AERIAL SURVEY OF ELEPHANTS & OTHER WILDLIFE IN THE CAPRIVI

MAY/JUNE 2013

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SUMMARY

An aerial survey of wildlife and domestic livestock took place in the Caprivi from 29 May to 8 June 2013. A total area of 16733 km^2 was sampled at an average intensity of 12.7%.

The estimates of numbers of each species (with their 95% confidence range) are given in the table below. The population of elephants has increased at an average rate of between 1.4% and 8.3%.per annum. However, the ratio of carcasses to live elephants indicates a possibly unsustainable number of animals being killed in much of the Caprivi.

SPECIES	ESTIMATED NUMBER	95% RANGE
Elephants	9165	6433 - 11898
Elephants in Family Groups	8310	5599 - 11020
Elephants in Bull Groups	856	507 - 1205
Elephant Carcass (recent)	112	33 - 208
Elephant Carcass (old)	683	427 938
Buffalo	5339	2270 - 9001
Bushpig	145	24 - 328
Duiker	221	84 - 357
Eland	259	54 - 594
Giraffe	324	50 - 618
Hippopotamus	3252	1847 - 4656
Impala	1743	647 - 2855
Kudu	893	372 - 1415
Lechwe	2515	1312 3718
Reedbuck	78	16 - 208
Roan	364	87 - 697
Sable	690	274 - 1259
Tsessebe	275	43 - 594
Warthog	1385	478 - 2292
Waterbuck	20	4 - 55
Wildebeest	317	140 - 776
Zebra	1421	606 - 2236
Crocodile	557	225 - 890
Cattle	136975	106500 - 167450

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1 INTRODUCTION

An assessment and strategy for wildlife protection and law enforcement by the Ministry of Environment and Tourism (Cumming 2012) identified the establishment of an effective monitoring system to be an important objective. Because of particular concern about increasing poaching of elephants in the Caprivi, this survey follows from the recommendation that an aerial survey of Bwabwata, Mudumu, Mamili, Khaudom and adjacent areas should be conducted to "establish numbers of live and dead elephant numbers and carcass ratios". Discussions with MET led to the decision to survey the entire Caprivi Region while Khaudom would be surveyed separately.

While the main emphasis was on numbers and distributions of elephants and elephant carcasses, sightings of other species were recorded. This report describes wildlife populations, human activities and other attributes in the section entitled Results. Details of results by stratum are given in Appendix II.

Descriptions of methods are provided in Appendix I. Stratified systematic transect sampling was used (Norton Griffiths, 1978) in a light aircraft (a Cessna 182) flying at a nominal height of 300 feet above the ground.

Although this survey was conducted earlier in the dry season than usual for "dry season" surveys, the extremely poor rainy season led to conditions that are more common later in the year. It was reasonable for this (2013) survey, therefore, to stratify the area based on the distribution of elephants (Fig. 1) seen during the 2011 dry season survey (MET 2011).

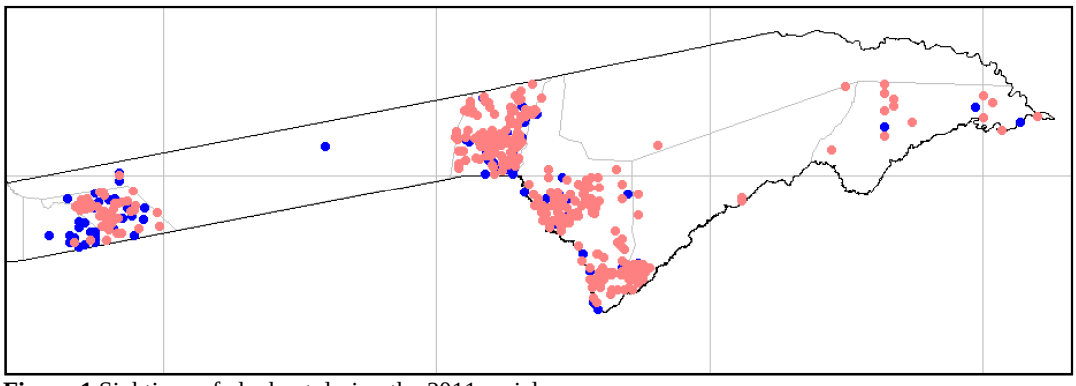

Figure 1 Sightings of elephant during the 2011 aerial survey
(pink = family groups; blue = bull groups)

Because of time and resource constraints, lower sampling intensities (Fig. 2) were selected for strata likely to have fewer elephants or elephant carcasses. A zone around Katima Mulilo was excluded from the survey in order to avoid the built-up area and the approach to the airport. A small area of Bwabwata across the river from Divundu was also excluded.

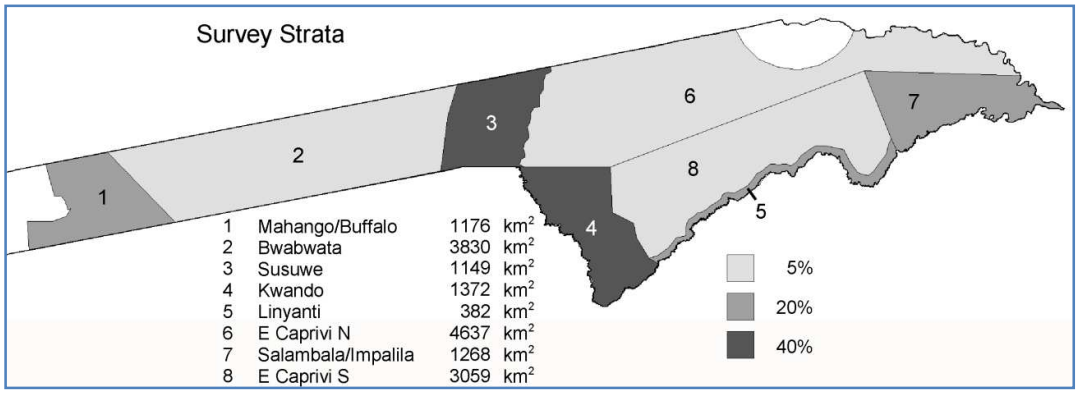

Figure 2 Strata used for the 2013 aerial survey

Transects were evenly spaced according to the required sampling intensity from a randomly chosen start point and oriented at right angles to major features (eg rivers) in each stratum, as far as possible (Fig. 3). Areas requiring higher sampling (20% and 40%) could not have been covered in a single flight, which would violate the assumptions of the precision calculation (see Appendix I). Transects in these strata were therefore divided into sets, each representing a separate 10% coverage, the results of which were combined in the final analysis. This had the additional advantage that in the event of the survey not being completed, a full coverage might still be available, albeit at a lower sampling intensity.

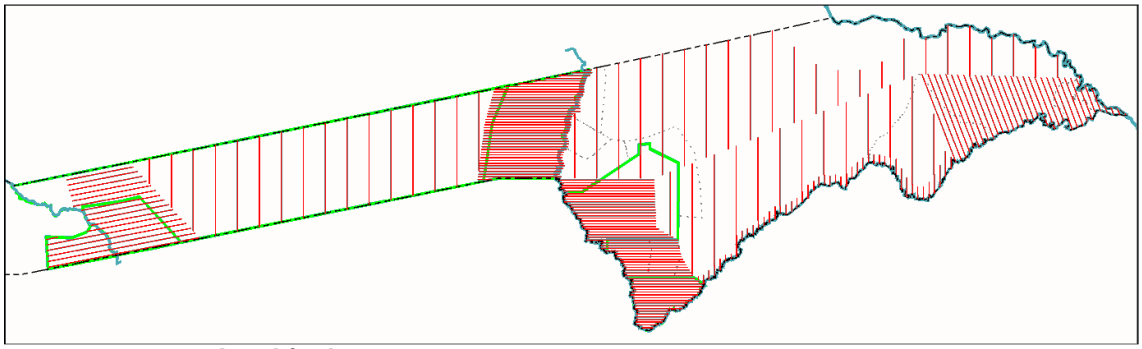

Figure 3 Transects selected for the survey

2 RESULTS AND DISCUSSION

For each species of wildlife in this section a sighting map is provided along with a table of estimates for each stratum. In the table the "range" refers to the range within which there is a 95% probability that the true number falls (i.e. it is the 95% confidence interval). Strictly, for most species this is actually the range within which 95% of independent *estimates* made by the same method would fall. The true value is likely to be higher on average because of undercounting bias.

"No. seen" is the number of animals seen within sampling strips and "No. out" is the number seen outside of the sampling strips. Where animals were seen only outside of the sampling strips no estimate can be made by this method although the record shows that the species occurs.

Wildlife species in this section are arranged in alphabetical order of their common names with the exception of: Elephant and buffalo, which are placed first and second respectively; monkeys, which are put next to baboons; crocodiles, which are placed with hippos; and carnivores, which are put together after zebra. At the end of the wildlife section, the carcasses of species other than elephant are reported. For each of the species, a map of the locations of sightings is provided.

Under elephants, elephant carcasses and carcass ratios are tabulated, followed by sightings of large birds. Sections 2.2 and 2.3 report attributes associated with humans, including livestock.

Full results by stratum are given in Appendix II.

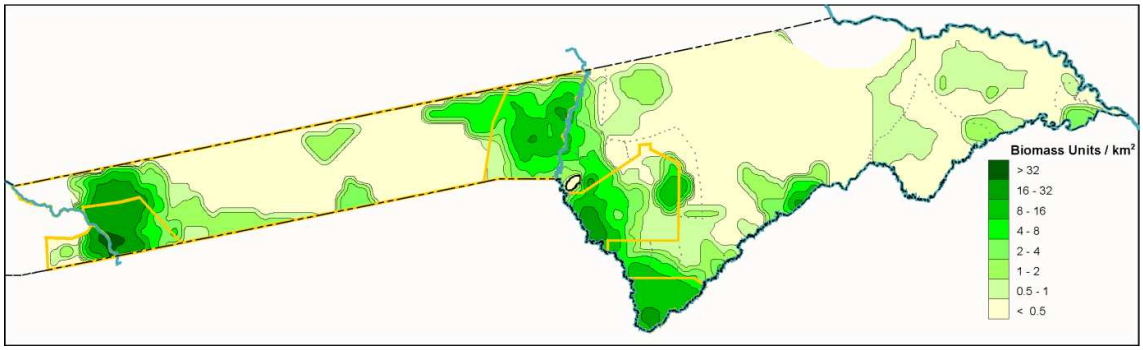

Figure 4 The density distribution of wildlife biomass in the Caprivi

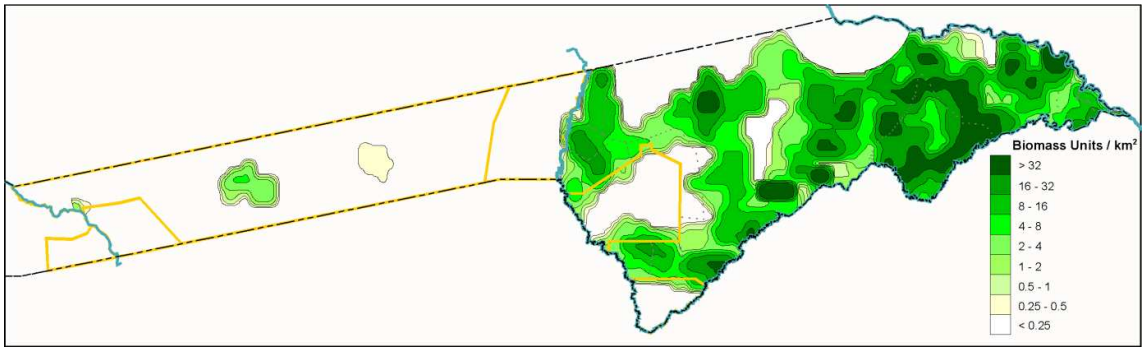

Figure 5 The density distribution of the biomass of domestic livestock in the Caprivi

Figures 4 and 5 illustrate the results of the survey in terms of biomass density, which contrast the differing distributions of wildlife and human activities. They also provide a better overview of distributions as they allow for sampling intensity as well as number seen: the sighting maps below can be deceptive in showing sightings concentrated not only where there are more animals, but where sampling intensity was greatest. One biomass unit = 450 kg of metabolic biomass.

The area around Katima Mulilo, excluded from the survey, would have been dominated by domestic livestock.

2.1 Observations of Wildlife

Elephant

The estimated number of elephants in Caprivi was less than the 2011 estimate (10847), although the two estimates are not significantly different and the present estimate of 9165 is possibly an undercount (see below). However, lack of a significant difference does not rule out decline because the precision of the two surveys is insufficient to reliably detect a decline smaller than 6000 animals between surveys. That is, if the population has actually gone down by 6000, there is a 20% chance with current precision that a comparison between surveys would have returned a non-significant result. For any lesser decline the probability of such a (type II) error, or false negative, is greater. The 2011 survey was less precise than the current one, so if the 2013 precision is repeated on a future survey the detectable decline is 4000 animals. More sensitivity will require more precision, and therefore more effort. Two-survey comparisons of population estimates are not the best way to detect change and it is better in this case to look at the carcass estimates (see below). Even if a decline were detected it would not necessarily reflect a population decline as the population is open and animals are able to move between the Caprivi and Botswana or Angola.

One anomaly in the results is that the two estimates (1887 and 4712) that make up the 20% coverage of the Mahango/Buffalo stratum are significantly different ($p<0.012$). The first of these 10% samples was flown over the midday period, to make up time that had been lost due to maintenance problems. The simplest explanation is that herds had congregated under tree canopies at the time of the first survey, and many that were within the sample were therefore missed. Although Buffalo, where most of the elephants were, is quite open, *Baikaea* and *Gibourtia* had dense canopies at the time and provided good shade. More elephants were observed outside the strip than in, which suggests herds were more often being observed obliquely under trees. A similar effect was noted on the 2011 survey of Buffalo. If the first survey is dropped from the result, the estimate for Buffalo becomes 4712 and the overall estimate for Caprivi 12260. In the report the mean estimate of the two Buffalo surveys (3300) was used, as it is more conservative, more comparable with the previous result, and there could be another reason for the high estimate obtained on the second count.

Estimates from previous surveys are difficult to compare because of differences in overall areas surveyed. Martin (2005) used data from a number of sources (eg Rodwell *et al.* 1995; Chase & Griffin (2004), Kolberg (2005) (Table 1) to show numbers since 1985 and to develop a model showing possible population dynamics.

Table 1 Estimates of elephant numbers

YEAR	TOTAL ESTIMATE
1985	3051
1986	1578
1989	2043
1992	6630
1993	4924
1994	5805
1998	4576
2003	5740
2004	8726

Survey methods from 1994 onwards were broadly similar apart from total counts of wetlands. Table 2 provides details of estimates/numbers from surveys between 1994 and 2013

Table 2 Results of aerial surveys of the Caprivi since 1994

Year	Estimate/ no counted	95% CL as % of Est.	95% range low		high	Survey type	Source of Information
1994	7950	59.00	3255	-	12645	Sample	ULG 1994
1994	5556	0.00		-		Total	Rodwell *et al.* 1995
1995	4883	25.56	3635	-	6130	Sample	Lindeque *et al. 1995*
1998	4576	27.30	3328	-	5824	Sample	MET 1999
2004	8725	28.28	6258	-	14983	Sample	Kolberg 2004
2004	860	0.00		-		Total	Stander *et al. 2004*
2005	6474	37.77	4035	-	8912	Sample	Chase & Griffin 2006
2007	3062	0.00		-		Total	Chase 2007
2007	11339	*10.18	*10185	-	*12493	Sample + total**	Chase 2008
2009	3450	0.00		-		Total	Chase 2009
2011	10847	32.70	7300	-	14394	Sample	Craig 2011
2013	9165	21.46	7198	-	11132	Sample	This survey

***** *the 95% confidence limits provided above have been calculated independently. Statistics presented in Chase 2008 are incorrect*

** *a sample survey except for Mamili NP surveyed as a total count*

Sample counts from 1995 (Lindeque *et al. 1995*) were of comparable precision. Estimates over the period increased at an average rate of 5% per annum. This is significant ($p < 0.015$) with a range of 1.4% - 8.3%.

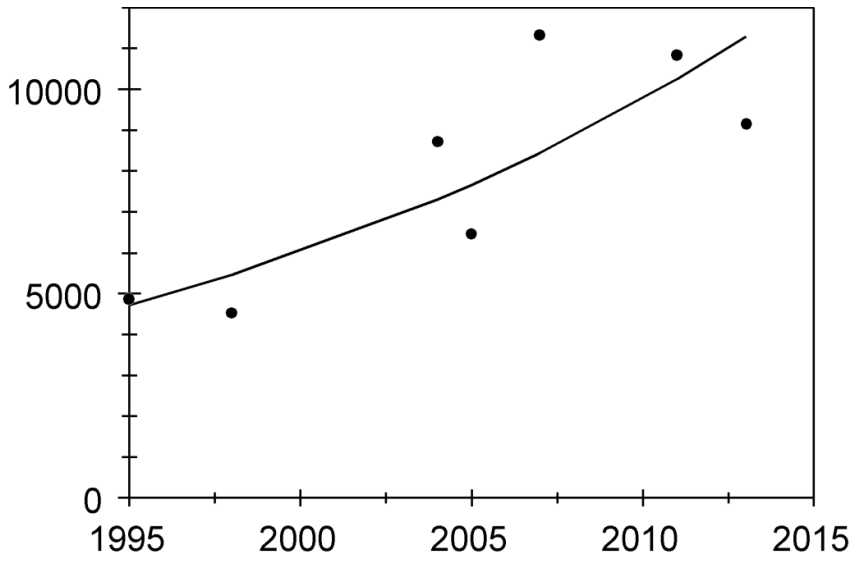

Figure 6 Elephant population trend in the Caprivi

Table 3 Estimates of total Elephant numbers (family & bull groups combined)

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	318	19 - 750	16	3	0.084
E Caprivi North	439	61 - 1063	22	39	0.095
E Caprivi South	646	36 - 1920	32	4	0.2127
Linyanti	165	73 - 410	33	40	0.434
Buffalo/Mahango	3299	2157 - 4442	650	477	2.8401
Kwando	2073	1424 - 2722	826	322	1.5319
Salambala-Impalila	301	93 - 516	61	32	0.2405
Susuwe	1923	1267 - 2579	769	353	1.6955
Caprivi overall	**9165**	**7198 - 11132**	**2409**	**1270**	**0.5477**

Distribution is best illustrated by a density map, which allows for sightings and sampling intensity, as below. The distribution of elephant resembled that recorded during the 2011 survey.

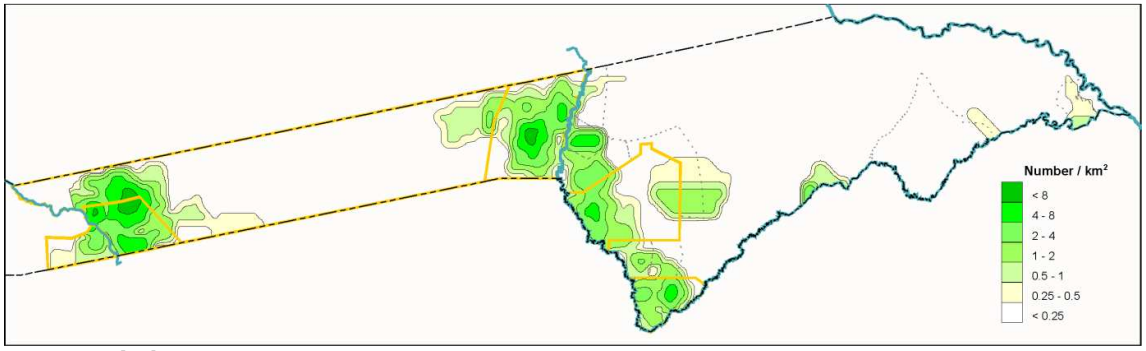

Figure 7: Elephant Density

Maps of the distributions of sightings of elephant bulls and family groups follow.

Table 4 Esimates of elephant family groups

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	199	10 - 614	10	0	0.0525
E Caprivi North	439	61 - 1063	22	39	0.095
E Caprivi South	585	29 - 1853	29	0	0.1928
Linyanti	135	64 - 378	27	37	0.3551
Buffalo/Mahango	3025	1886 - 4165	596	451	2.6044
Kwando	1911	1270 - 2553	762	316	1.4123
Salambala-Impalila	272	87 - 480	55	32	0.2175
Susuwe	1742	1094 - 2390	696	323	1.5359
Caprivi overall	**8310**	**6357 - 10263**	**2197**	**1198**	**0.4966**

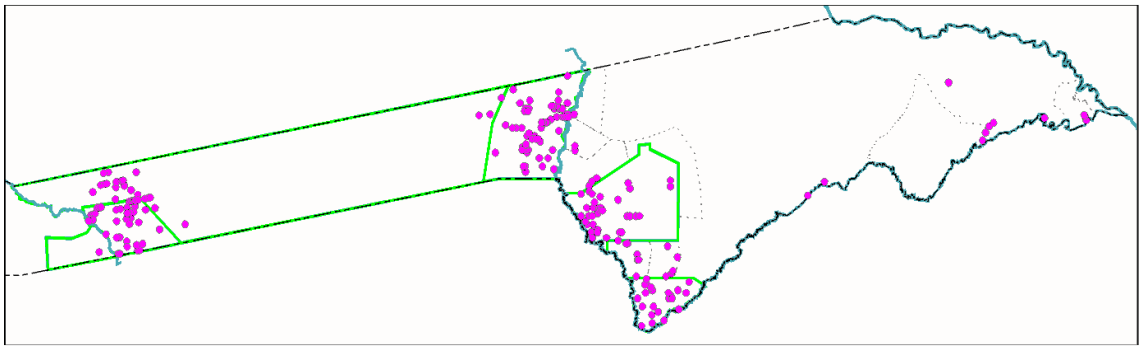

Figure 8 Sightings of elephant family groups

Table 5 Estimates of elephant bull groups

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	119	9 - 238	6	3	0.0315
E Caprivi South	61	7 - 192	3	4	0.0199
Linyanti	30	9 - 61	6	3	0.0789
Buffalo/Mahango	274	190 - 358	54	26	0.2357
Kwando	162	70 - 262	64	6	0.1196
Salambala-Impalila	29	6 - 83	6	0	0.0231
Susuwe	181	103 - 282	73	30	0.1597
Caprivi overall	**856**	**621 - 1090**	**212**	**72**	**0.0511**

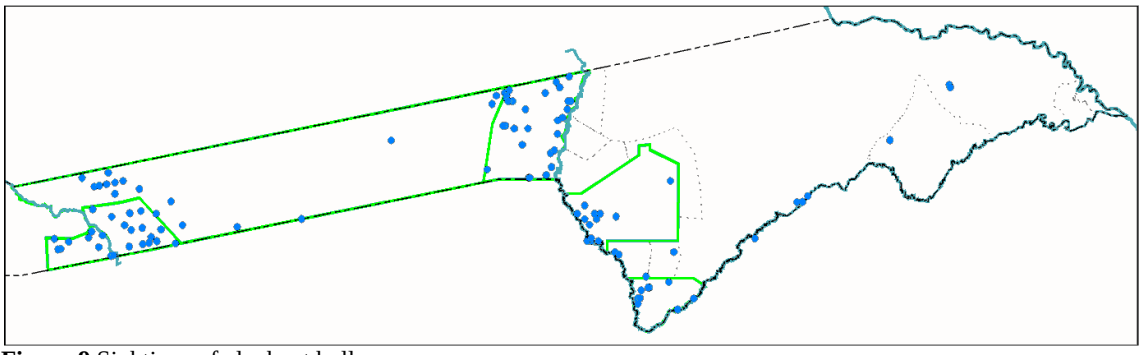

Figure 9 Sightings of elephant bull groups

Elephant spoor were recorded in most of the Bwabwata stratum to show that elephants use the area, though few were present at the time of the survey. Elsewhere recording was not feasible due to the density of other sightings. During the dry season their range is restricted by lack of surface water in much of the Caprivi and animals concentrate near the rivers. This has also been shown by wet and dry season surveys in the past (Chase & Griffin 2009).

Table 6 Elephant spoor sightings

Stratum	No. seen in
Bwabwata	142
Kwando Overall	1
Susuwe Overall	5
Caprivi Overall	**148**

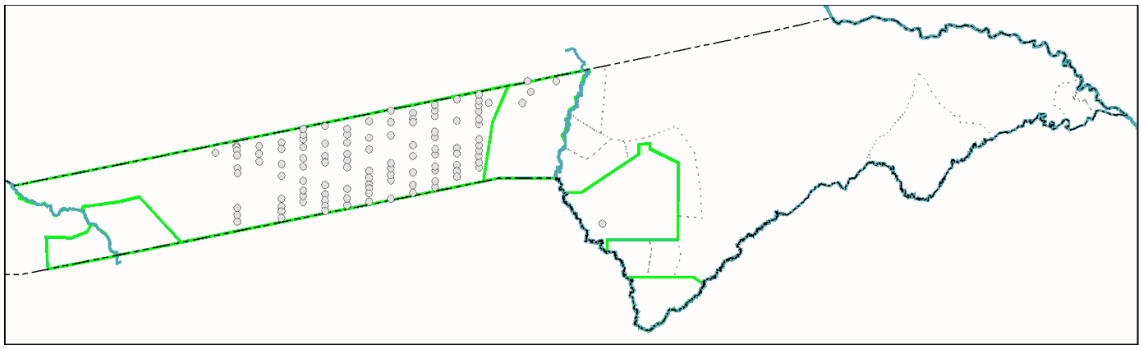

Figure 10 Locations of elephant spoor

Elephant Carcasses

Table 7 Total estimates of elephant carcasses (all classes combined)

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	40	2 - 95	2	0	0.0105
E Caprivi North	200	39 - 361	10	3	0.0432
E Caprivi South	141	8 - 317	7	1	0.0465
Linyanti	15	7 - 31	3	4	0.0395
Buffalo/Mahango	30	7 - 53	6	0	0.0258
Kwando	175	135 - 215	70	3	0.1294
Salambala-Impalila	25	5 - 48	5	0	0.02
Susuwe	169	125 - 214	68	4	0.1495
Caprivi overall	**795**	**559 - 1032**	**171**	**15**	**0.0475**

Towards the end of the survey, it was discovered MET field officers had been burning carcasses in Susuwe. These were therefore not in place to be counted in the sample, which would have resulted in a slight underestimate. The officers reported that they burned about 15 in Susuwe.

A low-intensity survey conducted by MET (MET, 2013) before the stratified sample count found a total of 57 carcasses in Mamili, Mudumu, Bwabwata and Mahango. Most of these were said to have been recent. The estimates for the corresponding areas from this survey (the combined totals for strata Kwando, Susuwe, Bwabwata and Buffalo/Mahango) is 414 carcasses, including 67 recent.

Estimated numbers of carcasses from the 2011 aerial survey (Craig 2012) were considerably lower than 2013 estimates. A previous high carcass count (150) (Rodwell *et al.* 1995) was reported for 1994 in Mahango and what is now Bwabwata. Other surveys have not reported carcasses. The difference between the estimates from 2011(293) and 2013(795) is 502 (±355), which is significantly different ($p < 0.006$). This means that between 147 and 857 carcasses have accumulated over the two years between the surveys. As the population is unlikely to be able to replace much more than 400 elephants per annum, the number lost is approaching an unsustainable level (also see below). The possibility that carcasses may be undercounted necessitates additional concern.

It can be seen from inspection of the results that a large proportion of the overall estimate is in the strata Bwabwata and E Caprivi north and south. As these were only covered at low sampling intensity, the precision of the estimates is low and this contributes to a low overall precision in the carcass estimate. This is unavoidable because the effort required to improve the precision in these extensive areas would be costly. The occurrence of a large number of carcasses in these strata is an important observation, however - it may be that much illegal hunting takes place away from core protected areas where it is less likely to be detected and elephants in some parts of the range may have been severely affected.

Carcass ratios

A "carcass ratio", (Appendix I) is a useful index of mortality (Douglas-Hamilton 1996). The ratio is not a direct measure of annual mortality, as visible carcasses in class 3 and 4 accumulate over several years.

Douglas-Hamilton *et al.* (Douglas-Hamilton & Hillman 1981; Douglas-Hamilton & Burril 1991) suggest a carcass ratio of 2 - 8% as being normal for a stable or increasing population, while a ratio of over 9% indicates a declining population.

The overall ratio for Caprivi is approaching the latter level. The high carcass ratios for Bwabwata and East Caprivi were possibly due to few elephants being present there during this season. A wet season survey might find lower ratios there. The ratios for the other strata were also high and the overall carcass ratio is 7.98%.

Table 8 Carcass ratios

Stratum	Carcass Ratio
Bwabwata	11.17
E Caprivi North	31.30
E Caprivi South	17.92
Linyanti	8.33
Buffalo/Mahango	0.90
Kwando	7.78
Salambala-Impalila	7.67
Susuwe	8.08
Caprivi overall	**7.98**

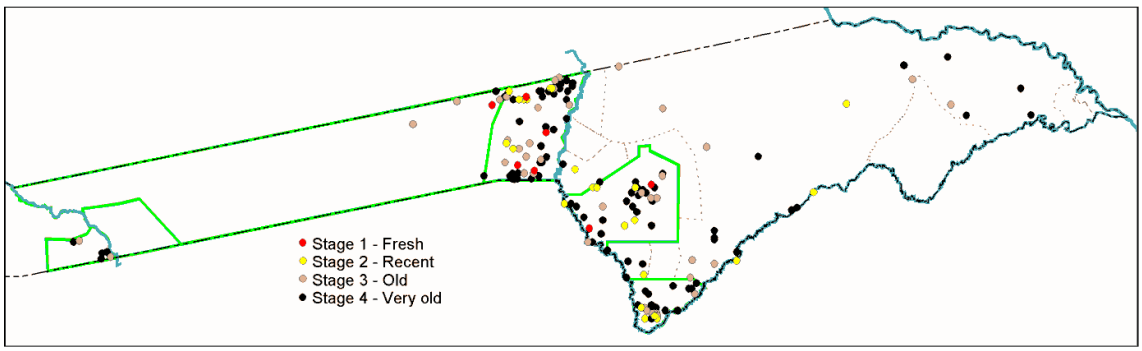

Figure 11 Sightings of elephant carcasses 2013

Carcasses seen were concentrated in those areas with the highest densities of elephants (but sampling was also concentrated there). The distribution of carcasses seen on both the 1994 (Rodwell *et al.* 1994) and 2011 surveys (Craig 2012) was similar but there were many fewer and carcass ratios were low (3.93% and 2.63% respectively).

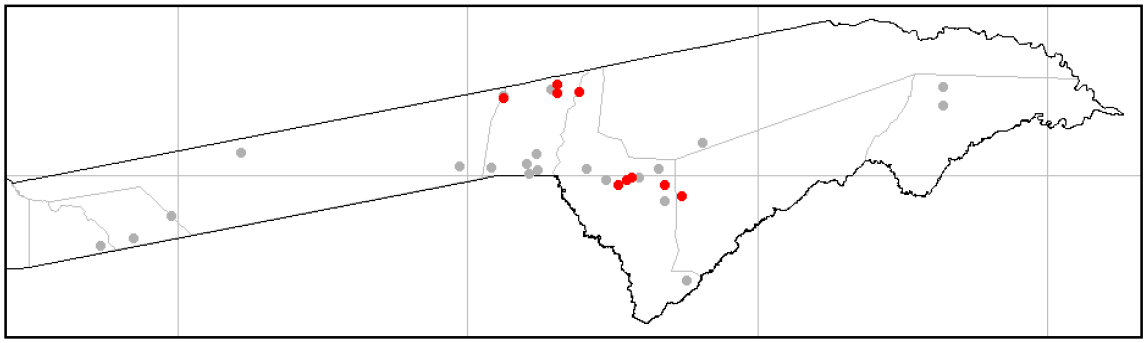

Figure 12 Sightings of elephant carcasses during the 2011 aerial survey (Craig 2012)

The following map illustrates apparent carcass density, which highlights likely poaching hot-spots.

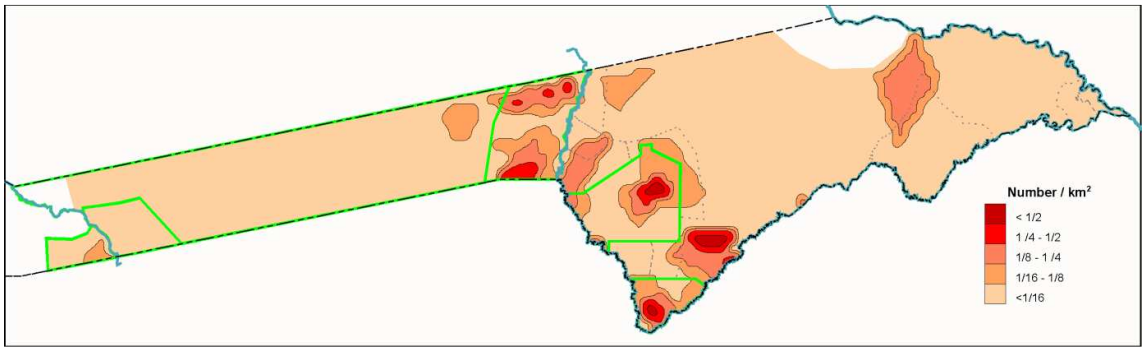

Figure 13: Carcass Density

Table 9 Estimates of recent elephant carcasses (classes 1 & 2 combined)

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
E Caprivi North	40	2 - 121	2	0	0.0086
E Caprivi South	0	1 - 0	0	1	0
Linyanti	5	3 - 14	1	2	0.0132
Kwando	35	17 - 53	14	0	0.0259
Susuwe	32	15 - 49	13	0	0.0286
Caprivi overall	**112**	**33 - 194**	**30**	**3**	**0.0067**

The figure of 112 for recent carcasses is less than expected if these represent carcasses under 1 year old, given the number of additional carcasses that have accumulated over the previous two years. These classes may be underestimated (they still have hide, making them less

visible), the main poaching may have taken place more than a year ago, or the progression of stages may be faster than given by Douglas-Hamilton (1996).

Table 10 Estimates of old elephant carcasses (classes 3 & 4 combined)

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	40	2 - 95	2	0	0.0105
E Caprivi North	160	21 - 299	8	3	0.0345
E Caprivi South	141	7 - 317	7	0	0.0465
Linyanti	10	4 - 23	2	2	0.0263
Buffalo/Mahango	30	7 - 53	6	0	0.0258
Kwando	140	104 - 176	56	3	0.1035
Salambala-Impalila	25	5 - 48	5	0	0.02
Susuwe	137	96 - 178	55	4	0.1209
Caprivi overall	**683**	**461 - 905**	**141**	**12**	**0.0408**

Table 11 Estimates of class 1 elephant carcasses

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Kwando	5	2 - 10	2	0	0.0037
Susuwe	12	5 - 21	5	0	0.011
Caprivi overall	**17**	**8 - 27**	**7**	**0**	**0.001**

Table 12 Estimates of class 2 elephant carcasses

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
E Caprivi North	40	2 - 121	2	0	0.0086
E Caprivi South	0	1 - 0	0	1	0
Linyanti	5	3 - 14	1	2	0.0132
Kwando	30	13 - 47	12	0	0.0222
Susuwe	20	8 - 35	8	0	0.0176
Caprivi overall	**95**	**26 - 176**	**23**	**3**	**0.0057**

Table 13 Estimates of class 3 elephant carcasses

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	40	2 - 95	2	0	0.0105
E Caprivi North	100	8 - 221	5	3	0.0216
E Caprivi South	40	2 - 95	2	0	0.0133
Buffalo/Mahango	10	2 - 22	2	0	0.0086
Kwando	45	20 - 73	18	2	0.0333
Salambala-Impalila	5	1 - 14	1	0	0.004
Susuwe	40	25 - 55	16	0	0.0352
Caprivi overall	**280**	**140 - 420**	**46**	**5**	**0.0167**

Table 14 Estimates of class 4 elephant carcasses

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
E Caprivi North	60	3 - 128	3	0	0.013
E Caprivi South	101	5 - 268	5	0	0.0332
Linyanti	10	4 - 23	2	2	0.0263
Buffalo/Mahango	20	4 - 40	4	0	0.0172
Kwando	95	72 - 118	38	1	0.0703
Salambala-Impalila	20	4 - 41	4	0	0.016
Susuwe	97	59 - 136	39	4	0.0857
Caprivi overall	**403**	**230 - 576**	**95**	**7**	**0.0241**

It is interesting that, although the majority of carcasses are identified as class 4, very old, most of these have accumulated over the past two years as fewer were present in 2011. Although old carcasses are presumed to be visible for up to 10 years (Douglas-Hamilton & Burril 1991), in this area, at least, they must progress quite rapidly to stage 4, which is characterised by the disarticulation of the skeleton.

Buffalo

Table 15 Estimates of buffalo numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
E Caprivi South	282	14 - 764	14	0	0.0931
Linyanti	861	177 - 1943	172	5	2.2621
Buffalo/Mahango	2183	598 - 3815	443	155	1.879
Kwando	1526	1265 - 2644	601	664	1.1273
Susuwe	487	216 - 1336	196	20	0.4298
Caprivi overall	**5339**	**3000 - 7679**	**1426**	**844**	**0.3191**

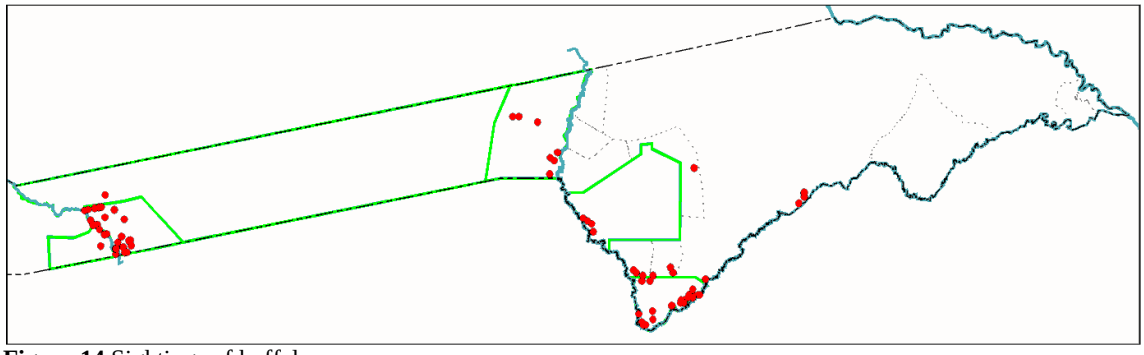

Figure 14 Sightings of buffalo

Because of their clumped distribution, it is extremely difficult to get a precise estimate of numbers of buffalo. Therefore, this species generally requires specifically designed aerial surveys to produce estimates that are comparable over time. Nevertheless, aerial surveys of the Caprivi have included buffalo in the estimates as shown in the following table.

Table 16 Estimates of buffalo from previous surveys

Year	Month	Estimated number	% 95% CL	Information source
1994	Aug	2526		Rodwell *et al.* 1995
1995	Sept	3018	128%	ULG 1995
1998	Aug/Nov	526	82.2%	MET 1999
2004	Aug	3262		Stander 2004
2004	Aug/Sept	3941	74.5%	Kolberg 2004
2007	Sept	5951		Chase 2007
2009	Sept	9633		Chase 2009

It is difficult to make realistic comparisons over the years as not only do survey areas and methods vary, animals are able to move freely across the international border into Botswana and Angola at those areas that are not fenced. (The Caprivi/Botswana border fence is a double electric fence from the Kavango River that ends only 35km from the Kwando River). Changes in estimated population sizes over the years or between seasons may therefore be a result of movements. In 1998 the Mamili wetlands were dry so the buffalo may have been across the border in Botswana resulting in the very low estimate. (The high number counted in 2009 was from a wetland survey that covered both sides of the border with Botswana and it is difficult to separate the numbers on each side: a large proportion of those counted appear to have been on the Chobe floodplain in Botswana.)

These previous surveys have shown similar distributions of buffalo (Chase 2009; MET 1999; Rodwell *et al.* 1995; ULG 1995; Kolberg 1994;) with a majority found in Mamili NP/Kwando area. The 2013 survey showed largely the same pattern, with concentrations in the protected areas.

In western Caprivi, buffalo were not seen during the survey in the Babwata stratum although they are known to use this area. They were not seen in the eastern Caprivi except just east of Mudumu NP and along the Linyanti.

Baboon

Baboons are difficult to see from the air. The numbers presented in Table 17 are likely to be underestimated.

Table 17 Estimates of baboon numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Buffalo/Mahango	36	7 - 110	7	0	0.0313
Kwando	174	70 - 347	70	0	0.1284
Susuwe	153	62 - 354	62	0	0.1347
Caprivi overall	**363**	**139 - 631**	**139**	**0**	**0.0217**

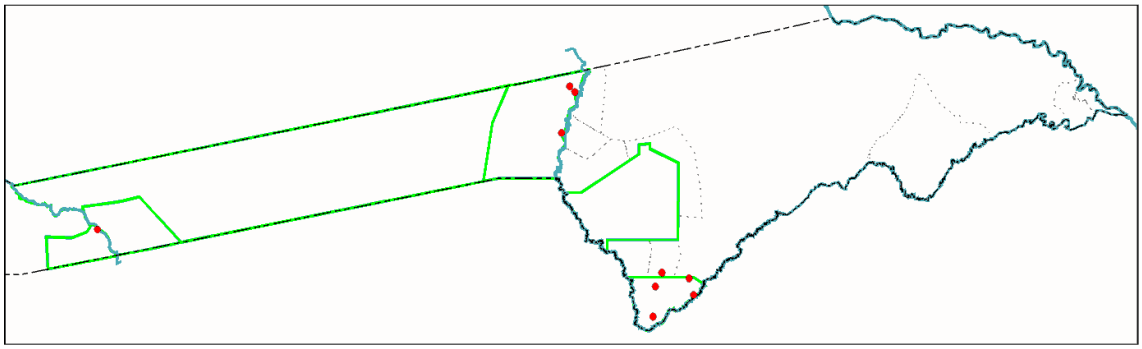

Figure 15 Sightings of baboons

Monkey

Like baboons, monkey numbers are likely to be underestimated and were only recorded in two locations.

Table 18 Estimates of monkey numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Salambala-Impalila	19	4 - 43	4	0	0.0154
Caprivi overall	**19**	**4 - 42**	**4**	**0**	**0.0012**

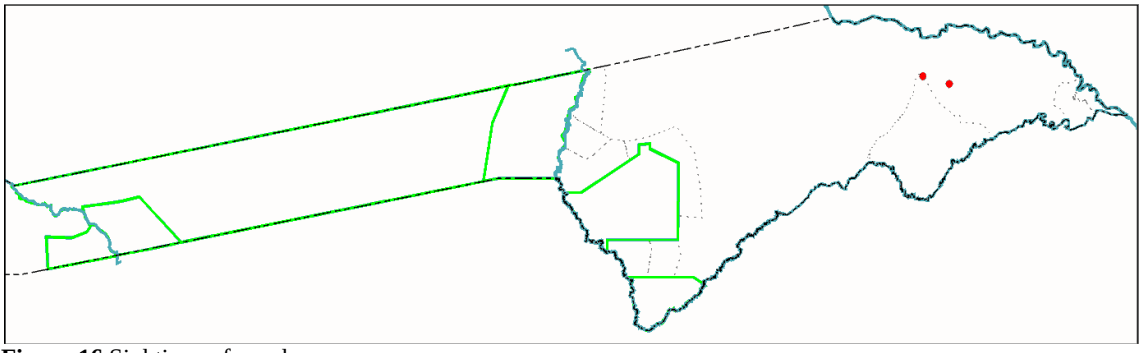

Figure 16 Sightings of monkeys

Bushpig

Being nocturnal animals, bushpig are not often seen during aerial surveys. Bushpig is one of the species in the Caprivi that are considered to be "problem animals".

Table 19 Estimates of bushpig numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
E Caprivi South	61	3 - 192	3	0	0.0199
Buffalo/Mahango	62	12 - 158	12	0	0.0536
Susuwe	22	9 - 53	9	0	0.0197
Caprivi overall	**145**	**24 - 296**	**24**	**0**	**0.0087**

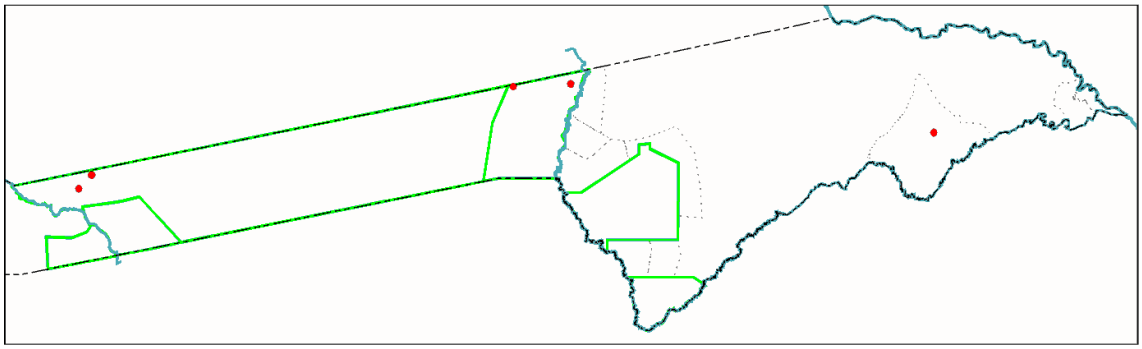

Figure 17 Sightings of bushpig

Duiker

Duiker are widespread but because of their small size their numbers (Table 20) are likely to be greatly underestimated (and see general, below).

Table 20 Estimates of duiker numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	60	3 - 148	3	0	0.0158
E Caprivi North	80	4 - 168	4	0	0.0173
Buffalo/Mahango	57	14 - 100	11	0	0.0488
Kwando	2	1 - 7	1	0	0.0018
Salambala-Impalila	14	3 - 41	3	0	0.0115
Susuwe	7	3 - 15	3	0	0.0066
Caprivi overall	**221**	**94 - 348**	**25**	**0**	**0.0132**

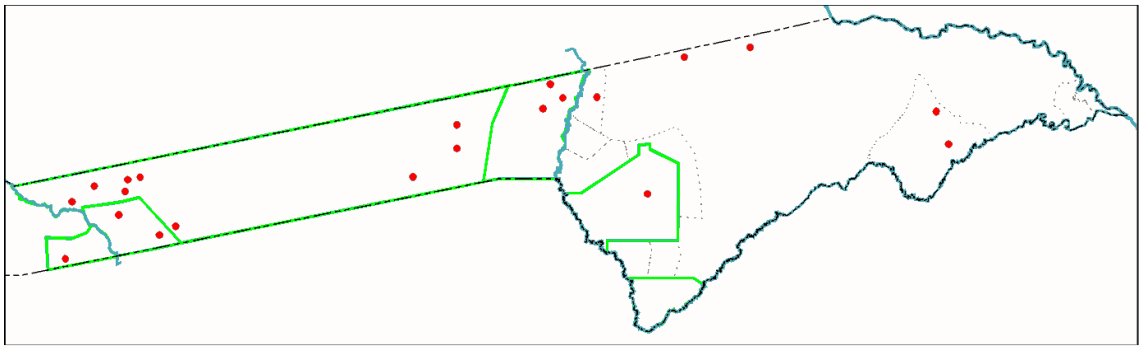

Figure 18 Sightings of duiker

Table 21 Estimates of duiker from previous surveys

Year	Number	Source
1994	128	ULG 1004
1994	0	Rodwell *et al.* 1995
1998	0	MET 1999
2004	*15	Kolberg 2004
2004	0	Stander 2004
2007	0	Chase 2007
2009	0	Chase 2009
2013	221	This survey

*number seen, not estimated from sample count

It is not known whether duiker were omitted from the 1994 and 1998 surveys or not seen.

Eland

Eland have been reintroduced to some conservancies (eg Wuparo).

Table 22 Estimates of eland numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
E Caprivi North	140	7 - 415	7	0	0.0302
Kwando	42	16 - 120	16	0	0.0311
Susuwe	77	31 - 150	31	0	0.068
Caprivi overall	**259**	**54 - 541**	**54**	**0**	**0.0155**

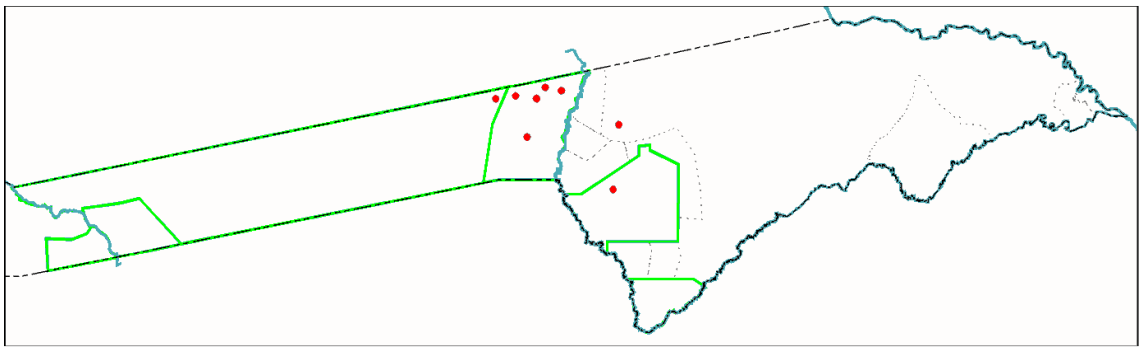

Figure 19 Sightings of eland

Table 23 Numbers of eland from previous surveys

Year	Number	Source
1994	787	ULG 1004
1994	189	Rodwell *et al.* 1995
1998	16	MET 1999
2004	0	Kolberg 2004
2004	0	Stander 2004
2007	0	Chase 2007
2009	0	Chase 2009
2013	259	This survey

Eland are found in dry forests and grasslands and have not been seen along the rivers or floodplains during aerial surveys. The estimate of 140 animals in the E Caprivi North stratum is from a single sighting in communal forest land east of Kwando and Mayuni conservancies. The low sampling intensity over this area produced a high estimate with very wide confidence limits.

Giraffe

Giraffe have been reintroduced to some conservancies but they are not numerous and appear to be concentrated in protected areas. Despite their size, they are cryptic and are often missed.

Table 24 Estimates of giraffe numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
E Caprivi North	100	5 - 306	5	0	0.0216
E Caprivi South	81	7 - 256	4	3	0.0266
Linyanti	45	9 - 126	9	0	0.1184
Buffalo/Mahango	54	11 - 134	11	0	0.0466
Kwando	15	6 - 34	6	0	0.0109
Susuwe	30	12 - 63	12	0	0.0265
Caprivi overall	**324**	**50 - 601**	**47**	**3**	**0.0194**

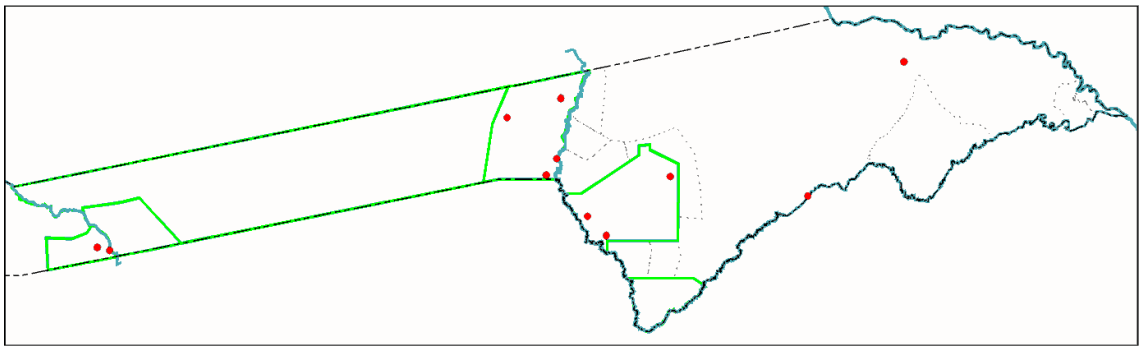

Figure 20 Sightings of giraffe

Table 25 Numbers of giraffe from previous surveys

Year	Number	Source
1994	360	ULG 1004
1994	76	Rodwell *et al.* 1995
1998	13	MET 1999
2004	65	Kolberg 2004
2004	21	Stander 2004
2007	1	Chase 2007
2009	11	Chase 2009
2013	324	This survey

Hippopotamus

Hippos are very numerous in all the rivers in the Caprivi and particularly in Mamili.

Table 26 Estimates of hippopotamus numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
E Caprivi North	60	3 - 153	3	0	0.013
E Caprivi South	242	12 - 558	12	0	0.0798
Linyanti	300	126 - 475	60	0	0.7891
Buffalo/Mahango	685	255 - 1115	138	17	0.5896
Kwando	1538	927 - 2149	611	10	1.1368
Salambala-Impalila	195	44 - 345	40	0	0.1554
Susuwe	231	107 - 355	93	0	0.2038
Caprivi overall	**3252**	**2432 - 4071**	**957**	**27**	**0.1943**

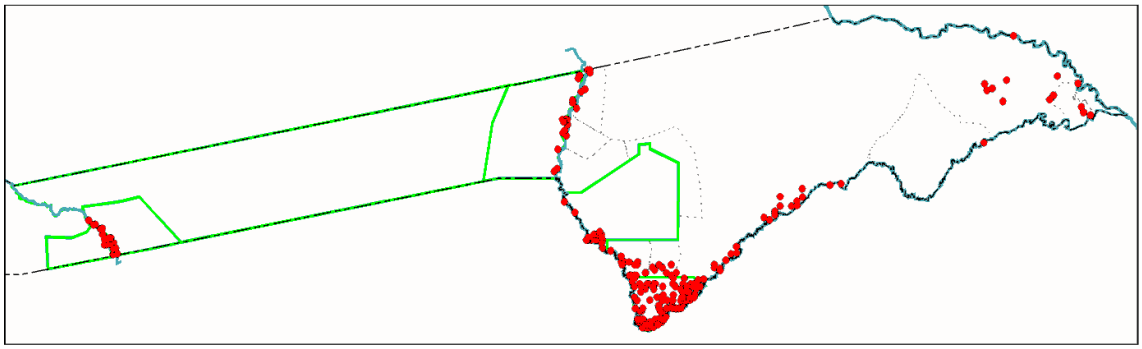

Figure 21 Sightings of hippopotamus

Table 27 Numbers of hippos from previous surveys

Year	Number	Source
1994	689	ULG 1004
1994	766	Rodwell *et al.* 1995
1998	946	MET 1999
2004	*202	Kolberg 2004
2004	1387	Stander 2004
2007	1269	Chase 2007
2009	1291	Chase 2009
2013	3252	This survey

*number seen, not estimated from sample count

Hippo are found where water bodies are sufficiently large and they appear to disperse in response to expanding wetlands. Note their widespread occurrence in the Zambezi/Chobe floodplains. In 2009, hippo in eastern Caprivi were largely found along the Chobe river and on the Zambezi not far from the Chobe confluence. In 2013, hippo were seen far inland west of Kasika conservancy and appear to be more numerous along the Linyanti. They are densely distributed along the Kwando.

Crocodiles

Crocodiles are found in all the river systems in the Caprivi. Because the survey was not designed specifically for crocodiles, the numbers are probably considerably under-estimated.

Table 28 Estimates of crocodile numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
E Caprivi North	180	9 - 411	9	0	0.0389
Linyanti	15	3 - 42	3	0	0.0395
Buffalo/Mahango	56	11 - 121	11	0	0.0482
Kwando	203	99 - 306	81	0	0.1497
Salambala-Impalila	62	12 - 136	12	0	0.0496
Susuwe	42	17 - 68	17	0	0.0369
Caprivi overall	**557**	**295 - 820**	**133**	**0**	**0.0333**

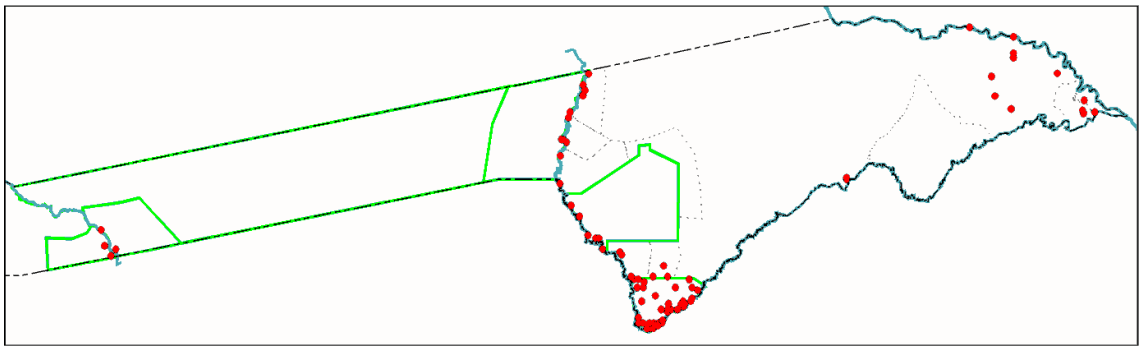

Figure 22 Sightings of crocodile

Table 29 Numbers of crocodiles from previous surveys

Year	Number	Source
1994	163	ULG 1004
1994	0	Rodwell *et al.* 1995
1998	0	MET 1999
2004	*35	Kolberg 2004
2004	207	Stander 2004
2007	243	Chase 2007
2009	151	Chase 2009
2013	557	This survey

*number seen, not estimated from sample count

Like hippos, crocodiles have moved inland from the Chobe and Zambezi rivers. This species require specially designed and dedicated surveys to provide good estimates of their numbers.

Although this estimate is much greater than any previous one, the apparent increase could simply be due to improved sighting conditions (eg more could have been sunning on land due to the seasonal temperatures) or the higher search rates achieved.

Impala

Impala are found in riverine areas in the Caprivi and are particularly numerous along the Kwando river, in Mamili and along the Kavango river.

Table 30 Estimates of impala numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Linyanti	10	2 - 28	2	0	0.0263
Buffalo/Mahango	335	125 - 545	65	0	0.2887
Kwando	1035	529 - 1541	411	30	0.7646
Salambala-Impalila	34	7 - 96	7	0	0.0269
Susuwe	329	132 - 539	132	0	0.2904
Caprivi overall	**1743**	**1169 - 2318**	**617**	**30**	**0.1042**

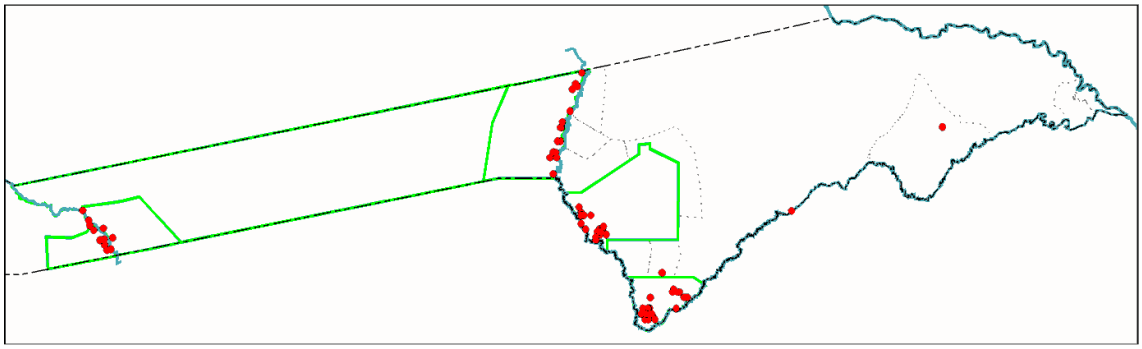

Figure 23 Sightings of impala

Table 31 Numbers of impala from previous surveys

Year	Number	Source
1994	742	ULG 1004
1994	278	Rodwell *et al.* 1995
1998	0	MET 1999
2004	*140	Kolberg 2004
2004	742	Stander 2004
2007	1361	Chase 2007
2009	1457	Chase 2009
2013	1743	This survey

*number seen, not estimated from sample count

The numbers of impala counted during the 2007 and 2009 surveys fall within the 95% confidence intervals of the 2013 estimate. There were very few seen in the Eastern Caprivi although they were fairly numerous along the Chobe in the past (Chase 2009). However it appears that sightings of impala along the Chobe in 2009 were seen on the Botswana side of the river.

Kudu

The cryptic colouring of kudu makes them difficult to see from the air and their numbers are under-estimated. Nevertheless, they are fairly widespread (Fig. 24) and are absent only from the human settlement areas and flooded areas.

Table 32 Estimates of kudu numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	219	13 - 538	11	2	0.0578
E Caprivi North	80	6 - 237	4	2	0.0173
Buffalo/Mahango	407	118 - 696	80	6	0.3506
Kwando	79	35 - 128	31	4	0.0582
Salambala-Impalila	5	1 - 14	1	0	0.0038
Susuwe	104	52 - 156	42	3	0.0916
Caprivi overall	**893**	**462 - 1324**	**169**	**17**	**0.0534**

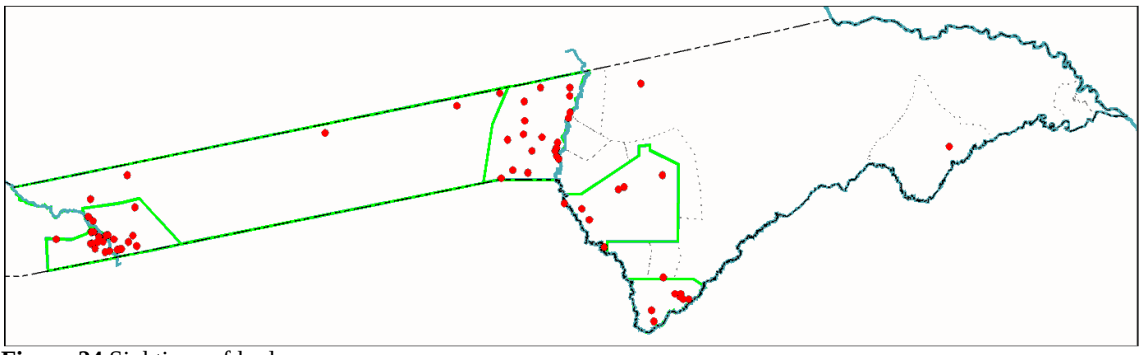

Figure 24 Sightings of kudu

Table 33 Numbers of kudu from previous surveys

Year	Number	Source
1994	280	ULG 1004
1994	551	Rodwell *et al.* 1995
1998	159	MET 1999
2004	*226	Kolberg 2004
2004	98	Stander 2004
2007	134	Chase 2007
2009	171	Chase 2009
2013	893	This survey

*number seen, not estimated from sample count

There is no clear trend from successive surveys.

Lechwe

Lechwe appear to be more widely distributed in Mamili than was recorded during the 2007 and 2009 total count surveys (Chase 2007 & 2009). This is likely to be a result of the extensive flooding over most of the National Park. They are considerably more numerous than they were between 2004 and 2009 when total counts gave figures around 750 animals.

Table 34 Estimates of lechwe numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Buffalo/Mahango	352	70 - 637	70	0	0.3027
Kwando	837	405 - 1268	335	18	0.6184
Susuwe	1326	931 - 1722	533	10	1.1695
Caprivi overall	**2515**	**1885 - 3145**	**938**	**28**	**0.1503**

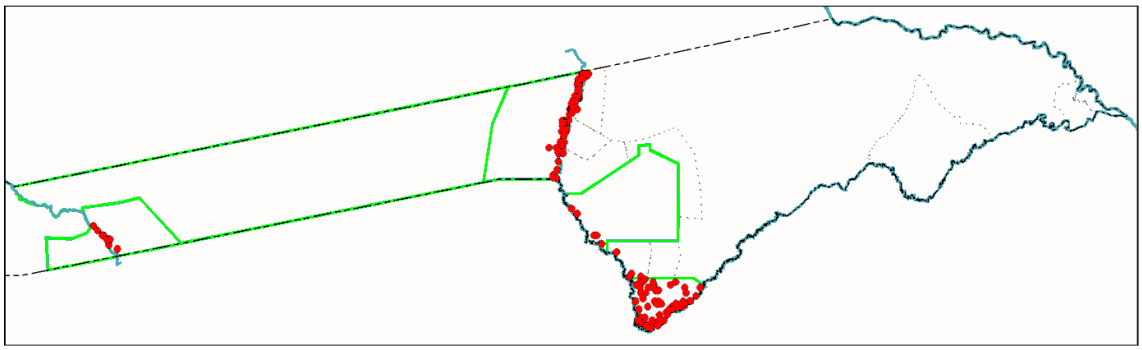

Figure 25 Sightings of lechwe

The numbers of lechwe appear to have declined along the Linyanti/Chobe system and there were none seen during this survey (Table 35). Chase (2009) reported most lechwe along the Chobe as being found on the larger islands (Sedudu & Kasika). The change may simply represent a short cross-border movement, however.

A similar trend was reported between 1980 and 1994 (Rodwell *et al.*1995), a decline that was attributed mostly to over-utilisation but also to the drying of the Linyanti and Lake Liambezi.

Table 35 Lechwe numbers in the Linyanti/Chobe river system.

Year	Number	Source
1994	2009	ULG 1004
1994	1109	Rodwell *et al.* 1995
1998	0	MET 1999
2004	0	Kolberg 2004
2004	314	Stander 2004
2007	134	Chase 2007
2009	77	Chase 2009
2013	0	This survey

Reedbuck

Reedbuck are not numerous in any part of the Caprivi. They are probably under-counted from the air because of their habit of lying down when frightened.

Table 36 Estimates of reedbuck numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Linyanti	25	5 - 69	5	0	0.0658
Buffalo/Mahango	53	11 - 147	11	0	0.0459
Caprivi overall	**78**	**16 - 175**	**16**	**0**	**0.0047**

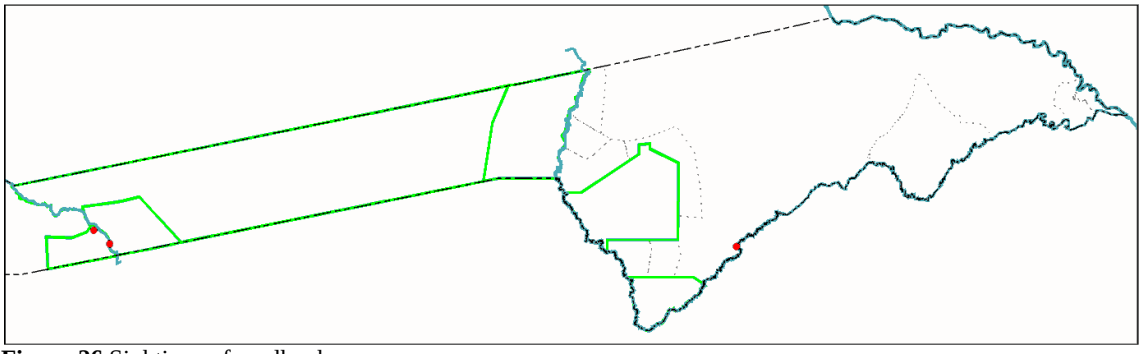

Figure 26 Sightings of reedbuck

The counts of reedbuck have been very variable over the years and the 2013 estimate falls within similar numbers from previous surveys. They are distributed along the Kavango, Linyanti and Chobe rivers. They were not seen in Mamili NP although this has been a stronghold of the species in the past.

Table 37 Numbers of reedbuck from previous surveys

Year	Number	Source
1994	173	ULG 1004
1994	93	Rodwell *et al.* 1995
1998	0	MET 1999
2004	0	Kolberg 2004
2004	76	Stander 2004
2007	162	Chase 2007
2009	105	Chase 2009
2013	78	This survey

Roan

Table 38 Estimates of roan numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	60	3 - 183	3	0	0.0158
Buffalo/Mahango	185	36 - 376	36	0	0.1592
Kwando	107	43 - 202	43	0	0.0791
Susuwe	12	5 - 31	5	0	0.0107
Caprivi overall	**364**	**133 - 594**	**87**	**0**	**0.0217**

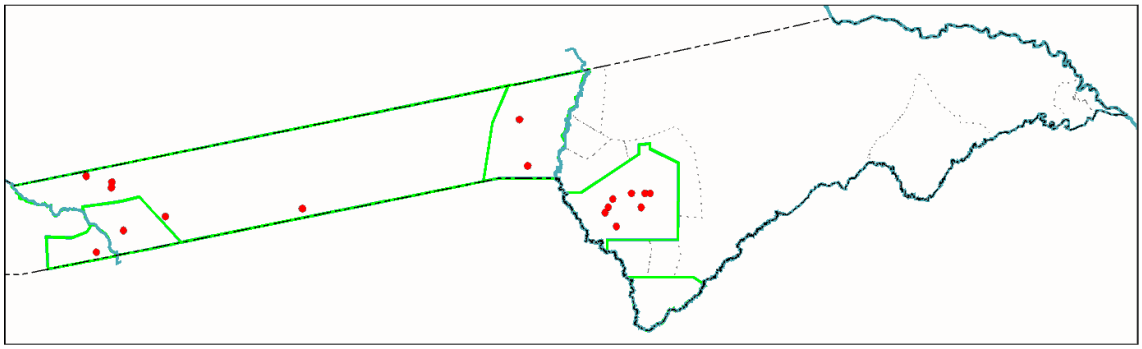

Figure 27 Sightings of roan

Roan have been recorded in small numbers over the past decade (Table 39).

Table 39 Numbers of roan from previous surveys

Year	Number	Source
1994	0	ULG 1004
1994	67	Rodwell *et al.* 1995
1998	44	MET 1999
2004	112	Kolberg 2004
2004	0	Stander 2004
2007	0	Chase 2007
2009	29	Chase 2009
2013	364	This survey

Sable

Table 40 Estimates of sable numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	40	30 - 122	2	28	0.0105
Buffalo/Mahango	271	78 - 520	53	25	0.2332
Kwando	84	34 - 220	32	2	0.062
Susuwe	296	132 - 488	118	14	0.2607
Caprivi overall	**690**	**356 - 1025**	**205**	**69**	**0.0412**

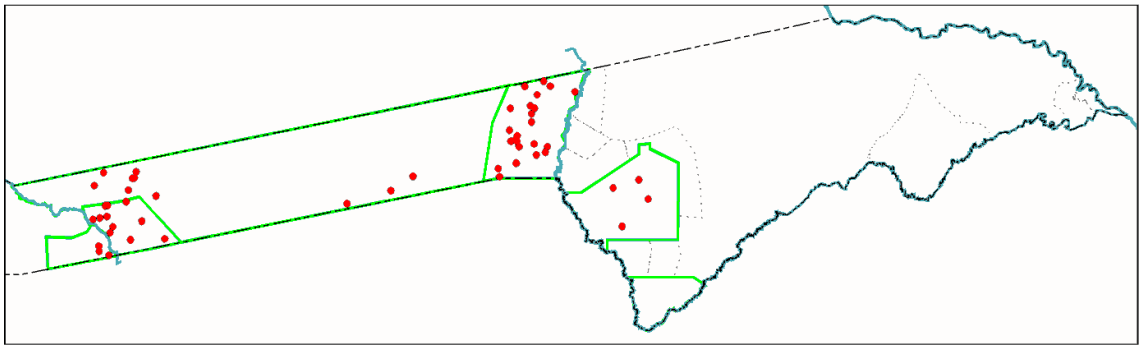

Figure 28 Sightings of sable

Table 41 Numbers of sable from previous surveys

Year	Number	Source
1994	613	ULG 1004
1994	452	Rodwell *et al.* 1995
1998	125	MET 1999
2004	724	Kolberg 2004
2004	45	Stander 2004
2007	102	Chase 2007
2009	20	Chase 2009
2013	690	This survey

Like roan, sable are found in the dry forests of Bwabwata NP. Previous surveys of the whole Caprivi provide similar estimates to the present one (ULG 2004, Rodwell *et al.* 1995, Kolberg 2004).

They were seen near the Kwando and Kavango rivers in 2007.

Sitatunga

Only 2 sitatunga were seen during the survey (these were outside the survey strips, in Botswana). The total counts of 2004, 2007 and 2009 recorded a few on the Kwando and in Mamili NP.

Table 42 Numbers of sitatunga seen

Stratum	No. seen in	No. out
Kwando		2
Caprivi overall		**2**

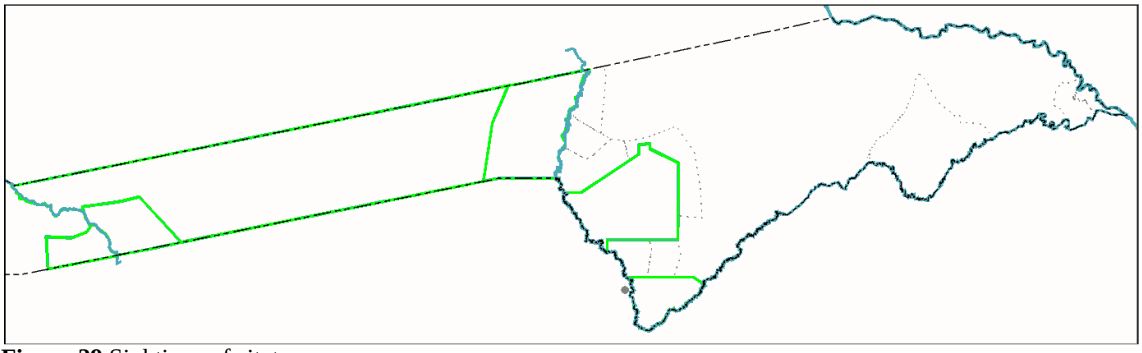

Figure 29 Sightings of sitatunga

Sitatunga are definitely present – one was seen while driving over Kongola bridge, but sighting conditions were very poor as the papyrus reeds were very dense. Notably, the aerial sighting was made as the aircraft was turning and the observer was looking vertically down into the reeds.

Steenbok

Table 43 Estimates of steenbok numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Buffalo/Mahango	10	2 - 24	2	0	0.0086
Caprivi overall	**10**	**2 - 23**	**2**	**0**	**0.0006**

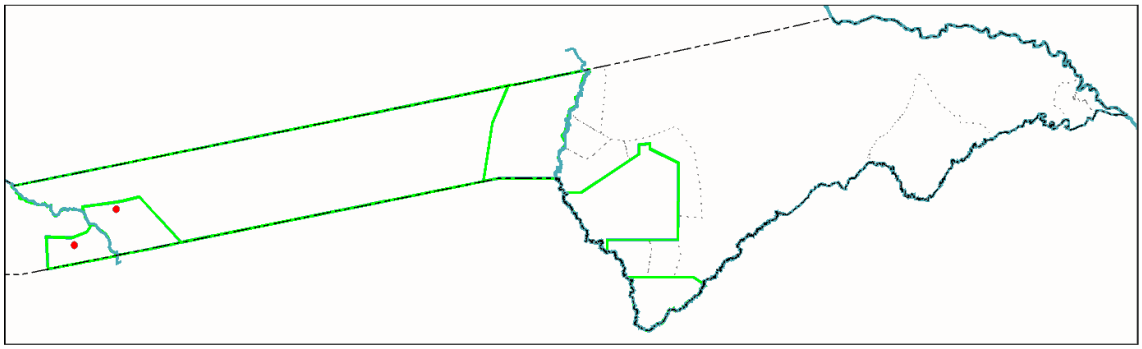

Figure 30 Sightings of steenbok

This species has not been reported on aerial surveys in the past.

Tsessebe

Table 44 Estimates of tsessebe numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	139	7 - 430	7	0	0.0368
Buffalo/Mahango	92	19 - 192	19	0	0.0794
Susuwe	43	17 - 101	17	0	0.0381
Caprivi overall	**275**	**43 - 565**	**43**	**0**	**0.0164**

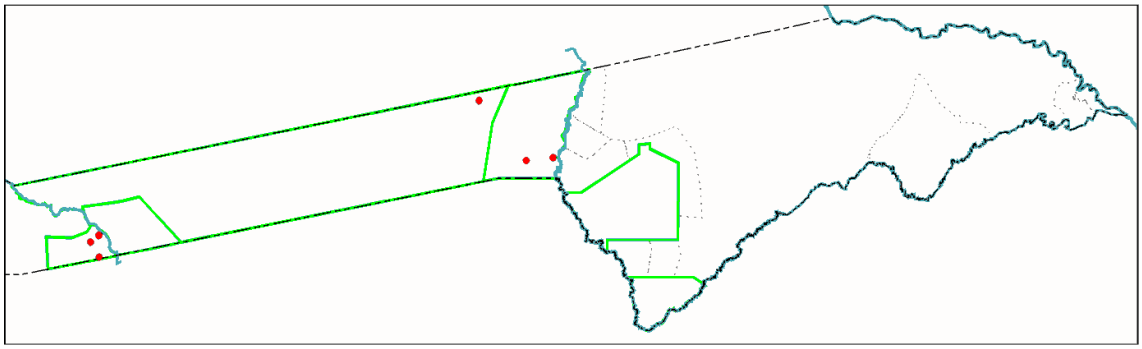

Figure 31 Sightings of tsessebe

Table 45 Numbers of tsessebe from previous surveys

Year	Number	Source
1994	153	ULG 1004
1994	28	Rodwell *et al.* 1995
1998	0	MET 1999
2004	*12	Kolberg 2004
2004	25	Stander 2004
2007	31	Chase 2007
2009	17	Chase 2009
2013	275	This survey

*number seen, not estimated from sample count

It is not possible to describe a trend for tsessebe as the numbers seen have been very variable. They have been counted previously in very small numbers near the Kwando and Kavango rivers as they were in the 2013 survey.

Warthog

Table 46 Estimates of warthog numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	80	4 - 193	4	0	0.021
E Caprivi South	61	3 - 185	3	0	0.0199
Linyanti	45	9 - 105	9	0	0.1184
Buffalo/Mahango	168	33 - 381	33	0	0.1448
Kwando	866	445 - 1288	346	12	0.64
Susuwe	166	72 - 259	67	0	0.1461
Caprivi overall	**1385**	**890 - 1881**	**462**	**12**	**0.0828**

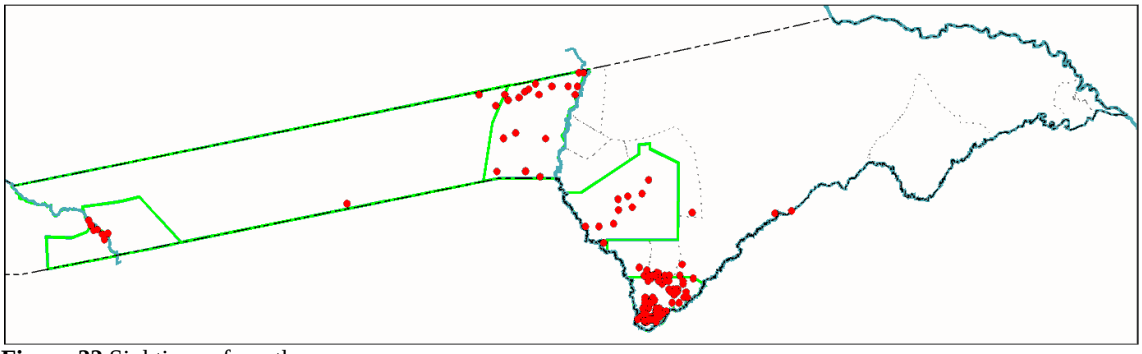

Figure 32 Sightings of warthog

Table 47 Numbers of warthogs from previous surveys

Year	Number	Source
1994	293	ULG 1004
1994	0	Rodwell *et al.* 1995
1998	94	MET 1999
2004	*52	Kolberg 2004
2004	226	Stander 2004
2007	176	Chase 2007
2009	173	Chase 2009
2013	1385	This survey

*number seen, not estimated from sample count

Warthog are numerous and widely distributed in the protected areas. Earlier surveys have counted very small numbers and it would seem that the distribution of this species has expanded considerably – for example within Mudumu NP and Susuwe where previously they have not been seen far from the river. Despite the relatively high estimate, this can be expected to be an under-count.

Waterbuck

Table 48 Estimates of waterbuck numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Linyanti	20	4 - 56	4	0	0.0526
Caprivi overall	**20**	**4 - 55**	**4**	**0**	**0.0012**

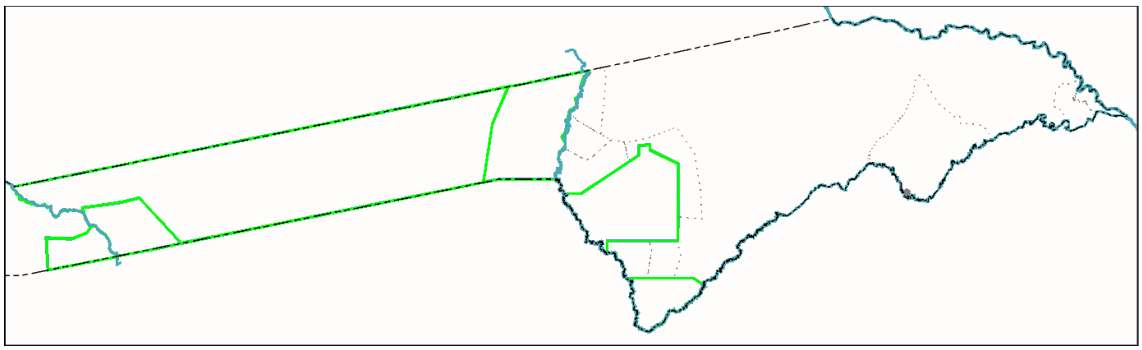

Figure 33 Sightings of waterbuck

Table 49 Numbers of waterbuck from previous surveys

Year	Number	Source
1994	136	ULG 1004
1994	0	Rodwell *et al.* 1995
1998	18	MET 1999
2004	*2	Kolberg 2004
2004	60	Stander 2004
2007	30	Chase 2007
2009	131	Chase 2009
2013	20	This survey

*number seen, not estimated from sample count

The consistently low numbers of waterbuck over the year imply that this species does not do well in the Caprivi, although habitats appear to be suitable. The one group seen in Salambala was close to the Botswana border.

Wildebeest

Table 50 Estimates of wildebeest numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Kwando	202	95 - 399	79	16	0.1493
Susuwe	115	45 - 242	45	0	0.101
Caprivi overall	**317**	**140 - 546**	**124**	**16**	**0.0189**

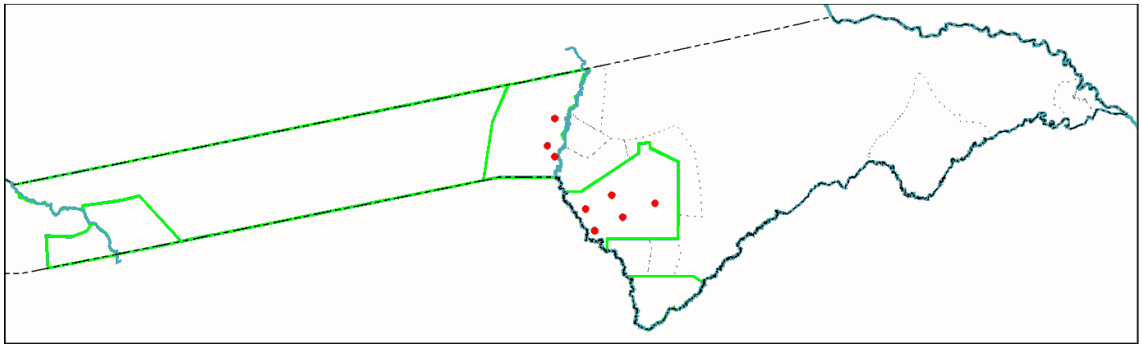

Figure 34 Sightings of wildebeest

Table 51 Numbers of wildebeest from previous surveys

Year	Number	Source
1994	0	ULG 1004
1994	0	Rodwell *et al.* 1995
1998	97	MET 1999
2004	100	Kolberg 2004
2004	6	Stander 2004
2007	35	Chase 2007
2009	64	Chase 2009
2013	317	This survey

Wildebeest are scattered within the protected areas on either side of the Kwando river, but away from the wetlands.

Zebra

Table 52 Estimates of zebra numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	99	5 - 307	5	0	0.0263
E Caprivi South	363	26 - 887	18	8	0.1197
Linyanti	60	12 - 169	12	0	0.1578
Buffalo/Mahango	285	56 - 549	56	0	0.2456
Kwando	316	173 - 509	125	48	0.2333
Susuwe	297	144 - 481	118	26	0.2619
Caprivi overall	**1421**	**788 - 2053**	**334**	**82**	**0.0849**

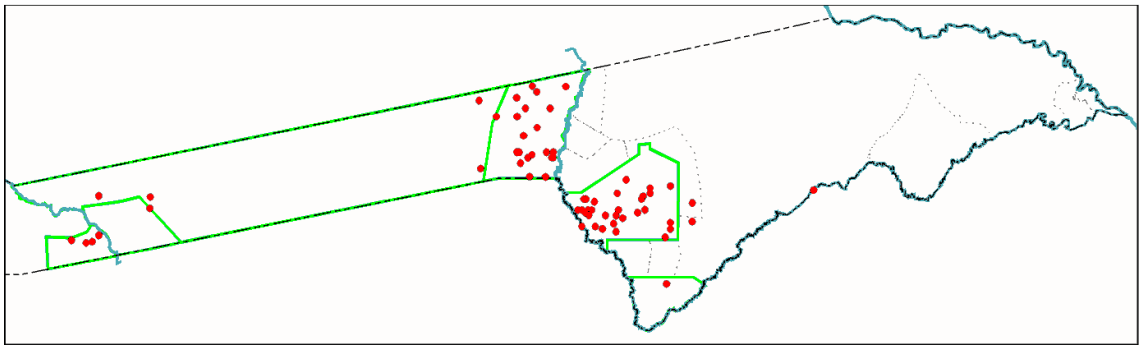

Figure 35 Sightings of zebra

Table 53 Numbers of zebra from previous surveys

Year	Number	Source
1994	167	ULG 1004
1994	257	Rodwell *et al.* 1995
1998	142	MET 1999
2004	2006	Kolberg 2004
2004	1084	Stander 2004
2007	1653	Chase 2007
2009	1689	Chase 2009
2013	1421	This survey

In 2004, 2007 and 2009, zebra were numerous along the Chobe river. Like impala, zebra sightings may have been on the Botswana side of the river during those three surveys. None were seen on the Namibian side of the Chobe in 2013, though they could have been present, but outside the sample.

Carnivores

Table 54 Numbers of carnivores seen

SPECIES	Stratum	No. seen in
Honey Badger	Bwabwata	1
	Caprivi overall	**1**
Hyaena	Buffalo/Mahango	2
	Kwando	4
	Caprivi overall	**6**
Lion	Kwando	6
	Caprivi overall	**6**

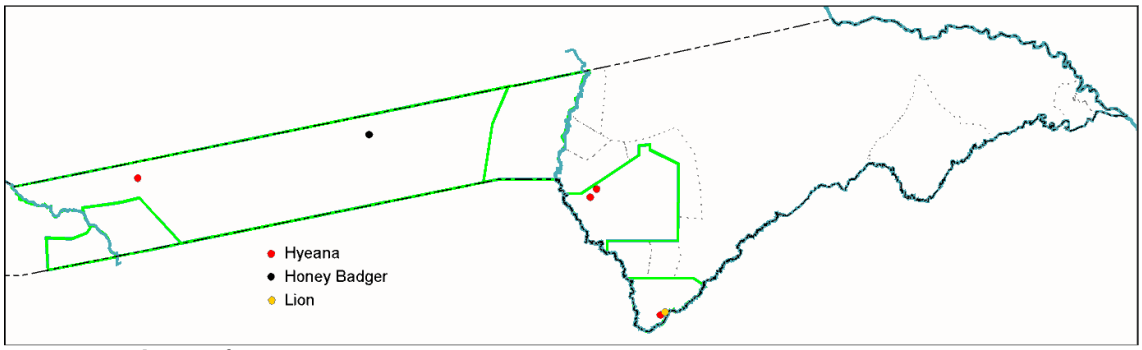

Figure 36 Sightings of carnivores

Carnivores are seldom seen on aerial surveys and the casual sightings merely serve to confirm their presence. The one group of lions seen was a pride feeding on a kill.

Carcasses of species other than elephant

Table 55 Estimates of class 2 carcasses of other species

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
E Caprivi North	20	1 - 59	1	0	0.0043
Linyanti	5	1 - 14	1	0	0.0132
Salambala-Impalila	5	1 - 14	1	0	0.0038
Caprivi overall	**30**	**3 - 69**	**3**	**0**	**0.0018**

Table 56 Estimates of class 3 carcasses of other species

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Buffalo/Mahango	5	1 - 14	1	0	0.0041
Kwando	7	3 - 15	3	0	0.0055
Susuwe	8	3 - 16	3	0	0.0067
Caprivi overall	**20**	**7 - 34**	**7**	**0**	**0.0012**

Table 57 Estimates of class 4 carcasses of other species

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	20	1 - 61	1	0	0.0053
E Caprivi North	20	1 - 61	1	0	0.0043
Kwando	13	5 - 23	5	0	0.0093
Salambala-Impalila	10	2 - 22	2	0	0.0077
Susuwe	12	6 - 25	5	1	0.011
Caprivi overall	**75**	**16 - 133**	**14**	**1**	**0.0045**

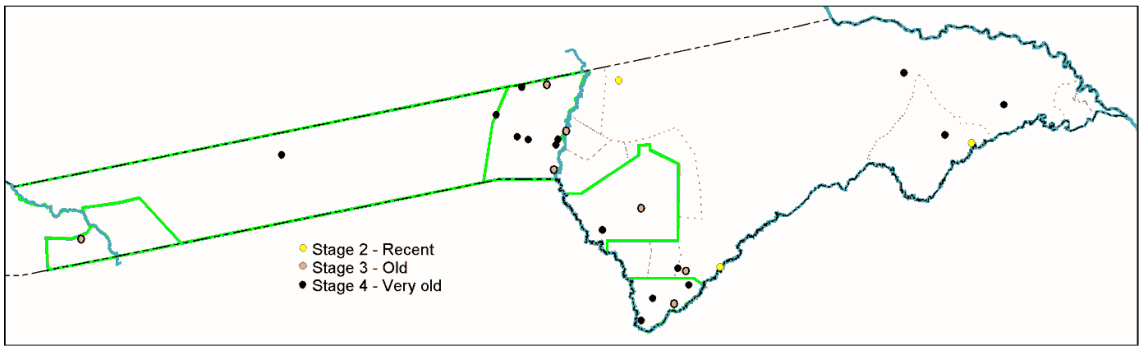

Figure 37 Sightings of the carcasses of species other than elephant

Ground Hornbill

Ground hornbills may be indicators of the quality of their habitats. This crew has been accustomed to count them routinely and they were included in the survey.

Table 58 Estimates of ground hornbill numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Buffalo/Mahango	36	7 - 113	7	0	0.0313
Kwando	5	2 - 14	2	0	0.0036
Salambala-Impalila	43	9 - 87	9	0	0.0346
Susuwe	10	4 - 29	4	0	0.0088
Caprivi overall	**95**	**22 - 179**	**22**	**0**	**0.0056**

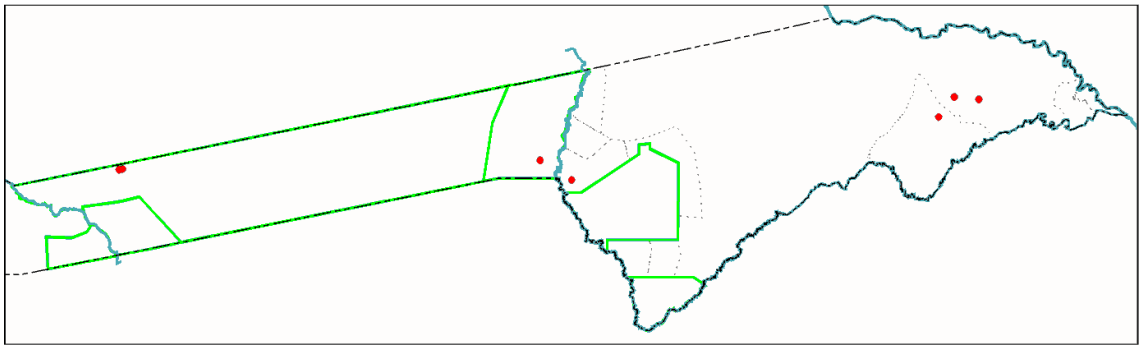

Figure 38 Sightings of ground hornbills

The habit of ground hornbills flying when disturbed render them quite visible on aerial surveys. The result reflects low numbers.

Ostrich

Table 59 Estimates of ostrich numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	99	5 - 219	5	0	0.0263
Buffalo/Mahango	26	5 - 65	5	0	0.022
Susuwe	17	7 - 41	7	0	0.0151
Caprivi overall	**142**	**24 - 260**	**17**	**0**	**0.0085**

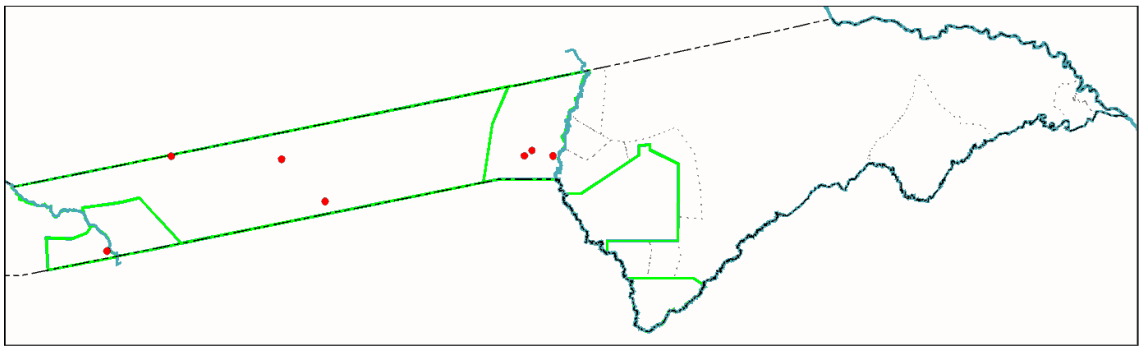

Figure 39 Sightings of ostriches

Table 60 Numbers of ostrich from previous surveys

Year	Number	Source
1994	211	ULG 1004
1994	6	Rodwell *et al.* 1995
1998	9	MET 1999
2004	58	Kolberg 2004
2004	0	Stander 2004
2007	0	Chase 2007
2009	0	Chase 2009
2013	142	This survey

Wattled Crane

Wattled crane is a threatened species of international conservation concern and as it is easily identified from the air, it was included in this survey.

Table 61 Estimates of wattled crane numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Buffalo/Mahango	36	7 - 110	7	0	0.0313
Kwando	2	1 - 7	1	0	0.0018
Salambala-Impalila	26	5 - 76	5	0	0.0208
Caprivi overall	**65**	**13 - 149**	**13**	**0**	**0.0039**

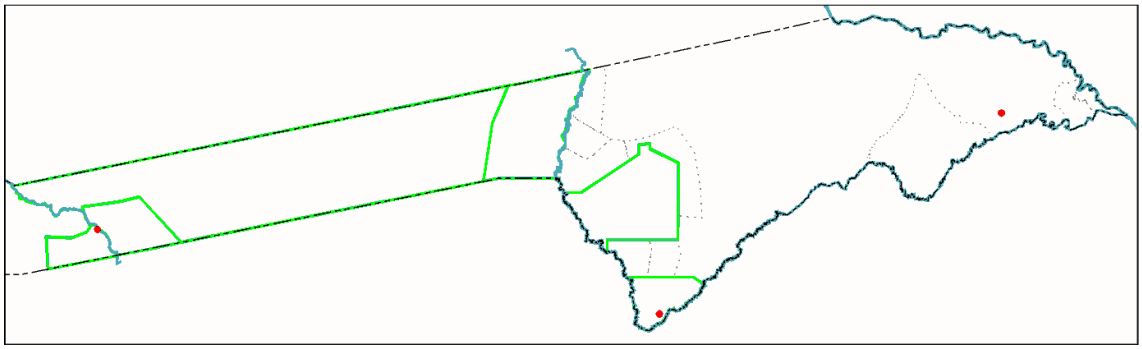

Figure 40 Sightings of wattled cranes

Saddlebill Stork

Table 62 Estimates of saddlebill stork numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Linyanti	5	1 - 14	1	0	0.0132
Kwando	37	17 - 67	15	2	0.0276
Salambala-Impalila	20	4 - 48	4	0	0.016
Caprivi overall	**62**	**22 - 103**	**20**	**2**	**0.0037**

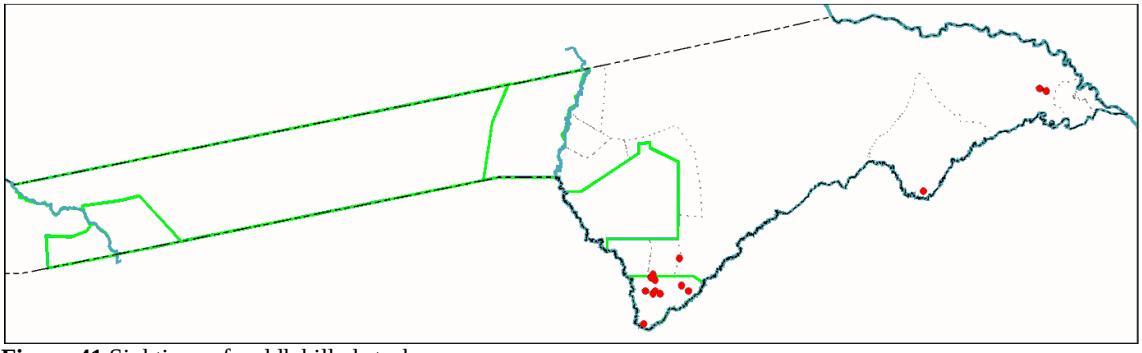

Figure 41 Sightings of saddlebilled storks

Openbill Stork

Table 63 Estimates of openbill stork numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
E Caprivi North	8788	440 - 26949	440	0	1.8994
Salambala-Impalila	19523	8167 - 30878	3984	150	15.582
Caprivi overall	**28310**	**7807 - 48814**	**4424**	**150**	**1.6919**

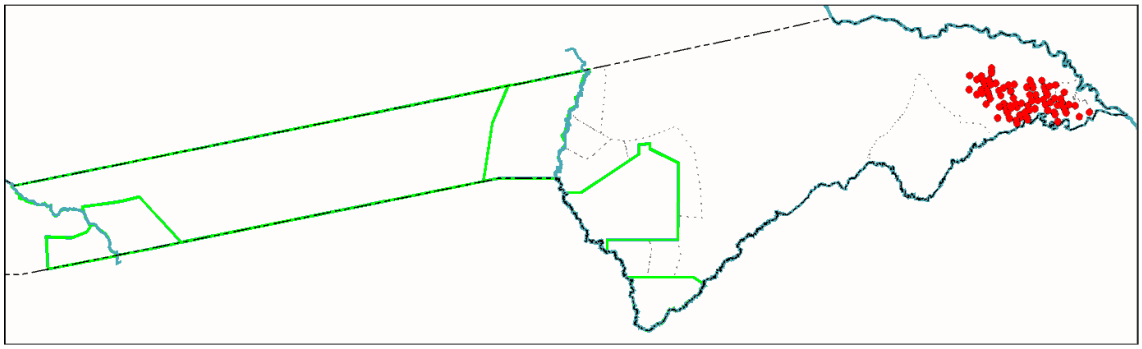

Figure 42 Sightings of openbill storks

Openbill storks are the most numerous wild species recorded. Restricted to the Zambezi/Chobe floodplain, the large feeding groups are highly visible. The coverage of Salambala-Impalila comprised two separate 10% surveys, one carried out in the morning (A) and the other in the afternoon (B). The two are significantly different, the latter returning a much lower estimate. This probably reflects a diurnal behavioural change.

2.2 Observations of Domestic Animals

Cattle

Table 64 Estimates of cattle numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	656	33 - 1577	33	0	0.1733
E Caprivi North	48014	27684 - 68344	2404	421	10.377
E Caprivi South	46992	25895 - 68089	2329	628	15.483
Linyanti	5902	3021 - 8783	1179	330	15.506
Buffalo/Mahango	24	5 - 74	5	0	0.0207
Kwando	4532	2368 - 6697	1815	302	3.3491
Salambala-Impalila	30698	21384 - 40012	6148	941	24.502
Susuwe	156	64 - 330	64	0	0.1379
Caprivi overall	**136975**	**108103 - 165846**	**13977**	**2622**	**8.1858**

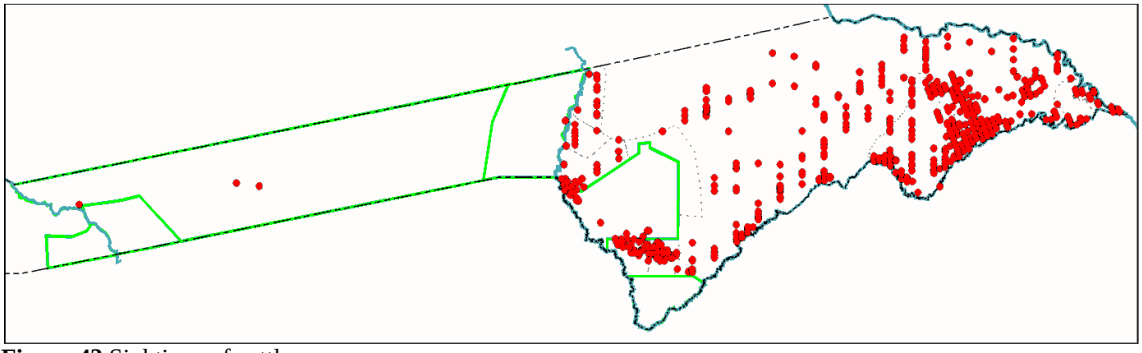

Figure 43 Sightings of cattle

Cattle are the most numerous animal in the Caprivi, found wherever there is human activity. Because of the low sampling intensity in much of central eastern Caprivi, the map in Fig. 43 shows low numbers of sightings of cattle in this area. Fig. 5 (page 4) shows the density distribution of domestic livestock which better illustrates the distribution of cattle.

Donkey

Table 65 Estimates of donkey numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Kwando	15	6 - 43	6	0	0.011
Caprivi overall	**15**	**6 - 43**	**6**	**0**	**0.0009**

Sheep/Goats

Table 66 Estimates of sheep/goat numbers

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
Bwabwata	278	14 - 669	14	0	0.0735
E Caprivi North	379	19 - 1151	19	0	0.082
E Caprivi South	767	38 - 2417	38	0	0.2526
Linyanti	105	21 - 293	21	0	0.2762
Buffalo/Mahango	120	25 - 371	25	0	0.1036
Kwando	207	83 - 411	83	0	0.1529
Salambala-Impalila	48	10 - 118	10	0	0.0385
Susuwe	12	5 - 35	5	0	0.0106
Caprivi overall	**1917**	**215 - 3658**	**215**	**0**	**0.1146**

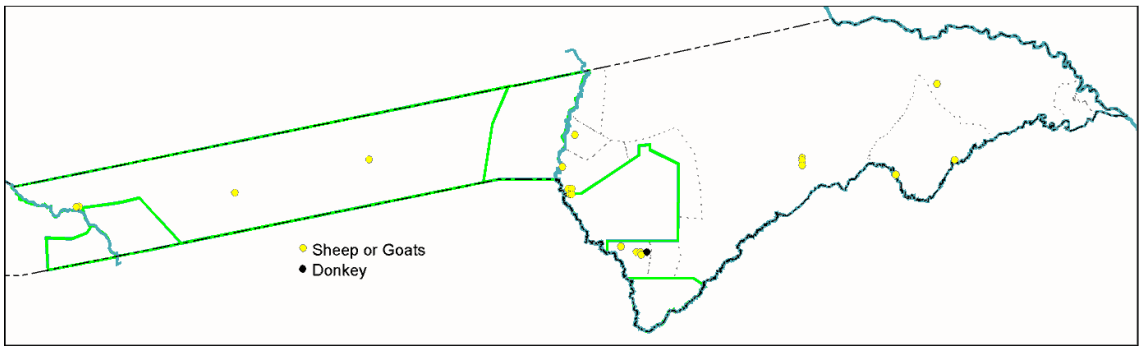

Figure 44 Sightings of donkeys and sheep or goats

2.3 Other Observations

This section describes attributes other than wildlife recorded during the survey. Estimates are tabulated for several attributes, including density estimates. This would be misleading for some cases: "villages" does not relate to the number of dwellings or people therein; fields extend beyond the sampling transect and the count does not reflect area. The counts may nevertheless serve as useful indices of occurrence and the estimates are given so that comparisons can be made between areas and years.

Table 67 Numbers of safari camps seen

Stratum	No. seen
E Caprivi North	1
Linyanti	1
Kwando	4
Salambala-Impalila	1
Susuwe	4
Caprivi overall	**12**

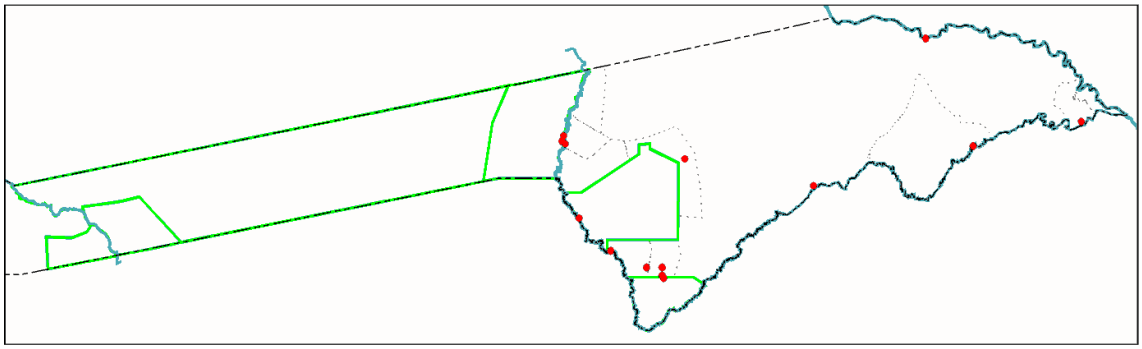

Figure 45 Sightings of safari camps

Table 68 Numbers of fishing camps seen

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
E Caprivi North	439	23 - 979	22	1	0.095
E Caprivi South	303	19 - 710	15	4	0.0997
Linyanti	140	78 - 203	28	2	0.3682
Kwando	28	11 - 47	11	0	0.0204
Salambala-Impalila	142	61 - 222	28	2	0.113
Susuwe	10	4 - 19	4	0	0.0088
Caprivi overall	**1061**	**421 - 1702**	**108**	**9**	**0.0634**

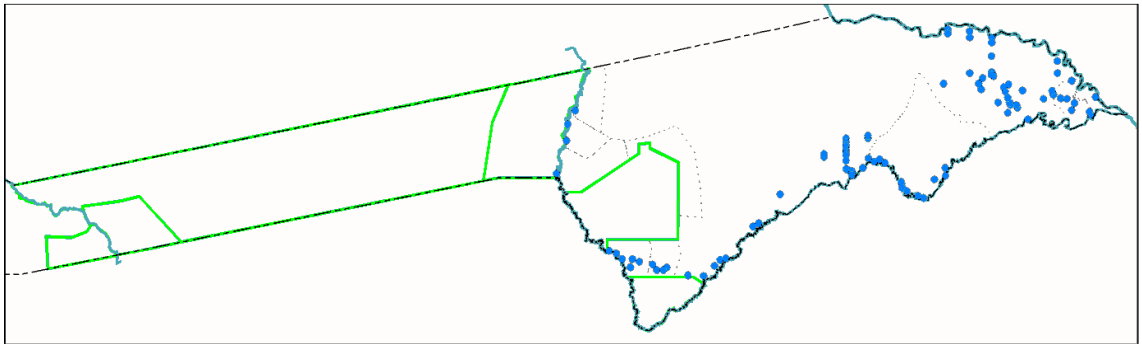

Figure 46 Sightings of fishing camps

Table 69 Numbers of fish traps/nets seen

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
E Caprivi North	300	15 - 624	15	0	0.0648
E Caprivi South	968	48 - 2403	48	0	0.3191
Linyanti	205	113 - 297	41	0	0.5392
Kwando	42	18 - 66	17	0	0.0313
Salambala-Impalila	302	108 - 495	61	3	0.2408
Susuwe	5	2 - 12	2	0	0.0043
Caprivi overall	**1822**	**473 - 3172**	**184**	**3**	**0.1089**

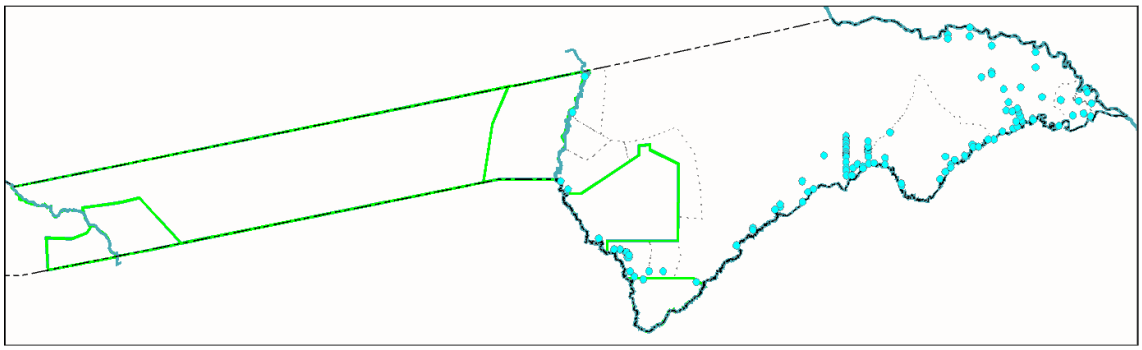

Figure 47 Sightings of fishing nets

Table 70 Numbers of canoes/boats seen

Stratum	Pop. Est	95%Range	No. seen in	No. out	No. km^{-2}
E Caprivi North	1538	161 - 2915	77	0	0.3324
E Caprivi South	1332	66 - 2945	66	0	0.4388
Linyanti	481	116 - 918	96	20	1.2625
Kwando	47	20 - 75	19	0	0.035
Salambala-Impalila	1108	700 - 1517	222	2	0.8847
Susuwe	40	16 - 64	16	0	0.0351
Caprivi overall	**4546**	**2499 - 6592**	**496**	**22**	**0.2717**

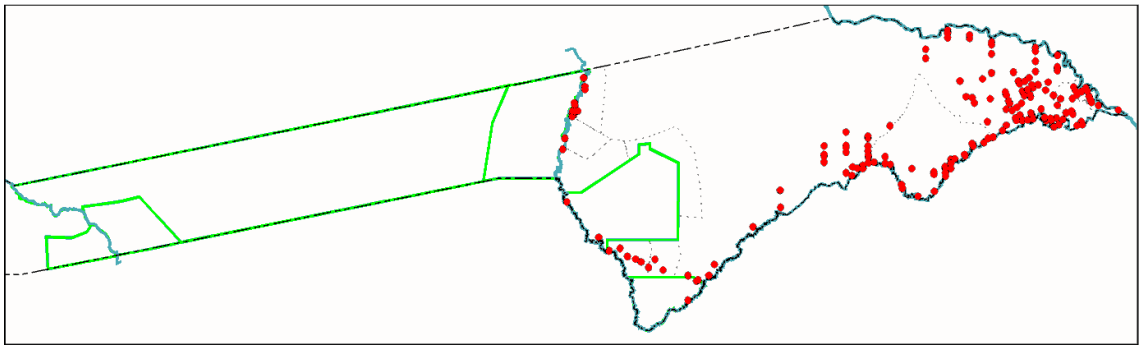

Figure 48 Sightings of canoes/boats

Table 71 Numbers of logging sites seen

Stratum	Pop. Est	95%Range	No. seen	No. out	No. km^{-2}
E Caprivi North	80	4 - 201	4	0	0.0173
Caprivi overall	**80**	**4 - 201**	**4**	**0**	**0.0048**

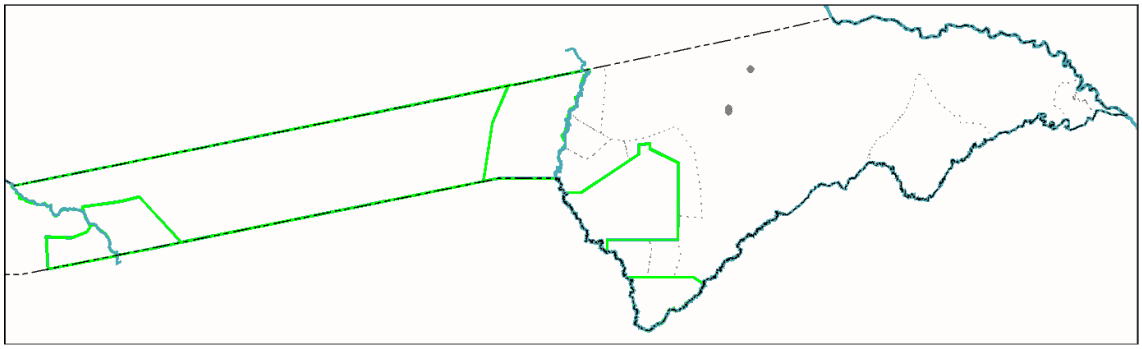

Figure 49 Logging sites seen

Logging was recorded because a considerable amount (unreported) was observed on the 2011 survey in the forest areas of East Caprivi. The subjective impression is that this is now much reduced. One of the sites recorded on the survey was not recent.

Table 72 Number of Fields/Cultivation seen

Stratum	No. seen in
Bwabwata	7
E Caprivi North	106
E Caprivi South	84
Linyanti	19
Buffalo/Mahango	1
Kwando	138
Salambala-Impalila	89
Susuwe	7
Caprivi overall	**451**

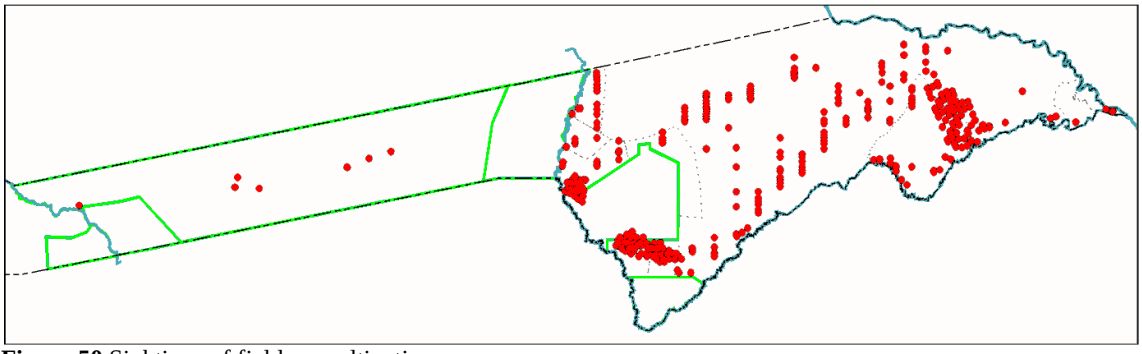

Figure 50 Sightings of fields or cultivation

Table 73 Numbers of Villages/Huts seen

Stratum	No. seen in
Bwabwata	11
E Caprivi North	59
E Caprivi South	59
Linyanti	4
Buffalo/Mahango	4
Kwando	89
Salambala-Impalila	161
Susuwe	4
Caprivi overall	**391**

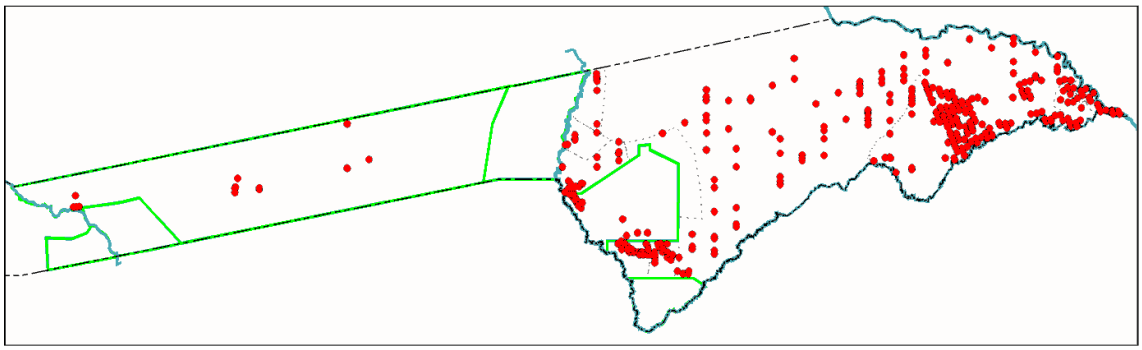

Figure 51 Sightings of villages and huts

3 GENERAL

3.1 Elephant mortality

The population of elephants in the Caprivi (~ 10 000) has been increasing and probably has a young age structure, with a small proportion of senescent animals. Such a population is likely to be characterised by an annual adult mortality of less than one percent (say, 0.5%) producing, on average each year, fifty carcasses. If carcasses persist for 5 – 10 years (Douglas-Hamilton & Hillman 1981), then assuming an average persistence of around 7 years, one might expect about 350 visible carcasses to be present at any time, yielding a carcass ratio of around 3.5%. This is consistent with previous carcass ratios (eg 3.93% in 1994 (Rodwell *et al.* 1995). It has been shown here that an additional 500 carcasses have accumulated since the previous survey – a rate of 250 per annum. This is over and above the natural rate because natural carcasses are close to equilibrium: i.e. for every 50 that are produced, 50 of the oldest pass the detectable stage, so there should be no annual increase in carcasses from natural deaths. The additional 250 carcasses increase the mortality to six times the natural rate – around 3%. As the natural increment is probably around 4%, this is approaching a level which is unsustainable (assuming, of course, that natural mortality is only about 0.5%). Of course there is precision on the carcass estimate: the overall mortality may be between twice and sixteen times the natural rate. It could be argued that decisions should be based on the worst-case scenario: that the rate of loss is well above what can be sustained. Even supposing losses are within the annual population increment, if these are due to ivory poaching, then older animals will have been targeted. That will change the population structure, which may have other consequences.

A further consequence of the observed recent increase in carcass numbers is that some of these will persist for up to ten years. This will make it increasingly difficult to measure the actual rate of carcass production, as one will be working with a higher baseline in comparison with which new carcass numbers are smaller in relative terms.

To deal with this, removing carcasses may not be a good option, as it will be difficult to locate and deal with the number being produced (only those within the sample will be known, and the amount of work may be prohibitive). However, if this is pursued, it is essential that good records are kept so that future surveys start from a good estimate of what should be present.

The distribution of carcasses shows that many occur away from the more intensively protected areas. This requires more attention from future surveys – and from management.

3.2 Elephant population

The point has been made above that comparing one survey with the previous is unlikely to detect any but the most severe population declines. However, as the number of repeat surveys increases, so does the detectability of any trend. The surveys in Fig. 6 above pick out an upward trend which is quite small, for example. Where possible, less intensive but more regular surveys are better than infrequent intensive ones. This is because every survey is subject to some bias due to varying environment or idiosyncrasy of implementation. These biases can never be eliminated as the possible causes of a difference between two surveys.

However, in the long run they become part of the background variation which comes out in the wash as more results are accumulated.

A notable finding is that the highest density of elephants appeared to be in the Buffalo core area of Bwabwata NP. The estimate for this area was the highest to date. In contrast, the eastern core area around Susuwe had lower estimates. This could be as a result of a regular seasonal movement (no previous survey took place at this time of year). On the other hand, it can be speculated that disturbance due to illegal hunting may have caused some animals to move to the western end of Bwabwata.

3.3 Wetlands Survey

The results include incidental sightings of species of interest (from previous wetland surveys) which enabled estimates for these species (principally hippo, crocodile and lechwe) to be made. Methods are not comparable with previous wetland counts, which covered the extension of wetlands into Botswana and were not restricted to the Namibia side. (It would be useful if future wetland counts distinguished the country in which sightings are made.) Additionally, previous wetland counts were total counts. This survey estimated higher populations than previous counts for the key species, despite the area of wetland cover being less. This is probably due to the higher search rate achieved on this survey, although sighting conditions at this time could have been better.

Hippos and crocodiles are likely to be undercounted at the best of times. Left and right observers differed significantly in the number of sightings of these species, which suggests a tendency to bias.

Sitatunga, which occur in the Caprivi, have never returned a meaningful result from any of the surveys of these wetlands. This calls for a completely different approach to their estimation.

3.4 Other species and attributes

Buffalo was the other major species counted (buffalo, elephant and hippo represent about 80% of the wildlife biomass of the Caprivi). The estimate, although imprecise, is comparable with previous results. Other incidentally recorded species were estimated with a variable degree of accuracy (see below).

Other attributes recorded relate to human activity. The distribution of these provides a useful negative background to the distribution of wildlife and actual or potential wildlife areas. That can help to guide the design of future surveys and, perhaps, the evaluation of conservancies.

The distribution of cattle was a secondary objective of the survey in order to highlight areas of potential contact with buffalo. This appears to have been achieved.

3.5 Accuracy of results

The fact that most species are subject to under-counting has been referred to throughout. The choice of 300ft a.g.l., a strip width of 200m per side and a speed of 90 knots are compromises between what is ideal and what is possible. If any of these could be safely reduced, estimates would probably increase and bias would be reduced (although never eliminated). It is assumed that elephants, being the largest species, are easier to count, but these results show that at the time of this survey, undercounting of elephants was a real possibility.

One guide to susceptibility to undercounting bias is to compare left and right observers' results. If there is bias, then it is likely to vary between observers. This is tabulated in Appendix II. Crocodiles and hippos have already been discussed in this context. The only other species with a significant difference is elephant carcass class 4. This is more likely to be a reflection of inconsistent classification than sighting bias.

The other approach is to compare estimates with true numbers. Arguably, the closest one can come to true numbers is using results from ground counts as reported for Susuwe and Mahango/Buffalo (WWF 2011). The results cover areas similar to those covered in this survey. The areas season and year are not equivalent and ground counts have their own biases. Where estimates from the two methods differ by less than a factor of two (eg elephants), it will remain a matter of controversy which result is closer to the truth. Larger differences for species suspected to be difficult to count from the air probably do indicate undercounting on this survey and the results make an interesting comparison (Table 74).

Table 74 Comparison of Ground Counts with aerial survey for Bwabwata East and West

Species	2011 WWF	2013	Ratio
Elephant	8439	5222	0.619
Buffalo	3591	2625	0.731
Duiker	2254	64	0.028
Giraffe	271	80	0.295
Impala	6194	664	0.107
Kudu	4332	511	0.118
Reedbuck	138	53	0.384
Roan	421	197	0.468
Sable	1474	567	0.385
Steenbok	519	10	0.019
Tsessebe	133	135	1.015
Warthog	1116	334	0.299
Wildebeest	160	115	0.719
Zebra	1674	582	0.348

The degree of undercounting is clearly very high for some species.

3.6 *Methodology caveats*

Surveys are seldom, if ever, perfect and this one was no exception. The following deviations from best practice were identified:

- Calibration yielded strips of which the left was wider than the right. Ideally these should be equal, but the calibration readings were stable so the strips were not readjusted. This is a problem of using streamers rather than rods, as the airflow is not symmetrical around the aircraft.
- The radar altimeter malfunctioned for short periods at the beginning of the survey.
- Canopy cover at this time of year was locally dense, especially in the teak woodland. This is likely to have caused undercounting. The optimum time for avoiding this is around October.
- Because of the short days and the logistics of reaching the airfields early, several flights continued past 11:00 am. This will have caused undercounting.
- Coverage excluded areas around Katima Mulilo and north of Divundu. Little wildlife was expected in these areas so the effect on the result is slight.
- Stratification excluded some areas that had contained little wildlife during the 2011 survey from the higher intensity sampling strata, though wildlife was present during this survey. Transects at the eastern end of strata E Caprivi north and south should have been oriented east-west, as north-south transects did not follow the wildlife gradient in this area. These design defects will have reduced precision.
- The stratification was not ideal for elephant carcasses. This could not have been foreseen. One objective of broad low-intensity coverage of most of the area was to gain an overview of the complete distribution of carcasses. This knowledge can be put to use in future surveys.
- The failure to report estimates according to exact management unit boundaries requires comment. Best practice is actually to design the stratification around wildlife concentrations without regard to management units. This was the approach adopted. Estimates can be constructed from the data, but this is seldom worthwhile as the precision of estimates in smaller units precludes meaningful comparisons, as does the mobility of animals across boundaries in the region.

4 ACKNOWLEDGEMENTS

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5 REFERENCES

Chase M.J. & C.R. Griffin 2004. *Elephant Distribution and Abundance in the Caprivi Strip: Results of an Aerial Survey in 2003.* Ministry of Environment and Tourism, Windhoek, Namibia.

Chase M.J. & C.R. Griffin 2006. *Elephant distribution and abundance in the lower Kwando river basin and west Caprivi.* Final report

Chase M.J. & C.R. Griffin 2006. *Elephant Distribution and Abundance in the Lower Kwando River Basin and West Caprivi.* US Fish and Wildlife Service, Washington, DC

Chase M. 2007. *Aerial wildlife census of the Caprivi River Systems: A survey of rivers, wetlands and floodplains September 2007.* Report to Ministry of Environment & Tourism, Windhoek, Namibia

Chase M.J. 2008. *Aerial survey of elephants in North East Namibia September-October 2007.* Conservation International, Cape Town, South Africa

Chase M. 2009. *Fixed-wing aerial wildlife census of the Caprivi River Systems: A survey of rivers, wetlands and floodplains September 2009.* Report to Ministry of Environment & Tourism, Windhoek, Namibia

Craig G.C. 2011. *Countrywide survey of elephants in Namibia: draft report.* Report to the Ministry of Environment and Tourism, Namibia

Cumming D.H.M. 2012 *A Needs Assessment and Strategy for Wildlife Protection and Law Enforcement by The Ministry of Environment and Tourism, Namibia*. Consultancy report MET

Douglas-Hamilton I. 1996. *Counting Elephants from the Air – Total Counts*. In: Ed Kadzo Kangwana. Studying Elephants. AWF Technical Handbook Series 7.

Douglas-Hamilton I. & A. Hillman 1981. *Elephant carcasses and skeletons as indicators of population trends in low-level aerial survey technique.* ILCA Monograph.

Douglas-Hamilton I. & A Burril 1991. Using carcass ratios to determine trends. In: *Proceedings of the International symposium on African Wildlife: Research and Management.*

Jolly G.M.1969. Sampling methods for aerial censuses of wildlife populations. E. Afr. Agricultural & Forestry Journal - special issue: 46 -49.

Kolberg H. 2004. Aerial Survey of North East Namibia 11 August to 19 September 2004. Technical Reports of Scientific Services. Ministry of Environment & Tourism, Windhoek, Namibia

Lindeque M., P.M. Lindeque, P.E. Stander, P. Erb, R. Loutit & J.L. Scheepers 1995. *Namibian elephant censuses in 1995: ELESMAP country report.* Ministry of Environment & Tourism, Windhoek, Namibia

Martin R.B. 2005. *Transboundary Species Project, Background Study, Elephants.* Ministry of Environment and Tourism, Windhoek, Namibia

MET. 1999. *Aerial Census of Wildlife in Northern Namibia August-November 1998.* Ministry of Environment and Tourism, Windhoek, Namibia

MET (2013). *Report on Elephant Carcasses in Caprivi.* Bwabwata Ecological Institute. Ministry of Environment and Tourism, Namibia.

Norton Griffiths M. 1978. Counting Animals. Handbook No. 1, African Wildlife Foundation, Nairobi, Kenya.

Rodwell T.C., J. Tagg & M. Grobler 1995. *Wildlife Resources in the Caprivi, Namibia The Results of an Aerial Census in 1994 in Comparison with Past Surveys.* Ministry of Environment and Tourism, Windhoek, Namibia.

Stander P. 2004. *Aerial census of the Caprivi River systems - a survey of water bodies and floodplains.* Namibia Nature Foundation. Windhoek, Namibia.

ULG 1994. Aerial census of animals in the Caprivi Strip, Namibia: Dry Season 1994. Wildlife Conservation in Northern Botswana technical report.

APPENDIX I: METHODS

Methods followed CITES aerial survey standards using Jolly's method for unequal size sampling units (Jolly, 1969). Track logs of the transects flown are shown in Fig. 52.

a. Data analysis

Jolly's (1969) method for blocks of unequal size was used to calculated estimates of density and variance for each species in each stratum as follows:

$$R = \frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} z_i}$$

$$\hat{Y} = Z.R$$

$$V_{\hat{Y}} = \frac{N(N-n)}{n}.(s_y^2 - 2.R.s_{zy} + R^2.s_z^2)$$

$$R = \frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} z_i}$$

$$\hat{Y} = Z.R$$

$$V_{\hat{Y}} = \frac{N(N-n)}{n}.(s_y^2 - 2.R.s_{zy} + R^2.s_z^2)$$

where:

R	= density of animals
Y	= total number estimated
Z	= total area of stratum
y_i	= number of animals counted in transect i
z_i	= area of transect i
n	= number of transects
N	= number of transects possible in stratum where $N = n.Z/\Sigma z$
s_y^2	= variance of number seen per transect
s_z^2	= variance of transect areas
s_{zy}	= covariance between number seen per transect and transect area
V_y	= variance of estimated number in stratum (i.e. variance of Y)

Overall estimates and variances were obtained from the sums of the stratum estimates and their variances.

Note that the term *N(N-n)/n* approaches zero as sampling intensity approaches 100%. Its application makes the assumption that all animals in the sample are seen once. This is violated if animals can move between transects during the survey, as can happen if transects are closely spaced or the survey cannot be completed in one flight. This is why some strata have repeated samples at 10%, rather than a single coverage at a higher intensity.

The standard error (*SE*) of the estimate is the square root of the variance and the 95% confidence limits of the estimate is $Y \pm t \, . \, SE$, where *t* is Student's t for a two-tailed probability of 0.05 and *n*-1 degrees of freedom.

b. Sampling intensity

High sampling intensities were selected for the areas likely to contain large numbers of elephants and elephant carcasses, because a high precision was required for these areas. In order to achieve the 40% sampling intensity that was desired, it would be necessary to space transects 1km apart with strip widths of 200m per side. With a 100m dead zone under the aircraft, this would leave a distance between transects of 600m outside the strip markers and would require extremely accurate navigation. Any deviation could lead to double counting of animals between closely spaced transects as well as disturbing animals on adjacent transects, which would violate the assumptions of the method of calculating precision. It was decided, therefore, to conduct four independent surveys of the "40%" strata and two of the "20%" strata at 10% sampling intensity. The estimated numbers of animals were calculated as a mean of the individual estimates. The combined variances were calculated as $V= \Sigma v/n^2$ (n is the number of surveys).
As carcasses do not move, carcass results were calculated as if the separate surveys were a single one at 40% or 20% sampling intensity, as appropriate.

c. Elephant sightings, carcass classification and ratios

Elephants were recorded as being in family groups or bull groups, defined as follows:

Family groups - herds in which females and young are present. Any bulls in the group are counted as part of the group.

Bull groups - single bulls or herds which contain no females or juveniles.

Carcasses were classified into four categories according to their estimated time since death (Douglas-Hamilton 1996). These have been divided further (to allow the objective recording of very recent deaths. The four classes are:

Carcass 1 - Fresh (<1 month): skin covered, with flesh present giving the body a rounded appearance; vultures often present; ground still moist from body fluids.

Carcass 2 - Recent (<1 year): rot patch still visible; hide still attached to carcass; bones not scattered

Carcass 3 - Old (>1 year): skin absent; bones not scattered; vegetation re-grown in rot patch.

Carcass 4 - Very old (up to 10 years): bones bleached and scattered.

The estimated time since death of carcasses may vary between regions as the rate of decomposition depends on a number of factors such as moisture and temperature.

A "carcass ratio" defined as the ratio of dead elephants to all elephants (dead plus live animals).

Douglas-Hamilton *et al.* (Douglas-Hamilton & Hillman 1981; Douglas-Hamilton & Burril 1991) suggest a carcass ratio of 2 - 8% as being normal for a stable or increasing population, while a ratio of over 9% indicates a declining population.

d. Searching rate

The searching rate (km^2/hr) was calculated for each transect and the mean for each stratum provided as an objective indication the survey quality.

e. Maintenance of height

The target height was maintained using a radar altimeter. This instrument malfunctioned initially. After repair, it failed spasmodically during the survey. This was dealt with by flying on the pressue altimeter until the radar altimeter came back on line, usually after some seconds.

Heights were recorded every minute or more to obtain a mean height for each transect.

Mean height and its range are reported below.

f. Sampling intensity

For most species, the positions of the sightings were simply plotted on a map of the area without accounting for the relative numbers of animals per sighting or the sampling intensity at which the sighting was made.

For more numerous species, the density of animals in cells measuring 0.025 degrees was calculated. These were filtered using a moving average. Empty cells were filled using Voronoi polygons surrounding the nearest filled cells. Resolution was doubled four times, filtering each time and cell values were converted to integer values of log(base2) density.

Contours were produced by making vectors of the boundaries between integer density values. These vectors were converted into Word Perfect graphics format (.WPG files) and plotted using the programme Corel Presentations.

g. Other information provided

The following are provided separately to the report:

- Original data sheets
- Original calibration sheet
- Digital list of all sightings
- Digital list of all transects
- Shape files for strata
- Shape files for track logs
- Bitmaps of all graphics
- Digital copy of the report

APPENDIX II: RESULTS

The survey crew comprised R. Maartens (pilot), C. Craig (coordinator and front-seat observer), N. Chitemamuswe (left hand observer) and D.Chipesi (right hand observer).

Supporting data indicating survey quality are given below.

Figure 52 Tracks flown on the 2013 Caprivi survey

a. Stratum statistics

Stratum Name	Area	No of Transects	Sampling Intensity %	Transect time (min)	Sample area (km^2)	Transect length (km)	Mean Ground Speed (knots)	Search Rate
Bwabwata	3788.6	16	5.04	154	190.76	484.7	101.98	1.24
Buffalo/Mahango A	1161.7	8	10.39	105	120.66	303.21	93.56	1.15
Buffalo/Mahango B	1161.7	9	9.64	100	111.94	284.35	92.13	1.12
E Caprivi North	4626.74	24	5.01	200	231.66	585.02	94.77	1.16
E Caprivi South	3035.13	13	4.96	132	150.43	381.98	93.76	1.14
Kwando A	1353.33	14	10.27	129	139.03	353.59	88.81	1.08
Kwando B	1353.33	14	10.09	118	136.52	346.26	95.07	1.16
Kwando C	1353.33	14	10.11	115	136.76	344.12	96.95	1.19
Kwando D	1353.33	13	9.5	125	128.57	326.29	84.57	1.03
Salambala/Impalila A	1252.9	19	10.38	122	130.01	329.34	87.46	1.07
Salambala/Impalila B	1252.9	17	9.6	97	120.25	302.95	101.19	1.24
Linyanti	380.64	47	19.98	77	76.04	193.61	81.47	0.99
Susuwe A	1134.15	11	9.61	91	108.94	277.88	98.94	1.2
Susuwe B	1134.15	10	10.05	96	114.02	281.77	95.1	1.19
Susuwe C	1134.15	10	10.08	99	114.34	290.21	94.98	1.15
Susuwe D	1134.15	10	10.38	102	117.69	298.55	94.83	1.15
TOTAL / MEAN	**16733.19**	**249**	**12.72**	**1862**	**2127.63**	**5383.84**	**93.68**	**1.14**

b. Calibration of strip widths

The results of the strip width calibration are given below. Messrs Chitemamuswe and Chipese were left and right observers respectively.

#	Height AGL(ft)	Left		Right		Width		Corrected		Total Width
		in	out	in	out	L	R	L	R	
1	290	8	29	7	25	220	190	227.5862	196.5517	424.1379
2	290	6	26	6	22	210	170	217.2414	175.8621	393.1034
3	310	11	33	4	24	230	210	222.5806	203.2258	425.8065
4	270	7	23	7	23	170	170	188.8889	188.8889	377.7778
5	280	7	29	6	22	230	170	246.4286	182.1429	428.5714
6	295	8	26	7	22	190	160	193.2203	162.7119	355.9322
7	270	8	26	7	21	190	150	211.1111	166.6667	377.7778
8	295	6	25	8	25	200	180	203.3898	183.0508	386.4407
9	265	7	27	7	21	210	150	237.7358	169.8113	407.5472
10	280	7	26	7	23	200	170	214.2857	182.1429	396.4286
11	300	9	31	7	24	230	180	230	180	410.0000
12	280	6	25	7	23	200	170	214.2857	182.1429	396.4286
13	300	8	27	8	26	200	190	200	190	390.0000
14	240	3	24	5	20	220	160	275	200	475.0000
15	290	8	27	6	22	200	170	206.8966	175.8621	382.7586
16	290	7	26	6	21	200	160	206.8966	165.5172	372.4138
17	280	8	28	7	21	210	150	225	160.7143	385.7143
18	295	9	28	7	22	200	160	203.3898	162.7119	366.1017
19	280	6	26	9	24	210	160	225	171.4286	396.4286
20	285	7	27	7	22	210	160	221.0526	168.4211	389.4737
21	260	6	25	7	20	200	140	230.7692	161.5385	392.3077
22	280	8	27	7	22	200	160	214.2857	171.4286	385.7143
									Mean	396.1757
									Variance	648.0925
									SE Mean	5.840388
									%CL	2.948383

c. Maintenance of height

The target height was 300 feet above ground. The mean height flown was 299 feet. 95% of recorded heights were within 25 feet of this value.

d. Comparison of observers

	Groups seen		Expected			
	L	R	L	R	Chi²	p
Baboon	3	7	5.524	4.476	2.578	0.1084
Buffalo	36	31	37.014	29.986	0.062	0.8033
Bushpig	1	4	2.762	2.238	2.512	0.113
Cattle	345	283	346.936	281.064	0.024	0.8765
Crocodile	59	20	43.643	35.357	12.074	0.0005**
Duiker	15	6	11.601	9.399	2.225	0.1358
Eland	4	4	4.42	3.58	0.089	0.7655
EleCarcass 1	5	2	3.867	3.133	0.742	0.3892
EleCarcass 2	8	13	11.601	9.399	2.498	0.114
EleCarcass 3	28	12	22.098	17.902	3.522	0.0605
EleCarcass 4	39	51	49.72	40.28	5.164	0.0231*
ElephantBull	40	44	46.405	37.595	1.976	0.1599
ElephantFamily	106	89	107.727	87.273	0.062	0.8036
Giraffe	8	4	6.629	5.371	0.633	0.4262
GroundHornbill	2	5	3.867	3.133	2.014	0.1558
Hippopotamus	148	86	129.272	104.728	6.062	0.0138*
Impala	49	26	41.433	33.567	3.087	0.0789
Kudu	30	31	33.699	27.301	0.907	0.3408
Lechwe	100	72	95.021	76.979	0.583	0.4451
Ostrich	5	3	4.42	3.58	0.17	0.6798
Reedbuck	1	2	1.657	1.343	0.583	0.4453
Roan	8	9	9.392	7.608	0.461	0.4973
Sable	24	20	24.308	19.692	0.009	0.9257
Sheep/goats	14	7	11.601	9.399	1.108	0.2925
Steenbok	1	1	1.105	0.895	0.022	0.8814
Tsessebe	4	2	3.315	2.685	0.317	0.5737
Warthog	69	62	72.37	58.63	0.351	0.5537
Wildebeest	6	1	3.867	3.133	2.628	0.105
Zebra	39	22	33.699	27.301	1.863	0.1723
Total	1197	919	1168.976	947.024	1.501	0.2205

APPENDIX III: RESULTS BY STRATUM

a. Estimates of numbers, densities and confidence limits

The following tables give the results for each stratum based on the numbers seen in the sample. Results for all species and attributes counted are given. Column 6, labelled PRP (Percent Relative Precision), is the 95% confidence interval expressed as a percentage of the estimate.

These are the individual stratum results which have been combined to give higher level results reported above. No. out is the number seen outside of the sampling units. Where the calculated lower limit of the confidence range is less than the number actually seen in the stratum (including all sightings, both in and out), the number seen is given as the lower limit of the range.

Stratum ***Bwabwata***

Area: 3789 km² Sampling intensity: 5 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Duiker	60	3	0	1726.83	148.4	3 - 148	0.0158
EleCarcass 3	40	2	0	677.05	139.4	2 - 95	0.0105
Old E carcasses	40	2	0	677.05	139.4	2 - 95	0.0105
All E carcasses	40	2	0	677.05	139.4	2 - 95	0.0105
Elephant spoor		142					
ElephantBull	119	6	3	3113.66	99.7	9 - 238	0.0315
ElephantFamily	199	10	0	38006.83	208.9	10 - 614	0.0525
All Elephants	318	16	3	41120.49	135.8	19 - 750	0.084
Kudu	219	11	2	22474.3	146	13 - 538	0.0578
Roan	60	3	0	3360.33	207	3 - 183	0.0158
Sable	40	2	28	1488.85	206.7	30 - 122	0.0105
Tsessebe	139	7	0	18623.35	208.9	7 - 430	0.0368
Warthog	80	4	0	2820.51	142.3	4 - 193	0.021
Zebra	99	5	0	9501.71	208.9	5 - 307	0.0263
Honey Badger		1					
Ostrich	99	5	0	3121.98	119.7	5 - 219	0.0263
Cattle	656	33	0	186672.28	140.3	33 - 1577	0.1733
Sheep/goats	278	14	0	33611.28	140.3	14 - 669	0.0735
OtherCarcass 4	20	1	0	372.15	206.7	1 - 61	0.0053
Field/Cult		7					
Village/Hut		11					

Stratum ***Buffalo/Mahango A***

Area: 1162 km² Sampling intensity: 10.4 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Buffalo	2975	309	89	1865043.47	108.5	398 - 6204	2.5609
Duiker	10	1	0	75.48	213.4	1 - 30	0.0083
EleCarcass 3	19	2	0	110.09	128.8	2 - 44	0.0166
EleCarcass 4	19	2	0	110.09	128.8	2 - 44	0.0166
Old E carcasses	39	4	0	220.18	91.1	4 - 74	0.0332
All E carcasses	39	4	0	220.18	91.1	4 - 74	0.0332
ElephantBull	164	17	4	3005.57	79.2	34 - 293	0.1409
ElephantFamily	1723	179	201	300592.32	75.2	427 - 3020	1.4835
All Elephants	1887	196	205	303597.89	69	584 - 3190	1.6244
Giraffe	77	8	0	4830.61	213.4	8 - 241	0.0663
Hippopotamus	799	83	13	119260.29	102.2	96 - 1616	0.6879
Impala	48	5	0	939.24	150.5	5 - 121	0.0414
Kudu	202	21	0	9684.36	115.1	21 - 435	0.174
Lechwe	298	31	0	23570.07	121.6	31 - 661	0.2569
Reedbuck	96	10	0	7547.83	213.4	10 - 302	0.0829
Roan	48	5	0	979.46	153.7	5 - 122	0.0414
Sable	106	11	11	3531.24	132.7	22 - 246	0.0912
Steenbok	10	1	0	89.38	232.2	1 - 32	0.0083
Tsessebe	164	17	0	8476.48	133	17 - 381	0.1409
Warthog	77	8	0	2822.69	163.1	8 - 203	0.0663
Zebra	135	14	0	15064.05	215.3	14 - 425	0.116
Crocodile	29	3	0	292.5	140	3 - 69	0.0249
Ostrich	10	1	0	75.48	213.4	1 - 30	0.0083
Cattle	48	5	0	2206.17	230.7	5 - 159	0.0414
Sheep/goats	241	25	0	55154.28	230.7	25 - 796	0.2072
OtherCarcass 3	10	1	0	76.86	215.3	1 - 30	0.0083
Field/Cult		1					
Village/Hut		4					

Stratum ***Buffalo/Mahango B***

Area: 1162 km² Sampling intensity: 9.6 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Baboon	73	7	0	4800.97	219.9	7 - 232	0.0625
Buffalo	1391	134	66	479456.06	114.8	200 - 2987	1.1971
Bushpig	125	12	0	8005.81	165.7	12 - 331	0.1072
Duiker	104	10	0	1558.29	87.7	13 - 195	0.0893
EleCarcass 4	21	2	0	328.16	201.3	2 - 63	0.0179
Old E carcasses	21	2	0	328.16	201.3	2 - 63	0.0179
All E carcasses	21	2	0	328.16	201.3	2 - 63	0.0179
ElephantBull	384	37	22	3255.06	34.3	252 - 516	0.3305
ElephantFamily	4328	417	250	842755.32	48.9	2211 - 6445	3.7252
All Elephants	4712	454	272	846010.38	45	2591 - 6833	4.0558
Giraffe	31	3	0	738.36	201.3	3 - 94	0.0268
Hippopotamus	571	55	4	43766.94	84.5	88 - 1053	0.4913
Impala	623	60	0	37916.16	72.1	174 - 1072	0.536
Kudu	612	59	6	63867.03	95.2	65 - 1195	0.5271
Lechwe	405	39	0	48036.17	124.9	39 - 910	0.3484
Reedbuck	10	1	0	97.98	219.9	1 - 33	0.0089
Roan	322	31	0	31012.7	126.2	31 - 728	0.2769
Sable	436	42	14	51326.46	119.9	56 - 958	0.3752
Steenbok	10	1	0	84.12	203.8	1 - 32	0.0089
Tsessebe	21	2	0	336.5	203.8	2 - 63	0.0179
Warthog	259	25	0	37155.12	171.3	25 - 704	0.2233
Zebra	436	42	0	46282.15	113.8	42 - 932	0.3752
Hyaena		2					
Crocodile	83	8	0	3387.91	161.7	8 - 217	0.0715
GroundHornbill	73	7	0	5144	227.7	7 - 238	0.0625
Ostrich	42	4	0	1312.65	201.3	4 - 125	0.0357
Wattled crane	73	7	0	4800.97	219.9	7 - 232	0.0625

Buffalo/Mahango Overall

Area: 1161.7 km²

Combined Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Baboon	36	7	0	1200.24	203.3	7 - 110	0.0313
Buffalo	2183	443	155	586124.9	74.8	598 - 3815	1.879
Bushpig	62	12	0	2001.45	153.1	12 - 158	0.0536
Duiker	57	11	0	408.44	76	14 - 100	0.0488
EleCarcass 3	10	2	0	32.88	121.7	2 - 22	0.0086
EleCarcass 4	20	4	0	88.28	99.7	4 - 40	0.0172
Old E carcasses	30	6	0	121.16	77.9	7 - 53	0.0258
All E carcasses	30	6	0	121.16	77.9	7 - 53	0.0258
ElephantBull	274	54	26	1565.16	30.8	190 - 358	0.2357
ElephantFamily	3025	596	451	285836.9	37.7	1886 - 4165	2.6044
All Elephants	3299	650	477	287402.1	34.6	2157 - 4442	2.8401
Giraffe	54	11	0	1392.24	147.1	11 - 134	0.0466
Hippopotamus	685	138	17	40756.8	62.8	255 - 1115	0.5896
Impala	335	65	0	9713.85	62.6	125 - 545	0.2887
Kudu	407	80	6	18387.85	71	118 - 696	0.3506
Lechwe	352	70	0	17901.56	81.1	70 - 637	0.3027
Reedbuck	53	11	0	1911.45	174.7	11 - 147	0.0459
Roan	185	36	0	7998.04	103.1	36 - 376	0.1592
Sable	271	53	25	13714.42	92.1	78 - 520	0.2332
Steenbok	10	2	0	43.38	140.3	2 - 24	0.0086
Tsessebe	92	19	0	2203.25	108.5	19 - 192	0.0794
Warthog	168	33	0	9994.45	126.7	33 - 381	0.1448
Zebra	285	56	0	15336.55	92.5	56 - 549	0.2456
Hyaena		2					
Crocodile	56	11	0	920.1	115.5	11 - 121	0.0482
GroundHornbill	36	7	0	1286	210.4	7 - 113	0.0313
Ostrich	26	5	0	347.03	155.3	5 - 65	0.022
Wattled crane	36	7	0	1200.24	203.3	7 - 110	0.0313
Cattle	24	5	0	551.54	208	5 - 74	0.0207
Sheep/goats	120	25	0	13788.57	208	25 - 371	0.1036
OtherCarcass 3	5	1	0	19.21	194.1	1 - 14	0.0041
Field/Cult		1					
Village/Hut		4					

Stratum ***E Caprivi North***

Area: 4627 km² Sampling intensity: 5 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Duiker	80	4	0	1829.71	110.8	4 - 168	0.0173
Eland	140	7	0	17657.95	196.6	7 - 415	0.0302
EleCarcass 2	40	2	0	1541.41	203.3	2 - 121	0.0086
Recent E carcasses	40	2	0	1541.41	203.3	2 - 121	0.0086
EleCarcass 3	100	5	3	3447.95	121.6	8 - 221	0.0216
EleCarcass 4	60	3	0	1071.8	113	3 - 128	0.013
Old E carcasses	160	8	3	4519.74	87	21 - 299	0.0345
All E carcasses	200	10	3	6061.15	80.6	39 - 361	0.0432
ElephantFamily	439	22	39	90868.69	141.9	61 - 1063	0.095
All Elephants	439	22	39	90868.69	141.9	61 - 1063	0.095
Giraffe	100	5	0	9921.58	206.3	5 - 306	0.0216
Hippopotamus	60	3	0	2045.28	156.1	3 - 153	0.013
Kudu	80	4	2	5731.36	196	6 - 237	0.0173
Crocodile	180	9	0	12500.12	128.7	9 - 411	0.0389
Openbill	8788	440	0	77073196.1	206.7	440 - 26949	1.8994
Cattle	48014	2404	421	96577467.7	42.3	27684 - 68344	10.3774
Sheep/goats	379	19	0	139112.37	203.3	19 - 1151	0.082
OtherCarcass 2	20	1	0	360.37	196.6	1 - 59	0.0043
OtherCarcass 4	20	1	0	396.86	206.3	1 - 61	0.0043
Safari Camp		1					
Fishing camp	439	22	1	68149.21	122.9	23 - 979	0.095
Fishtrap/net	300	15	0	24568.51	108.2	15 - 624	0.0648
Canoe/Boat	1538	77	0	442836.85	89.5	161 - 2915	0.3324
Logging	80	4	0	3445.75	152	4 - 201	0.0173
Field/Cult		106					
Village/Hut		59					

Stratum ***E Caprivi South***

Area: 3035 km² Sampling intensity: 5 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Buffalo	282	14	0	48780.14	170.4	14 - 764	0.0931
Bushpig	61	3	0	3630.15	216.9	3 - 192	0.0199
EleCarcass 2	0	0	1	0	0	1 - 0	0
Recent E carcasses	0	0	1	0	0	1 - 0	0
EleCarcass 3	40	2	0	619.28	134.4	2 - 95	0.0133
EleCarcass 4	101	5	0	5873.53	165.5	5 - 268	0.0332
Old E carcasses	141	7	0	6492.81	124.3	7 - 317	0.0465
All E carcasses	141	7	1	6492.81	124.3	8 - 317	0.0465
ElephantBull	61	3	4	3622.63	216.6	7 - 192	0.0199
ElephantFamily	585	29	0	338514.6	216.6	29 - 1853	0.1928
All Elephants	646	32	4	342137.23	197.4	36 - 1920	0.2127
Giraffe	81	4	3	6440.23	216.6	7 - 256	0.0266
Hippopotamus	242	12	0	21038.38	130.5	12 - 558	0.0798
Warthog	61	3	0	3274.39	206	3 - 185	0.0199
Zebra	363	18	8	57775.63	144.2	26 - 887	0.1197
Cattle	46992	2329	628	93756294	44.9	25895 - 68089	15.4826
Sheep/goats	767	38	0	573519.93	215.2	38 - 2417	0.2526
Fishing camp	303	15	4	34990.05	134.7	19 - 710	0.0997
Fishtrap/net	968	48	0	433199.15	148.1	48 - 2403	0.3191
Canoe/Boat	1332	66	0	547969	121.1	66 - 2945	0.4388
Field/Cult		84					
Village/Hut		59					

Stratum ***Kwando A***

Area: 1353 km² Sampling intensity: 10.3 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Baboon	107	11	0	10370.63	205.5	11 - 327	0.0791
Buffalo	438	45	194	104079.05	159.1	239 - 1135	0.3237
EleCarcass 2	29	3	0	379.34	144.1	3 - 71	0.0216
Recent E carcasses	29	3	0	379.34	144.1	3 - 71	0.0216
EleCarcass 3	58	6	0	2351.43	179.4	6 - 163	0.0432
EleCarcass 4	88	9	1	980.12	77.2	20 - 155	0.0647
Old E carcasses	146	15	1	3331.55	85.4	21 - 271	0.1079
All E carcasses	175	18	1	3710.89	75.1	44 - 307	0.1295
Elephant spoor		1					
ElephantBull	107	11	5	4675.35	138	16 - 255	0.0791
ElephantFamily	1635	168	76	270586.74	68.7	511 - 2759	1.2083
All Elephants	1742	179	81	275262.09	65.1	609 - 2876	1.2875
Giraffe	29	3	0	750.56	202.7	3 - 88	0.0216
Hippopotamus	1548	159	0	297315.36	76.1	370 - 2726	1.1436
Impala	866	89	0	220297.64	117	89 - 1880	0.6401
Kudu	29	3	0	378.24	143.9	3 - 71	0.0216
Lechwe	1012	104	0	276423.21	112.2	104 - 2148	0.748
Roan	68	7	0	4076.08	202.4	7 - 206	0.0503
Sable	10	1	0	80.48	199.1	1 - 29	0.0072
Warthog	915	94	12	159635.61	94.3	106 - 1778	0.6761
Zebra	224	23	8	23619.38	148.3	31 - 556	0.1654
Lion		6					
Crocodile	273	28	0	24053.69	122.9	28 - 608	0.2014
GroundHornbill	19	2	0	321.93	199.1	2 - 58	0.0144
Saddlebill	29	3	0	771.37	205.5	3 - 89	0.0216
Cattle	5753	591	99	6954454.22	99	690 - 11450	4.2508
Sheep/goats	136	14	0	16538.87	203.9	14 - 414	0.1007
OtherCarcass 4	10	1	0	86.58	206.5	1 - 30	0.0072
Safari Camp		3					
Fishing camp	19	2	0	346.32	206.5	2 - 60	0.0144
Fishtrap/net	39	4	0	436.55	115.9	4 - 84	0.0288
Canoe/Boat	49	5	0	495.07	98.8	5 - 97	0.036
Field/Cult		34					
Village/Hut		20					

Stratum ***Kwando B***

Area: 1353 km² Sampling intensity: 10.1 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Buffalo	1735	175	0	2009277.09	176.5	175 - 4797	1.2818
Duiker	10	1	0	85.08	201	1 - 30	0.0073
EleCarcass 1	20	2	0	153.1	134.8	2 - 47	0.0146
EleCarcass 2	10	1	0	96.34	213.9	1 - 31	0.0073
Recent E carcasses	30	3	0	249.44	114.7	3 - 64	0.022
EleCarcass 3	40	4	0	516.95	123.9	4 - 89	0.0293
EleCarcass 4	99	10	0	635.58	54.9	45 - 154	0.0732
Old E carcasses	139	14	0	1152.53	52.8	65 - 212	0.1025
All E carcasses	169	17	0	1401.97	48	88 - 249	0.1245
ElephantBull	159	16	1	5428.01	100.4	17 - 318	0.1172
ElephantFamily	2548	257	57	935624.9	82	458 - 4637	1.8825
All Elephants	2706	273	58	941052.92	77.4	610 - 4802	1.9997
Giraffe	30	3	0	778.79	202.7	3 - 90	0.022
Hippopotamus	466	47	0	85369.74	135.5	47 - 1097	0.3443
Impala	1219	123	0	258635.33	90.1	123 - 2318	0.901
Kudu	30	3	0	801	205.6	3 - 91	0.022
Lechwe	942	95	0	252506.84	115.3	95 - 2027	0.6959
Roan	238	24	0	25164.27	144	24 - 581	0.1758
Sable	10	1	0	87.78	204.2	1 - 30	0.0073
Warthog	724	73	0	66169.61	76.8	168 - 1279	0.5347
Wildebeest	109	11	0	10337.19	201.4	11 - 329	0.0806
Zebra	466	47	0	53085.82	106.8	47 - 964	0.3443
Hyaena		1					
Crocodile	178	18	0	3681.45	73.5	47 - 310	0.1318
Wattled crane	10	1	0	96.34	213.9	1 - 31	0.0073
Saddlebill	89	9	0	2547.05	122.2	9 - 198	0.0659
Cattle	4857	490	16	2673232.97	72.7	1325 - 8390	3.5892
Sheep/goats	307	31	0	81757.71	201	31 - 925	0.2271
OtherCarcass 3	20	2	0	172.94	143.3	2 - 48	0.0146
Fishing camp	40	4	0	675.88	141.6	4 - 96	0.0293
Fishtrap/net	79	8	0	1238.93	95.9	8 - 155	0.0586
Canoe/Boat	69	7	0	922.5	94.6	7 - 135	0.0513
Field/Cult		34					
Village/Hut		19					

Stratum ***Kwando C***

Area: 1353 km² Sampling intensity: 10.1 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Baboon	515	52	0	103567.98	135.1	52 - 1210	0.3802
Buffalo	1267	128	0	1069110.98	176.4	128 - 3500	0.9359
EleCarcass 2	79	8	0	1118.73	91.3	8 - 151	0.0585
Recent E carcasses	79	8	0	1118.73	91.3	8 - 151	0.0585
EleCarcass 3	30	3	2	214.09	106.5	5 - 61	0.0219
EleCarcass 4	79	8	0	506.76	61.4	31 - 128	0.0585
Old E carcasses	109	11	2	720.86	53.3	51 - 167	0.0804
All E carcasses	188	19	2	1839.59	49.3	95 - 281	0.1389
ElephantBull	119	12	0	3545.44	108.3	12 - 247	0.0877
ElephantFamily	1336	135	84	203890.07	73	360 - 2311	0.9871
All Elephants	1455	147	84	207435.51	67.6	471 - 2439	1.0748
Hippopotamus	1930	195	5	358199.71	67	637 - 3223	1.4258
Impala	643	65	30	109362.43	111.1	95 - 1358	0.4753
Kudu	109	11	0	3173.99	111.8	11 - 231	0.0804
Lechwe	594	60	8	58997.1	88.4	69 - 1118	0.4387
Roan	69	7	0	4181.51	201.7	7 - 209	0.0512
Sitatunga			2				
Warthog	910	92	0	345321.69	139.5	92 - 2180	0.6727
Wildebeest	257	26	16	56836.78	200.2	42 - 772	0.1901
Zebra	89	9	17	4248.3	158.1	26 - 230	0.0658
Hyaena		1					
Crocodile	139	14	0	7374.37	133.9	14 - 324	0.1024
Saddlebill	10	1	2	89.09	206.1	3 - 30	0.0073
Donkey	59	6	0	3168.69	204.8	6 - 181	0.0439
Cattle	3236	327	55	1662240.53	86.1	450 - 6021	2.391
Sheep/goats	247	25	0	55011.95	204.8	25 - 754	0.1828
OtherCarcass 3	10	1	0	85.34	201.7	1 - 30	0.0073
OtherCarcass 4	20	2	0	160.83	138.4	2 - 47	0.0146
Safari Camp		1					
Fishing camp	20	2	0	166.6	140.9	2 - 48	0.0146
Fishtrap/net	20	2	0	352.08	204.8	2 - 60	0.0146
Canoe/Boat	40	4	0	666.42	140.9	4 - 95	0.0292
Logging	10	1	0	87.09	203.7	1 - 30	0.0073
Field/Cult		32					
Village/Hut		25					

Stratum ***Kwando D***

Area: 1353 km² Sampling intensity: 9.5 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Baboon	74	7	0	4916.79	207.4	7 - 226	0.0544
Buffalo	2663	253	470	1785675.99	109.3	723 - 5575	1.9678
Eland	168	16	0	24237.61	201.4	16 - 508	0.1244
EleCarcass 3	53	5	0	1757.98	173.6	5 - 144	0.0389
EleCarcass 4	116	11	0	1263.94	66.9	38 - 193	0.0856
Old E carcasses	168	16	0	3021.92	71.1	49 - 288	0.1244
All E carcasses	168	16	0	3021.92	71.1	49 - 288	0.1244
ElephantBull	263	25	0	25861.99	133.2	25 - 614	0.1944
ElephantFamily	2126	202	99	222884.87	48.4	1098 - 3155	1.5711
All Elephants	2389	227	99	248746.86	45.5	1303 - 3476	1.7655
Hippopotamus	2210	210	5	741089.17	84.9	335 - 4086	1.6333
Impala	1410	134	0	428853.02	101.2	134 - 2837	1.0422
Kudu	147	14	4	5369.54	108.3	18 - 307	0.1089
Lechwe	800	76	10	151304.53	105.9	86 - 1647	0.5911
Roan	53	5	0	2393.91	202.6	5 - 159	0.0389
Sable	316	30	2	73109.38	186.6	32 - 905	0.2333
Warthog	916	87	0	134400.24	87.2	117 - 1715	0.6767
Wildebeest	442	42	0	87261.86	145.6	42 - 1086	0.3267
Zebra	484	46	23	67270.97	116.7	69 - 1049	0.3578
Hyaena		2					
Crocodile	221	21	0	7281.49	84.1	35 - 407	0.1633
Saddlebill	21	2	0	185.59	141	2 - 51	0.0156
Cattle	4284	407	132	7305906.83	137.5	539 - 10173	3.1655
Sheep/goats	137	13	0	11415.85	170.1	13 - 370	0.1011
OtherCarcass 4	21	2	0	209.19	149.7	2 - 53	0.0156
Safari Camp		0					
Fishing camp	32	3	0	265.02	112.3	3 - 67	0.0233
Fishtrap/net	32	3	0	242.02	107.3	3 - 65	0.0233
Canoe/Boat	32	3	0	909.68	208.1	3 - 97	0.0233
Field/Cult		38					
Village/Hut		25					

Kwando Overall

Area: 1353.3 km²

Combined Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Baboon	174	70	0	7428.46	99.5	70 - 347	0.1284
Buffalo	1526	601	664	310508.9	73.3	1265 - 2644	1.1273
Duiker	2	1	0	5.32	186.8	1 - 7	0.0018
Eland	42	16	0	1514.85	185.6	16 - 120	0.0311
EleCarcass 1	5	2	0	7.28	108.1	2 - 10	0.0037
EleCarcass 2	30	12	0	74.73	57.7	13 - 47	0.0222
Recent E carcasses	35	14	0	82	51.8	17 - 53	0.0259
EleCarcass 3	45	18	2	188.73	61.2	20 - 73	0.0333
EleCarcass 4	95	38	1	133.04	24.3	72 - 118	0.0703
Old E carcasses	140	56	3	321.77	25.7	104 - 176	0.1035
All E carcasses	175	70	3	403.78	23	135 - 215	0.1294
Elephant spoor		1					
ElephantBull	162	64	6	2469.42	61.6	70 - 262	0.1196
ElephantFamily	1911	762	316	102061.7	33.6	1270 - 2553	1.4123
All Elephants	2073	826	322	104531.1	31.3	1424 - 2722	1.5319
Giraffe	15	6	0	95.58	133.2	6 - 34	0.0109
Hippopotamus	1538	611	10	92623.38	39.7	927 - 2149	1.1368
Impala	1035	411	30	63571.77	48.9	529 - 1541	0.7646
Kudu	79	31	4	607.67	62.8	35 - 128	0.0582
Lechwe	837	335	18	46201.98	51.6	405 - 1268	0.6184
Roan	107	43	0	2238.49	88.8	43 - 202	0.0791
Sable	84	32	2	4579.85	162	34 - 220	0.062
Sitatunga			2				
Warthog	866	346	12	44095.45	48.7	445 - 1288	0.64
Wildebeest	202	79	16	9652.24	97.6	95 - 399	0.1493
Zebra	316	125	48	9264.03	61.2	173 - 509	0.2333
Hyaena		4					
Lion		6					
Crocodile	203	81	0	2649.44	51	99 - 306	0.1497
GroundHornbill	5	2	0	20.12	185	2 - 14	0.0036
Wattled crane	2	1	0	6.02	198.8	1 - 7	0.0018
Saddlebill	37	15	2	224.57	80.6	17 - 67	0.0276
Donkey	15	6	0	198.04	190.3	6 - 43	0.011
Cattle	4532	1815	302	1162240	47.8	2368 - 6697	3.3491
Sheep/goats	207	83	0	10295.27	98.4	83 - 411	0.1529
OtherCarcass 3	7	3	0	16.14	108.6	3 - 15	0.0055
OtherCarcass 4	13	5	0	28.54	84.8	5 - 23	0.0093
Safari Camp	10	4	1	31.15	114.6	5 - 21	0.0072
Fishing camp	28	11	0	90.86	69.3	11 - 47	0.0204
Fishtrap/net	42	17	0	141.85	56.4	18 - 66	0.0313
Canoe/Boat	47	19	0	187.1	58.1	20 - 75	0.035
Logging	2	1	0	5.44	189.3	1 - 7	0.0018
Field/Cult		138					
Village/Hut		89					

Stratum ***Salambala/Impalila A***

Area: 1253 km² Sampling intensity: 10.4 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Duiker	29	3	0	681.79	189.7	3 - 84	0.0231
EleCarcass 4	19	2	0	338.92	200.7	2 - 58	0.0154
Old E carcasses	19	2	0	338.92	200.7	2 - 58	0.0154
All E carcasses	19	2	0	338.92	200.7	2 - 58	0.0154
ElephantBull	58	6	0	2838.86	193.6	6 - 170	0.0462
ElephantFamily	347	36	0	22270.87	90.4	36 - 660	0.2769
All Elephants	405	42	0	25109.74	82.3	72 - 738	0.3231
Hippopotamus	337	35	0	20900.91	90	35 - 641	0.2692
Impala	67	7	0	3711.98	189.7	7 - 195	0.0538
Kudu	10	1	0	75.75	189.7	1 - 28	0.0077
Monkey	39	4	0	534.04	125.9	4 - 87	0.0308
Crocodile	10	1	0	87.81	204.3	1 - 29	0.0077
GroundHornbill	87	9	0	1811.71	103.1	9 - 176	0.0692
Saddlebill	19	2	0	336.23	199.9	2 - 58	0.0154
Openbill	30366	3151	150	118341528	75.3	7511 - 53221	24.2365
Cattle	32785	3402	473	47750713.1	44.3	18267 - 47302	26.1671
Sheep/goats	96	10	0	4781.11	150.7	10 - 242	0.0769
OtherCarcass 2	10	1	0	78.86	193.6	1 - 28	0.0077
OtherCarcass 4	19	2	0	140.99	129.4	2 - 44	0.0154
Safari Camp		1					
Fishing camp	106	11	1	1305.39	71.6	30 - 182	0.0846
Fishtrap/net	395	41	3	29187.95	90.8	44 - 754	0.3154
Canoe/Boat	1185	123	1	75701.12	48.8	607 - 1763	0.9461
Field/Cult		51					
Village/Hut		84					

Stratum ***Salambala/Impalila B***

Area: 1253 km² Sampling intensity: 9.6 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
EleCarcass 3	10	1	0	90.79	193.9	1 - 31	0.0083
EleCarcass 4	21	2	0	158	127.9	2 - 47	0.0166
Old E carcasses	31	3	0	248.79	107	3 - 65	0.0249
All E carcasses	31	3	0	248.79	107	3 - 65	0.0249
ElephantFamily	198	19	32	19312.42	148.8	51 - 493	0.158
All Elephants	198	19	32	19312.42	148.8	51 - 493	0.158
Hippopotamus	52	5	0	1032.48	130.8	5 - 120	0.0416
Crocodile	115	11	0	5218.3	133.6	11 - 268	0.0915
Wattled crane	52	5	0	2424.34	200.4	5 - 156	0.0416
Saddlebill	21	2	0	400.98	203.7	2 - 63	0.0166
Openbill	8679	833	0	6560587.55	62.6	3249 - 14109	6.9273
Cattle	28611	2746	468	36266586.3	44.6	15845 - 41378	22.836
Fishing camp	177	17	1	4990.54	84.5	27 - 327	0.1414
Fishtrap/net	208	20	0	7135.99	85.9	29 - 387	0.1663
Canoe/Boat	1032	99	1	85999.13	60.3	410 - 1653	0.8233
Field/Cult		38					
Village/Hut		77					

Salambala-Impalila Overall

Area: 1252.9 km²

Combined Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Duiker	14	3	0	170.45	183.5	3 - 41	0.0115
EleCarcass 3	5	1	0	19.35	178.4	1 - 14	0.004
EleCarcass 4	20	4	0	111.13	106.9	4 - 41	0.016
Old E carcasses	25	5	0	130.48	92.6	5 - 48	0.02
All E carcasses	25	5	0	130.48	92.6	5 - 48	0.02
ElephantBull	29	6	0	709.72	187.3	6 - 83	0.0231
ElephantFamily	272	55	32	10395.82	76.1	87 - 480	0.2175
All Elephants	301	61	32	11105.54	71.1	93 - 516	0.2405
Hippopotamus	195	40	0	5483.35	77.3	44 - 345	0.1554
Impala	34	7	0	927.99	183.5	7 - 96	0.0269
Kudu	5	1	0	18.94	183.5	1 - 14	0.0038
Monkey	19	4	0	133.51	121.8	4 - 43	0.0154
Crocodile	62	12	0	1326.53	119.1	12 - 136	0.0496
GroundHornbill	43	9	0	452.93	99.7	9 - 87	0.0346
Wattled crane	26	5	0	606.09	192.1	5 - 76	0.0208
Saddlebill	20	4	0	184.3	137.6	4 - 48	0.016
Openbill	19523	3984	150	3.12E+07	58.2	8167 - 30878	15.5819
Cattle	30698	6148	941	2.10E+07	30.3	21384 - 40012	24.5016
Sheep/goats	48	10	0	1195.28	145.8	10 - 118	0.0385
OtherCarcass 2	5	1	0	19.71	187.3	1 - 14	0.0038
OtherCarcass 4	10	2	0	35.25	125.2	2 - 22	0.0077
Safari Camp		1	1				
Fishing camp	142	28	2	1573.98	57	61 - 222	0.113
Fishtrap/net	302	61	3	9080.98	64.2	108 - 495	0.2408
Canoe/Boat	1108	222	2	40425.06	36.9	700 - 1517	0.8847
Field/Cult		89					
Village/Hut		161					

Stratum ***Linyanti***

Area: 381 km² Sampling intensity: 20 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Buffalo	861	172	5	289181.34	125.7	177 - 1943	2.2621
EleCarcass 2	5	1	2	20.26	181	3 - 14	0.0132
Recent E carcasses	5	1	2	20.26	181	3 - 14	0.0132
EleCarcass 4	10	2	2	40.01	127.2	4 - 23	0.0263
Old E carcasses	10	2	2	40.01	127.2	4 - 23	0.0263
All E carcasses	15	3	4	60.27	104.1	7 - 31	0.0395
ElephantBull	30	6	3	232.88	102.3	9 - 61	0.0789
ElephantFamily	135	27	37	14537.94	179.6	64 - 378	0.3551
All Elephants	165	33	40	14770.82	148.1	73 - 410	0.434
Giraffe	45	9	0	1615.33	179.6	9 - 126	0.1184
Hippopotamus	300	60	0	7496.89	58	126 - 475	0.7891
Impala	10	2	0	80.81	180.7	2 - 28	0.0263
Reedbuck	25	5	0	483.96	176.9	5 - 69	0.0658
Warthog	45	9	0	894.91	133.7	9 - 105	0.1184
Waterbuck	20	4	0	313.05	177.9	4 - 56	0.0526
Zebra	60	12	0	2917.59	181	12 - 169	0.1578
Crocodile	15	3	0	180.31	180	3 - 42	0.0395
Saddlebill	5	1	0	20.05	180	1 - 14	0.0132
Cattle	5902	1179	330	2048245.16	48.8	3021 - 8783	15.5056
Sheep/goats	105	21	0	8693.25	178.5	21 - 293	0.2762
OtherCarcass 2	5	1	0	20.13	180.4	1 - 14	0.0132
Safari Camp		1					
Fishing camp	140	28	2	967.15	44.7	78 - 203	0.3682
Fishtrap/net	205	41	0	2097.82	44.9	113 - 297	0.5392
Canoe/Boat	481	96	20	47316.92	91.1	116 - 918	1.2625
Field/Cult		19					
Village/Hut		4					

Stratum ***Susuwe A***

Area: 1134 km² Sampling intensity: 9.6 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Baboon	156	15	0	21321.42	208.3	15 - 482	0.1377
Buffalo	21	2	0	382.9	209.4	2 - 64	0.0184
Eland	52	5	0	2396.31	209.5	5 - 161	0.0459
EleCarcass 1	21	2	0	162.72	136.5	2 - 49	0.0184
EleCarcass 2	10	1	0	94.66	208.2	1 - 32	0.0092
Recent E carcasses	31	3	0	257.38	114.5	3 - 67	0.0275
EleCarcass 3	31	3	0	206.67	102.6	3 - 63	0.0275
EleCarcass 4	52	5	0	742.23	116.6	5 - 113	0.0459
Old E carcasses	83	8	0	948.89	82.4	15 - 152	0.0734
All E carcasses	115	11	0	1206.28	67.6	37 - 192	0.101
Elephant spoor		5					
ElephantBull	167	16	12	11439.8	143.1	28 - 405	0.1469
ElephantFamily	2020	194	62	477966.61	76.3	479 - 3560	1.7808
All Elephants	2186	210	74	489406.42	71.3	628 - 3745	1.9277
Giraffe	21	2	0	382.9	209.4	2 - 64	0.0184
Hippopotamus	208	20	0	5254.19	77.6	47 - 370	0.1836
Impala	239	23	0	50639.12	209.4	23 - 741	0.2111
Kudu	52	5	2	439.97	89.8	7 - 99	0.0459
Lechwe	1281	123	0	182860.32	74.4	328 - 2233	1.1291
Sable	344	33	3	27326.47	107.2	36 - 712	0.3029
Tsessebe	83	8	0	6126.47	209.4	8 - 258	0.0734
Warthog	31	3	0	852.86	208.3	3 - 96	0.0275
Wildebeest	250	24	0	24707.16	140.2	24 - 600	0.2203
Zebra	437	42	15	78119.88	142.4	57 - 1060	0.3855
Cattle	73	7	0	4638.4	208.2	7 - 225	0.0643
OtherCarcass 3	10	1	0	95.09	208.7	1 - 32	0.0092
OtherCarcass 4	10	1	1	94.67	208.2	2 - 32	0.0092
Fishing camp	10	1	0	95.28	208.9	1 - 32	0.0092
Canoe/Boat	42	4	0	865.56	157.4	4 - 107	0.0367
Logging	21	2	0	383.41	209.5	2 - 64	0.0184
Field/Cult		2					

Stratum ***Susuwe B***

Area: 1134 km² Sampling intensity: 10.1 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Buffalo	1830	184	20	2804437.96	207	204 - 5619	1.6137
Bushpig	50	5	0	2311.47	218.7	5 - 158	0.0439
Duiker	10	1	0	92.46	218.7	1 - 32	0.0088
Eland	99	10	0	8688.4	212	10 - 310	0.0877
EleCarcass 1	10	1	0	86.88	212	1 - 31	0.0088
Recent E carcasses	10	1	0	86.88	212	1 - 31	0.0088
EleCarcass 3	60	6	0	383.42	74.2	15 - 104	0.0526
EleCarcass 4	99	10	0	744.35	62.1	38 - 161	0.0877
Old E carcasses	159	16	0	1127.76	47.7	83 - 235	0.1403
All E carcasses	169	17	0	1214.65	46.6	90 - 248	0.1491
ElephantBull	109	11	6	2454.47	102.4	17 - 221	0.0965
ElephantFamily	1820	183	184	428016.68	81.3	367 - 3300	1.6049
All Elephants	1930	194	190	430471.15	76.9	445 - 3414	1.7014
Giraffe	60	6	0	3132.96	212.2	6 - 186	0.0526
Hippopotamus	119	12	0	4347.6	125	12 - 269	0.1052
Impala	428	43	0	71393.47	141.3	43 - 1032	0.3771
Kudu	129	13	0	2959.82	95.2	13 - 252	0.114
Lechwe	865	87	3	111931.24	87.5	109 - 1622	0.763
Sable	149	15	11	10784.46	157.5	26 - 384	0.1316
Tsessebe	90	9	0	7097.73	212.9	9 - 280	0.0789
Warthog	348	35	0	15012.67	79.6	71 - 625	0.307
Zebra	90	9	0	3513.21	149.8	9 - 224	0.0789
Crocodile	109	11	0	1826.94	88.4	13 - 206	0.0965
GroundHornbill	40	4	0	1402.02	212.9	4 - 124	0.0351
Ostrich	40	4	0	1402.44	212.9	4 - 125	0.0351
OtherCarcass 3	10	1	0	92.46	218.7	1 - 32	0.0088
OtherCarcass 4	20	2	0	351.86	213.3	2 - 62	0.0175
Canoe/Boat	60	6	0	577.8	91.1	6 - 114	0.0526

Stratum ***Susuwe C***

Area: 1134 km² Sampling intensity: 10.1 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Baboon	69	7	0	4355.69	215	7 - 219	0.0612
Buffalo	79	8	0	2687.52	147.8	8 - 197	0.07
Bushpig	40	4	0	1422.26	215	4 - 125	0.035
Duiker	20	2	0	148.17	138.8	2 - 47	0.0175
Eland	99	10	0	6904.28	189.5	10 - 287	0.0875
EleCarcass 1	20	2	0	153.86	141.5	2 - 48	0.0175
EleCarcass 2	60	6	0	988.42	119.5	6 - 131	0.0525
Recent E carcasses	79	8	0	1142.29	96.4	8 - 156	0.07
EleCarcass 3	50	5	0	496.01	101.6	5 - 100	0.0437
EleCarcass 4	89	9	2	1395.87	94.7	11 - 174	0.0787
Old E carcasses	139	14	2	1891.88	70.9	40 - 237	0.1224
All E carcasses	218	22	2	3034.17	57.1	94 - 343	0.1924
ElephantBull	179	18	6	3820.21	78.3	39 - 318	0.1574
ElephantFamily	1885	190	33	587261.3	92	223 - 3618	1.6616
All Elephants	2063	208	39	591081.51	84.3	324 - 3802	1.8191
Giraffe	40	4	0	800.8	161.4	4 - 104	0.035
Hippopotamus	317	32	0	31377.59	126.3	32 - 718	0.2799
Impala	506	51	0	44564.94	94.4	51 - 983	0.446
Kudu	99	10	1	4730.25	156.9	11 - 255	0.0875
Lechwe	1656	167	4	139673.52	51	811 - 2502	1.4605
Roan	10	1	0	87.44	213.3	1 - 31	0.0087
Sable	546	55	0	100931.71	131.7	55 - 1264	0.481
Warthog	139	14	0	14833.62	198.4	14 - 414	0.1224
Wildebeest	208	21	0	38559.56	213.3	21 - 653	0.1837
Zebra	555	56	11	46022.18	87.4	70 - 1041	0.4897
Crocodile	10	1	0	88.02	214	1 - 31	0.0087
Cattle	119	12	0	14530.22	229.1	12 - 392	0.1049
OtherCarcass 3	10	1	0	87.59	213.5	1 - 31	0.0087
OtherCarcass 4	10	1	0	88.89	215	1 - 31	0.0087
Fishing camp	20	2	0	155.75	142.3	2 - 48	0.0175
Fishtrap/net	10	1	0	100.9	229.1	1 - 33	0.0087
Canoe/Boat	10	1	0	88.89	215	1 - 31	0.0087
Logging	10	1	0	87.87	213.8	1 - 31	0.0087
Field/Cult		3					

Stratum ***Susuwe D***

Area: 1134 km² Sampling intensity: 10.4 %

Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Baboon	385	40	0	132924.13	214	40 - 1210	0.3399
Buffalo	19	2	0	333.54	214.4	2 - 61	0.017
Eland	58	6	0	2942.95	212.3	6 - 181	0.051
EleCarcass 2	10	1	0	81.75	212.3	1 - 30	0.0085
Recent E carcasses	10	1	0	81.75	212.3	1 - 30	0.0085
EleCarcass 3	19	2	0	167.04	151.7	2 - 49	0.017
EleCarcass 4	145	15	2	5571.49	116.8	17 - 313	0.1275
Old E carcasses	164	17	2	5738.53	104.6	19 - 335	0.1444
All E carcasses	173	18	2	5820.28	99.5	20 - 346	0.1529
ElephantBull	270	28	6	22226.21	125	34 - 607	0.2379
ElephantFamily	1243	129	44	145104.98	69.3	381 - 2105	1.0961
All Elephants	1513	157	50	167331.19	61.2	588 - 2438	1.334
Hippopotamus	279	29	0	18712.52	110.7	29 - 589	0.2464
Impala	145	15	0	5111.95	111.9	15 - 306	0.1275
Kudu	135	14	0	2297.88	80.4	26 - 243	0.119
Lechwe	1503	156	3	174351.43	62.8	559 - 2448	1.3255
Roan	39	4	0	1320.28	213.2	4 - 121	0.034
Sable	145	15	0	5213.59	113	15 - 308	0.1275
Warthog	145	15	0	3384.8	91.1	15 - 276	0.1275
Zebra	106	11	0	4824.97	148.2	11 - 263	0.0935
Crocodile	48	5	0	748.11	128.4	5 - 110	0.0425
Ostrich	29	3	0	750.29	214.3	3 - 91	0.0255
Cattle	434	45	0	97790.1	163.1	45 - 1141	0.3824
Sheep/goats	48	5	0	2062.94	213.2	5 - 151	0.0425
OtherCarcass 4	10	1	0	82.57	213.3	1 - 30	0.0085
Fishing camp	10	1	0	81.15	211.5	1 - 30	0.0085
Fishtrap/net	10	1	0	81.15	211.5	1 - 30	0.0085
Canoe/Boat	48	5	0	794.42	132.3	5 - 112	0.0425
Logging	10	1	0	82.57	213.3	1 - 30	0.0085
Field/Cult		2					
Village/Hut		4					

Susuwe Overall

Area: 1134.2 km²

Combined Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range	Dens /km²
Baboon	153	62	0	9912.58	132.1	62 - 354	0.1347
Buffalo	487	196	20	175490.1	174.1	216 - 1336	0.4298
Bushpig	22	9	0	233.36	138.5	9 - 53	0.0197
Duiker	7	3	0	15.04	105.5	3 - 15	0.0066
Eland	77	31	0	1308.25	95	31 - 150	0.068
EleCarcass 1	12	5	0	16.35	65.6	5 - 21	0.011
EleCarcass 2	20	8	0	54.2	74.6	8 - 35	0.0176
Recent E carcasses	32	13	0	70.55	52.4	15 - 49	0.0286
EleCarcass 3	40	16	0	52.93	36.9	25 - 55	0.0352
EleCarcass 4	97	39	4	360.06	39.5	59 - 136	0.0857
Old E carcasses	137	55	4	412.99	30	96 - 178	0.1209
All E carcasses	169	68	4	483.54	26.2	125 - 214	0.1495
Elephant spoor		5					
ElephantBull	181	73	30	2496.29	55.9	103 - 282	0.1597
ElephantFamily	1742	696	323	102396.9	37.2	1094 - 2390	1.5359
All Elephants	1923	769	353	104893.1	34.1	1267 - 2579	1.6955
Giraffe	30	12	0	269.79	110.8	12 - 63	0.0265
Hippopotamus	231	93	0	3730.74	53.6	107 - 355	0.2038
Impala	329	132	0	10731.84	63.7	132 - 539	0.2904
Kudu	104	42	3	651.75	49.8	52 - 156	0.0916
Lechwe	1326	533	10	38051.03	29.8	931 - 1722	1.1695
Roan	12	5	0	87.98	156.9	5 - 31	0.0107
Sable	296	118	14	9016.02	65.1	132 - 488	0.2607
Tsessebe	43	17	0	826.51	134.8	17 - 101	0.0381
Warthog	166	67	0	2130.25	56.4	72 - 259	0.1461
Wildebeest	115	45	0	3954.17	111.2	45 - 242	0.101
Zebra	297	118	26	8280.02	62.1	144 - 481	0.2619
Crocodile	42	17	0	166.44	62.4	17 - 68	0.0369
GroundHornbill	10	4	0	87.63	190.7	4 - 29	0.0088
Ostrich	17	7	0	134.55	136.9	7 - 41	0.0151
Cattle	156	64	0	7309.92	110.8	64 - 330	0.1379
Sheep/goats	12	5	0	128.93	191	5 - 35	0.0106
OtherCarcass 3	8	3	0	17.2	111	3 - 16	0.0067
OtherCarcass 4	12	5	1	38.62	101	6 - 25	0.011
Fishing camp	10	4	0	20.76	92.6	4 - 19	0.0088
Fishtrap/net	5	2	0	11.38	139.8	2 - 12	0.0043
Canoe/Boat	40	16	0	145.42	61.3	16 - 64	0.0351
Logging	10	4	0	34.62	118.1	4 - 22	0.0089
Field/Cult		7					
Village/Hut		4					

Caprivi Overall

Area: 16733 km²

Combined Estimates:

SPECIES	Pop. est.	No. seen	No. Out	Variance	PRP%	95%Range			Dens /km²
Baboon	363	139	0	18541.28	73.9	139	-	631	0.0217
Buffalo	5339	1426	844	1410085.36	43.8	3000	-	7679	0.3191
Bushpig	145	24	0	5864.96	104	24	-	296	0.0087
Duiker	221	25	0	4155.78	57.6	94	-	348	0.0132
Eland	259	54	0	20481.04	108.8	54	-	541	0.0155
EleCarcass 1	17	7	0	23.63	54.8	8	-	27	0.001
EleCarcass 2	95	23	3	1690.6	85.3	26	-	176	0.0057
Recent E carcasses	112	30	3	1714.23	72.6	33	-	194	0.0067
EleCarcass 3	280	46	5	5038.17	50	140	-	420	0.0167
EleCarcass 4	403	95	7	7677.84	42.8	230	-	576	0.0241
Old E carcasses	683	141	12	12716.02	32.5	461	-	905	0.0408
All E carcasses	795	171	15	14430.25	29.8	559	-	1032	0.0475
Elephant spoor		148							
ElephantBull	856	212	72	14209.76	27.4	621	-	1090	0.0511
ElephantFamily	8310	2197	1198	982619.4	23.5	6357	-	10263	0.4966
All Elephants	9165	2409	1270	996829.07	21.5	7198	-	11132	0.5477
Giraffe	324	47	3	19734.76	85.3	50	-	601	0.0194
Hippopotamus	3252	957	27	173174.82	25.2	2432	-	4071	0.1943
Impala	1743	617	30	85026.27	33	1169	-	2318	0.1042
Kudu	893	169	17	47871.87	48.3	462	-	1324	0.0534
Lechwe	2515	938	28	102154.57	25	1885	-	3145	0.1503
Monkey	19	4	0	133.51	118.1	4	-	42	0.0012
Reedbuck	78	16	0	2395.41	123.1	16	-	175	0.0047
Roan	364	87	0	13684.83	63.4	133	-	594	0.0217
Sable	690	205	69	28799.14	48.4	356	-	1025	0.0412
Sitatunga			2						
Steenbok	10	2	0	43.38	129.7	2	-	23	0.0006
Tsessebe	275	43	0	21653.11	105.6	43	-	565	0.0164
Warthog	1385	462	12	63209.96	35.8	890	-	1881	0.0828
Waterbuck	20	4	0	313.05	174.1	4	-	55	0.0012
Wildebeest	317	124	16	13606.41	72.6	140	-	546	0.0189
Zebra	1421	334	82	103075.52	44.5	788	-	2053	0.0849
Honey Badger		1							
Hyaena		6							
Lion		6							
Crocodile	557	133	0	17742.94	47.1	295	-	820	0.0333
GroundHornbill	95	22	0	1846.68	89.6	22	-	179	0.0056
Ostrich	142	17	0	3603.56	83.2	24	-	260	0.0085
Wattled crane	65	13	0	1812.35	129.3	13	-	149	0.0039
Saddlebill	62	20	2	428.92	65.4	22	-	103	0.0037
Openbill	28310	4424	150	108298730	72.4	7807	-	48814	1.6919
Donkey	15	6	0	198.04	186.8	6	-	43	0.0009
Cattle	136975	13977	2622	214743099	21.1	108103	-	165846	8.1858
Sheep/goats	1917	215	0	780344.88	90.8	215	-	3658	0.1146
OtherCarcass 2	30	3	0	400.21	132.3	3	-	69	0.0018

OtherCarcass 3	20	7	0	52.55	72.1	7	-	34	0.0012
OtherCarcass 4	75	14	1	871.42	78	16	-	133	0.0045
Safari Camp		7	3						
Fishing camp	1061	108	9	105792.01	60.4	421	-	1702	0.0634
Fishtrap/net	1822	184	3	469099.69	74	473	-	3172	0.1089
Canoe/Boat	4546	496	22	1078880.35	45	2499	-	6592	0.2717
Logging	92	9	0	3485.81	125.8	9	-	209	0.0055
Field/Cult		451							
Village/Hut		391							