RHINOWATCH SURVEY REPORT

CHIRISA SAFARI AREA
AND SENGWA WILDLIFE RESEARCH AREA
1992

A SYSTEMATIC GROUND SURVEY
OF BLACK RHINO

by

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Black Rhino emerging from wallow in the Sengwa Wildlife Research Area (Alibhai/Jewell)

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1 INTRODUCTION

1.1 THE PROJECT BACKGROUND

The world Black Rhino (*Diceros bicornis*) population is facing a severe crisis. It has declined dramatically over the last twenty three years. In 1970, an estimated 65,000 animals cut a huge swathe across the African continent, extending from Senegal in the far west to Somalia in the east and covering large areas of East Africa, all the way into Angola, Botswana, Namibia, Zambia, Mozambique, Zimbabwe and South Africa. However, by 1987 this population had been decimated to less than 4,000 (Cumming *et al.*, 1990), and the latest estimates suggest that the world population of this magnificent animal may be less than 2500 (Redmond, 1993). Fig. 1 and Table 1 show the present distribution of the Black Rhino in Africa (data from Redmond, 1993). The Black Rhino has been lost from much of its' original range, and currently only three countries are thought to have growing populations - Namibia, South Africa and Kenya (Redmond, 1993).

The cause of this catastrophic decline is the illegal poaching of animals for their horn. The horn is used primarily in Asian countries as an ingredient in traditional medicines, but has also been used extensively for making ceremonial dagger handles in the Yemen. Although the Black Rhino is protected from legal international trade under CITES Appendix I, the black market value of the African horn to the retailer is currently as much as $10,286 a kilogramme and there is thus a strong financial incentive to illegally poach the horn (Bradley-Martin, 1993)

Several different approaches have been used in attempts to protect the remaining animals. Despite much effort, control of the illegal international trade in Rhino horn has proved very difficult, partly because of the difficulty in tracing the trade routes and also because the use of Rhino horn is a culturally entrenched tradition (Bradley-Martin, 1993). Although recently some progress seems to have

COUNTRY	1990	1993
ZIMBABWE	1700	400
RSA	625	780
KENYA	400	410
NAMIBIA	400	450
TANZANIA	185	185
ZAMBIA	40	5
CAMEROON	15	50
RWANDA	9	0
ETHIOPIA	6	0
MALAWI	5	5
BOTSWANA	2	10
CHAD	2	0
SWAZILAND	2	6
MOZAMBIQ.	0	50
ANGOLA	0	50
UGANDA	0	3

TABLE 1. ESTIMATED POPULATIONS OF BLACK RHINO IN AFRICA (DATA FROM REDMOND (1993)).

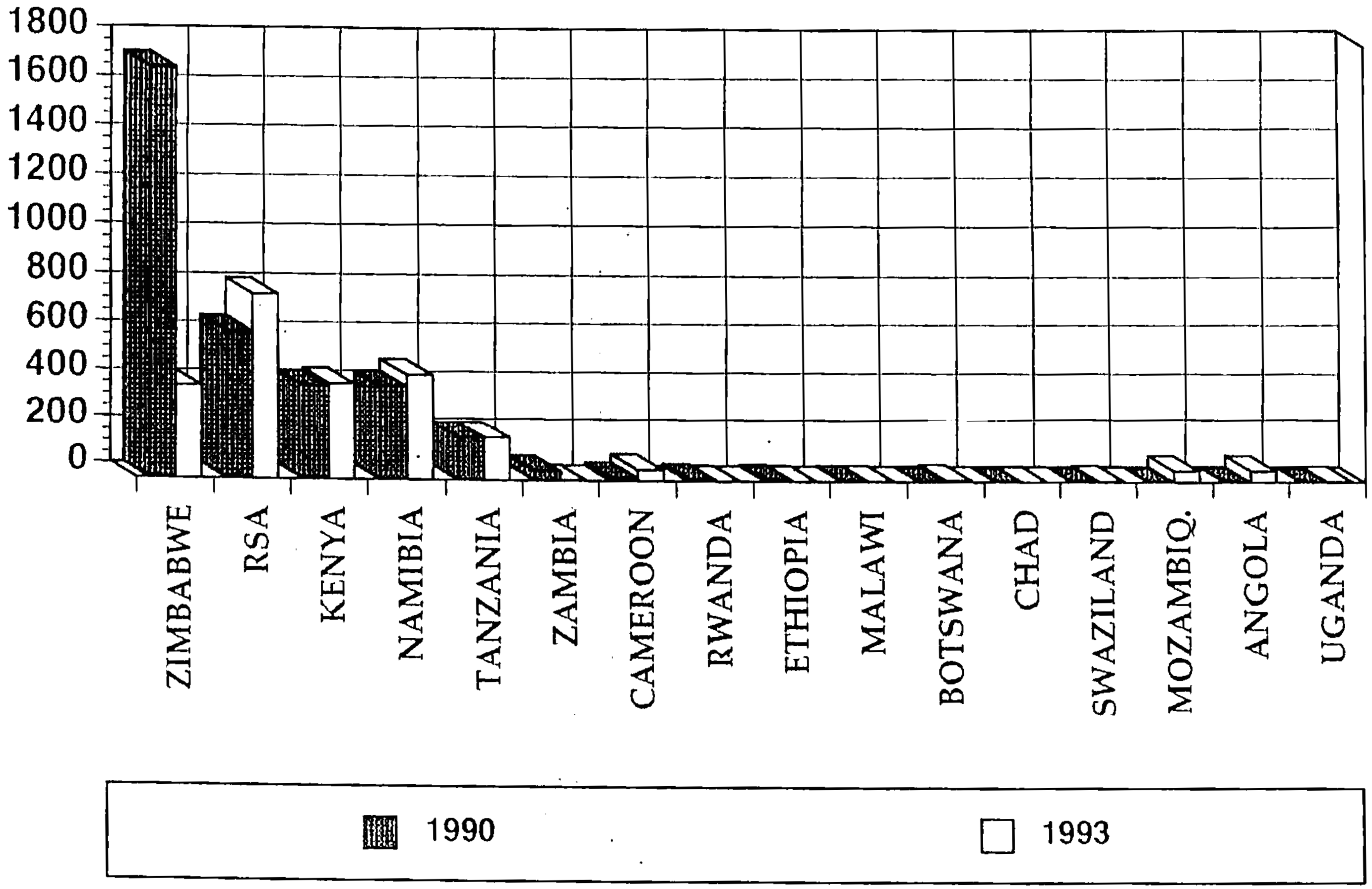


FIG. 1. ESTIMATED POPULATIONS OF BLACK RHINO IN 1990 & 1993 IN DIFFERENT COUNTRIES IN AFRICA (DATA FROM REDMOND (1993)).

been made in this area, it is not sufficient to guarantee the future safety of the Rhino. Protecting existing populations on the ground has been most successful where animals have been locally translocated to areas small enough to patrol and fence adequately (du Toit, pers. comm.). Effective protection of a low-density population in a large area is only feasible if sufficient financial resources are available or the poaching threat is small. Nevertheless, whether in game reserves, or larger areas, the effective protection of animals *in situ* is many times more cost-effective than attempts at protection through captive breeding (Leader-Williams, 1993) (Alibhai & Jewell, unpubl. - see Appendix 3).

Given that attempts at controlling the illegal trade in Rhino horn might not succeed before the wild population has been eliminated, and that captive breeding replacement rates for the Black Rhino are running at a negative value, it is vital that urgent attention be focused on protection of this species *in situ* .

In order to implement an effective management strategy for any *in situ* population, it is essential to have accurate, current information on the abundance and distribution of that population. Any strategy implemented without such information could constitute a waste of valuable and often scarce resources. Despite the threatened status of all five of the world's Rhino species, very little reliable census data for any of these species has been available, and many conservation policy decisions have been based on "guesstimates" (Cumming *et al,* 1990). RHINOWATCH was established in 1990, with the aim of providing reliable, current census data for Rhino populations to those responsible for formulating Rhino conservation policies (See Appendix 4).

In 1990, when RHINOWATCH was established, Zimbabwe was thought to have more than half of the world population of Black Rhino (1700 animals) (Cumming *et al,* 1990) and was considered the last stronghold for this species. In particular, the SEBUNGWE region was thought to have the largest single contiguous Black Rhino population in the world. However, these estimates were based on non-specific and generally unreliable surveys, which in some cases had been carried out many years earlier (Cumming *et al*, 1990). RHINOWATCH, in conjunction with the Zimbabwean Department of National Parks and Wildlife Management agreed to undertake a thorough ground census of the Black Rhino in a part of this region - the Chirisa Safari Area and Sengwa Wildlife Research Area. The resulting information on population density and distribution in this area would be made available to the Zimbabwean Department of National Parks and Wildlife Management for assistance in the updating of the appropriate management strategy for this endangered species.

1.2 THE PROJECT AIMS

The primary aim of the RHINOWATCH project was to undertake a thorough census of the Black Rhino population in Chirisa Safari area, and to present the results to the Department of National Parks and Wildlife Management of Zimbabwe, for use in revision of existing Rhino conservation and management strategies. In addition to this, a similar systematic ground survey of large mammals in Chirisa was undertaken and the results presented in a separate report.

1.3 THE STUDY AREA

The study area is situated in the western part of Zimbabwe and comprises the Chirisa Safari area and the Sengwa Wildlife Research Area. It ranges in altitude between 600-900m (see Figs. 2 & 3). The area (1,713 Km^2) is traversed by the Sengwa River, which meanders across a valley floor bounded by impressive escarpments and cliffs of Karoo sandstone, and has a wide range of vegetation types. The Sengwa River is flanked by alluvial riparian communities giving way to *Mopane* sp. scrub and *Brachystgia* sp. woodland towards the higher ground. Areas of predominantly *Combretum* sp. thicket and open grassland are interspersed with other vegetation types (Cumming, 1983). The Sengwa Wildlife Research Area (373 Km^2) is situated on the southern border of the Chirisa Safari Area. The Sengwa Wildlife Research Institute, the base for this project, is on the

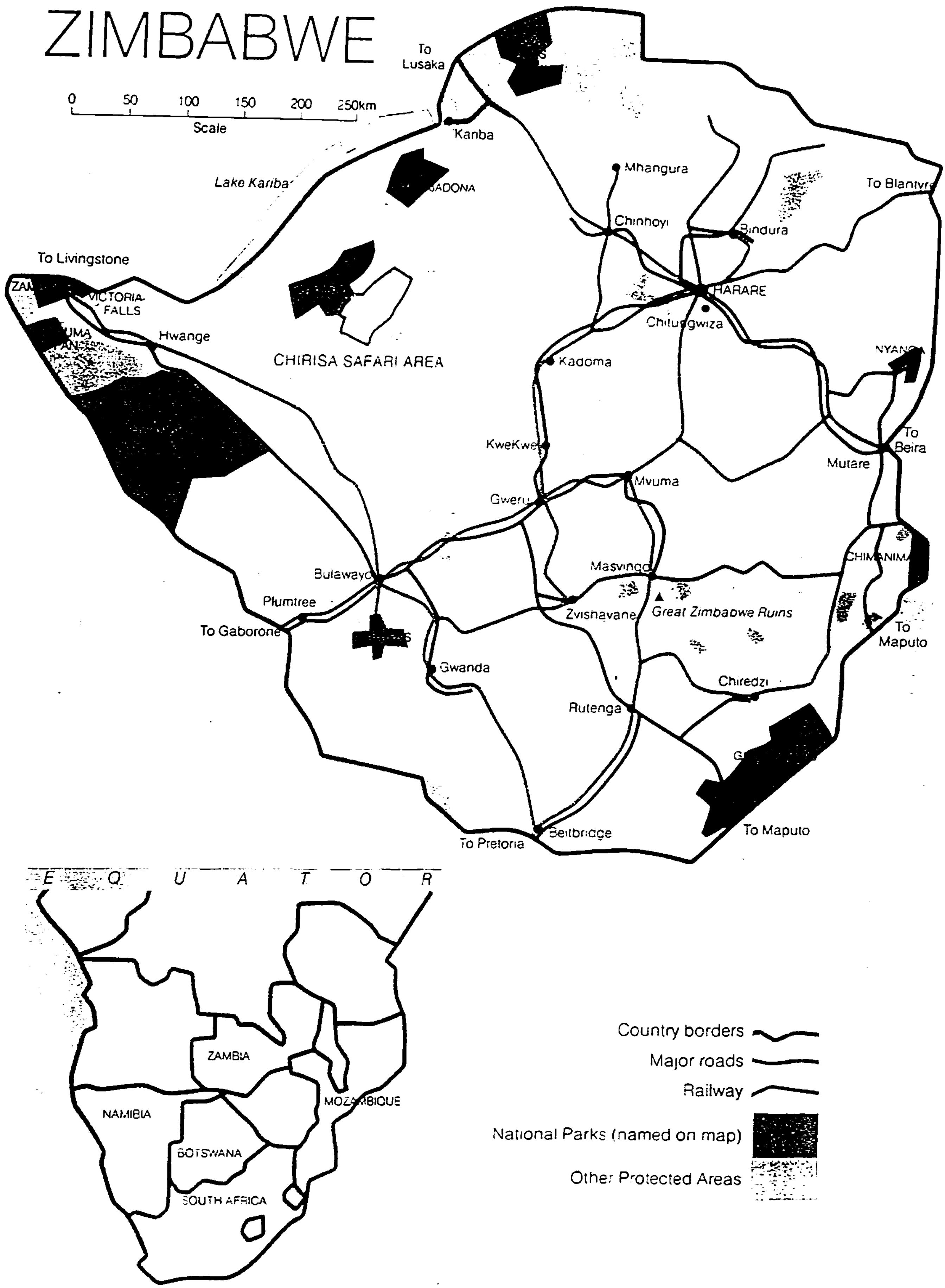
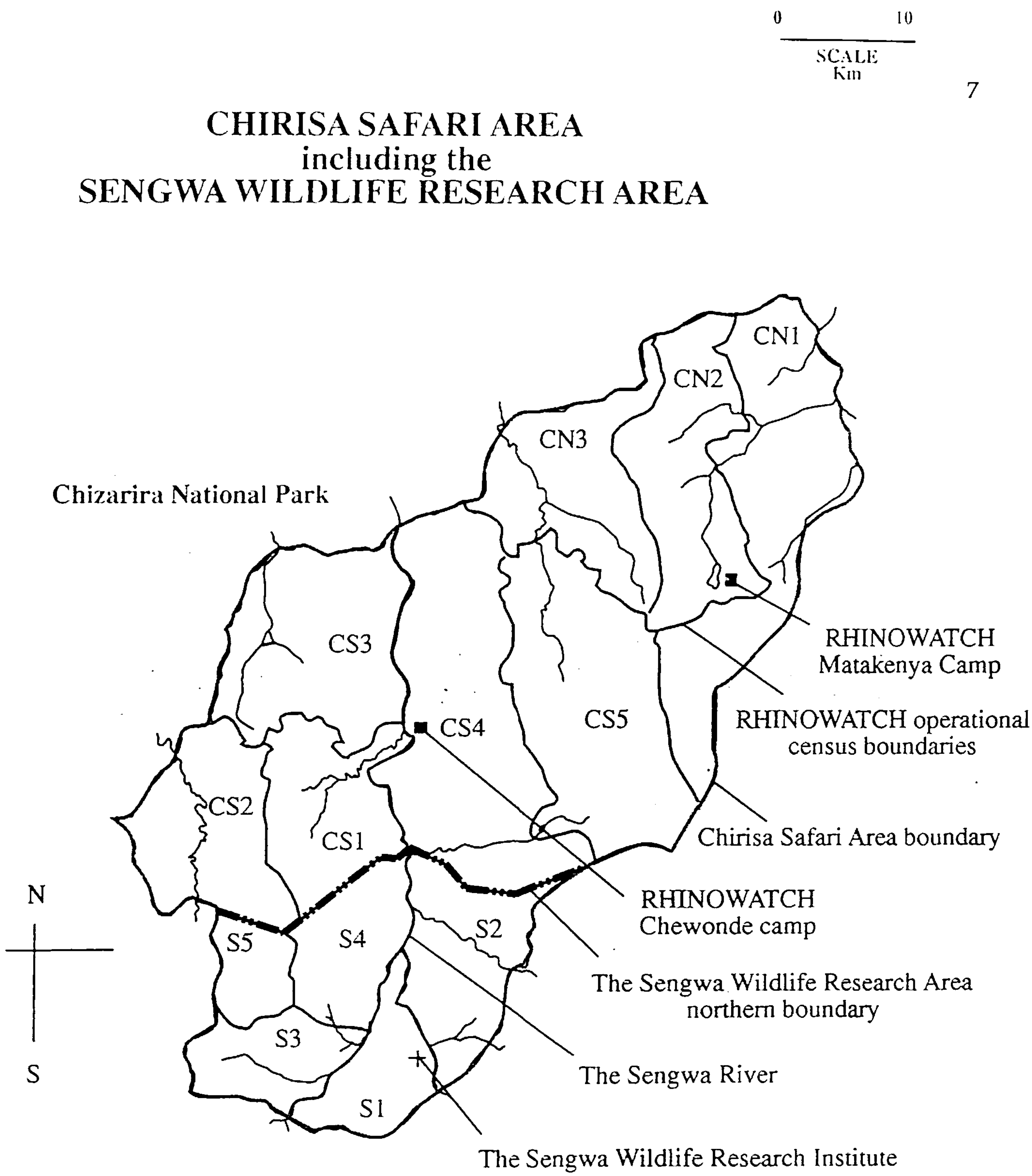


FIG. 2 . ZIMBABWE IN RELATION TO SOUTHERN AFRICA AND DETAILED MAP SHOWING CHIRISA SAFARI AREA.

CHIRISA SAFARI AREA
including the
SENGWA WILDLIFE RESEARCH AREA



Key:

S1 - CN3 = RHINOWATCH operational blocks
for census

FIGURE 3

south-east border of the Research Area and is equipped with excellent field research facilities. FOR THE PURPOSES OF THIS REPORT, CHIRISA SAFARI AREA SHOULD BE TAKEN TO INCLUDE THE SENGWA WILDLIFE RESEARCH AREA, UNLESS SPECIFICALLY INDICATED OTHERWISE.

The Chirisa Safari Area adjoins the Chizarira National Park to the north-east and these areas, together with the Chete Safari Area and the Matusadona National Park, and interspersed communal farming land, fall within the Sebungwe region of Zimbabwe.

2 METHODS

A thorough ground survey of the Black Rhino was undertaken in the Chirisa Safari Area and the Sengwa Wildlife Research Area in order to acquire accurate census figures for this species.

Parallel, systematic transects were walked at 1 km intervals over the entire 1,713 Km^2 study area. The grid lines running from west to east on the detailed 1:20,000 and 1:50,000 scale survey maps of the area provided ideal transect lines (Fig. 4). To facilitate the logistics of walking these lines, the study area was further divided into operational blocks (Fig. 3) within which sections of each transect could be located, approached and undertaken within one working day. Each block was surveyed in turn until the whole area had been covered. The time frame allowed for the project was just under three months, and four teams of three observers walked all the transects in this time, a total ground distance of 1,728 km (allowing for deviations due to natural obstacles etc). Two consecutive central camps were established as logistical bases. The first at Matakenya, from which blocks CN1, CN2, CN3, CS5 & part of CS4 were surveyed, and the second at Chewonde from which the rest of the area was surveyed (Fig. 3). Work in the Sengwa Wildlife Research Area was based at the Research Institute there, and proceeded concurrently with the work in the rest of Chirisa.

Transect line starting points were located using detailed survey maps of the area (1:50,000 series) and with the help of the local knowledge of experienced game scouts. Observers were driven to the starting point of the transect each morning from base-camp. The starting time for each transect was recorded. Transect lines were walked in west-east or east-west orientation (avoiding walking into the sun whenever possible) and navigated using compasses with sights, maps and the local knowledge of game scouts. Compasses were read to allow for grid readings and magnetic declination, calculated to be $\pm$ 6° 40′ for the study area. The four teams worked on four parallel grid lines at 1 km intervals concurrently, and were thereby able to keep a reasonable check on directional error. Slight deviations had to be made occasionally for impassable obstacles but these were corrected immediately afterwards. One observer in each team wore a pedometer to record the distance travelled. Estimated observation point co-ordinates were recorded using local landmarks, and later corrected by comparison with distance walked along transect, time and vegetation type.

All observations were recorded onto observation sheets (Appendix 1a, b & c) in the field and the results entered into a portable computer at base-camp.

2.1 RHINO SIGHTINGS

Rhino sightings were recorded if individuals were observed within 100m perpendicular distance of the transect line. The distance was calculated using a portable rangefinder and the angle from the perpendicular was measured using the compass. It was hoped that where possible, photographs could be taken of Rhinos to help with the identification of individuals using ear tears, horn shape etc (Towindo, 1990). Observations were recorded (Appendix 1c)

Rhino density was calculated using two methods:

2.1.1 THE HAYNE METHOD (Hayne, 1949b; Burnham & Anderson, 1976)

$$D_H = \frac{n}{2L}\left(\frac{1}{n}\sum\frac{1}{r_i}\right)$$

Where:

D_H = Hayne's estimator of density

n = No. of animals seen

L = Length of transect

r_i = Sighting distance to each animal i

The Hayne Method (Hayne, 1949b) assumes that the sines of the angles Ø of the observed sightings are a sample from a uniform random variable ranging from 0 to 1. This assumption implies that the average sighting angle is 32.7°. In cases where the Hayne model is not applicable, because the sighting angle is not exactly 32.7°, the modified model (Burnham & Anderson, 1976) can be applied.

2.1.2 A DIRECT EXTRAPOLATION FROM NUMBERS SEEN ON TRANSECT.

Transects were 1000 m (1 Km) apart, and Rhino sightings were recorded if an animal was seen 100m either side of the transect. The observation area therefore covered 20% of the total study area. Therefore, when the figure for the number of Black Rhino seen on transect was multiplied by ~~10~~ 5, this gave an estimate of total population by direct extrapolation from numbers seen on transect.

2.2 DUNG, BROWSE AND SPOOR COUNTS

It was hoped that dung, browse and spoor counts could be used to derive indices of rhino density per Km^2.

These figures would then be subjected to linear regression analysis to determine whether there was any relationship between them and actual rhino density as determined by sightings, spoor identification and carcass numbers. The indices would then be compared with those calculated by Towindo (1990) in the Sengwa Wildlife Research Area.

If comparable, the indices could be used to predict Black Rhino density in areas where dung, browse and spoor counts had been made - without the need for time-consuming further investigations. Observations were recorded.
(Appendix 1a)

2.2.1 DUNG PILE COUNTS

Observations of individual rhino dung (middens and scrapes) were recorded if within 10m perpendicular distance of the transect line. The observations were allocated age categories as follows (see Towindo, 1990):

Category a - Fresh, not > 1 day old. Dung wet and yellow/green inside

Category b - Not fresh, 2-3 days old. Dung less wet and brown inside.

Category c - Old, > 3 days old. Dung completely dry and may have termite infiltration.

2.2.2 BROWSE COUNTS

Black rhinos, as browsers, leave characteristic, blunt edges on the browse plants. Observations of rhino browse were made and recorded if within 5m perpendicular distance of the transect line. Each individual plant browsed was taken to be one unit. Age categories for browse were divided as follows (see Towindo, 1990):

Category a - Fresh cut, 1-3 days old. Wet cut edge with green edges and white pulpy interior.

Category b - Not fresh, 4-90 days old. Dry cut edge, but still fairly sharp. Brown edges.

Category c - Old, > 90 days old. Cut edge less identifiable and greyish in colour.

2.2.3 SPOOR COUNTS

Observations of rhino spoor were made, and recorded if within 5m perpendicular distance of the transect line. Age categories were allocated to spoor observations as follows (see Towindo, 1990):

Category a - Fresh, < 24 hours old. Sharp edges and clear outline. Surface detail clear.

Category b - Not fresh, 2-3 days old. Less sharp outline, often partially obscured by other animal tracks. Surface detail less clear.

Category c - Old, > 3 days old. Often very unclear outline and surface detail almost totally lost.

Each rhino track was counted as one unit. The ease of observation of spoor depended very much on the age of the spoor and the substrate on which the spoor had been made.

2.3 IDENTIFICATION OF INDIVIDUAL RHINO BY SPOOR

Raoul du Toit (1989) described the identification of individual Rhino by analysis of spoor, it having been shown that each animal had a unique spoor print. Provided the same foot was used to compare prints, it was shown to be possible to identify animals in the field by means of comparing their spoor prints.

Spoor seen were recorded in one of the three designated age categories, but only the fresher, more detailed spoor (predominantly category A - Towindo (1990)) were traced. Observations were recorded (Appendix 1b)

On finding spoor of sufficiently good detail to get an accurate tracing, a 0.5 cm thick and 30 cm^2 sheet of perspex was placed very carefully and with minimum pressure on top of the spoor . Tracings of spoor prints of the left hind foot of each individual track seen were made onto 26.5 cm^2 square acetate sheets using waterproof marker pens. Special care was paid to individual markings on the base of the foot, toe notches and to the general outline of the spoor. To minimise parallax error and subsequent distortion, three overhead tracings were made of each spoor print. In some cases, the spoor tracks were followed for a short distance off the transect to acquire a good tracing although the original sighting was only recorded if it was within 5m perpendicular distance of the transect line.

Details enabling the exact location of the spoor drawn to be ascertained were recorded on observation sheet no. 2 (Appendix 1b), and acetate sheets marked with the date, transect number and drawing number.

Spoor tracings of the left hind foot were compared both using superficial similarity as judged by eye and more objectively using Hierarchical Cluster Analysis. This method relies on the provision of a series of measurements of spoor tracings which could be compared between individuals.

A series of critical measurements of each left hind spoor tracing were drawn up (Fig. 5) and were compared by Hierarchical cluster analysis (see Krebs, 1989).

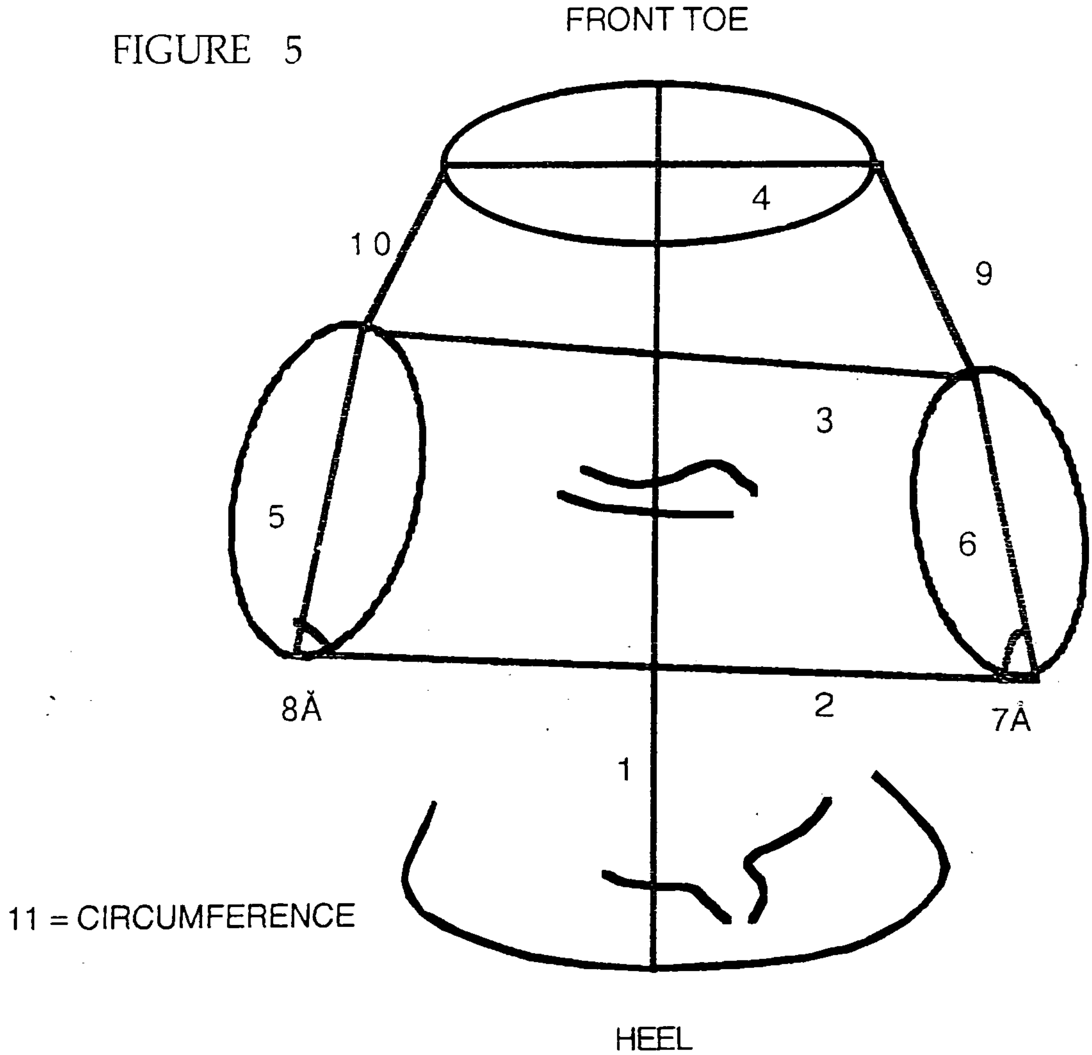
The measurements taken of the spoor were made by ruler and protractor and were inevitably approximate. In many cases the tracings were less clear than the optimum and a visual estimate was made of the best fit line. The measurements were as follows:

1 The length of the spoor across the longest point between the front of the foremost digit (digit 3) and the lowest point of the heel.

2 The width of the spoor between the bottom of two lines which divide digits 2 and 4 into their respective equal halves.

REPRESENTATIONAL SPOOR DRAWING OF LEFT HIND FOOT, SHOWING LINES FOR ANALYSIS

FIGURE 5



KEY

1 - 11 11 chosen lines and angles of foot

Lines of Measurement

Simplified Rhino spoor outline

Individual markings on spoor

3 The width of the spoor between the top of two lines which divide digits 2 and 4 into their respective equal halves.

4 The longest width of the front (digit 3) toe and one which divides it into two equal halves.

5 The length of digit 4, a line which divides the digit into two equal halves

6 The length of digit 2, a line which divides the digit into two equal halves

7 Angle = that made by the intersection of lines 6 and 2.

8 Angle = that made by the intersection of lines 5 and 2.

9 The distance between the top of digit 2 and the intersection with line 4

10 The distance between the top of digit 4 and the intersection with line 4.

11 The circumference of the spoor.

Using the Hierarchical Cluster Analysis Average between Groups, Average Within Groups and Complete Linkage Methods, an analysis was performed to try to distinguish between spoor of different individuals. Cluster Analysis requires complex computation and for this study, an IBM compatible MS DOS statistical package, UNISTAT, was used to analyse the data. Within Cluster Analysis several methods were tried and the results of three methods are reported in this study, all of them using the Euclidean Distance measurement.

2.4 RHINO CARCASSES

Observations of rhino carcasses were recorded if found within 100m perpendicular distance from the transect line. The observations were used for analysis only if the carcasses were estimated to be less than two years old. Age assessment was made using visual criteria based on carcass degradation.

For each carcass, the time of observation, local vegetation type, geographical landmarks, pedometer readings and nearest grid reference were also recorded. Perpendicular distances were calculated by means of range finders. This allowed the most exact estimation of the location on the map co-ordinate.

Estimates of Carcass density were calculated using the Hayne method (see above) and by simple extrapolation from sightings on transect to cover the total area of the survey (see above).

An estimate of carcass density of those carcasses less than two years old would allow an estimate of how many animals had been poached during that period. Obviously some of the carcasses seen might have come from animals which had died a natural death, but it was assumed that because of the relatively large number of carcasses found, most had been poached. In some cases it was possible to confirm this by finding a skull on which the horns had been removed or on which a bullet hole could be seen. However, intact skulls might have resulted from poached animals which had been wounded, evaded the poachers and died later.

Comparing the estimated number of carcases (< two years old) in the census area with previous estimates of population density from this time period would allow an estimation of the numbers of rhino remaining in the study area. This could then be compared with such estimations acquired by means of spoor analysis, sightings and calculated indices.

3 RESULTS

3.1 RHINO SIGHTINGS

Three Rhino were sighted on transect and identified as being different animals by spoor print. Sighting points are identified in Fig. 6. Since there was no statistically significant difference between the observed mean sighting angle and 32.7°, the Hayne method was used rather than the modified Hayne to calculate rhino density (Table 2).

3.1.1 USING THE HAYNE METHOD

The Black Rhino density for Chirisa was calculated as
0.009 ± 0.005 (SE) animals per Km^2

The total number of Black Rhino was therefore
0.009 X 1713 Km2 = 15.41 animals

3.1.2 USING DIRECT EXTRAPOLATION FROM NUMBERS SEEN ON TRANSECT

The area sampled by transect represented 20% of the total survey area
3 animals were seen within sample area. Therefore estimate by direct extrapolation = 3 X 100/20 = 15 animals

The two estimates derived from methods a and b give identical results.

Identification of individuals by photography proved to be impracticable at such a low population density. Attempts were made to photograph the three animals sighted, but were not successful.

CHIRISA SAFARI AREA

RHINO SIGHTINGS AND CARCASS DISTRIBUTION

0 10
SCALE
Km

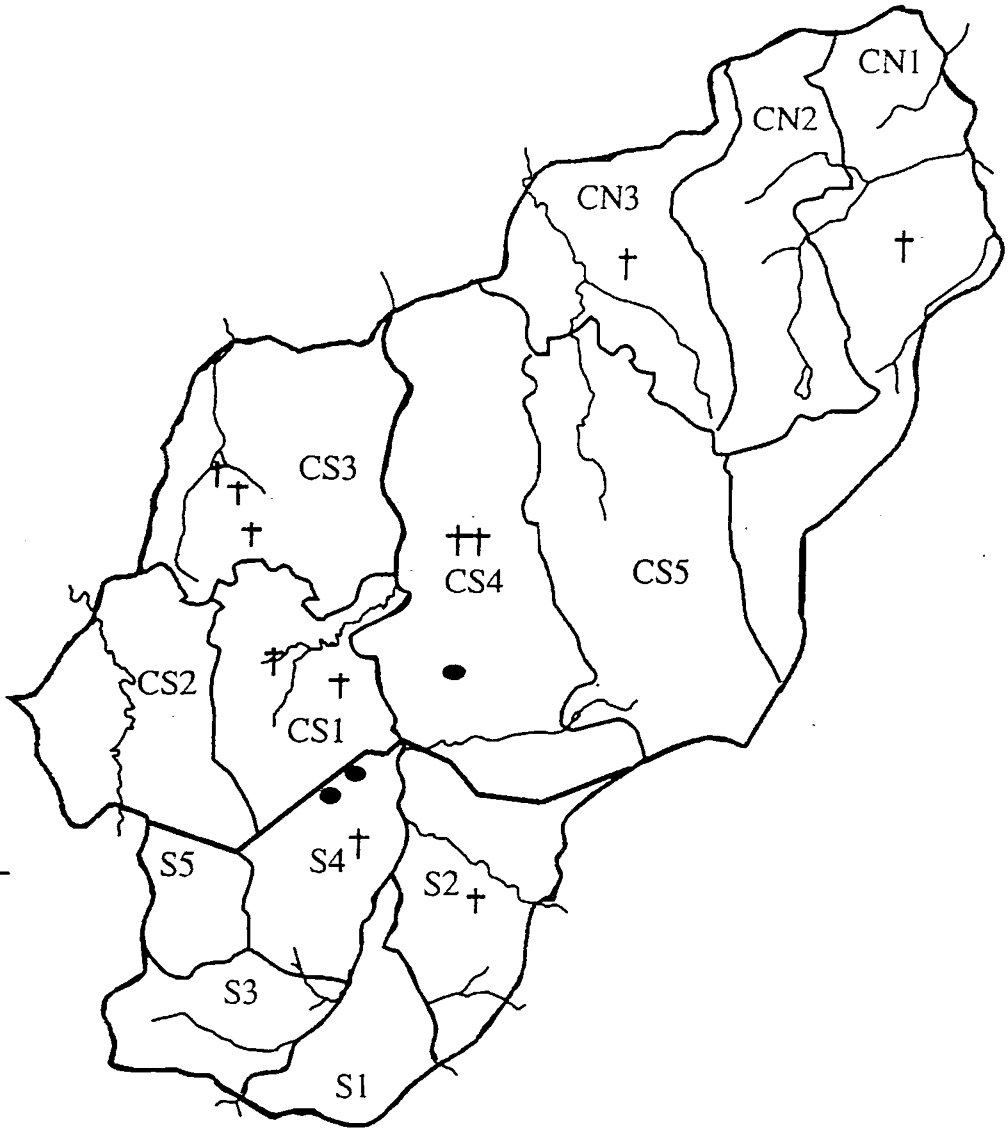


FIGURE 6

KEY

● = RHINO

† = RHINO CARCASSES < 2 YEARS OLD

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              LINE TRANSECT ESTIMATION OF POPULATION
                 DENSITY OF RHINO FROM SIGHTINGS

                  (Program HAYNE, Version 3.0)
================================================================================

             SIGHTINGS OF RHINO ON TRANSECTS IN CHIRISA


** ORIGINAL HAYNE ESTIMATE **
  ESTIMATE OF POPULATION DENSITY =          .00897  indiv.per unit area
  VARIANCE OF DENSITY =               .00002683    (Eq. 3.36)
  STANDARD ERROR OF DENSITY ESTIMATE =          .00518
  With     2 degrees of freedom.

 Z-Test of Null Hypothesis that Average Sighting Angle is 32.7 degrees
    OBSERVED MEAN ANGLE =   30.000
    Z =   -.217   (Eq. 3.37)
 Reject H(0) if Z is above 1.96 or below -1.96 for alpha of 5 %.
================================================================================

** MODIFIED HAYNE ESTIMATE **
  ESTIMATE OF POPULATION DENSITY =          .00969  indiv.per unit area
  VARIANCE OF DENSITY =               .00003129    (Eq. 3.39)
  STANDARD ERROR OF DENSITY ESTIMATE =          .00559
  With     2 degrees of freedom.

================================================================================
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TABLE 2

3.2 DUNG, BROWSE AND SPOOR COUNTS FOR CALCULATION OF RHINO DENSITY INDICES

Figs 7,8 & 9 show respectively the distribution of Rhino dung, browse and spoor signs in Chirisa.

Table 3 shows the incidence of Dung, Browse and spoor found on all the transects in Chirisa.

It was hoped that the following equations for prediction of Rhino density from activity signs (Towindo, 1990) would be used to determine Rhino density in the present study.

Rhino dung	$Y = 254.3X - 14.2$ ($t = 5.552$ $p = < 0.02$ $df = 3$)
Rhino spoor	$Y = 248.7X - 2.5$ ($t = 3.318$ $p = < 0.05$ $df = 3$)
Rhino browse	$Y = 1489.1X - 98$ ($t = 17.467$ $p = < 0.001$ $df = 3$)

Where Y = Total number of rhino in census area
X = no. of observations of rhino signs.

However, the incidence of Rhino activity signs was, not surprisingly, very low in the present study. The above equations were predicted for an estimated minimum population density of 0.1 Rhino Km^{-2} in Sengwa Wildlife Research Area in 1990 (Towindo 1990). However, the extremely low population at the time of the current census (Estimated here at 0.0174 Rhino Km^{-2}.) made insufficient data available for the calculation of Rhino density indices from Rhino signs. Because the Rhino population was very much lower than that in the study done by Towindo (1990), it was also impossible to extrapolate from his derived indices to arrive at a figure for the current Rhino population. It became clear therefore, that when the population had a very low density, indices based on signs were inadequate for estimates of population size based on above indices.

CHIRISA SAFARI AREA
DUNG
Number, Distribution and Frequency according to age category

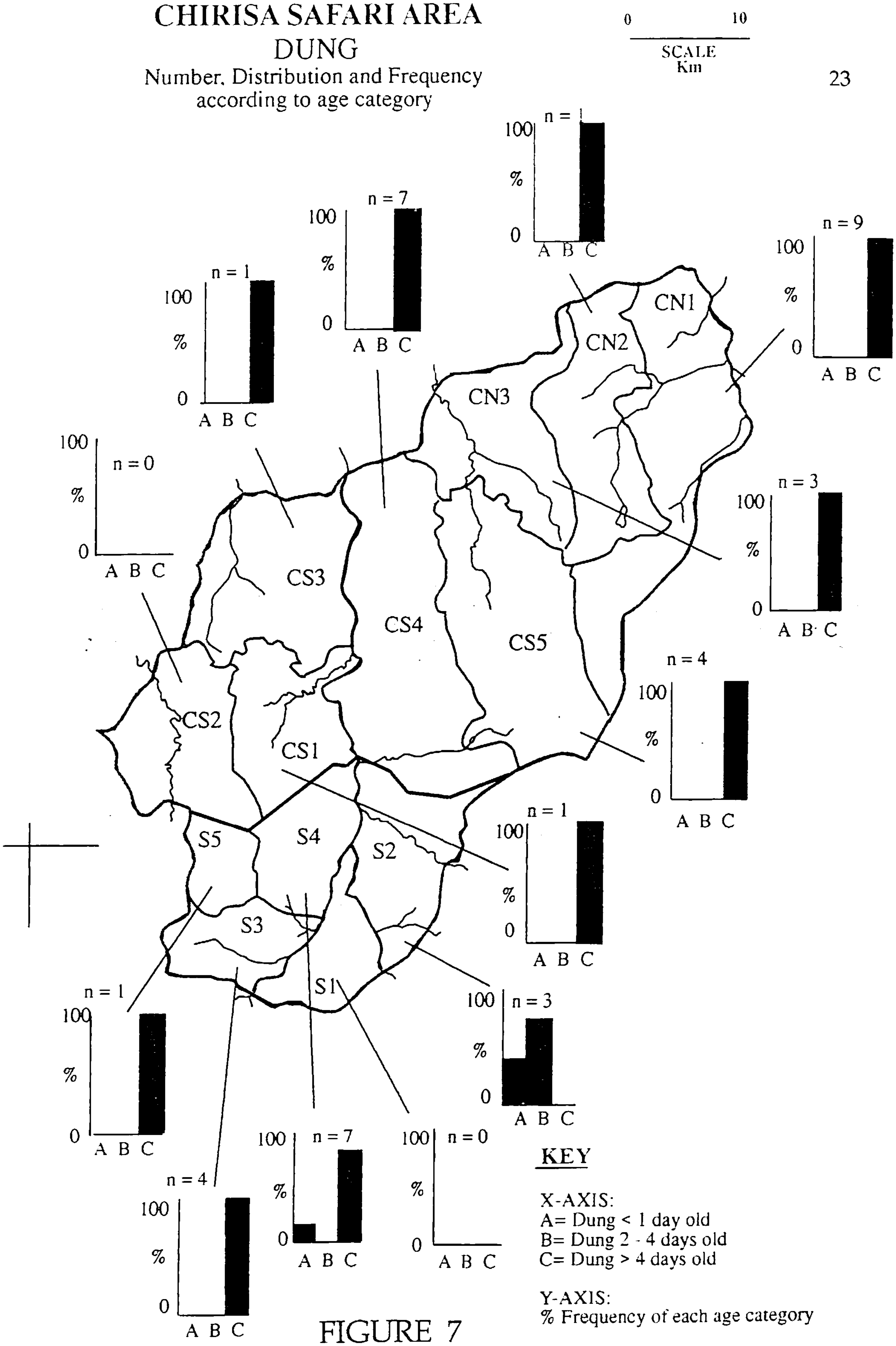


FIGURE 7

CHIRISA SAFARI AREA
BROWSE
Number, Distribution and Frequency according to age category

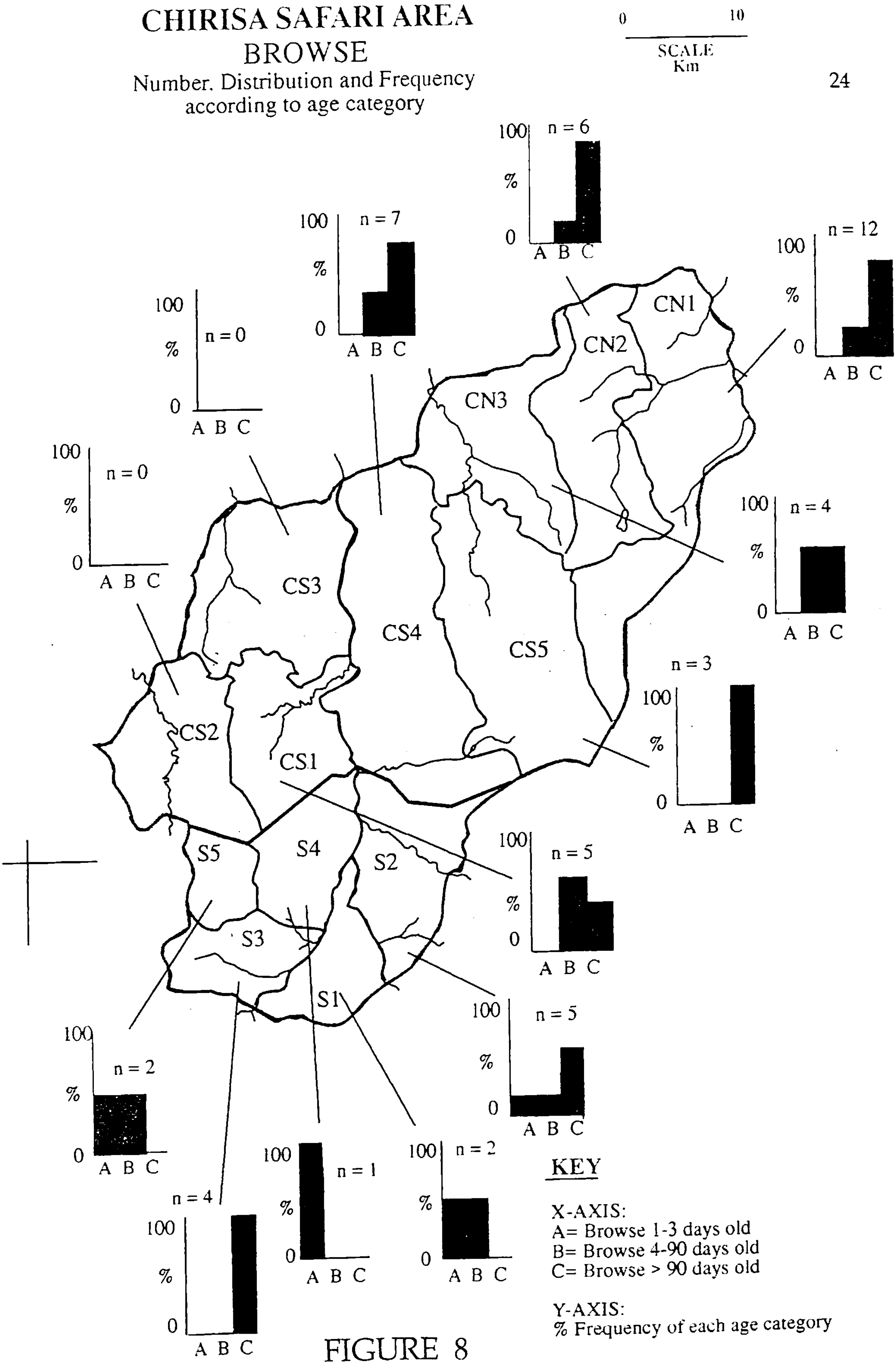


FIGURE 8

CHIRISA SAFARI AREA
SPOOR
Number, Distribution and Frequency
according to age category

0 10
SCALE
Km

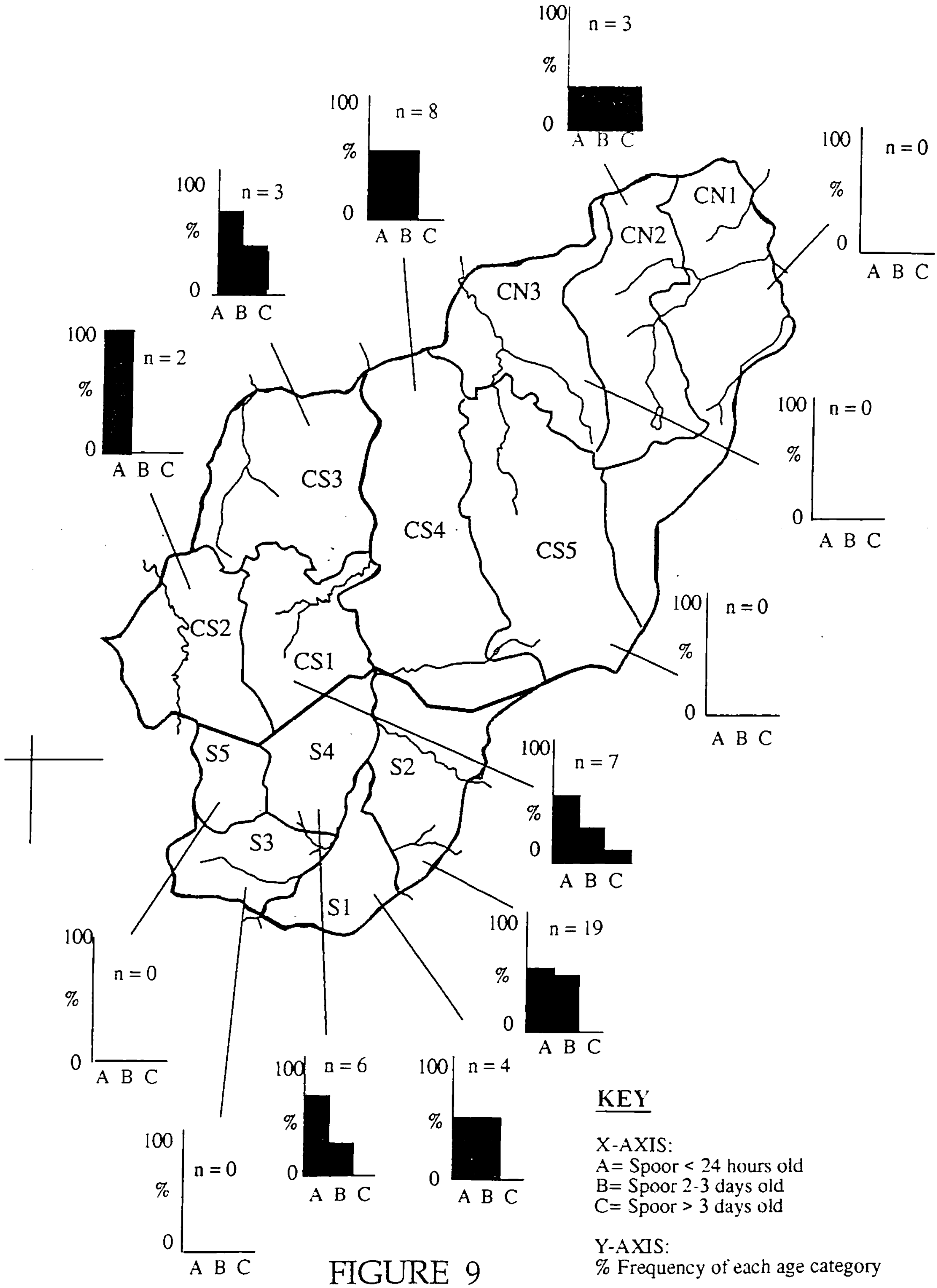


FIGURE 9

SIGN	TYPE A	TYPE B	TYPE C	TOTAL
SPOOR	30	19	5	54
DUNG	3	2	35	40
BROWSE	4	14	36	54

TABLE 3. INCIDENCE OF SPOOR, DUNG AND BROWSE IN CHIRISA. (TYPE A < 1 DAY OLD, TYPE B = 2-3 DAYS OLD, TYPE C > 3 DAYS OLD).

3.3 SPOOR DRAWINGS

3.3.1 DIRECT VISUAL ASSESSMENT

An average of three tracings were taken from 50 different tracks. Spoor drawings were of very variable quality, depending on the skill of the drawer, the age of the spoor and the type of substrate. Direct visual assessments and comparison of spoor were made independently three times. It was estimated that there were between 11 - 15 distinct spore patterns which could be attributed to different individuals. Because the spore drawings were not of a very high quality in every case, the estimate of Black Rhino numbers could not be narrowed down further.

3.3.2 CLUSTER ANALYSIS FOR SPOOR MEASUREMENTS

The models of hierarchical cluster analysis which gave the best separation were those based on:

1. Complete Linkage
2. Average Between Groups
3. Average Within Groups

Single linkage methods have a tendency of producing long strung-out clusters and this proved to be the case in the present study. The complete linkage method produces very tight compact clusters. The average method is used by most researchers as a compromise. Figs. 10, 11 & 12 show High Resolution Dendrograms for cluster analysis using the above models. It can be seen that the separation distances between predicted individuals for the Average Within Groups model are much shorter and if the arbitrary cut-off point of eight instead of 10 is used, then the predicted number of Black Rhino is 16. Using an arbitrary distance of 10 units as the cut-off point for the Complete Linkage and Average Between Groups Models and an arbitrary distance of 8 units for the Average Within Groups Model, Table 4 shows the predicted numbers of Black Rhino from cluster analysis of spore measurements and direct visual assessment.

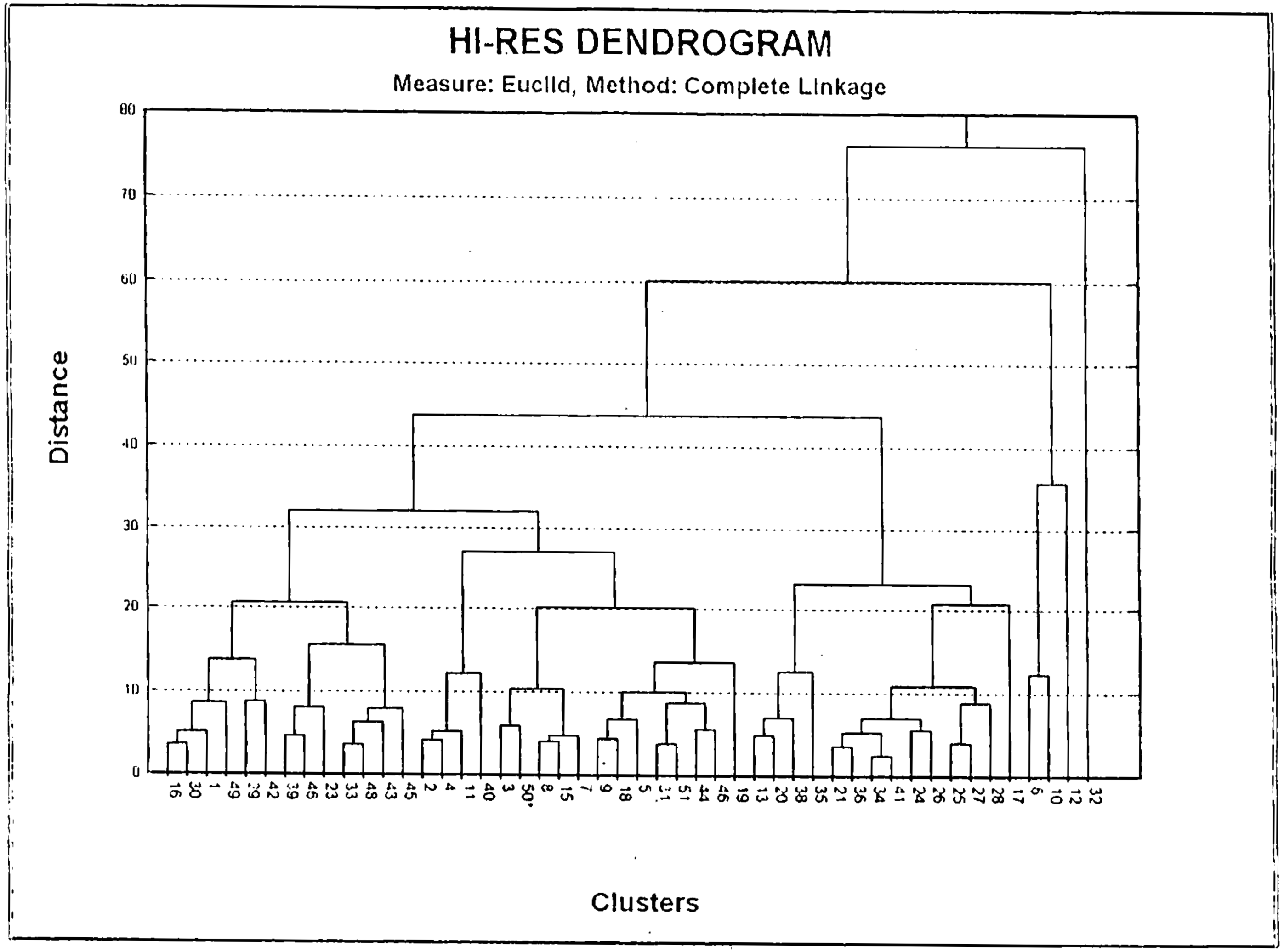

HI-RES DENDROGRAM
Measure: Eucild, Method: Complete Linkage
Distance
80
70
60
50
40
30
20
10
0
16 30 1 49 29 42 39 46 23 33 48 43 45 2 4 11 40 3 50* 8 15 7 9 18 5 31 51 44 46 19 13 20 38 35 21 36 34 41 24 26 25 27 28 17 6 10 12 32
Clusters

FIGURE 10

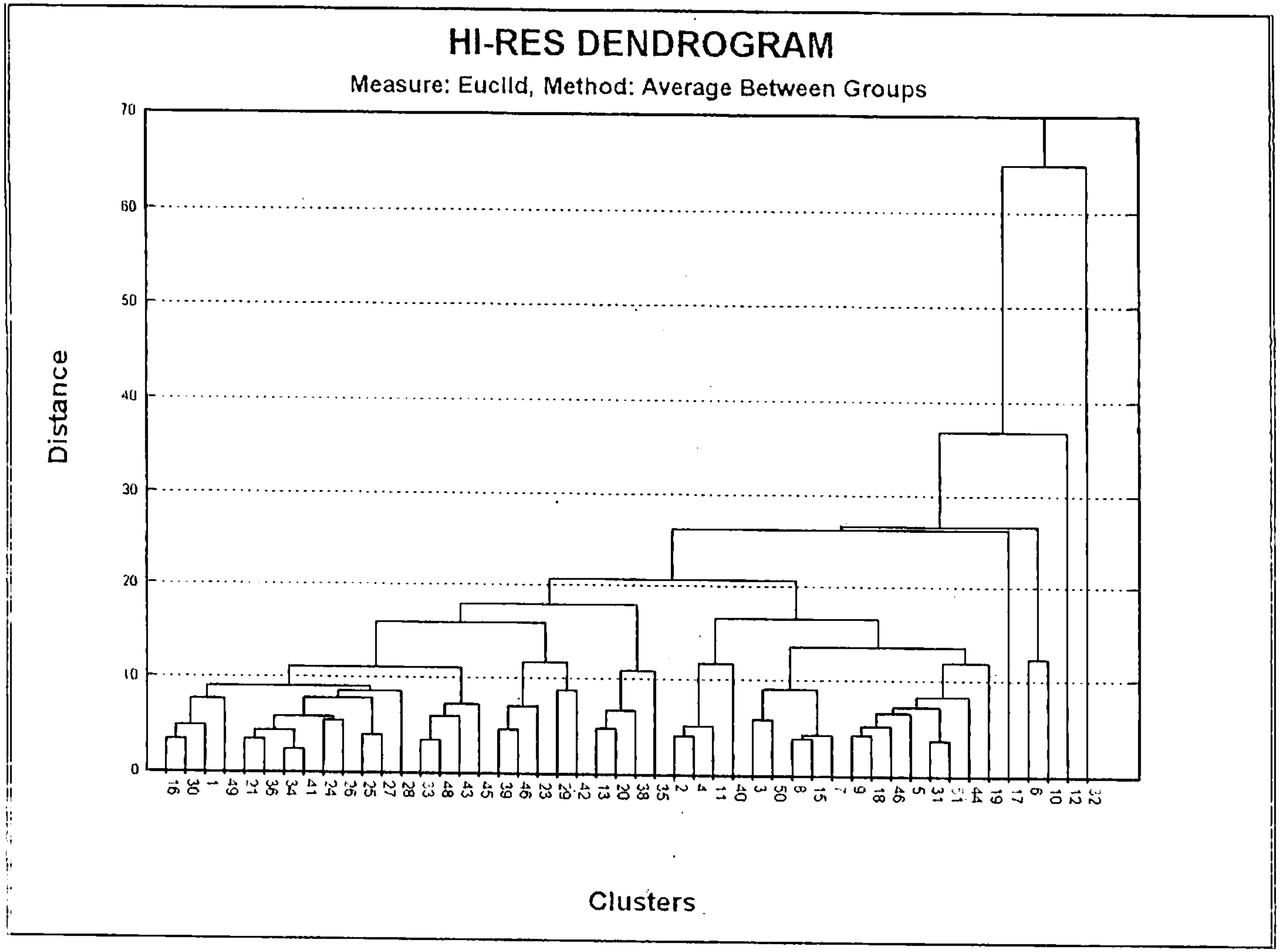

HI-RES DENDROGRAM
Measure: Eucild, Method: Average Between Groups
Distance
70
60
50
40
30
20
10
0
16 30 1 49 21 36 34 41 24 26 25 27 28 33 48 43 45 39 46 23 29 42 13 20 38 35 2 4 11 40 3 50 8 15 7 9 18 46 5 31 51 44 19 17 6 10 12 32
Clusters

FIGURE 11

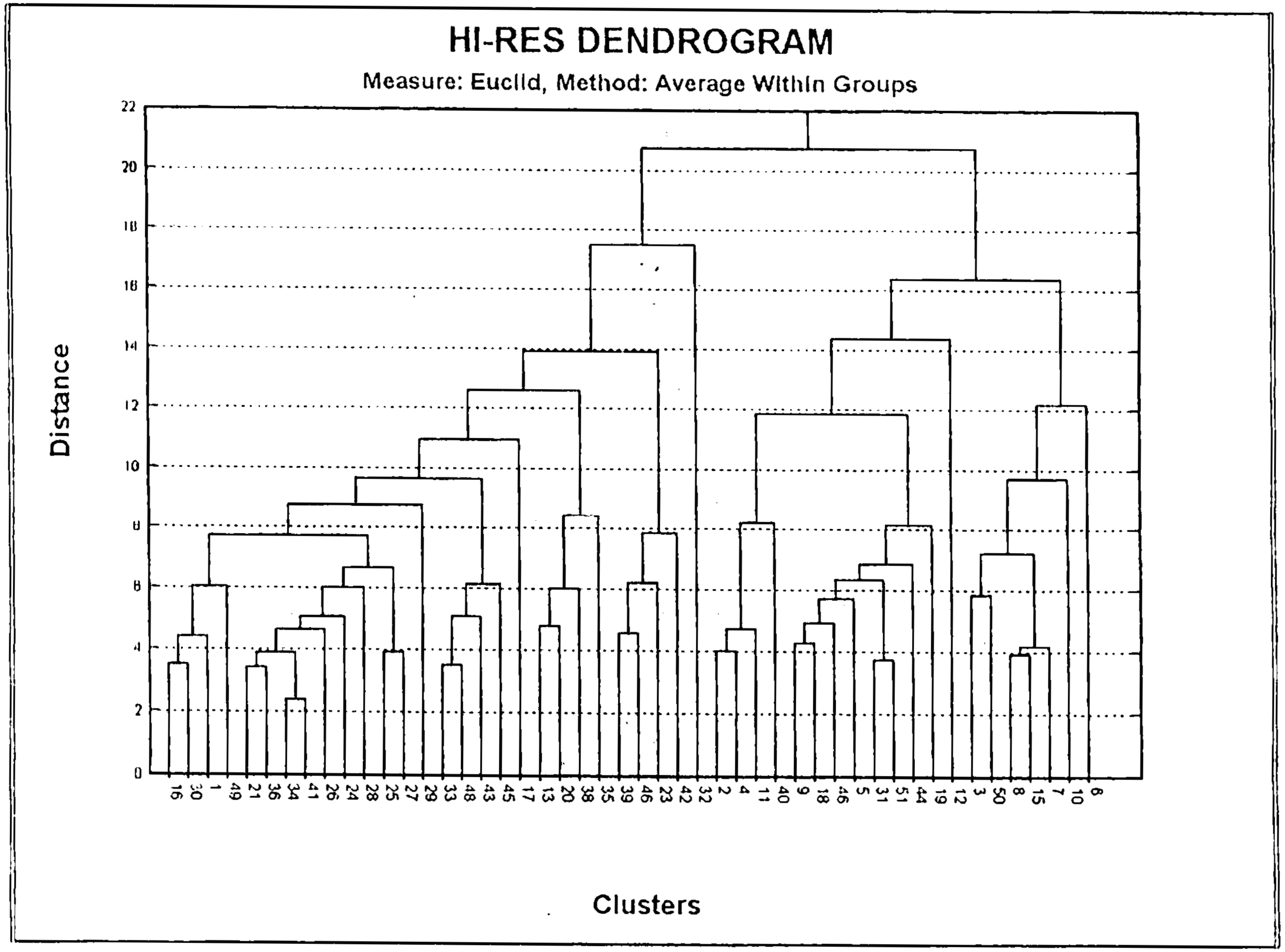

HI-RES DENDROGRAM
Measure: Euclid, Method: Average Within Groups
Distance
22
20
18
16
14
12
10
8
6
4
2
0
16 30 1 49 21 36 34 41 26 24 28 25 27 29 33 48 43 45 17 13 20 38 35 39 46 23 42 32 2 4 11 40 9 18 46 5 31 51 44 19 12 3 50 8 15 7 10 6
Clusters

FIGURE 12

METHOD	BLACK RHINO NUMBERS IN CHIRISA
1. DIRECT VISUAL ASSESSMENT	11 - 15
2. CLUSTER ANALYSIS	
A. Complete Linkage	19
B. Average Between Groups	16
C. Average Within Groups	16

TABLE 4. ESTIMATION OF BLACK RHINO NUMBERS IN CHIRISA USING (1) DIRECT VISUAL ASSESSMENT AND (2) CLUSTER ANALYSIS OF SPOOR MEASUREMENTS.

3.4 RHINO CARCASSES

11 Rhino carcasses estimated to be less than two years old were seen on transects at co-ordinates shown in the Fig 6. The density of Rhino carcasses was analysed using the Hayne method (Table 5) and by direct extrapolation.

3.4.1 THE HAYNE METHOD

Using the Hayne method (see above) the density of Rhino carcasses was calculated at

0.066 $\pm$ 0.02 (SE) carcasses per Km^2

Therefore the overall number of carcasses in Chirisa was estimated to be

0.066 X 1713 = 113.05 carcasses.

3.4.2 DIRECT EXTRAPOLATION FROM CARCASS SIGHTINGS ON TRANSECTS.

The transect sighting area represented 20% of the total survey area
11 carcasses seen within the 100 m of transect strip

Therefore 11 carcasses represents 20% of total.

Therefore estimated carcass number in Chirisa Safari area = 55 carcasses

Because these estimates differed substantially, a mean figure of 84 was taken, and estimates were made of the current 1992 Rhino population given two different previous estimates for population in 1990. Assuming that the natural mortality and birth rates balance:

```
==========================================================================

              LINE TRANSECT ESTIMATION OF POPULATION
                DENSITY OF RHINO FROM CARCASSES

                  (Program HAYNE, Version 3.0)
==========================================================================

   CARCASSES OF RHINO < TWO YEARS OLD ON TRANSECTS IN CHIRISA


** ORIGINAL HAYNE ESTIMATE **
  ESTIMATE OF POPULATION DENSITY =        .06579 indiv.per unit area
  VARIANCE OF DENSITY =            .00039348    (Eq. 3.36)
  STANDARD ERROR OF DENSITY ESTIMATE =          .01984
  With    10 degrees of freedom.

 Z-Test of Null Hypothesis that Average Sighting Angle is 32.7 degrees
   OBSERVED MEAN ANGLE =   30.000
   Z =   -.415   (Eq. 3.37)
 Reject H(0) if Z is above 1.96 or below -1.96 for alpha of 5 %.
==========================================================================

** MODIFIED HAYNE ESTIMATE **
  ESTIMATE OF POPULATION DENSITY =        .07105 indiv.per unit area
  VARIANCE OF DENSITY =            .00045887    (Eq. 3.39)
  STANDARD ERROR OF DENSITY ESTIMATE =          .02142
  With    10 degrees of freedom.

==========================================================================
```

TABLE 5

3.4.2.1 If the population in 1990 was 200 animals as estimated by Rowan Martin (Martin 1993):

200 - 84 animals existed in 1992 = 116

3.4.2.2 If the population in 1990 was 100 as estimated by Cumming (pers. comm. 1991)

100 - 84 animals existed in 1992 = 16

The Black Rhino population was therefore estimated by these two methods to be between 16 and 116.

Black Rhino on the border of the Communal Lands and the Sengwa Wildlife Research Area (Alibhai/Jewell)

4 DISCUSSION

The most striking finding to emerge from this survey was that the population of Black Rhino in Chirisa was very much smaller than had been estimated in the previous two years. Whether this was due entirely to poaching or partially to previous overestimates of population is speculative and can only remain so, given that previous censuses were, with a few exceptions, extremely unreliable "guesstimates". The most accurate survey recently undertaken in the Sengwa Wildlife Research Area by Towindo (1990) gave a figure of 130 ± 74 giving a possible range of 56 - 204 animals. The large number of carcasses found less than two years old (estimated 110) certainly pointed to poaching being the major determinant in the rapid decline of this abundance of this species. This was also borne out by constant contact with poachers and signs of poaching activity whilst conducting the survey. The estimated populations of Black Rhino in Zimbabwe in October 1992 are shown in Appendix 2.

The importance of conducting a very thorough ground survey became even more apparent as it was realised that the population density of Black Rhino was very low. Had transects not been walked at 1 Km intervals, many of the few observations might not have been made and the subsequent accuracy of estimates greatly reduced.

This project was planned when the population of Black Rhino in Chirisa was thought to be at least 100 animals, and census methods were planned accordingly. Close-up photography for the building of a photo-file for recognition of individual animals and the development of indices for estimation of Black Rhino populations by observation of browse, dung and spoor incidence were impossible to implement at what transpired to be an extremely low population density. However, the other methods used compensated for this, and allowed the development of a better strategy for census when dealing with low density populations. By estimating the population using several different methods, a fair degree of accuracy was thought to have been established. In addition to the modified Hayne method which produced an estimate with confidence limits, the other methods provided a useful comparison.

This project was the first to be conducted by RHINOWATCH and enabled a thorough revision of the suitability of the methods undertaken for the purpose of a Black Rhino census in the habitat concerned. It was found that the mechanical pedometers used were of minimal benefit, and that the use of compasses together with the local knowledge of game scouts were the most important factors in the navigation of the transects. It was initially thought that transects of random length, position and direction should be used rather than systematic transects which are subject to inadvertent design bias. However, it soon became apparent that in this thickly wooded terrain, the difficulty in locating and navigating such transects would be enormous and greatly prolong the time required to complete the work, as well as increasing error due to inaccurate navigation. In addition, the random transect approach is often used to compensate for the census of a small fraction of the area. Using systematic ground transects at intervals of 1 Km, RHINOWATCH surveyed 20% of the total area, a relatively large proportion of this 1713 Km^2 area.

The tracing of spoor prints for individual identification presented several problems. Firstly, the tracings were produced by many different workers and on many different substrates, and were consequently of variable quality and detail. Although du Toit (pers. comm.) recommends the analysis of good quality spoor tracings by eye the several attempts made at judging the differences in the often poor quality tracings by eye proved to be very difficult, and more confidence was placed in the Hierarchical Cluster Analysis. On only three occasions was it possible to directly connect a spoor tracing with the sighted Rhino. Furthermore, du Toit (1989) recommends that a tracing be made of all four feet on a track. In this project there was insufficient time to do this, but it would probably have helped with the analysis. It is felt that the tracing of spoor prints must be tightly standardised, preferably with the minimum number of workers responsible for the tracing to minimise the error introduced by individual tracing techniques. In addition, had the acetate sheet been placed directly on the spoor (du Toit 1989) there would probably have been less variation in tracing when done by an experienced worker than placing a perspex sheet down first. It became clear that the quality of tracings improved with the experience of the tracer, which was a problem in this particular project where there was a high worker turnover. It was found that the slightly higher rigidity of acetate over the polythene bags used by du Toit (1989) allowed a higher degree of accuracy in the tracing.

The Hierarchical Cluster Analysis of spoor measurement data was dependent on the selection of an arbitrary cut-off point to determine the estimated number of individuals. In this study a cut-off level of 8 - 10 units gave comparable figures with estimates obtained by the other methods, and may enable a more confident and independent use of the method in subsequent Black Rhino censuses. In the present study, all 11 variables were included to carry out Cluster Analysis. It is possible that not all these variables are pertinent and it is hoped that further multi-variate analysis will be performed to ascertain the significance of these variables at a future date.

Due to the extremely low frequency of observations of browse, dung and spoor it was impossible to calculate indices for these parameters to predict Black Rhino density. In his study in the Sengwa Wildlife Research Institute, Towindo (1990) calculated indices from these parameters for an estimated Black Rhino density of 0.1 animals per Km^2. The estimated density in the present study was 0.01 animals per Km^2 and too low for the calculation of indices. Similarly the indices calculated by Towindo (1990) were unable to predict Rhino density at such a low observation frequency of signs.

The carcass indicator as a means of estimating current population is only accurate where previous census figures are fairly accurate and in this case only points the true figure to be somewhere between 16 and 116 animals. Furthermore du Toit (1989) stated that a survey of carcasses in Chewore between 1984 and 1989 found only an estimated 50% of total carcasses. However, in Chewore no systematic survey had been undertaken , and it is likely that a much greater proportion of carcasses were located in the present study. If the carcass numbers were underestimated in this study and/or the 1990 census estimate of 200 animals for the Chirisa Area was too high, the current estimate of Black Rhino numbers would be towards the lower end of the 16-116 range, which is borne out by the results of other methods. The results of the different methods used to estimate Black Rhino density in Chirisa Safari Area are summarised in the Table 6.

Using the Hayne method and Hierarchical cluster analysis a population of between 15 and 19 animals is predicted and this, with consideration of the results of other methods suggests that

a reasonable estimate of the Black Rhino population in Chirisa is 15 ± 3 animals.

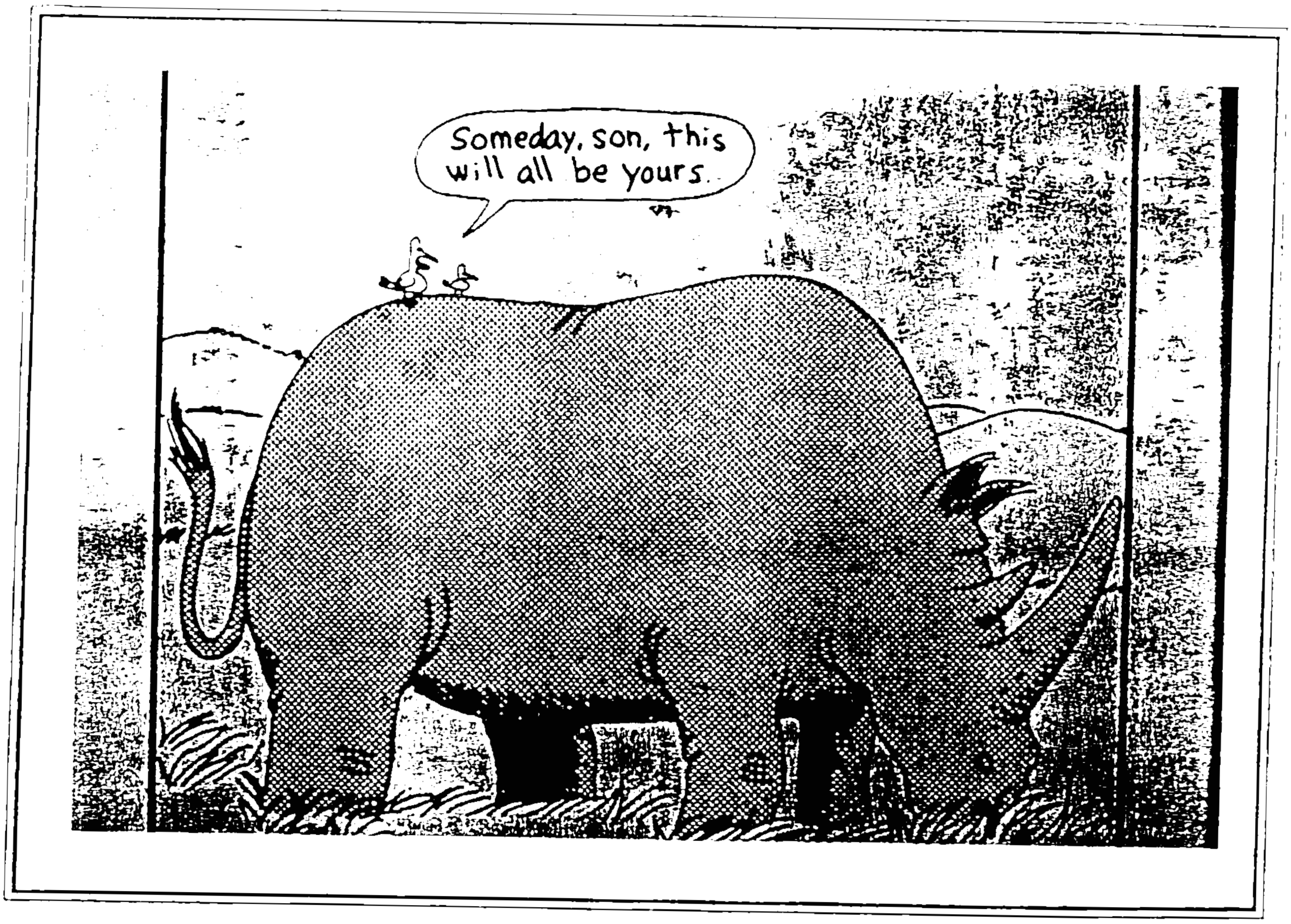
It is interesting that the direct visual assessment of spoor gave a figure within this range, despite the percieved inaccuracy of the method, and the different methods of estimating population by Rhino sightings using the Hayne method and direct extrapolation actually produced identical results.

In conclusion, RHINOWATCH aims to provide essential baseline data from Rhino and other large mammal census work in order to assist the appropriate authorities to plan effective conservation strategies. As such it is important that the results of a thorough census can be generated fairly quickly and interpreted with confidence. The preliminary results of this survey were submitted to the Department of National Parks and Wildlife Management of Zimbabwe immediately after the census had been completed. This census shows a dramatic decline in the Black Rhino population of Chirisa in the period 1990 - 92. This, together with less statistically reliable observations of Rhino populations as a result of de-horning work and the general observation of increased poaching levels throughout Zimbabwe in 1992, points to a dramatic decline throughout the whole country. In view of this, RHINOWATCH thoroughly endorses the

METHOD	BLACK RHINO NUMBERS IN CHIRISA
1. RHINO SIGHTINGS	
1.1 The Hayne Method	15
1.2 Direct Extrapolation	15
2. INDICES	NA
3. SPOOR ANALYSIS	
3.1 Direct Visual Assessment	11-15
3.2 Cluster Analysis	
3.2.1 Complete Linkage	19
3.2.2 Average Between Groups	16
3.2.3 Average Within Groups	16
4. CARCASS ANALYSIS	16 -116
5. FINAL ESTIMATE	15±3

TABLE 6. METHODS USED TO ESTIMATE BLACK RHINO POPULATION IN CHIRISA AND THE RESULTS OBTAINED.

adoption of the latest Zimbabwean Rhino conservation policy which involves the protection of these animals in Intensive Protection Zones throughout the country, thus optimising the distribution of limited resources whilst at the same time protecting the animal *in situ* and thereby placing value on the protection of all the flora and other fauna found within their natural habitat.


Someday, son, this will all be yours.

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Anton Jansen
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OBSERVATION SHEET NO. 1

RHINO SIGNS

DATE:
NAME:
BLOCK:
TRANSECT CODE:
DIRECTION - W OR E
TIME STARTED TRANSECT:
(SET PEDOMETER TO 0!)

1 DUNG/MIDDEN/SCRAPE (Within 10m of transect line)
(Category a = Fresh, not > 1 day
b = Not Fresh, 2-3d
c = > 4 days)

TIME	PED. RDG.	VEG. TYPE	LANDMK/GRID	CAT.

2 BROWSE (Within 5m of transect line)
(Age Category a = Fresh cut - 1-3 days
b = Not Fresh - 4-90 days
c = > 90 days)

TIME	PED.RDG.	VEG. TYPE	BROWSE TYPE	LANDMK/GRID	CAT.

3 SPOOR (Within 5m of transect line)
(Age Category a = Fresh, 24 hours or less
b = Not Fresh, 2-3 days
c = Old, 4-7 days)

TIME	PED. RDG.	VEG. TYPE	LANDMK/GRID	CAT.	DRAWING NO.

APPENDIX 1a

OBSERVATION SHEET NO. 2

SPOOR DRAWINGS

Aim for minimum parallax error by tracing directly above. Aim for good definition for measuring width, length and individual lines.

Label Acetate sheet with the following (in the top RH corner pref.)

1 Date
2 Transect No.
3 Drawing number - see point 3, Obs sheet 1

Then list here other details and attach this paper to spore drawing:

1 Name:

2 EW group:

3 Date:

4 Transect No:

5 Block:

6 Direction of Walk - W or E:

7 Time transect started:

8 Drawing number - point 3, Observation sheet 1:

APPENDIX 1b

OBSERVATION SHEET NO. 3

RHINO PHOTOGRAPHY

DATE:
NAME:
BLOCK:
TRANSECT CODE:
DIRECTION TAKEN (COMPASS IF OFF TRANSECT)
TIME STARTED TRANSECT
(Set Pedometer to 0)
FRAME NO. ON CAMERA AT BEGINNING:

Observation

Time:

Ped. Reading:

Veg type:

Landmarks:

*Photo frame no.

Grid Ref:

Film type:

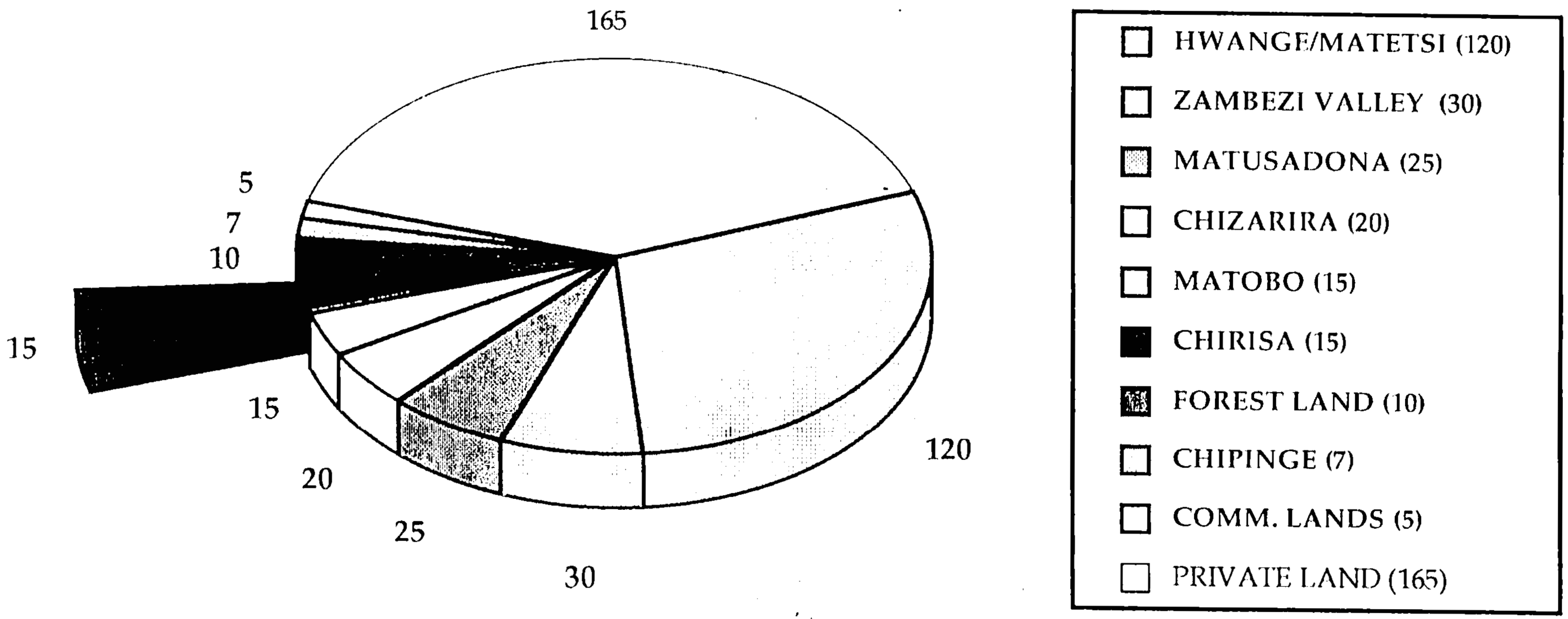
Notes:

(Notes should include - Physical description of obvious features of animal ie Ear notches, scars, Male/Female, Adult/Juvenile - Any behavioural notes.

* In order to subsequently connect the particular frame on a film with the Rhino seen at a particular location, it is necessary to keep a very careful record of frames and films. Write down for each picture taken, the corresponding frame number shown on your camera. Use as many observation sheets as you need. When you finish the film, take a sticky label and write your

1 Name
2 EW Group
3 Date
4 Block

APPENDIX 1c



APPENDIX 2. ESTIMATED NUMBERS OF BLACK RHINO IN ZIMBABWE (OCTOBER 1992)

Black Rhino Mother and Calf at sunset in the Sengwa Wildlife Research Area (Alibhai/Jewell)