



**AERIAL CENSUS OF  
ELEPHANTS AND OTHER  
LARGE HERBIVORES IN  
GONAREZHOU NATIONAL  
PARK AND SOME BORDERING  
LANDS, ZIMBABWE: 2001**

K. M. Dunham

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## SUMMARY

Elephants and other large herbivores, wild and domestic, in Gonarezhou National Park, Malapati Safari Area and Mahenye ward of Ndowoyo Communal Land, in south-eastern Zimbabwe, were surveyed from the air during the period 25-29 August 2001. The area surveyed totalled 5346 km<sup>2</sup>. The overall sampling intensity was 14.1 %.

The survey was designed to estimate the number of elephants. Some large herbivores are not easily seen from the air and their numbers were undoubtedly underestimated. Nonetheless, population estimates are given for these species, because the estimates provide useful indices of abundance (with measures of precision) that can be used to determine spatial distribution, as well as temporal trends in population number. No corrections have been applied to any of the estimates to compensate for any undercounting or missed animals.

The estimated population numbers of the principal large herbivores were: elephant 4992 (95% confidence interval (CI) 32.8 %); buffalo 1740 (CI 79.0 %); zebra 726 (CI 50.3 %); kudu 1435 (CI 32.8 %); impala 4123 (CI 36.7 %); waterbuck 324 (CI 52.8 %); giraffe 195 (CI 64.3 %); nyala 142 (CI 92 %); cattle 1786 (CI 87.0 %); and sheep and goats 1297 (CI 164 %). Few eland, sable and ostrich were seen. No wildebeest were seen.

The estimated total number of elephant carcasses represented 3.3 % of the estimated total number of live and dead elephants. Cattle, poachers' camps and huts erected by squatters were observed in the north of Gonarezhou National Park.

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## INTRODUCTION

Large wild and domestic herbivores were censused in Gonarezhou National Park, south-eastern Zimbabwe, as part of a continuing study to monitor their numbers in the Parks & Wild Life Estate and Communal Lands within Zimbabwe. This was the first survey in this region since 1998 and was part of a country-wide programme to survey the elephant range in Zimbabwe. Gonarezhou National Park is part of the Greater Limpopo Transfrontier Park (formerly called the Gaza-Kruger-Gonarezhou Transfrontier Park). Adjacent to the north of the National Park is Malilangwe Conservancy and to the north of that is Save Valley Conservancy. Both conservancies contain resident elephants and are fenced, but the fences hinder rather than prevent the movements of elephants.

## METHODS

### *Survey Area*

The survey area covered 5346 km<sup>2</sup> and included Gonarezhou National Park, Malapati Safari Area, Mahenye ward of Ndowoyo Communal Land (adjacent to the north-east boundary of Gonarezhou NP), and a small area of communal land between Malapati Safari Area and a veterinary control cattle/buffalo fence to the west of this Safari Area. To the east of the survey area is Mozambique and there is no barrier to the movement of elephants across the international border. To the west and south of the survey area are communal lands, which are separated from the National Park by veterinary control fences, which are designed to limit the movements of only cattle and buffalo.

A digital text file containing the co-ordinates (in degrees latitude and longitude) of the boundaries of seven strata was provided by D. Gibson, who has conducted several elephant surveys in Zimbabwe (e.g. Gibson 1999). The file format was modified to form a bna file that could be used by the WWF software for designing aerial surveys. The co-ordinates were not changed and therefore strata boundaries are essentially the same as those used during previous surveys. The bna file was imported into the software CARTALINX (Hagan, Eastman & Auble 1998) and the area of each stratum determined. These strata areas differed slightly from those used during the previous survey of this region (Mackie 1999): the new area estimates are used here because they are believed to be more accurate than the area estimates used previously. The entire survey area was estimated to be 5346 km<sup>2</sup>, which compares with the previous estimate of 5166 km<sup>2</sup> for the same piece of ground.

Stratum 6 of Mackie (1999) – Mabalauta – includes the section of Gonarezhou NP south of the railway, Malapati Safari Area and a small area of communal land between the Safari Area and a veterinary control fence to the west of Safari Area. The latter area and the Safari Area are managed as one, as a safari hunting concession. Therefore, although Mabalauta was treated as a single stratum during survey design and execution, the stratum was divided for analysis and reporting into two strata, namely Malapati and Mabalauta (NP), divided by the Malapati SA / Gonarezhou NP boundary (Map 1). This boundary was digitised from the Surveyor General's 1:250 000 map of the region, added to the CARTALINX coverage of the strata boundaries, and the areas of the subdivisions of the Mabalauta stratum determined.

### *Survey Design*

The procedures used followed those well established for aerial surveys of African large herbivores (Norton Griffiths 1978) and utilised during earlier surveys of large herbivores in Zimbabwe.

Systematic, parallel transects were positioned across each stratum. Transects were arranged at right angles to the principal environmental feature within a stratum (see Map 1 and Table 1 for transect orientations). The distance between adjacent transects varied between strata, according to the planned sampling intensity in each stratum. Overall sampling intensity was planned to be 12 % and the planned sampling intensity in each stratum was determined by using the elephant densities estimated in each stratum during 1998 (Mackie 1999) as the predicted elephant densities in equation 1 of Gibson (1992). As a consequence, those strata expected to contain large numbers of elephants were sampled more intensively than strata expected to contain few elephants. The minimum transect spacing was set at 2 km and the transect spacings used are given in Table 1.

Surveys were designed using WWF's custom software (AIRDESW, version dated 29/05/97). Given a stratum boundary in the form of a bna file, and the transect orientation and spacing, this program generated flight lines (the transects), with the first flight line offset from the end of the stratum by the random number entered as the "offset". The start and end points for each transect were transferred as waypoints to a GPS receiver in the plane prior to flying each stratum.

### *Flight Procedure*

The aircraft used was a Cessna 206. It was fitted with a radar altimeter and a Trimble GPS100 GPS receiver. During surveys, the aircraft was flown at approximately 160 km per hour at about 300 feet above ground level. The actual height was recorded from the radar altimeter every 30 seconds (of time) while flying along transects and later the mean height for each transect was calculated. Navigation along the transects was undertaken by the pilot, with reference to the GPS receiver and its course deviation indicator.

The aircraft crew included a pilot (Jon Cadd), a recorder (Kevin Dunham) who sat next to the pilot, and two observers (Crispin Jakopo and David Chipesi) who sat behind the pilot and recorder. Both observers had previous experience of observing during aerial surveys. All four crew could talk to one another through an intercom system.

All animals seen by the observers within the strips (see section *Strip Width and Calibration* below) were called to the recorder, who wrote down the species, the number of individuals of the group that were within the strip, and the GPS location against the time (to the nearest 30 seconds) after the start of the transect. Location was recorded as longitude when flying north-south, as latitude when flying east-west and consistently as one or the other when flying transects with other orientations. The recorder used a stopwatch to record the time (to the nearest second) taken to fly each transect.

Although the survey was designed especially to count elephants, all wild herbivores larger than impala were counted, together with domestic cattle, sheep, goats and donkeys. Sheep and goats could not be differentiated from the air and were lumped together as "sheep and goats".

During the survey, groups of elephant bulls were differentiated from elephant cow herds, although the latter may have included some bulls. Elephant carcasses were recorded and

classified as:

<b>Carcass category</b>	<b>Definition</b>
1	<b>Fresh:</b> intact; white droppings of vultures visible; vegetation trampled; fluid stain on ground around carcass visible (animal likely to have died within the last 3 months).
2	<b>Recent:</b> pieces of hide still attached; skeleton still partly articulated; no vulture droppings; no trampled vegetation; no fluid stain evident (less than 1 year old, but generally since the last rainy season, i.e. 3 to 8 months old).
3	<b>Old:</b> bones scattered and bleached (probably died during or before the last rainy season, i.e. more than 8 months old but generally more than 1 year old and up to several years old).

The carcass “ratio”, *sensu* Douglas-Hamilton *et al.* (1992), (although it is not a ratio, but a percentage) was calculated as the estimated number of all elephant carcasses (i.e. age categories 1, 2 and 3) as a percentage of the estimated number of all elephants (i.e. live + dead). Carcasses that could not be identified as elephant carcasses were recorded as “unidentified carcasses”.

Ostriches were recorded because they are large herbivores that are ecologically similar to large mammalian herbivores. Ground hornbills are large and conspicuous birds and any seen during the survey were recorded, at the request of the DNPWLM ornithology section.

Poachers’ camps, which were also recorded, were identified by the presence of meat racks (horizontal branches mounted above the ground), with or without meat, or meat hanging in trees. Huts were counted in Gonarezhou National Park and Malapati Safari Area.

Some large herbivores, e.g. kudu, are not easily seen from the air and their numbers were undoubtedly underestimated. Nonetheless, population estimates are given for these species, because the estimates provide useful indices of abundance (with measures of precision) that can be used to determine spatial distribution, as well as temporal trends in population number. No corrections have been applied to any of the estimates to compensate for any undercounting or missed animals.

All strata were flown during the period 25-29 August 2001 (Table 1).

#### *Strip Width and Calibration*

Two fishing rods were attached with custom brackets to each wing strut, so that the rods pointed backwards and parallel to the ground during level flight. The distance between the rods on each strut was arranged so that, when the aircraft was flying at 300 feet agl, the distance represented a strip about 150 m wide on the ground. Each rod was marked with a small piece of tape to provide the observers with a “decision point” (it was at this point that the observer decided whether an animal was inside the strip).

The strip widths were calibrated by flying the aircraft at right angles across an airstrip that



had two sets of large-sized numbers (from 1 to 25) arranged at 10 meter intervals along the side of the airstrip. The numbers were arranged as 25, 24, ..., 1, 0, 1, ..., 24, 25, with 0 near the centre of the airstrip. Each observer noted the largest and smallest number within his strip and the recorder noted the aircraft's height, which varied between 240 and 300 feet.

The nominal combined strip width at 300 feet was determined by averaging the combined strip widths, after adjusting these to 300 feet agl (see Appendix 1 for data and calculations).

One rod was re-adjusted after flying the Chipinda Pools and Mahenye strata and so the calibration exercise was then repeated (Appendix 1).

### *Data Analysis*

Population estimates and confidence intervals for individual strata were calculated with WWF's custom software (AIRSURVW, version dated 22/05/97), which uses Jolly's (1969) method 2 for unequal-sized sample units. Given the combined strip width when the plane was flying at 300 feet, and the mean height for each transect, the software determined the actual combined strip width for each transect. The area of each transect was calculated as the product of the actual combined strip width and the transect length (provided by AIRDESW). Search intensity (in minutes km<sup>-2</sup>) for a stratum was defined as the total time spent flying all transects within that stratum, divided by the total area of those same transects. The greater the search intensity, the less the probability that observers will not observe animals that are within the strips.

Transects near the boundary of a stratum were often broken into two or more sections, with land outside the stratum between the sections. For the purposes of analysis, data for all sections of the same transect were combined and entered into the program as one transect. The value of Student's *t* entered in the program to calculate the confidence interval was  $t_{n-1}$  for  $P = 0.05$  (Rohlf & Sokal 1981).

Population estimates for the entire study area and for various land units within it were calculated as the sum of the estimates for the strata within each land unit. The confidence interval for the population estimate for the entire study area and for land units that comprised more than one stratum was calculated as:

$$t_v \cdot \sqrt{\text{(Sum of Variances)}}$$

where:

$v$  = the degrees of freedom estimated by Satterthwaite's rule (Gasaway *et al.* 1986).

## **RESULTS**

The estimated numbers of elephants, elephant bulls in bull groups, elephants in cow herds, elephant carcasses (categories 1 & 3), unidentified carcasses, eland, buffalo, giraffe, impala, kudu, nyala, sable, waterbuck, cattle, sheep and goats, donkeys, ostriches and ground hornbills are given in Tables 2 to 21. A few crocodiles were seen (Table 22). Estimates of the population number are given for each stratum, for Gonarezhou National Park and for the entire survey area. Confidence intervals (CI) and confidence limits (CL) are 95 % confidence intervals and limits. "No. seen" is the number seen in the strips during the survey. There may

be small errors in the sums given at the foot of some tables. These are rounding errors: estimates, variances and sums were calculated with great precision in a spreadsheet, before being rounded to zero decimal places.

No wildebeest, rhinos, or elephant carcasses (age category 2) were seen during the survey. Small numbers of duiker, bushbuck, grysbok, spotted hyaena, honey badger and hippopotamus were seen during the survey, but no attempt has been made to estimate the numbers of these species. Hippopotamus populations are probably best counted during surveys dedicated to that species.

The estimated numbers of poachers' camps are given in Table 23 and the estimated number of huts built in Gonarezhou National Park by squatters is given in Table 24.

The spatial variation in the density of the principal wildlife species within the survey area is shown in Maps 2 to 12.

## DISCUSSION

### *Elephant Carcasses*

The estimated total number of elephant carcasses represented 3.3 % of the estimated total number of live and dead elephants (Table 6). A carcass "ratio" greater than 8 % is usually taken as indicative of a declining population number (Douglas-Hamilton *et al.* 1992) and in most strata the "ratio" was less than 9 %. Nonetheless, some poaching was evident: the elephant carcass (age category 1) found in the Naivasha stratum was a freshly killed animal, with its tusks removed and a large skin flap cut over the abdomen, presumably to encourage vultures to feed (although this carcass was found by the survey team before the vultures started to feed on it.) The other fresh elephant carcass seen during the survey was of an animal shot by safari hunters close to the border between Gonarezhou National Park and the communal land of Mahenye ward. The carcass "ratio" was high (50 %) in the Malapati stratum, because just one live elephant and one dead elephant were seen there. At 175 km<sup>2</sup>, Malapati is too small to maintain a viable elephant population and Malapati Safari Area is probably a sink area for the more numerous population of elephants in the adjacent National Park.

### *Settlement*

Squatters had entered Gonarezhou National Park and built huts in the Chipinda Pools stratum (Table 24). Often they were accompanied by cattle (Table 17). It was in this same stratum that four poachers' camps were seen (Table 23).

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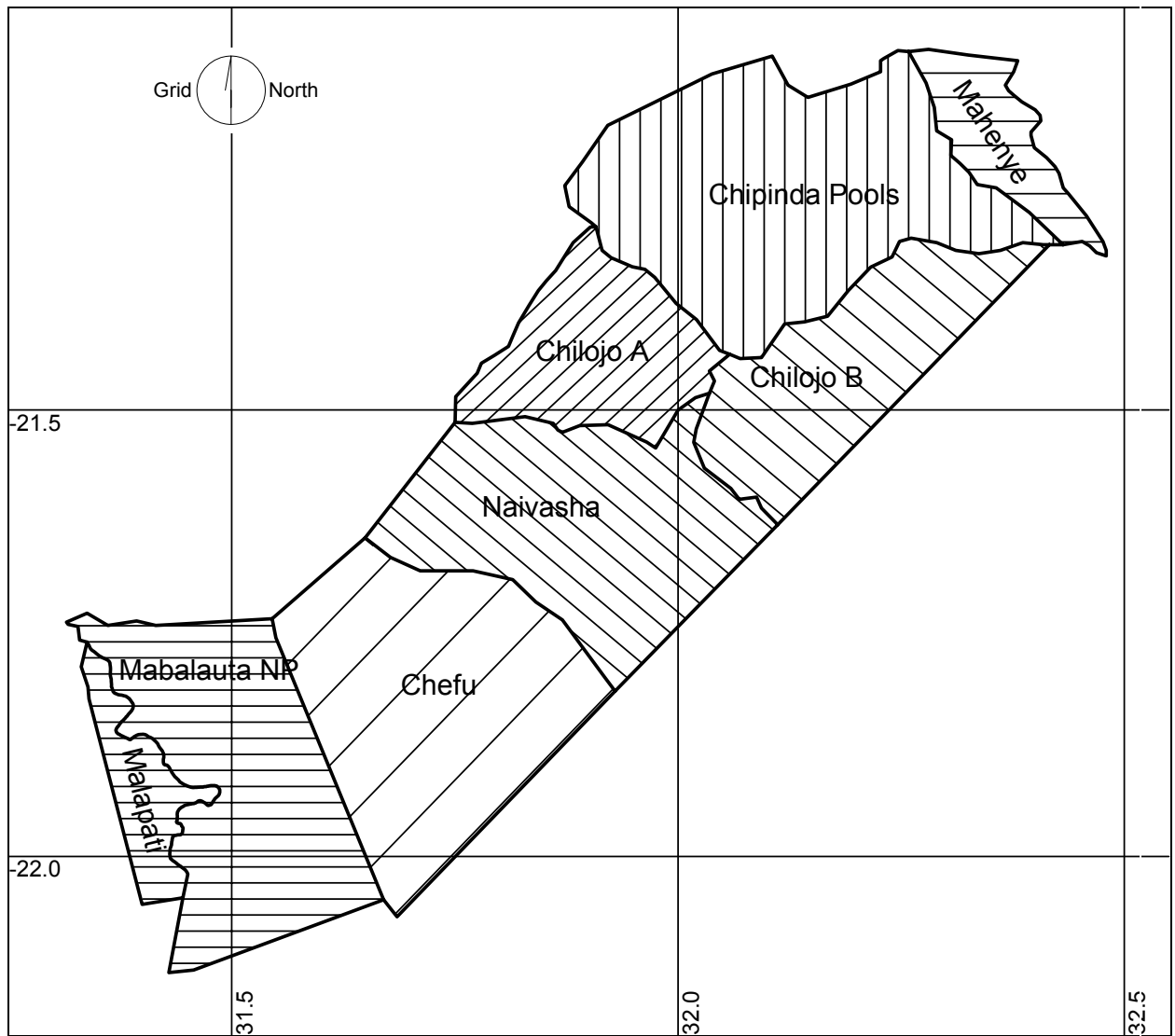
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- Dr Ivan Bond of WWF SARPO who managed the aerial survey programme, but still retained his sense of humour.



**Map 1.** The survey area in south-eastern Zimbabwe.

Strata names, strata boundaries (bold lines) and transects (thin, parallel lines) are shown. The survey area comprised Gonarezhou National Park (strata Chipinda Pools, Chilojo A and B, Naivasha, Chefu and Mabalauta NP), Malapati Safari Area and Mahenye ward in Ndowoyo Communal Land.

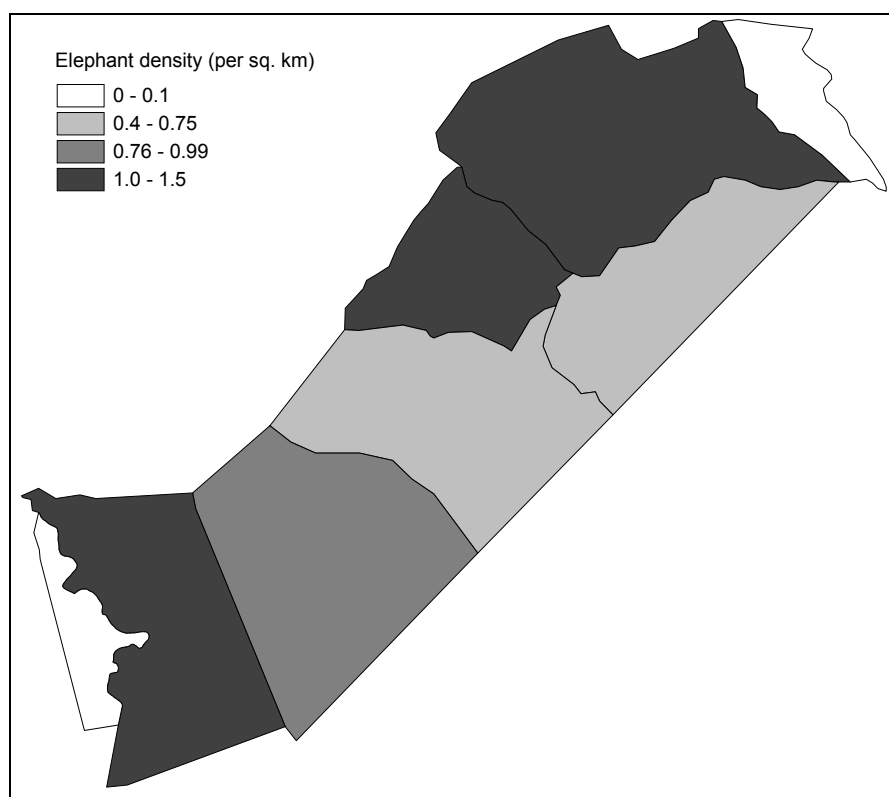
**Table 1. Sampling statistics for the 2001 aerial survey of elephants and other large herbivores in Gonarezhou National Park and adjacent lands**

Stratum name	Stratum area (km <sup>2</sup> )	Transect spacing (km)	Transect orientation (°)	Number of transects (= n)	Percent of stratum sampled	Time and Date sampled	Hours flown			Search intensity (minutes km <sup>-2</sup> )
							Transects	Stratum	Total	
<b>Gonarezhou National Park</b>										
1. Chipinda Pools	1167	2.4	0	24	14.86	am, 25/08	2.82	3.50	3.93	0.98
2. Chilojo A	460	2.0	45	13	19.05	pm, 28/08	1.35	1.80	2.55	0.92
3. Chilojo B	602	3.0	132	16	12.42	pm, 26/08	1.20	1.67	2.28	0.96
4. Naivasha	884	2.5	132	17	15.24	am, 28/08	2.02	2.75	3.60	0.90
5. Chefu	1017	6.0	42	6	6.65	am, 29/08	1.08	1.42	2.17	0.96
6b. Mabalauta NP	820	2.0	90	22	19.18	pm, 27/08	2.46	3.50	4.65	0.94
<b>Subtotal</b>	<b>4950</b>									
<b>Malapati Safari Area</b>										
6a. Malapati	175	2.0	90	16	19.32	pm, 27/08	0.52	- *	- *	0.93
<b>Mahenye Ward</b>										
7. Mahenye	221	3.0	90	8	11.34	pm, 25/08	0.45	0.70	1.22	1.07
<b>Total</b>	<b>5346 km<sup>2</sup></b>			<b>Overall</b>	<b>14.11 %</b>				<b>Mean</b>	<b>0.96</b>

\* Stratum 6a (Malapati) was flown as an extension of stratum 6b (Mabalauta NP)

**Table 2 : Population estimates and statistics for Elephant in and adjacent to Gonarezhou NP**

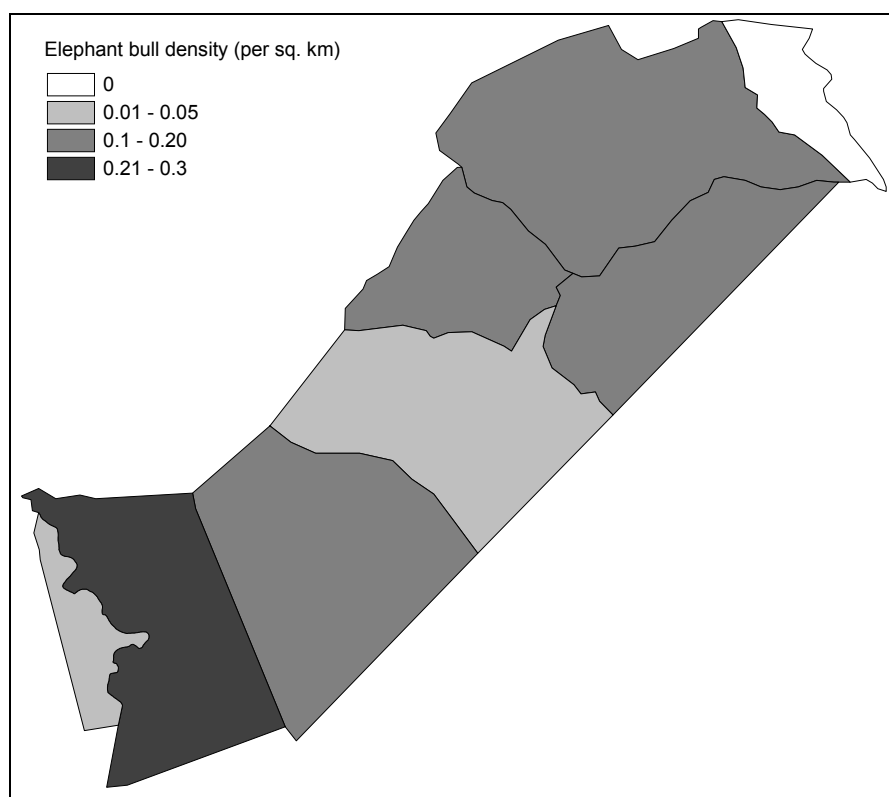
Stratum	Estimate	No. seen	Variance	% CI	Lower CL	Upper CL	Density (km <sup>-2</sup> )
<b>Gonarezhou National Park</b>							
Chipinda Pools	1730	257	350608	70.8	505	2955	1.48
Chilojo A	640	122	29754	58.7	264	1016	1.39
Chilojo B	258	32	13506	96.2	10	505	0.43
Naivasha	545	83	33740	71.5	155	934	0.62
Chefu	917	61	188313	121.6	0	2033	0.90
Mabalauta (NP)	897	172	31530	41.2	528	1266	1.09
<b>Subtotals</b>	<b>4987</b>	<b>727</b>	<b>647452</b>	<b>32.8</b>	<b>3350</b>	<b>6624</b>	<b>1.01</b>
<b>Malapati Safari Area</b>							
Malapati	5	1	23	197.6	0	15	0.03
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>4992</b>	<b>728</b>	<b>647475</b>	<b>32.8</b>	<b>3355</b>	<b>6628</b>	<b>0.93</b>



**Map 2.** Distribution of elephants in and adjacent to Gonarezhou NP during August 2001

**Table 3 : Population estimates and statistics for Elephant Bulls in and adjacent to Gonarezhou NP**

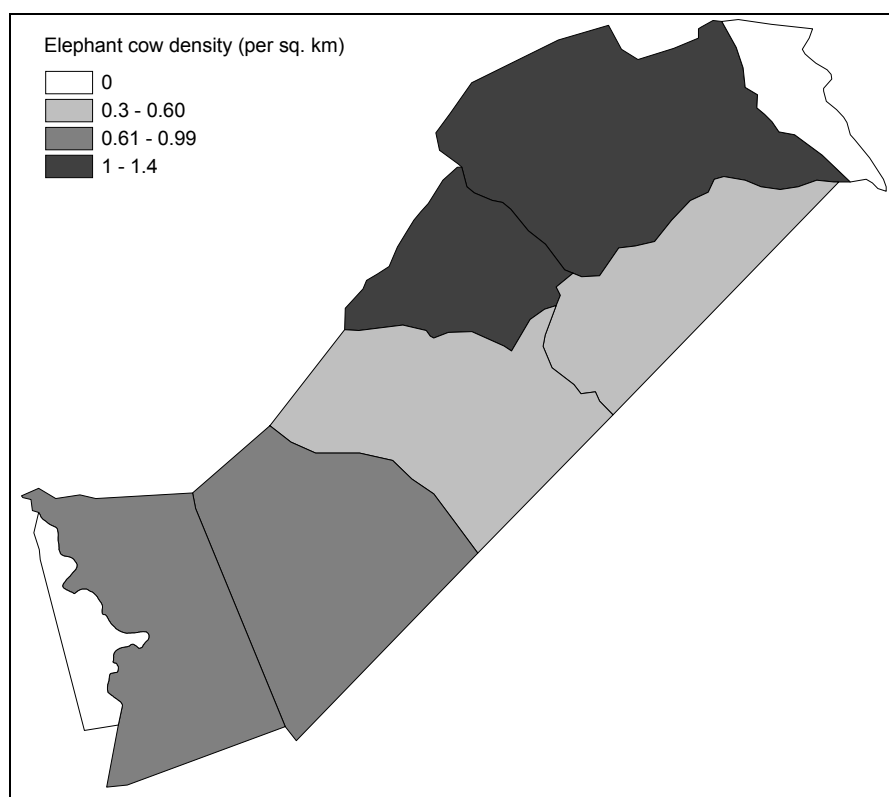
Stratum	Estimate	No. seen	Variance	% CI	Lower CL	Upper CL	Density (km <sup>-2</sup> )
<b>Gonarezhou National Park</b>							
Chipinda Pools	188	28	5225	79.4	39	338	0.16
Chilojo A	84	16	465	56.0	37	131	0.18
Chilojo B	72	9	1525	114.9	0	156	0.12
Naivasha	39	6	260	86.9	5	74	0.05
Chefu	120	8	3219	121.3	0	266	0.12
Mabalauta (NP)	209	40	2112	45.8	113	304	0.25
<b>Subtotals</b>	<b>712</b>	<b>107</b>	<b>12805</b>	<b>32.0</b>	<b>484</b>	<b>940</b>	<b>0.14</b>
<b>Malapati Safari Area</b>							
Malapati	5	1	23	197.6	0	15	0.03
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>718</b>	<b>108</b>	<b>12829</b>	<b>31.8</b>	<b>490</b>	<b>946</b>	<b>0.13</b>



**Map 3.** Distribution of elephant bulls in and adjacent to Gonarezhou NP during August 2001

**Table 4 : Population estimates and statistics for Elephant Cows in and adjacent to Gonarezhou NP**

Stratum	Estimate	No. seen	Variance	% CI	Lower CL	Upper CL	Density (km <sup>-2</sup> )
<b>Gonarezhou National Park</b>							
Chipinda Pools	1541	229	345384	78.9	325	2757	1.32
Chilojo A	556	106	29289	67.0	183	929	1.21
Chilojo B	185	23	11982	126.0	0	418	0.31
Naivasha	505	77	33480	76.8	117	893	0.57
Chefu	797	53	185095	138.8	0	1903	0.78
Mabalauta (NP)	688	132	29418	51.8	332	1045	0.84
<b>Subtotals</b>	<b>4272</b>	<b>620</b>	<b>634647</b>	<b>38.0</b>	<b>2649</b>	<b>5895</b>	<b>0.86</b>
<b>Malapati Safari Area</b>							
Malapati	0	0	0	0.0	0	0	0.00
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>4273</b>	<b>620</b>	<b>634647</b>	<b>38.0</b>	<b>2651</b>	<b>5896</b>	<b>0.80</b>



**Map 4.** Distribution of elephant cows in and adjacent to Gonarezhou NP during August 2001



**Table 5 : Population estimates and statistics for Elephant Carcasses 1 in and adjacent to Gonarezhou NP**

Stratum	Estimate	No. seen	Variance	% CI	Lower CL	Upper CL	Density (km <sup>-2</sup> )
<b>Gonarezhou National Park</b>							
Chipinda Pools	7	1	44	203.0	0	20	0.01
Chilojo A	0	0	0	0.0	0	0	0.00
Chilojo B	0	0	0	0.0	0	0	0.00
Naivasha	7	1	33	186.3	0	19	0.01
Chefu	0	0	0	0.0	0	0	0.00
Mabalauta (NP)	0	0	0	0.0	0	0	0.00
<b>Subtotals</b>	<b>14</b>	<b>2</b>	<b>77</b>	<b>126.8</b>	<b>0</b>	<b>32</b>	<b>0.003</b>
<b>Malapati Safari Area</b>							
Malapati	0	0	0	0.0	0	0	0.00
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>14</b>	<b>2</b>	<b>77</b>	<b>126.8</b>	<b>0</b>	<b>32</b>	<b>0.002</b>

**Table 6 : Population estimates and statistics for Elephant Carcasses 3 and carcass ratios in and adjacent to Gonarezhou NP**

Carcass ratio was calculated as the estimated number of all elephant carcasses (i.e. age classes 1, 2 and 3) as a percentage of all (i.e. live + dead) elephants.

Stratum	Estimate	No. seen	Variance	% CI	Lower CL	Upper CL	Density (km <sup>-2</sup> )	Carcass Ratio
<b>Gonarezhou National Park</b>								
Chipinda Pools	34	5	153	76.0	8	59	0.03	2.3
Chilojo A	16	3	51	98.5	0	31	0.03	2.4
Chilojo B	24	3	266	143.9	0	59	0.04	8.6
Naivasha	39	6	329	97.6	1	78	0.05	7.8
Chefu	15	1	226	256.8	0	54	0.02	1.6
Mabalauta (NP)	26	5	187	109.2	0	55	0.03	2.8
<b>Subtotals</b>	<b>154</b>	<b>23</b>	<b>1211</b>	<b>45.2</b>	<b>84</b>	<b>224</b>	<b>0.03</b>	<b>3.3</b>
<b>Malapati Safari Area</b>								
Malapati	5	1	24	200.3	0	16	0.03	50.0
<b>Mahenye Ward</b>								
Mahenye	0	0	0	0.0	0	0	0.00	- <sup>a</sup>
<b>Totals</b>	<b>159</b>	<b>24</b>	<b>1235</b>	<b>44.1</b>	<b>89</b>	<b>229</b>	<b>0.03</b>	<b>3.3</b>

<sup>a</sup> no elephants, live or dead, seen in this stratum

**Table 7 : Population estimates and statistics for Unidentified Carcasses in and adjacent to Gonarezhou NP**

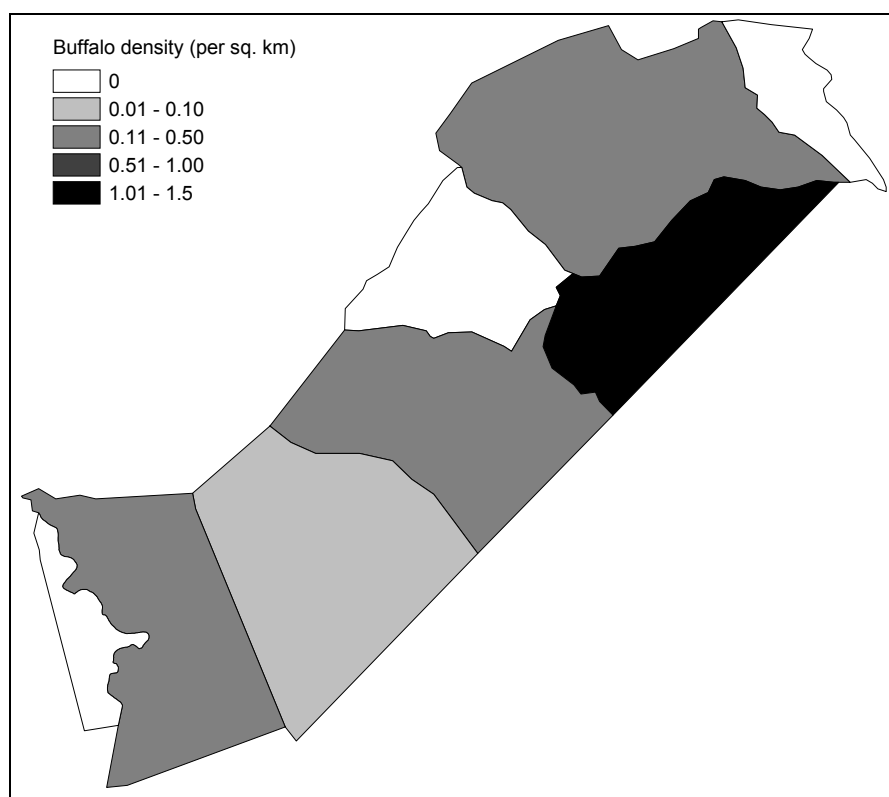
<b>Stratum</b>	<b>Estimate</b>	<b>No. seen</b>	<b>Variance</b>	<b>% CI</b>	<b>Lower CL</b>	<b>Upper CL</b>	<b>Density (km<sup>-2</sup>)</b>
<b>Gonarezhou National Park</b>							
Chipinda Pools	27	4	135	89.2	3	51	0.02
Chilojo A	21	4	60	80.5	4	38	0.05
Chilojo B	64	8	376	64.2	23	106	0.11
Naivasha	39	6	434	112.2	0	84	0.05
Chefu	0	0	0	0.0	0	0	0.00
Mabalauta (NP)	57	11	257	58.1	24	91	0.07
<b>Subtotals</b>	<b>208</b>	<b>33</b>	<b>1262</b>	<b>34.1</b>	<b>137</b>	<b>279</b>	<b>0.04</b>
<b>Malapati Safari Area</b>							
Malapati	31	6	140	81.1	6	56	0.18
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>240</b>	<b>39</b>	<b>1402</b>	<b>31.1</b>	<b>165</b>	<b>315</b>	<b>0.05</b>

**Table 8 : Population estimates and statistics for Eland in and adjacent to Gonarezhou NP**

<b>Stratum</b>	<b>Estimate</b>	<b>No. seen</b>	<b>Variance</b>	<b>% CI</b>	<b>Lower CL</b>	<b>Upper CL</b>	<b>Density (km<sup>-2</sup>)</b>
<b>Gonarezhou National Park</b>							
Chipinda Pools	74	11	4074	178.4	0	206	0.06
Chilojo A	0	0	0	0.0	0	0	0.00
Chilojo B	0	0	0	0.0	0	0	0.00
Naivasha	0	0	0	0.0	0	0	0.00
Chefu	0	0	0	0.0	0	0	0.00
Mabalauta (NP)	0	0	0	0.0	0	0	0.00
<b>Subtotals</b>	<b>74</b>	<b>11</b>	<b>4074</b>	<b>178.5</b>	<b>0</b>	<b>206</b>	<b>0.01</b>
<b>Malapati Safari Area</b>							
Malapati	0	0	0	0.0	0	0	0.00
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>74</b>	<b>11</b>	<b>4074</b>	<b>178.4</b>	<b>0</b>	<b>206</b>	<b>0.01</b>

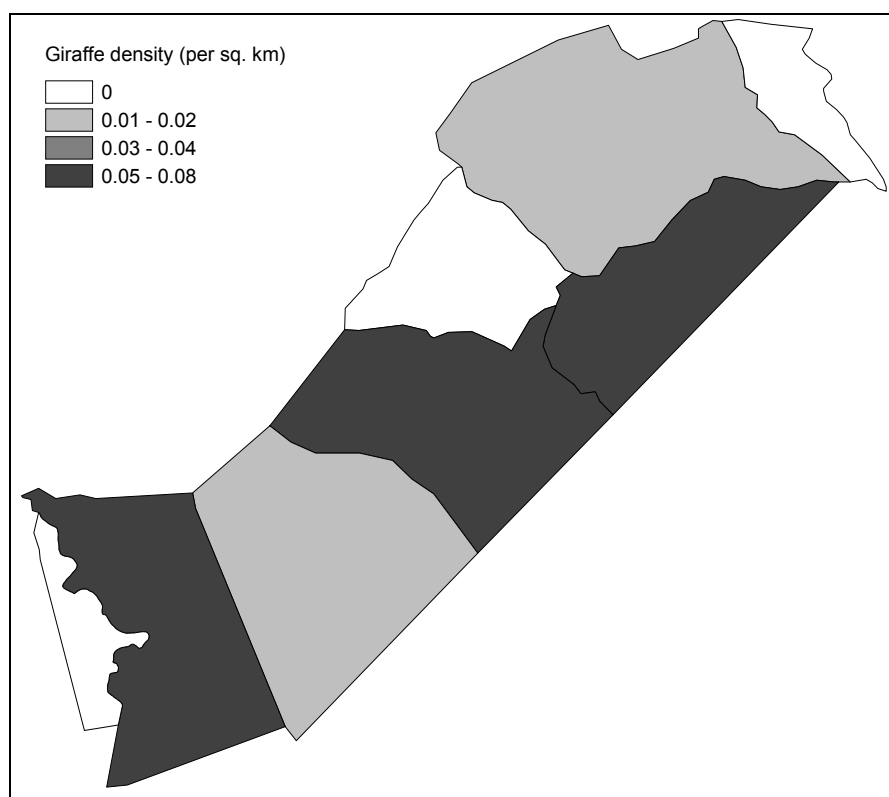
**Table 9 : Population estimates and statistics for Buffalo in and adjacent to Gonarezhou NP**

Stratum	Estimate	No. seen	Variance	% CI	Lower CL	Upper CL	Density (km <sup>-2</sup> )
<b>Gonarezhou National Park</b>							
Chipinda Pools	195	29	24643	166.4	0	520	0.17
Chilojo A	0	0	0	0.0	0	0	0.00
Chilojo B	724	90	203873	132.8	0	1687	1.20
Naivasha	394	60	114286	182.0	0	1110	0.45
Chefu	15	1	226	256.8	0	54	0.02
Mabalauta (NP)	412	79	125899	179.2	0	1150	0.50
<b>Subtotals</b>	<b>1740</b>	<b>259</b>	<b>468926</b>	<b>79.0</b>	<b>365</b>	<b>3115</b>	<b>0.35</b>
<b>Malapati Safari Area</b>							
Malapati	0	0	0	0.0	0	0	0.00
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>1740</b>	<b>259</b>	<b>468926</b>	<b>79.0</b>	<b>365</b>	<b>3115</b>	<b>0.33</b>

**Map 5.** Distribution of buffalo in and adjacent to Gonarezhou NP during August 2001

**Table 10 : Population estimates and statistics for Giraffe in and adjacent to Gonarezhou NP**

Stratum	Estimate	No. seen	Variance	% CI	Lower CL	Upper CL	Density (km <sup>-2</sup> )
<b>Gonarezhou National Park</b>							
Chipinda Pools	20	3	339	188.7	0	58	0.02
Chilojo A	0	0	0	0.0	0	0	0.00
Chilojo B	40	5	917	160.3	0	105	0.07
Naivasha	72	11	1712	121.5	0	160	0.08
Chefu	15	1	234	261.6	0	54	0.02
Mabalauta (NP)	47	9	689	116.3	0	102	0.06
<b>Subtotals</b>	<b>194</b>	<b>29</b>	<b>3891</b>	<b>64.5</b>	<b>69</b>	<b>319</b>	<b>0.04</b>
<b>Malapati Safari Area</b>							
Malapati	0	0	0	0.0	0	0	0.00
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>195</b>	<b>29</b>	<b>3891</b>	<b>64.3</b>	<b>70</b>	<b>320</b>	<b>0.04</b>

**Map 6.** Distribution of giraffe in and adjacent to Gonarezhou NP during August 2001

**Table 11 : Population estimates and statistics for Impala in and adjacent to Gonarezhou NP**

Stratum	Estimate	No. seen	Variance	% CI	Lower CL	Upper CL	Density (km <sup>-2</sup> )
<b>Gonarezhou National Park</b>							
Chipinda Pools	1225	182	140194	63.2	450	2000	1.05
Chilojo A	241	46	19992	127.6	0	550	0.53
Chilojo B	966	120	189040	95.9	39	1892	1.60
Naivasha	210	32	7457	87.2	27	393	0.24
Chefu	782	52	124909	116.2	0	1691	0.77
Mabalauta (NP)	667	128	84976	90.8	61	1274	0.81
<b>Subtotals</b>	<b>4091</b>	<b>560</b>	<b>566568</b>	<b>37.0</b>	<b>2577</b>	<b>5605</b>	<b>0.83</b>
<b>Malapati Safari Area</b>							
Malapati	31	6	336	125.9	0	70	0.18
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>4123</b>	<b>566</b>	<b>566905</b>	<b>36.7</b>	<b>2608</b>	<b>5638</b>	<b>0.77</b>



**Map 7.** Distribution of impala in and adjacent to Gonarezhou NP during August 2001

**Table 12 : Population estimates and statistics for Kudu in and adjacent to Gonarezhou NP**

Stratum	Estimate	No. seen	Variance	% CI	Lower CL	Upper CL	Density (km <sup>-2</sup> )
<b>Gonarezhou National Park</b>							
Chipinda Pools	612	91	24691	53.1	287	938	0.53
Chilojo A	52	10	496	92.4	4	101	0.11
Chilojo B	225	28	9796	93.6	14	436	0.37
Naivasha	125	19	4408	112.9	0	265	0.14
Chefu	180	12	5963	110.0	0	379	0.18
Mabalauta (NP)	120	23	2450	85.8	17	223	0.15
<b>Subtotals</b>	<b>1314</b>	<b>183</b>	<b>47804</b>	<b>33.3</b>	<b>876</b>	<b>1752</b>	<b>0.27</b>
<b>Malapati Safari Area</b>							
Malapati	93	18	7465	197.6	0	277	0.53
<b>Mahenye Ward</b>							
Mahenye	26	3	269	146.5	0	65	0.12
<b>Totals</b>	<b>1435</b>	<b>204</b>	<b>55539</b>	<b>32.8</b>	<b>965</b>	<b>1905</b>	<b>0.27</b>



**Map 8.** Distribution of kudu in and adjacent to Gonarezhou NP during August 2001

**Table 13 : Population estimates and statistics for Nyala in and adjacent to Gonarezhou NP**

Stratum	Estimate	No. seen	Variance	% CI	Lower CL	Upper CL	Density (km <sup>-2</sup> )
<b>Gonarezhou National Park</b>							
Chipinda Pools	0	0	0	0.0	0	0	0.00
Chilojo A	37	7	474	129.2	0	84	0.08
Chilojo B	0	0	0	0.0	0	0	0.00
Naivasha	13	2	60	125.1	0	30	0.02
Chefu	45	3	2061	258.7	0	162	0.04
Mabalauta (NP)	37	7	1117	190.5	0	106	0.05
<b>Subtotals</b>	<b>132</b>	<b>19</b>	<b>3713</b>	<b>99.0</b>	<b>1</b>	<b>263</b>	<b>0.03</b>
<b>Malapati Safari Area</b>							
Malapati	10	2	41	132.5	0	24	0.06
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>142</b>	<b>21</b>	<b>3754</b>	<b>92.1</b>	<b>11</b>	<b>272</b>	<b>0.03</b>



**Map 9.** Distribution of nyala in and adjacent to Gonarezhou NP during August 2001

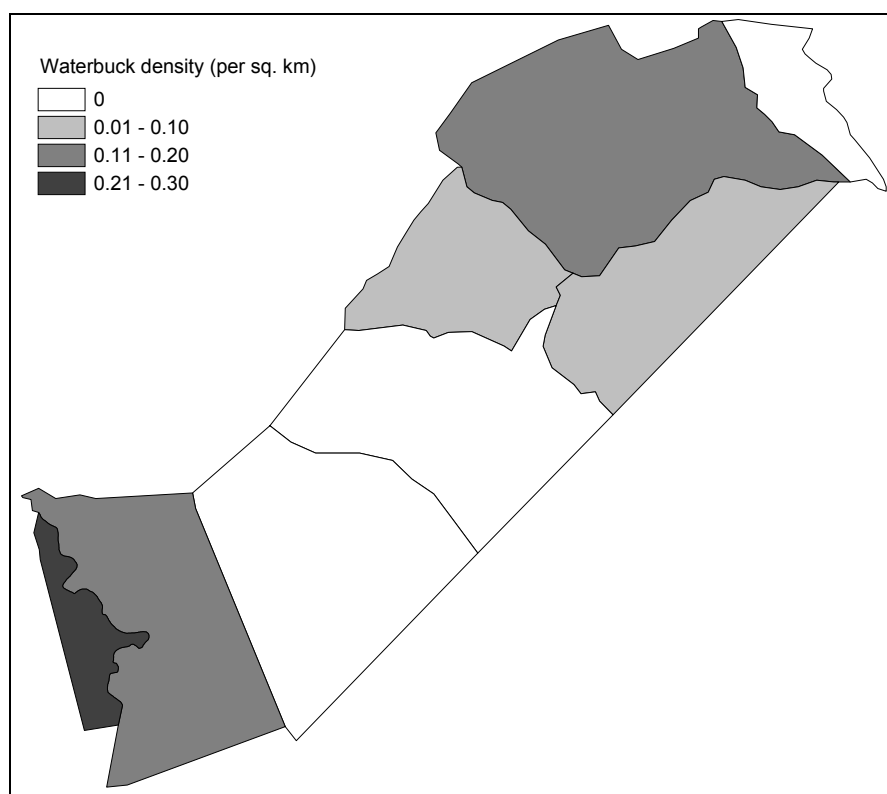
**Table 14 : Population estimates and statistics for Sable in and adjacent to Gonarezhou NP**

<b>Stratum</b>	<b>Estimate</b>	<b>No. seen</b>	<b>Variance</b>	<b>% CI</b>	<b>Lower CL</b>	<b>Upper CL</b>	<b>Density (km<sup>-2</sup>)</b>
<b>Gonarezhou National Park</b>							
Chipinda Pools	0	0	0	0.0	0	0	0.00
Chilojo A	0	0	0	0.0	0	0	0.00
Chilojo B	0	0	0	0.0	0	0	0.00
Naivasha	7	1	32	183.2	0	19	0.01
Chefu	0	0	0	0.0	0	0	0.00
Mabalauta (NP)	0	0	0	0.0	0	0	0.00
<b>Subtotals</b>	<b>7</b>	<b>1</b>	<b>32</b>	<b>171.7</b>	<b>0</b>	<b>19</b>	<b>0.001</b>
<b>Malapati Safari Area</b>							
Malapati	0	0	0	0.0	0	0	0.00
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>7</b>	<b>1</b>	<b>32</b>	<b>183.2</b>	<b>0</b>	<b>19</b>	<b>0.001</b>



**Table 15 : Population estimates and statistics for Waterbuck in and adjacent to Gonarezhou NP**

Stratum	Estimate	No. seen	Variance	% CI	Lower CL	Upper CL	Density (km <sup>-2</sup> )
<b>Gonarezhou National Park</b>							
Chipinda Pools	155	23	3809	82.5	27	282	0.13
Chilojo A	5	1	21	190.0	0	15	0.01
Chilojo B	8	1	61	206.1	0	25	0.01
Naivasha	0	0	0	0.0	0	0	0.00
Chefu	0	0	0	0.0	0	0	0.00
Mabalauta (NP)	110	21	2612	97.1	3	216	0.13
<b>Subtotals</b>	<b>278</b>	<b>46</b>	<b>6503</b>	<b>58.4</b>	<b>116</b>	<b>440</b>	<b>0.06</b>
<b>Malapati Safari Area</b>							
Malapati	47	9	780	127.8	0	106	0.27
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>324</b>	<b>55</b>	<b>7283</b>	<b>52.8</b>	<b>153</b>	<b>495</b>	<b>0.06</b>



**Map 10.** Distribution of waterbuck in and adjacent to Gonarezhou NP during August 2001

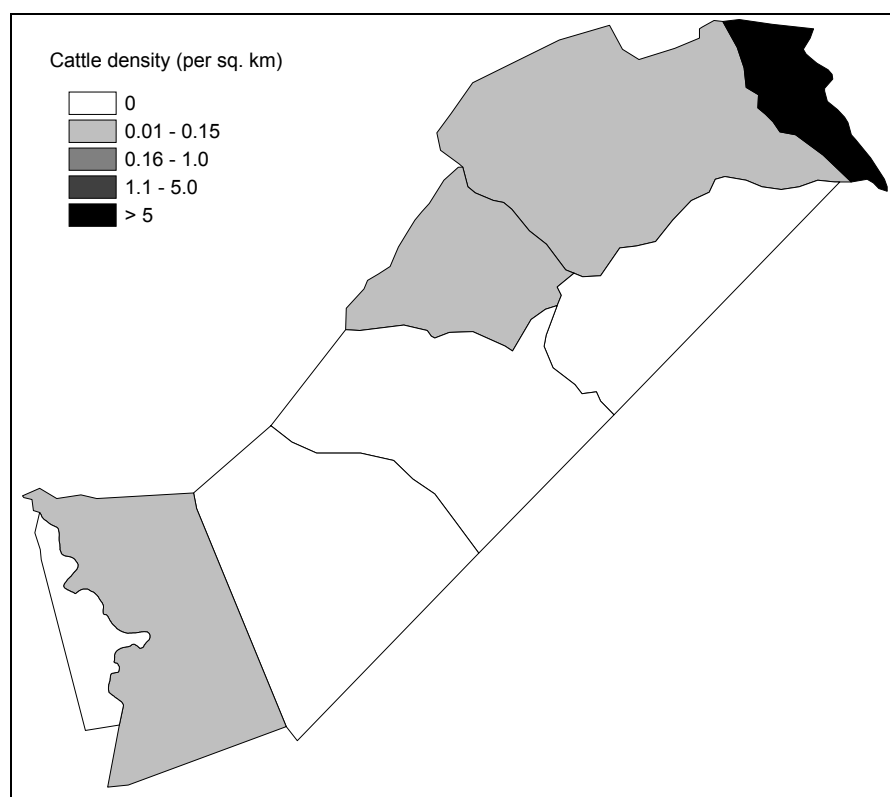
**Table 16 : Population estimates and statistics for Zebra in and adjacent to Gonarezhou NP**

Stratum	Estimate	No. seen	Variance	% CI	Lower CL	Upper CL	Density (km <sup>-2</sup> )
<b>Gonarezhou National Park</b>							
Chipinda Pools	262	39	8927	74.5	67	458	0.23
Chilojo A	0	0	0	0.0	0	0	0.00
Chilojo B	24	3	488	194.9	0	71	0.04
Naivasha	20	3	330	195.6	0	58	0.02
Chefu	60	4	3609	256.8	0	215	0.06
Mabalauta (NP)	355	68	19492	81.9	64	645	0.43
<b>Subtotals</b>	<b>721</b>	<b>117</b>	<b>32845</b>	<b>50.6</b>	<b>356</b>	<b>1086</b>	<b>0.15</b>
<b>Malapati Safari Area</b>							
Malapati	5	1	24	203.3	0	16	0.03
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>726</b>	<b>118</b>	<b>32869</b>	<b>50.3</b>	<b>361</b>	<b>1092</b>	<b>0.14</b>

**Map 11.** Distribution of zebra in and adjacent to Gonarezhou NP during August 2001

**Table 17 : Population estimates and statistics for Cattle in and adjacent to Gonarezhou NP**

Stratum	Estimate	No. seen	Variance	% CI	Lower CL	Upper CL	Density (km <sup>-2</sup> )
<b>Gonarezhou National Park</b>							
Chipinda Pools	47	7	1836	188.2	0	136	0.04
Chilojo A	63	12	3018	190.0	0	183	0.14
Chilojo B	0	0	0	0.0	0	0	0.00
Naivasha	0	0	0	0.0	0	0	0.00
Chefu	0	0	0	0.0	0	0	0.00
Mabalauta (NP)	115	22	10859	188.9	0	331	0.14
<b>Subtotals</b>	<b>225</b>	<b>41</b>	<b>15713</b>	<b>112.9</b>	<b>0</b>	<b>479</b>	<b>0.05</b>
<b>Malapati Safari Area</b>							
Malapati	0	0	0	0.0	0	0	0.00
<b>Mahenye Ward</b>							
Mahenye	1561	177	416365	97.7	35	3087	7.07
<b>Totals</b>	<b>1786</b>	<b>218</b>	<b>432078</b>	<b>87.0</b>	<b>232</b>	<b>3341</b>	<b>0.33</b>

**Map 12.** Distribution of cattle in and adjacent to Gonarezhou NP during August 2001

**Table 18 : Population estimates and statistics for Sheep and Goats in and adjacent to Gonarezhou NP**

<b>Stratum</b>	<b>Estimate</b>	<b>No. seen</b>	<b>Variance</b>	<b>% CI</b>	<b>Lower CL</b>	<b>Upper CL</b>	<b>Density (km<sup>-2</sup>)</b>
<b>Gonarezhou National Park</b>							
Chipinda Pools	0	0	0	0.0	0	0	0.00
Chilojo A	0	0	0	0.0	0	0	0.00
Chilojo B	0	0	0	0.0	0	0	0.00
Naivasha	0	0	0	0.0	0	0	0.00
Chefu	0	0	0	0.0	0	0	0.00
Mabalauta (NP)	0	0	0	0.0	0	0	0.00
<b>Subtotals</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.0</b>	<b>0</b>	<b>0</b>	<b>0.00</b>
<b>Malapati Safari Area</b>							
Malapati	0	0	0	0.0	0	0	0.00
<b>Mahenye Ward</b>							
Mahenye	1297	147	807798	163.9	0	3422	5.87
<b>Totals</b>	<b>1297</b>	<b>147</b>	<b>807798</b>	<b>163.9</b>	<b>0</b>	<b>3422</b>	<b>0.24</b>

**Table 19 : Population estimates and statistics for Donkeys in and adjacent to Gonarezhou NP**

<b>Stratum</b>	<b>Estimate</b>	<b>No. seen</b>	<b>Variance</b>	<b>% CI</b>	<b>Lower CL</b>	<b>Upper CL</b>	<b>Density (km<sup>-2</sup>)</b>
<b>Gonarezhou National Park</b>							
Chipinda Pools	0	0	0	0.0	0	0	0.00
Chilojo A	0	0	0	0.0	0	0	0.00
Chilojo B	0	0	0	0.0	0	0	0.00
Naivasha	0	0	0	0.0	0	0	0.00
Chefu	0	0	0	0.0	0	0	0.00
Mabalauta (NP)	0	0	0	0.0	0	0	0.00
<b>Subtotals</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.0</b>	<b>0</b>	<b>0</b>	<b>0.00</b>
<b>Malapati Safari Area</b>							
Malapati	0	0	0	0.0	0	0	0.00
<b>Mahenye Ward</b>							
Mahenye	44	5	929	163.5	0	116	0.20
<b>Totals</b>	<b>44</b>	<b>5</b>	<b>929</b>	<b>163.5</b>	<b>0</b>	<b>116</b>	<b>0.01</b>

**Table 20 : Population estimates and statistics for Ostriches in and adjacent to Gonarezhou NP**

<b>Stratum</b>	<b>Estimate</b>	<b>No. seen</b>	<b>Variance</b>	<b>% CI</b>	<b>Lower CL</b>	<b>Upper CL</b>	<b>Density (km<sup>-2</sup>)</b>
<b>Gonarezhou National Park</b>							
Chipinda Pools	20	3	354	192.9	0	59	0.02
Chilojo A	0	0	0	0.0	0	0	0.00
Chilojo B	0	0	0	0.0	0	0	0.00
Naivasha	0	0	0	0.0	0	0	0.00
Chefu	0	0	0	0.0	0	0	0.00
Mabalauta (NP)	0	0	0	0.0	0	0	0.00
<b>Subtotals</b>	<b>20</b>	<b>3</b>	<b>354</b>	<b>194.8</b>	<b>0</b>	<b>59</b>	<b>0.00</b>
<b>Malapati Safari Area</b>							
Malapati	0	0	0	0.0	0	0	0.00
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>20</b>	<b>3</b>	<b>354</b>	<b>192.9</b>	<b>0</b>	<b>59</b>	<b>0.00</b>

**Table 21 : Population estimates and statistics for Ground Hornbills in and adjacent to Gonarezhou NP**

<b>Stratum</b>	<b>Estimate</b>	<b>No. seen</b>	<b>Variance</b>	<b>% CI</b>	<b>Lower CL</b>	<b>Upper CL</b>	<b>Density (km<sup>-2</sup>)</b>
<b>Gonarezhou National Park</b>							
Chipinda Pools	54	8	783	107.5	0	112	0.05
Chilojo A	21	4	289	176.5	0	58	0.05
Chilojo B	97	12	1789	93.3	6	187	0.16
Naivasha	33	5	367	123.7	0	73	0.04
Chefu	0	0	0	0.0	0	0	0.00
Mabalauta (NP)	5	1	23	189.7	0	15	0.01
<b>Subtotals</b>	<b>210</b>	<b>30</b>	<b>3251</b>	<b>54.8</b>	<b>95</b>	<b>325</b>	<b>0.04</b>
<b>Malapati Safari Area</b>							
Malapati	0	0	0	0.0	0	0	0.00
<b>Mahenye Ward</b>							
Mahenye	35	4	1112	223.5	0	114	0.16
<b>Totals</b>	<b>245</b>	<b>34</b>	<b>4362</b>	<b>54.4</b>	<b>112</b>	<b>378</b>	<b>0.05</b>

**Table 22 : Population estimates and statistics for Crocodiles in and adjacent to Gonarezhou NP**

<b>Stratum</b>	<b>Estimate</b>	<b>No. seen</b>	<b>Variance</b>	<b>% CI</b>	<b>Lower CL</b>	<b>Upper CL</b>	<b>Density (km<sup>-2</sup>)</b>
<b>Gonarezhou National Park</b>							
Chipinda Pools	40	6	752	140.5	0	97	0.04
Chilojo A	0	0	0	0.0	0	0	0.00
Chilojo B	0	0	0	0.0	0	0	0.00
Naivasha	0	0	0	0.0	0	0	0.00
Chefu	0	0	0	0.0	0	0	0.00
Mabalauta (NP)	0	0	0	0.0	0	0	0.00
<b>Subtotals</b>	<b>40</b>	<b>6</b>	<b>752</b>	<b>141.9</b>	<b>0</b>	<b>97</b>	<b>0.01</b>
<b>Malapati Safari Area</b>							
Malapati	41	8	1513	200.2	0	124	0.24
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>82</b>	<b>14</b>	<b>2265</b>	<b>128.4</b>	<b>0</b>	<b>187</b>	<b>0.02</b>

**Table 23 : Estimates and statistics for Poachers' Camps in and adjacent to Gonarezhou NP**

<b>Stratum</b>	<b>Estimate</b>	<b>No. seen</b>	<b>Variance</b>	<b>% CI</b>	<b>Lower CL</b>	<b>Upper CL</b>	<b>Density (km<sup>-2</sup>)</b>
<b>Gonarezhou National Park</b>							
Chipinda Pools	27	4	125	85.9	4	50	0.02
Chilojo A	0	0	0	0.0	0	0	0.00
Chilojo B	0	0	0	0.0	0	0	0.00
Naivasha	0	0	0	0.0	0	0	0.00
Chefu	0	0	0	0.0	0	0	0.00
Mabalauta (NP)	0	0	0	0.0	0	0	0.00
<b>Subtotals</b>	<b>27</b>	<b>4</b>	<b>125</b>	<b>85.7</b>	<b>4</b>	<b>50</b>	<b>0.01</b>
<b>Malapati Safari Area</b>							
Malapati	0	0	0	0.0	0	0	0.00
<b>Mahenye Ward</b>							
Mahenye	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>27</b>	<b>4</b>	<b>125</b>	<b>85.9</b>	<b>4</b>	<b>50</b>	<b>0.01</b>

Table 24 : Estimates and statistics for Huts in and adjacent to Gonarezhou NP

<b>Stratum</b>	<b>Estimate</b>	<b>No. seen</b>	<b>Variance</b>	<b>% CI</b>	<b>Lower CL</b>	<b>Upper CL</b>	<b>Density (km<sup>-2</sup>)</b>
<b>Gonarezhou National Park</b>							
Chipinda Pools	128	19	2733	84.6	20	236	0.11
Chilojo A	0	0	0	0.0	0	0	0.00
Chilojo B	0	0	0	0.0	0	0	0.00
Naivasha	0	0	0	0.0	0	0	0.00
Chefu	0	0	0	0.0	0	0	0.00
Mabalauta (NP)	0	0	0	0.0	0	0	0.00
<b>Subtotals</b>	<b>128</b>	<b>19</b>	<b>2733</b>	<b>84.5</b>	<b>20</b>	<b>236</b>	<b>0.03</b>
<b>Malapati Safari Area</b>							
Malapati	0	0	0	0.0	0	0	0.00
<b>Totals</b>	<b>128</b>	<b>19</b>	<b>2733</b>	<b>84.6</b>	<b>20</b>	<b>236</b>	<b>0.02</b>

### Appendix 1. Calibration to determine strip width

Strip width (in meters) for one observer =  $10 * (\text{Difference} + 1)$ .

Combined strip width (in meters) =  $10 * (\text{Difference}_{\text{left}} + \text{Difference}_{\text{right}} + 2)$ .

*Calibration 1 (Chipinda Pools and Mahenye strata only)*

Run no.	Left observer: Crispin Jakopo			Right observer: David Chipesi			Combined strip width (m)	Height agl (ft)	Width at 300 ft (m)
	Outer	Inner	Strip Width	Outer	Inner	Strip Width			
1	21	12	100	23	7	170	270	270	300
2	18	9	100	>25	12			290	
3	25	11	150	25	10	160	310	300	310
4	25	9	170	25	11	150	320	300	320
5	-	-		>25	9			300	
6	24	7	180	>25	12			300	
7	>25	12		24	8	170		300	
8	25	9	170	>25	11			280	
9	25	10	160	22	7	160	320	280	343
10	23	8	160	25	11	150	310	270	344
11	>25	11		21	8	140		290	
12	>25	12		22	6	170		260	
13	22	7	160	24	11	140	300	260	346
14	-	-		24	7	180		270	
15	25	10	160	25	9	170	330	280	354
16	23	9	150	23	9	150	300	260	346
17	25	11	150	24	8	170	320	280	343
18	21	6	160	>25	12			260	
19	25	10	160	24	8	170	330	270	367
20	23	9	150	24	9	160	310	270	344
21	25	10	160	25	9	170	330	290	341
22	>25	10		22	9	140		280	
23	21	9	130	19	7	130	260	240	325
24	23	8	160	25	11	150	310	280	332
25	25	12	140	22	7	160	300	260	346
26	20	6	150	>25	13			270	
27	24	10	150	23	9	150	300	270	333
28	23	8	160	25	10	160	320	280	343
29	25	11	150	25	9	170	320	280	343
30	25	9	170	25	10	160	330	270	367
31	>25	13		-	-			290	
32	24	9	160	>25	10			270	
33	25	11	150	25	10	160	310	280	332
34	24	8	170	25	11	150	320	280	343
35	>25	12		24	10	150		280	
<b>Mean combined strip width (in meters) at 300 feet agl =</b>									<b>339</b>





### Appendix 2. Aerial survey flight summary

<b>Date</b>	<b>Time</b>	<b>Flight time (hours:minutes)</b>	<b>Duty</b>
24 Aug 2001	am	1.9 hours	Positioning, Harare to Malilangwe
24	pm	1.1 hours	Calibration
25	am	3:56	Stratum Chipinda Pools
25	pm	1:13	Stratum Mahenye
25	pm	0:30	Calibration
26	am	1:12	Stratum Naivasha – aborted flight because of intercom problem
26	pm	2:17	Stratum Chilojo B
27	am	0.08	Aborted flight – poor visibility
27	pm	4:32	Stratum Mabalauta
28	am	3:15	Stratum Naivasha + calibration
28	pm	2:33	Stratum Chilojo A + calibration
29	am	2:10	Stratum Chefu
29 Aug 2001	pm	2 hours	Positioning, Malilangwe to Harare

### Appendix 3. Transect start and end points.

#### Chipinda Pools

Number of transects : 24  
 Transect Bearing : 0.00 Degrees  
 Transect Spacing : 2.40 km

Transect # : 1 Start Lat : S 21 : 13.700 Start Lon : E 31 : 53.296 Finish Lat : S 21 : 16.789 Finish Lon : E 31 : 53.296 Length : 5.72 km	Start Lat : S 21 : 7.776 Start Lon : E 32 : 7.173 Finish Lat : S 21 : 24.232 Finish Lon : E 32 : 7.173 Length : 30.47 km
Transect # : 2 Start Lat : S 21 : 18.444 Start Lon : E 31 : 54.684 Finish Lat : S 21 : 11.729 Finish Lon : E 31 : 54.684 Length : 12.44 km	Transect # : 12 Start Lat : S 21 : 24.060 Start Lon : E 32 : 8.561 Finish Lat : S 21 : 8.900 Finish Lon : E 32 : 8.561 Length : 28.07 km
Transect # : 3 Start Lat : S 21 : 10.484 Start Lon : E 31 : 56.071 Finish Lat : S 21 : 20.013 Finish Lon : E 31 : 56.071 Length : 17.65 km	Transect # : 13 Start Lat : S 21 : 8.618 Start Lon : E 32 : 9.948 Finish Lat : S 21 : 23.730 Finish Lon : E 32 : 9.948 Length : 27.99 km
Transect # : 4 Start Lat : S 21 : 20.484 Start Lon : E 31 : 57.459 Finish Lat : S 21 : 9.800 Finish Lon : E 31 : 57.459 Length : 19.79 km	Transect # : 14 Start Lat : S 21 : 22.116 Start Lon : E 32 : 11.336 Finish Lat : S 21 : 8.186 Finish Lon : E 32 : 11.336 Length : 25.80 km
Transect # : 5 Start Lat : S 21 : 9.116 Start Lon : E 31 : 58.847 Finish Lat : S 21 : 21.593 Finish Lon : E 31 : 58.847 Length : 23.10 km	Transect # : 15 Start Lat : S 21 : 7.641 Start Lon : E 32 : 12.724 Finish Lat : S 21 : 20.657 Finish Lon : E 32 : 12.724 Length : 24.10 km
Transect # : 6 Start Lat : S 21 : 23.126 Start Lon : E 32 : 0.235 Finish Lat : S 21 : 8.432 Finish Lon : E 32 : 0.235 Length : 27.21 km	Transect # : 16 Start Lat : S 21 : 19.860 Start Lon : E 32 : 14.111 Finish Lat : S 21 : 6.221 Finish Lon : E 32 : 14.111 Length : 25.26 km
Transect # : 7 Start Lat : S 21 : 7.748 Start Lon : E 32 : 1.622 Finish Lat : S 21 : 24.428 Finish Lon : E 32 : 1.622 Length : 30.89 km	Transect # : 17 Start Lat : S 21 : 5.925 Start Lon : E 32 : 15.499 Finish Lat : S 21 : 18.522 Finish Lon : E 32 : 15.499 Length : 23.33 km
Transect # : 8 Start Lat : S 21 : 26.082 Start Lon : E 32 : 3.010 Finish Lat : S 21 : 7.209 Finish Lon : E 32 : 3.010 Length : 34.95 km	Transect # : 18 Start Lat : S 21 : 18.671 Start Lon : E 32 : 16.887 Finish Lat : S 21 : 8.679 Finish Lon : E 32 : 16.887 Length : 18.51 km
Transect # : 9 Start Lat : S 21 : 6.798 Start Lon : E 32 : 4.398 Finish Lat : S 21 : 26.538 Finish Lon : E 32 : 4.398 Length : 36.56 km	Transect # : 19 Start Lat : S 21 : 11.781 Start Lon : E 32 : 18.275 Finish Lat : S 21 : 19.125 Finish Lon : E 32 : 18.275 Length : 13.60 km
Transect # : 10 Start Lat : S 21 : 26.268 Start Lon : E 32 : 5.785 Finish Lat : S 21 : 6.387 Finish Lon : E 32 : 5.785 Length : 36.82 km	Transect # : 20 Start Lat : S 21 : 19.439 Start Lon : E 32 : 19.662 Finish Lat : S 21 : 14.183 Finish Lon : E 32 : 19.662 Length : 9.73 km
Transect # : 11	Transect # : 21 Start Lat : S 21 : 15.015 Start Lon : E 32 : 21.050

Finish Lat : S 21 : 19.362 Finish Lon : E 32 : 21.050  
Length : 8.05 km

Transect # : 22

Start Lat : S 21 : 19.000 Start Lon : E 32 : 22.438  
Finish Lat : S 21 : 15.854 Finish Lon : E 32 : 22.438  
Length : 5.83 km

Transect # : 23

Start Lat : S 21 : 16.929 Start Lon : E 32 : 23.825  
Finish Lat : S 21 : 18.830 Finish Lon : E 32 : 23.825  
Length : 3.52 km

Transect # : 24

Start Lat : S 21 : 18.900 Start Lon : E 32 : 25.213  
Finish Lat : S 21 : 18.255 Finish Lon : E 32 : 25.213  
Length : 1.20 km

## Chilojo A

Number of transects : 13

Transect Bearing : 45.00 Degrees

Transect Spacing : 2.00 km

Transect # : 1

Start Lat : S 21 : 17.752 Start Lon : E 31 : 54.513  
Finish Lat : S 21 : 19.854 Finish Lon : E 31 : 52.257  
Length : 5.51 km

Transect # : 2

Start Lat : S 21 : 24.164 Start Lon : E 31 : 49.272  
Finish Lat : S 21 : 18.994 Finish Lon : E 31 : 54.820  
Length : 13.54 km

Transect # : 3

Start Lat : S 21 : 19.808 Start Lon : E 31 : 55.584  
Finish Lat : S 21 : 29.638 Finish Lon : E 31 : 45.038  
Length : 25.74 km

Transect # : 4

Start Lat : S 21 : 30.849 Start Lon : E 31 : 45.377  
Finish Lat : S 21 : 20.283 Finish Lon : E 31 : 56.713  
Length : 27.67 km

Transect # : 5

Start Lat : S 21 : 20.676 Start Lon : E 31 : 57.931  
Finish Lat : S 21 : 30.784 Finish Lon : E 31 : 47.086  
Length : 26.47 km

Transect # : 6

Start Lat : S 21 : 30.544 Start Lon : E 31 : 48.982  
Finish Lat : S 21 : 21.455 Finish Lon : E 31 : 58.734  
Length : 23.80 km

Transect # : 7

Start Lat : S 21 : 22.320 Start Lon : E 31 : 59.444  
Finish Lat : S 21 : 30.640 Finish Lon : E 31 : 50.518  
Length : 21.79 km

Transect # : 8

Start Lat : S 21 : 31.047 Start Lon : E 31 : 51.720  
Finish Lat : S 21 : 23.119 Finish Lon : E 32 : 0.225  
Length : 20.76 km

Transect # : 9

Start Lat : S 21 : 23.820 Start Lon : E 32 : 1.112  
Finish Lat : S 21 : 31.072 Finish Lon : E 31 : 53.331  
Length : 18.99 km

Transect # : 10

Start Lat : S 21 : 30.984 Start Lon : E 31 : 55.065  
Finish Lat : S 21 : 24.690 Finish Lon : E 32 : 1.818  
Length : 16.48 km

Transect # : 11

Start Lat : S 21 : 25.590 Start Lon : E 32 : 2.491  
Finish Lat : S 21 : 31.417 Finish Lon : E 31 : 56.239  
Length : 15.26 km

Transect # : 12A

Start Lat : S 21 : 31.921 Start Lon : E 31 : 57.336  
Finish Lat : S 21 : 27.440 Finish Lon : E 32 : 2.144  
Length : 11.73 km

Transect # : 12B

Start Lat : S 21 : 26.463 Start Lon : E 32 : 3.193  
Finish Lat : S 21 : 26.243 Finish Lon : E 32 : 3.428  
Length : 0.57 km

Transect # : 13

Start Lat : S 21 : 32.138 Start Lon : E 31 : 58.742  
Finish Lat : S 21 : 32.476 Finish Lon : E 31 : 58.380  
Length : 0.89 km

## Chilojo B

Number of transects : 16

Transect Bearing : -48.00 Degrees  
Transect Spacing : 3.00 km

Transect # : 1  
Start Lat : S 21 : 32.089 Start Lon : E 32 : 1.071  
Finish Lat : S 21 : 37.214 Finish Lon : E 32 : 7.178  
Length : 14.18 km

Transect # : 2  
Start Lat : S 21 : 36.010 Start Lon : E 32 : 8.342  
Finish Lat : S 21 : 30.329 Finish Lon : E 32 : 1.573  
Length : 15.72 km

Transect # : 3  
Start Lat : S 21 : 28.671 Start Lon : E 32 : 2.194  
Finish Lat : S 21 : 34.807 Finish Lon : E 32 : 9.505  
Length : 16.98 km

Transect # : 4  
Start Lat : S 21 : 33.604 Start Lon : E 32 : 10.669  
Finish Lat : S 21 : 26.897 Finish Lon : E 32 : 2.678  
Length : 18.56 km

Transect # : 5  
Start Lat : S 21 : 26.516 Start Lon : E 32 : 4.821  
Finish Lat : S 21 : 32.400 Finish Lon : E 32 : 11.833  
Length : 16.29 km

Transect # : 6  
Start Lat : S 21 : 31.197 Start Lon : E 32 : 12.997  
Finish Lat : S 21 : 25.541 Finish Lon : E 32 : 6.257  
Length : 15.65 km

Transect # : 7  
Start Lat : S 21 : 24.213 Start Lon : E 32 : 7.272  
Finish Lat : S 21 : 29.994 Finish Lon : E 32 : 14.160  
Length : 16.00 km

Transect # : 8  
Start Lat : S 21 : 28.791 Start Lon : E 32 : 15.324  
Finish Lat : S 21 : 23.849 Finish Lon : E 32 : 9.436  
Length : 13.67 km

Transect # : 9  
Start Lat : S 21 : 22.798 Start Lon : E 32 : 10.781  
Finish Lat : S 21 : 27.587 Finish Lon : E 32 : 16.488  
Length : 13.25 km

Transect # : 10  
Start Lat : S 21 : 26.384 Start Lon : E 32 : 17.651  
Finish Lat : S 21 : 21.530 Finish Lon : E 32 : 11.868  
Length : 13.43 km

Transect # : 11  
Start Lat : S 21 : 20.348 Start Lon : E 32 : 13.056  
Finish Lat : S 21 : 25.181 Finish Lon : E 32 : 18.815  
Length : 13.38 km

Transect # : 12  
Start Lat : S 21 : 23.978 Start Lon : E 32 : 19.979  
Finish Lat : S 21 : 19.412 Finish Lon : E 32 : 14.538  
Length : 12.64 km

Transect # : 13  
Start Lat : S 21 : 18.521 Start Lon : E 32 : 16.075  
Finish Lat : S 21 : 22.774 Finish Lon : E 32 : 21.143  
Length : 11.77 km

Transect # : 14  
Start Lat : S 21 : 21.571 Start Lon : E 32 : 22.306  
Finish Lat : S 21 : 19.433 Finish Lon : E 32 : 19.759  
Length : 5.92 km

Transect # : 15  
Start Lat : S 21 : 19.151 Start Lon : E 32 : 22.020  
Finish Lat : S 21 : 20.368 Finish Lon : E 32 : 23.470  
Length : 3.37 km

Transect # : 16  
Start Lat : S 21 : 19.164 Start Lon : E 32 : 24.634  
Finish Lat : S 21 : 18.871 Finish Lon : E 32 : 24.283  
Length : 0.81 km

## Naivasha

Number of transects : 17  
Transect Bearing : -48.00 Degrees  
Transect Spacing : 2.50 km

Transect # : 1  
Start Lat : S 21 : 38.640 Start Lon : E 31 : 38.935  
Finish Lat : S 21 : 39.107 Finish Lon : E 31 : 39.492  
Length : 1.29 km

Transect # : 2  
Start Lat : S 21 : 40.800 Start Lon : E 31 : 43.678  
Finish Lat : S 21 : 37.540 Finish Lon : E 31 : 39.789

Length : 9.02 km  
Transect # : 3  
Start Lat : S 21 : 36.439 Start Lon : E 31 : 40.643  
Finish Lat : S 21 : 40.800 Finish Lon : E 31 : 45.844  
Length : 12.07 km

Transect # : 4A

Start Lat : S 21 : 48.027 Start Lon : E 31 : 56.630  
 Finish Lat : S 21 : 44.710 Finish Lon : E 31 : 52.674  
 Length : 9.18 km

Transect # : 4B  
 Start Lat : S 21 : 43.147 Start Lon : E 31 : 50.810  
 Finish Lat : S 21 : 42.443 Finish Lon : E 31 : 49.971  
 Length : 1.95 km

Transect # : 4C  
 Start Lat : S 21 : 41.350 Start Lon : E 31 : 48.667  
 Finish Lat : S 21 : 35.339 Finish Lon : E 31 : 41.497  
 Length : 16.64 km

Transect # : 5  
 Start Lat : S 21 : 34.238 Start Lon : E 31 : 42.351  
 Finish Lat : S 21 : 47.028 Finish Lon : E 31 : 57.605  
 Length : 35.40 km

Transect # : 6  
 Start Lat : S 21 : 46.029 Start Lon : E 31 : 58.580  
 Finish Lat : S 21 : 33.138 Finish Lon : E 31 : 43.205  
 Length : 35.68 km

Transect # : 7  
 Start Lat : S 21 : 32.037 Start Lon : E 31 : 44.059  
 Finish Lat : S 21 : 45.030 Finish Lon : E 31 : 59.555  
 Length : 35.96 km

Transect # : 8  
 Start Lat : S 21 : 44.030 Start Lon : E 32 : 0.530  
 Finish Lat : S 21 : 30.936 Finish Lon : E 31 : 44.913  
 Length : 36.24 km

Transect # : 9  
 Start Lat : S 21 : 30.804 Start Lon : E 31 : 46.922  
 Finish Lat : S 21 : 43.031 Finish Lon : E 32 : 1.505  
 Length : 33.84 km

## Chefu

Number of transects : 6  
 Transect Bearing : 42.00 Degrees  
 Transect Spacing : 6.00 km

Transect # : 1  
 Start Lat : S 21 : 48.725 Start Lon : E 31 : 55.648  
 Finish Lat : S 22 : 3.877 Finish Lon : E 31 : 40.974  
 Length : 37.76 km

Transect # : 2  
 Start Lat : S 22 : 0.740 Start Lon : E 31 : 39.323  
 Finish Lat : S 21 : 45.981 Finish Lon : E 31 : 53.616  
 Length : 36.78 km

Transect # : 3

Transect # : 10  
 Start Lat : S 21 : 42.032 Start Lon : E 32 : 2.480  
 Finish Lat : S 21 : 30.566 Finish Lon : E 31 : 48.805  
 Length : 31.73 km

Transect # : 11  
 Start Lat : S 21 : 30.820 Start Lon : E 31 : 51.274  
 Finish Lat : S 21 : 41.033 Finish Lon : E 32 : 3.455  
 Length : 28.27 km

Transect # : 12  
 Start Lat : S 21 : 40.034 Start Lon : E 32 : 4.430  
 Finish Lat : S 21 : 31.040 Finish Lon : E 31 : 53.704  
 Length : 24.89 km

Transect # : 13  
 Start Lat : S 21 : 31.482 Start Lon : E 31 : 56.397  
 Finish Lat : S 21 : 39.035 Finish Lon : E 32 : 5.406  
 Length : 20.90 km

Transect # : 14  
 Start Lat : S 21 : 38.036 Start Lon : E 32 : 6.381  
 Finish Lat : S 21 : 31.799 Finish Lon : E 31 : 58.942  
 Length : 17.26 km

Transect # : 15  
 Start Lat : S 21 : 30.582 Start Lon : E 31 : 59.657  
 Finish Lat : S 21 : 31.811 Finish Lon : E 32 : 1.123  
 Length : 3.40 km

Transect # : 16  
 Start Lat : S 21 : 30.362 Start Lon : E 32 : 1.561  
 Finish Lat : S 21 : 29.567 Finish Lon : E 32 : 0.613  
 Length : 2.20 km

Transect # : 17  
 Start Lat : S 21 : 28.911 Start Lon : E 32 : 1.998  
 Finish Lat : S 21 : 28.975 Finish Lon : E 32 : 2.074  
 Length : 0.18 km

Start Lat : S 21 : 43.499 Start Lon : E 31 : 51.331  
 Finish Lat : S 21 : 57.342 Finish Lon : E 31 : 37.924  
 Length : 34.50 km

Transect # : 4  
 Start Lat : S 21 : 53.944 Start Lon : E 31 : 36.525  
 Finish Lat : S 21 : 41.360 Finish Lon : E 31 : 48.712  
 Length : 31.36 km

Transect # : 5  
 Start Lat : S 21 : 40.800 Start Lon : E 31 : 44.566  
 Finish Lat : S 21 : 50.546 Finish Lon : E 31 : 35.126

Length : 24.29 km

Transect # : 6

Start Lat : S 21 : 47.149 Start Lon : E 31 : 33.728

Finish Lat : S 21 : 39.925 Finish Lon : E 31 : 40.723

Length : 18.00 km

### **Mabalauta (= Mabalauta NP and Malapati combined)**

Number of transects : 22

Transect Bearing : 90.00 Degrees

Transect Spacing : 2.00 km

Transect # : 1

Start Lat : S 21 : 44.493 Start Lon : E 31 : 32.811

Finish Lat : S 21 : 44.493 Finish Lon : E 31 : 19.413

Length : 23.05 km

Transect # : 2

Start Lat : S 21 : 45.573 Start Lon : E 31 : 20.187

Finish Lat : S 21 : 45.573 Finish Lon : E 31 : 33.079

Length : 22.18 km

Transect # : 3

Start Lat : S 21 : 46.653 Start Lon : E 31 : 33.524

Finish Lat : S 21 : 46.653 Finish Lon : E 31 : 20.029

Length : 23.22 km

Transect # : 4

Start Lat : S 21 : 47.733 Start Lon : E 31 : 20.048

Finish Lat : S 21 : 47.733 Finish Lon : E 31 : 33.970

Length : 23.96 km

Transect # : 5

Start Lat : S 21 : 48.813 Start Lon : E 31 : 34.415

Finish Lat : S 21 : 48.813 Finish Lon : E 31 : 20.349

Length : 24.20 km

Transect # : 6

Start Lat : S 21 : 49.893 Start Lon : E 31 : 20.536

Finish Lat : S 21 : 49.893 Finish Lon : E 31 : 34.860

Length : 24.65 km

Transect # : 7

Start Lat : S 21 : 50.973 Start Lon : E 31 : 35.306

Finish Lat : S 21 : 50.973 Finish Lon : E 31 : 20.827

Length : 24.91 km

Transect # : 8

Start Lat : S 21 : 52.053 Start Lon : E 31 : 21.118

Finish Lat : S 21 : 52.053 Finish Lon : E 31 : 35.751

Length : 25.18 km

Transect # : 9

Start Lat : S 21 : 53.133 Start Lon : E 31 : 36.196

Finish Lat : S 21 : 53.133 Finish Lon : E 31 : 21.409

Length : 25.44 km

Transect # : 10

Start Lat : S 21 : 54.213 Start Lon : E 31 : 21.701

Finish Lat : S 21 : 54.213 Finish Lon : E 31 : 36.642

Length : 25.71 km

Transect # : 11

Start Lat : S 21 : 55.293 Start Lon : E 31 : 37.087

Finish Lat : S 21 : 55.293 Finish Lon : E 31 : 21.992

Length : 25.97 km

Transect # : 12

Start Lat : S 21 : 56.373 Start Lon : E 31 : 22.283

Finish Lat : S 21 : 56.373 Finish Lon : E 31 : 37.532

Length : 26.24 km

Transect # : 13

Start Lat : S 21 : 57.453 Start Lon : E 31 : 37.977

Finish Lat : S 21 : 57.453 Finish Lon : E 31 : 22.575

Length : 26.50 km

Transect # : 14

Start Lat : S 21 : 58.533 Start Lon : E 31 : 22.866

Finish Lat : S 21 : 58.533 Finish Lon : E 31 : 38.423

Length : 26.77 km

Transect # : 15

Start Lat : S 21 : 59.613 Start Lon : E 31 : 38.868

Finish Lat : S 21 : 59.613 Finish Lon : E 31 : 23.157

Length : 27.03 km

Transect # : 16

Start Lat : S 22 : 0.693 Start Lon : E 31 : 23.448

Finish Lat : S 22 : 0.693 Finish Lon : E 31 : 39.313

Length : 27.30 km

Transect # : 17

Start Lat : S 22 : 1.773 Start Lon : E 31 : 39.759

Finish Lat : S 22 : 1.773 Finish Lon : E 31 : 23.740

Length : 27.56 km

Transect # : 18A

Start Lat : S 22 : 2.853 Start Lon : E 31 : 24.031

Finish Lat : S 22 : 2.853 Finish Lon : E 31 : 26.179

Length : 3.70 km

Transect # : 18B  
 Start Lat : S 22 : 2.853 Start Lon : E 31 : 26.708  
 Finish Lat : S 22 : 2.853 Finish Lon : E 31 : 40.204  
 Length : 23.22 km

Transect # : 19  
 Start Lat : S 22 : 3.933 Start Lon : E 31 : 37.469  
 Finish Lat : S 22 : 3.933 Finish Lon : E 31 : 26.505  
 Length : 18.87 km

Transect # : 20  
 Start Lat : S 22 : 5.013 Start Lon : E 31 : 26.302

Finish Lat : S 22 : 5.013 Finish Lon : E 31 : 34.537  
 Length : 14.17 km

Transect # : 21  
 Start Lat : S 22 : 6.093 Start Lon : E 31 : 31.605  
 Finish Lat : S 22 : 6.093 Finish Lon : E 31 : 26.099  
 Length : 9.48 km

Transect # : 22  
 Start Lat : S 22 : 7.173 Start Lon : E 31 : 25.896  
 Finish Lat : S 22 : 7.173 Finish Lon : E 31 : 28.674  
 Length : 4.78 km

## **Mahenye**

Number of transects : 8  
 Transect Bearing : 90.00 Degrees  
 Transect Spacing : 3.00 km

Transect # : 1  
 Start Lat : S 21 : 7.366 Start Lon : E 32 : 16.301  
 Finish Lat : S 21 : 7.366 Finish Lon : E 32 : 22.499  
 Length : 10.71 km

Transect # : 2  
 Start Lat : S 21 : 8.986 Start Lon : E 32 : 22.724  
 Finish Lat : S 21 : 8.986 Finish Lon : E 32 : 16.991  
 Length : 9.91 km

Transect # : 3  
 Start Lat : S 21 : 10.606 Start Lon : E 32 : 17.321  
 Finish Lat : S 21 : 10.606 Finish Lon : E 32 : 24.361  
 Length : 12.16 km

Transect # : 4  
 Start Lat : S 21 : 12.227 Start Lon : E 32 : 23.905  
 Finish Lat : S 21 : 12.227 Finish Lon : E 32 : 18.369  
 Length : 9.57 km

Transect # : 5  
 Start Lat : S 21 : 13.847 Start Lon : E 32 : 19.374

Finish Lat : S 21 : 13.847 Finish Lon : E 32 : 25.454  
 Length : 10.51 km

Transect # : 6  
 Start Lat : S 21 : 15.466 Start Lon : E 32 : 26.236  
 Finish Lat : S 21 : 15.466 Finish Lon : E 32 : 21.916  
 Length : 7.46 km

Transect # : 7  
 Start Lat : S 21 : 17.086 Start Lon : E 32 : 23.990  
 Finish Lat : S 21 : 17.086 Finish Lon : E 32 : 27.532  
 Length : 6.12 km

Transect # : 8A  
 Start Lat : S 21 : 18.707 Start Lon : E 32 : 28.567  
 Finish Lat : S 21 : 18.707 Finish Lon : E 32 : 27.219  
 Length : 2.33 km

Transect # : 8B  
 Start Lat : S 21 : 18.707 Start Lon : E 32 : 26.988  
 Finish Lat : S 21 : 18.707 Finish Lon : E 32 : 25.686  
 Length : 2.25 km



#### Appendix 4. Transect Summaries.

##### Species codes:

<b>Code</b>	<b>Species</b>
Bbk	Bushbuck
Buff	Buffalo
Catt	Cattle
Croc	Crocodile
Dkr	Duiker
Donk	Donkey
ElC1	Elephant carcass, age category 1
ElC3	Elephant carcass, age category 3
Eld	Eland
EleF	Elephant cow
EleM	Elephant bull
Ghb	Ground hornbill
Grf	Giraffe
Grys	Grysbok
Hipo	Hippo
Huts	Hut built by squatter
Imp	Impala
Kudu	Kudu
Nyl	Nyala
Ost	Ostrich
PCmp	Poachers' camp
Sab	Sable
Shoa	Sheep and/or goats
UnCa	Carcass of unknown species
Wbck	Waterbuck
Whog	Warthog
Zeb	Zebra

##### Other abbreviations

<b>Abbreviation</b>	<b>Meaning</b>
n	number of transects sampled
N	possible number of transects in stratum
t	Student's <i>t</i> value, $P = 0.05$
T #	transect number
-	no animals seen in strips

Date of Survey : 25/08/01  
 Stratum Locality : Gonarezhou  
 Stratum Area : 1167 km<sup>2</sup>  
 N : 164                      n : 24  
 Pilot : J. Cadd  
 Map overlay file : None

Stratum Name : Chipinda Pools  
 Base Line Length : 57.8 km  
 Calibrated Strip Width at 300ft : 339 m  
 t : 2.069  
 Observer : C.Jakopo, D.Chipesi

## Transect summary table :

T #	EleM	EleF	Zeb	Wbck	Imp	Kudu	EIC1	EIC3	UnCa	Catt	Whog	Hut	PCmp	Ost	Ghb	Eld	Grf	Buff
1	-	-	-	-	3	-	-	-	-	-	2	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	5	-	-	-	22	10	-	-	-	-	-	-	-	-	-	-	-	-
4	1	37	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	6	-	-	-	-	-	-	-	3	1	-	-	-	-	-
6	-	5	-	-	4	4	-	-	1	-	-	6	-	3	-	-	-	-
7	4	3	-	-	5	24	-	1	1	-	-	-	-	-	2	-	-	4
8	1	-	10	-	-	4	-	-	-	-	1	3	1	-	-	-	-	-
9	11	35	-	-	-	10	-	-	-	7	-	-	-	-	-	-	-	-
10	4	-	6	5	50	2	-	1	-	-	-	6	-	-	4	-	3	-
11	-	-	8	3	13	5	-	1	-	-	4	1	-	-	-	-	-	-
12	-	-	-	7	-	1	-	1	-	-	-	-	-	-	2	-	-	-
13	-	-	-	-	2	4	-	-	-	-	1	-	1	-	-	-	-	-
14	2	10	-	-	7	3	-	-	-	-	-	-	1	-	-	-	-	25
15	-	-	-	-	8	8	-	-	-	-	-	-	-	-	-	-	-	-
16	-	29	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
17	-	-	10	-	11	5	-	-	1	-	-	-	-	-	-	-	-	-
18	-	-	3	-	-	-	-	-	1	-	-	-	-	-	-	10	-	-
19	-	15	-	2	8	11	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-
21	-	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	70	-	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-

## Sighting Totals

	EleM	EleF	Zeb	Wbck	Imp	Kudu	EIC1	EIC3	UnCa	Catt	Whog	Hut	PCmp	Ost	Ghb	Eld	Grf	Buff
	28	229	39	23	182	91	1	5	4	7	8	19	4	3	8	11	3	29

Date of Survey : 28/08/01  
 Stratum Locality : Gonarezhou  
 Stratum Area : 460 km<sup>2</sup>  
 N : 63                      n : 13  
 Pilot : J.Cadd  
 Map overlay file : None

Stratum Name : Chilojo A  
 Base Line Length : 24 km  
 Calibrated Strip Width at 300ft : 359 m  
 t : 2.179  
 Observer : C.Jakopo, D.Chipesi

Transect summary table :

T #	EleM	EleF	Wbck	Imp	Kudu	EIC3	UnCa	Catt	Nyl	Dkr	Ghb	Grys
1	2	-	1	-	-	1	-	12	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	3	-	-	-	5	1	1	-	-	-	-	-
4	1	1	-	-	-	-	-	-	-	-	-	-
5	5	-	-	3	-	-	-	-	1	-	-	-
6	3	28	-	-	3	-	-	-	-	1	4	-
7	1	-	-	-	1	-	-	-	-	-	-	-
8	1	25	-	-	1	-	-	-	-	-	-	1
9	-	23	-	-	-	1	1	-	1	-	-	-
10	-	15	-	-	-	-	-	-	5	-	-	-
11	-	14	-	30	-	-	1	-	-	-	-	-
12	-	-	-	13	-	-	1	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-

Sighting Totals

	EleM	EleF	Wbck	Imp	Kudu	EIC3	UnCa	Catt	Nyl	Dkr	Ghb	Grys
	16	106	1	46	10	3	4	12	7	1	4	1

Date of Survey : 26/08/01  
 Stratum Name : Chilojo B  
 Stratum Locality : Gonarezhou  
 Base Line Length : 47 km  
 Stratum Area : 602 km<sup>2</sup>  
 Calibrated Strip Width at 300ft : 359 m  
 N : 128                      n : 16  
 t : 2.131  
 Pilot : J.Cadd  
 Observer : C.Jakopo, D.Chipesi  
 Map overlay file : None

## Transect summary table :

T #	EleM	EleF	Buff	Zeb	Wbck	Imp	Kudu	Hipo	EIC3	UnCa	Ghb	Dkr	Grf	Whog
1	-	-	-	-	-	-	-	-	-	2	4	1	-	-
2	-	-	-	-	-	-	10	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	1	-	-	-	-	-
4	1	11	40	-	-	11	-	-	-	1	3	-	-	-
5	-	-	-	3	-	20	1	-	-	-	-	3	-	-
6	5	-	-	-	-	-	-	-	-	-	-	1	1	-
7	1	-	-	-	-	-	2	-	-	1	4	-	-	-
8	-	-	-	-	-	2	6	-	-	-	-	1	-	-
9	-	-	-	-	-	56	-	-	-	1	1	-	-	-
10	-	-	50	-	-	-	9	-	-	1	-	2	4	-
11	-	1	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	2	-	-	-	1	-	3	-	-
13	-	11	-	-	-	19	-	-	2	-	-	-	-	7
14	2	-	-	-	1	10	-	1	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	1	-	-	-	1
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Sighting Totals

	EleM	EleF	Buff	Zeb	Wbck	Imp	Kudu	Hipo	EIC3	UnCa	Ghb	Dkr	Grf	Whog
	9	23	90	3	1	120	28	1	3	8	12	11	5	8

Date of Survey : 28/08/01  
 Stratum Locality : Gonarezhou  
 Stratum Area : 884 km<sup>2</sup>  
 N : 108                      n : 17  
 Pilot : J. Cadd  
 Map overlay file : None

Stratum Name : Naivasha  
 Base Line Length : 40.5 km  
 Calibrated Strip Width at 300ft : 359 m  
 t : 2.12  
 Observer : C.Jakopo, D.Chipesi

Transect summary table :

T #	EleM	EleF	Buff	Zeb	Imp	Kudu	EIC1	EIC3	UnCa	Grf	Dkr	Nyl	Ghb	Sab
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	21	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	3	-	-	-	-	-	4	4	-	-	-
4	-	15	-	-	-	-	-	1	-	-	1	-	-	-
5	-	11	-	-	-	-	-	1	1	-	2	-	-	-
6	-	-	-	-	9	-	-	-	-	-	4	-	3	-
7	-	-	60	-	14	-	-	-	-	-	1	-	-	-
8	2	1	-	-	-	3	-	1	-	-	-	-	-	-
9	1	21	-	-	1	11	-	-	-	-	2	1	2	1
10	2	8	-	-	-	-	-	-	-	1	1	-	-	-
11	-	-	-	-	4	-	1	-	-	6	-	-	-	-
12	-	-	-	-	-	-	-	3	3	-	1	1	-	-
13	-	-	-	-	-	5	-	-	-	-	-	-	-	-
14	-	-	-	-	4	-	-	-	2	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	1	-	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Sighting Totals

	EleM	EleF	Buff	Zeb	Imp	Kudu	EIC1	EIC3	UnCa	Grf	Dkr	Nyl	Ghb	Sab
	6	77	60	3	32	19	1	6	6	11	16	2	5	1

Date of Survey : 29/08/01  
 Stratum Locality : Gonarezhou  
 Stratum Area : 1017 km<sup>2</sup>  
 N : 97                      n : 6  
 Pilot : J.Cadd  
 Map overlay file : None

Stratum Name : Chefu  
 Base Line Length : 36 km  
 Calibrated Strip Width at 300ft : 359 m  
 t : 2.571  
 Observer : C.Jakopo, D.Chipesi

Transect summary table :

T #	EleM	EleF	Imp	Kudu	EIC3	Grf	Dkr	Nyl	Whog	Grys	Zeb	Buff
1	-	-	8	-	-	-	2	3	-	-	-	-
2	2	7	6	5	1	-	3	-	-	-	4	1
3	4	10	-	3	-	1	1	-	-	-	-	-
4	2	31	16	4	-	-	1	-	6	-	-	-
5	-	5	22	-	-	-	1	-	-	2	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-

Sighting Totals

	EleM	EleF	Imp	Kudu	EIC3	Grf	Dkr	Nyl	Whog	Grys	Zeb	Buff
	8	53	52	12	1	1	8	3	6	2	4	1

Date of Survey : 27/08/01

Stratum Name : Mabalauta (NP)

Stratum Locality : Gonarezhou

Base Line Length : 44.5 km

Stratum Area : 820 km<sup>2</sup>

Calibrated Strip Width at 300ft : 359 m

N : 117 n : 22

t : 2.08

Pilot : J.Cadd

Observer : C.Jakopo, D.Chipesi

Map overlay file : None

## Transect summary table :

T #	EleM	EleF	Buff	Zeb	Wbck	Imp	Kudu	EIC3	UnCa	Catt	Grf	Nyl	Dkr	Bbk	Ghb
1	-	-	-	23	-	-	-	-	1	22	2	-	-	-	-
2	1	10	-	12	-	15	-	-	1	-	2	7	3	2	-
3	6	3	-	-	-	-	-	-	1	-	-	-	-	-	-
4	-	4	2	-	6	-	7	-	-	-	-	-	-	-	-
5	3	-	75	3	-	-	-	-	-	-	-	-	1	-	-
6	6	16	-	17	-	-	7	-	-	-	-	-	-	-	-
7	-	23	-	-	2	-	-	-	1	-	-	-	-	-	1
8	-	-	-	-	-	4	3	1	-	-	-	-	-	-	-
9	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-
10	1	7	-	3	8	-	-	-	-	-	-	-	-	-	-
11	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-
12	4	-	-	-	-	7	4	-	1	-	-	-	-	-	-
13	-	21	-	-	-	47	1	-	-	-	-	-	-	-	-
14	1	-	-	-	5	-	-	2	-	-	5	-	-	-	-
15	-	-	2	-	-	-	-	-	1	-	-	-	2	-	-
16	4	6	-	-	-	-	-	2	3	-	-	-	-	-	-
17	3	20	-	10	-	5	-	-	-	-	-	-	-	-	-
18	3	17	-	-	-	42	-	-	-	-	-	-	-	-	-
19	3	-	-	-	-	-	-	-	1	-	-	-	2	-	-
20	-	-	-	-	-	8	1	-	-	-	-	-	1	-	-
21	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Sighting Totals

	EleM	EleF	Buff	Zeb	Wbck	Imp	Kudu	EIC3	UnCa	Catt	Grf	Nyl	Dkr	Bbk	Ghb
	40	132	79	68	21	128	23	5	11	22	9	7	9	2	1

Date of Survey : 27/08/01  
 Stratum Locality : Gonarezhou  
 Stratum Area : 175 km<sup>2</sup>  
 N : 86                      n : 16  
 Pilot : J.Cadd  
 Map overlay file : None

Stratum Name : Malapati  
 Base Line Length : 32.4 km  
 Calibrated Strip Width at 300ft : 359 m  
 t : 2.131  
 Observer : C.Jakopo, D.Chipesi

Transect summary table :

T #	EleM	Zeb	Wbck	Imp	Kudu	EIC3	UnCa	Dkr	Nyl	Croc
1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-
4	-	-	5	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-
6	-	-	3	-	18	-	1	-	-	-
7	1	-	-	-	-	-	-	1	-	-
8	-	-	-	-	-	-	1	-	-	-
9	-	-	-	3	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	1	-
11	-	-	-	-	-	1	-	-	-	-
12	-	-	-	3	-	-	-	-	1	8
13	-	1	-	-	-	-	1	-	-	-
14	-	-	-	-	-	-	2	-	-	-
15	-	-	1	-	-	-	1	-	-	-
16	-	-	-	-	-	-	-	-	-	-

Sighting Totals

	EleM	Zeb	Wbck	Imp	Kudu	EIC3	UnCa	Dkr	Nyl	Croc
	1	1	9	6	18	1	6	1	2	8

Date of Survey : 25/08/01  
 Stratum Locality : Gonarezhou  
 Stratum Area : 221 km<sup>2</sup>  
 N : 72                      n : 8  
 Pilot : J.Cadd  
 Map overlay file : None

Stratum Name : Mahenye  
 Base Line Length : 25.5 km  
 Calibrated Strip Width at 300ft : 339 m  
 t : 2.365  
 Observer : C.Jakopo, D.Chipesi

Transect summary table :

T #	Kudu	Catt	Shoa	Donk	Dkr	Ghb
1	1	32	3	-	1	-
2	-	-	-	-	-	-
3	2	-	-	-	-	-
4	-	-	-	-	-	-
5	-	37	-	-	-	4
6	-	58	54	3	-	-
7	-	50	90	2	-	-
8	-	-	-	-	-	-

Sighting Totals

	Kudu	Catt	Shoa	Donk	Dkr	Ghb
	3	177	147	5	1	4