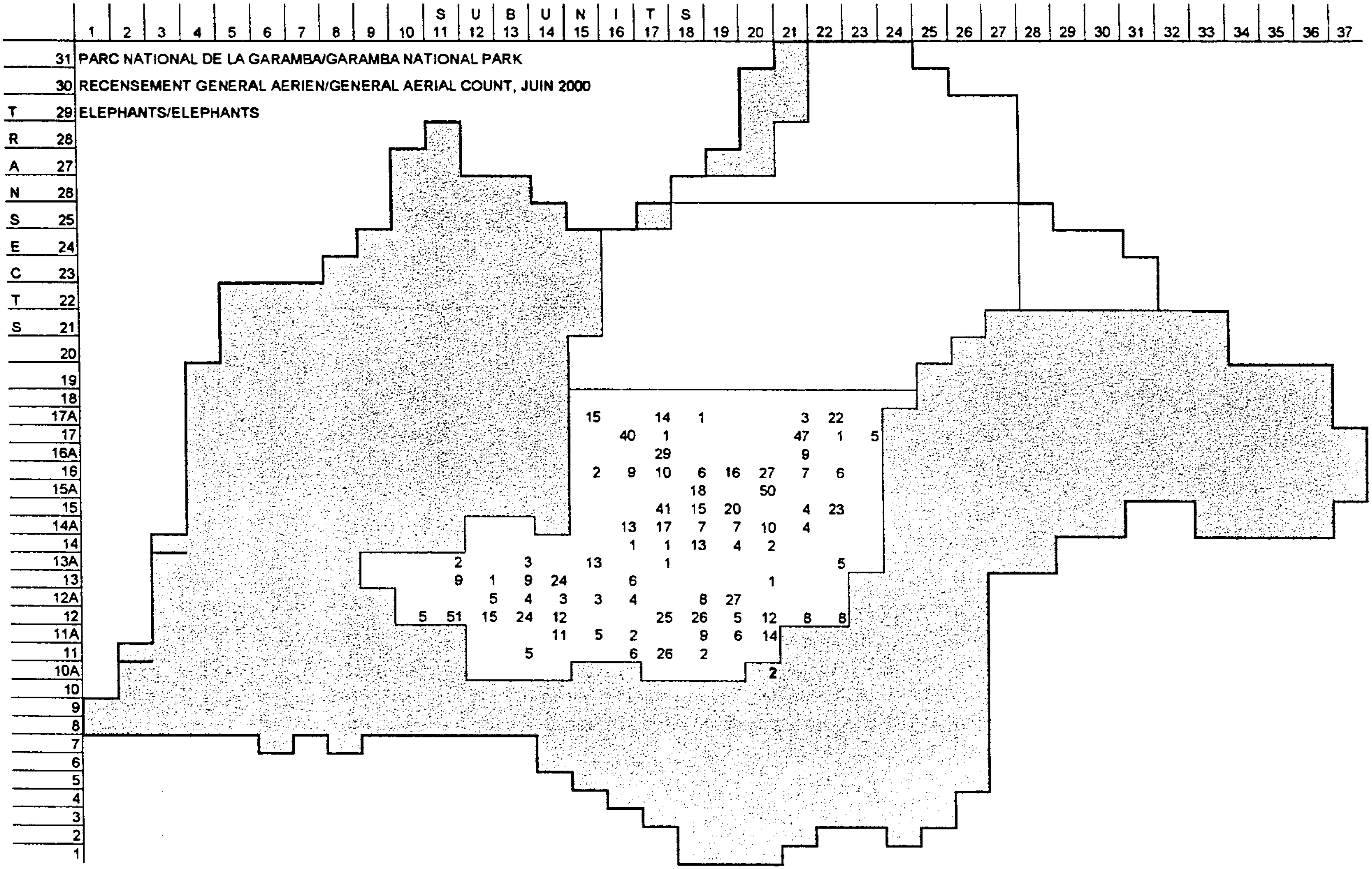
ALTITUDE DE VOL / FLIGHT ALTITUDE

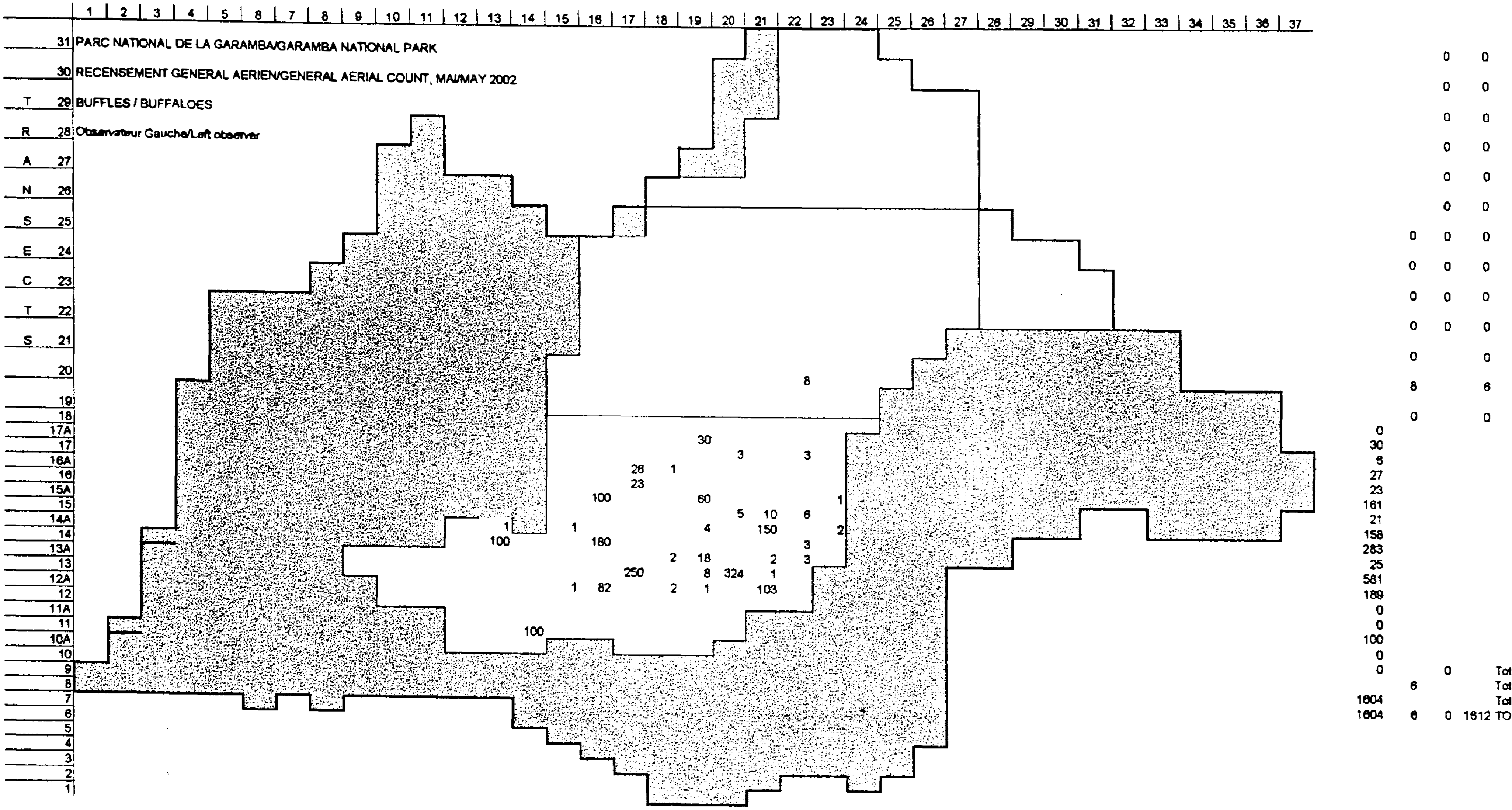
COMPTAGE DIRECT

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | S 11 | U 12 | B 13 | U 14 | N 15 | I 16 | T 17 | S 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | | | | | | | | | | | | | | | | | | | | | | 380 | 380 | 330 | | | | | | | | | | | | | | | | 350 | 350 | |
| 30 | | | | | | | | | | | | | | | | | | | | | | 380 | 350 | 400 | 400 | | | | | | | | | | | | | | | 383 | 382.5 | |
| T 29 | | | | | | | | | | | | | | | | | | | | | | 380 | 400 | 300 | 350 | 350 | 350 | | | | | | | | | | | | | 355 | 355 | |
| R 28 | | | | | | | | | | | | | | | | | | | | | 380 | 360 | 350 | 360 | 400 | 340 | 450 | | | | | | | | | | | | | 377 | 377.1 | |
| A 27 | | | | | | | | | | | | | | | | | | | | | 400 | 350 | 380 | 370 | 350 | 340 | 340 | | | | | | | | | | | | | 359 | 358.8 | |
| N 26 | | | | | | | | | | | | | | | | | | 380 | 390 | 360 | 400 | 340 | 370 | 370 | 370 | 380 | 420 | | | | | | | | | | | | | 378 | 378 | |
| S 25 | | | | | | | | | | | | | | | | | | 350 | 330 | 400 | 380 | 330 | 370 | 370 | 350 | 360 | 300 | 350 | | | | | | | | | | | 354 | 350 | 352 | |
| E 24 | | | | | | | | | | | | | | | | 350 | 340 | 360 | 360 | 300 | 350 | 350 | 350 | 360 | 320 | 360 | 350 | 300 | 370 | 400 | | | | | | | | | 346 | 357 | 351.3 | |
| C 23 | | | | | | | | | | | | | | | | 370 | 350 | 350 | 350 | 350 | 320 | 360 | 350 | 320 | 360 | 370 | 350 | 360 | 350 | 350 | 350 | | | | | | | | 350 | 351 | 350.6 | |
| T 22 | | | | | | | | | | | | | | | | 350 | 380 | 340 | 400 | 370 | 380 | 340 | 300 | 350 | 340 | 380 | 300 | 370 | 370 | 320 | 340 | | | | | | | | 351 | 350 | 350.4 | |
| S 21 | | | | | | | | | | | | | | | | 350 | 300 | 360 | 350 | 350 | 340 | 300 | 340 | 350 | 320 | 350 | | | | | | | | | | | | | 337 | | 337.3 | |
| 20 | | | | | | | | | | | | | | | 340 | 340 | 350 | 350 | 350 | 350 | 350 | 340 | 380 | 360 | 350 | | | | | | | | | | | | | | 351 | | 350.9 | |
| 19 | | | | | | | | | | | | | | | 400 | 340 | 330 | 340 | 350 | 360 | 350 | 370 | 380 | 350 | | | | | | | | | | | | | | | 357 | | 357 | |
| 18 | | | | | | | | | | | | | | | 380 | 360 | 300 | 350 | 320 | 380 | 270 | 360 | 380 | 330 | | | | | | | | | | | | | | 336 | | | | |
| 17A | | | | | | | | | | | | | | | 370 | 380 | 370 | 380 | 350 | 350 | 370 | 370 | 380 | | | | | | | | | | | | | | | 366.7 | | | | |
| 17 | | | | | | | | | | | | | | | 370 | 330 | 350 | 300 | 350 | 350 | 350 | 350 | 350 | | | | | | | | | | | | | | | 344.4 | | | | |
| 16A | | | | | | | | | | | | | | | 380 | 380 | 330 | 350 | 420 | 320 | 330 | 370 | 350 | | | | | | | | | | | | | | | 356.7 | | | | |
| 16 | | | | | | | | | | | | | | | 370 | 340 | 370 | 350 | 350 | 380 | 350 | 380 | 350 | | | | | | | | | | | | | | | 355.6 | | | | |
| 15A | | | | | | | | | | | | | | | 340 | 350 | 300 | 350 | 350 | 350 | 350 | 350 | 380 | | | | | | | | | | | | | | | 344.4 | | | | |
| 15 | | | | | | | | | | | | | | | 340 | 350 | 370 | 380 | 320 | 370 | 350 | 340 | 330 | | | | | | | | | | | | | | | 350 | | | | |
| 14A | | | | | | | | | | | | 380 | 380 | 380 | 350 | 370 | 350 | 350 | 300 | 370 | 330 | 350 | 350 | | | | | | | | | | | | | | | 349.1 | | | | |
| 14 | | | | | | | | | | | | 380 | 350 | 330 | 350 | 350 | 350 | 340 | 350 | 350 | 350 | 350 | 350 | | | | | | | | | | | | | | | 348.3 | | | | |
| 13A | | | | | | | | | 380 | 370 | 350 | 380 | 340 | 350 | 370 | 350 | 380 | 320 | 300 | 370 | 350 | 350 | 380 | | | | | | | | | | | | | | | 352 | | | | |
| 13 | | | | | | | | | 380 | 360 | 380 | 300 | 350 | 400 | 330 | 300 | 250 | 250 | 400 | 380 | 400 | 330 | | | | | | | | | | | | | | | | 339.3 | | | | |
| 12A | | | | | | | | | | 330 | 370 | 400 | 380 | 400 | 370 | 380 | 300 | 380 | 350 | 350 | 330 | 300 | | | | | | | | | | | | | | | | 353.8 | | | | |
| 12 | | | | | | | | | | 340 | 350 | 350 | 350 | 370 | 380 | 380 | 330 | 370 | 350 | 350 | 340 | 350 | | | | | | | | | | | | | | | | 354.6 | | | | |
| 11A | | | | | | | | | | | | 380 | 340 | 350 | 350 | 330 | 400 | 350 | 380 | 350 | | | | | | | | | | | | | | | | | | 356.7 | | | | |
| 11 | | | | | | | | | | | | 380 | 350 | 340 | 300 | 340 | 340 | 300 | 340 | 380 | | | | | | | | | | | | | | | | | | 333.3 | | | | |
| 10A | | | | | | | | | | | | 300 | 340 | 300 | 380 | 350 | 320 | 370 | 320 | 350 | | | | | | | | | | | | | | | | | | 334.4 | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 367 | | Total |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 349 | | | Total |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 348.5 | | | | Total |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 348.5 | 349 | 381 | 352.9 | TOTA |
| 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Low D | | | | | | | | | | | | | | | | | | | 390 | 360 | 400 | 350 | 365 | 355 | 374 | 352.5 | 390 | 345 | 363 | 357 | 345 | 0 | | | | | | | | | | |
| Med D | | | | | | | | | | | | | | | | 343 | 342 | 350 | 355.7 | 354 | 350 | 341 | 353 | 351 | 340 | 384 | 325 | | | | | | | | | | | | | | | |
| High D | | | | | | | | | ERR | 350 | 350 | 341 | 353 | 353 | 356 | 349 | 338 | 340 | 347.3 | 353 | 344 | 348 | 352 | 330 | 0 | | | | | | | | | | | | | | | | | |
| Dorr | ERR | ERR | ERR | **** | ERR | ERR | ERR | ERR | 360 | ERR | ERR | ERR | ERR | ERR | 360 | 357 | 0 | ERR | 0 | ERR | 360 | 373 | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | | | | | |
| Tota | ERR | ERR | ERR | **** | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | 358 | 350 | 227 | ERR | 273.3 | ERR | 368 | 353 | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | ERR | | | | | |



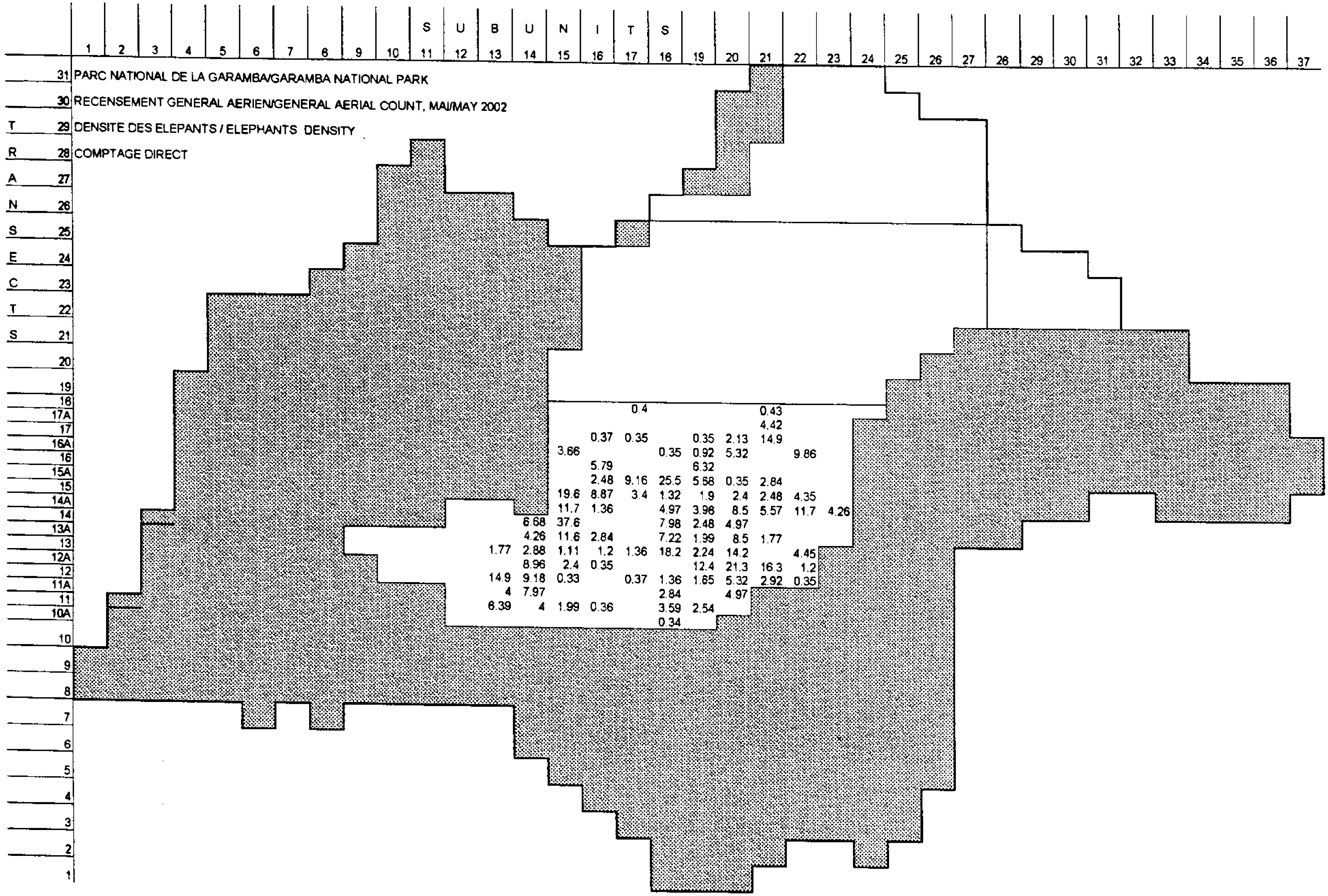

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 18 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | | | | | | | | | 0 | 0 | 0 | 239 | 342 | 214 | 199 | 494 | 548 | 87 | 334 | 351 | 531 | 153 | 3 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 239 | 342 | 214 | 199 | 494 | 548 | 87 | 334 | 351 | 531 | 181 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |


PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, JUIN 2000
ELEPHANTS/ELEPHANTS
SUBUNITS
TRANSECTS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37
31 30 29 28 27 28 25 24 23 22 21 20 19 18 17A 17 16A 16 15A 15 14A 14 13A 13 12A 12 11A 11 10A 10 9 8 7 6 5 4 3 2 1
15 14 1 3 22
40 1 47 1 5
29 9
2 9 10 6 16 27 7 6
18 50
41 15 20 4 23
13 17 7 7 10 4
1 1 13 4 2
2 3 13 1 5
9 1 9 24 6 1
5 4 3 3 4 8 27
5 51 15 24 12 25 26 5 12 8 8
11 5 2 9 6 14
5 6 26 2
2

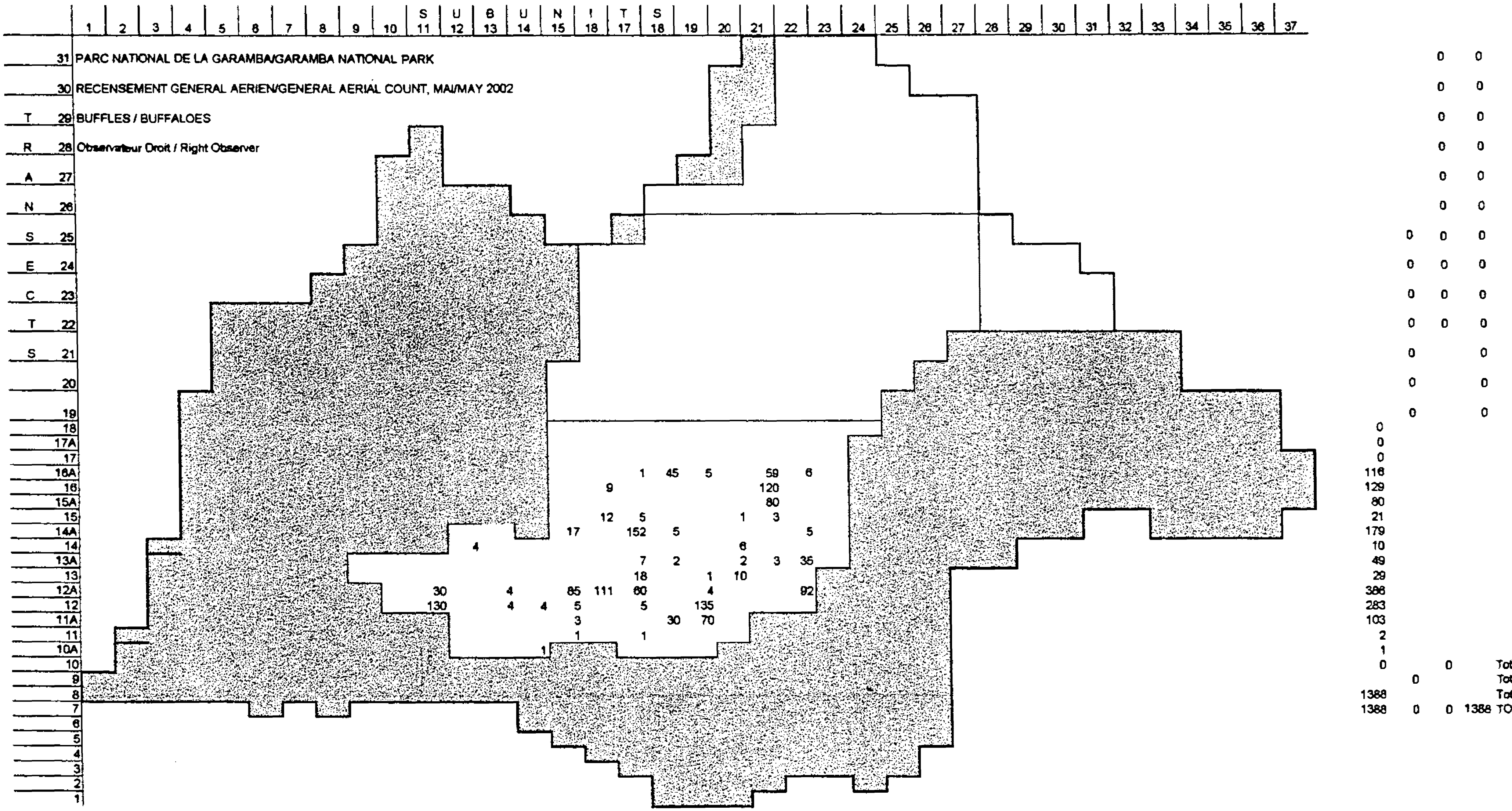



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 |
| High D | | | | | | | | | 0 | 0 | 0 | 29 | 324 | 201 | 101 | 362 | 299 | 5 | 119 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29 | 324 | 201 | 101 | 362 | 299 | 5 | 119 |

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 332 | 266 | 15 | 3 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 332 | 266 | 23 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

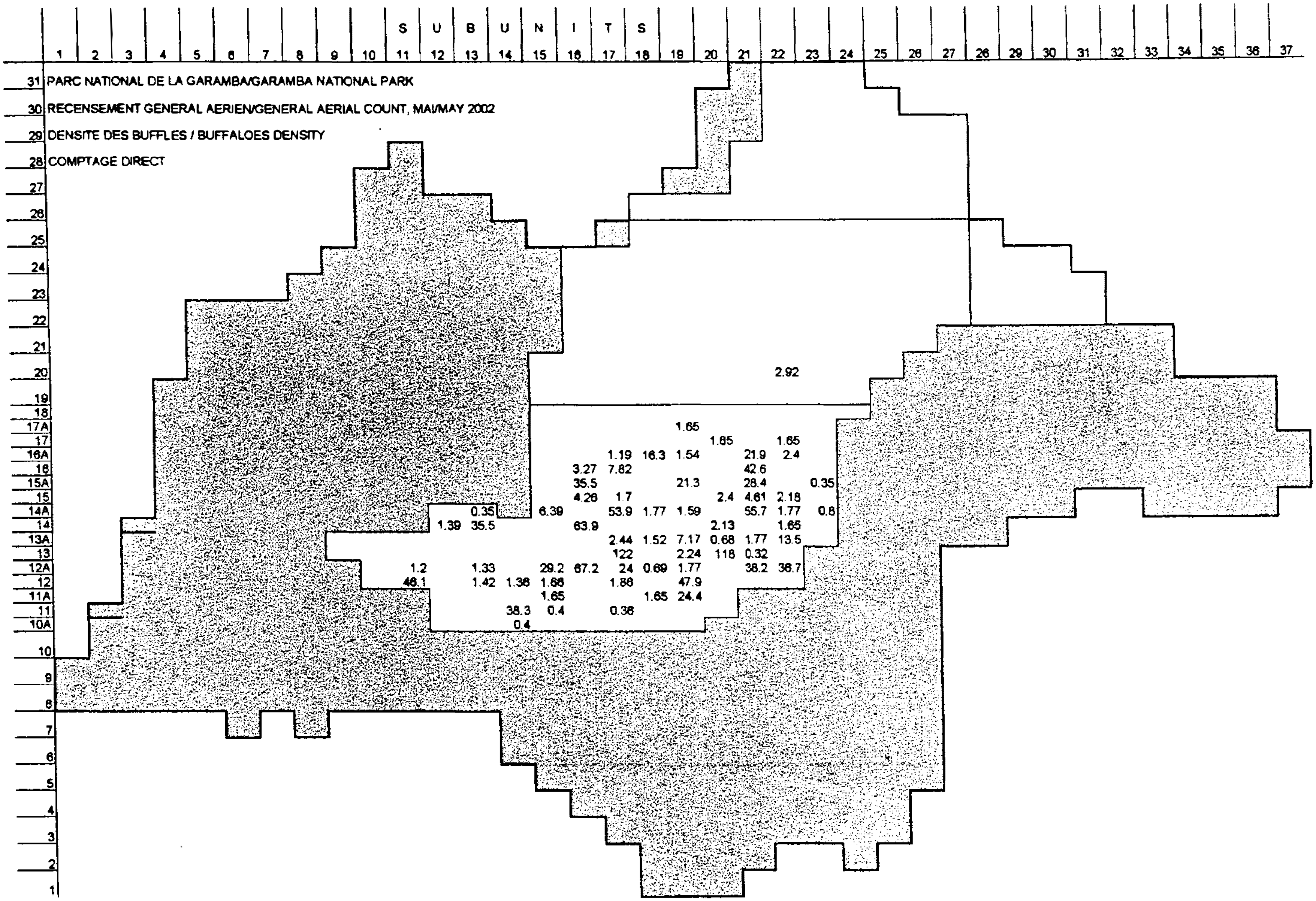



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | | | | | | | | | | 0 | 0 | 0 | 27.1 | 43.9 | 55 | 23.6 | 15.1 | 73.3 | 42.5 | 78 | 51.7 | 31.9 | 4.26 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27.1 | 43.9 | 78.3 | 23.6 | 15.1 | 73.3 | 42.5 | 76 | 51.7 | 31.9 | 4.26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | | | | | | | | | 0 | 0 | 0 | 210 | 18 | 13 | 98 | 132 | 249 | 82 | 215 | 19 | 265 | 138 | 0 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 210 | 18 | 13 | 98 | 132 | 249 | 82 | 215 | 19 | 265 | 138 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Annexe 5.15

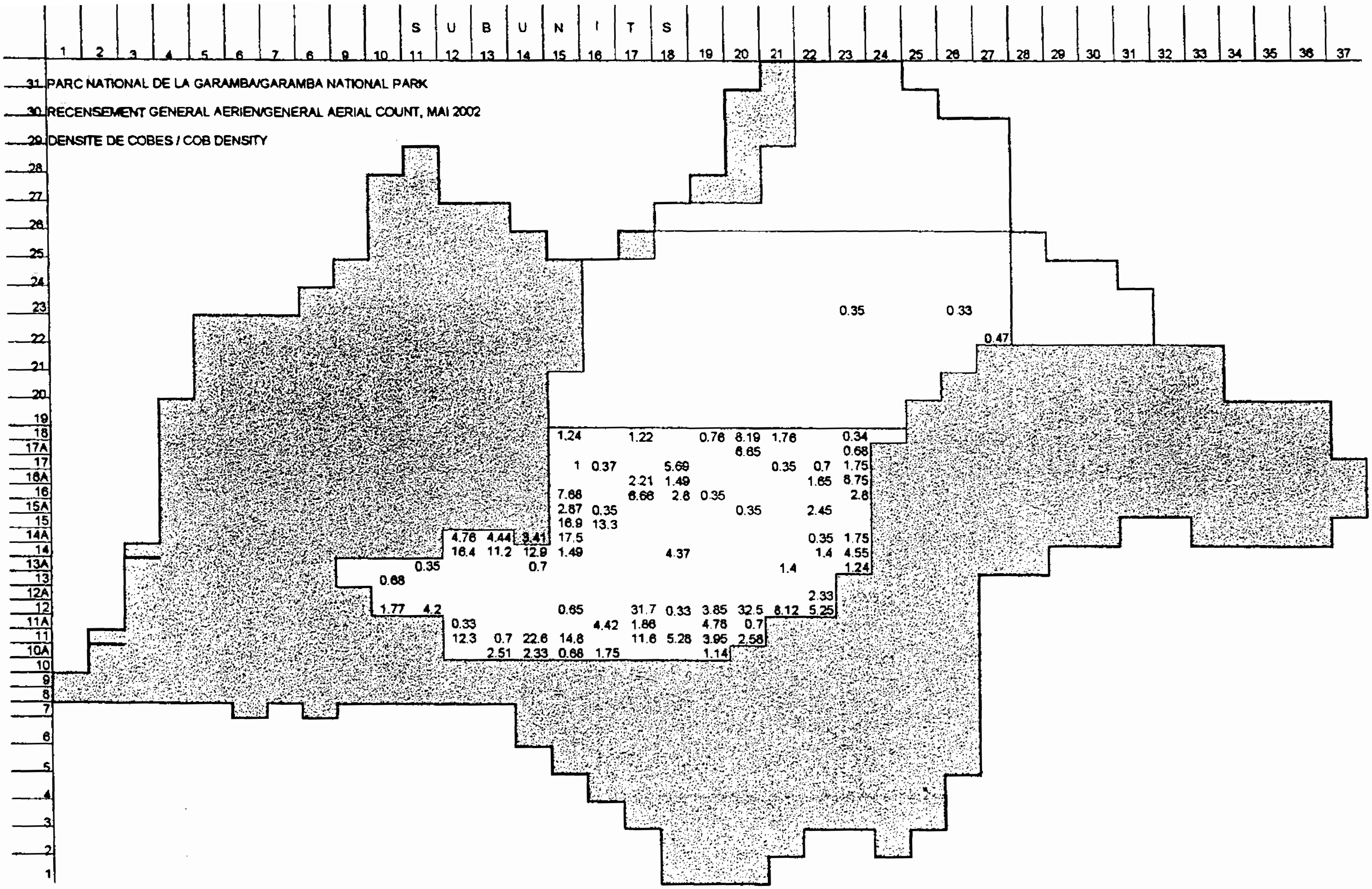



| | | | | |
|---|---|---|---|---|
| 31 | | | 0 | ERR |
| 30 | | | 0 | ERR |
| 29 | | | 0 | ERR |
| 28 | | | 0 | ERR |
| 27 | | | 0 | ERR |
| 26 | | | 0 | ERR |
| 25 | | 0 | 0 | ERR |
| 24 | | 0 | 0 | ERR |
| 23 | | 0 | 0 | ERR |
| 22 | | 0 | 0 | ERR |
| 21 | | 0 | | ERR |
| 20 | | 2.92 | | 2.92 |
| 19 | | 0 | | ERR |
| 18 | 0 | | | ERR |
| 17A | 1.65 | | | 1.65 |
| 17 | 3.29 | | | 1.65 |
| 16A | 43.3 | | | 8.87 |
| 16 | 53.7 | | | 17.9 |
| 15A | 65.5 | | | 21.4 |
| 15 | 15.1 | | | 3.03 |
| 14A | 122 | | | 15.3 |
| 14 | 105 | | | 20.9 |
| 13A | 27.1 | | | 4.51 |
| 13 | 240 | | | 60.1 |
| 12A | 200 | | | 22.3 |
| 12 | 100 | | | 18.7 |
| 11A | 27.7 | | | 9.22 |
| 11 | 37 | | | 12.3 |
| 10A | 0.4 | | | 0.4 |

| | | | | |
|---|---|---|---|---|
| 0 | 0 | 0 | ERR | Total Nord |
| 2.92 | 2.92 | 0 | ERR | Total Centr |
| 1062 | 0 | 0 | ERR | Total Sud |
| 1062 | 2.92 | 0 | ERR | TOTAL |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 |
| High D | | | | | | | | | | 0 | 47.3 | 1.39 | 38.6 | 37.6 | 32.9 | 174 | 215 | 22 | 110 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 47.3 | 1.39 | 38.6 | 37.6 | 32.9 | 174 | 215 | 22 | 110 |

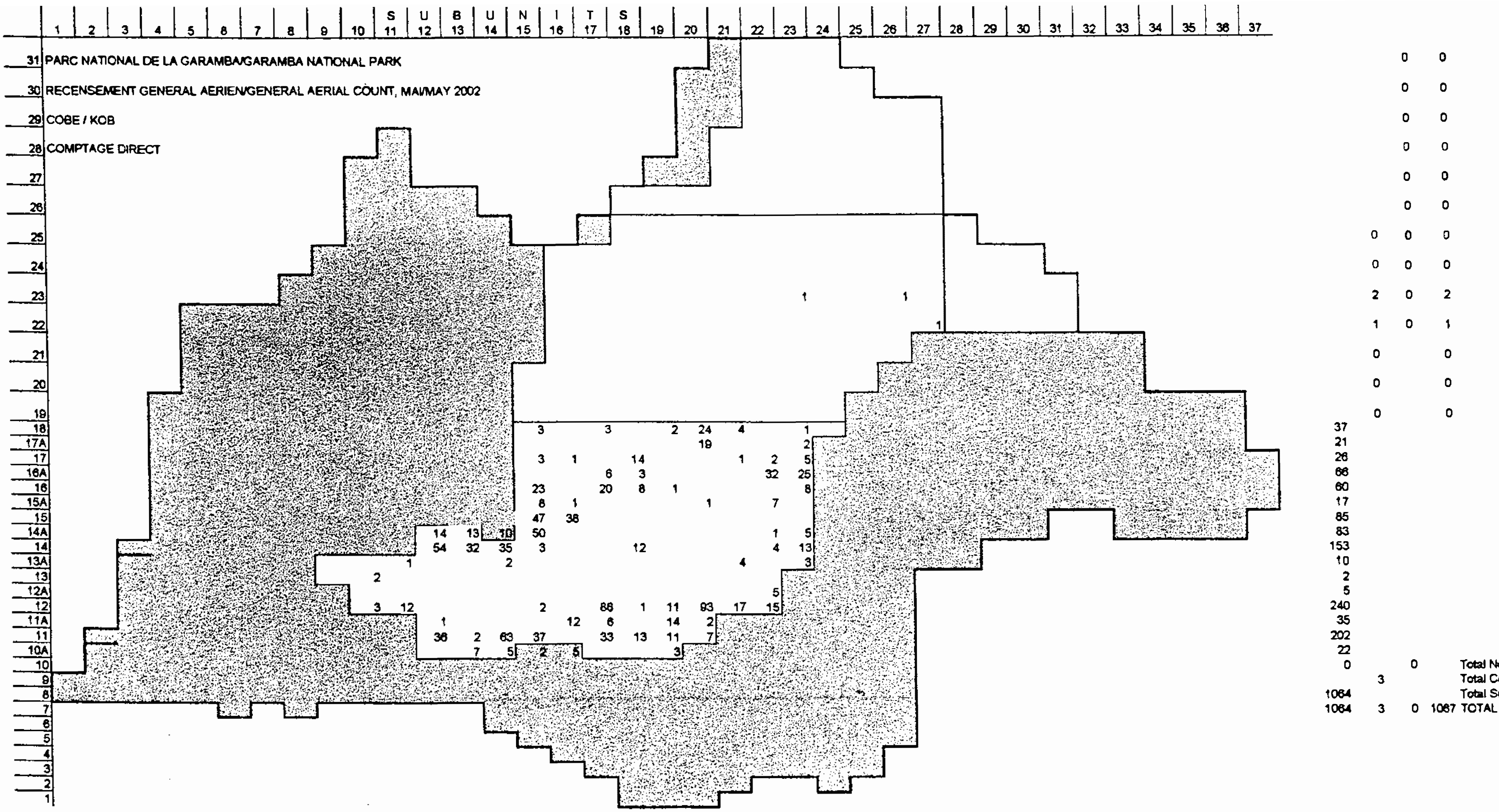
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 2.92 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 123 | 193 | 59.8 | 1.14 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 123 | 193 | 62.7 | 1.14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



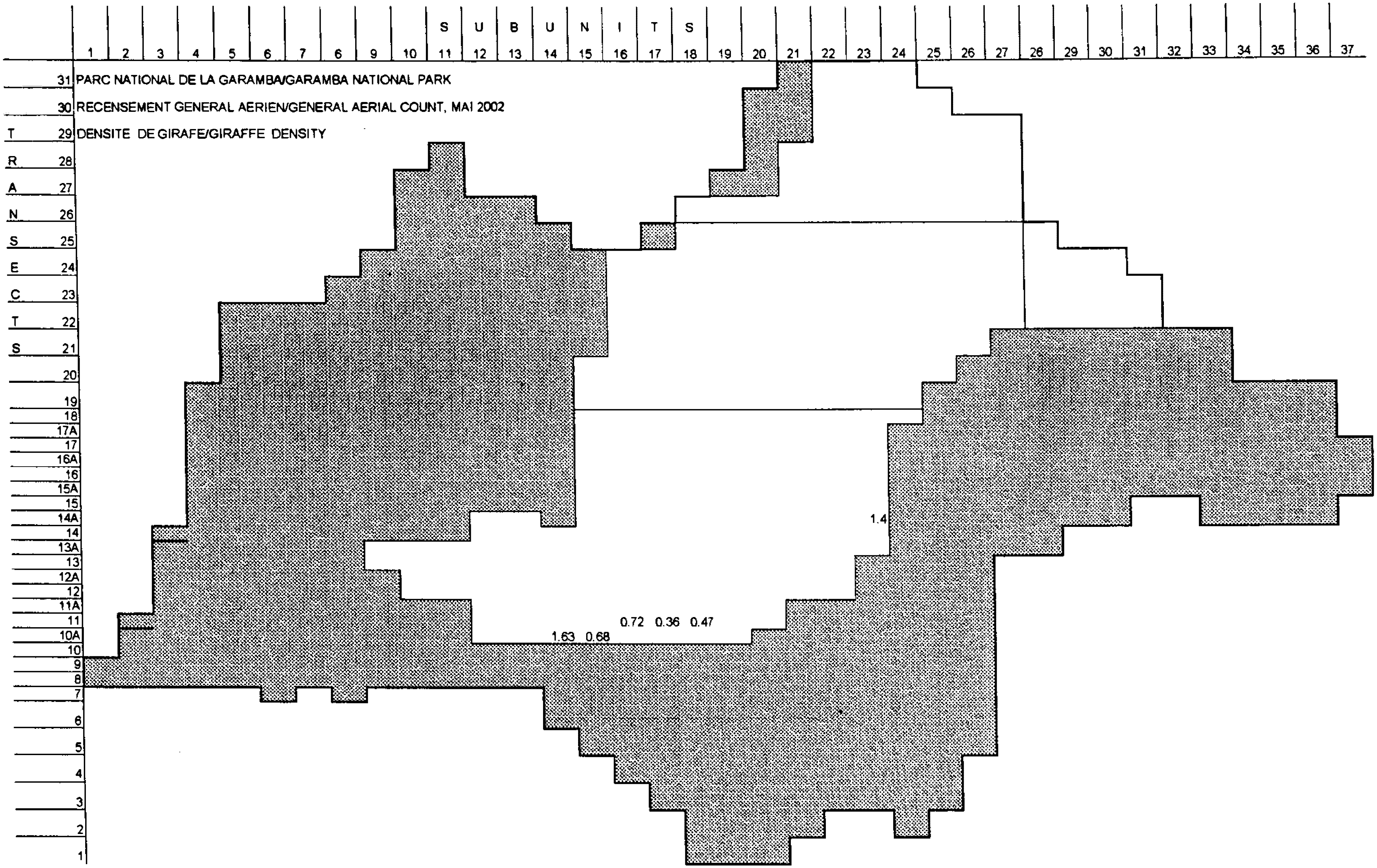

| | | | | | |
|---|---|---|---|---|---|
| 31 | | | 0 | 0 | |
| 30 | | | 0 | 0 | |
| 29 | | | 0 | 0 | |
| 28 | | | 0 | 0 | |
| 27 | | | 0 | 0 | |
| 26 | | | 0 | 0 | |
| 25 | | 0 | 0 | 0 | |
| 24 | | 0 | 0 | 0 | |
| 23 | | 0.68 | 0 | 0.68 | |
| 22 | | 0.47 | 0 | 0.47 | |
| 21 | | 0 | | 0 | |
| 20 | | 0 | | 0 | |
| 19 | | 0 | | 0 | |
| 18 | 13.5 | | | 13.5 | |
| 17A | 7.33 | | | 7.33 | |
| 17 | 9.86 | | | 8.86 | |
| 16A | 14.1 | | | 14.1 | |
| 16 | 20.3 | | | 20.3 | |
| 15A | 8.02 | | | 8.02 | |
| 15 | 30.2 | | | 30.2 | |
| 14A | 32.2 | | | 32.2 | |
| 14 | 54.3 | | | 54.3 | |
| 13A | 3.68 | | | 3.68 | |
| 13 | 0.68 | | | 0.68 | |
| 12A | 2.33 | | | 2.33 | |
| 12 | 86.4 | | | 86.4 | |
| 11A | 12.1 | | | 12.1 | |
| 11 | 74.1 | | | 74.1 | |
| 10A | 6.41 | | | 6.41 | |
| | 0 | 0 | 0 | 0 | Total Nord |
| | 1.15 | 1.15 | 0 | 1.15 | Total Cent |
| | 375 | 0 | 0 | 375 | Total Sud |
| | 375 | 1.15 | 0 | 377 | TOTAL |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 |
| High D | | | | | | | | | | 0.68 | 4.2 | 18.4 | 16.3 | 36.2 | 17 | 16.4 | 55.5 | 20 | 13.7 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.77 | 0 | 12.3 | 0 | 0 | 29.6 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.45 | 4.2 | 30.7 | 16.3 | 36.2 | 46.8 | 16.4 | 55.5 | 20 | 13.7 |

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 0 | 0.35 | 0 | 0 | 0.33 | 0.47 | | | | | | | | | | |
| High D | 51 | 9.62 | 14.1 | 21.8 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 51 | 9.62 | 14.1 | 22.2 | 0 | 0 | 0.33 | 0.47 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

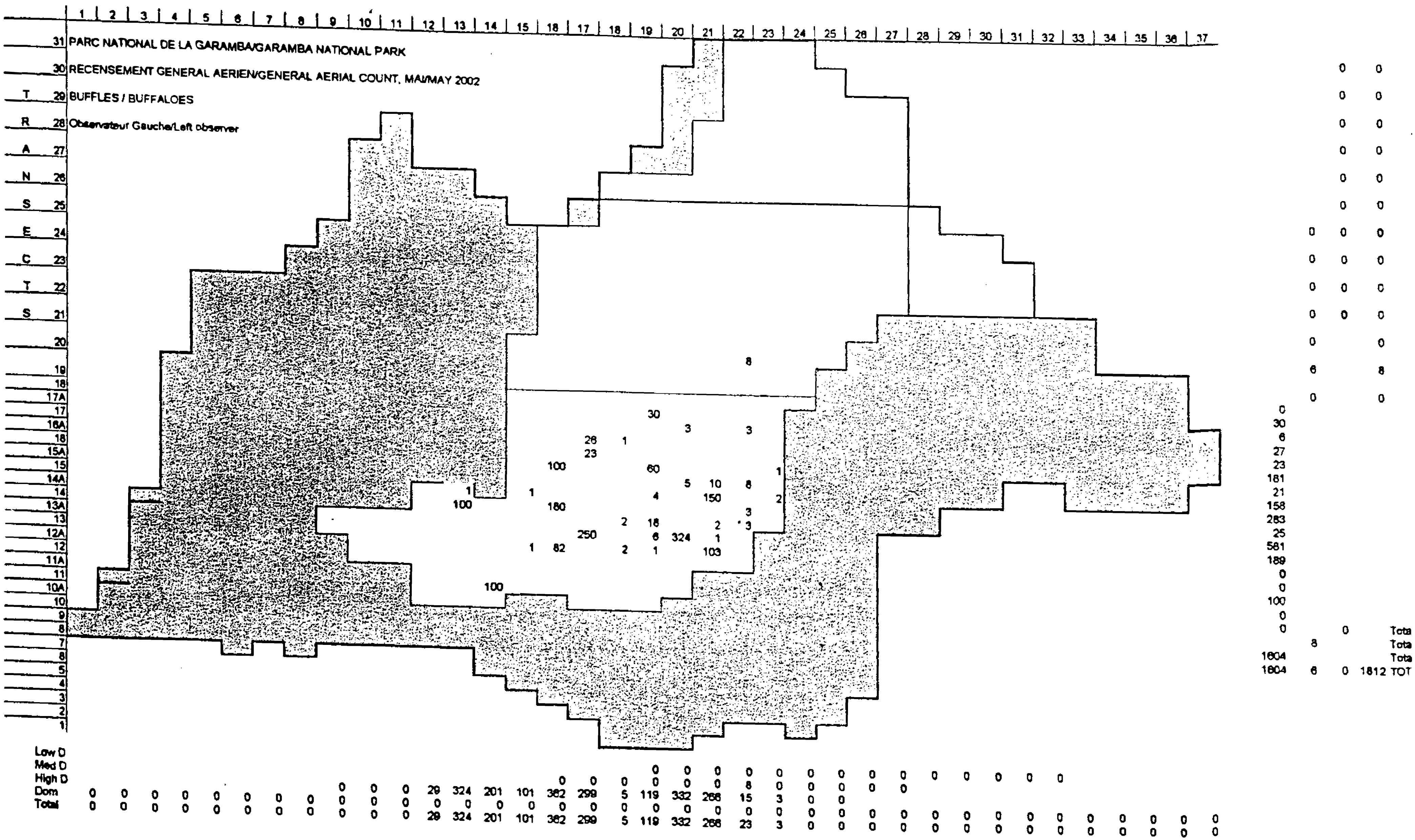


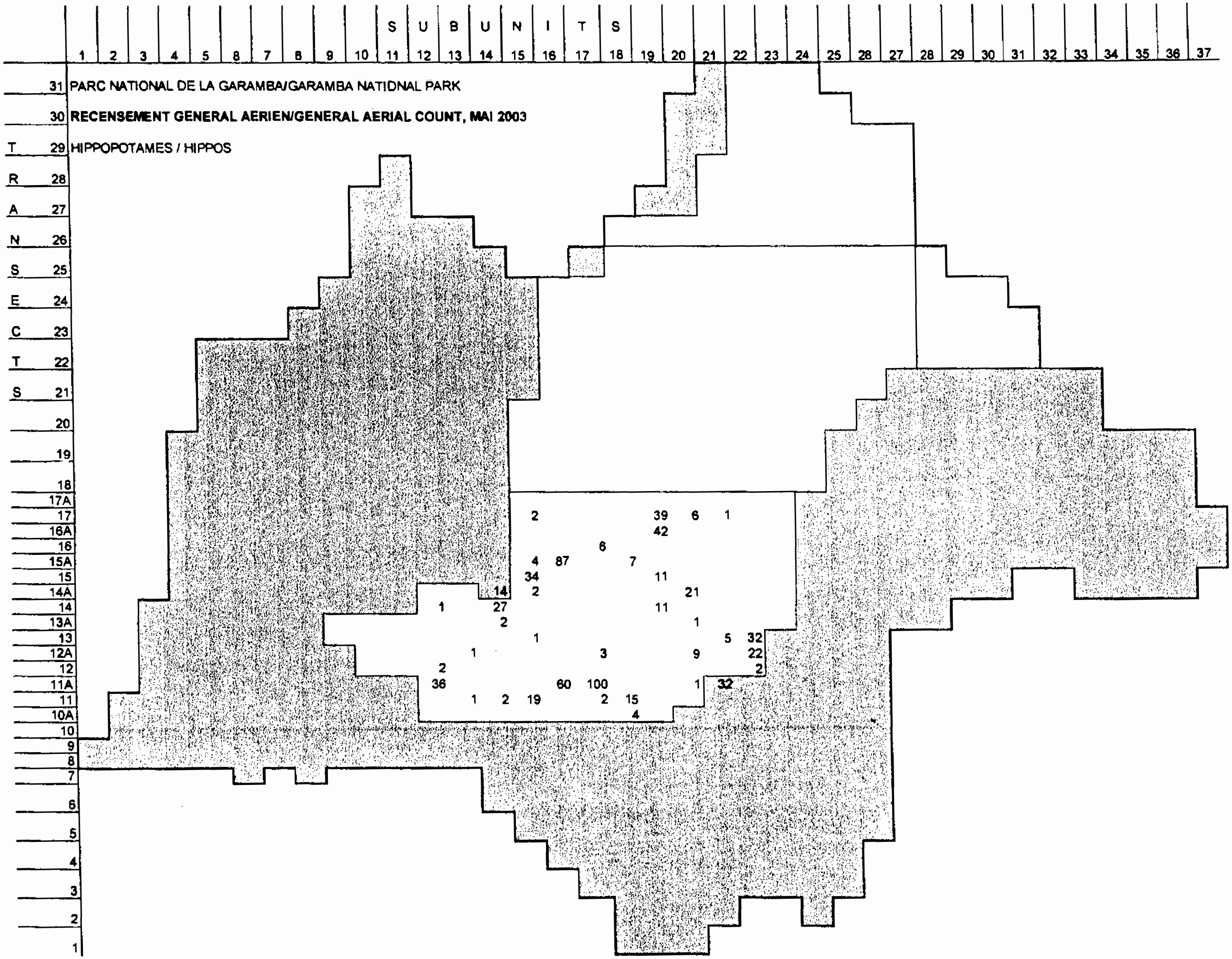

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| Med D | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | | | | | | | | | |
| High D | | | | | | | | | | 0 | 5 | 5 | 39 | 102 | 169 | 142 | 52 | 154 | 51 | 39 | 148 | 26 | 66 | 62 | 0 | 0 | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 39 | 102 | 169 | 144 | 52 | 154 | 51 | 39 | 148 | 26 | 66 | 63 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



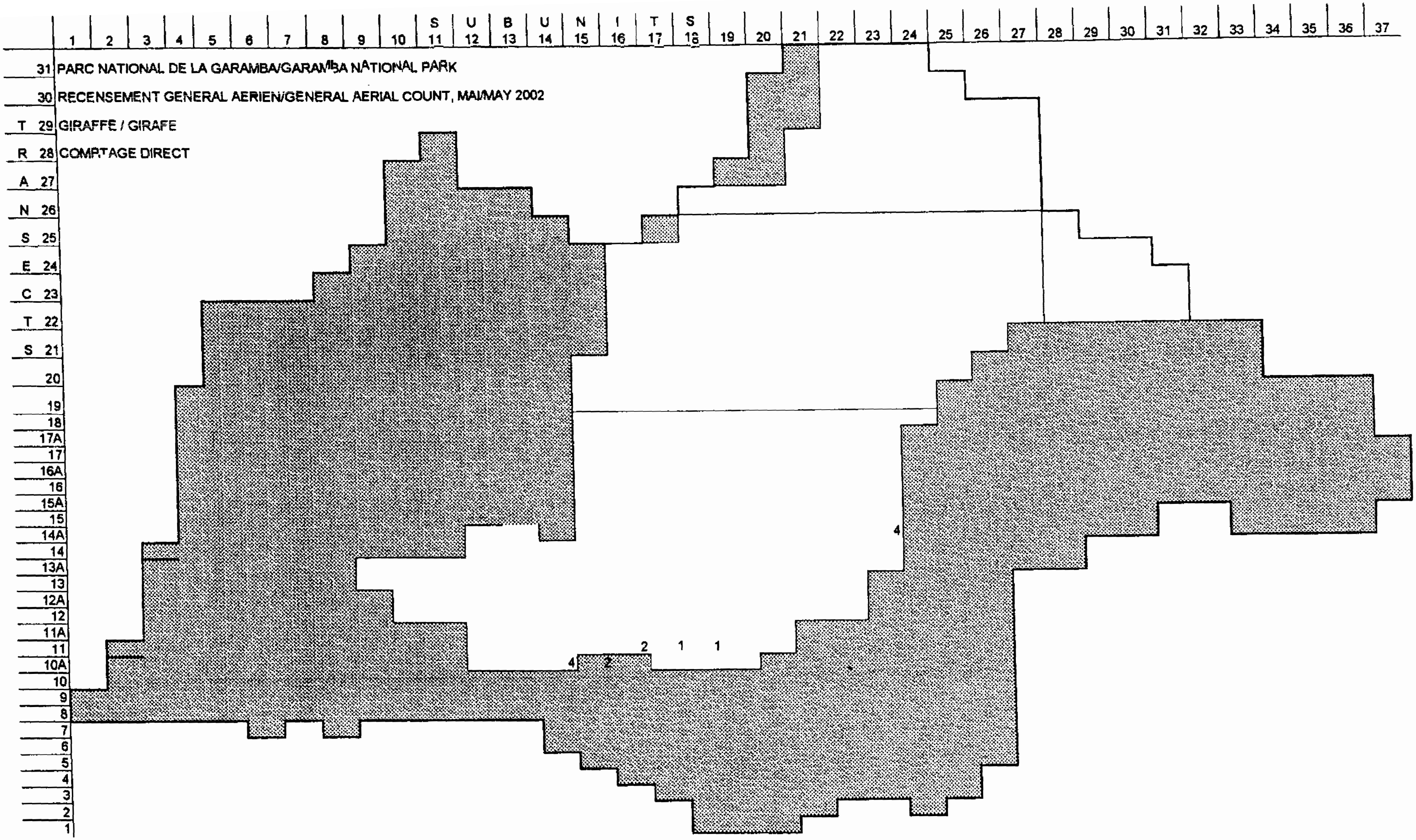

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 |
| High D | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0.72 | 0.36 | 0.47 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.72 | 0.36 | 0.47 |

| | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 0 | 0 | 0 | 0 | 1.4 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 1.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |


PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI/MAY 2002
BUFFLES / BUFFALOES
Observateur Gauche/Left observer
TRANSECTS
Low D
Med D
High D
Dom
Total
1804 6 0 1812 TOT



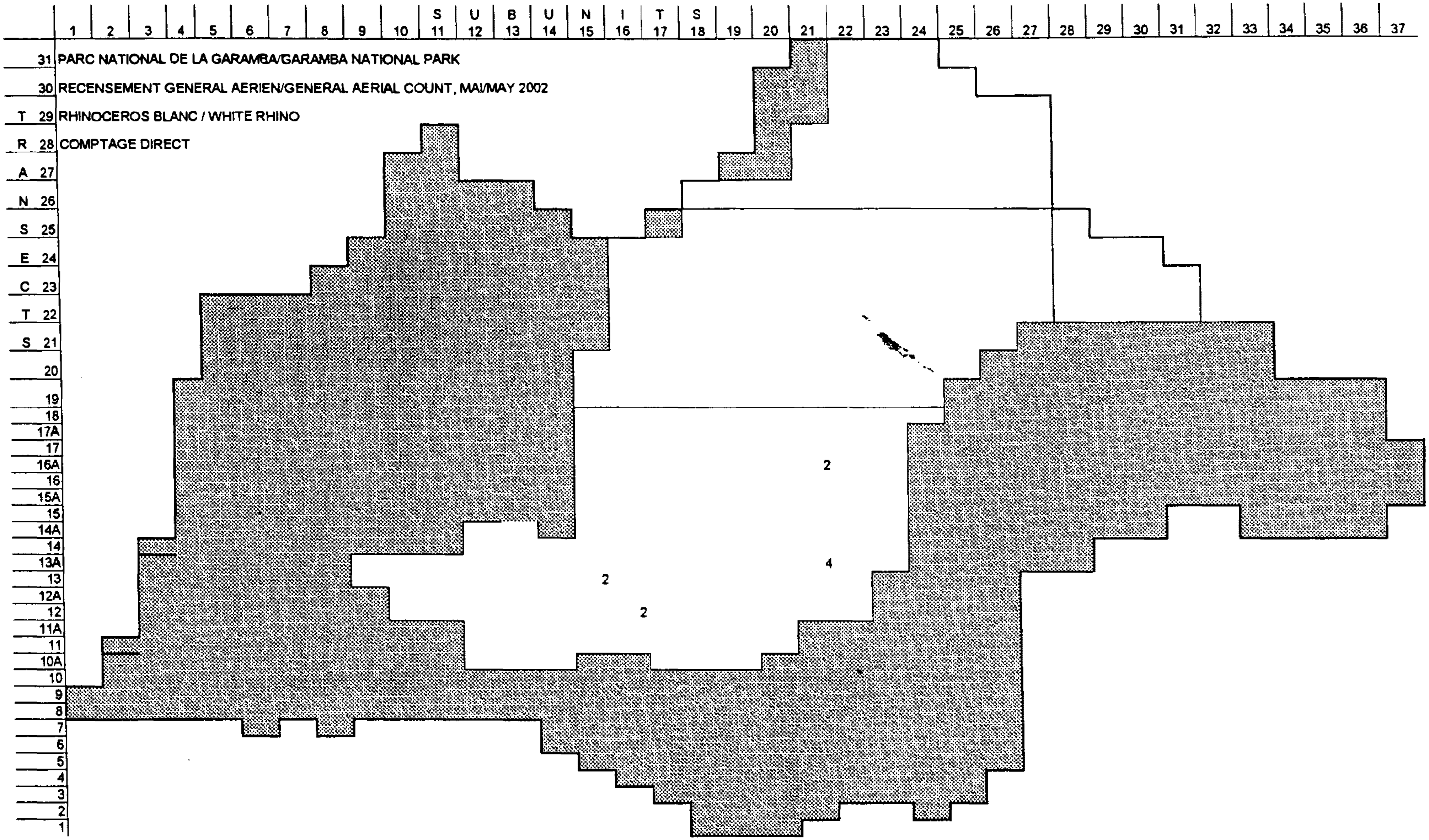

| | | | | | |
|---|---|---|---|---|---|
| 31 | | | 0 | 0 | |
| 30 | | | 0 | 0 | |
| 29 | | | 0 | 0 | |
| 28 | | | 0 | 0 | |
| 27 | | | 0 | 0 | |
| 26 | | | 0 | 0 | |
| 25 | | 0 | 0 | 0 | |
| 24 | | 0 | 0 | 0 | |
| 23 | | 0 | 0 | 0 | |
| 22 | | 0 | 0 | 0 | |
| 21 | | 0 | | 0 | |
| 20 | | 0 | | 0 | |
| 19 | | 0 | | 0 | |
| 18 | 0 | | | 0 | |
| 17A | 0 | | | 0 | |
| 17 | 48 | | | 48 | |
| 16A | 42 | | | 42 | |
| 16 | 6 | | | 8 | |
| 15A | 98 | | | 98 | |
| 15 | 45 | | | 45 | |
| 14A | 37 | | | 37 | |
| 14 | 39 | | | 39 | |
| 13A | 3 | | | 3 | |
| 13 | 38 | | | 38 | |
| 12A | 35 | | | 35 | |
| 12 | 4 | | | 4 | |
| 11A | 197 | | | 197 | |
| 11 | 39 | | | 39 | |
| 10A | 4 | | | 4 | |
| | 0 | 0 | 0 | 0 | Total Nord |
| | 0 | 0 | 0 | 0 | Total Centre |
| | 635 | 0 | 0 | 635 | Total Sud |
| | 635 | 0 | 0 | 635 | TOTAL |




| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 |
| High D | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 2 | 1 | 1 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| Tots | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 2 | 1 | 1 |

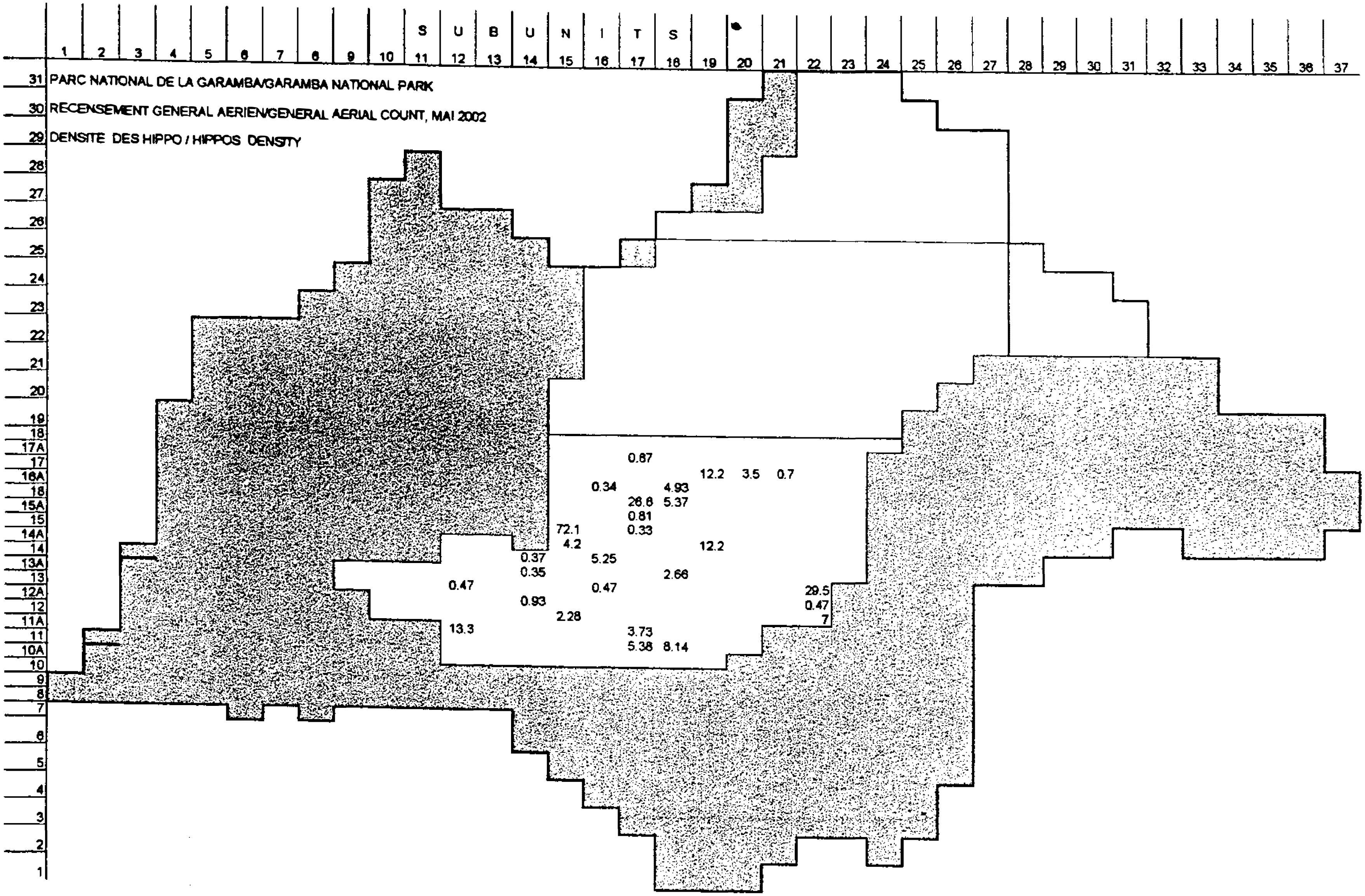
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 0 | 0 | 0 | 0 | 4 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tots | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Annexe 5.15




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

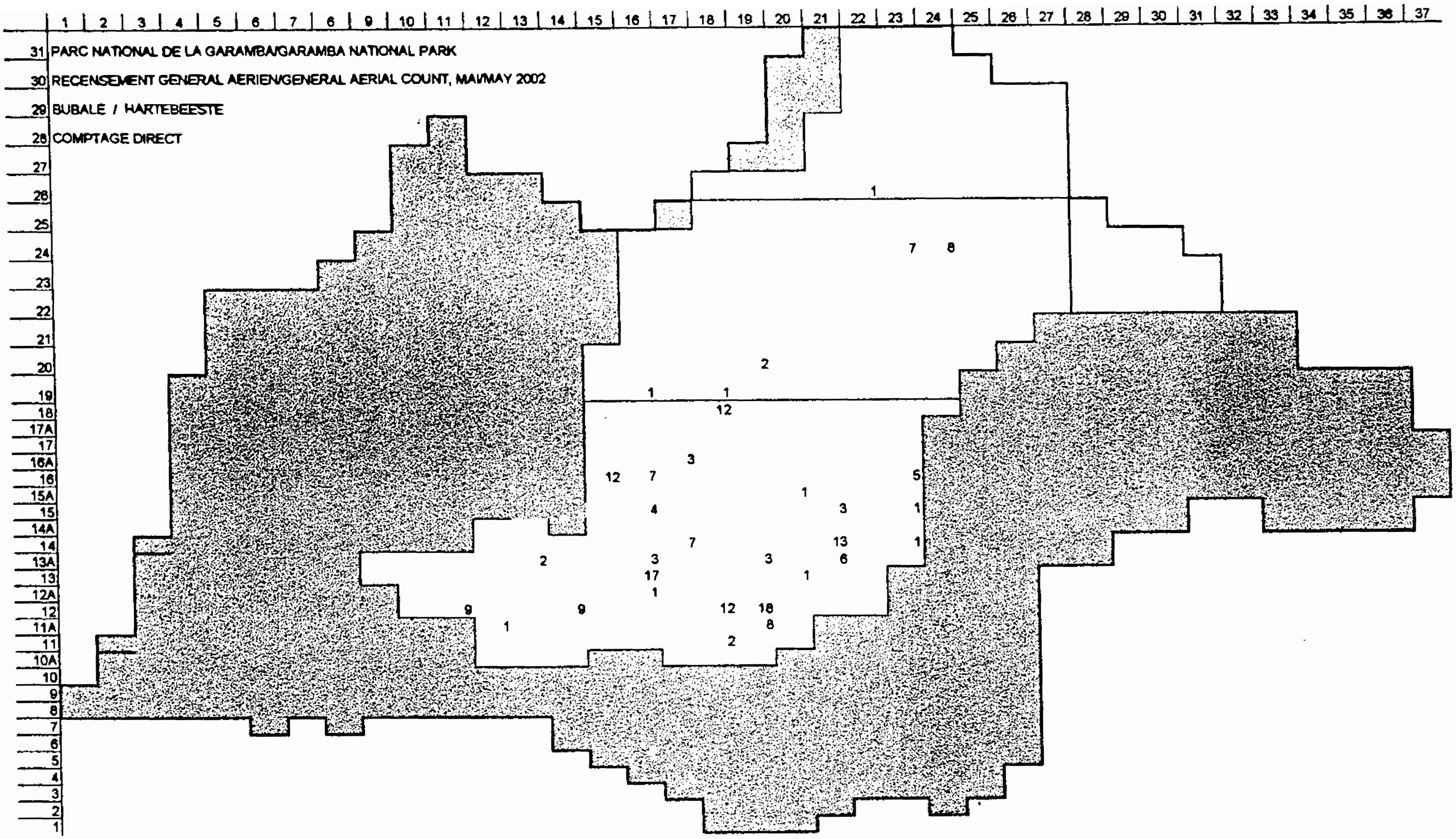
Annexe 5.15




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 |
| High D | | | | | | | | | | 0 | 0 | 0.47 | 0 | 1.65 | 2.28 | 8.05 | 37.6 | 21.1 | 24.4 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 72.1 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.47 | 0 | 1.65 | 74.4 | 8.05 | 37.6 | 21.1 | 24.4 |

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 3.5 | 0.7 | 38.9 | 0 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 3.5 | 0.7 | 38.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

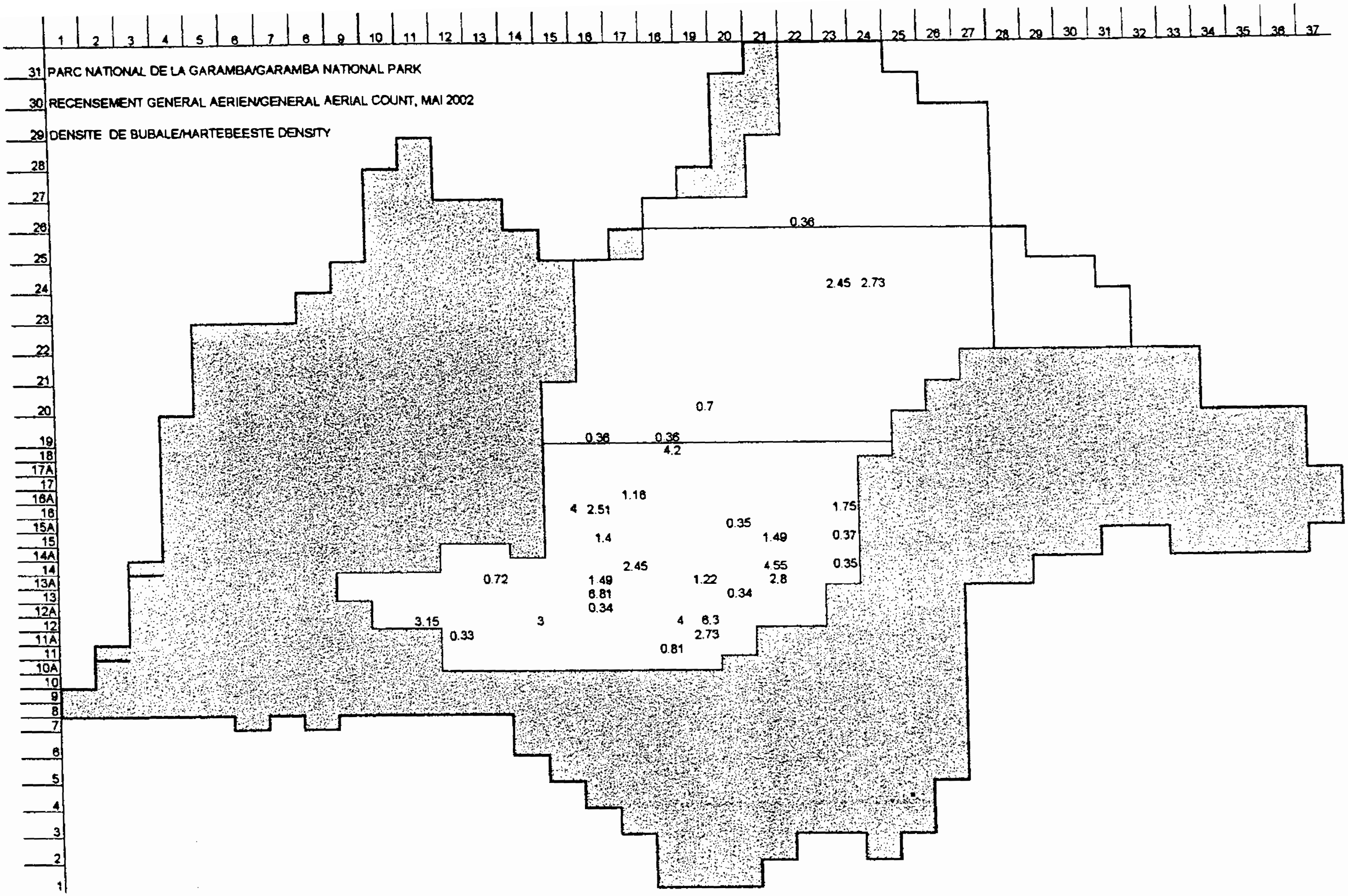
| | | | | |
|---|---|---|---|---|
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | | 0 | |
| | 0 | | 0 | |
| | 0 | | 0 | |
| 0 | | | 0 | |
| 0.67 | | | 0.67 | |
| 16.4 | | | 16.4 | |
| 5.27 | | | 5.27 | |
| 32 | | | 32 | |
| 0.61 | | | 0.61 | |
| 72.5 | | | 72.5 | |
| 16.4 | | | 16.4 | |
| 5.62 | | | 5.62 | |
| 3.01 | | | 3.01 | |
| 30.4 | | | 30.4 | |
| 1.4 | | | 1.4 | |
| 9.27 | | | 9.27 | |
| 17.1 | | | 17.1 | |
| 13.5 | | | 13.5 | |
| 0 | | | 0 | |
| 0 | 0 | 0 | 0 | Total Nord |
| 0 | 0 | 0 | 0 | Total Centr |
| 224 | 0 | 0 | 224 | Total Sud |
| 224 | 0 | 0 | 224 | TOTAL |




| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 1 | 0 | 1 | 2 |
| High D | | | | | | | | | 0 | 0 | 0 | 29 | 1 | 11 | 9 | 32 | 10 | 26 | 29 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29 | 1 | 11 | 9 | 33 | 10 | 27 | 31 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 0 | 7 | 6 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 2 | 24 | 0 | 7 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 2 | 24 | 1 | 14 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

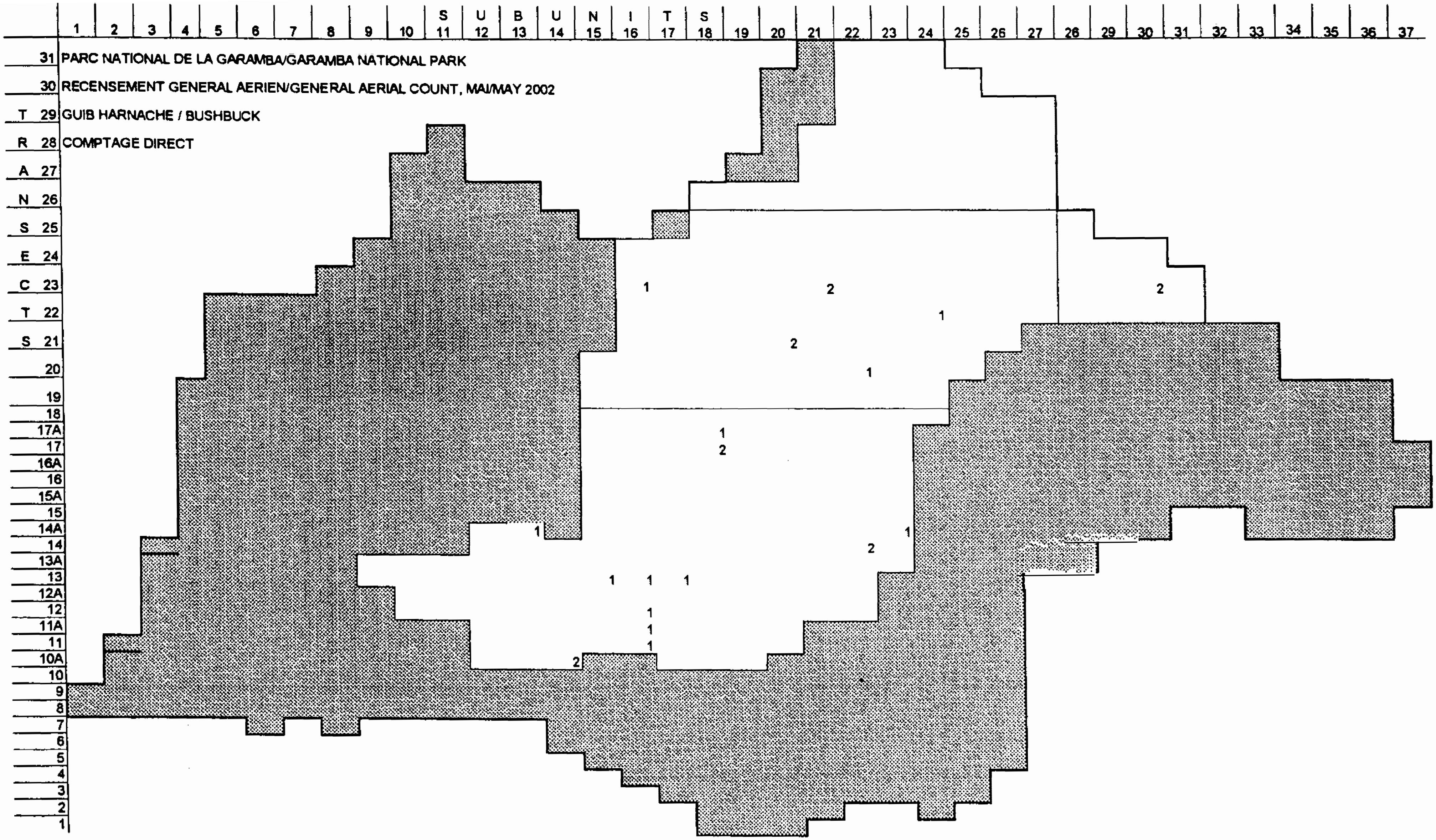
| | | | | |
|---|---|---|---|---|
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 1 | 1 | |
| | 0 | 0 | 0 | |
| | 15 | 0 | 15 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | | 0 | |
| | 2 | | 2 | |
| | 2 | | 2 | |
| 12 | | | | |
| 0 | | | | |
| 0 | | | | |
| 3 | | | | |
| 24 | | | | |
| 1 | | | | |
| 8 | | | | |
| 0 | | | | |
| 21 | | | | |
| 16 | | | | |
| 16 | | | | |
| 1 | | | | |
| 48 | | | | |
| 9 | | | | |
| 2 | | | | |
| 0 | | | | |
| 0 | | 1 | | Total N |
| | 19 | | | Total C |
| 163 | | | | Total S |
| 163 | 19 | 1 | 183 | TOTAL |




| | | | | |
|---|---|---|---|---|
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0.36 | 0.36 | |
| | 0 | 0 | 0 | |
| | 5.18 | 0 | 5.18 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | | 0 | |
| | 0.7 | | 0.7 | |
| | 0.72 | | 0.72 | |
| 4.2 | | | 4.2 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
| 1.16 | | | 1.16 | |
| 8.26 | | | 8.26 | |
| 0.35 | | | 0.35 | |
| 3.26 | | | 3.26 | |
| 0 | | | 0 | |
| 7.35 | | | 7.35 | |
| 6.23 | | | 6.23 | |
| 7.15 | | | 7.15 | |
| 0.34 | | | 0.34 | |
| 16.4 | | | 16.4 | |
| 3.06 | | | 3.06 | |
| 0.81 | | | 0.81 | |
| 0 | | | 0 | |
| 0 | 0 | 0.36 | 0.36 | Total Norc |
| 6.6 | 6.6 | 0 | 6.6 | Total Cen |
| 58.6 | 0 | 0 | 58.6 | Total Sud |
| 58.6 | 6.6 | 0.36 | 65.6 | TOTAL |

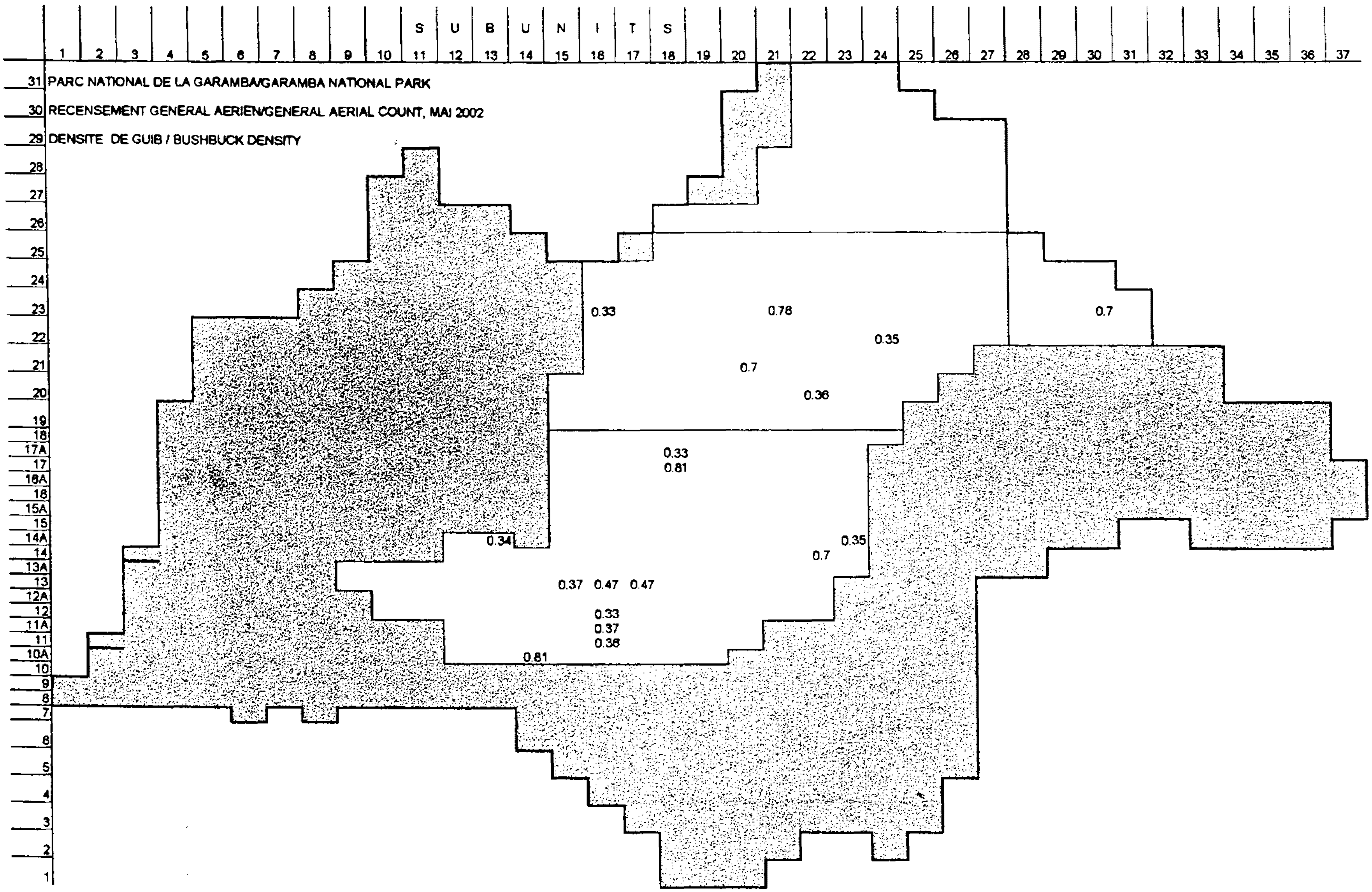
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 0.36 | 0 | 0.38 | 0.7 |
| High D | | | | | | | | | | 0 | 3.15 | 0 | 0.72 | 3 | 0 | 12.6 | 3.6 | 9.01 | 10.2 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.15 | 0 | 0.72 | 3 | 4 | 12.9 | 3.6 | 9.37 | 10.9 |

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0.36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 0 | 2.45 | 2.73 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 0.69 | 8.84 | 0 | 2.47 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0.69 | 8.84 | 0.36 | 4.92 | 2.73 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |




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

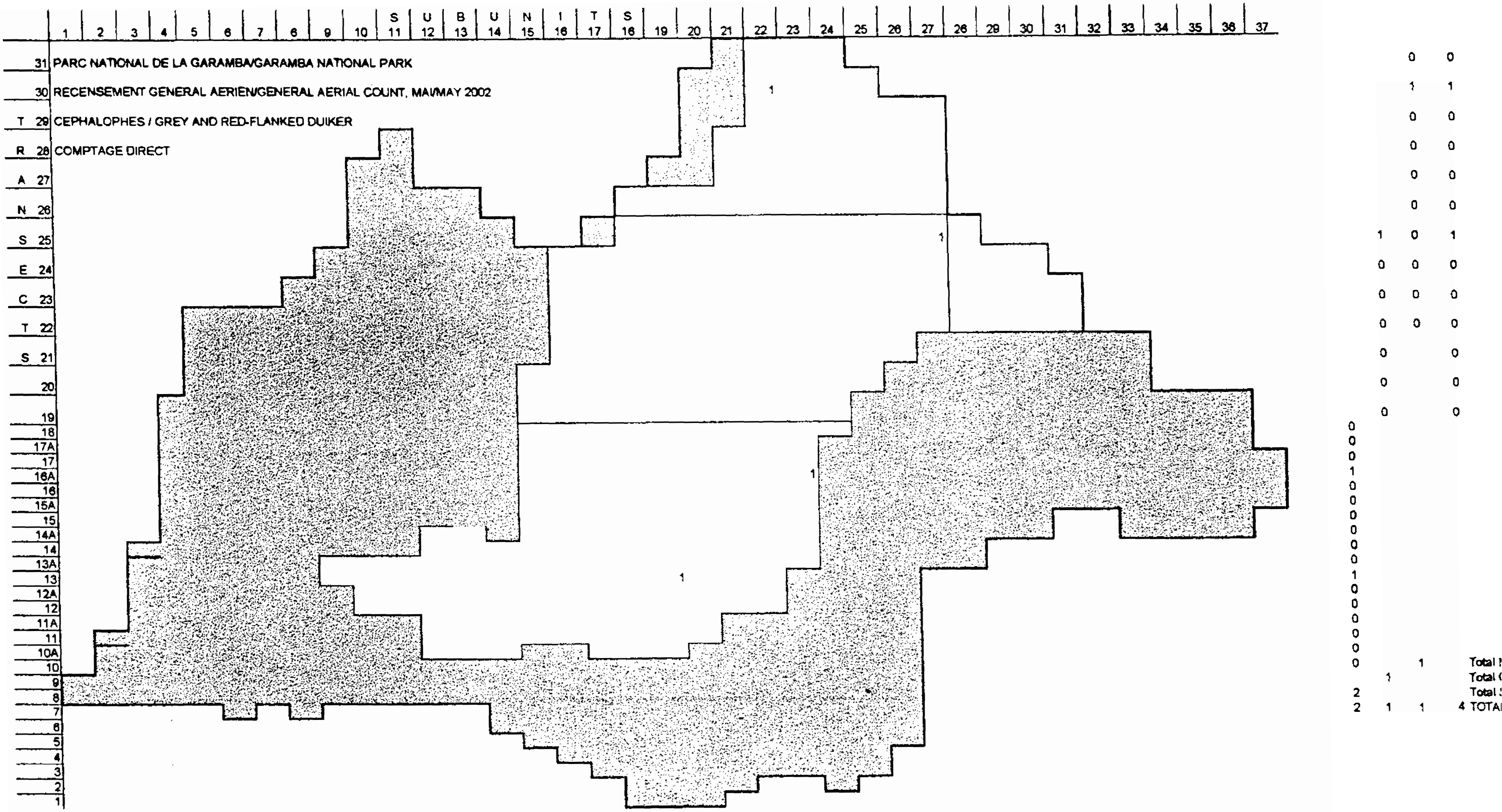
Annexe 5.15



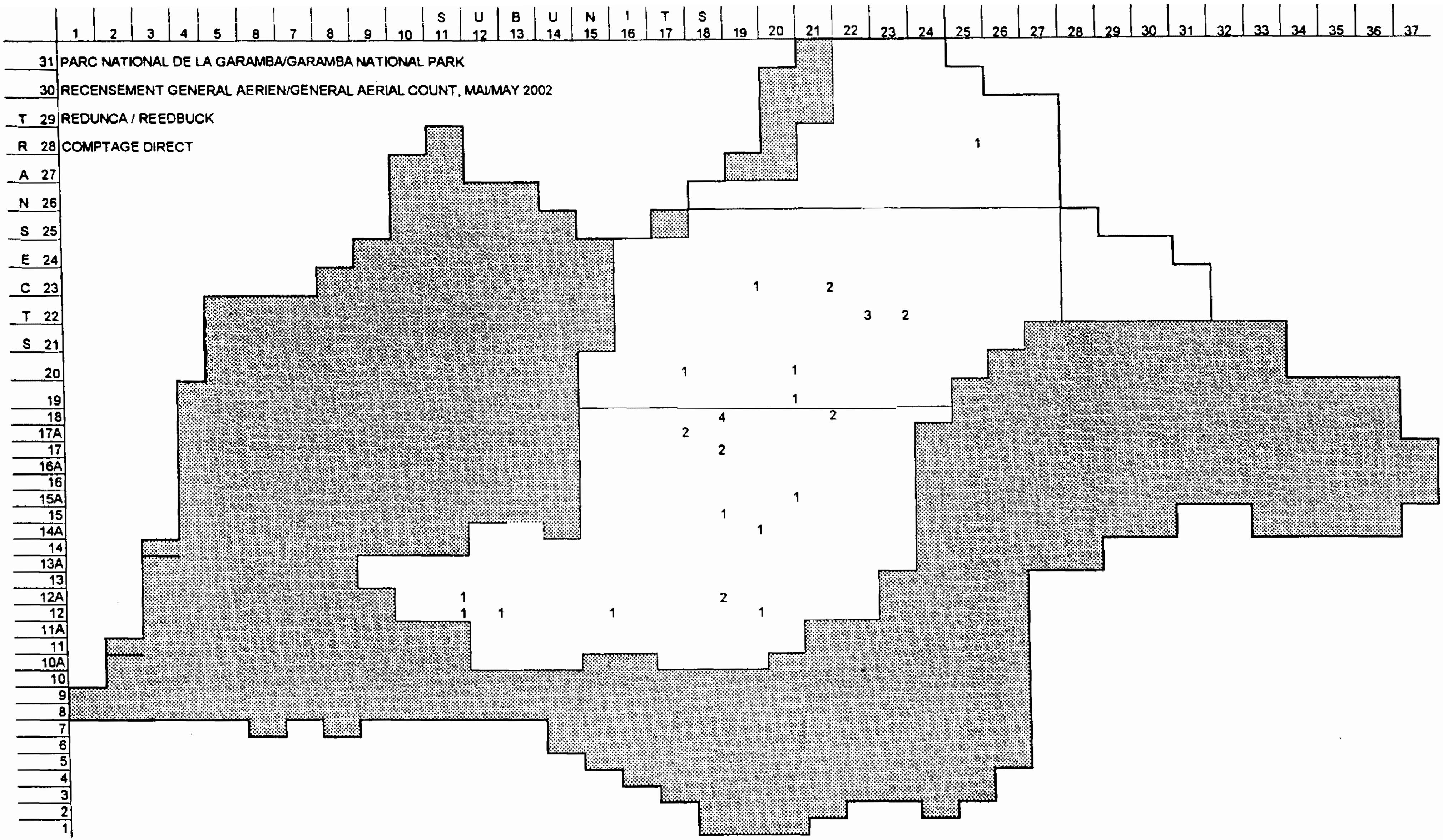

| Row | | | | | |
|---|---|---|---|---|---|
| 31 | | | 0 | 0 | |
| 30 | | | 0 | 0 | |
| 29 | | | 0 | 0 | |
| 28 | | | 0 | 0 | |
| 27 | | | 0 | 0 | |
| 26 | | | 0 | 0 | |
| 25 | | 0 | 0 | 0 | |
| 24 | | 0 | 0 | 0 | |
| 23 | | 1.09 | 0.7 | 1.79 | |
| 22 | | 0.35 | 0 | 0.35 | |
| 21 | | 0.7 | | 0.7 | |
| 20 | | 0.36 | | 0.36 | |
| 19 | | 0 | | 0 | |
| 18 | 0 | | | 0 | |
| 17A | 0.33 | | | 0.33 | |
| 17 | 0.81 | | | 0.81 | |
| 16A | 0 | | | 0 | |
| 16 | 0 | | | 0 | |
| 15A | 0 | | | 0 | |
| 15 | 0 | | | 0 | |
| 14A | 0.69 | | | 0.69 | |
| 14 | 0.7 | | | 0.7 | |
| 13A | 0 | | | 0 | |
| 13 | 1.3 | | | 1.3 | |
| 12A | 0 | | | 0 | |
| 12 | 0.33 | | | 0.33 | |
| 11A | 0.37 | | | 0.37 | |
| 11 | 0.36 | | | 0.36 | |
| 10A | 0.81 | | | 0.81 | |
| | 0 | 0 | 0 | 0 | Total Nord |
| | 2.5 | 2.5 | 0.7 | 3.2 | Total Cent |
| | 5.7 | 0 | 0 | 5.7 | Total Sud |
| | 5.7 | 2.5 | 0.7 | 8.9 | TOTAL |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 |
| High D | | | | | | | | | | 0 | 0 | 0 | 0.34 | 0 | 0.37 | 1.52 | 0.47 | 1.14 | 0 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.33 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.34 | 0 | 0.37 | 1.85 | 0.47 | 1.14 | 0 |

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.7 | 0 | 0 | | | | | |
| Med D | 0.7 | 0.78 | 0.36 | 0 | 0.35 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 0 | 0 | 0.7 | 0.35 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0.7 | 0.78 | 1.06 | 0.35 | 0.35 | 0 | 0 | 0 | 0 | 0 | 0.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

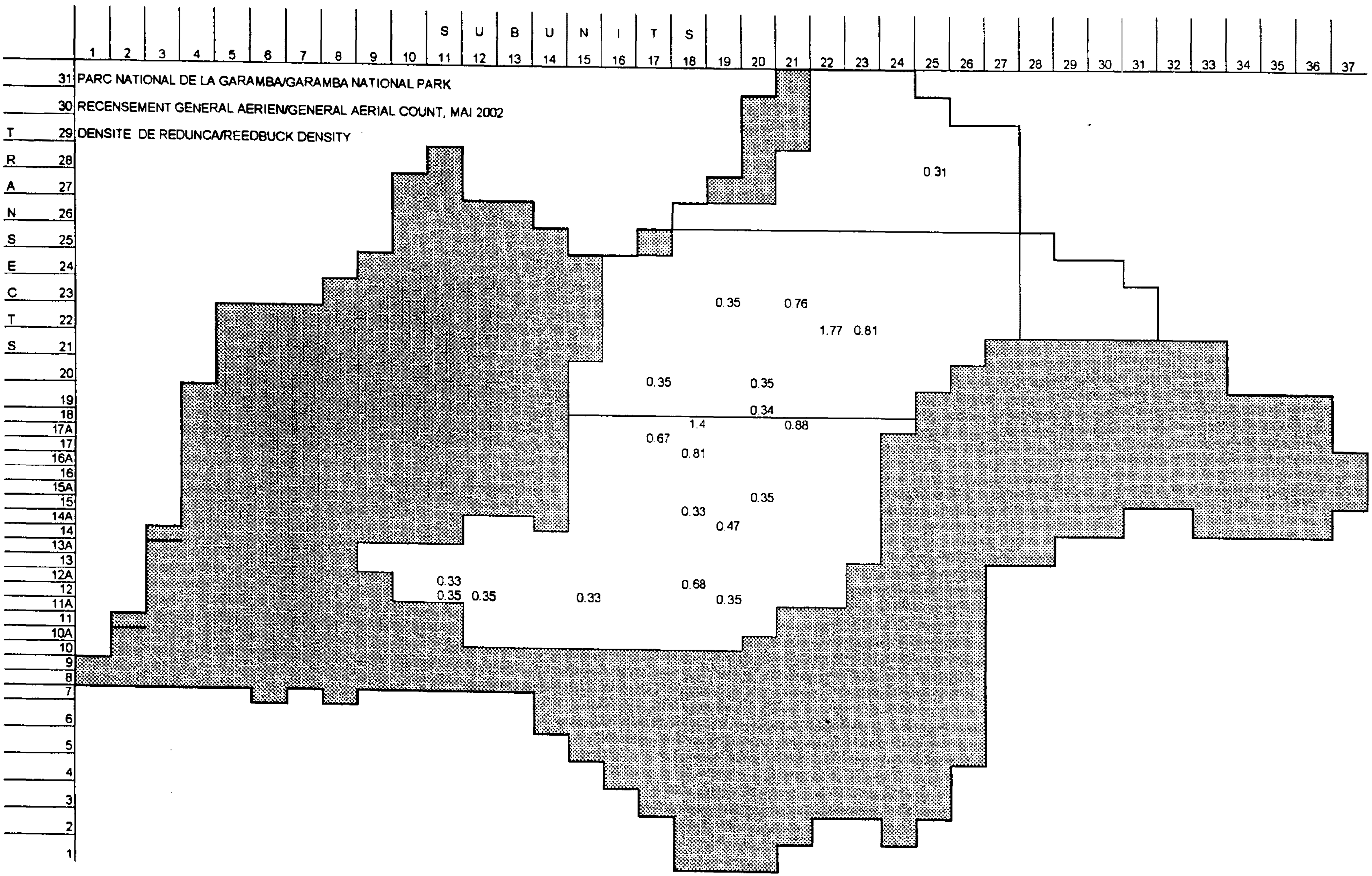



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|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

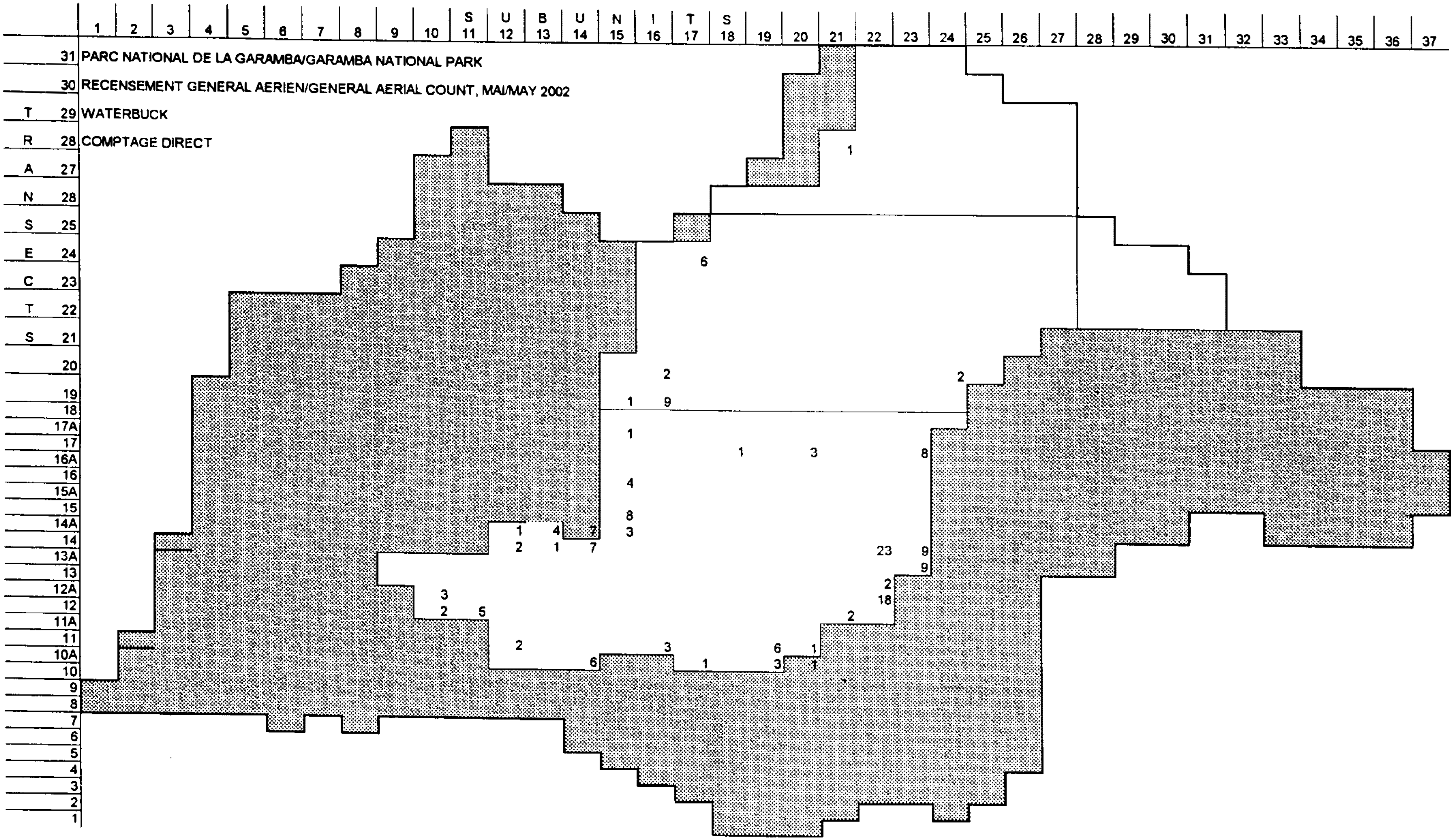



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|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

Annexe 5.15

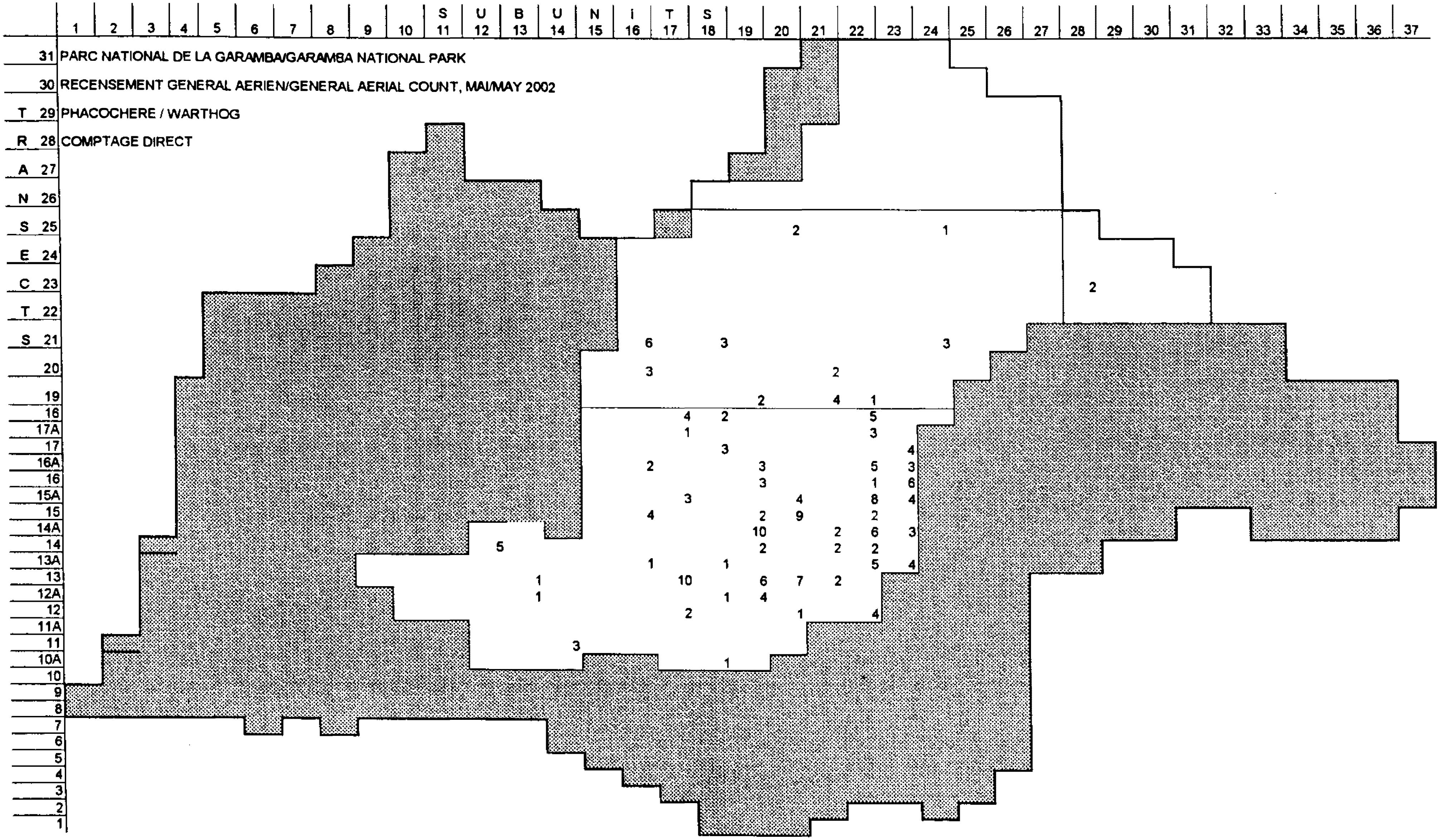



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0.31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 0 | 0.35 | 0 | 0.35 | 0.69 | 0.76 | 1.77 | 0.81 | 0 | 0 | 0 | 0 | | | | | | | | | | |
| High D | | | | | | | | | | 0 | 0.68 | 0.35 | 0 | 0 | 0.33 | 0 | 0.67 | 3.22 | 0.82 | 0.35 | 0.88 | 0 | 0 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.68 | 0.35 | 0 | 0 | 0.33 | 0 | 1.02 | 3.22 | 1.17 | 1.04 | 1.64 | 1.77 | 0.81 | 0 | 0.31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



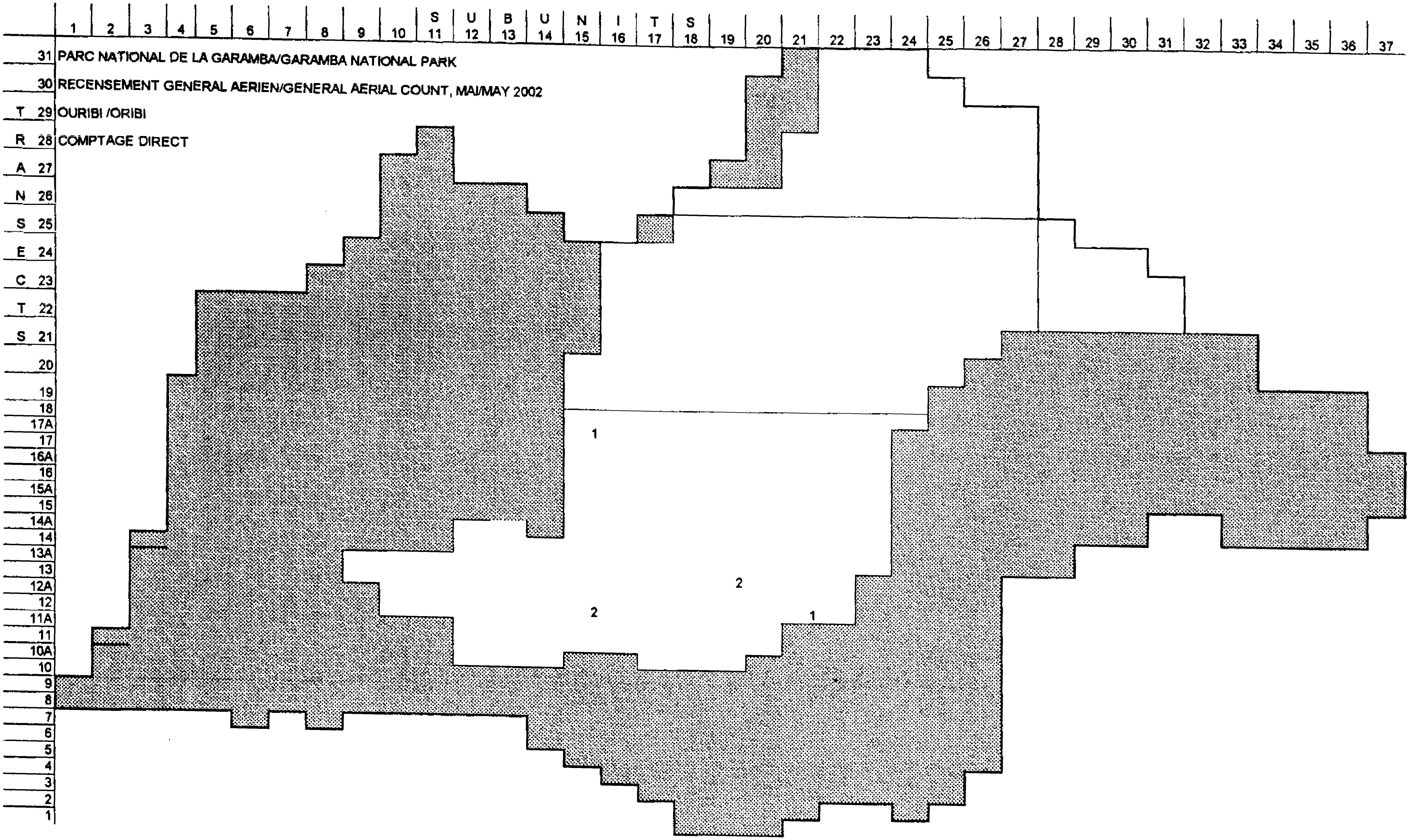

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 11 | 6 | 0 | 0 |
| High D | | | | | | | | | 0 | 5 | 5 | 9 | 2 | 25 | 7 | 3 | 0 | 1 | 6 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 9 | 2 | 25 | 7 | 14 | 6 | 1 | 6 |

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 4 | 2 | 43 | 26 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 4 | 3 | 43 | 26 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

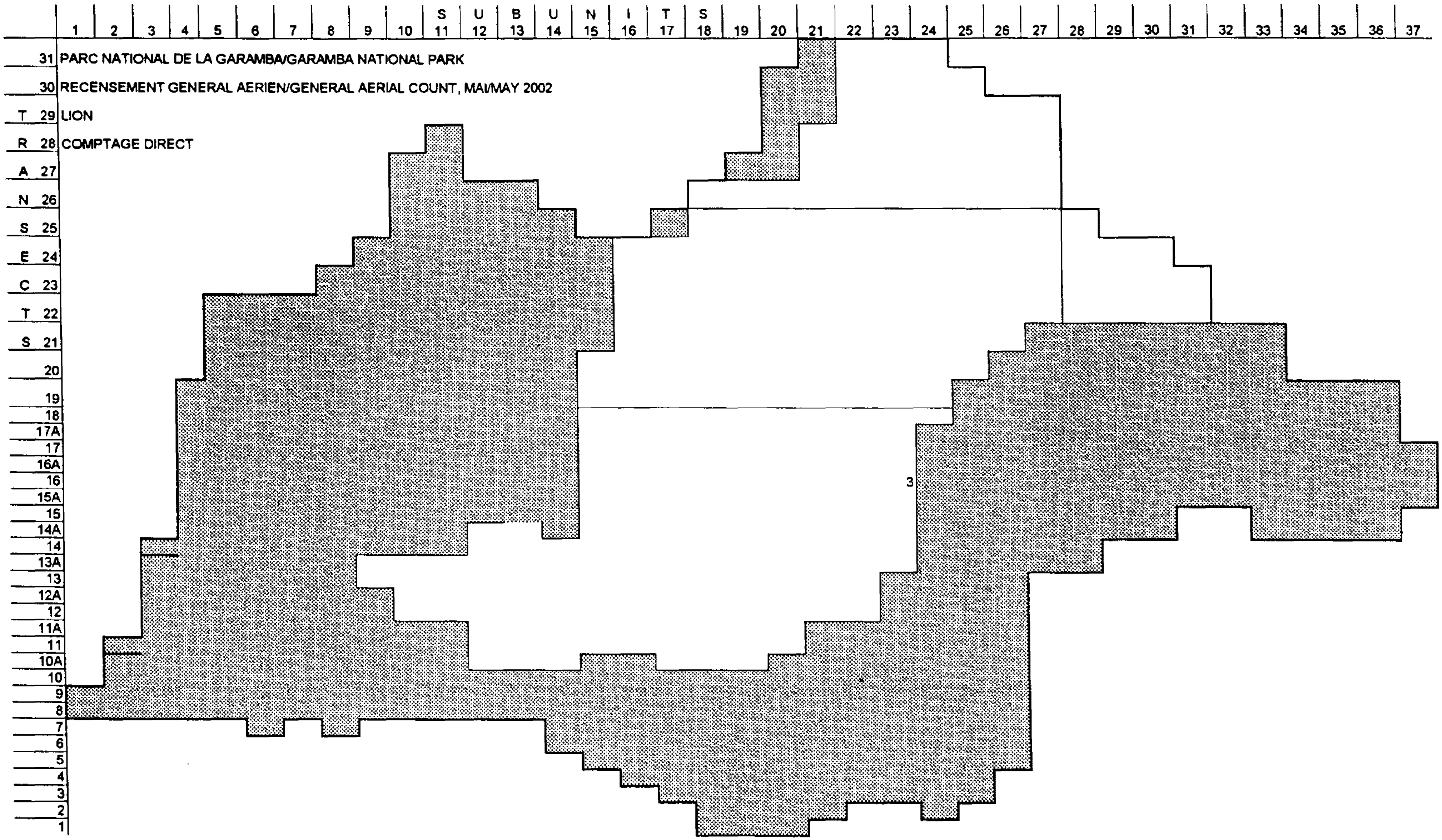



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 9 | 0 | 3 | 2 | 2 | 6 | 1 | 0 | 4 | 0 | 0 | 0 | | | | | | | | | | |
| High D | | | | | | | | | 0 | 0 | 0 | 22 | 8 | 5 | 3 | 7 | 20 | 7 | 30 | 21 | 6 | 41 | 24 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tote | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 8 | 5 | 3 | 16 | 20 | 10 | 32 | 23 | 12 | 42 | 24 | 4 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Annexe 5.15

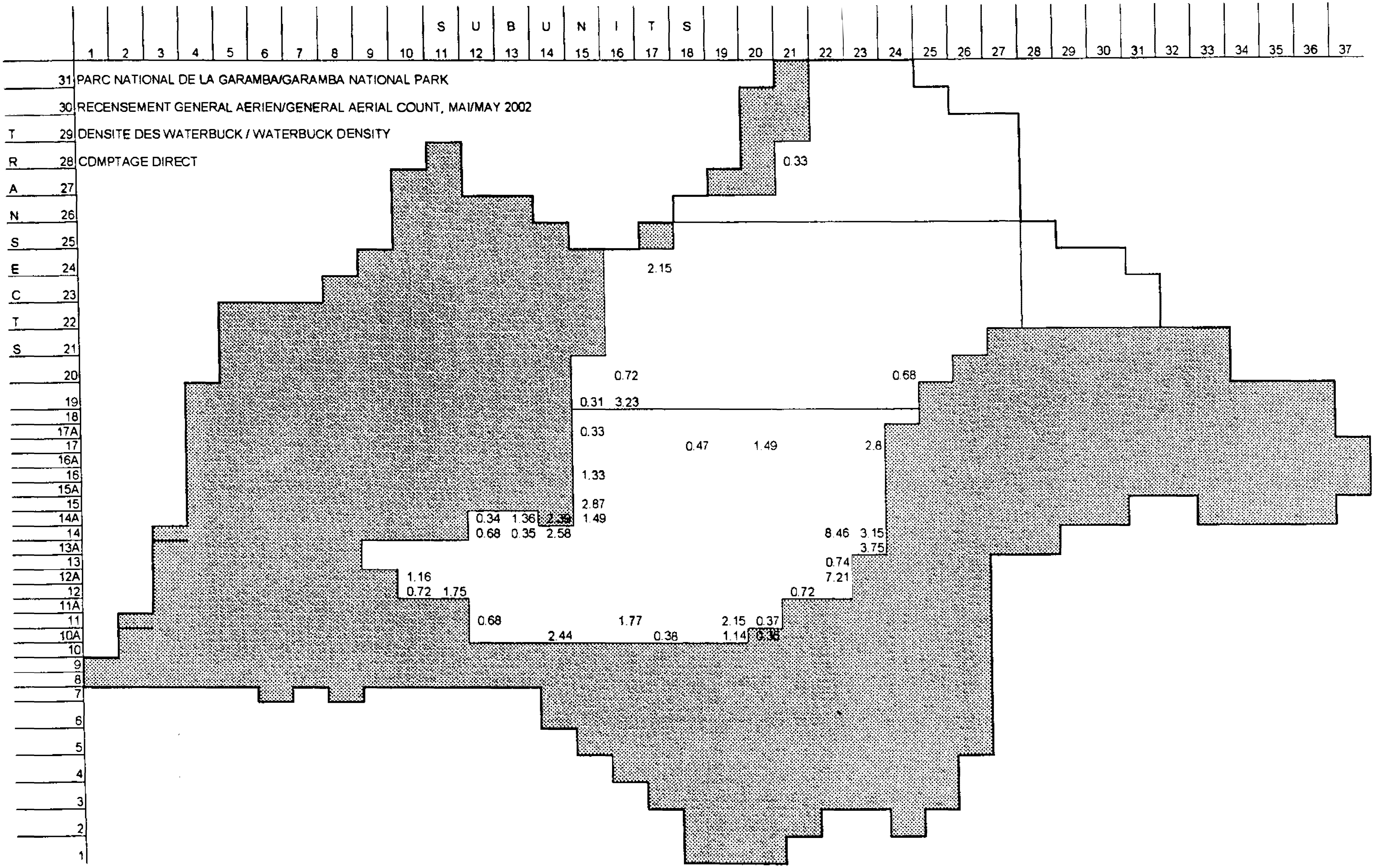



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|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

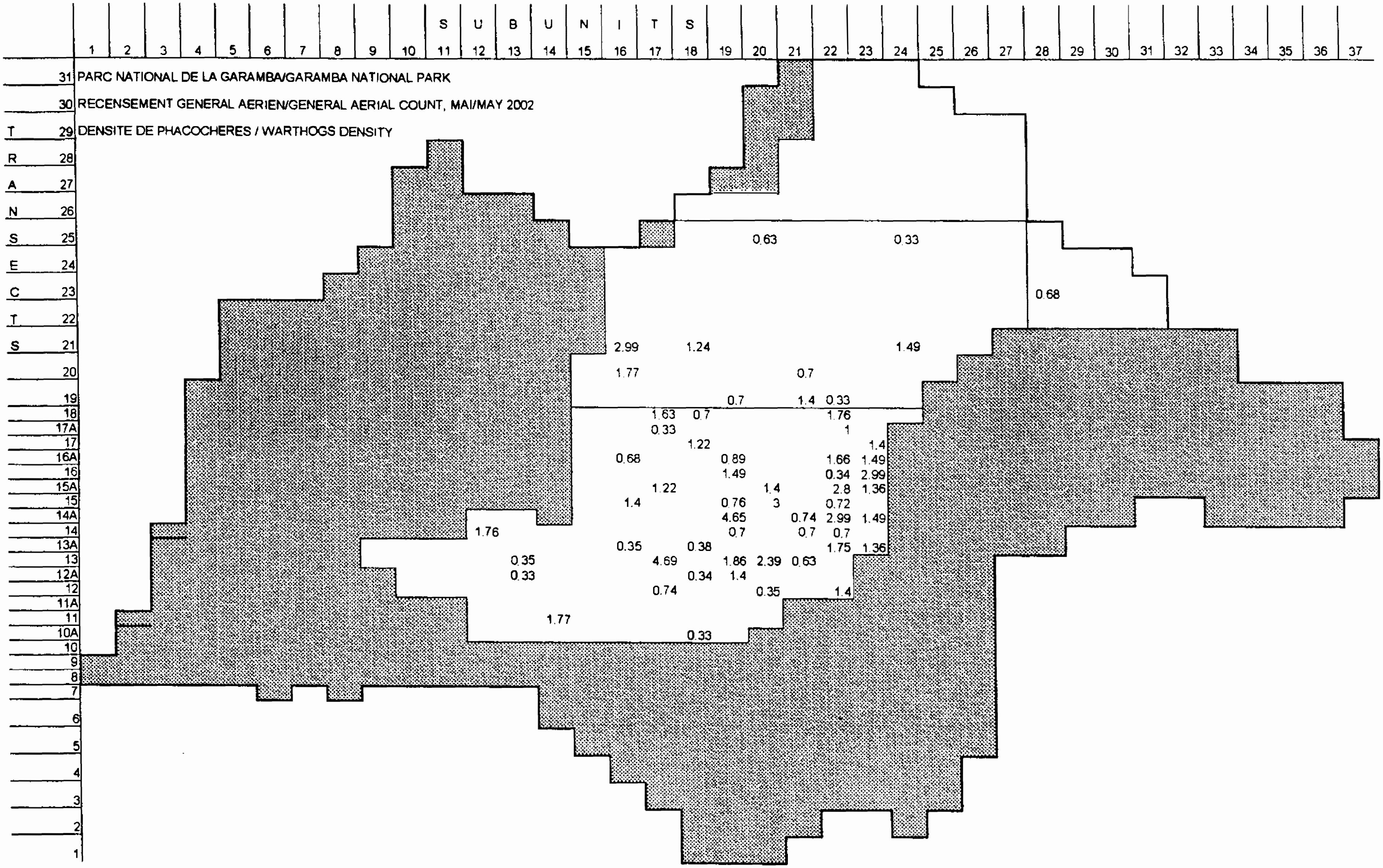



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | |
| Med D | | | | | | | | | | | | | | | | | 0 | 0 | 0 |
| High D | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tots | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| Med D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |
| High D | 0 | 0 | 0 | 0 | 3 | 0 | 0 | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tots | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

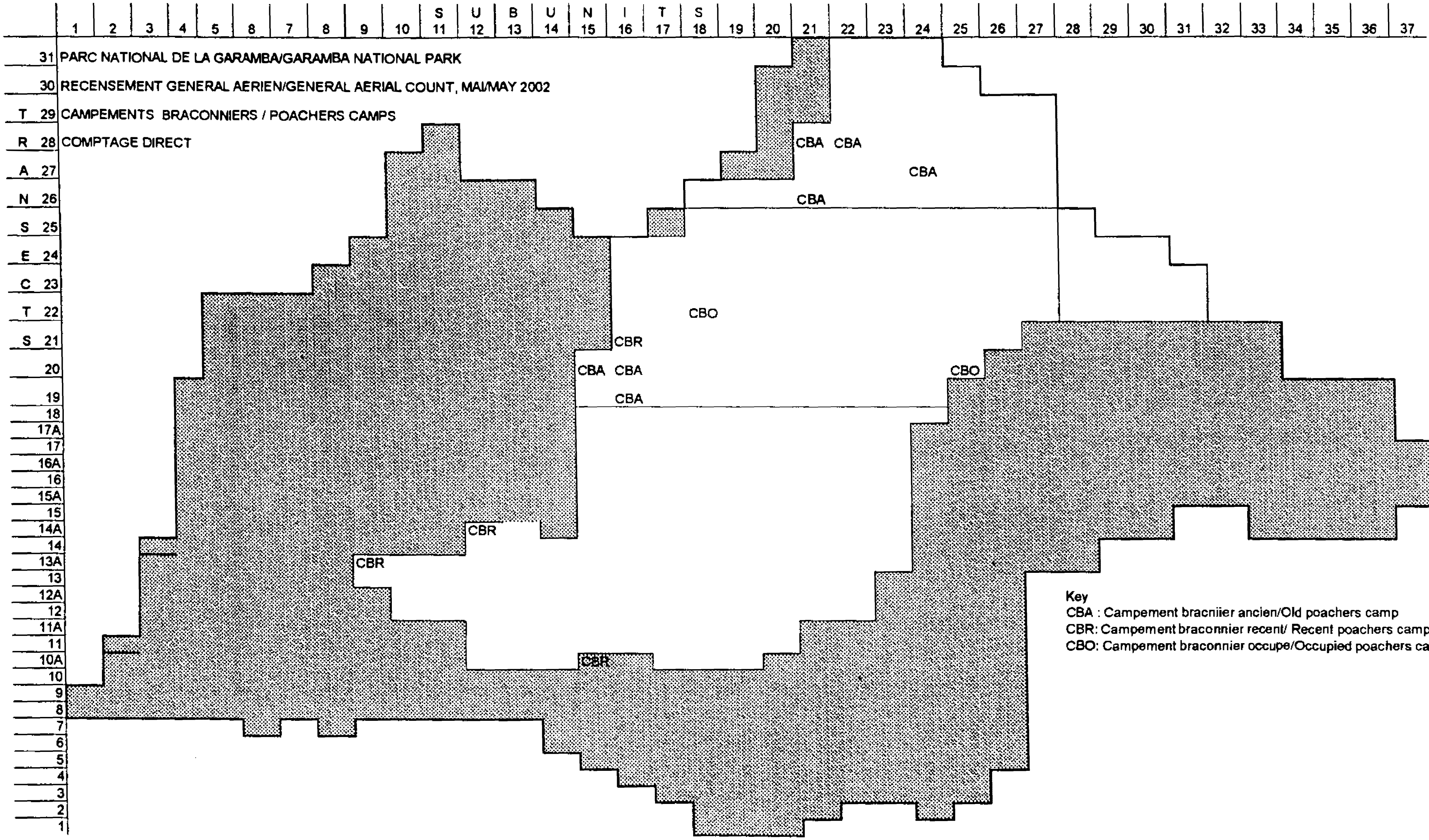



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | |
| Med D | | | | | | | | | | | | | | | | 3.95 | 2.15 | 0 | 0 | 0 | 0 | 0 | 0 | 0.68 | 0 | 0 | 0 | | | | | | | | | | |
| High D | | | | | | | | | | 0 | 1.75 | 0.68 | 1.71 | 2.58 | 0 | 1.77 | 0 | 0.47 | 2.15 | 1.86 | 0.72 | 16.4 | 9.7 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.72 | 0 | 0.68 | 0 | 0 | 4.85 | 0 | 0 | 0 | 0 | 0 | 0.33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.72 | 1.75 | 1.36 | 1.71 | 2.58 | 4.85 | 5.72 | 2.15 | 0.47 | 2.15 | 1.86 | 1.04 | 18.4 | 9.7 | 0.68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

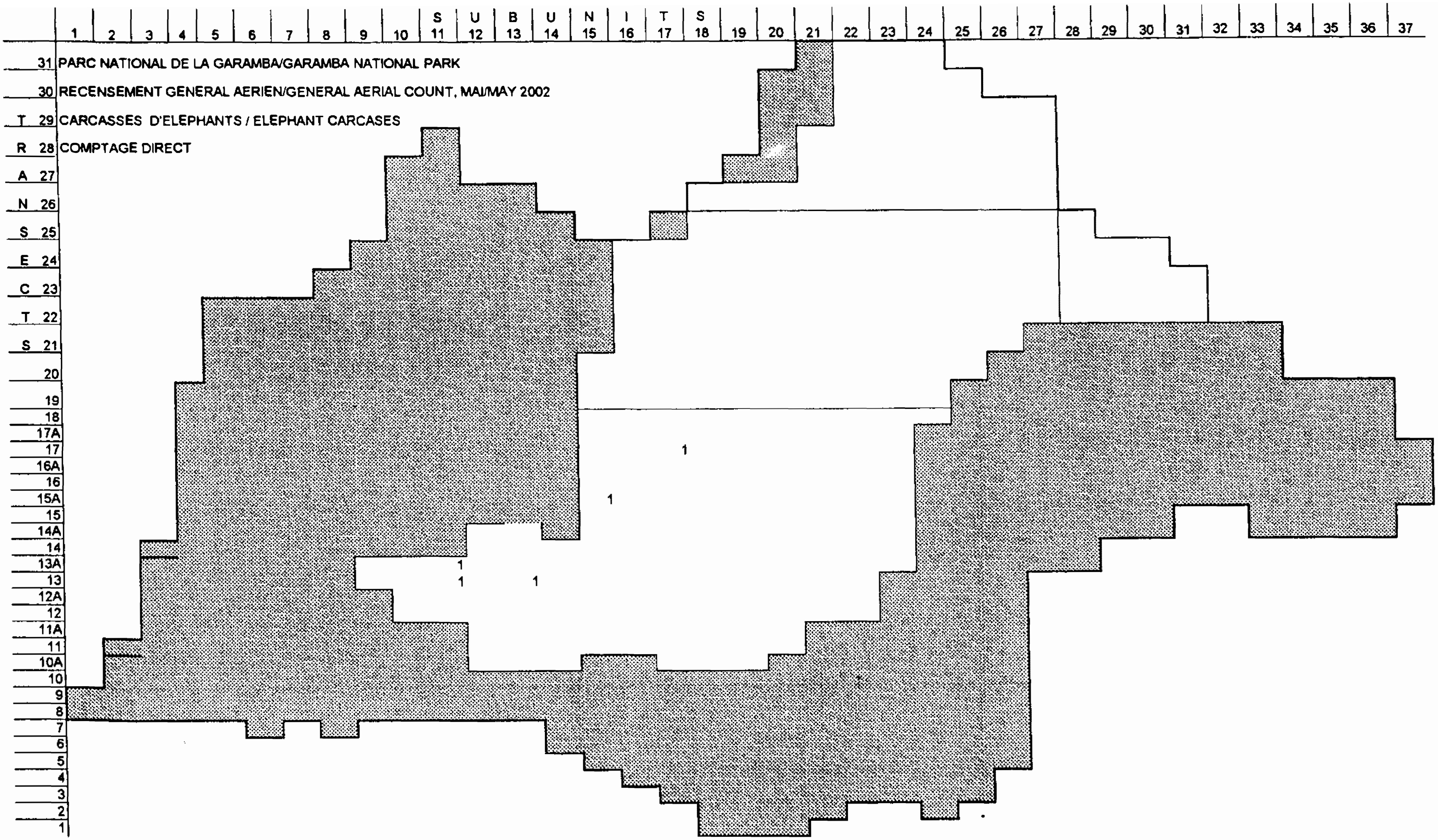



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 0 |
| Med D | | | | | | | | | | | | | | | | 4.76 | 0 | 1.24 | 0.7 |
| High D | | | | | | | | | | 0 | 0 | 1.76 | 0.68 | 1.77 | 0 | 2.43 | 8.6 | 2.64 | 11.8 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.76 | 0.68 | 1.77 | 0 | 7.19 | 8.6 | 3.87 | 12.5 |

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.68 | 0 | 0 | 0 | 0 | | | | | |
| Med D | 0.63 | 2.1 | 0.33 | 0 | 1.83 | 0 | 0 | 0 | | | | | | | | | | |
| High D | 7.13 | 2.07 | 15.1 | 10.1 | 0 | 0 | | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 7.76 | 4.16 | 15.4 | 10.1 | 1.83 | 0 | 0 | 0 | 0.68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

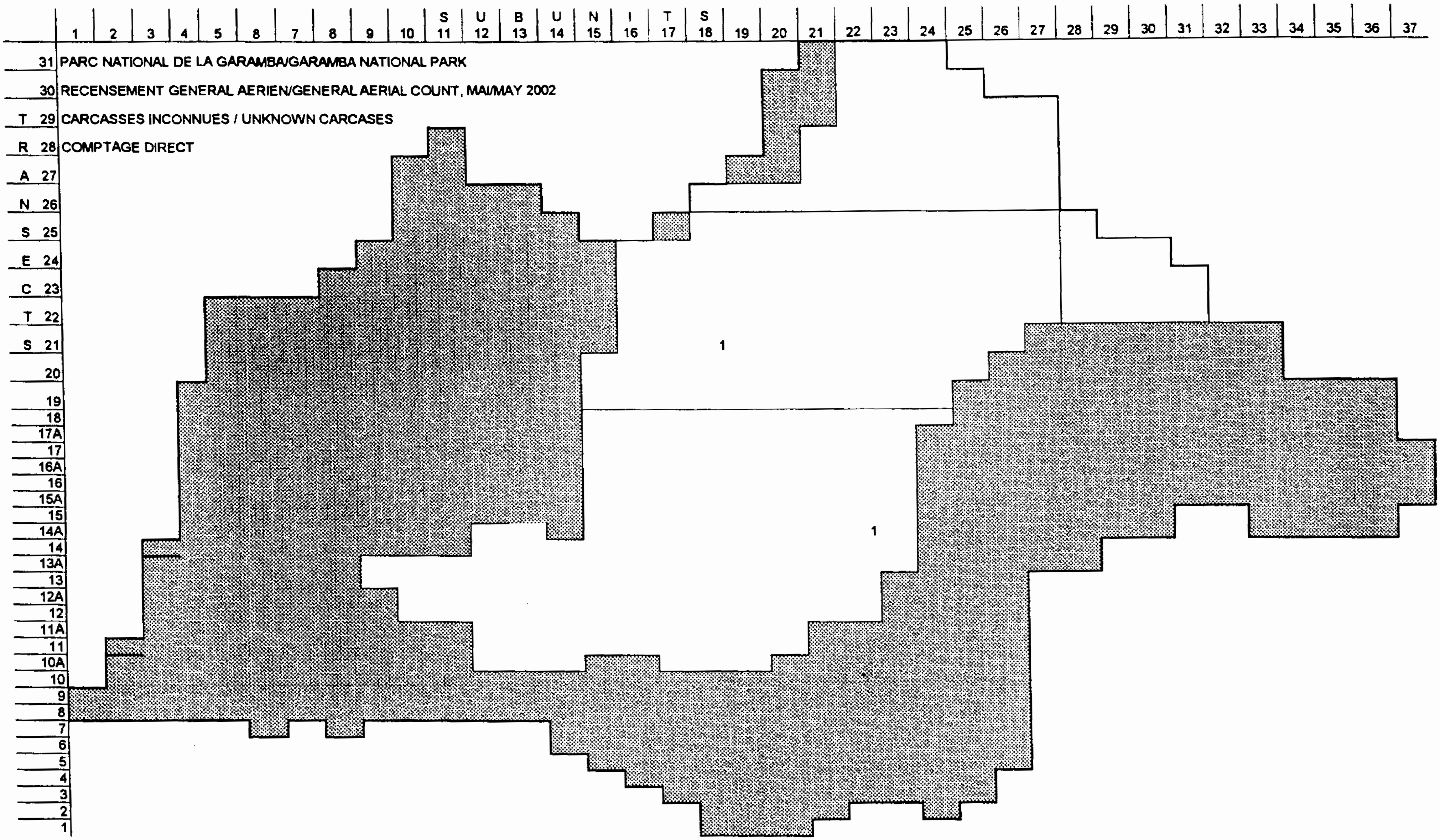



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|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




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | |
| Med D | | | | | | | | | | | | | | | | | 0 | 0 | 0 |
| High D | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tots | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |

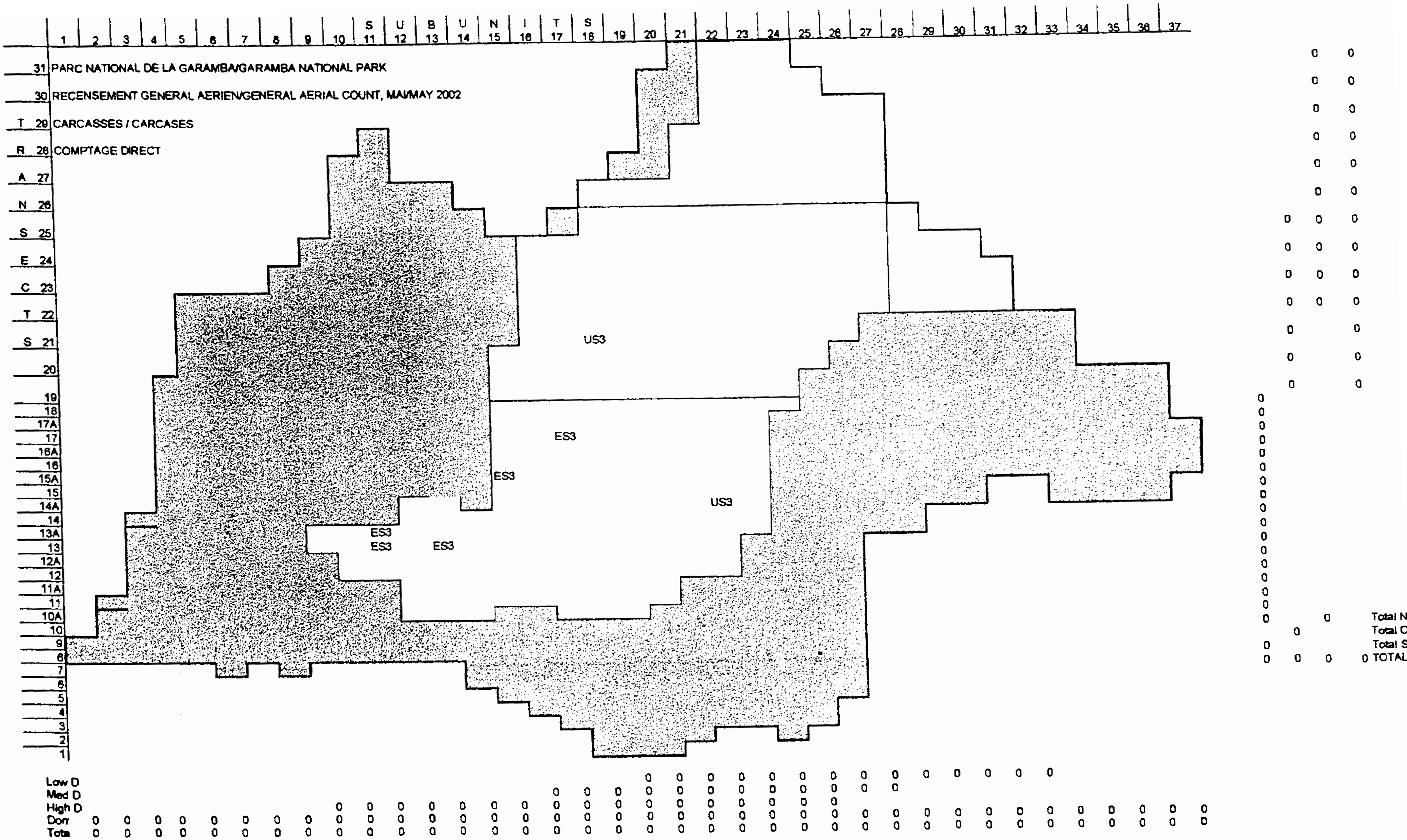
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| Med D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |
| High D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | | |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tots | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

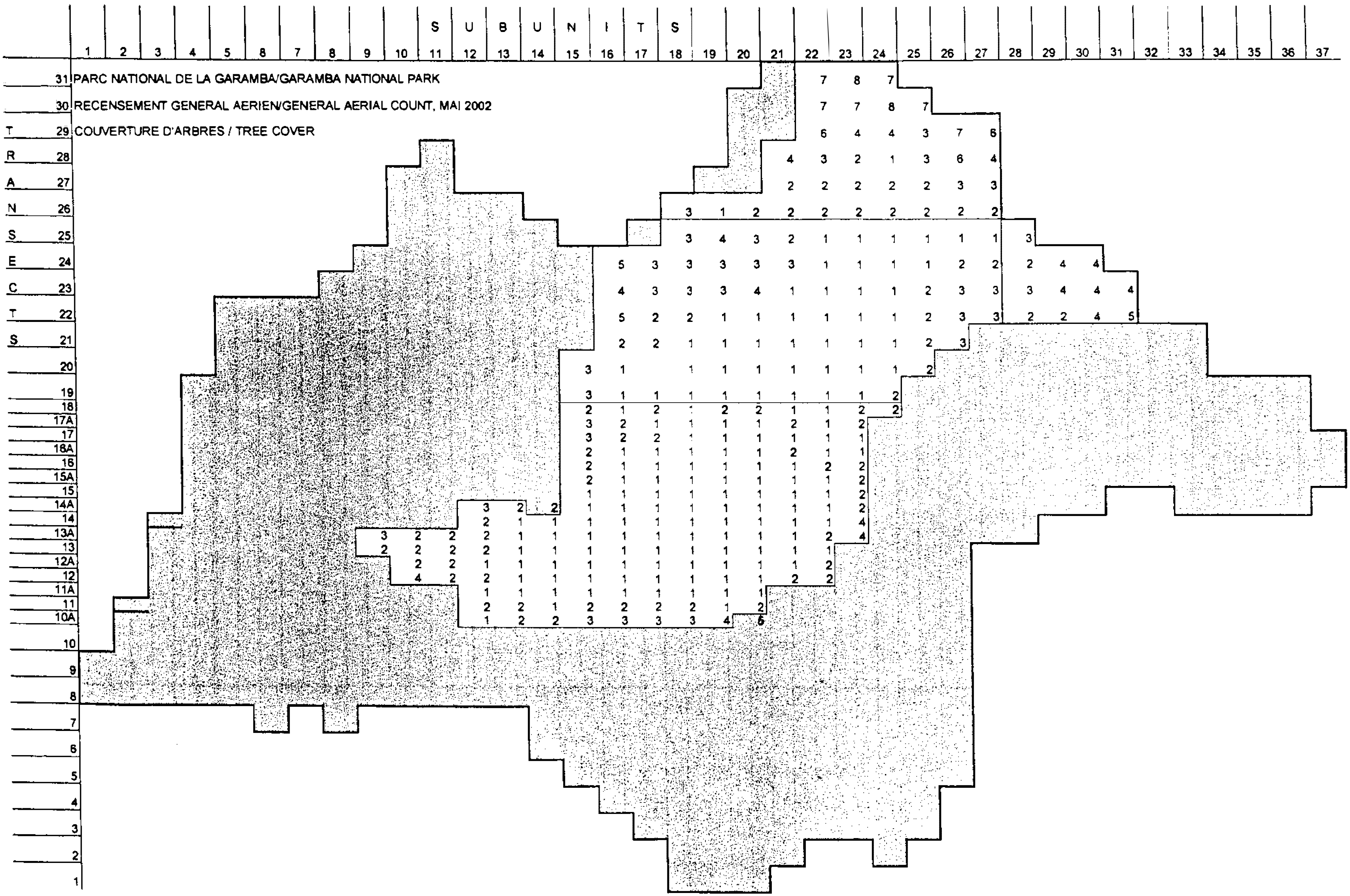



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | |
| Med D | | | | | | | | | | | | | | | | | 0 | 0 | 1 |
| High D | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dorr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tots | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

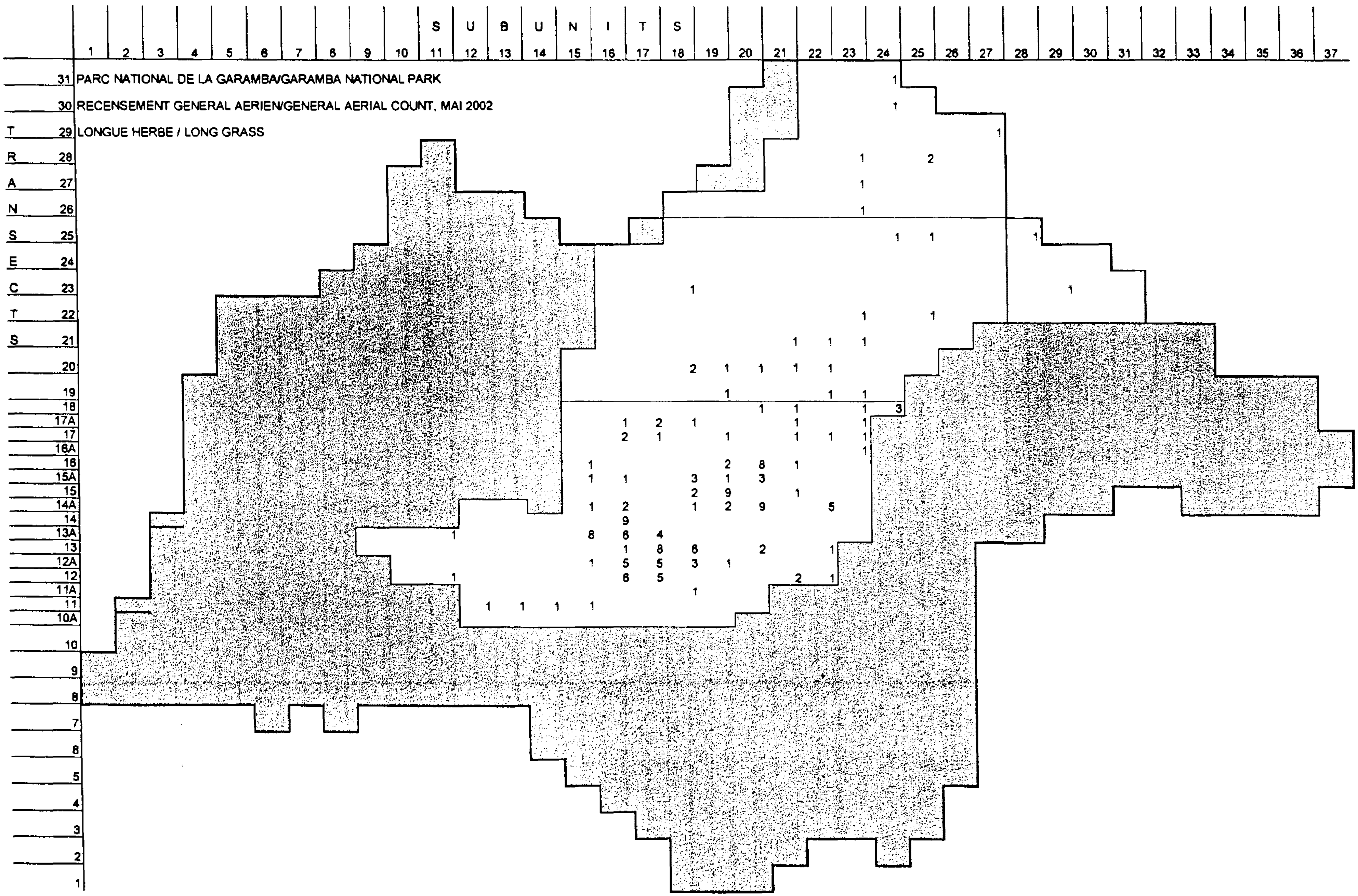
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| Med D | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |
| High D | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | | | | | | | | | | |
| Dorr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tots | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

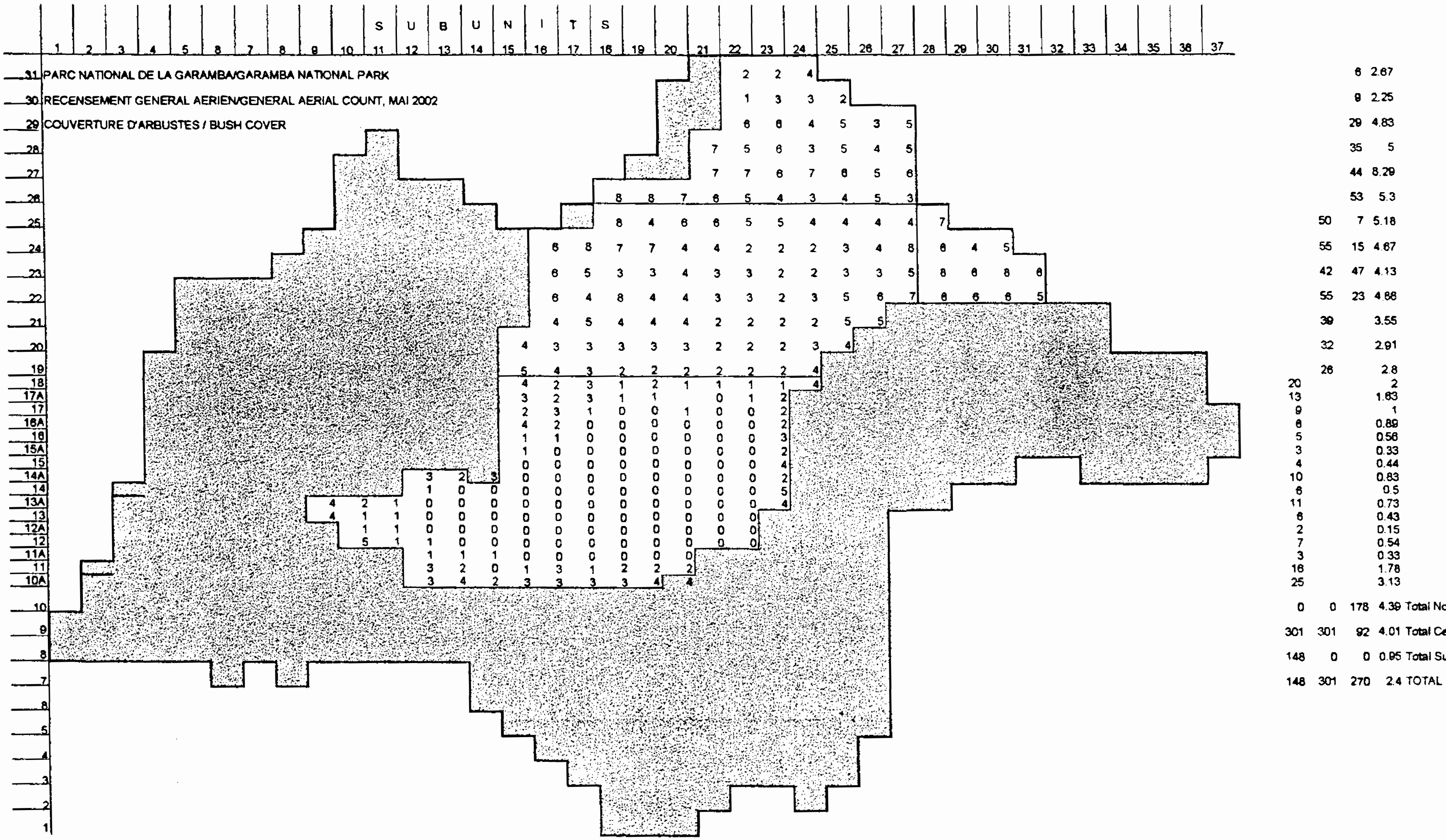
Annexe 5.15


PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI/MAY 2002
CARCASSES / CARCASES
COMPTAGE DIRECT
SUBUNITS
TRANSECTS
US3
ES3
Low D
Med D
High D
Dorr
Tota
Total N
Total C
Total S
TOTAL


PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 2002
COUVERTURE D'ARBRES / TREE COVER
SUBUNITS
TRANSECTS

Annexe 5.15


SUBUNITS
TRANSECTS
PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 2002
LONGUE HERBE / LONG GRASS




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | | | | | | | | | | | | | | | | | | | 8 |
| Med D | | | | | | | | | | | | | | | | 11 | 28 | 35 | 27 |
| High D | | | | | | | | | | 1 | 3 | 2 | 5 | 1 | 1 | 13 | 8 | 4 | 5 |
| Dom | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 5 | 0 | 8 | 0 | 0 | 24 | 18 | 0 | 0 | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 8 | 3 | 8 | 5 | 1 | 25 | 42 | 36 | 39 | 40 |

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Low D | 7 | 13 | 17 | 27 | 24 | 22 | 17 | 19 | 25 | 16 | 17 | 11 | 0 | | | | | |
| Med D | 27 | 22 | 19 | 17 | 20 | 24 | 22 | 22 | | | | | | | | | | |
| High D | 4 | 1 | 2 | 27 | 4 | 0 | | | | | | | | | | | | |
| Dom | 0 | 7 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 38 | 43 | 47 | 71 | 48 | 46 | 39 | 41 | 25 | 16 | 17 | 11 | 0 | 0 | 0 | 0 | 0 | 0 |

| TRANS | PNG 2002 AREA | | | | WARTHOG | | | | | WATERBUCK | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HIGH STH | MID NTH | LOW NTH | TOT NOR | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL |
| 31 | | | 8.58 | 8.58 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 12.38 | 12.38 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 17.37 | 17.37 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 21.39 | 21.39 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 20.45 | 20.45 | | | 0 | 0 | | | | 1 | 1 | |
| 26 | | | 30.62 | 30.62 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 28.88 | 2.86 | 31.73 | | 3 | 0 | 3 | | | 0 | 0 | 0 | |
| 24 | | 33.94 | 8.72 | 42.66 | | 0 | 0 | 0 | | | 6 | 0 | 6 | |
| 23 | | 34.30 | 22.94 | 57.24 | | 0 | 2 | 2 | | | 0 | 0 | 0 | |
| 22 | | 34.38 | 11.43 | 45.81 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 30.43 | | 30.43 | | 12 | | 12 | | | 0 | | 0 | |
| 20 | | 31.52 | | 31.52 | | 5 | | 5 | | | 4 | | 4 | |
| 19 | | 29.09 | | 29.09 | | 7 | | 7 | | | 10 | | 10 | |
| 18 | 27.57 | | | | 11 | | | | | 0 | | | | |
| 17a | 26.82 | | | | 4 | | | | | 1 | | | | |
| 17 | 25.36 | | | | 7 | | | | | 12 | | | | |
| 16a | 26.16 | | | | 13 | | | | | 0 | | | | |
| 16 | 26.09 | | | | 10 | | | | | 4 | | | | |
| 15a | 25.36 | | | | 19 | | | | | 0 | | | | |
| 15 | 25.73 | | | | 17 | | | | | 8 | | | | |
| 14a | 31.37 | | | | 21 | | | | | 8 | | | | |
| 14 | 34.16 | | | | 11 | | | | | 42 | | | | |
| 13a | 43.10 | | | | 11 | | | | | 9 | | | | |
| 13 | 38.93 | | | | 26 | | | | | 2 | | | | |
| 12a | 37.52 | | | | 6 | | | | | 21 | | | | |
| 12 | 37.60 | | | | 7 | | | | | 9 | | | | |
| 11a | 26.16 | | | | 0 | | | | | 0 | | | | |
| 11 | 24.64 | | | | 3 | | | | | 12 | | | | |
| 10a | 24.71 | | | | 1 | | | | | 11 | | | | |
| Total | 481.3 | 222.5 | 156.7 | 379.3 | 167.0 | 27.0 | 2.0 | 29.0 | | 139.0 | 20.0 | 1.0 | 21.0 | |
| Sum squ | 15040.7 | 7109.8 | 2341.3 | 13309.4 | 2559.0 | 227.0 | 0.0 | 231.0 | | 2925.0 | 152.0 | 1.0 | 153.0 | |
| | | | | Sum (Z*y) | 5216.2 | 813.0 | 0.0 | 936.1 | | 4486.6 | 620.6 | 21.4 | 694.4 | |
| | | | | R=Sy/Sz | 0.3 | 0.1 | 0.0 | 0.1 | | 0.3 | 0.1 | 0.0 | 0.1 | |
| | | | | Var y | 54.4 | 20.5 | 0.0 | 13.9 | | 114.5 | 15.8 | 0.2 | 9.9 | |
| Var z | 37.6 | 5.9 | 59.2 | 187.1 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | 12.8 | -37.7 | -3.5 | 1.8 | TOTAL | 20.4 | -24.2 | 0.6 | 2.8 | TOTAL |
| | | | | | WARTHOG | | | | | WATERBUCK | | | | |
| | | | Pop.est.(Y) | | **737** | **237** | **16** | **243** | **990** | **614** | **175** | **8** | **176** | **797** |
| | | | | SE(Y) | 162.0 | 195.7 | 7.7 | 159.3 | 254.2 | 235.8 | 161.4 | 9.8 | 134.0 | 315.75 |
| | | | | 95% C.L. | 330.5 | 399.2 | 15.7 | 325.1 | 498.2 | 480.9 | 329.3 | 20.0 | 273.4 | 618.88 |
| | | | | 95% C.L. | 44.8 | 0.0 | 0.0 | 0.0 | 50.3 | 78.4 | 187.9 | 256.3 | 155.5 | 77.67 |

| TRANS | PNG 2002 AREA HIGH STH | MID NTH | LOW NTH | TOT NOR | ELEPHANTS HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL | BUFFALOS HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | | | 8.58 | 8.58 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 12.38 | 12.38 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 17.37 | 17.37 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 21.39 | 21.39 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 20.45 | 20.45 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 30.62 | 30.62 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 28.88 | 2.86 | 31.73 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 33.94 | 8.72 | 42.66 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 34.30 | 22.94 | 57.24 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 34.38 | 11.43 | 45.81 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 30.43 | | 30.43 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 31.52 | | 31.52 | | 0 | | 0 | | | 8 | | 8 | |
| 19 | | 29.09 | | 29.09 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 27.57 | | | | 2 | | | | | 0 | | | | |
| 17a | 26.82 | | | | 13 | | | | | 30 | | | | |
| 17 | 25.36 | | | | 50 | | | | | 6 | | | | |
| 16a | 26.16 | | | | 58 | | | | | 143 | | | | |
| 16 | 26.09 | | | | 31 | | | | | 152 | | | | |
| 15a | 25.36 | | | | 127 | | | | | 241 | | | | |
| 15 | 25.73 | | | | 150 | | | | | 42 | | | | |
| 14a | 31.37 | | | | 142 | | | | | 337 | | | | |
| 14 | 34.16 | | | | 167 | | | | | 293 | | | | |
| 13a | 43.10 | | | | 108 | | | | | 74 | | | | |
| 13 | 38.93 | | | | 123 | | | | | 610 | | | | |
| 12a | 37.52 | | | | 177 | | | | | 575 | | | | |
| 12 | 37.60 | | | | 102 | | | | | 283 | | | | |
| 11a | 26.16 | | | | 53 | | | | | 103 | | | | |
| 11 | 24.64 | | | | 51 | | | | | 102 | | | | |
| 10a | 24.71 | | | | 1 | | | | | 1 | | | | |
| Total | 481.3 | 222.5 | 156.7 | 379.3 | 1355.0 | 0.0 | 0.0 | 0.0 | | 2992.0 | 8.0 | 0.0 | 8.0 | |
| Sum squ | 15040.7 | 7109.8 | 2341.3 | 13309.4 | 167617.0 | 0.0 | 0.0 | 0.0 | | 1113056.0 | 64.0 | 0.0 | 64.0 | |
| | | | | Sum (Z*y) | 43825.3 | 0.0 | 0.0 | 0.0 | | 100824.0 | 252.1 | 0.0 | 252.1 | |
| | | | | R=Sy/Sz | 2.8 | 0.0 | 0.0 | 0.0 | | 6.2 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 3524.4 | 0.0 | 0.0 | 0.0 | | 36903.5 | 9.1 | 0.0 | 4.9 | |
| Var z | 37.6 | 5.9 | 59.2 | 187.1 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | 204.4 | 0.0 | 0.0 | 0.0 | TOTAL | 721.6 | -8.9 | 0.0 | -0.1 | TOTAL |
| | | | | | ELEPHANTS | | | | | BUFFALOS | | | | |
| | | | Pop.est.(Y) | | **5,983** | **0** | **0** | **0** | **5,983** | **13,210** | **70** | **0** | **67** | **13,281** |
| | | | | SE(Y) | 1184.2 | 0.0 | 0.0 | 0.0 | 1184.2 | 3927.6 | 112.4 | 0.0 | 95.9 | 3930.42 |
| | | | | 95% C.L. | 2415.7 | 0.0 | 0.0 | 0.0 | 2321.0 | 8012.4 | 229.2 | 0.0 | 195.7 | 7703.62 |
| | | | | 95% C.L. | 40.4 | 0.0 | 0.0 | 0.0 | 38.8 | 60.7 | 326.9 | ERR | 292.2 | 58.01 |

| | PNG 2002 | | AREA | | | | GIRAFFE | | | | | LION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STH | MID NTH | LOW NTH | TOT NOR | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL |
| 31 | | | 8.58 | 8.58 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 12.38 | 12.38 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 17.37 | 17.37 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 21.39 | 21.39 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 20.45 | 20.45 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 30.62 | 30.62 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 28.88 | 2.86 | 31.73 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 33.94 | 8.72 | 42.66 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 34.30 | 22.94 | 57.24 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 34.38 | 11.43 | 45.81 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 30.43 | | 30.43 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 31.52 | | 31.52 | | 0 | | 0 | | | 0 | | 0 | |
| 19 | | 29.09 | | 29.09 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 27.57 | | | | 0 | | | | | 0 | | | | |
| 17a | 26.82 | | | | 0 | | | | | 0 | | | | |
| 17 | 25.36 | | | | 0 | | | | | 0 | | | | |
| 16a | 26.16 | | | | 0 | | | | | 0 | | | | |
| 16 | 26.09 | | | | 0 | | | | | 3 | | | | |
| 15a | 25.36 | | | | 0 | | | | | 0 | | | | |
| 15 | 25.73 | | | | 0 | | | | | 0 | | | | |
| 14a | 31.37 | | | | 4 | | | | | 0 | | | | |
| 14 | 34.16 | | | | 0 | | | | | 0 | | | | |
| 13a | 43.10 | | | | 0 | | | | | 0 | | | | |
| 13 | 38.93 | | | | 0 | | | | | 0 | | | | |
| 12a | 37.52 | | | | 0 | | | | | 0 | | | | |
| 12 | 37.60 | | | | 0 | | | | | 0 | | | | |
| 11a | 26.16 | | | | 0 | | | | | 0 | | | | |
| 11 | 24.64 | | | | 4 | | | | | 0 | | | | |
| 10a | 24.71 | | | | 6 | | | | | 0 | | | | |
| Total | 481.3 | 222.5 | 156.7 | 379.3 | 14.0 | 0.0 | 0.0 | 0.0 | | 3.0 | 0.0 | 0.0 | 0.0 | |
| Sum squ | 15040.7 | 7109.8 | 2341.3 | 13309.4 | 68.0 | 0.0 | 0.0 | 0.0 | | 9.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Sum (Z*y | 372.3 | 0.0 | 0.0 | 0.0 | | 78.3 | 0.0 | 0.0 | 0.0 | |
| | | | | R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 3.7 | 0.0 | 0.0 | 0.0 | | 0.6 | 0.0 | 0.0 | 0.0 | |
| Var z | 37.6 | 5.9 | 59.2 | 187.1 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | -3.3 | 0.0 | 0.0 | 0.0 | TOTAL | -0.8 | 0.0 | 0.0 | 0.0 | TOTAL |
| | | | | | GIRAFFE | | | | | LION | | | | |
| | | | Pop.est.(Y) | | **62** | **0** | **0** | **0** | **62** | **13** | **0** | **0** | **0** | **13** |
| | | | | SE(Y) | 45.5 | 0.0 | 0.0 | 0.0 | 45.5 | 17.4 | 0.0 | 0.0 | 0.0 | 17.36 |
| | | | | 95% C.L. | 92.8 | 0.0 | 0.0 | 0.0 | 89.1 | 35.4 | 0.0 | 0.0 | 0.0 | 34.02 |
| | | | | 95% C.L. | 150.1 | 0.0 | 0.0 | 0.0 | 144.2 | 267.3 | ERR | ERR | ERR | 256.85 |

| PNG 200 | AREA | | | | COB | | | | | HARTBEEST | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STH | MID NTH | LOW NTH | TOT NOR | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL |
| 31 | | | 8.58 | 8.58 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 12.38 | 12.38 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 17.37 | 17.37 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 21.39 | 21.39 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 20.45 | 20.45 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 30.62 | 30.62 | | | 0 | 0 | | | | 1 | 1 | |
| 25 | | 28.88 | 2.86 | 31.73 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 33.94 | 8.72 | 42.66 | | 0 | 0 | 0 | | | 15 | 0 | 15 | |
| 23 | | 34.30 | 22.94 | 57.24 | | 2 | 0 | 2 | | | 0 | 0 | 0 | |
| 22 | | 34.38 | 11.43 | 45.81 | | 1 | 0 | 1 | | | 0 | 0 | 0 | |
| 21 | | 30.43 | | 30.43 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 31.52 | | 31.52 | | 0 | | 0 | | | 2 | | 2 | |
| 19 | | 29.09 | | 29.09 | | 0 | | 0 | | | 2 | | 2 | |
| 18 | 27.57 | | | | 37 | | | | | 12 | | | | |
| 17a | 26.82 | | | | 21 | | | | | 0 | | | | |
| 17 | 25.36 | | | | 26 | | | | | 0 | | | | |
| 16a | 26.16 | | | | 66 | | | | | 3 | | | | |
| 16 | 26.09 | | | | 60 | | | | | 24 | | | | |
| 15a | 25.36 | | | | 17 | | | | | 1 | | | | |
| 15 | 25.73 | | | | 85 | | | | | 8 | | | | |
| 14a | 31.37 | | | | 83 | | | | | 0 | | | | |
| 14 | 34.16 | | | | 153 | | | | | 21 | | | | |
| 13a | 43.10 | | | | 10 | | | | | 16 | | | | |
| 13 | 38.93 | | | | 2 | | | | | 18 | | | | |
| 12a | 37.52 | | | | 5 | | | | | 1 | | | | |
| 12 | 37.60 | | | | 240 | | | | | 48 | | | | |
| 11a | 26.16 | | | | 35 | | | | | 9 | | | | |
| 11 | 24.64 | | | | 202 | | | | | 2 | | | | |
| 10a | 24.71 | | | | 22 | | | | | 0 | | | | |
| Total | 481.3 | 222.5 | 156.7 | 379.3 | 1064.0 | 3.0 | 0.0 | 3.0 | | 163.0 | 19.0 | 1.0 | 20.0 | |
| Sum equ | 15040.7 | 7109.8 | 2341.3 | 13309.4 | 148496.0 | 5.0 | 0.0 | 5.0 | | 4205.0 | 233.0 | 1.0 | 234.0 | |
| | | | | Sum (Z*y) | 32138.9 | 103.0 | 0.0 | 160.3 | | 5501.2 | 630.3 | 30.6 | 791.8 | |
| | | | | R=Sy/Sz | 2.2 | 0.0 | 0.0 | 0.0 | | 0.3 | 0.1 | 0.0 | 0.1 | |
| | | | | Var y | 5182.7 | 0.6 | 0.0 | 0.4 | | 169.6 | 30.2 | 0.2 | 16.9 | |
| Var z | 37.6 | 5.9 | 59.2 | 187.1 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | 8.9 | -1.7 | 0.0 | 6.0 | TOTAL | 39.9 | -14.9 | 1.7 | 14.5 | TOTAL |
| | | | | | COB | | | | | HARTBEEST | | | | |
| | | | | Pop.est.(Y) | **4,698** | **26** | **0** | **25** | **4,724** | **720** | **166** | **8** | **167** | **894** |
| | | | | SE(Y) | 1672.3 | 29.3 | 0.0 | 22.2 | 1672.6 | 277.7 | 205.7 | 9.4 | 169.7 | 385.13 |
| | | | | 95% C.L. | 3411.5 | 59.7 | 0.0 | 45.4 | 3278.2 | 566.6 | 419.6 | 19.2 | 346.1 | 754.86 |
| | | | | 95% C.L.a | 72.6 | 0.0 | 0.0 | 0.0 | 69.4 | 78.7 | 252.0 | 245.7 | 206.7 | 84.44 |

Annexe 5.15

| | PNG 2002 | AREA | | | BUSHBUCK | | | | | REEDBUCK | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STH | MID NTH | LOW NTH | TOT NOR | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL |
| 31 | | | 8.58 | 8.58 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 12.38 | 12.38 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 17.37 | 17.37 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 21.39 | 21.39 | | | 0 | 0 | | | | 1 | 1 | |
| 27 | | | 20.45 | 20.45 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 30.62 | 30.62 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 28.88 | 2.86 | 31.73 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 33.94 | 8.72 | 42.66 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 34.30 | 22.94 | 57.24 | | 3 | 2 | 5 | | | 3 | 0 | 3 | |
| 22 | | 34.38 | 11.43 | 45.81 | | 1 | 0 | 1 | | | 5 | 0 | 5 | |
| 21 | | 30.43 | | 30.43 | | 2 | | 2 | | | 0 | | 0 | |
| 20 | | 31.52 | | 31.52 | | 1 | | 1 | | | 2 | | 2 | |
| 19 | | 29.09 | | 29.09 | | 0 | | 0 | | | 1 | | 1 | |
| 18 | 27.57 | | | | 0 | | | | | 6 | | | | |
| 17a | 26.82 | | | | 1 | | | | | 2 | | | | |
| 17 | 25.36 | | | | 2 | | | | | 2 | | | | |
| 16a | 26.16 | | | | 0 | | | | | 0 | | | | |
| 16 | 26.09 | | | | 0 | | | | | 0 | | | | |
| 15a | 25.36 | | | | 0 | | | | | 1 | | | | |
| 15 | 25.73 | | | | 0 | | | | | 1 | | | | |
| 14a | 31.37 | | | | 2 | | | | | 1 | | | | |
| 14 | 34.16 | | | | 2 | | | | | 0 | | | | |
| 13a | 43.10 | | | | 0 | | | | | 0 | | | | |
| 13 | 38.93 | | | | 3 | | | | | 0 | | | | |
| 12a | 37.52 | | | | 0 | | | | | 3 | | | | |
| 12 | 37.60 | | | | 1 | | | | | 4 | | | | |
| 11a | 26.16 | | | | 1 | | | | | 0 | | | | |
| 11 | 24.64 | | | | 1 | | | | | 0 | | | | |
| 10a | 24.71 | | | | 2 | | | | | 0 | | | | |
| Total | 481.3 | 222.5 | 156.7 | 379.3 | 15.0 | 7.0 | 2.0 | 9.0 | | 20.0 | 11.0 | 1.0 | 12.0 | |
| Sum squ | 15040.7 | 7109.8 | 2341.3 | '13309.4 | 29.0 | 15.0 | 0.0 | 31.0 | | 72.0 | 39.0 | 1.0 | 40.0 | |
| | | | | Sum (Z*y | 463.2 | 229.7 | 0.0 | 424.4 | | 615.2 | 366.9 | 21.4 | 514.3 | |
| | | | | R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 1.0 | 1.3 | 0.0 | 2.1 | | 3.1 | 3.6 | 0.2 | 2.4 | |
| Var z | 37.6 | 5.9 | 59.2 | 187.1 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | 0.8 | -6.0 | -3.5 | 12.7 | TOTAL | 0.9 | -8.2 | 0.6 | 12.3 | TOTAL |
| | | | | | BUSHBUCK | | | | | REEDBUCK | | | | |
| | | | Pop.est.(Y) | | **66** | **61** | **16** | **75** | **143** | **88** | **96** | **8** | **100** | **193** |
| | | | | SE(Y) | 22.7 | 47.0 | 7.7 | 52.2 | 52.8 | 40.5 | 75.7 | 9.8 | 55.2 | 102.56 |
| | | | | 95% C.L. | 46.3 | 96.0 | 15.7 | 106.6 | 103.5 | 82.6 | 154.4 | 20.0 | 112.7 | 201.02 |
| | | | | 95% C.L.: | 70.0 | 0.0 | 0.0 | 0.0 | 72.3 | 93.5 | 160.2 | 256.3 | 112.2 | 104.42 |

| | PNG 2002 | AREA | | | RHINOS | | | | | HIPPOS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STI | MID NTH | LOW NTI | TOT NOR | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL |
| 31 | | | 8.58 | 8.58 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 12.38 | 12.38 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 17.37 | 17.37 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 21.39 | 21.39 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 20.45 | 20.45 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 30.62 | 30.62 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 28.88 | 2.86 | 31.73 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 33.94 | 8.72 | 42.66 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 34.30 | 22.94 | 57.24 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 34.38 | 11.43 | 45.81 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 30.43 | | 30.43 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 31.52 | | 31.52 | | 0 | | 0 | | | 0 | | 0 | |
| 19 | | 29.09 | | 29.09 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 27.57 | | | | 0 | | | | | 0 | | | | |
| 17a | 26.82 | | | | 0 | | | | | 2 | | | | |
| 17 | 25.36 | | | | 0 | | | | | 47 | | | | |
| 16a | 26.16 | | | | 2 | | | | | 118 | | | | |
| 16 | 26.09 | | | | 0 | | | | | 224 | | | | |
| 15a | 25.36 | | | | 0 | | | | | 2 | | | | |
| 15 | 25.73 | | | | 0 | | | | | 202 | | | | |
| 14a | 31.37 | | | | 0 | | | | | 42 | | | | |
| 14 | 34.16 | | | | 0 | | | | | 16 | | | | |
| 13a | 43.10 | | | | 4 | | | | | 8 | | | | |
| 13 | 38.93 | | | | 2 | | | | | 82 | | | | |
| 12a | 37.52 | | | | 0 | | | | | 4 | | | | |
| 12 | 37.60 | | | | 2 | | | | | 27 | | | | |
| 11a | 26.16 | | | | 0 | | | | | 139 | | | | |
| 11 | 24.64 | | | | 0 | | | | | 35 | | | | |
| 10a | 24.71 | | | | 0 | | | | | 0 | | | | |
| Total | 481.3 | 222.5 | 156.7 | 379.3 | 10.0 | 0.0 | 0.0 | 0.0 | | 948.0 | 0.0 | 0.0 | 0.0 | |
| Sum squ | 15040.7 | 7109.8 | 2341.3 | 13309.4 | 28.0 | 0.0 | 0.0 | 0.0 | | 137220.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Sum (Z*y | 377.8 | 0.0 | 0.0 | 0.0 | | 26490.1 | 0.0 | 0.0 | 0.0 | |
| | | | | R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 2.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 1.5 | 0.0 | 0.0 | 0.0 | | 5403.4 | 0.0 | 0.0 | 0.0 | |
| Var z | 37.6 | 5.9 | 59.2 | 187.1 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | 5.1 | 0.0 | 0.0 | 0.0 | TOTAL | -135.1 | 0.0 | 0.0 | 0.0 | TOTAL |
| | | | | | RHINO | | | | | HIPPOS | | | | |
| | | | Pop.est.(Y) | | **44** | **0** | **0** | **0** | **44** | **4,186** | **0** | **0** | **0** | **4,186** |
| | | | | SE(Y) | 25.6 | 0.0 | 0.0 | 0.0 | 25.6 | 1786.8 | 0.0 | 0.0 | 0.0 | 1786.80 |
| | | | | 95% C.L. | 52.3 | 0.0 | 0.0 | 0.0 | 50.3 | 3645.1 | 0.0 | 0.0 | 0.0 | 3502.12 |
| | | | | 95% C.L. | 118.5 | 0.0 | 0.0 | 0.0 | 113.9 | 87.1 | ERR | ERR | ERR | 83.67 |

| | PNG 2002 | AREA | | | GREY AND RED-FLANKED DUIKER | | | | | ORIBI | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STH | MID NTH | LOW NTH | TOT NOR | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL |
| 31 | | | 8.58 | 8.58 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 12.38 | 12.38 | | | 1 | 1 | | | | 0 | 0 | |
| 29 | | | 17.37 | 17.37 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 21.39 | 21.39 | | | 1 | 1 | | | | 1 | 1 | |
| 27 | | | 20.45 | 20.45 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 30.62 | 30.62 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 28.88 | 2.86 | 31.73 | | 1 | 0 | 1 | | | 1 | 0 | 1 | |
| 24 | | 33.94 | 8.72 | 42.66 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 34.30 | 22.94 | 57.24 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 34.38 | 11.43 | 45.81 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 30.43 | | 30.43 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 31.52 | | 31.52 | | 0 | | 0 | | | 0 | | 0 | |
| 19 | | 29.09 | | 29.09 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 27.57 | | | | 0 | | | | | 0 | | | | |
| 17a | 26.82 | | | | 0 | | | | | 0 | | | | |
| 17 | 25.36 | | | | 0 | | | | | 0 | | | | |
| 16a | 26.16 | | | | 1 | | | | | 0 | | | | |
| 16 | 26.09 | | | | 0 | | | | | 0 | | | | |
| 15a | 25.36 | | | | 0 | | | | | 0 | | | | |
| 15 | 25.73 | | | | 0 | | | | | 0 | | | | |
| 14a | 31.37 | | | | 0 | | | | | 0 | | | | |
| 14 | 34.16 | | | | 0 | | | | | 0 | | | | |
| 13a | 43.10 | | | | 0 | | | | | 0 | | | | |
| 13 | 38.93 | | | | 1 | | | | | 2 | | | | |
| 12a | 37.52 | | | | 0 | | | | | 0 | | | | |
| 12 | 37.60 | | | | 0 | | | | | 3 | | | | |
| 11a | 26.16 | | | | 0 | | | | | 0 | | | | |
| 11 | 24.64 | | | | 0 | | | | | 0 | | | | |
| 10a | 24.71 | | | | 0 | | | | | 0 | | | | |
| Total | 481.3 | 222.5 | 156.7 | 379.3 | 2.0 | 1.0 | 2.0 | 3.0 | | 5.0 | 1.0 | 1.0 | 2.0 | |
| Sum squ | 15040.7 | 7109.8 | 2341.3 | 13309.4 | 2.0 | 1.0 | 2.0 | 3.0 | | 13.0 | 1.0 | 1.0 | 2.0 | |
| | | | | Sum (Z*y | 65.1 | 28.9 | 33.8 | 65.5 | | 190.7 | 28.9 | 21.4 | 53.1 | |
| | | | | R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 0.1 | 0.1 | 0.3 | 0.2 | | 0.8 | 0.1 | 0.2 | 0.1 | |
| Var z | 37.6 | 5.9 | 59.2 | 187.1 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | 0.3 | -1.6 | 0.3 | -2.7 | TOTAL | 2.7 | -1.6 | 0.6 | -0.9 | TOTAL |
| | | | | | GREY AND RED-FLANKED DUIKER | | | | | ORIBI | | | | |
| | | | | Pop.est.(Y) | 9 | 9 | 16 | 25 | 33 | 22 | 9 | 8 | 17 | 39 |
| | | | | SE(Y) | 7.8 | 14.3 | 12.7 | 20.9 | 20.6 | 19.3 | 14.3 | 9.8 | 16.8 | 30.90 |
| | | | | 95% C.L. | 15.8 | 29.1 | 25.9 | 42.7 | 40.4 | 39.4 | 29.1 | 20.0 | 34.2 | 60.56 |
| | | | | 95% C.L. | 179.2 | 0.0 | 0.0 | 0.0 | 121.6 | 178.5 | 332.0 | 256.3 | 204.5 | 156.66 |

Annexe 5.15

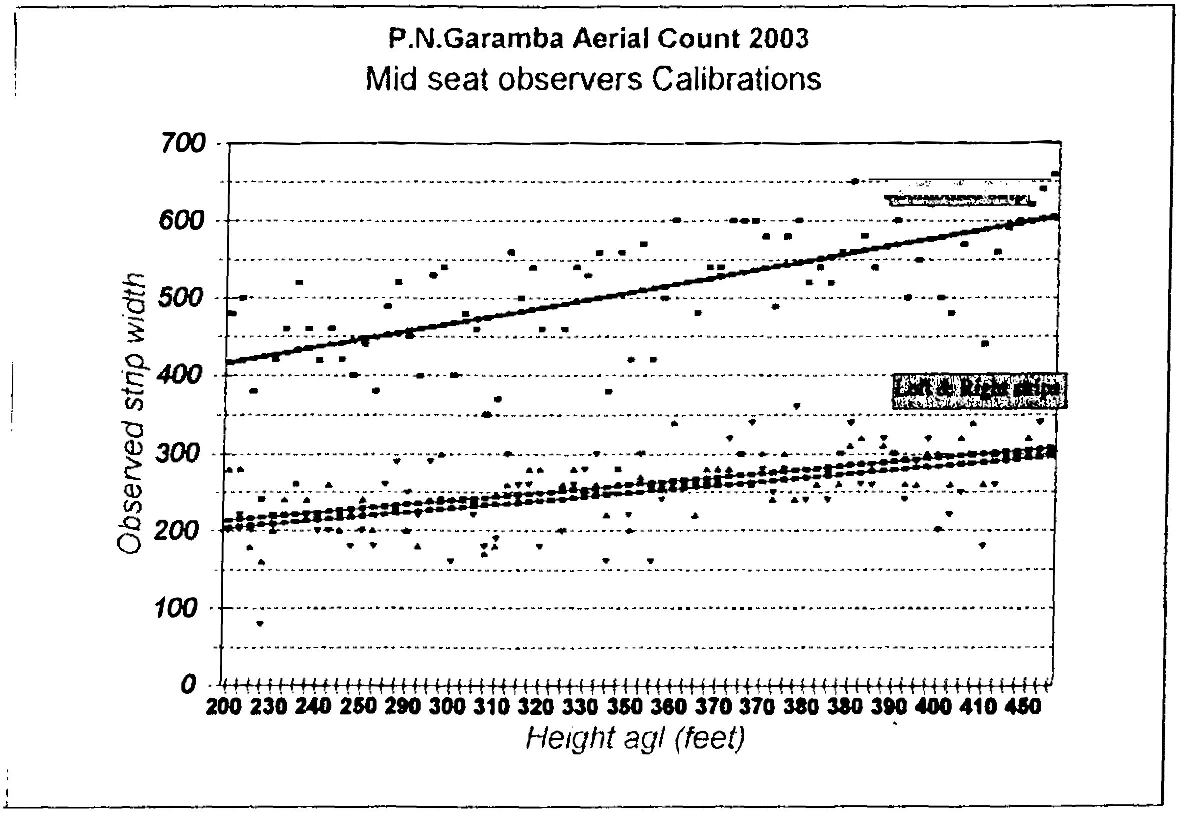
| | AREA | | | | ELE CARCASES | | | | | UNKNOWN CARCASES | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRANS. | HIGH STI | MID NTH | LOW NTI | TOT.NOF | HIGH STH | MID NTH | LOW NTI | TOT.NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL |
| 31 | | | 8.58 | 8.58 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 12.38 | 12.38 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 17.37 | 17.37 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 21.39 | 21.39 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 20.45 | 20.45 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 30.62 | 30.62 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 28.88 | 2.86 | 31.73 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 33.94 | 8.72 | 42.66 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 34.30 | 22.94 | 57.24 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 34.38 | 11.43 | 45.81 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 30.43 | | 30.43 | | 0 | | 0 | | | 1 | | 1 | |
| 20 | | 31.52 | | 31.52 | | 0 | | 0 | | | 0 | | 0 | |
| 19 | | 29.09 | | 29.09 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 27.57 | | | | 0 | | | | | 0 | | | | |
| 17a | 26.82 | | | | 0 | | | | | 0 | | | | |
| 17 | 25.36 | | | | 1 | | | | | 0 | | | | |
| 16a | 26.16 | | | | 0 | | | | | 0 | | | | |
| 16 | 26.09 | | | | 0 | | | | | 0 | | | | |
| 15a | 25.36 | | | | 1 | | | | | 0 | | | | |
| 15 | 25.73 | | | | 0 | | | | | 0 | | | | |
| 14a | 31.37 | | | | 0 | | | | | 1 | | | | |
| 14 | 34.16 | | | | 0 | | | | | 0 | | | | |
| 13a | 43.10 | | | | 1 | | | | | 0 | | | | |
| 13 | 38.93 | | | | 2 | | | | | 0 | | | | |
| 12a | 37.52 | | | | 0 | | | | | 0 | | | | |
| 12 | 37.60 | | | | 0 | | | | | 0 | | | | |
| 11a | 26.16 | | | | 0 | | | | | 0 | | | | |
| 11 | 24.64 | | | | 0 | | | | | 0 | | | | |
| 10a | 24.71 | | | | 0 | | | | | 0 | | | | |
| Total | 481.3 | 222.5 | 156.7 | 379.3 | 5.0 | 0.0 | 0.0 | 0.0 | | 1.0 | 1.0 | 0.0 | 1.0 | |
| Sum squ | 15040.7 | 7109.8 | 2341.3 | 13309.4 | 7.0 | 0.0 | 0.0 | 0.0 | | 1.0 | 1.0 | 0.0 | 1.0 | |
| | | | | Sum (Z*y | 171.7 | 0.0 | 0.0 | 0.0 | | 31.4 | 30.4 | 0.0 | 30.4 | |
| | | | | R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 0.4 | 0.0 | 0.0 | 0.0 | | 0.1 | 0.1 | 0.0 | 0.1 | |
| Var z | 37.6 | 5.9 | 59.2 | 187.1 | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | 1.4 | 0.0 | 0.0 | 0.0 | TOTAL | 0.1 | -1.3 | 0.0 | -0.1 | TOTAL |
| | | | | | ELE CARCASES | | | | | UNKNOWN CARCASES | | | | |
| | | Pop.est.(Y) | | | 22 | 0 | 0 | 0 | 22 | 4 | 9 | 0 | 8 | 13 |
| | | | | SE(Y) | 13.3 | 0.0 | 0.0 | 0.0 | 13.3 | 5.7 | 14.1 | 0.0 | 12.0 | 19.42 |
| | | | | 95% C.L. | 27.1 | 0.0 | 0.0 | 0.0 | 26.1 | 11.7 | 28.8 | 0.0 | 24.5 | 38.07 |
| | | | | 95% C.L. | 122.9 | 0.0 | 0.0 | 0.0 | 118.1 | 264.2 | 329.0 | ERR | 293.2 | 288.89 |

# PARC NATIONAL DE LA GARAMBA
# GARAMBA NATIONAL PARK

## RECENSEMENT GENERAL SYSTEMATIQUE
## GENERAL AERIAL SYSTEMATIC SAMPLE COUNT

**Calibration Graphs, Distribution Maps and Population Estimate Calculations**

**May / Mai 2003**




**Regression Output:**

| | | |
|---|---|---|
| Constant | | 218.1045 |
| Std Err of Y Est | | 59.65976 |
| R Squared | | 0.480829 |
| No. of Observations | | 75 |
| Degrees of Freedom | | 73 |
| | | |
| X Coefficient(s) | 0.87003 | |
| Std Err of Coef. | 0.105812 | |

y=mx+c

y= 0.87003 *alt + 218.1045

PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK

**RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 2003**

ALTITUDE DE VOL (en pieds) / FLIGHT ALTITUDE (in feet)

SUBUNITS (1–37) / TRANSECTS (1–31)

| Transect | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | | | | | | | | | | | | | | 370 | 370 | 350 | | | | | | | |
| 30 | | | | | | | | | | | | | | 380 | 350 | 300 | 360 | | | | | | |
| 29 | | | | | | | | | | | | | | 355 | 370 | 360 | 320 | 360 | 350 | | | | |
| 28 | | | | | | | | | | | | | 365 | 400 | 360 | 355 | 365 | 390 | 375 | | | | |
| 27 | | | | | | | | | | | | | 400 | 370 | 350 | 355 | 350 | 350 | 385 | | | | |
| 26 | | | | | | | | | | 390 | 370 | 350 | 360 | 345 | 350 | 360 | 350 | 360 | 365 | | | | |
| 25 | | | | | | | | | | 415 | 410 | 350 | 360 | 360 | 350 | 345 | 325 | 355 | 350 | 345 | | | |
| 24 | | | | | | | | 360 | 360 | 350 | 360 | 370 | 375 | 350 | 350 | 350 | 375 | 310 | 350 | 345 | 350 | 350 | |
| 23 | | | | | | | | 350 | 365 | 375 | 335 | 360 | 310 | 350 | 390 | 350 | 370 | 350 | 350 | 350 | 300 | 355 | 365 |
| 22 | | | | | | | | 350 | 355 | 365 | 330 | 350 | 365 | 330 | 355 | 350 | 365 | 350 | 365 | 365 | 370 | 380 | 350 |
| 21 | | | | | | | | 340 | 340 | 350 | 365 | 335 | 350 | 325 | 365 | 360 | 370 | 365 | | | | | |
| 20 | | | | | | | 380 | 380 | 350 | 360 | 350 | 370 | 350 | 355 | 360 | 355 | 350 | | | | | | |
| 19 | | | | | | | 350 | 345 | 345 | 330 | 340 | 350 | 350 | 340 | 340 | 350 | | | | | | | |
| 18 | | | | | | | 350 | 400 | 350 | 365 | 350 | 350 | 375 | 350 | 360 | 350 | | | | | | | |
| 17A | | | | | | | 360 | 345 | 350 | 350 | 340 | 340 | 350 | 320 | 350 | | | | | | | | |
| 17 | | | | | | | 330 | 355 | 360 | 350 | 370 | 350 | 330 | 340 | 370 | | | | | | | | |
| 16A | | | | | | | 340 | 340 | 345 | 355 | 350 | 350 | 355 | 330 | 350 | | | | | | | | |
| 16 | | | | | | | 360 | 350 | 350 | 340 | 355 | 350 | 345 | 345 | 345 | | | | | | | | |
| 15A | | | | | | | 340 | 350 | 350 | 350 | 355 | 350 | 350 | 350 | 350 | | | | | | | | |
| 15 | | | | | | | 350 | 350 | 350 | 350 | 350 | 360 | 360 | 370 | 380 | | | | | | | | |
| 14A | | | | 400 | 400 | 370 | 360 | 320 | 330 | 340 | 320 | 350 | 400 | 350 | 370 | | | | | | | | |
| 14 | | | 370 | 350 | 350 | 400 | 380 | 350 | 340 | 350 | 350 | 350 | 340 | 360 | 350 | | | | | | | | |
| 13A | 350 | 380 | 350 | 330 | 400 | 350 | 350 | 350 | 350 | 330 | 350 | 340 | 350 | 380 | 350 | | | | | | | | |
| 13 | 340 | 370 | 350 | 350 | 365 | 360 | 355 | 360 | 340 | 370 | 350 | 350 | 350 | 360 | | | | | | | | | |
| 12A | | 350 | 300 | 350 | 340 | 370 | 350 | 340 | 350 | 350 | 370 | 340 | 360 | 350 | | | | | | | | | |
| 12 | | 350 | 380 | 380 | 360 | 380 | 350 | 350 | 330 | 330 | 350 | 350 | 400 | 350 | | | | | | | | | |
| 11A | | | | 350 | 360 | 400 | 350 | 350 | 370 | 350 | 350 | 345 | **350** | | | | | | | | | | |
| 11 | | | | 360 | 350 | 350 | 365 | 370 | 350 | 350 | 355 | 340 | | | | | | | | | | | |
| 10A | | | | 360 | 370 | 350 | 380 | 350 | 355 | 345 | 345 | **350** | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | | | | | |

| Transect | | | | | |
|---|---|---|---|---|---|
| 31 | | | 363 | 363 | |
| 30 | | | 343 | 343 | |
| 29 | | | 353 | 353 | |
| 28 | | | 373 | 373 | |
| 27 | | | 363 | 363 | |
| 26 | | | 360 | 360 | |
| 25 | | 362 | 345 | 360 | |
| 24 | | 355 | 348 | 354 | |
| 23 | | 355 | 354 | 352 | |
| 22 | | 353 | 366 | 356 | |
| 21 | | 351 | | 351 | |
| 20 | | 360 | | 360 | |
| 19 | | 344 | | 344 | |
| 18 | 360 | | | 360 | |
| 17A | 345 | | | 345 | |
| 17 | 351 | | | 351 | |
| 16A | 346 | | | 346 | |
| 16 | 349 | | | 349 | |
| 15A | 349 | | | 349 | |
| 15 | 358 | | | 358 | |
| 14A | 359 | | | 359 | |
| 14 | 356 | | | 356 | |
| 13A | 354 | | | 354 | |
| 13 | 355 | | | 355 | |
| 12A | 348 | | | 348 | |
| 12 | 358 | | | 358 | |
| 11A | 358 | | | 358 | |
| 11 | 354 | | | 354 | |
| 10A | 357 | | | 357 | |
| | | | 359 | 359 | Total Nord |
| | 354 | 354 | 353 | 354 | Total Centre |
| | 354 | | | 354 | Total Sud |
| | 354 | 354 | 357 | 355 | TOTAL |

PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK

**RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 2003**

SAMPLE AREA PER SUB-UNIT

ECHANTILLONAGE PAR SOUS UNITE

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | S 11 | U 12 | B 13 | U 14 | N 15 | I 16 | T 17 | S 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 31 | | | | | | | | | | | | | | | | | | | | | | 2.7 | 2.7 | 2.61 | | | | | | | | | | | | | | | | 8.01 | 8.01 | |
| | 30 | | | | | | | | | | | | | | | | | | | | | | 2.66 | 2.61 | 2.4 | 2.66 | | | | | | | | | | | | | | | 10.32 | 10.32 | |
| T | 29 | | | | | | | | | | | | | | | | | | | | | | 2.83 | 2.7 | 2.66 | 2.48 | 2.66 | 2.61 | | | | | | | | | | | | | 15.74 | 15.74 | |
| R | 28 | | | | | | | | | | | | | | | | | | | | | 2.68 | 2.63 | 2.66 | 2.63 | 2.68 | 2.79 | 2.72 | | | | | | | | | | | | | 18.99 | 18.99 | |
| A | 27 | | | | | | | | | | | | | | | | | | | | | 2.83 | 2.7 | 2.61 | 2.83 | 2.61 | 2.61 | 2.86 | | | | | | | | | | | | | 18.68 | 18.68 | |
| N | 26 | | | | | | | | | | | | | | | | | | 2.79 | 2.7 | 2.61 | 2.66 | 2.59 | 2.61 | 2.66 | 2.61 | 2.66 | 2.68 | | | | | | | | | | | | | 26.57 | 26.57 | |
| S | 25 | | | | | | | | | | | | | | | | | | 2.9 | 2.67 | 2.61 | 2.66 | 2.66 | 2.61 | 2.59 | 2.5 | 2.63 | 2.61 | 2.59 | | | | | | | | | | 26.65 | 2.59 | 29.24 | |
| E | 24 | | | | | | | | | | | | | | | | 2.66 | 2.66 | 2.61 | 2.66 | 2.7 | 2.72 | 2.61 | 2.61 | 2.61 | 2.72 | 2.44 | 2.61 | 2.59 | 2.61 | 2.61 | | | | | | | | | 31.62 | 7.82 | 39.44 | |
| C | 23 | | | | | | | | | | | | | | | | 2.81 | 2.68 | 2.72 | 2.55 | 2.66 | 2.44 | 2.61 | 2.79 | 2.61 | 2.7 | 2.81 | 2.81 | 2.61 | 2.4 | 2.83 | 2.68 | | | | | | | | 31.60 | 21.06 | 41.92 | |
| T | 22 | | | | | | | | | | | | | | | | 2.61 | 2.83 | 2.66 | 2.53 | 2.61 | 2.68 | 2.53 | 2.63 | 2.61 | 2.66 | 2.61 | 2.68 | 2.66 | 2.7 | 2.74 | 2.61 | | | | | | | | 31.49 | 10.74 | 42.22 | |
| S | 21 | | | | | | | | | | | | | | | | 2.57 | 2.57 | 2.61 | 2.68 | 2.55 | 2.61 | 2.5 | 2.68 | 2.66 | 2.7 | 2.66 | | | | | | | | | | | | | 28.81 | | 28.81 | |
| | 20 | | | | | | | | | | | | | | | 2.74 | 2.74 | 2.61 | 2.66 | 2.61 | 2.7 | 2.61 | 2.63 | 2.66 | 2.63 | 2.61 | | | | | | | | | | | | | | 29.22 | | 29.22 | |
| | 19 | | | | | | | | | | | | | | | 2.61 | 2.59 | 2.59 | 2.53 | 2.57 | 2.61 | 2.61 | 2.57 | 2.57 | 2.61 | | | | | | | | | | | | | | | 25.87 | | 25.87 | |
| | 18 | | | | | | | | | | | | | | | 2.61 | 2.83 | 2.61 | 2.68 | 2.61 | 2.61 | 2.72 | 2.61 | 2.66 | 2.61 | | | | | | | | | | | | | | 26.57 | | | 26.57 | |
| | 17A | | | | | | | | | | | | | | | 2.66 | 2.59 | 2.81 | 2.61 | 2.57 | 2.57 | 2.61 | 2.46 | 2.61 | | | | | | | | | | | | | | | 23.32 | | | 23.32 | |
| | 17 | | | | | | | | | | | | | | | 2.53 | 2.83 | 2.66 | 2.61 | 2.7 | 2.61 | 2.53 | 2.57 | 2.7 | | | | | | | | | | | | | | | 23.54 | | | 23.54 | |
| | 16A | | | | | | | | | | | | | | | 2.57 | 2.57 | 2.59 | 2.63 | 2.61 | 2.61 | 2.63 | 2.53 | 2.61 | | | | | | | | | | | | | | | 23.37 | | | 23.37 | |
| | 16 | | | | | | | | | | | | | | | 2.66 | 2.81 | 2.61 | 2.57 | 2.63 | 2.61 | 2.59 | 2.59 | 2.59 | | | | | | | | | | | | | | | 23.47 | | | 23.47 | |
| | 15A | | | | | | | | | | | | | | | 2.57 | 2.81 | 2.61 | 2.61 | 2.83 | 2.61 | 2.61 | 2.61 | 2.61 | | | | | | | | | | | | | | | 23.50 | | | 23.50 | |
| | 15 | | | | | | | | | | | | | | | 2.61 | 2.61 | 2.61 | 2.61 | 2.61 | 2.66 | 2.66 | 2.7 | 2.74 | | | | | | | | | | | | | | | 23.82 | | | 23.82 | |
| | 14A | | | | | | | | | | | | 2.83 | 2.83 | 2.7 | 2.66 | 2.46 | 2.53 | 2.57 | 2.48 | 2.61 | 2.83 | 2.61 | 2.7 | | | | | | | | | | | | | | | 31.84 | | | 31.84 | |
| | 14 | | | | | | | | | | | 2.7 | 2.61 | 2.61 | 2.83 | 2.74 | 2.61 | 2.57 | 2.61 | 2.61 | 2.61 | 2.57 | 2.66 | 2.61 | | | | | | | | | | | | | | | 31.66 | | | 31.66 | |
| | 13A | | | | | | | | | 2.61 | 2.74 | 2.61 | 2.53 | 2.83 | 2.61 | 2.61 | 2.61 | 2.61 | 2.53 | 2.61 | 2.57 | 2.61 | 2.74 | 2.61 | | | | | | | | | | | | | | | 39.46 | | | 39.46 | |
| | 13 | | | | | | | | | 2.57 | 2.7 | 2.61 | 2.81 | 2.66 | 2.66 | 2.63 | 2.66 | 2.57 | 2.7 | 2.61 | 2.61 | 2.61 | 2.66 | | | | | | | | | | | | | | | | 36.89 | | | 36.89 | |
| | 12A | | | | | | | | | | 2.61 | 2.4 | 2.61 | 2.57 | 2.7 | 2.61 | 2.57 | 2.61 | 2.61 | 2.7 | 2.57 | 2.66 | 2.61 | | | | | | | | | | | | | | | | 33.84 | | | 33.84 | |
| | 12 | | | | | | | | | | 2.61 | 2.74 | 2.74 | 2.66 | 2.74 | 2.61 | 2.61 | 2.53 | 2.53 | 2.61 | 2.61 | 2.83 | 2.61 | | | | | | | | | | | | | | | | 34.45 | | | 34.45 | |
| | 11A | | | | | | | | | | | | 2.61 | 2.66 | 2.83 | 2.61 | 2.61 | 2.7 | 2.61 | 2.61 | 2.59 | 2.61 | | | | | | | | | | | | | | | | | 23.84 | | | 23.84 | |
| | 11 | | | | | | | | | | | | 2.66 | 2.61 | 2.61 | 2.68 | 2.7 | 2.61 | 2.61 | 2.83 | 2.57 | | | | | | | | | | | | | | | | | | 23.69 | | | 23.69 | |
| | 10A | | | | | | | | | | | | 2.66 | 2.7 | 2.61 | 2.74 | 2.61 | 2.63 | 2.59 | 2.59 | 2.61 | | | | | | | | | | | | | | | | | | 21.14 | | | 21.14 | |
| | 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0.00 | 0.00 | 98.32 | 98.32 | Total Nord |
| | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0.00 | 205.26 | 42.20 | 236.72 | Total Centre |
| | 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 444.39 | 0.00 | 0.00 | 444.39 | Total Sud |
| | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 444.39 | 205.26 | 140.52 | 779.43 | TOTAL |
| | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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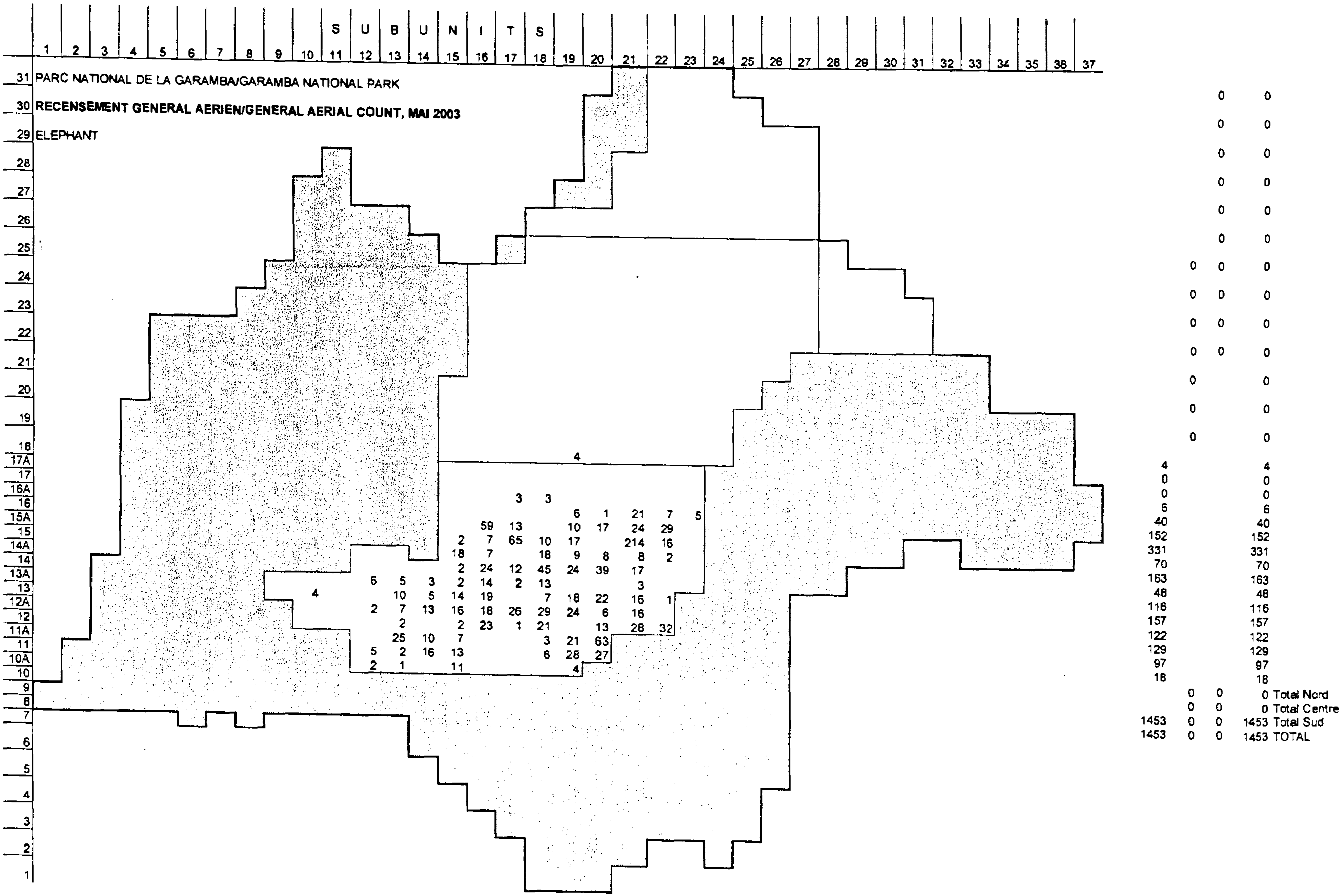
SUBUNITS
PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 2003
ELEPHANT
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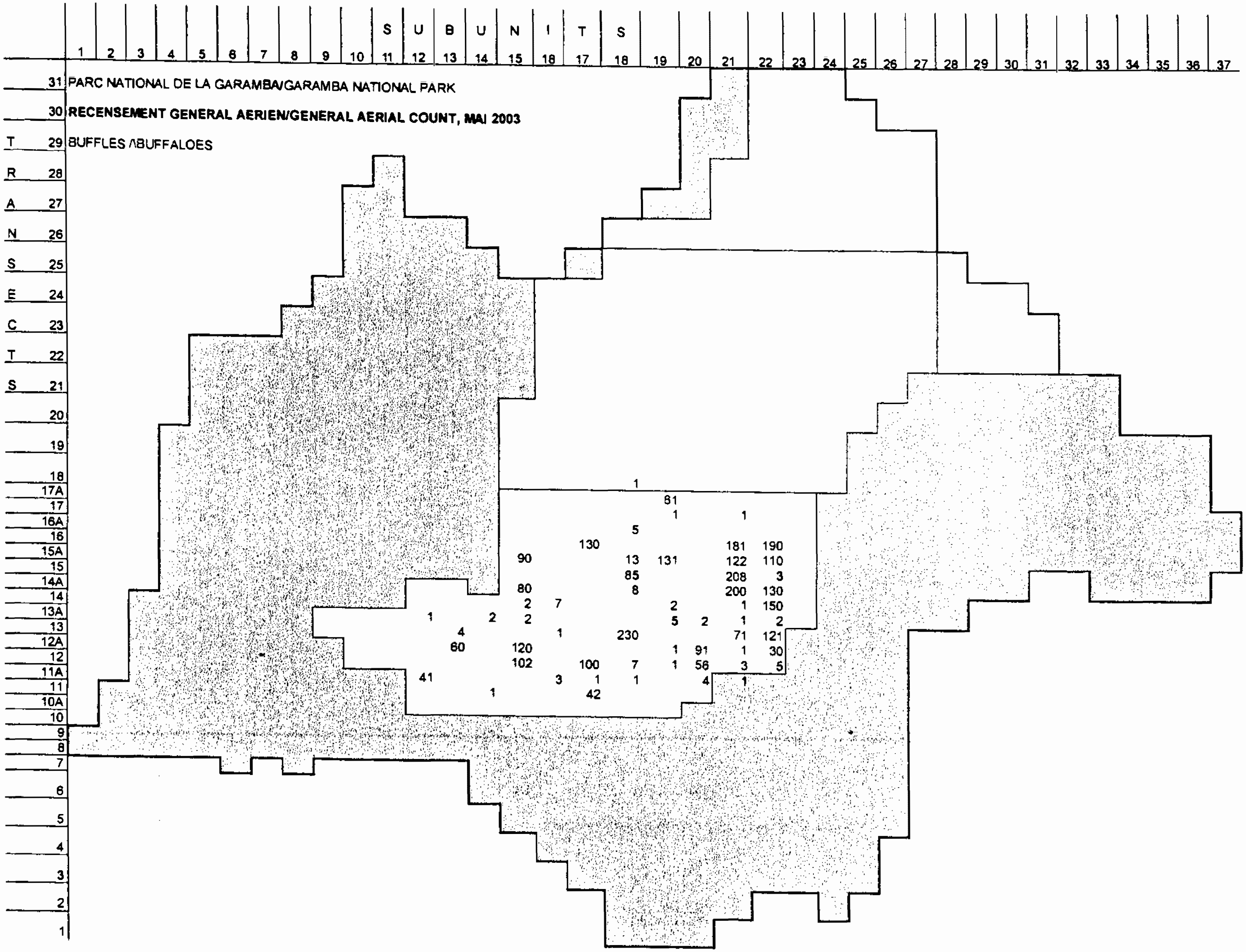
0 0 0 Total Centre
1453 0 0 1453 Total Sud
1453 0 0 1453 TOTAL

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| | | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | | 0 | |
| | 0 | | 0 | |
| | 0 | | 0 | |
| 1 | | | 1 | |
| 81 | | | 61 | |
| 2 | | | 2 | |
| 5 | | | 5 | |
| 501 | | | 501 | |
| 466 | | | 466 | |
| 296 | | | 296 | |
| 418 | | | 418 | |
| 162 | | | 162 | |
| 15 | | | 15 | |
| 427 | | | 427 | |
| 303 | | | 303 | |
| 274 | | | 274 | |
| 50 | | | 50 | |
| 43 | | | 43 | |
| 0 | | | 0 | |
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| 0 | 0 | 0 | 0 | Total Cer |
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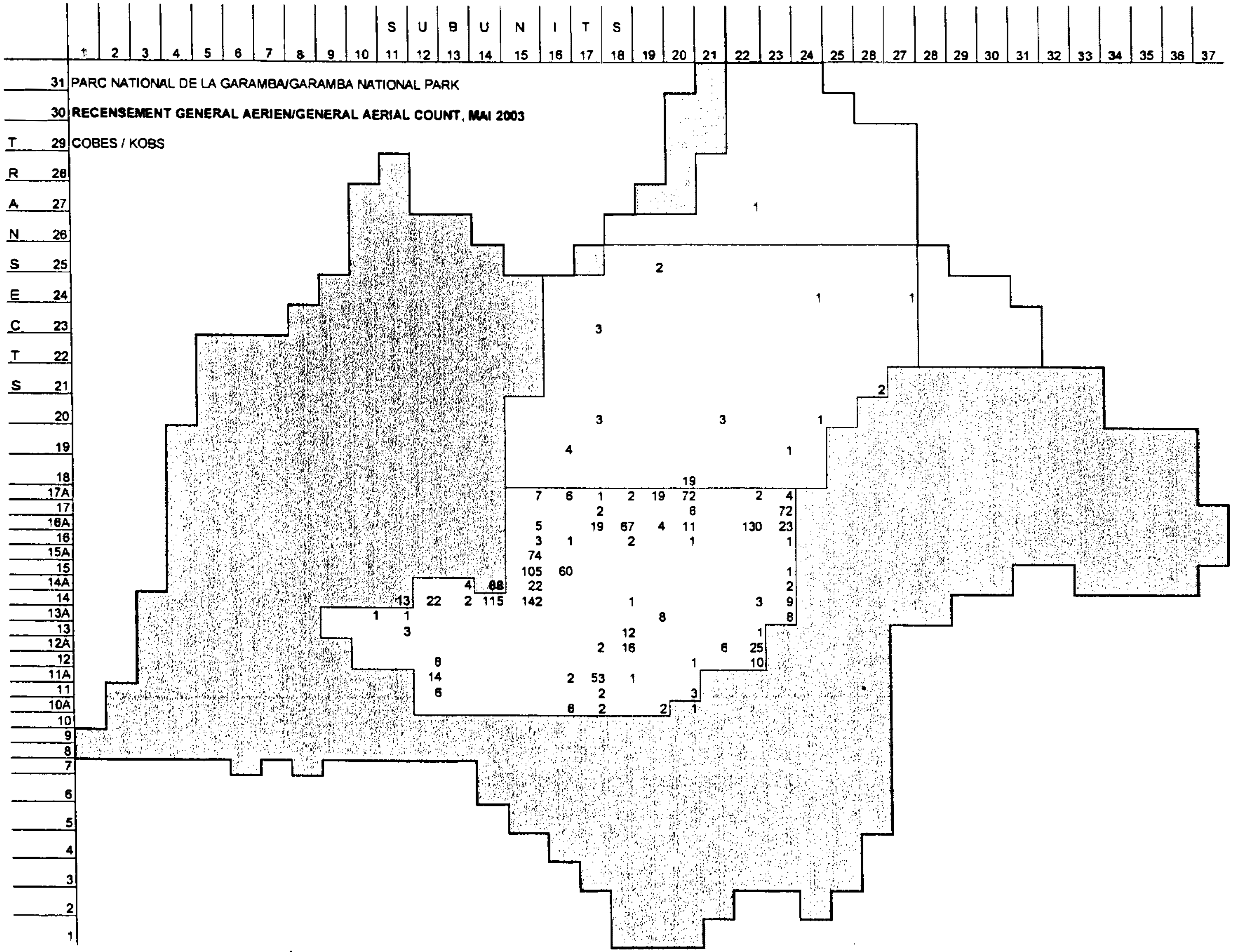


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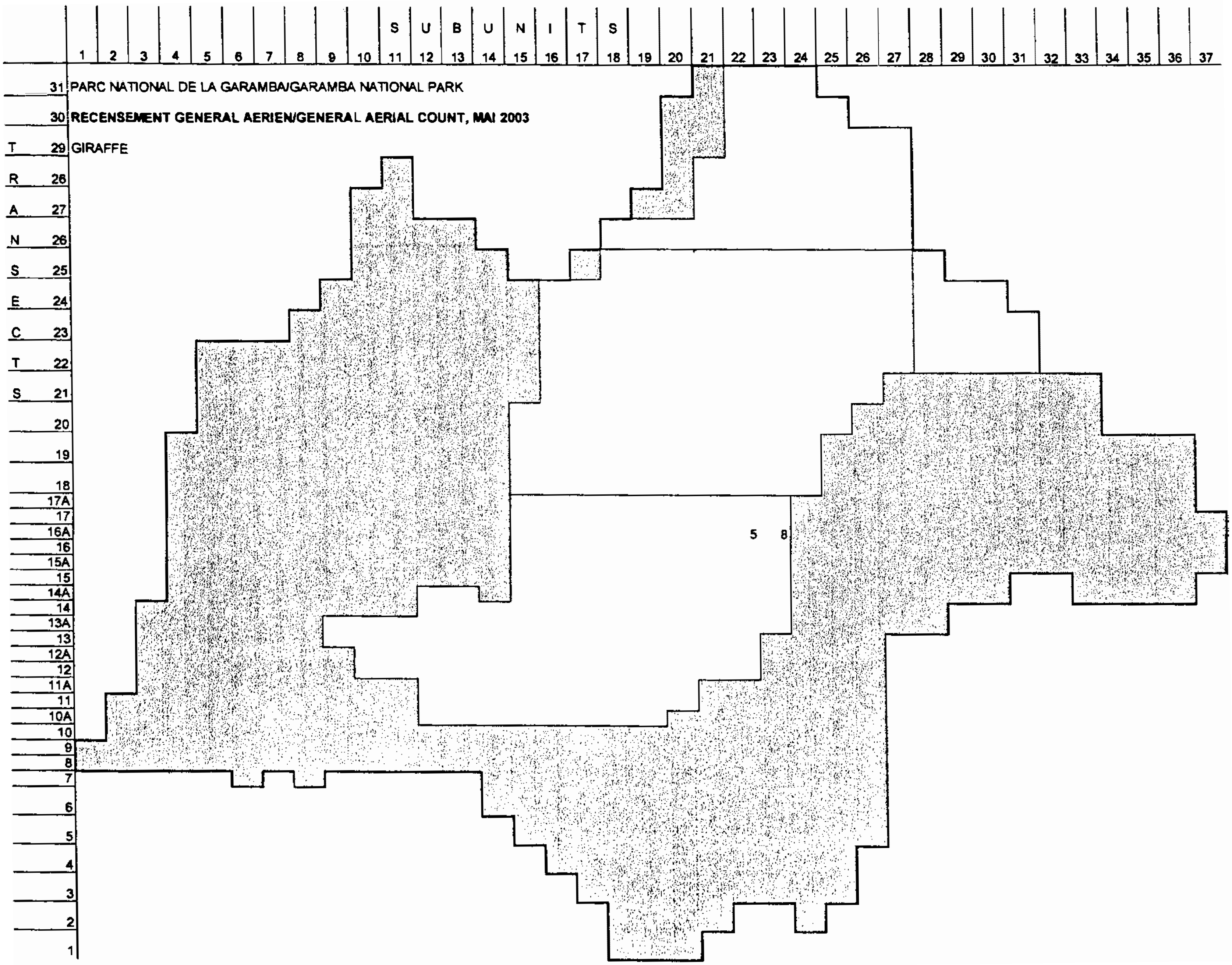
| | | 1 | 1 | |
| | | 0 | 0 | |
| | 2 | 0 | 2 | |
| | 2 | 0 | 2 | |
| | 3 | 0 | 3 | |
| | 0 | 0 | 0 | |
| | 2 | | 2 | |
| | 7 | | 7 | |
| | 5 | | 5 | |
| 19 | | | 19 | |
| 113 | | | 113 | |
| 80 | | | 80 | |
| 259 | | | 259 | |
| 6 | | | 6 | |
| 74 | | | 74 | |
| 166 | | | 166 | |
| 96 | | | 96 | |
| 294 | | | 294 | |
| 18 | | | 16 | |
| 16 | | | 16 | |
| 49 | | | 49 | |
| 19 | | | 19 | |
| 70 | | | 70 | |
| 11 | | | 11 | |
| 12 | | | 12 | |
| 0 | 0 | 1 | 1 | Total Nord |
| 21 | 21 | 0 | 21 | Total Centre |
| 1304 | 0 | 0 | 1304 | Total Sud |
| 1304 | 21 | 1 | 1326 | TOTAL |




| Transect | | | | | |
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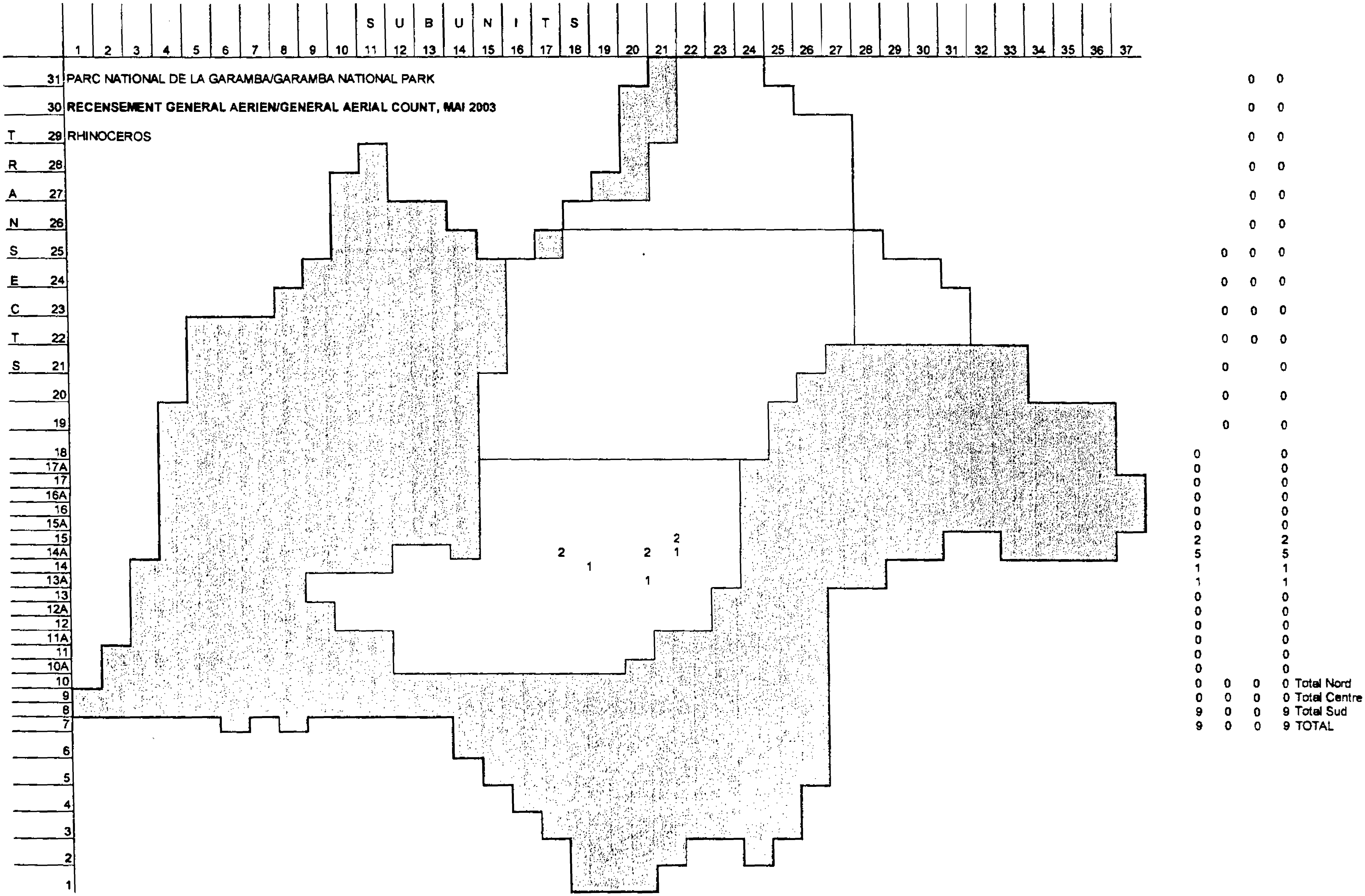
| 27 | | | 0 | 0 | |
| 26 | | | 0 | 0 | |
| 25 | | 0 | 0 | 0 | |
| 24 | | 0 | 0 | 0 | |
| 23 | | 0 | 0 | 0 | |
| 22 | | 0 | 0 | 0 | |
| 21 | | 0 | | 0 | |
| 20 | | 0 | | 0 | |
| 19 | | 0 | | 0 | |
| 18 | 0 | | | 0 | |
| 17A | 0 | | | 0 | |
| 17 | 0 | | | 0 | |
| 16A | 13 | | | 13 | |
| 16 | 0 | | | 0 | |
| 15A | 0 | | | 0 | |
| 15 | 0 | | | 0 | |
| 14A | 0 | | | 0 | |
| 14 | 0 | | | 0 | |
| 13A | 0 | | | 0 | |
| 13 | 0 | | | 0 | |
| 12A | 0 | | | 0 | |
| 12 | 0 | | | 0 | |
| 11A | 0 | | | 0 | |
| 11 | 0 | | | 0 | |
| 10A | 0 | | | 0 | |
| | 0 | 0 | 0 | 0 | Total Nord |
| | 0 | 0 | 0 | 0 | Total Centre |
| | 13 | 0 | 0 | 13 | Total Sud |
| | 13 | 0 | 0 | 13 | TOTAL |

Annexe 5.15


PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 2003
RHINOCEROS
SUBUNITS
TRANSECTS
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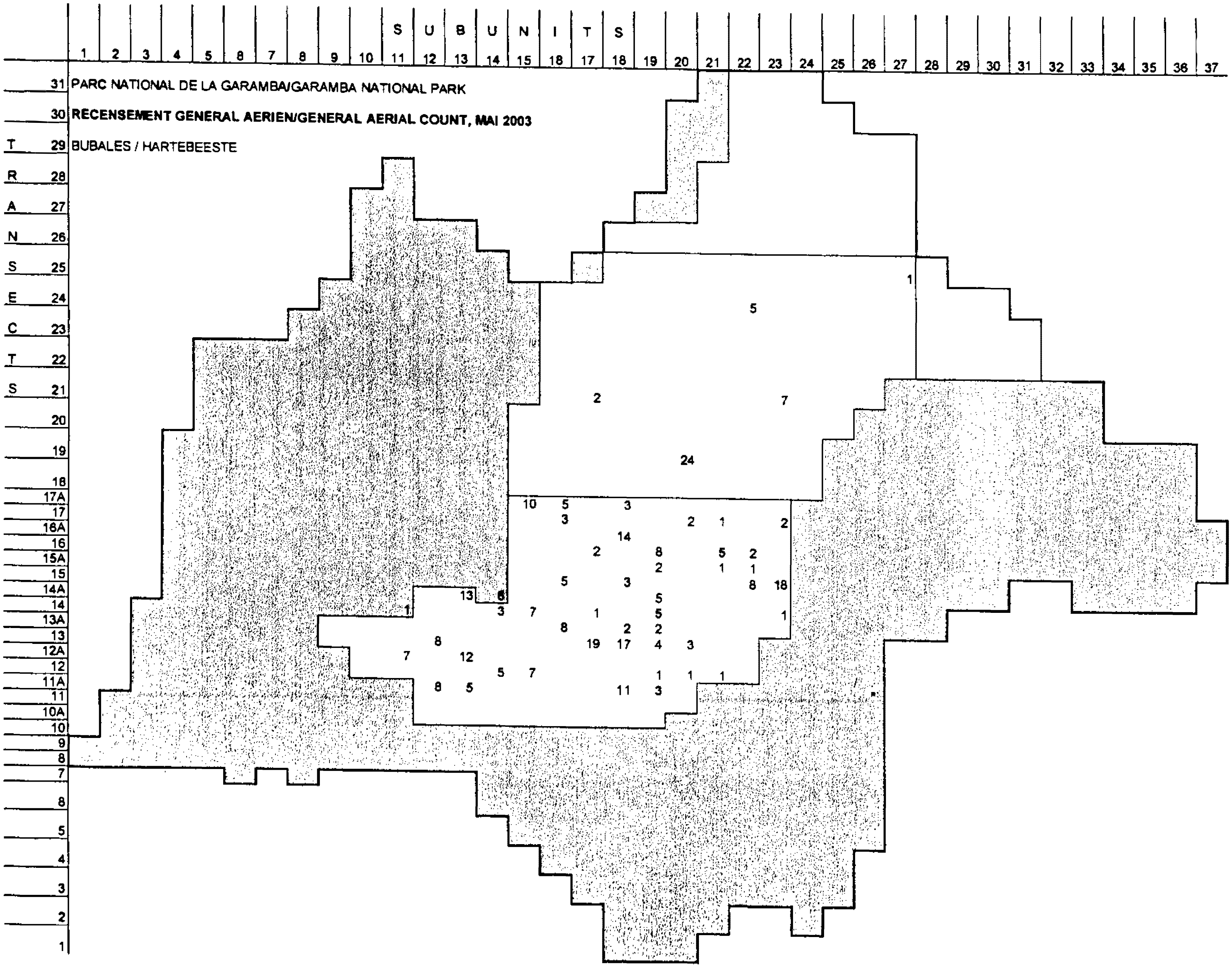
0 0 0 0 Total Centre
9 0 0 9 Total Sud
9 0 0 9 TOTAL

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| | | 0 | 0 | |
| | 1 | 0 | 1 | |
| | 5 | 0 | 5 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 9 | | 9 | |
| | 0 | | 0 | |
| | 24 | | 24 | |
| 0 | | | 0 | |
| 18 | | | 18 | |
| 8 | | | 8 | |
| 14 | | | 14 | |
| 17 | | | 17 | |
| 4 | | | 4 | |
| 32 | | | 32 | |
| 24 | | | 24 | |
| 17 | | | 17 | |
| 12 | | | 12 | |
| 51 | | | 51 | |
| 19 | | | 19 | |
| 15 | | | 15 | |
| 25 | | | 25 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
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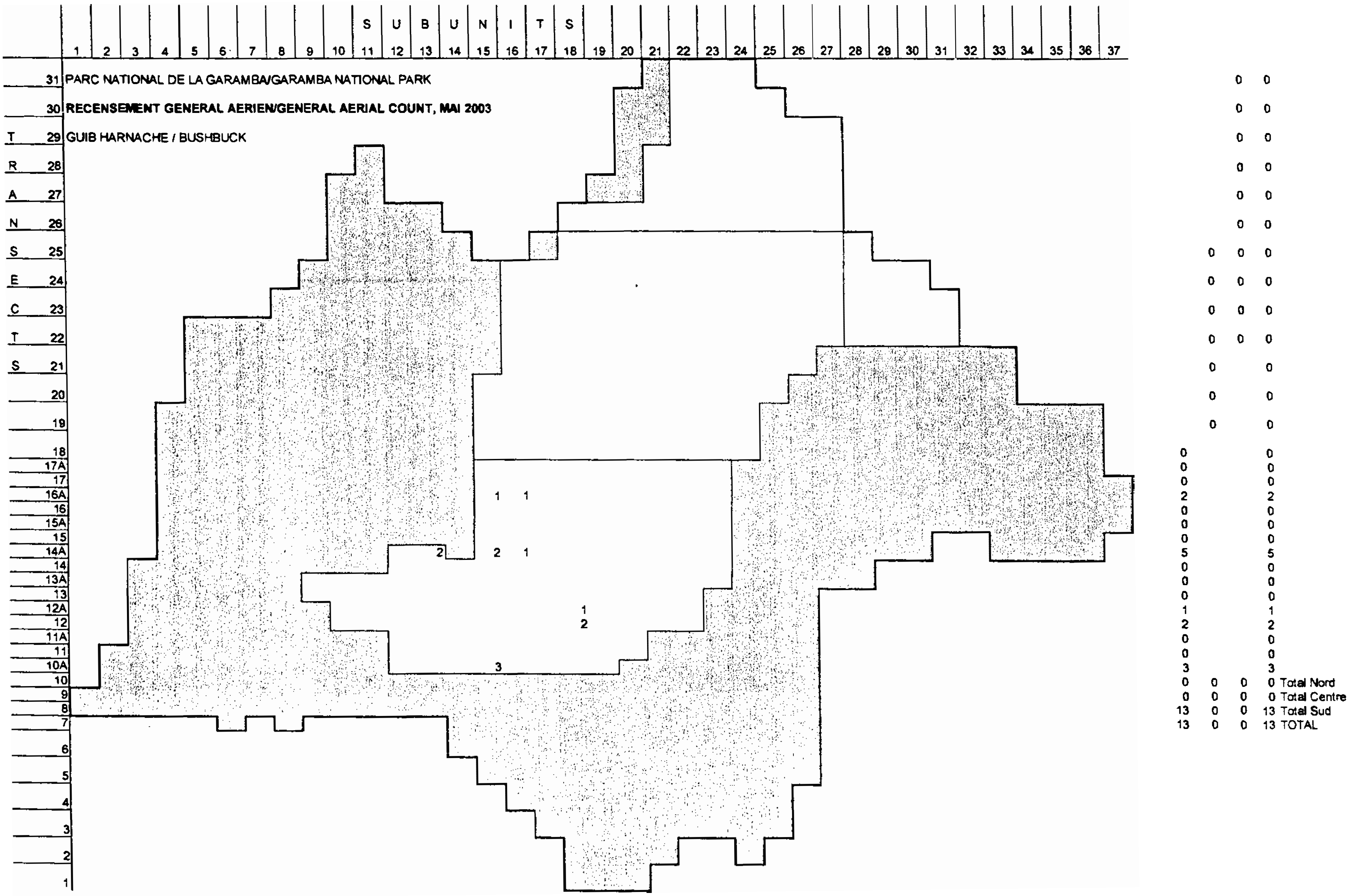
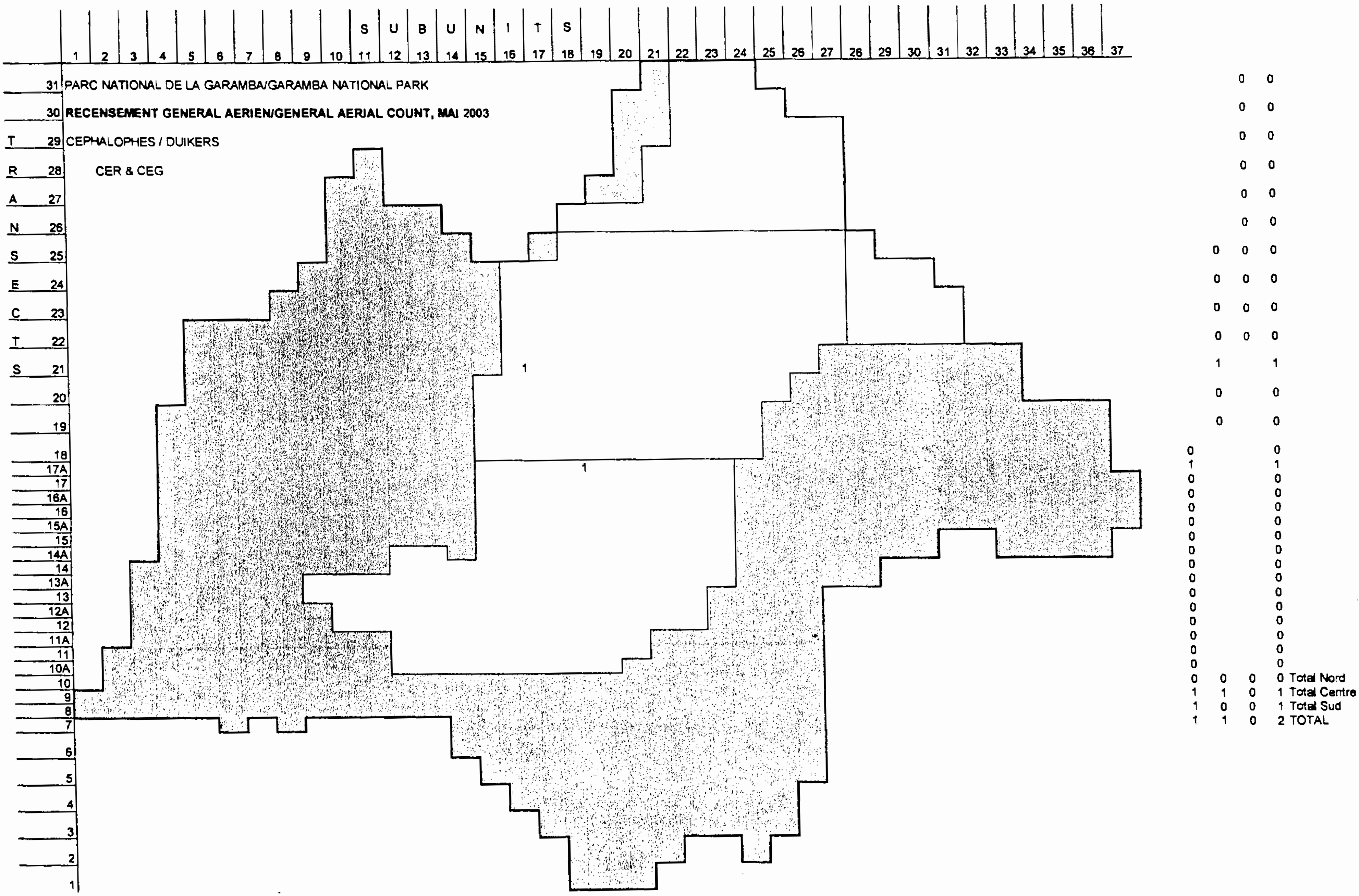
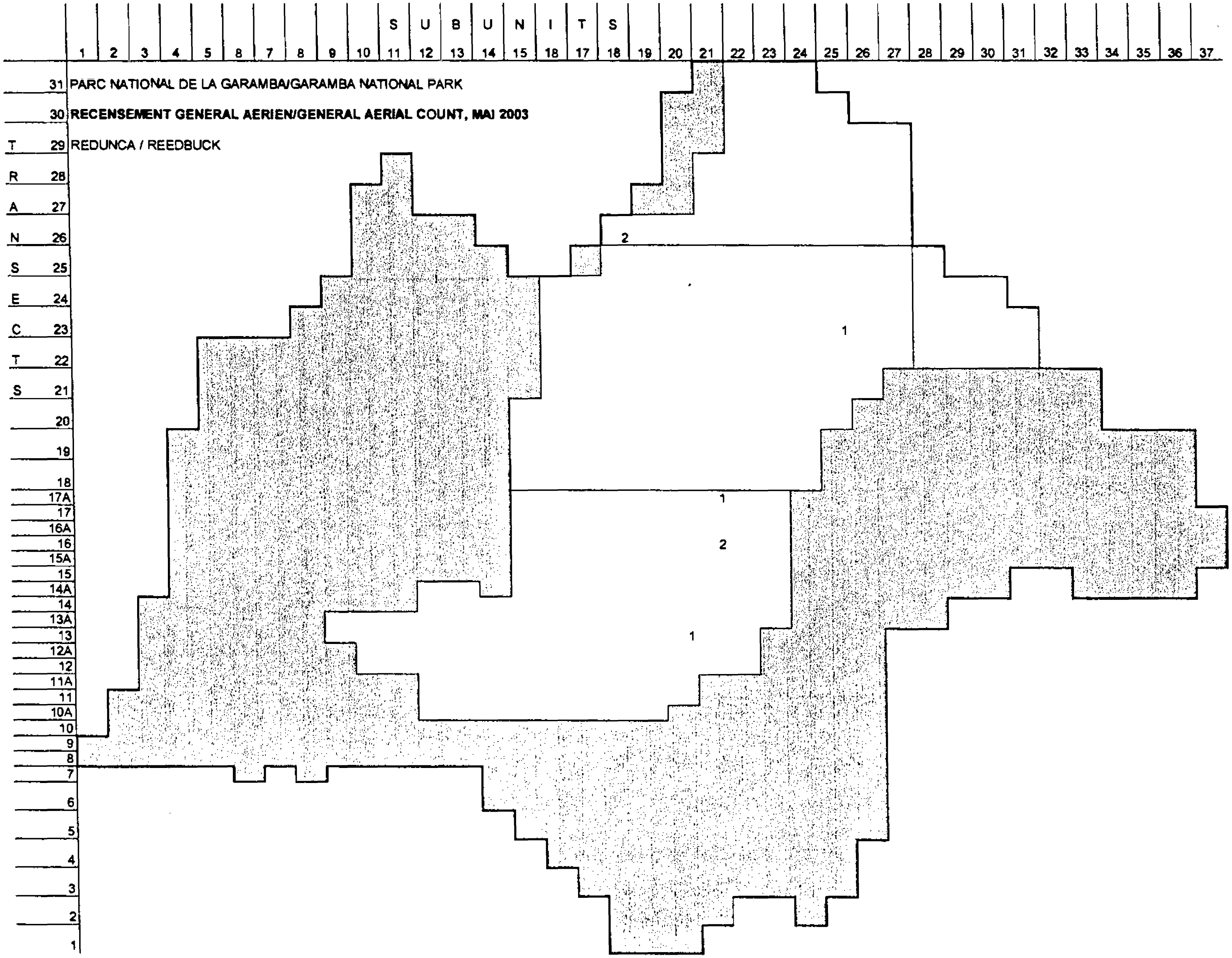
| 256 | 0 | 0 | 256 | Total Sud |
| 256 | 39 | 0 | 295 | TOTAL |


SUBUNITS
PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 2003
GUIB HARNACHE / BUSHBUCK
TRANSECTS
1 1
2 2 1
1
2
3
0 Total Nord
0 Total Centre
13 Total Sud
13 TOTAL


S U B U N I T S
T R A N S E C T S
PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 2003
CEPHALOPHES / DUIKERS
CER & CEG
0 0 0 0 Total Nord
1 1 0 1 Total Centre
1 0 0 1 Total Sud
1 1 0 2 TOTAL

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| 27 | | | 0 | 0 |
| 26 | | | 2 | 2 |
| 25 | | 0 | 0 | 0 |
| 24 | | 0 | 0 | 0 |
| 23 | | 1 | 0 | 1 |
| 22 | | 0 | 0 | 0 |
| 21 | | 0 | | 0 |
| 20 | | 0 | | 0 |
| 19 | | 0 | | 0 |
| 18 | 0 | | | 0 |
| 17A | 1 | | | 1 |
| 17 | 0 | | | 0 |
| 16A | 0 | | | 0 |
| 16 | 2 | | | 2 |
| 15A | 0 | | | 0 |
| 15 | 0 | | | 0 |
| 14A | 0 | | | 0 |
| 14 | 0 | | | 0 |
| 13A | 0 | | | 0 |
| 13 | 1 | | | 1 |
| 12A | 0 | | | 0 |
| 12 | 0 | | | 0 |
| 11A | 0 | | | 0 |
| 11 | 0 | | | 0 |
| 10A | 0 | | | 0 |
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| | 1 | 1 | 0 | 1 Total Centre |
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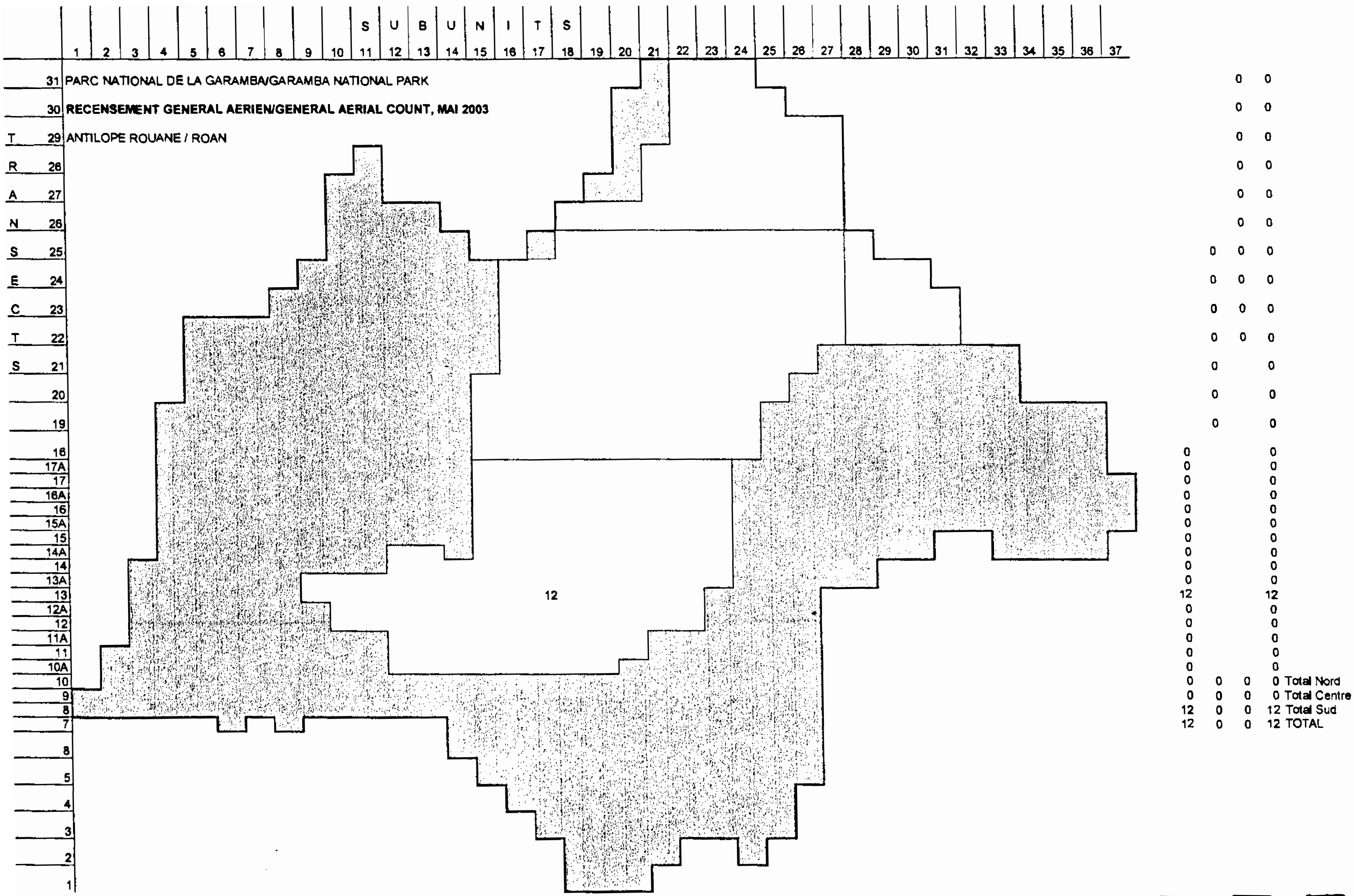
| | 4 | 1 | 2 | 7 TOTAL |

Annexe 5.15


SUBUNITS
TRANSECTS
PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 2003
ANTILOPE ROUANE / ROAN
12
12 0 0 12 Total Sud
0 0 0 0 Total Nord
0 0 0 0 Total Centre
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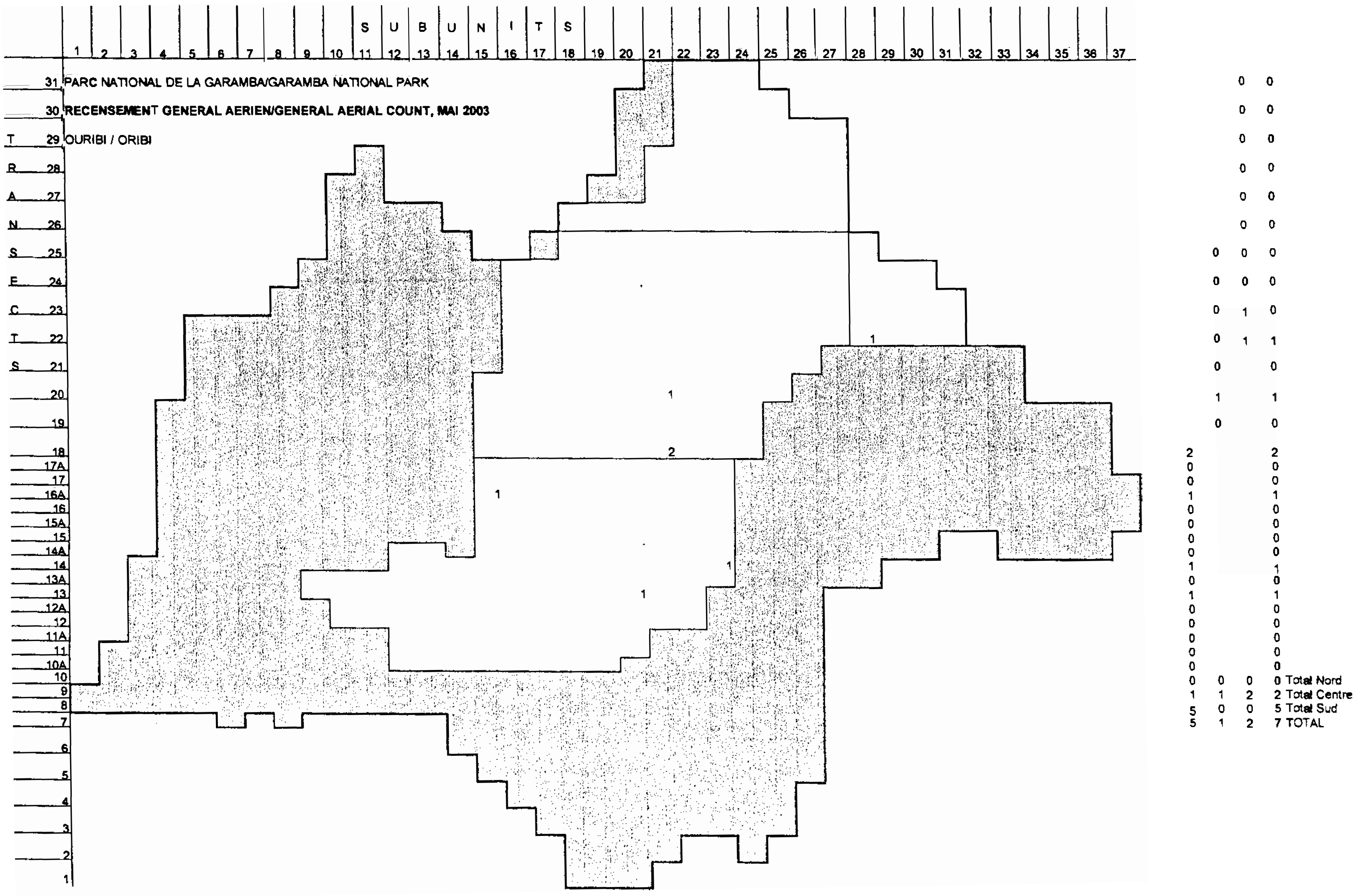
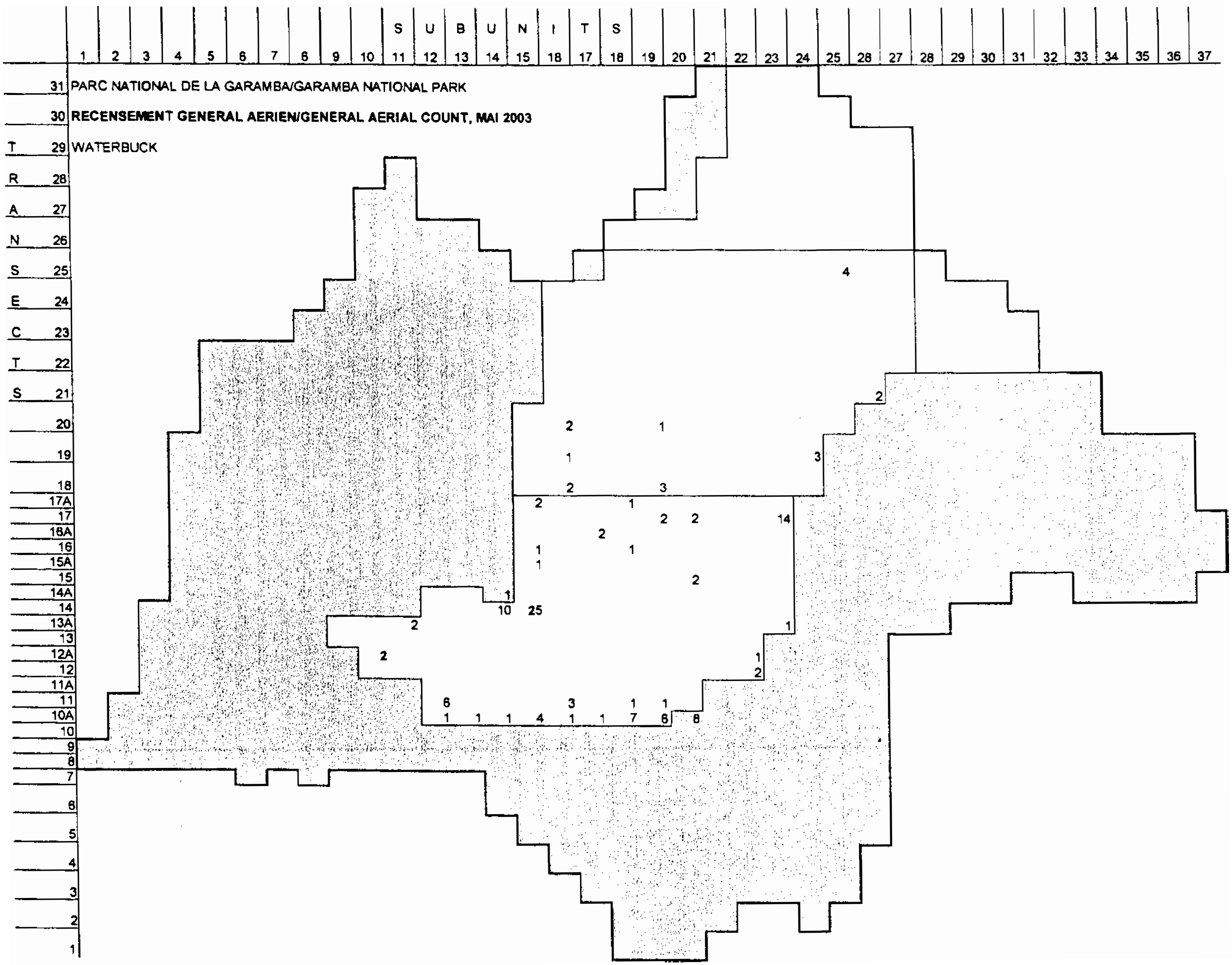

SUBUNITS
TRANSECTS
PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 2003
OURIBI / ORIBI
0 0 0 0 Total Nord
1 1 2 2 Total Centre
5 0 0 5 Total Sud
5 1 2 7 TOTAL

Annexe 5.15




| Transect | | | | | |
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| 27 | | | 0 | 0 | |
| 26 | | | 0 | 0 | |
| 25 | | 4 | 0 | 4 | |
| 24 | | 0 | 0 | 0 | |
| 23 | | 0 | 0 | 0 | |
| 22 | | 0 | 0 | 0 | |
| 21 | | 2 | | 2 | |
| 20 | | 3 | | 3 | |
| 19 | | 4 | | 4 | |
| 18 | 5 | | | 5 | |
| 17A | 3 | | | 3 | |
| 17 | 18 | | | 18 | |
| 16A | 2 | | | 2 | |
| 16 | 2 | | | 2 | |
| 15A | 1 | | | 1 | |
| 15 | 2 | | | 2 | |
| 14A | 1 | | | 1 | |
| 14 | 35 | | | 35 | |
| 13A | 3 | | | 3 | |
| 13 | 0 | | | 0 | |
| 12A | 3 | | | 3 | |
| 12 | 2 | | | 2 | |
| 11A | 0 | | | 0 | |
| 11 | 11 | | | 11 | |
| 10A | 22 | | | 22 | |
| | 0 | 0 | 0 | 0 | Total Nord |
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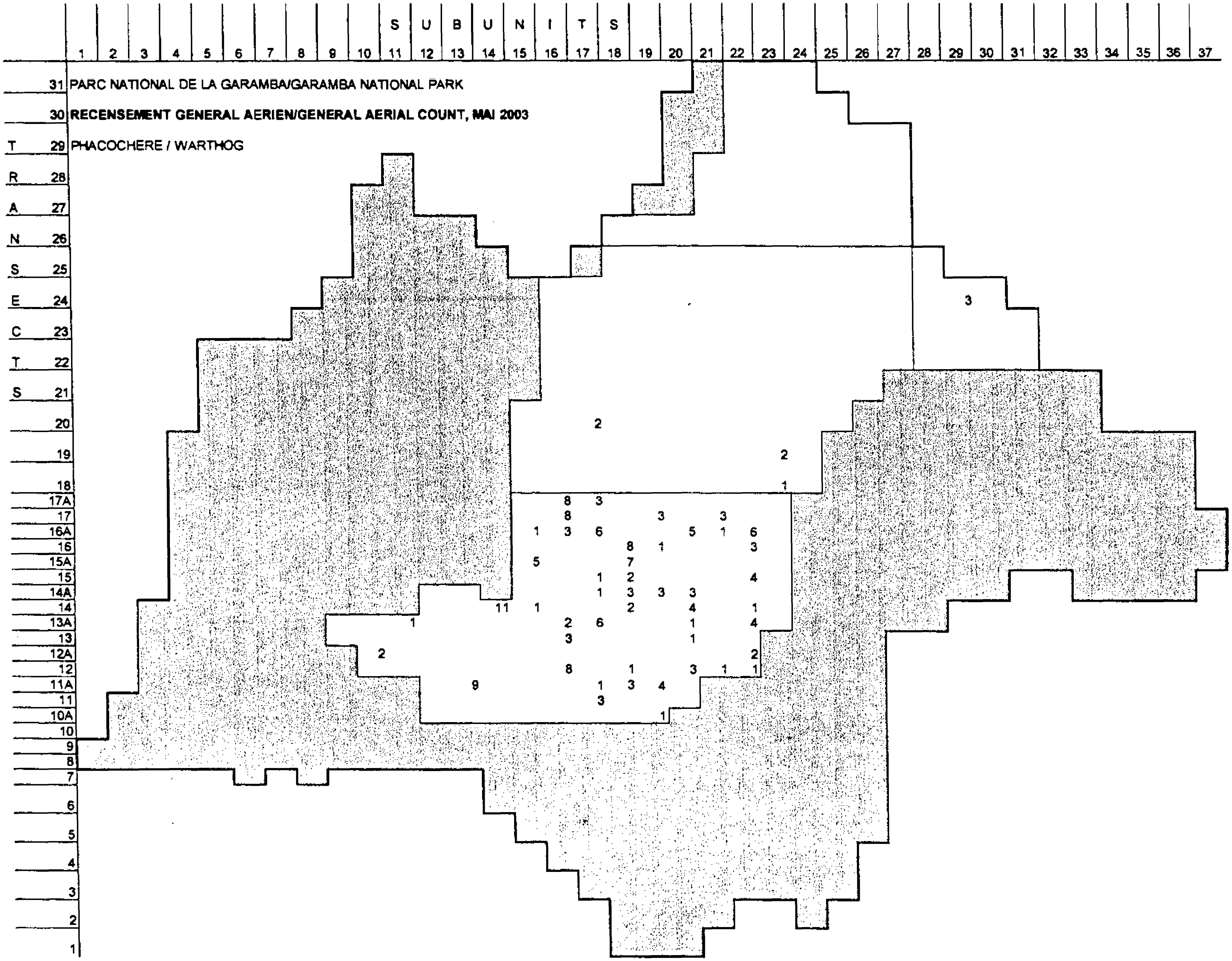
Annexe 5.15

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| | 0 | 0 | 0 | |
| | 0 | 3 | 3 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | | 0 | |
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| 14 | | | 14 | |
| 22 | | | 22 | |
| 12 | | | 12 | |
| 12 | | | 12 | |
| 7 | | | 7 | |
| 10 | | | 10 | |
| 19 | | | 19 | |
| 14 | | | 14 | |
| 4 | | | 4 | |
| 4 | | | 4 | |
| 14 | | | 14 | |
| 17 | | | 17 | |
| 3 | | | 3 | |
| 1 | | | 1 | |
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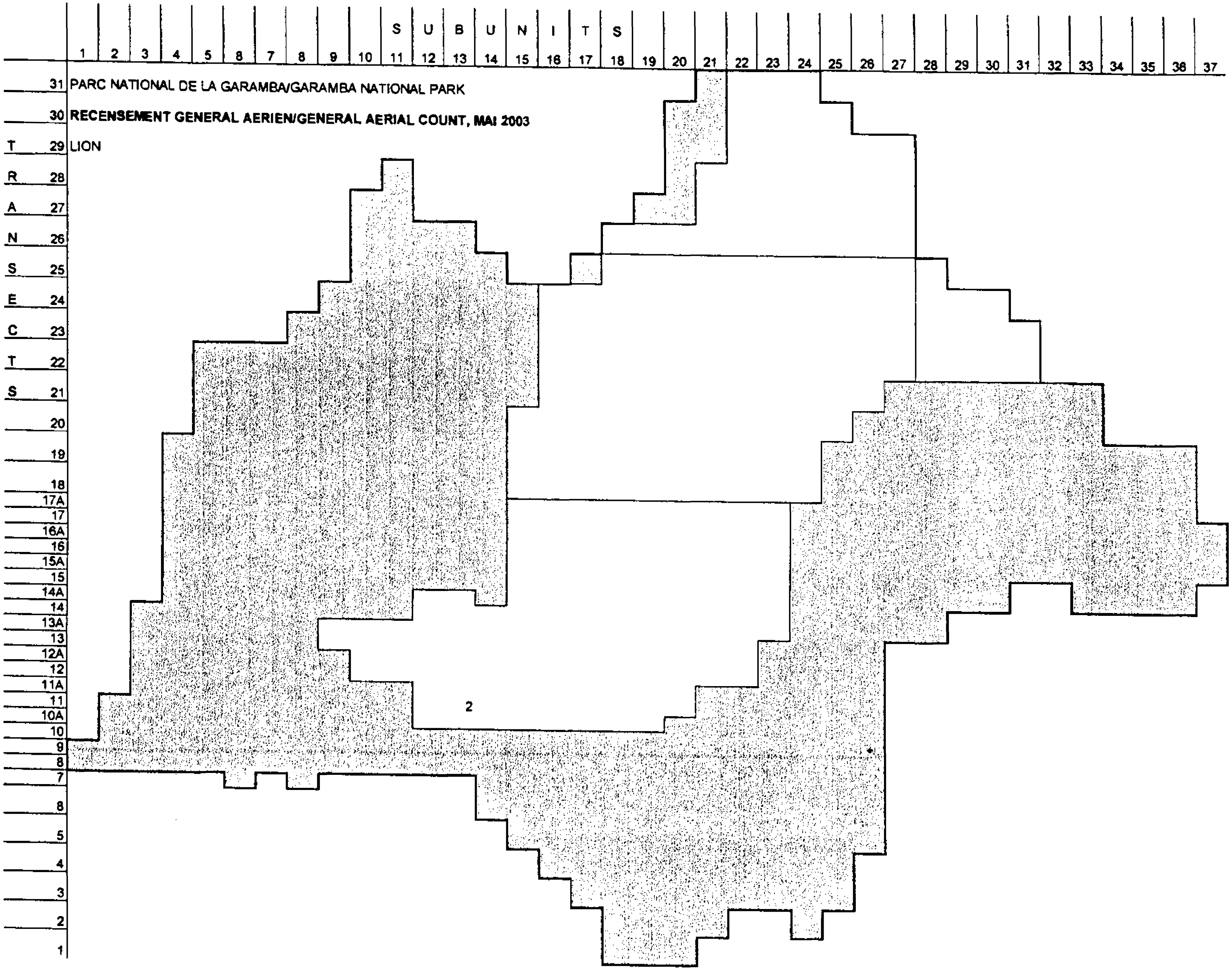


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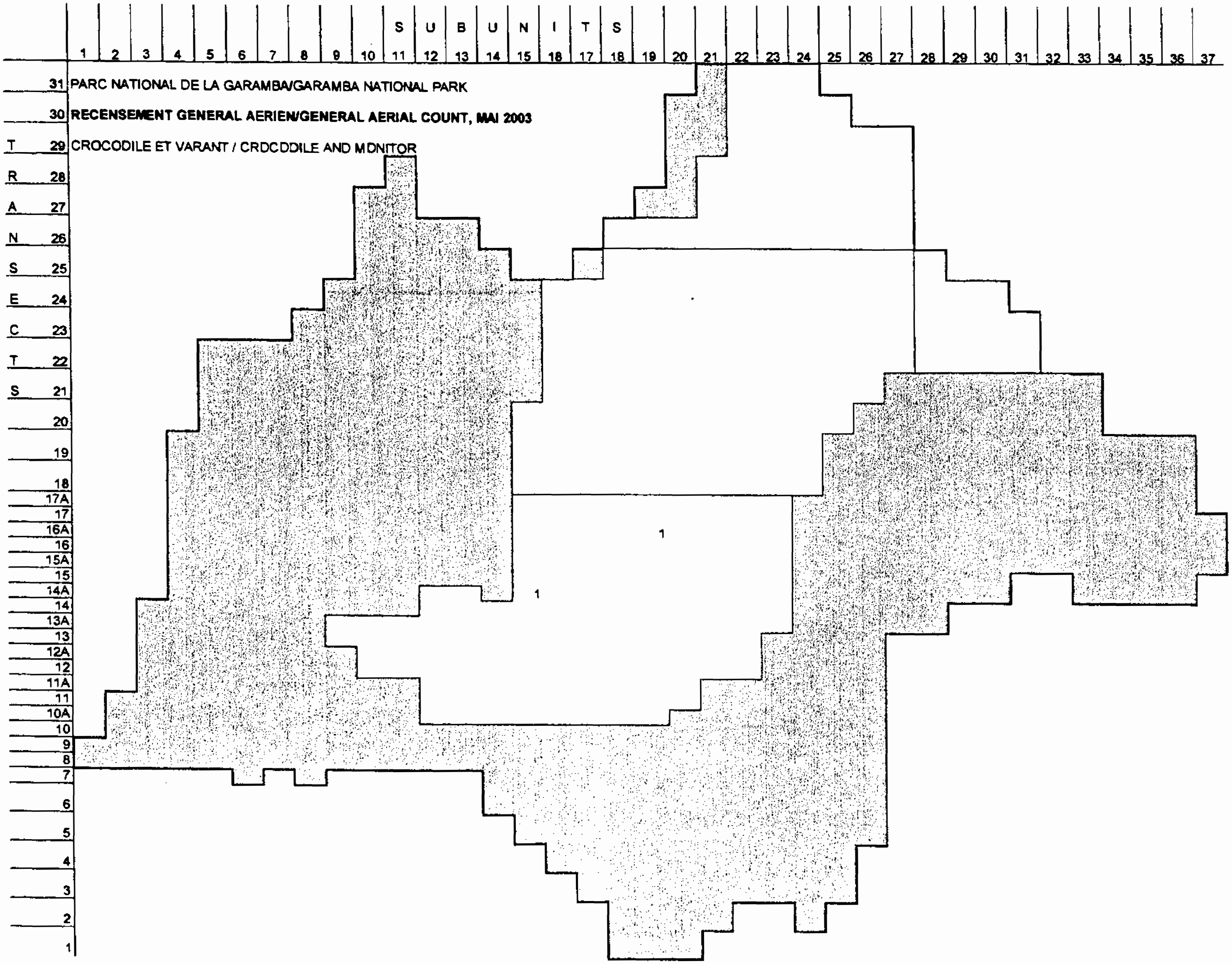
| 26 | | | 0 | 0 | |
| 25 | | 0 | 0 | 0 | |
| 24 | | 0 | 0 | 0 | |
| 23 | | 0 | 0 | 0 | |
| 22 | | 0 | 0 | 0 | |
| 21 | | 0 | | 0 | |
| 20 | | 0 | | 0 | |
| 19 | | 0 | | 0 | |
| 18 | | 0 | | 0 | |
| 17A | 0 | | | 0 | |
| 17 | 0 | | | 0 | |
| 16A | 0 | | | 0 | |
| 16 | 0 | | | 0 | |
| 15A | 0 | | | 0 | |
| 15 | 0 | | | 0 | |
| 14A | 0 | | | 0 | |
| 14 | 0 | | | 0 | |
| 13A | 0 | | | 0 | |
| 13 | 0 | | | 0 | |
| 12A | 0 | | | 0 | |
| 12 | 0 | | | 0 | |
| 11A | 0 | | | 0 | |
| 11 | 0 | | | 0 | |
| 10A | 2 | | | 2 | |
| 10 | 0 | | | 0 | |
| | 0 | 0 | 0 | 0 | Total Nord |
| | 0 | 0 | 0 | 0 | Total Centre |
| | 2 | 0 | 0 | 2 | Total Sud |
| | 2 | 0 | 0 | 2 | TOTAL |




| | | | | |
|---|---|---|---|---|
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
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| | | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | | 0 | |
| | 0 | | 0 | |
| | 0 | | 0 | |
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| 1 | | | 1 | |
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| 0 | | | 0 | |
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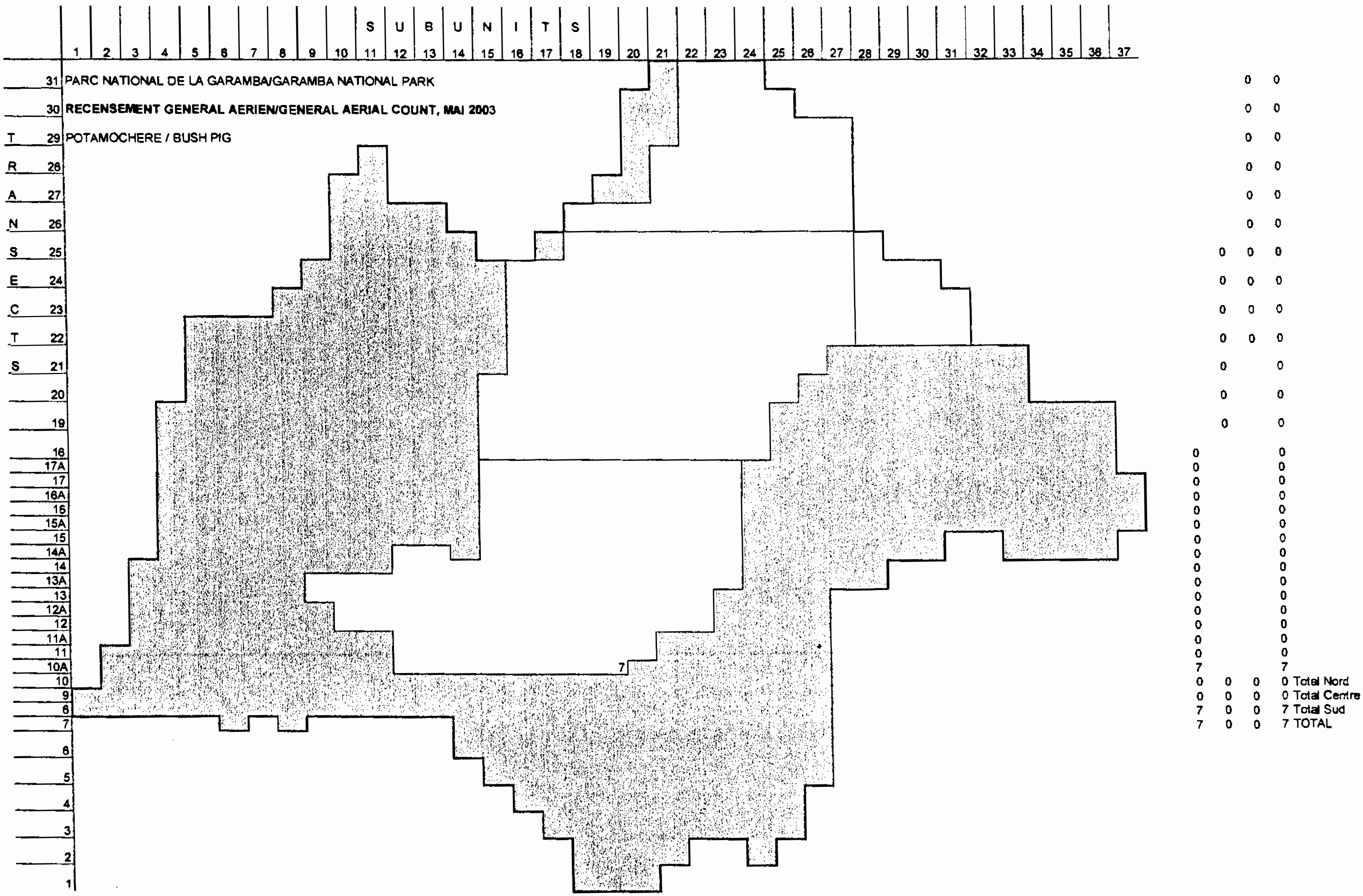
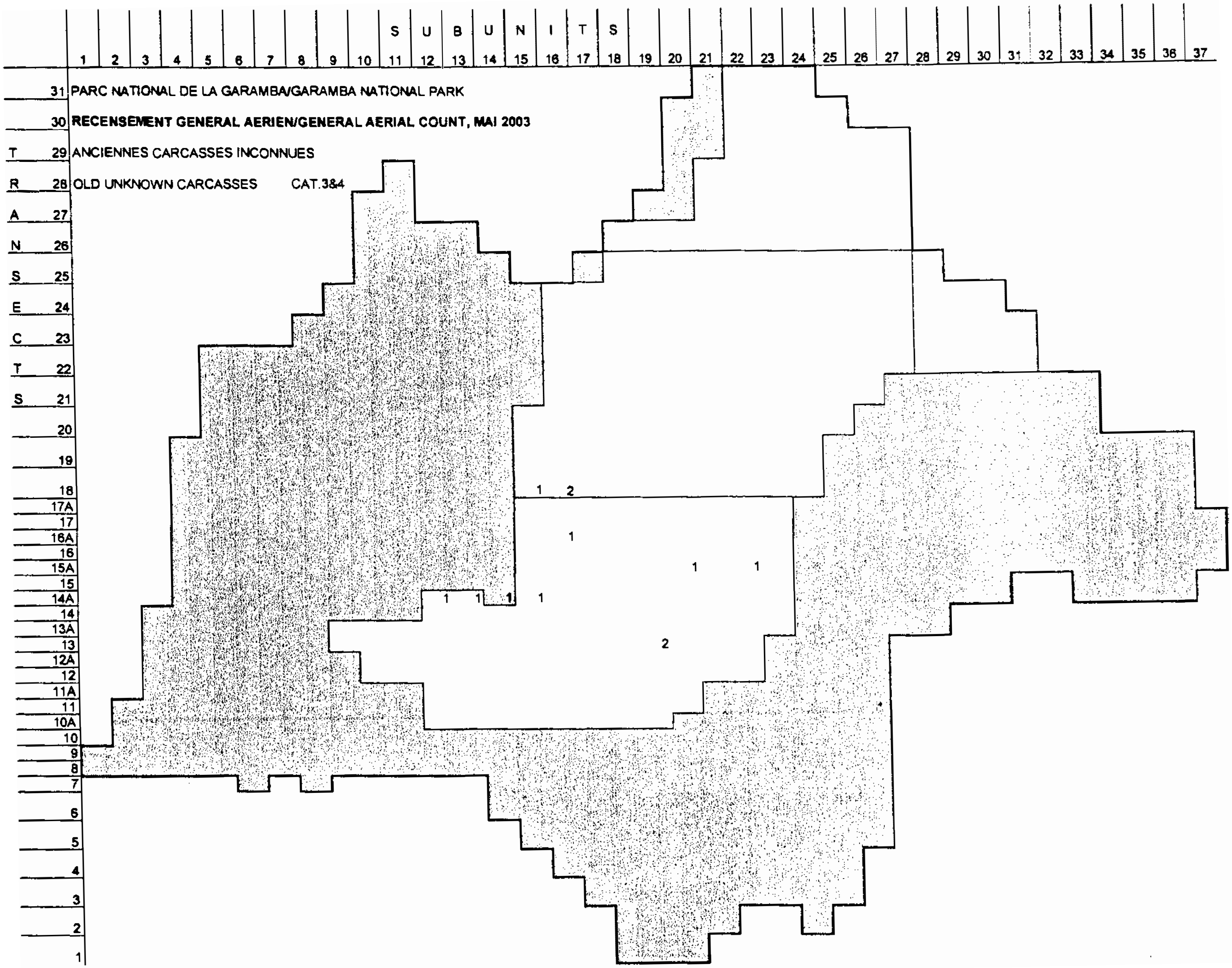
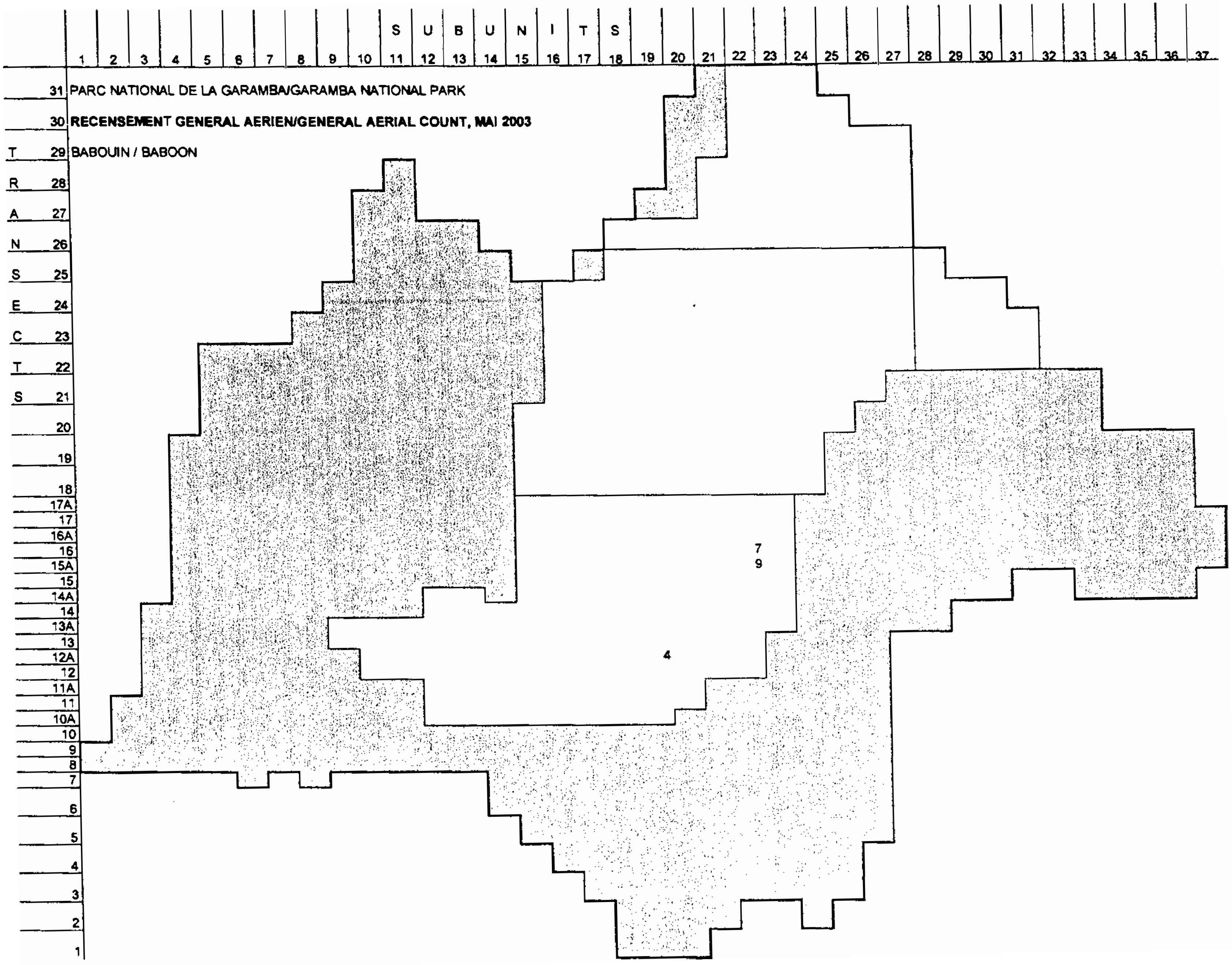
| 1 | | | 1 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
| 0 | 0 | 0 | 0 | Total Nord |
| 0 | 0 | 0 | 0 | Total Centre |
| 2 | 0 | 0 | 2 | Total Sud |
| 2 | 0 | 0 | 2 | TOTAL |

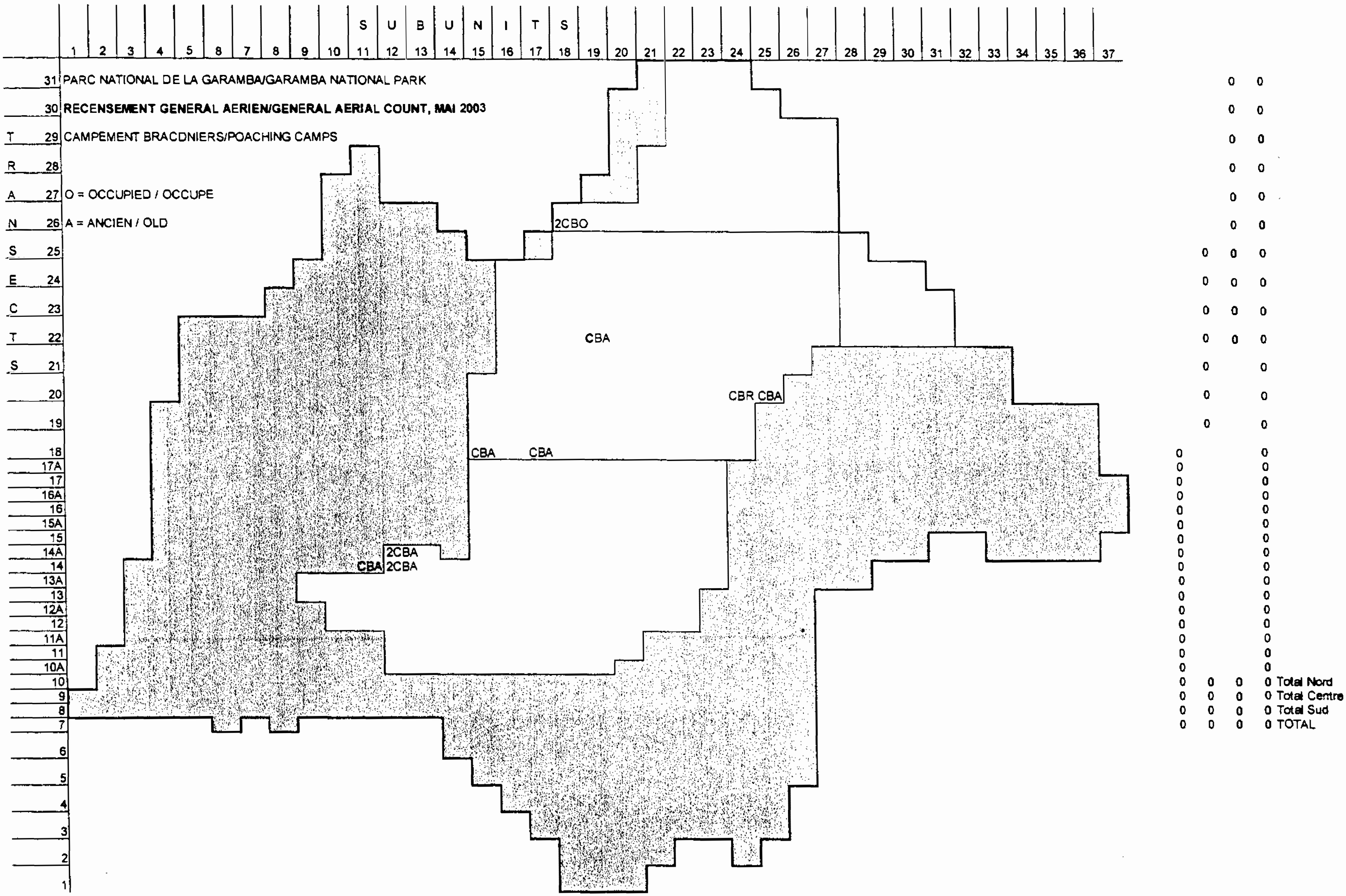

PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 2003
POTAMOCHERE / BUSH PIG
SUBUNITS
TRANSECTS
7
7 0 0 0 Total Nord
0 0 0 0 Total Centre
7 0 0 7 Total Sud
7 0 0 7 TOTAL




| | | | | |
|---|---|---|---|---|
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | 0 | 0 | |
| | 0 | | 0 | |
| | 0 | | 0 | |
| | 0 | | 0 | |
| 3 | | | 3 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
| 1 | | | 1 | |
| 0 | | | 0 | |
| 2 | | | 2 | |
| 0 | | | 0 | |
| 4 | | | 4 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
| 2 | | | 2 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
| 0 | | | 0 | |
| 0 | 0 | 0 | 0 | Total Nord |
| 0 | 0 | 0 | 0 | Total Centre |
| 12 | 0 | 0 | 12 | Total Sud |
| 12 | 0 | 0 | 12 | TOTAL |




| | | | | |
|---|---|---|---|---|
| 31 | | 0 | | 0 |
| 30 | | 0 | | 0 |
| 29 | | 0 | | 0 |
| 28 | | 0 | | 0 |
| 27 | | 0 | | 0 |
| 26 | | 0 | | 0 |
| 25 | 0 | 0 | | 0 |
| 24 | 0 | 0 | | 0 |
| 23 | 0 | 0 | | 0 |
| 22 | 0 | 0 | | 0 |
| 21 | 0 | | | 0 |
| 20 | 0 | | | 0 |
| 19 | 0 | | | 0 |
| 18 | 0 | | | 0 |
| 17A | 0 | | | 0 |
| 17 | 0 | | | 0 |
| 16A | 0 | | | 0 |
| 16 | 7 | | | 7 |
| 15A | 9 | | | 9 |
| 15 | 0 | | | 0 |
| 14A | 0 | | | 0 |
| 14 | 0 | | | 0 |
| 13A | 0 | | | 0 |
| 13 | 0 | | | 0 |
| 12A | 4 | | | 4 |
| 12 | 0 | | | 0 |
| 11A | 0 | | | 0 |
| 11 | 0 | | | 0 |
| 10A | 0 | | | 0 |
| Total Nord | 0 | 0 | 0 | 0 |
| Total Centre | 0 | 0 | 0 | 0 |
| Total Sud | 20 | 0 | 0 | 20 |
| TOTAL | 20 | 0 | 0 | 20 |


PARC NATIONAL DE LA GARAMBA/GARAMBA NATIONAL PARK
RECENSEMENT GENERAL AERIEN/GENERAL AERIAL COUNT, MAI 2003
CAMPEMENT BRACONIERS/POACHING CAMPS
O = OCCUPIED / OCCUPE
A = ANCIEN / OLD
SUBUNITS
TRANSECTS
2CBO
CBA
CBR CBA
CBA
CBA
2CBA
CBA 2CBA
Total Nord
Total Centre
Total Sud
TOTAL

| | AREA | | | | ELEPHANTS | | | | | BUFFALOES/BUFFLES | | | | | COBS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STH | MID NTH | LOW NTH | TOT.NOR | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL |
| 31 | | | 8.01 | 8.01 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 10.32 | 10.32 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 15.74 | 15.74 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 18.99 | 18.99 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 18.66 | 18.68 | | | 0 | 0 | | | | 0 | 0 | | | | 1 | 0 | |
| 26 | | | 26.57 | 26.57 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 26.65 | 2.59 | 29.24 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 2 | 0 | 0 | |
| 24 | | 31.62 | 7.82 | 39.44 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 2 | 0 | 0 | |
| 23 | | 31.60 | 21.06 | 41.92 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 3 | 0 | 0 | |
| 22 | | 31.49 | 10.74 | 42.22 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 28.81 | | 28.81 | | 0 | | 0 | | | 0 | | 0 | | | 2 | | 0 | |
| 20 | | 29.22 | | 29.22 | | 0 | | 0 | | | 0 | | 0 | | | 7 | | 0 | |
| 19 | | 25.87 | | 25.87 | | 0 | | 0 | | | 0 | | 0 | | | 5 | | 0 | |
| 18 | 26.57 | | | | 4 | | | | | 1 | | | | | 19 | | | | |
| 17a | 23.32 | | | | 0 | | | | | 81 | | | | | 113 | | | | |
| 17 | 23.54 | | | | 0 | | | | | 2 | | | | | 80 | | | | |
| 16a | 23.37 | | | | 8 | | | | | 5 | | | | | 259 | | | | |
| 16 | 23.47 | | | | 40 | | | | | 501 | | | | | 8 | | | | |
| 15a | 23.50 | | | | 152 | | | | | 466 | | | | | 74 | | | | |
| 15 | 23.82 | | | | 331 | | | | | 296 | | | | | 166 | | | | |
| 14a | 31.84 | | | | 70 | | | | | 418 | | | | | 96 | | | | |
| 14 | 31.66 | | | | 163 | | | | | 162 | | | | | 294 | | | | |
| 13a | 39.46 | | | | 48 | | | | | 15 | | | | | 18 | | | | |
| 13 | 36.89 | | | | 116 | | | | | 427 | | | | | 16 | | | | |
| 12a | 33.84 | | | | 157 | | | | | 303 | | | | | 49 | | | | |
| 12 | 34.45 | | | | 122 | | | | | 274 | | | | | 19 | | | | |
| 11a | 23.84 | | | | 129 | | | | | 50 | | | | | 70 | | | | |
| 11 | 23.69 | | | | 97 | | | | | 43 | | | | | 11 | | | | |
| 10a | 21.14 | | | | 18 | | | | | 0 | | | | | 12 | | | | |
| Total | 444.39 | 205.26 | 98.32 | 98.32 | 1453.0 | 0.0 | 0.0 | 0.0 | | 3024.0 | 0.0 | 0.0 | 0.0 | | 1304.0 | 21.0 | 1.0 | 0.0 | |
| Sum squ | 12862.49 | 205.26 | 42.20 | 236.72 | 247453.0 | 0.0 | 0.0 | 0.0 | | 1114280.0 | 0.0 | 0.0 | 0.0 | | 223866.0 | 95.0 | 1.0 | 0.0 | |
| | | 0.00 | 0.00 | 444.39 | 41474.2 | 0.0 | 0.0 | 0.0 | | 88056.5 | 0.0 | 0.0 | 0.0 | | 35117.0 | 602.9 | 18.7 | 0.0 | |
| | | 205.26 | 140.52 | 779.43 | | | | | | | | | | | | | | | |
| | | | | R=Sy/Sz | 3.3 | 0.0 | 0.0 | 0.0 | | 6.8 | 0.0 | 0.0 | 0.0 | | 2.9 | 0.1 | 0.0 | 0.0 | |
| | | | | Var y | 7700.2 | 0.0 | 0.0 | 0.0 | | 36182.9 | 0.0 | 0.0 | 0.0 | | 7839.3 | 5.3 | 0.2 | 0.0 | |
| Var z | 34.6 | 5.7 | 44.6 | 125.2 | | | | | STRAT. | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | 74.5 | 0.0 | 0.0 | 0.0 | TOTAL | 271.1 | 0.0 | 0.0 | 0.0 | TOTAL | -73.4 | -23.1 | 1.0 | 0.0 | TOTAL |
| | | | | | ELEPHANTS | | | | | BUFFALOES/BUFFLES | | | | | COBS | | | | |
| | | | Pop.est.(Y) | | 6,948 | 0 | 0 | 0 | 6,948 | 14,460 | 0 | 0 | 0 | 14,480 | 6,235 | 200 | 12 | 0 | 6,447 |
| | | | | SE(Y) | 1995.3 | 0.0 | 0.0 | 0.0 | 1995.3 | 4231.0 | 0.0 | 0.0 | 0.0 | 4231.00 | 2120.9 | 114.2 | 9.5 | 0.0 | 2124.0 |
| | | | | 95% C.L. | 4070.4 | 0.0 | 0.0 | 0.0 | 3910.8 | 8631.2 | 0.0 | 0.0 | 0.0 | 8292.76 | 4326.7 | 233.0 | 19.4 | 0.0 | 4163.1 |
| | | | | 95% C.L. | 58.6 | 0.0 | 0.0 | 0.0 | 56.3 | 59.7 | 0.0 | 0.0 | 0.0 | 57.35 | 69.4 | 0.0 | 0.0 | 0.0 | 64.6 |

| TRANS | AREA HIGH STH | AREA MID NTH | AREA LOW NTH | AREA TOT.NOR | GIRAFFES HIGH STH | GIRAFFES MID NTH | GIRAFFES LOW NTH | GIRAFFES TOT NTH | GIRAFFES TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 31 | | | 10 32 | 10 32 | | | 0 | 0 | |
| 30 | | | 15 74 | 15 74 | | | 0 | 0 | |
| 29 | | | 18 99 | 18 99 | | | 0 | 0 | |
| 28 | | | 18 68 | 18.68 | | | 0 | 0 | |
| 27 | | | 26 57 | 26 57 | | | 0 | 0 | |
| 26 | | 26.65 | 2.59 | 29.24 | | 0 | 0 | 0 | |
| 25 | | 31.62 | 7 82 | 39 44 | | 0 | 0 | 0 | |
| 24 | | 31 60 | 21 06 | 41 92 | | 0 | 0 | 0 | |
| 23 | | 31.49 | 10.74 | 42.22 | | 0 | 0 | 0 | |
| 22 | | 28.81 | | 28.81 | | 0 | | 0 | |
| 21 | | 29 22 | | 29.22 | | 0 | | 0 | |
| 20 | | 25 87 | | 25.87 | | 0 | | 0 | |
| 19 | 26.57 | | | | 0 | | | | |
| 18 | 23 32 | | | | 0 | | | | |
| 17a | 23.54 | | | | 0 | | | | |
| 17 | 23 37 | | | | 13 | | | | |
| 16a | 23.47 | | | | 0 | | | | |
| 16 | 23.50 | | | | 0 | | | | |
| 15a | 23.82 | | | | 0 | | | | |
| 15 | 31.84 | | | | 0 | | | | |
| 14a | 31 66 | | | | 0 | | | | |
| 14 | 39.46 | | | | 0 | | | | |
| 13a | 36.89 | | | | 0 | | | | |
| 13 | 33 84 | | | | 0 | | | | |
| 12a | 34 45 | | | | 0 | | | | |
| 12 | 23.84 | | | | 0 | | | | |
| 11a | 23 69 | | | | 0 | | | | |
| 11 | 21 14 | | | | 0 | | | | |
| 10a Total | 444.39 | 205.26 | 98.32 | 98.32 | 13.0 | 0.0 | 0.0 | 0.0 | |
| Sum squ | 12862.49 | 205.26 | 42.20 | 236.72 | 169 0 | 0.0 | 0.0 | 0.0 | |
| | | 0.00 | 0 00 | 444 39 | 303.8 | 0.0 | 0 0 | 0.0 | |
| | | 205.26 | 140.52 | 779.43 | | | | | |
| | | | | R=Sy/Sz | 0 0 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 10.6 | 0.0 | 0 0 | 0.0 | |
| Var z | 34.6 | 5 7 | 44 6 | 125.2 | | | | | |
| Covar zy | | | | | -3.8 | 0.0 | 0 0 | 0 0 | STRAT. TOTAL |
| | | Pop.est.(Y) | | | GIRAFFES 62 | 0 | 0 | 0 | 62 |
| | | | | SE(Y) | 75.4 | 0.0 | 0.0 | 0.0 | 75.4 |
| | | | | 95% C.L. | 153.7 | 0.0 | 0.0 | 0.0 | 147.7 |
| | | | | 95% C.L. | 247.3 | 0.0 | 0.0 | 0.0 | 237.6 |

| TRANS | RHINOS HIGH STH | RHINOS MID NTH | RHINOS LOW NTH | RHINOS TOT.NTH | RHINOS TOTAL | HIPPOPOTAMES/HIPPOS HIGH STH | HIPPOPOTAMES/HIPPOS MID NTH | HIPPOPOTAMES/HIPPOS LOW NTH | HIPPOPOTAMES/HIPPOS TOT NTH | HIPPOPOTAMES/HIPPOS TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| 31 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 25 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 0 | | 0 | | | 0 | | 0 | |
| 21 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 0 | | 0 | | | 0 | | 0 | |
| 19 | 0 | | | | | 0 | | | | |
| 18 | 0 | | | | | 0 | | | | |
| 17a | 0 | | | | | 48 | | | | |
| 17 | 0 | | | | | 42 | | | | |
| 16a | 0 | | | | | 6 | | | | |
| 16 | 0 | | | | | 98 | | | | |
| 15a | 2 | | | | | 45 | | | | |
| 15 | 5 | | | | | 37 | | | | |
| 14a | 1 | | | | | 39 | | | | |
| 14 | 1 | | | | | 3 | | | | |
| 13a | 0 | | | | | 38 | | | | |
| 13 | 0 | | | | | 35 | | | | |
| 12a | 0 | | | | | 4 | | | | |
| 12 | 0 | | | | | 197 | | | | |
| 11a | 0 | | | | | 39 | | | | |
| 11 | 0 | | | | | 4 | | | | |
| 10a Total | 9.0 | 0.0 | 0.0 | 0.0 | | 635.0 | 0.0 | 0.0 | 0.0 | |
| Sum squ | 31.0 | 0.0 | 0.0 | 0.0 | | 61663.0 | 0.0 | 0.0 | 0.0 | |
| | 277 9 | 0.0 | 0.0 | 0.0 | | 16587.5 | 0.0 | 0.0 | 0.0 | |
| R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 1.4 | 0.0 | 0.0 | 0.0 | |
| Var y | 1 7 | 0.0 | 0 0 | 0.0 | | 2430 8 | 0.0 | 0.0 | 0.0 | |
| Covar zy | 1.9 | 0 0 | 0.0 | 0 0 | STRAT TOTAL | -70.0 | 0.0 | 0 0 | 0.0 | STRAT. TOTAL |
| Pop.est.(Y) | RHINOCEROS 43 | 0 | 0 | 0 | 43 | HIPPOS 3,036 | 0 | 0 | 0 | 3,036 |
| SE(Y) | 29.6 | 0.0 | 0.0 | 0.0 | 29.59 | 1190.9 | 0.0 | 0.0 | 0.0 | 1190.9 |
| 95% C.L. | 60.4 | 0.0 | 0.0 | 0.0 | 58.00 | 2429.4 | 0.0 | 0.0 | 0.0 | 2334.2 |
| 95% C.L. | 140.3 | 0.0 | 0.0 | 0.0 | 134 77 | 80.0 | 0.0 | 0.0 | 0.0 | 76 9 |

| | AREA | | | | WATERBUCK | | | | |
|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STH | MID NTH | LOW NTH | TOT.NOR | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL |
| 31 | | | 8.01 | 8.01 | | | 0 | 0 | |
| 30 | | | 10.32 | 10.32 | | | 0 | 0 | |
| 29 | | | 15.74 | 15.74 | | | 0 | 0 | |
| 28 | | | 18.99 | 18.99 | | | 0 | 0 | |
| 27 | | | 18.68 | 18.68 | | | 0 | 0 | |
| 26 | | | 26.57 | 26.57 | | | 0 | 0 | |
| 25 | | 26.65 | 2.59 | 29.24 | | 4 | 0 | 0 | |
| 24 | | 31.62 | 7.82 | 39.44 | | 0 | 0 | 0 | |
| 23 | | 31.60 | 21.06 | 41.92 | | 0 | 0 | 0 | |
| 22 | | 31.49 | 10.74 | 42.22 | | 0 | 0 | 0 | |
| 21 | | 28.81 | | 28.81 | | 2 | | 0 | |
| 20 | | 29.22 | | 29.22 | | 3 | | 0 | |
| 19 | | 25.87 | | 25.87 | | 4 | | 0 | |
| 18 | 26.57 | | | | 5 | | | | |
| 17a | 23.32 | | | | 3 | | | | |
| 17 | 23.54 | | | | 18 | | | | |
| 16a | 23.37 | | | | 2 | | | | |
| 16 | 23.47 | | | | 2 | | | | |
| 15a | 23.50 | | | | 1 | | | | |
| 15 | 23.82 | | | | 2 | | | | |
| 14a | 31.84 | | | | 1 | | | | |
| 14 | 31.66 | | | | 35 | | | | |
| 13a | 39.46 | | | | 3 | | | | |
| 13 | 36.89 | | | | 0 | | | | |
| 12a | 33.84 | | | | 3 | | | | |
| 12 | 34.45 | | | | 2 | | | | |
| 11a | 23.84 | | | | 0 | | | | |
| 11 | 23.69 | | | | 11 | | | | |
| 10a | 21.14 | | | | 0 | | | | |
| Total | 444.39 | 205.26 | 98.32 | 98.32 | 68.0 | 13.0 | 0.0 | 0.0 | |
| Sum squ | 12862.48 | 205.26 | 42.20 | 236.72 | 1740.0 | 45.0 | 0.0 | 0.0 | |
| | | 0.00 | 0.00 | 444.39 | 2480.7 | 355.4 | 0.0 | 0.0 | |
| | | 205.26 | 140.52 | 779.43 | | | | | |
| | | | | R=5y/Sz | 0.2 | 0.1 | 0.0 | 0.0 | |
| | | | | Var y | 83.7 | 3.5 | 0.0 | 0.0 | |
| Var z | 34.6 | 5.7 | 44.6 | 125.2 | | | | | 5TRAT. |
| Cover zy | | | | | 2.4 | -17.9 | 0.0 | 0.0 | TOTAL |
| | | | | | WATERBUCK | | | | |
| | | | Pop.est.(Y) | | 421 | 124 | 0 | 0 | 544 |
| | | | | SE(Y) | 210.2 | 86.2 | 0.0 | 0.0 | 227.1 |
| | | | | 95% C.L. | 428.7 | 175.8 | 0.0 | 0.0 | 445.2 |
| | | | | 95% C.L. | 101.9 | 0.0 | 0.0 | 0.0 | 81.8 |

| | PHACOCHERE | | | | | LION | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL |
| 31 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 0 | 3 | 0 | | | 0 | 0 | 0 | |
| 23 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 2 | | 0 | | | 0 | | 0 | |
| 19 | | 2 | | 0 | | | 0 | | 0 | |
| 18 | 1 | | | | | 0 | | | | |
| 17a | 11 | | | | | 0 | | | | |
| 17 | 14 | | | | | 0 | | | | |
| 16a | 22 | | | | | 0 | | | | |
| 16 | 12 | | | | | 0 | | | | |
| 15a | 12 | | | | | 0 | | | | |
| 15 | 7 | | | | | 0 | | | | |
| 14a | 10 | | | | | 0 | | | | |
| 14 | 19 | | | | | 0 | | | | |
| 13a | 14 | | | | | 0 | | | | |
| 13 | 4 | | | | | 0 | | | | |
| 12a | 4 | | | | | 0 | | | | |
| 12 | 14 | | | | | 0 | | | | |
| 11a | 17 | | | | | 0 | | | | |
| 11 | 3 | | | | | 2 | | | | |
| 10a | 1 | | | | | 0 | | | | |
| Total | 165.0 | 4.0 | 3.0 | 0.0 | | 2.0 | 0.0 | 0.0 | 0.0 | |
| Sum squ | 2323.0 | 8.0 | 0.0 | 0.0 | | 4.0 | 0.0 | 0.0 | 0.0 | |
| | 4592.2 | 110.2 | 0.0 | 0.0 | | 47.4 | 0.0 | 0.0 | 0.0 | |
| R=5y/Sz | 0.4 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | |
| Var y | 41.4 | 1.0 | 0.0 | 0.0 | | 0.3 | 0.0 | 0.0 | 0.0 | |
| Var z | | | | | 5TRAT. | | | | | 5TRAT. |
| Cover zy | 0.6 | -5.3 | -3.3 | 0.0 | TOTAL | -0.5 | 0.0 | 0.0 | 0.0 | TOTAL |
| | PHACOCHERE | | | | | LION | | | | |
| Pop.est.(Y) | 788 | 38 | 37 | 0 | 864 | 18 | 0 | 0 | 0 | 10 |
| SE(Y) | 155.0 | 38.7 | 12.0 | 0.0 | 160.18 | 11.6 | 0.0 | 0.0 | 0.0 | 11.6 |
| 95% C.L. | 316.1 | 79.0 | 24.5 | 0.0 | 313.95 | 23.8 | 0.0 | 0.0 | 0.0 | 22.7 |
| 95% C.L. | 40.1 | 0.0 | 0.0 | 0.0 | 36.32 | 247.1 | 0.0 | 0.0 | 0.0 | 237.4 |

| | AREA | | | | BUBALES / HARTEBEEST | | | | |
|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STH | MID NTH | LOW NTH | TOT.NOR | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL |
| 31 | | | 8.01 | 8.01 | | | 0 | 0 | |
| 30 | | | 10.32 | 10.32 | | | 0 | 0 | |
| 29 | | | 15.74 | 15.74 | | | 0 | 0 | |
| 28 | | | 18.99 | 18.99 | | | 0 | 0 | |
| 27 | | | 18.68 | 18.68 | | | 0 | 0 | |
| 26 | | | 26.57 | 26.57 | | | 0 | 0 | |
| 25 | | 28.65 | 2.59 | 29.24 | | 1 | 0 | 0 | |
| 24 | | 31.62 | 7.82 | 39.44 | | 5 | 0 | 0 | |
| 23 | | 31.60 | 21.06 | 41.92 | | 0 | 0 | 0 | |
| 22 | | 31.49 | 10.74 | 42.22 | | 0 | 0 | 0 | |
| 21 | | 28.81 | | 28.81 | | 9 | | 0 | |
| 20 | | 29.22 | | 29.22 | | 0 | | 0 | |
| 19 | | 25.87 | | 25.87 | | 24 | | 0 | |
| 18 | 26.57 | | | | 0 | | | | |
| 17a | 23.32 | | | | 16 | | | | |
| 17 | 23.54 | | | | 8 | | | | |
| 16a | 23.37 | | | | 14 | | | | |
| 16 | 23.47 | | | | 17 | | | | |
| 15a | 23.50 | | | | 4 | | | | |
| 15 | 23.82 | | | | 32 | | | | |
| 14a | 31.84 | | | | 24 | | | | |
| 14 | 31.66 | | | | 17 | | | | |
| 13a | 39.46 | | | | 12 | | | | |
| 13 | 36.89 | | | | 51 | | | | |
| 12a | 33.84 | | | | 19 | | | | |
| 12 | 34.45 | | | | 15 | | | | |
| 11a | 23.84 | | | | 25 | | | | |
| 11 | 23.69 | | | | 0 | | | | |
| 10a | 21.14 | | | | 0 | | | | |
| Total | 444.39 | 205.26 | 98.32 | 98.32 | 256.0 | 39.0 | 0.0 | 0.0 | |
| Sum squ | 12862.49 | 205.26 | 42.20 | 236.72 | 6734.0 | 683.0 | 0.0 | 0.0 | |
| | | 0.00 | 0.00 | 444.39 | 7603.4 | 1064.9 | 0.0 | 0.0 | |
| | | 205.26 | 140.52 | 779.43 | | | | | |
| | | | | R=Sy/Sz | 0.8 | 0.2 | 0.0 | 0.0 | |
| | | | | Var y | 175.9 | 77.6 | 0.0 | 0.0 | |
| Var z | 34.6 | 5.7 | 44.6 | 125.2 | | | | | |
| Covar zy | | | | | 32.9 | -53.9 | 0.0 | 0.0 | STRAT. TOTAL |
| | | | | | BUBALES /HARTEBEEST | | | | |
| | | Pop.est.(Y) | | | 1,224 | 371 | 0 | 0 | 1,595 |
| | | | | SE(Y) | 280.1 | 356.0 | 0.0 | 0.0 | 453.0 |
| | | | | 95% C.L. | 571.5 | 726.2 | 0.0 | 0.0 | 867.8 |
| | | | | 95% C.L. | 46.7 | 0.0 | 0.0 | 0.0 | 55.7 |

| | GUIB HARNACHE /BUSHBUCK | | | | | CEPHALOPHES /DUIKERS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL |
| 31 | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 0 | | 0 | | | 1 | | 0 | |
| 20 | | 0 | | 0 | | | 0 | | 0 | |
| 19 | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 0 | | | | | 0 | | | | |
| 17a | 0 | | | | | 1 | | | | |
| 17 | 0 | | | | | 0 | | | | |
| 16a | 2 | | | | | 0 | | | | |
| 16 | 0 | | | | | 0 | | | | |
| 15a | 0 | | | | | 0 | | | | |
| 15 | 0 | | | | | 0 | | | | |
| 14a | 5 | | | | | 0 | | | | |
| 14 | 0 | | | | | 0 | | | | |
| 13a | 0 | | | | | 0 | | | | |
| 13 | 0 | | | | | 0 | | | | |
| 12a | 1 | | | | | 0 | | | | |
| 12 | 2 | | | | | 0 | | | | |
| 11a | 0 | | | | | 0 | | | | |
| 11 | 0 | | | | | 0 | | | | |
| 10a | 3 | | | | | 0 | | | | |
| Total | 13.0 | 0.0 | 0.0 | 0.0 | | 1.0 | 1.0 | 0.0 | 0.0 | |
| Sum squ | 43.0 | 0.0 | 0.0 | 0.0 | | 1.0 | 1.0 | 0.0 | 0.0 | |
| | 372.1 | 0.0 | 0.0 | 0.0 | | 23.3 | 28.6 | 0.0 | 0.0 | |
| | | | | | | | | | | |
| R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | |
| Var y | 2.2 | 0.0 | 0.0 | 0.0 | | 0.1 | 0.1 | 0.0 | 0.0 | |
| Var z | | | | | | | | | | |
| Covar zy | 0.7 | 0.0 | 0.0 | 0.0 | STRAT. TOTAL | -0.3 | -1.1 | 0.0 | 0.0 | STRAT. TOTAL |
| | GUIB HARNACHE/BUSHBUCK | | | | | CEPHALOPHES / DUIKERS | | | | |
| Pop.est.(Y) | 62 | 0 | 0 | 0 | 62 | 5 | 10 | 0 | 0 | 14 |
| SE(Y) | 33.6 | 0.0 | 0.0 | 0.0 | 33.59 | 5.8 | 14.1 | 0.0 | 0.0 | 15.2 |
| 95% C.L. | 68.5 | 0.0 | 0.0 | 0.0 | 65.84 | 11.8 | 28.7 | 0.0 | 0.0 | 29.6 |
| 95% C.L. | 110.2 | 0.0 | 0.0 | 0.0 | 105.91 | 247.3 | 0.0 | 0.0 | 0.0 | 208.8 |

| | AREA | | | | CARCASSES CAT 3&4 | | | | | CROCODILES | | | | | POTAMOCHERES | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STH | MID NTH | LOW NTH | TOT NOR | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT NTH | TOTAL |
| 31 | | | 8.01 | 8.01 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 10.32 | 10.32 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 15.74 | 15.74 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 18.99 | 18.99 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 18.68 | 18.68 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 26.57 | 26.57 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 26.65 | 2.59 | 29.24 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 31.62 | 7.82 | 39.44 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 31.60 | 21.06 | 41.92 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 31.49 | 10.74 | 42.22 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 26.81 | | 26.61 | | 0 | | 0 | | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 29.22 | | 29.22 | | 0 | | 0 | | | 0 | | 0 | | | 0 | | 0 | |
| 19 | | 25.67 | | 25.67 | | 0 | | 0 | | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 26.57 | | | | 3 | | | | | 0 | | | | | 0 | | | | |
| 17a | 23.32 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 17 | 23.54 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 16a | 23.37 | | | | 1 | | | | | 1 | | | | | 0 | | | | |
| 16 | 23.47 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 15a | 23.50 | | | | 2 | | | | | 0 | | | | | 0 | | | | |
| 15 | 23.82 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 14a | 31.84 | | | | 4 | | | | | 1 | | | | | 0 | | | | |
| 14 | 31.66 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 13a | 39.46 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 13 | 36.89 | | | | 2 | | | | | 0 | | | | | 0 | | | | |
| 12a | 33.84 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 12 | 34.45 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 11a | 23.84 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 11 | 23.69 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 10a | 21.14 | | | | 0 | | | | | 0 | | | | | 7 | | | | |
| Total | 444.39 | 205.26 | 98.32 | 98.32 | 12.0 | 0.0 | 0.0 | 0.0 | | 2.0 | 0.0 | 0.0 | 0.0 | | 7.0 | 0.0 | 0.0 | 0.0 | |
| Sum squ | 12862.49 | 205.26 | 42.20 | 236.72 | 34.0 | 0.0 | 0.0 | 0.0 | | 2.0 | 0.0 | 0.0 | 0.0 | | 49.0 | 0.0 | 0.0 | 0.0 | |
| | | 0.00 | 0.00 | 444.39 | 351.2 | 0.0 | 0.0 | 0.0 | | 55.2 | 0.0 | 0.0 | 0.0 | | 148.0 | 0.0 | 0.0 | 0.0 | |
| | | 205.26 | 140.52 | 779.43 | | | | | | | | | | | | | | | |
| | | | | R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 1.7 | 0.0 | 0.0 | 0.0 | | 0.1 | 0.0 | 0.0 | 0.0 | | 3.1 | 0.0 | 0.0 | 0.0 | |
| Var z | 34.6 | 5.7 | 44.6 | 125.2 | | | | | STRAT. | | | | | STRAT. | | | | | STRAT. |
| Cover zy | | | | | 1.2 | 0.0 | 0.0 | 0.0 | TOTAL | -0.0 | 0.0 | 0.0 | 0.0 | TOTAL | -3.1 | 0.0 | 0.0 | 0.0 | TOTAL |
| | | | | | CARCASSES CAT 3&4 | | | | | CROCODILES | | | | | POTAMOCHERES | | | | |
| | | Pop.est.(Y) | | | **57** | **0** | **0** | **0** | **57** | **10** | **0** | **0** | **0** | **10** | **33** | **0** | **0** | **0** | **33** |
| | | | | SE(Y) | 29.2 | 0.0 | 0.0 | 0.0 | 29.2 | 7.9 | 0.0 | 0.0 | 0.0 | 7.86 | 40.8 | 0.0 | 0.0 | 0.0 | 40.8 |
| | | | | 95% C.L. | 59.6 | 0.0 | 0.0 | 0.0 | 57.3 | 16.0 | 0.0 | 0.0 | 0.0 | 15.40 | 83.2 | 0.0 | 0.0 | 0.0 | 79.9 |
| | | | | 95% C.L. | 103.9 | 0.0 | 0.0 | 0.0 | 99.8 | 167.6 | 0.0 | 0.0 | 0.0 | 181.02 | 248.6 | 0.0 | 0.0 | 0.0 | 238.8 |

| | AREA | | | | REDUNCA / REEDBUCK | | | | | ANTELOPE ROUANE /ROAN | | | | | OURIBI / ORIBI | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STH | MID NTH | LOW NTH | TOT.NOR | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL |
| 31 | | | 8.01 | 8.01 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 10.32 | 10.32 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 15.74 | 15.74 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 18.99 | 18.99 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 18.68 | 18.68 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 26.57 | 26.57 | | | 2 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 26.65 | 2.59 | 29.24 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 31.62 | 7.82 | 39.44 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 31.60 | 21.06 | 41.92 | | 1 | 0 | 0 | | | 0 | 0 | 0 | | | 0 | 1 | 0 | |
| 22 | | 31.49 | 10.74 | 42.22 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 0 | 1 | 0 | |
| 21 | | 28.81 | | 28.81 | | 0 | | 0 | | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 29.22 | | 29.22 | | 0 | | 0 | | | 0 | | 0 | | | 1 | | 0 | |
| 19 | | 25.87 | | 25.87 | | 0 | | 0 | | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 26.57 | | | | 0 | | | | | 0 | | | | | 2 | | | | |
| 17a | 23.32 | | | | 1 | | | | | 0 | | | | | 0 | | | | |
| 17 | 23.54 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 16a | 23.37 | | | | 0 | | | | | 0 | | | | | 1 | | | | |
| 16 | 23.47 | | | | 2 | | | | | 0 | | | | | 0 | | | | |
| 15a | 23.50 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 15 | 23.82 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 14a | 31.84 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 14 | 31.66 | | | | 0 | | | | | 0 | | | | | 1 | | | | |
| 13a | 39.46 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 13 | 36.89 | | | | 1 | | | | | 12 | | | | | 1 | | | | |
| 12a | 33.84 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 12 | 34.45 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 11a | 23.84 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 11 | 23.69 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 10a | 21.14 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| Total | 444.39 | 205.26 | 98.32 | 98.32 | 4.0 | 1.0 | 2.0 | 0.0 | | 12.0 | 0.0 | 0.0 | 0.0 | | 5.0 | 1.0 | 2.0 | 0.0 | |
| Sum squ | 12862.49 | 205.26 | 42.20 | 236.72 | 6.0 | 1.0 | 4.0 | 0.0 | | 144.0 | 0.0 | 0.0 | 0.0 | | 7.0 | 1.0 | 0.0 | 0.0 | |
| | | 0.00 | 0.00 | 444.39 | 107.2 | 31.6 | 53.1 | 0.0 | | 442.7 | 0.0 | 0.0 | 0.0 | | 145.0 | 29.2 | 0.0 | 0.0 | |
| | | 205.26 | 140.52 | 779.43 | | | | | | | | | | | | | | | |
| | | | | R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 0.3 | 0.1 | 0.7 | 0.0 | | 9.0 | 0.0 | 0.0 | 0.0 | | 0.4 | 0.1 | 0.0 | 0.0 | |
| Var z | 34.6 | 5.7 | 44.6 | 125.2 | | | | | STRAT. | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | -0.3 | -0.5 | 3.7 | 0.0 | TOTAL | 7.3 | 0.0 | 0.0 | 0.0 | TOTAL | 0.4 | -1.0 | -2.2 | 0.0 | TOTAL |
| | | | | | REDUNCA /REEDBUCK | | | | | ANTELOPE ROUANE /ROAN | | | | | OURIBI / ORIBI | | | | |
| | | | Pop.est.(Y) | | 19 | 10 | 25 | 0 | 54 | 57 | 0 | 0 | 0 | 57 | 24 | 10 | 25 | 0 | 58 |
| | | | | SE(Y) | 13.4 | 13.8 | 17.9 | 0.0 | 25.3 | 67.3 | 0.0 | 0.0 | 0.0 | 67.32 | 13.7 | 14.0 | 8.0 | 0.0 | 21.2 |
| | | | | 95% C.L. | 27.3 | 28.2 | 36.5 | 0.0 | 51.5 | 137.3 | 0.0 | 0.0 | 0.0 | 131.94 | 28.0 | 28.6 | 16.4 | 0.0 | 41.5 |
| | | | | 95% C.L. | 142.7 | 0.0 | 0.0 | 0.0 | 96.1 | 239.3 | 0.0 | 0.0 | 0.0 | 229.94 | 116.9 | 0.0 | 0.0 | 0.0 | 71.2 |

| | AREA | | | | BABOUINS / BABOONS | | | | | CROCODILES | | | | | POTAMOCHERES | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRANS | HIGH STH | MID NTH | LOW NTH | TOT.NOR | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL | HIGH STH | MID NTH | LOW NTH | TOT.NTH | TOTAL |
| 31 | | | 8.01 | 8.01 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 30 | | | 10.32 | 10.32 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 29 | | | 15.74 | 15.74 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 28 | | | 18.99 | 18.99 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 27 | | | 18.68 | 18.68 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 26 | | | 26.57 | 26.57 | | | 0 | 0 | | | | 0 | 0 | | | | 0 | 0 | |
| 25 | | 26.65 | 2.59 | 29.24 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 24 | | 31.62 | 7.82 | 39.44 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 23 | | 31.60 | 21.06 | 41.92 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 22 | | 31.49 | 10.74 | 42.22 | | 0 | 0 | 0 | | | 0 | 0 | 0 | | | 0 | 0 | 0 | |
| 21 | | 28.81 | | 28.81 | | 0 | | 0 | | | 0 | | 0 | | | 0 | | 0 | |
| 20 | | 29.22 | | 29.22 | | 0 | | 0 | | | 0 | | 0 | | | 0 | | 0 | |
| 19 | | 25.87 | | 25.87 | | 0 | | 0 | | | 0 | | 0 | | | 0 | | 0 | |
| 18 | 26.57 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 17a | 23.32 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 17 | 23.54 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 16a | 23.37 | | | | 0 | | | | | 1 | | | | | 0 | | | | |
| 16 | 23.47 | | | | 7 | | | | | 0 | | | | | 0 | | | | |
| 15a | 23.50 | | | | 9 | | | | | 0 | | | | | 0 | | | | |
| 15 | 23.82 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 14a | 31.84 | | | | 0 | | | | | 1 | | | | | 0 | | | | |
| 14 | 31.66 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 13a | 39.46 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 13 | 36.89 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 12a | 33.84 | | | | 4 | | | | | 0 | | | | | 0 | | | | |
| 12 | 34.45 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 11a | 23.84 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 11 | 23.69 | | | | 0 | | | | | 0 | | | | | 0 | | | | |
| 10a | 21.14 | | | | 0 | | | | | 0 | | | | | 7 | | | | |
| Total | 444.39 | 205.26 | 98.32 | 98.32 | 20.0 | 0.0 | 0.0 | 0.0 | | 2.0 | 0.0 | 0.0 | 0.0 | | 7.0 | 0.0 | 0.0 | 0.0 | |
| Sum squ | 12862.49 | 205.26 | 42.20 | 236.72 | 146.0 | 0.0 | 0.0 | 0.0 | | 2.0 | 0.0 | 0.0 | 0.0 | | 49.0 | 0.0 | 0.0 | 0.0 | |
| | | 0.00 | 0.00 | 444.39 | 511.1 | 0.0 | 0.0 | 0.0 | | 55.2 | 0.0 | 0.0 | 0.0 | | 146.0 | 0.0 | 0.0 | 0.0 | |
| | | 205.26 | 140.52 | 779.43 | | | | | | | | | | | | | | | |
| | | | | R=Sy/Sz | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | |
| | | | | Var y | 8.1 | 0.0 | 0.0 | 0.0 | | 0.1 | 0.0 | 0.0 | 0.0 | | 3.1 | 0.0 | 0.0 | 0.0 | |
| Var z | 34.6 | 5.7 | 44.6 | 125.2 | | | | | STRAT. | | | | | STRAT. | | | | | STRAT. |
| Covar zy | | | | | -3.0 | 0.0 | 0.0 | 0.0 | TOTAL | -0.0 | 0.0 | 0.0 | 0.0 | TOTAL | -3.1 | 0.0 | 0.0 | 0.0 | TOTAL |
| | | | | | BABBOUINS / BABOONS | | | | | CROCODILES | | | | | POTAMOCHERES | | | | |
| | | | Pop.est.(Y) | | **98** | **0** | **0** | **0** | **96** | **10** | **0** | **0** | **0** | **10** | **33** | **9** | **0** | **0** | **33** |
| | | | | SE(Y) | 66.4 | 0.0 | 0.0 | 0.0 | 66.4 | 7.9 | 0.0 | 0.0 | 0.0 | 7.86 | 40.6 | 0.0 | 0.0 | 0.0 | 40.8 |
| | | | | 95% C.L. | 135.5 | 0.0 | 0.0 | 0.0 | 130.2 | 16.0 | 0.0 | 0.0 | 0.0 | 15.40 | 83.2 | 0.0 | 0.0 | 0.0 | 79.9 |
| | | | | 95% C.L. | 141.7 | 0.0 | 0.0 | 0.0 | 136.1 | 167.8 | 0.0 | 0.0 | 0.0 | 161.02 | 248.6 | 0.0 | 0.0 | 0.0 | 238.8 |

# PARC NATIONAL DE LA GARAMBA, RECENSEMENT GENERAL
# PILOT SUMMARY SHEET

Annexe 5.15

Survey...........Garamba N.P. General large mammal systematic sample survey

Dates: From.. 14 May 2003 To: 18th May 2003

Pilot.....Fraser Smith.......................... Aircraft....9Q-CBR C 206................

| DATE | TAKE OFF | LAND | HOURS | PURPOSE | FUEL |
|---|---|---|---|---|---|
| 14.5.2003 | 15:40 | 16:05 | 0.4 | Calibrations | |
| 15.5.2003 | 08:25 | 10:50 | 2.4 | Transect 31-26 | |
| 15.5.2003 | 16:08 | 17:38 | 1.5 | Transects 25-24 | |
| 16.5.2003 | 08:22 | 11:20 | 2.8 | Transects 23-18 | |
| 16.5.2003 | 16:02 | 17:52 | 1.8 | Transects 17A-16 | |
| 17.5.2003 | 08:10 | 10:37 | 2.5 | Transects 15A-13A | |
| 17.5.2003 | 16:29 | 17:25 | 0.9 | Transects 11-10A | |
| 18.5.2003 | 08:20 | 10:45 | 2.4 | Transects 13A-11A | |
| | | | | | |
| 4 days | | | 14.7 | Hrs@55Lit/hr = | 808.5lit |

# TRANSECT SUMMARY

Annexe 5.15

SURVEY. General systematic large mammal survey

DATES: From.14 May 2003....... To.18 May 2003........................ Aircraft..C206 9Q-CBR......................

AREAS.... Garamba National Park (5,000 km2)

Nominal flying height.......350.........feet Target strip width (L+R)......500................metres

Pilot...........Fraser Smith.......... FSO.............Kes Hillman Smith

RSO L.M. Amube Ndey RSO R.M..... Paulin Tshikaya

RSO L.R. Serge Iliabo RSO R.R......Mambo Marindo

Z..................................N...........................n................

| TRANS | DIR | ORDER FLOWN | DATE | SUBUNITS | FROM-TO | DISTANCE (km) | TIME (mins) | SPEED (kph) |
|---|---|---|---|---|---|---|---|---|
| 31 | W-E | 1 | 15.5.03 | 3 | 22-24 | 15 | 4.5 | 200 |
| 30 | E-W | 2 | 15.5.03 | 4 | 25-22 | 20 | 6.38 | 188 |
| 29 | W-E | 3 | 15.5.03 | 6 | 22-27 | 30 | 9.42 | 191 |
| 28 | E-W | 4 | 15.5.03 | 7 | 27-21 | 35 | 11.18 | 188 |
| 27 | W-E | 5 | 15.5.03 | 7 | 21-27 | 35 | 11.08 | 190 |
| 26 | E-W | 6 | 15.5.03 | 10 | 27-18 | 50 | 16.25 | 185 |
| 25 | W-E | 7 | 15.5.03 | 11 | 18-28 | 55 | 17 | 194 |
| 24 | E-W | 8 | 15.5.03 | 15 | 30-16 | 75 | 25 | 180 |
| 23 | W-E | 9 | 16.5.03 | 16 | 16-31 | 80 | 27.2 | 176 |
| 22 | E-W | 10 | 16.5.03 | 16 | 31-16 | 80 | 24.38 | 197 |
| 21 | W-E | 11 | 16.5.03 | 11 | 16-26 | 55 | 17.6 | 187 |
| 20 | E-W | 12 | 16.5.03 | 11 | 15-25 | 55 | 16.12 | 205 |
| 19 | W-E | 13 | 16.5.03 | 10 | 15-24 | 50 | 15.25 | 197 |
| 18 | E-W | 14 | 16.5.03 | 10 | 24-15 | 50 | 14.1 | 213 |
| 17A | W-E | 15 | 16.5.03 | 9 | 15-23 | 45 | 15.1 | 179 |
| 17 | E-W | 16 | 16.5.03 | 9 | 23-15 | 45 | 11.57 | 233 |
| 16A | W-E | 17 | 16.5.03 | 9 | 15-23 | 45 | 15.25 | 177 |
| 16 | E-W | 18 | 16.5.03 | 9 | 23-15 | 45 | 13.18 | 205 |
| 15A | W-E | 19 | 17.5.03 | 9 | 15-23 | 45 | 14.58 | 185 |
| 15 | E-W | 20 | 17.5.03 | 9 | 23-15 | 45 | 13.26 | 204 |
| 14A | W-E | 21 | 17.5.03 | 12 | 12-23 | 60 | 19.04 | 189 |
| 14 | E-W | 22 | 17.5.03 | 13 | 23-11 | 65 | 19.4 | 201 |
| 13A | W-E | 23 | 17.5.03 | 15 | 9-23 | 75 | 23.29 | 193 |
| 13 | E-W | 26 | 18.5.03 | 15 | 23-9 | 75 | 24 | 188 |
| 12A | W-E | 27 | 18.5.03 | 13 | 10-22 | 65 | 20 | 195 |
| 12 | E-W | 28 | 18.5.03 | 13 | 23-11 | 65 | 19 | 205 |
| 11A | W-E | 29 | 18.5.03 | 11 | 12-22 | 55 | 17.4 | 190 |
| 11 | E-W | 24 | 17.5.03 | 9 | 20-12 | 45 | 14.45 | 187 |
| 10A | W-E | 25 | 17.5.03 | 9 | 12-20 | 45 | 14.22 | 190 |
| | | | | | | | | |
| | | | | | **Trans.tot.km** | **1505** | **Avg kph** | **193** |

**COUNT EAST-WEST WAYPOINTS**

| EAST | | NORTH | | |
|---|---|---|---|---|
| -29 | 31.84957 | 4 | 37.94531 | 31-22 |
| -29 | 39.96121 | 4 | 37.94466 | 31-25 |
| -29 | 42.66391 | 4 | 35.24904 | 30-26 |
| -29 | 31.84957 | 4 | 35.25033 | 30-22 |
| -29 | 31.84989 | 4 | 32.55535 | 29-22 |
| -29 | 48.06996 | 4 | 32.55246 | 29-28 |
| -29 | 48.06449 | 4 | 29.85877 | 28-28 |
| -29 | 29.14204 | 4 | 29.86263 | 28-21 |
| -29 | 29.14204 | 4 | 27.16797 | 27-21 |
| -29 | 48.06352 | 4 | 27.16379 | 27-28 |
| -29 | 48.05902 | 4 | 24.47010 | 26-28 |
| -29 | 21.03007 | 4 | 24.47815 | 26-18 |
| -29 | 21.03007 | 4 | 21.78317 | 25-18 |
| -29 | 50.76011 | 4 | 21.77352 | 25-29 |
| -29 | 56.15972 | 4 | 19.07307 | 24-31 |
| -29 | 15.62145 | 4 | 19.09109 | 24-16 |
| -29 | 15.62145 | 4 | 16.39612 | 23-16 |
| -29 | 58.85984 | 4 | 16.37584 | 23-32 |
| -29 | 58.85727 | 4 | 13.68118 | 22-32 |
| -29 | 15.62113 | 4 | 13.70114 | 22-16 |
| -29 | 15.62017 | 4 | 11.00616 | 21-16 |
| -29 | 45.34312 | 4 | 10.99683 | 21-27 |
| -29 | 42.63849 | 4 | 8.30314 | 20-26 |
| -29 | 12.91714 | 4 | 8.31248 | 20-15 |
| -29 | 12.91231 | 4 | 5.61750 | 19-15 |
| -29 | 39.93031 | 4 | 5.61010 | 19-25 |
| -29 | 39.92903 | 4 | 2.91512 | 18-25 |
| -29 | 12.91264 | 4 | 2.92252 | 18-15 |
| -29 | 12.93291 | 4 | 1.57487 | 17A-15 |
| -29 | 37.24789 | 4 | 1.56876 | 17A-24 |
| -29 | 12.91264 | 4 | 0.22754 | 17-15 |
| -29 | 37.22600 | 4 | 0.22175 | 17-24 |
| ROUTE SOUTH 4 | | | | |
| -29 | 37.22472 | 3 | 58.87443 | 16A-24 |
| -29 | 12.91264 | 3 | 58.88022 | 16A-15 |
| -29 | 12.91264 | 3 | 57.53289 | 16-15 |
| -29 | 37.22472 | 3 | 57.52678 | 16-24 |
| -29 | 37.22343 | 3 | 56.17945 | 15A-24 |
| -29 | 12.91264 | 3 | 56.18524 | 15A-15 |
| -29 | 12.91264 | 3 | 54.83792 | 15-15 |
| -29 | 37.22343 | 3 | 54.83180 | 15-24 |
| -29 | 37.22182 | 3 | 53.48190 | 14A-24 |
| -29 | 4.80904 | 3 | 53.49220 | 14A-12 |
| -29 | 4.80871 | 3 | 52.14487 | 14-12 |
| -29 | 37.22150 | 3 | 52.13457 | 14-24 |
| -29 | 37.21957 | 3 | 50.78209 | 13A-24 |
| -28 | 56.70544 | 3 | 50.79787 | 13A-9 |
| -28 | 56.70576 | 3 | 49.45054 | 13-9 |
| -29 | 37.21924 | 3 | 49.43477 | 13-24 |
| -29 | 34.51654 | 3 | 48.09130 | 12A-23 |
| -28 | 59.40621 | 3 | 48.10289 | 12A-10 |
| -28 | 59.40621 | 3 | 46.75556 | 12-10 |
| -29 | 34.51654 | 3 | 46.74365 | 12-23 |
| -29 | 29.11339 | 3 | 45.40180 | 11A-21 |
| -29 | 4.80743 | 3 | 45.40759 | 11A-12 |
| -29 | 4.80743 | 3 | 44.05994 | 11-12 |
| -29 | 29.11339 | 3 | 44.05447 | 11-21 |
| -29 | 29.09151 | 3 | 42.70553 | 10A-21 |
| -29 | 4.78908 | 3 | 42.71133 | 10A-12 |

P.N.Garamba RECENSEMENT GENERAL 2003 Centre 1998,2000,2002,2003

| 24 | E-W | 23 | W-E | 22 | E-W | 21 | W-E | 20 | E-W | 19 | W-E | 18 | E-W |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Dist(km)* | Subunit | *Dist(km)* | Subunit | *Dist(km)* | Subunit | *Dist(km)* | Subunit | *Dist(km)* | Subunit | *Dist(km)* | Subunit | *Dist(km)* | Subunit |
| | goto 24-31E | 80 | start 23-16 | | goto 22-32 | 55 | start 21-16 | | goto20-26 | 50 | start 19-15 | | goto18-25 |
| 75 | start 24-30 | 75 | 17 | 80 | start 22-31 | 50 | 17 | 55 | start su 25 | 45 | 16 | 45 | start 18-24 |
| 70 | 29 | 70 | 18 | 75 | 30 | 45 | 18 | 50 | 24 | 40 | 17 | 40 | 23 |
| 65 | 28 | 65 | 19 | 70 | 29 | 40 | 19 | 45 | 23 | 35 | 18 | 35 | 22 |
| 60 | 27 | 60 | 20 | 65 | 28 | 35 | 20 | 40 | 22 | 30 | 19 | 30 | 21 |
| 55 | 26 | 55 | 21 | 60 | 27 | 30 | 21 | 35 | 21 | 25 | 20 | 25 | 20 |
| 50 | 25 | 50 | 22 | 55 | 26 | 25 | 22 | 30 | 20 | 20 | 21 | 20 | 19 |
| 45 | 24 | 45 | 23 | 50 | 25 | 20 | 23 | 25 | 19 | 15 | 22 | 15 | 18 |
| 40 | 23 | 40 | 24 | 45 | 24 | 15 | 24 | 20 | 18 | 10 | 23 | 10 | 17 |
| 35 | 22 | 35 | 25 | 40 | 23 | 10 | 25 | 15 | 17 | 5 | 24 | 5 | 16 |
| 30 | 21 | 30 | 26 | 35 | 22 | 5 | 26 | 10 | 16 | 0 | end 19-25 | 0 | end 18-15 |
| 25 | 20 | 25 | 27 | 30 | 21 | 0 | end 21-27 | 5 | 15 | | | | |
| 20 | 19 | 20 | 28 | 25 | 20 | | | 0 | end 20-15 | | | | |
| 15 | 18 | 15 | 29 | 20 | 19 | | | | | | | | |
| 10 | 17 | 10 | 30 | 15 | 18 | | | | | | | | |
| 5 | 16 | 5 | 31 | 10 | 17 | | | | | | | | |
| 0 | end 24-16 | 0 | end 26-32 | 5 | 16 | | | | | | | | |
| | | | | 0 | end 22-16 | | | | | | | | |

P.N.Garamba RECENSEMENT GENERAL 2003 Sud 1998,2000,2002,2003

| 17A | W-E | 17 | E-W | 16A | W-E | 16 | E-W | 15A | W-E | 15 | E-W | 14A | W-E |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Dist(km)* | Subunit | *Dist(km)* | Subunit | *Dist(km)* | Subunit | *Dist(km)* | Subunit | *Dist(km)* | Subunit | *Dist(km)* | Subunit | *Dist(km)* | Subunit |
| 45 | start17A-15 | | goto 17-24 | 45 | start16A-15 | | goto 16-24 | 45 | start15A-15 | | goto 15-24 | 60 | start 14A-12 |
| 40 | 16 | 45 | start 23 | 40 | 16 | 45 | start 23 | 40 | 16 | 45 | start 23 | 55 | 13 |
| 35 | 17 | 40 | 22 | 35 | 17 | 40 | 22 | 35 | 17 | 40 | 22 | 50 | 14 |
| 30 | 18 | 35 | 21 | 30 | 18 | 35 | 21 | 30 | 18 | 35 | 21 | 45 | 15 |
| 25 | 19 | 30 | 20 | 25 | 19 | 30 | 20 | 25 | 19 | 30 | 20 | 40 | 16 |
| 20 | 20 | 25 | 19 | 20 | 20 | 25 | 19 | 20 | 20 | 25 | 19 | 35 | 17 |
| 15 | 21 | 20 | 18 | 15 | 21 | 20 | 18 | 15 | 21 | 20 | 18 | 30 | 18 |
| 10 | 22 | 15 | 17 | 10 | 22 | 15 | 17 | 10 | 22 | 15 | 17 | 25 | 19 |
| 5 | 23 | 10 | 16 | 5 | 23 | 10 | 16 | 5 | 23 | 10 | 16 | 20 | 20 |
| 0 | end17A-24 | 5 | 15 | 0 | end16A-24 | 5 | 15 | 0 | end15A-24 | 5 | 15 | 15 | 21 |
| | | 0 | end 17-15 | | | 0 | end 16-15 | | | 0 | end 15-15 | 10 | 22 |
| | | | | | | | | | | | | 5 | 23 |
| | | | | | | | | | | | | 0 | end14A-24 |
| | | | | | | | | | | | | | |

P.N.Garamba RECENSEMENT GENERAL 2003 Sud 1998,2000,2002,2003

| 14A | W-E | 14 | E-W | 13A | W-E | 13 | E-W | 12A | W-E | 12 | E-W | 11A | W-E |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dist(km) | Subunit | Dist(km) | Subunit | Dist(km) | Subunit | Dist(km) | Subunit | Dist(km) | Subunit | Dist(km) | Subunit | Dist(km) | Subunit |
| 60 | start 14A-12 | | goto 14-24 | 75 | start 13A-9 | | goto 13-24 | 65 | start 12A-10 | | goto 15-23 | 45 | start 11A-12 |
| 55 | 13 | 60 | start 23 | 70 | 10 | 70 | start 23 | 60 | 11 | 65 | start 22 | 40 | 13 |
| 50 | 14 | 55 | 22 | 65 | 11 | 65 | 22 | 55 | 12 | 60 | 21 | 35 | 14 |
| 45 | 15 | 50 | 21 | 60 | 12 | 60 | 21 | 50 | 13 | 55 | 20 | 30 | 15 |
| 40 | 16 | 45 | 20 | 55 | 13 | 55 | 20 | 45 | 14 | 50 | 19 | 25 | 16 |
| 35 | 17 | 40 | 19 | 50 | 14 | 50 | 19 | 40 | 15 | 45 | 18 | 20 | 17 |
| 30 | 18 | 35 | 18 | 45 | 15 | 45 | 18 | 35 | 16 | 40 | 17 | 15 | 18 |
| 25 | 19 | 30 | 17 | 40 | 16 | 40 | 17 | 30 | 17 | 35 | 16 | 10 | 19 |
| 20 | 20 | 25 | 16 | 35 | 17 | 35 | 16 | 25 | 18 | 30 | 15 | 5 | 20 |
| 15 | 21 | 20 | 15 | 30 | 18 | 30 | 15 | 20 | 19 | 25 | 14 | 0 | end 11A-21 |
| 10 | 22 | 15 | 14 | 25 | 19 | 25 | 14 | 15 | 20 | 20 | 13 | | cont 5km 21 |
| 5 | 23 | 10 | 13 | 20 | 20 | 20 | 13 | 10 | 21 | 15 | 12 | | |
| 0 | end14A-24 | 5 | 12 | 15 | 21 | 15 | 12 | 5 | 22 | 10 | 11 | | |
| | | 0 | wpt 14-12 | 10 | 22 | 10 | 10 | 0 | end 12A-23 | 5 | 10 | | |
| | | | cont.5km | 5 | 23 | 5 | 9 | | | 0 | end 12-10 | | |
| | | | | 0 | end13A-24 | 0 | end 13-9 | | | | | | |

| 11 | E-W | 10A | W-E |
|---|---|---|---|
| Dist(km) | Subunit | Dist(km) | Subunit |
| | goto 11-21 | 45 | start 10A-12 |
| 45 | start 20 | 40 | 13 |
| 40 | 19 | 35 | 14 |
| 35 | 18 | 30 | 15 |
| 30 | 17 | 25 | 16 |
| 25 | 16 | 20 | 17 |
| 20 | 15 | 15 | 18 |
| 15 | 14 | 10 | 19 |
| 10 | 13 | 5 | 20 |
| 5 | 12 | 0 | end 10A-21 |
| 0 | end 11-12 | | |

Annexe 5.16

# Le Patrimoine mondial dans le bassin du Congo

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

Convention du patrimoine mondial

**Patrimoine mondial dans le bassin du Congo**

Texte et mise en page : Conrad Aveling

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# LE PATRIMOINE MONDIAL DANS LE BASSIN DU CONGO

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

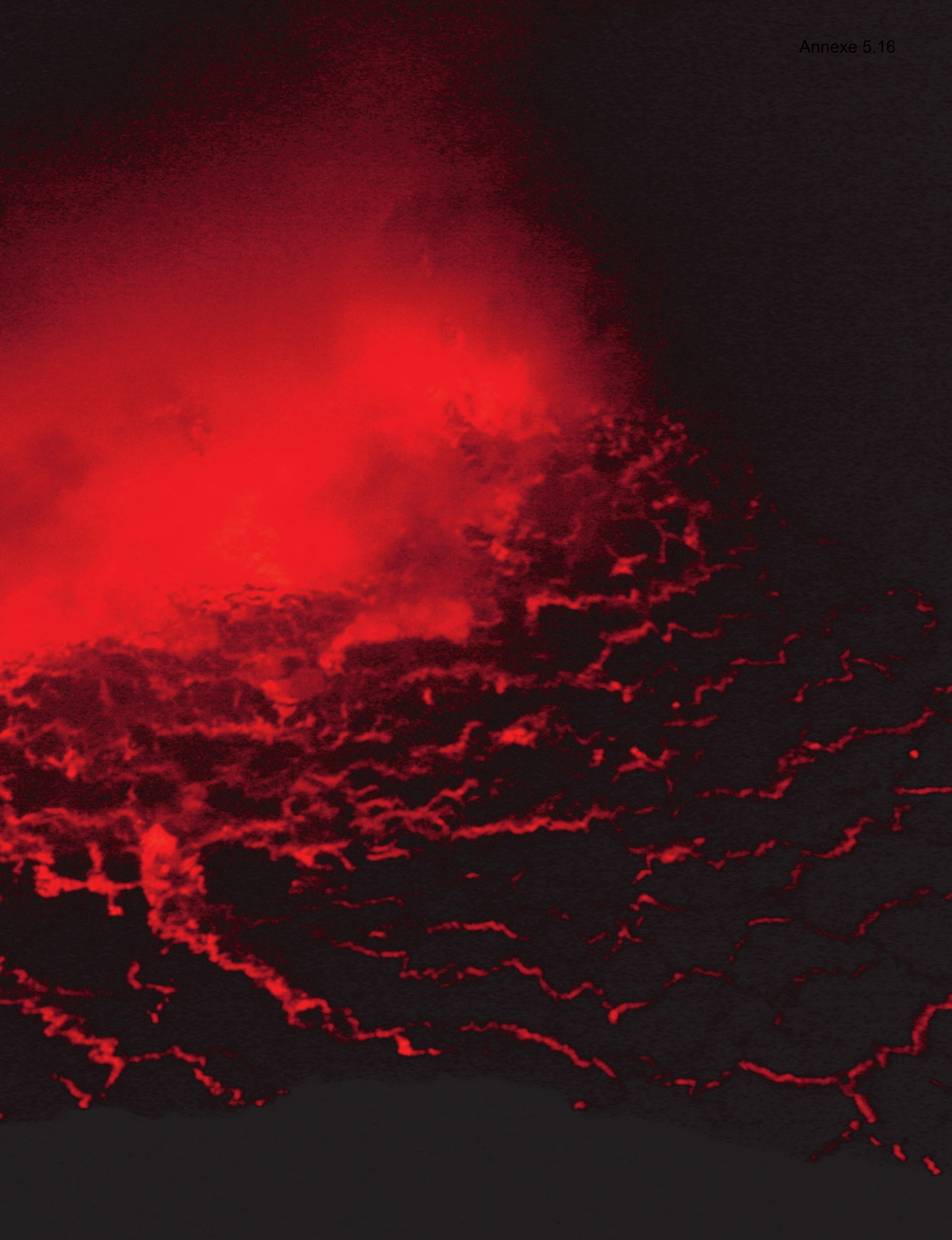
Convention du patrimoine mondial

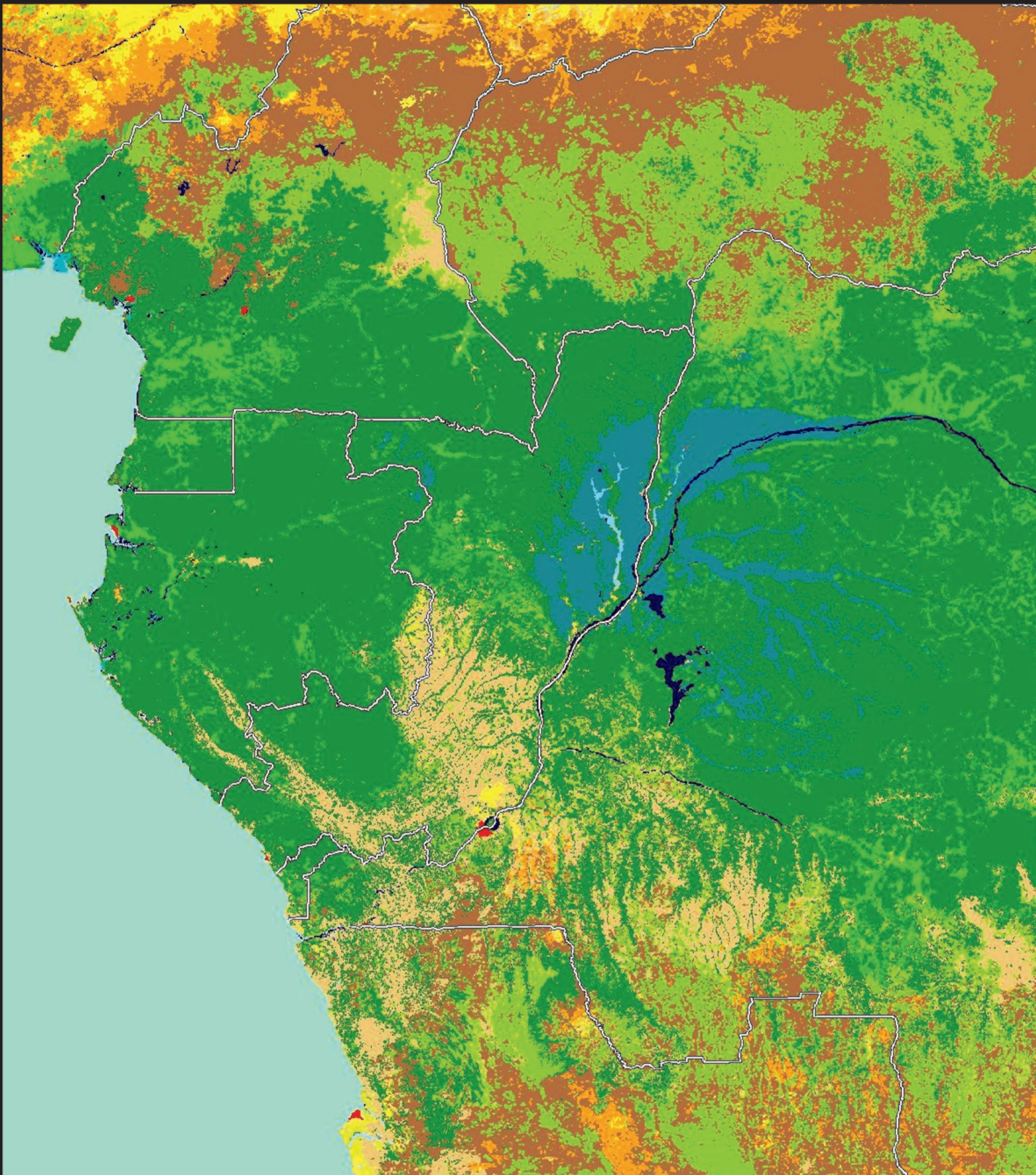
## SOMMAIRE



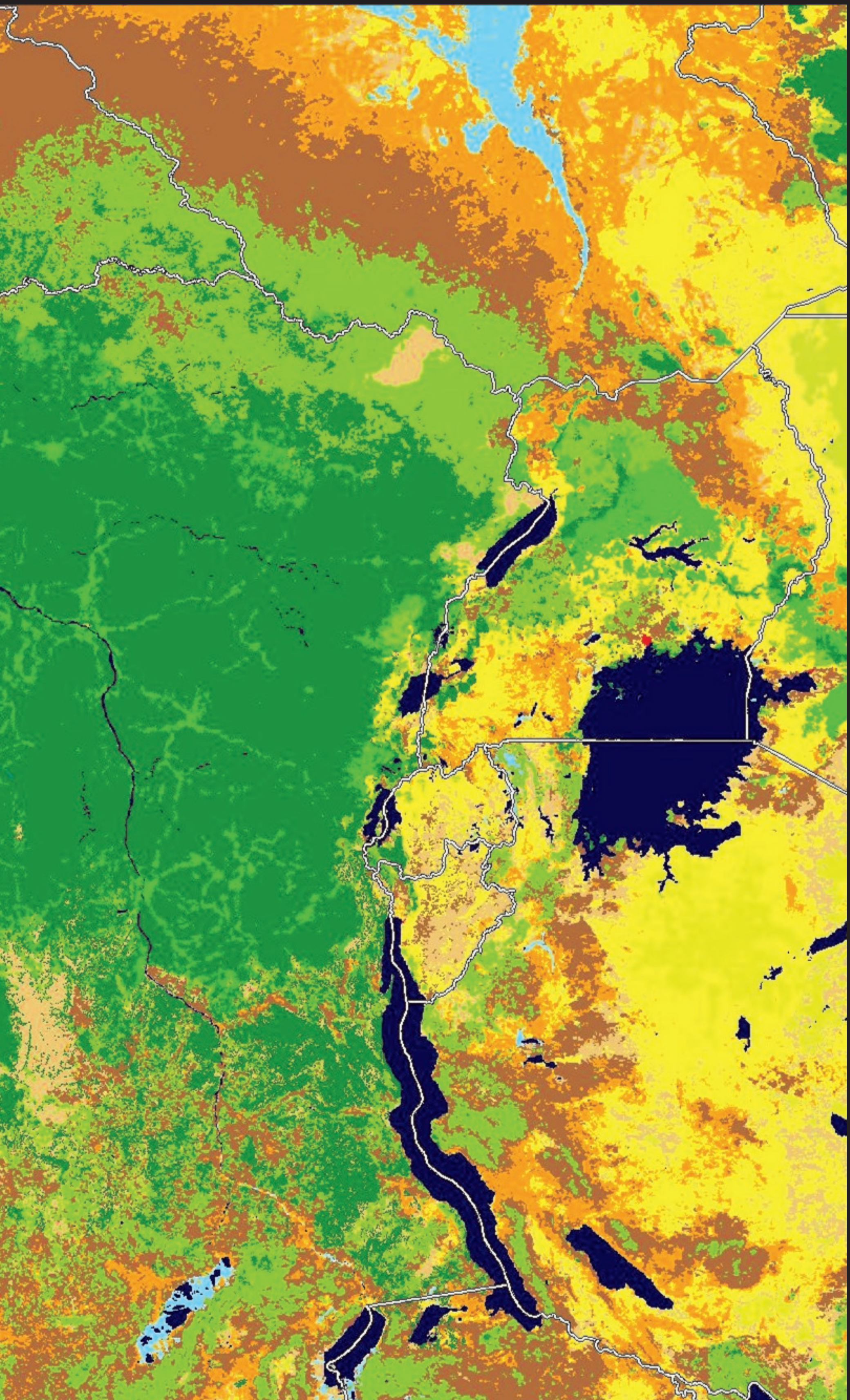
*Couverture: une mosaïque de savane-forêt dans la partie sud du parc national de la Salonga, RDC*
*Cette page : lac de lave en fusion dans le cratère du Nyragongo, Parc national des Virunga, RDC .*

*Photos © Kim S. Gjerstad*





*Les forêts humides d'Afrique centrale constituent le plus grand bloc de forêt tropicale après le bassin de l'Amazone. C'est une des dernières cessus biologiques non perturbés. Un éléphant pourrait, en théorie, aller du Rift Albertin à la côte gabonaise sans jamais quitter la forêt.*



*régions sur la planète où subsistent des zones forestières intactes permettant des pro-*
*Carte de végétation © Centre Commun de Recherche, CE*

# Préface

Les forêts sempervirentes d'Afrique centrale, d'une superficie d'environ 1,62 millions de km², constituent un patrimoine naturel d'exception. Elles abritent une grande partie de la biodiversité mondiale, jouent un rôle prépondérant dans la régulation du climat et la séquestration du carbone et fournissent à de plus de 30 millions d'habitants vivant en milieu forestier des produits et services indispensables à leurs modes de vie.

Les remarquables richesses naturelles d'Afrique centrale, en particulier les ressources forestières et minières, sont de véritables atouts pour le développement économique des pays de la région; leur gestion rationnelle contribuera à la croissance de ces nations. Un indicateur de bonne gouvernance sera la capacité de ces Etats à maintenir des écosystèmes représentatifs, notamment grâce à un réseau d'aires protégées efficacement gérées.

De par leur difficulté d'accès, une grande partie des forêts d'Afrique centrale est restée relativement peu touchée par les activités humaines, telles que l'exploitation forestière et minière industrielle. L'exploitation forestière fut ainsi longtemps confinée aux zones côtières. Cette situation évolue rapidement et de plus en plus de concessions sont attribuées dans les zones reculées, engendrant un réseau de plus en plus dense de pistes ouvertes à travers les blocs forestiers. Le rapport sur l'Etat des Forêts du Bassin du Congo de 2008 mentionne que 32% des forêts humides exploitables ont déjà été attribuées. En Guinée Equatoriale, au Gabon, en République Centrafricaine et au Congo Brazzaville, ce taux est particulièrement élevé, variant entre 77 et 93%. L'ouverture des forêts induit d'autres menaces. Ce n'est pas seulement l'exploitation forestière *stricto sensu* qui affecte le milieu naturel mais aussi l'installation de populations humaines dans les zones nouvellement ouvertes, en quête de travail et d'autres opportunités économiques. Ces migrations conduisent à une dégradation de la biodiversité imputable à l'accroissement de la déforestation pour l'agriculture et l'exploitation de produits forestiers non ligneux, en particulier la viande de brousse. Les populations locales sont pénalisées par cet afflux de populations qui ont un libre accès à leurs ressources naturelles.

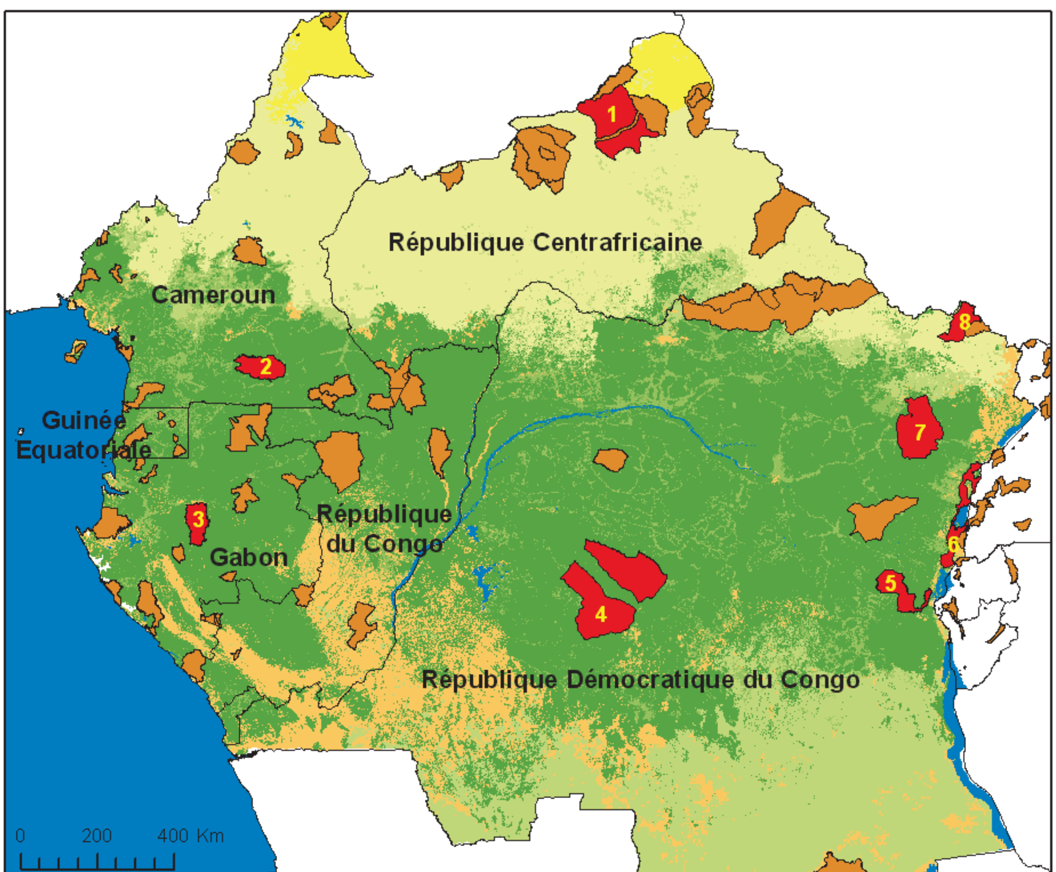
L'appui apporté à un réseau représentatif d'aires protégées en Afrique centrale a pour vocation de conserver la biodiversité. Cet objectif s'insère dans une approche plus globale raisonnant par paysages et garantissant à la fois le maintien des flux génétiques et processus naturels entre écosystèmes et les modes de vie traditionnels, dans une mosaïque de zones à usages multiples. Cette stratégie cherche à éviter que les aires protégées deviennent des îlots de biodiversité écologiquement déconnectés.

Cette brochure montre comment la *Convention du patrimoine mondial* de l'UNESCO contribue à cet objectif par le renforcement et la promotion d'aires protégées, à travers une gestion durable de l'ensemble du paysage dans lequel elles se trouvent.

Francesco Bandarin, Directeur
Centre du patrimoine mondial, UNESCO

*Actuellement près de 18.5 millions d'hectares de forêt d'Afrique centrale, soit quelque 10% de la superficie des forêts humides, ont été classés en aires protégées. Huit sites du patrimoine mondial existent en Afrique centrale (indiqués en rouge), six en zone forestière tropicale et deux en zone de savane au nord. Six des sites du patrimoine mondial d'Afrique centrale ont été inscrits sur la Liste du patrimoine mondial en danger.*

1. *Parc national Gounda-St. Floris*
2. *Réserve de faune du Dja*
3. *Parc national de la Lopé-Okanda*
4. *Parc national de la Salonga*
5. *Parc national de Kahuzi-Biega*
6. *Parc national des Virunga*
7. *Réserve de faune à Kapis*
8. *Parc national de la Garamba*



# LA CONVENTION DU PATRIMOINE MONDIAL

La Convention du patrimoine mondial est un instrument normatif adopté par la Conférence Générale de l'UNESCO en 1972. Il est fondé sur le principe que certains sites de la planète présentent une valeur universelle exceptionnelle et font partie d'un héritage commun de l'Humanité. En août 2009, on comptait 186 Etats parties à la Convention, conférant à cet instrument normatif une portée légale unanimement reconnue.

Afin de préserver l'avenir des futures générations, les pays sont encouragés à identifier des biens d'une valeur naturelle et/ou culturelle exceptionnelle pour inscription sur la Liste du patrimoine mondial. En désignant ces biens, les pays prennent un engagement vis-à-vis de la communauté internationale pour les protéger et les gérer au nom des générations à venir. La Liste du patrimoine mondial comprend 890 biens (en juin 2009) répartis dans 146 pays. Parmi ces biens, 176 sont des biens naturels et 25 sont inscrits comme mixtes en raison de leurs valeurs à la fois naturelle et culturelle. Parfois désignée comme le prix Nobel pour la Nature, la Liste compte des lieux parmi les plus spectaculaires de notre planète. Les biens

## ENCADRÉ 1 COMMENT SONT INSCRITS LES SITES DU PATRIMOINE MONDIAL?

Pour nominer un site, un pays doit tout d'abord entreprendre un inventaire de ses lieux naturels et culturels les plus significatifs (désigné comme liste indicative). De cette liste, un site sera nominé pour une inscription, en soumettant un dossier détaillé justifiant les motifs de reconnaissance de sa « valeur universelle exceptionnelle ». La nomination est ensuite évaluée par le Conseil International des Monuments et des Sites (ICOMOS) pour les sites culturels et par l'Union Internationale pour la Conservation de la Nature (UICN) pour les sites naturels. Ces instances adressent leurs recommandations au Comité du patrimoine mondial qui se réunit une fois l'an pour décider quels sites nominés peuvent être inscrits à la Liste du patrimoine mondial.

Pour être considéré de valeur universelle exceptionnelle et être inclus dans la Liste, un site doit réunir au moins un des 10 critères naturels et culturels. Dans le cas d'un site naturel, les critères suivants s'appliquent:

- ***Critère vii:*** représenter des phénomènes naturels ou des aires d'une beauté naturelle et d'une importance esthétique exceptionnelles ;
- ***Critère viii:*** être des exemples éminemment représentatifs des grands stades de l'histoire de la terre, y compris le témoignage de la vie, de processus géologiques en cours dans le développement des formes terrestres ou d'éléments géomorphiques ou physiographiques ayant une grande signification ;
- ***Critère ix:*** être des exemples éminemment représentatifs de processus écologiques et biologiques en cours dans l'évolution et le développement des écosystèmes et communautés de plantes et d'animaux terrestres, aquatiques, côtiers et marins ;
- ***Critère x:*** contenir les habitats naturels les plus représentatifs et les plus importants pour la conservation *in situ* de la diversité biologique, y compris ceux où survivent des espèces menacées ayant une valeur universelle exceptionnelle du point de vue de la science ou de la conservation.

Un site naturel nominé doit également réunir un certain nombre de conditions en rapport avec son intégrité. Cela suppose d'évaluer jusqu'à quel point le site :

- inclut tous les éléments justifiant de la valeur universelle exceptionnelle,
- garantit une superficie adéquate permettant une complète représentation des compositions et processus qui supportent la valeur du site,
- souffre d'effets négatifs liés au développement et / ou de négligence.

Par ailleurs, des mesures légales de protection et de gestion doivent être en place pour garantir la conservation des valeurs justifiant l'inscription du site. En d'autres termes, le bien doit justifier son caractère unique et démontrer que les structures nécessaires à sa protection et à sa gestion sont en place pour sauvegarder son intégrité et ses valeurs exceptionnelles.

naturels du patrimoine mondial couvrent actuellement près de 180 millions d'ha de terre et de mer, représentant 11% de la superficie des aires protégées dans le monde. Les biens du patrimoine mondial sont à la fois le refuge d'espèces animales ou végétales menacées mais également de vastes écosystèmes où s'opèrent des processus écologiques indispensables à la planète. La Convention s'est révélée un instrument normatif de la plus grande importance pour la conservation de la nature *in situ*.

Les biens du patrimoine mondial constituent un héritage commun dont la disparition serait une perte irremplaçable pour l'Humanité. Malgré la reconnaissance internationale dont ils font l'objet, plusieurs de ces sites sont menacés par les impacts du développement non durable, la pression d'un tourisme non contrôlé, ou des conflits. Le Centre du patrimoine mondial de l'UNESCO évalue précisément leur statut avec l'appui de l'UICN. En cas de menace sérieuse et imminente, un bien peut être inscrit sur la Liste du patrimoine mondial en péril. Actuellement, 15 sites naturels sont listés comme étant en péril, y compris les 5 sites du patrimoine mondial de la RDC. Il y a seulement 7 sites naturels classés au patrimoine mondial en Afrique centrale, 6 étant situés dans les forêts humides du bassin du Congo. L'un d'entre eux, l'écosystème et paysage culturel relique de Lopé-Okanda au Gabon, associe patrimoine naturel et culturel. Plusieurs autres sites d'une exceptionnelle importance biologique existent en Afrique centrale mais la plupart ne répondent pas encore aux critères pour une inscription sur la Liste du patrimoine mondial.

*L'okapi est une des 28 espèces de mammifères endémiques à la RDC. Cette étrange girafe de forêt, dont les origines savanicoles ne font aucun doute, est représentative de l'évolution et du mixage de diverses espèces forestières et savanicoles dans ce creuset évolutionnaire qu'est le bassin du Congo, lorsque périodes froides et périodes chaudes ont alterné au cours de millions d'années.*

*Photo © Kim S. Gjerstad*

## L'importance des forêts du bassin du Congo

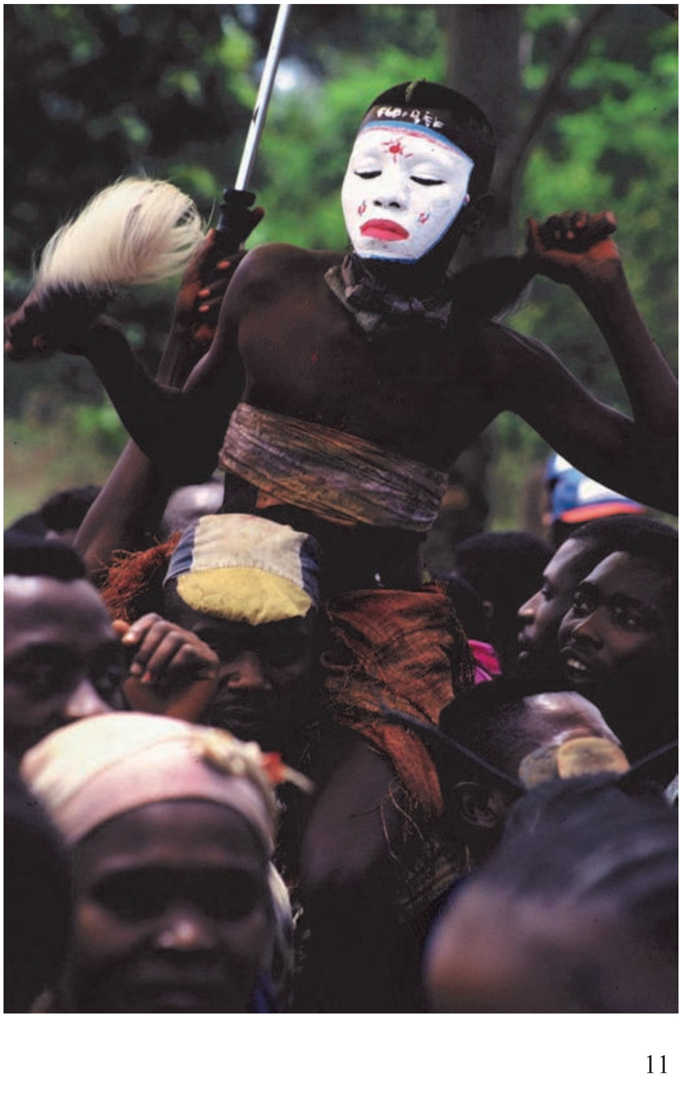
Les forêts humides d'Afrique centrale constituent la plus grande zone de forêts tropicales au monde après l'Amazonie. S'étirant sur plus de 2.000 km, de la côte atlantique du Golfe de Guinée aux plateaux du Rift Albertin dans l'Est de la République Démocratique du Congo, elles couvrent environ 1,62 millions de km² partagés entre 8 pays – Cameroun, République Centrafricaine, République Démocratique du Congo, République du Congo, Gabon, Guinée Equatoriale et quelque petites zones au Nigeria et en Angola. Plus de 80% sont de type guinéo-congolais, avec deux zones de forêt afro-montagnarde distantes de 2.000 km, au Cameroun et dans le Rift Albertin à l'Est de la RDC. Bien que ce vaste ensemble forestier soit communément désigné comme le bassin du Congo, il couvre en fait plusieurs bassins versants (Congo, Sanaga, Ntem, Ogooué, Nyanga, Niari et Kouilou), le bassin versant du Congo couvrant de loin la plus grande partie. *Grosso modo*, deux tiers des forêts humides d'Afrique centrale sont drainés par le fleuve Congo et 50% de ces forêts se situent en RDC.

Comme celles d'Amazonie, mais à la différence de celles d'Asie du Sud-Est ou d'Afrique de l'Ouest, les forêts du bassin du Congo forment un bloc forestier ininterrompu. A la différence de l'Amazonie cependant, où la plus grande partie des forêts s'étend juste au-dessus du niveau de la mer, approximativement 80% des forêts du bassin du Congo se situent entre 300 et 1.000 m au-dessus du niveau de la mer. Les précipitations annuelles moyennes sont comprises entre 1.600 et 2.000 mm, quoique le long des côtes du Cameroun et du Gabon la pluviométrie soit largement supérieure (3.000 à 11.000 mm). Le cycle des variations climatiques au cours des 2 derniers millions d'années a eu une forte influence sur les forêts du bassin du Congo. Au gré des contractions et extensions de la calotte glaciaire, des périodes fraîches et sèches ont alterné avec des périodes plus chaudes et plus humides provoquant des transgressions puis régressions de la forêt. Durant les périodes sèches, les forêts ont été réduites à une série de zones refuges situées le long des zones d'altitude de la côte atlantique, sur les plateaux de l'Est de la RDC et dans les forêts galeries et les zones marécageuses associées au fleuve Congo. Ces forêts, qualifiées de forêts-refuges, ont servi de réservoir d'espèces forestières dans des périodes où la forêt se contractait ; les forêts se fragmentant puis s'étendant par intervalle, les espèces forestières et non forestières furent alors entraînées, de manière répétitive, dans une spirale évolutive. L'okapi, la girafe forestière endémique à la RDC, est un exemple spectaculaire d'une espèce forestière ayant conservée certaines caractéristiques révélant ses origines savanicoles. A l'heure actuelle, ces zones se caractérisent par des niveaux de diversité biologique et d'endémisme bien plus élevés que dans les autres forêts du bassin du Congo.

La diversité globale des espèces des forêts d'Afrique centrale est élevée, tout en restant inférieure à celles d'Amazonie ou d'Asie du Sud-Est. Ce qui rend cependant ces forêts si particulières, c'est la spécificité de leur faune et de leur flore, tant au niveau des espèces qu'à celui des genres ou des familles. Les forêts de basse altitude hébergent environ 10.000 espèces de plantes vasculaires supérieures, dont 30% sont endémiques (incluant 9 familles endémiques). Les forêts de haute altitude abritent environ 4.000 espèces dont 70% sont endémiques (incluant 2 familles endémiques). De nombreuses espèces endémiques et emblématiques sont présentes dans les forêts d'Afrique centrale, telles que l'okapi, le bongo, la genette aquatique, le gorille et le bonobo ; de nombreuses espèces de petits primates et d'antilopes sont également exclusives à ces forêts. En plus de l'endémique paon du Congo, les forêts abritent au moins 5 familles d'oiseaux endémiques à l'Afrique. La diversité des amphibiens, des reptiles et des poissons est également élevée bien que ces 3 groupes soient encore mal connus, des espèces nouvelles étant régulièrement identifiées. Rien qu'en RDC, plus de 1.000 espèces de poissons d'eau douce sont recensées.

*Un jeune garçon Bakota à Mbomo (Parc national d'Odzala-Koukoua, Congo) célébrant le « Likinda », une cérémonie traditionnelle pour la circoncision. Plus de 150 groupes ethniques vivent dans les forêts d'Afrique centrale. .*

*Photo © C. Aveling*



Au-delà de son importance en termes de biodiversité et d'endémisme, le bassin du Congo est une des dernières régions dans le monde où l'inter-connectivité des forêts primaires permet aux mécanismes biologiques de se poursuivre naturellement, sans perturbation. Un éléphant pourrait, en théorie, se déplacer du Rift Albertin vers la côte gabonaise sans jamais quitter la forêt. Le bassin du Congo est également un gigantesque puits de carbone et joue à ce titre un rôle crucial au niveau de la planète pour la régulation des gaz à effet de serre. Enfin, il exerce une influence dominante sur les modèles de climat local puisque plus de 50% des précipitations de la cuvette centrale du bassin du Congo proviennent de l'évaporation et de l'évapotranspiration de la forêt elle-même.

Quelques 30 millions de personnes, appartenant à 150 groupes ethniques différents, peuplent les forêts d'Afrique centrale. Les vestiges de présence humaine dans certains sites (par exemple l'écosystème et paysage culturel relique de Lopé-Okanda) remontent à 400.000 ans, quand ces populations vivaient plus que probablement en bordure forestière, dans les mosaïques de savane-forêt formées au gré des variations climatiques. On ignore à partir de quand les hommes vécurent de manière permanente dans la forêt mais on pense que les populations semi-nomades de pygmées chasseurs-cueilleurs s'y sont installées il y a 20.000 ans et que les populations sédentaires Bantoues commencèrent à pénétrer dans la forêt par le nord-ouest il y a environ 4.000 ans. Au cours du millénaire, des relations complexes d'interdépendance se sont développées entre chasseurs-cueilleurs et populations Bantoues, les chasseurs-cueilleurs procurant viande, poissons et autres produits de la forêt aux cultivateurs qui fournissent les sources de protéines complémentaires en retour. Ces relations perdurent encore aujourd'hui même si progressivement les groupes pygmées se sédentarisent.

*Un chasseur au filet Mbuti dans la forêt de l'Ituri, Réserve de faune à okapis, en RDC. Les pygmées chasseurs-cueilleurs semi-nomades et les cultivateurs Bantous entretiennent des relations complexes d'interdépendance.*

*Photo © Kim S. Gjerstad*

Les pratiques agricoles traditionnelles dans les forêts d'Afrique centrale ont évolué sur la base de la culture sur brûlis avec des périodes de jachère relativement longues (>25 ans). Considérant la fertilité médiocre des sols dans la plupart des forêts d'Afrique centrale, l'agriculture sur brûlis, associée aux prélèvements des ressources naturelles fournies par la forêt, a été une stratégie parfaitement adaptée pour la survie des populations nomades forestières. Cependant, ce mode de vie traditionnel n'est durable que si les densités démographiques restent faibles. Dans de vastes zones du bassin du Congo, où la densité humaine est en-dessous de 2 habitants/km², l'agriculture traditionnelle prédomine encore. Cependant, là où les populations augmentent, en particulier le long des routes et autour des villes et villages, les périodes de jachère sont raccourcies et des halos de zones forestières dégradées apparaissent, associés aux problèmes de fertilité des sols. Avec le développement d'activités économiques (en particulier les industries extractives telles que l'exploitation forestière et/ou

*Chimpanzés et crocodiles, espèces protégées, en vente sur le marché de viande de brousse à Lambarene au Gabon. Le libre accès aux ressources naturelles conduit à une surexploitation du gibier.*

*Photos © S. Louembet (ci-dessous) & C. Aveling (à droite)*

minière) et la création d'un réseau de pistes de plus en plus dense le long desquelles s'établissent des peuplements humains, ces halos de déboisement évoluent en lambeaux de dégradation forestière fragmentant les blocs forestiers. Ce processus de dégradation forestière est encore exacerbé quand les populations rurales commercialisent les produits forestiers (comme la viande de brousse ou d'autres produits forestiers non ligneux) pour approvisionner les centres urbains voisins. Ces mêmes populations sont malheureusement les premières affectées par le résultat de ce processus de dégradation forestière.

*Une mosaïque de jachères et de forêt primaire dans une zone faiblement peuplée du Nord Congo. Pour les sols généralement pauvres des forêts d'Afrique centrale, la traditionnelle agriculture sur brûlis est durable uniquement pour des densités démographiques faibles (< 2 habitants/km²) et avec des rotations de jachères supérieures à 25 ans.*

*Photo © C. Aveling.*

L'évolution des modèles de répartition de la population au cours des 30 dernières années a eu des répercussions socioculturelles et socio-économiques importantes sur les populations rurales. Des nouveaux moyens d'extraction et de commercialisation des ressources naturelles ont été introduits et l'accroissement du brassage d'immigrants se traduit généralement par le rejet des systèmes traditionnels de gestion des ressources naturelles. Le libre accès aux ressources de la forêt conduit à leur raréfaction, exacerbée par la difficile cohabitation des systèmes traditionnels et normatifs de gestion des sols, et ce quasiment partout dans les forêts d'Afrique centrale. Les tensions ethniques et les conflits armés dans le bassin du Congo, causant épisodiquement de massifs mouvements de réfugiés, ont créé des pressions sur les systèmes et structures traditionnels de gestion des terres et des ressources naturelles.

Actuellement, approximativement 22,96 millions d'ha de forêts denses humides d'Afrique centrale, quelque 14% de la surface totale, bénéficient d'un statut d'aire protégée. La superficie des aires protégées varie considérablement, de quelques centaines d'hectares à 3,3 millions d'ha (Parc national de la Salonga, un site du patrimoine mondial). Toutefois, si la diversité des espèces est élevée dans les forêts du bassin du Congo, leur densité est relativement faible et pour cette raison, la plupart des aires protégées, à l'exception des plus vastes et des mieux protégées, ne sont probablement pas assez étendues pour garantir, à long terme, une protection de l'ensemble des espèces et des mécanismes écologiques. Cela a conduit à un changement dans les stratégies de conservation au cours des dernières années avec la mise en avant de l'approche *paysage* pour la conservation. L'idée consiste à renforcer l'intégrité biologique des aires protégées et de leurs zones périphériques en s'attaquant aux problématiques de conservation et de gestion dans les zones à usages multiples assurant ainsi leur connectivité. La stratégie consiste à gérer l'impact des activités humaines sur les écosystèmes de manière à maintenir les flux de gènes et les processus biologiques, évitant aux aires protégées d'évoluer en îlots de biodiversité écologiquement déconnectés.

Puisque la plupart des paysages écologiques s'étendent au-delà des frontières internationales, une approche régionale de la conservation se développe conjointement à l'approche *paysage*. En 2000, un atelier impliquant plus de 160 experts régionaux et internationaux, était organisé à Libreville afin d'identifier les sites les plus remarquables pour la conservation de la biodiversité en Afrique centrale. Certains de ces sites s'avéraient être dans le réseau existant d'aires protégées mais de nombreux autres étaient en dehors des zones classées. Ces sites furent alors regroupés en une série de paysages vastes et relativement intacts, sélectionnés sur la base de leur représentativité biologique, de la viabilité de leurs populations de faune sauvage, de l'intégrité et de la résilience de leurs écosystèmes et processus écologiques.

Le concept de paysage est un axe central du plan stratégique de convergence de la COMIFAC (*Commission des Forêts d'Afrique Centrale*) résultant du Sommet des Chefs d'Etat à Yaoundé en 1999 pour la gestion durable des forêts. La majorité des acteurs de la conservation actuellement impliqués dans le Partenariat pour les Forêts du Bassin du Congo (PFBC) se sont désormais appropriés le concept de paysage.

## ENCADRÉ 2. LE PARTENARIAT POUR LES FORÊTS DU BASSIN DU CONGO

Le partenariat réunit 10 Etats membres de la COMIFAC, des bailleurs de fonds, des ONGs, des institutions scientifiques et des représentants du secteur privé. Il regroupe actuellement 45 membres qui partagent le souci d'améliorer la communication et la coordination entre les membres pour développer des synergies entre leurs projets, programmes et politiques respectifs, en appui au plan de convergence de la COMIFAC.

**Gouvernements**
Belgique, Burundi, Cameroun, Canada, République Centrafricaine, Tchad, République Démocratique du Congo, Guinée Equatoriale, Union Européenne, France, Gabon, Allemagne, Japon, Pays-Bas, Rwanda, São Tomé et Príncipe, Afrique du Sud, Espagne, Royaume-Uni, Etats-Unis d'Amérique.

**Organisations internationales:**
Banque Africaine de Développement, COMIFAC, FAO, le Mécanisme Mondial de la Convention des Nations Unies pour la lutte contre la Désertification, GRASP (Great Apes Survival Partnership), Organisation Internationale du Bois tropical, Secrétariat de la Convention sur la Diversité Biologique, Secrétariat de la Convention sur les espèces migratoires, PNUD, PNUE, UNESCO, Banque Mondiale.

**ONGs et groupes de recherche:**
African Wildlife Foundation, Centre for International Forestry Research, Conservation International, Forest Trends, UICN, Jane Goodall Institute, Wildlife Conservation Society, World Resources Institute, WWF International.

**Secteur privé:**
American Forest and Paper Organisation, Inter-African Association of Forest Industries, International Technical Association for Tropical Timber, Society of American Foresters.

*Source: http://www.cbfp.org*

**ENCADRÉ 3. LES 10 AXES STRATÉGIQUES DU PLAN DE CONVERGENCE DE LA COMIFAC**

1. Harmonisation des politiques forestières et fiscales
2. Connaissance des ressources forestières
3. Aménagement des écosystèmes et reboisement
4. Conservation de la biodiversité
5. Valorisation durable des ressources forestières
6. Développement des activités alternatives et réduction de la pauvreté
7. Renforcement des capacités, participation des acteurs, information et formation
8. Recherche et développement
9. Développement des mécanismes de financement
10. Coopération régionale et partenariat

Source: http://www.biodiv.be/comifac2

Le PFBC (Encadré 2) a été lancé au Sommet Mondial pour le Développement Durable à Johannesburg en 2004. C'est une association de 45 organisations gouvernementales et non gouvernementales, y compris l'UNESCO, actives dans le bassin du Congo. Son objectif est de coordonner les initiatives des différents partenaires afin d'améliorer la cohérence et l'efficacité de leurs programmes et politiques pour le développement durable des écosystèmes forestiers. Le partenariat vise en particulier à renforcer la protection de la biodiversité et la bonne gouvernance, contribuant à améliorer le niveau de vie des habitants de la région. Appuyer les institutions de la COMICAF et aligner les activités du PFBC avec celles du Plan de Convergence de la COMIFAC (Encadré 3) sont au cœur de la stratégie du PFBC.

Le partenariat est gouverné via un processus de facilitation, assuré à tour de rôle par un des partenaires. Les Etats Unis furent le premier facilitateur de 2003 à 2004, suivis par la France (2005-2007) ; actuellement le partenariat est facilité par l'Allemagne (depuis 2008).

## LE PATRIMOINE MONDIAL DANS LE BASSIN DU CONGO

Considérant l'importance des forêts d'Afrique centrale en termes de biodiversité et leur superficie d'écosystèmes intacts, il est surprenant que si peu de sites forestiers aient pu accéder au statut de site du patrimoine mondial (carte page 8). Actuellement, seuls 6 biens du patrimoine mondial sont situés dans le bassin du Congo, chacun d'eux correspondant à l'un ou l'autre des 12 paysages forestiers prioritaires du PFBC. Quatre d'entre eux sont en RDC (Parcs nationaux des Virunga, de Kahuzi-Biega, de la Salonga et Réserve de faune à okapis[1]), un se trouve au Cameroun (Réserve de faune du Dja) et un au Gabon (Ecosystème et paysage culturel relique de Lopé-Okanda). Les quatre biens de la RDC figurent sur la Liste du patrimoine mondial en péril depuis la fin des années 1990 suite aux menaces créées par la guerre civile. Les autres pays d'Afrique centrale, la République du Congo, la République Centrafricaine et la Guinée Equatoriale[2], ne possèdent pas de sites du patrimoine mondial en zone forestière[3] bien qu'ils abritent des sites forestiers parmi les plus spectaculaires et de grande importance biologique. Les forêts recouvrant les îles du Golfe de Guinée (São Tomé, Príncipe et Bioko) ne sont pas représentées non plus sur la Liste du patrimoine mondial en dépit de leur niveau d'endémisme très élevé.

Les forêts d'Afrique centrale constituent une haute priorité pour le Centre du patrimoine mondial de l'UNESCO et de nombreuses activités ont été développées au cours de la dernière décennie visant à : i) protéger les sites inscrits sur la Liste du patrimoine mondial en péril; ii) identifier de nouveaux sites potentiels et iii) améliorer les capacités de gestion des sites potentiels afin qu'ils satisfassent aux critères du patrimoine mondial pour inscription sur la Liste.

Pour s'attaquer à ces défis, l'UNESCO a développé des alliances novatrices entre agences

*[1] Le 5è site du patrimoine mondial en RDC, le parc national de la Garamba, est situé en zone savanicole, au nord-est du pays.*

*[2] La Guinée Equatoriale n'est pas encore signataire de la Convention du patrimoine mondial.*

*[3] Le parc national Manovo-Gounda-St Floris, situé en zone de savane au nord de la RCA, est sur la liste du patrimoine mondial en péril.*

des Nations-Unies, les autorités nationales et des ONG environnementales implantées dans ces régions, chaque organisation apportant son propre réseau, son expérience et ses compétences au partenariat :

- **Les gouvernements nationaux** ont des réseaux d'aires protégées mais très souvent ne possèdent ni les capacités, ni les structures de gestion sur le terrain du fait de leur manque de ressources ;
- **Les ONG internationales** apportent leur expérience dans le domaine de la conservation, leurs capacités organisationnelles, leurs ressources en termes de formation et des financements pour renforcer le fonctionnement des aires protégées sur le terrain ;
- **UNESCO** utilise la *Convention du patrimoine mondial* comme un levier politique en faveur de la conservation de la biodiversité grâce à son contact permanant avec les Etats Membres, et mobilise des financements auprès de l'aide bilatérale, multilatérale ou auprès d'ONG pour appuyer le développement et la protection de sites importants.

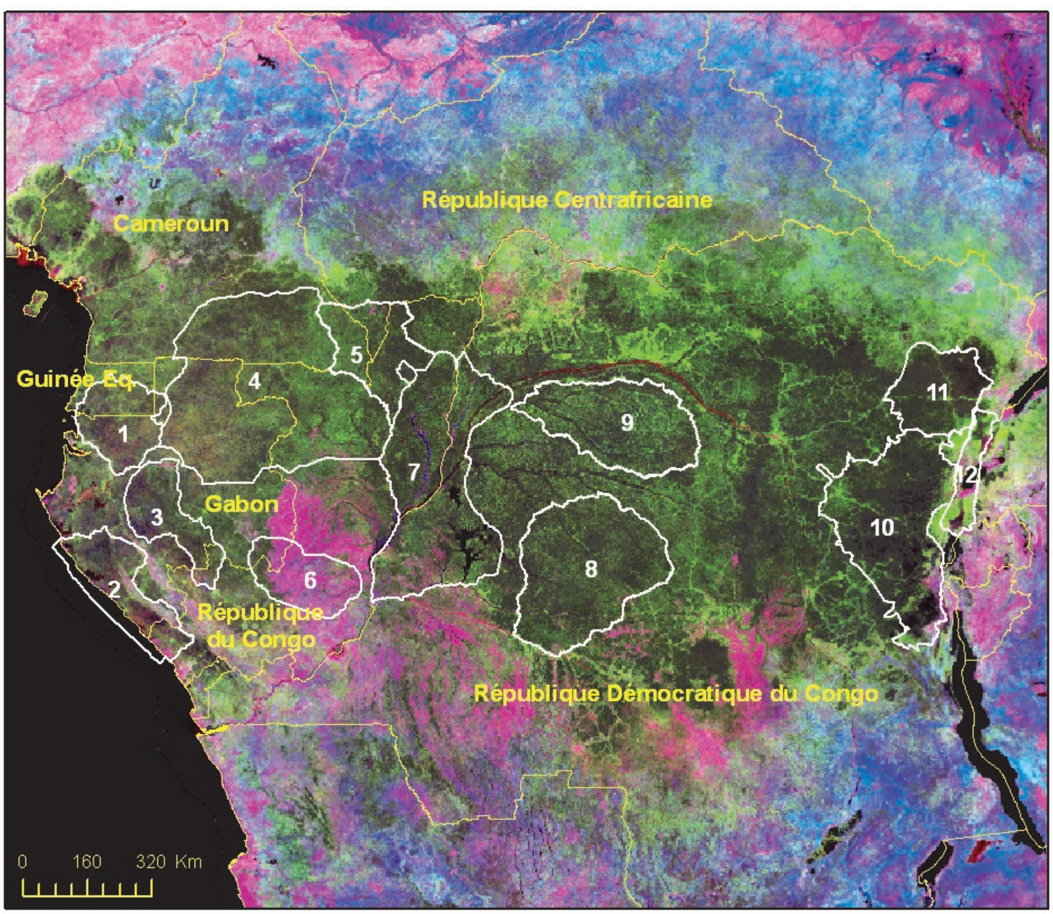
Le programme de l'UNESCO pour les forêts d'Afrique centrale est actuellement mis en œuvre à travers deux initiatives majeures : un programme d'appui d'urgence aux sites du patrimoine mondial en RDC intitulé : *Conservation de la biodiversité en zones de conflits armés : préserver les sites du patrimoine mondial en RDC,* initié en 2000, et l'*Initiative en faveur du patrimoine mondial forestier en Afrique central* (connu sous l'acronyme anglais CAWHFI) lancé en 2004 et se concentrant sur 3 paysages transfrontaliers au Gabon, en République du Congo, au Cameroun et en RCA.

*Les paysages forestiers d'Afrique centrale associent des aires protégées et des zones à usages multiples qui les bordent ou les relient. La stratégie par l'approche 'paysage' consiste à gérer conservation et activités de développement de manière à ce que l'intégrité des processus écologiques soit préservée.*

*Les paysages sont:*

1. *Monte Alén-Monts de Cristal*
2. *Gamba-Mayumba - Conkouati*
3. *Lopé-Chaillu-Louesse*
4. *Dja-Odzala-Minkébé (TRIDOM)*
5. *Tri-National de la Sangha (TNS)*
6. *Léconi-Batéké-Léfini*
7. *Lac Télé-Lac Tumba*
8. *Salonga-Lukenie-Sankuru*
9. *Maringa-Lopori-Wamba*
10. *Maiko-Tayna-Kahuzi Biega*
11. *Ituri-Epulu-Aru*
12. *Virunga*

*Source: OFAC*

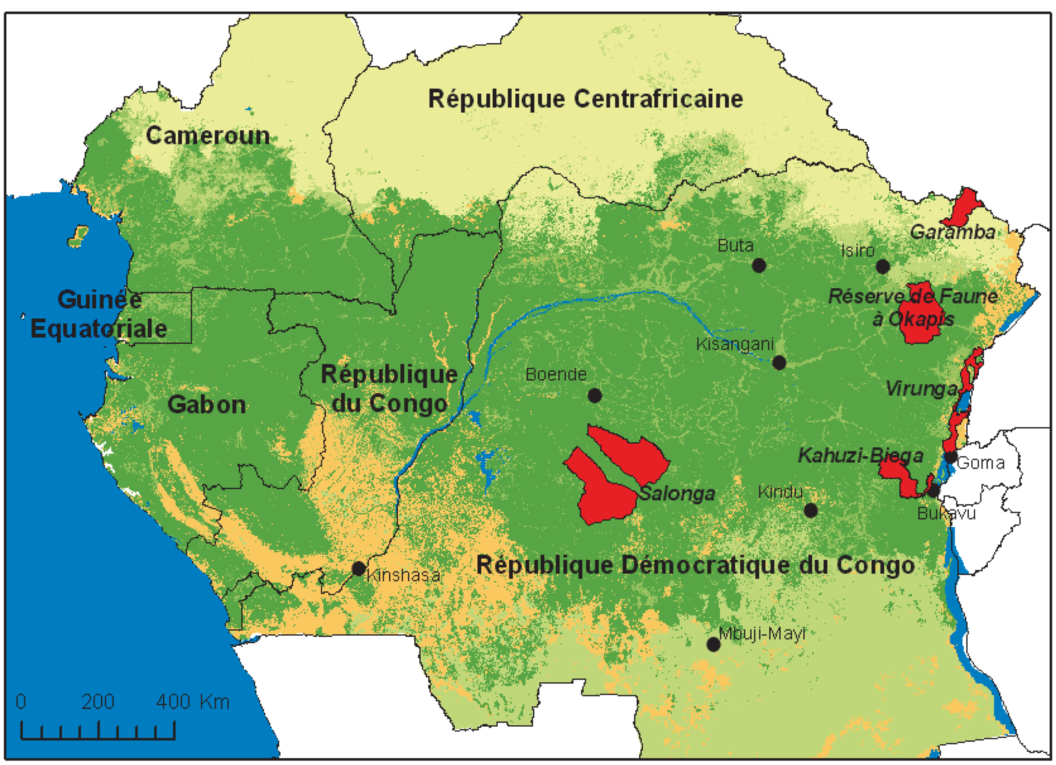


# CONSERVATION DE LA BIODIVERSITÉ EN ZONES DE CONFLITS ARMÉS

## Préserver les sites du patrimoine mondial naturel en République démocratique du Congo

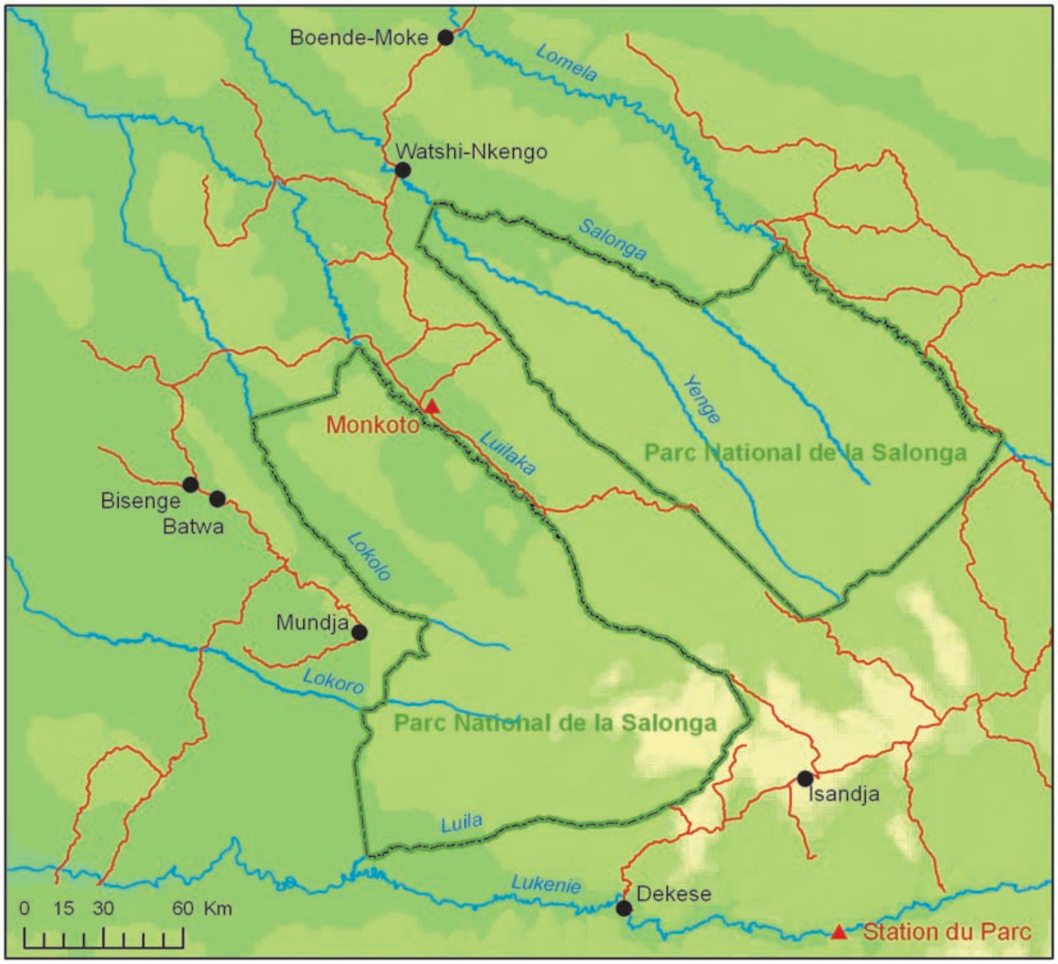
Vingt années de troubles civils et de marasme économique, suivies par une guerre civile dévastatrice, ont fragilisé les cinq sites du patrimoine mondial présents en RDC. Cette instabilité et cette insécurité se soldent par un impact sévère sur l'environnement. Le braconnage pour approvisionner les marchés de l'ivoire et de viande de brousse, l'exploitation forestière ou minière illégale, et les implantations illégales de populations fuyant les conflits font payer un lourd tribut aux ressources naturelles. Entre 1994 et 1999, les cinq sites furent placés sur la Liste du patrimoine mondial en péril. En réponse à cette crise, le Centre du patrimoine mondial de l'UNESCO incita à une alliance d'acteurs de la conservation pour fournir une aide d'urgence. Ces partenaires regroupaient l'agence nationale en charge des aires protégées : *l'Institut Congolais pour la Conservation de la Nature* (ICCN), et un groupe d'ONG internationales de conservation ayant chacune une expérience de terrain. Au départ le partenariat regroupait le Fonds Mondial pour la Nature (WWF), la Wildlife Conservation Society, Gilman International Conservation, Milwaukee Zoological Society, le International Rhino Fund, et le Programme International de Conservation des Gorilles[4] ainsi que l'agence de coopération bilatérale allemande (GTZ) et le gouvernment belge. Le programme, dénommé *Biodiversité dans les régions de conflits armés : préserver les sites du patrimoine mondial en RDC*, fut initié en 2000, lorsque la guerre civile était à son paroxysme, avec des financements de la Fondation des Nations Unies et le gouvernement Belge. Cette intervention a permis d'apporter un appui substantiel à ces sites pour préserver leur valeur écologique et leur intégrité à un moment où quatre d'entre eux étaient localisés dans des zones détenues par les factions rebelles et que la quasi-totalité des agences d'aide s'étaient temporairement retirées du pays. Plus tard, d'autres ONG (Fauna and Flora International, London Zoological Society, Frankfurt Zoological Society, African Parks, African Conservation Fund et UICN) ont rejoint le partenariat et une deuxième phase du programme a reçu des financements de l'Italie. Des négociations sont en cours pour une troisième phase avec des contributions de la Belgique et de l'Espagne.

[4] *Le Programme International pour la Conservation des Gorilles (PICG) est une coalition de trois partenaires : African Wildlife Foundation; Fauna and Flora International; le Fonds Mondial pour la Nature (WWF)*




*La longue période de conflit en RDC a sérieusement menacé l'intégrité du réseau d'aires protégées du pays. Entre 1994 et 1999 les cinq sites du patrimoine mondial (en rouge) ont été placés sur la liste des sites du patrimoine mondial en péril.*

# Parc national de la Salonga




**Le Parc national de la Salonga en bref**

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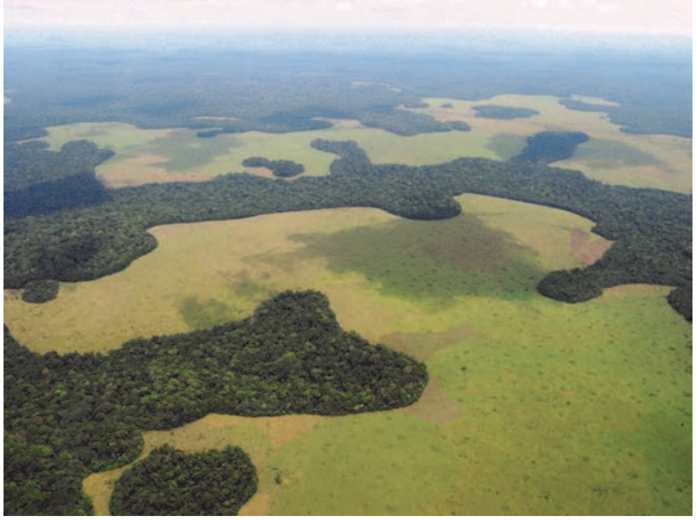
| **Statut** | Parc national (1970); Liste du patrimoine mondial (1984 - critères vii et ix); Site du patrimoine mondial en péril (1999) |
| **Coordonnées** | 1°00'-3°20'S, 20°-22°30'E |
| **Superficie** | 33,346 km² |
| **Altitude** | 350 – 700 m |
| **Ecorégions terrestres** | Forêts marécageuses congolaises de l'est, forêts congolaises centrales de basse altitude |
| **Ecorégions aquatiques** | Bassin central |
| **Partenaires de l'UNESCO** | MZS, WCS, WWF |

Le Parc national de la Salonga est la plus grande aire protégée de forêt dense humide du continent africain. Gérer ce vaste ensemble avec moins de 200 agents représente donc un énorme défi pour l'ICCN. Voyager à travers ou en périphérie du parc, à pied ou en pirogue, pour simplement visiter les postes de patrouille, peut prendre plus de 3 mois ! Transférer un braconnier auprès du tribunal le plus proche représente un voyage de 200 km à pied ou à bicyclette.

Le parc abrite une forêt de type guinéo-congolais dominée par des légumineuses de la famille Caesalpinacea, avec de larges inclusions de marécages et de forêt-galerie. Des clairières riches en sels minéraux (appelées aussi salines ou "*botoka njoku*"), attirant les grands mammifères et en particulier les éléphants, sont également présentes. Au sud du parc, des mosaïques de savane/forêt contribuent à sa diversité végétale. Que la biodiversité n'y soit généra-



*La végétation du Parc national de la Salonga est dominée par des espèces de la famille des Caesalpinacea avec des inclusions de vastes zones marécageuses et de forêt-galerie. Au sud, les mosaïques de savane-forêt renforcent la diversité florale de l'aire protégée.* Photos © Kim S. Gjerstad

lement pas aussi élevée que dans les forêts de la zone Atlantique à l'ouest ou du Rift Albertin à l'est, est plus que compensé par le fait que sa superficie offre le potentiel d'abriter de larges associations d'espèces. La présence de deux genres de primates endémiques (le bonobo et le singe des marais), ainsi que d'une espèce endémique (le singe nymphe des bois) et de plusieurs sous-espèces endémiques de primates font du Parc national de la Salonga une aire protégée remarquable d'un point de vue biogéographique. La très grande superficie du parc lui confère en outre une grande importance en termes de régulation du climat et de séquestration de carbone.

Les densités de populations humaines sont très basses dans cette zone reculée, en moyenne environ 2,4 habitants/km². L'exploitation des ressources naturelles représente plus de 95% des activités humaines (agriculture, pêche, chasse, produits forestiers non ligneux - PFNL). Le marasme socio-économique résultant des 20 dernières années de conflit a rendu les populations locales encore plus dépendantes de l'exploitation des ressources naturelles pour générer des revenus. Deux populations vivent dans les limites du parc. Les Kitwalistes, une secte religieuse, s'est réfugiée au nord-est du bloc nord dans les années 70 et y est toujours présente, comptant entre 3.000 et 4.000 membres hors d'atteinte de la loi. Dans le bloc sud les Iyaelema, appartenant à l'ethnie Mongo, qui ont refusé de quitter les terres de leurs ancêtres lors de la création du parc, occupent actuellement 8 villages comptabilisant environ 2.340 habitants. Leur présence est tolérée par les autorités du parc en raison d'un accord tacite fixant les activités permises.

*Les hommes dépendent fortement des ressources naturelles dans cette contrée éloignée. La pêche représente près de 65% des revenus des ménages installés autour du Parc national de la Salonga. La chasse commerciale a augmenté dans des proportions inquiétantes.*

Photo © J&T Hart

Malgré sa taille et son apparente inaccessibilité, des études récentes ont montré que les populations animales ont diminué durant la période d'instabilité politique. En fait, les rivières offrent des voies d'accès aisées aux braconniers et aux groupes armés, incluant les factions non contrôlées de l'armée, qui pénètrent profondément dans le parc pour ramener ivoire et viande de brousse. Des quantités massives de gibier sont désormais écoulées sur les marchés éloignés de Kinshasa ou dans la Province du Katanga où les prix de ces denrées sont jusqu'à dix fois supérieurs à ceux des villages et campements implantés autour du parc. Toutefois, un recensement de la faune publié en 2006 par WCS fait état d'une population de bonobos estimée à 14.800 individus, chiffre reflétant une dynamique de population saine.

# Parc national des Virunga


**Le parc national des Virunga en bref**

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| **Statut** | Parc national (1925); Site du patrimoine mondial (1979 - critères vii, viii, x); site du patrimoine mondial en péril (1994); site Ramsar (1996) |
| **Coordonnées** | 0°55'N -1°35'S et 29°10 - 30°00'E |
| **Superficie** | 7,900 km² |
| **Altitude** | 798 – 5.119 m |
| **Ecorégions terrestres** | Forêt d'altitude du Rift Albertin; savane soudanienne de l'est |
| **Ecorégions aquatiques** | Lacs de la vallée du Rift; montagnes du Rift Albertin |
| **Partenaires de l'UNESCO** | WWF, LZS, IGCP (regroupement de FFI, WWF et AWF), FZS, ACF |

Situé en bordure du Rift Albertin, le Parc national des Virunga est l'une des aires protégées les plus spectaculaires d'Afrique. Des lacs aux volcans en activité, aux savanes, en passant par les forêts sèches, les forêts denses humides, et les zones alpines afro-tropicales, on peut être tenté de prétendre que ne manquent que le désert et la mer parmi les biomes présents dans le Parc national des Virunga. Premier parc d'Afrique, il fut créé en 1925 pour protéger les gorilles de montagne établis sur les pentes des volcans Virunga. Il fut plus tard étendu au nord pour inclure les plaines herbeuses de la Rwindi, le lac Edouard, les forêts denses humides de la vallée de la Semliki et le massif du Rwenzori avec ses neiges éternelles. Le Parc national des Virunga est contigu avec six autres aires protégées situées dans les pays voisins (le parc des Volcans au Rwanda; les parcs nationaux Mgahinga, Bwindi, Queen Elizabeth, Rwenzori et Semliki en Ouganda) qui sont autant de réservoirs communs pour les espèces animales, un élément crucial en période de conflits armés. Les parcs nationaux de Bwindi et du Rwenzori sont tous les deux des sites du patrimoine mondial.

La très grande variété d'habitats implique que le parc des Virunga ait la diversité de faune et de flore la plus élevée en RDC. Des 2.077 espèces de plantes identifiées dans le parc, 230 sont endémiques aux montagnes du Rift Albertin. Dans une région ne représentant que 0,3% de la superficie totale de la RDC, les Virunga abritent plus de la moitié des espèces de mammifères connues dans le pays, (218 sur 415 espèces, dont 22 espèces de primates) et deux tiers des espèces d'oiseaux (706 sur 1094 espèces dont 25 sont endémiques à la vallée du Rift). En plus de la célèbre population de gorilles de montagne, estimés à 700 individus répartis entre la RDC, l'Ouganda et le Rwanda, le Parc national des Virunga abrite au Mont Tchiaberimu une petite population d'une autre sous-espèce de gorilles, le gorille de Grauer. Les chimpanzés sont également présents à plusieurs endroits. A la fin des années 1980, voir les gorilles et les chimpanzés était à la base d'une industrie touristique florissante qui générait annuellement en droits d'entrée jusqu'à 500.000 USD. Entre 2008 et 2009 le secteur des gorilles a été occupé par les forces rebelles, suscitant l'inquiétude pour la survie de la population de gorilles. Craintes infondées car les rebelles semblent avoir compris l'intérêt de maintenir en vie les grands singes puisque dès les premiers moments de leur occupation de la zone, ils avaient entrepris d'organiser des excursions touristiques. Des recensements récents ont également confirmé la présence d'une autre espèce emblématique de la RDC, l'okapi, qui n'avait plus été observée dans le parc depuis 50 ans.

*Le parc national des Virunga est contigu à plusieurs aires protégées dans les pays voisins Ouganda et Rwanda. Une fois la paix revenue à l'est du Congo, les populations de faune sauvage, y compris les espèces charismatiques, devraient repeupler le parc grâce à la contigüité des aires protégées.*

*Photo © Kim S. Gjerstad*

Avec plus de 1.000 km de délimitations et 200 km du nord au sud, le parc national des Virunga est particulièrement vulnérable aux pressions du fait de sa position géographique mais également de par sa forme étroite et allongée. Par ailleurs, les sols volcaniques fertiles supportent une des densités humaines les plus fortes d'Afrique, avec près de 600 habitants/km² à certains endroits. La dernière décennie, caractérisée par la guerre civile, a connu une augmentation dramatique des incursions dans le parc, entraînant une recrudescence du braconnage. Les hippopotames autrefois nombreux dans la zone centrale du parc sont passés de 23.000 en 1989 à moins de 500 aujourd'hui. Les populations de la plupart des espèces des savanes (éléphants, buffles et antilopes) ont décliné de la même façon. Les villages de pêcheurs se sont multipliés le long des côtes du lac Edouard dont le potentiel halieutique a périclité du fait de la surpêche. Il s'agit ici d'un véritable problème puisque sur les 80 espèces de poissons des lacs Edouard et Georges, connus à ce jour, 60 sont endémiques.

Le déboisement, en particulier dans les plaines de lave autour des deux volcans actifs, qui fournit du bois de chauffe et du charbon de bois à la ville de Goma en pleine expansion, est la principale menace à l'intégrité du secteur sud du parc. Il est extrêmement difficile de stopper ce phénomène du fait des multiples intérêts et groupes en présence, incluant parfois les militaires, les autorités locales et même le personnel du parc.

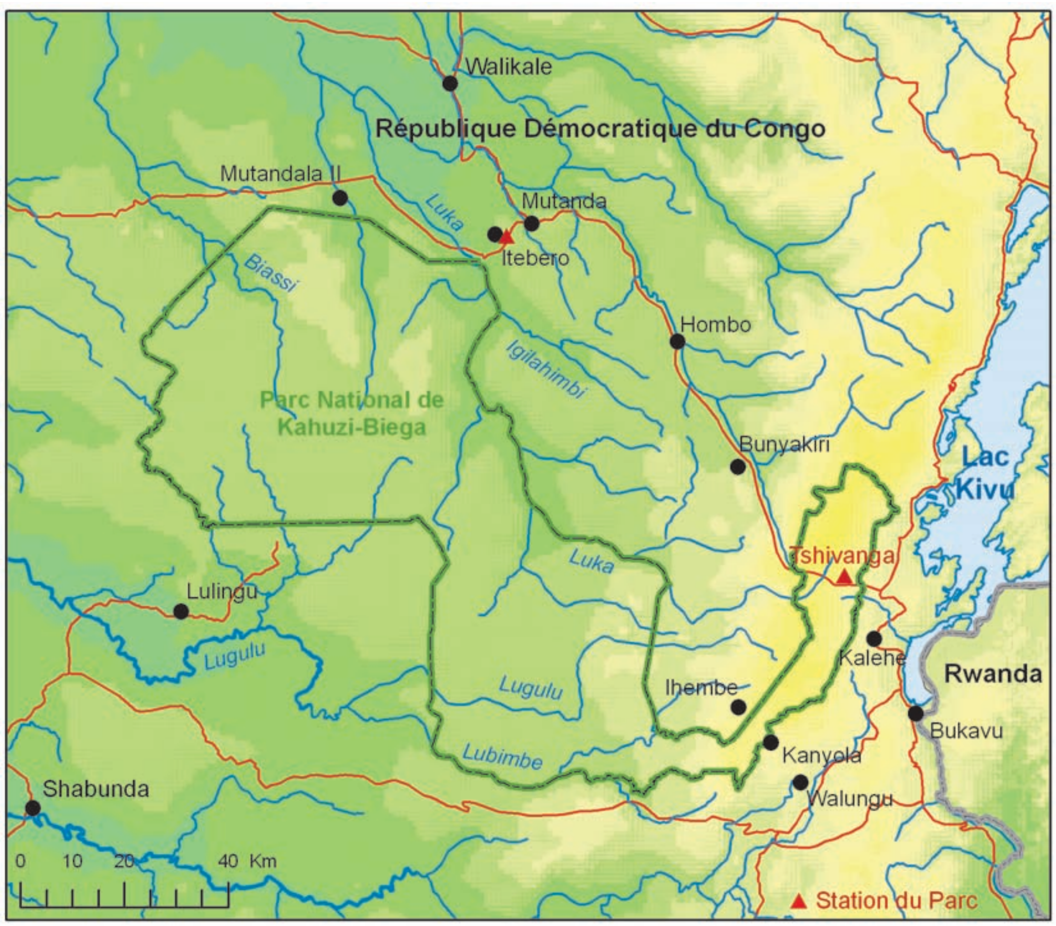
Enfin, l'intérêt croissant pour les réserves de pétrole et de gaz présentes dans la vallée du Rift, pour lesquelles plusieurs permis d'exploration sont en attente de promulgation présidentielle, constitue une autre menace à l'intégrité du complexe d'aires protégées partagé entre Ouganda, RDC et Rwanda.

*Une diversité exceptionnelle de paysages comprenant volcans, montagnes aux neiges éternelles, forêt dense, savane, rivières et lacs, fait du parc national des Virunga un des écosystèmes les plus diversifiés d'Afrique.* *Photos © Kim S. Gjerstad (à gauche), C. Aveling (au centre et à droite)*

# Parc national du Kahuzi-Biega

Créé en 1970 originellement pour protéger l'habitat du gorille de Grauer, une sous espèce endémique à la RDC, le parc fut par la suite étendu pour y inclure les forêts de basse altitude vers l'ouest avec une superficie totale de 6.000 km². Une si grande variation altitudinale (de 600 à 3.300 m) est rare pour un parc national en Afrique. Partout ailleurs sur le continent, les forêts de moyenne altitude ont laissé la place aux activités agricoles. Les terres autour du secteur le plus élevé du parc sont fortement peuplées avec des densités atteignant jusqu'à 300 habitants/km². A l'ouest, dans le secteur de plus faible altitude, les densités sont inférieures à 30 habitants/km². La culture sur brûlis domine les pratiques agricoles même si celles-ci sont de plus en plus délaissées au profit d'activités artisanales minières (or, diamants, coltan, étain).

Situées au centre du Rift Albertin, les forêts du Parc national du Kahuzi-Biega affichent une




**Le Parc national du Kahuzi-Biega en bref**

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| **Statut** | Parc National (1970, extension 1975); site du patrimoine mondial 1980 (critères vii, viii, x); site du patrimoine mondial en péril 1994 |
| **Coordonnées** | 1°36' – 2°37'S et 27°33' - 28°40'E |
| **Superficie** | 6.000 km² |
| **Altitude** | 700 – 3.308 m |
| **Ecorégions terrestres** | Forêts congolaises de basse altitude du nord-est<br>Forêts afro-montagnardes du Rift Albertin |
| **Ecorégions aquatiques** | Haut Congo, montagnes du Rift Albertin |
| **Partenaires de l'UNESCO** | GTZ, WWF, WCS |

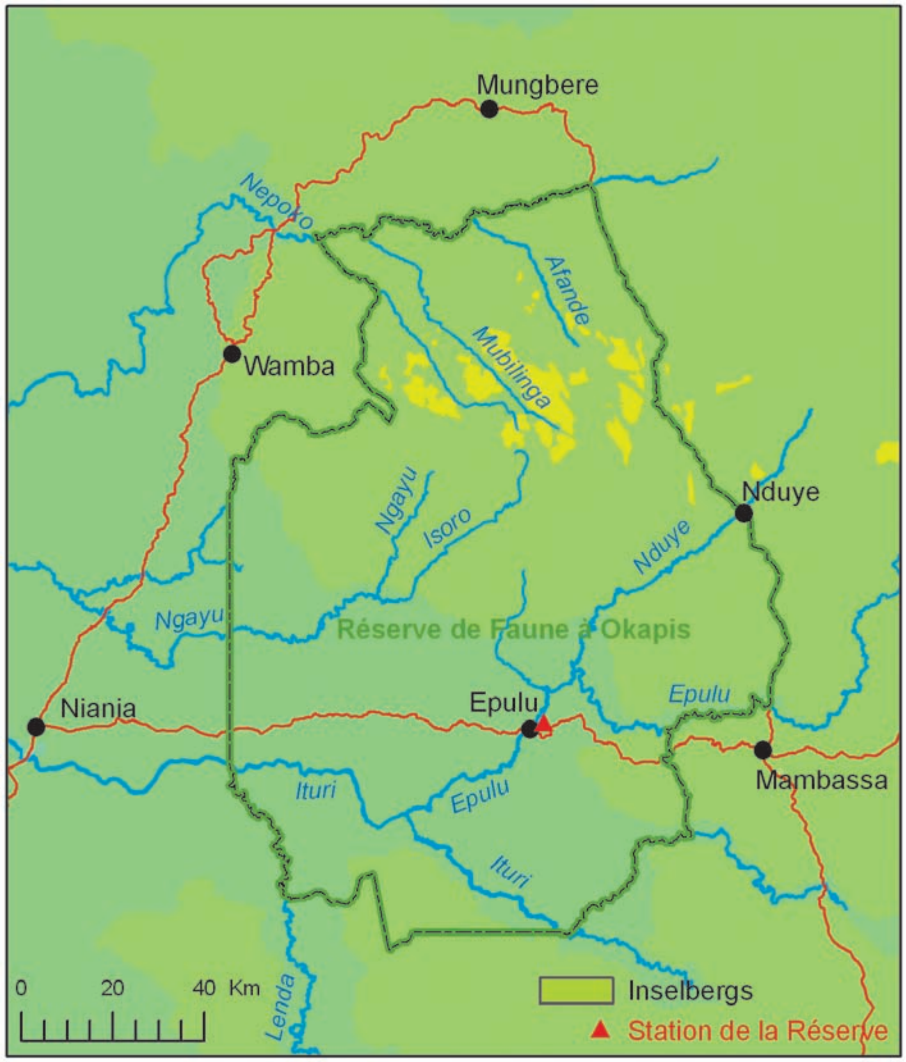
*Le tourisme basé sur l'observation des gorilles fut expérimenté dans le Parc national du Kahuzi-Biega dans les années 70. L'observation de gorilles est désormais devenue une activité générant des millions de dollars dans les trois pays de la région des grands lacs qui se partagent les populations de gorilles restantes.*

*Photo © Simon J. Childs*

diversité floristique exceptionnellement forte avec 1.171 espèces identifiées dont 145 endémiques au Rift Albertin. Aux forêts tropicales humides à canopée fermée de moyenne et basse altitude s'ajoutent des habitats tout aussi importants tels que les forêts de bambous, les forêts marécageuses, les tourbières, les forêts de fougères arborescentes et les prairies de haute altitude. Cette diversité floristique se double d'une diversité animale tout aussi exceptionnelle comptant 136 espèces de mammifères (dont 15 endémiques au Rift Albertin) et 335 espèces d'oiseaux (dont 29 endémiques au Rift Albertin).

La guerre civile a eu un effet dévastateur sur la faune du Kahuzi-Biega avec un braconnage qui se généralisa pour approvisionner en viande de brousse la ville de Bukavu en constant développement pendant les années 1990. En 2003, le secteur le plus élevé du parc avait perdu plus de 95% de sa population d'éléphants et près de 50% de sa population de gorilles, y compris plusieurs des familles de gorilles « habitués » pour le tourisme. De récentes études dans le secteur de basse altitude ont aussi confirmé que les populations animales avaient été sévèrement atteintes. Toutefois, aucune espèce n'a été perdue et il y a toutes les raisons de penser que ces populations pourront se reconstituer une fois que l'ICCN aura repris le contrôle de la zone. Jusqu'à une date récente, la présence de bandits armés, de milices rebelles et de déserteurs de l'armée, bon nombre d'entre eux étant impliqués dans les trafics de viande de brousse et d'exploitation illégale de minerais, avait fait de cette partie du parc une zone de non-droit inaccessible à l'ICCN. La situation s'assainit toutefois progressivement, bien que les implantations de populations et le déboisement, conséquence de la pratique de l'agriculture dans l'étroit corridor reliant les secteurs de haute et de basse altitude, demeurent un sérieuse menace pour l'intégrité du parc.

# Réserve de faune à okapis




| La Réserve de faune à okapis en bref | |
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| **Statut** | Réserve de faune (IUCN cat II Parc National), site du patrimoine mondial 1996 (critère x), site du patrimoine mondial en péril 1999 |
| **Coordonnées** | 1°00'-2°42'N et 28°02'- 29°08'E |
| **Superficie** | 13.726 km² |
| **Altitude** | 500 – 1.000 m |
| **Ecorégions terrestres** | Forêts congolaises du nord-est |
| **Ecorégions aquatiques** | Uélé, Bassin Central |
| **Partenaires de l'UNESCO** | GIC, WCS |

La Réserve de faune à okapis est située dans la forêt de l'Ituri, à l'ouest du Rift Albertin. Elle couvre près de 14.000 km² de forêt de basse et moyenne altitude avec de vastes étendues de forêt mono-dominante à *Gilbertiodendron*. Comme son nom le suggère, cette aire protégée fut créée pour protéger l'habitat de l'okapi, le mammifère endémique de RDC le plus étrange (photo page 10) Cette étonnante girafe de forêt fut décrite par les pygmées Mbuti à l'explorateur Stanley quand il traversa la forêt de l'Ituri dans les années 1860 mais c'est seulement à partir de 1901 que des spécimens furent capturés et décrits par les scientifiques. Plus tard, des études confirmèrent la distribution très limitée de l'okapi, confinée au nord-est de la RDC.

*Un bongo mâle, la plus grande espèce d'antilope forestière d'Afrique, dans une clairière (edo) de la Réserve de faune à okapis.*

*Photo © Reto Kuster*

La Réserve de faune à okapis abrite plusieurs autres espèces spectaculaires et endémiques dont le très rare paon du Congo, la genette aquatique et la genette géante. Plus de 90 espèces de mammifères de la réserve, qui affiche le plus grand nombre d'espèces de primates pour un bloc forestier en Afrique (13 espèces diurnes, 4 nocturnes), sont connues. Le parc national des Virunga a plus d'espèces mais elles sont dispersées à travers des habitats variés. Les chimpanzés sont présents, mais étonnamment pas le gorille alors que la forêt de l'Ituri est contigüe avec des zones forestières où le gorille est présent. Au nord de la réserve de spectaculaires inselbergs de granit émergent de la canopée. Ils hébergent des espèces végétales et animales spécialement adaptées à ce micro-habitat.

La zone couverte par la Réserve de faune à okapis est habitée par l'homme depuis au moins l'âge de pierre. Les premiers occupants étaient probablement les ethnies semi-nomades Mbuti et Efe regroupant environ 30.000 personnes dans la réserve. Le statut de réserve, plutôt que de parc national, permet à ces groupes semi-nomades de maintenir et poursuivre leurs activités traditionnelles dans la forêt. Cette zone est demeurée, jusqu'à récemment, une des moins peuplées du nord-est de la RDC. Toutefois, les 30 dernières années ont vu une constante immigration, vers l'est, de gens quittant les hautes terres surpeuplées, à la recherche de nouvelles terres agricoles. C'est maintenant une des menaces les plus sérieuses pour cette zone qui a connu une pression croissante se traduisant par le déboisement pour les besoins agricoles et par une intensification de la chasse. Cela a également conduit à des conflits entre les groupes ethniques résidents et les migrants.

Durant la guerre civile, Epulu fut la ligne de front entre les parties belligérantes. L'état de non droit que cela a engendré a fourni l'occasion à des milliers de mineurs itinérants, tout comme à des éléments de l'armée ougandaise, de pénétrer les forêts de l'est de la RDC pour l'exploitation du bois et des mines d'or, de diamant et de coltan. Les campements miniers itinérants composés de mineurs, de leurs familles, de commerçants itinérants et autres opportunistes sont apparus un peu partout dans la forêt. Les effets sur la faune furent dévastateurs, les campements miniers devenant autant de centres pour le commerce du gibier et de l'ivoire. Heureusement, la situation s'est grandement améliorée depuis 2007 quand l'ICCN a repris 95% du contrôle de la réserve et, avec l'appui des autorités administratives et traditionnelles, a fermé la plupart des campements. Le braconnage d'éléphants est également mieux contrôlé grâce à une meilleure collaboration entre les forces armées, les autorités administratives et à une surveillance plus efficace.

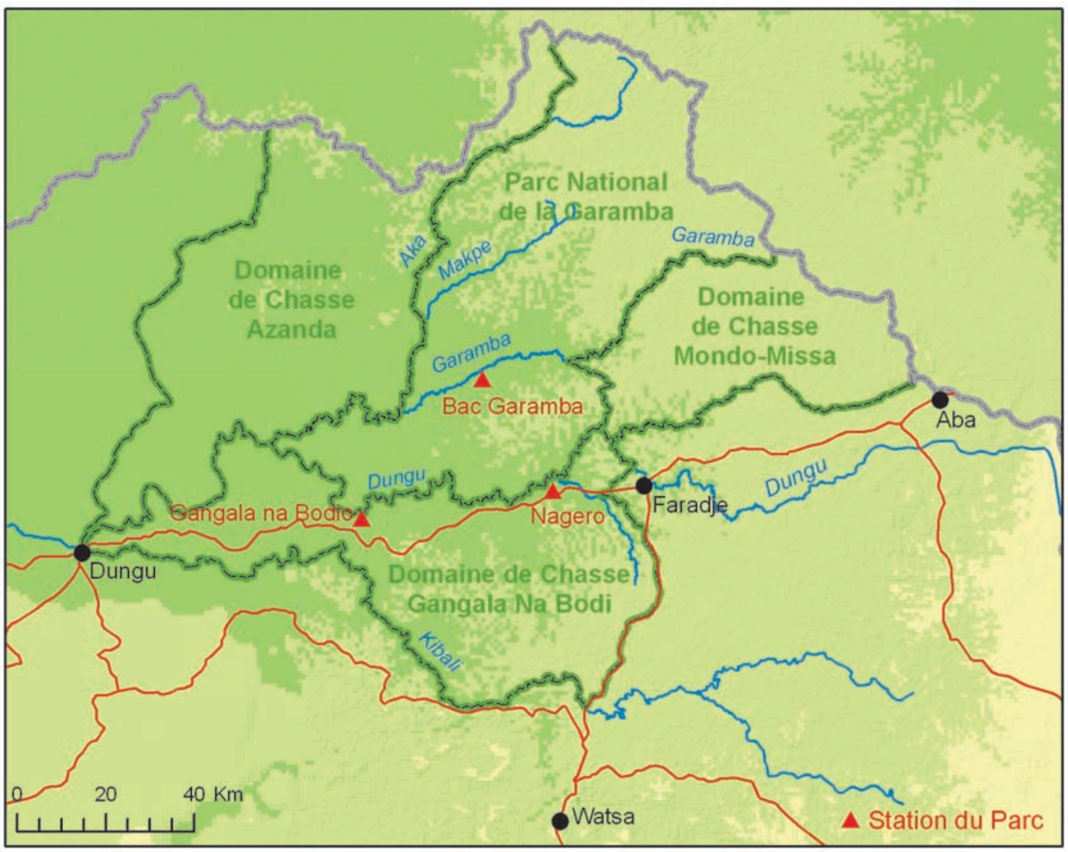
*Les inselbergs au nord de la Réserve de faune à okapis sont le refuge d'espèces animales et végétales particulièrement adaptées à ce micro-habitat.*

*Photo © Reto Kuster*

# Parc national de la Garamba

Créé en 1938, le Parc national de la Garamba revêt une importance particulière pour le réseau d'aires protégées de RDC car sa position à la limite septentrionale des mosaïques savane-forêt lui attribue une biodiversité unique. La partie sud du parc est dominée par des savanes herbeuses arbustives. Le long des rivières Dungu et Garamba s'étendent des mosaïques de forêts-galeries, de forêts et de fourrés. Plus au nord, la végétation est essentiellement un mélange de terres boisées, de forêts sèches denses, de forêts-galeries et de petites zones marécageuses. De manière contrastée, les domaines de chasse en périphérie sont dominés par de denses savanes arbustives et un mélange de savanes boisées et de forêts.

L'espèce emblématique de la Garamba est le Rhinocéros blanc du nord dont la dernière population extrêmement menacé, était encore récemment confinée au parc national de la Garamba. Garamba est également célèbre pour ses importantes populations d'éléphants qui




**Le parc national de la Garamba en bref**

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| **Statut** | Parc national (1938); site du patrimoine mondial (1980 – critères vii, x); site du patrimoine mondial en péril (1996) |
| **Coordonnées** | 3°45' - 4°41'N, 28°48' - 30°00'E |
| **Superficie** | 4.920 km² entouré par 3 domaines de chasse (Azande, Mondo-Missa, Gangala na Bodio) totalisant 10.000 km² |
| **Altitude** | 710 m à 1.061 m |
| **Ecorégion terrestre** | Mosaïque savane-forêt du Nord Congo |
| **Ecorégion aquatique** | Uélé |
| **Partenaires de l'UNESCO** | WWF, FFI, APN |

montrent des caractéristiques morphologiques communes entre l'espèce de forêt et celle de savane. Parmi les espèces typiquement savanicoles, on compte une sous-espèce de girafe congolaise endémique à la Garamba, l'antilope roanne et le bubale. Les espèces forestières évoluant dans les forêts-galeries incluent le chimpanzé, 8 petits primates (babouins, colobes et cercopithèques), 3 céphalophes, le bongo, le potamochère et l'hylochère.

*Le Parc national de la Garamba abritait, jusqu'à récemment ,la dernière population de rhinocéros blancs du nord. Aucun individu n'a été aperçu depuis novembre 2007.*

*Photo © C. Aveling*

Les populations autochtones sont les Azande qui pratiquent une agriculture de subsistance et la chasse. Les densités de population humaines sont faibles (environ 4 habitants/km²) mais les dynamiques sociales et la sécurité de la région ont été sérieusement affectées par les conflits en RDC tout comme par ceux qu'ont connus les pays voisins tels le Soudan et l'Ouganda. Au début des années 1990, la guerre au Soudan a conduit à l'installation de près de 80.000 réfugiés dans des camps à l'est et l'ouest du parc. Les milices soudanaises bien armées et organisées ont régulièrement visé le parc pour y braconner viande, ivoire et corne de rhinocéros. Depuis 2005, les rebelles ougandais de l'Armée de Résistance du Seigneur (LRA) se réfugient régulièrement en RDC pour éviter l'armée ougandaise. En janvier 2009, une attaque sur la station de Nagero a occasionnée la destruction des équipements vitaux (d'une valeur de 1,6m$US) et la mort de dix personnes, parmi lesquelles du personnel de l'ICCN et des membres de leurs familles.

Les populations animales ont décliné de façon drastique au cours des dernières années. En 2006, les éléphants et les buffles étaient estimés à respectivement 3.800 et 8.000 individus, à comparer respectivement aux 11.000 et 25.000 de 1995 et aux 20.000 et 50.000 de la fin des années 1970. Il y a également de sérieux doutes quant aux chances de survie de la dernière population au monde de rhinocéros blancs du nord. En 2004, alors qu'il subsistait une dizaine d'individus, il avait été proposé de déplacer un groupe de 5 reproducteurs vers un site plus sécurisé. L'idée avait finalement été rejetée par le gouvernement devant l'opposition des communautés locales à ce projet. En 2006, seuls 4 individus étaient recensés et plus aucun n'a été vu depuis. Aucune observation n'a été faite depuis novembre 2007 et il est possible que la sous-espèce soit désormais éteinte.

*Savanes herbeuses, savanes boisées, forêts galeries desservies par de nombreux cours d'eau font du Parc national de la Garamba un habitat idéal pour les grands herbivores tels l'éléphant, le buffle et la girafe. On constate un début d'accroissement de la population d'éléphants depuis la fin des hostilités.*

*Photos © C. Aveling*

En mars 2006, un recensement aérien couvrant 4.400 km² de la partie sud de la Garamba et les domaines de chasse adjacents a été conduit par le groupe spécialiste du rhino africain de l'UICN pour le compte de la Fondation African Parks qui gère le parc national de la Garamba sous contrat avec l'ICCN depuis septembre 2005. Bien que le recensement n'ait couvert qu'un tiers de la Garamba, les résultats ont montré des signes encourageants de récupération des populations d'éléphants, de buffles et d'hippopotames. Il y avait également une amélioration importante du ratio entre carcasses vieilles et récentes, les observations montrant que les anciennes étaient bien plus nombreuses que les récentes, témoignant d'une réduction de la pression du braconnage.

# Utiliser la Convention du patrimoine mondial pour intensifier l'appui international et renforcer les partenariats

## Protéger les sites du patrimoine mondial en RDC pendant les périodes de conflit

L'UNESCO a initié son intervention en RDC en faveur des cinq sites du patrimoine mondial au moment où la plupart des agences de développement avaient suspendu leurs activités dans le pays du fait de la guerre civile. Les personnes de ces sites du patrimoine mondial étaient dans une situation désespérée, sans aucune ressource et coupes de leur quartier général basé à Kinshasa. Quatre des sites étaient tombés aux mains des rebelles et le personnel de l'ICCN en poste sur le terrain a été obligé de composer avec un groupe disparate de seigneurs de la guerre qui ne se souciaient guère de la protection des sites du patrimoine mondial. L'occupation de ces sites a donné lieu au pillage des infrastructures existantes et à une exploitation massive de leurs richesses minières, forestières et animales. Dans cette situation de non-droit, des installations illégales, des campements miniers, des villages de pêcheurs, des fermes et ranches d'élevage ont proliféré dans les limites des parcs et la crainte fut réelle que ces sites ne soient irrémédiablement abimés si des mesures d'urgence n'étaient pas prises.

Face à cette situation, la stratégie de l'UNESCO fut de traiter la crise immédiatement sur le terrain, en utilisant la Convention du patrimoine mondial pour promouvoir la protection des sites et mettre très rapidement à disposition le matériel et le support technique indispensables. Parallèlement, des initiatives à plus long terme (renforcement de partenariats internationaux, recyclage du personnel de terrain, développement de financements durables) étaient également initiées afin de préparer l'ICCN aux défis de l'après-conflit. Face à la situation confuse et dangereuse des cinq sites du patrimoine mondial, l'UNESCO bénéficiait d'une position lui permettant d'intervenir, et plus important encore, d'être perçue comme un acteur totalement neutre, tant au niveau international que local puisque toutes les puissances en présence, impliquées d'une manière ou d'une autre dans le conflit, étaient signataires de la Convention du patrimoine mondial.

## Fournir des appuis directs sur le terrain pour faire face aux menaces urgentes pesant sur l'intégrité des sites

L'appui sur le terrain est délivré à travers une coalition de partenaires de l'ICCN réunis par l'UNESCO. Ces organisations affichant de longues années d'expérience en RDC ont toutes choisi de rester aux côtés de l'ICCN en cette période de crise. Au cours de la phase initiale des cinq premières années, de 1999 à 2004, la plus grande partie de cette aide a pris la place d'un appui financier pour payer les gardes et ainsi éviter qu'ils se démotivent et pour maintenir leurs interventions sur le terrain. Cette aide financière a été par la suite complétée par des dotations en équipements essentiels à la poursuite des activités de conservation tels que véhicules, systèmes de communication radio et uniformes, pour remplacer ceux qui avaient été pillés. Des services tels que la surveillance aérienne à la Garamba et aux Virunga furent également fournis. Il ne fait aucun doute que ces appuis et dotations permirent aux sites de survivre à la guerre. Bien que certaines valeurs à l'origine de la création de ces sites aient été affectées durant la crise, à l'exception vraisemblablement du rhinocéros blanc du nord, elles ont été malgré tout préservées. Ce n'aurait certainement pas été le cas sans l'intervention de l'UNESCO. Le courage du personnel de terrain de l'ICCN et de ses partenaires (qui ont couru les risques et supportés les coûts d'acheminement des fonds et de l'équipement sur le terrain) ont également été des éléments essentiels au succès de ces opérations.

Toutefois, si les parcs avaient été préservés entre 1999 et 2004, la situation au moment de la signature des accords de paix restait précaire dans les cinq sites et des actions d'urgence restaient requises pour traiter des aspects spécifiques à chaque aire protégée qui n'avaient pas été pris en compte dans le projet initial. Ainsi dans la deuxième phase du programme des plans d'action d'urgence furent développés pour s'attaquer aux menaces les plus sérieuses. La mise en œuvre de ces plans d'urgence sera poursuivie dans la troisième phase du projet.

**ENCADRÉ 5. PLANS D'ACTION D'URGENCE DEVELOPPES POUR LES 5 SITES DU PATRIMOINE MONDIAL EN RDC**

| | Menaces sur les sites | Actions d'urgence appuyées par l'UNESCO |
|---|---|---|
| **Parc national de la Garamba** | • Braconnage du rhinocéros, de l'éléphant et du buffle par des chasseurs locaux, et par les cavaliers fortement armés et bien organisés.<br>• Isolement et infrastructures en ruines.<br>• Présence de dizaines de milliers de réfugiés soudanais dans la périphérie du parc.<br>• Exploitation de l'or et du diamant dans les réserves de chasse adjacentes au parc. | • Formation des gardes spécifiquement développée pour renforcer la capacité des gardes à affronter les braconniers et les paramilitaires soudanais.<br>• Réhabilitation des infrastructures.<br>• Développement d'une stratégie de conservation communautaire avec des accords de cogestion avec les autorités traditionnelles. Les activités principales incluent l'appui aux infrastructures sociales (centres de santé, écoles …..). |
| **Parc national du Kahuzi-Biega** | • Présence de milices armées dans le secteur de basse altitude en faisant majoritairement une zone de non-droit.<br>• Braconnage d'éléphant et chasse commerciale pour la viande de brousse.<br>• Exploitation du coltan, de l'or et de l'étain.<br>• Agriculture et élevage illégal dans le corridor de Nindja, qui relie les zones d'altitude et les basses terres du parc. | • Appui à l'ICCN pour renforcer les activités de surveillance et reprendre le contrôle du secteur de basse altitude du parc.<br>• Sensibilisation intensive à un haut niveau, communication et délimitation participative avec les communautés pour résoudre le problème d'occupation illégale du corridor biologique de Nindja. |
| **Réserve de faune à okapis** | • Braconnage d'éléphant et chasse commerciale pour la viande de brousse.<br>• Exploitation de l'or et du diamant.<br>• Immigration dans les enclaves de villages permanents à l'intérieur de la réserve suite à la réhabilitation de la route nationale RN4. | • Collaboration avec les autorités militaires et policières pour déployer une surveillance conjointe. En 2007, le contrôle de la quasi-totalité de la réserve était obtenu, les campements miniers évacués et policiers et militaires impliqués dans le braconnage, notamment d'éléphants, étaient déplacés hors de la zone.<br>• Mise en place d'un système de suivi et de contrôle de l'immigration dans les enclaves villageoises de la réserve situées le long de la RN4.<br>• Mise à jour du plan d'aménagement. L'immigration dans la réserve et l'utilisation des ressources naturelles dans la réserve par les communautés bantoues et pygmées sont spécifiquement prises en considération. |
| **Parc national de la Salonga** | • Braconnage d'éléphant et chasse commerciale pour la viande de brousse. | • Collaboration avec la police et les autorités militaires pour déployer une surveillance conjointe contre le braconnage d'éléphant. |
| **Parc national des Virunga** | • Occupation illégale du parc, notamment sur les rives ouest du lac Edouard.<br>• Production illégale de charbon de bois dans les forêts sèches du secteur sud.<br>• Braconnage des grands mammifères, notamment l'hippopotame, dans les secteurs centre et nord du parc. | • Délimitation participative avec les communautés suivie d'une évacuation volontaire. A la fin 2008, quelque 70.000 personnes avaient quitté volontairement le parc (le projet de l'UNESCO fait partie d'une coalition de bailleurs contribuant aux initiatives d'évacuation volontaire).<br>• Appui au développement de solutions et d'alternatives à l'utilisation du charbon de bois. |

## Renforcement des capacités

Des années de laisser-aller, suivies par les effets dévastateurs de la guerre civile, ont érodé les capacités institutionnelles de l'ICCN, peu armé pour affronter les défis de l'après guerre. Le projet a été développé autour de trois axes clés :

- Le renforcement de l'application de la loi et du système de suivi permettant d'améliorer l'efficacité de la surveillance
- L'évaluation du niveau de conservation après guerre des sites et la mise en place de systèmes de suivi (monitoring) de la biodiversité et de systèmes de gestion de l'information
- La modernisation de l'approche de l'ICCN en introduisant de nouveaux concepts de conservation communautaire.

***Renforcement de l'application de la loi et du système de suivi***

Depuis 2002 un effort important porte sur la formation des gardes. La phase initiale a démarré à la Garamba et a été organisée par des spécialistes sud-africains. Entre 2005 et 2006 d'autres séances de formation pour les gardes de tous les sites furent organisées par FZS et LZS (avec des fonds européens et de l'UNESCO) à Ishango. La formation mettait plus

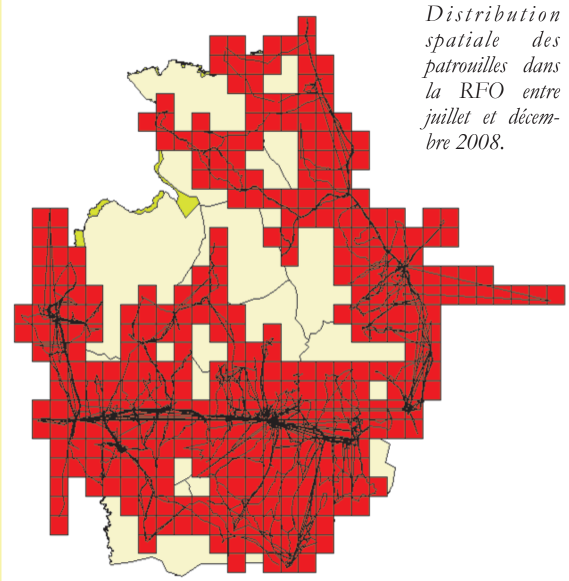
**Encadré 6. Suivi de patrouille**

Le suivi de patrouilles est un outil essentiel aux gestionnaires pour apprécier ce qui se passe dans leurs parcs. Il permet d'ajuster les stratégies d'aménagement en fonction des informations collectées par les patrouilles. Historiquement, les gardes ont toujours été censés fournir des rapports de patrouilles mais la réalité est que ces informations n'étaient pas exploitées car rarement enregistrées de manière systématique ; en outre, les gestionnaires du parc n'avaient ni les ressources ni le temps pour ce travail d'analyse. Trop souvent, le résultat a été des piles poussiéreuses de papiers non lus entassées sur le sol du bureau d'un gardien de parc.

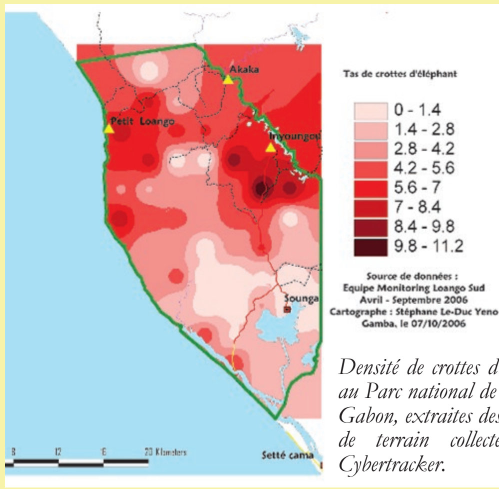
Ordinateurs et GPS ont cependant modifié cela. Des données géo-référencées peuvent désormais être collectées sur le terrain et directement intégrées dans un système SIG pour une analyse rapide. Un tel système, MIST (*Monitoring Information System*), est utilisé avec succès en RDC, dans le Parc national des Virunga et dans la Réserve de faune à okapis. Les données générées fournissent aux gestionnaires de parc une information à jour sur les menaces s'exerçant sur l'aire protégée, ce qui permet une utilisation plus efficace des ressources. MIST permet de mesurer de manière continue l'effort de patrouille (distribution spatiale, quantification des hommes-jours de patrouille) et son efficacité à contrôler les activités illégales et à protéger les espèces les plus vulnérables.

Dans les paysages du TRIDOM et de Gamba-Mayumba-Conkouati, la collecte de données sur le terrain a été améliorée par le recours à la technologie CyberTracker permettant de générer des données géo-référencées grâce à un ordinateur de poche utilisant un écran tactile. Les données sont directement intégrées dans un SIG sans risque d'erreur de transcription et sans perte de temps. CyberTracker permet aussi d'accélérer la collecte de données sur le terrain où papier et crayon ne sont plus indispensables.

* *www.cybertracker.org*



*Distribution spatiale des patrouilles dans la RFO entre juillet et décembre 2008.*




*Densité de crottes d'éléphant au Parc national de Loango, Gabon, extraites des données de terrain collectées avec Cybertracker.*

particulièrement l'accent sur les questions du commandement, de la législation sur la faune, de l'application de la loi, de la résolution des conflits, des compétences paramilitaires et de la maintenance des véhicules.

Le suivi de l'application de la loi (SAL) patrouille est désormais universellement reconnu comme un outil de gestion des aires protégées, en particulier en Afrique où le braconnage est souvent une des indésirables menaces pour l'intégrité des parcs. Il permet aux gestionnaires du parc d'évaluer l'efficacité et l'efficience de ses activités de surveillance en suivant l'effort de conservation (homme-jours de surveillance, répartition spatiale) et de le rapporter aux niveaux d'activités illégales constatées dans l'aire protégée. Le projet a élaboré un système de suivi harmonisé pour l'ensemble des sites, formé le personnel et fourni les GPS et équipement informatique permettant à toutes les données collectées d'être géo-référencées et intégrées dans un Système d'Information Géographique (SIG) sur site.

***Suivi écologique (ou bio-monitoring) et gestion d'information***

*Etude de l'état de conservation des sites.* Ayant perdu le contrôle de plusieurs zones pendant la période de guerre, il était essentiel de connaître leur état de conservation afin d'évaluer l'étendue des dégâts et d'identifier les mesures de correction post-conflit. Des équipes furent formées aux techniques de suivi écologique et un suivi mis en place dès que la situation le permit. Les activités de bio-monitoring ont été coordonnées par l'Unité de Monitoring de WCS en étroite collaboration avec le programme MIKE (*Monitoring of Illegal Killing of Elephants*) et les activités de monitoring du rhinocéros blanc du nord de l'*International Rhino Fund* et *African Parks*. Dans certains cas, comme dans le secteur gorilles du Kahuzi-Biega, l'insécurité empêchait la réalisation des recensements. Dans d'autres, comme à la Salonga ou dans la Réserve faune à okapi, il était possible de couvrir toute la zone, en rencontrant toutefois des difficultés considérables pour des raisons de logistiques et de sécurité. Bien que les résultats témoignent d'un général appauvrissement des populations animales (Encadré 7), la situation n'est pas désespérée. A l'exception du rhinocéros blanc du nord, aucune espèce ne semble avoir disparu et l'appréciation générale laisse supposer que la recolonisation peut s'effectuer si des mesures de conservation efficaces sont maintenues.

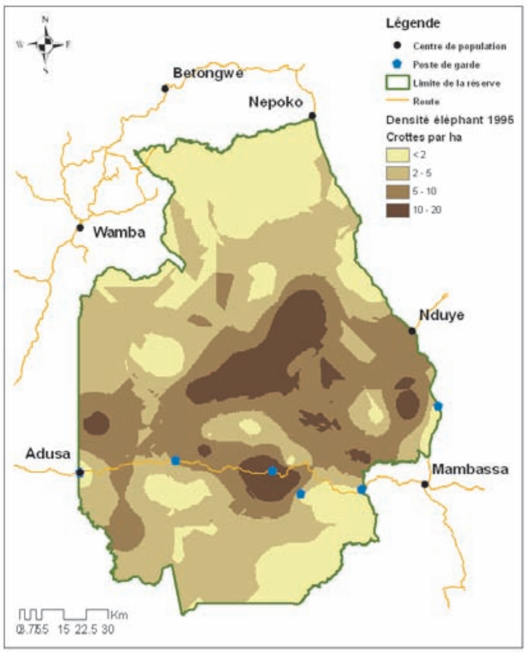
*Système de gestion d'information.* Le traitement des données se rapportant aux aires protégées est crucial. Une bonne gestion des données fournit non seulement une information essentielle à la planification des activités mais elle permet également aux aires protégées de communiquer plus efficacement avec les parties prenantes au niveau local, national ou international. Chose étonnante, il y avait un déficit de cartes détaillées des sites. Comme première étape, le projet a réalisé des cartes de base détaillées pour chaque site. Ce travail fut conduit par deux universités belges (Université Catholique de Louvain et l'Université de Gent avec l'appui du Bureau de Politique Scientifique Fédéral Belge). Parallèlement, le projet a développé et mis en place un système de gestion d'information connu sous le nom de SYGIAP (*Système de Gestion de l'Information des Aires Protégées*). L'équipement a été fourni, les opérateurs de saisie formés et les données, en particulier celles émanant des sites et des suivis patrouilles, ont commencé à alimenter le système (Encadré 6).

*Les éléphants de foret partout dans le bassin du Congo ont payés un lourd tribut au braconnage à cause du commerce international de l'ivoire. Les autorités civiles et militaires sont souvent impliquées.*

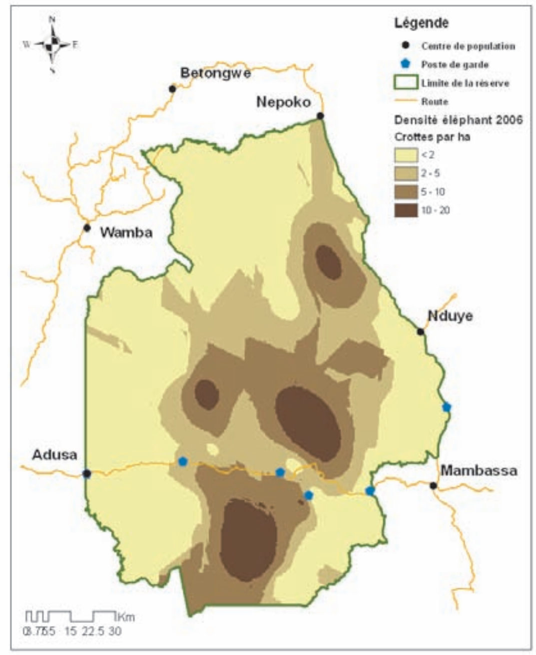
*Photo © Reto Kuster*

## ENCADRÉ 7. L'IMPORTANCE DES DONNÉES COLLECTÉES SUR LE LONG TERME POUR LE SUIVI DES POPULATIONS ANIMALES

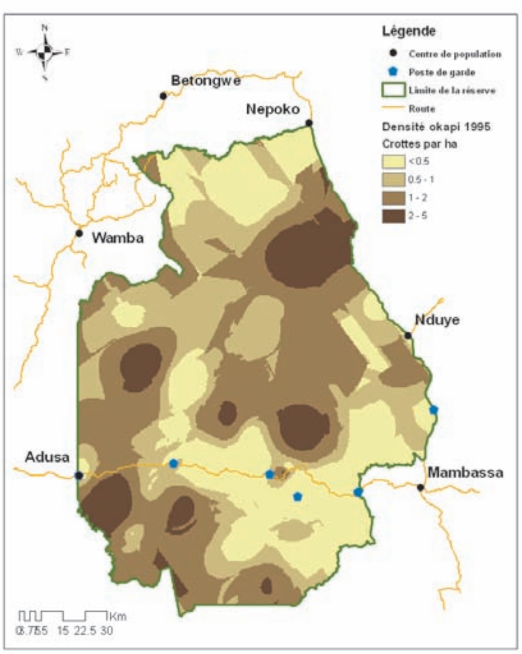
En utilisant une méthodologie standard, les équipes de suivi écologique de l'ICCN et de WCS ont pu montrer l'impact de la guerre sur les populations animales dans la Réserve de faune à okapis. Un déclin significatif a été observé non seulement pour les espèces emblématiques telles les éléphants et les okapis mais également pour les principales espèces de céphalophes.



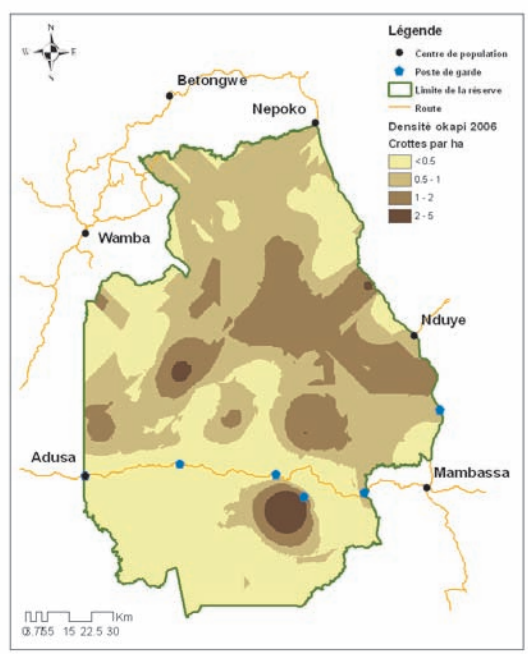

**Densité de crottes d'éléphant 1995**




**Densité de crottes d'éléphant 2006**




**Densité de crottes d'okapi 1995**




**Densité de crottes d'okapi 2006**

*Cartes: Rene Beyers*

## ENCADRÉ 8 LA DELIMITATION PARTICIPATIVE DANS LE PARC NATIONAL DES VIRUNGA

Les limites du parc national des Virunga ont été établies il y a 70 ans, quand les contextes démographiques et politiques étaient fort différents de ceux d'aujourd'hui. La croissance démographique et les migrations de populations causées par les récents conflits dans la région des Grands Lacs se sont traduits par une pression accrue sur les terres, celles situées dans le parc devenant l'objet de toutes les convoitises. Après tant d'années, la plupart des bornes et des repères physiques ont disparu, les descriptions des délimitations dans les textes légaux ne sont plus identifiables et des arrangements ont parfois été conclus entre l'ICCN et les populations locales afin de désamorcer les conflits nés des tensions pour l'accès aux terres cultivables. Ainsi, à de multiples endroits, les limites du parc ont été ignorées par les populations locales, soit délibérément, soit par inadvertance, et la période de conflits n'a fait qu'amplifier cette tendance. Au moment où l'ICCN tente de réinstaurer son contrôle sur le parc, la confusion concernant les limites du parc contribue à attiser les tensions et les conflits puisque au moins 3 interprétations de limites du parc existent : les limites de l'ICCN (qui peuvent correspondre ou pas aux vraies limites), les limites de la population (qui correspondent à l'interprétation, erronée ou pas, des communautés locales) et la limite légale (qui est la délimitation telle que définie dans les textes légaux).

L'ICCN et le WWF, avec l'appui du programme UNESCO, ont développé une méthode innovante pour traiter le problème en impliquant toutes les parties prenantes locales dans un processus de délimitation participatif. Les principes qui sous-tendent le processus sont :

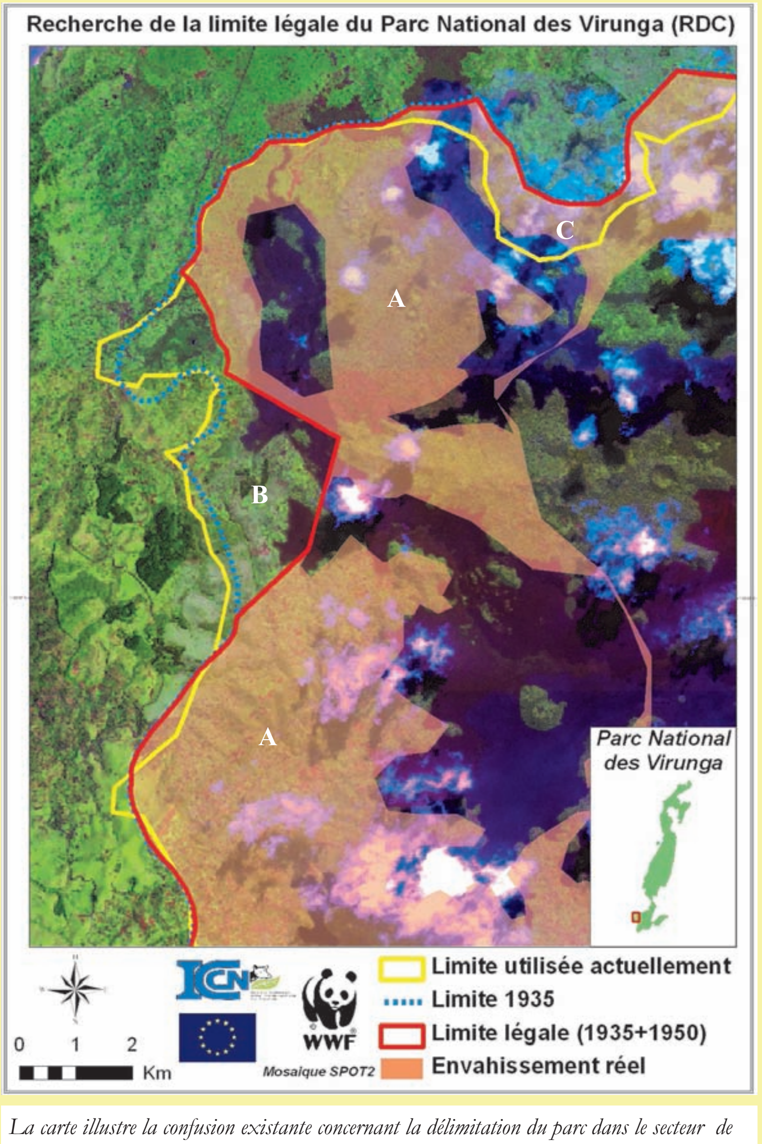
- le PNVi constitue un patrimoine national et international que seul un décret présidentiel peut changer
- les limites sont celles originellement publiées en 1935 et 1950
- les communautés locales doivent en connaître exactement l'emplacement afin de planifier leurs activités traditionnelles
- les délimitations, qu'elles soient naturelles ou aménagées, doivent être acceptées par tous et officiellement enregistrées (points GPS, placement d'indicateurs et description écrite des sites)
- autant que faire se peut, l'ICCN doit aider les communautés locales qui expriment une volonté de respecter les limites du parc à obtenir en compensation des terres en dehors des limites du parc

La méthode suppose que l'on travaille secteur par secteur avec une commission mixte composée de représentants du bureau du Gouverneur, du cadastre, des autorités traditionnelles, WWF et ICCN. Les géomètres, les agronomes et toute personne ressource possédant une connaissance historique particulière de la zone doivent également être impliqués.

Les désaccords sont résolus par consensus et les décisions formellement actées. Les repères physiques sont ensuite placés et un rapport certifié est signé conjointement par l'ICCN et les autorités traditionnelles.

Ce processus est la base sur laquelle les évacuations volontaires des gens illégalement installés dans le parc s'effectuent. L'ICCN et ses partenaires de la conservation aident à identifier les zones où ces populations peuvent être réinstallées et à négocier avec les communautés qui les hébergeront. Ce sont déjà près de 70.000 personnes qui ont été volontairement évacuées du parc. Les populations vivant en bordure et respectant les limites du parc reçoivent un appui de l'ICCN. Cela peut prendre plusieurs aspects, allant de mise en place de pépinières villageoises à celles de diverses infrastructures sociales (captage de sources, écoles, dispensaires, etc.).

*Source: WWF - PNVi.*

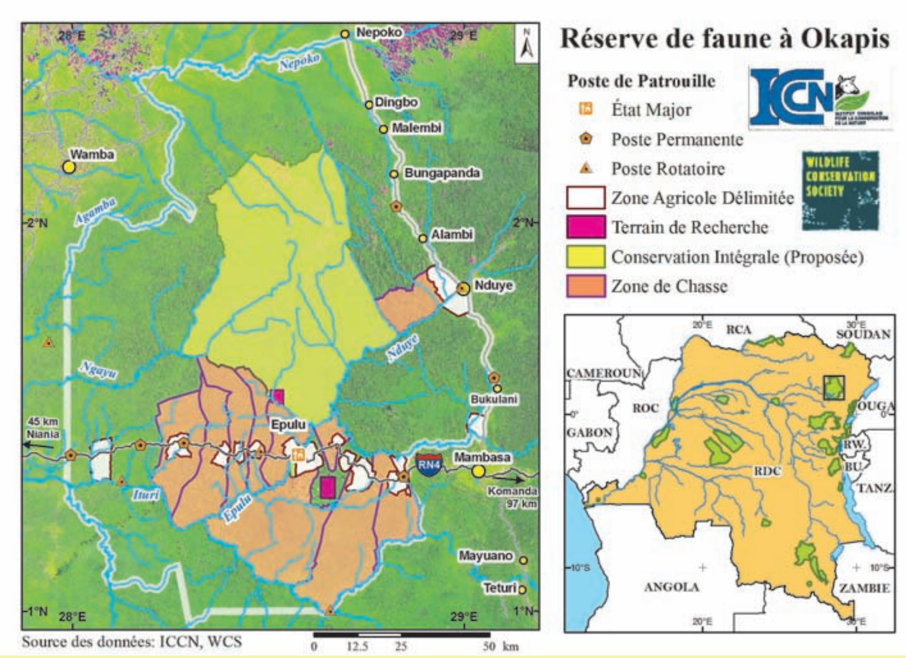



*La carte illustre la confusion existante concernant la délimitation du parc dans le secteur de Kirolirwe, au sud du PNVi. L'ICCN tente de faire respecter la limite marquée en jaune, qui suit plus ou moins la délimitation d'origine de 1935 (pointillés bleus) plutôt que la délimitation légale correspondent aux modifications de 1950 (ligne rouge). Si quasiment toute la zone est illégalement occupée, (A - zones en rose), l'interprétation erronée de l'ICCN signifie que dans certains endroits, on expulse des gens qui ont le droit d'être là (B) alors qu'on accepte par ailleurs la présence de gens à l'intérieur du parc (C) .*

*Carte: Bruno Hugel, WWF*

## Encadré 9. Zonage des activités humaines et gestion de l'immigration dans la Reserve de faune à okapis.

La Réserve de faune à okapis possède plusieurs campements à l'intérieur de ses limites. Ces enclaves sont des villages situés le long de la route nationale RN4 et le long de la limite qui existait avant la création de la réserve. Les pygmées Mbuti et Efe vivent également dans la réserve et sont autorisés à poursuivre leurs activités traditionnelles de chasse et de cueillette. S'assurer que les activités humaines exercées dans la réserve ne menacent pas l'intégrité du site est un des principaux défis que l'ICCN doit relever.




La récente période de conflit, suivie d'initiatives de réhabilitation après les accords de paix, a introduit de nouveaux défis. L'émigration pour fuir la guerre et la surpopulation des hautes terres à l'Est ont amené de nombreuses nouvelles familles à s'installer dans les villages de la réserve le long de la RN4. Le problème a été exacerbé par la réhabilitation de cette route qui d'un simple sentier pendant 20 ans est brusquement redevenue un axe de communication majeur emprunté chaque mois par des centaines de véhicules qui transportent des populations en quête de nouvelles terres. Cela s'est également traduit par une augmentation sans précédent du volume de ressources naturelles illégalement sorties de la forêt de l'Ituri (viande de brousse, bois et autres PFNL).

Depuis 2000, l'ICCN et ses partenaires WCS et GIC, à travers le programme UNESCO, ont développé des stratégies pour gérer ces épineux problèmes d'immigration et d'exploitation non durable des ressources naturelles par les villageois de la RFO. A travers un processus participatif impliquant toutes les parties prenantes, une série de zones agricoles sont en cours d'établissement autour des villages et des règles et principes sur le type et l'échelle des activités dans ces zones sont formellement validés par tous. En retour, la RFO aide les résidents à développer des activités agricoles plus durables en diversifiant et améliorant les pratiques agricoles. Parallèlement un système pour suivre et contrôler l'immigration dans la réserve a été mis en place afin de stabiliser le nombre d'arrivants dans les zones agricoles.

L'intégration des besoins particuliers des pygmées Mbuti et Efe dans la stratégie de gestion de la réserve constitue un défi particulier. Leur mode de vie semi-nomade de chasseurs-cueilleurs et leur relation particulière avec les communautés bantoues, décrite par les anthropologues comme « clientélisme politique » (une relation volontaire entre deux parties où les pouvoirs et accès aux ressources ne sont pas égaux), rend la gestion particulièrement complexe. Si la chasse traditionnelle et les activités de cueillette dans la réserve sont maintenues, il est évident que les limites doivent en être fixées. Les résultats du bio-monitoring mettent clairement en évidence que les niveaux actuels de chasse au filet, ainsi que la chasse au piège pratiquée par les bantous résidents qui approvisionnent les réseaux commerciaux de viande de brousse, réduisent de manière significative les populations d'ongulés. La création d'un système de zonage de la chasse, avec des règles acceptées et respectées par tout le monde, combinée avec une zone de protection intégrale, permettra de pérenniser les ressources qui constituent la base de leur mode de vie traditionnel.


*Photo © Kim S. Gjerstad*

***Introduction de nouveaux concepts de conservation communautaire***

Historiquement, l'ICCN était l'un des leaders de la gestion des aires protégées en Afrique. Malheureusement, les années de troubles et de négligence n'ont pas permis à l'ICCN de suivre les tendances récentes en matière de conservation , qui mettent d'avantages l'accent sur la consultation plutôt que sur la seul coercition. Dans le contexte qui caractérise la RDC, l'application de la loi et la gestion des forces militaires incontrôlées resteront à court terme des composantes importantes de la gestion d'aires protégées. Cependant la préservation des parcs ne sera durablement assurée que si les communautés locales comprennent qu'il est dans leur intérêt de les soutenir.

Un des objectifs du projet consistait donc à appuyer l'ICCN pour élaborer une stratégie nationale pour la conservation communautaire. Elle a été préparée avec l'appui technique de FFI, en étroite collaboration avec le PNUD/GEF, et a associé l'ensemble des partenaires de la conservation. Elle constitue désormais le document de référence pour toutes les aires protégées en RDC.

Appliquant cette stratégie, le projet a également développé un programme de formation pour les agents intervenant sur cette thématique. Les sessions de formation sont délivrées au personnel clé de tous les sites du patrimoine mondial et autres aires protégées en RDC.

La conservation communautaire doit être adaptée aux spécificités de chacun des sites. Toutefois, un élément commun à toutes les activités de conservation communautaire est le dialogue permanent à instaurer entre les différents protagonistes. C'est par ce dialogue que les problèmes et aspirations de chaque partie peuvent être exposés et des solutions négociées sur la base d'une répartition claire des droits et des responsabilités. Des initiatives pilotes ont été développées au cours de la première phase du projet et des activités plus substantielles ont été également initiées au cours de la mise en œuvre de la seconde phase (Encadrés 8 et 9).

## Renforcement et coordination des partenariats

***La coordination entre partenaires***

Une bonne coordination entre les différents acteurs est un élément clé pour le succès d'une intervention et là encore, le rôle de l'UNESCO a été essentiel. Les ONG environnementales et les bailleurs de fonds ont parfois du mal à travailler en phase mais dans le cas présent, la crise était si profonde que l'UNESCO s'est constituée en pilier sur lequel les partenaires se sont appuyés pour travailler en synergie. Le fondement de cette coordination est la Coalition pour la Conservation au Congo (*CoCoCongo*), un concept issu du noyau que formaient l'ICCN et ses partenaires lorsqu'ils s'étaient réunis pour la première fois à Nairobi en 1998 (à l'initiative de la GTZ) pour discuter des mesures d'urgence à prendre en faveur des sites du patrimoine mondial. Le *CoCoCongo* est composé de l'ICCN, de ses partenaires pour la conservation et des agences de développement qui contribuent financièrement. Il est basé à Kinshasa et assure une approche concertée et coordonnée au niveau national. Il est un outil important pour la communication avec la communauté internationale et est également un point de référence pour les nouveaux partenaires souhaitant se joindre aux efforts en cours.

Chaque site du patrimoine mondial possède un Comité de Coordination du Site (*CoCoSi*) créé pour garantir la coordination entre partenaires sur le terrain et s'assurer que les priorités de l'ICCN sont bien prises en considération. Cette structure innovante s'est révélée efficace et a permis à l'ICCN de réaffirmer son leadership dans les sites, un rôle qui avait été éclipsé durant les périodes de troubles, quand chaque partenaire avait tendance à travailler de manière isolée, soucieux avant tout de relever les défis sur le terrain. Le *CoCoSi* a depuis été reproduit au sein du réseau d'aires protégées de la RDC.

***La diplomatie de la conservation, le lobbying et la communication***
Un appui effectif sur le terrain dépend de la compréhension, par l'ensemble des parties en présence, de l'importance des sites, et de l'appui apporté au personnel de l'ICCN et de ses partenaires pour mener les activités de conservation. Dès le début du conflit, des missions diplomatiques ont été dépêchées pour rencontrer les divers protagonistes et obtenir un accord pour la poursuite des activités de conservation. Ces missions supposaient des rencontres au plus haut niveau avec les autorités compétentes de chaque pays impliqué dans le conflit ainsi qu'avec les commandements des différentes forces armées opérant dans la région. L'ensemble était coordonné avec la force de maintien de la paix des Nations-Unies, la MONUC, et l'armée congolaise. Elles étaient accompagnées de campagnes d'information dans les média afin de révéler la triste situation de ces sites. Des réunions tripartites entre les autorités en charge des aires protégées dans les zones contrôlées par le gouvernement et les zones sous contrôle des rebelles étaient organisées en terrain neutre à Nairobi. La sensibilisation menée par les missions de l' UNESCO a permis d'infléchir certains excès de l'armée congolaise dans les parcs et d'obtenir l'appui politique nécessaire pour traiter le problème de l'implantation illégale dans ces mêmes parcs.

**ENCADRÉ 10. ENGAGEMENTS DU GOUVERNEMENT DE LA RDC À LA CONFERENCE DES BAILLEURS DE PARIS EN 2004**

- Mettre en place un fonds fiduciaire pour la réhabilitation des sites du patrimoine mondial, avec une contribution inscrite à la Loi de Finances publiée par la RDC dès 2005 ;
- Prendre des mesures effectives afin d'évacuer les troupes et populations civiles ayant envahi les sites et contribué à leur dégradation ;
- Participer à la protection et à la restauration de l'intégrité des sites du patrimoine mondial ;
- Garantir le paiement des salaires au personnel des sites ;
- Appuyer le travail de l'ICCN ;
- Assurer que l'intégrité des sites est respectée et prendre en compte les intérêts des populations locales en encourageant le développement participatif et les projets de reconstruction ;
- Garantir que les populations bénéficient de manière correcte des retombées des bénéfices financiers générés par l'écotourisme.

Au niveau national et international, le Comité du patrimoine mondial a renforcé le dialogue avec la communauté de la conservation et assuré le lobbying pour accroitre son implication. En septembre 2004 le Centre du patrimoine mondial a organisé une conférence internationale pour les bailleurs et les partenaires de la conservation au Siège de l'UNESCO à Paris. Plus de 240 participants y ont pris part, créant ainsi le forum idéal pour démontrer à la communauté internationale l'engagement de l'ICCN en faveur de la conservation de la biodiversité, en dépit des circonstances prévalant dans le pays, et pour militer en faveur d'un appui politique et financier accru pour les sites du patrimoine mondial en RDC (Encadré 10). Des engagements importants envers l'ICCN en faveur des sites du patrimoine mondial furent pris par la Belgique, l'Italie, l'Allemagne (GTZ et KfW), les USA (CARPE), l'Union Européenne, la Banque Mondiale-GEF, le PNUD-GEF et l'UNF.

Le comité du patrimoine mondial de l'UNESCO se montra également particulièrement efficace pour développer un lobbying au plus haut niveau de l'Etat afin que :

- les travaux de réhabilitation de la RN3 et de la RN4, qui traversent respectivement le Parc national du Kahuzi-Biega et la Réserve de faune à Okapis soient suspendus jusqu'à ce qu'une étude d'impact environnemental soit réalisée et que des mesures de compensation agréées par tous soient prises ;
- les permis miniers attribués récemment et empiétant sur trois sites du patrimoine mondial soient de nouveau examinés, et qu'un groupe de travail technique mixte soit mis en place pour assurer le suivi de ce dossier ;
- des assurances formelles soient obtenues du gouvernement afin que les permis d'exploitation pétrolière attribués à Dominion Congo Limited, qui englobent la totalité des secteurs centre et sud du Parc national des Virunga, respectent le statut du parc;
- une meilleure collaboration soit développée entre l'ICCN et la MONUC et les FARDC, pour

permettre à l'ICCN de poursuivre ses activités de conservation. Dans certains cas la MONUC a participé à des activités conjointes de surveillance et a facilité des rencontres avec des groupes rebelles contrôlant certains sites. Les FARDC et la MONUC sont aussi membres d'une série de comités, connus comme *Comités de Sauvegarde*, pour les différents sites.

### *Financement durable*

Dans la première phase du programme, de 1999 à 2004, plus de 60% du budget du projet étaient affectés au paiement des primes sur les salaires du personnel des parcs permettant ainsi la poursuite des activités de conservation sur le terrain. Durant la seconde phase, tout en continuant à dépendre des bailleurs de fonds pour le paiement des gardes sur le court terme, il était essentiel de s'orienter vers une solution à plus long terme pour financer le fonctionnement des cinq sites du patrimoine mondial.

En travaillant étroitement avec les spécialistes en financement durable du WWF, l'UNESCO a développé un concept pour un fonds fiduciaire avec lequel elle a démarché des bailleurs. Ce fonds bénéficie de garanties légales et fiscales et apporte toutes les assurances aux nouveaux partenaires. Son capital sera investi à très long terme sur les marchés financiers internationaux et le retour sur investissement sera utilisé pour couvrir les besoins financiers des aires protégées prioritaires et la gestion des ressources naturelles dans leur périphérie. Le fonds sera géré par un conseil d'administration indépendant et représentatif des acteurs en présence, avec une majorité de membres issus du secteur privé. Les sources potentielles de financement incluent à la fois les bailleurs nationaux et internationaux et pourrait intégrer les contributions résultant de conversion de dettes, de crédits carbone. Un gestionnaire internationalement reconnu pour ses compétences va gérer les placements sur la base d'instructions fournies par le conseil d'administration en respectant des critères sociaux et environnementaux spécifiques. La stratégie d'investissement devrait être basée sur une diversification des types de produits et de marchés.

Le gouvernement belge a déjà réservé 1 million d'Euro pour constituer ce fonds fiduciaire

*Ci-dessous: l'appui direct aux gardes de l'ICCN avec fourniture d'équipement de terrain, versement de primes et formation a permis aux sites du patrimoine mondial en RDC de surmonter la période de conflits. Plusieurs agents de l'ICCN, ainsi que des membres de leurs familles, ont perdu la vie pendant cette période trouble.*

*Photo © Kim S. Gjerstad*

et d'autres potentiels investisseurs, comme la France, l'Allemagne et le Royaume Uni ont également manifesté leur intérêt. En juin 2008, le gouvernement de la RDC a mis en place un comité de pilotage chargé de définir le profil du fonds, d'élaborer ses outils de gestion et de mobiliser des ressources financières. Le comité de pilotage sera composé de représentants du gouvernement, de la société civile, d'ONG environnementales, d'agences de développement et du secteur privé.

## 10 ans plus tard en RDC….

Il est largement acquis que sans l'appui, à un moment si critique, du projet « Conservation de la biodiversité dans les zones de conflit armé » et sans l'engagement remarquable du personnel de l'ICCN sur le terrain ainsi que celui de ses partenaires restés à ses côtés pendant la crise, il ne resterait pas grand-chose de la valeur universelle exceptionnelle des sites du patrimoine mondial de la RDC. La forte pression exercée sur ces biens et qui menaçait de les submerger a pu être contenue et l'ICCN a pu peu à peu rependre, au cours des 8 années qui ont suivi, le contrôle sur les aires protégées. Il y a de nombreuses raisons d'être optimiste. L'ICCN a restauré son autorité sur la Réserve de faune à okapis. Aux Virunga , il est parvenu à obtenir le déplacement volontaire, hors des limites du bien, des occupants illégaux installés dans le Parc. A la Garamba, c'est la diminution de la pression du braconnage qui a pu être obtenue.

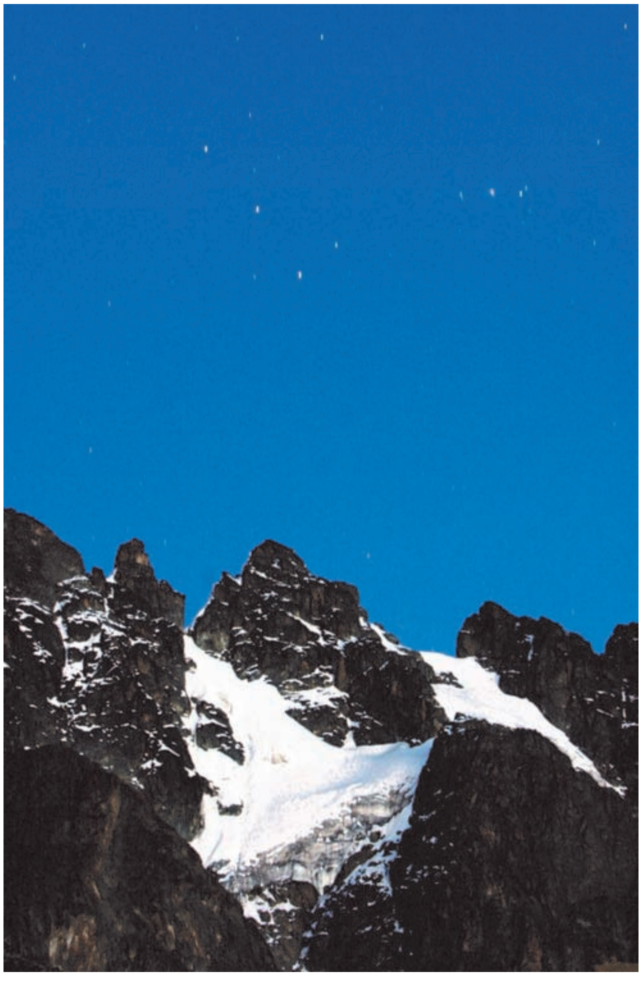
Toutefois, la bataille est loin d'être gagnée et de nouvelles crises continuent d'agiter la région, mettant à rude épreuve la détermination de l'ICCN et de ses partenaires. Début 2009, de nouveaux combats éclataient à l'est du Congo, à la suite des efforts du gouvernement pour neutraliser les groupes rebelles CNDP, FDLR et LRA. Ces combats ont affecté les Parcs nationaux du Kahuzi-Biega, des Virunga et de la Garamba. Dans chaque site, et à des niveaux variés, perdurent l'exploitation illégale des ressources naturelles ainsi que des implantations illégales de population. Cependant, le répit obtenu grâce au soutien de la communauté internationale pendant la période de crise a permis à l'ICCN de se rassembler et de préparer sa mutation d'une situation de gestion de crise vers un mode plus réfléchi, avec des objectifs à long terme basés sur une stratégie affirmée et bénéficiant de l'appui de la communauté internationale.

Le projet a démontré comment la Convention du patrimoine mondial peut mobiliser la communauté internationale en période de crise et exercer une pression afin de résoudre des problèmes affectant des sites à fort capital écologique. Le contexte particulier dans lequel ce projet a opéré a mis en évidence la valeur ajoutée que confère une vision commune partagée par plusieurs partenaires travaillant de concert sur le terrain. Les partenaires ont collaboré pour développer des liens novateurs entre conservation de la biodiversité et développement durable, des modèles réplicables ont été développés au niveau des sites pour traiter les menaces sur la biodiversité.

L'attention suscitée par l'intervention de l'UNESCO a rehaussé l'importance de la conservation de la biodiversité, en RDC mais plus globalement en Afrique centrale, et a ouvert la voie pour étendre la notion de patrimoine mondial dans le bassin du Congo.

*Glacier et neiges éternelles sur l'Equateur. Le massif du Ruwenzori, un des éléments exceptionnels ayant justifié l'inscription du Parc national des Virunga sur la Liste du patrimoine mondial. Le Parc a pu survivre à la période de guerre grâce à l'appui de l'UNESCO et la coalition d'ONG internationales de conservation*

*Photo © Kim S. Gjerstad*



# PRÉPARER LE TERRAIN POUR DE NOUVEAUX SITES DU PATRIMOINE MONDIAL EN AFRIQUE CENTRALE

## L'INITIATIVE POUR LE PATRIMOINE MONDIAL FORESTIER D'AFRIQUE CENTRALE (CAWHFI)

Bien que la RDC se taille la part du lion des forêts d'Afrique centrale et compte un nombre important de sites du patrimoine mondial, il existe d'autres sites hors de la RDC qui ont une importance exceptionnelle et pourraient prétendre au statut de site du patrimoine mondial. En capitalisant sur le succès du projet en RDC, le Centre du patrimoine mondial de l'UNESCO appuie, depuis 2004, une série d'interventions qui ouvrent la voie pour intégrer de nouveaux sites. Ces initiatives sont réalisées dans le cadre de l'Initiative pour le patrimoine mondial forestier d'Afrique centrale, connue sous l'acronyme CAWHFI (*Central African World Heritage Forest Initiative*).

CAWHFI est une collaboration entre le Centre du patrimoine mondial de l'UNESCO, la FAO, des ONG internationales de conservation (WWF, WCS, CI) et les autorités nationales en charge des aires protégées dans la sous-région. L'initiative est financée par la Fondation des Nations Unies, le Fonds Français pour l'Environnement Mondial et la Commission Européenne. Les ONG participant au programme apportent des fonds de contrepartie. Le projet a adopté une approche en 4 volets :

- appui sur le terrain pour renforcer la gestion d'aires protégées identifiées de par leur potentiel pour accéder au statut de site du patrimoine mondial ;
- Travailler avec le secteur privé et les parties prenantes locales afin de promouvoir une utilisation durable des ressources naturelles, en particulier le commerce du gibier, dans les paysages multi-usages où sont localisés les séries d'aires protégées concernées ;
- Utiliser le processus du patrimoine mondial pour améliorer la sensibilisation aux richesses naturelles exceptionnelles de ces sites et appuyer les gouvernements pour identifier et prioriser les sites qui, par une inscription sur la liste du patrimoine mondial, assureraient une meilleure représentation des valeurs universelles exceptionnelles du patrimoine naturel de la région ;
- Appui au développement de mécanismes de financement durable pour la conservation

L'approche par paysages transfrontaliers qui caractérise CAWFHI est totalement en phase avec les priorités stratégiques de la COMIFAC et du PFBC. Elle se concentre sur trois paysages exceptionnels :

i. Conkouati-Mayumba-Gamba (Républiques du Gabon et du Congo)
ii. Tri National de la Sangha (TNS) (Républiques du Cameroun et de Centrafrique)
iii. Tri National Dja-Odzala-Minkébé (TRIDOM) (Républiques du Gabon, du Cameroun, et du Congo)

Chacun de ces paysages transfrontaliers regroupe un ensemble d'aires protégées couvrant 25% de la superficie totale des paysages.

# Paysage de Gamba-Mayumba-Conkouati


**Le paysage Gamba-Mayumba-Conkouati en bref** *

**Pays concernés :** Républiques du Congo et du Gabon
**Coordonnées** : 1°36'26"S à 4°26'26"S; 9°15'48"E à 12°24'28"E
**Superficie :** 47.346 km², dont 36.926 km² terrestre et 10.420 km² marine
**Altitude :** 0 – 840 m
**Ecorégions terrestres :** Forêts congolaises atlantiques ; mosaïques savane-forêt congolaises de l'ouest
**Ecorégions aquatiques :** écorégion côtière équatoriale occidentale la plus méridionale
**Aires protégées**

Parc national de Loango, 153.581 ha, 2002, Gabon
Parc national de Moukalaba-Doudou, 502.805 ha, 2002, Gabon
Parc national de Mayumba, 80.000 ha, 2002, Gabon
Parc national de Conkouati-Douli, 505.000 ha, 1980/1999, République du Congo
Domaine de chasse de Ngové-Ndogo, 1956, Gabon (statut légal en cours de redéfinition)
Domaine de chasse d'Iguela, 1962, Gabon (statut légal en cours de redéfinition)
Domaine de chasse de Moukalaba, 20.000 ha, 1962, Gabon (statut légal en cours de redéfinition)
Domaine de chasse de Sette Cama, 1962, Gabon (statut légal en cours de redéfinition)
Réserve de faune de la plaine Ouanga, 1962, Gabon (statut légal en cours de redéfinition)
Aire d'exploitation rationnelle de faune des Monts Doudou, 1988 (quasiment entièrement redéfinie comme Parc national de Moukalaba-Doudou ; statut légal des zones restantes pas encore défini)

**Partenaires de l'UNESCO** : WWF, WCS.

*(*) Sources : l'Etat des Forêts 2006 et WWF Gabon*

Situé le long de la côte Atlantique du Gabon et du Congo, le paysage de Gamba-Mayumba-Conkouati couvre 53.290 km², dont les trois quarts sont au Gabon. Il est centré sur les parcs nationaux de Loango, de Moukalaba-Doudou et de Mayumba au Gabon et du parc national de Conkouati-Douli au Congo. Mayumba et Conkouati-Douli ont une partie marine qui s'étend respectivement à 15 et 22 km de la côte; étant contigus, ils offrent 120 km de zone côtière protégée. Le paysage comprend également 1.500 km² de concessions forestières, 4.300 km² de permis d'exploration et de production de pétrole et de gaz, un élevage de bétail de 1.000 km² au Gabon et 276 km² de plantations d'eucalyptus au Congo.

Le paysage est particulièrement varié car à la conjonction de trois des 200 écorégions identifiées par le WWF (*WWF Global 200 Ecoregions*) : la forêt équatoriale atlantique, les mosaïques savane-forêt congolaises de l'ouest et les mangroves côtières guinéo-congolaises. Ce mélange d'écosystèmes forme une biodiversité exceptionnellement riche et place le paysage parmi les priorités pour la conservation au niveau régional. Plus de 11% d'espèces de plantes du paysage sont endémiques à cette zone biogéographique. La diversité floristique de Mont Doudou est particulièrement élevée, ce qui tend à confirmer la théorie selon laquelle les Monts Doudou seraient une zone refuge forestière du Pléistocène. La diversité de la flore du paysage est à rapprocher de la diversité de sa faune, tant terrestre qu'aquatique. Il abrite d'importantes populations de grands mammifères comme l'éléphant de forêt, le gorille de plaine de l'ouest, le chimpanzé, le mandrill, le buffle de forêt, l'hippopotame et probablement la population la plus importante de lamantins en Afrique de l'ouest. Le fait que plusieurs de ces espèces puissent être observées en bord de mer fait de ce paysage un endroit très particulier. Le spectacle est encore renforcé par la présence du crocodile du Nil, de 4 espèces de tortues marines et de 17 espèces de cétacés, dont 5 espèces de baleines dans les eaux au large du paysage. Les baleines à bosse, migrant pour leur reproduction de l'océan austral vers les chaudes eaux tropicales sont particulièrement abondantes entre juin et octobre. On estime que 10% de la population mondiale de baleines à bosse se reproduit dans le Golfe de Guinée. Les 120 km de côte protégée des parcs nationaux de Mayumba et Conkouati-Douli constituent également la plus importante zone au monde pour la reproduction des tortues-luth.

*En haut: Une baleine à bosse au large du parc national de Mayumba au Gabon. On estime que 10% de la population des baleines à bosse viennent se reproduire dans le golfe de Guinée.*

*Photo © Tim Collins - Ocean Giants/WCS*

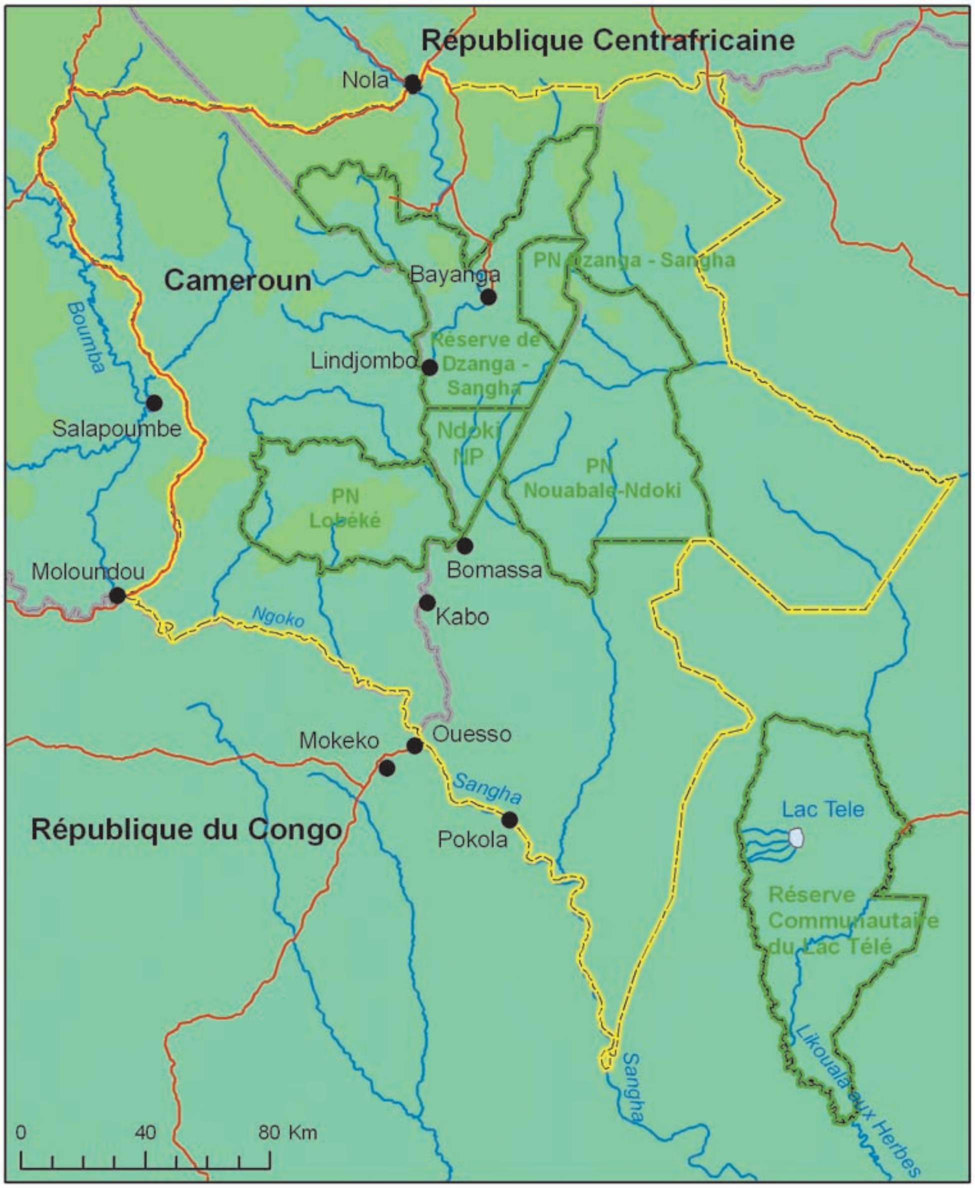
*En bas: Dans le complexe des aires protégées de Gamba, au Gabon, les éléphants de forêt fréquentent les plages et les lagunes du littoral.*

*Photo © A. Marin*

Les ressources naturelles du paysage, en particulier le poisson et le gibier, sont essentielles au mode de vie des populations. Celles-ci sont estimées à 26.000 personnes. L'exode rural a réduit la densité de population à 0,7 personne/km² mais les grandes villes dans ou à proximité du paysage exercent une forte pression sur ses ressources naturelles. Les villes les plus importantes sont Gamba, créée par Shell Gabon en 1963, et Mayumba. La seconde plus grande ville du Congo, Pointe-Noire, est située juste au sud du parc national de Conkouati-Douli. Avec une population d'environ 663.400 personnes (recensement de 2005), les marchés urbains de Pointe Noire ont un impact particulièrement élevé aux ressources naturelles du Parc national de Conkouati-Douli.

Les principales directes sur la biodiversité sont les pratiques non durables de chasse et de pêche locale et commerciale, l'exploitation forestière non durable, les pratiques agricoles non durables, les risques de pollution liés à l'exploitation pétrolière on-shore et off-shore, et les impacts environnementaux des futures activités minières. Plusieurs compagnies se sont vues attribuer des permis d'exploration pétrolière, de gaz et minière recouvrant l'ensemble des parcs nationaux du paysage. La production pétrolière off-shore dans les parcs nationaux de Mayumba et de Conkouati-Douli est déjà en cours.

# PAYSAGE DU TRI-NATIONAL DE LA SANGHA




**Le paysage des Tri-National de la Sangha en bref**

**Pays concernés** : République du Congo, du Cameroun et de la Centrafrique.
**Coordonnées** : 3°32'12"S à 0°40'29"S; 15°28'26"E à 1°34'08"E
**Superficie :** 36.236 km²
**Altitude :** 330 - 700 m
**Ecorégions terrestres :** Forêts congolaises du nord ouest.
**Ecorégions aquatiques :** écorégion de la Sangha
**Aires protégées :**

Parc national Nouabalé-Ndoki, 419.000 ha, 1993, République du Congo
Parc national de Lobéké, 43.000 ha, 2001, Cameroun
Parc national de Dzanga-Ndoki, 125.100 ha, 1990, RCA
Réserve spéciale de Dzanga-Sangha, 310.100 ha, 1990, RCA

**Partenaires de l'UNESCO** : WWF, WCS.
*(*) Source: Etat des forêts 2006*

Comme son nom le suggère, ce paysage couvre trois pays et est traversé du nord au sud par la rivière Sangha. Il recèle de vastes étendues de forêt intacte, offrant une quasi intégrité écologique et abritant une des plus grandes populations de mammifères d'Afrique, en particulier d'éléphants et de gorilles. Les perspectives de conservation sur une si grande zone sont particulièrement prometteuses, les aires protégées couvrant 21,5% du paysage avec des accords formels entre les trois pays concrétisés depuis 2000. Il existe un excellent potentiel pour le développement de l'écotourisme, en particulier pour l'observation de l'éléphant de forêt et du gorille, permettant de concentrer l'intérêt international sur le paysage. Le tourisme cynégétique qui a une forte valeur ajoutée économique est développé au Cameroun et en RCA, et a un potentiel considérable.

Dans sa partie congolaise le paysage couvre une superficie de 21,470 km², incluant le parc national de Nouabalé-Ndoki et cinq concessions forestières en exploitation qui jouent le rôle de zones tampons par rapport au parc. La partie centrafricaine couvre 4,644 km², composée essentiellement du parc national de Dzanga-Ndoki, divisé en deux secteurs, Dzanga et Ndoki, et de la réserve spéciale de Dzanga-Sangha jouant le rôle de zone tampon entre les deux secteurs. Les deux unités d'aménagement dans la réserve spéciale de Dzanga-Sangha ne sont actuellement pas exploitées. La partie camerounaise est centrée sur le parc national de Lobéké entouré au nord, ouest et sud par des zones tampons comprenant six zones cynégétiques villageoises, sept concessions de chasse sportive et 14 unités d'aménagement forestiers attribuées à cinq exploitants.

La composition végétale de ce paysage comprend la forêt de terre ferme semi-décidue, la forêt mono dominante à *Gilbertiodendron*, la forêt à Marantaceae, la forêt marécageuse, et la

*La très connue saline (bai) de Bayanga, dans la partie centrafricaine du paysage du Tri-National de la Sangha attire de grands rassemblements d'éléphants de forêt.*

*Photo © A. Billand, CIRAD*

forêt ripicole à *Uapaca*. Plusieurs espèces à forte valeur commerciale présentes dans ce paysage figurent sur la liste rouge de l'IUCN des espèces menacées ou vulnérables, incluant afromosia, ebène, sipo, sapelli, et acajou. Les quatre aires protégées constituent un sanctuaire de première importance pour ces espèces à fort potentiel économique.

Le paysage abrite nombre des mammifères emblématiques d'Afrique tels que l'éléphant de forêt, le gorille de basse altitude de l'ouest, le bongo, le buffle de forêt et l'hylochère. Cela est partiellement dû à la présence de plus de 100 clairières (localement connues sous le nom de *bais*) où ces espèces se retrouvent, attirées par les sels minéraux et la végétation qui tapisse ces zones ouvertes dans la forêt. Au Cameroun, certains de ces bais attirent des quantités très élevées de perroquets gris. Ces zones offrent un potentiel certain pour le développement de l'écotourisme. Une remarquable population de chimpanzés, sans contact antérieur avec l'homme, a été découverte au sud du parc national de Nouabalé-Ndoki, dans le triangle de Goualogou. Du fait de l'isolement de cette zone forestière, les chimpanzés n'éprouvent aucune crainte vis-à-vis de l'homme, ce qui a permis aux scientifiques de réaliser d'étonnantes études de comportement sur les outils utilisés par ces animaux.

*Les menaces sur le paysage sont le braconnage commercial du gibier, le braconnage des éléphants pour l'ivoire, l'exploitation forestière non aménagée et l'exploitation minière artisanale. Le trafic des perroquets gris (en bas à droite) est également une autre menace.*

*Photos © Reto Kuster*

La densité démographique du paysage est de 0,7 habitant/km², mais la majorité de la population se concentre dans les centres urbains et les campements forestiers. Dans les parties centrafricaine et congolaise, environ 30% de la population sont composés de divers groupes semi-nomades (Baka, Bambendzélé, Bangombé). L'influence de l'exploitation forestière sur la démographie est parfaitement illustrée dans ce paysage où des accroissements annuels de population de plus de 10% ont été constatés dans et autour des campements forestiers. Les populations immigrantes exercent de fortes pressions sur les ressources naturelles car elle, ne respectent plus les modes traditionnels d'exploitation. Si l'activité forestière demeure la principale occupation humaine dans le paysage, l'exploitation minière artisanale (particulièrement pour le diamant), la chasse, la pêche et l'agriculture n'en sont pas moins également importantes.

WWF et WCS ont été actifs dans cette zone au cours des deux dernières décennies et furent des artisans essentiels, avec l'appui de la GTZ, de la création de la Fondation de la Sangha Tri-National, première initiative de conservation transfrontalière de ce genre en Afrique. Après dix années de négociation, la fondation est opérationnelle avec un capital initial de 12 millions € (Encadré 11).

**ENCADRÉ 11. LA FONDATION DU TRI NATIONAL DE LA SANGHA. EXEMPLE D'UN FONDS DE CONSERVATION POUR LE FINANCEMENT DURABLE D'AIRES PROTÉGÉES.**

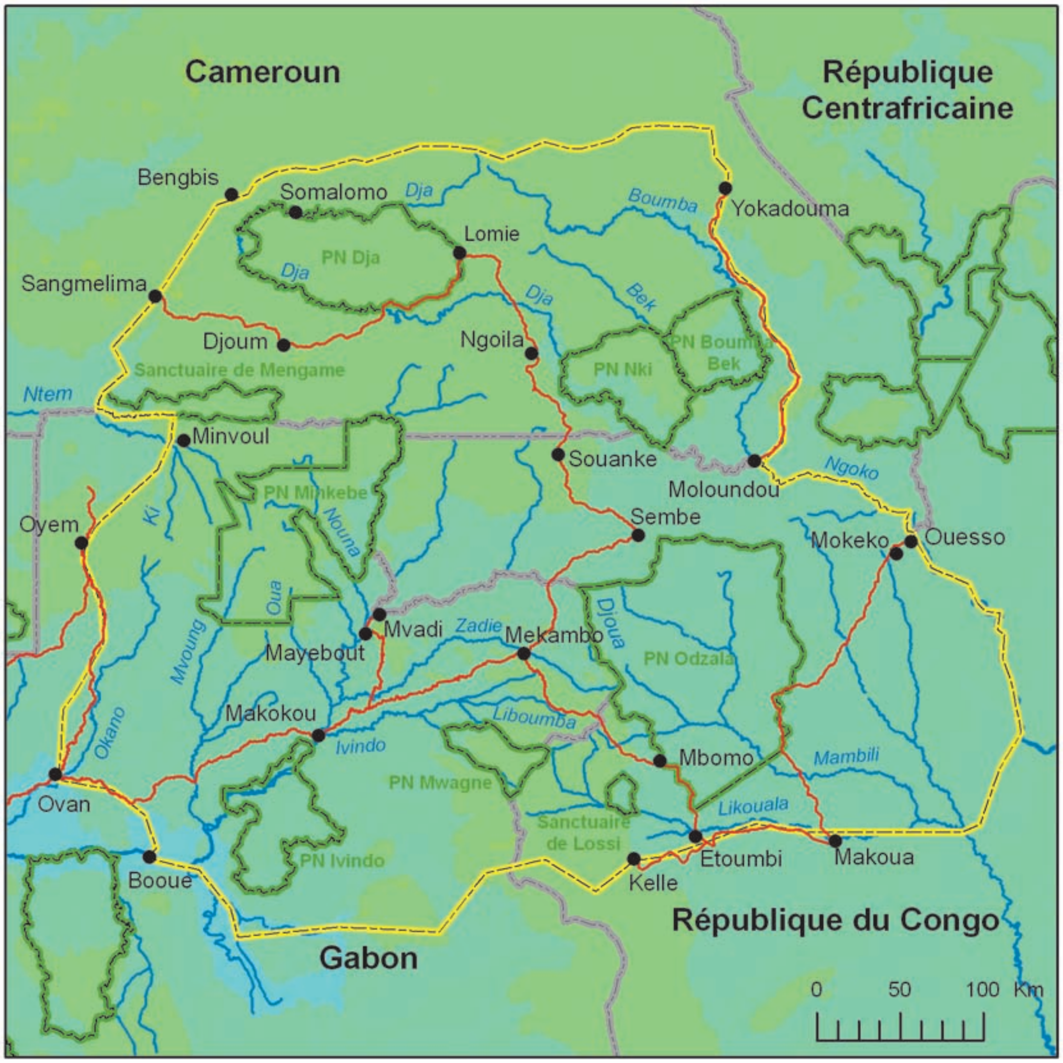
Le Tri-National de la Sangha (TNS) couvre une superficie de 28.000 km² de forêt de basse altitude et comprend les trois parcs nationaux de Lobéké au Cameroun, de Dzanga-Ndoki en RCA et de Nouabalé-Ndoki au Congo ainsi que leurs zones tampons. Le processus de mise en place du fonds fiduciaire pour le Sangha Tri-National ("*Fondation pour le Tri-National de la Sangha*") fut appuyé principalement par la Banque Mondiale/WWF Alliance pour la conservation des forêts et leur utilisation durable, GTZ, Wildlife Conservation Society (WCS), la Coopération française, l'AFD et le programme de l'USAID CARPE (Central African Regional Program for the Environment).

La Fondation fut créée en Mars 2007 sous la forme d'une association régie par la législation britannique, et dotée d'une agence d'exécution basée en Afrique centrale. Des accords formels définissent les termes de la collaboration entre la Fondation et chacun des trois pays. Celle-ci est gérée par un conseil d'administration composé de 11 membres composé de représentants des gouvernements du Cameroun, du Congo, de la RCA, de WCS, du WWF, de Regenwald Stiftung, de KfW, de l'AFD et de la société civile. Près de 12 millions d'euros ont déjà été mobilisés par la KfW, l'AFD et Regenwalt Striftung via la "Krombacher Regenwald Kampagne". Ces fonds seront investis sur les marchés financiers internationaux afin de produire un revenu régulier permettant de couvrir le financement d'activités identifiées pour la conservation et la gestion durable des ressources naturelles dans le TNS. Un financement récent de la Commission Européenne à CAWHFI devrait permettre à la Fondation d'attribuer une série de petites subventions, totalisant 400.000 euros sur une période de trois ans, au profit du parc et des parties prenantes éligibles.

*Source: http://carpe.umd.edu/tns_foundation, CE, WWF.*

*Le bai de Mbeli au parc national de Nouabalé-Ndoki - lieu privilégié pour observer la grande faune forestière typique d'Afrique centrale.* Photo © *M. Azink & J. Oonk*

# Paysage du TRIDOM




**Le paysage Trinational Dja-Odzala-Minkébé (TRIDOM) en bref ***

**Pays concernés :**République du Gabon, du Congo et du Cameroun
**Coordonnées** : 3°29'53''N à 0°26'28''N; 11°51'54''E à 15°57'21''E
**Superficie :** 186.500 km²
**Altitude :** 300 - 1000 m
**Ecorégions terrestres :** forêts congolaises du nord ouest
**Ecorégions aquatiques :** écosystème côtier équatorial du sud ouest ; écorégion de la Sangha
**Aires Protégées :**
Parc national d'Odzala-Koukoua, 1.350.000 ha, 1935/1999, République du Congo
Parc national de Minkébé, 756.700 ha, 1997/2000/2002, Gabon
Parc national de l'Ivindo, 300.000 ha, 1971/2002, Gabon
Parc national de Mwanga, 116.500 ha, 2002, Gabon
Parc national Boumba-Bek, 238.255 ha, 2005, Cameroun
Parc national Nki, 309.365 ha, 2005, Cameroun
Réserve de faune du Dja, 526.000 ha, 1950, Cameroun (Site du patrimoine mondial)
Sanctuaire de gorille de Mengame / complexe Kom, 95.800 ha, Cameroun (classement en cours)
Sanctuaire de gorilles de Lossi, 38.000 ha, 2001, Congo
**Partenaires de l'UNESCO :** WWF, WCS, CI / CyberTracker Conservation
(*) *Sources : Etat des forêts 2006 & WWF Gabon*

Ci-dessus : Gorilles de plaine de l'ouest et buffles de forêt se retrouvent dans le bai de Lokoué, dans le parc national d'Odzala-Koukoua au Congo.

Photo © C. Aveling

Le paysage des TRIDOM couvre une superficie de 186,500 km², soit quatre fois plus grand que chacun des deux autres paysages CAWFHI, et comprend 9 aires protégées totalisant 37.360 km² (20% du paysage). Il s'étend sur un plateau dont l'altitude varie de 300 à 1.000 m au-dessus du niveau de la mer. Il est parsemé de spectaculaires inselbergs (notamment dans le parc national de Minkébé) et est traversé longitudinalement par un escarpement long de 75 km orienté nord-sud, longeant la frontière Gabon-Congo et séparant les deux principaux bassins versants que ce paysage draine, l'Ogooué et le Congo. Un ensemble de rapides et de chutes spectaculaires ponctue la rivière Ivindo, jouant le rôle de barrière biogéographique dans le bassin versant de l'Ogooué.

La majeur partie du paysage est couverte de forêt de terre ferme incluant une forêt semi-décidue riche en Meliaceae, Ulmaceae et Sterculiaceae, une forêt à canopée ouverte à Marantaceae ainsi qu'une forêt mono-dominante à *Gilbertiodendron.* De grandes zones de forêt inondée de manière permanente ou saisonnière sont également présentes. La composition végétale montre une variation de l'influence Atlantique à l'ouest et du Congo à l'est. Les inselbergs et les zones rocheuses à Minkébé et au Dja sont couverts de prairies herbeuses et de buissons arbustifs comprenant de nombreuses espèces caractérisées par une distribution très limitée telles que Euphorbes et Orchidées. Plusieurs centaines de clairières ponctuent le paysage, dont les mieux connues sont celles du parc national d'Odzala-Koukoua . Comme dans le paysage TNS, plusieurs de ces bais sont riches en sels minéraux et attirent d'importantes concentrations de mammifères, incluant éléphants de forêt, gorilles de plaine de l'ouest, bongos, buffles de forêt et hylochères. Dans la partie sud-est du paysage (parc national d'Odzala-Koukoua) on remarque une zone de mosaïque savane-forêt qui constitue la limite la plus septentrionale du plateau des Bateke. Une faune typiquement savanicole est présente dans cette région, incluant la hyène tachetée et peut-être une population relique de lions. Ce paysage abrite les plus fortes concentrations d'éléphants de forêt en Afrique cen-

*Plusieurs espèces de mammifères typiquement savanicoles sont présentes dans les mosaïques savane-forêt du parc national d'Odzala-Koukoua, parmi lesquelles la hyène tachetée et peut-être une population relique de lions.*

*Photo © C. Aveling*

trale (estimation de 30.000 individus uniquement dans le massif forestier de Minkébé) et de buffles de forêt. Le fait qu'une grande partie de ce paysage demeure relativement inaccessible explique que des populations de mammifères significatives aient été protégées de la chasse commerciale et du braconnage pour l'ivoire. Toutefois, dans certains endroits, des épisodes récents du virus Ebola ont provoqué un déclin dramatique de la population de grands singes. Le parc national de Minkébé aurait perdu 98% de sa population de grands primates depuis le début des années 1990. Dans le parc national d'Odzala-Koukoua, où le premier épisode du virus fut identifié en 2002, le déclin de la population a également été sévère.

La densité démographique varie entre 1 et 2 habitants/km² à l'intérieur du paysage mais atteint 3 à 4 habitants/km² au sud de la partie camerounaise du paysage. De vastes zones des parties gabonaise et congolaise sont quasiment non habitées. Les principales activités sont l'agriculture sur brûlis, la culture du café et du cacao, l'exploitation forestière industrielle et l'exploitation minière artisanale, surtout pour l'or. (Encadré 12). Au Cameroun, l'exploitation forestière représente une part substantielle de l'économie villageoise depuis que 40% des taxes forestières sont reversées aux communautés locales. De fait, les forêts communautaires s'y développent rapidement.

Comme dans les autres paysages, la chasse commerciale pour la viande de brousse et l'ivoire sont les principales menaces. Des pathologies émergentes (en particulier Ebola) sont, récemment devenues une menace. Le développement de l'exploitation forestière a été particulièrement rapide au cours des dix dernières années, avec plus de 50% de la superficie du paysage déjà attribués. La partie centrale du paysage (sud du Ngoïla et ouest de Souanké) reste majoritairement non attribuée mais la pression pour l'attribution de ces zones s'accroît. Enfin l'exploitation minière industrielle à grande échelle démarrera prochainement et son impact sur le paysage sera certainement très important (Encadré 12).

### Encadré 12. Exploitation minière dans le paysage du TRIDOM

L'exploitation artisanale aurifère attire plusieurs milliers de personnes au cœur du paysage TRIDOM. En plus des dommages physiques occasionnés au milieu naturel, ce type d'activité non régulée s'accompagne généralement d'une intensification du braconnage, de contrebande transfrontalière et d'immigration illégale.

L'exploitation minière industrielle est programmée au cœur du paysage et constitue une menace sérieuse pour son intégrité écologique. Au Gabon, une compagnie chinoise (CMEC) a obtenu les droits d'exploitation pour le gisement de fer de Belinga et une société australienne (Sundance Resources Ltd) s'est vue accorder ceux du gisement de Mbalam au Cameroun ainsi que d'autres gisements (Nabeba, Letioukbala) dans le District avoisinant de Souanke au Congo. Une autre compagnie, Core Mining (Australie/France) a démarré une exploration des gisements de fer dans les monts Avima à l'ouest de Souanke. Les gisements de Belinga et Mbalam sont estimés à un milliard de tonnes, parmi les plus riches au monde. Pour exploiter Mbalam un chemin de fer pourrait être construit jusqu'à Kribi sur la côte du Cameroun. Pour l'exploitation de Belinga, une extension de la voie ferrée du Trans-gabonais est prévue et la construction d'un barrage hydro-électrique sur la rivière Ivindo a été étudiée. Cela aura un impact sévère sur le parc national de l'Ivindo et ses spectaculaires chutes et rapides à Kangou. Enfin, un important gisement de cobalt et de nickel à proximité de Lomié, à la limite de la réserve de faune du Dja, site du patrimoine mondial au Cameroun, a été attribué à une compagnie américaine (GEOVIC).

Ces activités industrielles auront toutes un impact significatif sur le paysage. Elles pourraient mettre fin à un paysage englobant des aires protégées interconnectées par une forêt continue si des mesures adéquates d'atténuation ne sont pas appliquées. Elles attireront des milliers de travailleurs qui vont inévitablement accroître la pression exercée sur les ressources naturelles, en particulier la chasse pour le gibier et l'ivoire et le défrichage pour l'agriculture. La construction de chemins de fer et de routes aura également un impact très important. Des possibilités de compensation de biodiversité (« *biodiversity offsets* ») liées à ces projets miniers sont actuellement à l'étude.

*Un camp d'exploitation aurifère à la limite du parc national de Minkébé au Gabon.*

*Photo © Gustav Mabaza*

## Les activités de CAWHFI dans les trois paysages

Les activités de CAWHFI sont organisées autour de trois composantes :

1. faire évoluer la gestion des aires protégées vers les standards du patrimoine mondial,
2. gérer la faune dans les zones multi-usages reliant les aires protégées,
3. identifier de sites potentiels du patrimoine mondial et accroître le nombre des nouvelles nominations.

La plupart des activités de terrain de CAWFHI sont mises en œuvre par WWF et par WCS, chacun ayant été actif dans les paysages au cours des 20 dernières années. Les deux organisations ont développé un large panel d'activités de conservation avec des fonds privés, mais également provenant de la coopération bilatérale et multilatérale. Considérant les défis particulièrement ardus pour la conservation auxquels doivent faire face les paysages, et les financements limités pour ce faire, CAWHFI a opté pour une approche pragmatique conçue pour réaliser des économies d'échelle en appuyant des activités complétant celles déjà mises en œuvre par WWF et WCS. Le financement CAWHFI représente approximativement 15 à 20% des fonds mobilisés par ces ONG dans les paysages.

### Renforcer la gestion des aires protégées

***Application de la loi et suivi des patrouilles***

Le renforcement de la gestion des parcs implique une meilleure efficacité des patrouilles et un appui financier couvrant les coûts de fonctionnement (primes, équipements, carburant, pièces détachées, construction de postes de patrouille). Une première formation des gardes a été menée et des systèmes de suivi de patrouilles développés pour un suivi continu du niveau et de l'impact de la surveillance. Une formation en suivi écologique a également été assurée.

En complément à la surveillance classique réalisée dans les aires protégées, CAWHFI a également soutenu financièrement les patrouilles transfrontalières, en particulier dans les paysages du TNS et du TRIDOM. Dans le cas du TNS, les aires protégées sont contigües et la coopération entre les autorités des parcs est relativement simple. La situation est plus compliquée dans le centre du paysage TRIDOM où les aires protégées ne sont pas contigües le long des frontières internationales et où l'éloignement est synonyme de faible contrôle sur les mouvements et activités des personnes opérant en périphérie. En particulier, le secteur Mouloundou de la rivière Dja le long de la frontière entre le Cameroun et le Congo est un haut-lieu de braconnage et de trafic illégal d'ivoire et de viande de brousse. CAWHFI a été pionnier dans les patrouilles de surveillance transfrontalières le long des frontières internationales.

*La formation a été un élément clé de l'appui fourni par l'UNESCO aux sites du patrimoine mondial en Afrique centrale. Etant donné l'éloignement de la plupart de ces sites, une bonne capacité d'adaptation aux conditions locales est essentielle.*

*Photo © Kim S. Gjerstad*

Un problème majeur, commun à tous les paysages, concerne la faible application de la loi sur la faune et la trop rare condamnation des contrevenants. Si le

*Une pêche non durable menace les ressources marines du paysage Gamba-Mayumba-Conkouati. La pêche au chalut illégale en zone côtière (photo à droite) et la pêche destructrice pour les ailerons de requins (photo à gauche) sont étroitement suivies par les partenaires de CAWHFI.*

*Photo © Tim Collins - Ocean Giants/WCS*

manque de bonne gouvernance et la corruption sont des facteurs contraignants, il est évident que les magistrats n'ont souvent pas conscience de l'importance des lois sur la faune et par conséquent ne s'intéressent guère à leur application. CAWHFI a organisé des ateliers et des visites de sites par les magistrats et les membres des administrations locales ; ce type d'intervention relativement simple se traduit par des résultats positifs quant à l'issue des poursuites judiciaires engagées.

Dans le cas du paysage de Gamba-Mayumba-Conkouati, qui englobe de larges zones d'habitats marins, une surveillance et des techniques de monitoring particulières ont été développées afin de prendre en compte les problématiques spécifiques liées aux activités de pêche industrielle illégales dans les limites du parc et de la pollution résultant de l'exploitation pétrolière en mer. La pêche industrielle illégale a un impact dévastateur sur les stocks de poissons et fragilise les modes de vie des populations locales. Les espèces marines charismatiques telles que les baleines, les dauphins, les requins (capturés pour leurs ailerons) et les tortues marines nécessitent une attention spéciale du fait de leur place dans la chaîne alimentaire. A Mayumba, une tour d'observation a été équipée avec un radar qui enregistre les activités de pêche illégale qui s'est avéré une manière efficace d'en réduire la fréquence dans le parc. Cependant au Gabon et au Congo, des efforts supplémentaires, de la part des services administratifs en charge de la pêche, sont nécessaires pour mettre un terme à ces activités non durables.

*L'impact de l'exploitation pétrolière sur les ressources marines nécessite un suivi rapproché et les compagnies pétrolières doivent être responsabilisées pour la pollution qu'elles occasionnent.*

*Photo © Tim Collins - Ocean Giants/WCS*

Des gardes bien équipés, appuyés par des ONG locales telles qu'*Aventure Sans Frontière*, *Gabon Environnement* et *Ibonga* patrouillent également sur les plages pendant la saison de ponte des tortues marines. Le comptage des nids et le marquage des tortues (avec réception GPS) confirment l'importance de ces plages, avec des densités jusqu'à 194 nids/km au plus fort de la période de ponte.

CAWHFI appuie également le suivi de l'impact de l'exploitation pétrolière, particulièrement à Mayumba. Cependant, si la détection de déversements accidentels de pétrole est relativement aisée, il est moins évident d'y être réactif et de convaincre l'industrie pétrolière d'accepter le principe du pollueur-payeur. Le projet collabore étroitement avec le centre gouvernemental anti-pollution afin de contribuer à l'élaboration d'un futur plan national, cette disposition faisant encore défaut au Gabon. L'exploitation pétrolière à Mayumba est un fait accompli (existant antérieurement à la création du parc), et le deviendra vraisemblablement à Counkouati (où le permis a été accordé après la création du parc) ; le projet explore donc activement les moyens de transformer une situation négative en une situation plus positive grâce à la mise en place d'accords avec les compagnies concernées.

***Planification de la gestion des aires protégées***

Il s'agit d'un important volet de CAWHFI avec une situation particulièrement complexe dans le parc national de Conkouati-Douli où les contraintes d'exploitation forestière et d'exploitation pétrolière doivent être dépassées. La mise à jour et le renforcement du plan de zonage ont été proposés pour le parc mais n'ont pas encore été approuvés. L'intervention de CAWHFI survient ainsi à un moment opportun pour le parc car il donne l'impulsion à une importante série d'activités de conservation en cours et renforce les pressions internationales sur la question controversée des industries extractives opérant dans des zones globalement importantes sur le plan de la conservation et bénéficiant d'un statut de protection totale.

***Ecotourisme***

Le potentiel pour le développement de l'écotourisme dans les paysages est énorme, tout comme le sont les défis à relever. CAWHFI appuie ces activités qui présentent un potentiel certain conférant une valeur ajoutée aux sites et procurant des revenus tangibles pour les parties prenantes locales. Lorsque les ONG locales sont directement impliquées dans la mise en œuvre des activités, l'appui des populations au parc est accru. Ce type de partenariat se révèle particulièrement prometteur dans le complexe de Gamba où une ONG environnementale locale, *Ibonga,* collabore avec l'aire protégée. Le projet a également fourni un appui pour le développement du tourisme d'observations des grands singes dans le parc national de Nouabale-Ndoki par la réhabilitation de plates-formes d'observation dans la célèbre clairière Mbeli, et la réalisation d'une étude de faisabilité pour le tourisme d'observations des chimpanzés. Cependant, plusieurs contraintes doivent être dépassées avant qu'une activité touristique significative se développe dans ces sites. Ces goulots d'étranglement pour le tourisme, que l'on retrouve partout en Afrique centrale, sont totalement hors du contrôle des parcs. Ils concernent des problématiques telles que le coût élevé des voyages internationaux à destination de la région, le manque de fiabilité des transports intérieurs, la

*L'observation des baleines deviendra probablement une importante attraction touristique au large des côtes du Gabon et du Congo.*

*Photo © Tim Collins - Ocean Giants/WCS* disponibilité de capacités d'hébergement adaptées et la volonté des opérateurs locaux d'investir dans un tourisme basé sur la nature.

## Gérer la faune dans les paysages

***Au-delà des limites des aires protégées***

Un des aspects particuliers des aires protégées dans le bassin du Congo est que, dans la plupart des cas, elles sont toujours ancrées dans des paysages naturels plus vastes, même si les ressources naturelles du paysage sont exploitées, par exemple via l'exploitation forestière. Ces paysages couvrent une plus grande superficie que les aires protégées en Afrique centrale et il paraît logique qu'une proportion très significative de la faune sauvage soit dans les concessions forestières. La gestion de la faune dans les concessions peut donc constituer une participation significative à la conservation de la biodiversité dans la région. Préserver

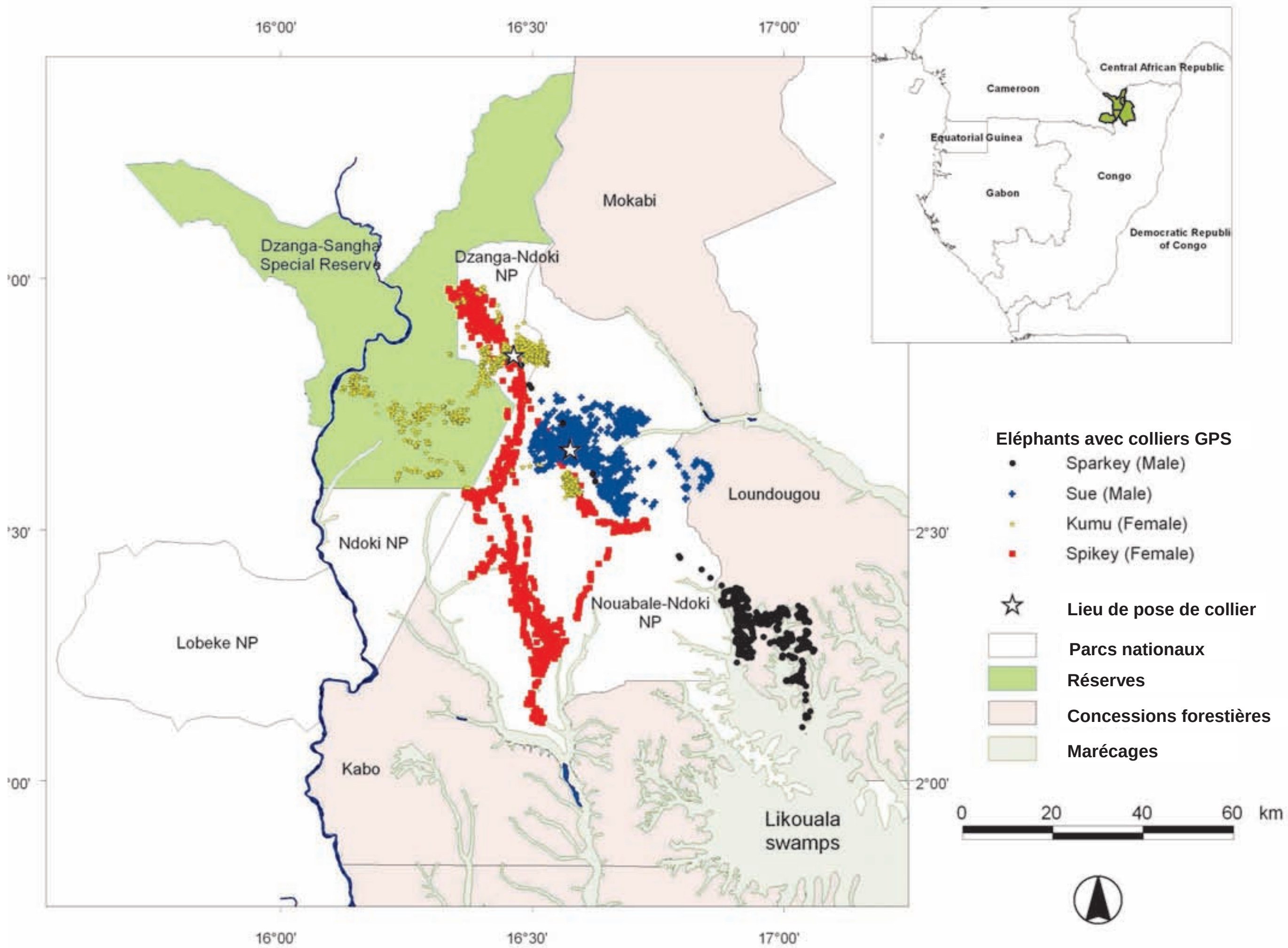
### ENCADRÉ 13. QUELQUES PRINCIPES POUR LA GESTION DE LA FAUNE DANS LES PAYSAGES À USAGES MULTIPLES

Si les modèles de gestion de la faune varient d'un site à l'autre, un certain nombre de principes communs peuvent être identifiés dans les différents projets pilotes mis en œuvre dans les paysage CAWHFI :

- la chasse contrôlée est encouragée par une stricte application des lois sur la faune dans la concession et par une application effective par les compagnies forestières des règlements intérieurs, en particulier en ce qui concerne le transport du gibier, des chasseurs et de l'équipement de chasse dans les véhicules de la société.
- L'accès aux ressources en faune est régulé par un zonage et une planification des usages. Cela peut inclure la définition de zones spécifiquement dédiées à la chasse et l'élaboration de plans simples de gestion. Au Gabon, avec l'appui du WWF, pour sécuriser le terroir villageois de Pény, la société forestière CBG, les autorités locales et les gestionnaires du parc ont contribué à la création d'une enclave à l'intérieur du parc national de Moukalaba-Doudou, à l'usage exclusif des autochtones. Au Cameroun des Zones d'Intérêt Cynégétique à Gestion Communautaire (ZICG) ou des Zones d'Intérêt Cynégétique (ZIC) peuvent être localisées à l'intérieur des concessions forestières, dans les forêts communautaires ou dans les zones d'agroforesterie. Dans les concessions forestières autour du parc national de Minkébé, le WWF a expérimenté une approche simple, pragmatique et participative basée sur le principe que si l'utilisation des véhicules pour la chasse est contrôlée (notamment par les routes pénétrant les concessions forestières), la chasse serait limitée à une bande de 15 à 20 km de part et d'autre des routes et des rivières car c'est la distance maximale qu'un chasseur peut parcourir à pied dans une journée. Ainsi une partie importante du massif forestier de Minkébé échappera à la chasse. Cependant, ce raisonnement ne tient que pour les chasseurs intéressés par la viande fraîche. Dans le cas de viande fumée, comme au Cameroun, les chasseurs évoluent à de plus grandes distances des axes de communication, utilisant des camps au plus profond de la forêt pour fumer et conserver la viande.
- Les communautés locales sont encouragées à prendre la responsabilité de la gestion de la faune sauvage afin que le système de libre accès à la ressource, si destructeur pour les populations animales, soit éliminé. Cela doit passer par la création de structures communautaires pour la gestion des ressources naturelles. Dans les paysages TNS et TRIDOM une attention particulière est apportée aux communautés semi-nomades de pygmées dont le mode de vie est souvent à l'origine de leur marginalisation par les autres ethnies. Des campagnes de sensibilisation sont essentielles et doivent être conduites pendant une période assez longue compte tenu de la résistance (due à l'ignorance et à la précarité des populations) pour limiter les prélèvements et rendre la chasse durable . Le renforcement des capacités des structures de gestion des ressources naturelles est essentiel.
- Des alternatives à la chasse peuvent aussi être promues afin de réduire la pression de la chasse. Diverses initiatives sont testées incluant l'importation par les concessionnaires de viande d'élevage pour les travailleurs, l'appui à des activités traditionnelles comme l'élevage familial et l'agroforesterie, l'artisanat et des systèmes de partage de revenus issus du tourisme. L'emploi dans les activités de gestion des aires protégées est également une incitation économique importante pour les parties prenantes locales, même si cela ne peut pas rivaliser avec la quantité d'emplois générés par l'exploitation forestière.
- La recherche et le suivi écologique nourrissent le processus de gestion. Diverses techniques de recherche et de suivi sont utilisées pour mesurer la pression de la chasse, le potentiel et la consommation de gibier ainsi que le statut des espèces animales.

Il y a évidemment des coûts économiques induits par la gestion de la faune dans les concessions mais la plupart peuvent, et doivent, être couverts par l'exploitant forestier. L'exploitation, à la différence de la gestion des aires protégées, génère des bénéfices et les coûts additionnels devraient être répercutés sur le consommateur, notamment dans le cas de bois certifiés.

*Sources : WWF-Gabon, WWF-Cameroon WCS-Congo.*




*Le domaine vital des éléphants de forêt n'a que faire des limites des aires protégées. Une approche paysage est nécessaire pour garantir les besoins écologiques des populations animales. La carte ci-dessus illustre les déplacements de 4 éléphants équipés d'un collier avec GPS dans le paysage du TNS et montre à quel point les éléphants font peu de cas des frontières créées par l'homme. Les itinéraires confirment que les individus fréquentent des zones aux divers usages (zones marécageuses, concessions forestières, aires protégées).*

*Carte © S. Blake*

les processus écologiques, à travers les paysages, permet de conserver les liens biologiques entre aires protégées en même temps que leurs principales valeurs. Par exemple, l'aire de déplacement de la plupart des éléphants de forêt vont bien au-delà des limites des aires protégées (carte ci-dessus).

Les plans d'aménagement forestiers sont désormais une obligation légale de par les lois forestières des trois pays. Cela signifie que, entre autres, que les questions sociales et les problèmes de gestion et conservation de la faune sauvage, et des autres PFNL présents dans les concessions forestières, doivent être spécifiquement traités lors de la préparation des plans d'aménagement. Cela suppose la réalisation d'études socio-économiques et d'inventaires de la faune afin de constituer des données de base sur l'utilisation des ressources naturelles et sur les populations de faune sauvage et d'identifier des zones de conservation dans les concessions.

De plus, depuis que les sociétés forestières, en particulier les compagnies européennes, évoluent vers les objectifs de certification de leurs bois pour les marchés européens, les capacités d'une société forestière à protéger la faune et à gérer durablement un site représentent de réels atouts commerciaux. La plupart des compagnies ayant une expertise limitée en la matière, elles sont particulièrement intéressées de collaborer avec des spécialistes pour les aider. Grâce à la contribution financière du FFEM à l'initiative CAWHFI, WWF et WCS ont pu étendre leur collaboration avec des sociétés forestières actives dans les trois paysages. CAWHFI contribue actuellement à la mise en œuvre des accords avec 11 sociétés forestières couvrant 5,3 millions d'hectares de forêt. L'encadré 13 présente quelques principes de la gestion de la faune dans les paysages à usages multiples où l'exploitation forestière constitue l'activité dominante.

***Trouver un bon équilibre entre l'exploitation durable de la faune et les besoins économiques des communautés locales.***
La viande de brousse est une composante importante du régime alimentaire des populations forestières, mais tous les indicateurs du bassin du Congo démontrent que la commercialisation de la viande de brousse, fortement influencée par la demande des marchés urbains, conduit à un réduction drastique des populations animales caractérisée par l'extinction localisée d'espèces de grands et moyens mammifères. Le poisson et les autres ressources aquatiques sont également importantes sur le plan alimentaire avec également une tendance à la surexploitation pour le commerce local et international. Ce sont les communautés locales, particulièrement dépendantes de ces ressources, qui sont les plus touchées (tant sur le plan alimentaire qu'économique) par leur amenuisement. CAWHFI appuie les initiatives visant une utilisation plus durable de la faune afin de sauvegarder les modes de vie traditionnels des populations. Une série d'initiatives est testée, visant d'une part l'exploitation durable de la faune et des ressources halieutiques (Encadré 15), et d'autre part des activités économiques alternatives telles que l'écotourisme, le petit élevage, l'agriculture, l'agroforesterie et l'artisanat local.

Cependant la coexistence avec la faune sauvage comporte des contraintes. Les maraudes, notamment par les éléphants, peuvent causer des dommages considérables aux cultures. Le problème est souvent particulièrement aigu en périphérie des aires protégées où les mesures de conservation ont contribué à l'accroissement des populations sauvages, créant un conflit

### ENCADRÉ 14. TROUVER DES SOLUTIONS POUR PROTÉGER LES CULTURES CONTRE LES MARAUDES DES ÉLÉPHANTS

Dans le complexe de Gamba, WWF recherche des solutions, avec l'appui d'une compagnie de service pétroliers qui fournit des câbles métalliques déclassés (utilisés pour nettoyer les conduites de pétrole) pour les reconvertir en barrières anti-éléphants.

Dans le parc national de Nouabalé-Ndoki une approche innovante est développée par WCS utilisant une variété de piment d'Afrique du Sud. Des briques séchées de fèces d'éléphant mélangées à du piment produisent en brûlant une fumée qui semble être un moyen de dissuasion efficace contre les éléphants. Du piment moulu mélangé avec de la graisse peut aussi être badigeonné sur des clôtures de câble (fournies par les sociétés forestières) dressées autour des champs. En outre, comme il y a un marché pour cette variété de piments, les familles participant au projet pilote peuvent l'utiliser comme sources de revenus complémentaires. Conkouati-Douli , la communauté expérimente un système de protection des cultures utilisant des clôtures électriques alimentées par énergie solaire.

Si aucune solution miracle n'a jamais été trouvée pour résoudre cet épineux problème, l'expérience en Afrique a montré que la participation active des cultivateurs eux-mêmes est essentielle dans la stratégie de protection .

*Sources: WCS &WWF*

*Les éléphants de forêt sont souvent attirés dans les plantations villageoises dans le complexe d'aires protégées de Gamba. Des câbles métalliques déclassés utilisés dans l'industrie pétrolière constituent de bonnes barrières de protection. Des cannettes vides enfilées sur le câble (voir photo dessus) cliquètent quand celui-ci est touché, ce qui remplace son effet dissuasif.*

*Photos © R. Beville (en haut); WWF-Gamba (en bas)*

## Encadré 15. Promouvoir la récolte durable des huîtres à Mayumba

La récolte d'huîtres par les plongeurs est une activité traditionnelle pratiquée depuis toujours par les résidents de Mayumba. Les huîtres de Mayumba se développent sur les racines aériennes des mangroves et sur le fond sableux ou vaseux de la lagune de Banio. Il est bien connu que les bancs d'huîtres engendrent une productivité élevée dans les écosystèmes estuaires. Les coquilles ralentissent les courants d'eau et fournissent des habitats pour les crabes, les autres crustacés, les poissons et les invertébrés. A leur tour ces espèces nourrissent d'autres communautés animales. En se nourrissant, les huîtres filtrent d'importantes quantités d'eau, contribuant ainsi au maintien de sa qualité.

La récolte d'huîtres (photo en haut) a diminué brutalement au cours des deux dernières années ; une étude réalisée par WCS en 2008 a mis en évidence la réduction de la population désormais localisée à un seul endroit. Les bancs d'huîtres traditionnellement exploités n'avaient plus d'huîtres adultes et la situation fut jugée critique.

Ce déclin résulte essentiellement du manque de contrôle (i) du nombre de plongeurs, (ii) de la durée de la saison de récolte et (iii) de la quantité d'huîtres récoltées par chaque personne. De plus, le retrait des coquilles de la lagune est particulièrement dévastateur. Par le passé, les huîtres étaient ouvertes dans la pirogue et les coquilles rejetées à l'eau. Les pratiques se sont récemment modifiées et les huîtres sont ramenées sur le rivage et ouvertes à l'aide d'eau chaude et de vapeur. Les coquilles vides sont ensuite abandonnées au bord de la lagune (photo au milieu). L'utilisation de vapeur pour ouvrir les coquilles tue tous les juvéniles ainsi que les huîtres non encore exploitables se trouvant sur le substrat. Jusqu'à 15 juvéniles peuvent se développer sur la coquille d'un seul adulte. Le gaspillage est donc très important. L'enlèvement des centaines de tonnes de coquilles de la lagune est doublement pénalisant : d'une part la génération future d'adultes pour la récolte suivante est détruite et d'autre part le substrat indispensable au développement des jeunes huîtres est éliminé. Ces deux effets combinés ont provoqué l'effondrement de la population d'huîtres, mettant fin aux activités d'exploitation commerciale à Mayumba. Par ailleurs, l'impact de la perte des bancs d'huîtres sur la qualité de l'eau et la productivité de la lagune devrait être important.

Plusieurs mesures ont été prises afin de réhabiliter les bancs d'huîtres et établir un système durable d'exploitation commerciale d'huîtres. Les interventions incluent :

- Une interdiction immédiate de récolte d'huîtres ;
- La mise en œuvre d'un programme de suivi afin de mesurer la rétablissement des populations et fournir un conseil aux autorités locales et utilisateurs quant au moment approprié pour recommencer la récolte ;
- La création d'une association de plongeurs et vendeurs ;
- L'établissement de contrôles sur la quantité et le timing des prélèvements afin d'assurer une exploitation durable et un renouvellement continu de la population ;
- Le développement d'un système de zonage où les prélèvements sont interdites afin de garantir un stock permanent de géniteurs ;
- Le retour obligatoire des coquilles dans la lagune immédiatement après la récolte ;
- La réhabilitation de l'habitat des huîtres utilisant les coquilles abandonnées sur le rivage (photo en bas).

Le succès de ce projet est dû en grande partie à l'Association des Plongeurs d'Huîtres de Mayumba qui a fourni un mécanisme efficace et localement accepté pour la régulation des prélèvement d'huîtres. En particulier le nombre de plongeurs et la durée de la saison de récolte sont limités, et seul les membres de l'association sont autorisés à plonger.

Ces efforts pour réhabiliter l'habitat et contrôler les prélèvements ont permis d'éviter une crise sérieuse. Les résultats du programme de suivi mettent en évidence le début d'un rétablissement de la population avec une augmentation de l'abondance de juvéniles en 2009.

*Source WCS-Mayumba*

*Photos © R. Parnell*

permanent entre les autorités du parc et les villageois. Si des solutions ne sont pas recherchées, cela peut créer un grand sentiment de frustration et sérieusement diminuer les efforts pour le développement de partenariats avec les collectivités locales. CAWHFI appuie des efforts pour prendre en compte ce problème (Encadré 14).

**Sensibilisation des communautés locales**

Une bonne communication et une large sensibilisation constituent des pré-requis pour le succès de toute activité visant à promouvoir l'utilisation rationnelle des ressources naturelles; de ce fait, CAWHFI soutient ce type d'activités. Les meilleurs résultats sont obtenus dans des situations où le projet peut impliquer des organisations locales compétentes et dynamiques. En Afrique centrale, de telles organisations restent relativement rares de sorte que le renforcement de capacités doit faire partie intégrante du projet. Dans le complexe de Gamba, l'ONG Ibonga-ACPE *(Association pour la Connaissance et Protection de l'Environnement)* est étroitement impliquée dans une large gamme d'activités de sensibilisation appuyées par CAWHFI (Encadré 16).

### Encadré 16. Appuyer les organisations environnementales de base. IBONGA-ACPE, une ONG locale pour la protection de l'environnement.

Créée en 1999, Ibonga (tortue en langue locale Balumbu) est une association à but non-lucratif basée dans le complexe des aires protégées de Gamba. Son objectif est de sensibiliser les communautés locales à la conservation et à leur implication dans la gestion durable des ressources naturelles. CAWHFI appuie plusieurs de leurs activités :

- **Education et formation environnementale** dans les écoles de Gamba, ciblant non seulement les élèves mais également les professeurs. Un curriculum environnemental a été développé en collaboration avec les autorités locales du secteur éducatif. Des classes vertes sont régulièrement organisées au parc national de Loango-sud.
- **Sensibilisation et communication** dans le complexe des aires protégées de Gamba. Un outil de communication particulièrement efficace a été la Caravane de la Conservation - un spectacle itinérant combinant danses, chansons, marionnettes, films, livres et posters (photo à droite). Le Ministère des Eaux et Forêts est étroitement impliqué dans les activités de sensibilisation. Ceci est important car ses activités anti-braconnages vitale, éveillent un antagonisme compréhensible, et les communautés locales ne comprennent guère les raisons du renforcement des lois sur la faune.
- **Centre d'Accueil du parc national Loango-sud** Ibonga gère le Centre d'Accueil du parc national Loango-sud en collaboration avec les autorités du parc. Le Centre sert de point d'entrée du parc, de point d'information, et d'écomusée. Ibonga vend des livres, des cartes postales et de l'artisanat local aux touristes.
- **Promotion de l'artisanat local**. Ibonga participe à la promotion et à la valorisation de l'artisanat de la région. Il gère une boutique à l'aéroport de Gamba où les produits sont vendus.
- **Suivi et protection des tortues marines.** Ibonga est membre du Partenariat pour les tortues marines du Gabon, dédié à la protection et au suivi des sites de ponte des 800 km du littoral gabonais. Ibonga organise un programme de recherche et de suivi des plages du complexe des aires protégées de Gamba (photo à droite) ; il organise également des visites guidées pour touristes et étudiants.

*Source : www.ibonga.org* *Photos ©WWF-Gamba*

## Identifier des sites potentiels du patrimoine mondial et accroître le nombre des nouvelles nominations

Parallèlement aux activités de terrain, qui renforcent les capacités de gestion des sites pour se mettre en phase avec les critères du patrimoine mondial, CAWHFI cherche aussi à élargir la portée du patrimoine mondial en Afrique centrale en appuyant les sites ayant le potentiel de satisfaire aux critères de la *Convention du patrimoine mondial*. Le projet aide notamment à préparer des propositions d'inscription, qui seront soumises au Comité du patrimoine mondial, et assiste aussi les Etats parties à établir des Listes indicatives, des autres sites potentiels de la région. Dans le cas du Parc National de la Lopé au Gabon, le site fut inscrit sur la Liste du patrimoine mondial en 2007. Du fait de l'exceptionnelle richesse archéologique du site, mettant en évidence une présence humaine vieille de 400.000 ans, le site fut inscrit comme site du patrimoine mondial mixte, ayant des valeurs culturelles et naturelles. Le projet de proposition d'inscription du Tri National de la Sangha pour l'ensemble d'aires protégées transfrontalières est en cours de préparation avec l'appui de la composante CAWHFI financée par la Commission Européenne.

Un atelier à Brazzaville en mars 2008, organisé par CAWHFI, a permis d'établir une liste exhaustive de sites forestiers d'Afrique centrale présentant une valeur naturelle significative évaluée en fonction des critères de la *Convention du patrimoine mondial*. Leur représentativité écologique fut contrôlée sur la base de la classification des 200 écorégions du WWF, dont 17 se trouvent en Afrique centrale. Cinq sites sont considérés de très grande valeur, soit par leur richesse intrinsèque, soit parce qu'ils apportent d'uniques et/ou nouvelles caractéristiques à la Liste du patrimoine mondial. Ces sites prioritaires sont:

- Les îles volcaniques de São Tomé, Príncipe et Annobón (São Tomé & Príncipe[5] et Guinée Equatoriale [6])
- Le complexe d'aires protégées transfrontalières des parcs nationaux de Korup et de Cross River (Cameroun et Nigeria)
- Le parc national des Monts de Cristal (Gabon)
- Le massif montagneux d'Itombwe et le parc national de Nyungwe (respectivement RDC et Rwanda)
- Le parc national des Plateaux Batéké (essentiellement des savanes avec quelques zones forestières) (Gabon et Congo)

De plus, trois autres sites furent identifiés comme potentiellement importants mais nécessitant des recherches complémentaires avant d'envisager de les ajouter sur la liste des sites prioritaires. Il s'agit des :

- Parcs nationaux de Mbam et Djerem (Cameroun),
- forêts d'altitude de l'Ouest Cameroun (Cameroun)
- forêts d'altitude du Mont Cameroun et de Bioko (Cameroun & Guinée Equatoriale).

L'atelier a aussi examiné les Listes indicatives, préparées par le Cameroun, le Gabon, la RCA et le Congo, afin de fournir une analyse objective de la valeur de ces sites, au regard des critères de *la Convention du patrimoine mondial.* Une publication a été éditée, destinée aux décideurs et autres parties prenantes dans la région. (http://whc.unesco.org/fr/cawhfi).

[5] *Sao Tomé: Principe n'a pas encore dressé de liste indicative.*

[6] *La Guinée Equatoriale n'est toujours pas signataire de la Convention du patrimoine mondial. Ceci est un réel problème car ce pays abrite plusieurs sites naturels d'exceptionnelle valeur, en particulier sur les deux îles de Bioko et Annobón.*

*Cão Grande, un culot volcanique spectaculaire qui domine la canopée dans le sud du parc national Ôbo, à São Tomé, où la pluviométrie annuelle dépasse souvent 7 mètres.*

*Photo © C. Aveling*

# Intégration des activités du patrimoine mondial au sein des politiques nationales et régionales de conservation

La Déclaration, signée par les Chefs d'Etat d'Afrique centrale au Sommet de Yaoundé, érige la protection des écosystèmes forestiers en élément à part entière du processus de développement. Elle réaffirme la volonté des signataires à promouvoir conjointement l'utilisation durable des forêts d'Afrique centrale en appui à leurs objectifs sociaux, économiques et environnementaux. Cette Déclaration a conduit à la création de la Commission des Forêts d'Afrique centrale (COMIFAC) qui est la première autorité pour la prise de décisions et la coordination des initiatives sous-régionales pour la conservation et la gestion durable des forêts. Elle a aussi ouvert la voie à la création du Partenariat pour les Forêts du Bassin du Congo. Celui-ci a été formalisé par la signature d'un accord en 2005, qui lui assure le cadre légal nécessaire à la mise en œuvre de 10 axes stratégiques connus sous l'appellation de Plan de convergence.

*Mont Kalami dans le parc national des plateaux Batéké, Gabon, site figurant sur la liste des sites potentiels du patrimoine mondial. Il pourrait également devenir une aire protégée transfrontalière, une des priorités de la COMIFAC, si le Congo créé le parc national d'Ogooué-Lekéti.*

*Photo © J-P Vander Weghe*

Une des principales considérations pour l'UNESCO est la cohérence de ses actions avec les priorités nationales et régionales pour la conservation, ainsi que l'intégration de ses initiatives dans des partenariats de développement nationaux, régionaux et internationaux. Le tableau ci-contre résume le Plan de convergence de la COMIFAC et ses activités associées. Il montre clairement que les activités du Centre du patrimoine mondial sont en phase avec au moins 9 des 10 axes stratégiques. Par ailleurs, une collaboration étroite est maintenue avec l'association régionale Réseau des aires protégées d'Afrique centrale, connue sous le sigle RAPAC, qui est un partenaire technique officiellement reconnu par la COMIFAC pour les questions concernant les aires protégées.

En développant ses activités à travers des acteurs de longue date dans la sous-région, le Centre du patrimoine mondial joue la complémentarité et garantit à ses activités une intégration au sein de partenariats régionaux et internationaux. Travaillant dans sept aires protégées différentes présentes dans huit paysages, sa stratégie d'intégrer ses activités aux initiatives existantes lui confère une certaine efficience. Le projet CAWHFI considère qu'aucune initiative ne peut, de manière isolée, mobiliser suffisamment de ressources pour s'attaquer aux nombreux défis de la conservation qui caractérisent ces vastes paysages. En unissant ses forces à celles d'acteurs qui interviennent localement, de substantielles économies d'échelle peuvent être réalisées tout en maintenant la spécificité des interventions qui caractérisent le patrimoine mondial.

Dans le cas du programme en RDC, le Centre du patrimoine mondial a été le promoteur d'un nouveau partenariat entre les différentes ONG de conservation et l'ICCN afin de mieux protéger les cinq sites du patrimoine mondial. Ce modèle a été répliqué par l'ICCN dans toutes ses aires protégées avec l'ensemble de ses partenaires de conservation.

La coordination CAWHFI, basée dans les bureaux de RAPAC à Libreville, assure la visibilité des activités du programme et par-

| | Axes du plan de convergence COMIFAC | Activités de la COMIFAC (les activités financées par CAWHFI apparaissent en gras) |
|---|---|---|
| 1 | Harmonisation des politiques forestières et fiscales | **Adhésion aux conventions internationales** ; rendre les politiques forestières cohérentes entre les différents pays et avec les autres politiques sectorielles ; harmonisation fiscale |
| 2 | Connaissance de la ressource | **Inventaire des ressources forestières** ; création / renforcement des observatoires nationaux et régionaux et des **bases de données** |
| 3 | Aménagement des écosystèmes et reboisement | **Zonage des zones forestières ; planification de la gestion des concessions et des aires protégées** ; **reboisement / régénération** ; lutte contre la désertification |
| 4 | Conservation de la Biodiversité | **Renforcement du réseau des aires protégées ; Gestion conjointe des zones transfrontalières ;** Identification, développement et protection des ressources génétiques forestières |
| 5 | Valorisation durable des ressources forestières | **Développement économique du secteur forestier, des PFNL, de la faune sauvage, du tourisme ; suivi de la gestion et de l'utilisation des ressources ; certification forestière** et traçabilité; **application de la loi contre l'exploitation illégale des ressources forestières, y compris le braconnage.** |
| 6 | Développement des activités alternatives et réduction de la pauvreté | **Alternatives au braconnage; micro-projets générateurs de revenus** |
| 7 | Renforcement des capacités, participation des acteurs, information et formation | **Participation des acteurs / fora ; implication des populations locales et groupes autochtones ; Communication, information, sensibilisation, éducation; formation** |
| 8 | Recherche et développement | Développement de programmes de recherche en phase avec les politiques forestières ; création de partenariats avec des institutions de recherche ; **utilisation des connaissances traditionnelles pour la gestion des ressources naturelles ; identification de techniques pour utiliser / régénérer les PFNL ; mise en place de structures pour le suivi des pathologies de la faune sauvage.** |
| 9 | Développement des mécanismes de financement | **Fonds fiduciaires ; fonds forestiers,** fonds régional commun ; **financement du secteur privé ; crédits Carbone ;** taxes pour la conversion des forêts. |
| 10 | Coopération et partenariat | Développement de mécanismes de collaboration et de codes de conduite. |

ticipe activement aux fora nationaux et régionaux. En particulier elle fournit une assistance technique aux comités nationaux du patrimoine mondial afin de préparer leurs listes de sites potentiels du patrimoine mondial  à soumettre au Centre du patrimoine mondial.

Il est également intéressant de souligner que, en se concentrant sur la collaboration transfrontalière entre ensembles d'aires protégées, CAWHFI promeut l'intégration régionale, important facteur de stabilité économique et sociale dans la région.

*La rivière Sangha traverse le paysage TNS. Cet ensemble de trois aires protégées transfrontalières devrait prochainement être désigné comme nouveau site du patrimoine mondial.*
*Photo © C. Aveling*

# Perspectives

Depuis la signature de la déclaration de Yaoundé, des avancées importantes ont été réalisées dans les domaines de l'exploitation forestière durable et de la conservation de la biodiversité dans le bassin du Congo. Ils figurent désormais sur les agendas politiques nationaux et régionaux. Au cours des deux dernières décennies, le réseau d'aires protégées, pierre angulaire de la conservation de l'exceptionnelle biodiversité de la sous-région, a été considérablement agrandi. En même temps, l'attention internationale et l'appui à la conservation se sont accrus de manière significative. Il est maintenant largement reconnu que les forêts du bassin du Congo font non seulement partie de notre patrimoine global, mais qu'elles jouent également un rôle primordial dans la régulation du climat et sont donc essentielles pour l'humanité. Une reconnaissance de ce rôle, lors des prochaines discussions dans le cadre de la Convention-Cadre des Nations Unies sur les changements climatiques, pourrait générer des ressources substantielles pour la conservation des forêts dans la région.

Néanmoins, des défis importants demeurent. Les aires protégées sont complètement sous-financées et restent particulièrement dépendantes d'appuis externes, tant financiers que techniques. L'avenir des aires protégées ne peut être garanti que par l'engagement des gouvernements à allouer les ressources nécessaires à leur gestion.

Malgré les efforts pour mettre en œuvre des pratiques forestières durables, la crise de la viande de brousse reste une réalité. Les opérations d'exploitation forestière et d'autres activités économiques ouvrent de grandes superficies de forêts jusqu'alors tranquilles, et la chasse commerciale touche de plus en plus les aires protégées. Des études récentes indiquent que la richesse économique entraîne une demande accrue pour la viande de brousse, surtout dans les zones urbaines. Ces tendances ne s'inverseront qu'à travers, d'une part un changement fondamental d'attitude vis-à-vis de la faune (en l'appréhendant comme faisant partie du patrimoine national) et d'autre part une clarification des droits, notamment en termes de propriété, par rapport à la ressource.

Parallèlement, l'intérêt croissant pour les ressources minérales et pétrolières de la sous-région crée de nouvelles menaces et défis pour les aires protégées, dont certaines abritent des réserves importantes de ces ressources. Face aux problèmes de développement, la pression politique sera forte pour déclasser des zones protégées en vue d'une exploitation industrielle. Actuellement au moins cinq des aires protégées dans les paysages couverts par CAWHFI, ainsi que le parc national des Virunga en RDC, sont menacés par des activités extractives à l'échelle industrielle, en dépit de leur statut légal excluant ce type d'activité. Même si un projet industriel ne touche pas directement une aire protégée, il peut induire un impact profond sur le tissu social et économique avec une incidence inéluctable sur les aires protégées et la biodiversité de sa zone d'intervention.

La situation en RDC, qui héberge la majeure partie des forêts du bassin du Congo et de très importantes zones pour la conservation de la biodiversité, demeure particulièrement inquiétante. Si la guerre est officiellement terminée, l'instabilité et l'insécurité continuent à affecter de nombreuses zones. Une économie parallèle, apparue durant la guerre et basée sur l'extraction illégale des ressources naturelles et minérales continue à prospérer avec des conséquences néfastes non seulement sur la biodiversité mais également sur les communautés locales.

L'UNESCO et ses partenaires de conservation considèrent que la *Convention du patrimoine mondial* peut apporter une contribution importante pour relever ces défis. A l'exception de la Guinée Equatoriale, tous les pays du bassin du Congo sont des Etats parties à la *Conven-*

*tion*. A ce titre, ils se sont engagés à protéger leur patrimoine de « valeur universelle exceptionnelle ». Actuellement sept aires protégées de la sous-région sont reconnues par la *Convention* et plusieurs autres ont été incluses dans les Listes Indicatives de ces pays. A travers ces initiatives, l'UNESCO et ses partenaires assistent les pays à préparer des propositions d'inscription pour la Liste du patrimoine mondial. Parallèlement l'UNESCO mène des actions de sensibilisation auprès des décideurs et autre parties prenantes sur les avantages du « système » du patrimoine mondial.

L'inscription sur la Liste du patrimoine mondial peut engendrer une fierté qui se traduit par un soutien national pour la conservation de ce patrimoine, tant au niveau du gouvernement qu'au niveau des communautés locales. Dans bien d'autres régions du monde, les gouvernements ont utilisé le statut du patrimoine mondial afin de promouvoir la biodiversité dans leur pays, le tourisme étant une des principales retombées attendues. Si l'Afrique centrale a encore un long chemin à parcourir avant de concurrencer, par exemple, la publicité développée par l'Australie autour du site du patrimoine mondial de la Grande Barrière de corail, ses forêts n'en sont pas moins uniques et constituent un potentiel à promouvoir commercialement. Avant la guerre, le tourisme basé sur les gorilles était un important facteur de développement économique autour des parcs de Kachuzi-Biega Virunga. Dans les paysages de la TNS et de Gamba-Mayumba-Conkouati, le potentiel est déjà valorisé à travers un écotourisme de grande qualité. Si elles sont bien ciblées, ces initiatives peuvent encore se développer.

Dans le cas particulier des cinq sites du patrimoine mondial en RDC, la communication et la sensibilisation ont été des éléments centraux des interventions de l'UNESCO afin de mobiliser l'appui de toutes les parties prenantes (gouvernement national et régional, armée, MONUC, communautés locales, société civile) pour la conservation des sites.

L'inscription sur la Liste du patrimoine mondial permettra de bénéficier d'une reconnaissance internationale quant à l'importance globale des aires protégées les plus significatives de la région. Le cas de la RDC a démontré que l'inscription peut engendrer l'appui international pour la conservation des sites du patrimoine mondial. Dans le cadre de la *Convention*, les pays acceptent la responsabilité partagée pour la conservation de ces sites. Le développement de fonds fiduciaires permet de générer des ressources financières durables pour la gestion de certains d'entre eux et fournit un mécanisme aux pays donateurs pour remplir leurs engagements vis-à-vis de la *Convention*. Les marchés de crédits de carbone, notamment si la déforestation évitée devient un critère acceptable, peuvent également constituer une contribution importante à un financement durable, les taux de déforestation en Afrique centrale étant deux fois inférieurs à ceux d'Amazonie et quatre fois inférieurs à ceux d'Asie du sud-Est.

Toutefois, pour être reconnus par la *Convention*, les sites doivent non seulement démontrer leur importance sur le plan international, mais également une capacité de gestion qui garantit le maintien sur le long terme de ces valeurs universelles exceptionnelles et de leur niveau d'intégrité. C'est pourquoi les initiatives de l'UNESCO mettent un accent particulier sur l'amélioration du niveau de gestion de ces sites dans le contexte plus large de leur paysage à travers le développement de modèles de gestion appropriés, et sur le renforcement des capacités des agences et autres parties prenantes concernées. Ces aspects importants des initiatives ont été rendus possibles par le développement de partenariats stratégiques développés avec les ONG internationales de conservation.

Le souhait de l'UNESCO est que ces efforts conjoints permettent l'émergence d'un réseau de sites du patrimoine mondial bien gérés à travers le bassin du Congo, qui refléteraient l'exceptionnel patrimoine naturel de la région, et qui bénéficieraient d'appui au niveau local, national et international.

## ACRONYMES

| | |
|---|---|
| APN | African Parks Network |
| AFD | Agence Française de Développement |
| ACF | Africa Conservation Fund |
| AWF | African Wildlife Foundation |
| CAWHFI | Central African World Heritage Initiative |
| CARPE | Central African Programme for the Environment |
| CBG | Compagnie des Bois du Gabon |
| CE | Commission Européenne |
| CI | Conservation International |
| CoCoCongo | Conservation Coalition for Congo |
| CoCoSi | Comité de Coordination du Site |
| Coltan | Un minerai contenant Colombite et Tantalite |
| COMIFAC | Commission des Forêts d'Afrique Centrale |
| CNDP | Congrès National pour la Défense du Peuple (milice armée) |
| CMEC | China National Machinery & Equipment Import & Export Corporation |
| CIB | Congolaise Industrielle des Bois |
| FAO | Food and Agriculture Organisation |
| FARDC | Forces Armées de la République Démocratique du Congo |
| FFI | Faune and Flora International |
| FFEM | Fonds Français pour l'Environnement Mondial |
| FZS | Frankfurt Zoological Society |
| FDLR | Force Démocratique pour la Libération du Rwanda (milice armée) |
| GEF | Global Environment Facility |
| GIC | Gilman International Conservation |
| GPS | Global Positioning System |
| GRASP | Great Apes Survival Partnership |
| GTZ | Deutsche Gesellschaft für Technische Zusammenarbeit |
| ICOMOS | Conseil International des Monuments et des Sites |
| IFO | Industries Forestières d'Ouesso |
| IRF | International Rhino Fund |
| ICCN | Institut Congolais pour la Conservation de la Nature |
| IUCN | International Union for the Conservation of Nature |
| KfW | Banque Kreditanstalt für Wiederaufbau |
| LEM | Law Enforcement Monitoring |
| LRA | Lord's Resistance Army (milice armée) |
| LZS | London Zoological Society |
| MIKE | Monitoring of Illegal Killing of Elephants |
| MIST | Monitoring Information System |
| MONUC | United Nations Organisation Mission in DR Congo |
| MZS | Milwaukee Zoological Society |
| ONG | Organisation non-gouvernementale |
| OFAC | Observatoire des Forêts d'Afrique Centrale |
| PDA | Personal Digital Assistant |
| PICG | Programme International de Conservation des Gorilles |
| PFBC | Partenariat pour les Forêts du Bassin du Congo |
| PFNL | Produits Forestiers Non Ligneux |
| PNKB | Parc National de Kahuzi-Biega |
| PNVi | Parc National des Virunga |
| PNUE | Programme des Nations Unies pour l'Environnement |
| PNUD | Programme des Nations Unies pour le Développement |
| RAPAC | Réseau des Aires Protégées en Afrique Centrale |
| RCA | République Centrafricaine |
| RDC | République Démocratique du Congo |
| RFO | Réserve de Faune à Okapis |
| RN | Route Nationale |
| SIG | Système d'Information Géographique |
| TRIDOM | Tri National Dja-Odzala-Minkébé |
| TNS | Tri National Sangha |
| WWF | World Wide Fund for Nature (Fonds Mondial pour la Nature) |
| WCS | Wildlife Conservation Society |
| UICN | Union International pour la Conservation de la Nature |
| UNESCO | United Nations Education, Scientific and Cultural Organisation |
| UNF | United Nations Foundation (Fondation des Nations-Unies) |
| USAID | United States Agency for International Development |

## Le Centre du patrimoine Mondial

Créé en 1992, le Centre du patrimoine mondial est le secrétariat UNESCO pour la Convention du patrimoine mondial. Assurant la gestion au jour le jour de la Convention, il organise les sessions annuelles du Comité du patrimoine mondial, conseille les Etats parties sur la préparation des propositions d'inscription, organise l'assistance internationale du Fonds du patrimoine mondial et assure, avec les organisations consultatives auprès du comité du patrimoine mondial (l'UICN et ICOMOS), le processus de production de rapports sur l'état de conservation des sites inscrits. Le Centre gère plusieurs grandes initiatives de conservation, telles celles du bassin du Congo, avec l'appui financier de plusieurs bailleurs de fonds.

## Le Partenariat

Les acteurs les plus importants de ce partenariat sont les Etats membres de la Convention concernés par cette initiative : les gouvernements des Républiques du Cameroun, de Centrafrique, du Congo, du Congo Démocratique, et du Gabon ainsi que leurs ministères et agences techniques respectives telles que l'ICCN, l'agence responsable de la gestion des aires protégées en RDC. Les activités contribuent au Plan de convergence de la COMIFAC et sont coordonnées avec la COMIFAC et son partenaire technique pour les questions d'aires protégées, le RAPAC. La FAO est un partenaire de la composante UNF de CAWHFI.

Les activités de terrain sont mises en œuvre par un consortium d'organisations internationales et régionales de conservation de la nature, la plupart ayant une longue expérience d'appui aux aires protégées du bassin du Congo. Le WWF, la WCS et Conservation International ont également mobilisé d'importants co-financements pour les programmes.

## Partenaires mettant en oeuvre les programmes

*Page opposée: un gorille mâle effectuant une démonstration dans une clairière du parc national d'Odzala-Kokoua au nord Congo.*

*Photo © Sylvain Gatti Florence Levréro, CNRS, Station Biologique Paimpont-Université de Rennes*

Nos programmes dans le bassin du Congo sont soutenus par

Annexe 5.17

iworry

# DEAD or ALIVE?

## VALUING AN ELEPHANT

# PREFACE

"Elephants are among the world's most charismatic mega fauna and our largest living land mammals. However, the survival of Africa's elephants is threatened by continuing demand for ivory desired for trinkets, religious statues, ornaments and accessories from Far Eastern Countries. As a result, elephant poaching is rife across Africa, with elephants being killed even in supposed safe and protected areas. The result is the unsustainable slaughter of one elephant every 15 minutes, decimating populations and damaging ecosystems.

This report looks at the financial value of elephants; alive. Every year, thousands of tourists travel to African nations to see elephants, yet without protective regulations, these nations can become devoid of the very animals which the hordes of eager tourists have come to see.

This report finds that alive, elephants present a huge revenue stream to local economies through tourism and, in the long term, elephants are worth significantly more roaming the world's savannahs and forests than with their tusks sitting on a mantlepiece or adorning someone's wrist.

Protecting elephants makes monetary sense. Data of this type can be used to show key decision makers that elephant conservation is a far more viable economic proposition than the ivory trade.  It's a powerful incentive to decision makers in charge of our natural resources to protect the species against rampant poaching.

Referring to wild animals as 'economic commodities' has created controversy in the past but where policy is determined by the value of an object, it's time to give the elephant a fair footing.

We must recognise the need to realise the value of our wildlife and environmental heritage in order to pass policies that safeguard against their destruction. Policy makers will not pass effective measures without tangible benefits to society, yet so far the discussion has seemly only focused on the consumptive value of an elephant, it's tusks. We need to look at the animal alive.

Arguments to protect Africa's elephants have typically been based on emotive and environmental reasons – their cognitive abilities, their benefit to the wider environment and their ancient beginnings. To many decision makers, this might be enough. But we must reach those that balance the purse strings to make effective policies happen.

Protecting elephants makes economic sense, whether you're responsible for a reserve in Tanzania or a National Park in Kenya -- if elephants live, tourists will come and economies can be boosted. It's another argument as to why we must save elephants and a financially compelling one."

Rob Brandford, **iworry Director**

# METHODOLOGY

This publication identifies reported ivory seizures worldwide. By 'reported ivory seizures', we mean publicly reported ivory seizures, focusing on newspaper and online reports. We have used a wide range of open source resources, including English, Chinese, and French-language media, but it should be noted that the reported ivory seizures identified in this document may not represent the total number of seizures this year and are only a proportion of all illegal ivory trade.

As part of international monitoring of the illegal trade in ivory, countries party to CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) are mandated to report information on elephant ivory seizures to TRAFFIC via the CITES Secretariat within 90 days of their occurrence which is then added to the ETIS database, though the time frame is often ignored. Variances in law enforcement, the rule of law and corruption levels, mean that reporting rates differ from country to country, and our figures may vary from TRAFFIC reported seizures.

The number of estimated elephants killed per seizure is an estimate and not a definitive number. We are using TRAFFIC's estimate that an average tusk weighs 5kg , extrapolating that an average elephant with two tusks carries 10kg of ivory.

We note that this is a very conservative estimate with 'tuskers' carrying much larger quantities, however this estimate serves as a basis to translate ivory seizure data into a relative estimate of the numbers of elephants represented by individual ivory shipments. There may be a variation between country or even regions with heavily poached elephant populations yielding smaller average tusk sizes while recently poached populations provide larger yields.

This report is produced by iworry, an elephant awareness campaign by the David Sheldrick Wildlife Trust. The iworry campaign raises awareness of the ivory poaching crisis and the impact trade in ivory is having on elephant populations. More information: **www.iworry.org**

**The David Sheldrick Wildlife Trust** has worked in Kenya for over 35 years to protect, conserve and preserve wildlife and habitats. Their conservation projects include Anti-Poaching and Aerial Surveillance initiatives, Mobile Vet Units, the Orphans' Project, Saving Habitats and Community Outreach. More information: **www.sheldrickwildlifetrust.org**

iworry would like to thank Gabriella Minerva and Amanda Woomer for their editorial assistance and contributions.


# SUMMARY

Elephants are one of the world's most recognisable mammals, thanks to their size and distinctive tusks. It is these distinctive teeth that are making the species increasingly vulnerable to the point that populations have reached a tipping point; if the slaughter of elephants continues then they will be wiped out within our lifetime .

Policy and decision making in the conservation of natural resources which includes, in many countries, elephants, is influenced more by dollar-denominated measures of benefits and costs than non-monetary measures. With ongoing slaughter threatening Africa's elephant populations, in order to secure the long term future of the species, it is imperative to speak to natural resource policy makers in a language they understand to highlight the benefits of protecting the species and identify the tangible benefits elephants can bring.

A single dead elephant's tusks are estimated to have a raw value of $21,000 (based on TRAFFIC estimate that an elephant carries an average of 5kg of ivory per tusk). By comparison, the estimated tourism value of a single living elephant is $1,607,624.83 over its lifetime to travel companies, airlines and local economies thanks to tourists willing to pay generously for a chance to see and photograph the world's largest land mammal. That makes a living elephant, in financial terms, as valuable as 76 dead elephants.

Our research finds that between January and August 2014, a reported 17,799.29kg (17.8 tonnes) of ivory was seized worldwide, representing 1,940 elephants slaughtered for their tusks. But it's not just elephants that are in danger. The slaughter so far has lost Africa's tourism industry, local communities and economies a total of $44,554,844.47 alone this year. More killings every day only increases this figure.

As a form of wildlife crime, the illegal trade in ivory benefits criminal gangs, corrupt military units and militia and even terrorist groups including Al-Shabaab and the Lord's Resistance Army.

Taken together, the findings demonstrate that the species are worth more alive than dead. Ending the killing and protecting elephants makes monetary sense. Worldwide, a single living elephant drives tens of thousands of dollars in tourism-related revenues. Alive, they benefit local communities and economies; dead they benefit criminal and even terrorist groups.

Given the overlap of ivory poaching locations and elephant tourism operations, every elephant killed makes these regions much less profitable. As a result of the findings, iworry recommends:

- An immediate end to all sales of ivory
- Greater funding for Anti-Poaching operations; boots on the ground
- Education in communities from which poachers are drawn as to the value elephants could bring to them in the long term
- Ensure tourism initiatives and projects give tangible benefits to communities
- Enhancing campaigns in ivory consumer countries to inform the public about the true cost of ivory.

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# THE YEAR SO FAR...

## JAN-AUG 2014

43 seizures
TRAFFICKED IVORY

17.8 tonnes
IVORY SEIZED

1,940
17.8 tonnes
ELEPHANTS KILLED TO PRODUCE IVORY

VALUE OF ELEPHANT over its lifetime to tourism
**$1,607,624.83**

Average raw VALUE OF IVORY an elephant carries
**$21,000**

$ 76x MORE VALUABLE is an elephant alive than dead

10% of CONTRABAND is usually seized

90% ILLEGAL IVORY benefitting terrorist and criminal groups

up to
# 19,400
elephants killed this year so far

# IVORY

## a popular product

Ivory has long been prized in cultures across the world but since 1989, it has been illegal to trade internationally in ivory. Two exceptions to this ban have since occurred; in 1999, Botswana, Namibia and Zimbabwe were allowed a 'one off sale' of ivory to Japan and in 2002, and a further 'one off sale' to China and Japan was approved, which took place in 2008.

Prior to the 'one-off' sales, the ban was initially successful in halting the elephant killing of the 1980's and combined with declining popularity among Western countries throughout the 20th century, meant the price of ivory slumped and poaching rates fell dramatically. By comparison, as a result of the sales to China, demand has been stimulated and a market has been created in which illegal poached ivory can be laundered, thus boosting domestic demand for ivory products. Combined with China's growing middle class who can afford endangered wildlife products such as ivory, the result has been a soar in demand.

Two types of elephant exist in Africa, the Forest Elephant and the Savannah Elephant; both are poached for their ivory. Research by Save The Elephants found that in 2014, uncarved ivory was worth $2,100 per kilo in China, three times its value in 2010.

2014. Born Free USA, Ivory›s Curse: The Militarization and Professionalization of Poaching in Africa. http://www.bornfreeusa.org/a9_ivorys_curse.php

17.8 TONNES OF IVORY SEIZED THIS YEAR

# seizures and terrorism

The illegal wildlife trade, which includes the illegal trade in ivory, is estimated to be worth $15–20 billion annually  and is the fourth most lucrative illegal activity behind arms, drugs and human trafficking.

Between January and August 2014, 43 seizures of ivory were reported or more than one a week. The combined weight of the seizures amounts to more than 17.779 tonnes (17.8 tonnes), or approximately 1,940 elephants slaughtered for their tusks.

Of the reported ivory seized: 10 seizures were in Kenya, five were in Gabon, five were in Vietnam and four were in China (including Hong Kong). Whilst this is significantly less than the 50 tonnes of ivory seized globally in 2013,  it cannot be seen as indicating poaching rates have diminished. Changing shipping routes, ports, reduction in a region's rule of law and reporting can all impact seizure rates.

It is widely known that corrupt officials, criminal groups and even terrorist groups are involved in the illegal trade in ivory. Using current estimates, the value of the seized ivory in 2014 amounts to $37,378,509.

Yet, it is estimated that a seizure rate of 10% in a developed country is considered "good" for general goods contraband – which includes ivory. This suggests that so far this year, an estimated 177,993kg (178 tonnes) of ivory has been illegally trafficked representing 19,400 elephants killed.

# TOURISM

## an Economic Alternative

The current population of elephants in Africa is unknown but estimates place the figure at between 300,000 and 400,000. As a species, elephants do not reach sexual maturity until at least 11 years old, live until 70 on average and reproduce slowly meaning at the current rate of slaughter, they will be wiped out within our lifetime.

As one of Africa's famous Big Five, elephants are a significant source of revenue for the tourism industry. In Kenya, Tanzania, Zambia and South Africa elephants are now an important part of the regional and national tourism industry, driving multi-million dollar revenue streams. Elephant viewing camps, safaris and photo-tours are all based around the thrilling experience of viewing wild elephants. When viewed through a non-consumptive lens (tourism), alive a single elephant can contribute $22,966 to tourism per year and because elephants live for multiple decades, the total revenue that each elephant can generate during its lifespan is immense - $1,607,624.83.

By comparison, an elephant carries an estimated two 5kg tusks or a total of 10kg (a conservative estimate). Dead, an elephant is worth an estimated $21,000. Alive, an elephant is worth 76 times as much.

As a key stone species, elephants shape their environment with species and animals within the ecosystem dependent on elephants for their own survival. Grazing the world's forests and savannahs, elephants generate vast sums of renewable cash for the local economy in the process.

Regionally, Kenya and Gabon account for the most seizures within Africa. Though tourism in Gabon remains largely underdeveloped, in Kenya elephants and wildlife tourism alone generates 12% of the Gross Domestic Product and creates over 300,000 jobs.

In fact Kenya is well established as a destination to view wildlife, raising Kshs'4,216,756,000 in National Park entrance fees in 2012 (around $47,657,000). Home to Africa's 'Big Five', elephant herds alongside rhino and buffalo draw hundreds of thousands of tourists each year. For instance, Tsavo East National Park, home to Kenya's single largest population of elephants accounts for over 20% of average annual visitation into Kenya Wildlife Service National Parks with other parks including Amboseli National Park and Samburu National Reserve home to world famous herds.

The slaughter of over 1,940 elephants so far this year to furnish the illegal trade in ivory represents $44,554,844 lost to tourism. This pales in comparison to the potential $445,548,444 lost to tourism if we take into account a 10% seizure rate - which is a standard among developed countries. Further loss of elephants only increases this figure and makes these regions less profitable.

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alive a single
elephant can
contribute
$22,966 to
tourism per year

# IVORY SEIZURES

Annexe 5.17

| DATE OF SEIZURE | IVORY SEIZED | WEIGHT (KG) | NUMBER OF ELEPHANTS KILLED PER SEIZURE | COUNTRY OF SEIZURE |
|---|---|---|---|---|
| January | 34kg | 34.00 | 3.4 | Gabon |
| January | 2 tusks | not known | 1 | Gabon |
| January | 1.8 tonnes | 1,800.00 | 180 | Singapore |
| 01-Jan-14 | 81 tusks | not known | 40.5 | Tanzania |
| 08-Jan-14 | 35 tusks | 275.00 | 17.5 | China |
| 10-Jan-14 | 34kg | 34.00 | 3.4 | Gabon |
| 14-Jan-14 | 14kg | 14.00 | 1.4 | China |
| 16-Jan-14 | 5kg | 5.00 | 0.5 | Kenya |
| 18-Jan-14 | 3.4kg | 3.40 | 0.34 | Kenya |
| 29-Jan-14<br>23-Jan-14 | 3.815 tonnes | 3,815.00 | 381.5 | Togo |
| 30-Jan-14 | 120kg | 120.00 | 12 | China |
| February | 95.82kg | 95.82 | 9.582 | China |
| February | 4.2kg | 4.20 | 0.42 | Vietnam |
| 08-Feb-14 | 143kg | 143.00 | 14.3 | Cameroon |
| 14-Feb-14 | 0.68 kg | 0.68 | 0.068 | Kenya |
| 16-Feb-14 | 79.5kg | 79.50 | 7.95 | Cambodia |
| 06-Mar-14 | 36 tusks | 170.00 | 18 | Cameroon |
| 21-Mar-14 | 77 pieces | 263.00 | 26.3 | Cambodia |
| 27-Mar-14 | 106 pieces of raw ivory tusks | 1,000.00 | 100 | Singapore |
| 04-Apr-14 | 7 tusks | 50.00 | 3.5 | Gabon |
| 07-Apr-14 | 48kg | 48.00 | 4.8 | Kenya |
| 01-May-14 | 0.092kg | 0.09 | 0.0092 | Zimbabwe |
| 09-May-14 | 3 tonnes | 3,000.00 | 300 | Cambodia |
| 24-May-14 | 1266kg | 1,266.00 | 126.6 | Vietnam |
| 05-Jun-14 | 2152 kg | 2,152.00 | 215.2 | Kenya |
| 08-Jun-14 | 125kg | 124.00 | 12.4 | Togo |
| 10-Jun-14 | 790kg | 790.00 | 79 | Ethiopia |
| 18-Jun-14 | 700kg | 700.00 | 70 | Togo |

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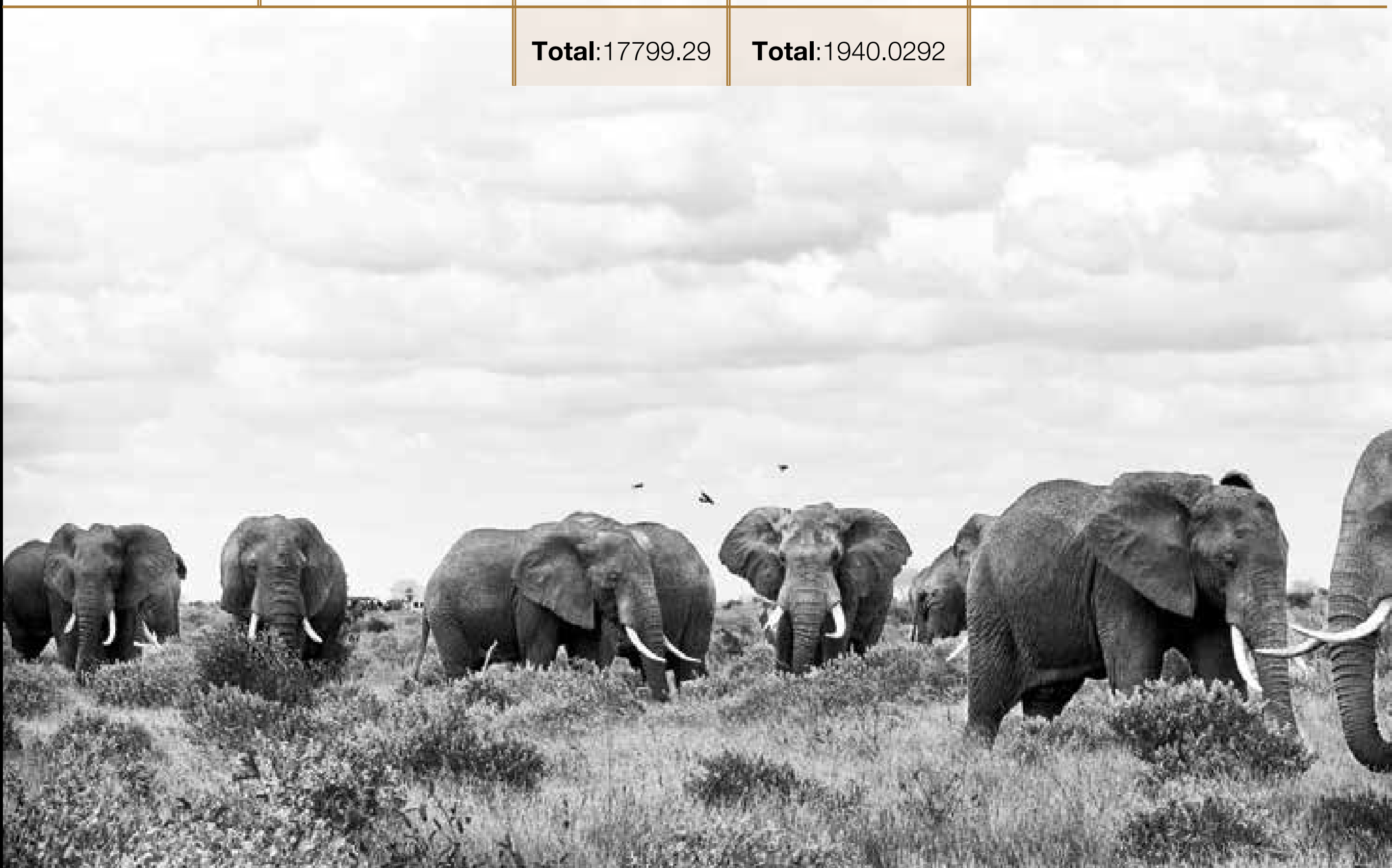
# IVORY SEIZURES

Annexe 5.17

| DATE OF SEIZURE | IVORY SEIZED | WEIGHT (KG) | NUMBER OF ELEPHANTS KILLED PER SEIZURE | COUNTRY OF SEIZURE |
|---|---|---|---|---|
| 22-Jun-14 | 90Kg | 90.00 | 9 | Vietnam |
| 28-Jun-14 | 6 tusks | not known | 3 | Namibia |
| July | 4 spikes | 14.00 | 1.4 | Gabon |
| 25-Jul-14 | 260kg | 260.00 | 26 | Kenya |
| 28-Jul-14 | 18 tusks | 46.00 | 9 | Thailand |
| 31-Jul-14 | 9 tusks | 84.00 | 4.5 | Kenya |
| 01-Aug-14 | 14.6 kg | 14.60 | 1.46 | Vietnam |
| 04-Aug-14 | 5 tusks | 12.00 | 1.2 | Kenya |
| 04-Aug-14 | 84kg | 84.00 | 8.4 | Kenya |
| 12-Aug-14 | 4 tusks | 30.00 | 2 | Benin |
| 15-Aug-14 | 30kg | 30.00 | 3 | Benin |
| 17-Aug-14 | 1000kg | 1,000.00 | 100 | Vietnam |
| 18-Aug-14 | 62kg including 2 tusks | 62.00 | 6.2 | Kenya |
| 12-Aug-14 | 30kg | 30 | 3 | Benin |
| 22-Aug-14 | 56kg | 56 | 5.6 | Benin |
| | | **Total**:17799.29 | **Total**:1940.0292 | |



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Annexe 5.17

iworry

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www.iworry.org
iworry is an elephant awareness campaign by the David Sheldrick Wildlife Trust.

Annexe 5.18

Peter Prokosch

# Tourism

## Investing in energy and resource efficiency

This chapter was developed in partnership with the World Tourism Organization

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# Acknowledgements

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# Contents

## List of figures



## List of tables



## List of boxes

## List of acronyms

BAU - Business-as-usual
Bn - Billion
CSR - Corporate Social Responsibility
DFI - Development Finance Institutions
DMO - Destination Management Organization
ERT - Environment-related tourism
EU - European Union
FDI - Foreign Direct Investment
G2 - Green Scenario 2
GDP - Gross Domestic Product
GEF - Global Environment Facility
GER - Green Economy Report
GHG - Greenhouse Gas
GSTC - Global Sustainable Tourism Criteria
Ha - Hectare
HCT - Hotels, catering and tourism
ICOMOS - International Council on Monuments and Sites
ILO - International Labour Organization
IPA - Investment promotion agencies
IUCN - International Union for Conservation of Nature
LDC - Least-developed countries
M&E - Monitoring and evaluation
Mt - Million tonnes
OSH - Occupational safety and health
PPI - Pro-poor income
ROI - Return on investment
SIFT - Sustainable Investment and Finance in Tourism network
SME - Small and Medium-sized Enterprise
ST-EP - Sustainable Tourism for Eliminating Poverty initiative
TEEB - The Economics of Ecosystems and Biodiversity
TIES - The International Ecotourism Society
TSA - Tourism Satellite Account
UNCTAD - United Nations Conference on Trade and Development
UNEP - United Nations Environment Programme
UNESCO - United Nations Educational, Scientific and Cultural Organization
UNWTO - World Tourism Organization
WTP - Willingness to pay
WTTC - World Travel & Tourism Council
WWF - World Wildlife Fund

# Key messages

**1. *Tourism has significant potential as a driver for growth for the world economy.*** The tourism economy represents 5 per cent of world GDP, while it contributes to 6-7 per cent of total employment. International tourism ranks fourth (after fuels, chemicals and automotive products) in global exports, with an industry value of US$1trillion a year, accounting for 30 per cent of the world's exports of commercial services or 6 per cent of total exports; 935 million international tourists were recorded in 2010 and 4 billion domestic arrivals in 2008. In over 150 countries, tourism is one of five top export earners, and in 60 it is the number one export. It is the main source of foreign exchange for one-third of developing countries and one-half of LDCs.

**2. *The development of tourism is accompanied by significant challenges.*** The rapid growth in both international and domestic travel, the trends to travel farther and over shorter periods of time, and the preference given to energy-intensive transportation are increasing the non-renewable energy dependency of tourism, resulting in the sector's contribution of 5 per cent to global GHG emissions. Other challenges include excessive water consumption compared with residential water use, discharge of untreated water, the generation of waste, the damage to local terrestrial and marine biodiversity, and the threats to the survival of local cultures, built heritage and traditions.

**3. *Green tourism has the potential to create new jobs and reduce poverty.*** Travel and tourism are human-resource intensive, employing directly and indirectly 8 per cent of the global workforce. It is estimated that one job in the core tourism industry creates about one and a half additional or indirect jobs in the tourism-related economy. The greening of tourism, which involves efficiency improvements in energy, water, and waste systems, is expected to reinforce the employment potential of the sector with increased local hiring and sourcing and significant opportunities in tourism oriented toward local culture and the natural environment.

**4. *Tourism development can be designed to support the local economy and poverty reduction.*** Local economic effects of tourism are determined by the share of tourism spending in the local economy as well as the amount of the resulting other economic activities. In greening the tourism sector, therefore, increasing the involvement of local communities, especially the poor, in the tourism value chain can contribute to the development of local economy and poverty reduction. This can include the local supply of products, labour, tourism services, and increasingly "green services" in energy and water efficiency and waste management. There is increasing evidence that more sustainable tourism in rural areas can lead to more positive poverty-reducing effects.

**5. *Investing in the greening of tourism can reduce the cost of energy, water, and waste and enhance the value of biodiversity, ecosystems and cultural heritage.*** Investment in energy efficiency has been found to generate significant returns within a short payback period. Improving waste management is expected to save money for tourism businesses, create jobs and enhance the attractiveness of destinations. The investment requirement in conservation and restoration is small relative to the value of forests, mangroves, wetlands, and coastal zones including coral reefs, which provide ecosystem services essential for the foundation of economic activities and for human survival. Investment in cultural heritage—the largest single component of consumer demand for sustainable tourism—is among the most significant and usually profitable investments a society or tourism sector can make. Under a green-economy investment scenario, tourism makes a larger contribution to GDP growth and significant environmental benefits include reductions in water consumption (18 per cent), energy use (44 per cent) and $CO_2$ emissions (52 per cent) compared with "business-as-usual".

***6. Tourists are demanding the greening of tourism.*** More than a third of travellers are found to favour environmentally-friendly tourism and be willing to pay for related experiences. Traditional mass tourism has reached a stage of steady growth. In contrast, ecotourism, nature, heritage, cultural, and "soft adventure" tourism are taking the lead and are predicted to grow rapidly over the next two decades. It is estimated that global spending on ecotourism is increasing about six times the industry-wide rate of growth.

***7. The private sector, especially small firms, can, and must be mobilised to support green tourism.*** The tourism sector involves a diverse range of actors. The awareness of green tourism exists mainly in a selection of larger scale firms. Smaller firms are mostly outside this sphere and diverse supplier groups may not be connected at all. Specific mechanisms and tools to educate small and medium sized tourism related enterprises are critical and are most effective when they are accompanied by actionable items. The promotion and widespread use of internationally recognised standards for sustainable tourism, such as the Global Sustainable Tourism Criteria (GSTC), can help businesses understand the practical aspects of sustainable tourism and assist with mobilising investment.

***8. Much of the economic potential for green tourism is found in small and medium-sized Enterprises (SMEs), which need better access to financing for investing in green tourism.*** The majority of tourism businesses are SMEs with potential to generate greater income and opportunity from green strategies. Their single greatest limiting factor for greening, however, is lack of access to capital. Governments and international organisations can facilitate the financial flow to these important actors with an emphasis on contributions to the local economy and poverty reduction. Public-private partnerships can spread the costs and risks of large green tourism investments. Besides reducing administrative fees and offering favorable interest rates for green tourism projects, in-kind support such as technical, marketing or business administration assistance, could also help.

***9. Destination planning and development strategies are the first step towards the greening of tourism.*** In developing tourism strategies, local governments, communities and businesses need to establish mechanisms for coordinating with ministries responsible for the environment, energy, labour, agriculture, transport, health, finance, security, and other relevant areas. Clear requirements are needed in such areas as zoning, protected areas, environmental rules and regulations, labour rules, agricultural standards, and health requirements particularly related to energy, emissions, water, waste and sanitation.

***10. Government investments and policies can leverage private sector actions on green tourism.*** Government spending on public goods such as protected areas, cultural assets, water conservation, waste management, sanitation, public transport, and renewable energy infrastructure can reduce the cost of green investments by the private sector in green tourism. Governments can also use tax concessions and subsidies to encourage private investment in green tourism. Time-bound subsidies can be given, for example, on the purchase of equipment or technology that reduces waste, encourages energy and water efficiency, the conservation of biodiversity, and the strengthening of linkages with local businesses and community organisations. At the same time, resource and energy use as well as waste generation need to be correctly priced to reflect their true cost to society.

# 1 Introduction

This chapter seeks to make the case, primarily an economic one, for investing in the "greening" of tourism and it provides guidance on how to mobilise such investments. The objective is to inspire policy makers to support increased investment in greening the sector. The chapter shows how green investment in tourism can contribute to economically viable and robust growth, decent work creation and poverty alleviation; while improving resource efficiency and minimising environmental degradation.

There is a growing body of evidence that greening tourism can lead to broad economic, social and environmental benefits for the host countries and their communities (Mill and Morrison 2006, Rainforest Alliance 2010, World Economic Forum 2009a, Klytchnikova and Dorosh 2009). Tourism's potential for creating employment, supporting livelihoods and enabling sustainable development is huge, given that it is one of the main sources of foreign-exchange income—the principal source for one-third of developing countries and one-half of the world's Least Developed Countries (LDCs) according to the UN Conference on Trade and Development (UNCTAD 2010).

The chapter starts with an explanation of what is meant by greening tourism, followed by a discussion of the challenges and opportunities facing the sector. It then discusses the goals for greening the sector and the potential economic implications of green investment being made in the sector, including the results from a modelling exercise. Finally, the chapter presents the conditions that are important for enabling the greening of the sector.

## 1.1 Tourism in a green economy

Tourism in a green economy refers to tourism activities that can be maintained, or sustained, indefinitely in their social, economic, cultural, and environmental contexts: "sustainable tourism". Sustainable tourism is not a special form of tourism; rather, all forms of tourism may strive to be more sustainable (UNEP and UNWTO 2005). A clear distinction should be made between the concepts of ecotourism and sustainable tourism: "the term ecotourism itself refers to a segment within the tourism sector with focus on environmental sustainability, while the sustainability principles should apply to all types of tourism activities, operations, establishments and projects, including conventional and alternative forms". [1]

Sustainable tourism describes policies, practices and programmes that take into account not only the expectations of tourists regarding responsible natural-resource management (demand), but also the needs of communities that support or are affected by tourism projects and the environment (supply)[2]. Sustainable tourism thus aspires to be more energy efficient and more "climate sound" (e.g. by using renewable energy); consume less water; minimise waste; conserve biodiversity, cultural heritage and traditional values; support intercultural understanding and tolerance; and generate local income and integrate local communities with a view to improving livelihoods and reducing poverty. Making tourism businesses more sustainable benefits local communities and raises awareness and support for the sustainable use of natural resources. In this chapter, the conceptual and operational framework for sustainability in tourism is based on the Global Sustainable Tourism Criteria (GSTC), an international consensus on the minimum criteria that a tourism business should follow to approach sustainability[3]. A group of key variables based on the GSTC are used for the analysis of the "greening" of tourism in this chapter.

The movement toward more sustainable tourism implies significant improvements in the performance of conventional tourism, as well as growth and improvements in smaller, niche areas centred on natural, cultural and community resources. The expansion of the latter, as a proportion of the industry as a whole, may have especially positive implications for biodiversity conservation and rural poverty reduction; whereas the greening of conventional and mass tourism is likely to have its largest effects on resource use and management, as well as on increased economic spillovers and the inclusion of disadvantaged populations.

1. *International Year of Ecotourism 2002*, http://www.unep.fr/scp/tourism/events/iye/pdf/iye_leaflet_text.pdf.

2. ILO (2010b) views sustainable tourism as "composed of three pillars: social justice, economic development, and environmental integrity. It is committed to the enhancement of local prosperity by maximizing the contribution of tourism to the destination's economic prosperity, including the amount of visitor spending that is retained locally. It should generate income and decent employment for workers without affecting the environment and culture of the tourists' destination and ensures the viability and competitiveness of destinations and enterprises to enable them to continue to prosper and deliver benefits in the long term".

3. The Global Sustainable Tourism Criteria were developed as part of a broad initiative managed by *The Partnership for Global Sustainable Tourism Criteria* (GSTC Partnership), a coalition of over 40 organisations working together to foster increased understanding of sustainable tourism practices and the adoption of universal sustainable tourism principles. The Partnership was initiated by the Rainforest Alliance, the United Nations Environment Programme (UNEP), the United Nations Foundation and the United Nations World Tourism Organization (UNWTO). See www.gstcouncil.org/resource-center/gstc-criteria.htm.

# 2 Challenges and opportunities for tourism in a green economy

## 2.1 Challenges

The tourism industry faces a multitude of significant sustainability-related challenges. Challenges that need to be resolved through the greening of the industry include (1) energy and GHG emissions; (2) water consumption; (3) waste management; (4) loss of biological diversity; and (5) effective management of cultural heritage.

**Energy and GHG emissions**

The tourism sector's growing consumption of energy, especially in travel and accommodation, and its dependence on fossil fuels has important implications for global GHG emissions and climate change as well as for future business growth. Several elements contribute to tourism's increasing energy consumption, including growth rates in international tourist arrivals and domestic travel; trends to travel further and over shorter periods of time; as well as preference given to energy-intense transportation (e.g. aircraft and car travel over train and bus, and flying first and business class instead of economy (Peeters et al. 2010). The sustainability and competitiveness of tourism depends in part on energy efficiency (reductions in overall energy use) and a more intensive use of renewable sources.

After transport, accommodation is the most energy-intensive component of the tourism industry, through its demand for heating or cooling, lighting, cooking (in restaurants), cleaning, pools and, in tropical or arid regions, the desalination of seawater. A general rule is that the more luxurious the accommodation, the more energy will be used. In a wide review of studies, energy-use in hotels range between 25 and 284 MJ/guest-night (Peeters et al. 2010). Tourism-related transport consumption of energy is related to travel mode. Coach and rail transport, cars and buses, aircraft and cruise ships have diverse energy intensities.[4]

There is no systematic international country dataset on energy consumption from tourism activities. UNWTO and UNEP (2008) estimate 250 MJ per person is consumed through activities not related to travel to the destination or accommodation on an average international tourist trip, 50 MJ per person is expended on shorter and less activity-oriented business trips and 100 MJ per person for Visiting Friends and Relatives (VFR) trips. The weighted global average of energy consumption for activities of international tourists is estimated at 170 MJ per trip, excluding transport and accommodation. As a comparison, world daily energy consumption per capita is estimated at 135MJ (a value that includes energy generation and industry).[5]

Given the rising global trend for travel and the growing energy intensity of most trips, future emissions from the tourism sector are expected to increase substantially, even considering current trends in technological energy-efficiency gains in transport (air and ground) and accommodation. Tourism is estimated to create about 5 per cent of total GHG emissions (1,302 Mt $CO_2$), primarily from tourist transport (75 per cent) and accommodation (21 per cent, mainly from air-conditioning and heating systems). A globally-averaged tourist journey is estimated to generate 0.25 tonnes of $CO_2$ (UNWTO and UNEP 2008). The World Economic Forum (WEF 2009b), using a different set of sub-sectors, estimated global GHG emissions from tourism to be 13 per cent higher (1,476 Mt $CO_2$ in 2005). The report distinguishes direct and indirect emissions from tourism, with direct emissions being defined as "carbon emissions from sources that are directly engaged in the economic activity of the tourism and travel sector." While these are included in the WEF estimate, indirect emissions are excluded, i.e. emissions from electricity usage in airline or travel agent offices, and emissions from transportation of hotel consumables, such as food or toiletries (Peeters et al. 2010). Scott et al. (2010) estimate the sector contributed between 5.2 per cent and 12.5 per cent of all anthropogenic radiative forcing in 2005.

Over the next 30-50 years, GHG emissions from the tourism sector are projected to grow substantially in a "business-as-usual" scenario, in large part because emissions from aviation, the most important emitter in the industry, are expected to grow by at least a factor of 2 to 3 (UNWTO and UNEP 2008, WEF 2009b). Aviation

4. For instance, in New Zealand, the total energy consumed for tourism transport and accommodation is distributed by 43 per cent for road transport, 42 per cent for air travel, 2 per cent for sea transport and 1 per cent for rail transport, with accommodation comprising the remaining 12 per cent. For local travel, coach tourism consumes the greatest energy per day, followed by camper tourists, soft comfort and auto tourists (Becken et al. 2003).

5. Own estimation with data from the International Energy Agency, available at http://data.iea.org/ieastore/default.asp.

and tourism are expected to account for a large share of emissions unless a major change in the emission trajectories is achieved (Peeters et al. 2010).

**Water consumption**

While water use by tourism, on a global basis, is far less important than agriculture, industry, or urban domestic use, in some countries and regions, tourism can be the main factor in water consumption. In such areas, it can increase pressure on already diminished water resources and compete with other sectors as well as subsistence needs of local populations (Box 1). Tourism can also directly affect water quality, for instance through the discharge of untreated sewage or freshwater abstraction (Gössling 2010).

Global direct water consumption by international tourism (accommodation only) is estimated to be 1.3 $km^3$ per year (Gössling 2005). Available data suggests that direct water use in tourism varies between 100 and 2,000 litres per guest night, with a tendency for larger, resort-style hotels to use significantly more water than smaller, pension-like establishments or campsites. The main water-consuming factors are golf courses, irrigated gardens, swimming pools, spas, wellness facilities and guest rooms.

UNEP (2003) estimates that in the USA, tourism and recreation consumes 946 million cubic metres of water per year, of which 60 per cent is linked to lodging (mostly spent on guest consumption, landscape and property management and laundry activities), and another 13 per cent to foodservice. Total yearly water consumption by tourism in Europe is estimated at 843 million cubic metres. Each tourist consumes 300 litres of freshwater per day on average, whereas "luxury" tourists can consume up to 880 litres. By comparison, average per capita residential consumption in Europe is estimated at 241 litres per day.[6]

**Waste management**

Waste management is another increasing and well-recognised challenge in the industry. Every international tourist in Europe generates at least 1 kg of solid waste per day, and up to 2 kg/person/day for the USA (UNEP 2003). By comparison, CalRecovery and UNEP (2005) report total country waste generation, including industrial and other sources, for Austria (1.18 kg/person/day), Mexico (0.68 kg/person/day), India (0.4 kg/person/day) and the USA (2.3 kg/person/day).

Impacts are also considerable for wastewater management, even in high-income countries. In the Mediterranean region, for instance, it is commonplace for hotels to discharge untreated sewage directly into the sea (WWF 2004), with 60 per cent of water used in tourism resulting in sewage in need of disposal (GFANC 1997). In the European Mediterranean, only 30 per cent of municipal wastewater from coastal towns receives any treatment before discharge. Anecdotal evidence suggests that this is also the case in many other countries outside the European Union (Gössling 2010).

6. Author's estimation with data from AQUASTAT-FAO. Available at http://www.fao.org/waicent/faoinfo/agricult/agl/aglw/aquastat/dbase/index.stm.

## Box 1: Water consumption for tourism and local communities

Tourism development is concentrated in coastal areas and on small islands, where potable water is typically scarce. This scarcity can be caused by either a physical absence of freshwater, or because the necessary infrastructure or resources are lacking. A tourism-thirsty industry can secure its water needs wherever it operates although this can create situations of stark water inequity between tourists and neighbouring communities. Tourism's water demands can even lead to the appropriation of supply to the detriment of local domestic and agricultural needs, caused by the overexploitation of aquifers and reservoirs and the lowering of groundwater tables.

In a popular resort area of one South Asian country, for example, privately-owned water tankers buy water from villages through local elites and transport it to supply nearby hotels. This leaves villagers with water supply to their communal standpipes for a few hours a day only (Tourism Concern 2009 and 2010). Luxury resorts on an East African island are estimated to use up to 2,000 litres of water per tourist per day, almost 70 times more than the average daily domestic consumption of local people (Gössling and Hall 2006).

Golf tourism is rapidly expanding. An estimated 9.5 billion litres of water are used to irrigate the world's golf courses per day, equivalent to the daily needs of 80 per cent of the global population. One Mediterranean island, where water is so scarce it must sometimes be shipped in, is planning to increase its golf courses from three to 17, with tourism cited as the principal driver. This will involve building over agricultural land and constructing several desalination plants to ensure continual supply (Tourism Concern 2009).

Source: Tourism Concern (2010)

**Loss of biological diversity**
There are many examples where large-scale tourism has had detrimental effects on biodiversity, including coral reefs, coastal wetlands, rainforests, arid and semi-arid ecosystems and mountainous areas (UNWTO 2010d). Coral ecosystems have suffered strong adverse impacts from the use of coral for construction materials for hotels, over-fishing off reefs to feed tourists, sewage dumping and sedimentation from improperly managed runoff from buildings, parking lots, and golf courses. Coastal wetlands, particularly mangroves, have routinely been damaged or destroyed to build beach resorts. And in arid and semi-arid ecosystems, golf courses and other water-intensive activities have lowered water tables affecting local fauna and flora. Biodiversity will be greatly affected by the way in which tourism grows and develops, especially in developing countries (UNEP 2010). And failure to incorporate biodiversity concerns in destination planning and investment will have detrimental effects on the natural environment, increase conflict with local communities, and lead to reduced value-creation potential for both the destination and investors (notably as interest in nature-based tourism is growing rapidly around the world and represents therefore a strategic argument for maintaining biodiverse environments, which are often tourist destinations in developing countries).

**Management of cultural heritage**
Interest in unique cultures by tourists can result in adverse impacts and severe disruption for communities. There are examples of communities overrun by large numbers of visitors, commercialisation of traditions and threats to cultural survival from unplanned and unmanaged tourism. Tourism destinations are occasionally built by outsiders (usually with government approval) in areas that indigenous or traditional communities consider to be theirs, and where the development was neither desired nor locally validated. These situations lead to conflicts that make cooperation and mutual benefits nearly impossible to achieve, and instil animosities that negatively affect the local communities and the tourism destination. Frequently, the cultural issues overlap and are aggravated by environmental issues such as access to water, coastal resources and wildlife. Over the last two decades, with the growth in ecotourism and alternative travel, tourism impacts on vulnerable cultures has begun to be taken seriously by the tourism industry, governments, non-governmental organisations and the cultural groups involved (Wild 2010).

## 2.2 Opportunities

The following trends and developments provide a particularly promising space for greening tourism: (1) sizing and growth of the sector; (2) changing consumer patterns; and (3) potential for addressing local development and poverty reduction.

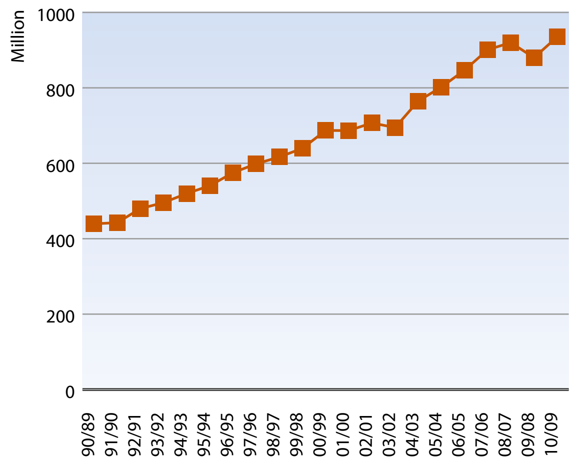



**Figure 1: World international tourist arrivals**
Source: UNWTO (2008, 2010b and 2011)

**Sizing and growth of the tourism sector**
Tourism is one of the most promising drivers of growth for the world economy. The sheer size and reach of the sector makes it critically important from a global resource perspective. Even small changes toward greening can have important impacts. Furthermore, the sectors' connection to numerous sectors at destination and international levels means that changes in practices can stimulate changes in many different public and private actors.

The tourism economy represents 5 per cent of global GDP, while it contributes to 6-7 per cent of total employment. International tourism ranks fourth (after fuels, chemicals and automotive products) in global exports, with an industry value of US$1 trillion a year, accounting for 30 per cent of the world's exports of commercial services or 6 per cent of total exports. Tourist arrivals have shown continuous yearly growth over the last six decades, with an average 4 per cent annual increase during the last two. This trend has held in spite of occasional short drops from international crises, such as pandemics, recessions and terrorism. International tourism arrivals reached 922 million in 2008, dropped to 880 million in 2009, and then recovered in 2010 with 935 million (UNWTO 2011) (Figure 1), while 4 billion domestic arrivals were recorded in 2008 (UNWTO and UNEP 2008). The tourist industry has been sensitive but resilient to economic, political and social global phenomena. The number of tourist trips is expected to continue to grow for the next decade, with the number of international tourist arrivals expected to reach 1.6 billion by 2020 (UNWTO, 2001).

The economic significance of tourism is highly variable across countries, however. While it represents only 1.9

per cent and 3.3 per cent of GDP in Japan and Peru respectively, it represents 7.7 per cent and 10.9 per cent of GDP in South Africa and Spain respectively (UNWTO 2010c, WTTC 2010b). Regarding employment, the tourism industry contributes with 2.8 per cent, 3.1 per cent, 6.9 per cent and 11.8 per cent of total employment for the same countries (UNWTO 2010c, WTTC 2010b). In terms of investment, it accounts for 5.8 per cent, 9.9 per cent, 13 per cent, and 13.8 per cent of total investment respectively (WTTC 2010 and 2010b).[7]

Proportionately, tourism will grow faster in less developed countries than in developed economies in the next ten years. Destinations in emerging economies receive 47 per cent of worldwide international tourist arrivals and US$306 billion in international tourism receipts (36 per cent of the global total). Moreover, growth in the decade since 2000 has been most marked in emerging economies (58.8 per cent). Market share has also grown more significantly in emerging economies (from 38.1 per cent in 2000 to 46.9 per cent in 2009). Recent trends and forecasts point to a spreading of tourism to new destinations**,** largely in developing countries, where there is outstanding potential to support development goals, and where new environmental and cultural attributes can make an important contribution to more sustainable tourism destinations (UNWTO 2010b).

**Changing consumer patterns**

Tourist choices are increasingly influenced by sustainability considerations. For instance, in 2007 TripAdvisor surveyed travellers worldwide and 38 per cent said that environmentally-friendly tourism was a consideration when travelling, 38 per cent had stayed at an environmentally-friendly hotel and 9 per cent specifically sought such hotels, while 34 per cent were willing to pay more to stay in environmentally-friendly hotels (Pollock 2007). CEDS and TIES (2005) found that a majority of international tourists are interested in the social, cultural and environmental issues relevant to the destinations they visit and are interested in patronising hotels that are committed to protecting the local environment, and increasingly view local environmental and social stewardship as a responsibility of the businesses they support. Choice experiments conducted in Uganda conclude that biodiversity attributes increase the willingness to visit tourism attractions, independently of other factors (Naidoo and Adamowickz 2005). Research also indicates that consumers are concerned about the local environments of their travel destinations and are willing to spend more on their holidays if they are assured that workers in the sector are guaranteed ethical labour conditions in the places they are visiting (ILO 2010b). On the other hand, Rheem (2009) argues that less than a third of American travellers indicate a willingness to pay some sort of premium for "green" travel, higher prices (cost premium) being seen as a demand barrier for 67 per cent of respondents.

Traditional mass tourism such as "sun-and-sand" resorts has reached a steady growth stage. In contrast, ecotourism, nature, heritage, cultural and "soft adventure" tourism, as well as sub-sectors such as rural and community tourism are taking the lead in tourism markets and are predicted to grow most rapidly over the next two decades. It is estimated that global spending on ecotourism is increasing by 20 per cent a year, about six times the industry-wide rate of growth (TEEB 2009a). Nature-based tourism is an important economic component of the entire tourism market, including 75 per cent of Australia's international tourism, 42 per cent of European recreational tourists in 2000 and contributing US$122.3 billion to the USA's tourism market in 2006 (UNWTO 2010d). About 14 per cent of international visitors to South Africa in 1997 engaged in an "adventure activity" during their stay (Travel to South Africa). Of the 826,000 tourists to Kenya in 1993, 23 per cent visited national parks and reserves for wildlife safari tourism (Sindiga, 1995). The Asia-Pacific region alone reported 10 per cent of tourism revenue came from ecotourism activities in 1993 (Dalem 2002).

There is empirical evidence that tourists seeking environmental and culturally differentiated destinations are willing to pay more for this experience. Inman et al. (2002) estimate this to be between 25 per cent and 40 per cent. WEF (2009) estimates that 6 per cent of the total number of international tourists pay extra for sustainable tourism options and 34 per cent would be willing to pay extra for them. One third to one half of international tourists (weighted toward the USA) surveyed in a CESD and TIES (2005) study said they were willing to pay more to companies that benefit local communities and conservation. Research by SNV (2009) records two studies where 52 per cent of respondents in a UK survey would be more likely to book a holiday with a company that had a written code to guarantee good working conditions, protect the environment and support local charities, while some 58.5 million US travellers would "pay more" to use travel companies that strive to protect and preserve the environment.

Wells (1997) presents a survey of nature-tourism willingness to pay (WTP) studies and shows that, in almost all cases, consumer surplus (private value of benefits from nature tourism) is higher than collected fees from tourists. In other words, the value of ecosystems for tourism is undervalued in many cases. For instance, Adamson (2001) estimates that 50 per cent or more of the economic value from Manuel Antonio National Park in Costa Rica is not captured in entrance

7. See Annex 1 for an indication of the economic dimension of tourism in a country sample.

fees. WTP for entrance fees from international tourists was estimated at US$12 (compared with a US$6 actual entrance fee) and US$6 for national tourists (compared with an actual fee of US$2). Furthermore, it is estimated that the average value of coral reef opportunities for recreation and tourism is US$65,200 per hectare per year in 2007 values, while it could reach up to more than US$1 million (TEEB 2009a). The maximum monetary value of ecosystem services for tourism, per hectare per year, has been estimated for coastal systems (US$41,416), coastal wetlands (US$2,904), inland wetlands (US$3,700), rivers and lakes (US$2,733) and tropical forests (US$1,426).

**Potential for local development and poverty reduction**

Making tourism more sustainable can create stronger linkages with the local economy, increasing local development potential. Of particular and recognised importance (Hall and Coles 2008) are: purchasing directly from local businesses, recruiting and training local unskilled and semi-skilled staff, entering into neighbourhood partnerships to make the local social environment a better place to live, work and visit for all; as well as the ability to improve the local natural environment within its areas of direct and indirect influence (Ashley et al. 2006). The move toward more sustainable tourism has been shown in a number of destinations to enhance this local development potential through several mechanisms:

1. Its ability to harness biodiversity, landscape and cultural heritage available in developing countries can play a major role in enhancing incomes and employment opportunities;

2. Tourism is a relatively labour-intensive sector traditionally dominated by micro and small enterprises with activities particularly suited for women and disadvantaged groups;

3. As a tourism product is a combination of different activities and inputs produced by many sectors, enhanced spending by tourists can benefit a wide range of sectors such as agriculture, handicrafts, transport, water and waste management, energy efficiency and other services;

4. As tourism development at destinations requires investment in facilities such as roads, water supply, and energy, it improves the basic common infrastructure facilities required for development of other sectors and improvement of quality of life (Bata 2010); and

5. Tourism employs more women and young people than most other sectors; providing economic benefits and independence to women is very important in terms of supporting child development and breaking the cycle of poverty.

# 3 The case for investing in the greening of tourism

## 3.1 Spending in the tourism sector

Tourism drives significant investments. Adding even small percentages of investment for a greener sector results in very significant increases in investment flows. Furthermore, much new investment flow is directed toward developing countries, where increased investment could have greater impact on green outcomes. It is estimated that travel and tourism-sector investments reached US$1,398 billion in 2009, or 9.4 per cent of global investment. It increased on average by 3 per cent during the last decade, notwithstanding a significant contraction in 2009 (-12 per cent). Global investment in tourism has fluctuated between 8 per cent and 10 per cent of total world investment over the last 20 years. In developing countries, such as in the Caribbean region, this figure could be as high as 50 per cent (WTTC 2010).[8] In OECD countries, investment in hotels, travel agencies and restaurants range from 6 per cent of national gross value added in Germany to 32 per cent in Portugal (OECD 2010).

Foreign Direct Investment (FDI) is an important source of world tourism investment. The stock of outward and inward FDI in the "hotels and restaurants" sector reported by UNCTAD (2009) accounts for almost 1 per cent of total FDI stock. This figure, however, does not take into account other tourism-related elements in other sectors, such as construction, transport or business activities. There is a growing focus on tourism as a generator of FDI in developing countries, where it is a priority of many Investment Promotion Agencies (IPAs). In this regard, the case of Costa Rica is illustrative as foreign investment in the tourism sector represented 17 per cent of total FDI inflows in 2009 and 13 per cent on average for 2000-09.[9]

## 3.2 Benefits in employment

Tourism is human-resource intensive due to the service nature of the industry. It is among the world's top job creators and allows for quick entry into the workforce for youth, women and migrant workers. The *wider* tourism economy provides, both directly and indirectly, more than 230 million jobs, which represents about 8 per cent of the global workforce. Women make up between 60 and 70 per cent of the labour force in the industry and half the workers are aged 25 or younger (ILO 2008). In developing countries, sustainable tourism investment can help create job opportunities, especially for poorer segments of the population.

The move toward more sustainable tourism can increase job creation. Additional employment in energy, water, and waste services and expanded local hiring and sourcing are expected from the greening of mainstream tourism segments. Furthermore, an increasing body of evidence suggests significantly expanded indirect employment growth opportunities from segments oriented toward local culture and the natural environment (Cooper et al. 2008, Moreno et al. 2010, Mitchell et al. 2009).

Tourism creates jobs directly and leads to additional ("indirect") employment. It is estimated that one job in the core tourism industry creates about one and a half additional jobs in the tourism-related economy (ILO 2008). There are workers indirectly dependent on each person working in hotels, such as travel-agency staff, guides, taxi and bus drivers, food and beverage suppliers, laundry workers, textile workers, gardeners, shop staff for souvenirs and others, as well as airport employees (ILO 2008). These relationships influence the many types of workplace relationships that include full-time, part-time, temporary, casual and seasonal employment and have significant implications for employment opportunities within the sector. A study of South Africa shows that direct employment in the core tourism sector only accounts for 21 per cent of total employment creation due to tourism spending in 2008 (Pan African Research & Investment Services 2010). Available data indicate that every new job in tourism can have multiplying effects in the whole economy, as illustrated in Table 1.

8. It is worth mentioning that WTTC estimates incorporate all fixed investment expenditure by tourism service providers and government agencies, in facilities, capital equipment and infrastructure for visitors. In this sense, it could be overestimating infrastructure investments that are not tourism sector specific but affect the whole economy (for instance, road improvements or airport construction). Still, it is the only cross-country source of tourism investment data available.

9. Author's calculations with data from the Central Bank of Costa Rica, www.bccr.fi.cr, accessed on September 12, 2010.

For the EU 27, GHK (2007) estimates direct and indirect employment multipliers for environment-related tourism at between 1.69 and 2.13. This means that for every 100 jobs directly created in the sector, 69 more are created elsewhere in the economy as a result of indirect effects and the figure increases to 113 when induced effects are taken into account. The authors define environment-related tourism (ERT), as activities where the natural environment (not the built environment) is responsible for influencing the choice of destination for the tourism activity, including visits to hills, mountains, coasts, farmland, woods, forests, springs, lakes and wildlife and the activities of fishing (sea, game and coarse), walking, climbing, golfing, skiing, cycling, bathing/swimming, etc.

It is estimated that sustainable tourism in Nicaragua, a destination that focuses very prominently on its culture and natural environment, has an employment multiplier of 2. That is, for every job in the tourism sector, an additional local employment is created, with higher wages than the national averages (Rainforest Alliance 2009).

| | Total employment per single job in the tourism sector | Employments per US$10,000 tourist expenditure |
|---|---|---|
| Jamaica | 4.61 | 1.28 |
| Mauritius | 3.76 | not available |
| Bermuda | 3.02 | 0.44 |
| Gibraltar | 2.62 | not available |
| Solomon Islands | 2.58 | not available |
| Malta | 1.99 | 1.59 |
| Western Samoa | 1.96 | not available |
| Republic of Palau | 1.67 | not available |
| Fiji | not available | 0.79 |
| UK (Edinburgh) | not available | 0.37 |

**Table 1: Sample of tourism employment multipliers**

Source: Cooper et al. (2008)

## 3.3 Local economic development and poverty reduction

### Local economic development

Tourism is an important and effective driver of local economic development. Tourist spending enters the local economy to varying degrees depending principally on the structure of the tourism business and its supply chain at a destination. The economic contribution entering the economy is the "local contribution" and is typically measured as an average amount per tourist, and as a percentage of the total tourism spending that stays in the local economy. That which is not retained in the local economy is "leakage." Multiplier effects are limited by leakages, which reduce the positive economic impacts of tourism. Wells (1997) reports values of leakage as a percentage of gross tourism receipts ranging from 11 per cent (Philippines) to 56 per cent (Fiji).

The "income multiplier" is used to describe the amount of the indirect economic activity resulting from the local contribution. The economic development potential of tourism is a direct function of the local contribution and multiplier—larger local contributions and larger multipliers each lead to greater economic activity in the local economy and there are important synergies between them. From a global perspective, Mill and Morrison (2006) review the literature on income multipliers and present a list of estimations from different countries and regions. Income multipliers can be relatively low for specific destinations such as the City of Winchester (0.19) and higher for a country such as Turkey (1.96). According to Cooper (2008), tourism impacts income in different ways depending on the country or region where it develops. Every US dollar spent by overnight tourists impacts income in the economy between 1.12 to 3.40 times. This high variability indicates that local economic impact development will depend on particular characteristics of the tourism business "model", in particular the quantity and type of products and services sourced from the local economy.

In destinations where a large percentage of tourist needs are locally supplied (beds and linens, food and beverage, equipment and supplies, labour, tour and transportation services, souvenirs, among others), local contribution and multipliers tends to be high, and the resulting economic impact correspondingly greater. In destinations where substantial income is not captured locally, economic impact from tourism is less. This effect can vary dramatically between destinations:

- For Granada, Nicaragua, the Rainforest Alliance (2009) reports a case study of sustainable tourism where local purchases represent only 16 per cent of total purchases;

- For the Canary Islands, Hernández (2004) finds that 43 per cent of total tourism expenditure is supplied from outside the local economy through direct, indirect and induced imports; and

- In New Zealand, it is estimated that 24 per cent of tourism expenditure is for imports of goods and services sold directly to tourists by retailers (Hernández 2004).

Looking at a single destination illustrates how substantial tourism's economic impact can be. For example, for Panama, Klytchnikova and Dorosh (2009) present a detailed evaluation of tourism's impact in the local economy of three different regions. The income multiplier for the tourism industry (hotels and restaurants) is the largest of all economic sectors. An additional US$1 in value added results in US$2.87 total income. This large multiplier is due to strong backward linkages in terms of demand for local food products as well as forward linkages of household spending from tourism income. This gain results from consumer spending effects as incomes earned in various activities are spent in the domestic economy. By way of comparison, multipliers are smallest (1.30 to 1.64) in sectors such as the Panama Canal, mining and textiles where there are few production linkages (as much of the inputs are imported). In contrast, the multipliers for the fruits, shellfish and other agricultural exports are especially large because much of the income earned accrues to rural households who spend a high proportion of their incomes on non-tradable goods and services in the local economy.

There is an increasingly convincing body of evidence indicating that more sustainable tourism can increase both the local contribution and multiplier effect. Within a given (or similar) destination, local contribution and multiplier increase the more the local community is involved in the tourism value chain, through the supply of products, labour, tourism services and, increasingly, "green services." The few available meta-studies indicate considerably higher multipliers for natural and culturally-oriented destinations (Chang 2001). And destination specific studies, such as Brenes (2007) for Costa Rica indicate similar effects. The logic is sound—more local purchases (substituting imports) will increase local contribution, and the income effect will be greatest when local actors are the beneficiaries of those linkages.

**Poverty reduction**

When tourism-related income grows with a substantial reorientation in favour of the poor, poverty can be reduced. In this regard, UNWTO launched in 2002 the ST-EP (Sustainable Tourism for the Elimination of Poverty) initiative, aimed at reducing poverty levels through developing and promoting sustainable forms of tourism.[10] Increased tourism, local contributions and multiplier effects can accrue to wealthy, middle income, or poor alike. Therefore, interventions must be made to help poor people become part of the processes that drive the industry (ILO 2010a). Investors and developers, as well as local and national governments, play a critical role in determining the role poorer populations play in the tourism industry. The local industry can also help by engaging in and encouraging the use of local companies for the provision of transport, services and food in order to generate local income and employment multipliers and contribute to alleviate local poverty:

- In the case of Malaysia, TPRG (2009) describes the case of accommodation businesses and the shares of income generated and distributed across the chain. The final impact on local communities depends on the business structure and the economic activities related to tourism. In the case of the accommodation sector, most income is captured by hotel owners. However, an important share is received by small-business owners and local people involved in informal activities (Figure 2). From all tourism expenditure, 28 per cent is captured by hotels, while crafts artisans obtain 5 per cent and local small businesses 11 per cent.

- In Zanzibar, Tanzania, Steck et al. (2010) estimate that only 10.2 per cent of total tourism income is captured by "poor" local people. The study found that the industry is heavily dependent on imports for both primary supplies and staff of suitable quality, both of which are normally avenues for participation of locals.

- In Panama, households capture 56 per cent of total local tourism income (Klytchnikova and Dorosh 2009). Which households benefit the most, however, depends on the region in which the tourism revenues are generated. In the Colón Zone, most of the gains in household incomes (63 per cent) go to urban non-poor households and only 20 per cent of the income gains accrue to poor households. In contrast, in Bocas del Toro, where poor households account for a larger share of the regional labour force, 43 per cent of the total increase in household incomes accrues to the poor while the percentage gain in household incomes is nearly the same across household groups. The results for Chiriqui Province report household income gains received by the poor of 19 per cent, although the share earned by rural households is higher (46 per cent).

Empirical studies suggest that, at best, between one-fifth and one-third of total tourist expenditure in the destination is captured by "the poor" from direct earnings and supply chains (Mitchell and Ashley 2007). The impact of tourism on poverty depends on various factors including employment, the skill level of the labour force, changes of prices (goods and services and factors of production), ownership of micro and small enterprises and labour-market composition. As with income effects, there is increasingly convincing evidence that more sustainable tourism (particularly in rural areas) can lead to more positive poverty-reducing effects.

- In Costa Rica, Rojas (2009) estimated the impact of tourism on poverty levels and found that without

10. The Sustainable Tourism for Eliminating Poverty (ST-EP) initiative has identified seven different mechanisms through which the poor can benefit directly or indirectly from tourism: (1) Undertaking measures to increase the level of the poor working in tourism enterprises; (2) Maximising the proportion of tourism spending that is retained in local communities and involving the poor in the supply process; (3) Promoting the direct sales of goods and services to visitors by the poor from informal businesses; (4) Establishing and managing more formal tourism enterprises by the poor, either individually or at a community level; (5) Using taxes or levies on tourism income or profits with proceeds benefiting the poor; (6) Supporting the poor in money or in kind, by visitors or tourism enterprises; and (7) Investing in infrastructure that offers local communities the chance to gain new access to available resources (UNWTO 2004b).

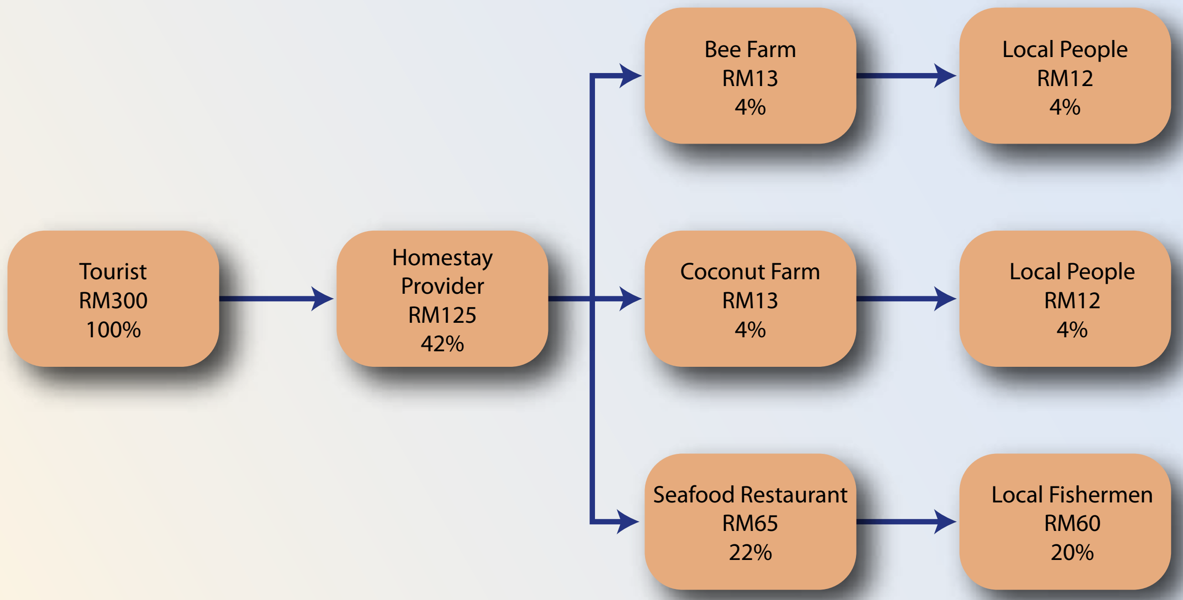



**Figure 2: Accommodation linkages and tourist income distribution in Tanjong Piai, Malaysia**
Source: TPRG (2009). Note: RM=Ringgit Malaysia (1 RM=US$0.30)

tourism incomes the local incidence of poverty would be higher in urban and rural sectors (Table 2). This result is consistent with other studies for the country. For instance, CEPAL (2007) estimates that tourism contributes to a reduction in poverty of 3 per cent in Costa Rica (and 1 per cent in Nicaragua). From a site comparison perspective, Brenes et al. (2007) estimated the impact of Tamarindo (mass tourism destination) and La Fortuna (natural and adventure attractions destination) and found that average monthly wages in La Fortuna (US$437) were higher than in Tamarindo (US$392). Moreover, they estimated a 0.64 probability of income improvement for La Fortuna inhabitants when working in the tourism sector. The evidence indicates that tourism is contributing to poverty reduction in Costa Rica, with the sustainability approach of the country as a driver of living conditions improvement.

■ In Malaysia, using a value-chain analysis, TPRG (2009) finds that economic benefits received by local people account on average for 34 per cent of total income generated by tourism. The relatively high "pro-poor" income share, particularly in restaurants (Table 3), may reflect various public and private initiatives to employ or involve locals in tourism business operations.

## 3.4 Environmental benefits

There is increasing motivation from both the private and public sectors to invest in making tourism more sustainable. Although the availability of global investment data specific to "sustainable tourism" is currently not of a sufficient quantity to draw any robust conclusions, it is clear that there is an increased awareness of the need and value of conserving unique natural, social and cultural assets of destinations.

Private and public investment in tourism includes infrastructure (roads, airports, national parks, private reserves, hospitality installations and other sites and facilities); environmental conservation (natural attractions, beaches, mountains, rivers, biodiversity, natural barriers and endemic species); education

| | With tourism income | Without tourism income |
|---|---|---|
| National | 17.69% | 19.06% |
| Urban | 16.93% | 18.40% |
| Rural | 18.73% | 20.0% |

**Table 2: Impact of tourism on poverty rates in Costa Rica, 2008**
Source: Rojas (2009)

| | Share in tourism revenue | Share of PPI |
|---|---|---|
| Accommodation and hotel meals | 88.4% | 7.3% |
| Restaurants | 4.4% | 47.0% |
| Retail | 3.7% | 27.0% |
| Tours and excursions | 3.0% | 18.8% |
| Other | 0.5% | n.a |

**Table 3: Breakdown of tourism income and pro-poor income (PPI) contribution in Malaysia**
Source: TPRG (2009)

(labour-force skills, including the "greening" of the skills base); capacity building; and technology improvements (cleaner production, sustainable management). Investment in sustainable tourism offers a wide range of opportunities, notably in the areas of water, energy, waste and biodiversity, which can generate significant returns.

There is a growing trend within the tourism industry of investment in sustainability. For instance, the Accor hotel chain has been testing environmental technologies such as photovoltaic electricity, grey water re-use and rain-water recovery. Additional capital expenditure in energy efficiency and sustainable construction and renovation projects is estimated at a relatively modest 6 per cent of total construction costs (for a 106-room hotel), with excellent returns (WTTC 2009). Sol Meliá Hotels & Resorts have institutionalised their sustainability programme with independent certification for the company, including hotels and corporate offices on an international level, and a specific budget for the strategic project of sustainable development, financed entirely by company funds (WTTC 2010).

**Energy**

In hotels and other accommodation there is considerable scope for investment in energy-efficient features and services, including refrigeration, television and video systems, air conditioning and heating (particularly reduction or elimination of these systems through improved design), and laundry. Such investments are driven by increasing energy costs; likely carbon surcharges; increasing expectations of customers (particularly from Europe and North America); technological advances with low-carbon technology; and in some cases, government incentives. Many leading airlines are exploring alternative fuel strategies, as well as changes in routing, aircraft and flight practices. The railroad industry, particularly in Europe, is positioning itself as a "green" and "community-linking" alternative to air travel. Increased energy efficiency for tourism translates as reduced operational costs, increased customer satisfaction, and higher investment in energy efficiency (through retrofits and improvements).

Evidence suggests that investment in a more efficient use of energy in the sector generates significant returns (Box 2). Hamele and Eckardt (2006) reported the results of environmental initiatives in European hotels, bed & breakfast and camping sites, on energy consumption. On average, energy costs in hotels represented about 6 per cent of their annual turnover, whereas in the "best practice" establishments, this expense factor typically represented 1.5-2.8 per cent. Recent studies have shown that a 6 per cent increase in investment in energy-efficient design & equipment can lower electrical consumption by 10 per cent (Six Senses 2009); low-cost water-efficient design and operation can reduce consumption by 30 per cent (Newsom et al. 2008, Hagler Bailly 1998), and

## Box 2: Investment in energy efficiency and savings

Six Senses, a luxury hotel group, reports that the return on investment of various energy-savings measures applied in resorts located in Thailand ranges from six months to ten years:

■ The energy monitoring system cost US$4,500, enabling the resort to achieve 10 per cent energy savings as well as to identify areas for further savings;

■ Investment for the mini chiller system was US$130,000, which saves US$45,000 annually, and thus pays off in 2.8 years;

■ The heat-recovery system cost US$9,000, saving US$7,500 annually, corresponding to 1.2 years payback time;

■ The laundry hot-water system cost US$27,000, saving US$17,000 annually (1.6 year payback time);

■ Efficient lighting cost US$8,500, resulting in US$16,000 savings per year, i.e. taking six months to pay back (not considering the longer life-span of the lights);

■ Investment in a water reservoir was US$36,000, leading to annual savings of US$330,000 (less than a month payback time);

■ Biomass absorption chillers cost US$120,000 resulting in US$43,000 saving annually, i.e. 2.8 years payback; and

■ Medium voltage (6.6kV) underground electric copper cables cost US$300,000. Payback is roughly 10 years from lower energy loss, but other benefits include less radiation, less power fluctuation, reduced fire risk and a prettier resort compared to old hanging low voltage electrical cables.

Source: Six Senses (2009)

that overall financial cost-recovery of a destination's green strategy (ratio of present value savings to present value capital expenditures) can be between 117 per cent and 174 per cent for investment recovery from hotel buildings operation efficiency (Ringbeck et al. 2010).

Rainforest Alliance (2010) presents an estimate of costs and benefits of sustainable-energy management practices for a sample of 14 tourism businesses in Latin America (Belize, Costa Rica, Ecuador, Guatemala and Nicaragua) based on GSTC indicators. The energy bill was reduced in 64 per cent of companies, with average annual savings of US$5,255 (maximum of US$17,300). Required investment ranged from 1 per cent to 10 per cent of annual operations costs. Average investment was US$12,278 (maximum US$56,530). The average payback of investments is 2.3 years.

**Water**

Internal water efficiency and management programmes, and investments in water-saving technology in rooms, facilities and attractions reduce costs. Greater efficiency and improved management allows for the increase of number of rooms/visitors in water-constrained destinations. With regard to the most water-consuming factor, irrigation, considerable reductions can be achieved through alternative gardening (choice of species, landscaping) as well as the use of grey water. Golf courses can be designed to require less water, and operators can measure soil moisture to help control and optimise water use. Hotels with spas and health centres can engage in a range of water-saving measures, while new hotel constructions can seek to avoid pool landscapes and other water-intensive uses (Gössling 2010).

With regard to direct water use for tourists, Fortuny et al. (2008) demonstrated that many water-saving technologies relevant to hotels and other businesses have short payback times (between 0.1-9.6 years), making them economically attractive. Investments in water-saving systems, grey water reuse and rainwater collection and management systems can help reduce water consumption by 1,045 $m^3$ per year, or a 27 per cent lower volume per guest per night.

Rainforest Alliance (2010) estimates the costs and benefits of sustainable tourism management practices for a sample of 14 businesses in Latin America (Belize, Costa Rica, Ecuador, Guatemala and Nicaragua) based on GSTC indicators. The water bill was reduced in 31 per cent of companies, with average annual savings of US$2,718 (maximum of US$7,900), a particularly large number given the very low price of water charged in those countries. Required investment ranged from 1 per cent to 3 per cent of annual operations costs. Average investment was US$2,884 (maximum US$10,000). Average annual savings were US$2,718, for a payback period of 1.1 years.

**Waste**

Improved waste management provides opportunities for business and society. Lower levels of generation improves financial return for private sector actors, and better management of that waste creates opportunities for jobs, and enhances the attractiveness of destinations. Hamele and Eckardt (2006), reporting the results of an analysis of 36 hotels in the 2 to 4-star categories in Germany and Austria, showed average values per overnight-stay for solid waste (1.98 kg) and waste water (6.03 litres). The average cost of managing these two waste streams is €0.28 per occupied room night. Rainforest Alliance (2010) presents an estimation of costs and benefits of sustainable tourism management practices for a sample of 14 very small businesses in Latin America (Belize, Costa Rica, Ecuador, Guatemala and Nicaragua) based on GSTC indicators where solid waste was reduced in 71 per cent of companies, with average annual savings of US$3,600.

**Biodiversity**

UNEP (2010) argues that biodiversity conservation will be greatly affected by the way in which tourism grows and develops, especially in developing countries hosting biodiversity hotspots, where tourism is expected to become increasingly important. Demand growth for experiences that involve contact with wildlife and pristine (or near pristine) ecosystems and the expectations from guests that tour operators respect and protect the natural resource base are increasingly driving changes in the tourist industry. Policies of mainstream tourism are likely to change towards more effective conservation of sensitive ecosystems, driven by market demand and large operator programmes (for instance, cruise-industry guidance on coastal systems). Moreover, the increasing trends for nature-based tourism will encourage conservation and tourism revenues (including protected-area fees) to grow in tandem. Current trends towards increasing nature-based and ecotourism are likely to continue or accelerate as pristine areas become increasingly rare, leading in turn to the incorporation of natural areas in tourism development and greater transfer of benefits toward natural areas.

Conservation and restoration provides a highly profitable, low-cost investment for maintaining ecosystem services (Box 3). Avoiding loss of ecosystems by conservation, particularly of forests, mangroves, wetlands and the coastal zone, including coral reefs, is a sound investment from a cost-benefit analysis. This appears to hold from both a societal investment perspective as well as a private one. The review of dozens of restoration projects worldwide concludes that restoration compared with biodiversity loss provides a benefit/cost ratio of 3 to 75

## Box 3: Strengthening the Protected Area Network (SPAN)

Strengthening the Protected Area Network (SPAN) is an initiative funded by the Global Environment Facility (GEF) designed to maximise the potential of the protected-area system in Namibia by strengthening its management and establishing partnerships. It is a six-year project with a GEF grant of US$8.5 million and co-financing amounting to US$33.7 million. GEF analysis indicates that tourism in Namibia's protected areas contribute to 3.1 to 6.3 per cent of the country's GDP. Investment by the government of Namibia in the past 20 years has achieved a rate of return of 23 per cent. The government has increased the annual budget for park management and development by 300 per cent in the past four years. A quarter of the park-entrance revenue is to be reinvested in park and wildlife management through a trust fund, providing additional sustainable financing of US$2 million annually. First implemented in 2007, The National Policy on Tourism and Wildlife Concessions on State Land has approved more than 20 new tourism and hunting concessions. After two years it had generated more than US$1 million annually in fees payable to the government. Local communities were granted most of the concession rights in protected areas, creating revenue and jobs for local people.

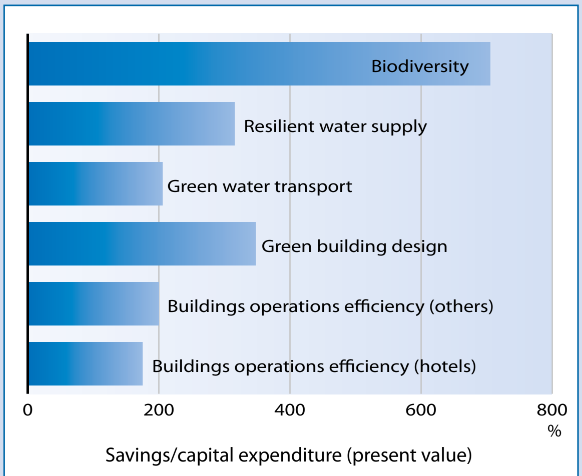
Source: GEF (2009)

in return of investments and an internal rate of return of 7 to 79 per cent (Nellemann and Corcoran 2010).

More than 70 per cent of Latin American hotels surveyed by Rainforest Alliance (2010) support biodiversity conservation while 83 per cent of them indicate that conservation practices have created competitive advantages through operation savings, improved image and process improvements. Ringbeck et al. (2010) report significant returns of green investments in tourism at major sun and beach destinations in Spain (Box 4). The authors estimated a present value of investments (capital expenditure) on water and energy efficiency, emissions mitigation and biodiversity conservation of

## Box 4: Financial cost-recovery of green programmes in tourism

Based on its experience with the greening process of one of the world's leading sun-and-beach tourist destinations (a seaside locale in Spain), Booz & Company report significant returns from investment in energy efficiency and GHG emissions, lower water consumption, better waste management practices and biodiversity conservation. The green




transformation strategy was developed after a thorough baseline analysis that showed, like most tourist destinations, unsustainable water and energy consumption patterns, problems with waste management and the risk of total depletion of key natural resources such as coral reefs and marine animals (main attractions). Capital expenditure on greening the tourism sector can quickly be offset by the savings in operation costs, which include not only the costs of greening initiatives, but also the socioeconomic effects of lost tourism revenue. Savings by reducing operation costs from green programmes, compared with the capital expenditure, range from 174 per cent (hotel buildings operation efficiency) to 707 per cent (biodiversity conservation). Private investment and public funding was used to secure sufficient funding. The greening transformation followed a three-step process, including an assessment of the destination's environmental status, the development of a green strategy and the collaborative execution of projects related to the green strategy.

Source: Ringbeck et al. (2010)

US$1 billion and a significantly higher present value of savings (US$2.5 billion), with strongest investment recovery from biodiversity.

## 3.5 Cultural heritage

The largest single component of consumer demand for more sustainable tourism is for cultural authenticity (CESD and TIES 2005). Cultural heritage includes living cultures, both mainstream and minority, as well as historical, religious, and archaeological sites. Tourism can offer opportunities for continuation, rejuvenation or enhancement of traditions and a way of life.

Culture is rarely static, and linking tourism and cultural survival may bring benefits as well as changes and challenges for a community to address. The possible socio-cultural costs and benefits of tourism to a vulnerable culture are rarely quantified. Tourism projects need to include a programme to monitor economic and cultural benefits so that vulnerable cultures can assess and manage the impacts of tourism on their communities (Wild 2010). Aside from the intangible benefits, most commentators believe that investment in cultural heritage is among the most significant, and usually profitable, investments a society, or tourism sector, can make (Box 5).

## 3.6 Modelling tourism[11]

To quantify the likely effects of increased investments in tourism, the green investment scenario (G2) simulated in the modelling exercise allocates on average 0.2 per cent of global GDP[12] (or US$248 billion at constant 2010 US dollar prices) per year between 2011 and 2050 to the tourism sector, which is further disaggregated into energy, water and waste management, staff training, and biodiversity conservation.[13] The green investment represents 4% of tourism GDP. This would most likely comprise a mixture of public as well as private investments. Assumptions of the model are presented in Annex 3 and results of simulations are detailed below.

**Results of the simulation**

The results of the simulations of the green investment scenario indicates that total arrivals of international tourists will increase by 2.8 per cent per year by 2030 and then at a lower rate of 2.5 per cent per year in the longer term to reach 2.6 billion in 2050, which is 30 per cent below the corresponding "business-as-usual" scenario (BAU2) due to the shift towards less frequent -but longer- trips in the green scenario[14]. The immediate impacts of international and domestic tourism will lead to a yearly direct tourism expenditure of US$11.3 trillion on average between 2010 and 2050 in the green investment scenario (in such areas as sales in the hotel sector, hotel payments for wages and salaries, taxes, and supplies and services). These direct expenditures have strong impacts on the destination economies resulting from various rounds of re-spending of tourism expenditure in other industries (i.e., industries supplying products and services to hotels). The total expenditure, including direct and indirect expenditures, will reach US$21.5 trillion on average over the next 40 years in the green scenario. The resulting higher economic growth drives the sector GDP to grow from US$3 trillion today to US$10.2 trillion in 2050, exceeding the corresponding BAU scenario by 7 per cent. Direct employment in this sector is expected to grow to 580 million in the green scenario by 2050, compared with 544 million in the corresponding BAU projection. The training of these new employees requires US$31 billion of investment per year on average in the next 40 years.

Despite the rising flow of tourists, the green investment will lead to significant resource conservation through considerable efficiency improvements and reduction of losses:

11. This section is based on the Millennium Institute's work for the Green Economy Report.

12. Tourism accounts for 5% of global GDP.

13. In the G2 green investment scenario, an additional 2 per cent of global GDP is allocated to a green transformation of a range of key sectors, of which tourism is one (see Modelling chapter for more detailed explanation of scenarios and results).

14. BAU2 refers to the BAU scenario with an additional 2 per cent of global GDP per year invested according to current patterns and trends (see Modelling chapter).

### Box 5: Differential economic contribution from cultural areas

In Western Australia, attempts have been made to measure the economic value of cultural heritage through direct tourism expenditure, using three locations: the city of Freemantle, the city of Albany and the town of New Norcia. In order to determine the proportion of the total overnight visitor expenditure that could be directly attributable to cultural heritage, an attribution factor was generated based on data from visitor surveys and other sources. The study found that between 63 per cent and 75 per cent of a visitor's expenditure was due to the cultural heritage of the area, generating in the region of US$40-$80 per visitor per day.

Source: Tourism Western Australia (http://www.westernaustralia.com, accessed on September 10, 2010)

■ Tourism **water consumption** is projected to be 6.7 $km^3$ in 2050 in the green scenario, undercutting the corresponding BAU scenario by 18 per cent. In the meantime, additional investments are projected to increase water supply, which is essential for many tourism-dependent, water-stressed countries—on average 0.02 $km^3$ per year above BAU2 from desalination, and 0.6 $km^3$ per year from conventional sources (treated wastewater, surface and underground water) through better management over the 40-year period.

■ Under the green scenario, tourism **energy supply and demand** will see both the expansion of renewables and efficiency improvements across all tourism activities. The incremental renewable-energy supply associated with tourism will be 43 Mtoe per year on average, including the expansion and introduction of renewable power generation and biofuels. On the demand side, the total energy consumption for various tourism activities will reach 954 Mtoe in 2050 under the green scenario, representing 44 per cent of avoided energy use relative to BAU2. These savings come from a mix of effective measures in individual activities—a modal shift to less carbon-intensive transport (e.g. electrified train and coach), behavioural changes (e.g. shorter-haul trips) to reduce total travel distance, better energy management (e.g. setting targets and benchmarking for hotels)—as well as across all sectors—technological advances in fuel efficiency and fewer inefficient uses due to better equipment or greater environmental awareness. More specifically, tourism transport, thanks to the transport-sector investments, will see the largest saving (604 Mtoe below the corresponding BAU scenario), followed by tourist accommodation, with 150 Mtoe of avoided consumption in 2050.

■ As a result of these energy savings, **$CO_2$ emissions** will be mitigated substantially relative to the corresponding BAU projection (-52 per cent by 2050), returning to the current level of 1.44 Gt in 2050, or 7 per cent of global emissions. The relative increase of the share of global emissions generated by tourism derives from a projected growth of tourism GDP higher than the average projected growth of global GDP. Tourism is expected to grow faster than most other sectors; and, without green investments, its environmental impacts would be much higher. By 2050, transportation is still the principal emitter (0.7 Gt), with aviation and cars accounting for 74 per cent and 24 per cent of the reduction respectively. Accommodation, as the second-largest emitter, will account for 0.58 Gt of emissions in 2050. The remaining $CO_2$ emissions (98 Mt) are caused by other tourism activities. In addition to the mitigation of $CO_2$ emissions in the green economy, as climate is a key resource for tourism and the sector is highly sensitive to the impacts of climate change, these sustainable practices will strengthen the capacity of tourist destinations to adapt to unfavourable climatic conditions.

■ Furthermore, the investment in tourism **waste management** allow for a higher rate of waste collection and reuse (recycling and recovery). In 2050, 207 Mt of waste will be generated by the tourism sector in the green scenario, compared with 180 Mt in the corresponding BAU scenario (due to higher GDP and tourist visitor nights in green scenarios). On the other hand, green investment is estimated to allow 57 Mt more reuse of waste than in the corresponding BAU scenario, therefore cutting net waste disposal (taking into consideration waste reuse) in 2050 by 30 Mt relative to BAU2.

■ These savings will result in potential avoided costs that can be reinvested in socially and environmentally responsible local activities (such as protected areas, local transportation or staff capabilities and skills), increasing the indirect and induced effects of tourism expenditure on local development. In particular, spending by visitors from wealthier regions to developing countries helps to create much-needed employment and opportunities for development, reducing economic disparities and poverty.

# 4 Overcoming barriers: enabling conditions

Tourism can have positive or negative impacts depending on how it is planned, developed and managed. A set of enabling conditions is required for tourism to become sustainable: to contribute to social and economic development within the carrying capacities of ecosystems and socio-cultural thresholds. This section presents recommendations to create the enabling environment for increased investment in sustainable tourism development, overcoming barriers in the areas of (1) private-sector orientation; (2) destination planning and development; (3) fiscal and government investment policies; (4) finance and investment; (5) local investment generation. Recommendations are based substantially on the policy recommendations of the International Task Force on Sustainable Tourism Development (ITF-STD).[15]

Tourism market tendencies indicate that the main drivers towards sustainable tourism investment decisions are consumer demand changes; business actions to reduce operational costs and increase competitiveness; coherent policies and regulations for environmental protection; technology improvements; private efforts for environmental and social responsibility and natural resource conservation. These are leading the transformation of the industry and determining the returns on investments.[16] The systemic characteristic of a sustainable tourism industry stresses the need to invest more in energy and water efficiency, climate-change mitigation, waste reduction, biodiversity conservation, the reduction of poverty, the conservation of cultural assets and the promotion of linkages with the local economy. The savings and higher returns expected from actions in those areas can simultaneously be invested in new green investment projects, creating a self-enforcing greening dynamic that could enhance competitiveness and strengthen sustainability.

A cross-cutting barrier to greener or more sustainable tourism investment is the lack of understanding and recognition of the value created for companies, communities and destinations from the greening of tourism. The sharing of knowledge, information and experiences among public, private and civil society actors is a necessary first step towards overcoming these barriers.

## 4.1 Private-sector orientation

Tourism is a heterogeneous industry[17] where hundreds (and sometimes thousands) of actors operate in multiple market segments, even within a single country or region. These segments include conventional and mass tourism as well as niche areas such as ecotourism, adventure tourism, rural tourism, community-based tourism, sports fishing, cruise tourism and more recently, health tourism. The principal businesses within the tourism industry are accommodation, tour operation, and transport (land, air, and aquatic). In addition, tourism has diverse linkages through several economic activities, from lodging, entertainment and recreation, to transportation, professional services and advertisement, among others.[18] While all can and should benefit in the medium to long term, greening will require very different actions and investments, and benefit companies in different ways—there is no single strategy or "recipe" for all to follow. A coherent strategy for green tourism growth must, therefore, cover all segments and activities, and the ways in which they interact.

The tourism industry is dominated by small and medium sized enterprises (SMEs). Although online travel agencies and large conventional tour operators control an important share of international travel from Europe and North America, tourism destinations are characterised

15. The ITF-STD was comprised of members from UNEP, UNWTO, 18 developed and developing countries, seven other international organisations, seven non-governmental organisations, and seven international business associations. It was an outcome of the 2002 World Summit on Sustainable Development, which declared that "fundamental changes in the way societies produce and consume are indispensable for achieving global sustainable development". The work of the Task Force will continue with its successor, the Global Partnership for Sustainable Tourism.

16. Drivers and likely implications of sustainable investments in key strategic areas for tourism (energy, climate change, water, waste, biodiversity, cultural heritage and the local economy) are summarised in Annex 2.

17. Tourism does not fit the standard notion of an "industry" because it is a demand-based concept. It is not the producer who provides the distinguishing characteristics that determine how tourism is classified, but rather the purchaser, i.e. the visitor (OECD 2000).

18 The Tourism Satellite Account (TSA) indicates that "tourism industries comprise all establishments for which the principal activity is a tourism characteristic activity." Tourism characteristics consumption products and tourism industries are grouped in 12 categories: accommodation for visitors, food and beverages serving activities, railway passenger transport, road passenger transport, water passenger transport, air passenger transport, transport equipment rental, travel agencies and other reservation services activities, cultural activities, sports and recreational activities, retail trade of country-specific tourism characteristic goods, and other country-specific tourism characteristic activities (see UNWTO 2010c).

by the predominance of smaller businesses. For example, close to 80 per cent of all hotels worldwide are SMEs (WEF 2009a) and, in Europe, this figure is 90 per cent.[19] Additionally, providers of goods and services for the industry tend to be small, local businesses. Reaching out to such a wide variety of small businesses, across numerous sectors, continents and languages is a daunting task. Without information, knowledge and tools, greening will be nearly impossible. Nonetheless, engaging these critical actors is a necessary condition for a sustainable industry. In Nepal, for instance, incentives for private-sector participation in capacity-building events and the implementation of sustainable action plans have helped to increase their access to international sustainable tourism markets, improved project performance and stimulated interest among other companies in Nepal in sustainable tourism business practices, creating synergies throughout the industry (UNEP 2008).

Organisational management is a key element of business sustainability. According to By and Dale (2010), successful management of change (political, economic, social and technological) is crucial for the survival and success of tourism SMEs, particularly with the following eight critical factors: adaptability and flexibility; commitment and support; communication and co-operation; continuous learning and improvement; formal strategies; motivation and reward; pragmatism; and the right people (skilled and motivated collaborators). Kyriakidou and Gore (2005) argue that best performing SME operations in hospitality, tourism and leisure industry share cultural features such as cooperative setting of missions and strategies, development of teamwork and organisational learning.

Tourism businesses are no different to other businesses when it comes to the criteria that must be considered in deciding whether to invest in them. However, there are some specific characteristics that will affect tourism business costs (Driml et al. 2010):

■ Tourism businesses are relatively labour-intensive and therefore labour costs often make up the largest proportion of operating costs;

■ The cost of inputs for capital investment and operation are higher for remote locations;

■ The cost of capital will attract a premium if there is uncertainty about returns from investment in tourism;

■ The price of land in tourist-desirable locations will be governed by competition with other land uses which may be able to pay more (due to higher returns);

■ Project planning and approvals cost will be high if assessment is lengthy or complex; and

■ Labour and land make up a high proportion of inputs and are subject to payroll tax and land tax.

A question is how to address these *basic* issues while making sustainable investment decisions. In this regard, the ITF-STD recommends that "tourism businesses and government institutions in charge of tourism should adopt innovative and appropriate technology to improve the efficiency of resource use (notably energy and water), minimise emissions of greenhouse gases (GHG) and the production of waste, while protecting biodiversity, helping reduce poverty and creating growth and sustainable development conditions for local communities." The business case for investing in these areas is sound. At the private-sector level, hotel owners, tour operators, and transport services can play a key role in protecting the environment and influencing tourists to make sustainable choices. Increased public environmental awareness, including traveller awareness, has contributed to the development of a host of voluntary industry initiatives and the definition of environmental performance at the national, regional and international levels (UNEP 1998). Many larger corporations are already addressing their environmental and social impacts. In many countries, SMEs account for the vast majority of businesses and can have a significant environmental impact; however, they tend to be more reactive to addressing environmental issues (Kasim 2009). Nevertheless, increasing pressure from consumers could force them to address more impacts in order to remain competitive.

**Enabling conditions for engaging the industry**

1. Tourism promotion organisations, resource management agencies and destination management organisations (DMOs) should link tourism products (i.e. parks, protected areas and cultural sites) more closely with marketing positions. This will ensure a consistent and unique selling position in world tourism markets based on high-value experiences at natural and cultural sites in a compact geographical area.

2. Tourism industry associations and wider industry platforms play an important role in engaging tourism businesses in sustainability as well as developing practical tools to respond to many common challenges. As in most industries, the concept of Corporate Social Responsibility is increasingly recognised in the tourism sector and is being promoted by industry bodies, at the international as well as national levels. However, a formal response, including measures such as triple-bottom-line reporting, environmental management systems and certification appears to be prevalent only within

19. www.hotelenergysolutions.net, accessed on September 30, 2010.

a selection of larger firms. Smaller firms are largely outside this sphere, and diverse supplier groups may not be connected at all. Experience in many countries has shown that well designed mechanisms and tools to educate SMEs are critical, but are most effective when they are accompanied by concrete, actionable items.

3. International development institutions, such as multilateral and bilateral cooperation agencies, and Development Finance Institutions (DFIs) should engage directly to inform, educate and work collaboratively with the tourism industry to integrate sustainability into policies and management practices, and secure their active participation in developing sustainable tourism. At the national level, government and civil-society engagement should be a critical part of these efforts to coordinate action.

4. The increased use of industry-oriented decision-support tools would help speed the adoption of green practices. Hotel Energy Solutions, TourBench and SUTOUR are examples of projects designed to provide assistance to Europe's tourism enterprises to identify potential investments and cost-saving opportunities for sustainable decision making to ensure profitability and competitiveness (saving money and investment in ecological building measures and equipment with low energy consumption); provide visitor satisfaction (fulfilling their demands and expectations for high environmental quality); achieve efficient use of resources (minimising the consumption of water and non-renewable energy sources); secure a clean environment (minimising the production of $CO_2$ and reducing waste); and conserve biological diversity (minimising the usage of chemical substances and dangerous waste products).

5. The promotion and widespread use of internationally recognised standards for sustainable tourism is necessary to monitor tourism operations and management. The private sector tends to perform best when clear criteria, objectives and targets can be identified and incorporated into their investment plans and business operations. The Global Sustainable Tourism Criteria (GSTC), issued in October 2008, provides the most promising current platform to begin the process of grounding and unifying an understanding of the practical aspects of sustainable tourism, and prioritising private sector investment.[20] The GSTC should be adopted in order to assess industry's performance and support policy recommendations. At a national and even sub-national level, GSTC, supported by information sharing and access to experts and experienced "greening" pioneers, is a critical step.

6. Economies of scope in the tourism sector could be achieved by means of *clustering*. A high environmental quality is a key input by those companies that pursue competitive advantages based on sound environmental management. In the case of tourism, the conservation of the natural capital of a country has a chainable effect and complementary influence on many firms. Clustering can strengthen backward and forward linkages in the tourism value chain and drive sustainability in the whole industry. Natural and cultural attractions are the most valuable assets for tourism development. The tourism *cluster* must become actively engaged in environmental management and conservation. Active collaboration with the public sector and community organisations will strengthen competitive position for the entire cluster. In the case of Croatia, for instance, Ivanovic et al. (2010) show that small businesses dominate the tourism market share in the total number of enterprises and generate the highest employment rates and income. However, they also show the lowest rate of productivity. This situation partly results from limited understanding of the potential benefits of clustering in tourism, including economies of scale; growth of technological and organisational know-how, and higher market share.

## 4.2 Destination planning and development

Destination planning and development strategies will be a critical determinant for the greening of tourism. Every destination is unique, and therefore each development strategy must be sensitive to the destination's unique assets and challenges, while creating a vision to deliver the destination's goals for environmental sustainability. Destination planners and policy officials are frequently unaware of the opportunities that greener tourism can bring to their destination. And even those who are aware usually lack the skills or experience necessary to build sustainability into new or ongoing destination development efforts.

Advancing greening goals through tourism planning and destination development requires the ability and institutional capacity to integrate multiple policy areas; consider a variety of natural, human and cultural assets over an extended time frame; and put in place the necessary rules and institutional capacity. A destination cannot successfully implement a green tourism strategy

20. The Global Sustainable Tourism Criteria Partnership began in 2007 and member organisations include the World Tourism Organization (UNWTO), United Nations Environmental Programme (UNEP), United Nations Foundation, Expedia.com, Travelocity-Sabre, and over 50 other organisations (Bien et al. 2008).

without the right laws and regulations in place, or the right governance structure to oversee them. Legislation should protect the environment, limit potentially harmful development, control detrimental practices, and encourage healthy behaviour. Clear rules in these areas, based on the destination strategy and its unique asset base, determine the direction, scale and scope of government and private investment in more sustainable tourism.

**Enabling conditions for greener destination planning**

1. Higher-level government, community and private tourism authorities must establish mechanisms for coordinating with ministries responsible for the environment, energy, labour, agriculture, transport, health, finance, security, and other relevant areas, as well as with local governments. Clear requirements such as zoning, protected areas, environmental rules and regulations, labour rules, agricultural standards, and health requirements (particularly for water, waste and sanitation) establish clear "rules of the game," and define the operating climate for investment. These decisions relate very closely to fiscal and investment considerations discussed in the following section.

2. Organisations engaged in developing tourism strategies should make use of credible scientific methods and tools encompassing economic, environmental and social approaches and assessments for sustainable development that will help stakeholders related to different components of the value chain understand their environmental and socio-cultural impacts.

3. Tourism Master Plans or Strategies provide a supply-side approach for developing a tourism destination. Environmental and social issues must be included in these plans in order to manage the critical assets and promote greener outcomes. Green transformation programmes will be more effective if produced by a multi-stakeholder participatory planning process, as well as through the development of partnerships at local, national, regional and international levels. Multilateral environmental and social agreements and the organisations that support them should be included in the process.[21] Public, private and civil-society stakeholders should make a decision on the kind of tourism industry they want to consolidate in the medium and long terms, considering the possible impacts on the natural resource base and the development opportunities for the country. Therefore, the creation of a sound institutional framework is required. Coordination among key actors and environmental regulations enforcement are key conditions. In addition, when investing in tourism sustainability, main short-, medium- and long-term objectives should be followed, based on:

   - The contribution to country macroeconomic balances;
   - The creation of local direct and indirect employment;
   - The use of local raw materials and inputs;
   - The benefits created in other productive sectors (multipliers *outside* the industry);
   - The effects on local development and poverty;
   - The modernisation, diversification and sustainability of the tourism value chain; and
   - The growth of the internal and external demand for sustainable tourism.

4. When promoting sustainable tourism, a coherent destination planning policy is necessary to create a sound international reputation, a *country brand* that differentiates and positions the country competitively. According to FutureBrand (2008), while tourism is often the most visible manifestation of a country brand, it is clear that the image, reputation and brand values of a country impact its products, population, investment opportunities and even its foreign aid and funding. Therefore, a holistic nation approach is required in order to align public and private sector initiatives to create a successful country brand based on sustainability.

5. Assessment of carrying capacity and social fabric should be considered to take into account external and internal impacts of tourism at destination. While it is difficult to evaluate due to great differences from one destination to another, maximum thresholds could be agreed on so as to provide guidance for the development of planning policies.

## 4.3 Fiscal policies and economic instruments

The greening of tourism will require a more sophisticated use of instruments within government purview, such as fiscal policy, public investment, and pricing mechanisms for different public goods.

21. For instance, the principles of the Global Code of Ethics for Tourism adopted by UNWTO and endorsed by the UN General Assembly as well as the recommendations and guidelines provided by Multilateral Environmental Agreements and conventions, as appropriate, including the Convention on Biological Diversity (CBD), the World Heritage Convention, the United Nations Framework Convention on Climate Change (UNFCCC), the United Nations Convention to Combat Desertification (UNCCD) and the Code of Conduct for the protection of children against sexual exploitation in travel and tourism.

Tourism investment from government should focus on business motivations for sustainable management as key targets. Incentives should be consistent with both environmental protection and value added creation. Market trends and competitive advantages need to be mutually reinforced. In this regard, policy coherence is a necessary condition. From a national perspective, sustainable tourism policy should address market failures (including externalities) in a consistent manner, avoiding the creation of additional distortions through government interventions. Like markets, governments can fail. Selected interventions must incentive a more efficient allocation of goods and resources than would occur in the absence of government action. Social policy should address compensation and benefits to workers, access to improved opportunities, human resource development, and value chain integration strategies. In the case of sustainable tourism policies, more coherence in terms of targets (location investments, development of specific areas for destination, national and local infrastructure investments), management (institutional coordination, impact analysis studies) and incentives (effectiveness, cost-benefit, and adequacy) is required to maintain sound competitive advantages. Where possible, the use of incentives should be based on market instruments rather than "command and control" measures. Some forms of market failures deserve special attention, particularly those that prevent learning how new sustainable tourism businesses can be produced profitably (self-discovery externalities), impede simultaneous and integrated investments which decentralised markets cannot coordinate (coordination externalities), and missing public inputs (legislation, accreditation, transport and other infrastructure, for instance).

**Enabling conditions in fiscal and government investment policies**

1. In the case of tourism, policy intervention towards investment sustainability can be justified as far as enabling conditions promote the sustainable use of natural resources and therefore create positive externalities for the society. Alternative, less productive uses of natural resources (i.e. unsustainable agriculture) or possible depletion activities (i.e. housing construction) could be compensated (for their opportunity cost) with policy instruments that increase profitability for sustainable tourism businesses and generate positive environmental externalities. Free-riding (non-compliance by companies) should be avoided with an effective performance monitoring and impact evaluation mechanism. There is a need to conduct periodical evaluations and impact analysis of tourism incentives, from an economic, social and environmental perspective.

2. Defining and committing to critical government investments in the green enabling environment plays a central role in determining private sector investment and direction. Government investments in protected areas, cultural assets, water, waste management, sanitation, transportation and energy infrastructure investments play a critical role in private sector investment decisions toward greener outcomes. Investments in public infrastructure related to tourism or investments in private tourism businesses should estimate their social and environmental impacts and adopt economic measures to compensate and offset unavoidable impacts.

3. Appropriate taxation and subsidy policies should be framed to encourage investment in sustainable tourism activities and discourage unsustainable tourism. Use of taxation is often resorted to for keeping developments in limits (for instance, taxes on use of resources and services at the destinations) and controlling the specific inputs and outputs (like effluent charges and waste services).

4. Tax concessions and subsidies can be used to encourage green investment at the destinations and facilities. Subsidies can be given on purchase of equipment or technology that reduces waste, encourages energy and water efficiency, or the conservation of biodiversity (payments for environmental services) and the strengthening of linkages with local businesses and community organisations.

5. Establish clear price signals to orient investment and consumption. The price for such public goods as water production and supply, electricity and waste management send important signals to the private sector. Governments frequently price these goods at very low levels (frequently even free) to encourage investment, only to find that low prices encourage waste, place a drain on communities and make it very costly (financially and politically) to raise prices.

## 4.4 Financing green tourism investments

Environmental and social investments are relatively new, and remain outside the mainstream of financial markets (particularly in developing countries). In many cases, barriers are based on misperceptions or lack of knowledge. For example, for many green investments, payback periods and amounts are not clearly established (due to limited experience with them), creating uncertainty for banks or other investors that can jeopardise financing. Also, the return on many green investments includes easily measurable components (such as energy savings), combined with more difficult to measure components such as "guest satisfaction" which can make calculating returns tricky.[22]

In other cases, framework conditions in destination countries limit investment. For example, higher interest rates in many countries make investments that are completely viable in wealthy countries, unviable in the local environment. Another frequently cited situation found in many developing countries is that the financial regulatory systems classify "environmental" investments as "non-productive assets", requiring banks to hold greater reserves, resulting in higher interest rates and less investment.

**Enabling conditions for finance**

1. The single greatest limiting factor for SMEs in moving toward greener tourism is lack of access to capital for this type of investments. Green investments must be seen as value-adding and made on their economic and financial merits, without prejudice. This will require greater private sector awareness of the value of green investment, and also policy coordination with Ministries of Finance and regulatory authorities.

2. Regional funds for local tourism development could help overcome financial barriers for green investments where investments also generate public returns (through positive externalities). Foreign direct investment (FDI), private equity, portfolio investment, and other potential funding sources should be also aligned with sustainable projects and strategies for the tourism industry. Ringbeck et al. (2010) argue that not all green initiatives are financially possible for the local or national parties undertaking them, and destinations are not always able to generate enough revenue through their own resources. When local financial resource limitations exist, obtaining external funding could help ensure the long-term sustainability of investments.

3. Mainstream sustainability into tourism development investments and financing. In this regard, the Sustainable Investment and Finance in Tourism (SIFT) network is working to integrate the expectations of private investors, the leveraged strength of the financing and donor community, and the needs of developing destinations. The SIFT Network aims to establish a common, voluntary standard to encourage greater sustainability in tourism investments by public, private and multilateral investors; intensify financing of sustainable tourism projects; increase sustainable investments in the tourism sector; improve capacity of developing destinations; and leverage unique knowledge and reach others. SIFT efforts should permeate to regional, national and local financial organisations (counterparts), and help integrate other global sustainable financial initiatives (e.g. UNEP FI, Equator Principles) to support green investments in tourism.

4. Establish partnership approaches to spread the costs and risks of funding sustainable tourism investments. In the case of small and medium enterprises, for example, besides sliding fees and favourable interest rates for sustainability projects, in-kind support like technical, marketing or business administration assistance, could help to offset the cash requirements of firms by offering them services at low cost. In addition, loans and loan guarantees could include more favourable grace periods, soften the requirements on personal asset guarantees or offer longer repayment periods. Loans for sustainable tourism projects could be set up with guarantees from aid agencies and private businesses, lowering risk and interest rates.

## 4.5 Local investment

As discussed above, sustainable tourism creates additional opportunities to increase local economic contribution from tourism. An often-overlooked aspect of these linkages is that they also offer opportunities for increased investment in local communities. Capitalised and formalised businesses in the tourism value chain enhance local economic opportunity (through employment, local contribution and multiplier effects) while also enhancing local competitiveness among tourists demanding greater local content. This win-win situation is recognised in the UNWTO's ST-EP initiative. Notably, many of the targeted mechanisms are investment enhancing as well as local-income enhancing.

This promotes a greater number and variety of excursions in a given destination, a "buy local" movement in food and beverages sector and growth of specialised niches. Efforts by tourism businesses to include local communities within value creation, public and private initiatives of local workers training, and the development of infrastructure and supporting industries, creates new conditions for business development, more equitable growth and less leakage. These businesses require investment, and can expect substantial growth opportunities in successful destinations.

**Enabling conditions for increasing local contribution**

1. Strengthen tourism value chains to back SME investment. Destination tourism is usually stable enough to provide sufficient guarantees for investors

22. For example, Frey (2008) found in a survey of South African tourism businesses that 80 per cent of respondents agree that responsible tourism management leads to enhanced employee morale and performance, improves company reputation and is an effective marketing tool. However, businesses are not investing sufficient time or money into changing management practices.

and bankers. Long-term contracts for products and services to hotels or other "anchor" businesses create suitable conditions, and simple mechanisms to monitor performance.

2. Expand the use of solidarity lending mechanisms to permit groups of local suppliers to access credit and build capital. Solidarity lending (guarantees provided by a peer group) has proven successful in fisheries, agriculture, and handicrafts – all industries of critical importance to successful sustainable tourism destinations.

3. Enhance development bank access to individuals and small businesses that are not eligible for credit, or are involved in the provision of public services (such as protected areas management, guiding, waste management, infrastructure construction, among others).

4. Establish seed funds to permit new green industries to develop locally. For example, solar collectors and photovoltaic systems can be imported as complete systems, or can be assembled locally from imported components. The latter encourages local investment and promotes local economic contribution. It also permits adaptation of the technologies to better suit local tourism needs.

# 5 Conclusions

Tourism is a leading global industry, responsible for a significant proportion of world production, trade, employment, and investments. In many developing nations, it is the most important source of foreign exchange and foreign direct investment. Tourism growth, environmental conservation, and social wellbeing can be mutually reinforcing. All forms of tourism can contribute towards a green economy transition through investments leading to energy and water efficiency, climate-change mitigation, waste reduction, biodiversity and cultural heritage conservation, and the strengthening of linkages with local communities. Making tourism businesses more sustainable will foster the industry's growth, create more and better jobs, consolidate higher investment returns, benefit local development and contribute to poverty reduction, while raising awareness and support for the sustainable use of natural resources.

The potential economic, social and environmental costs of a "business-as-usual" (BAU) scenario in the tourism industry are not always considered when evaluating the cost of investments toward sustainability. Concern about required investments and financing sources availability are common when considering actions for making tourism more sustainable. Nevertheless, empirical evidence shows that demand for traditional mass tourism has reached a mature stage whereas the demand for more responsible forms of tourism is booming and are predicted to be the fastest growing tourism markets in the next two decades. Tourism-market tendencies indicate that main drivers towards investment in sustainable tourism relate to consumer demand changes, actions to reduce operations costs and increase competitiveness, coherent policy and regulations, technology improvements, stronger efforts for environmental and social responsibility and natural resource conservation. These are leading transformation of the industry and determining the returns on investments.

In a BAU scenario up to 2050, tourism growth will imply increases in energy consumption (111 per cent), greenhouse gas emissions (105 per cent), water consumption (150 per cent), and solid waste disposal (252 per cent). On the other hand, under an alternative greener investment scenario (in energy and water efficiency, emissions mitigation and solid waste management) of US$248 billion (i.e. 0.2 per cent of total GDP), the tourism sector can grow steadily in the coming decades (exceeding the BAU scenario by 7 per cent in terms of the sector GDP) while saving significant amounts of resources and enhancing its sustainability. The green investment scenario is expected to undercut the corresponding BAU scenario by 18 per cent for water consumption, 44 per cent for energy supply and demand, 52 per cent for $CO_2$ emissions. This will result in potential avoided costs that can be reinvested in socially and environmentally responsible local activities—such as local transportation and staff capabilities and skills—increasing the indirect and induced effects of tourism expenditure on local development. In particular, the spending by foreign visitors from wealthier regions to developing countries helps to create much-needed employment and opportunities for development, reducing economic disparities and poverty, notably through the multiplier effect and the reduction of "leakage".

Tourism can have positive or negative impacts depending on how it is planned, developed and managed. Various enabling conditions are required for transforming tourism to contribute to social and economic development within the carrying capacities of ecosystems.

To promote sustainable tourism in a green economy, the national, regional, and local economy should first provide a good investment climate, featuring security and stability, regulation, taxation, finance, infrastructure, and labour. Various tourism stakeholders should collaborate and share knowledge and tools in order to understand the overall picture of environmental and socio-cultural impacts of tourism activities at destinations. There is also a need for policy coherence, which can include economic instruments and fiscal policy to reward sustainable investments and practices and discourage the most costly externalities associated with uncontrolled tourism expansion. In the case of tourism, government and private tourism authorities should coordinate with ministries responsible for the environment, energy, agriculture, transport, health, finance, security, and other relevant areas, as well as with local governments.

By steering the direction of policy and spearheading sustainability efforts, government authorities can motivate and influence other stakeholders—both public and private—to engage in behaviour that bolsters a destination's sustainability. It is necessary that tourism promotion and marketing initiatives emphasise sustainability as a primary option. To create local development opportunities, marketing efforts should ensure access to domestic and international markets by sustainable local, small, medium, community-based and other tourism suppliers (especially in developing countries). As the tourism industry is dominated by SMEs, it is also essential to facilitate their access to industry-oriented decision-support tools, information, knowledge as well as to capital. Partnership approaches to lower the costs and risks of funding sustainable tourism investment and in kind support to SMEs should be considered so as to facilitate the shift toward green tourism activities.

The design and implementation of a sustainable tourism *enabling environment* should be based on a sound formal and well-documented analysis. Policymakers should set baselines and measurable targets with regard to short-, medium-, and long-term results of sustainable tourism promotion and marketing. It is important to note that the "success" of tourism destinations should be evaluated not only in terms of "arrivals" but also in terms of broader economic, social and environmental drivers, as well as its impacts. Sustainable tourism policymaking should be based on sound quantitative analysis. Valuation exercises (such as choice experiments) can help identify opportunities for sustainable tourism development from the demand side. Tools such as input-output and general equilibrium models, business surveys, and the Tourism Satellite Accounts (TSA) can support policy design and business strategy. The adoption of international standards and criteria (e.g. GSTC) at a global scale is highly recommended in order to assess comparable results and unify an understanding on the practical aspects of sustainable tourism enabling prioritising of private sector investments. Further, increased adoption of management standards for environmental and labour performance[23] would greatly assist tourism operators in strengthening their internal management capacity to reduce environmental impacts and protect their workers, and enhance capacity to relate to community stakeholders.

The effects of tourism can vary dramatically between destinations. More quantitative studies are necessary to clearly understand the reasons for such variations, to expand the evidence base at a national and sub-national level on tourism and local employment, procurement through local supply chains, poverty reduction, environmental benefits, and other relevant areas. Domestic tourism (in many countries the most important source of tourism income) should be further analysed. Business performance and the determinants of higher ROI on green investments are key variables to study.

This chapter analyses the main variables that influence tourism development and aims to demonstrate that concerted "greener" policies can steer the growth of the sector toward a more sustainable path, generating economic benefits, while strengthening its social and environmental context. Its findings and recommendations are addressed to all tourism stakeholders.

23. Such as ISO 14000 series for environmental management, ISO 26000 series for social responsibility management and S.A. 8000 series for working conditions.

# Annex 1: Economic sizing of the sector

| Country | Domestic tourism consumption / total tourism consumption (%)* | Tourism gross domestic product / GDP (%)* | Jobs in tourism industries / total jobs (%)* | Tourism investment / total investment (%)** |
|---|---|---|---|---|
| Australia | 73.9 | 4.1 | 4.8 | 12.5 |
| Chile | 75.0 | 3.1 | 2.6 | 7.5 |
| China | 90.8 | 4.2 | 2.3 | 8.5 |
| Czech Republic | 45.3 | 3.0 | 3.3 | 11.0 |
| Ecuador | 69.4 | 4.1 | 1.8 | 12.4 |
| Honduras | 54.5 | 5.7 | 5.3 | 8.4 |
| Israel | 61.0 | 1.8 | 2.6 | 7.6 |
| Japan | 93.5 | 1.9 | 2.8 | 5.8 |
| Latvia | 51.4 | 1.9 | 9.0 | 7.4 |
| Lithuania | 56.4 | 2.6 | 2.6 | 9.8 |
| Netherlands | 80.8 | 3.0 | 4.3 | 7.3 |
| New Zealand | 56.2 | 12.0 | 9.7 | 15.0 |
| Peru | 74.4 | 3.3 | 3.1 | 9.9 |
| Philippines | 80.7 | 6.9 | 9.7 | 11.3 |
| Poland | 41.0 | 2.0 | 4.8 | 7.1 |
| Romania | 47.7 | 2.2 | 8.3 | 7.3 |
| Saudi Arabia | 61.5 | 5.0 | 3.9 | 3.9 |
| Slovakia | 44.1 | 2.9 | 7.3 | 11.4 |
| Slovenia | 43.0 | 4.9 | 11.5 | 12.0 |
| Spain | 42.3 | 10.9 | 11.8 | 13.8 |

* Estimated with TSA country data for latest year available (mainly 2007). ** 2009 values.

**Table A1-1: Economic relevance of tourism in selected countries**

Source: Author's calculations with data from UNWTO (2010c) and WTTC (2010)

# Annex 2: Drivers and likely implications of investment in sustainable tourism strategic areas

| Strategic area | Sustainability drivers | Likely implications |
|---|---|---|
| Energy | ■ Increased energy costs<br>■ Likely carbon surcharges<br>■ Customers expectations (particularly from Europe and North America) driving operators and entire supply chain<br>■ Availability of low-carbon technology<br>■ Possible government incentives<br>■ Decreasing costs of renewable energy technologies<br>■ Eco-labels and/or voluntary standards<br>■ Regulations/legislation on energy efficiency and performance of buildings | ■ Maintain or reduce operating costs for tourism operators through energy efficiency<br>■ Increased customer satisfaction<br>■ Investment in energy efficiency (retrofits, improvements)<br>■ New energy-efficient investment stock<br>■ Investment in more energy efficient features and services (such as efficient refrigeration, television and video systems, air conditioning and heating, and laundry)<br>■ Differentiation of operators and their value chains<br>■ Modest shift toward short-haul versus long-haul tourism, with the effect increasing with energy costs (and offset to the extent efficiency is increased) |
| Climate change | ■ Costs of GHG emissions (driven by post-Kyoto rules)<br>■ Concern of customer base about footprint<br>■ Host government policies and priorities (climate change mitigation and energy)<br>■ Uptake of Corporate Social Responsibility (CSR)<br>■ Climate change impact on tourism sites | ■ Same as for energy efficiency<br>■ Increased substitution of fuels toward electricity, particularly increased investment in passive solar collectors and PV, alternative fuels for vehicles<br>■ Increased number of project developers orienting business strategies toward lower-carbon footprint<br>■ Expectations of broader stakeholder base<br>■ Demand for carbon offsets and other mechanisms to compensate for residual emissions |
| Water | ■ Water scarcity<br>■ Price for water and conflicts<br>■ Expectations from travellers for responsible water management<br>■ Expectations from major tour operators | ■ Reduction in water costs from internal water efficiency<br>■ Investments in water saving technology in rooms, facilities (such as laundry and swimming pools) and attractions (such as golf courses, gardens, and water-based attractions)<br>■ Increase in number of rooms/visitors in water-constrained destinations<br>■ Slight advantage to destinations with more abundant water supplies in terms of variety of activities and cost of water resources<br>■ Increased use of water treatment systems, at firm/project level and destination |
| Waste | ■ Customer demand for clean destination<br>■ Public opinion<br>■ Degradation of water resources owing to waste dumping and waste water<br>■ Pressure from major tour operators | ■ Lower pollution and natural resource<br>■ Improved solid waste management<br>■ Reduction of open waste dumping sites and poorly managed landfills<br>■ Investments in waste water management equipment, treatment and disinfection.<br>■ Investment in sanitary landfills and solid waste recycling capacity<br>■ Lower sewage and clean-up fees |
| Biodiversity | ■ Increased tourist preference for experiences that involve contact with wildlife and pristine (or near pristine) ecosystems<br>■ Expectations from guests that operators protect the natural resource base<br>■ Government regulations regarding sensitive ecosystems such as coral reefs, coastal wetlands and forests<br>■ National policies to attract resources through tourism capable of protecting critical biological habitat<br>■ Ecosystem services potential for tourism revenue generation | ■ Demand for nature-based tourism likely to accelerate as pristine areas become increasingly rare<br>■ Increased number of policies and related practices in mainstream tourism to more effectively protect sensitive ecosystems<br>■ Improved design of individual projects and destinations incorporating biodiversity conservation *in situ*, and through compensatory mechanisms<br>■ Increased incorporation of natural areas in tourism development and greater transfer of benefits toward natural areas through entrance fees and Payment for Environmental Service (PES) schemes |

**Table A2-1: Drivers and likely implications of investment in sustainable tourism strategic areas**
Source: Author's compilation

| Strategic area | Sustainability drivers | Likely implications |
|---|---|---|
| Cultural heritage | ■ Tourist preference for experiences that involve contact with authentic cultural landscapes<br>■ Expectations from guests that their tourism operators respect and protect traditional culture<br>■ Increased awareness of World Heritage Sites<br>■ Recognition and appreciation for cultural diversity | ■ Respect and recognition of traditional culture, particularly in context of assimilation into a dominant culture. Help to community members to validate their culture, especially when external influences of modern life cause the young to become dissociated from traditional life and practices<br>■ Conservation of traditional lands and natural resources on which the culture has traditionally relied<br>■ Help to reduce poverty within a community or cultural group; Increased opportunities for young to remain in community instead of seeking alternative opportunities in cities and towns; Meeting needs of cultural group, such as health care, access to clean water, education, employment, and income<br>■ Reduced risk of losing unique cultural attributes |
| Linkages with Local Economy | ■ Demand for more contact with local communities<br>■ Greater number and variety of excursions in a given destination<br>■ "Buy local" movement in food and beverages sector<br>■ CSR uptake<br>■ Public and private initiatives of local workers training<br>■ Growth of specialised niches (ecotourism, rural tourism, adventure tourism, sports fishing, agrotourism, and community-based tourism)<br>■ Development of infrastructure and supporting industries | ■ Concerted efforts by tourism authorities, local officials and civil society organisations to increase local content<br>■ Responses by tourism operators and increasing use of indicators to track local contribution (which feed into tourism satellite accounts)<br>■ Deepening of supply chain in local economy, generating increased indirect employment<br>■ Increased spending in local economy from income effects in direct and indirect employee consumption and purchases<br>■ Improved income distribution among industry stakeholders<br>■ Decreased leakage (imports of intermediate goods and foreign workers) |

**Table A2-1: Drivers and likely implications of investment in sustainable tourism strategic areas**

Source: Author's compilation

# Annex 3: Assumptions of the model

**1. Tourism energy management:**
25 per cent of the tourism sector green investment (on average US$61 billion per year) is allocated in 2011-2050 to both energy demand reduction through efficiency improvements and increase of renewable energy supply.

Abatement of emissions from energy use: Emissions from tourism activities are reduced in the green scenario through efficiency improvements in tourism electricity and fuel consumption and behavioural changes towards longer stay and fewer trips, shorter travel distance and transport modal shifts (from aviation and private cars to cleaner transport, e.g. coach and electric railway). This investment adds up to US$18 Bn per year on average over the next forty years, or 29 per cent of the tourism energy green investment in the green investment case (G2). The same rates of efficiency gain and modal shifts as in associated GER sectors are assumed, while the assumption in increase of stay (by 0.5 per cent per year) and reduction of trips (to retain total guest nights) is based on the scenarios presented by UNWTO and UNEP (2008). The investment is estimated by using $CO_2$ abatement costs included in IEA (2009). More specifically, for tourism transportation:

■ The length of stay is assumed to increase by 0.5 per cent per year (on average 3.7 days in 2050) instead of a 0.5 per cent decrease per year (2.5 days in 2050) in business-as-usual (BAU), in line with the scenarios of UNWTO and UNEP (2008). To be consistent with the projected total guest nights in other scenarios, tourist arrivals in the green investment scenario are reduced. Thereby these travelling behavioural changes result in fewer but longer trips, but would not affect total number of guest nights. In addition, IEA's assumption of reduced travel is a good fit with the green tourism goal (short travel and longer stays).

■ With respect to transport modal shift and energy efficiency in the green scenario, to ensure coherence across the sectors, the same assumptions as in the GER transportation sector are used for tourism. In accordance with IEA's reports, it is assumed that by 2050 in the green scenario, 25 per cent of car travel and air travel is replaced by bus or rail. The ratio of transport energy efficiency in the green investment scenario (by 60 per cent) is based on the amount of green investment and unit abatement costs from IEA.

■ Renewable energy production: Additional investments of 71 per cent of the tourism energy green investment (or US$43 Bn on average per year) between 2010 and 2050 are allocated to the introduction and expansion of renewable power generation and biofuel production. The cost assumptions are collected from IEA (2009).

**2. Tourism water management:**
0.1 per cent of the tourism-sector green investment (on average US$0.24 billion per year) is allocated in 2011-2050 to both water demand reduction through efficiency improvements and increase of water supply[24]:

Water efficiency improvement: The amount of investment in water-efficiency improvement, aimed at reducing tourism water demand, is assumed to be US$0.16 billion per year on average (or 65 per cent of investment in tourism water management) over the 40-year period. The unit cost is assumed to be US$0.28/m3.

Water supply: The remaining (35 per cent) of tourism-sector water investment (US$0.86 billion per year on average between 2010 and 2050) aims to increase water supply from desalination and conventional water sources:

■ Desalination: 30 per cent of water-supply investment (US$0.026 billion per year on average), over the 40-year period will be invested in water desalination. The cost to supply water desalination is set at US$1.1/$m^3$.

■ Conventional water supply management: 70 per cent of the total water-supply investment (US$0.06 billion per year on average) is allocated to conventional water-supply management measures, including treatment of wastewater, reservoir storage, and surface and underground water supply. The unit cost to increase conventional water supply is set at US$0.11/$m^3$.

**3. Waste management:**
13 per cent of tourism-sector green investment (on average US$32 billion per year) is allocated in 2011-2050 to upstream (collection) and downstream (reuse) waste treatment:

■ Waste reuse: 8 per cent of the tourism waste investment is invested in waste recycling and recovery, totalling on average US$2.4 Bn per year over the next 40 years under the green investment scenario. The unit costs of recycling and compost are assumed to be US$138 per tonne and US$44.85 per tonne respectively.

24. The low level of investment allocated to tourism water sector is due to the relatively small amount of water consumption in tourism compared to the total of all sectors, as the same unit costs and improvement percentage are used for all water users.

■ Waste collection: the remaining 92 per cent of green investment in tourism waste management is allocated to improve the waste collection rate, totalling on average US$30 billion per year over the next 40 years under the green investment scenario. The upstream cost of waste treatment is assumed to rise from US$1083 per tonne in 1970 to US$1695.5 per tonne in 2050.

**4. Training of employees:**

12 per cent of tourism investment in the green investment scenario, or US$31 billion on average each year between 2011 and 2050. The cost of training per employee is assumed to be US$117 for 120 hours, while all new employees attend training for one year in total over the duration of their career (together with the assumption that as many as possible would be local workforce). Overall, the total cumulative cost of training one employee is assumed to reach US$2,854. A variety of scenarios were simulated to study and evaluate the impacts of the variation in training cost per employee per year, in the range of between 30 per cent lower and higher than the assumed cost (or from US$1,998 to US$3,711).

**5. Biodiversity conservation:**

50 per cent of tourism investment, or US$123 billion on average each year between 2011 and 2050. Three scenarios are simulated based on different biodiversity conservation costs. These are (a) US$119 per hectare, assuming only forest conservation—using the average cost offered by FONAFIFO[25]; (b) US$451 per hectare assuming the possibility to undertake forestry and agriculture on that land (based on the experience in Costa Rica, from Forestry chapter); (c) US$1,380 per hectare assuming that housing and other related business opportunities can be created, based on what is offered by Amazon Carbon and Biodiversity Investment Fund (ACIF)[26].

25. Fondo Nacional de Financiamiento Forestal, Costa Rica.

26. The Amazon Carbon and Biodiversity Investment Fund (ACIF) offers between US$276 and US$3,450 per ha, but it is a very specific case for 100,000 ha (US$3,450/ha seems high for an average). As a consequence, US$1,380/ha is used as a maximum value of conservation cost in this analysis.

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Annexe 5.19

World Tourism Organization

UNWTO

# Towards Measuring the Economic Value of Wildlife Watching Tourism in Africa

Briefing Paper

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# Towards Measuring the Economic Value of Wildlife Watching Tourism in Africa

## Briefing Paper

# Table of Contents

**Annexes**

# Executive summary

Set against the backdrop of the ongoing poaching crisis driven by a dramatic increase in the illicit trade in wildlife products, this briefing paper intends to support the ongoing efforts of African governments and the broader international community in the fight against poaching. Specifically, this paper looks at the wildlife watching market segment within the tourism sector and highlights its economic importance with a view to encouraging tourism authorities and the tourism industry to collaborate in strengthening anti-poaching measures and raising awareness of these issues among tourists. The analysis identifies key economic indicators and characteristics of wildlife watching tourism in African countries. This paper acts a first step towards a more systematic measurement of the economic value of the wildlife watching tourism market segment in Africa and in defining the role of the tourism sector in the fight against poaching. In its research, UNWTO followed a multi-level, participatory approach, collecting as much information as was available at the international, national and local levels and creating a network of contacts for potential future research.

This paper focuses specifically on non-consumptive forms of wildlife tourism which offer visitors the experience of observing wildlife in natural and non-captive habitats. Generally, the species of wildlife that can be observed through this form of tourism are the very same as those most often threatened by poaching and other environmental detriments. The research findings are based on a review of publications, economic data, case studies and other sources related to wildlife watching tourism, as well as on the exchange of experiences with international organizations working in the fields of nature conservation, tourism, sustainable development and wildlife crime. In addition, to address a scarcity of data and statistical information about the wildlife watching tourism segment and its economic value, a survey was carried out among African tourism ministries and authorities, protected area and wildlife

Note: The report was prepared under the supervision of Dr. Dirk Glaesser, *Director of Sustainable Development of Tourism, World Tourism Organization* with support from the *Regional Programme for Africa* and *Communications and Publications,* and contributions from Dr. Mohcine Bakhat, Gordon Clark, Virginia Fernandez-Trapa, Sofia Gutierrez, Borja Heredia Salis, Dr. Oliver Herrmann, Lyris Lyssens, Stephanie Roth, Enrico Saltarelli, Michèle Schaul, Stephanie Stein.



conservation institutions, and international and African-based tour operators. This briefing paper was likewise prepared in collaboration with the Convention on Migratory Species of Wild Animals (UNEP/CMS), which played an especially important role in establishing contact with protected area and wildlife conservation authorities.

A total of 48 governmental institutions (tourism authorities and protected area and wildlife conservation agencies) from 31 African countries participated in the survey. The sample represents 63% of UNWTO African Member States. Additionally, a total of 145 tour operators selling trips to Africa from 31 different countries participated, 50% of which were tour operators mainly from Europe (generally the principal source market for Africa) and 50% were Africa-based tour operators. The survey findings confirm that wildlife watching is a very important segment of tourism for most African countries, representing 80% of the total annual trip sales to Africa for the participating tour operators, with that share only increasing. The survey findings also indicated that for the vast majority of the countries denoted in the paper, poaching is seen as a serious problem that has negative impacts on tourism that threatens the sector's long-term sustainability and its development opportunities. For example, the employment opportunities generated for the local community in accommodation, restaurants and guiding, as well as the indirect benefits linked to the redistribution of protected area fees and community funds are at risk from the negative impacts of poaching.

Feedback from the survey also reveals a picture of where wildlife watching tourism is taking place and what kinds of activities travellers are taking part in. Wildlife watching tourism occurs mainly in protected areas; and nature, national parks and wildlife are considered the most important tourism assets for tourists travelling to Africa. While the regions that are most visited for the purposes of experiencing wildlife watching tourism are East Africa and Southern Africa, Central and West African tourism authorities are committed to further developing this type of tourism. Safari is the most popular kind of wildlife watching and is being offered by 96% of the participating tour operators. This is followed by bird watching, which is offered by 80% of the participating tour operators and seems to be combined frequently with other activities. In countries that are not considered classic safari destinations, the observation of great apes, marine wildlife and tracking of particular species are particularly important.

The exercise has also been successful in identifying key indicators related to wildlife watching tourism that assist in measuring the segment's economic importance and potential growth. For instance, a typical wildlife watching tour involves on average a group of six people, lasts 10 days, has an average daily price per person of US$ 433 and captures an additional US$ 55 in out-of-pocket expenses per person, per day. The findings also indicated the differences between standard and luxury segments with the greatest variation being in both average daily price per person per day (US$ 753 for a luxury package and US$ 243 for a standard package) and in out-of-pocket expenditures (US$ 59 for a traveller on a luxury package and US$ 44 per person per day on a standard package). Little variation was found between the segments related to the size of the group or the average length of stay which seem to be consistent characteristics of the wildlife watching product instead of factors directly related to the comfort of the experience.

With regards to protected area visitors and receipts, results suggest that a total of 14 countries are generating an estimated US$ 142 million in entrance fees for protected areas. Because this figure covers only a small number of countries and is based on some inconclusive data, it can be assumed that protected area receipts are indeed much higher than the figure suggests. Fortunately for the purposes of future analysis, the research found that there are numerous ongoing efforts being carried out by African governments to monitor data that could be useful in estimating the economic value of the wildlife watching tourism sector. That being said, further improvements are needed as these efforts are often not consistent and commonly lead to inconclusive results.

The data also indicated that while a majority of protected area authorities are involved in anti-poaching measures, the tourism authorities are only involved to a minor extent and most do not distribute information on poaching to tourists. Of the participating tour operators about 50% are funding anti-poaching initiatives and/or engaging in nature conservation projects, however only a few are proactively taking the initiative to inform their customers on the issue.

In conclusion, the findings suggest that guidance and capacity building in developing consistent monitoring of protected area visitors and receipts and subsequently putting together a framework for the analysis of these data are needed. In this regard, establishing a model linked to an overall assessment of the economic value of wildlife watching tourism in Africa that would connect data from protected areas with tour operators' performance would be most useful. In addition, based on the experiences gathered and the network established through this exercise, such a model could be developed and tested with relevant stakeholders, namely tourism and wildlife conservation authorities at the national and local levels, and the tour operator community. Ideally, the model should be able to look at specific kinds of wildlife watching tourism (safari, marine, bird watching, etc.) in order to be applicable to the very different settings in which wildlife watching tourism takes place.

Finally, while the involvement in anti-poaching initiatives by tour operators is not very extensive yet, the survey results suggest that there is potential for mobilizing the tourism sector in anti-poaching campaigns, which is significant in that the sector can play a key role in raising awareness and potentially financing (or co-financing) anti-poaching initiatives. Further research is recommended in order to assess the level of tour operators' concern with nature conservation as well as their involvement with conservation and anti-poaching initiatives and other types of initiatives in place. Such research could be designed in close cooperation with the target group and not be restricted to European and North American travel markets but could also include emerging markets for outbound tourism to Africa like Asia.

# 1. Background

## 1.1 Wildlife crime challenges nature conservation

African countries have long promoted biodiversity conservation through the sustainable use of natural resources and there have been major achievements in the protection and recovery of wildlife populations[1]. The dramatic increase in poaching and illicit trade of wildlife products since 2005 – often referred to as 'wildlife crime' – threatens to undermine these conservation achievements and endangers some of the most iconic species to become extinct within only a few decades – most prominently, elephants and rhinos, but also other big mammals such as lions and gorillas as well as smaller species[2]. Furthermore, wildlife is also threatened by the increasing loss of habitat and loss of range[3], among other pressures.

The increase in wildlife crime is a result of widespread poverty, underfunding of wildlife conservation efforts, lack of law enforcement and political instability in the concerned countries and a rising demand for exotic animal products overseas, foremost in the rapidly growing economies of Asia due to increasing wealth and recent changes in consumer spending patterns[4]. While in the past much of the poaching in Africa had been opportunistic, wildlife crime has become a serious criminal activity involving transnational networks of well-resourced and organized groups[5].

Poaching and the illegal wildlife trade lead to detrimental environmental, economic and social consequences. Wildlife crime threatens the future existence of species and impacts the ecological integrity of whole ecosystems, especially as big mammals are essential for the maintenance of biodiversity and ecosystem functions. Poaching deprives communities of their natural capital and cultural heritage and undermines sustainable economic development and poverty alleviation. Wildlife crime is also a security challenge that threatens national security, undermines government authority, breeds corruption and restricts the potential for sustainable investment, constraining a country's social and economic development[6].

Over time, the international community has become aware of the fact that poaching is the most immediate and direct threat to wildlife in Africa, making its upward trend a cause of serious concern. There has been progress in a number of countries but compliance with international conventions and law enforcement are still insufficient in many parts of the world[7]. Therefore, actions against wildlife crime are being reinforced and readjusted through the statements and agreements among numerous international governmental and nongovernmental bodies.

Examples of the enhanced efforts that are active in the international community to address these issues can be seen in programmes such as the Monitoring the Illegal Killing of Elephants (MIKE) and the Elephant Trade Information System (ETIS); the commitments made at Rio+20 (June 2012), CITES COP 16 (March 2013) and the G8 Summit (June 2013); the discussions held during the United Nations General Assembly (UNGA, September 2013), the African Elephant

1. Miliken/Shaw (2012); UNEP/IUCN/ TRAFFIC/CITES (2013); Blanc et al. (2007).
2. UNEP/IUCN/TRAF-FIC/CITES (2013); WWF/Dalberg (2012); Milliken/Shaw (2012); WWF (2013); UNODC (2014a).
3. Miliken/Shaw (2012); UNEP/IUCN/TRAF-FIC/CITES (2013); CITES (2010).
4. UNODC (2014a); UNEP/IUCN/TRAF-FIC/CITES (2013); CITES (2013).
5. UNODC (2013a); UNODC (2014a); WWF/Dalberg (2012); IISD (2013); UNEP/IUCN/TRAFFIC /CITES (2013).
6. WWF/Dalberg (2012); Republic of Botswana/IUCN (2013); ICCWC (2011); Ripple (2014); CITES (2013).
7. Nowell (2012); WWF/Dalberg (2012); IISD (2013); Milliken/Shaw (2012).

Summit (December 2013) and the London Conference on Illegal Wildlife Trade (February 2014); the side event held at the First United Nations Environment Assembly (UNEA) of UNEP (June 2014); and the launch of the Strategic Mission of the International Consortium on Combating Wildlife Crime (ICCWC) at CITES SC 65 (July 2014), among others[8].

## 1.2 Tourism is a driver of sustainable development

Tourism is increasingly referred to as a driver of sustainable development. It was mentioned in the UNGA Resolution 66/288 which endorses the Outcome Document of the United Nations Conference on Sustainable Development (Rio+20), "The future we want", as one of the sectors capable of making a significant contribution to the three dimensions of sustainable development, noting also that tourism is linked closely to other sectors and can create decent jobs and generate trade opportunities. The document builds on the previous Resolution 65/173, Promotion of Ecotourism for poverty eradication and environment protection, which "recognizes that the development of ecotourism, within the framework of sustainable tourism, can have a positive impact on income generation, job creation and education, and thus on the fight against the poverty".

Moreover, tourism has been identified as one of the ten key sectors to evolve towards a Green Economy and is included as one of the initial 10-Year Framework of Programmes (10YFP) to accelerate the shift towards more sustainable consumption and production patterns. Additionally, the Conference of the Parties (COP) of Multilateral Environmental Agreements (MEAs) such as the Convention on Biological Diversity (CBD) or the Ramsar Convention on Wetlands of International Importance have also approved respectively Decisions VII/14, on "Biological diversity and tourism" and XI/6 on "Cooperation with other conventions, international organizations, and initiatives" and Resolution XI/7 on "Tourism, recreation and wetlands", recognizing the potential of tourism to advance biodiversity conservation.

In economic terms, many countries in Africa, especially in Sub-Saharan Africa, have benefitted from strong growth in their tourism sector in recent years. Although the economic importance of tourism in Africa and the continent's share of the worldwide tourism market are relatively modest (5% of global international arrivals and 3% of global international receipts), tourism has been increasing steadily with an average annual growth rate of international tourist arrivals of about 6.1% per year between 2005 and 2013. During the same period, arrivals grew from 35 million in 2005 to reach a new record of 56 million in 2013[9]. The total international tourism receipts for Africa in 2013 reached US$ 34.2 billion. Absolute numbers are predicted to more than double during the upcoming decade, reaching 134 million international arrivals in 2030.

From a policy perspective, it is important to note that over 30 African countries have identified tourism as a national priority within the Enhanced Integrated Framework (EIF)[10]. This underlines that tourism is considered a priority sector for many African countries and much hope is put into future tourism development as a vehicle for economic growth, job creation and poverty alleviation[11]. The multiplier effects on local and national economies due to the broad range of goods and services included in its value chain have benefits beyond generating income and revenue[12].

Research related to pro-poor tourism and experiences have demonstrated the functions of tourism from the perspective of sustainable development and poverty alleviation[13]:

- Tourism can support the transformation and diversification of national economies;
- Tourism can be developed in remote areas and developing regions that do not offer other export options;
- Tourism is a labour-intensive industry and can create decent employment for women, young people and marginalized populations;
- Cultural and wildlife heritage is one of the assets of many developing countries that can be harnessed for economic development; and
- Tourism can create net benefits and offers a wide range of opportunities for micro, small and medium enterprises (MSMEs).

## 1.3 Tourism is affected by the loss of species

The world's highest levels of biodiversity occur in less-developed countries and these offer some of the world's most well-known wildlife watching destinations. Africa is exceptional for mammal diversity and the main destination for wildlife watching tourism[14]. According to the Centre for the Promotion of Imports from developing countries in the Netherlands (CBI), the destination of about half of all wildlife watching tourism trips booked worldwide is an African country. The global market size of wildlife tourism has been estimated at 12 million trips annually and is growing at a rate of about 10% a year[15].

The leisure tourism market in Africa represents over half of the international tourist arrivals to Africa[16] and is characterized by high-end trips to top wildlife watching and nature destinations, niche tourism products such as adventure trips and cultural heritage tours and lower-end beach holidays. The middle-income market on the other hand remains relatively underdeveloped[17]. The most established tourism products in Africa are safari, beach resort, business and Diaspora tourism[18] while newly emerging products are adventure tourism (mainly nature-related such as trekking and adventure sports), cultural heritage and wellness/health tourism[19].

The most important long-haul markets for Africa are France, United Kingdom, United States of America, Germany and Portugal. Smaller markets include tourists from other European countries, Canada and Australia, while important future source markets are in emerging countries like China, India and Russian Federation[20]. Furthermore, there is a significant increase in domestic and intraregional travel in Africa undertaken for a variety of purposes from business and shopping to visiting family, to cultural heritage sight-seeing and other leisure reasons.

Wildlife watching tourism, like other types of tourism, is sensitive to economic circumstances and has decreased during this recent economic recession. Nevertheless, wildlife watching tourism is a growing market segment and interest in wildlife watching trips has only increased with a rise in media coverage and Internet communication. Conservation issues and awareness of the risk of extinction of an increasing number of species also contribute to tourists' motivation to observe wildlife ranging freely in their natural habitats[21].

Countries in East and Southern Africa are known as the world's top destinations for the so-called "Big Five" watching (African Elephant, Cape Buffalo, leopard, lion and rhinoceros). In addition to Africa's classic safari destinations, alternative or complementary destinations are emerging with new products, for example gorilla trekking in Central Africa. These wildlife-related tourism products can only be experienced on the African continent and thus represent a unique selling proposition for African tourism. In addition to the mentioned iconic species, all African countries offer outstanding opportunities to experience wildlife and nature – including bird watching, observation of marine wildlife and viewing of agglomerations of wildlife along migration routes.

However, wildlife crime is threatening the very existence of iconic species that are essential to Africa's image as home to the world's top wildlife destinations and thus jeopardizes the basis of one of Africa's most important tourism products. Security, safety, the conservation of ecosystems, and the quality of tourism products and services are basic prerequisites for successful tourism development, while poaching has serious negative impacts on the political, social and economic framework in which tourism development can take place. Consequently, the loss of wildlife caused by poaching is likely to significantly impact tourism development in Africa as well as the tourism sector worldwide linked to the African market with the subsequent reduction of the sustainable development opportunities linked to the sector.

**8.** CITES (2014); WWF/Dalberg (2012); IISD (2014); ICCWC (2011).
**9.** UNWTO (2013); UNWTO (2014a); UNWTO (2014b); UNWTO (2014c).
**10.** A multi-donor programme providing trade-related assistance to LDCs (online), available at: www.enhancedif.org.
**11.** AFTFP (2009); Christie et al. (2013); UNWTO (2002a); UNWTO (2002b); (Ebbe 2010); UNWTO (2013); WTTC (2012).
**12.** Christies et al. (2013: 1).
**13.** UNEP/CMS (2006); Job/Paesler (2013); Christie et al. (2013); Higginbottom (2004).
**14.** Higginbottom (2004).
**15.** CBI (2014).
**16.** UNWTO (2014c).
**17.** Christie et al. (2013).
**18.** African Americans wishing to visit the countries of their ancestors.
**19.** Christie et al. (2013), AFTFP (2009).
**20.** AFTFP (2009); UNWTO (2014a).
**21.** CBI (2014).

# 2.
# Scope of the briefing paper

## 2.1 Objective

This briefing paper aims to identify key economic indicators and characteristics of wildlife watching tourism in African countries in order to highlight this market segment's economic importance and encourage tourism authorities and the tourism sector to collaborate in strengthening anti-poaching measures and raising awareness of these issues among tourists.

This paper is a first step towards measuring more systematically the economic value of the wildlife watching tourism market segment in Africa and in defining the role of the tourism sector in the fight against poaching.

## 2.2 Methodology

This briefing paper is based on a review of publications, economic data, case studies and other sources related to wildlife watching tourism; a survey among African tourism ministries and authorities; protected area and wildlife conservation agencies; international and African-based tour operators; as well as an exchange of experiences with international organizations working in the fields of nature conservation, tourism, sustainable development and fighting wildlife crime (a list of contributors can be found in annex 1).

The collaboration with the Convention on Migratory Species of Wild Animals (UNEP/CMS) for the preparation of the briefing paper is to be highlighted, especially for the key role that it played when establishing contact with protected area and wildlife conservation agencies.

The desk research was initiated in February 2014 and was followed by an online survey which was concluded on 15 April 2014. Consultations with representatives from a variety of relevant organizations took place during the process. A first draft of the document was presented to the

African Ministers of Tourism during the UNWTO Commission for African Member States[1] celebrated in Luanda, Angola, on 28 April 2014. A second round of consultations focusing on key questions of the survey was carried out with tour operators in the month of May applying the Delphi method[2]. The final analysis of data was carried out between June and July 2014. The validation of the results by the governmental institutions and contributors was completed in September 2014.

## 2.3 Definition of wildlife watching tourism[3]

Based on the definition of UNEP/CMS[4], this briefing paper defines: "Wildlife watching tourism is a type of tourism that is organized and undertaken in order to watch or encounter wildlife. Wildlife watching tourism exclusively relates to non-consumptive forms of wildlife-based activities as observing and sometimes touching or feeding of animals, in contrast to consumptive forms like hunting and fishing."

The specific tourism products with a main purpose of wildlife observation are often named after the animal or the group of animals primarily observed. For instance:

- Big Five watching (buffalo, elephant, leopard, lion, rhino);
- Gorilla tracking;
- Lemur tracking;
- Bird watching;
- Whale watching; and
- Dolphin watching.

Safari is the most common term for wildlife watching tourism. The word "Safari" originates from Swahili and means "journey". When used in English or German in colonial times, it referred to hunting expeditions. Currently the term safari is most often used as a synonym for wildlife watching tourism and refers to tourism taking place mainly in protected areas that offers the opportunity to observe and photograph wild animals in their natural habitats. The classic form of safari entails observing wildlife from four-wheel drive vehicles and staying in tented safari camps or lodges. Newly emerging forms of safari include trekking, kayaking or camel safaris[5].

While safari tours and the above-mentioned specific tourism products may represent the most common forms of wildlife-related tourism, this briefing paper encompasses all kinds of wildlife that may be observed by tourists. The research does not include captive or semi-captive settings of animals such as zoos. This paper aims to showcase the economic value and related characteristics of tourism products that are based on the opportunity to observe wild animals in their natural habitat, as it is this form of wildlife tourism that is threatened by poaching and other environmental detriments.

Furthermore, this paper focuses on non-consumptive forms of wildlife tourism and therefore does not include trophy hunting tourism. Trophy hunting tourism can be a legitimate

1. UNWTO has 49 African Member States (online), available at: http://www2.unwto.org/members/africa.
2. The Dephi method is an interactive method of analysis based on a survey which is conducted in two or more rounds, providing the participants in the second round with the results of the first so that they can alter their original assessment or stick to their previous opinion, (online), available at: www.rand.org.
3. For the following cf. Higginbottom (2004).
4. UNEP/CMS (2006).
5. FTFP (2009); Wikipedia.

and profitable wildlife conservation tool if managed effectively. Nevertheless, against the background of poaching and the illegal trade of wildlife products, the discussion of hunting tourism among stakeholders including nature conservation institutions and the African countries that take different approaches with regards to trophy hunting, remains controversial. Additionally, from both the tourism sector and the consumer perspectives, wildlife watching tours and trophy hunting are separate segments.

## 2.4 The economic value of wildlife watching tourism

It is important to note that the subject of this briefing paper is the economic value of tourism, most precisely of the wildlife watching market segment, and not the economic value of wildlife itself. The intrinsic value of wildlife and its various contributions to sustainable development and human well-being – including ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic – are manifold and maybe more or equally important as the economic value, but they are not the subject of this paper.

The economic value of tourism can be defined as the result of all economic impacts caused by tourism. These impacts are direct, indirect and induced through the total of tourism expenditures, creation of employment, positive and negative externalities, revenues from taxes and other public charges, foreign exchange earnings and the related multiplier effects[6].

UNWTO Statistics focus on measuring the direct economic contribution[7] of tourism to the national economy. They provide data and indicators on inbound, outbound and domestic tourism, as well as on tourism industries, employment and macroeconomic indicators related to inbound tourism such as for instance, the contribution of tourism to GDP. The inclusion of the full economic benefits of tourism[8] into UNWTO Statistics is currently under discussion[9].

Analyzing the economic value of the wildlife watching tourism market segment in Africa faces some of the following challenges[10]:

1. The availability of national tourism statistics for African countries is quite limited and refers to the direct economic contribution of tourism. At the national level, data on international tourist arrivals and international tourism receipts are available for the majority of countries. However, data on employment or tourism industries or indicators on the average length of stay and the average expenditure per day are being reported for only a small number of African countries[11]. In addition, Tourism Satellite Accounts (TSA)[12] are only available for a limited number of African countries.

2. Where data are available at national level, they mostly refer to the whole tourism sector, regardless of the different travel purposes. A few countries account indicators according to three different travel purposes, i.e. leisure, business, visiting friends and relatives (VFR) and others; but different segments of tourism such as beach tourism, nature tourism, cultural tourism or wildlife-related tourism are not identified.

3. Data on the tourism expenditure of wildlife watching tourism at the destination level are not collected systematically, or, where data are generated by registrations, surveys or studies, these are often not published.

The review of the literature and case studies revealed that there are numerous studies, projects and publications analyzing wildlife watching tourism. Although the economic value of wildlife watching tourism is usually referred to as important, the reviewed literature focuses mainly on how the economic value could be evaluated and points out that there are no valid data available for such analysis. The very few studies that eventually gathered concrete economic figures on the segment were based on very specific locations and demonstrate that the economic value of wildlife watching tourism can reach significant dimensions. They also reveal that, while the economic potential of wildlife watching tourism might be underestimated, the realization of its benefits in terms of tangible impacts on local economies and pro-poor benefits can only be achieved if tourism development is participatory, well-planned, managed and monitored, and follows the principles of sustainability.[13]

## 2.5 The survey

Given the scarcity of data at the national level for the region as well as the absence of relevant statistical information for the segment of wildlife watching tourism, UNWTO fielded a survey among relevant stakeholders. Specific questions addressing the number of arrivals to protected areas and related receipts were included in the survey. The existing official data on international tourism arrivals and receipts was used as a benchmark against which the results of the survey were contrasted (the available data on international tourism arrivals and receipts can be found in annex 2).

The survey was distributed to national tourism authorities, protected area and wildlife conservation authorities and individual protected areas. With the objective of accessing relevant data on the wildlife watching tourism segment potentially available at the national and local level, a selection of questions related to key economic indicators and characteristics of wildlife watching tourism were included in the survey. Moreover, international and African tour operators were surveyed to describe the supply side of wildlife watching tours.

The survey was conducted following a consultative process with various tour operator associations via online questionnaires from 26 February to 15 April 2014. A second round of consultations with tour operators focusing on validating the findings took place during May 2014 using the Delphi method.

The following four specific versions of the questionnaire were developed and sent to governmental institutions and the tourism sector:

– Ministries of tourism and national tourism authorities;

– National and local protected area and wildlife conservation agencies;

– Tour operators from Europe and United States of America (aka 'international tour operators'); and

– African-based tour operators.

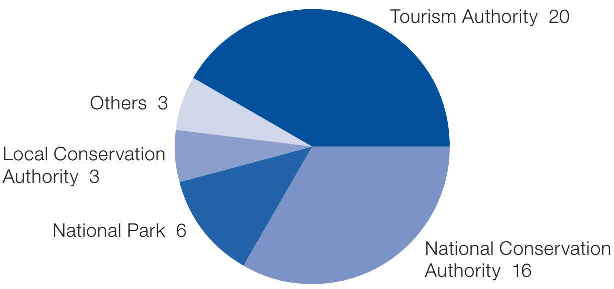
All questionnaires were available in English and French, and in the case of international tour operators, also in German.

### 2.5.1 Survey participation: governmental institutions

Tourism ministries of all 49 UNWTO African Member States[14] were invited to participate in the survey. The national authorities for protected areas and wildlife conservation were addressed through the national focal points of UNEP/CMS which is a partner in this UNWTO initiative. The UNEP/CMS focal points were asked to forward the survey to relevant conservation institutions and individual national parks (a list of participating governmental institutions can be found in annex 3).

In total, 48 governmental institutions from 31 countries replied, i.e. Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cabo Verde, Chad, Congo, Cote d'Ivoire, Democratic Republic Congo, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Kenya, Lesotho, Malawi, Mali, Mauritania, Mozambique, Niger, Senegal, Seychelles, Sierra Leone, South Africa, South Africa, Swaziland, Uganda, United Republic of Tanzania and Zimbabwe. The sample represents 63% of UNWTO Member States and the respondents include 20 national tourism authorities, 16 national wildlife conservation authorities, three local wildlife conservation authorities, six individual national parks and three other institutions. The balanced response of both governmental branches can be interpreted as a sign of their shared interest in the topic.

**Figure 2.1** Survey participants: governmental institutions




Governmental institutions, n = 48

The participating governmental institutions are from four African sub-regions – six participants from five Central African countries; 15 participants from 10 East African countries; 10 participants from four Southern African countries and 17 participants from 12 West African countries. There were no participating countries from Northern Africa. For nine countries (Democratic Republic of Congo, Ghana, Kenya, Lesotho, Senegal, South Africa, Swaziland, Tanzania and Uganda), replies were received from both the governmental branches of tourism and protected area and wildlife conservation.

**6.** Smith (1998); Freyer (2011).

**7.** Tourism Economic Contribution is understood as the direct, positive effects of Tourism Consumption, Tourism Gross Fixed Capital Investment and Tourism Collective Consumption on a national economy. This includes the Tourism Satellite Account (TSA) measures of Tourism Direct Gross Value Added, Tourism Direct Gross Domestic Product (GDP), and Employment in the tourism Industries consistent with the System of National Accounts. (UNWTO, 2011).

**8.** Tourism Economic Benefits are defined as the Tourism Economic Contribution plus the secondary effects (including both indirect effects and induced effects) on the national economy. (UNWTO, 2011).

**9.** UNWTO (2011).

**10.** cf. Higginbottom( 2004).

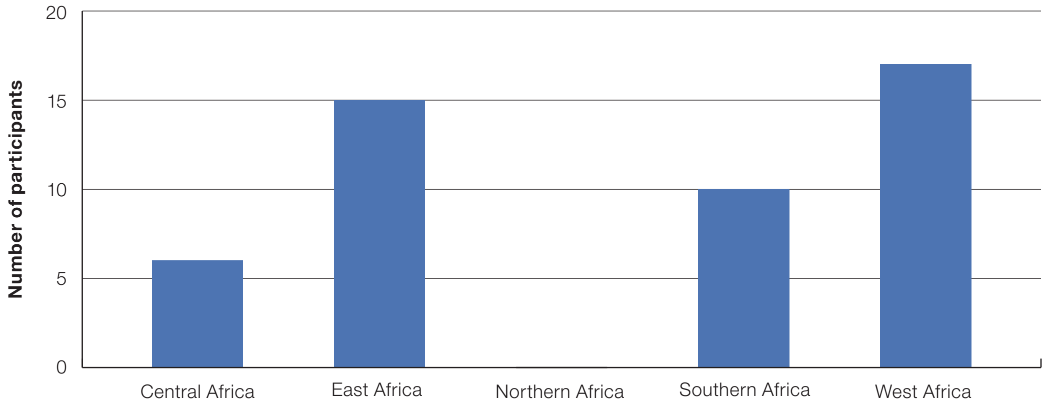
**11.** This absence of detailed economic data on tourism is not restricted to Africa; it is common for many countries worldwide. (UNWTO, 2014c, UNWTO, 2014d).

**12.** The TSA is a distinctive method of measuring the direct economic contributions of tourism consumption to a national economy. It is a macroeconomic policy analysis tool. (UNWTO, 2011).

**13.** cf. Higginbottom (2004).

**14.** UNWTO has 49 African Member States: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cabo Verde, Central African Republic, Chad, Congo, Côte d'Ivoire, Democratic Republic of Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Togo, Tunisia, Uganda, United Republic of Tanzania, Zambia and Zimbabwe, (online), available at: http://www2.unwto.org/members/africa.

**Figure 2.2** Survey participants: Governmental institutions by sub-regions




Governmental institutions, n = 48

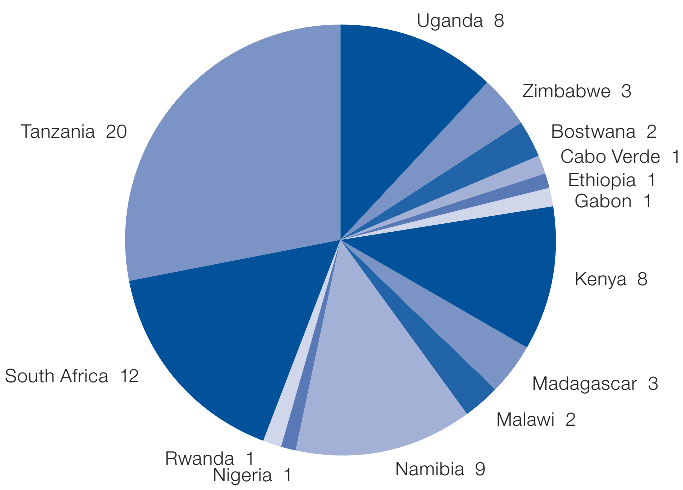
### 2.5.2 Survey participation: tour operators

Fifty-eight tour operator associations from 27 European and American countries and 12 African countries were contacted and requested to forward the survey invitation to their members. 17 responded positively and supported the survey (a list of the supporting tour operator associations can be found in Annex 4). In addition, about 700 individual tour operators from 38 countries were contacted directly and invited to participate in the survey.

A total of 159 tour operators from 34 countries replied to the survey. Tour operators were from Australia, Bangladesh, Botswana, Canada, Cabo Verde, Croatia, Czech Republic, Denmark, Ethiopia, Finland, France, Gabon, Germany, India, Italy, Kenya, Lithuania, Madagascar, Malawi, Namibia, Netherlands, Nigeria, Peru, Portugal, Republic of Korea, Rwanda, South Africa, Spain, Switzerland, Uganda, United Kingdom, United Republic of Tanzania, United States of America and Zimbabwe (a detailed list of the tour operators participating is given in Annex 5). 14 of the international tour operators surveyed do not offer trips to Africa and were therefore excluded from further analysis. The remaining 145 tour operators are from 31 countries; 72 are based in Africa and 73 in Europe, North America, Asia and Oceania.

Among the African tour operators, a majority of the participants are from countries that are well-known wildlife watching destinations such as Tanzania (20 participants),

**Figure 2.3** Survey participants: African tour operators by countries of origin




African tour operators, n = 72

South Africa (12 participants), Namibia (9), Uganda (8) and Kenya (8). Zimbabwe and Madagascar are represented by three participants each, Botswana, Cabo Verde, Ethiopia, Gabon, Malawi, Nigeria and Rwanda by either one or two participating tour operators each.

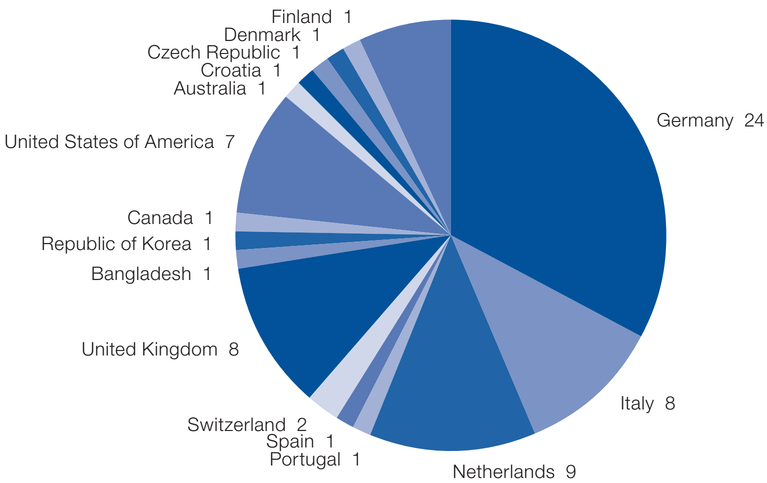
The majority of the participating international tour operators are from Europe (62 out of 73), mainly from Germany (24), The Netherlands (9), Italy (8), United Kingdom (8), France (5) and another four European countries. The high participation of European tour operators is linked to the fact that these are the main source markets for Africa and thus greater emphasis was placed in ensuring participation. Additionally, eight of the tour operators participating are from United States of America and Canada, two from Asia (Bangladesh and Republic of Korea) and one from Australia.

### 2.5.3 Size of participating tour operators

Out of the 145 tour operators that offer trips to Africa who responded, 140 provided information on their size[15]: 51% fall into the category of micro-enterprises having less than 10 employees; 32% are considered small enterprises with 10 to 50 employees; 10% correspond to medium enterprises with 50 to 250 employees, and; 7% are large enterprises with more than 250 employees. In total, 93% of the participating tour operators are considered MSMEs. It should be noted that from the large enterprises, 2 tour operators employ more than 6,000 employees.

15. The classification of enterprises per size used by the European Commission has been followed, (online), available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/special_sbs_topics/small_medium_sized_enterprises_SMEs.

**Figure 2.4** Survey participants: International tour operators by countries of origin




International tour operators, n = 73

# 3. Analysis of the surveys

*The following section presents the analysis of the results of the surveys (the questionnaires can be found in Annex 6).*

## 3.1 Characteristics of wildlife watching tourism

### 3.1.1 Safari is the most practiced type of wildlife watching tourism

Governmental institutions were asked about the type of wildlife watching that can be practiced in their countries through a multiple choice question: a) safari (Big Five and others); b) great apes (chimpanzee, gorillas); c) marine wildlife (including whale watching); d) bird watching; e) special wildlife tracking, and f) others. Additionally, tour operators were asked about the kinds of wildlife watching tours that they offer and the countries in which they operate.

All participating governmental institutions from 31 different countries answered this question. A total of 92% of the respondents mention that bird watching can be practiced in their country; 73% state this for safari; 35% state this for the observation of great apes; 45% state this for marine wildlife watching; 38% state that special wildlife tracking; and 29% state this for other kinds of wildlife watching tours.

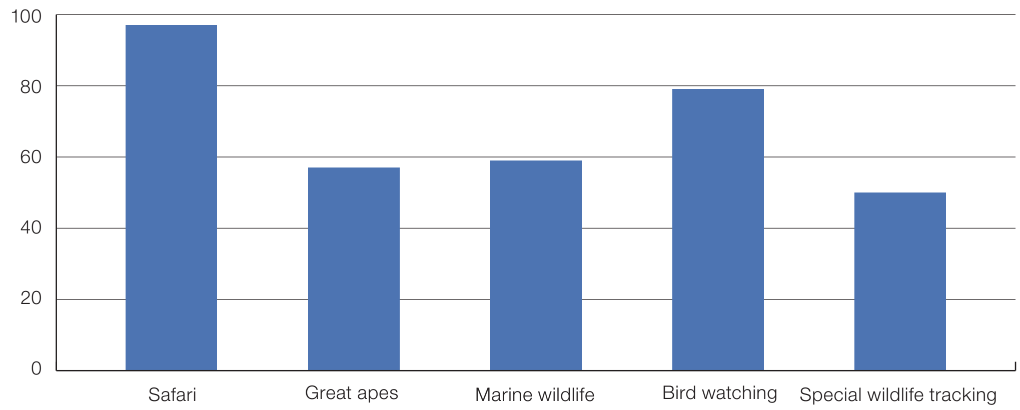
Analyzing the replies from the participating tour operators, bird watching is offered in 71% of African UNWTO Member States, safari tours in 65%; special wildlife watching in 49%; marine wildlife watching in 33%; observation of great apes in 24%; and other kinds of wildlife watching in 61%.

A total of 25 countries were mentioned by both the governmental institutions and tour operators as wildlife watching destinations. When comparing the public and private answers for the same country, it was noted that in a majority of cases (67%) those countries highlighted by the governmental institutions as wildlife watching destinations were also viewed by the tour operators. The biggest discrepancy between the answers of governmental institutions and tour operators related to the practice of bird watching. Bird watching was reported as available by governmental institutions in 92% of their countries, but was only highlighted by tour operators as being practiced in 71% of African countries. This discrepancy could be linked to the fact that although bird watching can be practiced in almost every African country, tour operators might often combine it with other activities rather than offer it as a specialized product and therefore the number of countries in which they view themselves operating is smaller.

The other discrepancy between responses related the percentage of countries that were considered in the replies of governmental institutions as wildlife watching destinations that were not considered as such by tour operators. Upon review, this group of countries fall into two general categories. Firstly, countries where despite the availability of natural resources, tourism is in its initial stages of development and secondly, countries that are specialized in a different type of product, such as beach and sun holidays.

All in all, 96% of the 145 tour operators participating offer safari tours; 56% offer tours focusing on the observation of great apes; 57% offer marine wildlife tours; 80% offer bird watching tours; 48% offer special wildlife tracking tours; and 36% other kinds of tours.

**Figure 3.1** Kinds of wildfile watching offered per tour operator (%)




Tour operators, n = 145

The results of the survey show that those countries in which a higher number of tour operators are active, are countries that are already known as wildlife watching destinations. Between 54%-61% of the 145 participating tour operators offer wildlife watching tourism products in each of the following countries: Botswana, Kenya, Namibia, South Africa and Tanzania. Data indicates that the main wildlife watching product are safari tours, offered by 55% of the tour operators, followed by bird watching (offered by 31%) and tours for the observation of marine wildlife, currently offered by 16% (this product is not available in Botswana).

Countries where wildlife watching tours are operated by 22%-50% of the participating tour operators are Madagascar, Malawi, Mozambique, Rwanda, Uganda, Zambia and Zimbabwe. For this second cluster of countries, the main product is also safari, which is being offered by 22% of the tour operators, followed by bird watching (offered by 18%) and tours for the observation of great apes which is offered by 11% (this product is only available in Rwanda and Uganda).

Between 5% and 18% of the tour operators offer wildlife watching tourism products in Congo, Ethiopia, Lesotho, Mauritius, Morocco, Senegal, Seychelles and Swaziland. Nineteen more countries are mentioned as wildlife watching destinations. This leaves out only 10 of the 49 UNWTO Member States in Africa without being mentioned as destinations for wildlife observation for the participating tour operators. However, it is important to note that this last group includes post-conflict countries and countries with very limited tourism development.

### 3.1.2 Locating wildlife watching tourism

When answering the question "does wildlife watching in your country/during your tours take place in protected areas?" a total of 96% of the participating governmental institutions and tour operators replied positively. Additionally, when listing the top five destinations for wildlife watching in their respective country, governmental institutions refer almost exclusively to protected areas. Some tour operators mention that wildlife watching tourism also takes place on private and communal lands, but to a much lesser extent.

From a sub-regional perspective, it is interesting to note that most of the activities of the 145 participating tour operators are taking place in East Africa (90% of the tour operators operate in the sub-region) and Southern Africa (66% of the tour operators operate in the sub-region[1]). In both sub-regions, the main products offered are safari followed by bird watching. The third most popular products are the observation of the Great Apes in East Africa and marine wildlife watching for Southern Africa. These two sub-regions also obtained the highest number of replies from their respective governmental institutions when they were asked to highlight the resources available in their countries (80% and 73% respectively); a correlation which could reflect the efforts of both the regions to create an enabling framework for the development of wildlife watching tourism.

West and Central African governmental institutions were asked if wildlife watching tourism takes place in their respective country, of which the replies were 73% and 44% respectively. However, as tour operators confirm this only with 14% and 19% respectively for the sub-regions, these figures can suggest rather the commitment of governmental institutions from West and Central Africa to opt for and develop wildlife watching tourism, which has not yet made it into the distribution channels.

In the Northern African sub-region no governmental institutions and only 2% of the tour operators mentioned wildlife watching tourism as a product on offer. This coincides with the fact that Northern African destinations are traditionally placing greater efforts in the development of other tourism products such as beach and sun as well as cultural tourism.

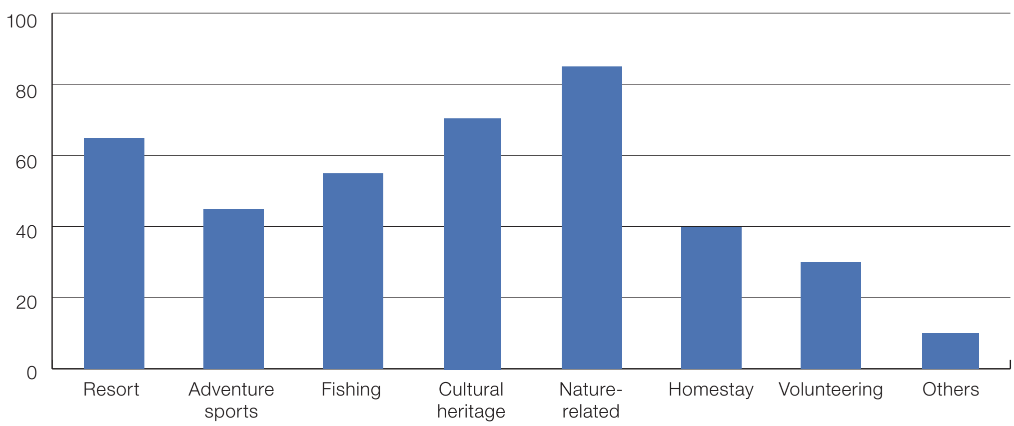
### 3.1.3 Wildlife watching takes place in combination with other tourism activities

National tourism authorities[2] were asked about the opportunities to combine wildlife watching with other activities in their countries as well as about the types of activities that are normally combined with wildlife watching through a multiple choice question including the following options: a) Resort; b) Adventure sports; c) Fishing; d) Cultural heritage; e) Nature-related activities; f) Homestay; g) Volunteering; h) Others. Additionally, tour operators were asked about the additional activities that are included in their wildlife tours.

A total of 23 governmental replies were received for this question out of which 90% indicate that wildlife watching tourism is indeed being combined with other activities. Most commonly wildlife watching is combined with nature-related activities (85%), followed by cultural heritage (70%) and resort/beach holidays (65%). Fishing, adventure sports such as dune surfing or kayaking. Homestay and volunteering are less frequently mentioned as activities typically combined with wildlife watching tours.

For the 145 participating tour operators, the most important additional activities included in their tours are cultural visits (history, architecture, tribal and village culture, wine tasting, city tours etc.), other nature-related and adventure/sports activities (including mountaineering, hiking, trekking, 4x4 drives, mountain biking, golf, scuba diving, snorkelling, kayaking, canoeing, white water rafting, etc.).

**Figure 3.2** Activities combined with wildlife watching tours (%)




Governmental institutions, n = 23

# Case Studies (1)

## Bird watching in South Africa

In 1997, a quantitative study on avitourism to South Africa conservatively estimated that the country received between 11,400 and 21,200 birdwatchers per year which contributed US$ 12 to 26 million to the South African economy (Turpie & Ryan, 1998; cited after Biggs et al., 2011). South Africa is a well-known bird watching destination with a diversity of bird habitats and a high number of endemic species. Since 1997, there has been a significant increase in bird watching tourism in South Africa, reflected in the increasing number of tour operators specializing in birding and the number of bird watching tourism products being offered. The market has undergone considerable growth and the number of bird watching tourists and revenues generated by this market segment have only continued to increase to date. The development of birding tourism has been promoted by community projects supported by NGOs from the tourism sector. Currently, there are more opportunities for small business development along birding routes, which contributes to the creation of jobs for local communities (e.g., local birding guides) and supports conservation. (Biggs et al., 2011).

1. UNWTO African sub-regions are: Central Africa (Angola, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of Congo, Equatorial Guinea, Gabon and São Tome and Principe); East Africa (Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Tanzania, Uganda, Zambia and Zimbabwe); Northern Africa (Algeria, Morocco, Sudan and Tunisia); Southern Africa (Botswana, Lesotho, Namibia, South Africa and Swaziland); and West Africa (Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo).
2. The question was only addressed to the tourism authorities and not included in questionnaire of the conservation agencies.

## Mountain Gorillas in Uganda

In the Bwindi Forest National Park in Uganda, mountain gorilla families that are accustomed to humans can be visited by small tourist groups for one hour with a special guide. The permit to visit a gorilla family costs between US$ 500 and 700 per person. The visits to a single gorilla family that attracts an average of 10 tourists in a day generates between US$ 5,000 and 7,500 per day. Over a year's time, visits to this same family can generate up to about US$ 500,000 per year (visits are not made every day).The total income of gorilla visits in the Bwindi Forest National Park is about US$ 15 million per year. Additionally, a similar amount is spent by the tourists on accommodation, transport and other services. (Lengefeld, 2013).

## Kichwa Tembo Masai Mara Tented Camp, Kenya

The tented camp Kichwa Tembo Masai Mara is located on the Masai Mara Nature Reserve in the remote western Mara in Kenya's southwest. The main attractions are the year-round concentration of wildlife and the camp's location on the route of the Great Migration. As it is a private concession land, bush walks and night drives are allowed. The tented camp offers considerable luxury for a maximum of 80 guests. The camp has about 200 employees, 70% of whom are locals from the Masai Mara region. An average of 60% of the fruits, vegetables and other farm products that are consumed are obtained from local suppliers. The camp also supports local schools, reforestation, environmental education, health, and anti-AIDS programmes. The camp generates total annual revenues of US$ 8 to 10 million, of which US$ 1.5 million is paid directly to local communities for the lease fee, salaries and purchases of local products. (Lengefeld, 2013).

## Marine turtle observation

In 2004, a WWF study analyzed the non-consumptive use of marine turtles for observation in 13 locations in the tropics and subtropics of Africa, Asia, Latin America and the Caribbean. In nine of these locations, this activity is considered a major revenue generator while in the other four locations is only one of many attractions. The gross-revenue attributed to marine turtle observations was calculated by multiplying the average tourist expenditure by the number of tourists that participated in this activity. The analysis included all expenditures (food, accommodation, souvenirs, transport and others) made by tourists during their stay at the turtle-watching site. The costs of turtle observation tours were relatively low as little transport and no special equipment were needed. On the other hand, tourists needed to travel to remote beaches and the excursions were undertaken mainly at night, which generates higher travel costs.

At the nine locations where marine turtles were the major attraction, the study showed revenues generated from US$ 41,000 to US$ 6.7 million per site per year, with an average of US$ 1.7 million per year at a single site. The sites employed anywhere from 30 to 1,280 tour guides, and the hostel/resort owners and their employees received direct economic benefits from the turtle-watching tourism. At the four destinations where turtles are only one of many attractions, the revenue from turtle observation ranged from US$ 3,000 to US$ 106,000 per year with an average of US$ 41,000 per year. (Troëng/Drews, 2004).

## 3.2 Importance of wildlife watching tourism and its main beneficiaries

### 3.2.1 Nature, national parks and wildlife are among the most important assets for wildlife watching destinations

To better understand the perceived importance of wildlife watching tourism in the African countries surveyed, the national tourism authorities were asked both “how important is wildlife for tourism in your country?” and “is wildlife watching tourism a valuable source of income for your country?” In response, a total of 24 replies were received, out of which 79% state that wildlife watching tourism is “very important” for their countries; 17% state that it is “important” for their countries. 79% found that wildlife watching is a valuable source of income.

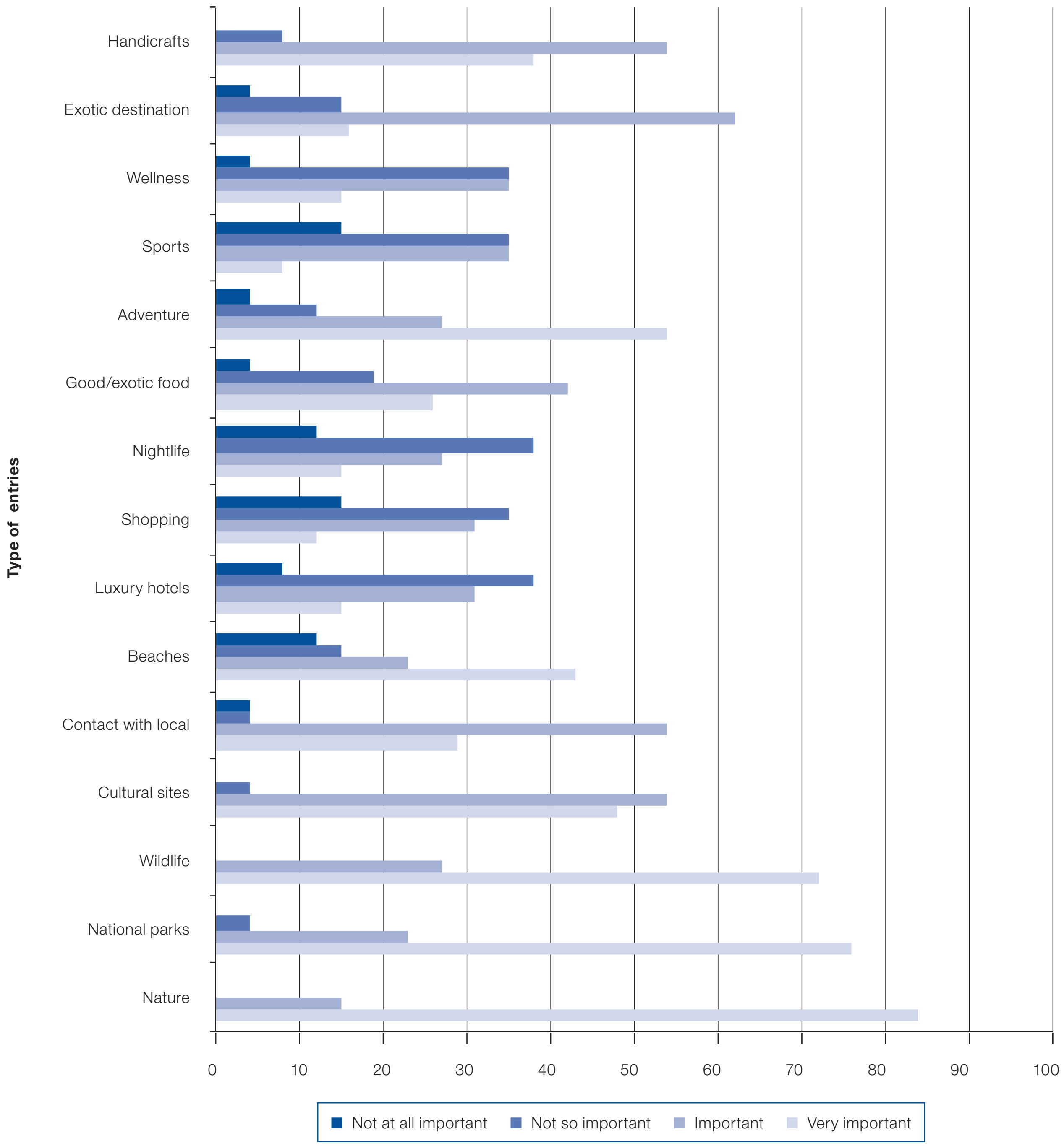
National tourism authorities[3] and tour operators were also asked to highlight the degree of importance for the visitor/customer of the following items: a) Nature; b) National Parks; c) Wildlife; d) Cultural sites; e) Contact with local community; f) Beaches; g) Luxury hotels; h) Shopping; i) Nightlife; j) Good/exotic food; k) Adventure; l) Sports; m) Wellness; n) Exotic destination; o) Handicrafts.

The 25 governmental replies received reveal that nature, national parks, wildlife, adventure and cultural sites are among the most important assets for the visitors to their countries (rated as “very important” by 84%, 76%, 72%, 54% and 48% of respondents, respectively). Also “important” but to a lesser extent, are beaches (43%), handicrafts (38%), good/exotic food (26%), the contact with local communities (29%). Exotic destinations, shopping, nightlife, wellness and sports are not so important for the tourists from the perspective of the governmental institutions. One participant also mentioned in the comments section that security is an important issue for tourists.

Tour operators were asked the same questions. The 145 replies received from tour operators show that 95% of the respondents evaluate wildlife, nature and national parks as “very important” for their customers (rated 95%, 92% and 87% respectively). Culture, contact with local communities, adventure, exotic destinations, good/exotic food and exotic destinations get high rankings as well (36%, 31%, 31%, 27% and 25% respectively). Beaches, luxury hotels and handicrafts range in the middle, while the majority evaluates shopping, wellness, sports and nightlife as “not so important” or “not at all important”.

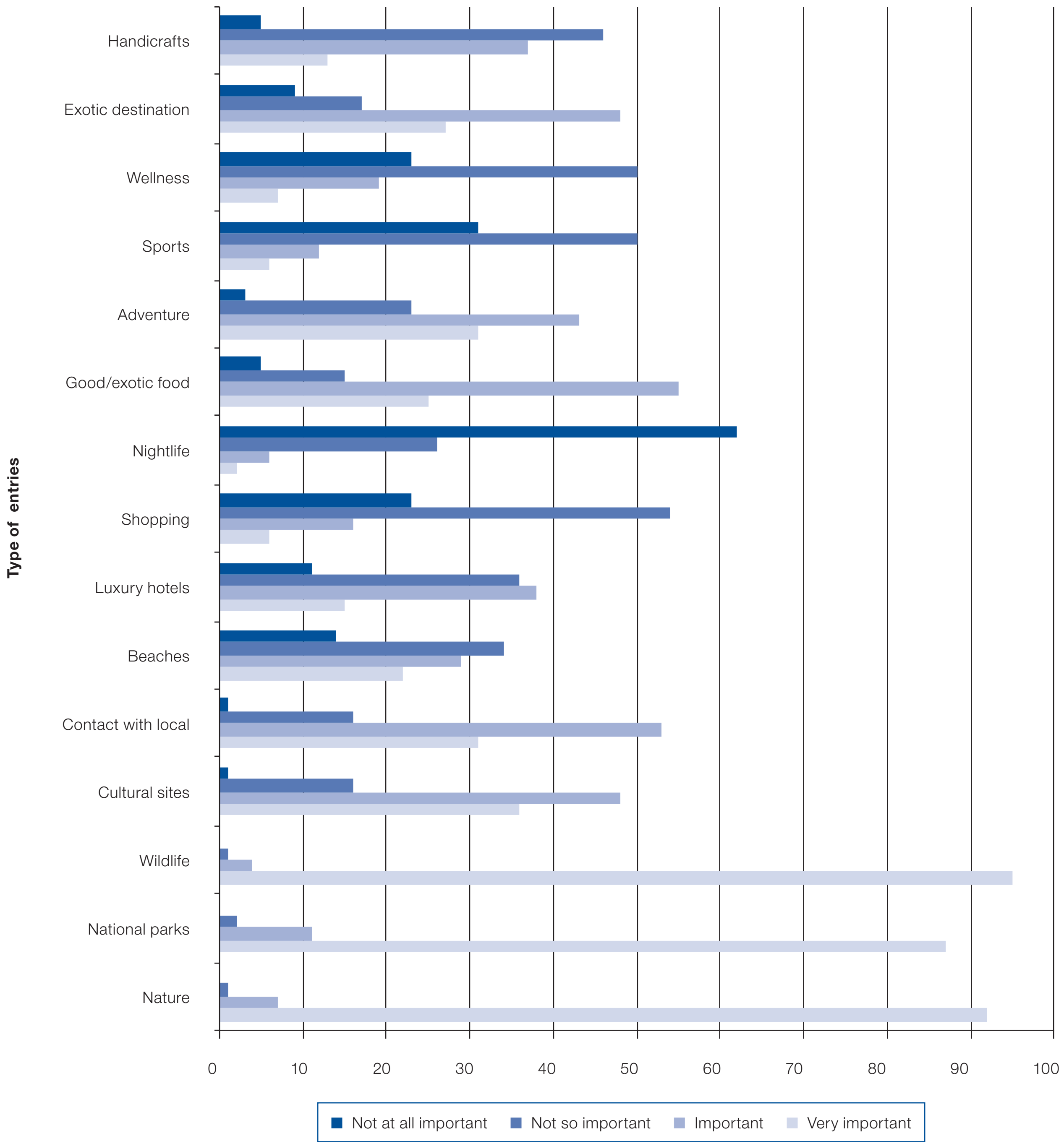
3. The question was only addressed to the tourism authorities and not included in questionnaire of the conservation agencies.

**Figure 3.3** Importance of tourism assets for visitors (%)




Governmental institutions, n = 25

**Figure 3.4** Importance of tourism assets for customers (%)




Tour operators, n = 145

### 3.2.2 Wildlife watching tourism benefits a wide range of stakeholders, especially national parks, local tourism providers and the local community

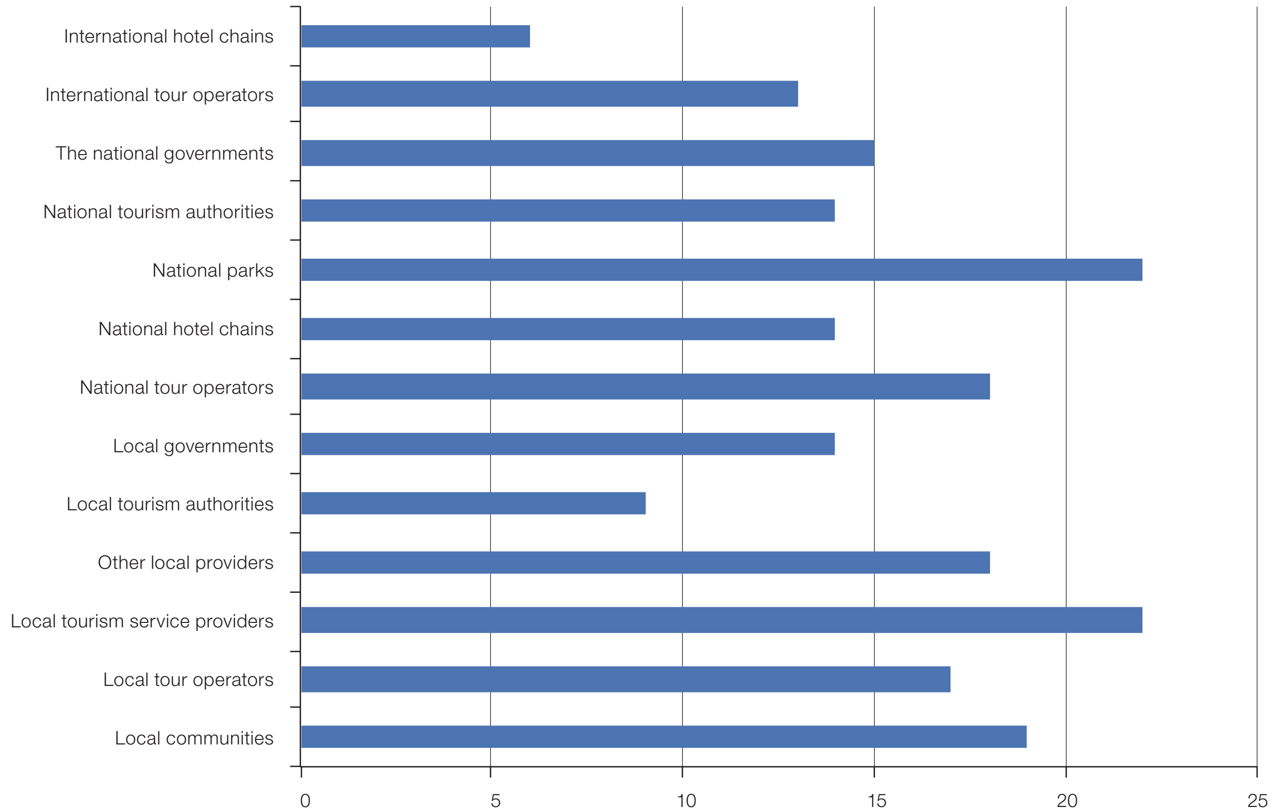
National tourism authorities[4] were asked about who benefits from wildlife watching tourism through a multiple choice question, which gave the following options: a) Local communities; b) Local tour operators; c) Local tourism service providers; d) Other local providers; e) Local tourism authorities; f) Local governments; g) National tour operators; h) National hotel chains; i) National Parks; j) National tourism authorities; k) National governments; l) International tour operators; m) International hotel chains.

The 26 governmental institutions that responded indicated that there is a wide range of beneficiaries from wildlife watching tourism in their countries (the majority selected an average of eight different beneficiary categories from the 13 options proposed). National parks and local tourism providers are mentioned most frequently as beneficiaries (both by 85% of respondents), but also local communities (73%), national tour operators (69%) and other local providers (69%). Between 50% and 58% of the participants state that national and local governments, national tourism authorities, international tour operators and national hotel chains benefit as well. Local tourism authorities are mentioned by 35%, and international hotel chains by 23% of the participants.

Governmental institutions were also requested to indicate whether local communities "receive direct and/or indirect benefits" from wildlife watching tourism by selecting among the following replies: a) Supply of food and beverages; b) Supply of cultural goods and services; c) Supply of other goods and services; d) Proportion of national park fees; e) Proportion of taxes/licenses related to tourism.

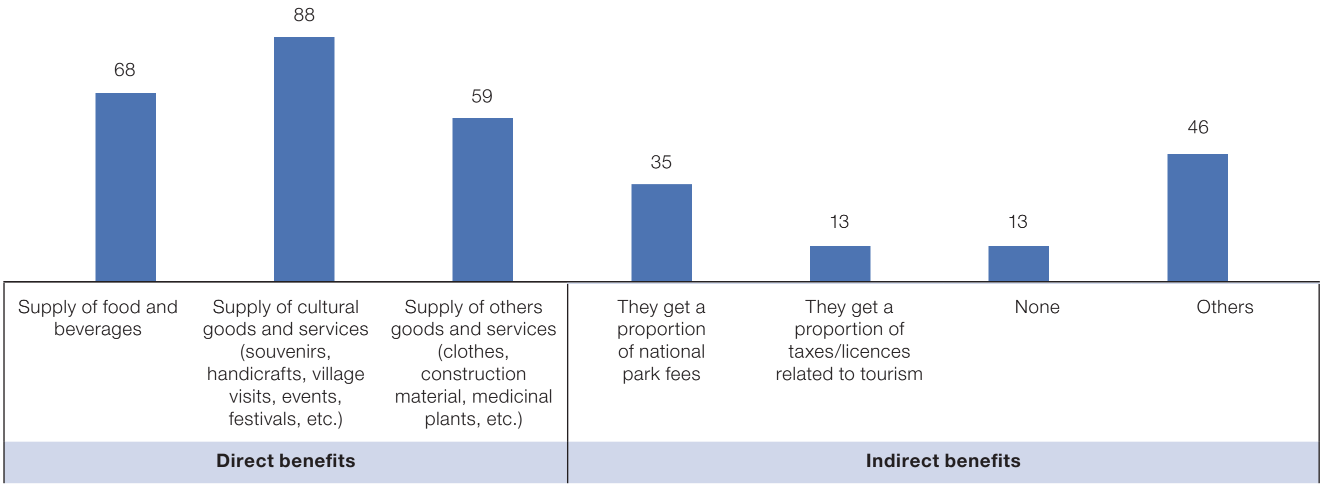
The replies from the majority of the 47 governmental institutions that answered this question indicate that local communities are involved in wildlife watching tourism and obtain direct (72%) and indirect (82%) benefits from it. In most cases, local communities provide different goods and services directly to the tourists, cultural goods and services being the most important ones for the participating governmental institutions (mentioned in 88% of the cases), followed by food and beverages (68%) and other goods and services (59%). With regard to indirect benefits, 35% of the responses from participating governmental institutions

**Figure 3.5** Beneficiaries of wildlife watching tourism (%)




Governmental institutions, n = 26 (cases) Question included only in the questionnaire addressed to Tourism authorities.

**Figure 3.6** Direct and indirect beneficiaries for wildlife watching tourism (%)




reported that communities get a proportion of national park fees; 13% mention the proportion of tourism-related taxes or licenses as an indirect benefit for communities, and; 46% of the replies list other indirect benefits. For instance:

– Community development programmes, e.g., education, health, youth, SME development, ecotourism, alternative livelihoods;

– Establishment of infrastructure like water supply and access roads to parks in remote areas;

– Tourism concessions areas allowing for the establishment of self-employed/SME tourism businesses; and

– Nature conservation.

### 3.2.3 Wildlife watching offers a wide range of employment areas for the local community

Governmental institutions were requested to indicate whether "local communities are employed by tourism service providers that offer wildlife watching tours in your country" and the type of jobs that they are offered through the following multiple choice options: a) Accommodation; b) Restaurants; c) Tour guides; d) Local tour operators; e) Transport; f) Porters; g) Craftsmen; h) Rangers[5]; and i) Others.

A total of 48 governmental institutions replied to this question and 75% of those responses state that members of local communities are employed within the wildlife watching tourism sector. Where the response indicates local community involvement, the most important employment areas are tour guiding (86%), accommodation (83%), restaurants (75%), craftsmen (72%) and rangers (70%). To a lesser extent opportunities for work are provided in transport companies and with local tour operators (61% and 58%). Porters are mentioned by only a small number of participants (36%) but this may be due to the fact that porters are only required for certain forms of tourism that involve challenging and/or overnight trekking in remote areas, e.g., tracking of primates in dense rainforests. Other forms of employment mentioned by the participants are cultural performances, jobs in accounting, security, outreach and communication.

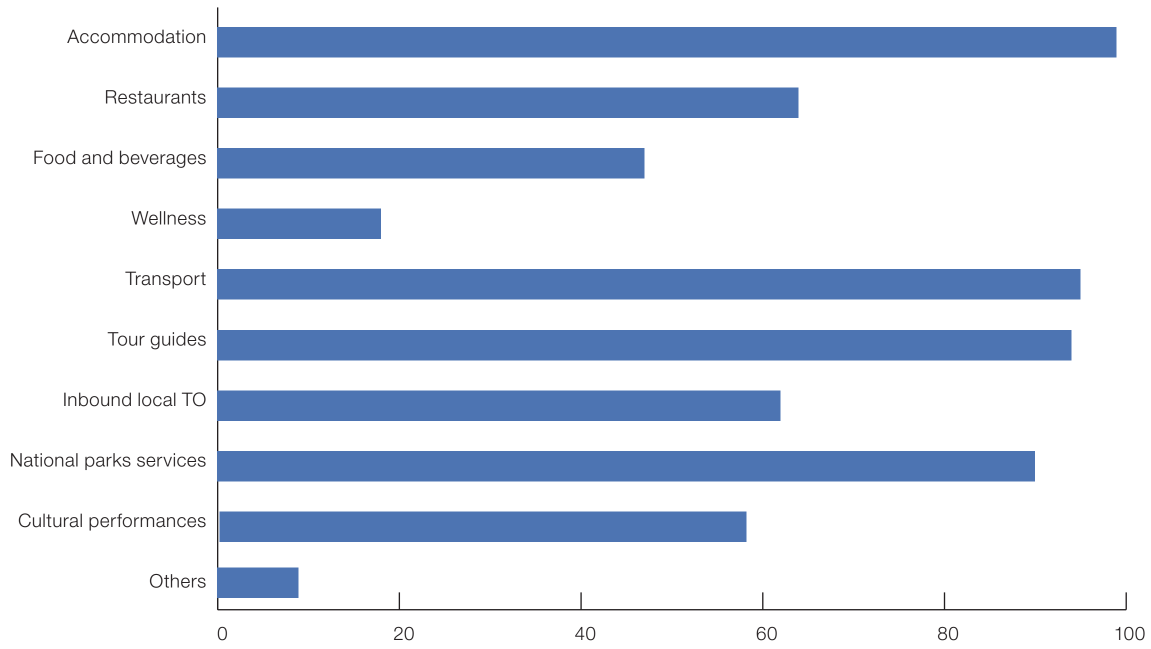
Additionally, tour operators were asked to list the local services that they commonly include in their wildlife watching tours as well as those services that are typically used by their customers but not included in their tours through the following multiple choice answer: a) Accommodation, b) Restaurants; c) Food and beverages; d) Wellness; e) Transport; f) Tour guides; g) Inbound local tour operators; h) National park/ protected area service; i) Cultural performances; j) Others.

The responses from the 145 tour operators that replied to this question mention that their wildlife watching tours commonly include accommodation (99%), transport (95%), tour guides (94%) and national park services (90%). Restaurants (64%), local tour operators (62%), cultural performances (58%) and food and beverages (47%) are included to a lesser extent. Wellness services (e.g., beauty treatments, massages) and other services are not commonly included in the tours. Among the other services listed by the participants are sports and adventure activities, meet and greet services, special wildlife permits, luggage service, souvenirs, motorcycle rent and trophy fees.

4. The question was only addressed to the tourism authorities and not included in questionnaire of the conservation agencies.

5. Only the national and local protected area and wildlife conservation agencies questionnaire included "Rangers" among the multiple choice answers and not the national tourism authorities' questionnaire. 23 governmental institutions answered this question.

**Figure 3.7** Local services included in wildlife watching tour packages (%)




Tour operators, n = 145

On the other hand, with regards to the services that their customers typically use in addition to their tour package, all the listed services are mentioned by fewer participants. This could imply that local services are booked through the tour operators rather than purchased by the tourists on-site. Cultural performances/ souvenirs (66%), wellness (63%) and food and beverages (47%) get the highest numbers, followed by restaurants (33%), local tour operators (13%) and national park services (12%). Other services typically used by customers of the participating tour operators but not included in the packages are sports and adventure activities, education, homestay, tips, porter fees and laundry.

## 3.3 Economic dimension of wildlife watching tourism

### 3.3.1 Efforts are ongoing in protected areas to monitor wildlife watching tourists, but results are not yet consistent

All governmental institutions were requested to indicate whether they monitor the numbers of wildlife watching tourists through any or all of the following multiple choice options: a) Entrance tickets; b) Official registration forms; c) Surveys; d) Tourist information point; e) Others.

A total of 47 governmental institutions provided an answer and 81% report that numbers of wildlife watching tourists are monitored, in all cases by official registration, entrance tickets sold for protected areas, monitoring tourist information points or similar records. Nevertheless, only six of the national level governmental institutions entered information on the results of these activities and further research would need to be undertaken to ensure their comparability.

Additionally, national and local protected area and wildlife conservation agencies were asked the question “do tourists visit your national park mainly for wildlife watching or do they come for other activities?” offering the following multiple choice options: a) 100% of visitors come to observe wildlife; b) Visitors come to observe wildlife and for other nature-related activities; c) Visitors come mainly for other nature-related activities.

A total of 24 national and local wildlife and conservation agencies provided an answer that 38% reporting that 100% of the visitors to protected areas come to observe wildlife; 54% visitors come to observe wildlife and for other nature-related activities, and 8% visitors come mainly for other nature-related activities.

In the absence of regular statistical records of the number of wildlife watching tourists, the number of protected area visitors and receipts is valuable information for the evaluation of the importance of wildlife watching tourism for a country or a destination and therefore the questionnaires addressed to governmental institutions included detailed questions in this regard.

Governmental institutions from 14 countries entered data on the number of protected area visitors and receipts. Based on the results, three groups of countries can be distinguished according to their visitor numbers:

1. Countries with a major number of visitors in protected areas: between 2 and 5 million visitors per year. It is estimated that these countries have receipts up to US$ 90 million. (Kenya, South Africa).

2. Countries with a medium number of visitors in protected areas: between 100,000 and over 500,000 visitors per year. It is estimated that they have receipts between US$ 2 and 15 million. (Ethiopia, Lesotho, Swaziland, Tanzania, Uganda and Zimbabwe).

3. Countries with a limited number of visitors in protected areas: between 1,000 and 90,000 visitors per year. It is estimated that they have receipts between US$ 20,000 and 700,000 per year. (Burkina Faso, Chad, Cote d'Ivoire, Democratic Republic of Congo, Ghana, Niger).

According to the survey replies, protected area receipts from the 14 above-mentioned countries would total US$ 142 million per year. When using the total number of visitors in combination with the average entry fees provided for the same calculation, the total protected area receipts for the same countries would add up to US$ 168 million per year.

It should be noted that the replies related to protected area visitors and receipts of protected areas are spread over a very large range. This could be linked to the different circumstances of the participating countries. Nevertheless, further research would be required to validate and complement these data and therefore, only estimations are being presented.

### 3.3.2 Wildlife watching represents 80% of the total annual sales of trips to Africa and sales are increasing

The tour operators were asked to describe their business performance to provide information about the following items: a) the number of tours sold that includes wildlife watching; b) the number of customers on tours that include wildlife watching; c) the percentage of their product portfolio that wildlife watching tours represent; d) their annual sales, and; e) the sales trends.

From the participating 145 tour operators, depending on the question, between 105 and 123 entered data related to the number of tours, customers and percentage of their product portfolio that wildlife watching represents. In total, the tour operators participating represented more than 26,500 tours per year[6], with the biggest seller selling 3,000 and the smaller seller selling 1 tour per year. The average tours sold is 181 tours per year per tour operator. However, this figure is not representative for the whole sample of respondents due to the difference in sizes of the tour operating companies (83% of the respondents are MSMEs) and therefore, the data has been split depending on the size of the tour operator in the table below.

| | Micro | Small | Medium | Large |
|---|---|---|---|---|
| Tours sold including wildlife[7] | 4,076 | 9,656 | 7,337 | 4,323 |
| Share of wildlife tours out of all tours sold with Africa as a destination | 76% | 70% | 72% | 66% |
| Number of tour operators replying | 57 | 43 | 11 | 6 |
| Average number of tours sold annually per operator | 72 | 225 | 667 | 721 |

Participating tour operators sold tours to more than 144,000 customers per year. The range started as low as 2 customers and reached 13,500 customers per year per tour operator, with an average of 1,203 customers per year per tour operator. In the following, data is provided related to the size of the tour operating companies (82% of the respondents are MSMEs).

6. Replies totalled in 26,783 tours.

7. In order to calculate the breakdown of tours per size of tour operator, only the entries from tour operators which had provided information on their size was used.

| | Micro | Small | Medium | Large |
|---|---|---|---|---|
| Customers booking wildlife[8] | 17,167 | 50,621 | 44,135 | 25,236 |
| Share of wildlife tours out of all tours sold with Africa as a destination | 78% | 77% | 65% | 62% |
| Number of tour operators replying | 57 | 40 | 12 | 5 |
| Average customers annually per operator | 301 | 1,266 | 3,678 | 5,047 |

All in all, wildlife watching represents a high percentage of the participating tour operators' product portfolio (73%) and clients (75%).

A total of 83 tour operators provided data on annual sales from wildlife watching tours, which totaled US$ 263 million. When analyzing the annual revenue from wildlife watching tours by tour operator size, it was discovered that out of the sample, 52% are micro enterprises which have annual sales of US$ 47 million in total (average per company is US$ 1 million); 31% of the sample is comprised of small enterprises which have annual total sales of US$ 92 million (average per company is US$ 3.5 million); 12% of the sample is composed of medium enterprises with annual sales of US$ 48 million (average per company is US$ 5 million), and; 5% of the sample is represented by large enterprise with annual sales adding up to US$ 70 million (average per company is US$ 17.5 million).

In total, wildlife watching tours represent 88% of the total annual revenues of trips to Africa for the participating tour operators. Interestingly, 20% of the participating tour operators sell only wildlife watching tours.

The majority (60%) of the 140 participating tour operator respondents state that the sales of wildlife watching tours have been increasing over the last five years. Another 24% find the situation stable and only 16% experienced a decrease in the wildlife watching tours sold in the same period. Some of the participants state that the reasons for decreased demand most probably link to the financial crisis and recession in North America and Europe. However, security issues, poaching and negative media coverage are also mentioned as factors influencing the decrease of arrivals.

### 3.3.3 The average price per person per day of a standard wildlife watching tour is US$ 243 and US$ 753 for a luxury wildlife watching tour

Tour operators were also asked to elaborate on the following key economic indicators: a) average size of groups; b) average length of stay; c) average tour price per day (excluding flights), and; d) average additional out-of-pocket spending per day.

Replies provided by the tour operators have been analyzed by splitting them into the two main segments, i.e. standard tours and luxury tours. This segmentation was done based on data provided and validated with each operator. Key economic indicators were provided by 114 to 128 tour operators. 128 tour operators replied to the second round of consultations which intended to confirm some initial results.

Out of the 128 tour operators that participated in the second round of consultations, 42% are specialized in the "standard" segment while 28% are specialized in the "luxury" segment. Another 30% positioned themselves in both segments targeting customers from the "standard" and the "luxury" markets.

The data of the survey suggests that the average number of participants in a wildlife watching tour is 6 persons, though the number of participants can range from 1 to 30 persons. In the "standard" market segment the average number of participants per tour is 7 and can range from 2 to 30 persons. In the "luxury" market segment the average number of participants per tour is 5 and ranges from 1 to 24.

The average length of stay for a typical wildlife watching tour from the overall sample (128 tour operators) is 10 days. In the "standard" market segment the average length of stay is 11 days; the range starts at half a day and reaches up to 42 days. In the "luxury" market segment the average length ranges from a day and half to 18 days.

The average daily price (excluding flights) for a wildlife watching tour from the overall sample (128 tour operators) is US$ 433. In the “standard” market segment the average price per day for a wildlife watching tour is US$ 243 and ranges from US$ 86 to 500 per day. In the “luxury” market segment the average price per day of a wildlife watching tour is US$ 753 and ranges from US$ 179 to 2,500 per day.

As the average number of participants and the average length of stay for both the luxury and standard segments are very similar, it can be concluded that they are intrinsic characteristics to the wildlife watching product that do not necessarily relate to the level of comfort of the experience. The indicator that clearly differentiates the segments is the average daily price, and this clearly works to identify which market the tour operators are targeting. It is important to note that within the African region the prices for both the “standard” and the “luxury” segments vary in each country depending on the level of tourism development of the destination and the size of the market offer.

Based on the overall responses, the average daily additional out-of-pocket spending from the full sample (128 tour operators) is US$ 55. In the “standard” market segment the average the reported additional spending per day is US$ 44, with additional spending ranging from US$ 7 to 250 per day. In the “luxury” market segment the average additional spending per day is US$ 59 with a range of US$ 1 to US$ 104.

**The typical wildlife watching tour**

Average number of participants:

**6**

Average length of stay:

**10 days**

Average tour price per day:

**US$ 433 per person**

Average out-of-pocket spending per day:

**US$ 55 per person**

8. In order to calculate the breakdown of customers per size of tour operator, only the entries from tour operators which had provided information on their size could be used.

# Case Studies (2)

## Serengeti-Ngorongoro Circuit, Tanzania

According to a study conducted in 2009, the southern circuit at Serengeti-Ngorongoro receives 300,000 tourists per year on the 300 km stretch between Arusha and Serengeti. The total inbound tourism expenditure generated at this destination is US$ 500 million per year, which is more than half of Tanzania's foreign exchange earnings from tourism. The price of a typical wildlife watching package is US$ 1,600 for 6 days/ 5 nights (US$ 320 per day). Additionally, tourists spend an average US$ 226 out-of-pocket (US$ 37/day).

Among the local tourism providers that benefit from this income are tour operators and providers of accommodation, parking, transport, cultural goods and services as well as food and beverages. Along the safari circuit there are about 3,500 crafts and souvenir stalls that employ 7,000 sellers and 21,000 crafters. About US$100 million per year (19% of the earnings) are considered pro-poor, meaning that they reach local people via wages and tips when they are employed by tourism providers. Furthermore, local small producers provide about half of the food consumed at the circuit. The local population obtains indirect benefits from tourism through funds allocated by the protected area management to the communities.

Together with the second part on Kilimanjaro tourism, the 2009 study reveals that Tanzania captures about half of the total value of the global value chain for a package holiday sold in Europe. The great majority of the inbound tour operators and tourism providers are owned by Tanzanians. Foreign companies are not common but pay significantly higher wages than local companies. The benefits of tourism at Serengeti-Ngorongoro could be enhanced by establishing better linkages between accommodations and local food producers as well as capacity building to foster local employment in the tourism sector and to increase the margins of the craft sector. (Steck/ODI, 2009).

## Economic impact of nature tourism in Zambia

In Zambia, tourism is one of the fouressential sectors identified for sustainable development. Yet, the economic impact of nature tourism has been underestimated. In 2005, tourism was characterized by a small and fragmented private sector, inconsistent policies, weak incentive structures, poor business climate, limited fiscal support of the tourism sector and lacking financial resources of the Zambia Wildlife Authority and the Ministry of Tourism. Even under such unfavourable circumstances, a World Bank study showed that the economic impact of nature tourism is significantly higher than previously perceived.

In 2005, only 26% of international tourist arrivals were nature-tourists, but these 176,000 visitors realized an export value of tourist spending of US$ 194 million which is 3.1% of the direct GDP. Summing up direct and indirect linkages, the 176,000 nature tourists contributed nearly 16% of Zambian exports and 6.5% of the GDP, more than 6% of wages and net income of unincorporated business, 7% of government revenues and nearly 10% of formal sector employment (54,000 formal jobs). The fiscal revenues generated in 2005 by international nature tourists visiting national parks were about US$ 5 to US$ 8 million, meaning that the revenues exceeded by far the US$ 1 million in funds allocated to the Zambia Wildlife Authority in the same year.

In 2007, approximately 206,000 international tourists (30% of overall international tourist arrivals) came to Zambia to experience Victoria Falls, wildlife and nature-based activities. Considering the many challenges the tourism sector in Zambia was facing in 2005, the opportunities for developing nature and wildlife tourism and enhancing the benefits of tourism are growing. Tourism, and specifically nature and wildlife tourism, can be an important source of revenues and employment if appropriate revenue-sharing mechanisms are put in place to enhance the benefits for local communities and pro-poor impacts of tourism. (Hamilton et al., 2007).

## 3.4 Effects of poaching on tourism

### 3.4.1 Nature conservation and wildlife are managed but with many shortcomings

Governmental institutions and tour operators were requested to evaluate nature conservation and wildlife management in their countries or the countries in which they operate through a multiple choice answer: a) Very well managed; b) Well managed; c) Managed but there are many shortcomings; d) Poorly managed or not at all.

Of the 23 governmental institutions that answered this question, 57% of the responses indicate that nature conservation and wildlife are "managed but with many shortcomings", 26% state "well managed", 17% reply "very well managed". "Poorly managed or not at all" was not mentioned in the replies.

Of the 144 tour operators that answered this question, 51% state that nature conservation and wildlife are "managed but with many shortcomings", 31% reply "well managed, 13% state "very well managed", while 5% reply with "poorly or not at all".

The quite similar assessment indicates that nature conservation and wildlife are equally important from a conservation but also tourism sector perspective. In their replies, many tour operators singled out poaching as the biggest threat to wildlife.

### 3.4.2 Poaching has a negative impact on the tourism experience

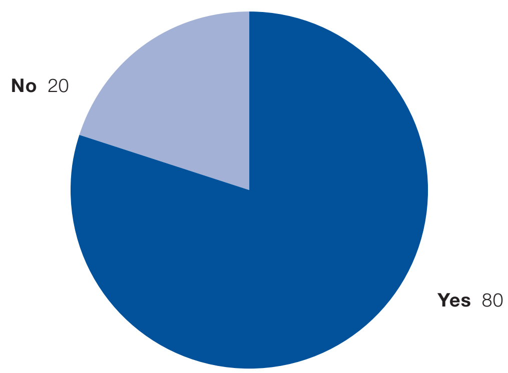
Governmental institutions were requested to indicate whether there are problems with poaching in their respective countries and which animals are being poached among the following: a) terrestrial mammals; b) marine wildlife; c) birds; d) others. Additionally, both governmental institutions and tour operators answered the question "Do you consider poaching as an issue that affects wildlife watching tourism?" and tour operators were requested to indicate the "difficulties encountered during tours because of poaching activities".

Out of the 46 governmental institutions that replied to the first question, 93% confirm that there are problems with poaching in their countries or in their protected areas. The majority of the governmental institutions state that terrestrial mammals are the most commonly poached (70%). Marine wildlife and birds are threatened to a much lesser extent (indicated by 25% and 30% of the participants respectively). Other species were mentioned by 5% of the governmental institutions that replied.

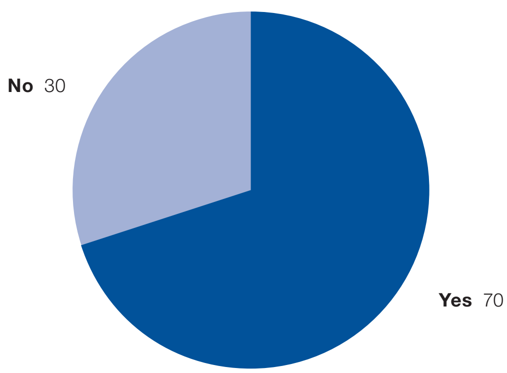
Additionally, out of the 46 governmental institutions and the 145 tour operators that replied to these questions, 80% of the governmental institutions and 70% of the tour operators state that it is affecting wildlife watching tourism. The following explanations were provided:

**Figure 3.8** Does poaching affect wildlife watching tourism? (%)

Government institutions respond:




Tour operators respond:




Government institution respondents, n = 46

Tour operators respondents, n = 145

– Poaching decreases wildlife populations and adversely affects ecosystems;

– Poaching has a deteriorating effect on the tourism experience: reduced wildlife populations and changes in animal behaviour diminish the chance to observe wildlife. Animals become shyer and are harder to find and approach;

– Bad sightings occur (carcasses, rhinos without horns, marked animals, slaughtered and living animals on sale) that significantly affect the tourism experience;

– Poaching threatens security. Shootings in the parks, no-go areas, warning signs, encounters with poachers and armed anti-poaching patrols make tourists feel unsafe or are put in actual danger;

– It creates a bad image of a country or a destination and therefore fewer tourists visit the places affected by poaching;

– Anti-poaching measures are a big financial burden for the protected areas and countries in general; and

– Poaching results in lower numbers of tourists, reduces tourism receipts and affects the long-term sustainability of tourism.

While a majority of the tour operators state that tourism is affected by poaching, only 26% of the participants report direct impacts on their operations, e.g., additional costs for extra security measures, the necessity to change itineraries because of blocked roads or closed areas and a negative impact on the tourists' satisfaction as wildlife observation is less guaranteed and bad sightings as described above occur.

### 3.4.3 Tour operators can play an important role in raising awareness of the issue and (co-) funding anti-poaching initiatives

Governmental institutions and tour operators were requested to indicate whether they "are involved or fund anti-poaching activities" and/or "distribute specific information on poaching". Additionally, tour operators were asked whether their "customers are concerned with poaching".

A total of 47 governmental institutions provided responses with 77% indicating that they are involved with anti-poaching measures. For instance: patrolling and law enforcement (prosecution), awareness raising campaigns, environmental education and working with communities are important anti-poaching measures. Other actions are gaining the support of other authorities, participating in policy making at regional and international levels and the gathering intelligence and research on poaching. Many participants indicate a variety of measures or state that there is a broad anti-poaching strategy in place.

The 26% of governmental institutions that replied that are not engaging in such measures are in most cases tourism ministries or national tourism authorities that are not responsible for wildlife conservation. Otherwise, all but one protected area/wildlife conservation authority state that they engage in anti-poaching activities.

Of the 145 tour operators that replied, 49% state that they fund anti-poaching initiatives; 51% do not engage in such measures; 34% of the tour operators know that their suppliers are involved in anti-poaching support; 58% are not aware of such initiatives and 8% indicate that their suppliers do not fund anti-poaching.

A total of 45 governmental institutions mentioned that 42% do not distribute information on poaching, however, 22% state that this is planned for the future. Looking at the different types of institutions, the answers are the same: a third of the tourism ministries and a third of the protected area/wildlife conservation authorities distribute information on poaching to visitors and/or the general public, more than half of them do not distribute such information or are only currently developing it.

Of the 145 tour operators that replied, the majority (58%) does not distribute information on poaching. 23% say they use a variety of media and measures to inform their clients (websites, flyers, travel information, newsletters, press releases, give-aways, brochures etc.). In many cases, the tour guides inform the tourists about the topic. Sometimes tourists visit an education center that informs them about poaching. Some tour operators distribute information materials developed by nature conservation NGOs. About 40 NGOs, institutions and anti-poaching projects and other organizations are mentioned in the responses to the survey.

32% of 145 participants state that their customers actively ask about poaching, another 51% say that the customers express their concern when the topic comes up – depending on the tour operator, this was found to happen very often (70%) or occasionally (30%). Only 16% report not experiencing concerns of the tourists regarding the topic.

The extensive comments of the participating tour operators reveal their deep concern with the topic of poaching (see box below).

**Tour operators' comments (selection)**

"Africa without wildlife would deprive all TO the basis of their existence. Semi-captive settings are no solution, wildlife needs to be at free range in big game parks."

*(Germany, translated from German)*

"Wildlife conservation should play a bigger role for the tourism sector and the revenue it generates. (…)"

*(Germany, translated from German)*

"(…) It is terrible that human beings with intelligence can be so barbaric at this day and age. (…) PLEASE DO something to save the rhinos and elephants."

*(South Africa)*

"We are willing to support anti-poaching activities but only if the government gets serious with the whole issue. Without government intervention, it will be a fruitless effort (…)."

*(Tanzania)*

"The increased media coverage about poaching has been a matter for our clients. In many cases, they have seen evidence of poaching (…) with skittish animals, carcasses or areas devoid of game."

*(Tanzania)*

"Great concern with the elevated rhino and elephant poaching activity occurring in Africa, this will ultimately impact the wildlife viewing opportunities as well as devastate the tourism industry."

*(United States of America)*

# 4. Conclusions and recommendations

The review of the literature and case studies reveal that while there are numerous studies, projects and publications analyzing wildlife watching tourism, more is needed in terms of measuring its value. Although the economic value of wildlife watching tourism is usually referred to as important, the reviewed literature focuses mainly on how the economic value could be evaluated and points out that there are no valid data readily available for such analysis. Additionally, an estimation of the overall value of the segment based only on the available case studies of specific destinations are not broadly representative and can be misleading given the different levels of tourism development in Africa. However, although there are ongoing efforts being carried out to monitor data that could be relevant for estimating the economic value of the wildlife watching tourism sector, such as monitoring the number of arrivals and receipts of protected areas, these efforts are often inconsistent and commonly lead to inconclusive analysis.

The main findings of this briefing paper are based on the primary data gathered through the surveys carried out among national tourism authorities, protected area and wildlife conservation authorities, individual protected areas and international and African tour operators. In a majority of cases, the replies of governmental institutions are aligned with the replies of tour operators and in the cases where alignment did not happen, an interesting debate on the links between governmental perception and market presence of destinations was triggered. The representative response to the survey and the correlation of replies from public and private sectors supports most of the findings well.

The results of the survey reflect the serious concern of both governmental institutions and tour operators related to the poaching crisis and its negative impact on tourism. It is clear this criminal activity is viewed as a threat to the long-term sustainability of tourism and potentially jeopardizes the development opportunities linked to the sector. Moreover, the feedback from the participating governmental institutions and tour operators confirm that wildlife watching is a very important segment of tourism for most African countries as well as a profitable one, with potential to benefit the local community. In fact, local communities appear to be involved in wildlife watching tourism in most of African countries, mainly through employment in accommodation, restaurants and guiding. Communities also function as suppliers of goods and services, primarily food and beverages and receive sometimes indirect tourism benefits through redistribution of revenues from protected area entrance fees and funds allocated to community development projects. Additionally, the annual revenues of wildlife watching tours represent 80% of the total annual revenues of trips to Africa for the participating tour operators. The replies provided indicate that revenues are expected to grow further. On average, the annual turnover of a micro tour operator is US$ 1 million; US$ 3.5 million for a small tour operator, US$ 5 million for a medium tour operator; and US$ 17.5 million for a large tour operator.

According to the survey, wildlife watching tourism takes place mainly in protected areas and nature, national parks and wildlife are among the most important assets for wildlife watching destinations. Safari appears to be the main kind of wildlife watching. Safari tours are being operated by 96% of the participating tour operators and the sub-regions that are most frequented for safari tours are East and Southern Africa, where countries which are already known as wildlife watching destinations are located. From both sub-regions also higher numbers of governmental replies were received; an indication that here enabling frameworks for the development of wildlife watching tourism are already in place. It is to be noted that a great number of governmental replies were also received from the Central and West African sub-regions, which indicates the existing will to further develop wildlife watching tourism in these destinations. However, the number of tour operators active in Central and West Africa is still small.

Bird watching appears to be the second most practiced type of wildlife watching which can be observed in almost every African country and is being offered by 80% of the tour operators. The operation of bird watching tours mainly takes place in top safari destinations and indicates that bird watching could be offered more frequently in combination with other activities than as a specialized product. In fact, the results of the survey point out that wildlife watching tourism is normally combined with nature-related activities, cultural heritage and resort/beach holidays. In the third place and with variations depending of the region come marine wildlife tours and the observation of Great Apes, followed by special tracking of wildlife, which are especially important for countries that are not classic safari destinations but do play a role as wildlife watching destinations.

Through analysis of the data, it was possible to identify key characteristics and economic indicators related to the segment of wildlife watching tourism in Africa. A typical wildlife watching tour involves a group of 6 persons, lasts 10 days and has an average daily price per person per day

of US$ 433 as well as involves out-of-pocket expenses of US$ 55 per person per day. These indicators were also analyzed per market segment (standard, luxury) and it was noted that neither the size of the group or average length of stay would register remarkable variations for the different segments. In this regard, the analysis seems to indicate that the average size of the group and length of stay are intrinsic characteristics to a wildlife watching product which do not necessarily relate to the level of comfort of the experience. The variation in the average price per person per day is on the other hand significant: US$ 753 for a luxury package and US$ 243 for a standard package. From the participating sample, 42% of the participating tour operators offer standard wildlife watching tours, 28% are specialized in luxury tours and 30% target both standard and luxury clients.

Data on protected area visitors and receipts from 14 countries was used were conclusive data was provided, and indicates that wildlife watching tourism is generating a considerable amount of revenues for the countries where it is taking place. The protected area receipts of these 14 countries totaled US$ 142 million per year. As this figure relates to only a small number of countries, one can assume that protected area receipts are indeed much higher. Guidance and capacity building for a more consistent monitoring of protected area visitors and receipts as well as a framework for their analysis are needed. In this regard, the development of a model for the structured integration and evaluation of available data, in order to harness it for an overall assessment of the economic value of wildlife watching tourism in Africa, which would connect data from protected areas with tour operators' performance, would be useful.

A majority of the protected area authorities participating in the survey is involved in anti-poaching measures. Tourism authorities are involved only to a minor extent and the majority does not distribute information on poaching. From the side of the participating tour operators, about half of them fund anti-poaching initiatives or engage in a nature conservation project. Only a few inform their customers on the issue. Although the involvement in anti-poaching initiatives is not very extensive yet, the survey shows that there is potential for mobilizing the tourism sector in anti-poaching campaigns since they can play a key role in awareness raising and potentially (co-) finance anti-poaching initiatives.

Finally, this briefing paper is to be seen as a first step towards measuring the economic value of wildlife watching tourism in Africa and defining the role of the tourism sector in the fight against poaching. The exercise has succeeded in identifying key economic indicators and characteristics of wildlife watching tourism in African countries. Despite the limitations, the findings support the potential of the tourism sector to advance its contribution to the fight against poaching in Africa and confirm the importance of wildlife watching tourism for the sustainable development of the region.

# Annex I

## List of contributions and tour operators

### List of contributions

The following organizations and institutions contributed to the briefing paper by providing case studies, other publications and expertise:

- Adventure Travel Trade Association (ATTA)
- African Travel and Tourism Association (ATTA)
- Association of British Travel Agents (ABTA)
- Convention of Migratory Species of Wild Animals (UNEP/CMS)
- Convention on International Trade in Endangered Species of Wild Fauna (CITES)
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
- Federal Agency for Nature Conservation of Germany (BfN)
- International Consortium on Combating Wildlife Crime (ICCWC)
- International Fund for Animal Welfare (IFAW)
- International Institute for Sustainable Development (IISD)
- International Union for Conservation of Nature (IUCN)
- United Nations Office on Drugs and Crime (UNODC)
- World Wildlife Fund (WWF)

### List of tour operator associations

The following tour operators associations provided support to circulate the survey invitation:

- ABTA, UK
- Tour Operators' Initiative for Sustainable Tourism Development (TOI)
- Deutscher ReiseVerband e.V. (DRV), Germany
- Association of French Tour Operators (SETO/CETO)
- Netherlands Association of Travel Agents and Tour Operators (ANVR)
- The African Travel & Tourism Association (ATTA), UK
- Adventure Travel Trade Association (ATTA), USA
- American Society of Travel Agents (ASTA)
- Association of Danish Travel Agents and Tour Operators (Danmarks Rejsebureau Forening)
- Tanzania Association of Tour Operators
- Africa Travel Association, USA
- forum anders reisen e.V., Germany
- Association of Independent Tour Operators (AITO), UK
- Schweizerrischer Reise-Verband (SRV), Switzerland
- Association for the Promotion of Tourism in Africa (APTA), USA
- Association of Croatian Travel Agencies
- ASTOI Confindustria Viaggi (Associazione Tour Operator Italiani)

## List of participating tour operator

**AFRICA**

| | Country | Tour operator |
|---|---|---|
| 1 | **Botswana** | Gavin Blair Safaris |
| | | Golden Okavango t/a Golden Africa |
| 2 | **Cabo Verde** | Naturalia Capa Verde Lda |
| 3 | **Ethiopia** | Abeba Tours Ethiopia |
| 4 | **Gabon** | ngondetour |
| 5 | **Kenya** | African Quest Safaris Ltd |
| | | Asilia Safaris |
| | | Eco Adventures Africa |
| | | Impact Adventure Travel |
| | | Kent Tours & Travel Ltd |
| | | Outdoor Africa |
| | | Simba Holidays |
| | | Arp Travel Group |
| 6 | **Madagascar** | Asisten Travel |
| | | Le Voyageur |
| | | SETAM |
| 7 | **Malawi** | Rpss |
| | | Ulendo Safaris |
| 8 | **Namibia** | ATC Namibia |
| | | Chameleon Holidays |
| | | Chameleon Safaris Namibia |
| | | E. Safaris & Tours |
| | | Eagles Rock Tours & Safaris |
| | | Karibu Safari Namibia |
| | | Namib Enviro Tours cc |
| | | Sense of Africa and Wild Africa Travel, Tourvest |
| | | Ultimate Safaris |
| 9 | **Nigeria** | Johnpaul Ezeani |
| 10 | **Rwanda** | Amahoro Tours |
| 11 | **South Africa** | ATC-African Travel Concept (DMC) |
| | | Africa Geographic Travel |
| | | African Adventure Safaris |
| | | Bushtracks Expeditions |
| | | Kirfara |
| | | Mozambique Tourism |
| | | Roads to roam |
| | **South Africa** | Rockjumper Birding Tours |
| | | Sun Safaris |
| | | Sunway Safaris |
| | | The Savannah Africa |
| | | Wow Cape Town Tours |
| 12 | **Uganda** | Around Africa Safaris |
| | | BIC Tours Ltd |
| | | Kagera Safaris / Miriam Kyasiimire |
| | | Kombi Nation Tours |
| | | Mamaland safaris. Tony Byarugaba |
| | | Matoke Tours |
| | | Surf Tours & Travel |
| | | The Far Horizons |
| 13 | **United Republic of Tanzania** | BMS Safaris Limited |
| | | Blackmamba Travels Lts |
| | | Chem Chem Safaris |
| | | Duma Explorer |
| | | Fast Travel & Adventure Limited |
| | | Four Seasons Safari Lodge Serengeti |
| | | Intoafrica Eco Travel Ltd |
| | | Kibo Guides (TZ) Ltd |
| | | Leopard Tours Ltd |
| | | Manyara Ranch Conservancy |
| | | Melau Tours and Safaris |
| | | Nomad Tanzania Ltd |
| | | Safari Makers Ltd |
| | | Serengeti Balloon Safaris |
| | | Summit Expeditions & Nomadic Experience |
| | | The African Footprint Co. Ltd (B2B Safaris) |
| | | The Map's Edge Ltd |
| | | Wild Things Ltd |
| | | Wildlife (East Africa) Ltd |
| | | Karibu Africa Safaris Ltd |
| 14 | **Zimbabwe** | Natureways Safaris Pvt Ltd |
| | | Nyati Travel |
| | | Zambezi Safari & Travel Co. |

## EUROPE

| | Country | Tour operator |
|---|---|---|
| 15 | **Croatia** | Olymptours by Ratko Flajpan |
| | | El-pi Tours Malinska* |
| | | Frodo d.o.o., Yacht Base travel agency* |
| | | Hvar Touristik* |
| | | Katarina Line* |
| | | Lang International* |
| | | PENTA d.o.o.* |
| | | Zlatna Greda Ltd. tourist agency* |
| 16 | **Czech Republic** | Stella Travel |
| 17 | **Denmark** | Limpopo Travel |
| 18 | **Finland** | Koonono Tours Ltd |
| 19 | **France** | Kuoni |
| | | Les Circuits Découverte by Club Med |
| | | Rev Vacances |
| | | Vacance Transat (Transat France) |
| | | Voyageurs du Monde |
| 20 | **Germany** | AST African Special Tours GmbH |
| | | Afrika à la Carte Reisen |
| | | Albatros-Tours |
| | | Art of Travel GmbH |
| | | Bikeworld Travel GmbH |
| | | Chamäleon Reisen GmbH |
| | | DER Touristik |
| | | Daktaritravel |
| | | Djoser Reisen GmbH |
| | | ETC Reisen Edutainment Travel Company |
| | | Elangeni African Adventures |
| | | Escape tours GmbH |
| | | Globetrotter Select |
| | | Jacana Tours |
| | | Karibu Safaris GmbH |
| | | Klipspringer-Tours GmbH |
| | | Makalali - African Exclusive Tours |
| | | S.A.Landprogramm |
| | | SA Travel |
| | | Severin Travel Africa |
| | | Studiosus Reisen |
| | **Germany** | Tour Vital |
| | | Thomas Cook AG Segment Continental Europe |
| | | Wikinger Reisen |
| | | R.U.F Touristik GmbH* |
| | | Rucksack Reisen* |
| | | Tour Exquisit* |
| 21 | **Italy** | FollowMe |
| | | Best Tours Italia |
| | | Hoteplan Italia Spa |
| | | Il Diamante |
| | | NAAR Tour Operator |
| | | Settemari Spa |
| | | Viaggi Dell'elefante |
| | | Viaggi del Mappamondo |
| 22 | **Lithuania** | Baltic tour* |
| 23 | **Netherlands** | Bongo Asili Travel |
| | | Kuoni Netherlands/NDTC |
| | | Live To Travel |
| | | Mondi Reizen |
| | | SNP Natuurreizen (SNP Nature Travel) |
| | | Travel Trend |
| | | Travelhome |
| | | Vamonos Travels |
| | | De Jong Intra Vakanties |
| 24 | **Portugal** | Zoom Travel - Tailor Made Tour Operator |
| 25 | **Spain** | A Step Ahead S.L. |
| 26 | **Switzerland** | Stohler Tours |
| | | Africa Design Travel |
| 27 | **United Kingdom** | Baobab Travel |
| | | Jacada Travel Ltd |
| | | Marketing Worldwide |
| | | Natural High Safaris |
| | | Rainbow Tours |
| | | Thomas Cook |
| | | TripAfrica |
| | | Wildlife Trails |

| AMERICA | | |
|---|---|---|
| 28 | **Canada** | Goway Travel |
| 29 | **Peru** | Andean Lodges* |
| 30 | **United States of America** | David Mark Erickson Travel |
| | | Africa Adventure Consultants |
| | | AfricanMecca Inc |
| | | Infinite Safari Adventures |
| | | Journeys International |
| | | Timeless Africa |
| | | Travcoa |

| ASIA | | |
|---|---|---|
| 31 | **Bangladesh** | Discovery Tours And Logistics |
| 32 | **India** | Greener Pastures* |
| | | Navigator India* |
| 33 | **Republic of Korea** | Sihnae Lee |

| AUSTRALIA | | |
|---|---|---|
| 34 | **Australia** | The Classic Safari Company |

* **Participating tour operators that were not offering trips to Africa at the time of the survey.**

**Note:** The above list of participating tour operators has been configured as per the entries to the survey.

# Annex II
## Available data

### Available data on international tourism arrivals and receipts for African countries

| | | INTERNATIONAL TOURIST ARRIVALS (1,000) | | | | INTERNATIONAL TOURIST RECEIPTS (US$ million) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2010 | 2011 | 2012 | 2013 | 2010 | 2011 | 2012 | 2013 |
| 1 | Algeria | 2,070 | 2,395 | 2,634 | 2,733 | 219 | 209 | 217 | 350 |
| 2 | Angola | 425 | 481 | 528 | 650 | 719 | 646 | 706 | 1,234 |
| 3 | Benin | 199 | 209 | 220 | 231 | 149 | 188 | 170 | .. |
| 4 | Botswana | 2,145 | .. | .. | .. | 78 | 33 | 34 | 45 |
| 5 | Burkina Faso | 274 | 238 | .. | 218 | 72 | 133 | 84 | .. |
| 6 | Burundi | 142 | .. | .. | .. | 2 | 2 | 1 | 2 |
| 7 | Cameroon | 573 | 604 | 817 | 912 | 159 | 409 | 349 | 576 |
| 8 | Cabo Verde | 336 | 428 | 482 | 503 | 278 | 368 | 414 | 462 |
| 9 | Central African Republic | 54 | .. | .. | .. | 11 | .. | 11. | .. |
| 10 | Chad | 71 | 77 | 86 | 100 | .. | .. | .. | .. |
| 11 | Congo | 194 | 218 | 256 | 297 | .. | .. | .. | .. |
| 12 | Côte d'Ivoire | 252 | 270 | 289 | .. | 201 | 141 | .. | .. |
| 13 | Democratic Republic of the Congo | 81 | 186 | .. | 191 | 11 | 11 | 7 | 1 |
| 14 | Djibouti | .. | .. | .. | 63 | 18 | 19 | 21 | 22 |
| 15 | Equatorial Guinea | .. | .. | .. | .. | .. | .. | .. | .. |
| 16 | Eritrea | 84 | 107 | .. | .. | .. | .. | .. | .. |
| 17 | Ethiopia | 468 | 523 | 596 | 681 | 522 | 770 | 607 | 621 |
| 18 | Gabon | .. | .. | .. | .. | .. | .. | .. | .. |
| 19 | Gambia | 91 | 106 | 157 | 171 | 74 | 83 | 88 | .. |

| | | INTERNATIONAL TOURIST ARRIVALS (1,000) | | | | INTERNATIONAL TOURIST RECEIPTS (US$ million) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2010 | 2011 | 2012 | 2013 | 2010 | 2011 | 2012 | 2013 |
| 20 | Ghana | 931 | .. | .. | .. | 620 | 694 | 914 | 853 |
| 21 | Guinea | .. | .. | .. | 56 | 2 | 2 | 1 | .. |
| 22 | Guinea-Bissau | .. | .. | .. | | 13 | 9 | 7 | .. |
| 23 | Kenya | 1,470 | 1,785 | 1,781 | 1,433 | 800 | 926 | 935 | 881 |
| 24 | Lesotho | 414 | 397 | 422 | 320 | 25 | 29 | 46 | 39 |
| 25 | Liberia | .. | .. | .. | .. | 12 | 232 | .. | .. |
| 26 | Madagascar | 196 | 225 | 256 | 196 | 321 | .. | .. | .. |
| 27 | Malawi | 746 | 767 | .. | .. | 33 | 34 | 34 | .. |
| 28 | Mali | 169 | 160 | 134 | 142 | 205 | 267 | 142 | .. |
| 29 | Mauritania | .. | .. | .. | .. | .. | .. | 48 | 41 |
| 30 | Mauritius | 935 | 965 | 965 | 993 | 1,282 | 1,484 | 1,477 | 1,321 |
| 31 | Morocco | 9,288 | 9,342 | 9,375 | 10,046 | 6,703 | 7,281 | 6,703 | 6,854 |
| 32 | Mozambique | 1,718 | 1,902 | 2,113 | 1,886 | 197 | 231 | 250 | 241 |
| 33 | Namibia | 984 | 1,027 | .. | 1,176 | 438 | 518 | 485 | 409 |
| 34 | Niger | 74 | 82 | .. | 123 | 105 | 96 | 50 | .. |
| 35 | Nigeria | 1,555 | 715 | .. | 600 | 576 | 628 | 559 | 543 |
| 36 | Rwanda | 504 | 688 | 815 | 864 | 202 | 252 | 282 | 294 |
| 37 | Sao Tome and Principe | 8 | 12 | .. | .. | 11 | 16 | 13 | 13 |
| 38 | Senegal | 900 | 1,001 | .. | 1,063 | 453 | 484 | 407 | .. |
| 39 | Seychelles | 175 | 194 | 208 | 230 | 274 | 291 | 310 | 344 |
| 40 | Sierra Leone | 39 | 52 | 60 | 81 | 26 | 44 | 42 | 59 |
| 41 | South Africa | 8,074 | 8,339 | 9,188 | 9,537 | 9,070 | 9,515 | 9,994 | 9,238 |
| 42 | Sudan | 495 | 536 | .. | 591 | 94 | 185 | 772 | 773 |
| 43 | Swaziland | 1,078 | 879 | 1,093 | 968 | 50 | 21 | 30 | 13 |
| 44 | Togo | 202 | 300 | 235 | 327 | 66 | 79 | 95 | .. |
| 45 | Tunisia | 6,903 | 4,785 | 5,950 | 6,269 | 2,645 | 1,914 | 2,227 | 2,190 |
| 46 | Uganda | 946 | 1,151 | 1,197 | 1,206 | 784 | 959 | 1,135 | 1,184 |
| 47 | United Republic of Tanzania | 754 | 843 | 1,043 | 1,063 | 1,255 | 1353 | 1,713 | 1,880 |
| 48 | Zambia | 815 | 920 | 859 | 915 | 125 | 146 | 155 | 224 |
| 49 | Zimbabwe | 2,239 | 2,423 | 1,794 | 1,833 | 634 | 664 | 749 | 851 |

# Annex III
Governmental institutions

## List of participating governmental institutions

| | COUNTRY | NAME | INSTITUTION TYPE |
|---|---|---|---|
| 1 | **Benin** | Direction du Parc National de la Pendjari | National Park |
| 2 | **Botswana** | Ministry of Tourism, Environment & Wildlife | Tourism Ministry |
| 3 | **Burkina Faso** | Ministère de la Culture et du Tourisme | Tourism Ministry |
| 4 | **Burundi** | Ministère du Commerce, de l'Industrie, des Postes et du Tourisme | Tourism Ministry |
| 5 | **Cameroon** | Ministry of Tourism and leisure | Tourism Ministry |
| 6 | **Cabo Verde** | General Directorate of Environment | National Wildlife Conservation Authority |
| 7 | **Chad** | Ministère de l'Environnement et des Ressources Halieutiques | Environment Ministry |
| 8 | **Congo** | Wildlife Conservation Society (WCS) Programme Congo | National Wildlife Conservation Authority |
| 9 | **Cote d'Ivoire** | Ministère du Tourisme | Tourism Ministry |
| 10 | **Democratic Republic Congo** | Administration Nationale du Tourisme | National Tourism Authority |
| | | Institut Congolais pour la Conservation de la nature (ICCN) | National Wildlife Conservation Authority |
| 11 | **Eritrea** | Ministry of Agriculture | Agriculture Ministry |
| 12 | **Ethiopia** | Ethiopian Wildlife Conservation Authority (EWCA) | National Wildlife Conservation Authority |
| 13 | **Gabon** | Ministère des Mines, de l'Industrie et du Tourisme | Tourism Ministry |
| 14 | **Gambia** | Gambia Tourism Board | National Tourism Authority |
| 15 | **Ghana** | Bui National Park | National Park |
| | | Wildlife Division of Forestry Commission | National Wildlife Conservation Authority |
| | | Forestry Commission Wildlife Division | National Wildlife Conservation Authority |
| | | Ministry of Tourism, Culture & Creative Arts | Tourism Ministry |
| 16 | Guinea | Office guinéen des Parcs et Réserves | National Wildlife Conservation Authority |

| | COUNTRY | NAME | INSTITUTION TYPE |
|---|---|---|---|
| 17 | **Kenya** | Kenya Wildlife Service | National Wildlife Conservation Authority |
| | | Ministry of East African Affairs, Commerce and Tourism | Tourism Ministry |
| | | County Government of Migori | Others (County Government) |
| 18 | **Lesotho** | Sehlabathebe National Park | National Park |
| | | Ministry of Tourism, Environment and Culture | Tourism Ministry |
| 19 | **Malawi** | Department of National Parks and Wildlife | National Wildlife Conservation Authority |
| 20 | **Mali** | Office Malien du Tourisme et de l'Hôtellerie (OMATHO) | National Tourism Authority |
| 21 | **Mauritania** | Parc National du Diawling | National Park |
| | | Direction des Aires Protégées et du Littoral | National Wildlife Conservation Authority |
| 22 | **Mozambique** | Ministry of Tourism | Tourism Ministry |
| 23 | **Niger** | Ministère du Tourisme et de l'artisanat | Tourism Ministry |
| 24 | **Senegal** | Direction des Parcs Nationaux: Parc National des Iles de la Madeleine | National Park |
| | | Ministère du Tourisme et des Transports Aériens | Tourism Ministry |
| 25 | **Seychelles** | Seychelles Islands Foundation | Local Wildlife Conservation Authority |
| 26 | **Sierra Leone** | National Tourist Board of Sierra Leone | National Tourism Authority |
| 27 | **South Africa** | CapeNature | Local Wildlife Conservation Authority |
| | | Western Cape Nature Conservation Board trading as CapeNature | Local Wildlife Conservation Authority |
| | | South African National Parks | National Wildlife Conservation Authority |
| | | National Department of Tourism | National Tourism Authority |
| 28 | **Swaziland** | Big Game Parks | National Wildlife Conservation Authority |
| | | Swaziland National Trust Commission | National Wildlife Conservation Authority |
| | | Swaziland Tourism Authority | National Tourism Authority |
| 29 | **Uganda** | Uganda Wildlife Authority | National Wildlife Conservation Authority |
| | | Ministry of Tourism Wildlife and Antiquities | Tourism Ministry |
| 30 | **United Republic of Tanzania** | Tanzania National Parks | National Wildlife Conservation Authority |
| | | Wildlife Division | National Wildlife Conservation Authority |
| | | Tanzania Association of Tour Operators (TATO) | Others (Tour Operator Association) |
| 31 | **Zimbabwe** | Zimbabwe Tourism Authority | National Tourism Authority |

**Note:** The above list of participating tour operators has been configured as per the entries to the survey.

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Annexe 5.19

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Direction des Inventaires et Aménagement Forestiers

**(DIAF)**

Ministère d'Environnement et Développement Durable

(MEDD)

# PROTOCOLE METHODOLOGIQUE DE L'EVALUATION DU COUVERT FORESTIER NATIONAL DE REFERENCE EN REPUBLIQUE DEMOCRATIQUE DU CONGO

*Document de travail*

UN-REDD PROGRAMME

Mai, 2015

## Table de matières

## Abréviations

CCNUCC : Convention Cadre des Nations Unies sur les Changements Climatiques

CBERS : China – Brazil Earth Resources Satellite

DIAF: Direction d'Inventaire et d'Aménagement Forestier

ETM+: Enhanced Thematic Mapper Plus

FAO : Organisations des Nations Unies pour l'Alimentation et l'Agriculture

GES : Gaz à effet de serre

IFN : Inventaire Forestier National

INPE : l'Agence Nationale de Recherche Spatiale Brésilienne

LASER : Light Amplification by Stimulated Emitted Radiation

LIDAR : Light Detection And Radiation)

MECNT : Ministère d'Environnement Conservation de la Nature et Tourisme

MNV : Mesure, Rapportage et Vérification

MSS : Multi Spectral Scanneur

NASA : National Aeronautics and Space Administrator

RADAR : Radio Detection And Ranging

RBV : Return Beam Vidicon

R.D.C : République Démocratique du Congo

REDD+ : Réduction des Emissions liées à la Déforestation et la Dégradation de forêts

SPOT : Satellite Pour l'Observation de la Terre

TM: Thematic Mapper

USGS: United States Geological Survey

# 1. Introduction

## 1.1. Contexte du projet TerraCongo

Dans un contexte global d'augmentation des émissions de GES dues à la déforestation et à la dégradation des forêts, les pays membres de la Convention Cadre des Nations Unies sur les Changements Climatiques (CCNUCC) ont pris des engagements d'atténuation concrets par la promotion des activités REDD+.

La République Démocratique du Congo (RDC) s'est engagée dans le mécanisme international de la Réduction des Emissions liées à la Déforestation et la Dégradation des forêts; qui prend en compte la conservation de carbone forestier, la gestion durable des forêts et l'accroissement des stocks de carbone «REDD+». En cette phase de préparation du processus, une attention soutenue s'est focalise sur la construction de la stratégie nationale, l'établissement d'un cadre institutionnel et légal pour la mise en œuvre de la REDD+, mais aussi sur la mise en place d'un Système National de Mesure, Notification et Vérification (MNV) complet et opérationnel. Ce dernier, vise essentiellement l'amélioration de la qualité de l'inventaire forestier national, de l'inventaire des gaz à effet de serre du secteur forestier, ainsi que du système de suivi et de surveillance du couvert forestier par satellite.

Partant de l'appui de la FAO dans le cadre du Programme ONU-REDD, la Direction des Inventaires et Aménagement Forestiers (DIAF) au sein du Ministères d'Environnement Conservation de la Nature et Tourisme (MECNT), a reçu mandat de réaliser les deux composantes du mécanisme MNV à savoir : l'Inventaire Forestier National (IFN) et le Système National de Surveillance des Terres par Satellite de la RDC (SNSF - TerraCongo) dont les résultats devraient alimenter l'élaboration des communications nationales sur les changements climatiques et instruire la construction de la stratégie nationale REDD+.

Le SNSF – TerraCongo, initié en 2011, résulte d'une collaboration entre la FAO, l'ONU-REDD et l'Agence Nationale de Recherche Spatiale Brésilienne (INPE). Il est le premier implémenté dans de pays tropicaux ayant adopté le mécanisme d'initiative REDD+. Ce projet se concentre de manière générale sur le développement des processus technique pour la mise en place des procéder pour : (i) le suivi du couvert forestier de la R.D.C et (ii) la diffusion des données par son portail https://rdc-snsf.org

Le présent rapport est la suite d'une série de documents de travail du projet TerraCongo, notamment « Data pre-processing for TerraCongo project version one », » Data pre-processing for TerraCongo project version two » et « Building baseline Landsat data mosaic for circa 1990 – the case of the Democratic Republic of the Congo ». Ce document décrit particulièrement la méthodologie développée pour la production de la carte de couverture forestière nationale de référence de la République Démocratique du Congo (RDC).

En dehors de l'introduction et la conclusion, le document est subdivisé en trois : la première donne un aperçu général des termes et les caractéristiques de données utilisées, la seconde partie décrit l'approche méthodologique du projet TerraCongo et la dernière partie présente le résultat du projet.

## 1.2. Objectif générale du projet

L'objectif général du projet TerraCongo est de calculer la couverture forestière nationale de référence (1990) et les changements de la couverture forestière entre la période 1990 et 2010 en République Démocratique du Congo.

### 1.2.1. Objectifs Spécifiques

Les objectifs spécifiques de projet TerraCongo sont : i) produire l'état de référence de la couverture forestière nationale pour la période 1990; ii) produire la couverture forestière de l'année 2010 ; iii) cartographier les changements de la couverture forestière nationale de la RDC entre les périodes 1990 et 2010 ; iv) Produire le statistique de l'état de référence de la couverture forestière nationale de la période 1990 ; v) évaluer les changements entre 1990-2010 ; vi) construire une base de données SIG pour le portail SNSF.

Ce rapport est le premier de la série de protocole méthodologique d'évaluation du couvert forestier de la RDC. Il présente l'approche méthodologique, qui a conduit à l'élaboration de la cartographie du couvert forestier national de référence de la RDC, pour l'année 1990. Le second rapport sera consacré à la méthodologie d'évaluation du couvert forestier de l'année 2010 et leurs changements.

## 1.3. Table de Personnel

Le projet SSTS – TerraCongo a compté avec la participation de l'équipe de de la Division de Géomatique de la DIAF, qui ont reçu des formations spécifiques en Télédétection, SIG, statistiques, géostatistiques, traitement de données en Bases de données et langage de programmation.

Agents de la DIAF

| | |
|---|---|
| Mr. Christophe Musampa | Chef de Division Géomatique, 2012 – 2014 |
| Mr. Francois Kayembe Mumonayi | Expert DIAF/SSTS et Chef de Division Géomatique, 2015 - |
| Mr. Cedric Bobuya Ezebe | Expert DIAF/SSTS |
| Mr. Duadet Mbenza Ngimbi | Expert DIAF/SSTS |
| Mr. Eric Manzila | Expert DIAF/SSTS |
| Mr. Héritier Koy Kondjo | Expert DIAF/SSTS |
| Mr. Joël Bongwele Bakungola | Expert DIAF/SSTS |
| Mr. Laurent Kalau Kanika | Expert DIAF/SSTS |
| Mr. Valere Nsasi Khumba | Expert DIAF/SSTS |
| Mr. Vedastin Kosa | Expert DIAF/SSTS |
| Mr. Wilfred Kombe Ibey | Expert DIAF/SSTS |
| Mr. Francois mukendi mulumba | Informaticien DIAF/SSTS |
| Mr. Mike Luboya Kapuba | Informaticien DIAF/SSTS |

## 1.4. Partenariat

La réalisation des activités de pré-IFN a été possible grâce à la synergie mise en place par différents partenaires à savoir:

JICA/JAFTA: La coopération Japonaise à travers la JAFTA a mis en place un projet de Renforcement du Système National de Monitoring des Ressources Forestières pour la Promotion de la Gestion Durable des Forêts dans le cadre de la REDD+ en République Démocratique du Congo. La gestion durable des forêts sera d'application en RDC et la promotion de la REDD + sera basée sur les informations du monitorage des ressources forestières. Le suivi des ressources forestières sera assuré de façon adéquate suivant le plan d'opération du Système d'Inventaire des Ressources Forestières Nationales.

Les résultats attendus du projet sont :

- Cartes forestières de base de la province pilote du Bandundu produites.
- Modalités et procédures d'étude sur terrain pour l'inventaire des ressources forestière nationales développées.
- Une base de données des ressources forestières nationales constituée et développée.
- Un système d'inventaire des ressources forestières nationales avec un plan d'opération mis en place.
- La formation spécialisée en divers sujets de Télédétection en RDC et Japon.

Le projet pour le moment ne concerne que la province de Bandundu

USFS : Le service forestier américain fournis une assistance technique ciblée au MECNT. Cette assistance technique touche particulièrement les domaines de l'inventaire forestier, du système de MNV et du zonage forestier. Dans le domaine de l'inventaire forestier et du système de MNV, USFS organise des sessions de formation aux agents de la DIAF dans le renforcement de capacité, assiste dans l'harmonisation des méthodologies et la mise en place du système de MNV. Dans le domaine du zonage forestier, USFS accompagne la DIAF et le CNPZ (Comité National de Pilotage du Zonage) dans le développement des méthodologies et la production d'outils de planification de l'utilisation des terres. Les manuels de macro-zonage et de micro-zonage sont maintenant produits, une équipe de formateurs de la DIAF, du CNIE et de la DEP a été formée, et envoyée sur le terrain pour former les acteurs locaux.

FAO : La FAO c'est le partenaire UNREDD qui appuie techniquement les trois composantes de le MNV au niveau nationale. La FAO appui à la DIAF à développer son système de surveillance de forêts, à renforcer les capacités techniques et physiques de la Division de géomatique, pour assurer le correct stockage, analyse et disposition final des données et résultats liés à MNV.

Beaucoup d'autres partenaires donnent directement ou indirectement leur contribution au Système National de Surveillance des Forets de la RDC notamment WWF, AGEDUFOR, FRM, WRI, OSFAC. La collaboration entre les partenaires au sein de la DIAF est nécessaire car elle permet la coordination des différentes activités afin d'avoir les meilleurs résultats pour améliorer la connaissance et la gestion des forets en RDC.

# 2. Considération Générale

Le 2e chapitre est consacré à la présentation du programme satellites Landsat, les caractéristiques des capteurs et des images satellites Landsat qui ont été utilisées dans ce projet.

Le premier sous-point intitulé : « présentation du programme satellite Landsat » donne un bref aperçu synthétisé de missions spatiales d'observation civiles de la terre Landsat. En suite le second sous-point intitulé « capteurs et images satellites Landsat » décrit les caractéristiques techniques de capteurs de télédétection en générale, ceux des capteurs Landsat (Multi Spectral Scanneur – MSS, Thematic Mapper – TM, Enhanced Thematic Mapper Plus – ETM+ en particulier) et présente en fin les caractéristiques techniques de images Landsat prises par ces capteurs.

## 2.1. Présentation du programme spatial Landsat

Le programme spatial Landsat (PSL) est une mission d'observation spatiale civile de la terre. Ce programme est sous la responsabilité de la « National Aeronautics and Space Administrator » (NASA), laquelle est une agence du gouvernement des Etats Unies, spécialisée à la recherche aéronautique et aérospatiale. La mission Landsat dispose d'une longue série d'archive d'images satellites d'observation de terre (Gyanesh, Member, & Brian, 2007), qui permet de suivre l'évolution des phénomènes environnementaux depuis près de 40 ans déjà. Les données satellites d'archive Landsat sont depuis 2009 libre d'utilisation et téléchargement sur, par exemple, le site de l'U.S. Geological Survey http://earthexplorer.usgs.gov/

## 2.2. Capteurs satellitaires et images satellites Landsat

### 2.2.1. Capteurs des engins de télédétection

Rappelons premièrement la définition de la télédétection. De manière large, la télédétection est une discipline qui mesure ou acquière des informations sur des objets ou phénomènes, par intermédiaire des instruments des mesures (capteurs) sans compact apparat avec ces objets.

Le capteur de télédétection désigne un instrument permettant de mesurer des objets ou phénomènes étudiés dans une longueur d'onde donnée (figure 1). Il existe deux types des capteurs. Le capteur actif dispose de leur propre source d'énergie. Il émet et recueil la fraction d'énergie restituer par l'objet, appelée couramment « écho ». Dans cette catégorie des capteurs sont contenues LIDAR (Light Detection And Radiation) ; LASER (Light Amplification by Stimulated Emitted Radiation) ; RADAR (Radio Detection And Ranging) et RISAT. Le capteur passif reçoit une énergie réfléchie par un objet grâce à une énergie émise par un autre corps, dont le plus courant est le soleil. Les satellites passifs dont les images sont couramment utilisées en télédétection sont : SPOT ; LANDSAT; MODIS ; CBERS ; etc.

### 2.2.1. Programme Landsat et ces Senseurs

Le programme Landsat a été développé par la NASA et l'Institut des études géologiques américain (USGS) au milieu des années 1960. Huit satellites Landsat ont été lancés entre 1972 et 2013. Les capteurs embarqués sur les satellites Landsat ont permis de capturer plusieurs millions d'images, disponibles de manier gratuit en internet. Celles-ci constituent des ressources uniques pour l'étude des changements climatiques, le suivi forestière, l'utilisation des sols, la gestion de l'habitat ; ainsi que pour de nombreuses autres applications dans les domaines de l'Environnement, la géologie, les études géo-sociaux etc.

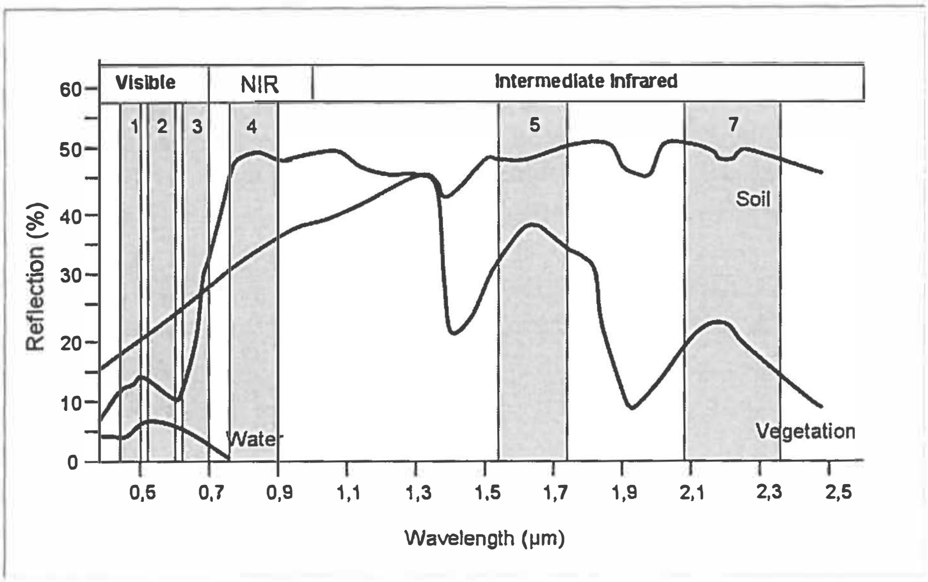


*Figure 1 Signature spectrale des objets dans une portion de spectre électromagnétique*

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Le capteur MSS fait partie de la première génération d'instruments aérospatiaux des mesures équipés sur des satellites Landsat 1-3. Le capteur MSS dispose de quatre bandes spectrales, qui acquièrent des informations radiométriques respectivement sur deux bandes spectrales du visible (vert et rouge) et deux bandes spectrales du proche infrarouge (tableau 1). Les images acquises par ces capteurs ont une résolution spatiale de 80 mètres. Les satellites Landsat 1 et 2 étaient en plus équipés des caméras photographiques Return Beam Vidicon – RBV capable d'acquérir des scènes avec 80 m de résolution spatial. Ces cameras initialement conçu comme des instruments principaux du LT1, ne seront qu'utilisés que sur les LT1-2 avant d'être abandonnées, puisque la qualité des scènes prises par le MSS étaient plus supérieurs, mais aussi ces cameras furent probablement responsable d'un disfonctionnement dans la LT1.

Le capteur TM (Thermique) est embarqué sur les satellites LT4 et LT5 avec une version moderne de MSS. Le capteur TM dispose en plus d'une bande spectrale thermique, laquelle recueille l'information à 120 m de résolution spatiale. Ces deux capteurs ont une résolution spatiale de 30 m et 16 jours de résolutions temporelles (tableau 1).

Le capteur ETM+ (Enhance Thermal Mapper) a été conçu pour le satellite LT-7, après que l'instrument ETM fut perdu lors de la mise en orbite du LT-6. Ce capteur est une version amélioré du capteur TM et ETM du LT-6. Le ETM+ possède une forte résolution radiométrique, due aux huit bandes spectrales sur lesquelles ils opèrent et particulièrement à l'ajoute de la bande spectrale panchromatique (acquisition de scène à 15 m de résolution spatiale) et de l'augmentation de la résolution spatiale de celle l'infrarouge thermique à 60 m.

En fin, les capteurs OLI et TIRS sont des instruments de mesure du satellite LT-8. Le capteur principal est OLI (Operational Land Imager), capable d'obtenir 9 bands spectrales, incluant les 7 bands d'ETM+, 1 band pour la correction atmosphérique et une 2 e pour la détection des nuages. Le capteur TIRS (Thermal Infrared Sensor) continue l'obtention des données thermales dans deux bands (Band 10 et 11) a une résolution de 100 m. Ces autres informations et d'autres informations sur les satellites Landsat et fonctionnement des capteurs peuvent être consultées sur le présent site : http://landsat.gsfc.nasa.gov/.

### *Image Landsat MSS et TM*

Les images satellites Landsat, comme leurs nom l'indique sont de produits aérospatiaux des satellites d'observation de la terre du même nom « Landsat ». Ces images sont acquises respectivement par les capteurs MSS et TM. Le capteur MSS a quatre bandes spectrales, qui sont sensibles dans les fenêtres atmosphériques sur des gammes suivantes en fonction de chacune de bande : Bande 1 : 0,5 – 0,6 µm, Bande 2 : 0,6 – 0,7 µm, Bande 3 : 0,7 – 0,8 µm et Bande 4 : 0,8 – 1,1 µm. Les deux premières opères dans les gammes de longueurs d'onde du visible et les autres dans celle de proche infrarouge.

Le TM était considéré différent du MSS par l'ajout de trois bandes spectrales : 5-7, dont la bande 6 qui fonction dans la gamme de longueur d'onde thermique et dispose d'une résolution spatiale de 120 m. Tandis que, les autres bandes ont toutes une résolution spatiale de 30 m. Avec 7 bandes spectrales, le TM est considéré comme une image à haute résolution permettant de produire des couches thématiques. Les bandes de la TM sont sensibles dans les fenêtres atmosphériques suivantes : bande 1 : 0,4 – 0,5 µm, bande 2 : 0,5 -0,6 µm, bande 3 : 0,63- 0,69 µm, bande 4 : 0,7- 0,9 µm, bande 5 : 1,55 – 1,7 µm, bande 6 : 10,4 – 12,5 µm et bande 7 : 2,0 – 2,3 µm (Girard & Colette, 1999).

### *Image Landsat ETM+*

Le ETM+ est l'avant dernier génération des images satellites du LT-7. Les bandes 1-5-7 n'ont pas changé des caractéristiques à l'exception l'ajout d'une bande et la modification de la bande spectrale 6 (60 m de résolution spatiale). Le précédent, la bande 8 panchromatique dispose d'une résolution spatiale de 15 m. Comme, les LT 4-5, le ETM+ a aussi les caractéristiques techniques orbitales identiques que les précédents (source : NASA).

Le tableau 1 présente l'historique de mission satellite Landsat depuis 1972.

*Tableau 1 Caractéristiques des images et des satellites Landsat*

| Caractéristiques | Landsat 1 - 3 | Landsat 1 – 4 | Landsat 6 | Landsat 7 | Landsat 8 |
|---|---|---|---|---|---|
| Début et fin de mission | LT-1 : 1972-1978<br>LT-2 :1975-1981<br>LT-3 : 1982-1993 | LT-4 : 1982-1993<br>LT-5 : 1984-2013 | 1993 (échec) | 1999- | 2013- |
| Statut satellite | Achevée | Achevée (LT-4)<br>Fonctionne en mode dégradée (LT-5) | Echec lors de lancement | Actif | Actif |
| Masse Engin | 816-960kg | 1938-1961 kg | - | 2200 kg | 2600 kg |
| Capteurs | MSS : radiomètre<br>RVB : caméra vidéo | MSS et TM : radiomètre | ETM : radiomètre | ETM+ : radiomètre | OLI et TIRS : radiomètre |
| Bandes spectrales | 0,5-0,6 μm<br>0,6-0,7 μm<br>0,7-0,8 μm<br>0,8-1,1 μm | 0,45-0,52 μm<br>0,52-0,6 μm<br>0,63-0,69 μm<br>0,76-0,9 μm<br>1,55-1,75 μm<br>2,08-2,35 μm | - | 0,45-0,52 μm<br>0,53-0,61 μm<br>0,63-0,69 μm<br>0,78-0,9 μm<br>1,55-1,75 μm<br>2,09-2,35 μm | 0,43-0,453 μm<br>0,45-0,515 μm<br>0,525-0,6 μm<br>0,63-0,68 μm<br>0,845-0,885 μm<br>1,56-1,66 μm<br>1,36-1,39 μm<br>2,1-2,3 μm |
| Infrarouge thermique | - | 10,4-12,5 μm | - | 10,4-12,5 μm | 10,3-11,3 μm<br>11,5-12,5 μm |
| Panchromatique | - | - | - | 0,52-0,9 μm | 0,5-0,68 μm |
| Résolution spatiale | Générale : 80m | Générale : 30 m<br>Infrarouge thermique : 120 m | - | Générale : 30 m<br>Panchromatique : 15 m<br>Infrarouge thermique : 100m | Générale : 30 m<br>Panchromatique : 15 m<br>Infrarouge thermique : 60m |
| Technique de prise d'image | Whiskbroom | Whiskbroom | - | Whiskbroom | Pushbroom |
| Résolution temporelle | 18j | 16j | - | 16j | 16j |
| Orbite | Altitude : 907-915 km<br>Heure : 9h45' | Altitude : 705 km<br>Heure : 9h30-10h | - | Altitude : 705 km<br>Heure : 10h-10h15' | Altitude : 705 km<br>Heure : 10h |

Source de donnée : Adaptation de NASA

## 2.3. Gestion de Données

La surveillance de Forêt demande la collecte, téléchargement et traitement de données géographiques en format Raster (images de satellite) et Vecteur (Couches vectoriels). Ces données peuvent être comptes par milles, donc une bonne gestion des données est nécessaire pour assurer sa correcte disponibilité.

Les données ont été nomes selon critères suivent :

- Format de fichier :
    - Tif : Pour les données Raster
    - Shp : Pour les donnes Vector
- Nom du Projet :
    - FnF : Projet estimation de la superficie Forestière en 1990
    - ChD : Projet de Détection de Changement
- Nom de la Province ;
    - BCKN : Bas-Congo
    - BD : Bandundu
    - EQ : Equateur
    - KA : Katanga
    - KE :Kassai Occidental

    - KO : Kassai Oriental
    - KVMA : Kivus et Maniema
    - PO : Province Orientale
- Nom de la scène Landsat  par ligne et colonne (raw – path). Exemple : 185068.tif
- Nom du Système de Coordonnées :
    - WGS : WGS 84
    - WMC : World Mercator
    - UTM : Universal Transversal Mercator
- Autres :
    - Source : OSFAC, FAO, WRI
    - Date : JJDDAA : 1305514  13 avril 2014
    - Index : Couche indicative des scènes

Exemples :

Réppertoire FnF_KA_1990 : Projet FNF en Katanga

- Fichiers : *FnF_171065.tif, FnF_171066.tif, FnF_171068.tif, FnF_171069.tif, FnF_172064.tif*

# 3. Couverture du sol

Les guides de bonnes pratiques liées aux activités du secteur de l'utilisation des terres, changements d'affectation des terres et foresterie, faite des recommandations aux pays sur le choix de collecter les données sur les superficies forestières. Ces données doivent être adéquates pour le calcul de carbone, cohérentes, complètes et transparentes.

L'IPCC recommandes six grandes catégories pour la préparation des inventaires des gaz à effet de serre. De même façon, la DIAF compte avec une stratification par types d'occupation du sol (SPIAF et CNIE, 1994) avec 16 types d'occupation du sol. Aux fin de quantifier les terres forestières, le projet TerraCongo a simplifié la légende du SPIAF (Tableau 2) à deux classes : Forêt et Non Forêt

## 3.1. Définition de la forêt

Selon la définition officielle de la forêt en RDC, la classe forêt se rapporte à une zone comprenant une superficie d'au moins demi-hectare, dont les arbres se développent et disposant d'une densité inférieur ou égale à 30% de la couverture forestière, avec une hauteur d'au moins 5 m (Résolution 5094/CAB/MIN/ECN-T/JEB/08 de 22 oct. 2008).

Bien que la définition de foret actuelle réponde aux attentes de la communauté internationale pour ce qui regarde un clair encadrement surtout dans le mécanisme REDD+, elle ne spécifie pas si les plantations sont ou pas inclus comme patrimoine forestier de la RDC.

La classe Non forêt comprend les autres types d'occupation du sol différent de celle décrite par la précédente classe.

***Tableau 2 Eléments du territoire par types d'occupation du sol***

| *Type d'occupation du sol* | Formations forestières et non forestières associées |
|---|---|
| Forêt | Forêts denses humides (sempervirente et semi-décidue) |
| | Forêts denses de montagnes |
| | Forêt de Bambou |
| | Forêt dense sèche dégradée |
| | Forêts claires (miombo) |
| | Forêt sur sol hydromorphe |
| | Forêt de Galerie |
| | Forêt de Mangrove |
| | Forêt secondaire (jeune et vieille) |
| | Savane boisée |
| Non forêt | Eau (surface et lac) |
| | Route (national, provinciale, territoriale et piste) |
| | Mosaïque forêt - savane |
| | Plantations agricoles |
| | Savane herbeuses |
| | Mosaïque champs et villages |

Source : modification de SPIAF et CNIE -1994 (TerraCongo 2014).

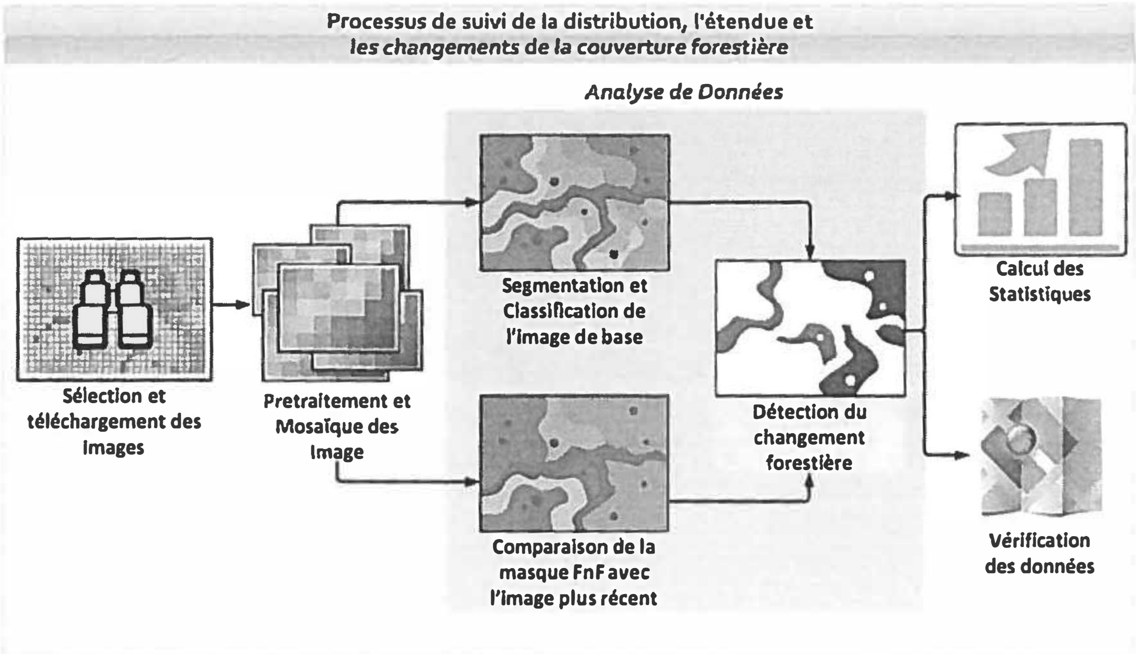
# 4. Méthodologie

Avec les données disponibles à la DIAF, aux autres Directions du Ministères et en Intérêt, la division de géomatique a élaboré une approche méthodologique pour représenter de façon explicite et complète (mur à mur) l'étendu forestier du pays en utilisent comme base la télédétection (IPCC, 2006).

L'approche méthodologique utilisée pour l'élaboration de la carte référence nationale du couvert forestier et leurs changements en République Démocratique du Congo comprend quatre étapes principales (Figure 2Figure 1):

- Les téléchargements des images satellites et organisation des données,
- le prétraitement,
- l'analyse de données satellitaires et
- la vérification des résultats.

*Figure 2 Synthèse méthodologique*




## 4.1. Téléchargement des images satellites et organisation des données

Selon l'échelle de travail, la précision et la disponibilité des images qui permettent cartographier et suivre la couverture de sol, la DIAF a décidée d'utiliser les images satellites Landsat.

Ces images utilisées ont été acquises sur le site d'U.S. Geological Survey (USGS), http://earthexplorer.usgs.gov/ (Figure 2). Due à sa superficie et aux nombres importants des images satellites à téléchargées, il était souhaitable de mettre en place une approche logique et cohérente pour le stockage des données. Premièrement, la liste des images à télécharger a été produite, grâce à la grille d'identification des images Landsat (WRS-2 grid's path and row). Deuxièmement, deux bases de données ont été construites, pour enregistrer ces images. En fin, les images correspondantes et répondant aux critères préalablement définies, par le projet ont été téléchargées.

L'étape de téléchargement a été la plus laboureuse, due au débit limité de la bande passante d'internet disponible à la DIAF, lequel rendait le processus de recherche et des téléchargement d'images très complexe, situation d'autant paradoxale sachant que le site de l'USGS dispose d'une d'interface performante à la visualisation et aux téléchargements des images.

La localisation sous le tropique de la RDC et la pluviométrie (**Erreur ! Source du renvoi introuvable.** a) sont des facteurs limitant à l'obtention des images sans couvertures nuageuses. En outre, les traitements d'images satellites souffrent quelques fois des effets de saisonnalités et de condition d'éclairage du soleil lors de prise de scènes par les satellites, lesquelles engendrent de contrastes non négligeables sur l'apparence des canopées dans les zones forestières dans la cuvette centrale. Ainsi, la compréhension de ce processus est l'un de premier challenge à quoi ce projet c'était fixé, pour disposer d'une mosaïque de 1990 adéquate.

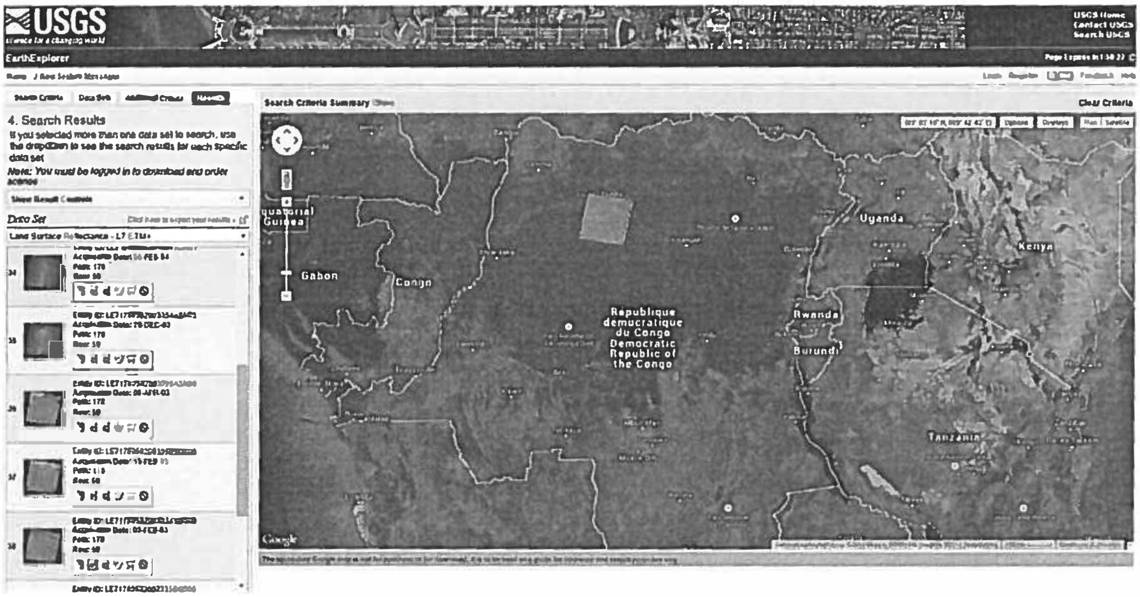



*Figure 3 Portail USGS de recherche et téléchargement des images satellites*

## 4.2. Prétraitement des images satellites

Les prétraitements des images satellites regroupent l'ensemble de procéder appliquer aux données brutes, pour corriger les erreurs géométriques et radiométriques souvent disponibles dans certaines images satellites Level 1 (http://earthexplorer.usgs.gov/), lesquelles sont généralement dues à l'obsolescence des capteurs et quelques fois aux interactions des valeurs numériques des signaux satellites avec celles émises par les aérosols atmosphériques, appelées aussi « bruits atmosphériques ». De manière générale, ces perturbations sont influencées par la densité des activités journalières de l'univers, ces perturbations affectent toutes les images acquises par les satellites passifs, dont les LT 4-5 et 7.

Lorsqu'elles sont réalisées, les prétraitements permettent d'améliorer la lisibilité des images, laquelle est indispensable pour des analyses et traitements ultérieurs, notamment l'extraction d'informations biophysiques à la quantification des phénomènes environnementaux, dont celles en rapport avec couverture forestière qui fait l'objet de ce projet. Notons, qu'aucune correction n'a été effectuée sur les images utilisées dans le cadre du projet TerraCongo. Ceci est dû à la qualité et aux types d'images satellites Landsat utilisées.

Les images satellites Landsat utilisées étaient déjà corrigées avec le code de prétraitement LEDAPS (Masek, et al., 2012). Ces images correspondent aux deux plages des périodes de projets à savoir 1990 et 2010. Les scènes d'images de la saison sèche ont été préférées à celle de la saison de pluie, dans la majorité des provinces de la RDC due à la faible fréquence des perturbations nuageuses (Figure 5). Par ailleurs, une combinaison des scènes prises en saisons sèches et pluvieuses étaient nécessaires, pour amélioration de la qualité des distinctions dans les provinces du Katanga et Bas-Congo dont respectivement l'agressivité des couverts végétales et des phénomènes atmosphériques rencontrées constituent une limitation à l'acquisition des images de bonne qualité.

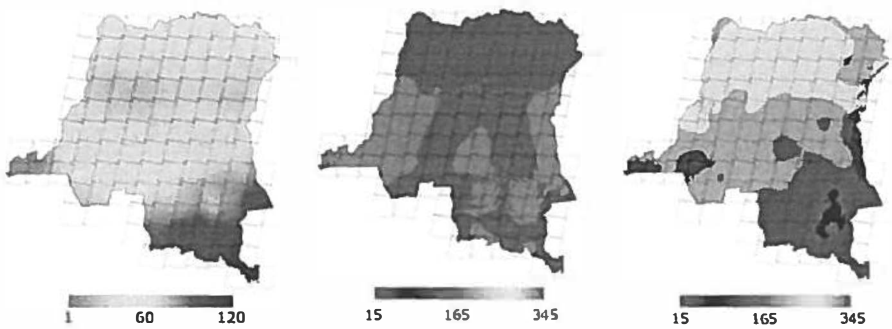



*Figure 4 - Précipitation saisonnière (1) ; - probabilité de pluie minimum par jour (2 ) ; - probabilité de pluie maximum par jour (3) - source : WorldClim*

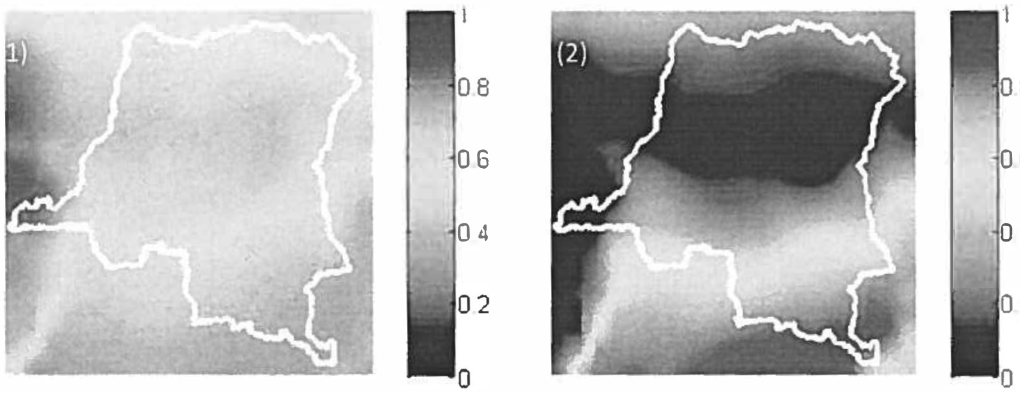



*Figure 5 Distribution des nuages (source : image satellite MODIS) : (1) - moyenne mensuelle ; (2) - fraction saisonnière mensuelle*

### 4.2.1. Transformation de système de référence

La transformation des systèmes de référence avait pour but de convertir les systèmes des coordonnées de l'ensemble des images satellites téléchargées en un système de référence spatiale unique, pour permettre de disposer d'une base de données spatiale harmonisée. Etant donné que la RDC ne dispose pas encore d'un référentiel spatiale, qui représente mieux cette dernière, les images satellites téléchargées (MSS, TM et ETM+) ont été converties de leurs référentielles spécifiques d'origines, pour la majorité « Universal Transverse Mercator » (UTM) en référentielle géographique (WGS 84) et rattacher à ellipsoïde WGS 84.

Les images Landsat téléchargées dans le site de l'USGS avait une projection UTM. La R.D.C est comprise entre quatre zones UTM (figure : 4). Par ailleurs, ces images ont été réprojetées en coordonnées Géographique avant la production de la mosaïque nationale.

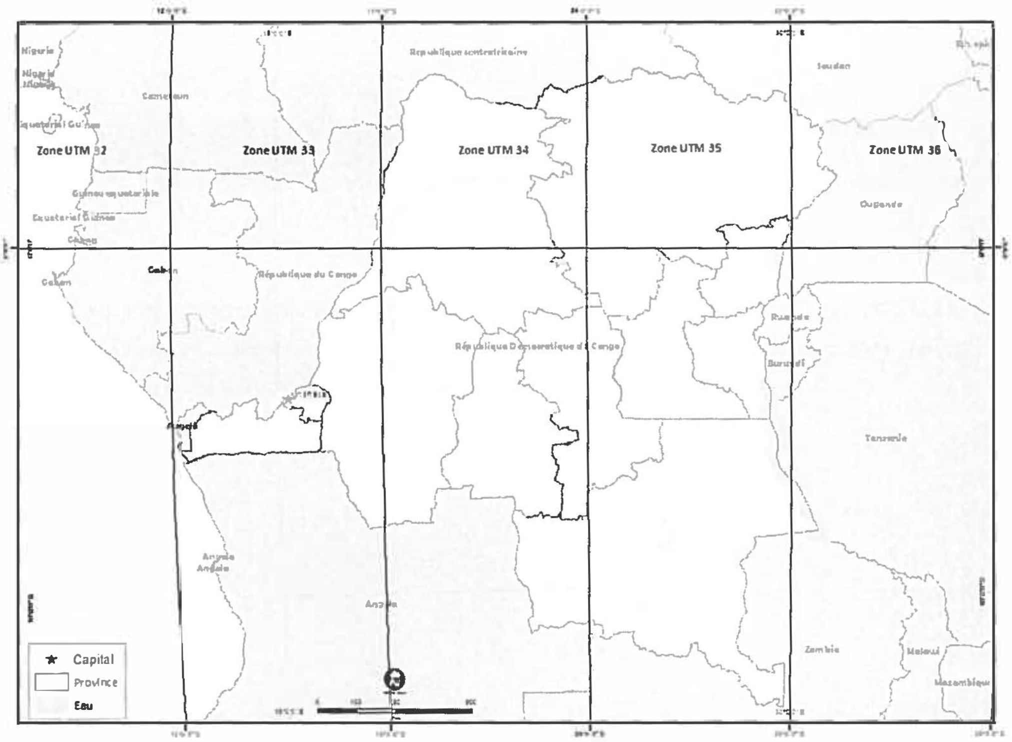



*Figure 6 Répartition de zone UTM pour la RDC*

L'équipe de TerraCongo avait pour l'occasion développée un outil (appelé « **Project Raster By Band** »), sous le module Model Builder d'Esri 10.0 en vue d'automatiser ces processus (Annexe 1.a). La fonctionnalité de cet outil est conditionnée sur une certaine logique architecturale (Annexe 1.b). Les images individuelles devraient être respectivement stockées dans un répertoire en fonction de chacune de province, en suite chaque images de la province nommées d'après la nomenclature de l'identifiant path-row de la grille Landsat (WRS-2 grid's Landsat) stockées aussi dans un répertoire distinct et finalement stocker dans un répertoire parent (UTM).

### 4.2.2. Mosaïque des images

La mosaïque des images est un processus qui permet de lier deux ou plusieurs images adjacentes en une image unique. Cette opération est indispensable, pour l'analyse de données à l'échelle nationale de la RDC. Vue la grandeur de la RDC et due à la performance des outils informatiques disponibles, il n'était pas possible de faire une mosaïque nationale. L'option choisie était de créer des mosaïques partielles par provinces et les fusionnées en suite.

### 4.2.3. Composition colorée

La composition colorée était directement réalisée après la transformation des images. Cette étape vise à combiner les bandes spectrales des images sélectionnées par l'étude aux canaux des couleurs (RGB), en vue de disposer d'une composition colorée fausse couleurs naturelle nécessaire pour identifier des phénomènes environnementaux étudiés. Plusieurs compositions colorées existent (James, 2001) et leurs utilisations dépendent des domaines d'applications. Une composition colorée en fausse couleurs naturelle a été réalisée, pour l'ensemble des scènes du projet. Elle a combiné les bandes spectrales 7 (2,09-2,35 µm) ; 4 (0,77-0,90 µm) et 5 (1,55-1,75 µm) des imagaes Landsat TM et ETM+ aux canaux de couleurs Rouge (R) -Verte (V) – B (Bleu).

Due aux nombres important des images, un outil « Composit Band » a été développé (annexe 2.a et 2.b), pour automatiser ces processus.

## 4.3. Analyse de données

### 4.3.1. Segmentation des mosaïques

Les segments sont des éléments d'entrées indispensables du Projet TerraCongo. Leurs qualités déterminent la durée d'édition manuelle qu'un projet est soumis sur TerraAmazone. La segmentation est un processus très exigent et parfois complexe, qui nécessite des outils (ordinateur) très performants. Dans le cadre de ce projet, la segmentation a été réalisée en fonction de limite provinciale des mosaïques d'images.

Concrètement l'opération a consisté à subdiviser une image brute en multiples polygones. Le logiciel Ecognition Developer 8.7 possède plusieurs types de méthodes de segmentation. Dans le cas de notre travail, nous avions utilisé la segmentation « Multi résolution Segmentation ». Elle fusionne consécutivement les pixels ou des objets d'image existants ayants des valeurs spectrales proches, similaires ou semblables, avec leurs voisins sur la base de critères relatifs d'homogénéité (Figure 7). Ce critère d'homogénéité est une combinaison de critères et de forme spectrale. Les résultats peuvent être modifiés en changeant les paramètres. Deux niveau de segmentation étaient utilisées dans ce projet et les paramètres ci-après ont respectivement permis de construire 2 niveaux de segmentation, notamment une grande (scale 200 ; shape 0,5 ; compactness 0,5) et petite segmentation (scale 70 ; shape 0,5 et le compactness 0,5).

Cette étape est la plus délicates et nécessite d'être réalisée avec beaucoup de prudence et précision, car elle influe sur des processus ultérieurs, notamment la classification numérique.

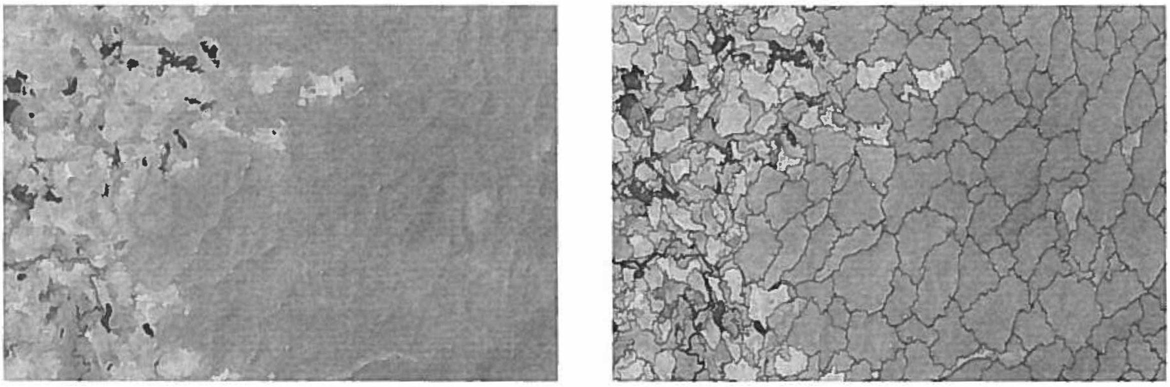


*Figure 7 a ) Image brute ; b) segmentation de l'image de gauche*

### 4.3.2. Pré-classification

La pré-classification s'est réalisée automatiquement grâce à un outil développé sur le Model Builder d'Esri appelé « **Calcul Forest No forêt** » (annexe 3.a et 3.b), qui est une adaptation du modèle de mélange linéaire (INPE, 2013). Cet outil permet d'extraire automatiquement d'une part l'information de surfaces forestières sur base d'une combinaison des valeurs moyennes caractéristiques des profils horizontales d'entrainement réalisés aléatoirement sur la bande spectrale 5 (SWIR) de l'image Landsat et d'autre part extrait l'information associée à couverture non forestières contenues dans la bande spectrale 7 (MIR), par la même procédure que celle précédemment décrite. Les deux bandes spectrales successivement détaillées, ont été choisies puisque leurs réflectances permettent de distinguer respectivement l'état de la végétation forestière, fréquemment utilisée lors des études d'analyse descriptive du couvert forestier. Alors que la bande 7 permet de séparés terre et l'eau fortement, la band 7 permet donc de voir clairement les aires de sol nu et les roches.

En plus des informations des deux bandes spectrales 5 et 7, l'indice de végétation (NDVI) fréquemment utilisée en télédétection optique a été complété, car c'est un bon indicateur pour les suivis d'état du couvert forestier (Justice, Townshend, Holben, & and Tucker, 1985). Cet indice sans dimension mesure le bilan énergétique absorbé et émise par la surface de la terre. De manière générale, le NDVI correspond à la fraction normalisée, qui combine les réflectances mesurées dans le canal du proche infrarouge (PIR) : 0,7-0,9 µm et celui du rouge (R) : 0,63 - 0,69 µm. Cet indice varie entre -1 et +1. Il est calculé par l'expression mathématique suivant :

$$\mathrm{NDVI} = \frac{\rho bande\ 4\ (PIR) - \rho bande\ 3\ (R)}{\rho bande\ 4\ (PIR) + \rho bande\ 3 (R)}$$

Avec :

- *NDVI* : Normalized Difference Vegetation Index. Dans la pratique les valeurs négatives et proche de 0 correspondent à l'eau et les sols dénudés, tandis que celle très élevées correspondent aux surfaces végétales.
- $\rho bande\ 4$: réflectance ou la radiance de la bande spectrale proche infrarouge et
- $\rho bande\ 3$ : réflectance ou la radiance de la bande spectrale rouge

### 4.3.3. Classification masque forêt /non forêt

Après avoir identifiées les types d'occupation du sol (lors de missions anticipatives réalisées sur les terrains, des Experts SIG/RS du projet TerraCongo utilisent), ces informations sont combinées pour générer des couches thématiques finales au moyen de Terra Amazone, par une procédure édition manuelle.

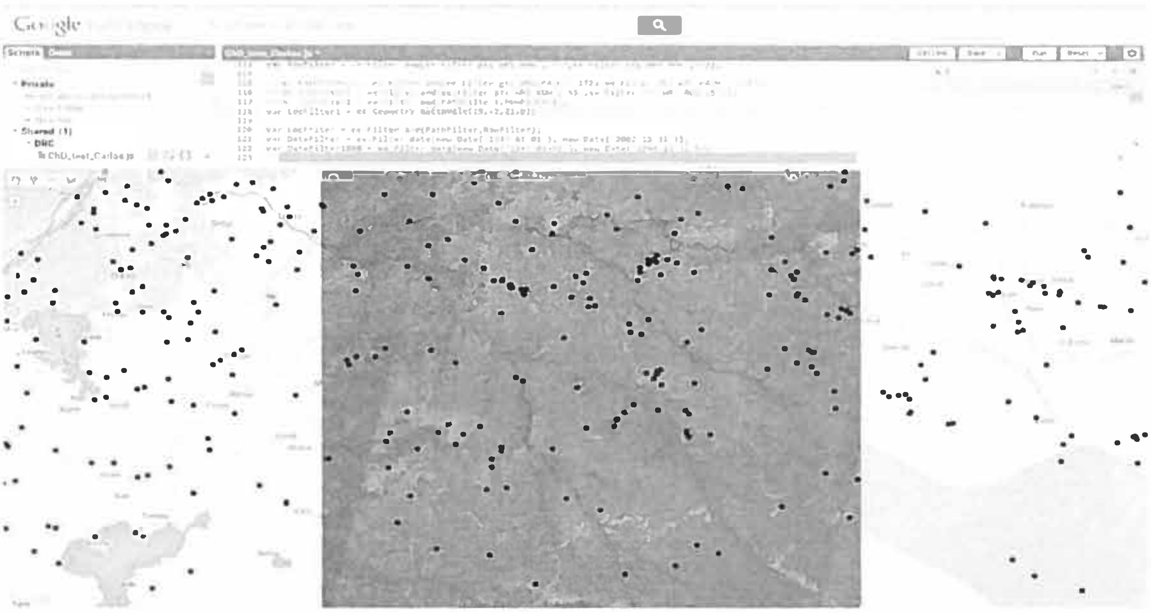
Dans le cadre du projet TerraCongo et en rapport avec les objectifs évoqués ci-haut (1.2), lequel consiste à produire une cartographie de référence nationale de la RDC (année 1990) et en suite leurs changements (année 2010). Les processus de classifications mise en place avaient permis de produire des couches thématiques finales, soient la couche Forêt et la couche Non forêt (pour l'année de référence 1990), en se basant sur la stratification forestière du Ministère d'Environnements Conservations de la Nature et Tourisme (MECNT), comme évoquer dans la sous 3 (Eléments d'occupation du sol). Ainsi, sont regroupés dans le couche thématique « Forêt », dans le cadre du projet TerraCongo : les écosystèmes forestiers comprennent les forêts (de production permanente ; de forêts protégées et les forêts classées) et arbustes développées sur une superficie au moins un hectare, disposant d'une hauteur supérieur à 5 mètre (Code Forestier RDC, 2002) et dont la densité de canopée est supérieur à 30%. Finalement, dans la couche finale « Non Forêt » des entités environnementaux et artificielles qui ne sont pas de forêts.

## 4.4. Détection de changement

La détection de changement de la période 1990-2010 s'est basée sur l'analyse multitemporelle des mosaïques 1990 et 2010, faite avec un script encodé en java script en utilisant la bibliothèque et les méthodes de Google Earth engin (https://ee-api.appspot.com)

L'analyse de la détection suit les étapes ci-après :

1. Filtrage des images par date, jour julien, zone d'intérêt et année de référence
2. Sélection des images par capteur : 1990 Landsat 4 et Landsat 5 ; 2010 Landsat 5 et Landsat 7
3. Sélectionner le meilleur pixel disponible dans les deux périodes en utilisant la fonction « addqa » du script. Cette fonction sélectionne le pixel sur la base de filtre construit dans le point 1, elle tient compte la température des pixels pour filtrer les zones nuageuses et le NDVI.
4. Composition de chaque bande avec le meilleur pixel sélectionné dans le point antérieur.
5. Calcul des ratios (index) entre B3/B4, B3/B5, B3/B7, B4/B5, B4/B7, B5/B7
6. composition de la mosaïque multitemporelle avec les 8 bandes et les 12 ratios des deux périodes.
7. Prise des échantillons et classification des échantillons en forêt stable, non foret stable et déforestation pour entrainer le script.
8. Classification du mosaïque en changement négatif ou en non changement.
9. Exportation des résultat en Google drive.



## 4.5. Vérification et validation

La vérification des classifications a été réalisée grâce à un outil **Collect Earth** (figure 7) développé par l'équipe de la FAO Rome. Ce dernier est un logiciel qui est en interaction avec des deux bases de données d'images satellites Google Earth ® et celle de Bing de Microsoft. Un jeu de points - (920 points avec des coordonnées longitude et latitude) a été tirée aléatoirement de la couche résultats de classifications de l'année de référence de l'ensemble de la RDC. Ces points ont été ensuite chargés sur Collect Earth en vue de vérifier la précision des résultats de classifications du projet TerraCongo.

A l'aide de l'interface de Collect Earth (figure 7), l'expert SIG/RS de projet TerraCongo pouvait vérifier le point de la couche finale évaluée, pour identifier l'état des forêts simultanément sur les deux interfaces d'images satellites de Google Earth ® professionnel et Bing de Microsoft grâce aux outils disponibles sur ces moteurs d'archive d'image satellite. Les informations vérifiées sont implémentées sur la base de données de vérification en vue de produire une matrice de confusion, des résultats évalués.

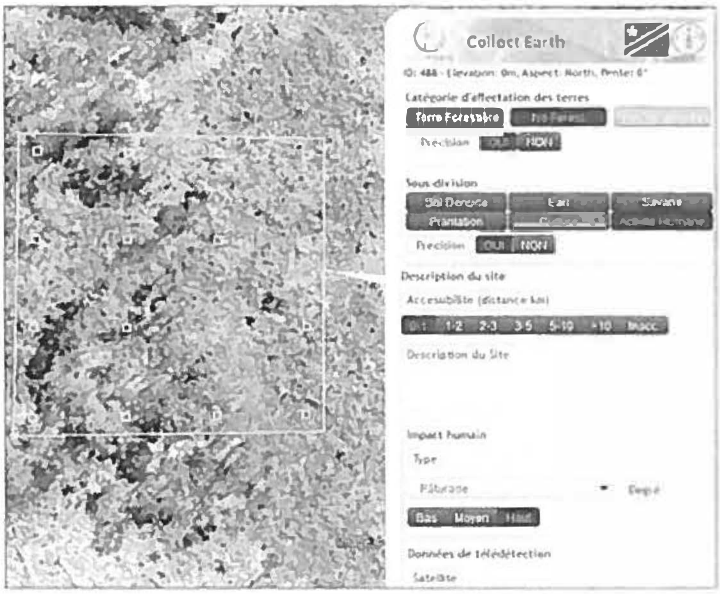



***Figure 8 Vérification des résultats de couvert forestier de référence (1990) sur Collect Earth***

La matrice de confusion et des analyses de vérifications des résultats de classifications de la couverture forestière de référence de la République Démocratique du Congo de l'année 1990 a été évaluée selon l'approche développée par Olofsson et al., (2014).

# 5. Résultats

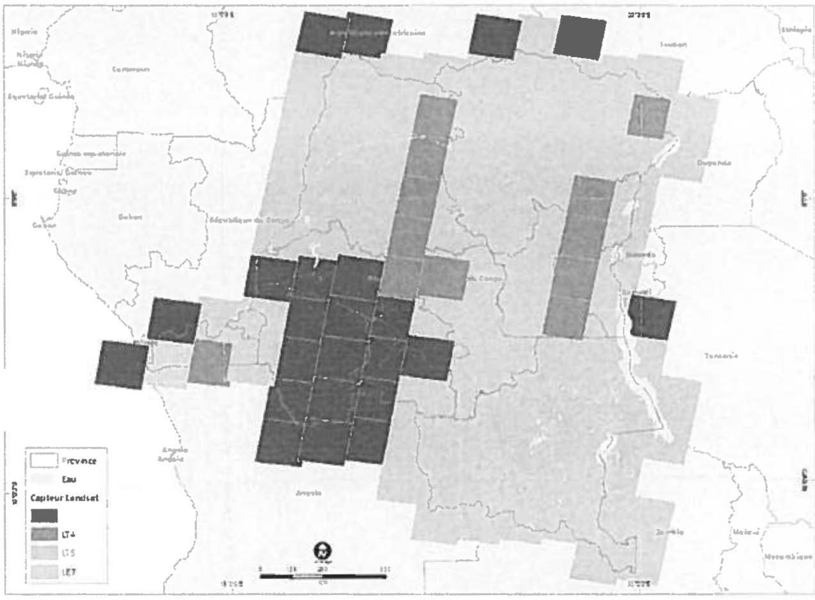
## 5.1. La base de données Landsat de l'année de référence

La Figure 8 présente (a) les images satellite Landsat (MSS, TM et ETM+) téléchargées et (b) les années d'images satellites qui ont été traitées, pour la production de la cartographie du couvert forestier de référence de la République Démocratique du Congo.

FIGURE 8

Base de données de référence des images satellites Landsat 1990

(a)




(b)

Au total 120 images satellites Landsat ont été stockées dans la base de données des images de référence du projet TerraCongo. La lecture de résultat de la figure 8.a montre que 70% des images utilisées dans ce projet ont été acquises par les capteurs (MSS et TM) de satellite Landsat 5, suivie des celles acquises par le satellite Landsat 4 (10%). En fin, la nomenclature d'enregistrement initialement adopté en début du projet n'avaient pas permis d'identifié les images satellites Landsat stockées de la base de données en fonction de les types des capteurs et satellites (scènes Landsat en couleurs rouge).

Le résultat de la figure 8.b démontre une proportion équilibrée des nombres des images téléchargées et utilisées en fonctions des années d'acquisitions par les capteurs respectives. La majorité des images qui constituent la base de données de référence étaient prises à l'année 1986 (30%) et la plus faible proportion se rapporte à l'année 1984 (1,66%).

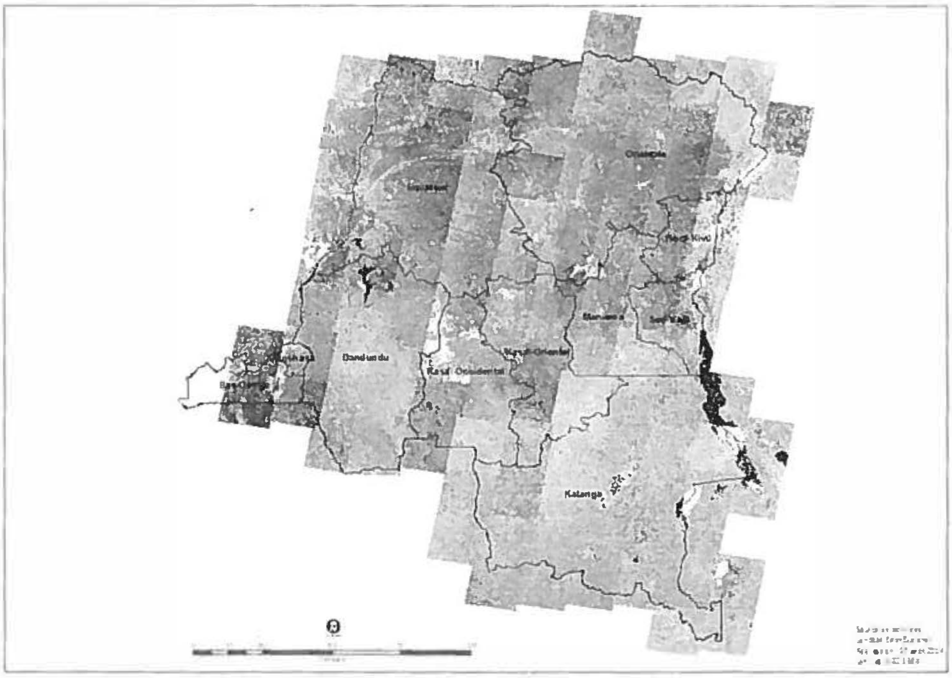
## 5.2. Mosaïque d'image de l'année de référence

La figure 9 montre la mosaïque produite partant des images téléchargées et disponibles dans la base de données de référence du projet TerraCongo. Cette mosaïque dispose d'une particularité, celle d'avoir une couverture nuageuse très marginale et localisées essentiellement, dans la partie Ouest de la province de Kasaï occidental. Cette situation la confère une aptitude d'être qualifiée d'un bon produit aux regards, des limitations des couverts nuages fréquemment enregistrées dans les images satellites optiques acquises à travers les tropiques et dans certaines provinces de la RDC.

La province du Bas-Congo avait deux images satellites téléchargées n'ont traitées due à leurs fortes quantités de nuages (supérieur au seuil de critère définit par le projet TerraCongo : >30%), les autres provinces ont présenté des taux de nuages nulles, due à la mise en place de l'approche de substitutions des scènes d'images nuageuses à celle non nuageuses adoptées dans ce projet.

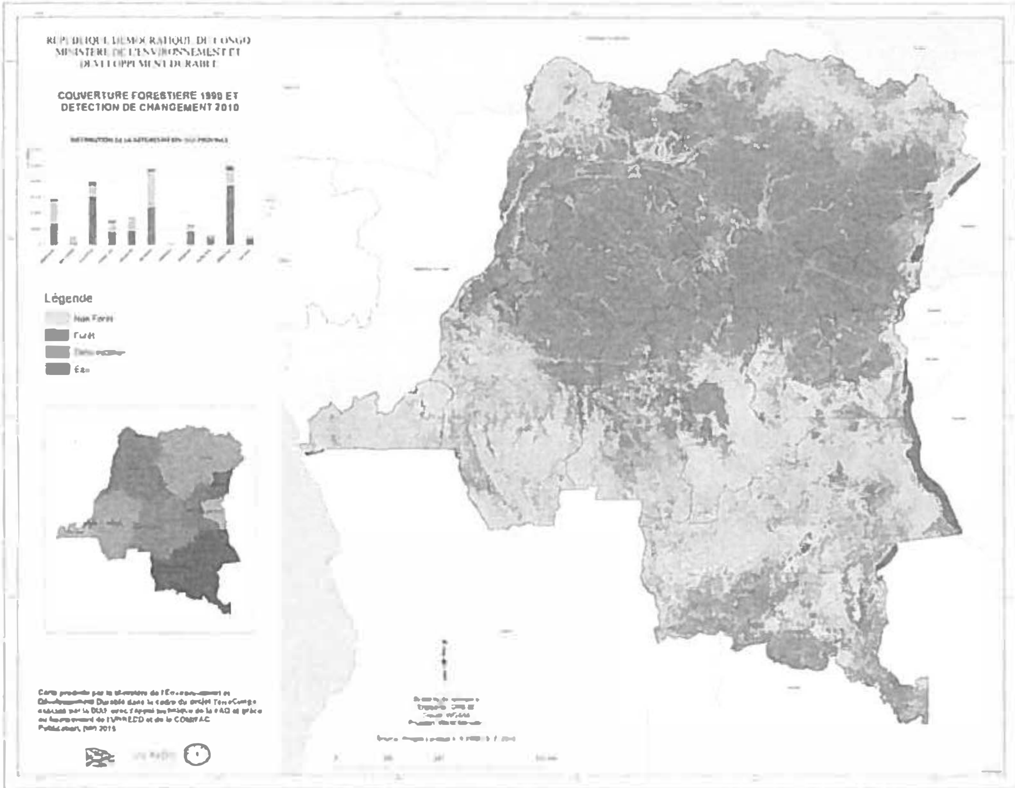
FIGURE 9

Mosaïque des images satellites de référence de la couverture forestière 1990 de la RDC



## 5.3. Evaluation de changement du couvert forestier entre l'année de références 1990 et 2010

### 5.3.1. Carte de détection de changement du couvert forestier (1990 - 2010)



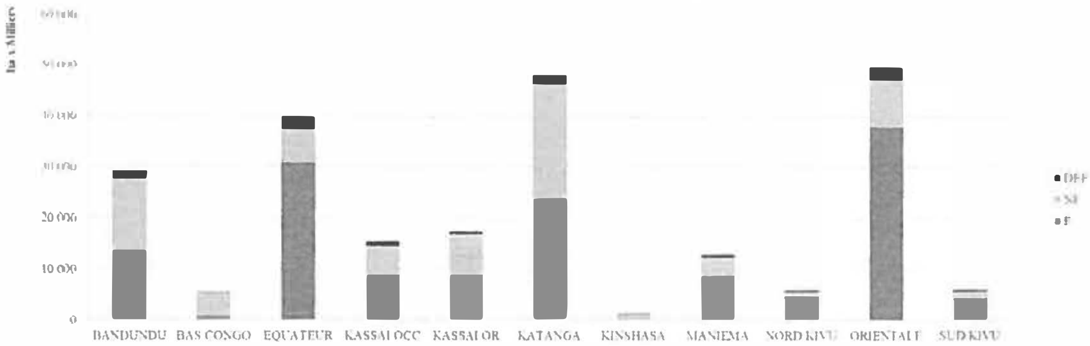

### 5.3.2. Analyse des Résultats de la détection de changement par province.

Le résultat de l'estimation de la couverture forestière en 1990 et la détection de changement négative à 2010 donne un taux de déforestation annuel relative à la superficie forestière de 0,31% +/- 0,042% et un taux de déforestation annuel absolu de 0,21% +/- 0,04%.

Les principales provinces forestières sont : orientales, Katanga, Equateur et Bandundu, les 4 ont 74% du couvert forestier. Cependant elles ont le taux de déforestation les plus élevés du pays ; en total elles ont perdu 47 millions d'hectares qui correspondent au 73% de la superficie déforestée dans la période évaluée.

Cette analyse a permis de confirmer le point chaud de déforestation : Kisangani, Watsha, Wamba, Plateau de Bateke, Kananga, Gemena, Lisala, Bumba

DISTRIBUTION DE LA DÉFORESTATION PAR PROVINCE




| Province | F | NF | DEF | EAU | Total |
|---|---|---|---|---|---|
| BANDUNDU | 13637684 | 14138471 | 1581209 | 432631 | 29789994 |
| BAS CONGO | 1020162 | 4313753 | 69369 | 40860 | 5444143 |
| EQUATEUR | 30849820 | 6611776 | 2450661 | 551757 | 40464014 |
| KASAI OCC | 8702304 | 5603503 | 1078784 | 62409 | 15447000 |
| KASAI OR | 8934848 | 7799795 | 535617 | 28972 | 17299233 |
| KATANGA | 23784851 | 22609281 | 1619326 | 1686114 | 49699572 |
| KINSHASA | 85028 | 964744 | 33234 | 21634 | 1104640 |
| MANIEMA | 8701318 | 3451631 | 600182 | 58738 | 12811868 |
| NORD KIVU | 4711398 | 680129 | 440625 | 164047 | 5996200 |
| ORIENTALE | 38060811 | 9131365 | 2597351 | 474907 | 50264434 |
| SUD KIVU | 4323167 | 1258292 | 329764 | 506602 | 6417824 |
| Total | 142811389 | 76562740 | 11336122 | 4028671 | 234738922 |

Tableau : Distribution d'affectation des aires en hectare et par province

| Province | F | NF | DEF | EAU |
|---|---|---|---|---|
| BANDUNDU | 10% | 18% | 14% | 11% |
| BAS CONGO | 1% | 6% | 1% | 1% |
| EQUATEUR | 22% | 9% | 22% | 14% |
| KASAI OCC | 6% | 7% | 10% | 2% |
| KASAI OR | 6% | 10% | 5% | 1% |
| KATANGA | 17% | 30% | 14% | 42% |
| KINSHASA | 0% | 1% | 0% | 1% |
| MANIEMA | 6% | 5% | 5% | 1% |
| NORD KIVU | 3% | 1% | 4% | 4% |
| ORIENTALE | 27% | 12% | 23% | 12% |

| | | | | |
|---|---|---|---|---|
| **SUD KIVU** | **3%** | **2%** | **3%** | **13%** |

Tableau : Distribution relative d'affectation des aires en pourcentage et par province

### 5.3.3. Ajustement de la précision

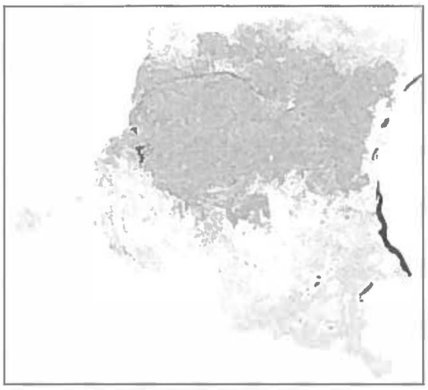
| **Area en Ha - (1 Pixel - 900m2)** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | CollectEarth | | | |
| | | | F | NF | D | Total | |
| ChD | Forêt | F | 442 | 9 | 5 | 456 | 97% |
| | Non forêt | NF | 40 | 264 | 6 | 310 | 85% |
| | Déforestation | D | 20 | 11 | 136 | 167 | 81% |
| | | Total | 502 | 284 | 147 | **933** | |
| | | | 88% | 93% | 93% | | **90%** |

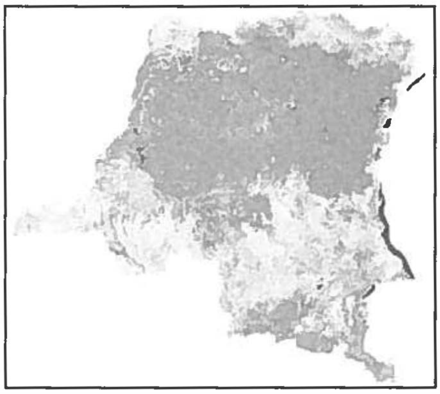
| Classe | Non Ajustée | Ajustée |
|---|---|---|
| Forêt | 142,811 389 Ha | 152,605,529 +/- 3775854 Ha |
| Non forêt | 76,562 740 Ha | 68,496,441 +/- 3645296 Ha |
| Déforestation | 0,37% | 0,314 +/- 0,063% |

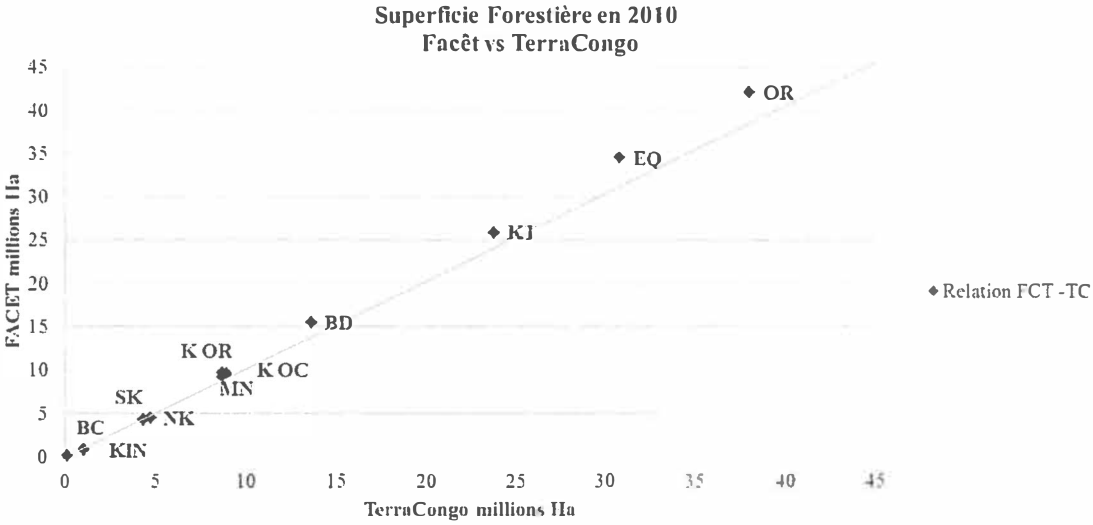
### 5.3.4. Relation FACET - TerraCongo

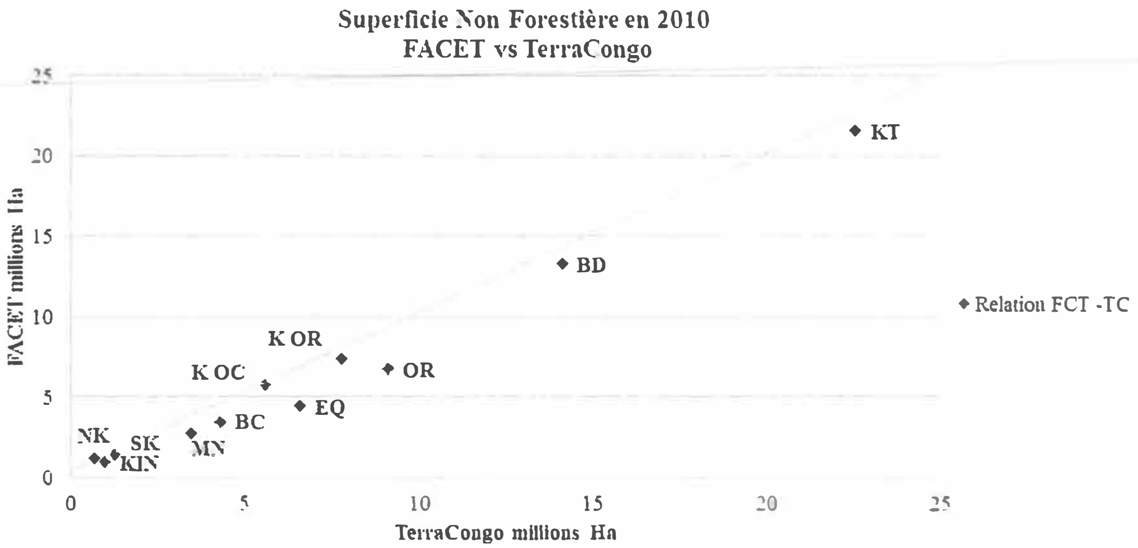
La comparaison entre Facet et Terracongo se résume en ce terme :

La superficie forestière en 2010 entre Facet et TerraCongo, en le comparant par province a un comportement linéaire et presque symétrique entre les deux cartes, tandis que la superficie non forestière entre les deux cartes est moins linéaire mais garde une forte corrélation.










## 6. Conclusion et remerciement

Partant des images satellitaires Landsat téléchargées sur le site des United States Geological Survey (USGS), le Projet TerraCongo est arrivé à produire l'état de lieu de référence des forêts de la République Démocratique du Congo en 1990, appelée « couverture forestière nationale de référence de la République Démocratique du Congo ». L'approche méthodologique développée a conduit à la production d'une mosaïque consistante de référence de la République Démocratique du Congo, laquelle sera utilisée dans la deuxième phase du projet, comme input à l'évaluation des changements des couverts forestiers nationaux et à la quantification des taux de changement nationale entre les périodes 1990 et 2010.

En fonction de ces qui précède, les résultats démontre qu'en 1990 la couverture forestière nationale de la République Démocratique du Congo occupait une superficie de 154 millions d'hectares soit 66 % du territoire national. La majorité de ces forêts était concentrée dans les 7 provinces de la République Démocratique du Congo (notamment les provinces de l'équateur, Orientale, Nord-Kivu, Maniema, Sud-Kivu, Kasaï Orientale et Bandundu), dont les trois premières constituent des provinces forestières de la République Démocratique du Congo.

L'analyse de changement a permis de confirmer le point chaud de déforestation : Kisangani, Watsha, Wamba, Plateau de Bateke, Kananga, Gemena, Lisala, Bumba.

L'analyse a permis d'avoir un résultat suivant de superficie forestière et non forestière avec des ajustement et des non ajustement suivant : 142,8 Mah (non ajusté) et 152 Mah +/- 3Mha (ajusté) pour la foret et 76Mha (non ajusté) et 68Mha+/-3Mha (ajusté) pour non foret.

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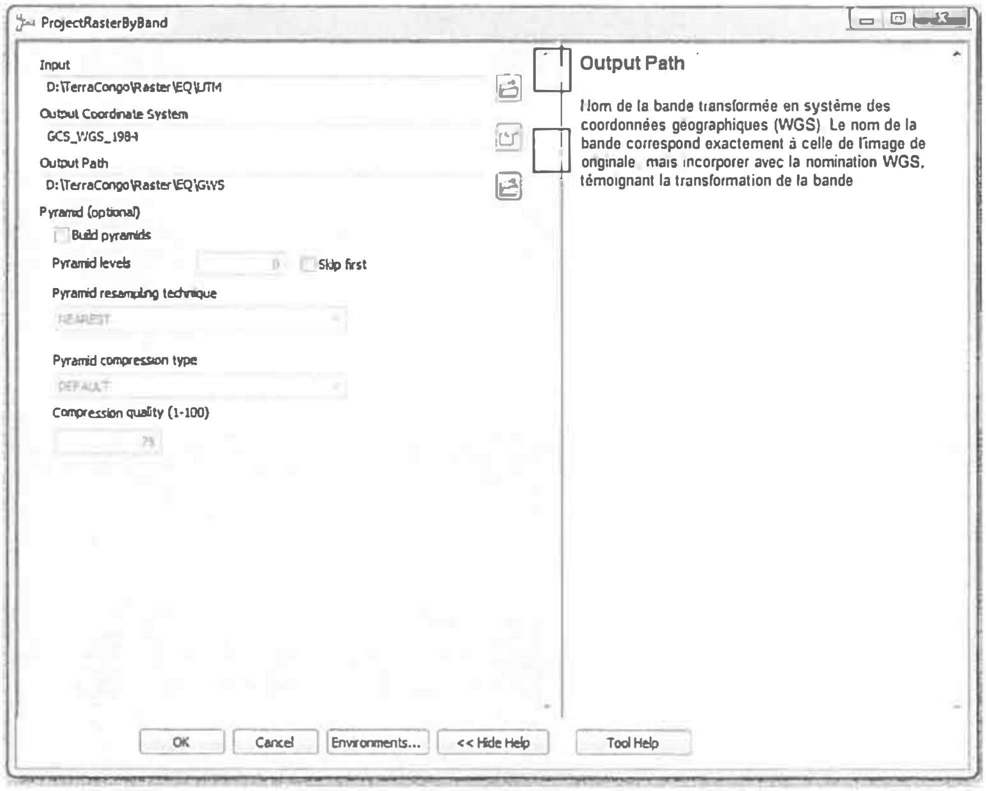
http://www.nasa.gov/

http://earthexplorer.usgs.gov/

# 8. Annexes

## 8.1. ANNEXE 1

(a) Boite de dialogue de l'outil Project Raster By Band



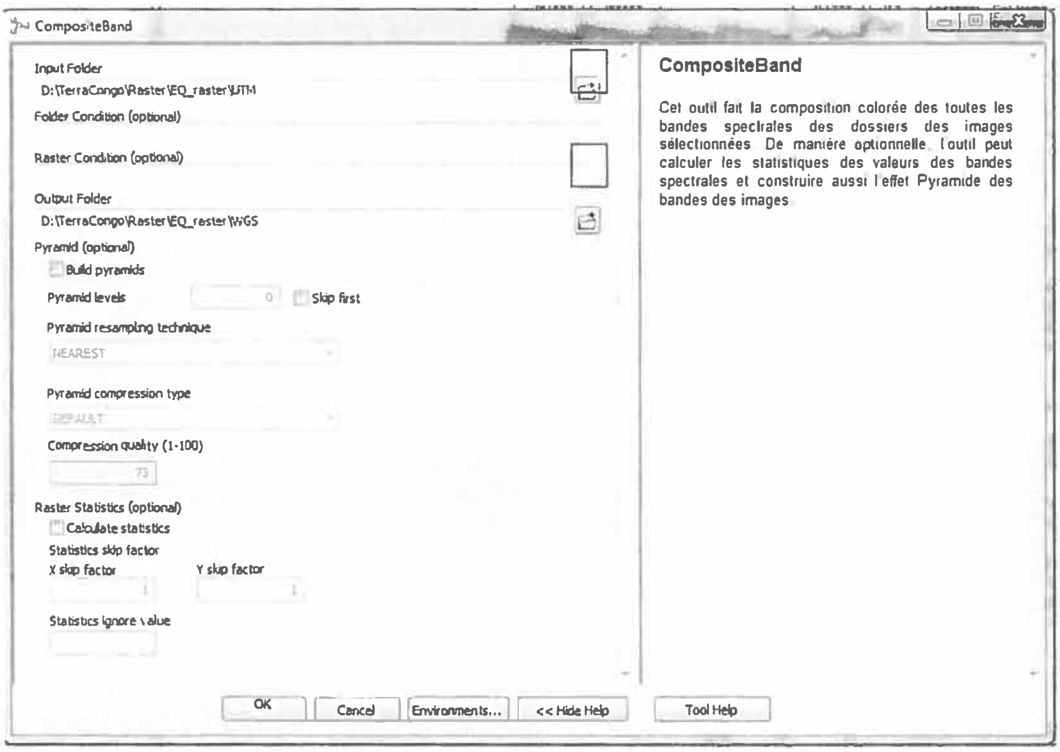

(b) Item descriptive de l'outil Project Raster By Band

| Paramètres du model | Description | Format des données |
|---|---|---|
| Input | Répertoire ou sont stockés les dossiers des images brutes téléchargés et/ou acquises auprès des tiers, en fonctions des années sélectionnées et destiner à subir la transformation | Dossier UTM |
| Output Coordinate System | Les systèmes de coordonnées des images de sorties | Opérateur de transformation |
| Output Path | Illustre le chemin de localisation et/ ou d'enregistrement des dossiers des images transformées en système des coordonnées géographiques (WGS). Les bandes spectrales sont nommées WGS après leurs transformations. | Dossier WGS |

* Outil (model) développé grâce au Moel Builder d'Esri, par l'équité TerraCongo et fonction sous Arc GIS 10.x

# 8.2. ANNEXE 2

(a) Boite de dialogue de l'outil Composit Band



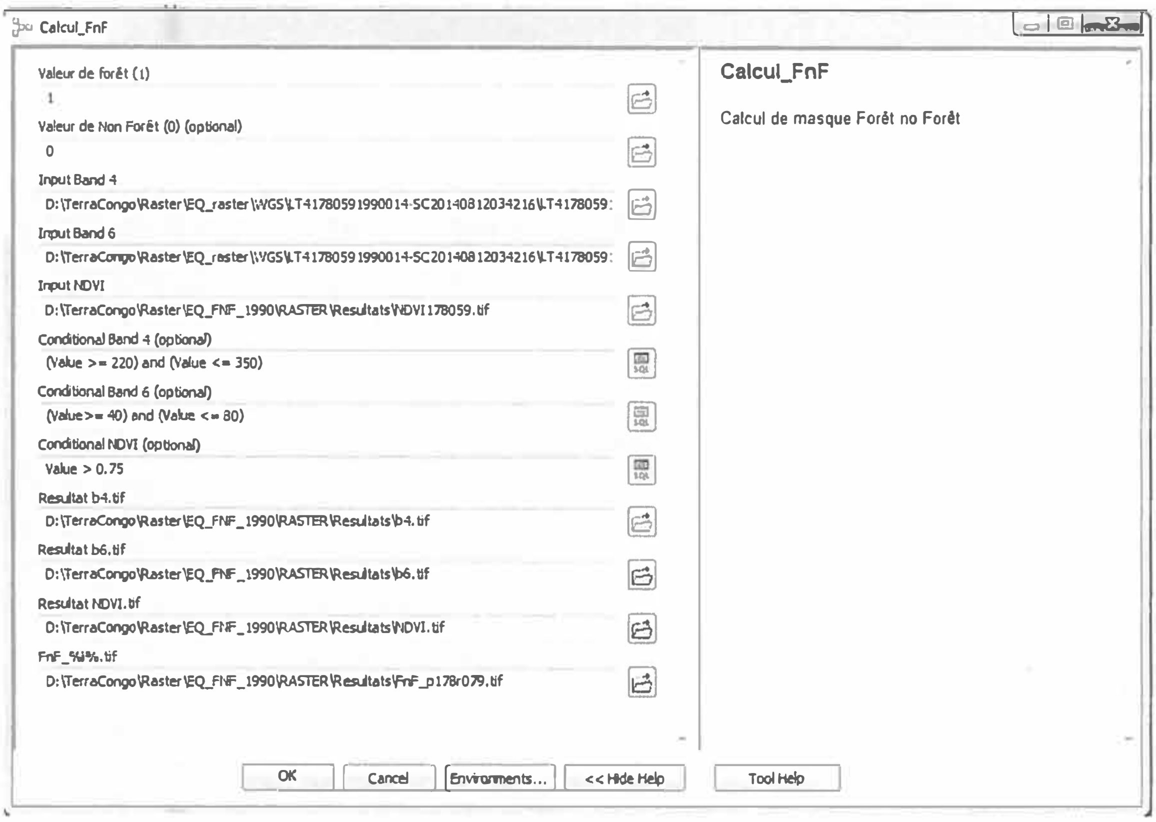

(b) Item descriptive de l'outil Composit Band

| Paramètres du model | Description | Format des données |
|---|---|---|
| WGS | Répertoire ou sont stockés les dossiers des images brutes transformés en WGS, en fonctions des années sélectionnées et destinées à subir une composition colorée. | Dossier WGS |
| Folder Condition (optional) | Cet onglet permet de définir les sous dossiers sur lequel devront être faites la composition colorée. | String |
| Raster Condition (Optional) | Cet onglet permet de créer une restriction sur les bandes spectrales qui devront être associées, lors de processus de composition colorée | String |
| Output Path | Chemin de localisation des images composées | Dossier WGS |

* Outil (model) développé grâce au Moel Builder d'Esri, par l'équité TerraCongo et fonction sous Arc GIS 10.x

## 8.3. Annexe 3

(a) Biote de dialogue de l'outil Calcul Forest/ No Foret




(b) Item descriptive de l'outil Calcul Forest No Forest

| Paramètres du model | Description | Format des données |
|---|---|---|
| Valeur de forêt | 1 pour illustrer la forêt | String |
| Valeur de Non forêt Zéro (0) Optional | 0 pour illustrer la non forêt | String |
| Input Bande 4 | La bande 4 : proche infrarouge. Elle permet de distinguer une forêt au sein d'une scène d'image satellite | .tif |
| Input Bande 7 | La bande 7 : moyenne infrarouge. Elle permet de distinguer la non forêt dans une scène d'image satellite | .tif |
| Input NDVI | La couche de NDVI préalablement calculée partant des bandes spectrales associées | .tif |
| Conditional Bande 4 (optionla) | Les valeurs inférieures et supérieures associées à la bande spectrale proche infrarouge, qui facilitera la distinction de la forêt des autres composantes de l'écosystème dans une scène d'image satellite | String |

| | | |
|---|---|---|
| Conditionnel Bande 7 (optional) | Les valeurs inférieures et supérieures associées à la bande spectrale moyenne infrarouge, qui facilitera la distinction des non forêts des autres composantes de l'écosystème dans une scène d'image satellite | String |
| Conditionnel NDVI (optional) | La condition optimale permettant la distinction des forêts sur une scène | |
| Résultat b4 | Résultat de la bande proche infrarouge | .tif |
| Résultat b6 | Résultat de la bande moyenne infrarouge | .tif |
| Résultat NDVI | Résultat de NDVI | .tif |
| FnF_%i% | Résultat masque forêt non forêt : une carte dont la valeur 1 : illustre la répartition des forêts dans une scène et 0 : la non forêt | .tif |

* Outil (model) développé grâce au Moel Builder d'Esri, par l'équité TerraCongo et fonction sous Arc GIS 10.x

## 8.4. Annexe 4

Exemplaire de fiche de vérification de résultat sur terrain

**Ministère de l'Environnement, Conservation de la Nature et Tourisme**
**Direction des Inventaires et Aménagement Forestiers - DIAF**
**Projet : Système de Surveillance de Terre par Satellite**

**Fiche de Terrain**

UN-REDD
PROGRAMME

**Tronçon :** ____________ **Équipe :** ____________ Code de l'équipe : ____________

Technicien: ____________ **ID point GPS:** ____________ Date | | /12/2013

Coordonnées du point - système géodésique **WGS84**, format dd.ddddd Heure: | | |

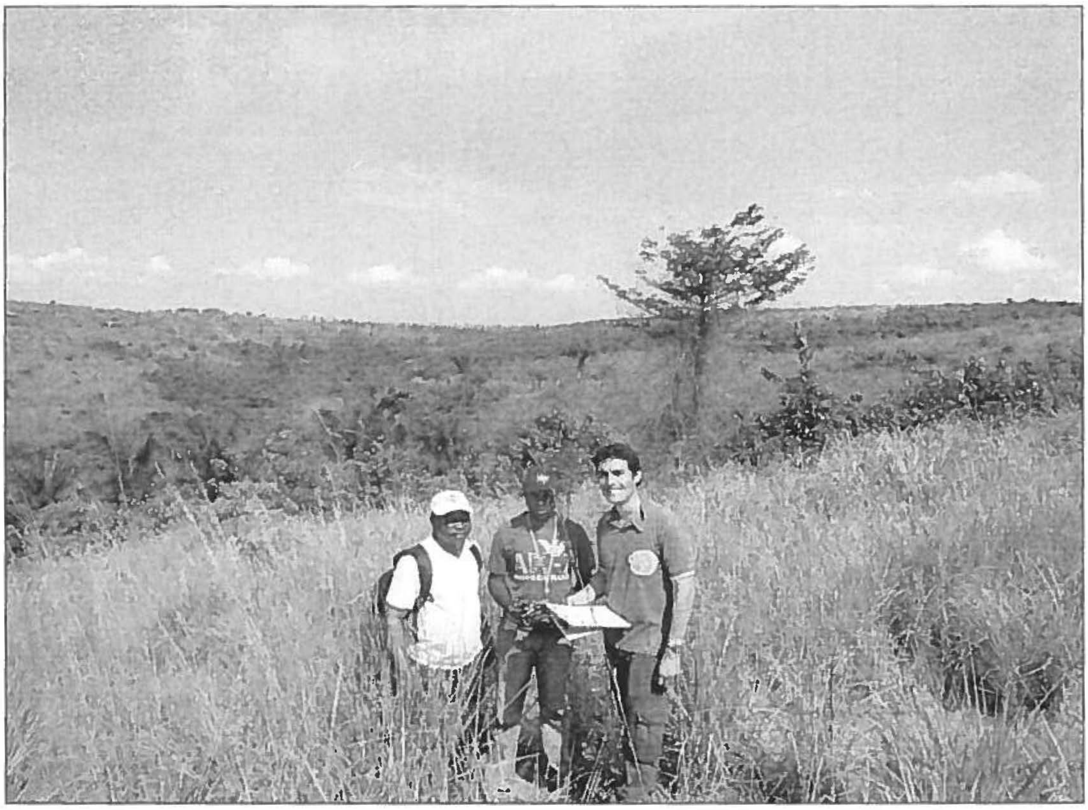
**Latitude Y (S ou N) :** ____________ **Longitude X (E ou W) :** ____________

Photo N ____________ Photo E ____________

Photo S ____________ Photo W ____________

Couverture ____________ Cod ____________

**Observations** ____________



© Equipe TerraCongo, (2014): Validation sur Terrain, dans la province de Kasaï Occidentale, 2013