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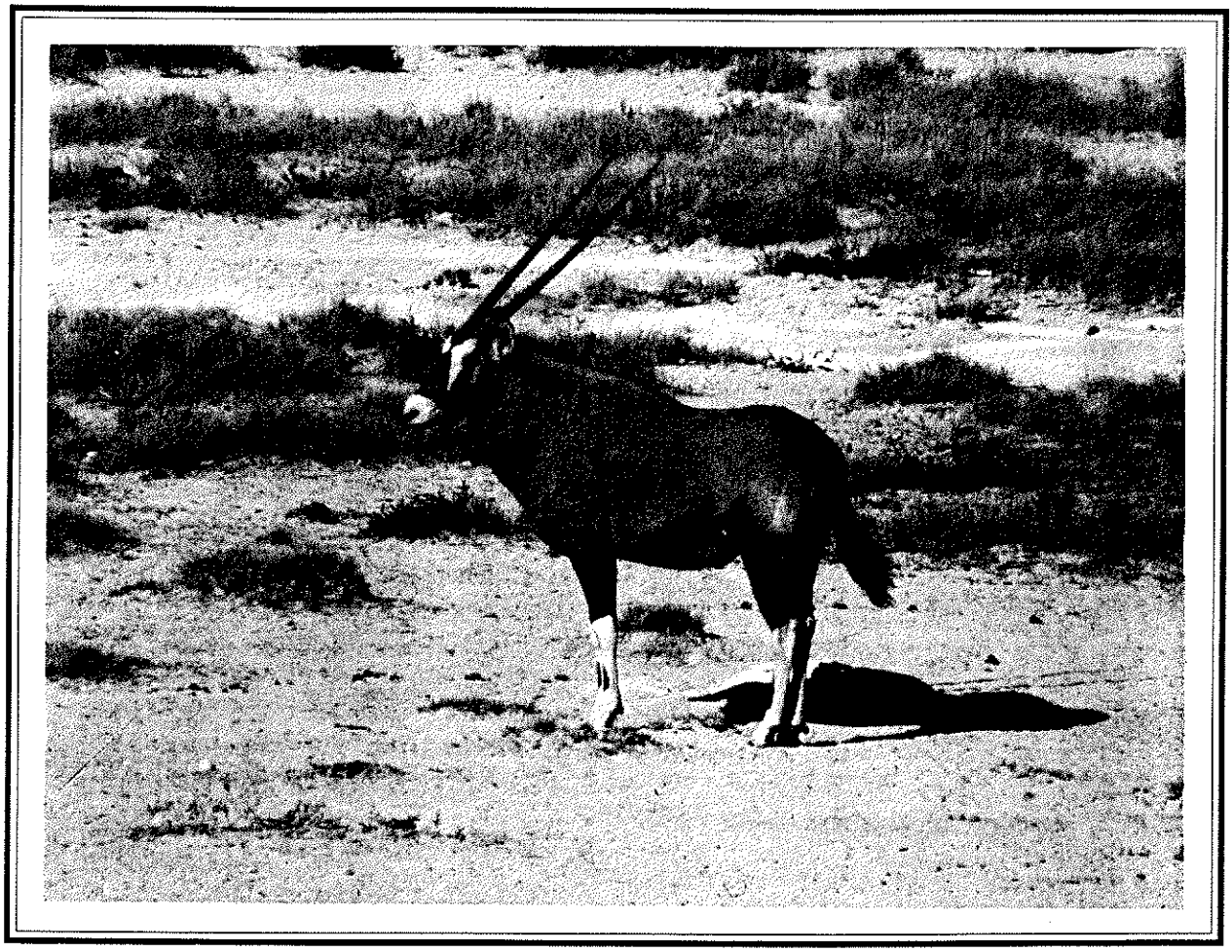
Abstract: Over a two year period from August 1969 to June 1971 I carried out a detailed survey of the Mammals of the then Wankie National Park (now Hwange National Park). During the survey "Museum type" specimens were collected and detailed analysis was also undertaken on stomach contents, reproductive tracks etc. At the same time an estimate of the status of the large mammals was carried out and details of the approximate number of each species was included in the final publication. The distribution and status of many mammals species having changed considerably aver those 25 years, I started a new year survey on 1996. A few example follow. The elephant population has doubled, while the buffalo's one has halved. Lions, leopards and hyenas numbers have doubled, while cheetahs number have declined considerably, which is possibly due to increased numbers of the other large carnivores in the Park. Others species have increased while others have decreased and almost disappeared from the Park.

PRELIMINARY ANALYSIS REPORT

BIODIVERSITY OF HWANGE NATIONAL PARK

PART I

LARGE MAMMALS AND CARNIVORES



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March 1997

BIODIVERSITY
OF
HWANGE NATIONAL PARK

PART I
LARGE MAMMALS
AND
CARNIVORES

by
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Chipangali Wildlife Trust and Department of National Parks & Wildlife Management
Project Permit No. 14(1)(C)(ii) 33/95

CONTENTS

SUMMARY

Over a two year period from August 1969 to June 1971 I carried out a detailed survey of the Mammals of the then Wankie National Park (now Hwange National Park) and the results of that survey was published in early 1975. The survey covered not only the large and more charismatic mammal species but also the rodents, bats and small carnivores.

During that survey "Museum type" specimens were collected and detailed analysis was also undertaken on stomach contents, reproductive tracks etc., and the specimens were housed at the Natural History Museum in Bulawayo. At the same time an estimate of the status of the large mammals was carried out and details of the approximate number of each species was included in the final publication.

Over 25 years have passed since that original survey was carried out and since 1969/71 no major update or survey had been done. The distribution and status of many mammal species has changed considerably over those 25 years and the Acting Director of the Department of National Park & Wildlife Management realised that a new initiative and survey was essential. As a result, he issued me with a permit to undertake another survey.

The new survey was to last for only one full year and I commenced work during the first week of January 1996 and completed my task on 31st December 1996. The original plan was also to study the small mammals such as rodents and bats but it soon became obvious that it was not going to be possible in only one year. Therefore, the 1996 survey covered only the large mammals and carnivores of the Hwange National Park.

The results of the 1996 survey clearly showed that there were indeed many changes in the status and distribution of the species studied. A few examples follow. The elephant population has doubled or even trebled in 25 years from a figure of about 10 000 to well over 20 000 or perhaps even nearly 30 000. During the same period the buffalo population has halved compared to what it was in 1969/71 and the present estimate in not more than 5 000 animals.

Lions, leopards and hyaena numbers have doubled while cheetah numbers have declined considerably, which is possibly due to increased numbers of the other large carnivores in the Park. Wild dog densities were found to be much lower but the other small carnivores have remained the same.

The tsessebe has almost disappeared from the Park with only a very small population remaining in the Robins area while there was no evidence of any Red hartebeest left in the Park.

The present survey has revealed two new species for the Park. The Black-footed cat and oribi can now be added to the list of mammals occurring in the Hwange National Park. Reedbuck have almost disappeared from the "Ten Mile Drive" area near Main Camp while grysbok which was common 25 years ago along the Lukozi River is now extremely rare in that area.

The white rhino is now almost extinct in the Park but that was as a result of poaching in the early 1990's. Black rhino are still present in fair numbers in the Sinamatella area. Other species such as sable have increased while others have decreased. However there are still good populations of zebra, kudu, roan, sable, wildebeest and many others in the Park.

INTRODUCTION

At the beginning of 1995 a new Minister of Environment and Tourism was appointed to the Zimbabwe cabinet and he indicated that he was not happy with the wildlife situation in the country as a whole and immediately placed a temporary ban on the capture and translocation of wildlife in the country. He also prohibited the export of wildlife, the rhino dehorning programme and several other projects.

The Minister admitted that he needed to know more about what was going on in the wildlife industry and, therefore, felt that new and additional wildlife surveys were required, in fact, essential, before he would make any major decisions regarding the export of animals etc.

I immediately decided to write to Mr. Willis Makombe, Acting Director of the Department of National Parks & Wildlife Management and offer my services, free of charge, to undertake a detailed mammal survey of the Hwange National Park. I had, in fact, some 25 years previously undertaken a detailed mammal survey of the Park while I was still employed as Curator of Mammals and Director of the National History Museum in Bulawayo.

My original survey took place over a two year period and lasted from August 1969 to June 1971 and after a considerable amount of analysis of reproductive tracts, stomach contents and taxonomic work of the specimens collected, a scientific report was written and published early 1975.

Over the period from the time that I carried out the original survey (1969/71) to the present time (1996) no follow-up of the distribution and status of the mammals of the Park had been undertaken. Therefore, I believed that it was necessary, if not essential, that an entirely new survey be carried out.

On 31st July 1995, I wrote to Mr. Willis Makombe offering my services, together with all the necessary support staff, vehicles, camp equipment etc. necessary to undertake such a project. Mr. Makombe wasted no time in replying. He was most positive and also felt that a new survey was essential. He stated the following:

> "I can safely state that I have no knowledge of any exercises carried out in Hwange in order to ascertain the population of species except for the rhino and elephant. The Department still bases its answers to questions on the population dynamics in Hwange National Park based on your 1975 book.
>
> "My answer to your questions is that, in principle, I do agree that there should be new initiatives to reveal what Hwange has with regard to mammals through structured surveys.
>
> "I therefore agree that you carry out the survey on one condition. The condition is that you agree to expose one of our young ecologists in the area to the whole process and that the young ecologist receive recognition in the final reports.
>
> "I know there is no problem with you in a simple request such as this. I am sure you are aware that many of our recently recruited ecologists have not received the assistance they need in the area of research. I, therefore, see this as an opportunity for the exposure".

Willis Makombe went on to say that he would seek the Minister's approval for such a survey and after several more letters to and from Mr. Makombe, a Research Permit was received which officially enabled me to commence the survey of the Hwange National Park. However, Mr. Makombe did indicate that the Department had no funds whatsoever to

support the survey and that I would have to obtain my own funding for the project.

We were very successful in our fund-raising drive and in the end we had sufficient funds to undertake the entire year's survey (see Acknowledgements for details of the people and organisations that supported the project).

The original idea was to cover all the mammals of the Hwange National Park as I had originally done in 1969/71 but as the survey progressed, and during the first couple of months of 1996, I could see that it was not going to be possible to cover the entire Park and all its mammals in only one year. I, therefore, decided that the survey would exclude the Orders Insectivora, Macroscelidea, Chiroptera, Pholidata, Lagomorpha, Rodenta and Tubulidentata from the list of species to be studied and that we would concentrate on the Primates, Carnivora, Proboscidea, Perissodactyla and Artiodactyla.

The reason for leaving out a number of Orders to be studied was that in order to determine what rodents, bats and other small mammal species were present in the Park we would have had to collect actual "museum type" specimens. In addition, a considerable amount of time would have been spent working at night collecting bats and rodents and we did not have sufficient time to do all that.

In addition to ascertaining the distribution of the large mammals of the Orders mentioned above during the present 1996 survey we also attempted to get some indication of the population status of the Artiodactyla, Proboscidea, Perissodactyla and some of the larger carnivores such as lion, leopard, cheetah, wild dog and hyaena.

As a result of the year long survey we now have up-to-date data on the large mammals of the Hwange National Park and it would now be worthwhile to consider a survey of the distribution and status of the small mammals, reptiles, amphibians and birds all of which are just as important as the more spectacular large mammals. It is, therefore, essential that the Bio-diversity survey of the Hwange National Park continues and that the other groups mentioned above are studied in detail.

ACKNOWLEDGEMENTS

First and foremost I would very much like to thank Mr. Willis Makombe, Acting Director of National Parks and Wildlife Management for his support for the project and for obtaining the required permission from the Hon. Chen Chimutengwende, Minister of Environment & Tourism. Without the support of these two gentlemen we would never have got the project off the ground.

In the field in the Hwange National Park I received nothing but encouragement and support from the Provincial Warden, Mr. Donald Mutape. He was one of the people who definitely read each Progress Report and always acknowledged and commented on them. He also asked questions concerning the distribution and status of the mammals in his Park and showed a great deal of interest in what was going on.

Thanks are due to the Wardens at Main Camp (Soneni Moyo), Sinamatella (Norman English), Robins (Sam Gapara) and Umtshibi (Andy Searle) for their support. Without their help we would really not have achieved as much as we did.

Thanks are also due to Beatrice Russell (Research Technical Assistant at Main Camp) and Peter Ngwenya (Research Scout) for their help with the field work. Both of them accompanied our survey team on numerous occasions into the field.

We also received a great deal of help with the field work from numerous other people. Perhaps those that helped most during the year were the teams of Val Fielder and Sandy McAdam and the second team of Laraine King and Debbie Trivella. These four ladies were unbelievable as they made a determined effort to get up to Hwange every month of the year. As a result, they covered hundreds of kilometres of marked transects and helped in many other ways.

Other people who also helped a great deal and especially with the covering of marked transects included Wally Higgs, Dee Higgs, Aubrey Pakenham, Debbie Grant, Bill King, Tony Hunt, John Fielder and last but by no means least my wife Paddy Wilson.

As far as the aerial surveys were concerned, Pat Cox of Harare was kind enough to fly me around on numerous long transects throughout the Park and his knowledge of the Park was unbelievable. In addition, Val Fielder, Kevin Wilson, Nicky Wilson and John Fielder also participated in the aerial surveys.

I was also fortunate to participate in the National Parks Annual Aerial Survey of elephant and other large mammals in the Hwange Park during September 1996 and I thank Clare Davies and Colin Craig for their support and for permission to use their data in this report.

Andy Searle very kindly flew me around in the National Parks helicopter and we covered vast areas of the central section of the Park. The helicopter flights took us into many areas where there were no roads and as a result we obtained a much clearer picture of the distribution and status of many of the mammals in the Park. We were also able, from time to time, to check the pans from the air to determine which pans still had water in them. However, it would not have been possible to use the National Park's helicopter without having to pay for flying time. Our project was, in the beginning, required to pay $850 an hour for the use of the helicopter and towards the end of the year the cost was increased to $1,000 an hour.

The aerial surveys by helicopter was only made possible with financial support from the Royal Netherlands Embassy in Harare. They kindly provided funds to hire the helicopter and for fuel for our three vehicles used during the survey and also for the maintenance

and repairs of the vehicles. A very special thanks is therefore due to Dr. Rob Visser of the Royal Netherlands Embassy for obtaining the funds for the survey and to Peter Kunjeku of the Wildlife Society for administering the funds.

I am also grateful to Amtec Motors and especially George Nyabadza and Brian Stevenson for the loan of a Kia vehicle which was used by our survey team. The vehicle proved to be very useful and we were delighted that the two gentlemen mentioned above considered our survey worthy of support.

During a long "trek" into the southern and central parts of the Park I had the pleasant company and support of Val Fielder, Sandy McAdam, Carl Schmahl, Keith Stewart, John Fielder and Pat Cox. They all helped a great deal with various transects and more often than not had the worst roads allocated to them which they covered without complaining. I also thank them most sincerely for using their own private vehicles during the survey and they also covered their own fuel costs.

Allan Elliott, M.P. for Hwange and Managing Director of "Touch the Wild" Safaris, very kindly agreed to sponsor our year long survey by providing $1 500 each month for fuel costs. His very generous offer was greatly appreciated and without his help we really would have had a financial problem.

The Matabeleland Branch of the Wildlife Society, through its Chairman, Colin Gillies, very kindly allocated funds to repair our old Landrover and to get it in proper running order ready for the survey. I am most grateful to the Society for their tremendous help. A great deal of help in getting the vehicle repaired was through the support of Jan Kappeyne and his colleagues. Mark Honman and his father Buster Honman and cousin Adam Shannon also did a considerable amount of work on the vehicle and to all of them many thanks indeed.

Craig Biddlecombe of Premier Products kindly helped fit an observation hatch in the canopy of the Landrover and Ken Hansen of Sabat Batteries provided a new battery for the vehicle. Alan Goodman and Gary Ainscough of Simms Electrical and Diesel Services attended to all the electrical repairs and rewired much of the vehicle while Kit Bowie of Bowie Tyres helped with new tyres.

Dennis Scott and Allan Baker of William Smith and Gourock were wonderful in providing some camp equipment for the fieldwork and Mike Maguire of Bonar Industries also provided us with camp equipment.

Wally Higgs, of Samuel Osborn kindly arranged licences and insurance for the Landrover and Ursula Dare of Phoenix Brushware donated brushware and plastic goods. To both of them I am most grateful.

M.H. Esat of Esats Supermarket provided us with tin trunks for our camping excursions in the Park and Allan Forrest of Typocrafters kindly donated two field journals and Brian Hanbury of Advance Wholesalers supplied us with some groceries for our field staff.

The late Robbie Roberts and his partner S. Mugezi of Multisigns kindly undertook the signwriting jobs on our vehicle and to them I was most grateful.

The Trustees of the Chipangali Wildlife Trust are thanked most sincerely for allowing me time to undertake this year long survey and they paid my salary for the full year. The Chipangali Wildlife Trust (Research Branch) contributed tens of thousands of dollars towards the project and to the Trustees I am most grateful. They also agreed that I could use two of the Chipangali vehicles for the fieldwork and I was delighted to see that three of the Trustees, namely Peter Rollason (Chairman), Wally Higgs and Aubrey Pakenham

could find time to visit the survey team in the field. Their encouragement and support was greatly appreciated.

My driver Collen Khumalo and cook Adam Ntini were unbelievably helpful and I thank both of them for their support.

My secretary Yvonne Walker not only did all the computer work and helped produce this report but she also attended to all my correspondence and queries during my year long absence in the field. Pam Mason, my Research Assistant, helped a great deal with many aspects of the analysis of the field data, helped produce maps and tables and carried out the Bibliography survey. To both ladies a great many thanks.

My son Kevin and his wife Nicky also assisted in many ways and it was a pleasure having them help in the field on several occasions.

Special thanks are also due to Eric Coetzee of Automated Office Systems and Services for producing 60 copies of this report, printed on a RISO Digital Printer.

Last and by no means least has been the incredible help from my wife Paddy. Not only did she spend the entire year in the field with me but she also acted as driver, covered marked transects, prepared maps, attended to visitors and V.I.P's, helped evaluate data for the final report and also helped prepare meals. To Paddy, many thanks indeed.

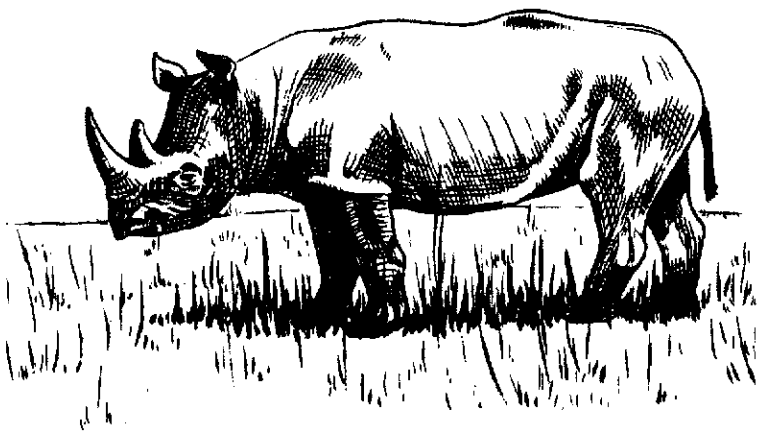
DURATION OF SURVEY

The fieldwork commenced during the first week of January 1996 and continued until 31st December 1996. Therefore, a full year was spent in the Park and consequently covered all the seasons of the year. However, a number of trips were made back to Bulawayo from time to time to deal with other projects and to attend to correspondence etc.

In addition to the survey work done during the hours of daylight, additional time was spent on an open vehicle with a spotlight at night searching for nocturnal animals, especially small carnivores.

This report on the results of the survey was written during January, February and March 1997. Therefore, the entire length of time allocated to this survey and the production of the report was 15 months.

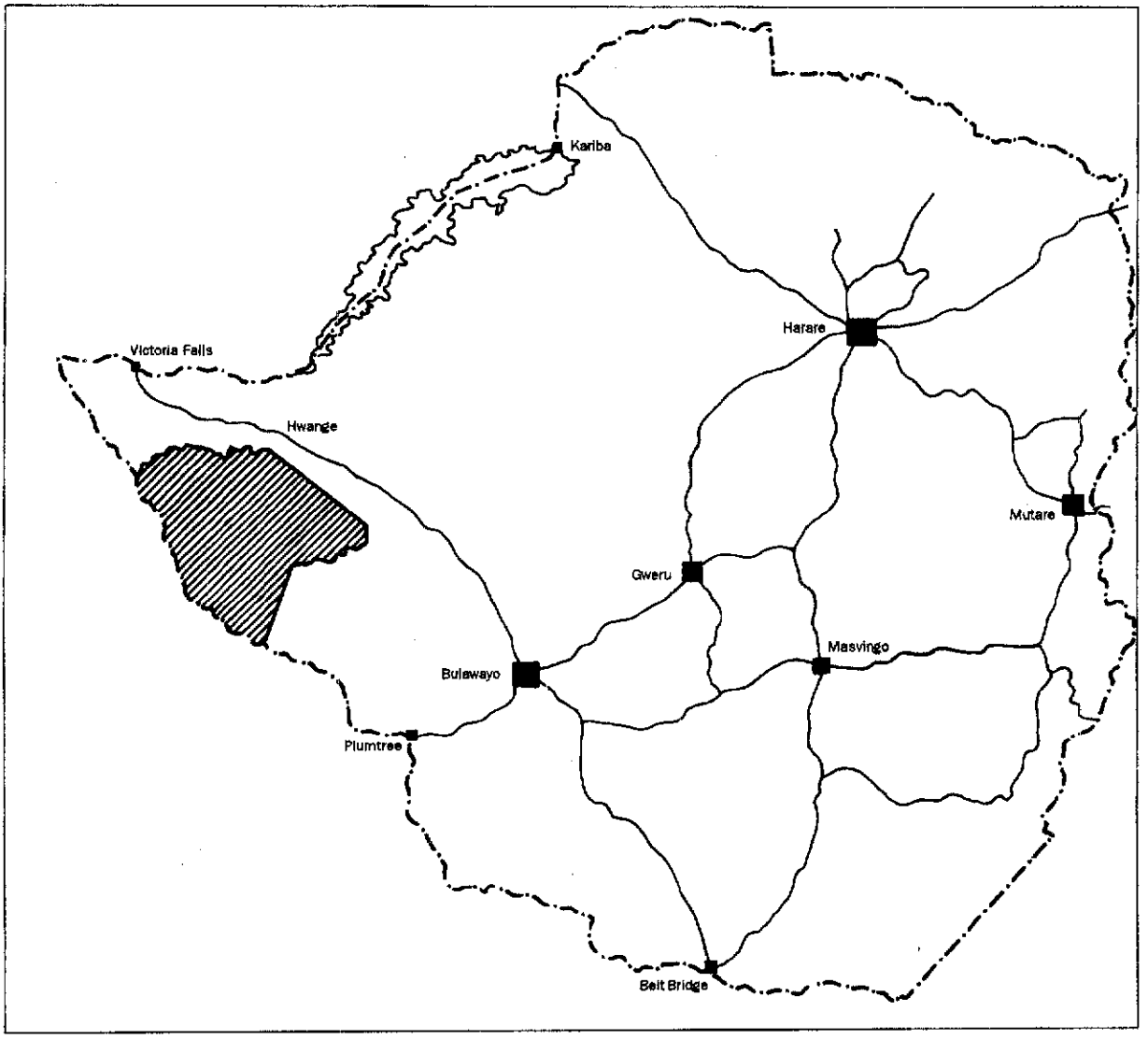
Finally the production of this report, in only three months, would not have been possible without the full time assistance of Yvonne Walker, Pam Mason and my wife Paddy.



DESCRIPTION OF HWANGE NATIONAL PARK

Location

The Hwange National Park is situated between latitudes 18°30' and 19°50' south and longitudes 25°45' and 27°30' east. The National Park lies in the north-west of Zimbabwe in the province of Matabeleland North and is the largest National Park in the country. It covers an area of about 14 600 square kilometres and is bounded to the west by Botswana. The Matetsi and Deka Safari areas lie north of the Park and in the south the Tsholotsho Communal land. To the south-east lies various State Forest Reserves and private land (Map 1).



Map 1 - Map of Zimbabwe showing situation of Hwange National Park

Topography, geology and soils

Topography

The most important and significant topographical feature of the Hwange National Park is unquestionably the watershed (Wilson 1975).

The Park lies astride this watershed which clearly divides the Zambezi drainage basin to the north from the Makadikadi basin to the south. To the north of the watershed the

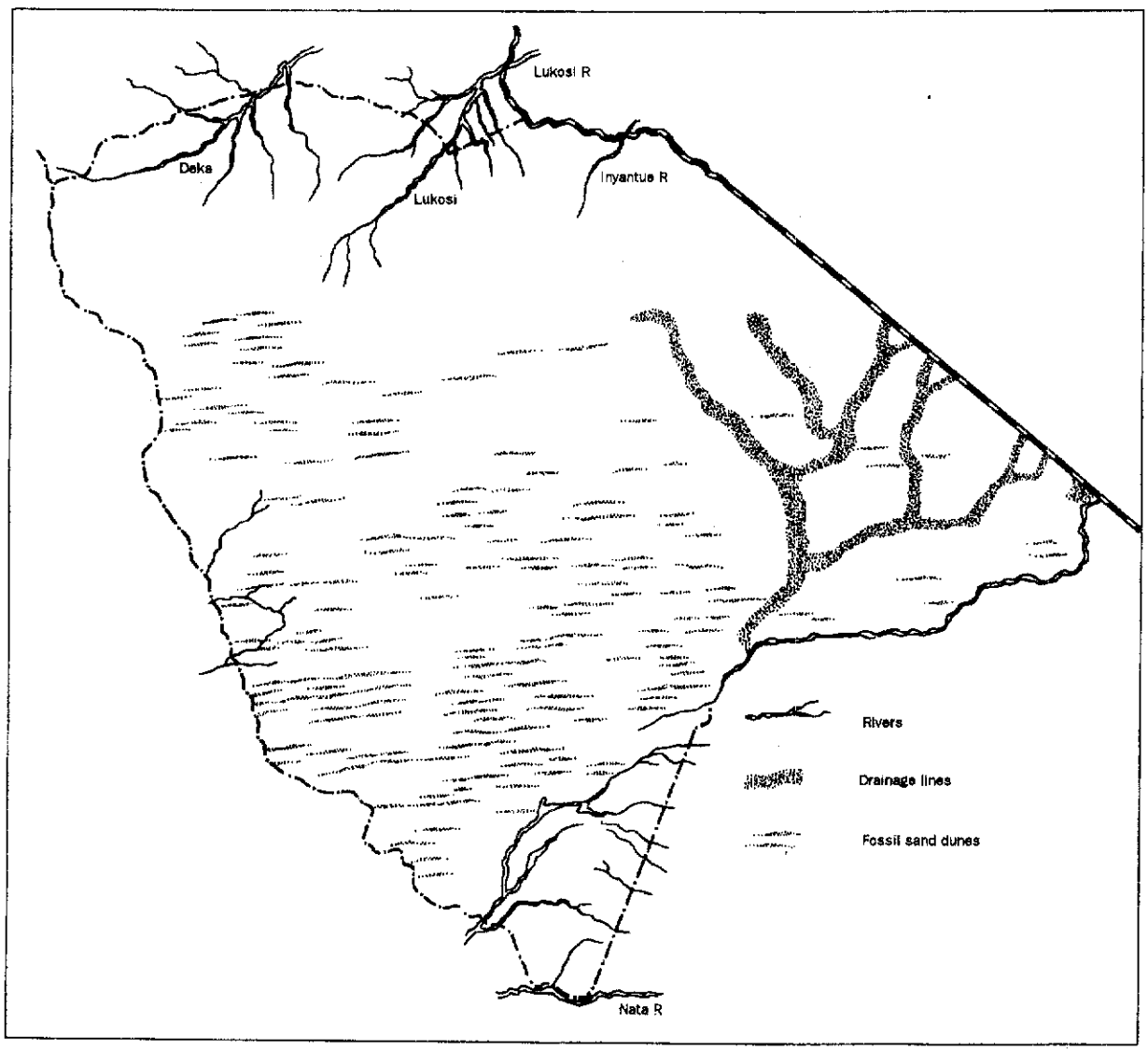
northern facing slopes are drained by the Deka and Lukozi Rivers and also some of the smaller tributaries of the Gwaai River.

While the Hwange National Park is essentially a flat area, the country becomes more broken in the north with an altitude of about 1,000 m above sea level, and ranging from 840 m on the Deka River to about 1,153 m at Bumboosi.

The southern limit of the Deka basin is marked by a low escarpment while the top of the watershed is marked by flat country where the altitude ranges from 1,070 m to 1,100 m above sea level (Jones 1989).

South of the watershed which is very wide and flat, drainage is limited to fossil drainage lines and there are no major rivers. In this area there are a vast number of seasonal pans and one of the main features of the area is the remnants of long east/west orientated fossil sand dunes. Some of these sand dunes run for over 25 km in the east-west direction (Map 2).

The Manga, Triga, Linkwasha and Summamalisa open grassy vleis are all fossil drainage lines and they are all pronounced features.



Map 2 - Map of Hwange National Park showing main rivers and other drainage lines

In the extreme south-west of the Hwange National Park, in the Dzivanini area, the altitude drops to about 940 m above sea level and in this area of seasonally inundated mud flats there are another two small rivers, namely the Gwabazabuya and Dzivanini. These seasonal streams flow into the Nata River and south-west into Botswana.

Geology and soils

There are four main geological types in the Hwange National Park. These are the vast areas of Kalahari sands which cover two thirds of the Park, the Batoka Basalts in the Dzivanini and Robins areas, the Karoo sediments which are most noticeable in the Sinamatella area and the Pre-cambrian rocks lying south and west of Sinamatella (Map 3). The soils of any area obviously reflect the underlying geology. Each of the four main geological types are discussed in more detail below.

Kalahari Sands

The aeolian sands cover over two thirds of the Hwange National Park stretching from Main Camp to the Botswana border (Map 3). The aeolian deposits (sands) are an accumulation of windblown sand and dust and in Hwange these deposits cover the same karoo bedrocks that are exposed in the northern sections of the Park.

The entire southern African subcontinent is very much like a vast shallow basin raised around the edges with a huge shallow depression lying in the interior. In this vast area many millions of tons of rock have, over a period of millions of years, been worn down into sand grains.

As a result of the low rainfall and consequently very little runoff the sands and grains were not washed away by large rivers into the oceans. Consequently the area of lakes and small rivers were silted and clogged and the Kalahari sands were blown around by the prevailing winds (Greaves 1996). These deposits of Kalahari sands have been shaped by wind considerably since its original deposition by successive periods of wet and dry climates.

The fossil sand dunes already mentioned above are but one example of the action of wind. As a result of long dry and arid periods, the wind blew the sand into a series of long parallel dunes in an east-west direction. At one time these sand dunes were much higher than they are today where they are now seldom more than 20 m in height while the crests of these dunes lie about 1.5 km apart. (See Map 2). As I flew over the area in a helicopter the long ridges of the dunes were most noticeable especially as they are now fixed with vegetation. These depressions or troughs between the fossil sand dunes are also very pronounced especially as they support long lines of dozens of small pans.

It is generally believed that the fossil sand dunes were formed about 18,000 to 13,000 years ago (Thomas 1983) and the ensuing wet period saw the formation of streams which eroded the Kalahari sands in the north of the Park and also at Dzivanini. (Rogers 1993; Flint & Bond 1968).

Broderick (1984) indicates that the aeolian Kalahari sands are about 60 m in depth but in some places, and especially in the central area, may be up to 150 m deep.

There are also, in places, and especially lying in the depressions between the fossil sand dunes, an area of impervious hard pans at varying depth which is a significant edaphic factor. (Rogers 1993).

In some of these areas there are places where clayey loam soil occurs which has an underlayer of limestone. This is particularly noticeable in the Linkwasha, Kennedy, Dopi, Manga and Main Camp areas (Wilson 1975).

The redistribution of the original sand deposits through wind and water have led to the accumulation of some clays and silts in the inter-dune troughs and other drainage lines and the calcrete in the fossil lake basins have a modifying effect (Jones 1989).

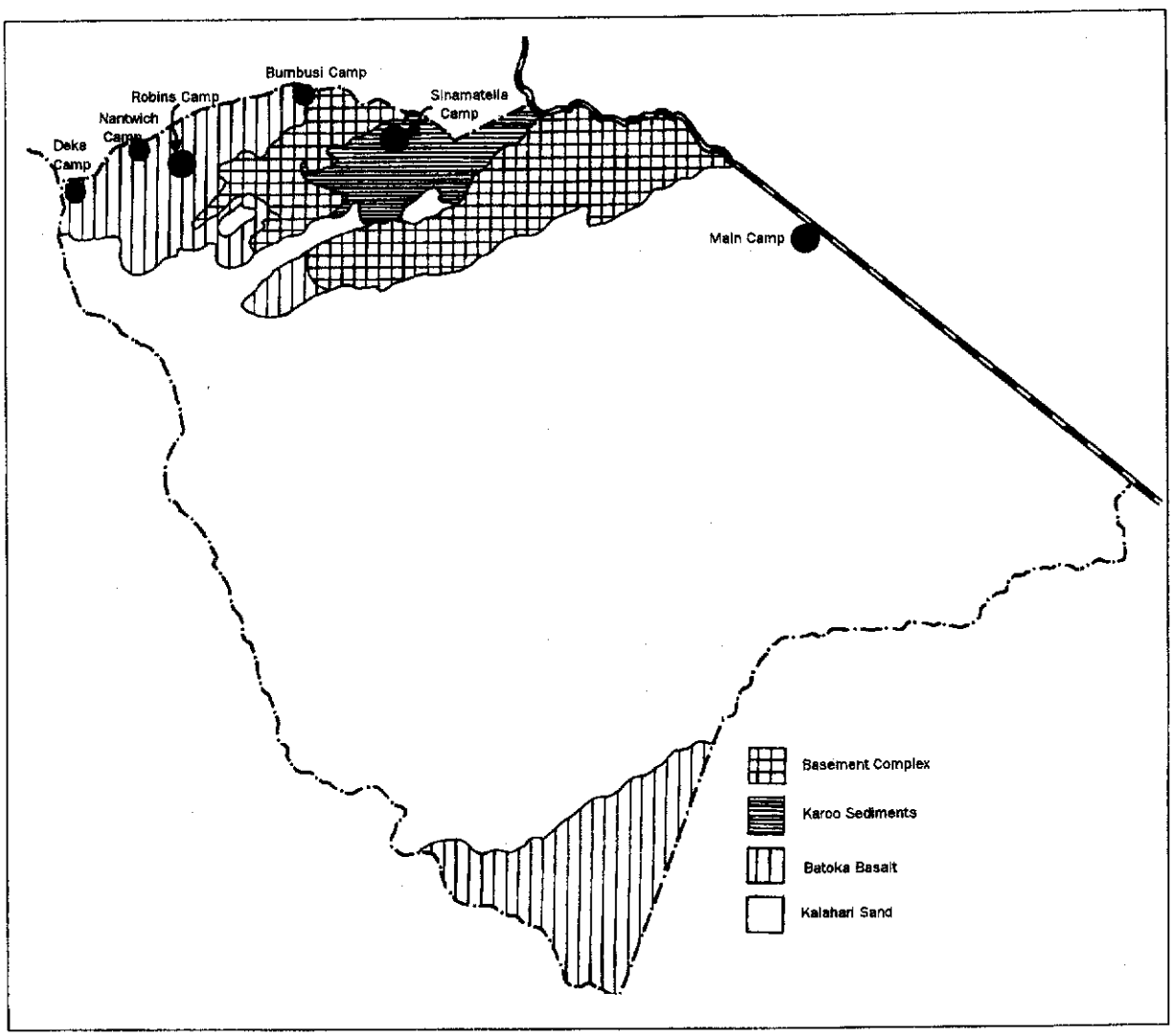
These calcrete deposits are of recent geological formation in the Kalahari sands of Hwange National Park. Calcrete consists mainly of lime precipitated from soil water where the rainwater becomes saturated in carbonates produced by chemical weathering (Greaves 1996). Greaves has pointed out that as it percolates through the sands some is deposited below the surface and as a result cements the soil together.

It is in these areas where the calcrete lies close to the surface that wildlife will dig or scrape in order to obtain salt and other minerals. As a result of thousands of years of utilisation by wildlife, pans have been formed.

BATOKA BASALTS

Batoka basalts are of Jurassic age in the Robins and Dzivanini areas and occur as horizontal lavas divided by a layer of sandstone into a lower and upper part (Rogers 1993). In the Dzivanini area the Batoka basalt underlies the shallow Kalahari sands which according to Harrison (1978) and Broderick (1984) vary between 1.5 m and 50 m in depth.

In the basalt areas the soils are mainly red clay lithosols with limited areas of moderately



MAP 3 - Geology of the Hwange National Park

deep to shallow self churning vertisols in some drainage lines and upland situations (Rogers 1993). In these basalt areas the country is undulating rocky terrain in places and dissected by numerous small streams.

There are extensive flat areas of deep black self-churning clays which are derived from basalt in certain areas in the Robins area, the Dandari vlei and in the Dzivanini Mudflats. (See Map 3).

Karoo Sediments

The Karoo sediments of the Hwange National Park lie in the Sinamatella area especially to the south of the Sinamatella Camp. The geology of this area is very complex and additional details of its composition has been described by Watson (1960).

Madumabisa mudstones are overlain unconformably by Escarpment Grits. These mudstones are well exposed in the Sinamatella area and the grits form the hard caps of the steep sided escarpment so typical of the area and especially of the Sinamatella hill itself.

Below these Madumabisa mudstones lie the Upper and Lower carbonaceous mudstones and Hwange sandstones. Soils of the Karoo sediments are generally shallow clays with limited areas of vertisoles and much alluvium along the main water courses in the area.

The Sinamatella escarpment on which the camp is situated rises from the generally flat country and this is capped by a layer of sandstone. The general area is one of flat to undulating country dissected by many small streams and some large rivers.

Pre-Cambrian Rocks

The soils derived from the Basement Complex geology are predominately sandy lithosols and some areas of deeper pockets of siallitic soils. There are also vast areas of rocky outcrops of castle kopjes and areas of sandy clay soils on the flat areas in between the kopjes (Rogers 1993).

The Pre-Cambrian rocks are "supra-chrystal" belts separated by expanses of granite gneiss (Lockett 1979; Rogers 1993). The "supra chrystal belts" are the Malaputese, Inyantue and Tshontanda Formations. While the Malaputese Formation is composed of quartzite and metapelites and pink paragneiss, the Inyantue and Tshontanda Formations are mainly composed of various schists, gneisses and quartzites.

The area of Pre-Cambrian rocks lying west of Sinamatella (See Map 3) have been described by Watson (1960) as composed mainly of hard flaggy red-brown quartzitic sandstones overlying coarse white sandstones.

Climate

Rainfall

Rogers (1993) has given the average annual rainfall of the Hwange National Park as 620 mm but mentions that this varies across the Park from 570 mm at Sinamatella to 652 mm at Main Camp. There is apparently a decrease in rainfall as one approaches the Botswana border and in the south of the Park.

The average annual rainfall at Main Camp has varied between 336 mm to 1,160 mm between 1918 and 1990. The mean monthly and annual rainfall taken from daily rainfall records from Main Camp, Sinamatella and Robins areas are given in Table 1. These means are based on 71 years of records for Main Camp/Dete Railway Station, 61 years from Robins Camp and 68 years from Sinamatella/Hwange Police Station (Jones 1989).

Most of the rain in the Hwange National Park falls between the months of November and March but some rain does fall at other times of the year although the amounts may be

Table 1 - Mean monthly and annual rainfall in Hwange National Park (after Jones 1989)

	Main Camp				Robins				Sinamatella			
Month	Mean	sd	min	max	Mean	sd	min	max	Mean	sd	min	max
July	0.1	0.3	0.0	2.5	0.1	0.3	0.0	2.5	0.0	0.2	0.0	1.3
Aug	0.3	1.4	0.0	8.1	0.7	4.0	0.0	30.5	1.1	7.7	0.0	64.0
Sept	3.9	8.7	0.0	45.7	2.0	4.5	0.0	17.8	1.7	4.2	0.0	26.7
Oct	20.3	24.6	0.0	104.1	18.7	25.9	0.0	137.1	15.0	20.3	0.0	96.0
Nov	69.8	35.7	3.3	160.3	68.0	48.2	0.0	210.4	55.9	32.8	1.5	144.3
Dec	142.2	80.6	31.9	438.0	148.9	100.3	16.5	643.9	135.9	76.8	12.2	362.2
Jan	164.6	87.3	29.2	539.2	152.3	93.1	27.0	447.3	149.5	85.2	27.9	418.3
Feb	137.5	88.8	13.2	483.6	131.7	90.7	22.6	409.2	129.5	84.6	23.0	425.0
Mar	85.4	66.7	1.5	278.7	75.0	61.7	0.0	307.8	75.7	63.4	0.0	253.7
Apr	24.2	27.6	0.0	127.4	26.2	27.0	0.0	109.2	21.1	22.1	0.0	83.8
May	4.8	8.1	0.0	41.9	5.0	12.0	0.0	69.5	4.4	9.0	0.0	38.6
Jun	0.3	0.8	0.0	4.0	1.0	3.5	0.0	22.9	0.5	2.0	0.0	15.2
Annual	653.2	187.4	335.6	1156.3	629.6	199.1	305.3	1273.9	590.4	168.7	261.5	1138.1

insignificant. The annual rainfall in the Main Camp area is significantly higher than at Sinamatella. However, even though Robins Camp is closer to Sinamatella the rainfall in the area is no different to that of other stations (Jones 1989).

The pattern of rainfall in the Hwange National Park, which is very seasonal, obviously causes marked contrasts to the vegetation and these bring with them great changes in the behaviour of the large mammals of the Park.

While the rainy season usually commences in November each year, after a very hot period in September and October, the commencement of the rains varies from year to year. Hwange's rainfall is indeed most unreliable. While the annual average for the Park may be 640 mm per annum the variation from year to year can be enormous. For example, during the 1923/24 rainy season only 362 mm of rain fell whereas three times that amount was recorded in 1973/74 when over 1,160 mm was recorded. There are on average about 75 days during the rainy season when rain falls and very often these are in the form of local thunderstorms.

During periods of low rainfall which appears to be about once every 5 years the runoff into the seasonal pans, rivers and streams can be very low. It is during these dry periods that wildlife is effected a great deal and considerable pressure is brought to bear on the places where water is present. This will be discussed in greater detail under Pans and Waterpoints.

TEMPERATURES

The mean monthly maximum temperatures recorded at Main Camp range from 24°C in June to a 33°C high in October (Rogers 1993). The mean maximum and minimum screen temperatures recorded at Main Camp since 1951 are given in Table 2.

October is the hottest month of the year with the average temperature at Main Camp being 32°C. On the other hand, July is the coldest month of the year and the average screen temperature at Main Camp since 1951 being 4.6°C. There is also a great variation in daily temperatures which is about 20° in midwinter to about 13° in midsummer (Jones 1989).

Frost also occurs in the Hwange National Park from time to time especially during the months of May to August. During these periods temperatures drop to a ground minimum of -5°C or even lower. Black frosts which are usually lower than -7°C also occur approximately once every 5 years (Rogers 1993). The average number of frost days, in

Table 2 - Mean monthly maximum and minimum screen temperatures at Main Camp (after Jones 1989)

Maximum	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Mean	24.5	27.3	31.0	32.8	31.4	29.4	29.1	28.8	29.0	28.4	26.6	24.3
SD	1.0	1.1	0.9	1.1	1.6	1.9	1.8	1.7	1.7	1.6	1.3	1.0
Min	22.7	25.1	28.3	31.1	28.6	25.6	26.3	25.9	26.4	25.0	23.7	22.8
Max	26.7	30.0	32.8	35.0	35.2	34.5	33.3	34.1	33.0	32.0	28.7	26.9
n	36	36	36	36	36	35	36	36	36	35	33	33
Minimum												
Mean	4.0	6.7	11.8	16.1	17.6	18.0	17.9	17.7	16.3	13.4	8.1	4.5
SD	1.5	1.3	1.3	1.2	0.9	0.8	0.8	0.7	1.1	0.9	1.1	1.6
Min	0.5	4.4	8.0	11.7	15.9	15.6	16.7	16.5	122.6	11.7	5.6	0.3
Max	7.2	9.6	14.7	18.7	19.2	19.8	19.8	19.1	18.5	15.7	10.3	7.7
n	36	36	36	36	36	36	36	36	36	35	35	35

other words days when the minimum ground temperature drops to 0°C or less, is about 32 per year. The lowest ground minimum temperature ever recorded in Hwange was -14°C in 1971.

Table 3 gives details of the ground minimum temperatures recorded at Main Camp for the months of May to August since 1971 (after Jones 1989).

Table 3 - Ground minimum temperatures recorded at Main Camp (after Jones 1989)

	May	Jun	Jul	Aug	Frost Days	Black Frost Days	Lowest Temp
Mean	4.9	1.1	0.5	3.1	32.0	0.8	-5.9
SD	1.6	2.0	1.7	2.2	21.4	2.1	2.6
Min	1.4	-3.2	-3.2	-2.3	7.0	0.0	-14.4
Max	8.0	4.0	3.5	6.7	91.0	9.0	-2.0
n	16	17	16	16	17	17	17

VEGETATION

In a very detailed survey of the woody vegetation of the Hwange National Park (Rogers 1993) classified no less than 30 different woody vegetation types in eleven groups. Five of the groups, representing 16 types of vegetation were associated with non-Kalahari sand environments on Basalt, Basement Complex and Karoo sediments. Most of these vegetation types occurred on shallow soils.

The remaining six groups representing 14 vegetation types were located on Kalahari sands. It was found during her survey that about three-quarters of the Hwange National Park was covered by Kalahari sand vegetation types and only a quarter by non-Kalahari vegetation types (Rogers 1993).

Table 4 gives details of the areas, in square kilometres, of each of the 16 non-Kalahari sand vegetation types occurring in the Park and that covers an area of 3,518.74 sq. km or 24.65% of the entire Hwange National Park (Rogers 1993).

Table 5 shows the 14 vegetation types of the remaining 6 groups found on Kalahari sand. These 14 vegetation types cover 14,272.76 sq. km of the Hwange National Park with 34% of the entire National Park, or 45% of the Kalahari sand area found to be covered by

Table 4 - The areas in square kilometres, of each non-Kalahari sand vegetation type (after Rogers 1993)

Type	(abbreviated name)	Area Square km	% of total area
Type 1	Combretum - Boscia angustifolia open scrub and thicket	14.98	0.10
Type 2	Mopane - Acacia woodland	163.70	1.15
Type 3	Mopane - Commiphora marlothii	8.67	0.06
	Total area of Group A	187.35	1.31
Type 4	Castle kopje mixed woodland	179.07	1.25
Type 5	Mopane-Julbernardia wooded bushland	308.24	2.16
Type 6	Combretum-Baphia thicket	366.82	2.57
	Total area of Group B	854.13	5.98
Type 7	Mopane-Combretum woodland	469.14	3.29
Type 8	Mopane-T. prunioides woodland	120.35	0.84
Type 9	Mopane-C. elaeagnoides thicket	102.82	0.72
	Total area of Group C	692.31	4.85
Type 10	Riverine vegetation	92.82	0.65
Type 11	Mopane-Acacia-Combretum grassland to woodland	216.73	1.52
	Total area of Group D	309.55	2.17
Type 12	Mopane-C. hereroense bushed grassland to bushland	592.36	4.15
Type 13	Mopane-Combretum bushland	322.92	2.26
Type 14	Mopane bushland	188.60	1.32
Type 15	Mopane-Vepris zambesiaca woodland	(mapped with Type 8)	
Type 16	Mopane-Acacia-Grewia bicolor stunted woodland	371.52	2.60
	Total area of Group E	1475.40	10.34
Total area of non-Kalahari sand vegetation		3518.74	24.65

Notes: Details of the Table above were extracted from Rogers (1993) page 22.

Kalahari sand bushland types, while just over 9% of the entire Park was found to be covered by Kalahari grassland and bushed grassland types (Rogers 1993).

On the Kalahari sands, bushed grassland comprises 12% of all vegetation types, however only a very small part of Hwange National Park is covered by pure grasslands and this represents only 0.6% of the Park. A very detailed analysis of the woody vegetation of the Hwange National Park has been undertaken and published by Rogers (1993). Therefore there was no necessity to undertake additional work on vegetation during my 1996 survey. In the section on vegetation, which now follows, I should make it clear that all the details have been extracted from Rogers (1993). However, a much more simplified and modified map of the vegetation of the Hwange National Parks is given in Map 4.

Non-Kalahari Sand Vegetation Types

Group A - Woodland thicket types on Lower to Upper Karoo sediments

The three communities within this group are confined to small areas in the Sinamatella region, occurring on both sandstones and mudstones of the Karoo Series. They cover an area of 187.35 square kilometres.

Colophospermum mopane and *Diospyros quiloensis,* although rarely dominant, are most often represented in the group. *Canthium glaucum, Combretum elaeagnoides, C.*

Table 5 - The areas in square kilometres, of each Kalahari sand vegetation type (after Rogers 1993)

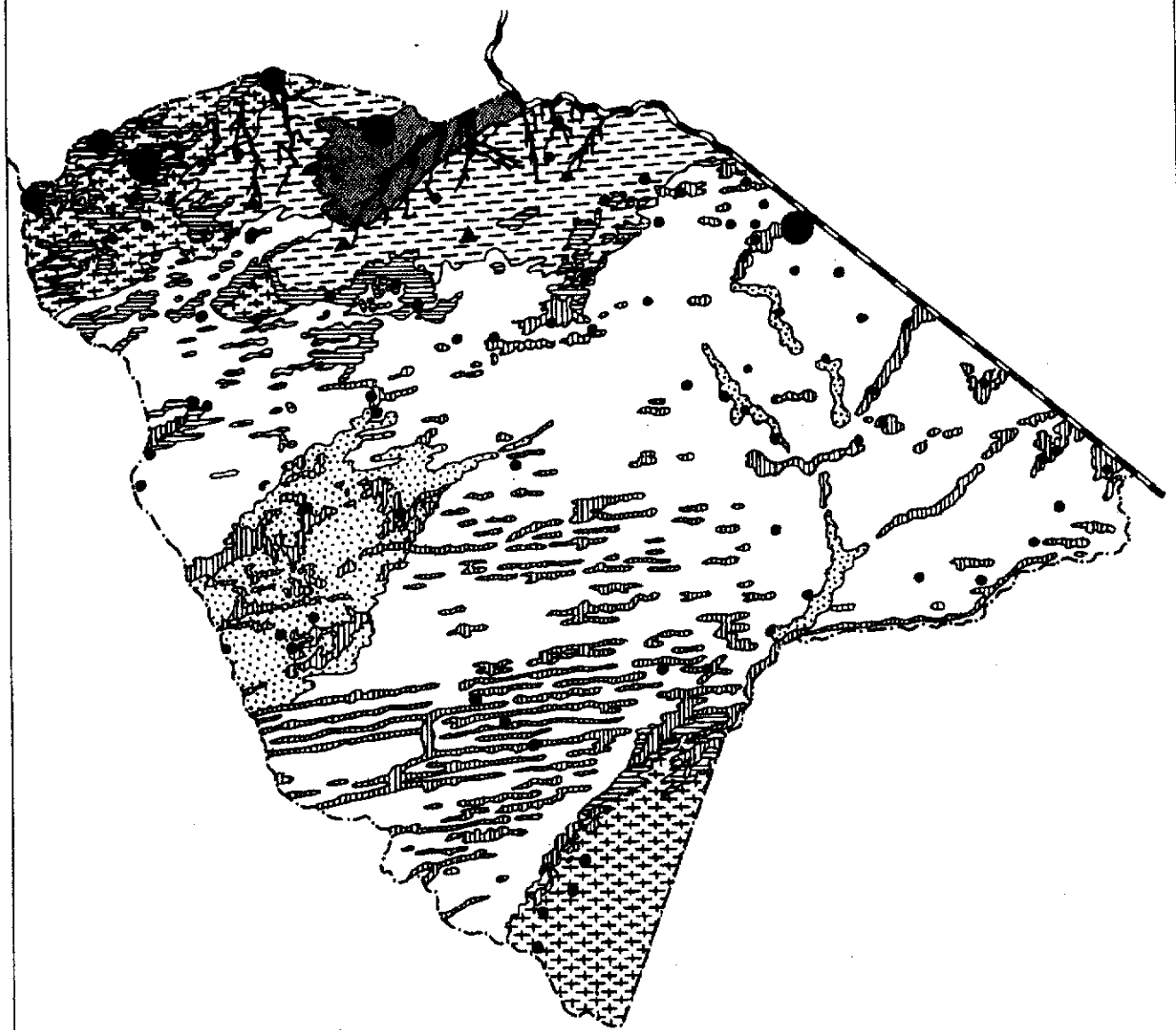
Type	(abbreviated name)	Area Square km	% of total area
Type 17	Mopane woodland-Combretum bushed grassland mosaic	185.83	1.430
Type 18	Acacia-Boscia albitrunca-Mopane bushed grassland	781.81	5.48
Type 19	C. hereroense-Hyphaene bushed grassland	334.33	2.34
	Total area of Group F	1301.97	9.12
Type 20	Acacia-Munulea sericea bushland	967.21	6.78
Type 21	T.sericea-L.nelsii bushland	781.98	5.48
Type 22	Mopane-C. apiculatum wooded bushland	28.32	0.20
Type 23	Baikiaea-Combretum woodland	1329.07	9.31
	Total area of Group G	3106.58	21.76
Type 24	T. sericea-A. erioloba bushland	258.28	1.81
Type 25	T. sericea-Baikiaea bushland	2572.44	18.03
	Total area of Group H	2830.72	19.83
Type 26	Burkea africana-Pterocarpus angolensis bushland and woodland	1336.77	9.37
Type 27	Baikiaea-Guibourtia woodland	603.96	4.23
Type 28	Baikiaea-Croton gratissimus woodland	411.43	2.88
	Total area of Group 1	2352.16	16.48
Type 29	Ecotone Baikiaea-Commiphora mossambicensis woodland and thicket	855.42	5.99
	Total area of Group J	855.42	5.99
Type 30	Burkea africana-T. brachystemma bushland	221.82	1.55
	Total area of Group K	221.82	1.55
Total area of Kalahari sand vegetation		10668.67	74.75
Total area of all woody vegetation types		14187.41	
Grassland		84.92	0.59
Mandavu Dam		0.43	0.00
Total area of Hwange National Park		14272.76*	
Notes:	* This is the area of Hwange National Park up to the road which runs north-south along the inside edge of the Zimbabwe-Botswana border.		

Details of the Table above were extracted from Rogers (1993) page 23.

mossambicense, Markhamia zanzibarica and *Acacia ataxacantha* are common.

TYPE 1 *COMBRETUM - BOSCIA ANGUSTIFOLIA* OPEN SCRUB AND THICKET ON LOWER KAROO SANDSTONE.
This scrub or thicket type occurs as small islands of vegetation. It can be seen on low, elongated dome-shaped, sandstone ridges on the eastern sies of the Masuma and Mandavu Dam. This type can be recognised as either open scrub or thicket (2 to 4 m tall) often dominated by *Combretum elaeagnoides, C. apiculatum, C. celastroides* and *C. collinum* with scattered *Lonchocarpus eriocalyx.*

Other common species include *Diospyros quiloensis, Colophospermum mopane, Canthium pseudorandii, Combretum collinum* and *Boscia angustifolia* var. *corymbosa.* Indicator species are *Canthium pseudorandii, Combretum collinum* and *Abrus schimperi.*



Mopane bushland on Basalt. Open to medium density bushland on rocky, undulated to flat terrain interspersed with seasonal streams and open grassland, some of which are flooded in the rainy season.

Mopane wooded bushland, woodland and thicket on rocky, dissected terrain with castles kopjes in some areas. High plant species diversity

Mopane woodland and mixed species thickets on clay and sandstone. Flat to undulating terrain with steep-sided hills (such as the area on which Sinamatella Camp is situated).

Terminalia - Acacia bushed grassland and bushland on sandy clay soils in fossil viei line depressions. Seasonal pans common.

Grassland and bushed grassland (sometimes bushland) in fossil viei lines, fossil dune depressions and pan depression areas.

Mopane bushed grassland to bushland mainly confined to the watershed on seasonally waterlogged soils. Often found in ecotone areas i.e. where different vegetation types and geological strata meet.

Zambezi Teak woodland and Terminalia bushland on Kalahari Sands. Medium to dense vegetation on flat to undulating terrain, covering extensive areas.

Map 4 - A much simplied map of the vegetation of the Hwange National Park.
A comprehensive map of the vegetation can be found in Rogers (1993)

TYPE 2 *COLOPHOSPERMUM MOPANE* - *ACACIA* WOODLAND ADJACENT TO RIVERINE VEGETATION

This mopane woodland is found in the low lying Madumabisa mudstone areas adjacent to the riverine vegetation of watercourses such as the Lukozi River and its tributaries.

This type is less diverse than other types in this group, and commonly includes *Diospyros quiloensis, Dichrostachys cinerea, Combretum mossambicense, Terminalia prunioides, Erythroxylum zambesiacum, Acacia robusta* and *Acacia ataxacantha* in the well developed understorey. The indicator species *Acacia robusta* is generally associated with seasonally moist habitats in Hwange National Park.

TYPE 3 *COLOPHOSPERMUM MOPANE* - *COMMIPHORA MARLOTHII* MIXED WOODLAND ON SCREE SLOPES.

This community or vegetation type is easily identified since it occurs only on steep scree slopes of escarpments of Karoo formations in the Sinamatella area. This species rich community (81 species) is a thicket or woodland thicket type, with no one species dominant. Almost always present are *Colophospermum mopane, Markhamia zanzibarica, Canthium glaucum, Combretum elaeagnoides, Grewia flavescens* var. *flavescens* and *Diospyros quiloensis.*

This type occurs on lithosols of the steep scree slopes of escarpments in the Sinamatella area. The species of woody plants found in this habitat are those which are thicket forming on rocky soils. The most common trees are usually found on rocky outcrops or in rocky areas, such as *Commiphora marlothii* and *Sterculia africana.*

GROUP B - MIXED BUSHLAND, THICKET AND WOODLAND ON BASEMENT COMPLEX FORMATIONS.

This group of vegetation types is found in the Sinamatella and Robins sub-regions and in the north western area of the Main Camp sub-region, mainly on the Basement Complex.

The group is the most species rich in the Park (185 species). Most of the species present are generally found in rocky habitats or can be found in the middle to highveld where conditions are more moist. For example *Afzelia quanzensis, Strychnos madagascariensis, Lannea discolor* and *Catunaregam spinosa* (*Xeromphis obovata*) are typically found in rocky areas, and *Diplorhynchus condylocarpon, Brachystegia boehmii, Euclea divinorum* and *Terminalia sericea* are frequently present in areas of higher rainfall.

TYPE 4 CASTLE KOPJE MIXED WOODLAND AND THICKET

This type is widespread in distribution in the Sinamatella area, occurring in the Mambanje area north west of Dete and on 2 km wide north-east, south-westerly oriented series of rocky kopjes. It is also found west of Sinamatella Camp on and around Bumboosie Hill on Basement Complex.

This is the most diverse of all the vegetation types in the Park (156 species). The community is generally mixed woodland and thicket with *Colophospermum mopane, Combretum apiculatum, Commiphora mossambicensis, Diospyros quiloensis, Erythroxylum zambesiacum, Kirkia acuminata* being most commonly represented.

The indicator species of the type are *Bridelia mollis, Commiphora karibensis, Elephantorrhiza goetzei, Sterculia africana* and *Afzelia quanzensis.* They are species typically found in rocky areas.

TYPE 5 *COLOPHOSPERMUM MOPANE* - *JULBERNARDIA-COMBRETUM* WOODED BUSHLAND

In this mixed bushland to woodland, *Colophospermum mopane* and *Julbernardia globiflora* are commonly co-dominants with *Combretum zeyheri, C. apiculatum* and *Terminalia sericea. Diplorhynchus condylocarpon, Commiphora mossambicensis, Diospyros quiloensis, Carphalea pubescens, Erythroxylum zambesiacum, Catunaregam spinosa, Pterocarpus rotundifolius* and *Grewia monticola* are found in the understorey. There are

numerous species occuring in this type which are found in miombo or *Brachystegia* woodland, for example, *Strychnos madagascariensis, Brachystegia boehmii, Lannea discolor* and *Pseudolachnostylis maprouneifolia.*

TYPE 6 *COMBRETUM* - *BAPHIA* THICKET

Combretum - *Baphia* thicket covers an extensive area (366.8 square kilometres) from Dete to Shumba, along the watershed, on the ecotone between the Kalahari sands and other geological types. The reddish sandy clay soils on which it occurs are Kalahari sands overlying Basement Complex or Basalt. The topography is usually flat to sloping.

In this diverse thicket to bushland type (130 species), the species most frequently occurring in samples include *Combretum apiculatum* (sometimes dominant) with *C. celastroides, C. elaeagnoides, Colophospermum mopane, Erythroxylum zambesiacum, Baikiaea plurijuga, Diospyros quiloensis, Pterocarpus rotundifolius, Grewia monticola* and *Commiphora mossambicensis.*

GROUP C - *COLOPHOSPERMUM MOPANE* WOODLAND AND THICKET ON GRANITIC GNEISS AND MADUMABISA MUDSTONES.

This mopane woodland group (types 7, 8 and 9) covers an extensive area in the Sinamatella region (692,3 square kilometres). In these woodlands dominated by *Colophospermum mopane*, species such as *Diospyros quiloensis* and *Erythroxylum zambesiacum* are almost always present.

Although mopane woodland is often thought of as species poor, this is the third most diverse group with 156 woody species. Many of the thicket species are common, including *Combretum elaeagnoides, Markhamia zanzibarica, Carphalea pubescens, Cassia abbreviata, Cissus cornifolia, Acacia nigrescens, Commiphora mossambicensis, Combretum apiculatum, Dalbergia melanoxylon, Commiphora africana, C. pyracanthoides, Grewia monticola, Dichrostachys cinerea* and *Grewia flavescens* var. *flavescens.* The indicator species for the group is *Terminalia prunioides.*

TYPE 7 *COLOPHOSPERMUM MOPANE* - *COMBRETUM* WOODLAND ON BASEMENT COMPLEX

This is the most extensive of the mopane woodland types covering 469 square kilometres. It can be found on the rocky ground of the Basement Complex from the northern boundary of the Park around Inyantue Siding stretching in a belt 1 km to 15 km wide, in a south west, north east orientation, to the edge of the Dandari Vlei.

It varies from woodland to bushland and thicket dominated by *C. mopane* with thicket species such as *Combretum apiculatum, C. elaeagnoides, Xeroderris stuhlmannii, Commiphora mollis, Terminalia randii, T. stuhlmannii, Diospyros quiloensis, Erythroxylum zambesiacum, Cissus cornifolia, Dichrostachys cinerea* and *Grewia monticola*

TYPE 8 *COLOPHOSPERMUM MOPANE* - *TERMINALIA PRUNIOIDES* WOODLAND ON MADUMABISA MUDSTONES.

This type, found on Madumabisa mudstone on slightly raised ground, is found only in the Sinamatella sub-region on Karoo mudstones. *Colophospermum mopane* is always present as a tree and dominates this type forming a uniform woodland about 8 to 10 m tall. *Erythroxylum zambesiacum, Acacia nigrescens* and *Diospyros quiloensis* trees are scattered throughout this type. In the understorey *Combretum elaeagnoides, Terminalia prunioides, Erythroxylum zambesiacum, Commiphora pyracanthoides, Commiphora africana, Diospyros quiloensis, Grewia monticola* and *Vepris zambesiaca* are found.

TYPE 9 *COLOPHOSPERMUM MOPANE* - *COMBRETUM ELAEAGNOIDES* THICKET ON BASEMENT COMPLEX

This thicket is found from Deteema to Chingahobe, Dolilo and to below Bumboosie Hill. It covers a large area about 5 km on either side of the Inyantue River and north of Shumba

Pans to the eastern edge of the Dandari Vlei. This is a *C. mopane - Diospyros quiloensis - Combretum elaeagnoides* thicket type with *Erythroxylum zambesiacum, Dichrostachys cinerea,* and *Carphalea pubescens. Diospyros quiloensis* trees and *Berchemia discolor* are the indicator species.

Other species include *Combretum mossambicense, Lonchocarpus capassa, Flueggea virosa* and *Combretum imberbe* which are indicative of a sometimes riverine habitat. Thicket species such as *Xeroderris stuhlmannii, Canthium glaucum, Markhamia zanzibarica, Carphalea pubescens, Grewia flavescens* var. *flavescens, Combretum apiculatum* and *C. zeyheri* are commonly found in this community. The presence of species such as *Bauhinia petersiana, Combretum collinum, C. Zeyheri, Pseudolachnostylis maprouneifolia, Vitex payos* and *Baphia massaiensis* are indicative of the sandier soils of this type compared to the other mopane types of this group.

GROUP D - *COLOPHOSPERMUM MOPANE* - *COMBRETUM IMBERBE* WOODLAND TO BUSHED GRASSLAND IN SEASONALLY INUNDATED AREAS.

This group comprises two communities (types 10 and 11) which occur on alluvium and seasonally inundated soils in the Sinamatella, Robins and Dzivanini areas. In the Sinamatella area the first type in this group is found on the banks of the Lukozi River and Tshakabika Rivers and the second type in the Dzivanini area along the Gwabasabuya, Limpande and Dzivanini Rivers. In the Robins area the second type in this group is found on the upper reaches of the Little Toms, Big Toms, Salt Pans, Dolilo and Deteema Rivers, all along the Bumboosie River and surrounding Shumba Pans. *Lonchocarpus capassa, Combretum mossambicense* and *Combretum imberbe* (>3 m) are the indicator species for the group.

TYPE 10 RIVERINE VEGETATION WITH *DIOSPYROS MESPILIFORMIS* AND *COMBRETUM MOSSAMBICENSE*

This riverine vegetation is found mainly on the banks and terraces of the large rivers in the Sinamatella area on Karoo sediments and the granitic gneisses of the Basement Complex.

It is a diverse, tall woodland type (124 species) with a well developed understorey tending to thicket with species as *Diospyros quiloensis, Canthium glaucum* and *Strychnos potatorum. Combretum hereroense* is always present as a tree and *Combretum imberbe, Diospyros mespiliformis, Lonchocarpus capassa, Acacia galpinii, Kigelia africana* and *Colophospermum mopane* are common constituents of the canopy. *Flueggea virosa* (formerly *Securinega virosa*), *Combretum mossambicense* and *Dichrostachys cinerea* are common in the understorey. The indicator species are *Diospyros mespiliformis, Combretum mossambicense, Flueggea virosa* and *Diospyros quiloensis.*

TYPE 11 *COLOPHOSPERMUM MOPANE* - *ACACIA* - *COMBRETUM* GRASSLAND TO WOODLAND IN SEASONALLY INUNDATED AREAS.

This community which varies from open bushed grassland to bushland, thicket and woodland, is usually dominated by *Colophospermum mopane* with scattered *Combretum imberbe, C. hereroense, Lonchocarpus capassa* and *Ziziphus mucronata.* Other common species include *Acacia nigrescens* and *Dichrostachys cinerea.*

According to Sweet (1971) some or all of the soils of this type may be sodic. More sampling of the soils and species composition of this type is required. Boreholes yield salty water in the Dzivanini area.

GROUP E - *COLOPHOSPERMUM MOPANE* BUSHED GRASSLAND TO WOODLAND ON THE WATERSHED, ON BASALT AND KAROO FORMATIONS.

This group consists of a seasonally waterlogged type on deep soils derived from basalt

(type 12), two types of shallow soils derived from basalt (typically in the Robins area, types 13 and 14) and two types on deep clay - one in the Sinamatella area (type 15) and the other (a seasonally waterlogged type) widespread in the Dzivanini area (type 16). It is the most geographically extensive group of the non-Kalahari sand types covering an area of 1,475.4 square kilometres. Only *Colophospermum mopane* is consistently present in almost all samples in this group.

TYPE 12 *COLOPHOSPERMUM MOPANE* - *COMBRETUM HERERoense* BUSHED GRASSLAND TO BUSHLAND ON THE WATERSHED.

Type 12 is widespread in distribution along the watershed, stretching from Dete to Shumba, Dandari Vlei and the Botswana border. It is the most extensive of the non-Kalahari sand vegetation types with an area of 592.,4 square kilometres (4% of the Park). This community is associated with seasonally waterlogged soils derived from basalt and Kalahari sands where they meet.

In this mixed bushed grassland type *C. mopane* is almost always present but is not always dominant. Co-dominant species include *Combretum apiculatum, C. hereroense, C. imberbe, C. adenogonium, Terminalia sericea* and *Bolusanthus speciosus*. Other common species include *Pterocarpus rotundifolius, Commiphora mossambicensis, Diplorhynchus condylocarpon, Dalbergia melanoxylon, Euclea divinorum, Peltophorum africanum* and *Grewia monticola.*

TYPE 13 *COLOPHOSPERMUM MOPANE* - *COMBRETUM* BUSHLAND ON BASALT.

This bushland and bushed grassland type is the typical *C. mopane* bushland of the Robins area and is found along the boundary with the Matetsi Safari Area, west of the Big Toms River and north of Tsamhole.

The species composition within type 13 varies with the topography; i.e. *Kirkia acuminata* is common in rocky areas, on hill tops; while *Diplorhynchus condylocarpon* may be found in more moist conditions; and *Combretum imberbe, C. hereroense* and *Peltophorum africanum* are typical of seasonally waterlogged location.

The only low trees (about 3 to 4 m tall) usually found in this bushland are *C. mopane, Combretum apiculatum* and *C. hereroense.* The indicator species are *Diplorhynchus condylocarpon, Pterocarpus rotundifolius, Peltophorum africanum* and *Sclerocarya birrea.*

TYPE 14 *COLOPHOSPERMUM MOPANE* BUSHLAND ON BASALT

This is the second type of bushland confined only to the basalt of the Robins area. It is found at or near (up to 8 km away from) the contact between basalt and the Basement Complex and Kalahari sand. The topography is undulating with low hills and many seasonal streams. Other than *Colophospermum mopane*, common species of this slightly more dense bushland type include *Combretum apiculatum, Commiphora pyracanthoides, Acacia nigrescens* and *Dalbergia melanoxylon.*

TYPE 15 *COLOPHOSPERMUM MOPANE* - *VEPRIS ZAMBESIACA* WCODLAND ON MADUMABISA MUDSTONES.

This mopane woodland type occurs predominantly on Madumabisa mudstones in the Sinamatella area. *Dichrostachys cinerea*, an indicator of disturbance, is always present in this type. The well developed understorey consists of *Diospyros quiloensis, Commiphora africana, C. pyracanthoides, Terminalia stuhlmannii, Dalbergia melanoxylon* and *Grewia bicolor.*

TYPE 16 *COLOPHOSPERMUM MOPANE* - *ACACIA* - *GREWIA BICOLOR* STUNTED WOODLAND IN THE DZIVANINI AREA.

This type occurs extensively on deep basalt-derived clays in the Dzivanini area only. It covers an area of 371.5 square kilometres. The topography is flat to gently undulating.

There are only 26 species represented in the samples of this type, the least diverse in the Park. *C. mopane* is the dominant species, with the next most common species *Dichrostachys cinerea. Dalbergia melanoxylon, Acacia sieberiana, A. robusta, A. nilotica, Acacia erubescens, Ximenia americana* and *Grewia monticola* are also common. The indicator species is *Grewia bicolor* which is found as a low shrub with *Boscia matabelensis.*

The soils are mostly grey to black deep, self churning clays which crack when dry. In depressions in these areas, shallow lakes and marshes are formed, the extent of which depend upon the rainfall. In the dry season the areas can be seen as grasslands interspersed in the stunted mopane woodland. Periodic prolonged waterlogging, together with long dry periods from May to October, severely restrict the number of woody species which can survive on the Dzivanini mud flats. Only *Colophospermum mopane* was present in all samples, sometimes as scattered trees or as a stunted woodland.

Kalahari Sand Types

There are 6 groups (F to K) described below. They cover three quarters of the Park from Main Camp to the Botswana border and south to the edge of the Dzivanini flats. *Baikiaea plurijuga* is the most common constituent of woodlands, and *Terminalia sericea* of bushlands. Indicator species of Kalahari sand types are *Baphia massaiensis, Acacia erioloba, Terminalia sericea, Ochna pulchra* and *Rhus tenuinervis. Acacia erioloba, A. fleckii, Rhus tenuinervis, Lonchocarpus nelsii* are found in every Kalahari sand vegetation type. Species which are only found in the Kalahari sand types are *Croton pseudopulchellus, Combretum psidioides* and *Guibourtia coleosperma.* The terrain of the Kalahari sands is characteristically flat.

Group F - *Combretum imberbe* bushed grassland on periodically waterlogged soils.

This group is widely distributed in the Kalahari sands and consists of types 17, 18 and 19. It extends over 1,302 square kilometres or 9% of the Park.

Type 17 *Colophospermum mopane* woodland - *Combretum* bushed grassland mosaic on ecotone Kalahari sands

This type is found in an extensive area just south of Shumba Pans, around Mopane Pan and in the Dzivanini area at the edge of the Kalahari sands and adjacent to the Gwabasabuya River and in patches along the Botswana border south of Korodziba Pan. It is a mosaic of *Colophospermum mopane* woodland or bushland interspersed with areas of *Combretum apiculatum, C. hereroense, C. collinum* and *Acacia nigrescens.*

Only *Colophospermum mopane* and *Acacia nigrescens* are commonly found as trees in representative samples. Common species are *Commiphora africana, Grewia flavescens* var. *flavescens, Terminalia sericea* and *Lonchocarpus nelsii.* The indicator species are *Acacia nigrescens* and *Lonchocarpus capassa.*

The surface soils are mostly sandy clays and the rest clays. They are derived from the underlying geology which is basalt, in the Dzivanini area and possibly in the Mopane Pan to Nehimba areas. There are several species which frequently occur in this type which are more typical of non-Kalahari sand vegetation types such as *Colophospermum mopane, Combretum apiculatum, Lonchocarpus capassa* and *Acacia nigrescens.*

Type 18 *Acacia - Boscia albitrunca - Colophospermum mopane* bushed grassland in interdune troughs

This type is widespread in the Triga Vlei area, Libuti, Josivanini, on the Jupanda, Manga, Kennedy and Linkwasha fossil vleis. It is associated with inter-dune troughs and fossil vlei line topography of the Kalahari sands. It is also found on the ecotone Kalahari sands in

an area south of Libuti, near Leasha. It is the most extensive type within this group covering an area of 781.8 square kilometres.

This type is dominated by grassland with scattered clumps of trees and bushes. The trees include species such as *Acacia erioloba, A. luederitzii, Combretum imberbe* and *Colophospermum mopane,* and the bush species are mainly *Combretum hereroense, C. apiculatum, Acacia erubescens, Grewia flavescens* var. *flavescens, Dichrostachys cinerea, Commiphora africana, Diospyros lycioides* and *Ziziphus mucronata. Boscia albitrunca* is a very noticeable evergreen constituent of this community with its striking gnarled, white trunk.

There are scattered seasonal pans all along the dune troughs, with clumps of *Ziziphus mucronata* and *Diospyros lycioides* often fringing the pan edge. There is also typically a large tree at the pan edge - a 15 to 20 m *Colophospermum mopane, Combretum imberbe* or *Acacia erioloba.* The indicator species are *Ziziphus mucronata* and *Boscia albitrunca.*

TYPE 19 *COMBRETUM HEREROENSE* - *HYPHAENE* BUSHED GRASSLAND ON CALCRETE.

Type 19 is found mainly in the east of the Park, in calcrete areas such as the ten mile drive, Ngweshla, Makwa, at the top of the Kennedy Vlei, Mbiza to Ngamo at the heads of fossil vlei lines and in the Josivanini and Shape areas. It is also found in inter-dune troughs of the northern dunes i.e. from Josivanini north and east to the Mbazu and Mandiseka area in the Park. Some of the larger areas of calcrete, such as Makololo and Ngamo, may have been playa lakes during the third pluvial of the Pleistocene era.

This type is the most diverse of the Kalahari sand types (107 species). The community is characteristically open bushed grassland dotted with *C. imberbe* trees and sometimes tall (25 metre) *Hyphaene* palms, and clumps of *C. hereroense, Diospyros hereroense* and *Dichrostachys cinerea* bushes. There is some concern over the regeneration of the *Hyphaene* palms since there are no palms of intermediate height or age (e.g. on the Mbiza or Makololo flats).

Common species include *Terminalia sericea* and *C. zeyheri.* The indicator species are *Burkea africana* and *Combretum imberbe.*

These calcrete areas are more extensive in area than the long, narrow dune troughs in which the *Acacia-Boscia albitrunca* - Mopane bushed grassland community is found. At the edges of the calcrete areas, with which this type is usually associated, the bushland becomes thicket and grades into type 30.

Combretum imberbe and *C. hereroense* are the most common species of tree, with *Terminalia sericea, Maytenus senegalensis* and *Peltophorum africanum* the most common of the tall shrubs. *Lonchocarpus capassa, Dalbergia melanoxylon* and *Grewia monticola* are common in the low shrub stratum.

GROUP G - *ACACIA-BAIKIAEA* BUSHLAND AND WOODLAND ON KALAHARI SANDS.

This group of bushland and woodland types (20, 21, 22 and 23) is widespread in distribution, occurring from the railway line in the east to the Botswana border. The area covered by the group is about 3,106.6 square kilometres or 21.8% of the Park. It is the most extensive group of vegetation types with 106 woody species.

TYPE 20 *ACACIA-MUNDULEA SERICEA* BUSHLAND

Type 20 is found in the Triga Vlei, Wexcau area, Josivanini, Umkowazaan, Shape and Guvalala area and is associated with inter-dune troughs and eroded dune troughs especially in the Triga Vlei system. It covers an area of 967.2 square kilometres, nearly 7% of the Park.

This bushland is usually dominated by *Acacia* species such as *A. luederitzii* and *A. ataxacantha*, and sometimes *A. erubescens. Colophospermum mopane, Lonchocarpus nelsii* and *Boscia albitrunca* may also be dominant or very common, although the latter species if not found in the northern Kalahari sand areas. In the tree canopy layer only three species are commonly represented in samples - *Acacia erioloba, Lonchocarpus nelsii* and *A. luederitzii. Mundulea sericea* is almost always present as a tall shrub and *Dichrostachys cinerea, Terminalia sericea, Combretum collinum, Grewia flavescens* var. *flavescens, Combretum hereroense* and *Ochna cinnabarina* are also very common shrubs.

TYPE 21 *TERMINALIA SERICEA* - *LONCHOCARPUS NELSII* BUSHLAND

Type 21 is found in the Guvalala, Nyamandhlovu, Sinanga and Umkowazaan to Libuti areas on flat terrain, in shallow fossil drainage lines and in or adjacent to dune troughs on sandy clay soils.

This type has a variable physiognomy, from bushland to thicket and woodland but is most often bushland. *Lonchocarpus nelsii, Combretum collinum, Terminalia sericea* and *Acacia erioloba* trees are often present. In the tall shrub layer *Dichrostachys cinerea* and *Acacia ataxacantha* are the most frequently encountered species, with others such as *Acacia fleckii, Combretum collinum, Ochna pulchra, Grewia flavescens* var. *flavescens* (which is always present) *Combretum zeyheri* and *Lonchocarpus nelsii.* The indicator species if *Ochna pulchra.*

This community occurs adjacent to type 23 *Baikiaea* woodland and type 26 *Burkea africana* bushland and woodland. It mainly occurs in an area which was logged from the 1920's until 1944 and has a high elephant density in the dry season. This vegetation may thus be a degraded form of *Baikiaea* woodland as Childes & Walker (1987) have suggested.

TYPE 22 *COLOPHOSPERMUM MOPANE* - *COMBRETUM APICULATUM* BUSHLAND

This type occurs in the Manga Two area, Makona, Wexcau, Triga Vlei and Josivanini area in flat, depressed areas on sandy clay soils. It covers an area of only 28.3 square kilometres, the least extensive of the Kalahari sand types.

Colophospermum mopane trees are common although not usually dominant. Scattered *Combretum apiculatum, Acacia fleckii, Boscia albitrunca, Terminalia sericea* and *Lonchocarpus nelsii* and *Combretum collinum* are common constituents. The presence of *Colophospermum mopane* and *Baikiaea plurijuga* together in the same community is unusual. They are usually representative of the shallow clay soils and deep sandy soils respectively.

The indicator species are *Colophospermum mopane* and *Dalbergia melanoxylon.* Other species which differentiate this type from the other types in group G include *Markhamia zanzibarica, Erythroxylum zambesiacum, Cissus cornifolia, Commiphora mossambicensis, Allophylus africanus, Combretum apiculatum, Euclea divinorum, Peltophorum africanum, Dichapetalum rhodesicum* and *Pterocarpus angolensis.*

TYPE 23 *BAIKIAEA* - *COMBRETUM* WOODLAND THICKET ON FOSSIL SAND DUNE CRESTS.

This woodland thicket type is found mainly on fossil sand dune ridges in the central and southern Kalahari sand areas of the Park and on the western edges of most fossil drainage lines in the eastern part of the Park. It occurs west and south of the Dopi fossil drainage line as small patches of woodland surrounded by *Terminalia - Baikiaea* bushland (type 25). It covers an area of 1,329.1 square kilometres in over 600 patches of woodland thicket and is the most fragmented vegetation type.

This type is dominated by *Baikiaea plurijuga* which is present in the canopy layer in all samples of this type. Other trees include *Acacia erioloba, Lonchocarpus nelsii* and *Croton gratissimus* the latter two of which may be classified as tall shrubs (over 3 m tall). Common tall shrubs (1-3 m tall) include *Combretum celastroides* (can be over 3 m in height), *Dichrostachys cinerea, Ochna cinnabarina, Acacia ataxacantha, Grewia flavescens* var. *flavescens, Baphia massaiensis, Croton gratissimus* and *Acacia fleckii.* Of the low shrub (<1 m tall) species *Grewia avellana* is the most commonly encountered, with *Rhus tenuinervis, Hippocratea indica* and *Croton pseudopulchellus.* The indicator species are *Baikiaea plurijuga, Combretum celastroides, Grewia avellana, Croton gratissimus* and *C. pseudopulchellus.*

At the edge of this woodland, *Baikiaea* trees may be replaced by pure samples of *Acacia erioloba* trees.

GROUP H - *TERMINALIA - COMBRETUM* BUSHLAND

This group of bushland types (24 and 25) occurs extensively in the Kalahari sand area covering an area of 2,830.7 square kilometres or about 20% of the Park. *Combretum* species (*C. collinum* and *C. zeyheri*) and *Terminalia sericea* dominate these types. Also common are *A. erioloba, Baphia massaiensis, Ochna pulchra, Combretum psidioides, Croton pseudopulchellus, Erythrophleum africanum* and *Burkea africana.*

TYPE 24 *TERMINALIA SERICEA - ACACIA ERIOLOBA* BUSHLAND

This vegetation is found in or beside fossil drainage lines (especially the Dopi vlei) and in the Triga Vlei where sands have been eroded. It thus has a relatively restricted distribution.

The main difference between this bushland and type 25 bushland is that *Baikiaea plurijuga* is completely absent from this type. *Terminalia sericea, Acacia erioloba* and *Burkea africana* are always present (usually as scattered trees), and in the tall shrub layer *Ochna pulchra* is always present with *Baphia massaiensis, Combretum psidioides* and *Ancylanthos bainesii* and *Acacia ataxacantha.*

TYPE 25 *TERMINALIA SERICEA - BAIKIAEA PLURIJUGA* BUSHLAND

This *Terminalia sericea* bushland is the most widespread of all vegetation types covering an area of 2,572.4 square kilometres or 18% of the Park. Although *Baikiaea plurijuga* does not occur in every sample representing this type, species which are usually associated with *Baikiaea* do. Thus *Bauhinia petersiana, Combretum collinum, Baphia massaiensis* and *Croton pseudopulchellus* are almost always present in this type. The latter species is one which differentiates this type from the former *Terminalia* bushland type.

It is found west of Nyamandhlovu Pan and near Caterpillar, to the Botswana border and to the southern-most limit of the Kalahari sand. It occurs on deep redistributed Kalahari sand and on fossil dune crests adjacent to type 23 *Baikiaea plurijuga - Combretum celastroides* woodland.

Species which occur with the dominant *Terminalia sericea* include *Baikiaea plurijuga, Combretum collinum, C. zeyheri, Ochna pulchra, Baphia massaiensis, Dichrostachys cinerea, Acacia ataxacantha, A. fleckii* and *Croton pseudopulchellus.* The indicator species are *Commiphora angolensis, Croton pseudopulchellus, Baikiaea plurijuga* and *Pterocarpus angolensis.*

GROUP I - *BAIKIAEA PLURIJUGA* WOODLAND AND BUSHLAND ON DEEP KALAHARI SANDS.

Within this group are two typical *Baikiaea* woodland types and a bushed woodland type. Type 27 is widely distributed in the Main Camp to Mandiseka area in the east of the Park.

Types 26 and 28 are found in the eastern Kalahari and west of the extension of Manga fossil drainage line and between Dina pan, Tibukai and Cement on the Botswana border.

The indicator species for this group are *Vitex payos, Guibourtia coleosperma, Diplorhynchus condylocarpon* and *Pseudolachnostylis maprouneifolia.*

TYPE 26 *BURKEA AFRICANA - PTEROCARPUS ANGOLENSIS* BUSHLAND AND WOODLAND.

This type is usually found in the eastern edges of fossil vlei lines, on redistributed Kalahari sands. It is often found adjacent to *Baikiaea - Guibourtia coleosperma* woodland, Type 27 and is also widely distributed west of the Manga Vlei line.

This bushland to woodland type is dominated by *Burkea africana, Terminalia sericea* and *Erythrophleum africanum.* Common shrubs include *Combretum zeyheri, C. psidioides, Baphia massaiensis, Combretum collinum* and *Ochna pulchra* and *Vitex payos. Diplorhynchus condylocarpon, Bauhinia petersiana, Strychnos spinosa* and *Guibourtia coleosperma* are common as low shrubs.

The indicator species is *Combretum collinum*, separating this type from type 27. Other differential species include *Acacia ataxacantha, Croton pseudopulchellus* and *Dichapetalum rhodesicum. Baikiaea plurijuga* is present in only two thirds of the samples of this type which is similar to type 25.

TYPE 27 *BAIKIAEA PLURIJUGA - GUIBOURTIA COLEOSPERMA* WOODLAND

This vegetation type is found only in the eastern Kalahari sand areas, on deep redistributed sand and is often situation adjacent to type 30 and calcrete areas. It is more extensive than type 28 covering an area of 604 square kilometres. It is found around Main Camp and down to Ngamo in the east and as far as Manga Vlei in the west. It is not found west of the Manga Vlei extension in this Park.

Since the rainfall is thought to be on average higher in the east of the Park than the west, one could hypothesize that this type is associated with more moist or mesic conditions.

This woodland is dominated by *Baikiaea plurijuga* and *Guibourtia coleosperma. Croton pseudopulchellus, Erythrophleum africanum* and *Pterocarpus angolensis* are important constituents. *Burkea africana* and *Terminalia sericea* are also often present as trees. *Ochna pulchra, Terminalia sericea, Combretum zeyheri* and *Pseudolachnostylis maprouneifolia* are common tall shrubs. In the low shrub stratum *Diplorhynchus condylocarpon, Strychnos spinosa, Vitex payos* and *Pterocarpus angolensis* are common.

The indicator species are *Baikiaea plurijuga, Guibourtia coleosperma* (1-3 m) and *Pseudolachnostylis maprouneifolia.* Other species which differentiate this type from type 29 are *Dichrostachys cinerea* and *Acacia erioloba.*

TYPE 28 *BAIKIAEA PLURIJUGA - CROTON GRATISSIMUS* WOODLAND

This type is very similar to type 27 and is found near Dete, on White Hills and in the west of the Kalahari sand area near Shakwanki and north east of Xibi Amabandi. It is found on deep redistributed Kalahari sand, and is characteristically found on the catenal position between type 27 and ecotone *Baikiaea plurijuga* woodland to bushland.

Indicator species are *Croton gratissimus* (1-3 m) and *Vangueria infausta.* Other species which differentiate this type from types 26 and 27 are *Grewia monticola, Rhus tenuinervis* and *Grewia avellana.*

In this woodland type *Baikiaea plurijuga* is almost always present as a tree, with *Guibourtia coleosperma* and *Croton gratissimus.* In the tall shrub layer *Croton pseudopulchellus, C. gratissimus, Baphia massaiensis, Combretum zeyheri, C. collinum, C. psidioides, Ochna*

pulchra, Terminalia sericea and *Vangueria infausta* are common. In the low shrub layer *Dichapetalum rhodesicum, Dichrostachys cinerea, Grewia avellana, Bauhinia petersiana* and *Burkea africana* are common.

GROUP J - ECOTONE *BAIKIAEA PLURIJUGA* WOODLAND AND THICKET ON RED KALAHARI SANDS.

TYPE 29 ECOTONE *BAIKIAEA PLURIJUGA* - *COMMIPHORA MOSSAMBICENSIS* WOODLAND AND THICKET

Ecotone *Baikiaea plurijuga - Commiphora mossambicensis* woodland thicket is found in the northern reaches of the Kalahari sand - the most extensive tracts of this type being in the Robins sub-region. It covers an area of 855.4 square kilometres within the Park. It is a well developed *Baikiaea* woodland type, in terms of canopy cover and its diverse and dense understorey.

This teak woodland being on the ecotone, has the greatest species diversity of the teak woodland types, with 99 species. In the canopy, which is dominated by *Baikiaea plurijuga*, there is also *Erythrophleum africanum, Combretum apiculatum, Terminalia sericea, Erythroxylum zambesiacum* and *Burkea africana.* In the tall shrub layer *Ochna pulchra, Baphia massaiensis, Combretum collinum, Bauhinia petersiana* and *Terminalia sericea* are common. *Catunaregam spinosa* (formerly *Xeromphis obovata*), *Diplorhynchus condylocarpon, Grewia monticola* and *Dichapetalum rhodesicum* are common in as low shrubs.

GROUP K - *BURKEA AFRICANA* BUSHLAND SURROUNDING CALCRETE AREAS.

TYPE 30 *BURKEA AFRICANA* - *TERMINALIA BRACHYSTEMMA* BUSHLAND

This Kalahari sand group is restricted in distribution to the east of the Park, from Main Camp to Ngamo, adjacent to or surrounding calcrete areas, along the top of the eastern watershed area.

The vegetation is bushland, thicket or woodland dominated by *Burkea africana* and *T. sericea* with *Erythrophleum africanum, Combretum imberbe* and *Combretum hereroense.* It is the presence of the latter *Combretum* species, which are tolerant of waterlogged conditions, and which separate this type from type 26 *Burkea* bushland and woodland. The latter type is also found adjacent to calcrete areas.

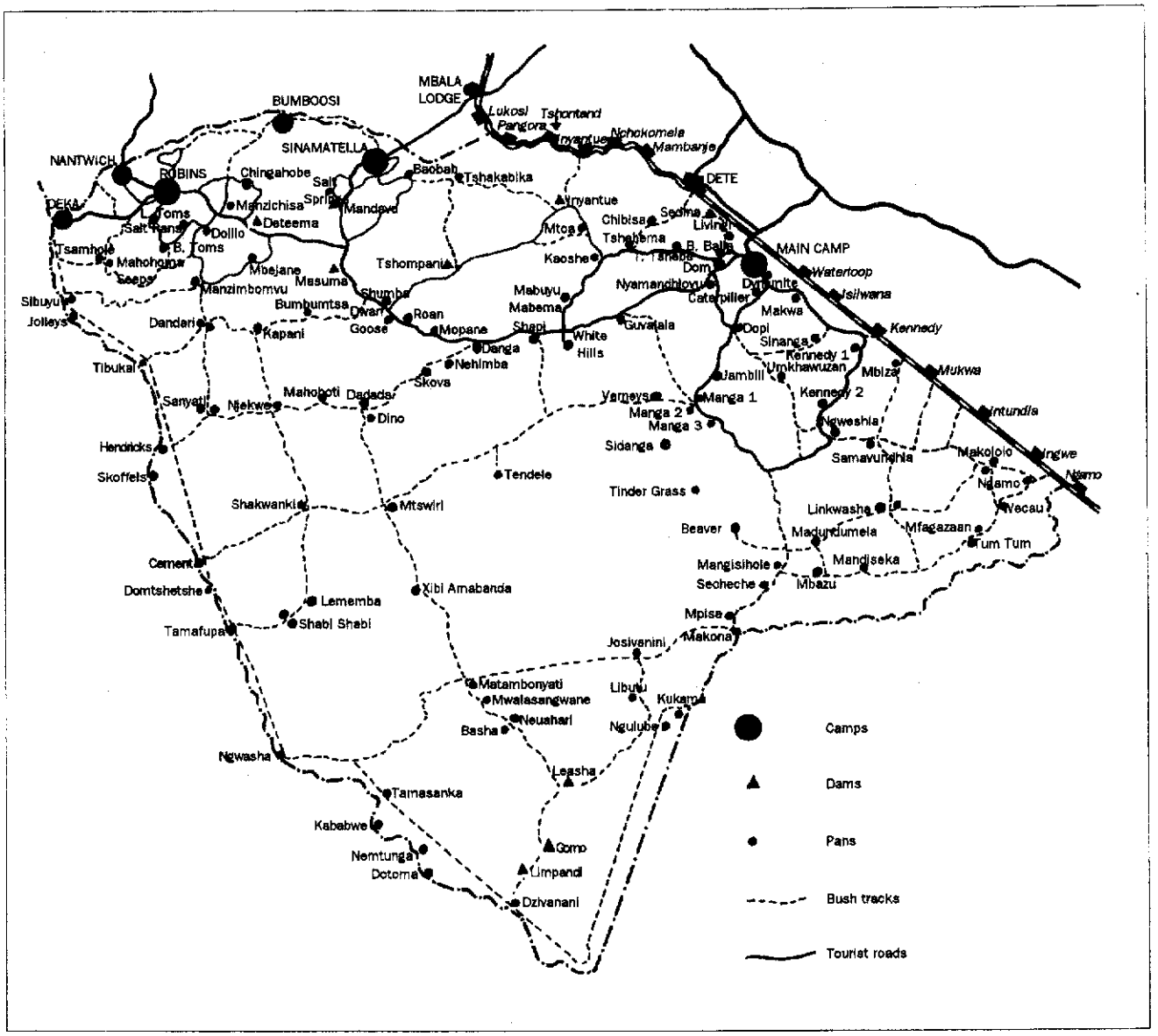
Scattered *Guibourtia coleosperma* and *Combretum imberbe* trees may be found in this type. Other common constituents include *Ochna pulchra, Combretum psidioides, Annona stenophylla, Diplorhynchus condylocarpon, Strychnos spinosa* and *Swartzia madagascariensis.* Type 30 is differentiated from Type 29 by the obvious absence of *Baikiaea plurijuga* and the presence of *Terminalia brachystemma, Annona stenophylla* and *Combretum imberbe.*

Hyphaene petersiana is a notable species in this type but its distribution is patchy (it is not a consistent component of the samples representing this type. Other unusual species to be found here, but rarely so, are *Parinari curatellifolia* (found nowhere else in the Park) and *Kigelia africana* (usually only found in riverine fringe in Hwange).

PANS AND OTHER WATERPOINTS

A vast number of natural pans and other waterpoints exist in the Hwange National Park. These natural waterpoints consist of pans, seeps, springs and pools in the large rivers such as the Deka and Lukozi. By far the majority of them are seasonal and only contain water during the rainy season and into the early dry season (Map 5).

The Deka River is quite different and there are many pools in the river that do not dry up during the dry season. These pools are extremely important as far as the wildlife is concerned. While the Deka River may stop flowing during the dry season there is always



Map 5 - Distribution of main pans and other waterpoints in Hwange National Park

some water present in the large pools. These more permanent pools become important refuges for such species as otters, hippo, crocodiles, water mongoose and many others.

In addition to the Deka River small pools continue to exist in the Tshowe, Denda, Sinamatella and Tshakabika Rivers while the largest of all the rivers, the Lukozi, almost completely dries up. However, elephant dig into the moist areas of sand to obtain water during the dry season.

Natural seeps can be found at Nehimba, Shakwanki, Lememba, Shabi Shabi and many years ago seeps also existed at Tamafupa, Ngwasha and Tamasanka. During the present survey in 1996 none of these last named seeps were still flowing. They had all dried up over the period of time. Perhaps they will flow again if there are several very wet seasons in a row. Natural springs where water bubbles up out of the ground exist at Dolilo, Salt Springs and Tshakabika (Map 5).

As a result of the drying up of most of the pans during the dry season, the Department decided many years ago to sink boreholes close to a number of pans and to pump water into them (see **HISTORY**). In this way wildlife would remain in the Hwange National Park and close to the pans during the dry season and not move out of the area into Botswana or towards the Gwaai River.

The first borehole in the Park was drilled at Ngweshla Pan in 1935 while other holes were sunk at Dom, Shapi, Nyamandhlovu, Shumba, Big Toms and Little Toms in 1936. A borehole was drilled at Kennedy I in 1944 and the next year, 1945, a hole was sunk at Ngamo.

During the 1950's a large number of holes were drilled and the following pans had diesel engines or windmills installed: Caterpillar, a second hole at Dom, two holes at Guvalala, two holes at Jambili, another hole at Kennedy I, Kennedy II, Linkwasha, Madundumela, Makololo, Makwa, Manga 1, Mbiza (two holes), another hole at Ngweshla, another hole at Nyamandhlovu, another hole at Shapi, Sadima, Tchabema and Verneys.

Table 6 gives full details of all the holes drilled in the Park and the date when they were drilled (Jones 1989).

The first dam to be constructed in the Hwange National Park was at Masuma in 1936 followed by Mtoa I and Mtoa II. The Deteema dam was built in 1938 and in 1951 dams were built at Nantwich, Robins, Chingahobi. 1953 saw the building of Mandavu Dam and Masuma II. The next year, 1954, dams were built at Tshompani, Gomo and Limpande. Inyantue dam was built in 1958 and during the same year Masuma II dam breached and was never repaired.

Leasha dam was built in 1965 and a borehole was also sunk there the same year. Finally 1971 saw the building of the Salt Pans dam. During the present survey I found that all three dams in the Dzivanini area were breached in 1995/96 season. These were the Leasha, Gomo and Limpande dams.

Table 7 gives details of all waterpoints in the Hwange National Park that were pumped during the late dry season of 1996 and while the present wildlife survey was being carried out.

GAZETTEER

A full and detailed list of the main pans, dams, seeps and springs in the Hwange National Park is given in Appendix A. In addition, a G.P.S. reading has also been included and this should no doubt help any future researchers locate some of the not so well known pans.

GLOSSARY OF TERMS USED

Many of the scientific and other words or descriptions used in the text may not be familiar to all people reading this report. Therefore, I have included in Appendix B a full and detailed list of the words that I believe require explaining.

Table 6 - Drilling dates and other data for game water supply boreholes in Hwange National Park (after Jones 1989)

Locality	No.	Year drilled	Depth m	Yield cu.m	Comments
Baobab	2/69	1969	-	2.7	
Basha	3/65	1965	83	4.1	
Beaver	60	1963	84	3.4	
Bumboosi	18/70	1970	68	3.0	Now domestic
Bumbutsa	9/69	1969	92	2.7	
Caterpillar	38	1957	70	4.5	
	11/67	1967			
Chibisa	2758	1972		2.0	Dry since 1975
Dandari	8/68	1968			Dry
	9/68	1968	42	4.6	Dry since 1982
Deteema	1/64	1964	44	6.5	Used when dam low
Dina	12/70	1970		5.5	Salty not used
Dolilo	4/64	1964		6.5	Closed
Dom	3	1936	73	2.3	
	16	1950	55.7	2	
Dopi	11/67	1967	57	4.5	
	2773	1972		5.4	Salty not used
	2839	1973	63	9.6	
Gomo	59	1963			Salty not used
Guvalala	19	1952	100	2.4	
	20	1952	100	4.3	Salty
	14.65	1965	100	4.2	
	2774	1972			
	3071	1974			
Inyantue	19/70	1970		4.8	Feeds dam
Insimbi	2943		90		Salty not used
Jambile	31	1956	60	3.1	
	32	1956	60	0.8	
Josivanini	5/65	1965	100	4.8	
Kalinyati	4/64	1964	47	6.5	Location? Robins region?
Kapula	13/65	1965	54	11.0	Closed (pumped to Masuma '87)
Kennedy I	2	1944			
	12	1950	45	5.5	
Kennedy II	39	1957	65	9.0	
Leasha	1/65	1965		41	Salty not used
Libuti	58	1963		41	Salty not used
Livingi	2759	1973	87	6.0	
Linkwasha	42	1957		9.0	Wind pump
Madundumella	43	1957	109	6.8	
Mahoboti	13/70	1970	75	2.6	Salty not used
	2953	1974	120	7.2	
Makololo I	40	1957	52	9.0	
Makona	57	1963	107	7.2	
Makwa	156	1950	56	6.5	
			37	4.0	
Makukumalo		1965			Salty not used
Malusha	4/65	1965	68	2.7	Salty not used
Mandesika	54	1963	81	5.5	
Manga I	34	1956		4.8	
	3153	1984	81	4.0	
Manga II	4/66	1966		4.6	
	3072	1984	80	4.6	
Manga III	3/66	1966			
	3018	1984	100	7.4	

Table 6 contd...

Locality	No.	Year drilled	Depth m	Yield cu.m	Comments
Manzibomvu	2/64	1964	80	4.0	
Mbazu	55	1963	93	7.2	
Mbiza	44	1957		6.5	Wind pump
	45	1957		6.5	Not used
Mabuyamabema	11/68	1968	78	4.5	
Mfagazaan	53	1963	61	4.8	
Mopane	8/69	1969	60	6.5	
Mtswiri	3.67	1967	62	3.2	Salt closed 197?
Nantwich	47	1963			Domestic/Game supplements dam
	7/68	1968			
	14/70	1970	46	8.1	
Mjekwa	11/70	1970	80	4.7	
Ngamo	9	1945			
	6/69	1969	37	5.5	
Ngweshla	1	1935	41	3.3	
		1950	78	4.3	
Nyamandhlovu	8	1936	59	1.1	
	17	1951	47	6.5	
Samavundhla	51	1963	24	2.2	
	5/69	1969	50	4.7	
Sanyati	2954	1974			Salty not used
	3148	1984	103	0.6	Yield too low not used
Secheche	56	1963	73	2.9	
		1984	100	6.0	
Shapi	6	1936	24	3.4	
	25	1952	25	4.9	
Shumba	4	1936	37	0.8	
Sidina	E1	1959	45	1.0	
Sidanga					Not used
Sinanga	2868	1973	83	7.2	
Summamalisha	13/67	1967	68	4.8	Closed 1975
Shabi-Shabi	10/68	1968		1.8	Not used
Tendele	10/67	1967	85	3.4	Closed 198?
Tsamhole	10/69	1969	66	5.5	
Tshompani	1/68	1968	39	1.2	Supplies Dam
Tshebema	29	1952			
	7/69	1969	91	2.6	
Tshebetshebe	10/68	1968		5.0	
	2775	1972		4.8	
Toms Big		1936			
	101	1963			
Toms Little		1936			
	100	1963			
Umkhawuzan	2887	1973	70	7.2	
Umkombo	3034	1976	100		Never used
Umpufa		1967		4.1	Closed 197?
Umtshibi	2810	1973	45	8.2	
Verneys	35	1956			Went dry 1973
	2/66	1966			Went dry
Wexcau	52	1963	47	4.5	

Table 7 - List of pans where diesel engines, solar heaters or windmills were operational during 1996

Name of Pan/Dam	Area R, M, S	Type of water pumping equipment	Notes
Umtshibi	M	Diesel Engine	
Dom	M	Diesel Engine	
Dopi	M	Diesel Engine	Sponsored by WLS during 1995
Caterpillar	M	Solar	
Nyamandhlovu	M	Diesel Engine	
Guvulala	M	Diesel Engine	
Makwa	M	Solar	
Jambili	M	Diesel Engine	
Manga I	M	Diesel Engine	Sponsored by WLS during 1995
Manga II	M	Diesel Engine	Sponsored by WLS during 1995 and 1996
Manga III	M	Diesel Engine	
Ngweshla	M	Diesel Engine	
Samavundhla	M	Diesel Engine	
Makona	M	Diesel Engine	
Dynamite	M	Diesel Engine	
Shumba	S	Diesel Engine	
Sinanga	M	Solar	Sponsored by WLS during 1995
Kennedy I	M	Diesel Engine	
Kennedy II	M	Diesel Engine	
Big Toms	R	Diesel Engine	
Little Toms	R	Diesel Engine	
Bumboosi	S	Diesel Engine	
Mandavu Dam	S	Diesel Engine	
Ngamo	M	Solar	
Nantwich	R	Diesel Engine	
Robins Camp	R	Diesel Engine	
Shapi	M	Solar	
Tshompani Dam	S	Diesel Engine	Sponsored by WLS during 1995 and 1996
Bumbumtsa	R	Diesel Engine	Sponsored by WLS during 1995 and 1996
Deteema Dam	R	Diesel Engine	Sponsored by WLS during 1996
Mbiza Pan	M	Diesel Engine	Sponsored by WLS during 1995 and 1996
Secheche Pan	M	Diesel Engine	Sponsored by WLS during 1995 and 1996
Baobab Pan	S	Diesel Engine	Sponsored by WLS during 1995
Beaver Pan	M	Diesel Engine	Sponsored by WLS during 1995
Dandari	R	Diesel Engine	Sponsored by WLS during 1995
Mabuya Mabema	M	Diesel Engine	Sponsored by WLS during 1995
Manzimbomvu	R	Diesel Engine	Sponsored by WLS during 1995
Mfagazaan	M	Diesel Engine	Sponsored by WLS during 1995
Njekwa	R	Diesel Engine	Sponsored by WLS during 1995
Tsamshole	R	Diesel Engine	Sponsored by WLS during 1995
Tshebe Tshebe	M	Diesel Engine	Sponsored by WLS during 1995
Mandiseka	M	Solar	
Mkhazana	M	Diesel Engine	
Makolola	M	Diesel Engine	
Basha	M	Diesel Engine	
Wexcau	M	Diesel Engine	
Fagazaan	M	Diesel Engine	
Mangisihole			
Masoboti	R	Diesel Engine	
Livingi	M	Diesel Engine	
Mbazu	M	Diesel Engine	
Madundumela	M	Diesel Engine	
Josivanini	M	Diesel Engine	
Inyantue	S	Diesel Engine	
Masuma	S	Diesel Engine	
Tshebema	M	Diesel Engine	

R = Robins, M = Main Camp, S = Sinamatella

METHODS OF SURVEY

Large Carnivores (Lions, leopards, spotted hyaena, wild dogs and cheetah)
The distribution of the large carnivores was determined between 1st January 1996 and 31st December 1996 by sightings of these carnivores by myself, various volunteers, tourists, professional guides and the staff of the Department of National Parks & Wildlife Management.

As a result of two studies being carried out on wild dogs by two separate research teams a number of wild dogs were marked with radio collars. This had, therefore, made the identification of several wild dog packs a lot easier. As a result, a lot more reliable data is available on wild dogs compared to the other carnivores.

A special form (Appendix C) was designed and supplies were left at the three main entrances to the game viewing areas of the Park (Sinamatella, Main Camp and Robins Camp) and the National Parks staff at the gates were requested to hand out the forms to visitors entering the Park and to collect completed forms from the visitors once they left the Park. This method of obtaining sightings of the large carnivores proved to be most successful but records are biased in favour of Main Camp.

Firstly the Main Camp staff were very keen to assist the project and, as a result, made a more determined effort to hand out the forms to the tourists. Secondly there were a lot more visitors in the Main Camp area compared to the Robins and Sinamatella Camps. At the Sinamatella gate the staff felt that if the visitors wanted the forms they should collect them at the main office before going into the Park. As most visitors did not call in at the office before going on a game viewing drive, not many of them received forms to record carnivore sightings. The Warden at Sinamatella also confirmed that visitors could collect the forms at the office before going into the Park if they wished to do so. However, some forms were handed out to visitors at the Sinamatella gate and I was indeed most grateful for that help.

Robins Camp kept a supply of forms at the main office which visitors could take with them and the attendant at the gate also handed them out to visitors. As there were a lot less visitors in the Robins area there were obviously far fewer observations and returns.

As a result of the "Large Carnivore Forms" we were able to obtain records of over 1,144 sightings of these secretive carnivores which included 450 prides of lions, 137 leopards, 298 groups of spotted hyaena, 140 wild dogs packs, 45 cheetah, 33 black-backed jackals, 12 side-striped jackals, 7 honeybadgers, 7 servals, 13 bateared foxes and 5 caracals. Without these forms we would not, in any way, have obtained so much information.

A full discussion of the status and distribution of each species of carnivore is given in the profile of that particular species. As the raw data accumulated from these forms run into hundreds of A4 pages it is not possible to include the raw data in this report. It is however available for examination, if required, and the records have been lodged at the Research Office at Main Camp in the Hwange National Park.

Marked transects (road strip counts)
Transects were marked out along most of the roads and tracks throughout the Park. These were accurately measured in most instances and full details of vegetation, etc. noted. These transects were covered by vehicle as often as possible and all wildlife seen each time the transect was covered were recorded on a special form designed for the job. (See Appendix D). In all cases, a minimum of two people were present when the transect was

Table 8 - Description of marked transects and number of times each transect was covered (Map 6)

Transect No	Description of Transect (route taken)	No. of times covered
1	Main Camp to Ngweshla (via Makwa/Kennedy)	24
2	Main Camp to Nyamandhlovu (via Balla Balla)	12
3	Makwa Road via Sinanga Pan to Dopi Umkhawuzan Road	11
4	Dopi via Umkhawuzan to Kennedy 2	4
5	Dopi via Manga Pans to Ngweshla	15
6	Makwa Road via Caterpiller and Dopi to Dom	14
7	Nyamandhlovu turn-off to White Hills Pans	14
8	Tshebema turn-off via Tshebema around loop to tar road	5
9	Guvalala to Manga 1	1
10	Safari Lodge along tar road to Main Camp	3
11	Ngweshla to Ngamo	9
12	Ngweshla loop road	8
13	Shapi Pan to Tendele/Manga track	3
14	Verneys Pan to Tendele turn-off	3
15	Sinamatella Camp around Kashawe loop road	18
16	Salt Springs loop road	11
17	Lukozi River drive	18
18	Sinamatella to Masuma Dam	14
19	Sinamatella Road to Deteema Dam	7
20	Robins Camp Road via Chingahobi Dam to Robins road	9
21	Masuma Dam to Shumba	19
22	Shumba to Tshompani Dam	2
23	Tshompani Dam to Tshakabika	1
24	Lukozi River to New Inyantue Dam	2
25	Inyantue Dam to railway line at Inyantue siding	1
26	Inyantue siding along railway to Mbala	1
27	Mbala Lodge to Sinamatella Camp	10
28	Robins Camp Road via Salt Pan and Big Toms to main road	7
29	Robins Camp Road around Tshowe loop	1
30	Shumba along main road to White Hills turn-off	14
31	Balla Balla via Chibisa around loop to Tshebema	1
32	Samavundhla to Mbiza along railway line to Ngamo	1
33	Ngamo to Makona via Mbazu	1
34	Josivanini to Leasha via Matambonyati	1
35	Makona to Leasha via Libuti	3
36	Dzivanini to Ngwasha	2
37	Ngwasha to Tamafupa	1
38	Tamafupa to Mitswiri	2
39	Mitswiri to Main Road	1
40	Mitswiri along Manga/Verneys Road to Tendele turn-off	1
41	Leasha to Dzivanini	1
42	Tamafupa to Jolleys	1
43	Deteema via Mbejane to Sibuyu	1
44	Samavundhla to Mangishole (via Linkwasha)	3
45	Shumba via Bumbumtsa to Dandari	3
46	Kapani to Shakwanki	1

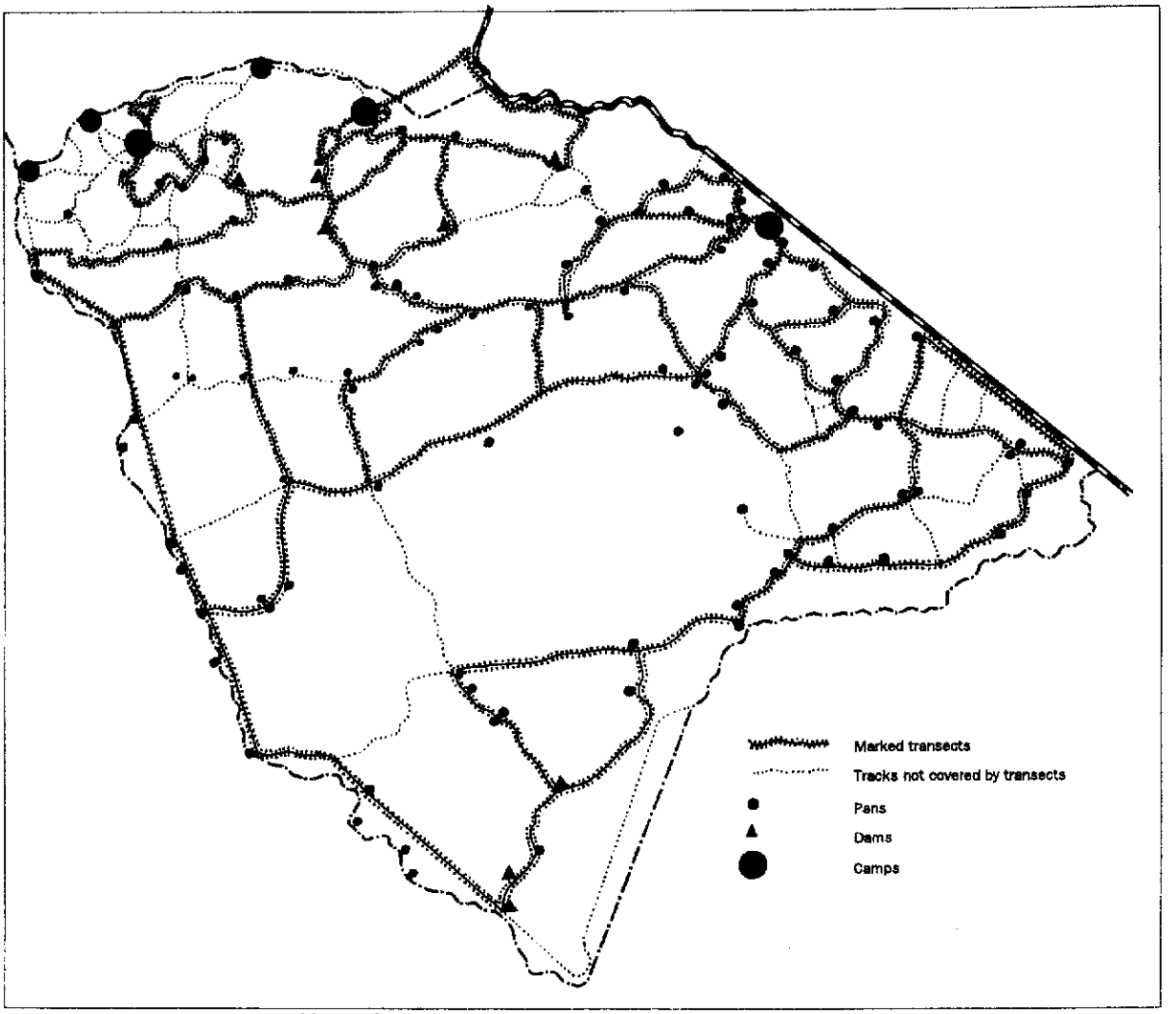
Note: A much more detailed description of each transect is given in Appendix E

being covered, on other occasions three people were present. One person did the driving of the vehicle while the second person completed the form and made observations of wildlife seen. Binoculars were always used to study the animals seen.

A total of 46 transects were marked out in the Hwange National Park (See Map 6). Many of the transects were covered on numerous occasions while others in the more remote

sections of the Park and along the Botswana border were only covered on one or two occasions.

Table 8 gives brief details of the description of the transects and number of times each transect was covered while Map 6 shows the location of each transect and Appendix E gives a full description of each transect. Many volunteers helped with this aspect of the survey and in fact these '"road strip counts" along the roads and tracks provided the bulk



Map 6 - Details of 46 marked transects for '"road strip counts"

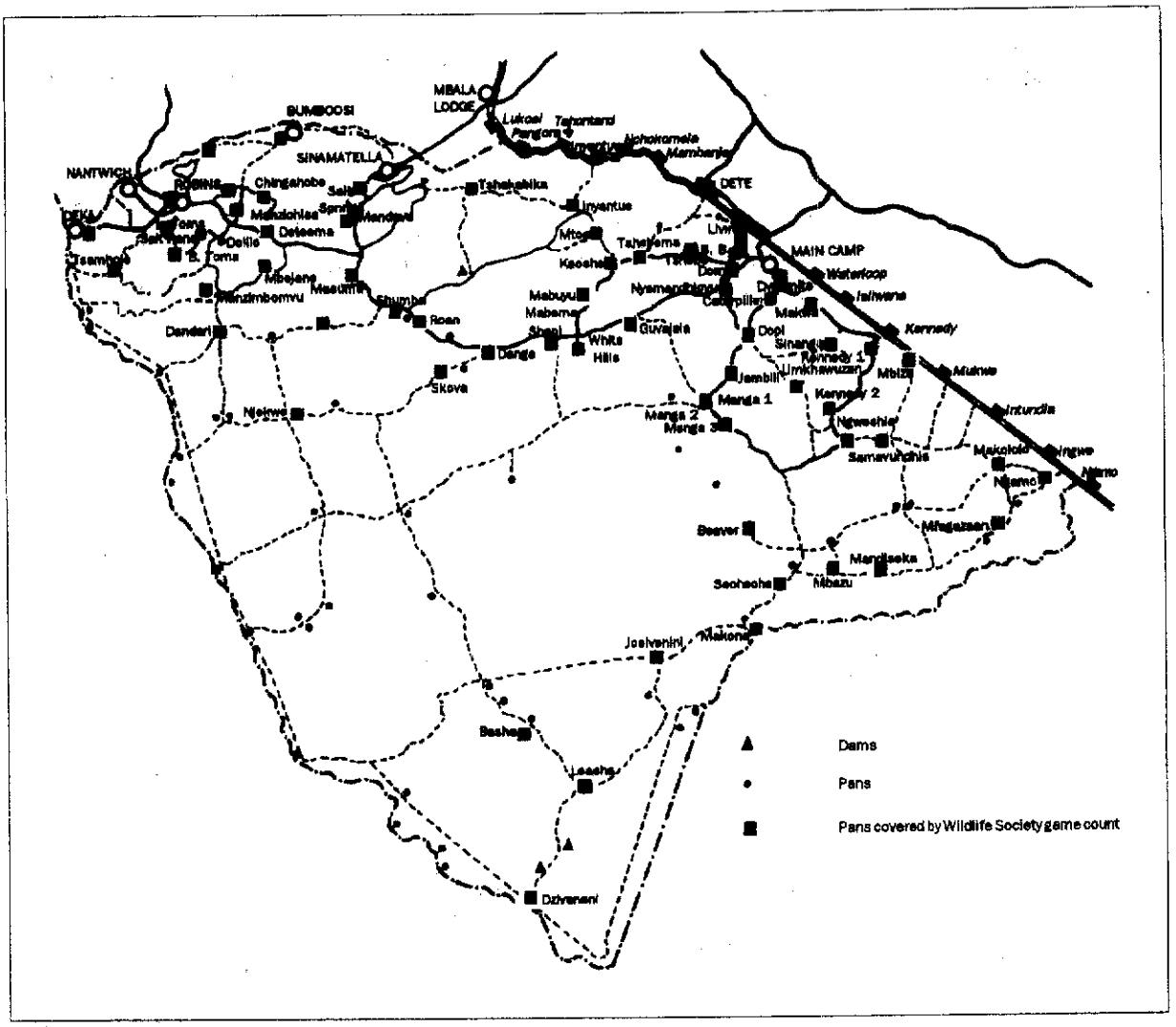
of the data on the distribution and status of the antelope of the Park. In addition, hundreds of records of the classification and composition of antelope herds were also obtained as a result of these "road strip counts".

Once again, and as mentioned above with the carnivore sightings, the raw data from the marked transects is considerable and cannot be included in this report. However, the records are kept at Main Camp in the Hwange National Park with the Research Branch of the Department.

Wildlife report form

Booklets of "Wildlife Report Forms" were printed (see Appendix F). These booklets were made small enough to fit into a shirt pocket and the object of the forms was for any person wishing, or interested enough, to make casual observations on wildlife seen in the Park to fill in the form and send it to me for our records and analysis.

Details given on these forms were used for the distribution, sex and age classification of all species occurring in the Park. The data entered onto these forms was not in any way



Map 7 - Showing all pans and other waterpoints covered by Wildlife Society members during 24 hour game count in September 1996

intended to determine the status of the various species seen. As a result of this exercise a total of 824 forms were completed by a large number of people. Details of the sex and age composition of groups of mammals seen are discussed under the profile of each species.

Wildlife Society 24 hour waterhole count (1996)

Each year for over 20 years the Matabeleland Branch of the Wildlife Society of Zimbabwe has carried out a 24 hour game count of all species visiting the pans which hold water in the Hwange National Park. During September 1996 the results of the game count were found to be much lower than in previous years and this was as a result of the very good rains during the 1995/96 rainy season. As a result, a large number of pans in the Park still had water in them which was unusual and different to previous years. It was therefore not possible to cover every pan in the Park with water in it during the 1996 waterhole count. Appendix G shows type of form used by the Wildlife Society members to record wildlife seen during the 24 hour game count.

Therefore, the figures presented in Table 9 represent an absolute minimum number of animals in the Park and while not entirely comparable with data obtained in 1994 and 1995 the figures nevertheless still give a very valuable indication of the distribution of many species occurring in the Park. This will be discussed in greater detail later. Map 7 shows pans covered by Wildlife Society during 1996.

Table 9 - Wildlife Society Annual Game Census for Hwange National Park for the period 1994-1996

Species	1994	1995	1996
Aardwolf	5	-	-
Antbear	-	-	-
Baboon, Chacma	3121	4130	2223
Bat-eared fox	18	1	8
Buffalo	6941	3611	1166
Bushbuck	56	47	27
Bush-pig	25	25	2
Caracal	-	-	-
Cheetah	4	7	-
Civet	11	10	10
Duiker, Common (Grey)	115	96	5
Eland	166	372	37
Elephant	13396	17162	9565
Gemsbok (Oryx)	5	5	-
Giraffe	436	658	534
Grysbok, Sharpe's	-	-	-
Hartebeest, Red	1	-	-
Hippopotamus	47	35	60
Honey Badger	16	9	10
Hyaena, Brown	13	-	-
Hyaena, Spotted	418	423	246
Hyrax, Yellow spotted	3	8	-
Impala	5205	4129	3205
Jackal, Black-backed	193	175	125
Jackal, Side-striped	36	13	21
Klipspringer	3	5	1
Kudu	1851	1702	641
Leopard	20	15	4
Lion	164	192	63
Mongoose, Banded	309	129	167
Mongoose, Dwarf	4	1	10
Mongoose, Slender	14	3	16
Mongoose, White-tailed	5	2	18
Otter	-	2	-
Porcupine	6	4	-
Reedbuck	49	77	46
Rhinoceros, Black	6	5	2
Rhinoceros, White	4	3	2
Roan	351	200	92
Sable	1014	706	197
Serval	2	-	1
Steenbok	27	34	5
Tsessebe	36	86	12
Vervet Monkey	354	401	259
Warthog	685	587	382
Waterbuck	168	137	90
Wild Dog	26	45	22
Wildebeest	1222	1100	1243
Zebra	2740	2868	1481
Totals:	**39 691**	**39 220**	**22 020**

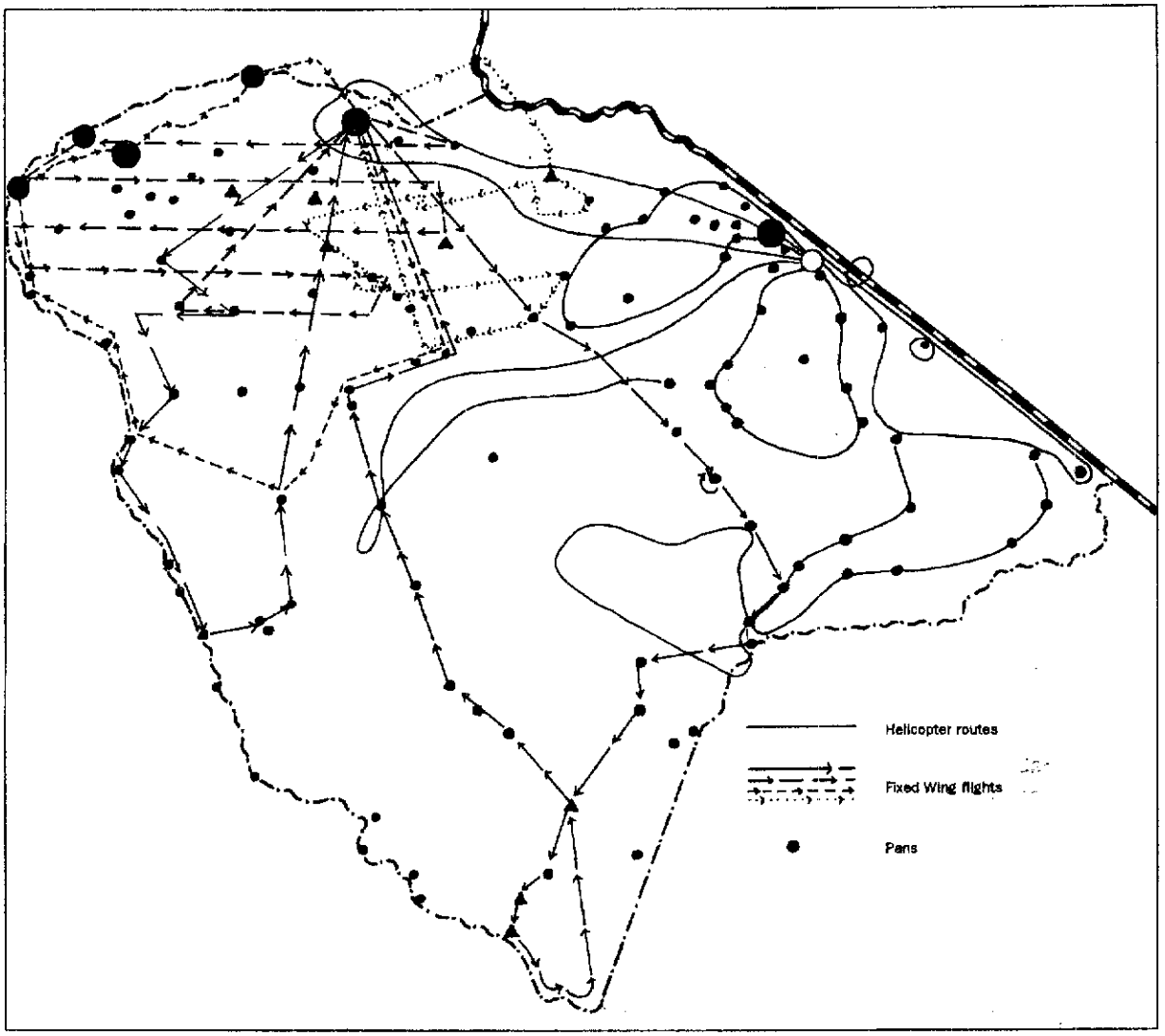
Table 9 therefore includes details of animals seen during the 24 hour counts at waterholes for the years 1994 to 1996.

Aerial survey (helicopter)

As a result of funds being made available by the Royal Netherlands Embassy in Harare for aerial surveys it was possible to make use of the National Parks helicopter based at Umtshibi Camp. Approximately 30 hours flying time was undertaken with the helicopter and many remote areas of the central unexplored area of the Park were covered. On each flight the pilot was Warden Andy Searle and I accompanied him on every flight.

The helicopter proved to be one of the most ideal methods of finding out what wildlife species existed in the south and central areas of the Park and at the same time it was even possible to accurately count the number of animals in most of the herds observed. This was particularly important with large elephant herds where it was possible to hover over a herd and count every animal present. It also proved to be ideal when counting buffalo and the presence of gemsbok in several areas well away from roads was confirmed.

It should be clearly emphasised that the helicopter was not used to ascertain total wildlife populations in the Park. Map 8 gives details of helicopter and fixed wing flights undertaken and areas covered during the present survey.



Map 8 - Showing direction and flights by fixed wing aircraft (Ref. Pat Cox) and helicopter flights over Hwange National Park

Aerial survey (fixed wing)

Mr. Pat Cox from Harare very kindly agreed to fly me over certain sections of the Park with his fixed wing aircraft. We were, therefore, fortunate to cover the north-western boundary

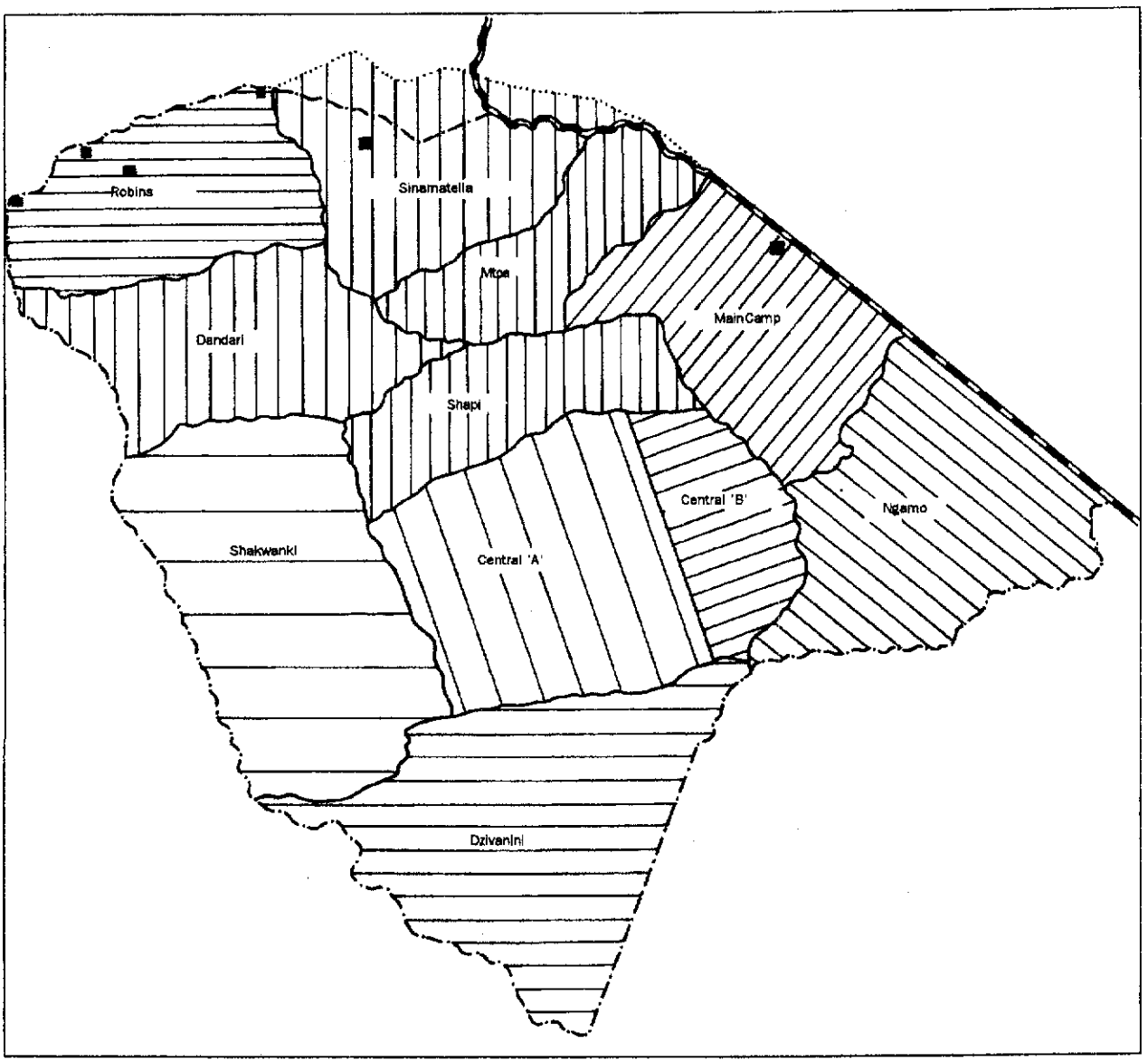
of the Park along the Botswana Border as well as the Dzivanini area. In addition we also covered considerable distances in the Robins, Deka and Bumboosi areas. All these remote parts of the Park were out of reach with the helicopter and as a result it was possible to cover areas that would otherwise have been left out.

These surveys with Pat Cox also enabled us to see what was happening along the Botswana Border as far as elephant and buffalo movement was concerned. Map 8 gives details of flights over Park during this survey.

National Parks annual aerial survey

In addition to the use of the helicopter and the fixed wing aircraft belonging to Pat Cox and as a result of the funds being provided by the Royal Netherlands Embassy, I was able to contribute financially towards the National Parks annual aerial survey of Matabeleland North which included the Hwange National Park. As details of methods used are already given in great detail in the report by Clare Davies (Davies 1996) there is no point in repeating the methods used. In any case these aerial surveys are recognised internationally as the most efficient way of counting buffalo, elephant and some other large species and the same survey has been repeated for several successive years.

Permission was also obtained from National Parks to make full use of the results of their



Map 9 - Showing transects covered by National Parks team during annual aerial survey of Hwange National Park during September 1996 (after Davies 1996)

Table 10 - Sample and flight data: Hwange National Park (modified from Davies 1996)

Stratum	Area km²	Tran. space km	No. of Trans.	Total Tran. Length	Tran. area km²	Samp. int. %	Date	Mins flown Trans	Mean speed kts
Robins	1029	3	13	347.26	105.78	10.28	12.9.96 am	117	0.96
Dandari	1290	3.5	20	369.72	112.36	8.71	13.9.96 am	124	0.97
Shakwanki	2143	9	7	235.81	71.36	3.33	13.9.96 pm	74	1.03
Dzivanini	2098	4	16	528.50	161.13	7.68	14.9.96 am	184	0.93
Sinamatella	1522	4	15	374.51	114.00	7.49	13.9.96 am	123	0.99
Mtoa	826	3	18	276.97	84.67	10.25	17.9.96 pm	93	0.97
Main Camp	1261	3	18	420.41	130.01	10.31	18.9.96 am	135	1.01
Shapi	923	3	19	306.98	94.05	10.19	18.9.96 pm	99	1.01
Central B	1723	6	7	294.08	89.08	5.17	16.9.96 pm	98	0.97
Central A	775	3	15	255.89	78.43	10.12	19.9.96 pm	89	0.93
Ngamo	1629	3	18	526.76	151.82	9.32	19.9.96 am	180	0.95
Total:	15219	N/A	166	3936.89	1192.69	8.44	N/A	1316	

September 1996 survey and, therefore, details of all the large mammals encountered during the annual aerial survey are now included under the profile of each species in this report. Map 9 gives full details of transects flown during this survey while Appendix H shows the form used by two observers when counting wildlife during the aerial survey. Sample and flight data for the Hwange National Park is given in Table 10 while full details of all species and numbers of each species seen during this survey are included in Table 11 and under the profile of that particular species while Appendix I gives full details of all species seen during the annual aerial survey together with additional data not included in Table 11. It should be noted here that population estimates for most of the large mammals of the Hwange National Park were obtained from these transects and survey, and supplemented by my own findings.

Table 11 - Large mammal populations - Hwange National Park - Annual Aerial Surveys. Figures for 1996, 1995 and 1994 with numbers actually seen, estimated populaton and 95% CI. range

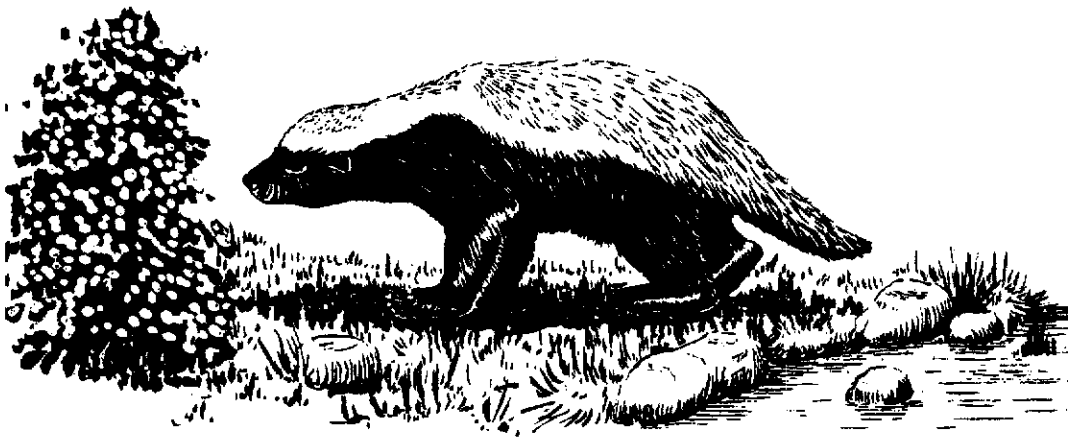
	1996			1995			1994		
Species	No. seen	No. estimated	95% CI. range	No. seen	No. estimated	95% CI. range	No. seen	No. estimated	95% CI. range
Elephant	2300	27907	21270-34544	2344	22762	18712-26812	3008	31576	20847-42305
Buffalo	158	1830	693-2987	151	1415	192-2637	416	3237	1093-5382
Eland	9	104	9-203	30	301	30-607	63	490	63-972
Gemsbok	11	125	37-212	4	48	4-98	23	391	23-914
Giraffe	214	2536	1706-3366	183	2036	1388-2684	202	2230	1669-2791
Impala	369	4312	2560-6065	273	2957	1734-4180	207	2115	805-3425
Kudu	114	1419	977-1860	114	1290	842-1737	106	1283	777-1790
Roan	4	39	5-73	7	67	20-114	19	182	19-366
Sable	178	1942	1224-2660	148	1405	865-1944	186	1548	588-2507
Waterbuck	14	164	14-365	16	155	22-288	18	163	18-350
Wildebeest	62	665	62-1390	68	638	68-1529	148	1151	148-2266
Zebra	210	2393	1539-3246	314	3043	2116-3970	322	3086	1898-4274

Data from Davies (1994), Davies (1995) and Davies (1996) with permission from National Parks & Wildlife Management

Night observations

On numerous occasions night work was carried out from an open vehicle and with the aid of a 500,000 cp. spotlight and all wildlife seen was recorded.

These night observations were usually undertaken on dark nights with no moon visible. It was only as a result of these nocturnal drives that it was possible to see some of the smaller nocturnal carnivores such as the White-tailed mongoose, aardwolf, honeybadger, bat-eared foxes etc. The results of these night observations for each of the nocturnal species seen are discussed under the profile of that particular species.



PREHISTORY OF HWANGE NATIONAL PARK

Early Stone Age stone artifacts including some quarry debris and stone tools have been discovered at the bottom of Giraffe Pan and on the road between Manga and Ngweshla. In this area the road is paved with material containing quarried silcrete and calcrete which came from borrow pits near Summamlisha Pan. There is also abundant evidence of Early to Late Stone Age stone hand axes, flakes and cores in the gravel used to pave other roads in the Park. In the north west of the Park near Nantwich, Early Stone Age artifacts have also been discovered.

The Early Stone Age period could be roughly classified as that time lying between 2.5 million years ago and as recent as 200 thousand years ago. Therefore, these Early Stone Age sites in the Hwange National Park indicate that primitive man existed in the area at least 200 thousand years ago.

The Middle Stone Age extended from roughly 200 kya (thousand years ago) up to about 30 kya. From the Main Camp gravel pits there is evidence of Middle Stone Age stone tools and more stone tools, stone cores and flakes have also been found near Mtoa Pan north of Main Camp.

Other places where Middle Stone Age stone tools have been discovered are at Nehimba, near Dopi Pan and on the Matetzi River near the road bridge. Some Middle Stone Age artifacts have also been discovered at the Inyantue Dip (Jones and Atkinson 1993).

It is generally believed that the Late Stone Age period occurred from about 45 thousand years ago right up to the nineteenth century AD. There is considerable overlapping in the time periods between the Late Stone Age and the Early Iron Age as a result of the varying rates of change from one "Age" to another in different geographical areas. The Early Iron Age period is thought to have occurred between 3000 to 1500 years ago.

Late Stone Age/Early Iron Age sites are much more plentiful in the Hwange area compared to the Early and Middle Stone Ages. Stone tools of the Late Stone Age have been discovered in the Main Camp gravel pits, Dopi gravel pits, Giraffe Pan, Mtoa Pan, Baobab holes, Nehimba seeps, Shakwanki seeps (also some pottery) and Shabi Shabi seep (again with some pottery). See Map 10.

There is considerable evidence of Late Stone Age/Early Iron Age pottery fragments and animal spoor engraving on the Bumboosie Ridge where at least six different sites have been discovered. The rock engravings on the Bumboosie Ridge and others at Deteema Dam clearly indicate the presence of man in the area thousands of years ago. According to Cooke (pers. comm) in Wilson (1975) the engravings of the spoor of the animals belong to the late Stone Age Wilton complex which could be dated at between 20,000 and 10,000 years ago. There is also evidence of Late Stone Age artifacts along the Lukozi River.

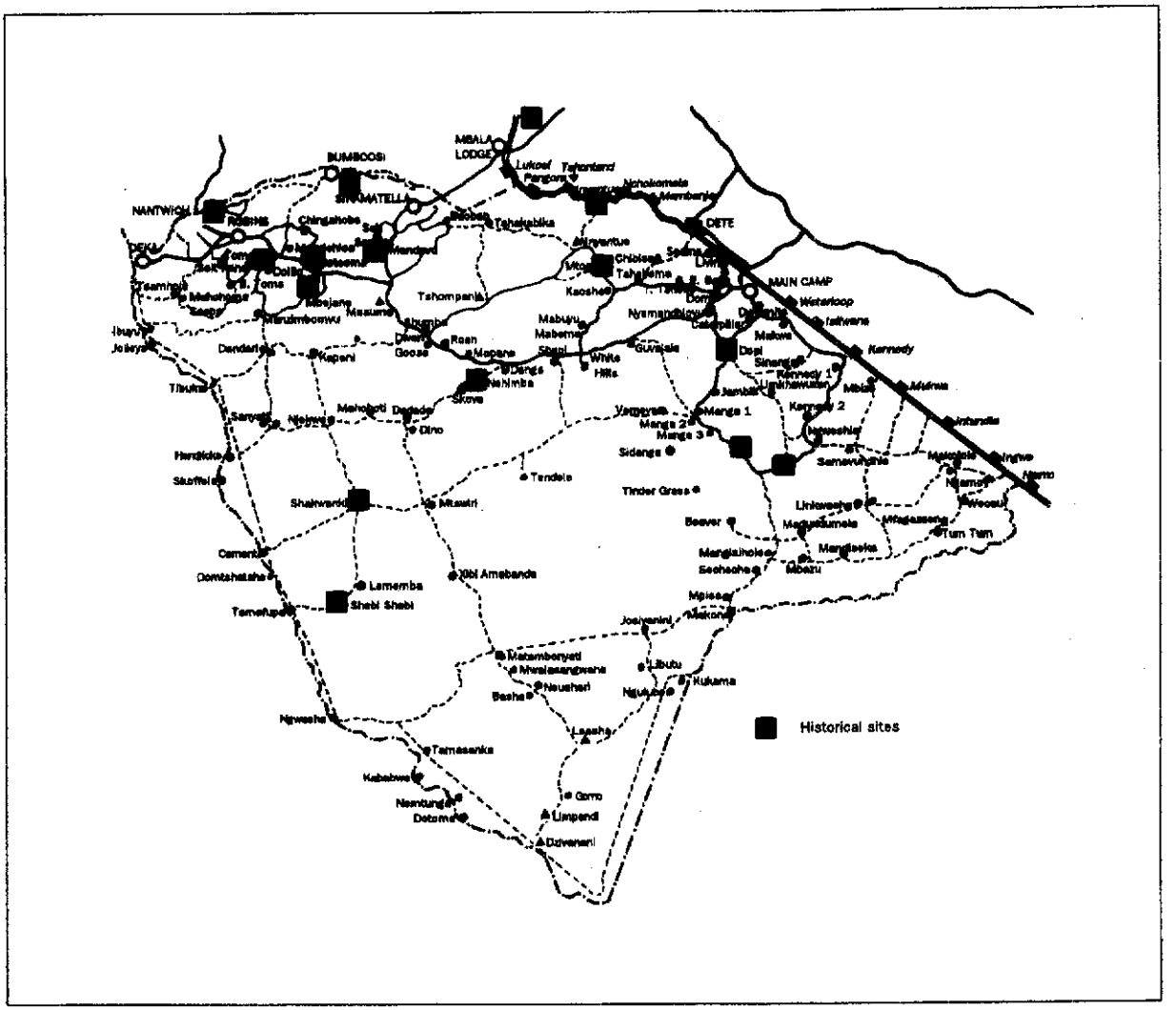
Coming to the period from about 500 years ago up to nearly the present time there is considerable evidence of human activity in the Hwange National Park and surrounding area. This period one could perhaps assign to the Late Iron Age period.

Evidence of human activity has been recorded at the following sites. (Jones & Atkinson 1993).

Dorelia Springs "A"	Recent village site
Dorelia Springs "B"	Crude stone walling
Dolilo River	Circular stone walling, pottery fragments
Deteema River	Circular stone walling

Bumboosie River	Circular stone walling
Bumboosie Hill	Circular stone walling
Deteema River	Engraved spoor and tsoro board in bedrock
Mbejane Pan	Human skull
Deteema Dam	Human skeletal material
Mandavu Dam	Circular stone wall (terraced)
Lukozi/Mbala Confluence	Stone wall ruins
Mtoa Ruins	Circular stone walls, pottery, bones (from food animals)
Chakula Ruins (forestry land)	Late Iron Age village with pottery, beads, figurines

In addition to the above, there are still many more Late Iron Age sites showing the existence of human occupation. Map 10 shows some of the sites in the Hwange National Park where artifacts have been recovered.



Map 10 - Showing some of the historical sites in the Hwange National Park where artifacts from the Early Stone Age period to the present time have been found

HISTORY

While the Late Stone Age people lived in the Bumboosie/Deteema area between 20,000 and 10,000 years ago, the evidence of more recent ruins around Mtoa, Mandavu Dam, Chakula and many other areas, clearly shows that man has been around and hunting the Hwange area for many thousands of years.

In addition and much more recently, the San or Bushman inhabited the area as hunter-gatherers and their hunting activities only really ended with the development of the Wankie Game Reserve in 1928. The vast dry area of todays Hwange National Park was no doubt only considered as a Game Reserve because it was thought to be useless for any other form of land use, especially as there was no permanent water in the Kalahari sand areas.

As well as the San who once hunted throughout the area, and no doubt for thousands of years, the white man arrived in the area as hunters and later as settlers in the late 1800's. It was during that period that a considerable amount of elephant hunting took place and ivory was traded extensively.

When Ted Davison, who was only 22 years old at the time, first moved into the area as the first Game Warden in 1928 he found many bushman (San) hunting parties operating in the Park and there were also several people with valid permits who were allowed to capture game in the Ngweshla area and along the railway line.

Frederick Courtney Selous and Tom Sadler were among the first Europeans to explore the area in the late 1800's. Selous (1908) states that he preferred to hunt in the hilly country north of what is now the Hwange National Park.

Coming from the south, Selous travelled up through the Kalahari Sand country as far north as the vast Linkwasha and Dopi Vleis by oxwagon where he left his wagons and thereafter travelled on foot further north. In those days the Tsetse fly did not penetrate into the Kalahari sand area but were present in vast numbers in the Mopane country to the north. It was because of the presence of the tsetse flies in the north that Selous left his oxen and wagons in the Kalahari Sand velt.

Tom Sadler also hunted in the Mopane country near Robins Camp and it is generally believed that the two streams, Big Toms and Little Toms were named after him (Wilson 1975). Tom Sadler hunted the area in about 1875 while Selous operated there a few years earlier in about 1873.

Even though Ted Davison was appointed as the first Game Warden of the Reserve in 1928, it was only proclaimed as a Game Reserve in terms of the Game & Fish Preservation Act under Proclamation No. 8 in 1930.

Most of the area lying west of the railway line was unexplored country prior to 1928 although there was some activity along the railway line. For example, John Lundin and J. Herbst had permits to capture game in the area. They ran a game capture operation in the Kennedy area and at Petties and Balcarres Farms near Main Camp. Their permits to capture game expired when the area was proclaimed a Game Reserve (Wilson 1975, Davison 1967).

The exploitation of hardwoods, especially *Baikiaea plurijuga, Guibourtia coleosperma, Pterocarpus angolensis* and *Afzelia quanzensis,* took place for many years and between 1912 and 1930 vast quantities of timber was removed from a 16 km wide strip along the railway line from Ngamo to Inyantue. It is believed that about 340,000 cubic metres of

timber was extracted from the Park (Jones 1989).

Between 1947 and 1949 a number of farms were included in the Park when it was proclaimed a National Park in terms of the National Parks Act No. 53 of 1949. These included the Deka, Makohoma, Sunnyside and Sinamatella Farms (Jones 1989). The farms of Prestwich and Nantwich were also incorporated and proclaimed part of the National Park in 1952. Additional land was also added to the Park in 1956.

The late Mr. H.G. Robins who took over the farms Big Toms and Little Toms in 1914 lived for many years in the area now known as Robins Camp. Robins built an observatory at his home and from the top of the three-storey tower he studied the stars. His telescope and many of his personal items still exist in the building today which is used as an office for the Warden at Robins Camp. Robins died in 1939 and the Robins Game Reserve, which he owned, was bequeathed to the Nation on his death . This Game Reserve retained its status as an individual area until 1975.

In the early days and when Ted Davison first moved into the area, very little was known of the Park and there were virtually no roads or even bush tracks. There was a very rough track which ran from Dete on the railway line to Shapi Pan but very little else. In those days a map of the area showed only Ngweshla, Shapi and Heatleys Pans (Davison 1967).

As there was virtually no water in the Kalahari Sand country during the dry season there was consequently very little game and Davison (1967) said the Kalahari sand dried out almost completely during the dry season. Any game that did exist, and there was very little, moved towards the Gwaai River and its tributaries where Selous found most of his game in the 1870's (Davison 1967).

Davison mentioned that on a two day journey in 1928 he saw only 3 giraffe at Tshebema Pan (which was dry) and about 20 impala near Garagangwe Pan which was also dry. At Shapi Davison saw a single ostrich and at night he heard elephant and hyaena but none were seen.

On another trip in 1928 Davison found two dead sable that were stuck in the mud at Ngweshla Pan. He goes on to say that in 1928/29 there was a nucleus of giraffe, eland, kudu, sable, roan, impala and elephant in the Reserve but other species were rare. He noted that lions were plentiful and tracks were found at almost every waterhole and pan and they could be heard almost every night.

As a result of the large lion population and the fact that antelope and other species were not plentiful in the Park it was decided as a matter of policy to reduce the lion population. This they thought would give the other game a chance to increase. Davison used traps, trap guns and hunted the lions with dogs in order to reduce the population. He mentioned that hyaena sometimes got caught in the traps set for lions and they proved to be more tenacious than the lions. Hyaena were not common in the area in the early days and there were very few signs of wildebeest, buffalo and not many zebra.

In an attempt to keep wildlife in the Park and to supply a permanent water supply for the animals, the first borehole was drilled at Ngweshla Pan in 1935. Over the years that followed boreholes and windmills were established at many of the Pans.

The main road from Bulawayo to the Victoria Falls was the Pandamatanga Road in those early days and the first visitors rest camp was built at Main Camp in 1935 very close to the spot where Selous camped in 1875.

PREVIOUS COLLECTING AND RESEARCH IN THE HWANGE NATIONAL PARK

Ted Davison, as mentioned before, was the first Warden of the Hwange National Park and from the time of his appointment in 1928 to the time when the first researcher arrived in Hwange National Park in 1958 was 30 years. This meant that for 30 years no research had been undertaken in the Hwange National Park. The first researcher to work in the Park was Thane Riney, a Fulbright Scholar from the United States of America who arrived in November 1958.

Ted Davison, in his book "Wankie. The Story of a Great Game Reserve" published in 1967 had this to say about research, and I quote him in full:

> "The park soon began to attract another type of visitor. These were the scientists who were hankering for a field where they could work and study wildlife in its natural state. One of the first to come was a Fulbright Scholar from the United States, who arrived in November 1958. He was very knowledgeable on the habits of deer, both in the U.S.A. and New Zealand but knew little about the behaviour of African game and he arrived with preconceived ideas of what he would find. Although he may have been right in many of his conclusions, we were not prepared to accept them until he had proved them on the spot. He was anxious to study the local movements of animals and with this object in view he devised a bow and arrow with a rubber cup filled with different coloured paints, which was fired at animals. I have referred to this before, but it was not very successful as there were too few observers who knew what to look for. Red paint on an animal's rump looked like blood and white paint looked like bird droppings and could not be recognised as a distinguishing mark. This Fulbright Scholar stayed and worked in the park for over a year but did not produce much in the way of information which was of use to us."

While Ted Davison did not feel that Riney's work was of any value I personally believe that at least a start had been made, no matter how insignificant, and the ground work for future research on wildlife was laid.

In my book on the "Mammals of the Wankie National Park, Rhodesia" published in 1975 I stated the following:

> "Research first commenced in the Wankie National Park in 1958 when a Fulbright Research Unit was set up under the sponsorship of the National Museums of Rhodesia. The main objects were to initiate research on large mammals in Rhodesia and to encourage the establishment of a wildlife research organisation. As the Fulbright team was to be in Rhodesia for only a limited period it was hoped that projects could be started which could then be carried on by Rhodesian biologists after the departure of the Fulbright sponsored biologists.
>
> By December 1958 a total of 21 projects were already under way of which several were designed specifically for Wankie National Park.
>
> These included :
> (a) The effects of burning on the game population,
> (b) Effects of water manipulation on the game population and
> (c) The analysis of the habitats of big game in which specially prepared forms were filled in by staff in the Wankie National Park."

In January 1960 Dr. Graham Child arrived at Main Camp and some of the projects initiated

and others suggested by Thane Riney were implemented. Unforuntately Child only stayed in Hwange until September 1960. Wilson (1975) mentioned that from the time the original projects were designed by Riney, as described above, until his major 2 year wildlife survey of the Park was undertaken in 1969/71, very little, if anything, had been published on the mammals of the Hwange National Park. This represented another 13 years from the time that Riney designed the first projects in 1958 to the time the 1969/71 survey was undertaken (Wilson 1975).

By the time I commenced my survey in 1969 the Park was already 41 years old and as far as I can see there were only two scientific publications dealing with the mammals of the Hwange National Park, these being by Weir and Davison (1965) on the drinking activities of the large mammals and another by Wallach & Anderson (1968) on the immobilisation of elephants. Dr. John Weir also studied the ants and dung beetles of the Hwange National Park and later Dr. Zumpt studied parasites of game animals. During April 1962 Dr. Condy of Zimbabwe also studied the internal parasites of wildlife in the Hwange National Park.

However the lack of scientific publications on the mammals of the Hwange National Park can be explained by the fact that up until 1965 there were no full time ecologists in the Hwange National Park and in fact, there was only one ecologist in the Department of National Parks & Wildlife Management at that time and he was based in Harare. Therefore, all the research work undertaken in the Hwange National Park was by guest research workers and it was generally Entomologists, with the exception of Thane Riney.

With the formation of the new Research Branch of National Parks & Wildlife Management which was created in late 1964, a number of wildlife biologists were employed and 1965 saw the first full time ecologist at Main Camp.

The administration of the National Parks of Southern Rhodesia reverted to the Southern Rhodesia Government on 1st November 1963 as a result of the dissolution of the Federation of Rhodesia and Nyasaland. On the same date the Federal Department of National Parks was amalgamated with the Southern Rhodesia Department of Wildlife Conservation to form the new Department of National Parks and Wildlife Management. (NPWL Annual Report 1963).

During 1963, 22 animals were captured in Hwange and moved to the Matopos National Park and another 56 to Kyle Game Reserve. One kudu and four wildebeest were also captured in Hwange and moved to other areas. A further four black rhino (1 male and 3 females) were obtained from the Kariba operations and released in Hwange.

As far back as 1963 there was discussion and mention that the damage caused by buffalo and elephant gave rise for concern and that additional waterpoints should be created to eliminate heavy concentration of wildlife at existing watering points (NPWL Annual Report 1963).

In 1964 it was reported that 8,000 wildebeest existed around one pan in the "southern section" of the Park and that heavy concentration of buffalo were also experienced, one herd of over 3,000 buffalo being counted and herds of several hundred being common place (NPWL Annual Report 1964).

Tsessebe were recorded at Shumba and they appeared to be on the increase while impala were recorded in the Main Camp area for the first time. Reedbuck appeared to be increasing, 12 having been seen on one afternoon in the ten mile drive (NPWL Annual Report 1964).

During 1964, the following animals were shot on "Game Control Work", arising from crop raiding, fence protection and sick or injured animals:

46 elephant; 170 buffalo; 18 wildbeest; 7 kudu; 20 sable; 14 impala; 9 warthog; 4 eland; 1 reedbuck; 1 tsessebe; 5 waterbuck and 9 zebra. (NPWL Annual Report 1964).

The 1964 Annual Report says "During 1964 the Research Branch was not sufficiently developed technically or administratively to execute all its functions. Although specialised professional and scientific staff in the wildlife field are difficult to find all the vacancies were filled in the course of the year 1964."

By the end of 1964 the Research Branch of the Department was completely consolidated and I joined the Department in January 1965 in order to assist with various research projects. A full working programme of the Research Branch was developed and implementation of the projects commenced in 1965.

During 1966 there were confirmed reports of Red hartbeest in the Ngamo area and during the same year the reintroduction of white rhino took place. By the end fo 1966, 16 White rhino had been released into the Manga vlei area.

In addition, a culling unit was set up at Shapi and the team consisted of one Warden, two Rangers, one Biologist and 5 Game Scouts. Aerial census of elephant during the year suggested that there were approximately 5,000 elephant in the whole Park (NPWL Annual Report 1966).

The total compliment of Research staff in the National Parks in 1967 was 6 Officers.

In December 1966, 90 elephant and 155 buffalo were culled and the remaining animals on quota of 500 elephant and 1,000 buffalo were removed during the year (NPWL Annual Report 1967). During the same year 50 wildebeest were culled from a group of 500 on the Ngamo Flats.

In October 1968 the new post of Botanical Ecologist in the Wankie National Park was filled. Cropping of wildebeest continued and during the year another 230 animals were removed from the Ngamo and Makalola areas. In addition, 969 impala were cropped during the year of which 712 were from the Robins area and 257 from Sinamatella. An aerial survey of wildebeest in the Main Camp area on 13th December 1968 gave a total count of 497 animals.

In 1969 the establishment of the Wildlife Research Officers was increased by 4 professional staff, making a total of 11 Research staff and 4 Technical Officer.

It was in August 1969 that I commenced my two year Mammal Survey of the Hwange National Park and by that time I had already left the Department of National Parks and Wildlife Management and joined the National History Museum in Bulawayo as Keeper of Mammals. At that time John Rushworth was Botanist at Main Camp, Basil Williamson the Ecologist and John Herbert the Senior Ecologist.

Prior to my detailed survey of the Wankie National Park the only collecting of mainly small mammals ever undertaken was by Peter Wright during 1967 and 1968. His collection, now housed in the National History Museum in Bulawayo, consisted of 130 specimens of rodents and bats.

After completion of my own survey in June 1971 numerous other wildlife ecologists were employed at the Hwange National Park and at no time for the past 25 years (up until December 1996) has the National Park ever been without at least one full time ecologist.

In fact, on many occasions there were up to 4 or even 5 researchers in the Park at the same time.

Table 12 gives a list of the Wildlife Ecologists and Technicians employed at Hwange over the past 36 years with some indication of how long each one of them worked in the Park. In the case of Researchers employed from 1965 to about 1973 it has been extremely difficult to obtain any data on how long and when they were stationed in the Hwange National Park.

Table 12 - List of Research Staff based at Hwange National Park during the period Jan. 1960 - Dec. 1996 (36 years)

Name of Researcher	Postition held	Period of employment at Hwange National Park						No. of years	
Graham Child	Ecologist	Jan.	1960	-	Sep.	1960		¾	
Jeremy Anderson	Ecologist	Apr.	1966	-	Sep.	1967		1	
Dave Higgins	Ecologist	Oct.	1968	-	Dec.	1969		1	
Basil Williamson	Ecologist	Jun.	1969	-	Oct.	1981		12	
John Herbet	Ecologist		-	-		-		?	*
J. Rushworth	Botanist		1970	-		1977		8	*
Russell Williams	Technician		1974	-		1978		5	*
Mike Kerr	Ecologist		1974	-		1977		4	*
Sue Childs	Ecologist		-	-		-		?	*
Mike Jones	Ecologist	Oct.	1973	-	Feb.	1975		1	
		Oct.	1984	-	Sep.	1989		5	
Beatrice Russell	Technician	Jan.	1991	-	Dec.	1996		6	
Kit Hustler	Ecologist	Mar.	1982	-	Mar.	1985		3	
Clare Davies	Ecologist	Nov.	1989	-	Aug.	1993		3	(1)
Stewart Towindo	Ecologist	Jun.	1993	-	Dec.	1996		3	
Felix Furmdagomo	Ecologist	Aug.	1993	-	Dec.	1996		3	
Cathy Rogers	Botanist	Aug.	1987	-	Jun.	1992		5	
Drew Coneybear	Ranger	Oct.	1968	-	Mar.	1974		5	
	Ecologist	Oct.	1978	-	Jan.	1986		7	
Norman Monks	Technician	Aug.	1977	-	Oct.	1984		7	
A. Bhiza	Technician		1982	-		1986		5	*
C. Tafangenyasha	Ecologist		1986	-		1990		5	*
P. Kagoro	Technician		1986	-		1989		4	*
F. Mahari	Pilot/Ranger		1995	-		1996		2	*
Mapfumo	Ecologist		1992	-		1992		?	*

(1) Note that one year was spent in Harare (i.e. 1992); * Data supplied by B. Russell.

A list of all approved Research Projects together with details of researcher, date project commenced and details of scientific and other reports produced is given below. A number of Theses have also been produced over the years and these are also included on the following pages. However, it should be noted that there are dozens of un-referred Departmental reports that have been produced over the years. Most of these are unfortunately not readily available to the public but copies are housed in the library at the Headquarters of the Department of National Parks & Wildlife Management in Harare.

Listed below are mammal projects undertaken by National Parks Researchers in the Hwange National Park over a period of 30 years (1965-1995), Masulani (1996). Details of the mammal projects mentioned below were extracted from the Departmental Report entitled "Inventory of all Research Projects done by the Branch of Terrestrial Ecology and under its Auspices: 1965 to 1995" compiled by Riwilo Masulani.

Title of Project:
Status and distribution of large mammals in Hwange National Park

Project No:
HNP/A4/2a/2; HNP/A4/2a 1/1?

Researchers:
CONYBEARE, A.M.G; MONKS, N.J.

Date Project started:
March 1978;

Status of Project:
Completed (1982)

Duration of Project:
5 years

Publications/Reports:
Referred Scientific: Nil
Unpublished Departmental Reports: Various

Title of Project:
Home range, seasonal movement, habitat selection and utilisation by an African Buffalo herd in the Sinamatella area.

Project No:
HNP/C4/1a/5

Researcher:
DUCKWORTH, F.W.

Date Project started:
August 1978;

Status of Project:
Completed (July 1980)

Duration of Project:
2 years

Publications/Reports:
Referred Scientific: Nil
Unpublished Thesis: DUCKWORTH, F.W.
Unpublished Departmental Reports: Various

Title of Project:
The Status, distribution and movements of Wild dog in Hwange National Park

Project No:
HNP/C4/a/8; D/M/153; D/M/173; D/M/177

Researchers:
CHILDS, S.C; GINSBERG, J; McCREERY, K; RASMUSSEN, G; ROBINS, R; DAVIES, C.

Date Project started:
18th March 1982;

Status of Project:
Active

Duration of Project:
(up to December 1996): 14 years

Publications/Reports:
Referred Scientific:
CHILDS, S.L. (1988) The past history, present status and distribution of the hunting dog *Lycaon pictus* in Zimbabwe. Biological Conservation 44: 301-316.
Unpublished Thesis: DAVIES, C. (1993). The Home range of the African Wild dog *Lycaon pictus* in Hwange National Park, Zimbabwe.

Title of Project:
Road strip counts in the Main Camp area

Project No:
HNP/B4/3a1/1

Researcher:
CONYBEARE, A.

Date Project started:
October 1977;

Status of Project:
Ongoing ???

Duration of Project:
(up to December 1996): 19 years

Publication/Reports:
Referred Scientific: Nil
Unpublished Dept. Reports: Various

Title of Project:
Aerial counts of large mammals in the basalt areas of Hwange National Park

Project No:
HNP/B4/2a/1

Researchers:
WILLIAMSON, B.R. and DAVIES, C.

Date Project started:
November 1977:

Status of Project:
Terminated

Publications/Reports:
Referred Scientific: Nil
Unpublished Departmental Reports: Various

Title of Project:
Road strip counts of large mammals in the Robins area of Hwange National Park

Project No:
HNP/B4/3a/1

Researchers:
CONYBEARE, A. and JONES, M.

Date Project started:
5th October 1977:

Status of Project:
Unknown

Publications/Reports:
Referred Scientific: Nil
Unpublished Departmental Reports: 'Some?'

Title of Project:
Aerial monitoring of selected large mammals species in Hwange National Park

Project No:
HNP/B4/4a/2

Researchers:
ST. C. GIBSON, D; JONES, M; BOWLER, M and DAVIES, C.

Date Project started:
November 1977:

Status of Project:
Annual project (ongoing)

Publications/Reports:
Referred Scientific: Nil
Unpublished Departmental Reports: Various

Title of Project:
Monitoring of the buffalo herds in the Robins sub-region in respect of herd movement, herd size in relation to the impact on the conservation works in the basalt areas.

Project No:
HNP/C4/1a1/6

Researchers:
CONYBEARE, A. and Field Staff at Robins Camp

Date Project started:
20th November 1978:

Status of Project:
Terminated

Publications/Reports:
Referred Scientific: Nil
Unpublished Departmental Reports: 'Some?'

Title of Project:
Dispersal of translocated Black rhinoceros in Hwange National Park
HNP?

Researchers:
CONYBEARE, A. and O'HARA, B.

Date Project started:
29th February 1984:

Status of Project:
Active

Duration of Project:
(up until December 1996):
13 years

Publications/Reports:
Referred Scientific: Nil
Unpublished Departmental Reports: 'Some?'

Title of Project:
Population dynamics of elephant in Hwange National Park

Project No:
HNP/C4/1a/7

Researchers:
WILLIAMSON, B

Date Project started:
5th March 1979:

Status of Project:
'Shelved'. Supposed to be a monitoring project with no time limit envisaged.

Publications/Reports:
Referred Scientific: Nil
Unpublished Departmental Reports: Various

Title of Project:
Numbers, distribution, population structure and feeding habits of giraffe in the 10 mile drive area of Hwange National Park

Project No:
HNP?

Researcher:
CONYBEARE, A.

Date Project started:
???:

Status of Project:
Completed??

Publications/Reports:
Referred Scientific: Nil
Unpublished Departmental Reports: Cannot be traced?

Title of Project: (Proposal)
Some factors on the ecology of basalt vleis and their utilisation by grazing ungulates.
Project No:

-

Researchers:
JONES, M.A.

Date Project started:
?:

Status of Project:
'Aborted'

Publications/Reports:
None

Title of Project:
Aspects of the ecology of wildebeest (*Connochaetus taurinus*) in Hwange National Park

Project No:
HNP/C4/1a/1

Researchers:
WILLIAMSON, B.R.

Date Project started:
July 1968:

Status of Project:
Completed (January 1978)

Duration of Project:
9½ years

Publications/Reports:
Referred Scientific: Nil
Unpublished Departmental Reports: Final Report (not published)

Title of Project:
Vegetation succession and elephant use in Kalahari sand area of Hwange National Park

Project No:
HNP/C6/-/1

Researchers:
CONYBEARE, A.

Date Project started:
13th March 1979:

Status of Project:
Completed

Publications/Reports:
Referred Scientific: Nil
Unpublished Thesis: CONYBEARE, A (1991) The population dynamics of some woody species in the Kalahari sand vegetation of Hwange National Park.
Unpublished Departmental Reports: Various

Title of Project:
Aspects of reproductive and nutritional biology of elephant in Hwange National Park

Project No:
HNP/C4/1a/3

Researchers:
CONYBEARE, A.

Date Project started:
?:

Status of Project:
Completed

Publications/Reports:
No progress reports can be traced
No reports or publications

Table 13 gives a list of referred scientific mammal publications in recognised scientific journals of work undertaken in the Hwange National Park. It is not known why, but for some reason these publications were not included in the inventory of Riwilo Masulani mentioned above.

Table 13 - Referred scientific publications and books concerning mammals of the Hwange National Park not covered by Masulani (1996)

Author	Date of Publication	Title of Publication
WEIR, J.S.	(1960)	A possible course of evolution of animal drinking holes (pans) and reflected changes in their biology. Proc. 1st Fed. Sci. Cong. Salisbury, 5pp Marden & Co., Salisbury.
CONDY, J.B.	(1963)	Internal parasitism of animals in Wankie National Park South African Journal of Science 59(9): 415-418.
ROTH, H.H. & AUSTEN, B.	(1966)	Twin Calves in Elephants. Saugetierkundliche Milleilungen Heft 4, S.342-345 Okt. 1966.
WEIR, J.S. & DAVISON, E.C.	(1966)	Daily occurrene of African game animals at waterholes during dry weather Zool. Afr. 1: 353-368.
DAVISON, E.C.	(1967)	Wankie - The Story of a Great Game Reserve. Books of Africa.
WEIR, J.S.	(1969)	Chemical properties and occurrence on Kalahari sand of salt licks eroded by elephants J. Zool., Lond (1969) 158; 293-310.
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HERBERT, H.J. & AUSTEN, B.	(1972)	The past and present distribution of the hook lipped (Diceros bicornis) and square lipped (Ceratotherium simum) rhinoceros in Wankie National Park. Arnoldia 5(26)
WILSON, V.J.	(1975)	Mammals of the Wankie National Park Museum Memoir No. 5. 147 pages. National Museum and Monuments of Rhodesia.
HOWELLS, W.W. & HANKS, J.	(1975)	Body growth of the impala (Aepyceros melampus) in Wankie National Park. Journal of South African Wildlife & Mgt. Ass. 5(2): 95-98.
WILLIAMSON, B.R.	(1975)	The Condition and Nutrition of Elephant in Wankie National Park. Arnoldia Rhod. 7(12): 1-20.
WILLIAMSON, B.R.	(1975)	Seasonal Distribution of elephant in Wankie National Park. Arnoldia 7(11): 1-16.
CONYBEARE, A.	(1975)	Notes on the feeding habits of kudu in the Kalahari sand area of Wankie National Park, Rhodesia. Arnoldia Rhod. 7(14): 1-7.
WILLIAMSON, B.R.	(1976)	Reproduction of the female elephant in Wankie National Park. S. Afr. J. Wild. Res. 6(2): 89-93.
CONYBEARE, A. & HAYNES, G.	(1984)	Observation on elephant mortality and bones in waterholes. Quaternary Research 22: 189-200.

DISCUSSION AND RECOMMENDATIONS

In this section of my report I would like to clearly emphasise that the opinions given here are entirely my own and do not necessarily follow those of members of staff of the Department of National Parks and Wildlife Management and I alone am responsible for statements made and in writing this discussion.

I would also like to mention that in most species of mammals, with the possible exception of elephant and buffalo, census techniques are still far from accurate and as a result I have had to evaluate all the data available when trying to come up with a population figure.

I have already had several "experts" advise me that various species are more common than I have stated and that several species "are coming out of our ears" or occur "everywhere." A good example is for the cheetah. Because a researcher or a safari operator may have seen two or three animals in a single day does not necessarily mean that the species is common. The results presented in this report are as I have seen it over the past year and once again I would like to reiterate that a considerable amount of research and detailed fieldwork is still essential if we are to fully understand, and get accurate data on the status of the mammals of the Hwange National Park.

When I commenced the 1996 survey one of my first tasks was a literature survey of scientific publications on the Mammals of the Hwange National Park and I was extremely disappointed and concerned at the almost total lack of published data. As already discussed before in this report I mentioned that from January 1965 to the end of December 1995, a period of 30 years, there were many biologists/ ecologists working in the Park. At no time during those 30 years had the Park even been without one ecologist and at some periods there were even two or sometimes three full time researchers stationed at Main Camp.

Table 12 of this report clearly illustrates the number of ecologists that have worked in Hwange and their duration of stay in the Park. Some ecologists were employed in the park for over 10 years. The total number of scientific publications on the mammals of the Hwange National Park written by staff of the Department over a period of 30 years, and published in scientific journals, that I could trace number only eight, as follows:

Conybeare, A.	(1975)	Feeding habits of kudu in Kalahari sand area of Wankie National Park. Arnoldia 7(14): 1-7.
Williamson, B.R.	(1975)	The condition and nutrition of elephant in Wankie National Park. Arnoldia 7(12): 1-20.
Williamson, B.R.	(1975)	Seasonal distribution of elephant in Wankie National Park. Arnoldia 7(11): 1-16.
Williamson, B.R.	(1976)	Reproduction in female elephant in Wankie National Park. S. Afr. J. Wildl. Res. 6(2): 89-93.
Roth, H.H. & Austen, B.	(1966)	Twin calves in elephant. Sangt. Mitti 14(4): 342-345.
Herbert, H.J. & Austen, B.	(1972)	The past and present distribution of hook-lipped and square-lipped rhino in Wankie National Park. Arnoldia 5(26).
Howells, W.W. & Hanks, J.	(1975)	Body growth of the impala in Wankie National Park. J. S. Afri Wildl. M. Assoc. 5(2): 95-98.

Weir, J.S. & Davison, E.C.	(1966)	Daily occurrence of African game animals at waterholes during dry weather. Zool. Africana 1: 353-368.

As can be seen from the dates of the publications, all the above were written in the 1960's and 1970's, which was over 20 years ago.

In 1984 Conybeare and Haynes wrote a paper "Observations on elephant mortality and bones in the waterholes" and this was the only scientific paper I could find on mammals of the Hwange National Park published in the 1980's and 1990's. However, there were several Theses on mammals produced over the years, as follows:

Conybeare, A. M.	(1972)	Habitat preference of kudu in the Kalahari sand area of Wankie National Park. Unpublished thesis for Certificate in Field Ecology: Univ. of Rhodesia.
Duckworth, B.J.	(1972)	The distribution and movement in buffalo herds in the Kalahari sand area of Wankie National Park. Unpublished Thesis for Certificate in Field Ecology. Univ. of Rhodesia.
Howells, W.W.	(1974)	Population dynamics and body growth of impala in Wankie National Park. Unpublished thesis for Certificate in Field Ecology. Univ. of Rhodesia.
Conybeare, A. M.	(1991)	Elephant occupancy and vegetation change in relation to artificial water points in a Kalahari sand area of Hwange National Park. Unpublished thesis for D.Phil. Univ. of Zimbabwe.
Davies, C.	(1993)	Home range of the African wild dog in the Hwange National Park. Unpublished M.Sc thesis. Univ. of Zimbabwe.

All the above theses were produced for higher degrees or Certificates of Field Ecology but unfortunately none of the results were published in scientific journals. In addition, all the people mentioned above have since left the Department of National Parks & Wildlife Management for greener pastures.

There may well be a small number of other scientific publications on mammals that I may have missed but I do not believe there are very many and I cannot trace any major scientific publications on elephant, rhino, zebra, kudu, eland, sable, roan, wildebeest, buffalo, lion, hyaena, leopard, cheetah or even wild dog. The only publication available dealing with all the mammals of the Hwange National Park was my own book "Mammals of Wankie National Park" published in 1975 and that publication was the result of the two years of fieldwork in 1969/71.

However, the lack of scientific publications does not in any way suggest that no scientific work was undertaken on mammals over the years. A large number of Departmental reports covering all aspects of wildlife and project reports were produced over many years but unfortunately they are very difficult to find and not readily available.

For example, Masulani (1996) in his report states that Departmental reports for all the projects he listed could be found at Main Camp, Hwange National Park. However, Beatrice Russell, Research Technician at Main Camp, said she could not find any of the reports in the files at Main Camp and that they must have been moved to the archives some time

previously. Even at the Department's head office in Harare, I was unable to find several reports, especially those concerning wildebeest, spotted hyaena and several others.

As mentioned before, Masulani (1996) compiled a very comprehensive and worthwhile report on all projects initiated in Zimbabwe by the various research units of the Department of which the mammals of the Hwange Research Unit was just one of the sections covered. One pages 48-51 of this report I have given a full and detailed list of the 15 projects on mammals for the Hwange National Park for the period 1965-1995 (30 years) as given by Masulani (1996).

Details of those 15 projects relating to mammals of the Hwange National Park as discussed by Masulani (1996) are self explanatory. It can be seen from Masulani's data that only two projects were ever completed and fully written up (but not published) and those were of ones for higher degrees or a thesis. Of the 15 projects started in the Hwange National Park no scientific publications were ever written.

I would now like to turn my attention to the present survey and discuss in some detail some of the findings covering the large mammals of the Hwange National Park.

Elephant: There is no doubt that the elephant population has increased dramatically over the past 25 years from an estimated 10 000 animals in November 1973 to an estimated 27 907 in September 1996. The 95% C.L. range is from 21 270 to 34 545 with a 95% C.L. of 23.8%. This overpopulation of elephant in the Hwange National Park is clearly a major problem and already one species, i.e. grysbok, and possibly also bushbuck, may have disappeared from the Lukozi River riverine vegetation due to the destruction of the habitat by elephant.

Elephant have also, on numerous occasions, been seen driving other game away from waterpoints and many species have to wait for hours to get to water while others, e.g. roan, do not wait for long and move off without drinking. During the dry season elephant were even entering the Sinamatella Camp and destroying the vegetation at the Camp. If this continues, in no time the Sinamatella Camp will look as dry as the Mopane woodland in the valley below.

I could go on and on writing about the elephant population but clearly something will have to be done in the very near future or we may lose many mammal species and also have the habitat destroyed to such an extent that it would take decades to recover.

Unfortunately no research on the elephant population in the Hwange National Park is being carried out at the present time. As the elephant is a very economically important species, it requires at least one full time ecologist carrying out research on its movements, feeding habits and reproduction.

Buffalo: While elephant numbers have doubled in the last 25 years so the buffalo population has halved. In 1973 Wilson (1975) estimated that there were 10 000 buffalo in the Park and now in 1996 there are less than 5 000. The 1996 aerial survey of the Park gave an estimate of only 1 840 buffalo with a 95% C.L. range of from as few as 693 to 2 987 with a 95% C.L. of 62.3%. Even if the figure of 2 987 was doubled then the population would still be about 5 000 animals.

The availability of water is another important factor and is essential for buffalo especially during the dry season when buffalo will move to find water. In addition, a considerable number of buffalo have also been culled and hundreds captured in the Hwange National Park over the years. The culling and translocation of buffalo would also have attributed

to the reduction of the population to what it is today. Twenty five years ago there were many large herds of buffalo, some numbering over 1 000 animals. Today there are very few records of even 500 buffalo together.

There is considerable movement of buffalo across the Botswana border and I am led to believe (Cynthia Hunter, pers. comm.) that hundreds of buffalo are destroyed each year in Botswana by hunting by the local population and killed on the roads by heavy vehicles.

RECOMMENDATION: (ELEPHANT & BUFFALO RESEARCH UNIT)
I would very strongly emphasise that as the elephant and buffalo are such important species, from every possible point of view, they require a great deal of attention. Apart from some work being carried out by a guest researcher from America on feeding behaviour of elephant in the Park and another study by another guest researcher north of Hwange Park studying buffalo. no other meaningful work is at present being done.

I would strongly suggest that the Department immediately employs or allocates an ecologist full time to study elephant and buffalo in the Hwange National Park and in fact the entire north-western part of Zimbabwe. I am certain that funding could be obtained to initiate such a project and I know it would attract international support, together with vehicles, aircraft, etc.

As the largest concentration of elephant and buffalo in Zimbabwe occurs in north-western Matabeleland (including Hwange National Park), with an estimated population of 33 471 elephant with a 95% C.L. range of between 26 390 and 40 551 animals, it is essential that an elephant and buffalo research unit be established without delay and based at Main Camp.

As both of these large mammals are easily counted from the air it would be very useful if both species were studied at the same time and by the same team of people. Any foreign researchers should then become part of that team which should be co-ordinated by a Zimbabwean.

Eland: The eland population was found to be much lower during 1996 than it was 25 years ago. The only large herd seen during the 1996 survey was one of 70 animals at Ngamo. Therefore, where have all the other large herds of eland disappeared to? This requires immediate research to establish what has happened to the large herds of eland of over 400 that were once common many years ago.

Roan: Fortunately the roan population is still stable and there are still good numbers in the Park. However, there now appear to be less roan in the Ngweshla/ Ngamo area than there were 25 years ago and more have been recorded in the Robins area. There appears to have been a shift in the population which could be as a result of an increase in the sable in the Makololo/ Ngamo/ Ngweshla area.

Sable: The sable population is in very good shape and there are many breeding records of the species. All the sable appear to be in superb condition and the Makololo/ Ngweshla area is definitely the main concentration area of the species in the Park.

Impala: There are still many thousands of impala in the Hwange National Park. In spite of the fact that they were heavily culled many years ago their numbers have increased dramatically and today there are more than there has ever been in the past. Not only is the population very high in most areas but they have extended their range and have spread out considerably over the past 25 years.

During the rainy season of 1995/96 and 1996/97 there were a large number of herds of 100 impala or more in the Main Camp/ Makwa/ Kennedy area and they were also

breeding at an unbelievable rate. The impala is perhaps one of the species that could possibly be fully utilised by selling animals to people wanting them. The population could stand the removal of a few thousand animals. However, the herds seen in the Robins and Sinamatella area during 1996 appear to be smaller than they were 25 years ago when herds of 100 or more were not uncommon. Nevertheless, they still occur in both areas in large numbers.

Wildebeest: While there is still a good population of wildebeest in the Park their numbers are down from what they were years ago. Groups of over 500 are now rare and during the whole year of the survey there was no evidence of concentrations of 1 000 or more as recorded some years ago.

There are also very few wildebeest in the Robins and Sinamatella areas and without doubt the largest concentration exists in the Ngamo/ Makololo/ Ngweshla and Kennedy areas.

Waterbuck: This species was never plentiful in the Hwange National Park and at present (1996) the largest concentration occurs in the Ngweshla/ Makololo area. This species should be watched carefully to ensure that their numbers do not decline to a very low level.

Tsessebe: Now almost absent from the Park. At one time, 25 years ago, they were always seen on the Shumba Plains where two or three reasonably sized herds existed. They now appear to be absent from the vast Shumba grasslands and some movement to the north and even out of the Park into the Matetzi area appears to have taken place.

This movement may be as a result of drying up of the Shumba plains during several years or even possibly as a result of an overpopulation of elephant in the Shumba area. However, one large herd of tsessebe was seen in the Deka area of the Park and another herd was seen in the Dett Vlei at the Safari Lodge.

Gemsbok: This species has remained in low numbers for many years although there still appears to be about 100 in the Park. They were seen in several areas in the Kalahari sand country but never in large numbers. Two calves were seen during the 1996 survey so they are obviously still breeding. Those seen were all in superb condition.

Mini antelopes: Duiker are still plentiful and there are large numbers of steenbok in the Park. Klipspringer occupy a specialised habitat and are difficult to see and study, while the grysbok has almost disappeared from the riverine vegetation along the Lukozi River. This may well be as a result of the destruction of its habitat by elephant but the species could be a lot more common in the broken country east of Shumba where they would be difficult to find. The Lukozi grysbok population may well have shifted south.

Oribi: This species has now appeared in the Park and it is exciting to see that a small population now exists in the area of open grassland around Shabi Shabi. This is very good news.

Recommendation: (Antelope Research Unit)
Because of their importance, the antelope of the Hwange National Park could quite easily bring in a great deal of money. They are very valuable animals and surplus antelope could quite easily be sold for considerable sums of money. However, before this can be done an Antelope Research Unit should be established to accurately determine the size of the various populations of species, to study their food and feeding habits and reproductive potential. Such a unit could be based at Umtshibi Camp where excellent holding facilities for captured animals exists and where office space and staff accommodation is available. This unit should also be headed by a full time ecologist based at Umtshibi Camp. The unit could study all the antelope of the Park and also in addition, giraffe, hippo, zebra, warthogs

and any other species not included in the buffalo/ elephant research units or the rhino and carnivore research units.

Carnivores:
As far as the large predators are concerned, the lion and spotted hyaena populations have increased considerably over the years and leopard are now very often seen by tourists during the hours of daylight. Cheetah numbers as well as wild dogs have decreased and groups are smaller than previously recorded. This may well be as a result of the vast increase in lion and spotted hyaena population. On one occasion, a group of hyaena were seen killing and eating a cheetah and hyaena were also recorded chasing wild dogs off their prey. The relationship between the large carnivores is unknown.

Recommendation: (Large Carnivore Research Unit)
A very detailed and long term study of the predators of the Park is long overdue and the relationship of the predators to each other needs to be investigated. A number of sick lions were recorded in the Sinamatella area and this was discussed with the Provincial Warden and also the Warden at Sinamatella. It is a problem that should be watched carefully and a research project on the large carnivores in Hwange would attract external funding and this project should be considered without delay.

A very recent (1995/96) outbreak of rabies and possibly other diseases in the Serengeti in Kenya/ Tanzania resulted in the death of over 1 000 lions. I believe we should not treat our large carnivores, which are top of the food chain predators, casually. They have been neglected for over 30 years and now require urgent attention.

Research on these species is essential and I would very strongly recommend that a Large Carnivore Research Unit be established at Main Camp. This unit could then incorporate the present two wild dog research teams into its programme which could monitor the distribution and status and reproductive rate of these very valuable predators. The unit could also work in the surrounding safari areas to determine what effect hunting has on the population of lion, hyaena, leopard, wild dog and cheetah in the Park.

Rhino Research & Monitoring unit (Sinamatella)
A full time ecologist is already employed at Sinamatella and he is responsible (with the Warden at Sinamatella) in monitoring the Black rhino population in the IPZ. This is, as far as I can see, the only unit in the Hwange National Park that is functioning well and it should be left as it is at present. However, the unit should also look into the status of the White rhino in the Park which it may already be doing.

In spite of the fact that the population of several species of mammals in the Hwange National Park is now much lower than it was 25 years ago and that other species have doubled in numbers, the state of the wildlife in the Hwange National Park is very good. After two very good rainy seasons, the vegetation and pans throughout the Park look good indeed and the vegetation in particular is now looking better than it has been for many years.

Finally may I take this opportunity to say that it was indeed a great pleasure and a privilege for me to have spent 1996 in the Hwange National Park and I thank the staff of the Department of National Parks & Wildlife Management for their wonderful co-operation and for allowing me to be part of the "team" for the year.

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Please Note: The list of references cited above are not complete and many more references with full details of journals in which published will be included in the final report.

Appendix A - Gazetteer and GPS co-ordinates of some pans, dams, seeps, springs etc. for Hwange National Park.

Name	Area	Type	GPS co-ordinates
Balla Balla	M	N	18° 43.65S 26° 55.19E
Baobab	S	P	18° 36.01S 26° 22.71E
Basha	M	P	19° 30.31S 26° 35.10E
Beaver (Beva)	M	N	19° 10.91S 26° 55.89E
Mbejane (Bejane)	R	N	18° 44.25S 26° 08.53E
Bembesi	M	N	18° 50.26S 26° 38.25E
Big Toms	R	P	18° 41.74S 25° 59.31E
Boss Longone 1	M	N	18° 47.58S 26° 48.20E
Boss Longone 2	M	N	18° 47.47S 26° 47.84E
Boss Longone 3	M	N	18° 47.61S 26° 47.57E
Boss Longone 4	M	N	18° 47.44S 26° 47.90E
Bumboosi 1 (Bumbusi)	S	Sp	18° 30.50S 26° 10.90E
Bumboosi 2 "	S	Sp	18° 30.71S 26° 10.81E
Bumboosi 3 "	S	?	18° 30.35S 26° 10.86E
Bumboosi Hide	S	Sp	18° 30.43S 26° 10.91E
Bumboosi 4 (Bumbusi)	S	Sp (Dry)	18° 31.05S 26° 10.59E
Bumboosi River Pan	S	N	18° 31.44S 26° 10.03E
Bumbumtsa	R	P	18° 50.05S 26° 13.02E
Caterpiller	M	P	18° 48.02S 26° 58.00E
Chibisa/Chavisa/Chivisa	M	?	18° 41.26S 26° 46.56E
Chawato	S	Sp	18° 31.05S 26° 14.92E
Chingahobe	R	D	18° 35.99S 26° 07.28E
Tshompani Dam (Chompani)	S	D/P	18° 43.42S 26° 27.98E
Tshompani Pan (Chompani)	S	N	18° 43.47S 26° 31.53E
Crocodile Pools Hide	R	Rv	18° 37.17S 26° 02.39E
Dadada Pan (Dada)	M	N	18° 59.21S 26° 18.93E
Dandari 1	R	P	18° 49.95S 26° 03.06E
Danga	M	N	18° 52.45S 26° 29.34E
Deka Camp	R	Sp	18° 40.29S 25° 48.70E
Deka '141'	R	Rv	18° 38.22S 25° 55.19E
Dete Cesspools	M	Cspl.	18° 38.00S 26° 51.47E
Deteema Picnic Site	R	Sp	18° 40.88S 26° 09.13E
Dina (Dino)	M	N	18° 59.81S 26° 18.66E
Dobashuro Spring	S	Sp	18° 34.67S 26° 15.82E
Dolilo Borehole	R	P	18° 42.42S 26° 03.49E
Dom	M	P	18° 45.09S 26° 54.00E
Dopi	M	P	18° 50.87S 26° 55.62E
Dwarf Goose Pan	M	N	18° 49.75S 26° 21.49E
Dynamite Pan	M	P	18° 45.46S 26° 58.35E
Dzivanini (see Zibanini)	-	-	-
Gomo Dam	M	D	19° 41.65S 26° 36.92E
Gosivanini (Josivanini)	M	P	19° 23.06S 26° 45.14E
Guvalala	M	P	18° 49.81S 26° 44.46E
Hendricks	R	N	19° 01.94S 25° 59.79E
Inyantue Dam (see New Inyantue)	-	-	-
Jambili	M	P	18° 55.29S 26° 53.16E
Kaoshe	M	N	18° 43.85S 26° 43.93E
Kapani Pan	R	N	18° 51.42S 26° 08.87E
Kennedy I	M	P	18° 52.51S 27° 08.14E
Kennedy II	M	P	18° 58.10S 27° 05.24E
Leasha Dam	M	D	19° 35.93S 26° 39.37E
Lememba	M	N	19° 17.74S 26° 13.03E
Limpandi	M	Rv	19° 44.43S 26° 35.75E
Linkwasha	M	W	19° 09.03S 27° 10.37E
Little Toms	R	P	18° 40.67S 25° 57.46E
Little Zibanini (Dzivanini)	M	N	19° 46.09S 26° 33.72E
Livingi	M	P	18° 42.32S 26° 55.43E
Mabuya Mabema	M	N	18° 46.80S 26° 40.18E
Madundumela	M	P	19° 11.52S 27° 04.34E
Mahohoma Seep 1	R	Sp	18° 40.27S 25° 54.59E

Appendix A contd...

Name	Area	Type	GPS co-ordinates
Makololo 1	M	P	19° 04.01S 27° 20.57E
Makololo 2	M	N	19° 04.27S 27° 19.59E
Makona	M	P	19° 19.42S 26° 55.19E
Makwa	M	P	18° 47.49S 27° 02.91E
Mandavu Picnic Site	S	D	18° 38.76S 26° 16.18E
Mandiseka	M	P	19° 14.99S 27° 08.54E
Manga 1	M	P	18° 57.41S 26° 51.29E
Manga 2	M	P	18° 59.32S 26° 53.24E
Manga 3	M	P	19° 02.36S 26° 56.28E
Manzichisa 1	R	Sp	18° 40.23S 26° 04.59E
Manzimbomvu	R	P	18° 46.46S 26° 03.02E
Masuma	S	D	18° 43.79S 26° 16.77E
Matambo Pan (Matambonyati)	M	N	19° 25.08S 26° 29.00E
Mvalasangwane Pan	M	N	19° 28.43S 26° 31.86E
Mbazu	M	N	19° 14.98S 27° 08.55E
Mbiza	M	P/W	18° 56.75S 27° 15.10E
Mfagazaan	M	P	19° 11.65S 27° 19.43E
Mitswiri (Mtswiri)	M	N	19° 08.57S 26° 20.96E
Mopane (Pump removed)	M	P	18° 51.75S 26° 25.29E
Mpisa	M	N	19° 18.02S 26° 57.53E
Mtoa	M	N	18° 41.59S 26° 41.08E
Nantwich	R	P/D	18° 35.88S 25° 54.25E
Nehimba	M	Seep	18° 54.16S 26° 25.66E
New Inyantue	S	D	18° 38.89S 26° 38.50E
Ngamo 2	M	N	19° 05.35S 27° 26.95E
Ngwenya	M	N	18° 44.44S 26° 51.37E
Ngweshla	M	P	19° 01.71S 27° 06.28E
Njekwe	R	P	18° 59.62S 26° 09.73E
Nyamandhlovu	M	P	18° 46.55S 26° 53.33E
Roan	M	N	18° 50.48S 26° 22.66E
Robins Camp (Office)	R	P	18° 37.79S 25° 59.16E
Salt Pan Dam	R	D/Sp	18° 41.06S 26° 01.90E
Samavundhla	M	P	19° 02.05S 27° 10.07E
Secheche	M	P	19° 15.38S 26° 59.33E
Sedina	M	P	18° 43.27S 26° 56.81E
Shabi Shabi	M	Seep	19° 19.19S 26° 10.28E
Shakwanki 1	M	Seep	19° 08.63S 26° 13.47E
Shapi (Shape)	M	P	18° 51.88S 26° 35.18E
Shumba Big	M	N	18° 50.50S 26° 18.49E
Shumba Pan	S	P	18° 48.42S 26° 20.75E
Sibaya 1	M	N	18° 40.43S 26° 54.11E
Sinamatella Windmill	S	W	18° 35.37S 26° 19.04E
Sinamatella River	S	Rv	18° 35.46S 26° 19.61E
Sinanga	M	N	18° 51.14S 27° 04.01E
Sanyati Pan	R	N	18° 59.56S 26° 03.49E
Skoffels (Stoffels)	R	N	19° 04.44S 25° 57.95E
Tsamhole	R	P	18° 44.79S 25° 53.17E
Tshakabika	S	Sp	18° 36.88S 26° 28.71E
Tshebe Tshebe	M	P	18° 43.53S 26° 50.28E
Tshebema (Chebema)	M	P	18° 43.84S 26° 45.77E
Tshompani	S	D/P2	18° 43.42S 26° 27.98E
Tibukai	R	N	18° 53.40S 25° 57.66E
Tum Tum	M		19° 12.78S 27° 18.58E
Umkhawuzan (Mukazani)	M	N	18° 55.63S 26° 59.31E
Wecau (Wexcau)	M	P	19° 07.99S 27° 21.85E
White Hills	M	N	18° 52.05S 26° 38.76E
Xixi Amabanda	M	N	19° 18.80S 26° 27.08E
Zibanini (Dzivanini/Dzivanini)	M	N	19° 47.12S 26° 33.55E

Note: 1) All co-ordinates were supplied by Mrs. Val Fielder, Wildlife Society of Zimbabwe, Matabeleland Branch.

2) M = Main Camp area; R = Robins Camp area; S = Sinamatella Camp area; N = Natural pan; P = Pumped pan; Sp = Spring; R = River; W = Windmill; D = Dam

Appendix B - Glossary of some terms used in text

Adaptation - The process by which an animal becomes suited to its environment.

Annual - A plant that completes its life cycle from seedling to mature seed-bearing plant in one season.

Biomass - The total weight of a species per unit of geographical area.

Browser - An animal that eats mainly from the leaves, buds and twigs of trees and shrubs.

Carnivore - An animal that lives by eating the flesh of other animals.

Carrying capacity - The number of animals of a given size which can be supported for a given time by the vegetation growing in that area without adversely affecting the vegetation production.

Diurnal - Term describing an animal that is active during the hours of daylight.

Ecology - The study of the relationship between living things and their enivronment, including both their non-living surroundings and other animals.

Ecosystem - The ecological system formed by the interaction of organisms and their environment.

Extinction - When a species no longer exists either in the wild or in captivity it is said to be extinct.

Gestation period - The period of time required for a mammal to develop in its mother's womb from the date of conception, at mating, through to birth.

Grazer - An animal that feeds primarily on grass.

Gregarious - A sociable animal that lives in flocks or herds.

Habitat - The immediate surroundings of a creature or plant which normally provides everything it requires to live.

Herbivore - An animal that feeds on plants.

Hibernate - A creature hibernates when it spends time in a deep sleep or torpor to avoid harsh climatic conditions such as cold winters.

Indigenous - An animal or plant that is native to the locality.

Kopje - An Afrikaans name used throughout southern Africa to describe a small rocky hill or outcrop.

Mammal - A term for the group of animals that are warm-blooded, have milk producing glands, are partly covered in hair and bear their young alive.

Migrate - Animals migrate when they undertake seasonal movements, often covering long distances, because of variations in food or water supplies due to changing seasons.

Nocturnal - A creature that is active by night.

Omnivore - A creature that eats both meat and vegetation.

Pan - A natural waterhole.

Parasite - An organism living in or on another to its own advantage in terms of food and shelter.

Perennial - Persisting throughout the year, or for a number of years.

Predator - An animal that catches other animals for food.

Prey - A animal caught by a predator.

Savanna - Extensive areas of natural grassland.

Scavenger - An animal that lives off the dead remains of other animals or plants.

Solitary - A term describing an animal that lives alone without compansions for most of the time.

Species - A term, singular or plural, for a group of animals or plants with common characteristics and which do not breed with others.

Territory - An area used by an animal for feeding and/or breeding, often defended against its own kind and sometimes against other species too.

Veld - An Afrikaans term for bush.

Vlei - A Afrikaans word used widely throughout southern Africa for an area of marshy ground.

Wallow - A mud or dust bath in which animals lie or roll to cool off and obtain protection from skin parasites.

Appendix C - Large carnivore sightings

DEPARTMENT OF NATIONAL PARKS and CHIPANGALI WILDLIFE TRUST
ZOOLOGICAL SURVEY - HWANGE NATIONAL PARK
Visitors sightings of large carnivores mentioned below.
(Please use separate form for each sighting)

LION LEOPARD CHEETAH BROWN HYENA SPOTTED HYENA WILD DOG SERVAL CARACAL

We would welcome your participation in this survey. If you are lucky enough to see any of the large carnivores mentioned above please complete the form below and hand it in to the attendant at the gate when leaving.

SPECIES	TOTAL NUMBER	DATE	TIME
IF POSSIBLE GIVE SEX AND AGE CLASSIFICATION OF GROUP			
MALES	FEMALES	UNSEXED	YOUNG
LOCALITY (Nearest Pan)			
HABITAT			
NOTES (eg. at kill/carcass, etc.)			
YOUR NAME (Please Print)		CONTACT ADDRESS	

N.B. If you would like more details concerning this survey, please contact:
Mr. V.J. Wilson, Chipangali Wildlife Trust, P.O. Box 1057, Bulawayo, Zimbabwe

Appendix D - Marked transect form ("road strip count")

ZOOLOGICAL SURVEY
HWANGE NATIONAL PARK

ROAD STRIP COUNT

Exact route taken:

Date: Time: (Start) Time: (Finish)

Names of Observers:

Time	Speedo Reading always start at O	Species seen and numbers	Distance from vehicle (in mtrs)	Habitat (if at pan or waterhole please say so)

NOTES: Please give details of the following: Conditions of pans and if water present/absent, roads, vegetation. Time to cover transect, total distance covered, any other interesting observations.

Signatures: and

Appendix E - Full details and description of Marked Transects used for "road strip counts". (A summary is given in Table 8)

Transect No. 1 From main tar road at Main Camp, down road via Makwa, Kennedy I and Kennedy II to Ngweshla Pan.
Distance: 53.7 km.

Transect No. 2 From Main Camp entrance gate along tar road and north along Balla Balla loop road. Then at Tshebema turn-off and south again to Dom Pan and along main tar road towards Nyamandhlovu and then along second Nyamandhlovu turn-off to Platform and around loop back to main tar road. Then along tar road and return to Main Camp.
Distance: 22.3km.

Transect No. 3 From main Makwa/Kennedy road to Sinanga Pan and then along road to Dopi-Umkhawuzane road.
Distance 16.4 km.

Transect No. 4 From Dopi Pan along bush track via Umkhawuzan Pan to Kennedy II Pan.
Distance 25.0 km.

Transect No. 5 From Dopi Pan via Jambili and Manga Pans to Ngweshla.
Distance: 58.3 km.

Transect No. 6 From Dopi turn-off on main Makwa road, via Caterpillar and Dopi Pans around loop to main tar road near Dom Pan.
Distance: 27.4 km.

Transect No. 7 From second Nyamandhlovu turn-off (from Main Camp) along tar road to White Hills Pan turn-off and then along bush track to White Hills Pan.
Distance: 30.7 km.

Transect No. 8 From Tshebema turn-off (north of Dom Pan) along Tshebema road via Ngwenya, Tshebema, Mabuya Mabema road to main Shumba tar road.
Distance: 52.4 km.

Transect No. 9 From Guvalala Pan along old bush track direct to Manga 1 Pan.
Distance: 23.6 km.

Transect No. 10 From Safari Lodge entrance along main tar road to Main Camp Petrol Station.
Distance: 12.7 km.

Transect No. 11 From Ngweshla Pan to Ngamo Pan, at Pump.
Distance: 38.3 km.

Transect No. 12 From Ngweshla loop road - along bush track around open plain to south of Ngweshla Pan.
Distance: 4.4 km.

Transect No. 13 From Shapi Pan south to Tendele/Manga track.
Distance: 25.0 km.

Transect No. 14 From Verney's Pan along bush track to turn-off to Tendele Pan.
Distance 26.4 km.

Transect No. 15 From Sinamatella gate to Kashawe loop road and around Kashawe loop and then Sinamatella River drive and stop at main Sinamatella/Shumba road.
Distance: 31.0 km.

Transect No. 16 From main Sinamatella/Shumba road along track via Salt Springs and end on main road again near Mandavu Dam turn-off.
Distance 8.4 km.

Transect No. 17 From main Sinamatella/Shumba road along loop road down Lukozi River to Sinamatella River loop road.
Distance: 30.0 km.

Transect No. 18 Along Sinamatella/Shumba road at turn-off to Sinamatella loop road entrance down road to Masuma Dam.
Distance: 17.2 km.

Transect No. 19 From main Sinamatella/Shumba road along Robins Camp road to Deteema Dam.
Distance 20.5 km.

Transect No. 20 From Robins Camp road around Chingahobe loop road and past Chingahobe Dam to main Robins road again.
Distance: 25.4 km.

Transect No. 21 From Masuma Dam along main road to Shumba Picnic Site.
Distance: 14.6 km.

Transect No. 22 From Shumba Picnic Site to Tshompani Dam.
Distance: 18.4 km.

Transect No. 23 From Tshompani Dam to Tshakabika Hot Springs.
Distance: 19.0 km.

Transect No. 24 From Lukozi River (at crossing near Sinamatella) to Inyantue Dam.
Distance: 31.0 km.

Transect No. 25 From Tshakabika/New Inyantue Dam road to Inyantue Railway Siding.
Distance: 12.0 km.

Transect No. 26 From Inyantue Railway Siding north along railway line to Mbala Lodge on main Hwange/ Sinamatella road.
Distance 27.0 km.

Transect No. 27 From Mbala Lodge along main road to Sinamatella Camp.
Distance: 20.8 km.

Transect No. 28 From main Robins Camp road to Salt Pans then along to Big Toms and Little Toms Pans and back to main Robins road.
Distance: 27.0 km.

Transect No. 29 From main Robins Camp road along Tshowe loop road and around loop ending where loop road joins the Tshowe road again.
Distance: 17.2 km.

Transect No. 30 From Shumba Picnic Site along main tar road to White Hills Pan turn-off.
Distance 39.5 km.

Transect No. 31 From Balla Balla Pan north along road via Sibaya/Chibisa and around to Tshebema.
Distance 28.9 km.

Transect No. 32 From Samavundhla Pan (at Borehole) along road to Mbiza on railway line then south along railway line to Ngamo.
Distance 40.0 km.

Transect No. 33 From Ngamo Pan (Borehole) to Makona (via Wexcau/Mbiza).
Distance 69.4 km.

Transect No. 34 From Josivanini Pan to Leasha Dam via Mtambonyati Pan.
Distance: 60.1 km.

Transect No. 35 From Makona Pan to Josivanini then south to Libuti and then to Leasha Dam.
Distance: 77.0 km.

Transect No. 36 From Dzivanini to Ngwasha along Botswana Border road.
Distance 39.1 km.

Transect No. 37 From Ngwasha Pan to Tamafupa Pan along the Botswana Border road.
Distance 41.6 km.

Transect No. 38 From Tamafupa Pan to Mitswiri Pan via Shabi Shabi, Lememba and Shakwanki.
Distance: 46.3 km.

Transect No. 39 From Mitswiri Pan to main tar road via Nehimba.
Distance 45.3 km.

Transect No. 40 From Mitswiri along bush track direct to along Verneys road. Transect stopped at turn-off to Tendele Pan.
Distance: 32.5 km.

Transect No. 41 From Leasha Dam to Little Dzivanini Pan.
Distance: 39.0 km.

Transect No. 42 Tamafupa Pan along Botswana Border road to Jolley's Pan.
Distance: 102.0 km.

Transect No. 43 From Deteema to Mbejane to Manzimbomvu to Sibuyu.
Distance: 72.0 km.

Transect No. 44 From Samavundhla to Mangisihole Pan (via Linkwasha/Madundumela).
Distance: 58.0 km.

Transect No. 45 From Shumba Pan via Bumbumtsa to Dandari.
Distance: 62.0 km.

Transect No. 46 From Kapani Pan to Shakwanki Pan.
Distance: 51.0 km.

Note: As there are a large number of very old tracks and many well used elephant paths which resemble old roads in the Robins Camp area, the routes taken are not clearly defined and therefore distances are variable.

Appendix F - Wildlife Report Form

NATIONAL PARKS AND CHIPANGALI WILDLIFE TRUST

WILDLIFE REPORT No:
Species:

Herd Composition

Young of the year	*Yearlings*	*Sub-adults*	*Adult*		Total
			Males	*Females*	

Habitat

Food and feeding:

Locality & Grid Ref:

Date: Time: Weather:

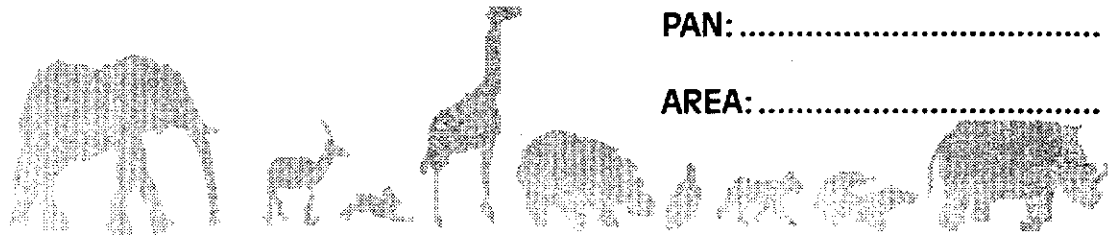
Notes:

Name:
(capitals) *Designation*

Please send this completed form to: V.J. Wilson Chpangali Wildlife Trust
P O Box 1057 BULAWAYO

Appendix G - Form used by members of Wildlife Society to record animals seen during 24 hour game count

WILD LIFE SOCIETY OF ZIMBABWE
MATABELELAND BRANCH



PAN: .....

AREA: .....

24 HOUR GAME CENSUS RECORDING FORM

SHEET NO.: ..... OBSERVERS: ..... DATE: .....

TIME	SPECIES	ADULTS				TOTAL	DRANK	DIRECTION		COMMENTS
		M	F	U	Y		Y/N	From	To	Behaviour/Condition

PLEASE USE A 24 HOUR CLOCK.
START NEW RECORDING FORMS FOR THE SECOND 24 HOUR PERIOD
INDEX:- M—MALE ADULTS, F—FEMALE ADULTS, U—UNCLASSIFIED Y—YOUNG

Appendix H - Form used by observers during the National Parks annual aerial survey of Hwange National Park

AERIAL SURVEY DATA SHEET					
Region		Start Locstat		Pilot	
Stratum		End Locstat		Recorder	
Transect		Start Time		Rt. Observer	
Date		End Time		Lt. Observer	
		Total Time			

Time	Alt.	Left Observer		Right Observer		Notes
		Locstat (Left)	No./Sps	Locstat (Right)	No./Sps	
0.00						
0.30						
1.00						
1.30						
2.00						
2.30						
3.00						
3.30						
4.00						
4.30						
5.00						
5.30						
6.00						
6.30						
7.00						
7.30						
8.00						
8.30						
9.00						
9.30						
10.00						
10.30						
11.00						
11.30						
12.00						
12.30						
13.00						
13.30						
14.00						

Appendix I - Full detai\ls of all animals seen during the National Parks annual aerial survey in September 1996

HWANGE NATIONAL PARK

BLOCKS INCLUDED:

G	TOTAL AREA:	1029	km²
I	TOTAL AREA:	1290	km²
J	TOTAL AREA:	2143	km²
K	TOTAL AREA:	2098	km²
Q	TOTAL AREA:	1522	km²
R	TOTAL AREA:	826	km²
S	TOTAL AREA:	1261	km²
T	TOTAL AREA:	923	km²
U	TOTAL AREA:	1723	km²
V	TOTAL AREA:	775	km²
W	TOTAL AREA:	1629	km²

BLOCK AREA: 15219 km² SAMPLING INTENSITY: 7.84 %

COMBINED ESTIMATES:

SPECIES	Pop. est.	No. seen	Variance	95% cl test	95% Range		Dens /km²
ELEPHANT	22897	1875	10241950	28.0	16496<>	29297	1.50
ELEPHANT M	4997	424	265199	20.6	3967<>	6027	0.33
ELE CARC. 2	11	1	113	198.1	1<>	32	0.00
ELE CARC. 3	1139	89	21766	25.9	844<>	1434	0.07
BUFFALO	1840	158	328628	62.3	693<>	2987	0.12
DUIKER	513	40	8967	36.9	324<>	702	0.03
ELAND	104	9	2429	94.8	9<>	203	0.01
GEMSBOK	125	11	1916	70.3	37<>	212	0.01
GIRAFFE	2536	214	172139	32.7	1706<>	3366	0.17
GRYSBOK	13	1	149	187.6	1<>	37	0.00
HIPPO	88	7	4399	150.3	7<>	221	0.01
IMPALA	4312	369	767774	40.6	2560<>	6065	0.28
KUDU	1419	114	48694`	31.1	977<>	1860	0.09
OSTRICH	86	8	1836	99.2	8<>	172	0.01
BLCK RHINO	27	2	629	187.7	2<>	77	0.00
ROAN	39	4	292	87.0	5<>	73	0.00
SABLE	1942	178	128779	37.0	1224<>	2660	0.13
WARTHOG	423	37	14100	56.2	185<>	660	0.03
WATERBUCK	164	14	10163	123.2	14<>	365	0.01
WILDEBEEST	665	62	131206	108.9	62<>	1390	0.04
ZEBRA	2393	210	182010	35.7	1539<>	3246	0.16
KLIPSPRINGER	13	1	158	187.9	1<>	38	0.00
CROCODILE	63	5	2646	162.9	5<>	166	0.00
BUFF CARC2	11	1	104	189.8	1<>	31	0.00
SPT HYAENA	32	3	357	116.5	3<>	70	0.00
ZEBRA CARC2	10	1	90	195.2	1<>	29	0.00
JACKAL	13	1	180	200.7	1<>	40	0.00
LION	127	13	6239	124.8	13<>	285	0.01
TOTAL ELES	27907	2300	11012187	23.8	21270<>	34544	1.83
CULL-SITE	504	44	7425	34.2	332<>	676	0.03
WATER	1504	130	30115	23.1	1157<>	1851	0.10