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Wildlife Resources in the Caprivi, Namibia: The Results of an Aerial Census in 1994 and Comparisons with Past Surveys

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ABSTRACT

Protected and proclaimed areas in the Caprivi, Namibia, hold most of the economically valuable wildlife species in that region. This wildlife is presently being viewed as a potential resource base to support the many community-based conservation and development programmes in the Caprivi. We conducted the second comprehensive annual aerial census of Caprivi's protected areas in 1994 to provide baseline data on all wildlife species, to determine if the present wildlife resource could support local development objectives, and to determine trends in wildlife numbers (when compared with past aerial surveys of the Caprivi). Elephants were present in the greatest numbers relative to all other species, with over 5000 individuals observed. Most other species were seen in numbers probably sufficient to support their continued existence and growth, but not consumptive use.

This paper includes a detailed description of methods and strata used in the 1994 census. It also lists recommended changes to the 1994 methods, which are aimed at improving the accuracy of future Caprivi counts while maintaining repeatability for comparison of data over time

1. INTRODUCTION

The Caprivi region of Namibia, with its perennial rivers and relatively high rainfall (600-700mm), contains most of the riverine and much of the woodland habitats of an otherwise arid to semi-arid country. Due to this environment and its proximity to large herds of free ranging wildlife species in Botswana and Zimbabwe, Caprivi has the potential to support some of the highest densities of Elephant Loxadonta africana, buffalo Syncerus caffer and economically important antelope species in Namibia.

Since the independence of Namibia in 1990, the Caprivi's potential as a wildlife resource base has received considerable attention from both the Namibian Government through the Ministry of Environment and Tourism (MET) and non government organizations such as: Integrated Rural Development and Nature Conservation (IRDNC), World Wildlife Fund (WWF) and Namibia Nature Foundation (NNF), who are cooperating to develop management programmes aimed at managing, monitoring and utilizing Caprivi's natural resources in a sustainable manner.

The objective of the 1994 aerial census was to cover all the protected areas of the Caprivi, and to provide the first comprehensive set of baseline data on the present status and distribution of its valuable wildlife species. These data were then used to determine if the wildlife resources are sufficient to support present wildlife-based development expectations. It was also the intention of this census to establish and test a set of census methods for the long-term monitoring of population trends and distribution of wildlife species in the Caprivi. The 1994 Caprivi census was also intended to be a valuable baseline with which both past and future wildlife numbers and trends in the Caprivi could be compared. Special attention was given to determining elephant numbers and distribution in the protected areas, as they were not only the most abundant wildlife species, but also the greatest cause of conflict with local communities (O'Connell & Rice in prep.).

2. STUDY AREA

The Caprivi region of Namibia is bordered in the west by the perennial Okavango River[1], and in the east by the Chobe and Zambezi Rivers. It is also surrounded by the countries of Angola and Zambia in the north, and Botswana and Zimbabwe in the south and east respectively. The Caprivi is further divided geographically by the Kwando River into the West and East Caprivi. It is a relatively flat land area, with an average altitude of 1000m ±60m.

There are at present three protected areas in Caprivi: West Caprivi Game Reserve, Mudumu National Park and Mamili National Park (Fig. 1). The climate of the Caprivi is considered subtropical with an annual rainfall of about 600-700mm, a dry winter, and hot, wet summer (Erkkila & Siiskonen 1992).

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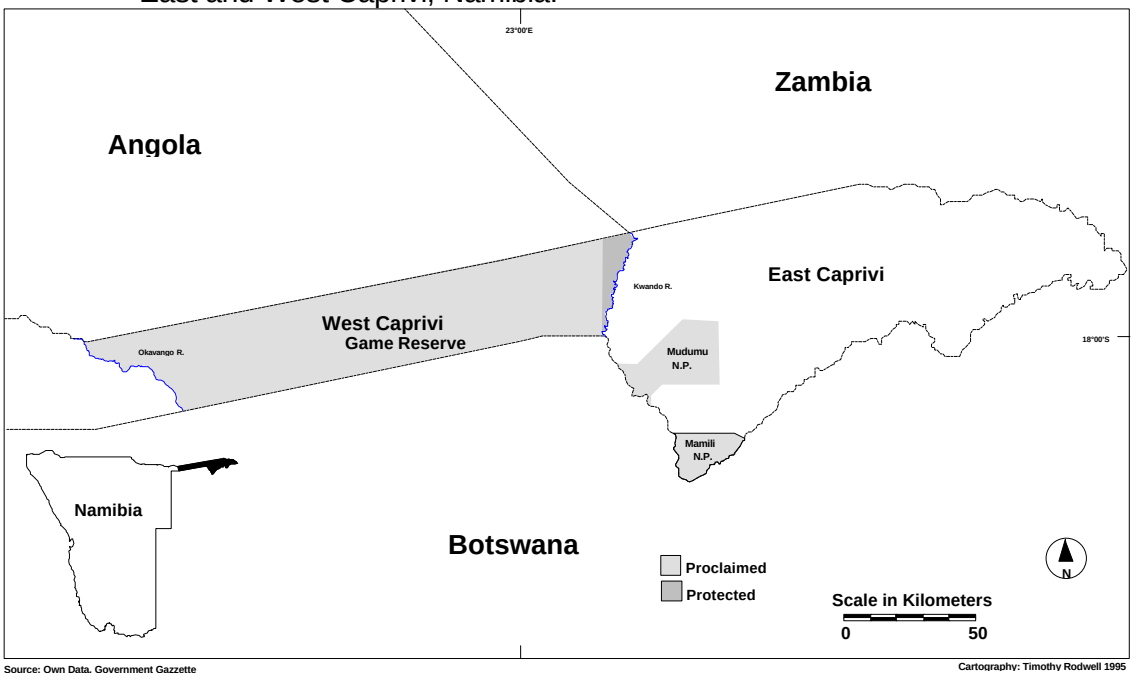
[1] This definition of the Western regional boundary of Caprivi refers to the situation at the time of the census design.

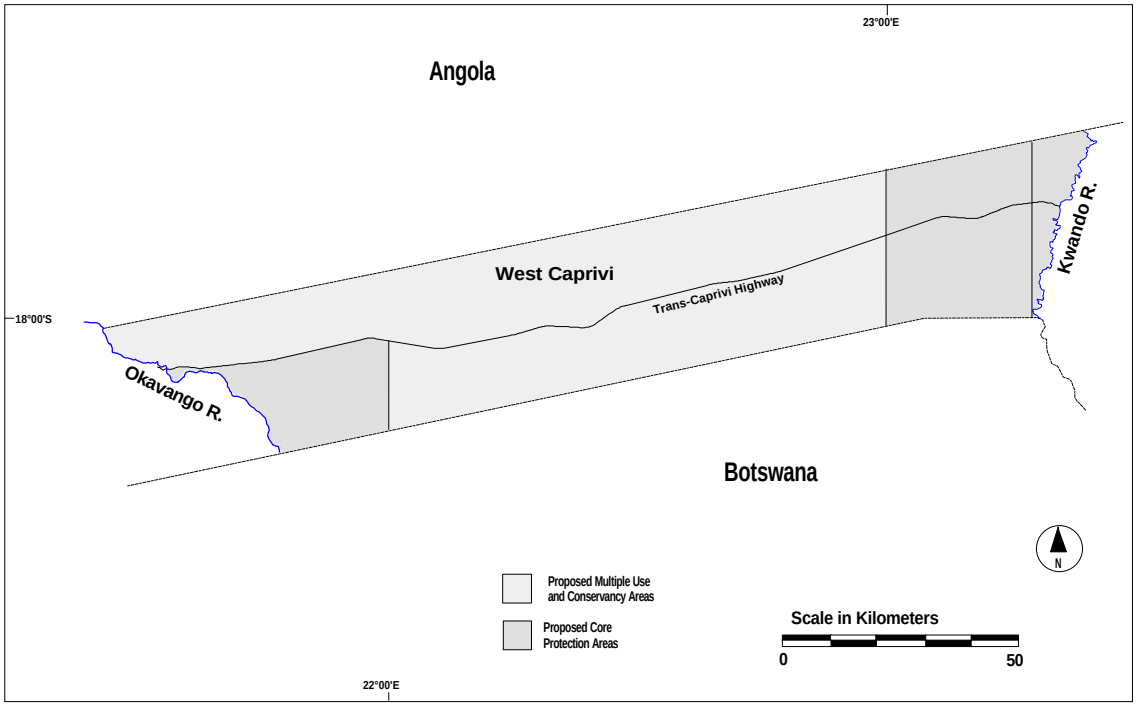
Figure 1: Current National Park, Game Reserve and protected area boundaries in the East and West Caprivi, Namibia.



2.1. West Caprivi

The West Caprivi Game Reserve (WCGR) includes almost all of the approximately 5715 km^2 of West Caprivi, except for a small triangle of land along the Kwando River (Fig. 1), which although not included in the Game Reserve, is administered by the Namibian MET. The WCGR has had a confusing history, which includes occupation by the South African Defense Force (SADF) from the early 1960's to 1989. The West Caprivi Nature Park was proclaimed in 1963, and upgraded to a Game Reserve in 1968. It has included rural human settlements among its wildlife populations throughout its history, and at present there are approximately 4,500 people within the WCGR (Brown & Jones 1994). The presence of rural communities in the WCGR has made administration of this area as a game reserve, extremely complicated, and as a result, it is presently under scrutiny for partial de-proclamation (Fig. 2). There is strong motivation to establish two core regions of complete protection on the west and east ends of the West Caprivi, while converting the remaining area to one in which multiple land use programmes and conservancies could be established (Jones 1995).

Figure 2: Proposed land reforms for the West Caprivi.



Source: Brown 1994

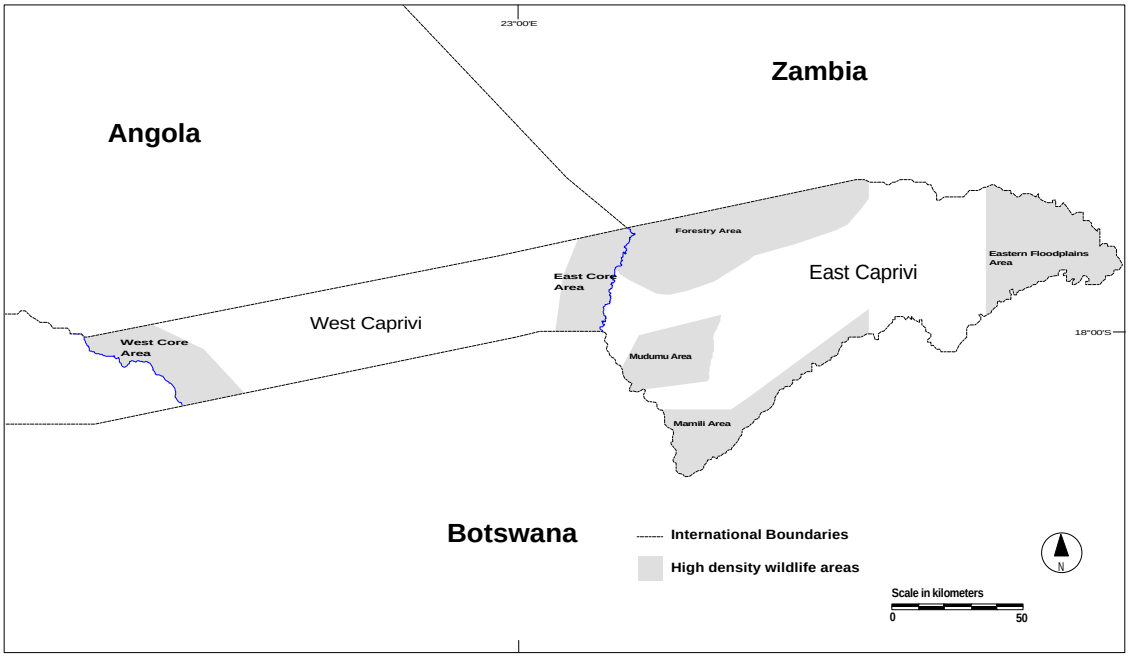
Cartography: Timothy Rodwell 1995

The West Caprivi is made up primarily of three physiographic features; 1) perennial Kavango and Kwando rivers with their associated floodplains and riparian vegetation, 2) a parallel system of drainage lines (Omirumba) tending south east containing mostly grasslands, and 3) deep Kalahari sands forming dunes supporting woodland savanna mostly of a mixed Baikiaea composition. The only permanent water is in the perennial rivers, with seasonal rain-filled pans forming in the omirumba (Brown & Jones 1994).

2.2. East Caprivi

The East Caprivi is approximately 12,000 km^2 in size with a human population of about 60,000 (Erkkila & Siiskonen 1992), scattered in rural settlements and concentrated in the town of Katima Mulilo. There were originally four areas known to hold abundant wildlife: The Northern Forestry area, Mudumu N.P. area, Mamili swamps area, and the Eastern Floodplains (Fig. 3). It was noted in 1968, that of these areas, the Eastern Floodplains had particularly high concentrations of wildlife along the road from Katima Mulilo to the Botswana border (Logan 1968). Of these high density wildlife areas, parts of Mudumu and Mamili were proclaimed as National Parks in 1990, and the Eastern Floodplains and areas surrounding the East Caprivi national parks were identified by the MET and IRDNC as areas of focus for community- based conservation programmes.

Figure 3: Approximate areas of the East and West Caprivi that held the highest wildlife densities between 1980 and 1990.



2.2.1. Mudumu N.P.

Mudumu N.P. (about 760 km^2) is situated on the Kwando River, and contains mainly mixed mopane Colophospermum mopane woodlands with a lightly wooded "malapo" at its center, and floodplains with associated riparian vegetation along its river edge.

2.2.2. Mamili N.P.

Mamili N.P. (about 360 km^2) lies between the Kwando and Linyanti Rivers. It makes up the largest protected wetland in Namibia and can have up to 80% of its surface area flooded in times of high floods. Most of its area consists of extended floodplains with two savanna woodland "islands".

3. MATERIALS AND METHODS

3.1. 1994 Aerial Census

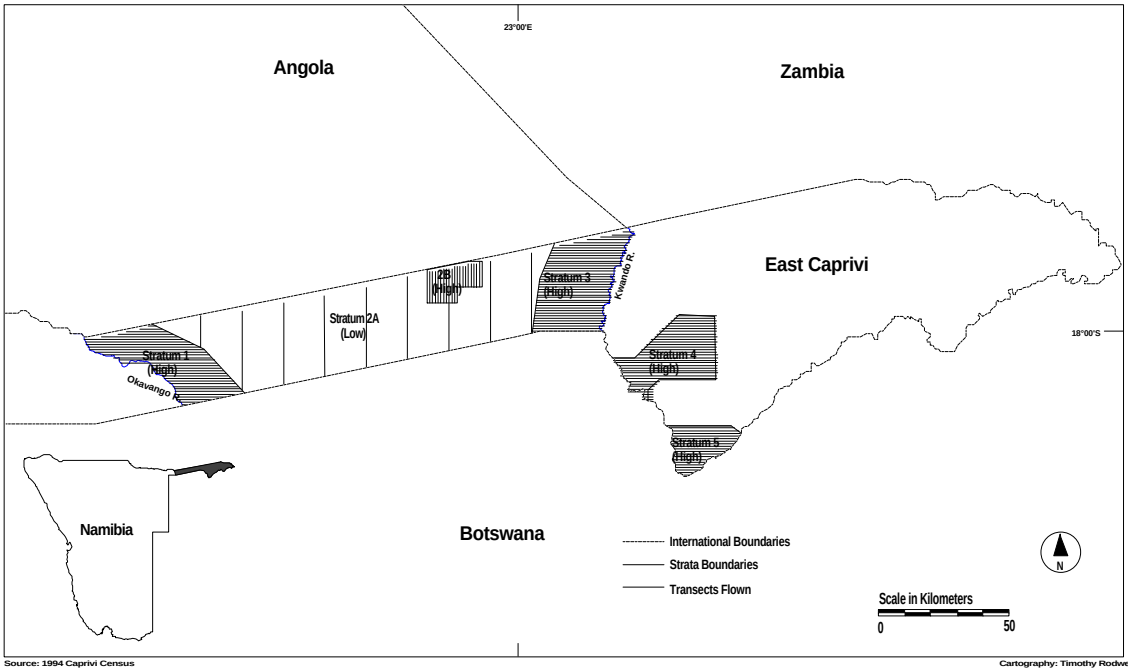
3.1.1. Strip Widths

Variables affecting accuracy and precision of counting large mammals from the air, were minimized by counting animals in two strips of widths 250m and 500m on either side of the aircraft (Pennycuick & Western 1972). Elephant and buffalo were searched for up to 500m, and all other species up to 250m from the aircraft. Strip widths were calibrated by marking the wing struts with numbers every 5cm, then flying over a marked position on an airfield, 100m above ground level (AGL). Fuel drums set to 250m and 500m from the fly-over point were then sighted by the observer with a corresponding strut number. This process was repeated until all the observers felt comfortable with a strut marker for each of the 250m and 500m distances from the aircraft. Strings were then attached to these numbers, to delineate the strips while in flight.

3.1.2. Stratification

Due to time and budget constraints, the census areas were divided into strata based on their wildlife densities, and surveyed with varying degrees of intensity. These strata were determined using prior knowledge from previous surveys, reports from ground monitoring, and known limiting factors such as water availability. Transects in high density strata were flown 1 km apart in an east/west orientation to be approximately perpendicular to the rivers, and approximately 15 km apart in a north/south orientation in the low density areas (Fig. 4), in accordance with the recommendations of Norton-Griffiths (1978). Transects near the Angola border were terminated approximately 1 km short of the border to prevent flying over possibly hostile territory. As strip widths of 500m on either side of the aircraft were used for elephants and buffalos, high intensity census areas were surveyed with 100% coverage (100% sample) for these species, while all other species were surveyed as a ±50% systematic sample. Regions where low intensity counts were made, were surveyed with approximately 6% (elephant & buffalo) and 3% (other species) systematic sampling. The high density Stratum 2B, in the middle of low density Stratum 2A, was defined by a 10km zone around a concentration of water holes still holding water at the date of the census. Reports from ground based community game guards in that area had indicated high concentrations of game in that stratum (S. Mayes personal communication).

Figure 4: Map of Caprivi showing strata and actual transects flown during the 1994 aerial census of Caprivi. Transect location shows spacing and orientation in each stratum. "High" and "Low" denote high and low sampling intensity as described in the text.



River surveys were conducted on the Kwando and Kavango Rivers at a height of approximately 200m above the water employing a zigzag pattern across the rivers, in order to get a minimum estimate of hippopotamus Hippopotamus amphibius numbers.

Because of the wetlands nature of Mamili N.P., hippos were counted in this area as part of the sample strips in that stratum, and were not visible further than 250m from the aircraft due to dense wetland vegetation and surface water.

3.1.3. Aircraft and Personnel

A Cessna 337 aircraft was used for the 1994 aerial census of the Caprivi. An average ground speed of 160km/hr (86 knts) was maintained throughout the census, at a mean altitude of 104m. The altitude and ground speed was maintained by combined use of the barometric altimeter and on board "Garmin 100 SRVY" Global Positioning System (GPS). The census team was comprised of a pilot and recorder/navigator in the front, and two observers in the rear seats. It has been repeatedly shown that observer bias can have a large affect on census results (Caughley *et al*. 1976). The same observers (all with previous census experience) were therefore used for all areas except Mudumu N.P. where the same observers were not available.

3.1.4. Navigation and Recording

A digital map of the Caprivi was created using MapViewer™ software (Golden Software, Golden, Colorado U.S.A), with all relevant landmarks, tracks and boundaries. All transects were drawn on this map, and their beginning and end point co-ordinates were recorded in an ascii computer file formatted and uploaded into a GARMIN 100 SRVY GPS before each day's flight, to be used by the pilot for transect navigation. The recorder/navigator certified location accuracy by keeping watch on land marks recorded on a paper copy of the digital map of each day's flying area. At each sighting made by observers, the recorder would note down on paper the details of the sighting, as well as a waypoint™ number taken from a position stored in the GPS, to correspond with each sighting. The altitude was also stored with each sighting.

All species of wildlife observed were recorded, as well as human settlements, ground water, domestic animals and elephant carcasses. Large herds of buffalo were photographed and later counted on a projected image to improve counting accuracy (Norton Griffiths 1973).

3.1.5. Calculations

All census observations were added to an ascii computer file of locations, downloaded from the GPS at the end of each day's flying. This file was then converted to a spreadsheet format for calculations. Total numbers of animals seen, as well as density estimates and 95% confidence limits (for species not surveyed at 100% sampling intensity) were then calculated using Jolly's (1969) method for unequal sampling units as outlined by Norton-Griffiths (1978). Actual strip widths were calculated by averaging the actual altitude above the ground for each transect, then calculating the true strip width (Pennycuick & Western 1972). Altitude above ground was obtained by using a simple computer program, to subtract each GPS altitude (above sea level) at a known location, from its nearest known contour altitude (taken from a 1:250,000 scale contour map of the Caprivi). Although it is accepted that GPS errors can be as great as 100m, they are typically accurate to 15m (GARMIN 1993), and it was assumed that overall positive and negative errors would cancel each other out over the course of a transect. It is recognized that this method has its faults, but in the absence of a radar altimeter it

has shown to be fairly consistent, giving a mean recorded flying altitude of 103.98m (SE=2.62, n=144).

3.2. Past Surveys

Previous surveys of portions of West Caprivi were few and irregular because of the complicated politics of the region. The East Caprivi had more regular surveys conducted on an almost annual basis between 1980 and 1990. The East Caprivi surveys were as consistent as could be expected for the available resources of the time, and although they did not include indices of precision and estimation, they can be considered a good minimum estimate of wildlife numbers through this period of Caprivi's history.

With the exception of the 1993 Caprivi census which set the standards for 1994, most past surveys of the various Caprivi regions were carried out in military helicopters and occasionally fixed wing aircraft. A crew of two observers, a pilot and a recorder/navigator were used for observation. Generally, in regions of high wildlife density, strips of 500m on either side of the helicopter or aircraft were searched with transects one kilometer apart, and the wildlife reported as numbers from a total count. High density strata were identified from road patrols and previous surveys, and over the years took the approximate form of those East Caprivi high density wildlife areas shown in Figure 3.

4. RESULTS AND DISCUSSION

The 1994 Caprivi census took place in late August 1994 to take areas advantage of the good visibility and low foliage cover. A summary of census search rates and are given in Table 1.

Table 1. Summary of the census strata, sampling intensity, and census performance indicators for the 1994 Caprivi Census (see Figure 4 for strata locations).

Stratum	Total Area (km^2)	% Area Sampled (Elephant/Other)	No. Transects	Avg. Transect Length (km)	Search Time (Hrs.)	Total Flying Time (Hrs.)	Search Rate (km^2/Hr.)
1	818	100/52	32	26	6.3	7.0	129
2A	3796	6/2	9	25	2.1	3.0	107
2B	254	100/45	24	11	2.2	2.3	117
3	987	100/49	41	24	7.7	9.2	129
4	757	100/60	33	23	5.2	6.3	147
5	357	100/55	19	19	3.0	3.8	119
Totals/Avg.	6969		158	21	26.5	31.6	125

4.1. Wildlife Observations

Table 2 shows the results of the 1994 Census of the protected areas of East and West Caprivi, and total numbers for the Caprivi. Included in this table are the number of most species seen in both the 250m and 500m strips, as well as the calculated estimates for the species observed in systematic sample strips of less than 100%

Table 2. Observed and estimated wildlife numbers from the 1994 Caprivi Census. Species are listed in order of abundance. Blank cells in the table denote the absence of that species in that stratum, or the absence of an estimate when sampled at 100% coverage. C.I. = 95% Confidence Interval. (see figure 4 for location of strata)

Species	Stratum 1 (W. Caprivi) West Core			Stratum 2 (West Caprivi, Central) Low Density (A)			Stratum 2 (West Caprivi, Central) High Density (B)			Stratum 3 (W.Caprivi) East Core			Stratum 4 (E.Caprivi) Mudumu N.P.			Stratum 5 (E.Caprivi) Mamili N.P.			Totals East & West Caprivi		
	No. seen	Est. (Y)	+/- C.I.	No. seen	Est. (Y)	+/- C.I.	No. seen	Est. (Y)	+/- C.I.	No. seen	Est. (Y)	+/- C.I.	No. seen	Est. (Y)	+/- C.I.	No. seen	Est. (Y)	+/- C.I.	No. seen	Est. (Y)	+/- C.I.
Elephant	1532									2953			433			638			**5556**		
El. Carcass	15			8	135	115	6			67			2			2			**100**	**227**	**98**
Buffalo	401									950			2			1173			**2526**		
Lechwe										38	76	89				571	1033	484	**609**	**1109**	**460**
Hippo.	74									220						258	472	192	**552**	**766**	**179**
Sable	97	187	115				1			133	265	155							**231**	**452**	**150**
Kudu*	23	44	28	12	213	375				126	251	92	7	12	13	17	31	31	**185**	**551**	**334**
Impala*							2	4	7	87	175	103	61	99	95				**150**	**278**	**139**
Zebra										78	156	81	61	101	145				**139**	**257**	**165**
Eland										94	189	251							**94**	**189**	**251**
Reedbuck	26	50	41							2			3	5	6	25	38	29	**56**	**93**	**50**
Giraffe										43	76	36							**43**	**76**	**36**
Roan	3	6	6							4	6	6	33	55	65				**40**	**67**	**65**
Tsesebe										31	28	26							**31**	**28**	**26**
Osterich	2			1						3	6	5							**6**	**6**	**5**
Settlements#	11			2			1			1									**15**		
Cattle	450	867	512										42	70	78				**492**	**937**	**518**
Goats	138	266	155	18	766	1035	16	35	60							70	128	211	**242**	**1195**	**905**

*** Minimum estimate only because of difficulty in observing true densities from the air.**

 # Settlements = a collection of dwellings

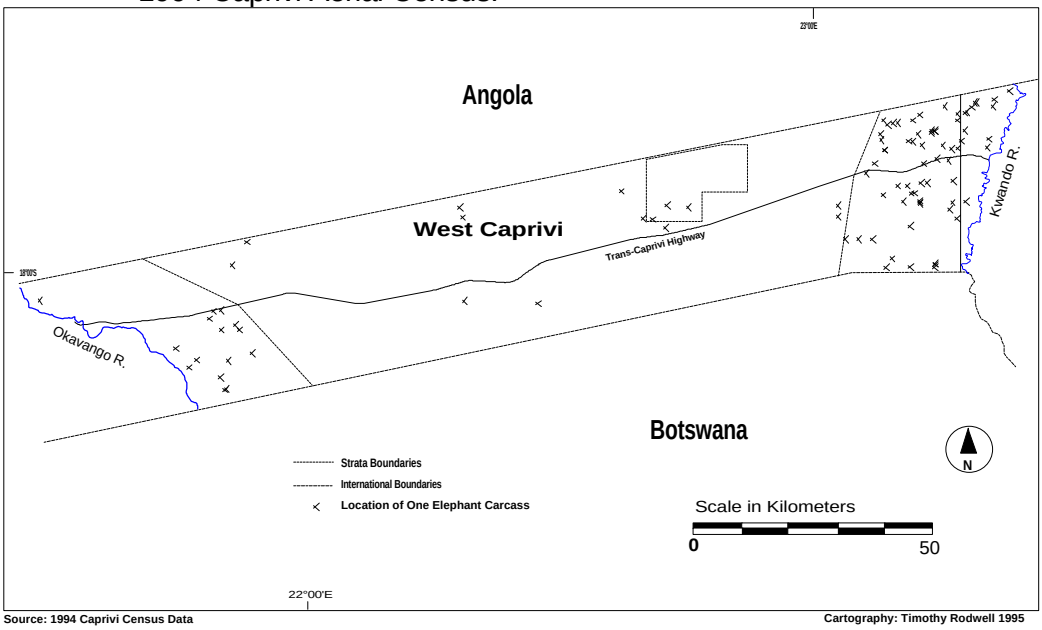
intensity. As the wildlife in these areas are mostly gregarious species at low densities, the 95% confidence intervals (95% C.I.) for these estimates were unavoidably high, as has also been seen in most multi-species censuses in southern Africa (Gibson 1994). An attempt was made to decrease these high 95% C.I. ranges by using an analysis of herds rather than individuals, as outlined by Samuel and Pollock (1981), but the high variability in number of individuals in different herds actually increased the final 95% C.I. ranges. It is doubtful whether changes in stratification or sampling intensity would decrease these 95% C.I. ranges significantly. Significant improvement in 95% C.I. ranges over the next few years will probably only occur if the populations of these species increase to the point where they are distributed more evenly throughout the strata. For all of those estimates with minimum 95% C.I. of less than the number actually seen, the number actually seen becomes the minimum. Species such as duiker Sylvicapra grimmia, warthog Phacochoerus aethiopicus and various predators were seen in most strata but were excluded from Table 2 as it is impossible to even guess at their true densities from an aerial census.

Of most striking note was the large number of elephant relative to other species in all strata. This number of elephants can be considered to be fairly accurate, based on 1993 figures (see tables 4, 5, 8 & 9), but is probably still an underestimate of total numbers, as is shown to be the case in most aerial censuses (Caughley 1974), including helicopter counts (Melton 1978). At this time of the year, the Caprivi elephants tend to congregate in very large clusters of herds, some totalling over 500 animals within an area of a few square kilometers. These herds might easily have been missed if low intensity sample counts were used to estimate elephant numbers. The obvious disadvantage of a total count of elephants, is the lack of an index of precision. An experiment is therefore planned for 1995, comparing high intensity sample counts (± 40%) with another complete count in the high density strata.

4.2. Elephant Mortalities and Densities

Elephant carcasses, approximately 1% and 2% of the live population for strata 1 and 3, and less than 0.5% for Mudumu and Mamili N.P. (see Table 2 for actual numbers), generally coincide with ground reports of mortalities of the same order of magnitude in these areas (Rodwell unpublished). In stratum 3, where ground patrols and mortality reporting is most consistent, the total number of elephant carcasses reported from the ground between 1992 and 1994 was 102 carcasses. Of these 102 carcasses, 23 were from elephants less than about 5 years of age. If the young carcasses are removed from the ground reported numbers (because of their rapid deterioration), the total number of sub-adult and adult carcasses reported from the ground is only ±15 % higher than those visible from the air. The number of elephant carcasses seen in the stratum 2A and 2B in central West Caprivi (Fig. 5), relative to the absence of any live elephant populations in these strata at the time of the census, most likely indicates the presence of missed elephants at 6% sampling, and elephant herds that are known to inhabit these areas in the wet season (S. Mayes Personal Communication).

Figure 5: Locations of elephant carcasses observed in the West Caprivi during the 1994 Caprivi Aerial Census.



Source: 1994 Caprivi Census Data

Cartography: Timothy Rodwell 1995

The elephant densities shown for each stratum in Table 3 are all two to three times higher than those listed as "preferred elephant densities" for those areas of Namibia (Lindeque 1995), and even though preliminary evidence from Caprivi elephant satellite tracking indicates these populations migrate to Botswana and Zambia during the rainy season, they are still spending most of the year in Caprivi (Rodwell unpublished).

Table 3. Summary of elephant densities observed in the different strata of the 1994 Caprivi Census, compared with target densities for each of those areas.

Area (Stratum)	Total Area (km^2)	No. Elephants (n)	1994 Density (n/km^2)	Target Density (n/km^2)*
W.Caprivi (1)	818	1532	1.87	0.42-0.83
W.Caprivi (2A&2B)	4050	0**	0.00	0.38-1.00
W.Caprivi (3)	987	2953	2.99	0.38-1.00
Mudumu N.P. (4)	757	433	0.57	0.00-0.50
Mamili N.P. (5)	357	638	1.79	0.00-1.00
Totals/Avg.	6969	5556	1.44	0.24-0.87

*** Source: Lindeque 1995**

**** Very low density in the dry season, undetected with 6% sampling**

4.3. Distribution

Elephants

Figure 6 and Figure 7 show the distribution and numbers of elephants in West and East Caprivi respectively. Important to note on these maps is the north/south distribution of the elephants in the West Caprivi in Strata 1 and 3. In Stratum 1 it was thought that similar habitat and resources would make this a continuous stratum of even distribution for the elephants, but approximately 95% of the elephants were observed south of the Trans-Caprivi Highway. If it is accepted that the probability of elephant mortality is equal north and south of the Trans-Caprivi Highway, then the elephant carcass distribution of Stratum 1 (Fig. 5) reinforces the idea that this distribution trend south, is not temporary. A similar trend was in evidence in the 1993 census of this same stratum.

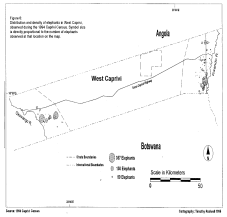
The most obvious impact of this observed elephant distribution is to increase the density of elephants in Stratum 1. If the elephant distribution seen in Stratum 1 (Fig. 6), and inferred by carcass distribution, is accurate and permanent, then the density of elephants in this stratum is likely to be over three elephants/km^2, as the total area of their distribution could be as little as about 465 km^2 as opposed to 818 km^2 listed in Table 3.

The distribution of elephants in Stratum 3 also indicates a trend to the south. This trend is most likely only recent as indicated by the even distribution of mortalities in this stratum (Fig. 5), but is likely to be reinforced if conflict with Angolan's in the north continues to worsen as it has over the past two years (personal observation). One interesting note on the Mamili N.P. elephant distribution (Fig. 7) is that it very neatly falls into the shape and orientation of the Nkasa and Lupala wooded "islands" if these "islands" are overlaid on the distribution map.

Buffalo

Buffalo distribution seen in Figure 8 and Figure 9 show the population to be made up primarily of very few, but very large herds. The largest herd of buffalo in Stratum 3 has been seen completely inside and outside of Namibia, but is regularly observed in the central east core area. This indicates the potential complications in assessing the resource value of free ranging species.

Counts of buffalo in Mamili N.P. show a more even distribution of smaller herds, and possible indication of a more stable and settled population. Buffalo populations in the Mamili N.P. area are not avoiding the communal lands north of Mamili, which could be an indication that community based conservation efforts in the region are having a positive impact.


Angola
West Caprivi
Botswana
Scale in Kilometers
0
50

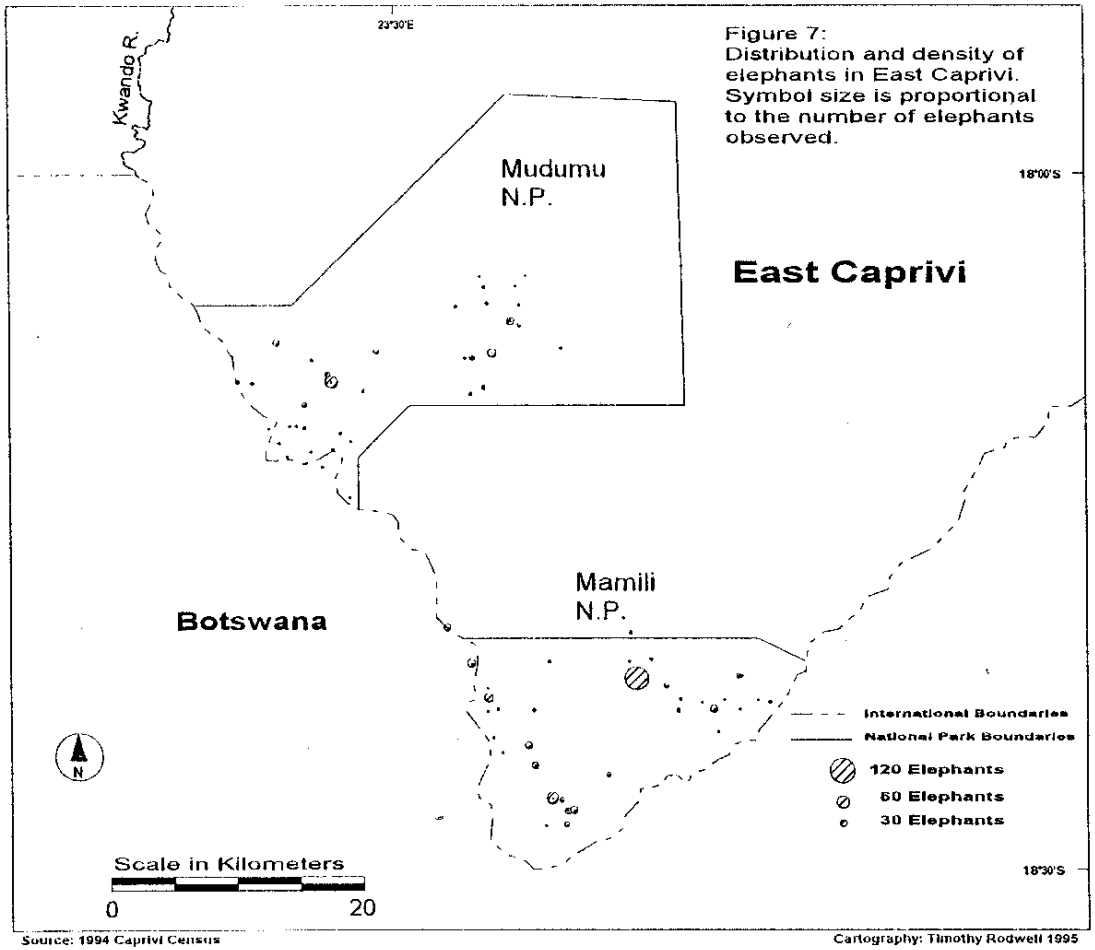
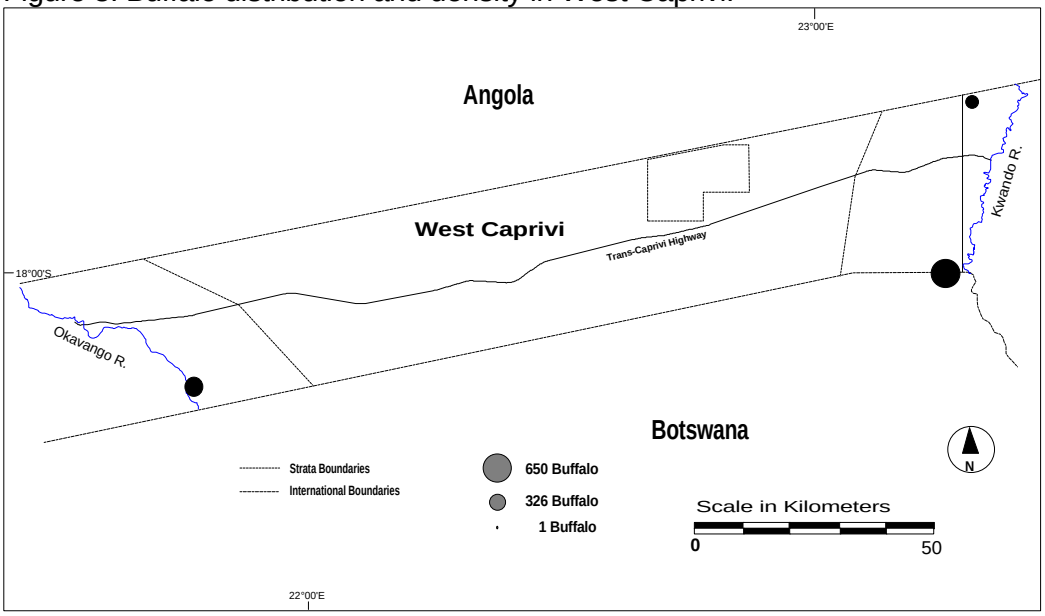


Figure 7:
Distribution and density of elephants in East Caprivi. Symbol size is proportional to the number of elephants observed.

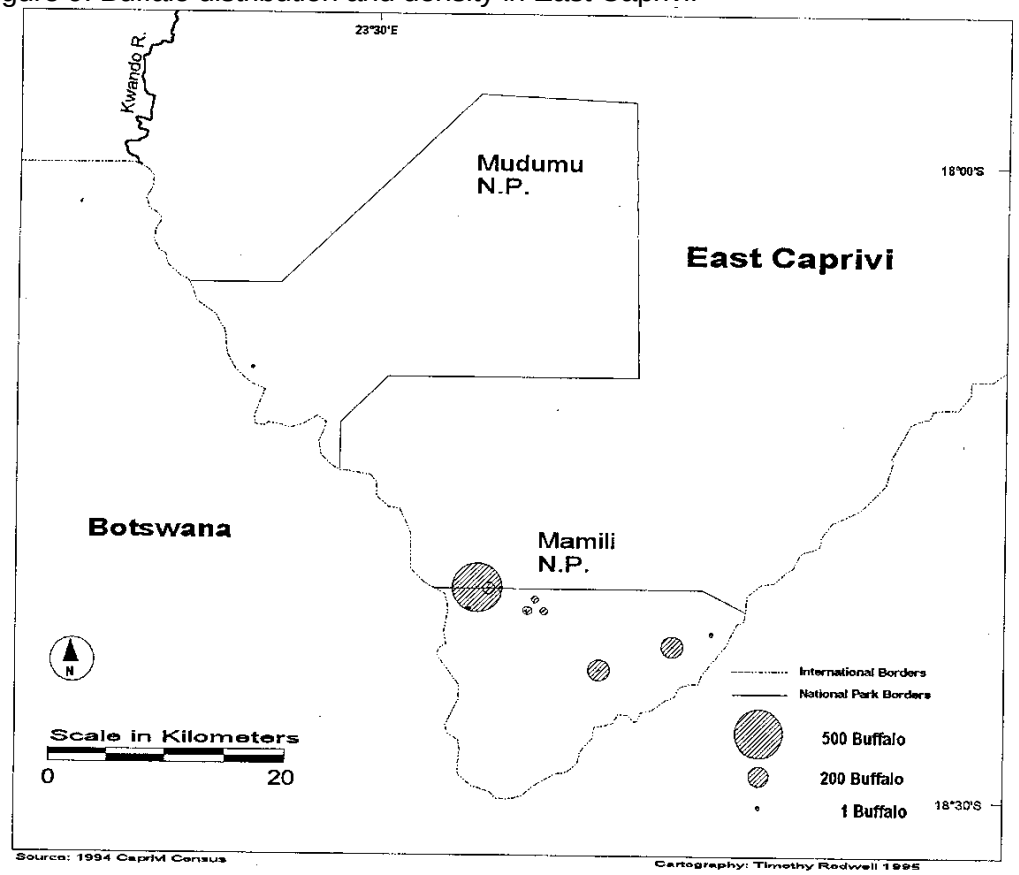
Figure 8: Buffalo distribution and density in West Caprivi.



Source: 1994 Caprivi Census

Cartography: Timothy Rodwell 1995

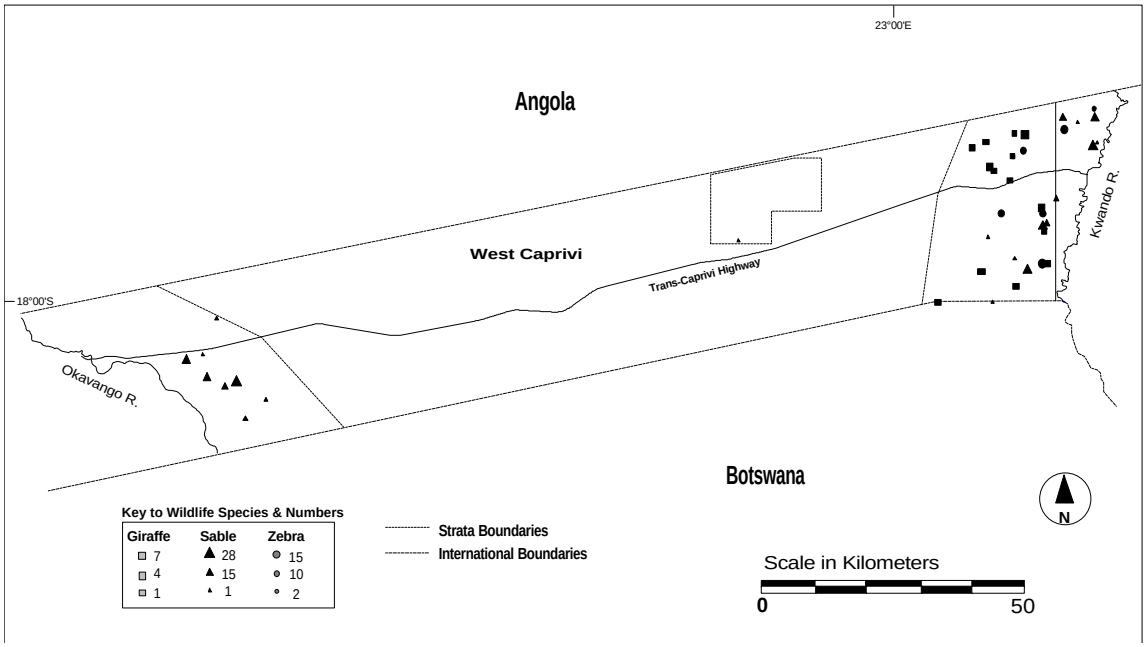
Figure 9: Buffalo distribution and density in East Caprivi.



Giraffe, Sable, Zebra

Figure 10 shows the distributions of giraffe Giraffe camelopaerdalis, sable Hippotragus niger and zebra Equus burchelli (species with important economic value) in the West Caprivi. The only viable population of giraffe left in the Caprivi seems to be in Stratum 3. Giraffe have been sighted in Stratum 2, but only rarely, and not in herds as seen in Stratum 3. Sable appear to be doing well in the West Caprivi and are widely distributed in the two proposed core areas. Zebra are well distributed in Stratum 3, and ground reports suggest a stable to increasing population.

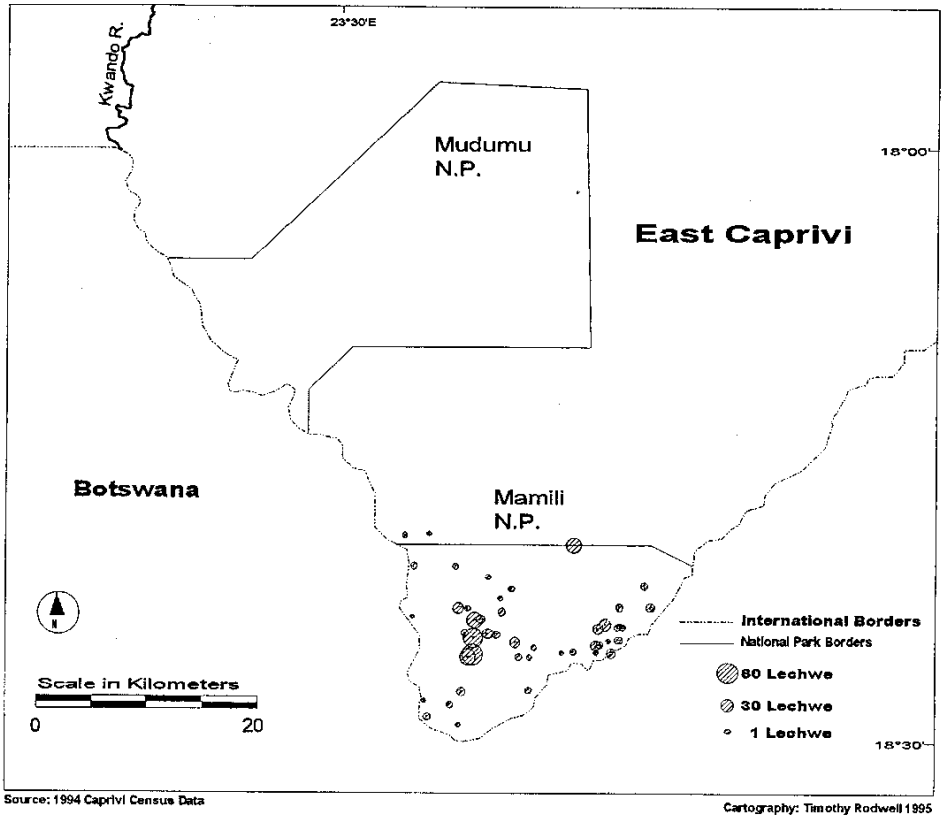
Figure 10: Distribution and density of giraffe, sable and zebra, observed in the West Caprivi during the 1994 Caprivi Census.



Lechwe and Hippopotamus

The lechwe Kobus leche in Mamili N.P. suffered a major population crash from 1980, but in recent years their even distribution and numbers in Mamili N.P.'s wetland habitat (Fig. 11) suggests they might be stabilizing. It is evident that the dynamics of this lechwe population needs to be examined more closely to understand how environmental and man-induced changes are affecting them.

Figure 11: Distribution and density of Lechwe observed in Mamili N.P.



The hippopotamus distribution and numbers in Figure 12 seems to indicate an even and well established use of Mamili N.P.'s habitat.

4.4. Trends

In order to obtain useful insights into Caprivi's Wildlife history by comparison with past surveys, it is important to understand the limitations of those comparisons first. Due to discrepancies in method and other variables, all the surveys of Caprivi were not identical, but can be seen as generally consistent. The information in Tables 4 - 9 therefore cannot be used for fine or quantitative analysis of trend, year to year, but they can be used as coarse indicators of gross trends and local "extinctions" over the course of many years.

As all the wildlife areas in Caprivi were not surveyed every survey period, we have identified those areas most often surveyed in the most consistent manner, and reported the number of each species actually seen (minimum number) in each of those areas for each survey period. Figure 13 indicates each of those areas, as well as the strata and transects used in the 1993 and 1994 Caprivi Censuses.

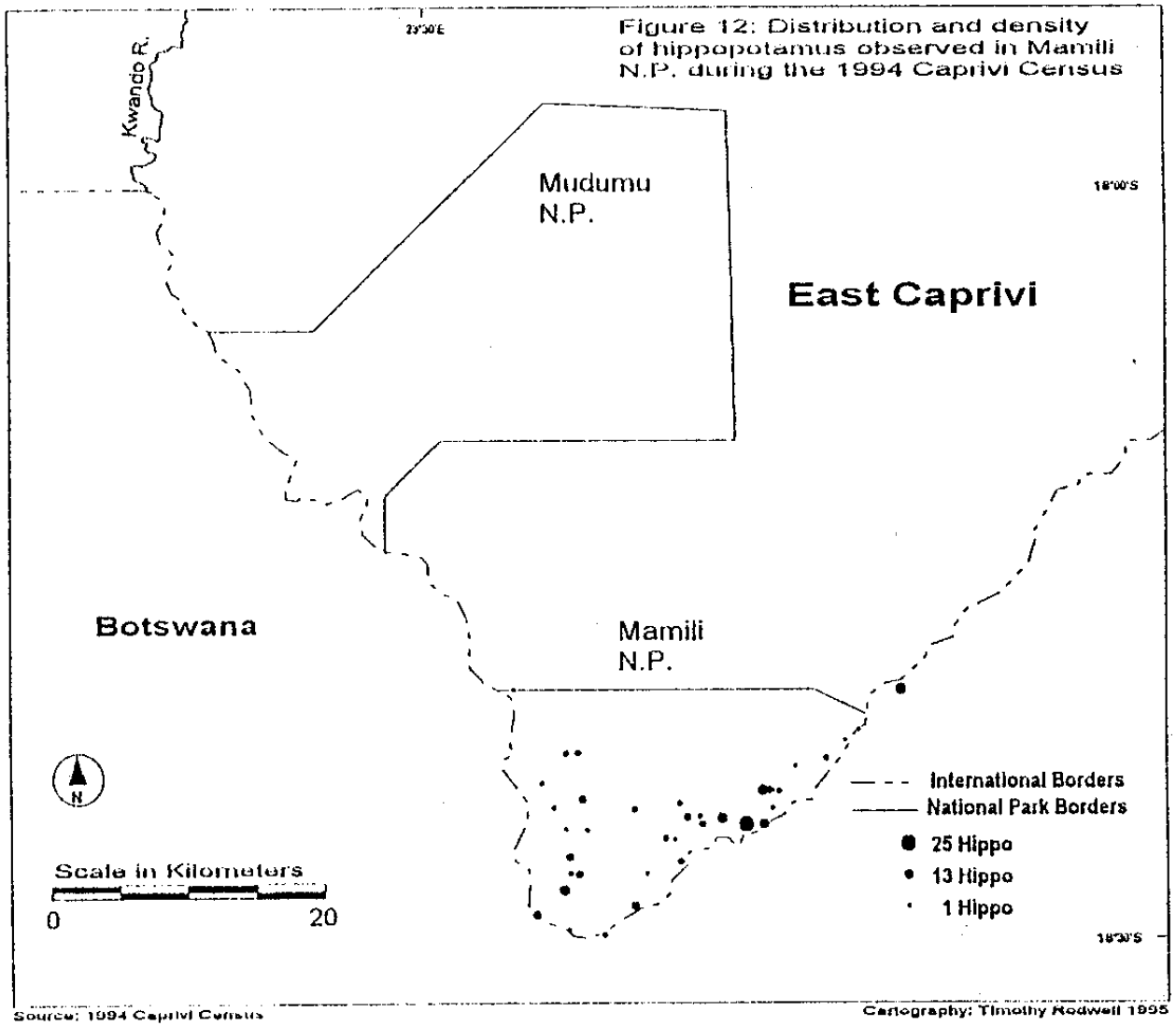
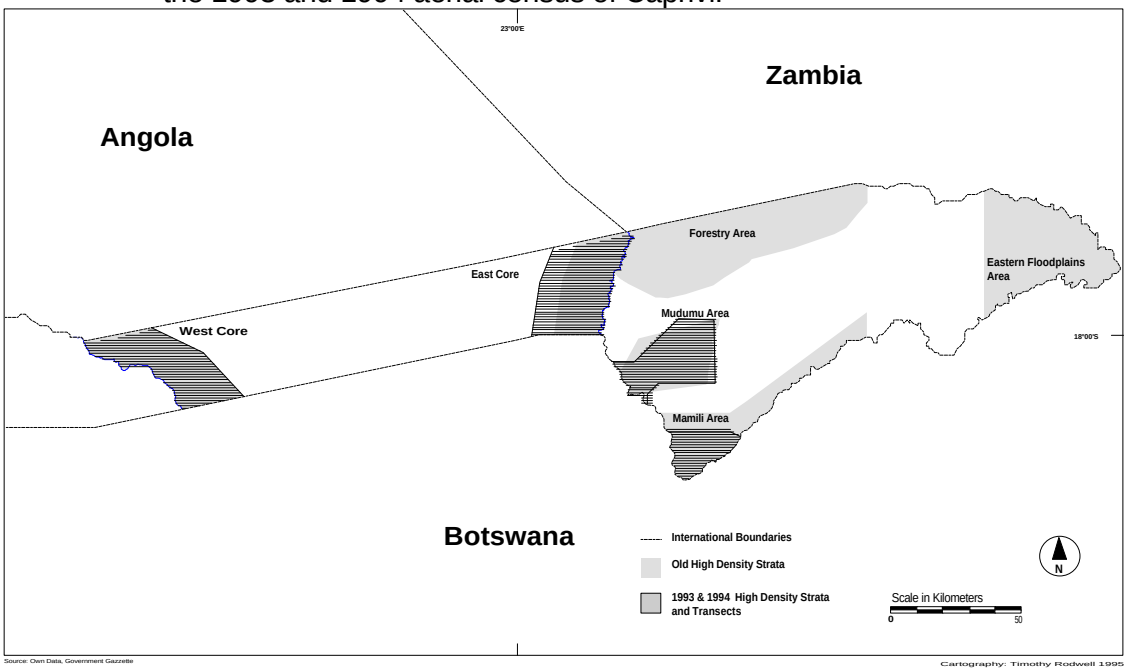


Figure 12: Distribution and density of hippopotamus observed in Mamili N.P. during the 1994 Caprivi Census
Kwando R.
Mudumu N.P.
East Caprivi
Botswana
Mamili N.P.
N
Scale in Kilometers
0
20
International Borders
National Park Borders
25 Hippo
13 Hippo
1 Hippo
Source: 1994 Caprivi Census
Cartography: Timothy Rodwell 1995

Figure 13: Map of Caprivi showing high density wildlife areas most often censused between 1980 and 1990, compared with the strata and transects used for the 1993 and 1994 aerial census of Caprivi.



Tables 4 - 9 are a compilation of wildlife numbers from the most complete aerial surveys of high density areas in the Caprivi from 1980 to 1994. These tables include only those species considered countable from the air. The tables are listed by area as indicated in Figure 13, and areas not completely covered in any one year are noted as exceptions on the table.

4.4.1. West Caprivi.

Before 1993, only the two "core" areas of West Caprivi on the Kavango and Kwando Rivers were surveyed in a fairly consistent manner, and in 1993 and 1994, so little was seen in the central region of West Caprivi, that it has been excluded from these tables altogether. The most striking feature of Tables 4 and 5, is the dramatic increase in elephant and buffalo numbers. The positive trends in total population increase are great enough to be viewed as legitimate, and are substantiated by reports from people that have been living in the area since the South African Defense Force occupied Caprivi (S. Mayes Personal Communication). The extremely sharp increase in numbers seen in the "East Core" region of West Caprivi is also considered legitimate, and most likely due to immigration from Botswana and Angola following increasing disturbances in the north and dramatic decreases in human presence after the SADF departed the region.

Other species which seem to have increased significantly in strata 1 and 3 are the sable and giraffe. MET ground reports confirm this positive trend in sable in both core areas, but there is very little evidence to show that the possible increase in giraffe is any more than the variability in spotting giraffe from the air.

Table 4. Wildlife numbers observed during aerial censuses of the **West core area** of West Caprivi, from 1985 to 1994. Blank cells denote the absence of that species from that stratum.

Species/Yr.	1985*	1987**	1990**	1993	1994
Elephant	1	868	1085	1209	1533
Buffalo	200	250	307	380	401
Hippo.	?	?	?	76	74
Sable	52	33	28	16	97
Kudu	55	59	40		23
Lechwe					
Eland					
Impala					
Zebra					
Giraffe					
Tsessebe	6				
Roan		16			3
Reed Buck				2	26
Wildebeest					
Water Buck					
Ostrich					
Cattle	?	?	?	120	473
Goats	?	?	?	8	138

? = Unknown whether searched for or not.

* Census in wet season 1985

** Only South of the road censused

Table 5. Wildlife numbers observed during aerial censuses of the **East core area** of West Caprivi, from 1981 to 1994. Blank cells denote the absence of that species from that stratum.

Species/Yr.	1981**	1988	1989	1993	1994
Elephant	410	884	728	2825	2946
Buffalo	19		7	656	950
Hippo.	122	94	89	251	220
Sable	113	64	47	32	133
Kudu	75	52	28	48	126
Lechwe	113	102	59	33	68
Eland	75	15	39	106	94
Impala	21	49	21	147	87
Zebra	95	49	23	63	78
Giraffe	15	32	4	27	43
Tsesebe	35	16		20	31
Roan	66	4		7	4
Reed Buck	32	9	8	6	2
Wildebeest	49			2	
Water Buck	47				
Ostrich		7	2	7	3
Cattle	?	?	?		
Goats	?	?	?		

? = Unknown whether searched for or not.

** Only South of the road censused

Negative trends that seem significant in Table 5 are the decrease in roan Hippotragus equinus and wildebeest sightings. Roan are seen on the ground in greater numbers than in the air in this area, but are known to be scarce, and wildebeest are known to exist in only one small herd that has not been seen for a while (personal observation).

4.4.2. East Caprivi

Not a great deal of recent information is available on the Forestry area in East Caprivi, but negative trends in this area, in all species, were confirmed by a low intensity census (approximately 7% coverage) of the East Caprivi in September 1994 during co-operation with Botswana Census Team (Gibson 1994). No elephant or buffalo were seen at that time, but human settlements and cattle were found in this region. It is evident from Tables 6 through 9 that the majority of the elephants reported in East Caprivi up until 1988 were seen in the forestry area, but these herds have all but disappeared since then. There is evidence from satellite tracking of elephants that there are still north/south Movements from Mudumu N.P. through the Forestry area to Zambia, but these movements are reversed in a few weeks and the elephants return to Mudumu N.P. (T.C.Rodwell unpublished).

Table 6. Wildlife numbers observed during aerial censuses of the **Forestry area** of East Caprivi, from 1980 to 1989. Blank cells denote the absence of that species from that stratum.

Species/Yr.	1980	1982	1983	1984	1985	1986	1988	1989
Elephant	1509	1936	1550	1768	1353	567	1075	335
Buffalo	236	150	80	185	45	74	24	140
Hippo.								
Sable	19	26	3	1	4			
Kudu	14	69	18	36	18	15	3	
Lechwe	1							
Eland	4	8	74	15	34			
Impala	10							
Zebra	9					1		10
Giraffe								
Tsessebe		15	15		3			
Roan	33	9	1	1	2			
Reed Buck		1	1	3	1			
Wildebeest	1							
Water Buck								

Table 7. Wildlife numbers observed during aerial censuses of the **Eastern Floodplains area** of East Caprivi, from 1980 to 1989. Blank cells denote the absence of that species from that stratum.

Species/Yr.	1980	1982	1983	1984	1985	1986	1989
Elephant	15			41	19	157	240
Buffalo							
Hippo.	34	20	2	2	8		
Sable	8						
Kudu	4						
Lechwe	1088	272	78	90	27	7	6
Eland							
Impala	29						
Zebra							
Giraffe							
Tsessebe							
Roan							
Reed Buck	6	2	2	10	2		4
Wildebeest	5						
Water Buck					42		

Probably the most notable of all trends in the East Caprivi can be seen in the Lechwe populations in Tables 7, 8 and especially 9. The massive decrease in numbers from over 10 000 in the early 1980s, to a few hundred in 1994 has been attributed mostly to over utilization, but the effect of substantial changes in habitat in these regions should

Table 8. Wildlife numbers observed during aerial censuses of the **Mudumu N.P. area** of East Caprivi, from 1980 to 1994. Blank cells denote the absence of that species from that stratum.

Species/Yr.	1980	1982*	1983	1984	1985	1986	1988	1989	1990	1993**	1994
Elephant		193	539	149	310	158	143	387	534	405	433
Buffalo	621	217									2
Hippo.		175					71	77	27	35	
Sable	55	47	41	31	33	14	16	17	20		
Kudu	3	5	15	5	12	18	24	5	17	11	7
Lechwe	430	1139						33	12	4	
Eland	67	9									
Impala		15	96	45	94	37	89	58	123	15	60
Zebra	56	581	407	488	138	120	129	68	258	80	61
Giraffe	12	6		1							
Tsessebe	54	10	33	14	9	1	6		19		
Roan	39	32	14	26	12	14	14	17			33
Reed Buck	2	8	4		2		9	3	4		4
Wildebeest		22									
Water Buck											

* Stratum may have included part of Mamili N.P. in 1982

**Transects 2km apart, as opposed to 1 km apart in other years

Table 9. Wildlife numbers observed during aerial censuses of the **Mamili N.P. area** of East Caprivi, from 1980 to 1994. Blank cells denote the absence of that species from that stratum.

Species/Yr.	1980	1982	1983	1984	1985	1986	1988	1989	1990	1993	1994
Elephant	32	135	100	57	72	136	169	179	491	187	625
Buffalo		217		8	228	132	515	634	766	625	1173
Hippo.	182	123	98	182	139	24	227	181	159	136	245
Sable											
Kudu	6			16	48		18	27	19	2	17
Lechwe	9470	7074	4494	5173	4249	2672	1630	1887	1224	340	571
Eland											
Impala				5				1			
Zebra										1	
Giraffe											
Tsessebe		3									
Roan											
Reed Buck	15	15		27	6	16	10	19	5		29
Wildebeest											
Water Buck											

not be underestimated. The Linyanti Swamps area and Lake Liambezi to the north east of Mamili N.P. have been almost completely dry for over a decade, and Mamili N.P. itself has far less water coverage in the wet season than it did in the late 1970's

Another important negative trend to note is the local "extinction" of giraffe and wildebeest from East Caprivi somewhere in the mid 1980's. No giraffe or wildebeest have been seen in East Caprivi since then, and the chances of them naturally recolonizing Mudumu or Mamili N.P. is small as a result of the rivers between these protected areas and Botswana, and the large, human settled area between Zambia and Mudumu and Mamili N.P.

While all wildlife populations (excluding elephants) seemed to have declined in number between 1980 and 1990, there have been indications on the ground over the past couple of years that Mudumu N.P. is stabilizing (G. Burton personal communication). Herds of impala and kudu are being observed more often. Small herds of buffalos which in the past only inhabited Mudumu N.P. temporarily, seem to be remaining permanently, and the herds of elephants seen in Mudumu N.P. are observed less in large herds clumped together (a sign of stress), and more in small family herds. These indicators are

all very difficult to observe from the air in their early stages, but will hopefully become more obvious if the positive trends continue.

4.5. Recommendations for Changes to the Method

The navigation and data recording system set up for the 1994 Caprivi Census, proceeded very smoothly, with an extremely high rate of accuracy in terms of transect location and total coverage flown. The 500m strip width used to search for elephant and buffalo was at the limit of our searching range and should not be increased.

Elephant, buffalo and elephant carcass sightings were not recorded separately into the 250m and 500m observation strips in 1993 and 1994. Future censuses in the Caprivi should ensure all observation data is separated into 250 m and 500 m observation strips, to allow elephant, buffalo and elephant carcass observations to be analyzed either as sample (using only the 250 m strip observations) or total count data. As Botswana and Zimbabwe use mostly sample counts for estimation of their elephant population sizes, it is important that Caprivi also has sample data to compare with their estimates. If confidence limits on elephant number estimates from a sample analysis seem acceptable for local management purposes, then the value of total counts for elephants in these areas should be re-assessed.

Based on aerial survey results from 1993 and 1994, the high density stratum, Stratum 1, should be reduced to that area of the stratum south of the Trans-Caprivi Highway. This will not render past results incomparable with the future as almost all (over 95%) wildlife sightings in this stratum were seen South of the Tans-Caprivi Highway in 1993 and 1994. The area North of the Trans-Caprivi Highway should then become part of the low density stratum 2.

The high density stratum, 2B should not be repeated in future censuses as it was shown to be impractical. Regardless of the known higher wildlife densities and known water resources in this stratum, the wildlife density was still too low to justify a different sampling intensity from the rest of Stratum 2. Higher densities of wildlife in small areas such as these can best be assessed using ground monitoring techniques such as are presently being introduced in these areas. Sampling in Stratum 2 should be increased to at least 10 % to try and pick up the very low density of elephants that were possibly missed at 6 % sampling.

5. CONCLUSION

5.1. Long Term Monitoring

The Caprivi is an important and unique wildlife habitat, and it is under great pressure as a natural resource base. If this resource is to be utilized in a sustainable manner, it is important that it continue to be monitored on a regular basis, in order to ensure MET and community conservation objectives adapt to its dynamic needs as a resource base. The value of the aerial census is considerably enhanced by M.E.T. and community game guard ground monitoring efforts, and both should be continued as complimentary activities. As noted in the Results and Discussion section, trends in the wildlife populations (especially in Caprivi where number estimates have such large confidence limits) have little meaning as isolated indices, and the more regularly they are

monitored, the greater is the chance that meaningful distribution and growth trends can be extracted from the surveys over time.

5.2. Caprivi Wildlife as a Resource Base

If protected or proclaimed areas in the Caprivi are seen as the reservoirs of wildlife to re-populate communal and conservancy areas around them, then it seems as if the Kwando proposed core area and Mamili N.P. hold the greatest potential for this purpose in the near future. It is thus vital for the wildlife and wildlife-based development programmes in the Caprivi, that these areas receive appropriate attention, and that the Kwando core area gets finalized and stabilized as soon as possible. The unproclaimed triangle on the Kwando River edge of the Kwando core area comprises all of the river frontage that supports most wildlife populations during the critical dry season, and it should be managed as part of the whole Kwando core region.

Mudumu N.P. and Central West Caprivi don't hold high densities of wildlife, other than elephant, at present, although these habitats could support greater diversity and density. It is probable that the provision of strategic water points will facilitate the increase of wildlife numbers in these areas. If signs of stabilization in Mudumu N.P. continue, re-stocking of giraffe and buffalo, possibly followed by sable and roan might be considered. As there are no giraffe in Mudumu N.P., and the Kwando River prevents movements to Botswana, it is probably not necessary to only consider giraffe from Botswana or Zambia for re-introduction. Buffalo, sable and roan might best be re-introduced from local sources such as Mamili N.P. or Mahango G.R.

Of all the wildlife species presently in the Caprivi, it seems only elephant, and to a lesser extent buffalo, exist in high enough densities to support sustained consumption in the near future. Other species important for tourism, live sale and consumption; such as sable, giraffe, and zebra, seem to be stable and perhaps increasing in number in some protected areas, but still exist only in numbers high enough to support their own existence and growth. As it may be many years before these species can provide sufficient spill-over into communal lands for consumption, non consumptive use of the wildlife, such as tourism, might be the best avenue to explore in the short term. The Kwando region of West Caprivi supports the last viable populations of giraffe and wildebeest in Caprivi, but their low numbers are cause for extreme concern as they could disappear from this final range as they did in East Caprivi.

The benefits of spill-over of wildlife from reserves to surrounding areas is limited to a few selected areas. Under these circumstances, in order to accelerate the growth of wildlife populations outside of reserves for short term benefit, it may be advisable to plan experimental conservancies for Caprivi that will be fenced and stocked with species, indigenous to the area, that are known for their rapid growth rate and resilience (eg. impala and kudu). These units, and the wildlife in them, could be intensively managed with the intention of maximizing short term benefits, thus reducing the dependency on protected areas as the sole source of wildlife for re-stocking purposes.

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