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DRAFT

ENVIRONMENTAL PROFILE

of

ZIMBABWE

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Prepared by the

Arid Lands Information Center
Office of Arid Lands Studies
University of Arizona
Tucson, Arizona
85721

Mark W. Speece, Compiler

THE UNITED STATES NATIONAL COMMITTEE FOR MAN AND THE BIOSPHERE
Department of State, IO/UCS
WASHINGTON, D. C. 20520

An Introductory Note on Draft Environmental Profiles:

The attached draft environmental report has been prepared under a contract between the U.S. Agency for International Development (AID), Office of Forestry, Environment, and Natural Resources (ST/FNR) and the U.S. Man and the Biosphere (MAB) Program. It is a preliminary review of information available in the United States on the status of the environment and the natural resources of the identified country and is one of a series of similar studies now underway on countries which receive U.S. bilateral assistance.

This report is the first step in a process to develop better information for the AID Mission, for host country officials, and others on the environmental situation in specific countries and begins to identify the most critical areas of concern. A more comprehensive study may be undertaken in each country by Regional Bureaus and/or AID Missions. These would involve local scientists in a more detailed examination of the actual situations as well as a better definition of issues, problems and priorities. Such "Phase II" studies would provide substance for the Agency's Country Development Strategy Statements as well as justifications for program initiatives in the areas of environment and natural resources.

Comments on the attached draft report would be welcomed by USMAB and ST/FNR and should be addressed to either:

James Corson
MAB Project Coordinator
IO/UCS/MAB
SA-5 Rm 410
Department of State
Washington, D.C. 20520

OR

Molly Kux
Office of Forestry, Environment, and Natural Resources
U.S. AID
Washington, D.C. 20523

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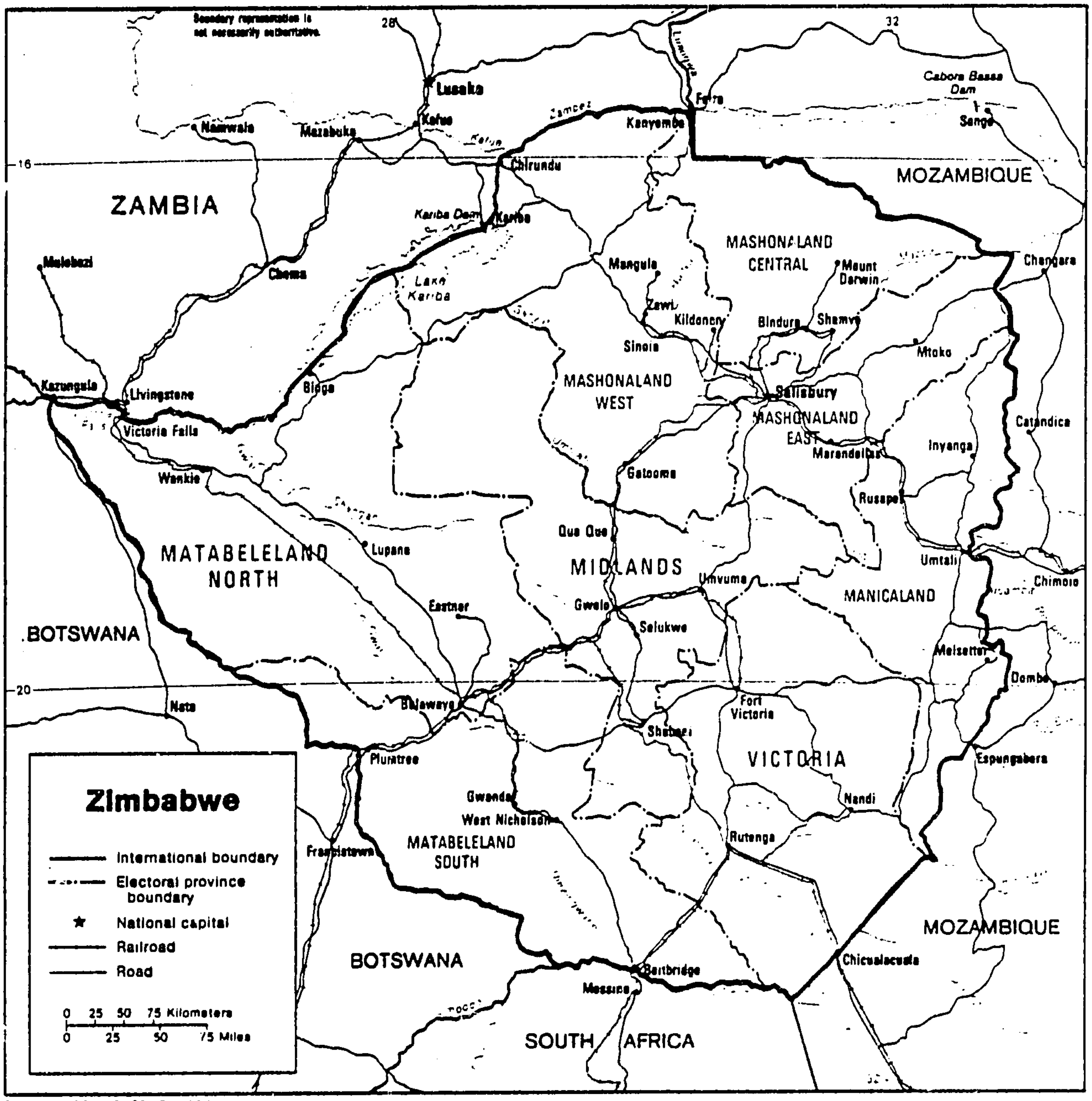

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SUMMARY

The Republic of Zimbabwe is a landlocked country in south central Africa. Variations in elevation (from around 600 m to nearly 2,000 m) form the basis for distinguishing the major geographic zones, which are: Highveld, Middleveld, Lowveld, and Eastern Highlands. Rainfall ranges from less than 500 mm in the southern most part of Zimbabwe to over 1,500 mm along the eastern boundary. The population is predominantly rural (≅ 80 %), and agriculture still plays an important role in the economy, accounting for 64 percent of employment and around 12 percent of the GDP. Agriculture in particular was hard hit by the civil war and international sanctions imposed against the white minority regime. The sector began to recover in 1980 when a majority government achieved independence.

Many of Zimbabwe's major environmental problems are connected with agriculture. However, the country's relatively good industrial base has brought several potentially serious pollution problems also. The most pressing problems are summarized below.

Soil erosion problems are estimated to be moderate to serious on about 12 percent of the country's commercial agricultural land. In addition, prior to majority rule, the vast majority of the population was restricted to mediocre to marginal lands, so that pressures on subsistance agricultural land has been severe. About half of this category may have suffered irreversible erosion damage. Soil loss of 50 tons per hectare is not uncommon.

Deforestation and rangeland degradation are serious in most regions of Zimbabwe. The two major factors behind deforestation are clearing for agricultural use (including traditional slash and burn cultivation) and fuelwood gathering. Estimates indicate that about 70,000 ha of new land is cleared annually, and that another 75,000 to 100,000 ha of wooded area is cleared for fuelwood needs. Rangeland degradation has become serious as herd size has increased. From 1964 to 1977 the livestock population on formerly African lands increased by 119 percent. Nearly 50 percent of these lands had only very poor grazing conditions remaining. Zimbabwe has, however, introduced several successful range management schemes on a local level.

Environmental health issues were exacerbated before majority rule because the majority of the population lacked access to Zimbabwe's modern health care system. These policies were repudiated in 1980, but the magnitude of new demand on health services will keep progress in this area slow. Overcrowded housing with few facilities is still the rule in urban areas.

Rural areas are usually less crowded which alleviates conditions somewhat, but sanitation and water systems are usually still inadequate. Water borne diseases are also a problem, especially in areas of intensive irrigation development. Zimbabwe has, however, carried out several successful local campaigns to eliminate snail vectors and reduce bilharzia incidence.

Industrial pollution while not a nationwide problem, is nevertheless more serious locally than in most of Zimbabwe's neighbors. Lake McIlwiane, near Salisbury, and several other lakes near urban centers suffer serious eutrophication. Often the problem can be directly traced to urban sewage effluent or industrial wastes. Airborne pollution fallout has also severely burned vegetation around some industrial installations. Mines further contribute to local pollution problems.

Wildlife seems to be threatened primarily by destruction of habitat as human activities expand. Past tsetse control programs based on mass destruction of wildlife are no longer carried out, and hunting and poaching are only local problems at worst, not really affecting overall animal populations.

Prospects seem rather bleak in some areas. The severe erosion and devegetation problems of the formerly African areas will extend into previously European areas. Even with access to these new areas, population pressure on the land will remain high. Zimbabwe's policy of encouraging urbanization in attempting to reduce this pressure is likely to increase urban health problems and industrial pollution in the short term.

1.0 Introduction

This draft environmental profile summarizes information available in the United States on the natural resources and environment of of Zimbabwe. The report reviews the major environmental problems of Zimbabwe and the impact of the development process upon resources and the environment. This draft report represents the first step in developing an environmental profile for use by the U.S. Agency for International Development (U.S. AID) and Zimbabwean government officials. The next step in this process should be a field study to evaluate the information presented here, obtain additional information, and define the issues, problems, and priorities in greater detail. This entire process should help provide direction in future efforts to deal with the management, conservation, and rehabilitation of the environment and natural resources.

The information and interpretations in this report are preliminary and are not intended to attain the detail and accuracy required for development planning. The report represents a cooperative effort by the Man and the Biosphere (MAB) project staff of the Arid Lands Information Center (ALIC). The primary research, writing, and analysis were done by Mark Speece, through the resources of ALIC and the University of Arizona Library. The cooperation of James Carson, AID/MAB Project Coordinator, and other AID personnel is gratefully acknowledged.

Arid Lands Information Center (ALIC)
MAB Project Staff

Charles Hutchinson	Director, Applied Remote Sensing Program; Profile Coordinator
Mark Speece	Profiler
Steven L. Hilty	Profiler
Mercy Valencia	Profile Editor
Robert G. Varady	Profiler

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2.0 General Description

2.1 Geography and Climate 1/

The Republic of Zimbabwe, with an area of 390,308 square km, is located in south-central Africa. The country is landlocked, surrounded by (clockwise from the northwest) Zambia, Mozambique, South Africa, and Botswana. the Caprivi Strip of Namibia just touches the westernmost point of Zimbabwe. Zimbabwe became a British colony in 1923 and was known as Southern Rhodesia (in contrast to Northern Rhodesia, which later became Zambia). In 1965 the white minority regime unilaterally declared the country's independence, and took the name Rhodesia. It was never officially recognised by the USA or the international community, and African resistence to the white regime mounted.

In 1979 the white government brought some African nationalists into the government and the country was renamed Zimbabwe-Rhodesia. This new arrangement also failed to achieve international recognition, but finally in 1980, the country became legally independent under African rule and the name Zimbabwe was adopted. To avoid confusion, the country will be refered to as Zimbabwe throughout this report.

Zimbabwe lies in tropical Africa, and is usually classed as part of the savanna ecological zone (cf. e.g. O'Connor 1978). Climatically, most of the country is subhumid by UNESCO standards, but the areas along the northern and southern borders are semi-arid (UNESCO 1977). The country may conveniently be divided into four geographic regions, based primarily on relief.

2.1.1 Geographic Division

Zimbabwe's highveld consists of land above 1,220 m and extends across the center of the country (Fig. 1). It forms the watershed between the Zambezi to

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1 Sources: Collins. 1965.
Europa. 1980a.
Howe. 1953.
Kay. 1970.
McNaughton. 1971.
McNaughton. 1970.
Nelson et al. 1975.
Schulze and McGee. 1978.
Stocking and Elwell. 1976.
Torrance. 1973.
Torrance. 1978.

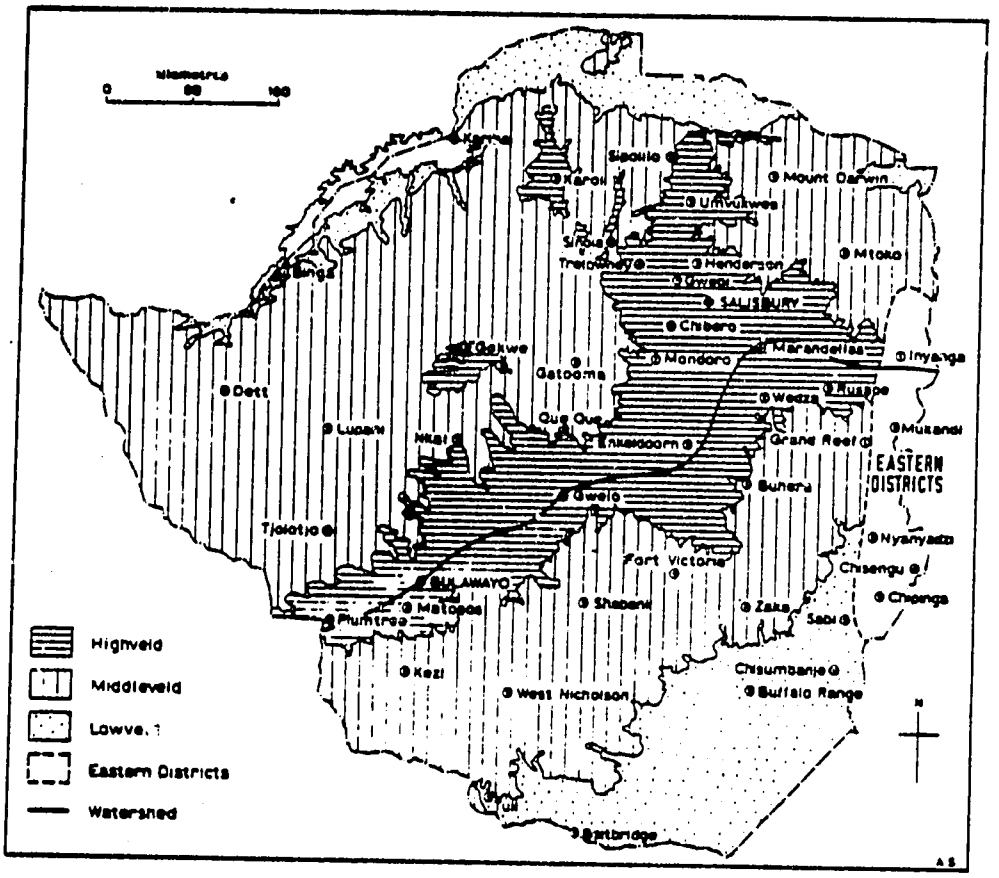


Figure 1. Geographic Divisions in Zimbabwe

Source: Stocking and Elwell. 1976.

the north and the Limpopo and Sabi (Save) Rivers to the south. The highveld, (as well as the other two veld regions) consists primarily of gently undulating plateaux. Perhaps the most distinctive feature of the highveld, however, is the Great Dyke, which runs north-south from the region around Umvukwes to the area southeast of Gwelo. This massive extrusion of ancient lava is only a few miles wide in most areas, but can rise as much as 460 m above the surrounding countryside. The Great Dyke's highest segment is in the area of Umvukwes, where it reaches elevations of over 1,700 m.

The Middleveld flanks the highveld on the north and south, and consists of land between 915 and 1,220 m in elevation, which is about 40 percent of the country. Most of the Middleveld in the northwest is fairly featureless, while in the south and northeast it is often dissected by watercourses. The transition to the Lowveld (below 915 m) is usually imperceptible. Lowveld is found along the northern and southern borders, and is also dissected by numerous water courses in many regions. The most extensive area of Lowveld however, consists of gently undulating plains between the Limpopo and Sabi Rivers.

Zambia's fourth region, which some observers include in the Middle- and Highveld, consists of mountainous highlands along the eastern border. These mountains mark the edge of the tableland which comprises most of southcentral Africa. The Iyanga Mountains in the northern part of this zone are the highest, with Iyangani itself reaching nearly 2,600 m. Throughout the rest of the range peaks between 1,800 m and 2,100 m may be found.

2.1.2 Climate

Rainfall. The northeastern portion of Zimbabwe enjoys the highest rainfall, with some areas of the eastern mountains receiving over 1,500 mm of precipitation annually. A primary source of moisture in the country is from the northeast monsoon out of the Indian Ocean, while a secondary source comes with winds which curve across Africa from the Atlantic. In both cases, these winds reach Zimbabwe from the northeast, and the higher elevations there capture much of the available moisture. Generally, average annual precipitation declines from the northeast to the southwest (Fig. 2). In the southernmost part of Zimbabwe, average annual precipitation is less than 500 mm.

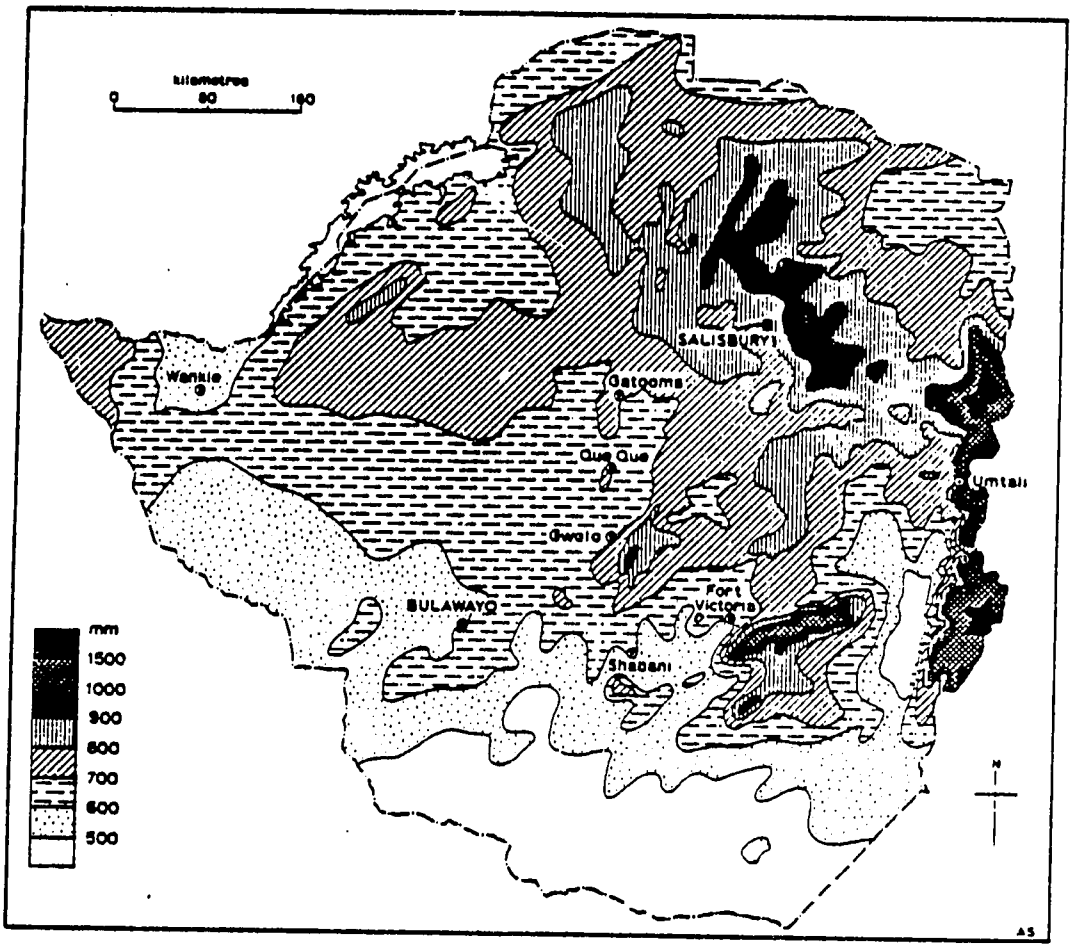


Figure 2. Mean Annual Rainfall over Zimbabwe

Source: Stocking and Elwell. 1976.

Throughout Zimbabwe the rainy season is normally in the summer, from November through March. January is usually the wettest month, but in some areas of the northeast and around Ft. Victoria, December may be wetter than January. In a few areas in the southwest, the shift is in the other direction, and more rain normally occurs in February (Fig. 3). Winter is dry throughout most of the country, with July and August receiving hardly any rain. The eastern region of Zimbabwe is an exception to this rule, and many areas in the east receive significant amounts of rain even in winter months.

The country experiences differing degrees of reliability in rainfall. There is some tendency for several wet years to be followed by a series of drought years, but no definite cycle has been distinguished. Southern Zimbabwe shows the most variability from the annual average, a characteristic of arid and semi-arid regions. The variability decreases from south to north, and rainfall is not likely to vary from the annual average by more than 20 percent in the central northern portion of the country (cf. Appendix I, Fig. 2).

Temperatures. Although Zimbabwe lies in tropical Africa, elevations moderate temperatures somewhat. The mean annual temperature is several degrees lower throughout much of the country than in surrounding areas (Fig. 4). Throughout the eastern highlands, mean annual temperatures are less than 17.5° C. Mean annual temperature ranges from 17.5° C to 20° C throughout most of the Highveld, from 20° C to 22.5° C in the Middleveld, and between 22.5° C to 25° C in much of the Lowveld. In the northern most part of the country, along the borders with Zambia and Mozambique, mean annual temperatures reach 27.5° C.

Mean daily maximums in the summer (January) can climb to as high as 35° C in the extreme northeastern and southeastern parts of Zimbabwe. In general, the daily maximum ranges in the high 20s to low 30s, with a general trend of higher temperatures toward the south. Mean daily minimums during the winter (July) are lowest in the southwest, averaging less than 5° C. Frosts do occur occasionally here, as well as in the eastern highlands and some other areas, but they are rarely severe. (Appendix I, Figs. 5 and 6 show additional temperature data for Southern Africa.)

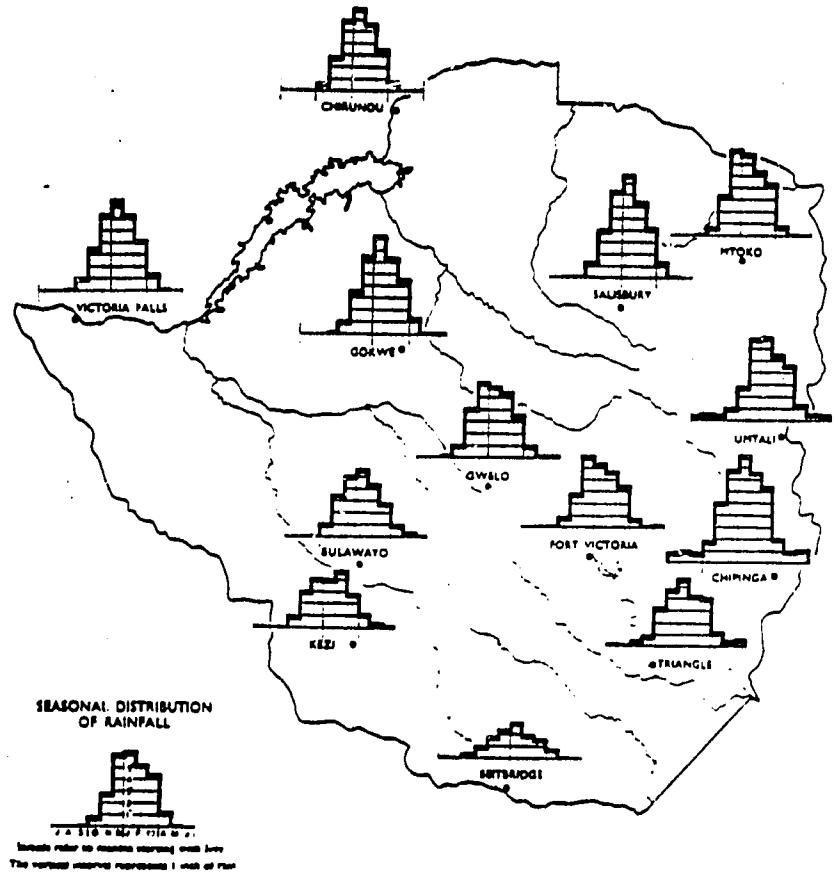
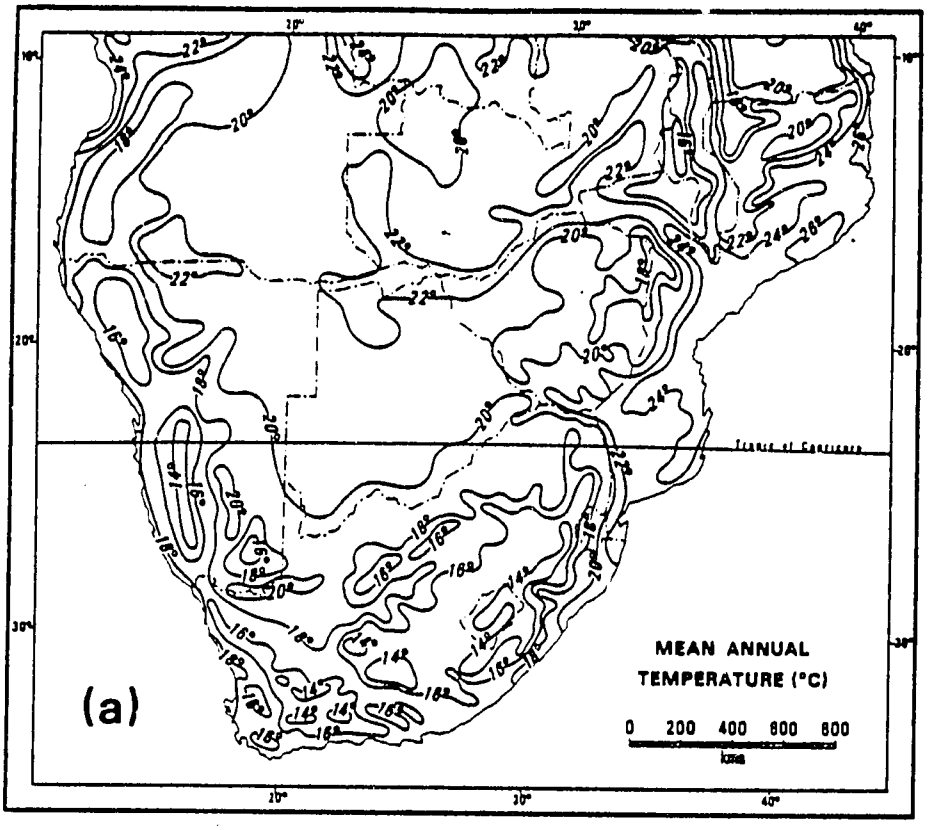


Figure 3. Seasonal Distribution of Rainfall

Source: Collins. 1965.



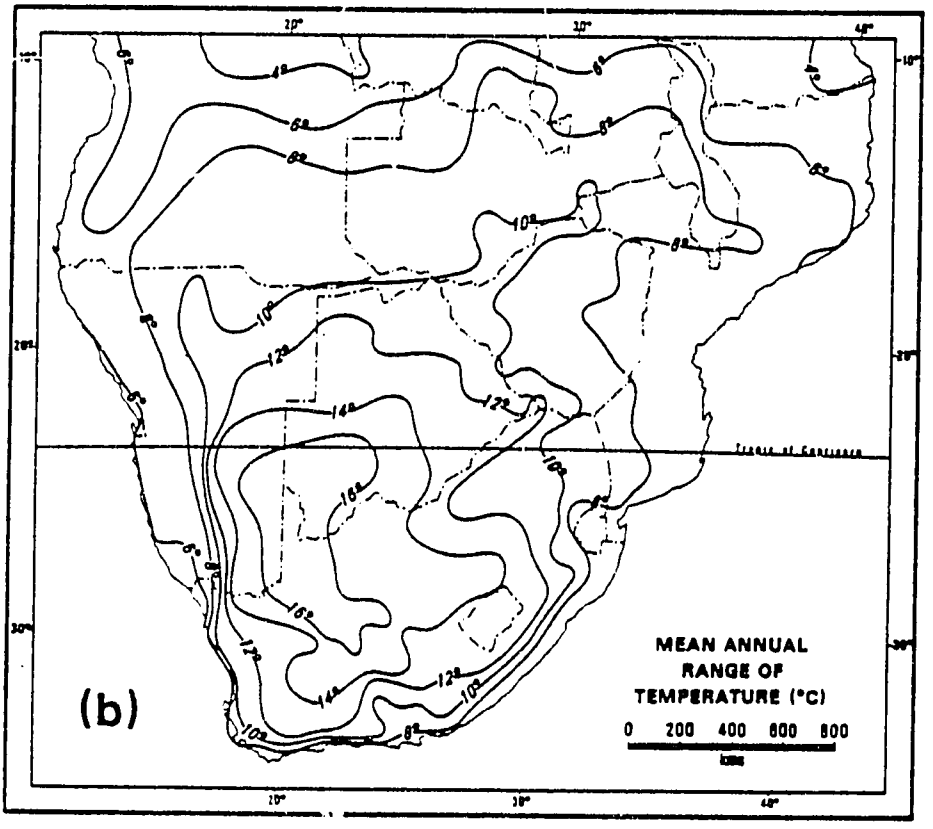


Figure 4. Temperature Data for Southern Africa

Source: Schulze and McGee. 1978.

Sunshine and Humidity. Variations in sunshine are not primarily dependent on length of daylight in Zimbabwe, since this varies only a few hours over the year. Cloudiness is the main factor, and the drier western portion of the country receives the most sunshine, while the wettest eastern region receives the least. Throughout the country, sunshine differs by about 25 percent from dry to wet seasons. Rarely do spells of more than three consecutive days without sunshine occur, even during the summer rains (Table 1; cf. Appendix I Fig. 7).

Relative humidity in the eastern highlands remains between 60 to 70 percent throughout the dry season, and reaches 75 to 80 percent in the summer. It falls off to less than 50 percent during the dry season in most of the western half of Zimbabwe. Northeastern areas and the Highveld generally experience relative humidities between 70 and 75 percent during the rainy season, while the rest of the country averages between 60 and 70 percent.

2.2 Demographic Characteristics 2/

2.2.1 Population and Distribution

No census has been conducted in Zimbabwe since 1969, so that current estimates of population and other demographic data may vary widely. U.S. AID 1980 gives a figure of 7,429,000 for the population in mid-1980, which is close to several other estimates. Population growth rate was an estimated 3.4 percent from 1969 to 1979, and the World Bank (1971) estimates that by the year 2,000 Zimbabwe s population will be around 13,400,000. The urban population in Zimbabwe is usually considered to be near 20 percent of the total but the urban growth rate may be up to twice as high as the overall growth rate. The term "urban" is not usually defined. In mid-1979, there were 12 towns and cities with a population greater than 19,000 (Table 2), which constituted nearly 19 percent of the population.

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2 Sources: Europa. 1980a.
Europa. 1980b.
Legum. 1980.
U.S. AID. 1980.
U.S. AID. 1981.
World Bank. 1981.

Table 1. Hours of Sunshine at Zimbabwe Stations

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
[illegible]	8.3	8.8	8.5	8.0	7.8	7.3	6.9	7.1	7.5	7.5	8.1	8.3
Mean	10.2	10.8	11.5	12.4	13.6	13.0	13.1	12.7	12.0	11.3	10.6	10.2
Max. Possible												
BULAWAYO 33 YEARS	9.2	9.6	9.4	8.9	7.4	6.9	7.1	7.0	7.7	8.5	9.1	9.1
Mean	11.1	11.6	12	12.8	13.0	13.3	13.3	12.7	12.3	11.7	11.3	10.9
Max. Possible												
[illegible] 14 YEARS	7.6	7.7	8.3	8.5	8.0	7.1	6.3	6.4	7.5	7.5	8.3	7.4
Mean	10.8	11.1	11.6	12.4	12.9	13.3	13.0	13.5	11.8	11.4	11.0	10.4
Max. Possible												
[illegible] 12 YEARS	8.6	8.3	9.0	8.7	7.1	6.4	6.7	6.0	8.3	8.8	9.1	8.7
Mean	11.3	10.8	11.1	11.5	11.8	11.7	11.7	11.7	11.8	10.6	11.2	11.3
Max. Possible												
FORT VICTORIA 20 YEARS	8.6	8.9	8.8	8.3	7.1	6.8	6.6	6.8	7.5	8.3	8.8	7.8
Mean	11.0	11.4	12.0	12.8	13.1	13.3	13.2	12.7	12.2	11.6	11.3	10.9
Max. Possible												
GATOORA 27 YEARS	9.0	8.6	8.7	8.6	8.7	8.3	8.6	8.7	7.7	8.8	8.4	8.1
Mean	10.7	11.3	11.7	12.1	12.7	12.8	12.8	12.6	11.9	11.8	11.0	10.8
Max. Possible												
[illegible] 16 YEARS	8.1	8.8	9.1	9.3	7.3	6.4	6.6	6.8	8.0	8.3	8.4	7.9
Mean	11.0	11.4	11.8	12.8	13.0	13.3	13.1	12.7	12.2	11.8	11.1	10.8
Max. Possible												
[illegible] 16 YEARS	8.3	8.3	9.1	9.0	8.8	8.8	8.8	8.1	7.8	8.3	8.8	8.3
Mean	10.8	11.1	11.8	12.3	12.7	13.0	12.8	12.4	11.8	11.3	11.0	10.8
Max. Possible												
[illegible] VALLEY/TYIMANDALE 8 YEARS	7.6	8.1	7.8	7.8	7.3	6.8	7.0	7.3	8.0	7.8	8.1	7.4
Mean	11.0	11.4	11.8	12.2	13.1	13.3	13.1	12.7	12.1	11.8	11.1	10.8
Max. Possible												
[illegible] 10 YEARS	7.8	8.8	8.8	8.8	8.6	8.8	8.8	8.6	7.8	8.0	8.0	7.8
Mean	10.8	11.2	11.8	11.8	12.3	12.4	12.3	12.1	11.7	11.3	11.0	10.7
Max. Possible												
[illegible] 13 YEARS	8.8	8.3	8.3	8.1	8.3	8.3	8.8	8.3	7.1	7.8	8.6	8.8
Mean	11.3	11.8	11.8	12.4	12.8	12.8	13.0	12.6	12.0	11.7	11.3	11.1
Max. Possible												
[illegible] 22 YEARS	8.7	8.6	8.3	8.5	8.8	8.3	7.1	6.8	7.6	8.1	8.8	8.5
Mean	10.8	11.2	11.8	12.4	12.7	13.3	13.2	12.8	12.1	11.8	11.1	10.8
Max. Possible												
[illegible] 17 YEARS	8.6	8.1	8.8	8.0	8.8	8.6	8.3	8.6	7.8	8.3	8.6	8.8
Mean	10.8	11.2	11.8	12.0	12.8	12.7	12.8	12.6	11.8	11.3	10.8	10.6
Max. Possible												
[illegible] VE 15 YEARS	8.8	8.6	8.3	8.1	8.8	8.0	8.6	8.8	7.8	8.1	8.7	8.5
Mean	10.7	11.0	11.8	12.1	12.8	12.8	12.8	12.3	11.8	11.3	10.7	10.7
Max. Possible												
[illegible] 14 YEARS	8.3	8.6	8.7	8.0	7.1	6.8	7.0	7.1	8.4	8.8	8.3	8.8
Mean	11.1	11.8	12.0	12.8	13.0	13.3	13.1	12.7	12.3	11.7	11.3	11.0
Max. Possible												
[illegible] VALLEY 13 YEARS	8.1	7.8	8.3	8.4	7.3	6.8	7.0	7.0	7.8	8.1	8.7	7.8
Mean	11.0	11.3	11.8	12.3	12.8	13.3	12.8	12.4	12.1	11.8	11.2	10.9
Max. Possible												
[illegible] 32 YEARS	8.7	8.4	8.8	8.1	8.8	8.0	8.1	8.3	7.0	8.3	8.6	8.8
Mean	11.2	11.6	12.0	12.8	12.8	13.8	13.1	12.7	13.2	11.7	11.3	11.1
Max. Possible												
[illegible] 20 YEARS	8.8	8.3	8.8	8.7	8.3	8.3	8.4	8.8	7.0	7.8	8.3	8.3
Mean	10.8	11.2	11.7	12.2	12.6	12.8	13.8	12.4	11.8	11.4	11.0	10.8
Max. Possible												
[illegible] 8 YEARS	7.7	8.8	8.1	8.4	7.1	6.7	7.3	7.8	8.8	7.4	8.8	7.8
Mean	10.8	10.8	11.6	11.3	11.8	11.7	11.7	11.8	11.8	11.3	10.7	10.8
Max. Possible												
[illegible] 44 YEARS	8.7	10.3	8.8	8.4	7.3	6.8	8.3	8.8	7.3	8.8	8.4	8.8
Mean	11.2	11.8	12.0	12.8	12.8	13.3	13.1	12.7	12.2	11.7	11.3	11.1
Max. Possible												

Source: Collins. 1965.

Table 2. Principal Towns and Cities

(estimated population at June 30th, 1979)

Salisbury (capital)	627,000	Que Que	51,000	Fort Victoria	24,000
Bulawayo	363,000	Gatooma	33,000	Marandellas	23,000
Gwelo	70,000	Wankie	33,000	Shabani	20,000
Umtali	63,000	Sinoia	27,000	Redcliff	19,000

Source: Europa. 1980a.

Population density in Zimbabwe was about 17.7 persons per square km in the late 1970s, but 94.2 persons per square km on agricultural land (World Bank 1981). The greatest densities are found in the areas surrounding the two largest urban areas, Salisbury and Bulawayo (Fig. 5). In the southern and westernmost parts of Zimbabwe, densities are less than five persons per square km.

2.2.2 Composition 3/

Africans make up approximately 96 percent of Zimbabwe's population. Two major ethnic groups predominate, but a number of other groups are also found mostly in border regions. According to the last complete census, taken in 1969, nearly 71 percent of the African population was Shona (Table 3). The ancestors of the Shona entered the region of modern Zimbabwe at least 1,000 years ago, and one Shona group, the Rozwi, established the ancient state of Zimbabwe. Shona economy has always been based primarily upon subsistence agriculture, although by the mid-twentieth century the traditional Shona economy had been greatly depressed by a century of land confiscation and encroachment by the world economy.

The Shona, sometimes referred to as Mashona, are subdivided into seven main groups, although a significant number identify themselves only as Shona, rather than as members of one of the subgroups. The most numerous are the Karanga, found in the area around Ft. Victoria (Fig. 6). The Zezuru inhabit the region around Salisbury, the Manyika and the Ndau are found in eastern Zimbabwe, and the Korekore in northern areas. One group, the Kalanga in northwestern Zimbabwe, is separated from other Shona groups. The Rozwi in modern times have had no particular localization and are found throughout Shona areas in the eastern half of the country. The languages these groups speak are dialects which are usually but not always intelligable by the other Shona groups.

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3 Sources: Kay. 1970.
Nelson et al. 1975.
Palmer. 1977b.
Simson. 1979.
U.S. Dept. of State. 1981.

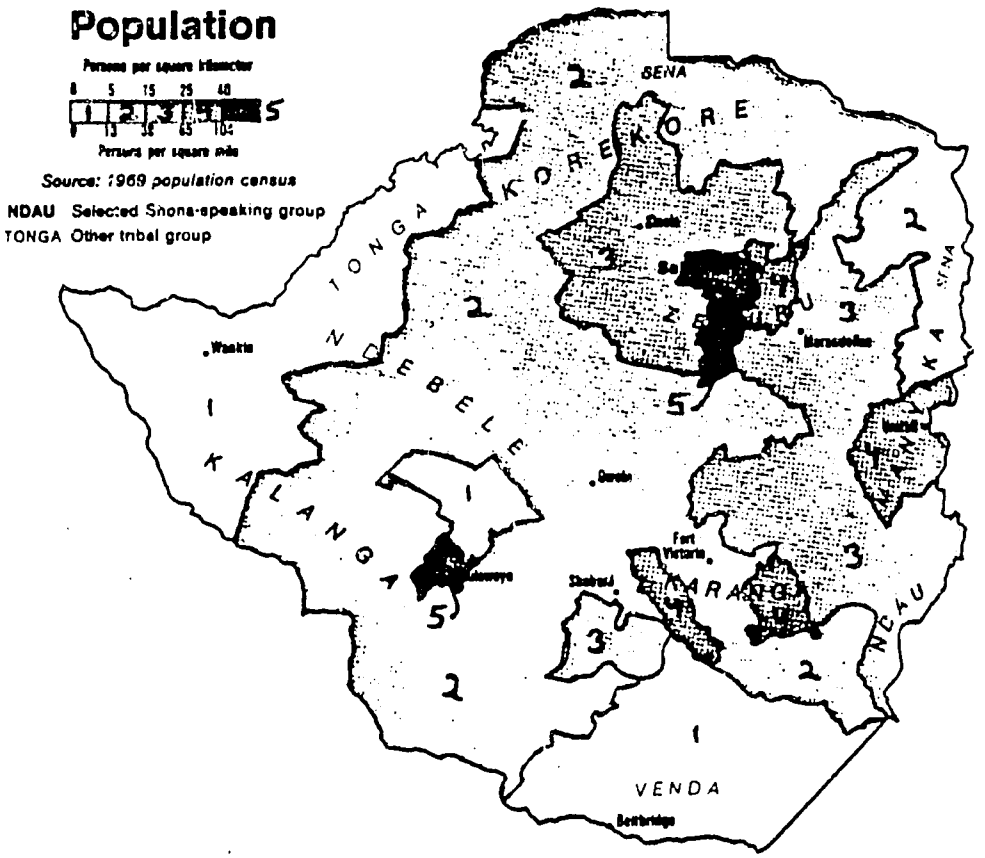

Figure 5. Population Distribution

Source: Available from U.S. GPO, Map 503850 2-79 (543857)

Table 3. Linguistic Composition of African Population of Zimbabwe, 1969

Linguistic Group	Number of Persons	Percentage of All African-Language Speakers
Shona Speakers		
Shona*	1,262,870	26.0
Karanga	753,740	15.5
Zezuru	650,460	13.4
Manyika	348,350	7.2
Ndau	178,000	3.7
Korekore	144,020	3.0
Kalanga	86,100	1.8
Other	10,420	0.2
Total	3,433,960	70.8
Ndebele and Nguni speakers	764,190	15.8
Speakers of Other Indigenous African Languages		
Sena-Chikunda	92,480	1.9
Tonga (Tonka)	60,260	1.2
Venda	37,730	0.8
Sotho-Tswana	29,350	0.6
Thonga-Hlengwe	2,500	0.1
Other	13,920	0.3
Total	236,240	4.9
Speakers of Nonindigenous African Languages		
Nyanja (Malawi)	251,800	5.2
Yao (Malawi)	17,600	0.4
Senga (Zambia)	16,100	0.3
Lozi (Zambia)	8,070	0.2
Ngoni (Mozambique)	4,620	0.1
Xhosa (South Africa)	5,870	0.1
Bemba (Zambia)	4,880	0.1
Other	66,550	1.4
Total	375,490	7.8
Speakers of languages not identifiable or not stated	37,050	0.7
Grand Total	4,846,930	100.0

*Persons identified themselves as speaking Shona rather than one of the Shona dialects.

Source: Nelson et al. 1975.

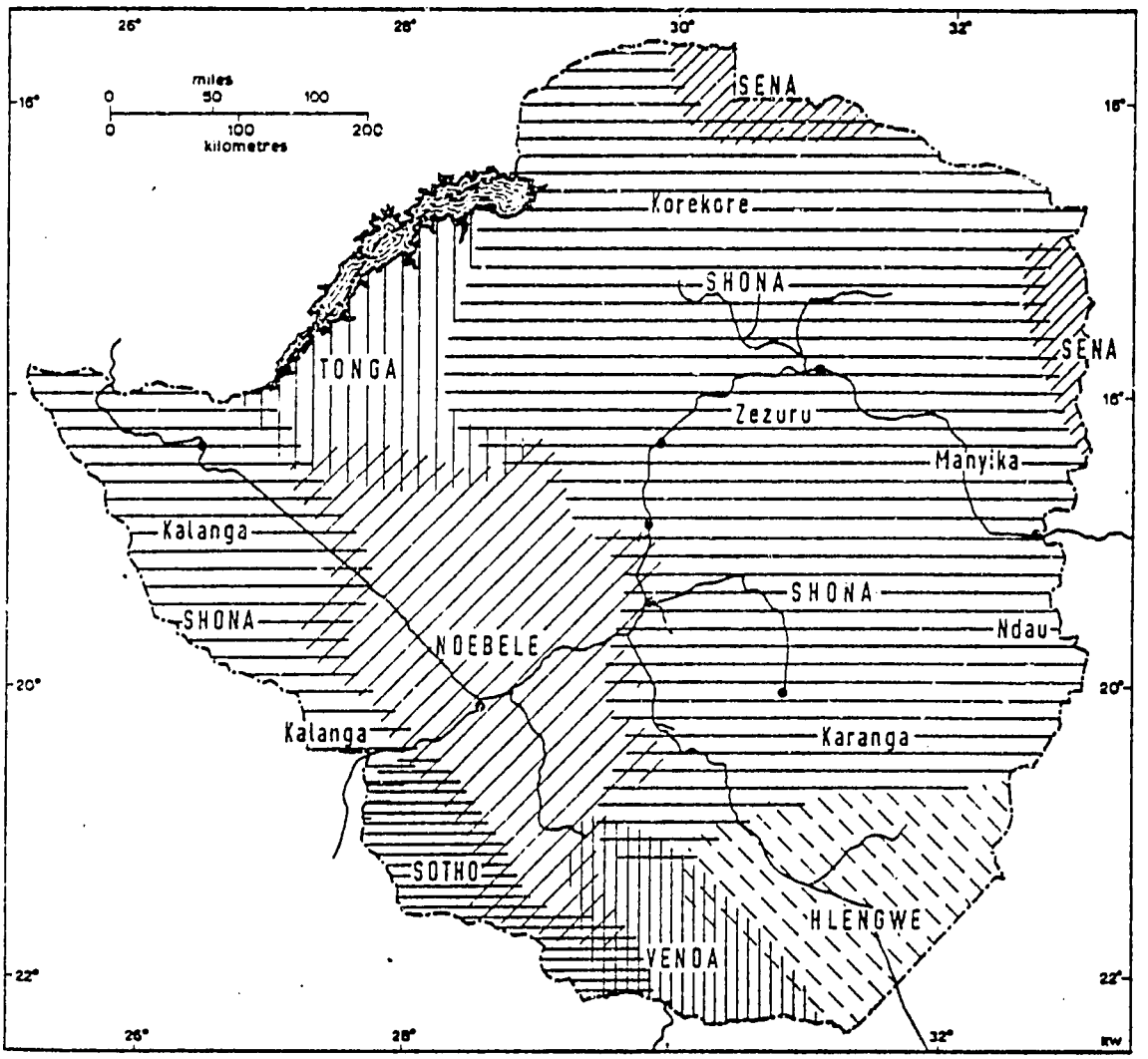

Figure 6. The African Peoples

Source: Kay. 1970.

Nearly 16 percent of Zimbabwe's population identified itself as Ndebele (Matabele) or Nguni, a wider grouping of which the Ndebele are part. The Ndebele are relative newcomers in Zimbabwe. They entered the area in the 1830s and 1840s from the Natal region of South Africa to the south, and originated as refugees from the Zulu state of the early nineteenth century. The Ndebele were in the process of consolidating their own state in western Zimbabwe by the end of the 1800s, but European penetration ended the process. The traditional economy was based primarily upon cattle herding, with some supplementary cultivation. The Ndebele language is classified as part of the Nguni language group, and is related to Zulu, Xhosa, and Swazi. Like the Shona languages, those of the Nguni group are Bantu.

The remaining African population is divided among numerous other small groups, nearly all of which also belong linguistically to the wider Bantu family. The most important of these smaller groups are noted in Table 3 and on Figure 6.

Europeans first began settling in Zimbabwe about 1890, and soon gained control of the area. They constituted 3.6 percent of Zimbabwe's population in 1978, according to official estimates by the white government then in power. Emmigration by whites to escape the civil war was heavy during the next two years. Emmigration by whites has continued, but the mass exodus expected by some observers after power officially passed to an African government in 1980 has not yet occurred In 1982 the white population probably remains slightly under three percent of the total. The majority are of British origin, although often this may go back generations and trace through settlers in South Africa. By the 1970s, slightly over 40 percent of whites in Zimbabwe had been born there. English was most used language among the European population, and remains Zimbabwe's official language.

2.2.3 Public Health [4]

Until 1980 one had to talk about two separate population groups in Zimbabwe when discussing public health. The white minority, about 3.6 percent of the population, enjoyed modern health care. They were well insulated from the environmental diseases common in the developing world, and disease patterns resembled those found in the developed world. Degenerative diseases accounted for a major portion of morbidity and mortality. The accident rate was high, and children suffered mostly from acute episodic diseases. The African population for the most part had severely restricted access to health care, although Africans resident in urban areas were better off than the majority in rural areas. Little data is available regarding the post 1980 situation. The health care system is undoubtedly severely taxed in trying to extend high quality health services to the majority of the population.

Zimbabwe's overall death rate was 13.6 per 1,000 in the mid-1970s, compared to 19.0 per 1,000 in 1960 (World Bank 1981). Average life expectency at birth was about 54 years. Infant mortality rates give an idea of the relative level of health care among various population groups. Based on local studies, in 1976 the infant mortality rate among Europeans was 16.2 per 100. Among Africans, it ranged from 21 in Salisbury to as much as 300 in certain rural areas. The range in rural areas was usually between 120-220 per 1,000 (Simson 1979). Malnutrition, lack of sanitation facilities, poor personal hygiene, and absence of knowledge about preventive health measures all contribute to low standards of public health among the majority of the population. Problems are exacerbated by shortages of medical facilities and personnel.

Detailed data on incidence of diseases is not readily available. The most common causes of death among rural Africans are malnutrition, vitamin deficiency, gastro-intestinal diseases,

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[4] Sources: Family Health Care and AFRICARE. 1978.
Gelfand. 1971.
Nelson. 1975.
Simson. 1979.
U.S. AID. 1980.
World Bank. 1981.

tuberculosis, measles, or various combinations. About 35 percent of deaths from these causes occur in young children. Most common illnesses include malaria, tuberculosis, schistosomaisis (bilharzia), helminthiasis, tape-worm and other parasites, trypanosomiasis, and dysentary. Most are chronic. Table 4 summarizes the most prevalent diseases in 1969.

The mining workforce is particularly susceptable to pulmonary tuberculosis and a wide variety of respiratory conditions. Because migrant labor implies disruption of family life, the incidence of syphilis and gonorrhea is also high among mine workers. Accidents are another factor in public health, and the mining industry accounted for a large proportion of the 41,701 work-related accidents reported in Zimbabwe in 1973-74.

2.3 Economic Characteristics 5/

Zimbabwe's economic structure is relatively well diversified. In 1979, manufacturing accounted for 24.8 percent of the GDP, agriculture for 12.4 percent, and mining 7.9 percent (Table 5). Per capita income was $US 530, although there was a wide disparity between the wage economy ($US 1,260) and the subsistence economy ($US 44). Approximately 64 percent of the labor force was employed in agriculture in the mid 1970s and of these, over 70 percent are engaged in subsistence agriculture (Table 6). International sanctions and the civil war had restricted growth in many sectors of the economy until 1980. Agriculture was particularly affected, as the former regime forced many rural people into "protected" camps and many others fled the countryside to escape the war. Figures from after 1980, once they become available, are likely to show renewed growth in most sectors, reflecting the return to more secure conditions in rural areas, the reestablishment of normal trade relations, and an influx of foreign aid.

2.3.1 Agriculture and Livestock

Although Zimbabwe produced substantial amounts of cash crops, particularly tobacco before 1964,

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5 Sources: Europa. 1980a.
Europa. 1980b.
Legum. 1980.
Robbins. 1978.
U.S. AID. 1979.
U.S. AID. 1981.
World Bank. 1981.

Table 4. Prevalent Diseases in Zimbabwe, 1968

Disease	Incubation Period	Mode of Transmission	Reported Incidence or Prevalence	Seasonal Exacerbation
Amebiasis (amebic dysentery)	21-28 days	Contaminated food and water	High incidence	November-March
Boutonneuse fever (African tick typhus)	5-7 days	Tick bite	Occurs, but incidence not known	March-April
Filariasis	3-9 months	Mosquito bite	---- -do- ----	n.a.
Helminthiases	6 weeks	Larval form penetrates skin	Moderate to high incidence	None
	2 months	Ingestion of embryonated ova		
	3-6 weeks	Ingestion of infective ova		
	6 weeks	Larval form penetrates skin		
	12 weeks	Ingestion of embryonated ova		
Leprosy	Indefinite	Direct contact	466 cases in 1971	Do
Malaria (not differentiated in reporting)	14 days 12 days 30 days	Mosquito bite	High incidence	February-May
Measles	10-14 days	Direct contact; and droplet spread	4,280 cases in 1963	n.a.
Onchocerciasis	90-120 days	Blackfly bite	Occurs, but incidence not known	n.a.
Relapsing fever (tick borne)	3-12 days	Tick bite; and coxal fluid of tick	---- -do- ----	n.a.
Salmonellosis	½-2 days	Direct contact; contaminated food and water; fomites	Occurs, but incidence not known	n.a.
Schistosomiasis (bilharziasis or snail fever)	28-42 days	Larval form enters from fresh water	High incidence (about 75 percent of total African population)	None
Shigellosis (bacillary dysentery)	1-7 days	Contaminated food and water	High incidence	November-March
Tuberculosis	4-6 weeks	Airborne; direct contact; fomites; and contaminated milk	3,684 cases in 1966	None
Typhoid fever	7-21 days	Direct contact; contaminated food and water; and fomites	216 cases in 1966	April-October
Venereal disease (chancroid)	3-5 days	Sexual contact	Moderate incidence	None
Venereal disease (gonorrhea)	3-9 days	---- -do- ----	High incidence	Do
Venereal disease (Lymphogranuloma venereum)	5-12 days	---- -do- ----	Moderate incidence	Do
Venereal disease (syphilis)	10-70 days	---- -do- ----	High incidence	Do
Yaws	14-90 days	Direct contact; fomites	Occurs, but incidence not known	Do

n.a.—not available.

Source: Family HealthCare and AFRICARE. 1978.

Table 5. Gross Domestic Product by Industry

(Z$ million)

	1975	(%)	1976	(%)	1977	(%)	1978	(%)	1979	(%)
Subsistence Agriculture	85	4.4	98	4.7	96	4.6	84	3.8	72	2.9
Commercial Agriculture	238	12.4	252	12.2	238	11.4	221	9.9	233	9.5
Mining and Quarrying	126	6.6	149	7.2	145	7.0	156	7.0	193	7.9
Manufacturing	449	23.5	474	22.9	457	22.0	512	23.0	609	24.8
Electricity and Water	50	2.6	56	2.7	56	2.7	62	2.8	68	2.8
Construction	94	4.9	88	4.3	84	4.0	68	3.1	82	3.3
Finance, Insurance, Real Estate	130	6.8	139	6.7	149	7.2	154	6.9	163	6.6
Distribution	258	13.5	262	12.7	242	11.6	296	13.3	290	11.8
Transportation and Communication	159	8.3	172	8.3	184	8.8	191	8.6	210	8.5
Public Administration and Defense	130	6.8	163	7.9	204	9.8	241	10.8	270	11.0
Education	65	3.4	73	3.5	76	3.7	86	3.9	96	3.9
Other Services	129	6.7	141	6.8	149	7.2	159	7.1	173	7.0
Total	1,912	100.0	2,066	100.0	2,081	100.0	2,228	100.0	2,457	100.0

Source: U.S. AID. 1981.

Table 6. Employment

	1969 Census	Estimates, March 1980*
Agriculture and forestry†	285,383	343,000
Mining and quarrying	51,101	63,400
Manufacturing	104,478	149,900
Construction	48,892	39,400
Electricity and water	5,641	6,600
Transport and communications	25,706	44,000
Trade	66,670	68,000
Finance, insurance and real estate	9,191	12,200
Public administration	35,888	77,600
Services and other	173,900	205,400
Total	806,850	1,000,500

* Employees only. † Excludes Africans self-employed in agriculture.

Labour force (mid-1970): Agriculture, etc. 1,198,000; Industry 252,000; Services 425,000; Total 1,875,000 (ILO estimate).

Source: U.S. AID. 1981.

agricultural policy under the white regime stressed self-sufficiency in food production. By the late 1970s the country had achieved this goal for nearly every food crop, and had actually become a modest food exporter. Agricultural output had grown rapidly throughout the period until the mid-1970s, except for a temporary setback during severe drought in 1973. After 1976, however, the increasing intensity of the war began to have a severe impact on the agricultural sector. Sales from African areas dropped and output from European farms, the largest sector, stagnated in real terms. Basic services could not be provided in most areas, which particularly affected livestock. Commercial herds declined from about 3.1 million head of cattle to 2.3 million. The tribal herd declined from 3.4 to 3.0 million.

Following majority rule in 1980, it is expected that Zimbabwe will require several years to rebuild its agricultural sector to the point where it can again supply its export markets. Good weather in 1980 gave these efforts a boost, and a record maize crop was harvested. Some observers believe that with sanctions lifted and free access to the world market, food production will suffer as farmers return to tobacco. Most of the shift would be expected to come from maize production, since tobacco areas were shifted to maize in the 1960s. However, tobacco prices for Zimbabwe's first post-sanctions crop were disappointing, which has discouraged any immediate rapid shift to tobacco cropping

In the late 1970s, the majority of production came from European farms, which were largely oriented toward commercial markets. African agriculture was largely subsistence; in fact, Africans were forbidden to raise tobacco, and were not allowed access to the commercial maize marketing network for their crops. Agricultural policy has changed rapidly since 1980, but data is not yet available to show the impact on production. Tables 7 and 8 present some figures from the period before majority rule.

Table 7. Production by Commodity, Value and Indices of Total Agricultural and Food Production, Average 1961-65, Annual 1970-79

Commodity	Price Weight	Average 1961-65	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
	Dollars	1,000 Metric Tons										
Wheat	60	2	40	82	78	70	85	85	98	90	90	85
Corn	47	833	700	1,179	1,540	635	1,700	1,400	1,400	1,300	1,400	1,000
Millet	40	240	220	220	220	220	220	220	220	220	220	140
Sorghum	40	58	50	50	50	50	50	50	50	50	60	40
Pulses	60	21	23	24	24	25	26	26	26	26	26	26
Potatoes	90	22	22	23	24	25	25	23	25	26	26	24
Cassava	29	43	46	47	49	45	50	48	50	50	52	54
Tobacco	940	105	60	60	65	57	80	95	103	83	85	112
Cotton	281	3	53	50	48	35	43	40	38	38	32	29
Cottonseed	30	6	118	110	100	70	86	80	76	76	64	58
Peanuts, in shell	115	123	104	108	125	110	120	120	122	110	120	120
Tea	841	1	2	3	4	3	3	3	3	3	3	3
Sugar, raw	75	133	145	175	200	248	250	265	250	275	275	280
Meats	343	170	177	185	195	200	200	200	186	210	193	185
Aggregates of Production		Million Dollars at Constant Prices										
Crops		180.7	150.4	178.1	203.7	149.5	226.5	226.2	232.8	209.8	215.4	217.8
Livestock		58.3	60.7	63.5	66.9	68.6	68.6	68.6	67.2	72.0	66.2	63.5
Total Agriculture		239.0	211.1	241.6	270.6	218.1	295.1	294.8	300.0	281.8	281.6	280.9
Total Food		138.3	137.9	168.3	192.2	151.8	205.0	191.5	189.7	190.3	189.9	154.7
Indices of Production		(1961-65 = 100)										
Crops		100	83	89	113	83	125	125	128	116	119	120
Total Agriculture		100	88	101	113	91	123	123	126	118	118	118
Total Food		100	100	122	139	110	148	138	137	138	137	119
Per Capita Agriculture		100	70	78	84	65	86	83	81	74	71	69
Per Capita Food		100	79	94	103	79	103	93	89	86	83	70
Index of Population 1961-65 Population - 4,228,000		100.0	125.6	130.1	134.6	139.5	144.3	149.2	154.4	159.6	164.9	170.3

Source: USDA. 1980.

Table 8. Agricultural Production in Zimbabwe 1965-74 ($million)

	1965	1966	1967	1968	1969	1970	1971	1972	1973
					$ millions				
EUROPEAN AGRICULTURE									
Gross output	148.6	148.9	150.3	144.4	178.3	175.8	215.8	242.0	257.2
AFRICAN AGRICULTURE									
Estimated consumption	27.6	41.1	53.5	36.6	51.4	30.1	56.5	60.4	36.5
Crop Sales									
Tobacco	0.2	0.1	0.2	0.1	0.4	0.3	0.5	0.4	0.4
Maize	1.9	2.8	4.5	0.8	3.0	0.6	1.7	1.9	0.4
Groundnuts	1.4	1.9	2.2	0.5	1.5	0.8	2.4	6.7	2.9
Cotton	0.2	0.3	0.5	0.7	2.1	2.2	4.3	7.1	7.6
Other	0.6	0.6	0.5	0.3	0.4	0.3	0.4	0.9	0.5
Total Crop Sales	4.2	5.7	7.9	2.5	7.4	4.2	9.2	17.1	11.8
Livestock Sales									
Cattle	3.2	3.4	3.1	3.2	5.0	5.5	6.0	6.7	8.7
Sheep, goats & pigs	0.6	0.5	0.7	0.9	0.9	0.9	0.8	0.1	1.3
Other produce	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Livestock Sales	4.0	4.1	3.9	4.3	6.1	6.6	7.1	7.8	10.2
Total Sales	8.2	9.8	11.8	6.8	13.5	10.8	16.3	24.9	22.0
Total Output	35.8	50.9	65.3	43.3	64.9	49.9	72.8	85.3	58.5
Sales as a % of Total Output	23%	19%	18%	16%	20%	20%	22%	29%	38%

Note: Estimates of capital formation and changes in stocks have been omitted.

Source: Robbins. 1978.

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3.0 Natural Resources

3.1 Geology and Mineral Resources

3.1.1 Geology

Table 9 and Figure 7 illustrate the following discussion, which is based on Collins (1965) and Pelletier (1964).

Basement Complex in Zimbabwe consists of one of the oldest known parts of the earth's crust. This "Shield" has been exposed on surface by prolonged erosion, following tectonic arching, so that although it forms the central watershed, it is the foundation on the flanks of which rest the younger sedimentary formations. The schist belts (gold belts) are subdivided into three geological systems.

The oldest, the Sebakwian System, consists of fine grained metasediments, granulities and magnesian tuffs and lavas, intruded by serpentinites. The Bulawayan System consists of a great thickness of metamorphosed lavas, locally termed "epidiorites" or "greenstones". The lavas range from basaltic pillow lavas to andesite with associated volcanic fragmental rocks. The Shamvaian System sediments lie in isolated troughs that were folded on a N 60° E trend, different from the older rocks. They are predominantly greywackes, feldspathic grits, slates and conglomerates, that have been partly recrystallised. Serpentine and other ultramafic rock types, locally termed "soapstone", are intrusive into the schist belts. They often contain chrome ore and asbestos.

Granites and Gneissic rocks of the Basement Complex are heterogeneous masses of predominantly granodioritic composition, that intrude the marginal rocks of the schist belts with generally parallel foliations. Doming of the larger batholiths has resulted in the pushing aside of the peripheral schist belts as arcs. Gold bearing veins and lodes occur in the schist belts, also beryl, lithium, niobium-bearing pegmatite dykes.

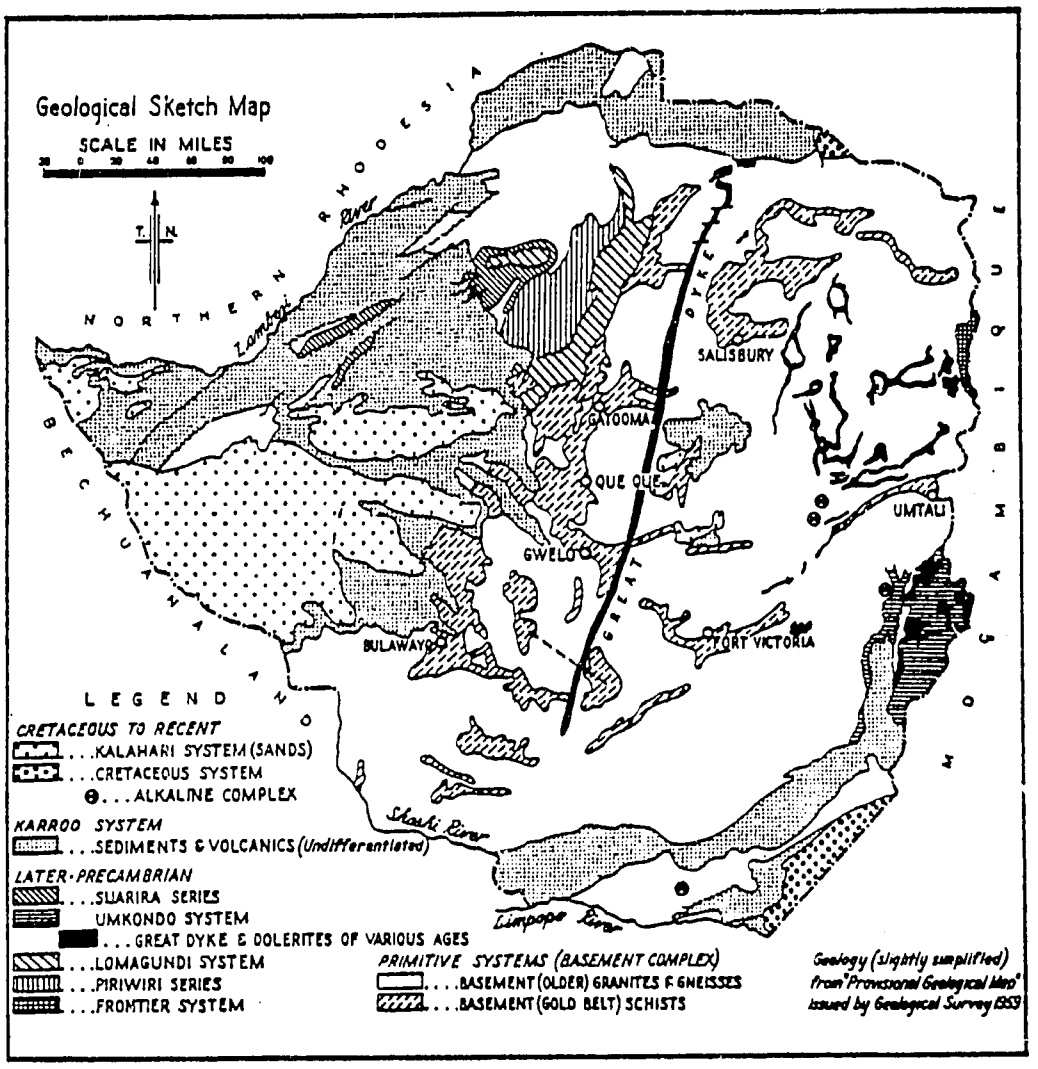
Metamorphic Belts flank the central shield. In the broad south-eastern charnockite belt the constituents are predominantly granitic, recognizably derived by high temperature metamorphism from Basement Complex material.

Table 9. Geological Formations

TABLE OF FORMATIONS			
PERIOD	AGE million years	FORMATION and RHODESIAN SYSTEM	EVENT
RECENT AND PLEISTOCENE	2	**RECENT SYSTEM** Soils, sands and alluvium with human stone artifacts	Various cycles of erosion following uplift and tectonic arching
CAINOZOIC	70	**KALAHARI SYSTEM** Sandstone and sand	
CRETACEOUS	138	**CRETACEOUS SYSTEM** Conglomerate, grit and marl	Intrusive ring complexes and through faulting [illegible] Zambezi and Sabi valleys
JURASSIC	180	**KARROO SYSTEM** Batoka basalt	Lava extrusion
TRIASSIC	225	Nyamandhlovu and Forest sandstones and escarpment grit Madumabisa mudstone	
PERMIAN	270	Upper Wankie mudstones and sandstones Lower Wankie mudstones and sandstones	Bubye Coal Wankie coal
UPPER CARBONIFEROUS		Dwyka fluvio glacial	Semi glaciers at Somabula
	500 to 700	**Sijarira Series** (age uncertain)	Faulting and peneplanes Mineralization [illegible]
	1600 to 1900	**Pirtwiri Series** (age uncertain) Kalvaga greywacke, slate grits	[illegible] folding on N.E. trends. Formation of pegmatite [illegible] Upper Zambezi [illegible]
		LOMAGUNDI SYSTEM Argillaceous series Arenaceous series Deweras formation	Mineralization [illegible]
		UMKONDO SYSTEM	Mineralization [illegible]
		FRONTIER SYSTEM	Folding and intrusion of N.N.E. trends
	2050	**THE GREAT DYKE**	Mineralization [illegible] asbestos [illegible] faulting of N.N.E. trends
		S. E. CHARNOCKITE BELT	High grade metamorphism and folding on E.N.E. trends
		SHAMVIAN SYSTEM	Mineralization [illegible] asbestos [illegible] E.N.E. trends and intrusion of granites producing [illegible]
EARLY PRECAMBRIAN	2350	**BULAWAYAN SYSTEM** (BASEMENT COMPLEX)	Mineralization [illegible] intrusion of granite batholiths producing [illegible]
	3350	**SEBAKWIAN SYSTEM** (BASEMENT COMPLEX)	Mineralization [illegible] folding and intrusion of gneisses producing [illegible]
		PRE-SEBAKWIAN Granulites and Gneisses	Isoclinal folding and migmatite

Source: Collins. 1965.

Figure 7. Geological Sketch Map



Source: Pelletier. 1964.

Great Dyke consists of four elongated lopoliths 320 miles long, three in a N.N.E. trending graben, and the fourth at the north end, is elongated north north-east. Each lopolith shows a complex layering from serpentinised dunite with chromite bands, through pyroxenite to norite at the top. The layers are curved, concave upwards in cross section, but gravity anomalies indicate a deep tapering "root". The age is 2,050 million years.

Umkondo System lies in a shallow basin on the south-east flank of the shield. The constituent rocks are a thin basal arkose, a thick dolomitic limestone with many shale intercalations in the north-east, and a thick quartzite overlain in the south-west by amygdaloidal lavas. These are unconformably overlain by the red sandstone and shale of the Mapari Series. Although not folded, the series has been intruded by many large and very thick dolerite sills.

Lomagundi System west of Sinoia, includes the thick deposits of conglomerate, arkose and lavas of the "Deweras formation". These are overlain by an "Arenaceous Series" of feldspathic grit, quartzite and dolomites with algal structures. The "Argillaceous Series" consists of black graphitic and silty striped slates with thin sandstones.

Piriwiri Series of black graphitic slate and thin cherty quartzites, overlain by the Kanyaga greywacke has long been a geological puzzle. It strikes parallel to the Lomagundi System, which it overlaps and is metamorphosed at its northern end. Some geologists have suggested that it is the deepwater sedimentary equivalent of the Lomagundi System. The Lomagundi and Piriwiri rocks have both been isoclinally folded together on north-east axes with west dipping limbs.

Sijarira Series rests with strong unconformity on older rocks. It consists of hard quartzitic sandstones often with red shale pellets, interbedded thin chocolate coloured shales, and occasional pebble beds composed of fresh feldspar fragments and angular quartz grains. On the whole the beds, though indurated, are unmetamorphosed and little disturbed.

Karroo System is one of the major rock systems of southern Africa and covers the 100 million years or so from the Upper Carboniferous period to the

Jurassic. The Zambezi and Limpopo depressions formed separate basins of deposition throughout most of Karroo times. In the center of the Zambezi Basin at least 10,000 feet of sediment accumulated during this period, the rocks being entirely non-marine in origin, but including a wide range of continental facies. The oldest Karroo rocks are of glacial origin, and are correlated with the famous Dwyka glacial stage of South Africa. The youngest rocks in the basin are aeolian sandstones interbedded with basalt lavas

Cretaceous System consists of sandstones lying apparently unconformably on the Karroo System in the southeasternmost part of Zimbabwe.

Tertiary Deposits. A considerable area of the north-west is covered by the Kalahari System. On geomorphological evidence this is considered to be late Tertiary and probably Mio-Pliocene in age. There are beds of chalcedony and pipe sandstone at its base, but it consists mainly of unconsolidated pink to red sands with a maximum thickness of about 250 feet.

Quaternary Deposits. These are thin discontinuous deposits mainly in river valleys. They include terrace gravels, alluvium, calcretes and ferricretes, redeposited Kalahari type sands and cave breccias. Their main interest lies in the Stone Age cultural remains which are often associated with them, and in the information they give on the environment of prehistoric man in this region.

3.1.2 Minerals [6]

Mining is an important sector of Zimbabwe's economy. With the lifting of sanctions following Zimbabwe's independence in 1980, mining activities and minerals exports have begun rapid expansion (Africa Research Bulletin 15 March - 14 April 1981). Data on production since independence is not yet available, but Tables 10a & b give figures for previous years (note apparent discrepancies).

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[6] Sources: Collins. 1965.
Europa. 1980a.
Europa. 1980b.
Nelson. 1975.
Pelletier. 1964.
U.S. Bureau of Mines. 1976.

Table 10a. Estimated Mining Production

		1973	1974	1975	1976	1977
Hard coal[1]	'000 metric tons	1,980	2,700	2,493	2,924	2,500
Iron ore[2]	" "	352	384	384	384	125
Antimony concentrates[2]	" "	200	300	300	360	300
Bauxite	" "	2	2	2	2	2
Chromium ore[2]	" "	272	295	295	305	300
Copper ore[2]	" "	35	40	48	44	33
Gold[2]	kilogrammes	15,500	15,000	19,000	19,000	19,000
Magnesite	'000 metric tons	20	20	20	20	20
Nickel ore[2]	metric tons	11,80	15,000	10,000	16,000	13,000
Silver[2]	" "	5	5	5	4	4
Tin concentrates[2]	" "	600	600	600	600	600
Tungsten concentrates[2, 3]	" "	194	115	48	32	32
Phosphate rock	'000 metric tons	150	130	130	130	140
Asbestos	" "	165	165	165	165	200

[1]Sales. [2]Figures refer to the metal content of ores and concentrates. For copper the figures cover all copper-bearing materials in the form they are to be used or exported. [3]Twelve months ending September 30th of year stated.

Other minerals (metric tons, 1965); Corundum 3,259; Sulphur (recovered) 35,000; Diamonds 4,683,000 metric carats; (1970) Manganese ore 200 (metal content).

Source: Europa. 1980b.

Table 10b. Mining Production

		1975	1976	1977	1978	1979
Asbestos	'000 metric tons	261.5	281.4	273.2	248.9	259.6
Chromium ore	" " "	875.7	863.9	677.3	477.8	541.8
Coal	" " "	3,300	3,593	3,029	3,065	3,188
Cobalt	metric tons	18	—	—	17	204
Copper*	'000 metric tons	47.6	41.3	34.8	33.8	29.6
Gold	'000 troy oz.	354	387	402	399	386
Iron ore	'000 metric tons	1,246	1,353	1,176	1,123	1,201
Nickel*	metric tons	9,121	14,604	16,671	15,701	14,591
Silver	'000 troy oz.	242	200	207	1,109	977
Tin	metric tons	997	915	920	945	947

* Figures refer to the metal content of ores and concentrates.

Source: Europa. 1980a.

Approximately 90 percent of Zimbabwe's mineral production is exported. The most important minerals include:

Gold occurs in extensive fields in basement schists throughout the Highveld and bordering Middleveld areas (Fig. 8). Over a thousand small mines have been worked in Zimbabwe within the last century, but a few major mining concerns have extracted the majority of metals. Zimbabwe has an estimated 20 million troy ounces of gold reserves, and can be a significant factor in the world gold market. In 1974 when production was more than double the 1979 output, the country accounted for two percent of world gold production.

Asbestos is mostly found in basement schists in the region of Shabani, southeast of Bulawayo, although a few productive mines are scattered in other areas. Zimbabwe has an estimated five million tons of reserves (10% of world reserves) and in 1974 accounted for about four percent of world production.

Chromite also occurs in basement schists and is particularly associated with the Great Dyke. Estimated reserves are 560 million tons, which is around 20 percent of the world total. In 1974 production from Zimbabwe accounted for nine percent of world output.

Copper has been mined in Zimbabwe from ancient times. The major deposits are found in the Lomagundi System in the region of Sinoia. Reserves are estimated at 600,000 tons, and production in 1974 was abut one percent of the world total.

Coal is found extensively in the northwest and the southeast, primarily in the Karroo System. Zimbabwe has an estimated two billion tons of coal reserves.

Nickel in Zimbabwe accounted for 2 percent of world production in 1974. Estimated reserves are about 700 million tons.

Other important minerals include tin, iron ore, limestone, pyrites containing sulphur, tantalite, lithium, mica, phosphates, antimony, bauxite, magnesite, silver, tungsten, and many others.

The majority of Zimbabwe's mineral production has always been exported; even during the years when sanctions were in effect some 80 to 90 percent of most mineral production was exported. In 1974 the

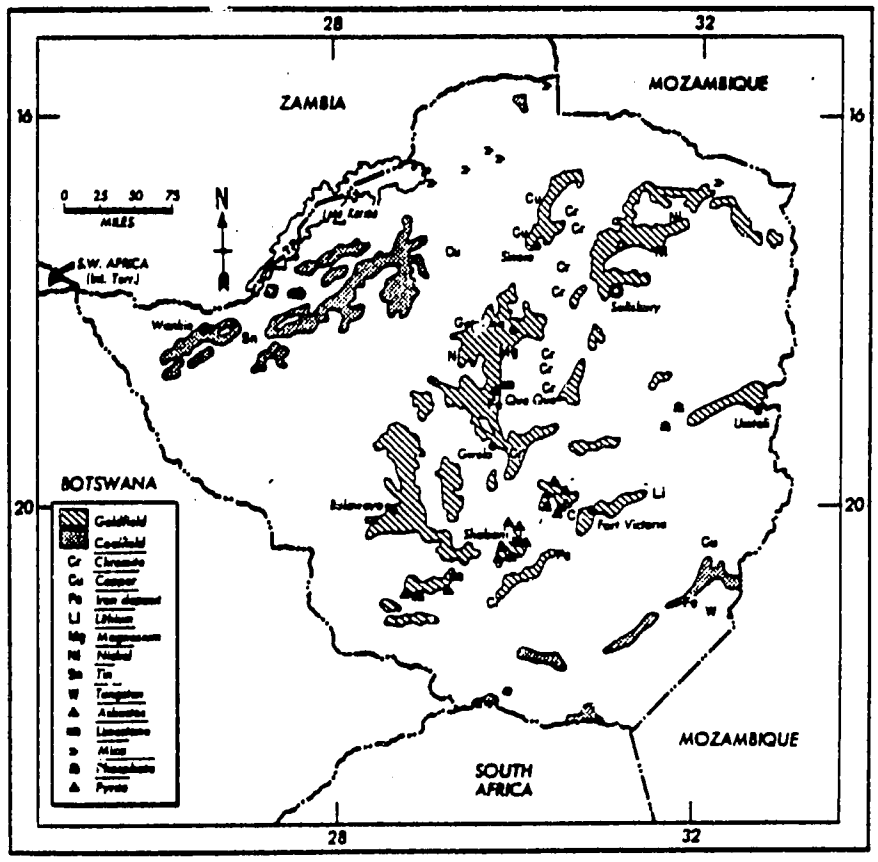

Figure 8. Mineral Deposits in Zimbabwe

Source: Nelson. 1975.

total value of mineral exports was estimated at about US$ 270 million. Over half of the country's coal production, however, goes toward domestic energy needs.

Energy. Energy needs are provided through local resources except approximately 20 percent which is met by imported oil. Over half of Zimbabwe's coal production is used within the country. Hydroelectric power also contributes heavily although about one-third of the electricity must be imported. Most comes from Kariba North, which is in Zambia. Zimbabwe also has one of the world's largest ethanol programs, and produces about 15 percent of its fuel requirements from agricultural products, mostly sugar. Recent estimates of the proportions various energy sources contribute to national energy supply are noted in Table 11.

3.2 Water Resources [7]

Water use in Zimbabwe has traditionally depended primarily upon surface water and rainfall. Agriculture has been the main water user, and consequently has been most productive in the Highveld where the annual water is sufficient. Figure 9 shows water surplus and deficit in the southern African context, while Appendix 4 Figure 1 gives data for selected stations in Zimbabwe.

3.2.1 Surface Water

Zimbabwe's rainfall patterns (cf. Section 2.1.2) give rise to an uneven distribution of surface water. Most effective rainfall is concentrated in the northeast and occurs during the four to five month rainy season. Few of the country's rivers are perennial; 50 to 70 percent of total annual runoff is likely to occur as stormflow during the

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[7] Sources: Collins. 1965.
Grizic. 1980
Hindson and Wurzel. 1963.
Nelson. 1975.
Kay. 1970.
Robbins. 1978.
Simson. 1979.
U.N. Dept. of Economic and Social Affairs. 1973.
Wilson. 1978.
Wurzel and Ward. 1967.
Wurzel and Ward. 1969.

Table 11a. Relative Importance of Energy Sources by Energy Content (1978)

Energy Source	*Estimated percentage of national energy supply*
Hydro-Electricity	33%
Coal	27%
Wood fuel	28%
Liquid fuels	10%
Bagasse	2%

Table 11b. Investment for Domestic Energy Supplies (1978)

Domestic Energy Source	*Annual value of energy*	*Number of users*	*Investment by Government and Private to assure supplies*	*Investment per capita of users*
	($ million)	*(millions)*	*($ million)*	*($)*
Electricity	13	1,3	105	80,77
Coal	4	0,3	15	50,00
Liquid fuels	80	1,3	96	73,85
Wood fuel	14	6,0	1	0,17

Source: Johnston. 1981.

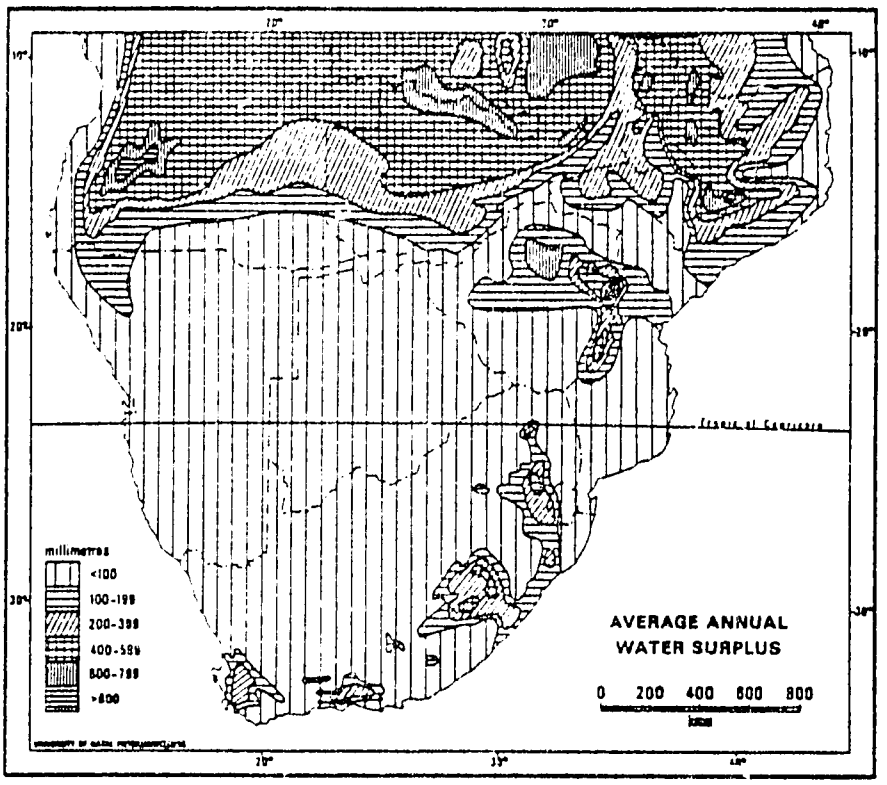


Figure 9a. Annual Water Surplus

Source: Schulze and McGee. 1978.

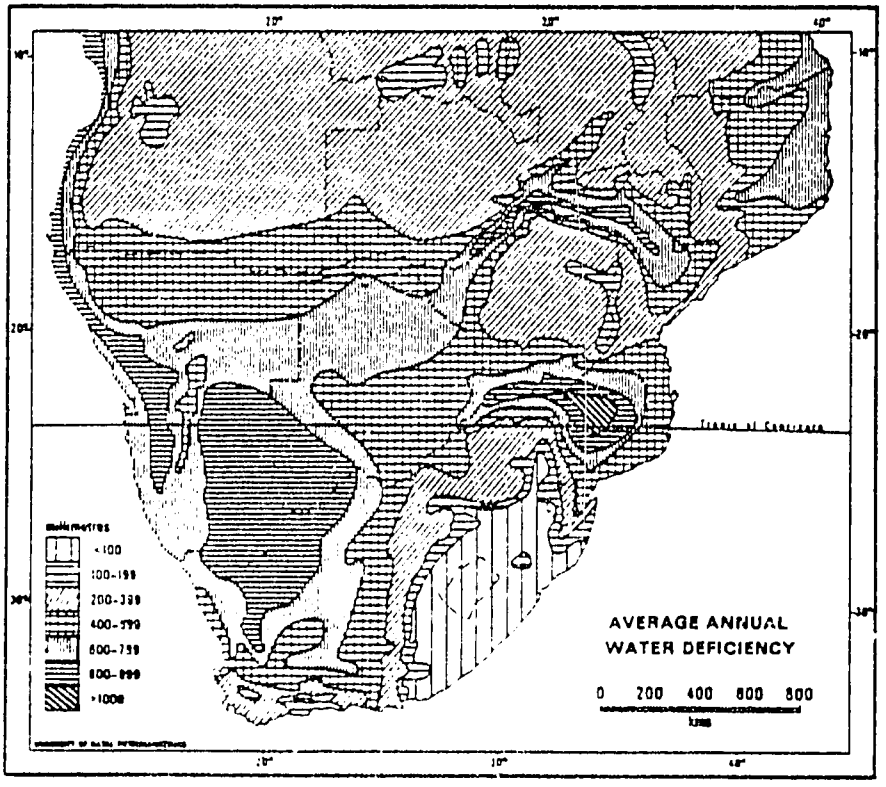


Figure 9b. Annual Water Deficiency

Source: Schulze and McGee. 1978.

rainy season. Potential runoff is consequently greatest in the Highveld and eastern highlands (Appendix 4, Fig. 2).

Potential evapotranspiration is high throughout most of the country, and is moderated only in highland areas of the north and east. Less than eight percent of total rainfall is estimated to actually enter the river systems as runoff, and the vast majority of this runoff is concentrated in the northeast portion of the country (Tables 12, 13; Appendix 4, Figs. 1 and 2). Three of the major hydrological zones in Zimbabwe (A, C, D on Fig. 10) drain into the Zambezi River, which forms the country's northwestern boundary. The southern zone (B) drains into the Limpopo, which marks the southern boundary of Zimbabwe. The Sabi River (zone E) flows directly into the Indian Ocean after traversing Mozambique. Zimbabwe's eastern border regions are part of a local zone in Mozambique which also drains directly to the sea.

Table 12. Estimated Potential Surface Water Resources

Average annual rainfall (mm)	675
Mean annual runoff (10^9 m^3)	20.1
Mean annual runoff (mm)	52
Runoff as % of rainfall	7.7%
Mean annual runoff--Zambezi River at Victoria Falls (10^9 m^3)	30.2
Total Potential Yield at 10% risk (10^9 m^3)	10.5
Total Potential Yield as % of mean annual runoff	52%
Total Potential Yield as % of average annual rainfall	4%
Total optimum storage required to develop Potential Yield (10^9 m^3)	32.8
Total optimum storage as % of mean annual runoff	163%
Total existing storage (10^9 m^3)	3.6
Total existing storage as % of optimum storage	11%

Source: Robbins. 1978.

Table 13. Surface Water Resources by Hydrological Zone

Zone*	Area (sq km)	Mean annual runoff mm	Mean annual runoff 10^3 m^3
A	102,980	21	2,208,800
B	62,060	24	1,467,540
C	89,980	58	5,390,500
D	37,660	98	3,694,300
E	85,050	71	5,799,200
F	7,080	212	1,504,500
	381,810	484	20,064,840

*See Figure 10 for zones.

Source: Robbins. 1978.

Zimbabwe stores surface water behind over 7,200 dams throughout the country, which have a total capacity of 3,600 million cubic meters. Eighty percent of this capacity is in the 85 largest dams. Characteristics of five dams are noted in Table 14; Table 15 presents data on the largest lake in Zimbabwe, Lake Kariba, which lies on the border with Zambia.

3.2.2 Groundwater

Many of the geological formations in Zimbabwe constitute poor aquifers. Figure 11 shows that most comparatively good aquifers are found in the northwestern portion of the country. Table 16 gives an overview of the groundwater characteristics of major geological formations (cf. also Fig. 7). Grizic (1980) estimates that approximately two billion cubic m could be economically extracted from ground water sources annually. Detailed data available for groundwater in the Sabi Valley (southeast Zimbabwe) are presented in Appendix IV

Although surface water provides the majority of water used in Zimbabwe, groundwater is a more reliable year-round source, and wells provide drinking water to most villages or livestock. Traditional watering points are most often simply holes dug in the alluvium of watercourses. In southern Zimbabwe over 30 known thermal springs occur and are usually associated with faults in

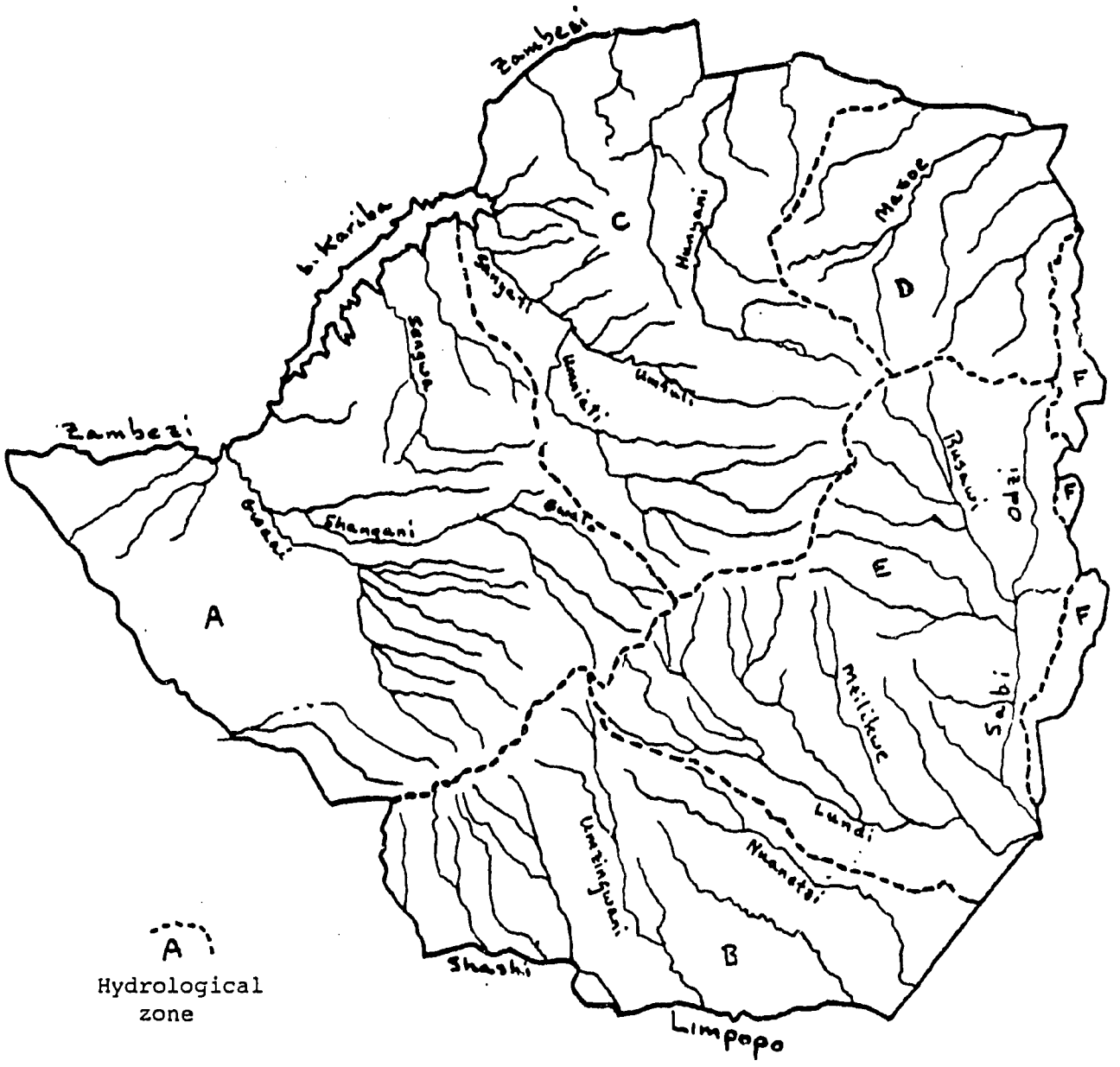


Figure 10. Sketch Map of Drainage

Table 14. Existing Dams and Reservoirs

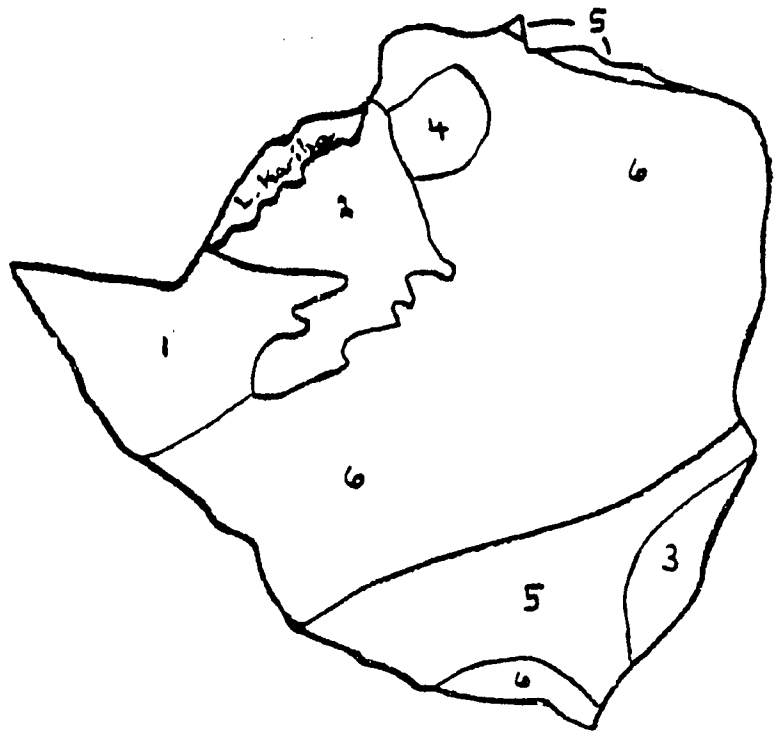
[Data as of November, 1971]

Name	Region	River	Basin area km2	Date constructed	Height m	Length of crest m	Volume content of dam m3	Storage capacity 106 m3	Surface area of reservoir km2
Kariba	Border	Zambezi	–	1956-60	128	620	1,050,000	160,000	5,200
Kyle	South	Several rivers near Fort Victoria	4,000	1958-61	63	309	55,000	1,330	91
Bangala	South	Downstream Kyle (Lowveld)	5,800	1961-63	50	396	88,000	130	11
Manjiranji	South	Chiredzi	1,540	1964-66	52	316	660,000	284	20
Tokwe Mokorsi	South	Tokwe	7,100	–	97	378	500,000	2,100	113

Table 15. Water Balance of Lake Kariba

[Data for year 1968-69]

Inflow	Million acre-ft.	Disposal	Million acre-ft.
From upper drainage basin	55.9	Turbine discharge	16.9
From lower drainage basin	6.8	Spillway discharge	32.5
From rainfall on lake	3.7	Gross evaporation	6.7
		Plus increase in storage	10.6
		Apparent gain	– 0.3
Total inflow	66.4	Total disposal	66.4



1. Sandstones, conglomerates, etc. of the Continental terminal Kalahari sandstones and sands (south of the equator)

2. Continental intercalaire, Nubian Sandstones, sandstone Karroo and other Pre-Cretaceous continental sandstones

3. Complex-structured tectonized zones of northern Africa Marly sandstones, flysch, etc., of the Jurassic Cretaceous

4. Calcareo-dolomitic massifs and plateaux of the Upper Pre-Cambrian and the Cambrian

5. Infra-Cambrian (primary) schists of the Karroo Predominantly Eocene clays

6. Crystalline and metamorphic rocks

Figure 11. Sketch Map of Aquifers

Source: U.N. Department of Economic and Social Affairs. 1973.

Table 16. Aquifer Characteristics of Major Geological Formations

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Kalahari sands are consolidated at depth and associated with alluvial filling in the beds of watercourses. They probably contain the country's largest reserves of ground water; in some places, bore-holes sunk into these sands yield more than 70 m^3/hr.

Cretaceous conglomerates (thickness: 700 m) sometimes yield 2 to 7 m^3/hr, with 750 to 2,400 ppm of dissolved solids.

Jurrassic lavas constitute a poor aquifer, except for the sandstone beds they contain or overlie, which may hold artesian water; one well yields 6 m^3/hr, with 1,200 ppm of dissolved solids. The deep bore-holes, however, have encountered only basalts and are sterile.

Upper Karroo (Triassic) sandstones are capable of yielding as much as 60 m^3/hr; the very fine-grained pelites, however, are dry.

The Lower Karroo (Permian) is represented by argillaceous shales and also by sandstones capable of yielding artesian water which is sometimes heavily mineralized.

Crystalline formations are generally overlain by an alluvial or weathered layer which may be as much as 50 m or more thick but which has been removed by erosion in many places. Water can be found in the basement fractures.

The Umkondo crystalline system is little known but is thought to contain large amounts of exploitable water.

The Lomagundi system with some exceptions (4 m^3/hr to the north of the Hunyana Range) is less productive than the Umkondo.

Intrusive granites constitute a poor aquifer extending over the whole of the country. The areas with dolerite dikes contain the most promising water bodies, which are identified by electrical methods of geophysical prospecting.

Gold beds (Bulawayan system) contain basalts, conglomerates and various metasediments. To the east of Salisbury, some wells yield 7 to 12 m^3/hr.

Source: U.N. Dept. of Economic and Social Affairs. 1973.

post Karroo basalts. Over 26,000 boreholes have also been drilled in the country.

3.2.3 Water Use and Water Law 8/

Overall water use in 1980 was estimated to be approximately 1.5 billion cubic m annually, which represents 15 percent of the estimated practical potential. The agricultural sector accounts for 88 percent of total water use. Per capita use is approximately 600 liters per day (compared to about 1,000 liters/day in South Africa). Trends in water use and population growth indicate that Zimbabwe may be using 50 percent of its potential by the turn of the century, and will reach the limit of what its water resources can support within 50 years (Grizic 1980).

Water law is based upon the Water Act No. 41 of 1976. Most surface water in Zimbabwe is classified as public. The status of groundwater is not clear in the available documentation, but the state retains the right to regulate extraction and use of groundwater. The state holds legal power to regulate all uses of public surface water also. Normally any reasonable quantity of water may be abstracted per dwelling or livestock unit on riparian land. A license must be granted for most non-primary water use, including agricultural, industrial or institutional water use, or even primary use on non-riparian land. Any alterations of water courses, including damming, must be licensed. Any change in groundwater use must be declared to the proper water authorities, who may regulate such actions. The government also retains the right to regulate or prohibit any pollution of public water or groundwater.

3.3 Soils and Agricultural Land Use

3.3.1 Soils 9/

Zimbabwean soils may be divided into five broad categories the first three of which reflect a

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8 Sources: Grizic. 1980.
Pilditch. 1980.

9 Sources: Collins. 1965.
Purves and Blyth. 1969.
Russell. 1973.
Salmon. 1971.
Thompson. 1972.

broad progression in intensity of weathering (Table 17). Halomorphic and hydromorphic soils are more accurately distinguished by drainage characteristics. Collins (1965) contains a detailed description of soils in Zimbabwe, which is followed here.

Weakly Developed soils comprise regosols, which are deep sands with weakly developed AC profiles, and lithosols which are heterogeneous soils shallower than ten inches, over consolidated weathering rock.

Calcimorphic soils comprise vertisols and siallitic soils. The clay fraction of vertisols is always predominantly montmorillonitic while siallitic soils often consist either of illite or poorly crystalline illite-montmorillonoid mixed layer minerals. In the hotter, drier areas vertisols are characterized by well-developed, friable, granular surface horizons with excellent physical conditions for plant growth and therefore for cropping under irrigation. Vertisols formed under more humid conditions, however, have much denser, harder surface horizons. Siallitic soils are confined mainly to the hotter drier areas of Zimbabwe.

Kaolinitic soils comprise three groups, namely fersiallitic, para-ferrallitic and ortho-ferrallitic soils. Fersiallitic soils tend to be formed on parent materials that give rise to sandy soils mainly in areas where rainfall is relatively low. As rainfall increases towards the central plateau, fersiallitic soils form on progressively more basic parent materials or other materials that give rise to predominantly clayey soils. Para-ferrallitic soils are confined to parent materials that give rise to predominantly sandy soils on the higher rainfall parts of the central plateau. Although their clay fractions are essentially ferrallitic in character, para-ferrallitic soils have significant reserves of weatherable minerals. This feature is thought to result from their rapid annual desiccation at the end of the rainy season. Orthoferrallitic soils are intensely weathered soils that are found only in areas of Zimbabwe where there is normally sufficient winter rainfall to maintain the soil in a moist condition all the year round.

Halomorphic soils are represented almost entirely by sodic soils, which morphologically resemble solonetz and solodized-solonetz. Their genesis,

Table 17. Soils in Zimbabwe

OUTLINE OF SOIL CLASSIFICATION			
ORDER	GROUP	Mapping Units	FAMILY
1 **WEAKLY DEVELOPED SOILS** *Soils with very feeble development of genetic horizons*	1 **Regosol Group**	1	Deep sands with less than 16 silt + clay above 72 inches; very little or no reserves of weatherable minerals extremely low silt/clay ratios. (mainly Kalahari sands).
	2 **Lithosol Group**	2	Very shallow soils, less than 18 inches deep, over weathering rock or gravel.
2 **CALCIMORPHIC SOILS** *Unleached soils, generally with large reserves of weatherable minerals, base saturation usually over 80%, clay fractions predominantly 2 1 lattice. E/C values over 40 m e*	3 **Vertisol Group**	3B.E.X	Moderately deep to deep, dark self-churning clays; clay fractions mainly montmorillonite; E/C values over 60 m.e.
			Vertisols without appreciable free water soluble salts or exchangeable sodium formed mainly on basic and ultrabasic rocks
		3Z.S	Vertisols with appreciable water soluble salts and or exchangeable sodium formed mainly on Macumbadia shales
	4 **Sialitic Group**		Soils in which the clay fractions are predominantly illite-montmorillonite mixed 3-layer minerals; E/C values usually over 40 m.e. with or without illuvial calcareous accumulations in the lower solum or underlying material.
		4E X	Sialitic red granular clays formed on basic and ultrabasic rocks
		4P M S	Shallow to moderately shallow sialitic soils formed on other miscellaneous rocks
		4C	Deep sialitic soils formed on alluviums and colluviums
3 **KAOLINITIC SOILS** *Moderately to strongly leached soils, clay fractions mainly kaolinite together with appreciable amounts of free sesquioxides of iron and aluminium*	5 **Ferrisialitic Group**		Soils with appreciable reserves of weatherable minerals; base saturation over 40%, usually between 60 and 80%, clay fractions contain some 2 1 lattice minerals. E C values range from about 15 to about 40 m.e
		5E.X	Ferrisialitic red granular clays formed on basic and ultrabasic rocks
		5S A	Ferrisialitic relatively shallow soils formed mainly on sedimentary rocks
		5F	Ferrisialitic light textured soils formed on various other materials
		5P G.M	Ferrisialitic dark sandy clays formed mainly on basic rocks
		5D	Weakly ferrisialitic soils on deep sands formed on various other rocks
	6 **Para-ferrallitic Group**		Mainly sandy soils that have some essentially ferrallitic characteristics, but which are not ferrallitic.
		6G	Para ferrallitic predominantly sandy soils formed mainly on basic rocks
		6M	Para ferrallitic sandy soils formed on miscellaneous other sandy deposits
	7 **Ortho-ferrallitic Group**		Highly porous, true ferrallitic soils; very little or no reserves of weatherable minerals; base saturations lower than 40%, and usually lower than 30%, only 1 1 lattice clay minerals present and, except in the case of some soils formed on Umkondo sandstone, gibbsite always present. E/C values less than 15 m.e. Red ortho-ferrallitics have colours redder than 5YR, yellow ortho-ferrallitics 5YR or yellower
		7E	Red ortho-ferrallitic soils formed on basic rocks
		7S	Yellow ortho-ferrallitic soils formed on Umkondo shales
		7G M	Red and yellow ortho-ferrallitic soils formed on granites and Umkondo sandstones
4 **HALOMORPHIC SOILS** *Soils in which the morphology of the profile is attributable to the presence of significant amounts of exchangeable sodium and/or water soluble salts, or to the past influence of sodium during pedogenesis*	8 **Sodic Group**	8	Strongly sodic soils, weakly sodic soils, and saline sodic soils
	9 **Non-sodic Group**	Not mappable in extent	
5 **HYDROMORPHIC SOILS** *Soils in which the dominant morphological characteristics are attributable to wetness, whether permanent or seasonal*	10 **Calcic hydromorphic Group**	Not mappable in extent	Mainly clays; base saturation usually exceeds 80% (not mappable; normal cationic complexes of SE, SX and sometimes SS).
	11 **Non-calcic hydromorphic Group**	11	Mainly sands, which are leached and strongly acid in reaction with base saturations lower than about 50% (Mapped in complexes, but also normal cationic complexes of 68, 69 and 11)

Source: Collins. 1965.

however, is different since it appears most unlikely that they evolved from solonchaks in view of the relatively humid conditions under which most of them are found. Lateral water movement across the surface of the dense impermeable sodic horizon is thought to be responsible for the very abrupt change between surface and subsoil horizons.

Hydromorphic soils occur mainly on the central plateau, most frequently in broad depressions. They comprise two main types namely, calcic hydromorphic soils and non-calcic hydromorphic soils. The former are predominantly clayey soils with high base saturation while the latter are predominantly sandy leached soils of low base saturation.

Figure 12 shows the distribution of soils in Zimbabwe, keyed to Table 17. Appendix IV contains some data from specific test sites in the country, while Table 18 gives characteristic details on major non-calcareous soils in the country.

3.3.2 Agriculture [10]

Climate, relief, soils, and available water present conditions such that Zimbabwe may be divided into five broad agricultural zones, the general characteristics of which are related in Kay 1970 (Fig. 13):

Region I covers one to six percent of the country. Rainfall is high and effective rain everywhere is in excess of 63.5 cm. This region is restricted

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[10] Sources: Beach. 1977.
Christopher. 1971a.
Christopher. 1971b.
Clarke. 1975.
Europa. 1980a.
Grant. 1981.
Kay. 1970.
Nelson. 1975.
Palmer. 1970.
Palmer. 1977a.
Palmer. 1977b.
Riddell. 1978?.
Robbins. 1978.
Simson. 1979.
Whitlow. 1979a.
Whitlow. 1979b.

Figure 12. Soils

Source: Adapted from Collins. 1965.

Table 18. Descriptive Details and Analytical Data of 16 Subsoils

Soil number	Soil group[1]	Parent material	Sample depth inches	pH	Clay %	TEB me %[2]		CEC me %[2]		% CEC %	Base saturation %[2]	
						a	b	a	b		a	b
1	Ortho-ferrallitic	Umkondo quartzite	35–41	5,1	28	1,5	1,5	3,3	2,1	36,3	45,4	71,4
2			52–58	4,8	27	1,1	1,1	2,9	1,8	37,9	37,9	61,1
3	Ortho-ferrallitic	Umkondo quartzite	40–48	4,4	30	0,6	0,6	3,4	2,0	41,1	17,6	30,0
4			59–64	4,5	31	0,5	0,5	2,6	2,0	23,1	19,2	15,0
5	Ortho-ferrallitic	Dolerite	11–16	5,3	62	4,4	4,5	15,0	6,8	54,6	29,3	66,2
6			48–52	5,6	68	1,9	1,8	7,3	3,7	49,3	26,0	48,6
7	Ortho-ferrallitic	Granite/dolerite	50–57	4,6	51	0,7	0,7	4,4	2,6	40,9	15,9	26,9
		C.V.						1,7	2,0			
8	Para-ferrallitic	Granite	58–64	4,4	40	1,3	1,2	4,5	3,2	28,9	28,9	37,5
9			78–84	4,5	41	1,7	1,7	4,4	3,4	22,7	38,6	50,0
10	Para-ferrallitic	Granite	19–24	4,4	34	0,8	0,8	3,2	1,7	46,8	25,0	47,1
11			39–45	4,4	34	0,4	0,4	2,5	1,7	32,0	16,0	23,5
12	Para-ferrallitic	Granite	21–27	4,8	4	0,3	0,3	0,6	0,4	33,3	50,0	75,0
13			36–41	4,5	12	0,7	0,7	2,0	1,3	35,0	35,0	53,8
14	Para-ferrallitic	Granite	55–61	5,3	22	1,6	1,6	2,3	1,7	26,1	69,6	94,1
15	Para-ferrallitic	Karroo sandstone	4–17	4,7	3	0,6	0,6	1,5	1,0	33,3	40,0	60,0
16			20–31	4,3	4	0,5	0,6	1,4	1,1	21,4	35,7	54,5
17	Para-ferrallitic	Karroo sandstone	105–111	4,8	24	3,4	3,3	4,5	3,8	15,6	75,6	86,8
		C.V.						1,7	2,0			
18	Fersiallitic	Micaceous schist in gneissic country	9–14	5,5	28	5,0	4,8	6,0	4,9	18,3	83,3	98,0
19			29–34	5,9	24	4,9	4,9	5,9	5,1	13,6	83,0	96,1
20	Fersiallitic	Gabbro	45–52	5,9	62	25,3	24,6	29,3	26,0	11,3	86,0	94,6
21	Fersiallitic	Amphibolite	50–56	5,9	45	8,9	8,9	11,7	9,8	16,2	76,1	90,8
		C.V.						1,7	3,0			
22	Siallitic	Gneiss	17–23	5,1	44	12,7	13,3	17,8	13,6	23,6	71,3	97,8
23			32–38	5,5	51	18,2	18,6	21,5	19,0	11,6	84,6	97,9
24	Siallitic	Granite alluvium	20–26	6,1	31	10,9	10,9	12,4	10,3	16,9	87,9	105,8
25	Siallitic	Gneiss	24–34	5,9	36	14,5	14,4	16,8	14,8	11,9	86,3	97,3
		C.V.						1,7	3,0			

[1] Thompson (1965)
[2] a values obtained by leaching with *M* NH_4OAc at pH 7
b values obtained by leaching with 0,2 *M* NH_4Cl at field pH
[3] CEC % = 100 (a − b) / a

Source: Russel. 1973.

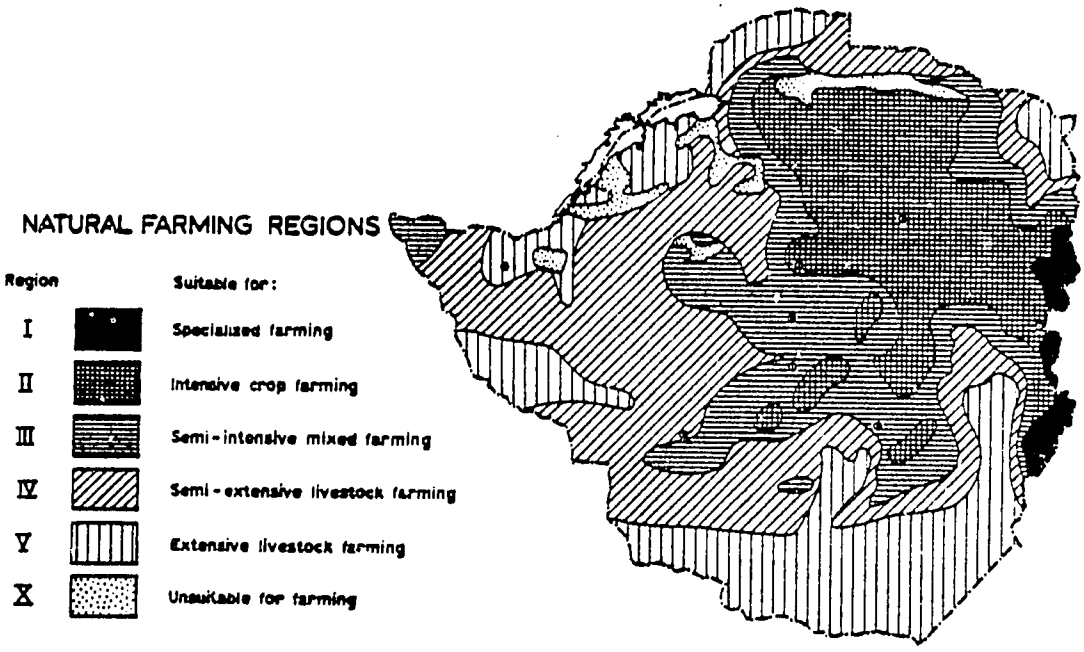

Figure 13. Natural Farming Regions

Source: Kay. 1970.

to the higher, more mountainous parts of the eastern highlands and its agricultural potential is much affected by high altitudes (which give rise to a relatively cool growing season) and by the limited occurrence of sites suitable for arable cultivation; also the heavy rain encourages grassland farming. Consequently the region has been described as suitable for specialized and diversified farming, i.e. intensive livestock farming, the cultivation of crops such as seed potatoes, vegetables, tea, possible coffee and deciduous fruits, and the plantation of wattle and of softwoods, notably pines.

Region II covers 18.7 percent of the country. Rainfall is moderately high and effective rain is between 50-63.5 cm, dry spells are infrequent and rarely severe. This region is suitable for intensive farming based on crop production with subsidiary livestock enterprises.

Region III covers 17.4 percent of the country. Rainfall is only moderate and effective rain is between 41-51 cm; mid-season dry spells are common and often severe. This region is marginal for tobacco and maize but can produce drought-resistant crops. It is suitable for semi-intensive farming based on mixed livestock and crop husbandry in which livestock enterprises are likely to be dominant.

Region IV covers 33.0 percent of the country. Rainfall is low and effective rain is between 35-45 cm. Seasonal droughts and severe dry spells during the rains are common. Crop production is limited to drought-resistant plants except in very favoured localities. Semi-extensive farming based on livestock enterprises is recommended for this region.

Region V covers 26.2 per cent of the country. Rainfall is too low (effective rain everywhere is less than 41 cm) and too erratic for reliable production of even drought-resistant crops. This region is suitable for only extensive farming which is based on the grazing potential of the veld.

Region X covers 3.1 percent of the country and consists of excessively broken country where steep slopes and skeletal soils preclude any farming (regardless of climatic conditions) and of other localities (such as floodplains, swamps and areas of very poor soil) which are physically unsuitable for agriculture.

These distinctions are somewhat skewed toward suitability for commercial farming, but a large proportion of farming in Zimbabwe is traditional subsistence cultivation. Prior to the beginning of majority rule, land in Zimbabwe was divided according to race with approximately half the country allocated to the African population (Fig. 14; Table 19). Current policy of course, has repudiated these divisions based on race, but in practice the government has moved cautiously in land reform. General patterns in 1982, then, are still similar to those in the late 1970s, and there is some utility in examining the pre-1980 situation.

African Areas. The major tenure category in African areas was the Tribal Trust Lands. The majority (74%) of these lands were located in natural farming regions IV and V, which are only marginally suited for crop production (Table 20; compare Figs. 13 and 14). Nevertheless, 80 percent of the rural population was located on Tribal Trust Lands. As a result, the carrying capacity of these marginal lands has been greatly exceeded, and some of Zimbabwe's most serious soil erosion and other agriculture-related problems are to be found in the areas which were Tribal Trust Lands. Table 21 gives figures for land under cultivation in Tribal Trust Lands. It is not clear whether the great drop in cultivated land shown in 1977 is due to the unreliability of the statistics or to increasing degradation of the land combined with increasing insecurity due to the war. Probably each factor is involved.

Traditional cultivation. Most soils in Zimbabwe are not particularly fertile, and Africans generally have been restricted during most of the current century to the least favorable areas. In traditional agriculture the problems of increasing fertility was met by the practice of ash culture by which branches and brushwood were heaped on a patch of land and fired. (Often called shifting cultivation, or slash and burn, the system is known as chitemene in Zambia.) In this process phosphate, potash, liming materials and absorptive charcoal were added from the ashes. Sterilization of the soil by heat from the fire increased the availability of nutrients, including nitrogen and sulphur, and reduced competition from micro-organisms and weeds. The process was hard work and risky for the operator and required 150-200 hectares for the subsistence of a family. As operated in Zimbabwe it enabled two or three crops to be taken before the patch of land was

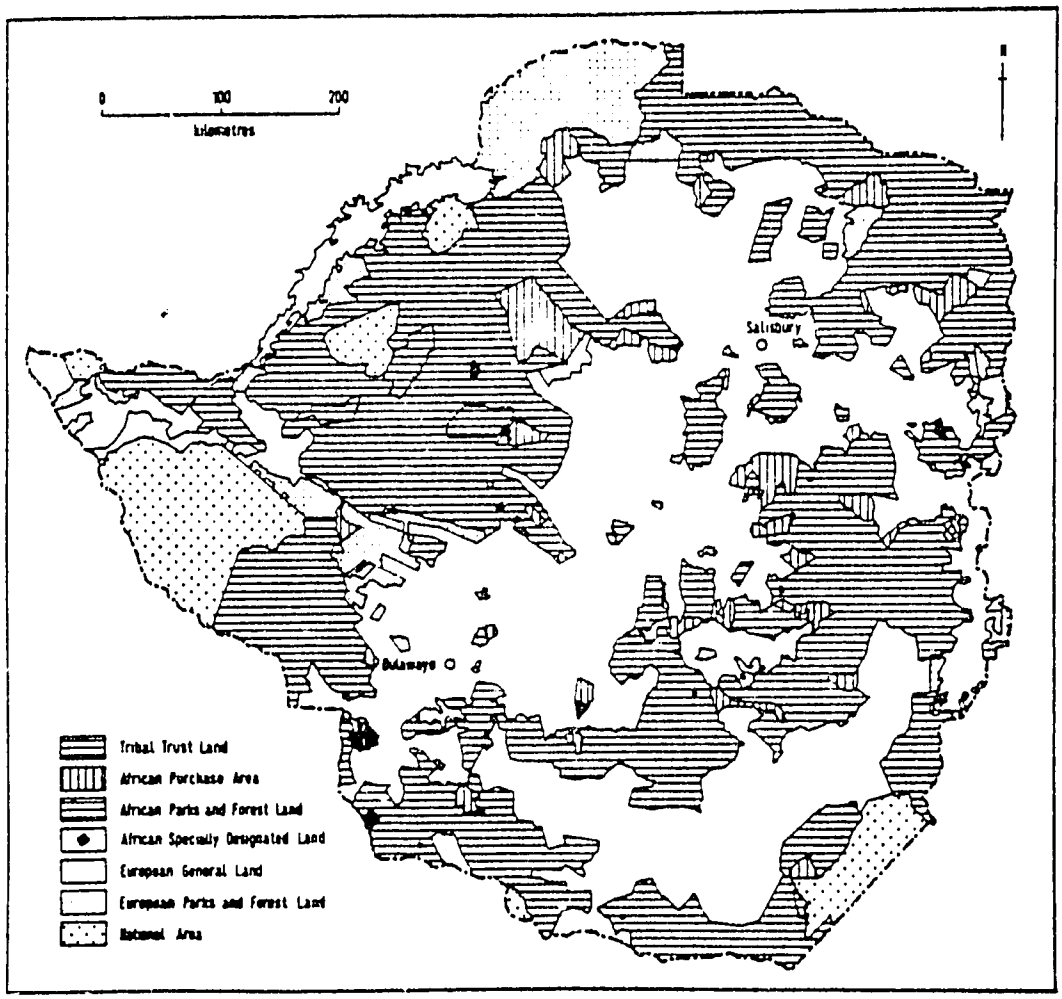

Figure 14. Land Tenure in Zimbabwe, 1970

Source: Christopher. 1971b.

Table 19. Land Tenure, 1970

	Tenure	Area (ha)	
European	Forest land	738 229	
	Parks and wild life reserves	1 794 682	
	General area	15 663 712	
	Specially designated	9 301	
Total European area			18 205 924
African	Forest land	177 795	
	Parks and wild life reserves	255 335	
	African Purchase land	1 486 416	
	Tribal Trust land	16 161 314	
	Specially designated	121 663	
Total African area			18 202 523
National area			2 680 047
RHODESIA			39 088 494

SOURCE: Schedule of Land Tenure Act, 1969.

Source: Christopher. 1971b.

Table 20. Land Tenure and Agro-ecological Regions

Tenure Category	Agro-ecological regions I	II	III	IV	V	TOTAL
Intensive Conservation Areas (I.C.A.)	2,9%	26,8%	22,1%	24,8%	23,4%	100,0%
African Purchase Areas (A.P.A.)	0,8%	19,8%	36,8%	34,9%	7,7%	100,0%
Tribal Trust Lands (T.T.L.)	0,5%	8,9%	16,4%	44,4%	29,8%	100,0%
Parks and Wildlife Land (PWL) +	1,6%	0,7%	8,0%	50,8%	38,9%	100,0%
Forest Lands (FOR)	9,3%	—	18,7%	63,8%	8,2%	100,0%
Total	1,8%	15,4%	18,5%	37,4%	26,9%	100,0%

+ Includes National Land, Safari Areas etc.

Source: Whitlow. 1979a.

Table 21. Estimates of Changes in Cultivated Land in the Tribal Trust Lands, 1900 - 1977

Year	*Cultivated Area Per Person (ha)*	*Total Area Under Cultivation (ha)*	*Author*
1900	0.43	215 000	Kay (1970)
1945	0.48	480 000	Kay (1970)
1962	0.52	1 134 600	Stubbs (1977)
1975	0.60	1 800 000	Walker (1975)
1976	0.69	2 427 000	White-Spunner (1976)
1977	0.56	1 177 300	Stubbs (1977)

Source: Whitlow. 1979b.

allowed to revert to bush. Then, it was fifteen or more years until the presence of indigenous legumes of the genus Croteliaria showed that the land was again ready for use. The system when properly practiced was self-sustaining and conservative.

Knowledge of the necessity for the process may now be lost, as evidenced by attempts just to plough or dig over soils for immediate planting of crops and by the idea that soils which have been depleted by years of cropping can be "rested" under a tumbledown grass fallow for a few years to recover. In addition, of course, rising population and restricted access to land have greatly increased the demands on land under subsistence cultivation. Many experiments have been done on sites where the land has been left fallow under poor grass cover, and there was no evidence of improvement of fertility during the fallow period. The burning process, the shortness of the time under crops, and the reversion to bush including leguminous shrubs were all essential features of the successful system of shifting cultivation, and without all of them cropping is impossible in the absence of manure or fertilizers.

European Agriculture. European areas, most of which were usually called Intensive Conservation Areas, covered most of the relatively good cropland in the country. With the added advantages of modern technological and managerial inputs, as well as much less pressure on the land, European areas have been much more productive. Even among Europeans, however, there was wide diversity, and about ten percent of the Europeans owned about 60 percent of the European farmland. The sector was therefore characterized by a large number of relatively small farms, which are usually the most productive. Many of the largest plantations were owned by British or South African companies.

About 1.4 million acres were under cultivation in European areas in 1976. Tobacco was the major crop by value before 1965. It was severly cut back after sanctions were imposed, although Zimbabwe continued to sell some tobacco secretly. Maize became a major European as well as African grown crop, and production of cotton, groundnuts, wheat, and many other crops required for self-sufficiency increased drastically. Table 7, which shows value of all crops, regardless of sectoral origin, indicates that maize was by far the most

important agricultural product by value in 1979. Table 22 indicates volume of output, and shows the predominence of maize.

Table 22. Output of Selected Crops and Livestock by Year

Crop	Year (000) metric ton 1961-65 Average	1974	1975	1976
Cereals	1119	2064	1781	1790
Tobacco	109	80	95	85
Maize	815	1700	1400	1400
Wheat	2	85	85	90
Millet	240	220	220	220
Roots & Fibers	22	23	23	23
Groundnuts in Shell	103	125	125	120
Pigs*	127	192	200	200
Cattle*	3558	5700	6000	6100
Poultry*	6700	8200	8300	8404
Cow Milk Whole Fresh**	218	250	253	255
Fruits	48	71	74	77
Seed Cotton	6	99	144	117
Cotton Seed	4	66	96	78
Vegetables & Melons	75	111	115	119
Sugar Cane	917	2500	2608	2716

* 1000 head
** (kg/an.)

Source: Robbins. 1978.

3.4 Vegetation

3.4.1 Native Flora 11/

Very detailed discussions of vegetation in the Sudano-Zambezian region (which covers nearly all

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11 Sources: Dye and Walker. 1980.
Rattray. 1960.
Rattray. 1961.
Rattray and Hld. 1961.
Tomlinson. 1974.
Werger and Coetzee. 1978.
Wild. 1975.

of Zimbabwe) appear in Werger and Coetzee (1978). However, the following discussion is based on Rattray (1961) and Rattray and Wild (1961), who specifically discuss vegetation in Zimbabwe. The numbered categories are keyed to Figure 15. Additional data on vegetation categories too small to be mapped at this scale appear in Rattray (1961).

Biotic or Secondary Grasslands are considered by many ecologists to be derived from forest or woodland and maintained by fire. In certain areas, however, it is possible that these grasslands may be considered as transitional to High Montane Climax Grasslands. The two main types in Zimbabwe are:

1. Themeda/or Loudetia/or Exotheca with evergreen forest patches. These short dense tufted grasslands are dominated by Themeda triandra on the more fertile red soils, or by Loudetia simplex on the poorer granite sands. Occuring at high altitudes and under high rainfall conditions in the Eastern Districts, these grasslands are regarded as a fire sub-climax to evergreen forest, relics of which occur in patches in sheltered fire-protected localities. Common associated species are Andropogon schirensis, Bewsia biflora, Eragrostis racemosa, Elyonurus argenteus, Tristachya hispida and Setaria sp., often invaded by bracken (Pteridium aquilinum), Philippia, Kotschya and other shrubs when protected from fire.

2. Hyparrhenia types are tall dense grasslands dominated by Hyparrhenia filpendula or H. Dissoluta. They occur on the plateaux of the main watershed on granite sand, particularly between Salisbury and Rusape at altitudes above 1,370 m and are regarded as a fire sub-climax to woodland. Common associated grasses are Andropogon spp., Chloridion cameronii, and Eragrostis spp.

Hyparrhenia grasslands often surround and merge with edaphic grasslands resulting from shallow soils subject to varying periods of waterlogging, and dominated by Loudetia simplex or Schizachyrium spp.

Edaphic Grasslands result from waterlogging or shallowness of soil, and include the following three types in Zimbabwe:

3. Loudetia types. A number of edaphic grasslands or "vleis" occur at altitudes above 1,070 m on shallow soils generally derived from

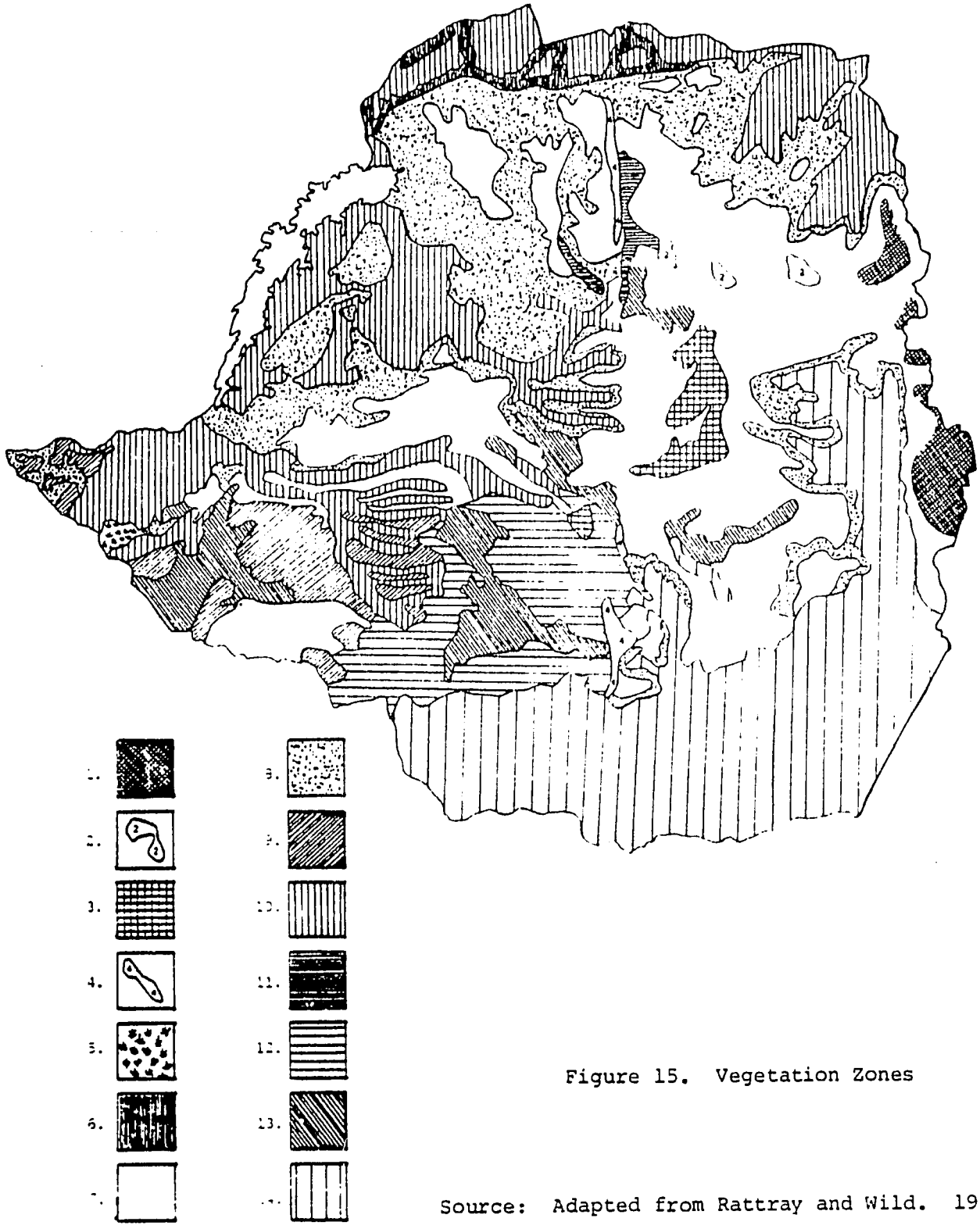

Figure 15. Vegetation Zones

Source: Adapted from Rattray and Wild. 1961.

granite and subject to varying periods of waterlogging. They are dominated by Loudetia simplex or L. flavida alone or in association with each other or with a number of other species. The Loudetia species themselves are usually found on the drier fringes, and depending on the degree of wetness and length of the period of waterlogging (whether very temporary or permanent) may be associated in varying combinations with such species as Monocymbium ceresiforme, Schizachyrium spp., Brachiaria fififolia, Eragrostis capensis, Aristida macilenta, Sporobolus subtilis, Andropogon eucomus, Scleria welwitschii, S. grieqifolia, and Eriocaulon lacteum.

4. Andropogon types. Tufted grasslands of Andropogon gayanus or A. schirensis, sometimes with Loudetia simplex, occur in Zimbabwe on the shallow soils of the Great Dyke which are largely derived from norite and pyroxenite and are high in magnesium and chrome. Themeda triandra is often co-dominant or locally dominant, and Panicum maximum is another common species at least in the southern half of the Dyke.

5. Swamp and Papyrus sudd. Only one patch on the western border was large enough to map in Rattray and wild aquatic and subaquatic grasses such as Echinochloa pyramidalis, Pennisetum purpureum, Miscanthidium teretifolium, Eleocharis plantaginea and Echinochloa stagnina are common.

Thickets are mostly deciduous consisting of woody species up to 4.5-6 m high. They are usually secondary, developing on old lands which have had a certain amount of protection from fire.

6. Commiphora-Combretum Pterocarpus antunesii Thicket. In the hot Zambezi Valley, with a low effective rainfall and deep sandy soils, Combretum eleagnoides and C. celastroides together with Schrebera trichoclada, Acacia mellifera subsp. detinens, Terminalia sp., Commiphora spp., and a number of others form a dense impenetrable thicket. These are particularly common between the northern escarpment and the Zambezi itself. They appear to have developed as a result of previous cultivations, and grass cover is absent except for a few annuals. These thickets are often called "Jesse" bush locally.

Woodlands:

7. Brachystegia Woodland, often with Julbernardia globiflora or J. paniculata is one of the most common vegetation associations in Zimbabwe, and is particularly common in the highveld. It consists of deciduous woodland six to 12 m high of Brachystegia spiciformis along or more frequently in association with Julbernardia globiflora or Brachystegia boehmii or both. On the Eastern Border Brachystegia utilis sometimes replaces B. spiciformis. Other tree species which may occur are Faurea saligna, F. speciosa, Combretum molle, Uapaca kirkiana, Pterocarpus angolensis, Albizia antunesiana, Strychnos spinosa, S. pungens, Monotes glaber and Gardenia spatulifolia. Brachystegia tamarindoides occurs on rocky hills and ridges. On Kalahari sands it is often associated with Baikiaea plurijuga and Pterocarpus angolensis. Although largely stratified in Zambia, where it occurs most commonly under higher rainfall conditions, this type of woodland in Zimbabwe is generally unstratified or has only a few small bushes as an understory. The grass cover is sparse and includes such species as Hyparrhenia filipendula, H. dissoluta, Brachiaria brizantha, Pogonarthria squarrosa, Rhynchelytrum nyassanum, Craspedorhachis rhodesiana and Eragrostis spp. In the high rainfall areas of the Eastern Districts Loudetia simplex is a common species. The type occurs most commonly in 75-115 cm rainfall areas above 1,220 m on several soil types but always in well drained sites.

8. Brachystegia Escarpment Woodlands is also very common, especially in the northern half of Zimbabwe. It consists of deciduous, and usually unstratified, woodland 6 to 12 m high of Brachystegia boehmii alone or frequently in association with Julbernardia golbiflora, and, at the higher altitudes, with Brachystegia spiciformis. As this type of woodland commonly occurs on the escarpments, below the plateaux where Brachystegia spiciformis predominates at altitudes between 900 m and 1,220 m, B. boehmii flourishes under warmer and drier conditions than the former. Common tree associates include Pilostigma thornningii, Monotes engleri, Afrormosia angolensis, Afzelia quanzensis, Combretum spp., Diospyros mespiliformis, Peltophorum africanum, Kirkia acuminata, Acacia spp. and others. Brachystegia allenii is common on the Zambezi escarpment and frequently produces hybrid populations with B. boehmii. At the lower

altitudes B. boehmii often merges with Colophospermum mopane woodlands or savannas on granite sands. The grass cover is sparse and similar to that associated with Brachystegia spiciformis but on heavy red soils derived from dolerite or epidiorite it may be better developed and Themeda triandra, Heteropogon contortus and Setaria sphacelata are more common. Pure communities of Brachystegia boehmii are sometimes found at altitudes above 1,220 m in the B. spiciformis zone and are then very often indicative of stony, gravelly, poor soils with a tendency to waterlogging in wet spells.

9. Baikiaea Woodland does not differ radically from the deciduous Baikiaea forest of Zambia, but perhaps because of more frequent fires, heavier game populations in the past, or less readily available water supplies, the Baikiaea is less well grown, more open and with a poorer development of understorey species than in Zambia. It consists of deciduous woodland over 7.5 m high, dominated by Baikiaea plurijuga usually in association with Pterocarpus angolensis and Guibourtia coleosperma. It occurs exclusively on Kalahari sand with an annual rainfall of about 50-70 cm.

Other common tree associates include Brachystegia spiciformis, Brachystegia boehmii, Julbernardia globiflora, Afzelia quanzensis, Dialium engleranum, Ochna pulchra, Ricinodendron rautanenii, Kirkia acuminata, Burkea africana, Erythrophleum africanum, Combretum spp., and Commiphora spp. This type of woodland is often stratified with numerous small trees and bushes such as Paropsia brazzeana and Baphia obovata, and also as a result of secondary growth after the timber trees have been cut out.

The grass cover is very spare but generally consists of tall species of Aristida (such as A. graciliflora var. robusta, and A. pilgeri). Triraphis schlechteri, Tristachya rehmannii, Digitaria spp., and Eragrostis spp.

The area occupied by these Baikiaea woodlands was probably originally dominated by Parinari curatellifolia, but this species has given way to Baikiaea, which in turn is now being invaded by the two Brachystegia species and Julbernardia globiflora.

10. Colophospermum mopane Woodland is fairly common in western and northern Zimbabwe. This deciduous woodland consists of pure or almost pure communities of Colophospermum mopane six to 15 m high. It occurs on deep well drained soils at altitudes below 900 m with an annual rainfall of less than 60 cm. Other physiognomic types, dominated by Colophospermum, occur extensively even up to altitudes of 1,220 m and a rainfall of 65-75 cm, but these are generally woodland savannas, tree savannas or, probably more commonly, tree/bush savannas. Where the Colophospermum is tall and well developed with an almost closed canopy, there is usually no understory of any sort and no grass cover. In the Sabi Valley however, dense Mopane woodland oten has an understory of shrubby Grewia bicolor.

It is often difficult to determine where the Colophospermum woodland types change to woodland savannas as there is considerable variation in tree density. In the north, for example, under higher rainfall conditions the Mopane country in the Zambezi Valley varies between woodland and woodland savanna whereas in the drier south woodland savanna, tree savanna and tree/bush savanna types are more common.

Savannas:

11. Parinari savanna is an open evergreen tree savanna of Parinari curatellifolia, over six m high (very often derived from woodland) with a conspicuous grass cover. It occurs on sandy soils with poor drainage and a high water table, or on the margins of some edaphic grasslands. Parinari savanna is most commonly found on the main plateau at altitudes above 1,220 m and where the rainfall is more than 60 cm annually particularly just northwest of Salisbury.

Faurea speciosa, Protea gaguedii, P. angolensis, Cussonia spicata, Strychnos spp., are sometimes associated with the Parinari particularly on the fringes. The grass cover generally contains a mixture of dryland and moisture loving species depending on the soil moisture status. Thus Hyparrhenia spp., Cymbopogon sp., Andropogon schinzii, Chloridion cameronii, Brachiaria nigropedata and other dryland species may be found in varying proportions with such species as Loudetia simplex, Pennisetum sp., Schizachyrium spp., Alloteropsis semialata, and several others.

12. Terminalia savanna is found in the Bulawayo area and consists of deciduous tree savanna up to about 7.5 m high, and of varying density, Terminalia sericea often occurs in association with Burkea africana, on granite or gneissic sands at altitudes between 1,070 m and 1,370 m where the rainfall is 50-60 cm annually.

At times the Terminalia may form almost pure communities while at others it would appear that Burkea is dominant. On the whole, however, it is perhaps more common to find a number of tree species associated with these two genera, very often forming a tree/bush savanna type. Some of these are Heeria insignis, Peltophorum africanum, Protea gaguedii, Faurea saligna, Lannea discolor, Ficus capensis, Rhus lancea, Pseudolachnostylis maprouneifolia, Pterocarpus angolensis, Dombeya rotundifolia, Piliostigma thonningii, Bolusanthus speciosus, Combretum spp., and a number of others. As the rainfall decreases Sclerocarya caffra and Kirkia acuminata sometimes becomes more frequent. Eventually Combretum spp. or Colophospermum mopane, or both, appear and may ultimately become the dominant trees of the savanna.

The grass cover is good and where the rainfall is around 60 cm annually, Hyparrhenia filpendula, H. dissoluta, Chloridion cameronii, Schizachyrium semiberbe, Pogonarthria squarrosa, Heteropogon contortus and Digitaria spp. are common, while towards the drier parts, Eragrostis rigidior, E. gummiflua and E. superba, become more abundant than the Hyparrhenia spp.

13. Acacia savannas occur in west central Zimbabwe and in small patches elsewhere. They consist of deciduous trees of varying density up to nine m high (often including areas of tree/bush or scrub savanna), dominated by one or more species of Acacia (largely depending on soil type) such as A. nigrescens, A. tortillis subsp. heteracantha, A. karroo, A. nilotica subsp. kraussiana, A. mellifera subsp. detinens, A. gerrardii, A. rehmanniana, A. polyacantha subsp. campylacantha and A. giraffae. These occur largely where the rainfall is below 65 cm annually. They are found on various soil types:

- On Kalahari Sands in 50-60 cm rainfall areas, Acacia giraffae forms extensive tree savannas. The grass cover consists largely of tall perennial Aristida spp., Eragrostis pallens, Digitaria sp. and Panicum sp.

- On basement schists in 50-60 cm rainfall areas Acacia gerrardii together with A. nilotica subsp. kraussiana, A. karroo and A. rehmanniana form a characteristic tree savanna which, depending on biotic influences, may include tree/bush savanna types as well as a certain amount of secondary scrub growth. A number of other trees are often associated such as Combretum apiculatum, C. hereroense, Ormocarpum trichocarpum, Sclerocarya caffra and Peltophorum africanum. The grass cover is predominantly Themeda triandra in association with Heteropogon contortus, Cymbopogon plurinodis, Eragrostis sp. and Bothriochloa insculpta.

- On heavy black clay soils derived from basalt in 50-60 cm rainfall areas Acacia nilotica subsp. kraussiana often occurs as a well grown open tree savanna. The grass cover is predominantly Setaria porphyrantha with Dichanthium papillosum, Sorghum versicolor, Bothriochloa insculpta and Panicum maximum associated.

- On deep colluvial soils of the Zambezi Valley with a rainfall of 50-60 cm Acacia tortillis subsp. heteracantha forms extensive areas of tree savanna. An understory of shrubs is often present and the grass cover includes species of Eragrostis, Aristida and Urochloa and Dactyloctenium aegyptium.

- On heavy black clays derived from basalt in the Sabi Valley with a rainfall of 30-40 cm Acacia nigrescens in pure stands or with Sclerocarya caffra co-dominant forms a well developed open tree savanna. Shrubs such as Flacourtia indica, Securinega virosa, Bridelia mollis and Combretum spp. occur scattered throughout. The grass cover is characterized by Setaria mombassana, Ischaemum brachyatherum, Sorthum versicolor and Brachiaria eruciformis.

- On deep sandy soils derived from sandstones of the Permian system in the Sabi Valley in the 30-40 cm rainfall zone Acacia nigrescens, together with Colophospermum mopane, Sclerocarya caffra and Commiphora spp., form a tree savanna which includes areas of tree/bush savanna on account of the presence of such small tree and bush species as Phyllanthus discoideus, Pteleopsis anisoptera, Heinsia crinita and Strophanthus kombe. The grass cover here consists mainly of Panicum maximum, Cenchrus ciliaris, Pogonarthria squarrosa, Digitaria pentzii, D. perrottettii, Enteropogon macrostachyus and Aristidia spp.

14. Colophospermum mopane savannas are deciduous tree savannas of varying densities up to 11.5 m high or more. They consist of Colophospermum mopane alone, or in association with a number of other trees, the chief genera of which are Acacia, Combretum, Sclerocarya, Brachystegia, Kirkia, Adansonia and Commiphora. The most typical of the tree savanna types are usually on undisturbed sites of Colophospermum alone and the physiognomy becomes more of the tree/bush type when mixed with other species and where disturbance has taken place.

Colophospermum mopane is dominant or co-dominant, over extensive areas of savanna in southern Zimbabwe, particularly where the rainfall is below 50 cm. These savannas occur on a number of soil types but are best developed on those that are sandy, fairly deep and well-drained. Where the soils are heavy and badly drained the trees become small or stunted, and when the sub-soil is compacted and strongly alkaline with a high exchangeable sodium content the trees become scrub-like and the grass cover is absent or consists of only a few ephemeral annuals. These bare, "Sikwakwa" patches are common in granite soils at the higher altitudes and where the rainfall is about 50 cm annually. Where the Colophospermum savanna reaches its maximum development the grass cover is good and may vary from one which is predominantly perennial to one which is almost entirely annual depending largely on past management or treatment. Common perennials are Eragrostis rigidior, Cenchrus ciliaris, Schmidtia bulbosa and Urochloa spp., while the annuals are Enneapogon cenchroides, Aristida adscensionis, Eragrostis vicosa, Dactyloctenium aegyptium and Urochloa spp.

The following tree savanna types of Colophospermum may be recognized:

- Colophospermum alone--Eragrostis (Kalahari, Permian).
- Colophospermum--Brachystegia boehmii--Aristida (Kalahari).
- Colophospermum--Acacia--Combretum--Cenchrus (Basalt).
- Colophospermum--Commiphora--Adansonia--Aristida (annual) (several soil types).

3.4.2 Range Use [12]

Reference to Figure 13 will show that a major portion of Zimbabwe is much more suited to livestock grazing than to cultivation. Estimated livestock populations are noted in Table 23, and livestock products in Table 24.

The war began to affect the livestock sector by 1977, and after that year populations began to fall. The commercially owned cattle herd was estimated at about 2.3 million at the beginning of 1981, and the African owned traditional herd at just under three million head.

Little data is available on stocking rates in any part of Zimbabwe, but some observers note that rangeland degradation is widespread. Taylor and Walker (1978) have determined stocking rates and biomass of cattle and game for a 12,000 ha cattle section and an 8,000 game section of a ranch in southeastern Zimbabwe, which lies within the Colophospermum mopane (Fig. 15, No. 14) savanna zone (Table 25). Utilization of vegetation by cattle and game is presented in Table 26, and Table 27 indicates range condition.

3.4.3 Forestry and Wood Use [13]

Tables 28 and 29 indicate that wood consumption in Zimbabwe was slightly greater than 6 million cubic m in 1978/79. The vast majority of wood consumed is for fuel. Zimbabwe does contain about 95,000 ha of timber plantations which are managed on a sustained yield basis for industrial wood needs, but these plantations contribute only about 60 percent of total industrial needs, and very little to fuelwood requirements. Table 30 presents data on fuelwood consumption.

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[12] Sources: Europa. 1980.
Gammon and Roberts. 1978.
Taylor and Walker. 1978.
Ward and Cleghorn. 1970.

[13] Sources: Banks. 1981.
Chavunduka. 1981.
Fuller. 1980.
Fuller. 1981.
Johnston. 1981.
Rea. 1981.

Table 23. Livestock

('000 head)

	1976	1977	1978	1979
Cattle	6,316	6,614	6,027	5,569
Sheep	689	688	705	587
Pigs	201	226	209	175
Goats	1,774	1,828	1,944	1,348
Poultry*	4,200	4,200	4,400	4,700

* Belonging to registered poultry producers only.

Source: Europa. 1980

Table 24. Livestock Products

('000 metric tons)

	1977	1978	1979
Beef and veal	152	152	135
Mutton and lamb	1.3	1.1	1.0
Goats' meat	0.3	0.3	0.3
Pig meat	16	14	9
Poultry meat*	12	12	13
Other meat	14	13	11
Cows' milk	208	200	210
Butter	1.3	0.7	0.8
Cheese	1.7	1.9	1.7
Hen eggs	6.1	6.1	6.0
Cattle hides	16	17	13

* Production by registered poultry producers only.

Source: Europa. 1980

Table 25. Estimates of the Numbers and Biomass of the Herbivore Species on the Game and Cattle Sections of Buffalo Range Ranch

Species	Game section				Cattle section	
	Number		Biomass (t)		Number	Biomass (t)
	Minimum	Safe realistic estimate	Minimum	Safe realistic estimate		
Impala	3000	3000	114	114	1000	38
Zebra	130	305	38	82		
Hippo	25	25	104	104		
Kudu	90	150	15	27		
Eland	50	75	21	32		
Sable	64	80	12	39	32	6
Wildebeest	168	225	20	22		
Warthog	284	350	12	15	255	11
Bushbuck	100	150	3	4		
Waterbuck	30	50	5	8		
Cattle					1261 L.U.*	573
Total			343	445		628
kg ha^{-1}			45·1	58·5		58·5

* 1 Livestock Unit (L.U.) is equivalent to 455 kg mass

Source: Taylor and Walker. 1978.

Table 26. The Percentage Bulk Contribution (C), Percentage Utilization (U) and Percentage Contribution to the Diet (D) of Various Herbaceous Species in the Cattle and Game Sections of Buffalo Range Ranch (t=trace)

	Cattle section			Game section		
	C	*U*	*D*	*C*	*U*	*D*
Digitaria pentzii	39·0	30·0	42·4	34·2	36·7	33·5
Urochloa mossambicensis	23·3	44·8	37·8	20·8	46·2	25·7
Schmidtia pappophoroides	12·5	13·9	6·3	23·7	31·6	20·0
Heteropogon contortus	3·3	35·3	4·2	0·8	57·9	1·2
Aristida congesta	0·5	27·0	0·5	0·3	23·9	0·2
A. barbicollis	0·3	6·1	0·1	0·1	18·1	0·1
A. scabrivalvis				0·2	12·0	0·1
A. leucophaea	t			0·1	31·2	0·1
A. adscensionis	0·4	6·2	0·1	1·0	32·1	0·9
Eragrostis superba	0·9	28·8	0·9	0·4	52·0	0·6
E. rigidior	1·7	28·1	1·7	2·1	47·7	2·7
E. aspera				t		
E. trichophora				t		
Pogonarthria squarrosa	5·2	12·5	2·4	12·5	34·9	11·6
Tragus berteronianus	1·5	5·0	0·3	2·0	8·9	0·5
Panicum maximum	1·7	37·8	2·3	1·1	25·2	0·7
Enteropogon macrostachyus	0·2	24·5	0·2	2·2	29·2	1·7
Rhynchelytrum villosum	0·1	29·5	0·1	0·2	6·8	0·1
Enneapogon scoparius	0·2			0·1	13·4	0·1
E. cenchroides	0·3			0·6	18·4	0·3
Chloris roxburghiana	0·4	4·7	0·1	0·2	19·4	0·1
Cenchrus ciliaris	0·1			0·2	1·9	0·1
Brachiaria deflexa	0·2	10·3	0·1	0·1	5·7	0·2
B. nigropedata				t	10·3	
Sporobolus ioclados				0·1	32·1	0·1
Tripogon minimus	0·1	1·3	t	0·1		
Bothriochloa radicans	0·8	6·6	0·2			
Themeda triandra	0·8	4·8	0·1			
Andropogon gayanus	1·6	6·0	0·3			
Perotis patens	0·1	6·0	0·1			
Hyparrhenia filipendula	t					
Setaria anceps	t					

Source: Taylor and Walker. 1978.

Table 27. Comparisons of the "Range Condition" on the Cattle and Game Sections of Buffalo Range Ranch Using Various Indicator Measures

	Cattle section		Game section		*t*-value
	Mean	S.E.	Mean	S.E.	
Cover-abundance (%)	37·8	1·4	30·5	1·6	**
Height (m) dry season	64·0	3·2	45·8	3·2	***
Moribund grass (%)	6·2	1·7	2·6	0·7	*
Dead tufts (density m⁻²)	6·4	0·7	5·9	0·6	NS
Scrub (density m⁻²)	4·2	0·6	3·5	0·5	NS
Litter cover (%)	29·6	2·4	21·5	2·2	*
Soil capping	19·9	2·2	14·2	1·7	*
Erosion (%)					
severity	13·6	1·6	11·8	1·7	NS
extent	65·3	4·2	52·4	4·2	*
Utilization (%)	28·1	2·3	43·0	3·2	***

*** = $P < 0.001$, ** = $P < 0.01$, * = $P < 0.05$

Source: Taylor and Walker. 1978.

Table 28. Roundwood Removals

('000 cubic metres, year ending June 30th)

	Coniferous (soft wood)		Broadleaved (hard wood)		Total	
	1977/78	1978/79	1977/78	1978/79	1977/78	1978/79
Sawlogs, veneer logs and logs for sleepers	286	230	97	94	383	324
Pitprops (mining timber)	—	—	43	43	43	43
Other industrial wood	48	63	720	741	768	804
Fuel wood	1	1	4,747	4,965	4,748	4,966
Total	335	294	5,607	5,843	5,942	6,137

Sawnwood Production (estimates, '000 cubic metres, year ending June 30th): 128 (coniferous 106, broadleaved 22) in 1977/78: 127 (coniferous 112, broadleaved 15) in 1978/79.

Source: Europa. 1980a.

Table 29. Estimated Wood Consumption in Zimbabwe 1978/79

Wood Category	*Source and Amount, 000's m³ u.b.* *Conif. Plant/s*	*Euc. & Wattle*	*Indig. W/Land*	*Total*		*Notes*
Sawlogs (veneers & sleepers incl.)	230(i)	13(i)	81(ii)	324	(i)	Mainly E. Dist. plantations
Poles, piling & posts	—	20	665(iii)	685	(ii)	Mainly State Forests & T.T.L.
Round mining timb.	—	12	31	43	(iii)	Per capita basis—T.T.L. 0,16 m³ u.b.
Pulpwood	63	29	—	92		
Other uses	1	26	-	27		
Sub. Total Indust. Wood	294	100	776	1 170		
Fuelwood						
Comm. sales	—	91(iv)	—	91	(iv)	Based on plantation returns
Comm. Farm. Sector (v)					(v)	C.S.O. returns
(a) Dom. Fuelwood	—	124	555	679(vi)	(vi)	Est. to be 70% of total of (v)
(b) Tobacco curing	—	54	238	292(vii)	(vii)	Est. to be 30% of total of (v)
Tribal Trust Lands	—	—	3 500(viii)	3 500	(viii)	per capita consumption of 0,85 m³ u.b.
Mining sector	—	—	131	131(ix)	(ix)	Per capita basis
Urban areas	—	—	281	281(x)	(x)	Per capita basis
Sub Total F/wood	—	289	4 705	4 974		
Grand totals	294	389	5 481	6 144		

Source: Banks. 1981.

Table 30a. Firewood Consumption Estimate Based on Forestry Commission Data (1979)

Sector	*Annual Fuelwood consumption* $m^3 \times 10$	*Estimated annual woodfuel consumption in Zimbabwe (million tonnes)*
Rural Areas	3,50	2,38
Commercial Farms	0,68	0,46
Mines	0,13	0,09
Urban Areas	4,59	3,12
Totals	4,59	3,12

Note: The specific gravity of local timber is assumed to be 680 kg/m^3

Source: Johnston. 1981.

Table 30b. Estimate of the Value of Woodfuel Consumed Annually

Location of Wood fuel	*Fuel used (under bark*	*Fuel used (million cords)* $m^3 \times 10^6$)	*Estimate of price per cord*	*Total value ($ million)* ($)
Rural areas	3,50	2,06	$4	8,24
Farms	0,68	0,40	6	2,40
Mines	0,13	0,08	7	0,56
Urban areas	0,28	0,17	16	2,72
			Total:	13,92

Note: 1 tonne of wood fuel = 1,471 m^3 of solid timber
= 0,866 cord of indigenous

1 cubic metre = 0,589 cord

Source: Johnston. 1981.

3.5 Fauna

3.5.1 Mammals [14]

Bigalke (1978), the most recent source on southern African mammals, considers that 407 species occur in southern Africa, in which he includes Zimbabwe (Table 31). Hanks (1974) shows 77 species (representative rather than exhaustive), while Collins (1965) states that 166 species are found in Zimbabwe (Table 32).

Some of the most distinctive mammals include the African elephant (Loxodonta africana), found mostly in lowveld areas (Fig. 16); the hippopotomus (Hippopotomus amphipius), found mostly in the major river valleys along the country's borders; the reintroduced white rhino (Ceratotherium simum); and the giraffe (Giraffa camelopardelis). The buffalo (Syncerus caffer), Burchell's zebra (Equus burchelli), and a number of antelope occur throughout as do two species of pig (Appendix V, Table 1 lists mammals occurring in Zimbabwe). Among the most distinctive large carnivores are the lion (Panthera leo), leopard (Panthera pardus), and cheetah (Acinonyx jubatus).

3.5.2 Avifauna [15]

Nearly the entire country of Zimbabwe falls within the broad classification of south central highlands in the context of ecological habitats for birds in southern Africa (Winterbottom 1978). Mackworth-Praed and Grant (1962) and Prozesky (1974) present detailed guides to the birds of southern Africa. Collins (1965) summarizes the avifauna of Zimbabwe only, and the following discussion is based on him.

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[14] Sources: Bigalke. 1978.
Collins. 1965.
Haltenorth and Diller. 1977.
Hanks. 1974.
Smithers. 1966.

[15] Sources: Collins. 1965
Mackworth-Praed and Grant. 1962.
Prozesky. 1974.
Winterbottom. 1978.

Table 31. Orders, Families and Approximate Numbers of Mammals--Africa and Southern Africa

	No. of species in	
	Africa	southern Africa
LIPOTYPHLA		
Potamogalidae (Otter Shrews)	3	1
Chrysochloridae (Golden Moles)	16	14
Erinaceidae (Hedgehogs)	6	1
Soricidae (Shrews)	56	215
MENOTYPHLA		
Macroscelididae (Elephant Shrews)	13	8
CHIROPTERA		
Pteropodidae (Fruit Bats)	26	17
Rhinopomatidae (Mouse-tailed Bats)	2	0
Emballonuridae (Sheath-tailed Bats)	7	4
Nycteridae (Slit-faced Bats)	11	7
Megadermatidae (Big-eared Bats)	2	1
Rhinolophidae (Horseshoe Bats)	17	10
Hipposideridae (Leaf-nosed Bats)	14	4
Vespertilionidae (Simple-nosed Bats)	64	34
Molossidae (Mastiff Bats)	31	16
PRIMATES		
Lorisidae (Pottos)	2	2
Galagidae (Galagos)	5	2
Cercopithecidae (Monkeys)	47	10
Pongidae (Apes)	3	2
PHOLIDOTA		
Manidae (Scaly Anteaters)	4	4
LAGOMORPHA		
Leporidae (Hares)	10	9
RODENTIA		
Sciuridae (Squirrels)	31	14
Anomaluridae (Scaly Tails)	7	2
Pedetidae (Springhare)	1	1
Muridae		
Murinae	79	40
Cricetidae	70	35
Dendromurinae	14	8
Otomyinae	12	10
Cricetinae	1	1
Gerbillinae	33	10
Lophiomyinae	1	0
Criceomyinae	5	4
Petromyscinae	3	2
Microtinae	1	0
Rhizomyidae (Bamboo Rats)	2	0
Muscardinidae (Dormice)	7	4
Dipodidae (Jerboas)	3	0
Hystricidae (Porcupines)	5	1
Thryonomyidae (Cane Rats)	2	2
Petromyidae (Dassie Rat)	1	1
Bathyergidae (Mole Rats)	13	10
Ctenodactylidae (Gundis)	5	0
Spalacidae (Blind Mole Rat)	1	0
CARNIVORA		
Canidae (Jackals, etc.)	11	5
Mustelidae (Weasels, etc.)	7	5
Viverridae (Genets, etc.)	37	22
Hyaenidae (Hyaenas)	3	2
Protelidae (Aardwolf)	1	1
Felidae (Cats)	10	7
TUBULIDENTATA		
Orycteropodidae (Aardvark)	1	1
PROBOSCIDEA		
Elephantidae (Elephant)	1	1
HYRACOIDEA		
Procaviidae (Dassies)	11	6
SIRENIA		
Trichechidae (Manatee)	1	1
Dugongidae (Dugong)	1	1
PERISSODACTYLA		
Equidae (Zebras)	5	3
Rhinocerotidae (Rhinos)	2	2
ARTIODACTYLA		
Suidae (Pigs)	3	2
Hippopotamidae (Hippos)	2	1
Tragulidae (Chevrotain)	1	1
Giraffidae (Giraffe and Okapi)	2	1
Bovidae (Antelopes)	78	39

Source: Bigalke. 1976.

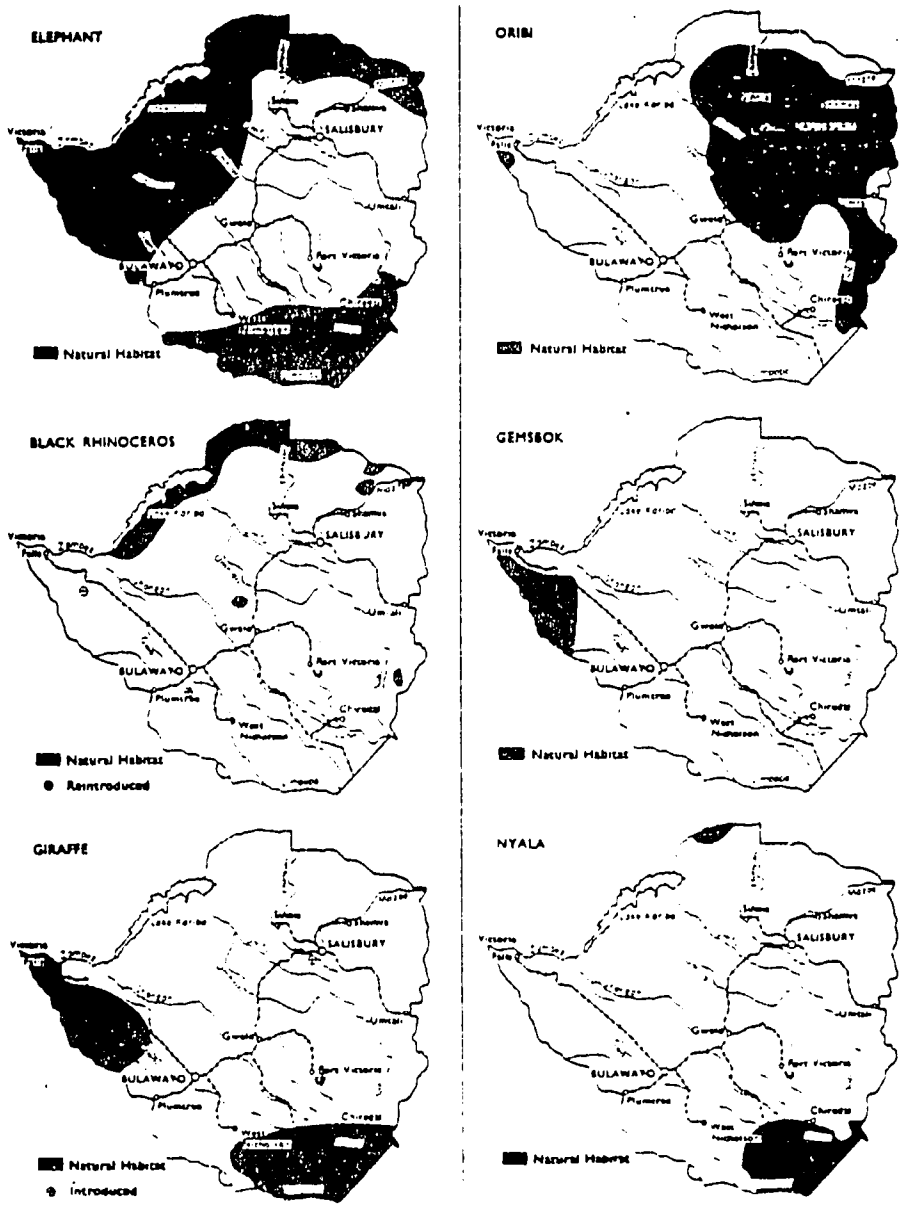
Table 32. Orders of Mammals in Zimbabwe

The 166 species of mammals known to occur in Rhodesia are divided among the various Orders as follows:–

Insectivora	17	including 4 Elephant Shrews and 2 Golden Moles
Chiroptera	43	from the tiny Banana Bat, *Pipistrellus nanus*, to the large Straw-coloured Fruit-Bat, *Eidolon helvum*
Primates	5	1 Baboon, 3 Monkeys, the Bushbaby, *Galago crassicaudatus*, and the Night Ape, *G. senegalensis*
Pholidota	1	The Pangolin, *Manis temminckii*
Carnivora	30	including the Lion, *Panthera leo*, Leopard, *P. pardus*, Cheetah, *Acinonyx jubatus*, 5 species of Mongoose, 2 Genets, 2 Jackals, 2 Hyaenas and the Wild Dog, *Lycaon pictus*
Tubulidentata	1	The Aardvark, *Orycteropus afer*
Proboscidea	1	The Elephant, *Loxodonta africana*
Hyracoidea	2	2 Dassies or Rock Rabbits
Perissodactyla	3	The Black Rhino, *Diceros bicornis*, the Square-lipped Rhino, and the Zebra.
Artiodactyla	27	This order includes 22 species of Antelope, 2 Pigs, the Hippopotamus, the Giraffe, and the Buffalo.
Lagomorpha	4	The Hares.
Rodentia	32	including the Porcupine, *Hystrix africaeaustralis*, 2 Mole Rats, 3 Squirrels, the Spring Hare, *Pedetes capensis*, the Cape Rat, *Thryonomys swinderianus*, and a range of 24 species of Rats and Mice.

Source: Collins. 1965.

Figure 16. Distribution of Selected Mammals



Source: Collins. 1965.

Of the 571 species known to occur in Zimbabwe, some 75 are found only during a restricted time of the year. Among these visiting species are the true migrants from breeding grounds in Europe, including the White Stork (Ciconia ciconia), Abdims's Stork (C. abdimii), the Greenshank (Tringa nebularia), and the European Swallow (Hirundo rustica). From Asia comes the Eastern Red-footed Falcon (Falco amurensis). The second class of visitors are intra-tropical migrants, which include the Jacobin Crested Cuckoo (Clamator jacobinus), the Didric Cuckoo (Chrysococcyx caprius), Klass' Cuckoo (C. klaas), the Harlequin Quail (Coturnix delegorguei), and many others which visit from other parts of Africa usually during the summer season. The Pitta (Pitta angolensis), occurs only on passage, not apparently remaining for any length of time in Zimbabwe.

The remaining species are resident in the country and represent 76 Families, including colorful birds such as the Coraciidae (Rollers); Meropidae (Bee-eaters); Psittacidae (Parrots and Lovebirds); Musophagidae (Louries); Nectarinidae (Sunbirds).

The Struthionidae are represented by one species, the Ostrich (Struthic camelus); the Pelecanidae, with two species; the Aegypidae with 5 species. The Sagittariidae, a family confined to Africa and represented by one species, the Secretary-bird (Sagittarius serpentarius), are distinguished by the plumes on the head which resemble old-fashioned quill pens.

Zimbabwe is rich in Eagles, Buzzards, Harriers and Hawks, whose family the Accipitridae includes 37 species from the largest Eagle, the Martial (Polemaetus bellicosus), the female with a wing span over seven feet to the Little Sparrow Hawk (Accipiter minullus), the smallest of the group. Worthy of note in this family is the Fish Eagle (Haliaetus vocifer), which can be heard wherever there are large stretches of water with fish. Closely allied to this family are the Falconidae, the Falcons and Kestrels which include the migrant Peregrine (Falco peregrinus), and its African equivalent the Lanner (Falco biarmicus). The rare Taita Falcon (Falco fascinucha) is known to nest in the gorges at the Victoria Falls.

The western areas of Zimbabwe are rich in game birds and in seasons of good rains waterfowl as well. Among the former the Helmeted Guineafowl

(Numida meleagris) and Swainson's Francolin (Francolinus swainson) are the commonest species, found particularly in areas of cultivated land with adjacent water. The Natal Francolin (F. natalensis) and the Crested Francolin (F. sephaena) are also common. The many dams, created to conserve water, and naturally occurring low lying areas filled by heavy rains are suitable habitat for a range of some 15 species of waterfowl, the commonest being the Red-billed Teal (Anas erythrorhyncha) and the Knob-billed Goose (Sarkidiornis melanotis). Rarely seen is the fast flying Garganey (A. querquedula), a palearctic migrant. The Dwarf Goose (Nettapus auritus) is found on more permanent waters with water lilies and other aquatic vegetation.

The family Columbidae are represented by 13 species, most of whic have a wide distribution, with the exception of such species as the Rick Pigeon (Columba guinea), which lives in hills with cliffs and is therefore restricted to the areas offering this type of habitat, or the Blue-spotted Wood Dove (Turtur tympanistra), which is confined to the Eastern Districts.

Whatever the type of country, there is a wide range of smaller species. Among these are some of the Sylviidae, a family with 40 species, and many of the Ploceidae with its 51 species. In the latter family, the Weavers, while easily distinguished in the colourful breeding dresses, revert to an indifferent, usually brownish plumage in the off season and may look very alike even under careful scrutiny.

The Family Turdidae (24 species) which includes the Thrushes, Robins, and allied groups, also includes Heuglin's Robin (Cossypha heuglini), common in gardens in towns where there is sufficient cover. Swynnerton's Robin (Pogonocichla swynnertoni) is narrowly confined in its distribution to the Eastern Districts where it lives in evergreen forest, while the Scrub Robin (Erythropygia leucophris) occurs througout, no less than four races being known from within Zimbabwe limits.

The Bucerotidae, or Hornbills, are represented by eight species and certain of the species are common and widespread.

3.5.3 Herpetofauna and Invertebrates

Poynton and Broadley (1978) discuss southern African herpetofauna in detail, without usually distinguishing Zimbabwe separately. Table 33 indicates the range of amphibians and reptiles which occur in southern Africa. Werger (1978) contains extensive discussion of the invertebrate fauna of the southern African region as a whole, although again, Zimbabwe is not usually distinguished separately.

3.5.4 Ichthyofauna and Fishing

Bomaker, Jackson, and Jubb (1978) discuss the fish fauna of southern Africa in detail, and have compiled a checklist of southern African river fishes (Appendix V, Table 2). Collins (1965) contains a brief discussion of specifically Zimbabwean fish, which follows here.

Zimbabwe contains components of two Ethiopian Sub-regions, the Zambeze sub-region, made up of the Zambezi River and its watershed; and the Australe sub-region, made up of the coastal rivers south of the Zambezi complex.

The fish fauna of the Zambeze sub-region is basically tropical with a tendency towards sub-tropical components. Many tropical families are absent and others such as Mormyrids, Characids, Citharinids, Bagrids, Schilbeids and Cyprinodontids have little diversification, whereas the Cyprinids and Cichlids show a relative increase in importance.

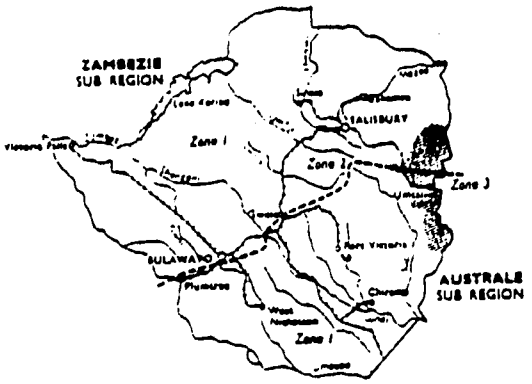
Within these two sub-regions there is an uneven distribution of species due to the wide range of physical conditions in the country and three separate ecological zones, common to both sub-regions, may be defined. These zones are shown in Figure 17, and Table 34 shows distribution of important species.

Zimbabwe does not contain any large lakes, and commercial fishing is not important on a national scale. However, the economic potential of the genus Tilapia and other species is being used by a local industry based on Lake Kariba and some of the larger dams such as Lake McIlwaine. An estimated total catch of 40,000 tons annually was possible in 1965. In addition, the smaller rivers and streams are fished by rural Africans and provide a valuable source of protein.

Table 33. Composition of the Southern African Herpetofauna

Order or Family		Tropical		Transitional		Cape		Introduced, Littoral or Marine	
	Total	No. of Forms	% of Total	No. of Forms	% of Total	No. of Forms	% of Total	No. of Forms	% of Total
Order Apoda	1	0	—	1	100	0	—	—	—
Pipidae	5	1	20.0	2	40.0	2	40.0	—	—
Leptodactylidae	6	0	—	1	17.0	5	83.0	—	—
Bufonidae	25	6	24.0	16	64.0	3	12.0	—	—
Microhylidae	20	3	15.0	11	55.0	6	30.0	—	—
Ranidae (s.l.)	131	36	27.5	85	65.0	10	7.5	—	—
Total Anura	187	46	24.5	115	61.5	26	14.0	—	—
Total Amphibia	188	46	24.5	116	61.5	26	14.0	—	—
Order Testudinata	27	8	29.5	10	37.0	4	15.0	5	18.5
Order Crocodylia	2	2	100.0	0	—	0	—	—	—
Gekkonidae	116	11	9.5	101	87.0	3	2.5	1	1.0
Agamidae	9	4	44.5	4	44.5	1	11.0	—	—
Chamaeleonidae	22	1	4.5	20	91.0	1	4.5	—	—
Scincidae	96	19	20.0	70	73.0	5	5.0	2	2.0
Cordylidae	81	5	6.0	69	85.0	7	8.5	—	—
Lacertidae	43	8	18.5	31	72.0	4	9.5	—	—
Varanidae	2	2	100.0	0	—	0	—	—	—
Total Sauria	369	50	13.5	295	80.0	21	5.5	3	1.0
Amphisbaenia	18	1	5.5	17	94.5	0	—	—	—
Typhlopidae	11	2	18.0	7	63.5	1	9.0	1	9.0
Leptotyphlopidae	11	4	36.5	5	45.5	2	18.0	—	—
Boidae	2	1	50.0	1	50.0	0	—	—	—
Colubridae	120	53	44.0	54	45.0	13	11.0	—	—
Elapidae	30	12	40.0	13	43.5	4	13.5	1	3.0
Viperidae	17	8	47.0	7	41.0	2	12.0	—	—
Total Serpentes	191	80	42.0	87	45.5	22	11.5	2	1.0
Total Reptilia	607	141	23.0	410	67.5	47	7.5	10	1.5

Source: Poynton and Broadley, 1978.



Zone 1. The Low Altitude Ecological Zone
Confined to areas with a minimum of 70°F mean annual temperature

Zone 2. The High Altitude Ecological Zone
Confined to areas with a range of mean annual temperature between 65°F and 70°F

Zone 3. The East Mountain Ecological Zone

Figure 17. Ecological Subregions and Zones

Source: Collins. 1965.

Table 34. Distribution of More Important Fish Species

Sub-region	Zone 1		Zone 2		Zone 3	
	Zambeze	Australe	Zambeze	Australe	Zambeze	Australe
Lung fish *Protoperus annectens*	X	X				
Cornish Jack *Mormyrops deliciosus*	X					
Gnathopemus macrolepidotus	X	X	X	X		
Mormyrus lacerda	X					
Bottle nose *Mormyrus longirostris*	X	X				
Tiger fish *Hydracinus vittatus*	X	X				
Kafue Pike *Hepsetus odoe*	X					
Chessa *Distichodus* spp.	X	X				
Yellow fish *Barbus marequensis*	X	X	X	X		
Barbus codringtoni	X					
Mudsucker *Labeo forskalii*	X					
Mudsucker *Labeo altivelis*	X	X				
Purple mudsucker *Labeo congoro*	X	X				
Vundu *Heterobranchus logifilis*	X					
Barbel *Clarias ngamensis*	X					
Barbel *Clarias mossmabicus*	X	X	X	X		
Silver barbel *Schibe mystus*	X					
Amphilus platchir					X	X
Electric cat fish *Malapterurus electricus*	X					
Eels *Anguila* spp.	X	X	X	X	X	X
Bream *Tilapia mossambica*	X		X	X		
Bream *Tilapia andersonii*	X					
Bream *Tilapia macrocnir*	X					
Red breasted bream *Tilapia melanopleura*	X	X	X	X	X	X
Large mouth bream *Serranochromis* spp.	X					
Climbing perch *Crenopoma multispinis*						
Spiny eel *Mastacembelus mellandii*	X					

Source: Collins. 1965.

3.5.5 Endangered Species

The IUCN lists seven endangered mammals (IUCN 1978) and one endangered crocodile (IUCN 1975) in Zimbabwe (Table 35a). Summaries of the status and distribution of these eight endangered animals are presented in Appendix V, Table 3. Mammals occuring in Zimbabwe and listed by the Federal Register (USFWS 1981) in addition to those in the IUCN list are also noted in Table 35b. Bothma (1975) additionally identifies five mammals as rare which do not appear in either IUCN or the Federal Register (Table 35c).

Table 35. Endangered Species

a. IUCN List

Mammals

Crocidura maquassiensis	Maquassi musk-shrew
Lycaon pictus	African wild dog
Hyaena brunnea	Brown hyaene
Panthera pardus	Leopard
Acinonyx jubatus	Cheetah
Loxodonta africana	African elephant
Diceros bicornis	Black rhinoceros

Reptiles

Crocodylus niloticus	Nile crocodile

b. Mammals in Federal Register but not IUCN

Hippopotamus amphibius	Hippopotamus
Tragelaphus spekei	Sititunga
Hippotragus equinus	Roan Antelope
H. niger variana	Sable Antelope
Damaliscus lunatus	Tsessebe
RHINOCEROTIDAE (all species)	
(Cerathotherium simum)	(White Rhino)
Orycteropus ater	Aardvark
Mellivora capensis	Honey Badger
Viverra civetta	African Civit
Proteles Cristatus	Aardwolf
Erinacens frontalis	African Hedgehog

c. Listed by Bothma only

Ourebia ourebi	Oribi
Alcelaphus lichtensteini	
A. buselaphus	Red hartebeest
Neotragus moschatus	Suni
Aryx gazella	Gemsbok

3.5.6 Protected Areas [16]

According to Tomlinson (1980), the British administration in Zimbabwe first began to implement conservation measures at the end of the nineteenth century. Initial efforts were aimed entirely at large mammal species, but eventually other species of mammals, reptiles and amphibians, and a number of plants received protected status. However, some mammals were regarded as "vermin" and were persecuted with the administration's backing. The wild dog (Lycaon pictus), for example, has nearly been eliminated from the country. Table 36 summarizes major conservation legislation. Tsetse control programs also worked counter to conservation efforts, and between 1930 and the early 1950s over half a million game animals were killed. The program was discontinued because of public outcry against killing so much wildlife, and because selective hunting, fenced areas, and spraying eventually proved at least as effective.

By the late 1970s, a total area of 4,649,696 ha (11.8% of Zimbabwe's surface area) had been set aside for conservation purposes. There are nine National Parks and two Special National Parks covering an area of 2,687,395 ha (58% of all conservation areas), nine Recreational Parks covering 39,928 ha (0.86%), four Animal Sanctuaries covering 14,440 ha (0.31%), 15 Safari Areas covering 1,896,397 ha (40.82%) and 28 Botanical Reserves and Gardens covering 7,536 ha (0.16%). Figure 18 depicts these areas with the exception of Botanical Reserves. Tables 37-40 list these areas, while Appendix V, Table 4 presents details on a number of Zimbabwe's protected areas.

The purposes of the various categories may be defined as follows.

National Parks. Areas comprising large expanses of land, relatively untouched by man's influence, and comprising diverse plant and animal communities. The main objective in these areas is to preserve and protect representative examples of all the major indigenous biotic communities which occur throughout the country.

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[16] Sources: IUCN. 1971.
IUCN. 1977.
IUCN. 1980.
Tomlinson. 1980.

Table 36. History of Conservation Legislation

Year	*Act*	*Major features*
1891	Game Law Amendment Act	Certain mammal species listed for protection.
1899	Game Preservation Ordinance Act	26 administrative districts, each listing (a) which mammals are protected; (b) which mammals could be hunted.
1906	Game Preservation Ordinance Amendment Act	Royal game status conferred on certain species.
1913	Herbage Preservation Ordinance	Prevention of destruction to vegetation by fire; removal of trees at discretion of owner.
1927	Water Act	Prohibition of tree felling less than 100 m from water's edge.
1929	Game & Fish Preservation Act	Designation of land for preservation of natural communities; lawful hunting methods prescribed; certain species declared vermin with rewards offered for their destruction; controls on fish exploitation.
1929	Nature Reserves Forest Produce Act	Controls on exploitation of indigenous and plantation timber.
1930	Tsetse Fly Act	Designation of hunting areas for complete elimination of game animals (tsetse fly hosts); cancellation of former restricted hunting areas.
1931–1935	Game & Fish Preservation Act Amendments	Proclamation of 9 game reserves; increased powers of law enforcement; introduction of prescribed management practices such as veld burning and vermin control.
1935–1940	Game & Fish Preservation Act Amendments	Protection of certain amphibians and reptiles.
1941	Natural Resources Act	Protection of landscapes and scenery for their aesthetic appeal and scenic value; emphasis on protection of trees, grasses and soils; conservation education.
1947–1949	Game & Fish Preservation Act Amendments	Game wardens appointed for law enforcement; first controls on utilisation of certain areas by tourists; veld management regulations.
1949–1953	National Parks Act	Establishment of Government Department of National Parks; two types of nature reserve: (a) *National Parks*—mainly for outdoor recreation and protection of spectacular landscapes; (b) *Game Reserves*—specifically provided for the protection and viewing of wild animal life.
1954	Federal National Parks Act	Administration of all national parks in Rhodesia, Northern Rhodesia (Zambia) and Nyasaland (Malawi); 14 national parks in Rhodesia covering ca 2 million ha of land.
1960	Wild Life Conservation Act	Establishment of government department designated as 'Game Department' personnel responsible for control of 'Big Game' species in farming areas and tsetse fly zones.
1961	Fish Conservation Act	Further controls on fish exploitation
1963	Parks & Wild Life Act	Amalgamation of National Parks and Game Departments; combined jurisdiction over 13 national parks, 8 game reserves and 5 controlled hunting areas.
1973	Trapping of Animals Act	Improved controls on trapping methods.
1974	Bees Act	Controls on the exploitation of bees.
1975	Parks & Wild Life Act	Decentralisation of authority to intensive conservation areas where the utilisation of wild life is under the control of land owners; certain plant species given equivalent status to that of royal game; redesignation of certain conservation areas for specific types of tourist utilisation; jurisdiction over 67 conservation areas covering 11·8 % of the total land area of Rhodesia (see Appendices 1–5).

Source: Tomlinson. 1980.

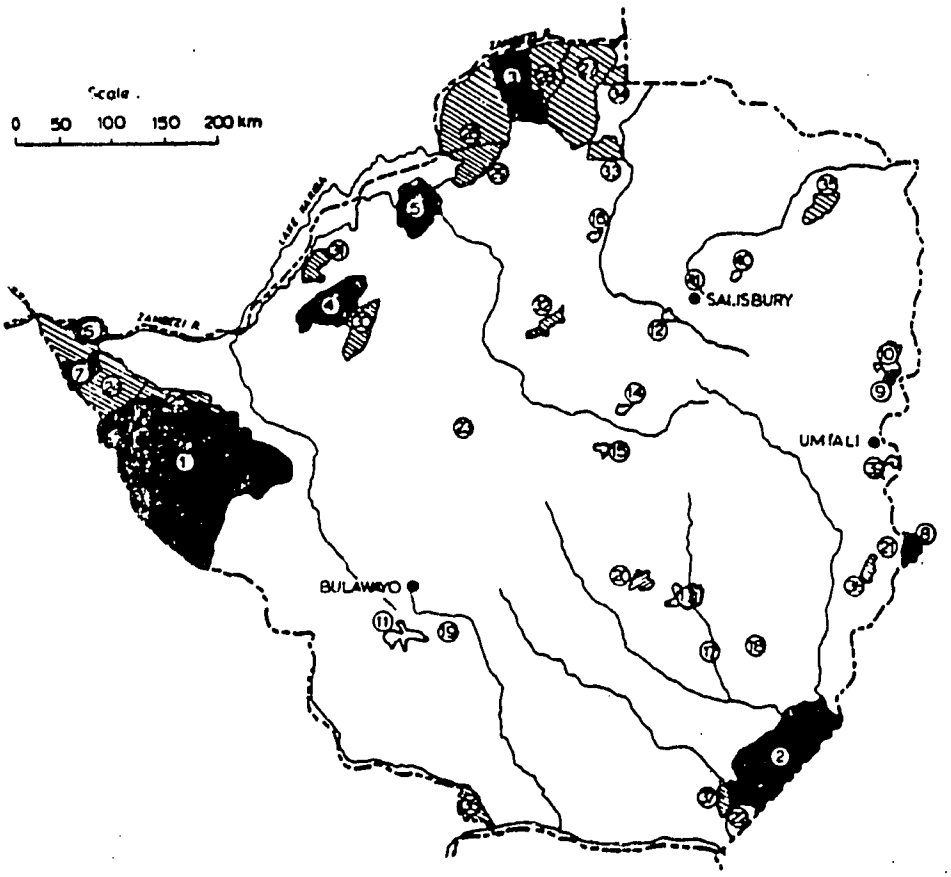

Figure 18. Location Map for Tables 37 - 40

Source: Tomlinson. 1980.

Table 37. National Parks

No. (See Fig. 1)	Conservation area	Size (ha)	Major features	Major plant communities	Notable vertebrate populations	Planning status				Conservation management issues
						SCA	WsA	WA	DA	
1	Wankie National Park	1465108	Large concentrations of big game species	*Baikiaea-Combretum Terminalia Burkea Colophospermum* Woodlands & scrub savanna	Elephant, buffalo, giraffe, eland, large predators. Black & white rhino (re-introduced). Diverse species representation.	—	✓	✓	✓	History of timber logging. Animal reduction, erosion control, pumped water, fire control
2	Gonarezhou National Park	496400	Large concentrations of big game. Scenic riverine landscape.	*Colophospermum*-savanna and scrub. *Androstachys* woodlands. Riverine woodlands.	Black rhino (reintroduced) Elephant—large tuskers. Nyala, zebra, hippo, bartebeest. Diverse species representation.	—	✓	✓	✓	Riverine vegetation damage by elephant. Animal reduction Limited pumped water supplies.
3	Mana Pools National Park	219600	Large concentrations of big game. Scenic flood plain vegetation communities.	*Commiphora-Combretum* thickets. *Colophospermum Acacia* woodlands. Riverine woodlands	Diverse species representation. Hippo, buffalo, black rhino, eland, impala. Large predators, crocodiles. Significant avifauna.		Not planned			Excessive utilization of flood plain by herbivores. Animal reduction
4	Chizarira National Park	191000	Large variety of big game. Scenic escarpment. Perennial streams.	*Brachystegia-Colophospermum* woodland and scrub savanna. *Hyparrhenia* grasslands	Diverse species representation. Tsessebe, black rhino, waterbuck, roan.		Not planned			Severe elephant and fire damage to woody species. Animal reduction.
5	Matusadona National Park	137000	Big game, scenic lakeshore Diverse fish populations. Zambezi escarpment	*Commiphora-Combretum* thickets. *Brachystegia* woodland on escarpment.	Black rhino, buffalo, elephant, hippo, impala, crocodile. Tigerfish. *Tilapia spp.* Aquatic avifauna (fish eagle).	—	✓	✓	✓	Thicket damage Animal reduction
6	Victoria Falls National Park	57300	Spectacular falls. Rain forest. Zambezi river frontage with big game	Rain Forest-*Colophospermum*, *Brachystegia* and *Baikiaea* woodlands.	Diverse species representation. Sable, Choke ostrich, waterbuck.		Not planned			Logging history Animal reduction Pumped water erosion control, fire control Development of permanent footpaths at Falls
7	Kazuma Pan National Park	31290	Open grassland savanna with large pan. Rare ungulate species with seasonal avifauna.	*Acacia* savanna grassland.	Rare ungulates well-represented. Gemsbok, tsessebe, oryx, roan, water fowl		Not planned			Secure, undertimed, fire control. No resident staff—managed as part of Matetsi Wildlife Area.
8	Chimanimani National Park	17110	Unspoiled scenery. Montane wilderness, perennial streams.	Dry mitmontane forest and grasslands. Broad species diversity. Endemics (*Podocarpus*).	Eland, endemic amphibians and reptiles.		Not planned			Fire damage. Largely wilderness
9	Mtarazi Falls National Park	2495	Montane landscapes. Spectacular falls, scenic.	Moist and dry sub-montane forests, grasslands and heathlike sub-montane scrub, endemics.	Samango monkey, blue duiker crowned eagle	—	✓	✓	✓	Fire damage. Burning management
10	Inyanga Special National Park	28900	Montane landscapes (modified) Trout fishing. High intensity recreation.	Moist and dry sub-montane forests, grasslands and heathlike scrub	Samango monkey, blue duiker endemic reptiles and amphibians. Crowned eagle.	✓	✓	✓	✓	History of extensive cultivation. Fire damage. Burning management. Exotic afforestation.
11	Matopos Special National Park	44200	Huge granite outcrops. Scenic cave-bushmen paintings. Historical. High intensity recreation. Fenced game enclosure.	Variable woodland associated with boulder strewn granite hills and valley grassland (*Aloe* spp.).	Introduced ungulates including white rhino. Naturally occurring klipspringer, leopard. Black eagle and hyraxes.	✓	✓	✓	✓	Recovering from primitive cultivation Fire management

Note: SCA = Special Conservation Area.
WsA = Wilderness Area.
WA = Wild Area.
DA = Development Area.
Koppie = Granite Inselberg.

Source: Tomlinson. 1980.

Table 38. Recreational Parks and Sanctuaries

No (See Fig 1)	Conservation area	Size (ha)	Major features	Major plant communities	Notable vertebrate populations	Planning status				Conservation management aims
						SCA	WIA	WA	DA	
12	Mellowane Recreational Park	6108	Municipal impoundment. High intensity recreation. Game enclosure, fishing and water sports.	*Brachystegia* woodlands. *Hyperrhenia* grasslands.	Introduced antelope and white rhino. Diverse waterfowl populations. *Tilapia mariae*	–	–	✓	✓	Controlled burning. Animal reduction. Commercial and sport fisheries, recreational leases etc.
13	Kyle Recreational Park	16900	Irrigation impoundment. Game enclosure. Water sports, fishing. High intensity recreation	*Brachystegia* woodlands. Kopje vegetation *Hyperrhenia* grasslands.	Introduced antelope and white rhino. Kudu and reedbuck naturally occurring. Introduced black bass.	✓	–	✓	✓	Controlled burning. Animal reduction Sport fishing, recreational leases etc.
14	Ngezi Recreational Park	5800	Impoundment fishing, resident game populations. Great Dyke	*Brachystegia* woodlands. *Hyperrhenia* and Serpentine grasslands.	Naturally occurring populations of reedbuck, sable, crocodile.	–	–	✓	✓	Old mine workings, logging. Controlled burning. Sport fishing.
15	Sebakwe Recreational Park	2700	Impoundment, Botanical Reserves, endemic plants. Water sports Great Dyke.	*Brachystegia-Acacia* woodlands. Serpentine grasslands-endemics.	Reedbuck		Not planned			Old mine workings. Fire management
16	Sinoia Caves Recreational Park	148	Deep, flooded calcite caves.	*Brachystegia* woodlands.	Bats		Not planned			Garden development. Structural protection of caves
17	Bangala Recreational Park	2800	Irrigation impoundment recreational park.	*Brachystegia* woodlands. Kopje vegetation	–		Not planned			Surrounded by rapidly expanding human population. No resident staff
18	Manjeremje Recreational Park	3501	Irrigation impoundment Proposed recreational park.	*Brachystegia* woodlands Kopje vegetation	–		Not planned			Surrounded by rapidly expanding human population. No resident staff
19	Umzingwane Recreational Park	1235	Municipal impoundment Proposed recreational park.	*Acacia*, *Colophospermum*, *Terminalia* woodlands.	–		Not planned			Expanding tourist utilization. Sport fishing.
20	Muskwadike Sanctuary	12900	Irrigation impoundment, Ecological Training Centre-Schools. Wild herbivore domestication project.	*Brachystegia* woodlands. Kopje vegetation, *Hyperrhenia* grasslands	Limited natural ungulate populations. Domesticated eland herd and other species. Introduced black bass.		Not planned			Controlled burning. Old mine workings. Paddocking for domestication project
21	Melsetter Eland Sanctuary	1200	Entirely fenced	Sub-montane grassland Patches of forest and heath-like scrub	Naturally occurring but confined eland herd		Not planned			Fire management.
22	Manjenje Pan Sanctuary	300	Oxbow pan in alluvial woodland. Pumped water supply. Fenced.	Alluvial riverine woodlands. Diverse reeded community.	Diverse waterfowl populations.		Not planned			Surrounded by rapidly expanding human population. No resident staff
23	Mbeze Pan Sanctuary	40	Oxbow pan in alluvial woodland.	Combretum woodlands *Colophospermum* woodlands. Diverse reeded community.	Diverse waterfowl populations.		Not planned			Surrounded by rapidly expanding human population. No resident staff

Source: Tomlinson, 1980.

Table 39. Safari Areas and Botanical Gardens

No. (See Fig. 1)	Conservation area	Size (ha)	Major features	Major plant communities	Notable vertebrate populations	Planning status				Conservation [illegible]
						SCA	WLA	WA	DA	
24	Mosetse Safari Area	292000	Huntable populations of wide variety of species in the country (20 major spp.).	*Colophospermum* savanna woodlands. *Baikiaea* woodlands	Particularly diverse species representation. Many rare species well represented.		Not planned			History of unsuccessful cattle ranching and some intensive management for hunting, pumped water and fire control.
25	Deka Safari Area	31000	Limited species of large game.	*Baikiaea*, *Acacia*, *Colophospermum* woodlands, dry deciduous thickets.	Limited species: elephant, buffalo. Translocated black rhino from Wankie National Park		Not planned			Limited hardwood extraction.
26	Urungwe Safari Area	288000	Huntable populations of large game. Adjoins Zambezi River and Lake Kariba.	*Colophospermum* woodlands *Commiphora-Combretum* thickets.	Diverse species representation, black rhino.		Not planned			Some mining—long hunting history
27	Chewore Safari Area	339000	Huntable populations of large game, adjoins Zambezi River	*Brachystegia-Colophospermum* woodlands	Diverse species representation, black rhino		Not planned			Untouched—secure.
28	Sapi Safari Area	118000	Huntable populations of large game. Adjoins Zambezi River	*Colophospermum* woodlands *Commiphora-Combretum* thickets.	Diverse species representation, black rhino, nyala		Not planned			Long hunting history
29	Charara Safari Area	170000	Huntable populations of large game, adjoins Lake Kariba	*Brachystegia*, *Colophospermum* woodlands.	Diverse species representation, black rhino		Not planned			Untouched—some mining.
30	Chirisa Safari Area	171300	Huntable populations of large game. International Wild Life Research Centre	*Brachystegia*, *Acacia*, *Colophospermum* woodlands.	Diverse species representation, black rhino		Not planned			Untouched. Adjacent to expanding human populations.
31	Chete Safari Area	108108	Huntable populations of large game, adjoins Lake Kariba, rugged terrain	*Colophospermum* woodlands *Commiphora* thickets	Diverse species representation, black rhino.		Not planned			Untouched.
32	Hartley Safari Area	71997	Limited game species.	*Brachystegia* woodlands	Limited species representation		Not planned			Some poaching. No resident staff.
33	Doma Safari Area	76000	Limited big game species.	*Brachystegia* woodlands	Limited species representation		Not planned			Adjacent to rapidly expanding human populations. No resident staff
34	Dande Safari Area	52300	Limited big game species	*Colophospermum* woodlands.	Limited species representation		Not planned			Some poaching. No resident staff
35	Umfurudzi Safari Area	76000	Limited big game species.	*Brachystegia*, *Pterocarpus*, *Termnalia* woodlands	Limited species representation		Not planned			Some poaching. No resident staff.
36	Tuli Safari Area	40400	Big game species. Historical and botanical reserves.	*Colophospermum*, *Acacia*, *Combretum* scrub-woodland	Diverse species representation, wildebeest.	✓	—	✓	—	History of human occupation with cattle, pumped water, animal reductions.
37	Malapati Safari Area	16300	Limited big game species	Riverine woodlands and [illegible] thickets	Diverse species representation, nyala		Not planned			Adjacent to rapidly expanding human populations. Managed as part of Gwaai-Shoko National Park.
38	Chipanga Safari Area	26160	Game species	*Colophospermum* woodlands *Commiphora-Combretum*	Limited species representation		Not planned			Some poaching. Staffed part-time by [illegible]
39	Vumba Botanical Garden	42	Developed gardens	Natural mixed montane forest with developed area for exotics	Sunbirds, monkey, blue duiker		Not planned			Intensive garden development.
40	Ewanrigg Botanical Garden	286	Developed gardens	Transplanted alien, cycads, exotics	—		Not planned			Intensive garden development.
41	National Botanical Garden	66.5	Developed gardens	[illegible] gardens of representative indigenous and exotic communities.	—	Planned in detail by staff of National Herbarium				Intensive garden development

Source: Tomlinson. 1980.

Table 40. Botanical Reserves (Not Depicted on Map)[a].

Botanical reserve	*Size (ha)*	*Plant community*	*Conservation and management status*
Pioneer	38	*Schotia brachypetala*	Secure within Tuli Safari Area.
Tolo	44	*Acacia galpinii*	Secure within Tuli Safari Area.
South Camp	26	*Xanthocercis zambesiaca*	Secure within Tuli Safari Area.
Chirinda Forest	949	Montane forest. Diverse species.	Secure—unique evergreen forest with tropical affinities.
Banti Yellow-wood[a]	175	*Podocarpus milanjianus*	Secure. Management plans to be formulated.
Stapleford Cycad[a]	212	*Encephalartos manikensis*	Secure. Management plans to be formulated.
Sebakwe Acacia[b]	60	*Acacia karoo*	Secure within Sebakwe Recreational Park.
Sebakwe Great Dyke	165	Serpentine Grassland	Secure within Sebakwe Recreational Park.
Sebakwe Mountain Acacia[b]	53	*Brachystegia glaucescens*	Secure within Sebakwe Recreational Park.
Chisekera Hot Springs[a]	94	*Acrostichum aureum*	Secure. Management plans to be formulated.
Miware Raphia Palm[a]	34	*Raphia farinifera*	Secure. Management plans to be formulated.
Tingwa Raphia Palm[a]	290	*Raphia farinifera*	Secure. Management plans to be formulated.
Mazoe[a]	8	*Brachystegia glaucescens*	Secure. Management plans to be formulated.
Bunga Forest	39	Montane forest. Diverse species.	Secure. Adjacent to Vumba Botanical Garden.
Shashi Mulala Palm[a]	300	*Hypaene benguellensis*	Surrounded by rapidly expanding human populations.
Chingwarara Cycad[a]	256	*Encephalartos concinnus*	Surrounded by rapidly expanding human populations.
Kubarakwawena[a]	2	*Oxytenanthera abyssinica*	Surrounded by rapidly expanding human populations.
Marishira[a]	2	*Oxytenanthera abyssinica*	Surrounded by rapidly expanding human populations.
Nyangwe[a]	8	Low altitude evergreen forest	Surrounded by rapidly expanding human populations.
Pungwe Bridge Forest[a]	14	Low altitude evergreen forest	Surrounded by rapidly expanding human populations.
Rumise[a]	39	Low altitude evergreen forest	Surrounded by rapidly expanding human populations.
Togwe[a]	4	*Oxytenanthera abyssinica*	Surrounded by rapidly expanding human populations.
Haroni Forest[a]	20	Low altitude closed forest	Surrounded by rapidly expanding human populations.
Rusitu Forest[a]	150	Low altitude closed forest	Surrounded by rapidly expanding human populations.

[a] Where Botanical reserves occur outside of other conserved categories of land, protection is nominal and usually not supported by presence of staff or even fencing.
[b] Not worthy of this status and will in due course be deproclaimed.

Source: Tomlinson. 1980.

Recreational Parks. Areas which are normally situated in close proximity to urban centers and include features (such as dams) which have the potential for a wide range of outdoor recreational activities.

Animal Sanctuaries. Areas which contain unusually diverse, abundant or rare animal species.

Botanical Gardens. Areas set aside for the purpose of propagating both indigenous and exotic plant species for the enjoyment of the public.

Safari Areas. Large areas provided specifically for outdoor recreational pursuits such as camping, sport hunting, fishing, photography, game viewing and bird watching.

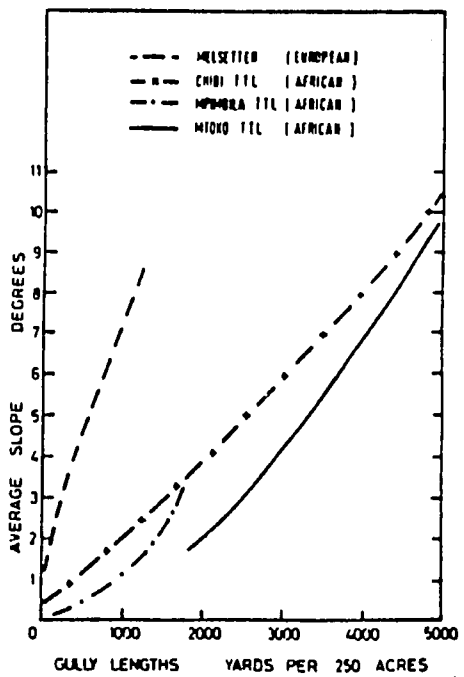

Figure 21. Variation of Rill and Gully Erosion to Average Slope by Land Tenure

Source: Whitlow. 1980.

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4.0 Major Environmental Problems

4.1 Soil Erosion [17]

Zimbabwe began to implement soil conservation programs over four decades ago, particularly stressing the use of contour ridges. Nevertheless, soil erosion remains one of the country's most critical problems. By 1974 an estimated 12 percent of Zimbabwe's cultivable land in the commercial agricultural sector had suffered moderate to serious damage, and crop yields had fallen significantly. Precise data was not available for subsistance farming lands in African areas, but it was thought that up to one half of the land had suffered irreversible damage. The rate of soil loss from poor-yielding maize cropped land was calculated in 1979 at approximately 50 tons per hectare annually.

Erosion hazards depend upon five main factors: Rainfall erosivity is a measure of kinetic energy available in raindrops which strike the soil surface. Temporal distribution and intensity of rains, as well as total quantity of rain, is important in determining erosivity. Most erosive rain occurs during the rainy season (September through April), but is unevenly distributed over the country (Fig. 19). Figure 20 shows mean annual erosivity, indicating that if only the impact of raindrops is considered, the eastern highlands and two areas near Salisbury and Fort Victoria have the most potential for soil erosion. Erodibility of the soil is a measure of the soil's resistance to raindrop impact.

Slope affects erosion potential also; in general, erosion increases with the greater degree of sloping. Figure 21 shows variations in gully erosion with slope for four test areas of Zimbabwe. Vegetative cover provides protection from the impact of raindrops and helps bind the soil. Loss of vegetative cover makes soil much more prone to erosion (cf. Section 4.2 for more extensive discussion of devegetation).

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[17] Sources: Elwell. 1979.
Elwell. 1980.
Elwell and Stocking. 1973.
Elwell and Stocking. 1976.
Owens and Watson. 1979.
Stocking. 1971.
Stocking and Elwell. 1976.
Whitlow. 1980.

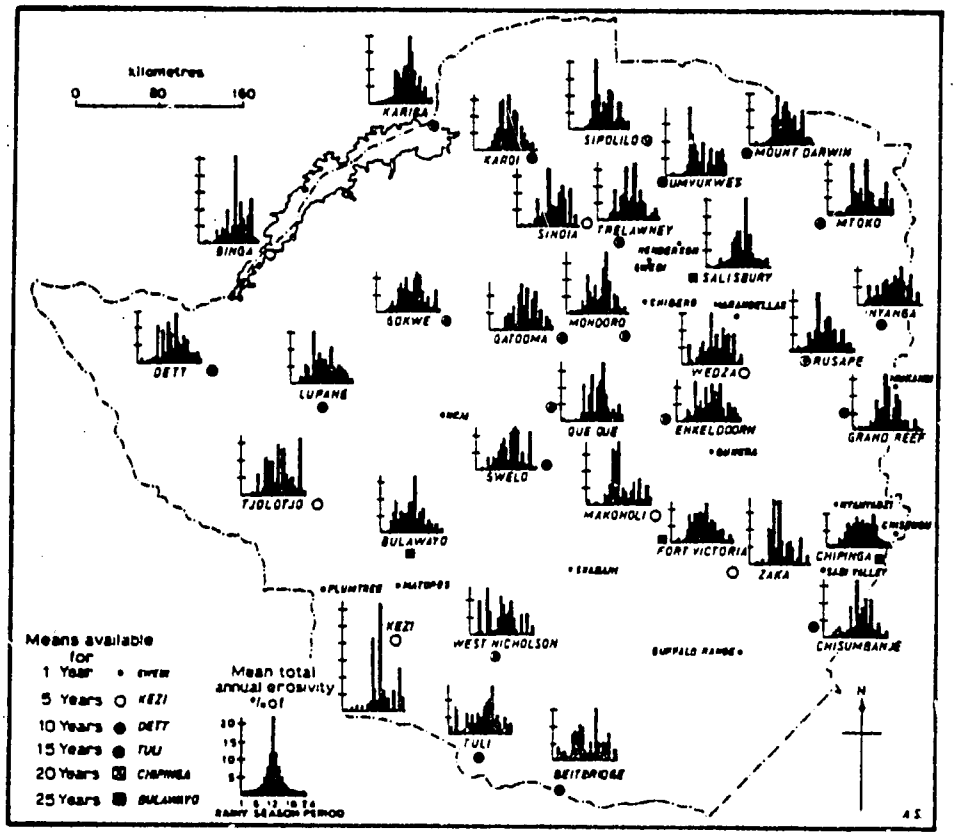

Figure 19. Mean Percentages of Erosive Rain Falling in Ten-Day Periods Throughout the Rainy Season

Source: Stocking and Elwell. 1976.

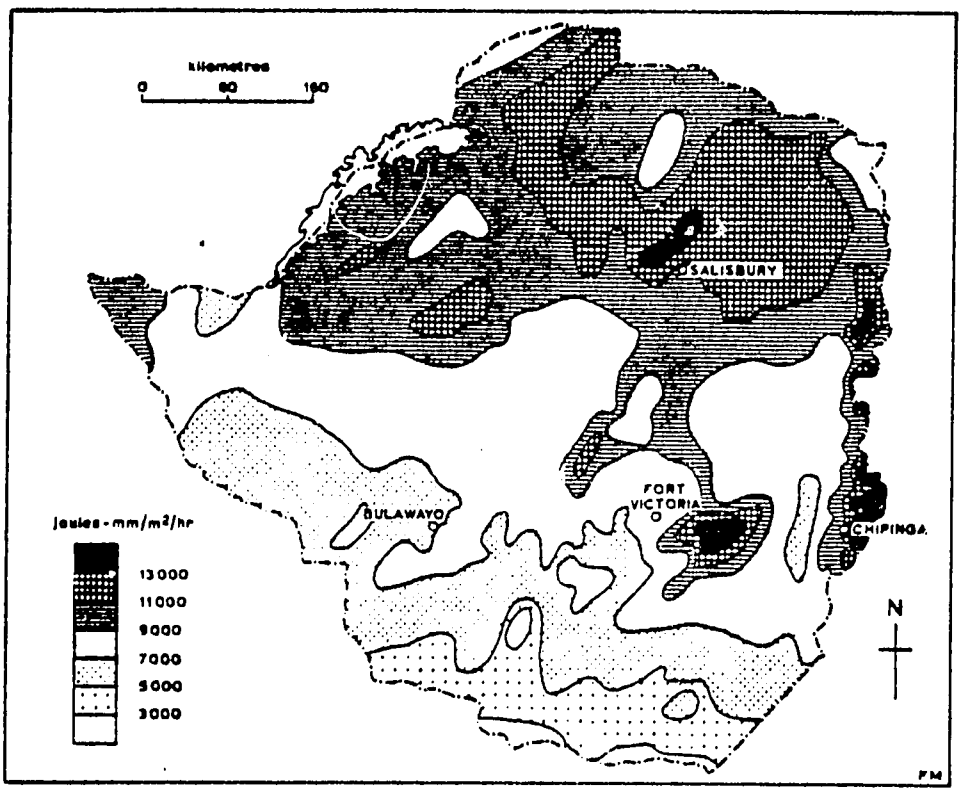

Figure 20. Mean Annual Erosivity over Zimbabwe

Source: Stocking and Elwell. 1976.

Land use and management is the fifth major factor in soil erosion, and it affects vegetative cover as well in many cases. Vegetation must be cleared from areas which are to be cultivated, leaving the soil bare and susceptible to erosion until crop cover is established. Many observers have singled out the African Tribal Trust Lands for poor agricultural management and high erosion rates, blaming the situation on "primative" agricultural practices. However, it should be noted that before majority rule in 1980, Africans generally were restricted to only about half of the cultivable land in Zimbabwe, despite the fact that they constituted over 95 percent of the population. Furthermore, the African lands were inevitably the marginal lands which were not well suited to intensive use.

It is not surprising that, under these conditions, the carrying capacity of the land in the Tribal Trust Areas was exceeded, and erosion has become serious. Figures 22-24 help indicate the magnitude of the problem.

One result of Zimbabwe's severe erosion problems is that the rivers carry heavy sediment loads. Little data is available on the magnitude of silt load, although one measurement in 1974 gave 10,000 tons per day carried by the Mazoe River (northeast of Salisbury). The season of the measurement was not stated, although it was undoubtedly during the rainy season. The total soil carried away by the river during the 1973/74 season was approximately one million tons. Water management plans have been disrupted because many small dams and weirs have filled with silt.

4.2 Deforestation and Rangeland Degradation [18]

The major factors behind deforestation are the clearing of new agricultural land and the use of wood for fuel. According to estimates, between 75,000 ha to 100,000 ha of wooded area is cleared annually for fuelwood needs

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[18] Sources: Banks 1981.
Chavunduka. 1981.
Fuller. 1980.
Fuller. 1981.
Gammon and Roberts. 1978.
Hayward. 1971?
Rea. 1981.
Taylor and Walker. 1978.
Ward and Cleghorn. 1970.

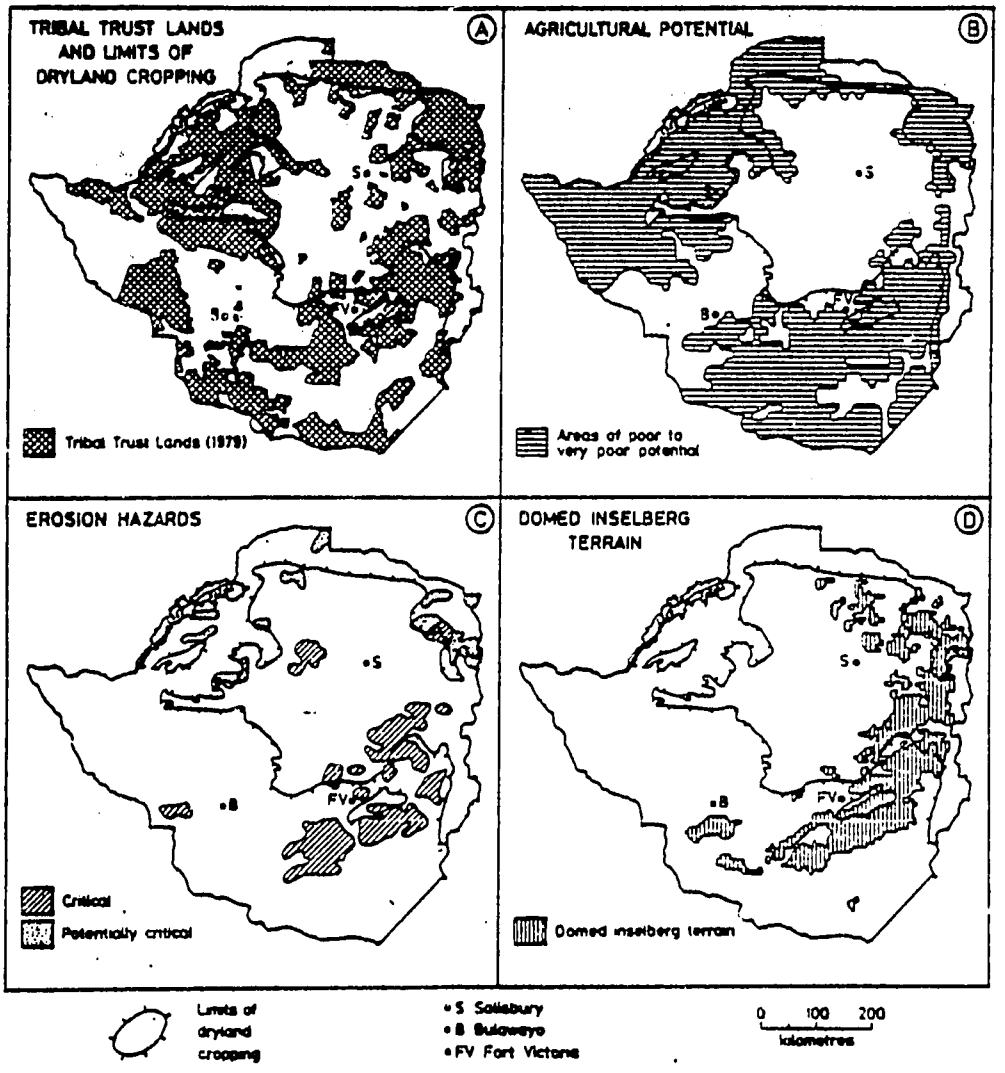

Figure 22. Environmental Constraints on Agricultural Development in the Tribal Trust Land Areas of Zimbabwe

Source: Whitlow. 1980.

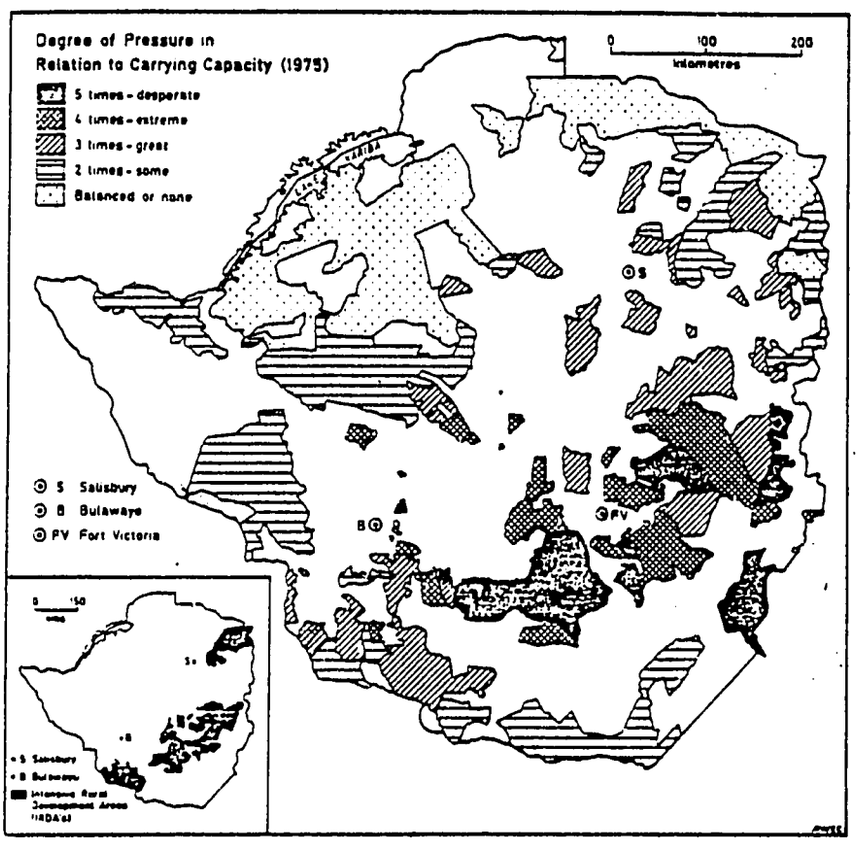

Figure 23. Human and Livestock Population Pressure in the Tribal Trust Lands of Zimbabwe

Source: Whitlow. 1980.

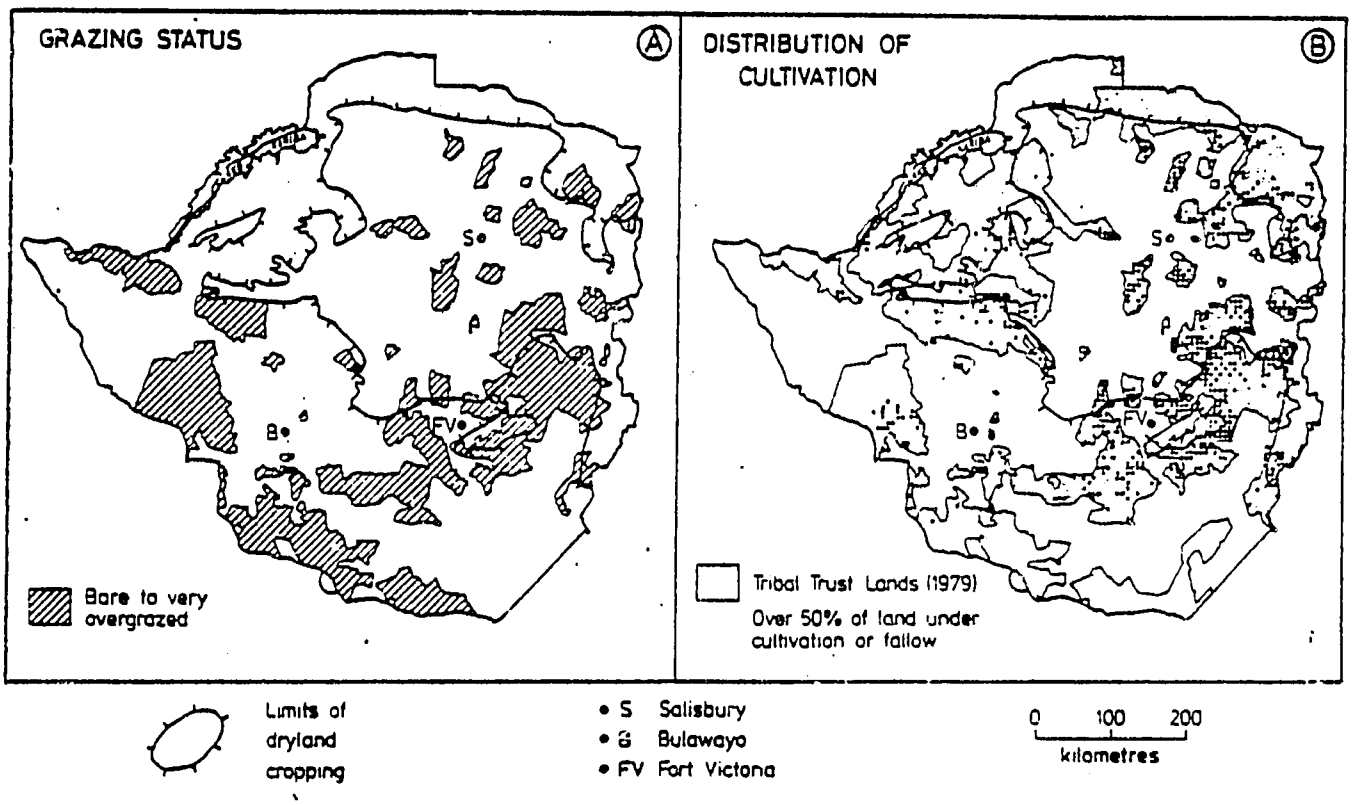

Figure 24. Present Status of Land Use in the Tribal Areas of Zimbabwe

Source: Whitlow. 1980.

Banks 1981 and Fuller 1982 respectively). Banks (1981) also states that cultivated area increased by about 70,000 ha annually throughout the 1960s and most of the 1970s. He believes, however, that most fuelwood came from lands which were being cleared for cultivation, so that total annual clearing of woodland is near the figures cited for fuelwood clearing above. Fuller (1981), on the other hand, believes that a great amount of wastage occurs. He includes clearing for cultivation as wastage when the wood is not put to use, but does not cite figures for this category. It may be worth noting that clearing for fuelwood accounts for only 22 percent as much area as clearing for traditional agriculture in Zambia (Speece 1982).

The FAO estimated that about 60 percent of the total area in the Tribal Trust Lands was wooded in 1963, while other estimates in 1978 put wooded area at about 30 percent. Currently, woodlands may be disappearing at the rate of about 1 1/2 percent per annum (Banks 1981). Several surveys in tribal areas have shown moderate to severe fuelwood shortages in 20 to 35 percent of the local areas sampled. Zimbabwe's Natural Resources Board considers the declining woodlands and accompanying scarcity of fuelwoods a national problem (Johnston 1981).

Rangeland degradation, usually due to overgrazing, is similarly a major problem throughout Zimbabwe. A survey of grazing conditions in Tribal Trust Lands carried out in the early 1960s found that nearly 50 percent of these lands had very poor grazing conditions (cf. Figure 24a). Although more recent surveys of grazing conditions have not been attempted, the situation has almost certainly worsened. Between 1964 and 1977 the livestock population on Tribal Trust Lands increased by 119 percent. In local areas, particularly around dip tanks, watering places, or trackways, devegetation is often very serious, and erosion in such cases has proceeded rapidly. In a few areas, however, the situation has improved. One reason is that severe droughts have caused high livestock mortality, reducing grazing pressure. In other cases successful range management schemes have been introduced (Whitlow 1980).

4.3 Environmental Health Issues

Family Health Care and AFRICARE (1978) has summarized many of the major environmental health issues and is followed here. The situation described pertains to the years just before majority rule was implemented. Thus some of the worse conditions, particularly in the cities, may have been alleviated somewhat, but the magnitude of the problems is large enough that even changes in government policy are not likely to have solved the problems after only a few years.

Housing. Salisbury's official population of 123,000 was housed in comfortable, well-built, and often highly luxurious colonial-type houses. The city is surrounded by ten African townships where the municipal-built houses are often overcrowded, most are without indoor running water, and few have indoor electricity. The black population, officially listed at 400,000, is actually much higher.

This picture is repeated to a greater or lesser degree in Zimbabwe's 14 other main cities and towns, where one million blacks live in segregated municipal townships. These are the workers needed for the fast-developing manufacturing industries. They were subjected to residential segregation by the Land Apportionment Act as amended in 1931.

Slum conditions largely prevail throughout the townships. Originally these dwellings were intended as residences for transients, and are built in rows of identical houses or blocks of flats.

The great broadening and advancement of industry in the 1950s and early 1960s coupled with poverty and overcrowding in areas, forced the townships to accommodate an influx of rural people into the cities Job seekers often stayed illegally with friends and relations; the unemployed sought shelter; families doubled up in single dwellings. Shanty towns sprung up to supplement urban housing; these consist of temporarily constructed shacks in unsanitary conditions.

Urban African housing in many areas constitutes a health hazard, especially to families with young children. Further industrial development will call for substantial input into the urban housing.

A further consideration is the ownership of urban housing (townships) by the municipalities and by a few large industrial companies. Most municipal housing is subeconomic.

The housing of Africans on European-owned farms largely took the form of compound dwelling, comprised of family units mostly of the pole and dhaka (a mud mixture) variety. Squalor, lack of latrines, water shortages, and generally poor sanitary conditions prevailed in many compounds. More recently farmers provided centralized housing for their workers in the form of single unit compounds. These are better built and equipped but enforce a type of communal living not customary to rural Africans. Overcrowding and lack of supervision led to slum conditions and squalor in many compounds.

Housing in the TTLs is to a large extent the traditional, with the extended family living in a series of huts built around a communal area. These are built of poles and dhaka with a thatched roof. They range from primitive to well-constructed, comfortable homesteads.

In the African Purchase Areas, housing was usually built by the farmers themselves and has a more European look; constructed of brick, embellished with a tin roof, windows, and a few steps reaching to the front door. Private ownership has probably resulted in more ventilation and sanitation improvements than have been effected by the educational efforts of the health authorities.

Water. Water supplies are adequate and efficiently treated and controlled in the cities and in many of the smaller towns and settlements; dams exist in some areas where the rainfall is low and pressure is difficult to maintain in piped systems. In rural areas people depend on streams and rain storage tanks. Water supply is inadequate and constitutes a major source of waterborne infections, both through intermediate vectors and through contamination by human and animal vectors.

The country is divided into six watershed zones in which estimated potential for water supply is recorded as a basis for planning and for setting priorities in water resources development.

Based on current utilization, population growth and industrial development, it is estimated that, with appropriate planning, water resources will be sufficient well into the 21st century.

Water pollution control is an integral part of water resource development and is the responsibility of the national authority under the Water Act of 1970. Local authorities and industry are required to meet standards for treatment of effluents before discharge into water.

At the village level the provision of adequate supplies of clean water to rural communities may be the most important single factor in preventing disease and promoting the health of adults and children. But it is the most expensive and is hard to come by. The Provincial Medical Office of Health for Matabele Land reports on the creation of 100 protected wells in a small rural area over a period of four years. With the health assistant gaining the cooperation and voluntary labor of the local people, these wells replaced the old water holes in river beds used by the people for washing, drinking, and cooking. Not only did the new wells provide an adequate supply of safe water throughout the

year but the people were better informed on the relationship of water to health--a relationship of which they had been largely unaware.

In this context, Evans (1978) notes that irrigation development in Zimbabwe has often led to increased populations of Biomphalaria pfeifferi and Bulinus globosus, both bilharzia vectors. Zimbabwe has carried out successful local campaigns to eliminate snail vectors and greatly reduce the incidence of bilharzia.

Sanitation and Waste Disposal. Excreta disposal in Zimbabwe is by means of water-closets in the cities, night soil collection in poorer urban areas, pit latrines in the compounds and in some homesteads in the TTLs, and the neighboring bushes in the poorer areas of the TTLs. Recently a better constructed and ventilated pit has been designed which is an improvement on the old, appears to be acceptable to the population, and is inexpensive to install.

4.4 Industrial and Urban Pollution [19]

According to Robarts, perhaps the most serious and prevalent water pollution problem in Zimbabwe is eutrophication. Eutrophication can be defined as the enrichment of a water body with plant nutrients resulting in the growth of large populations of algae and aquatic plants. The nutrients responsible for the increased populations are nitrogen and phosphorus, although other nutrients including carbon may be important. Examples of eutrophic or enriched lakes due to sewage effluents include Lake McIlwaine (just southwest of Salisbury) and Upper Umgusa (near Bulawayo). Little data is available on Upper Umgusa, but Lake McIlwaine has been extensively studied over the last two decades. Figure 25 shows the lake's location, and the brief following discussion is taken from Marshall (1978).

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[19] Sources: Cormack. 1975.
Fullstone. 1980.
Grant. 1973.
Greichus et al. 1978.
Marshall. 1978.
Marshall and Falconer. 1973a.
Marshall and Falconer. 1973b.
McKendrick and Williams. 1969.
Mitchell and Marshall. 1974.
Neely. 1975.
Robarts. 1975.
Wells. 1975.

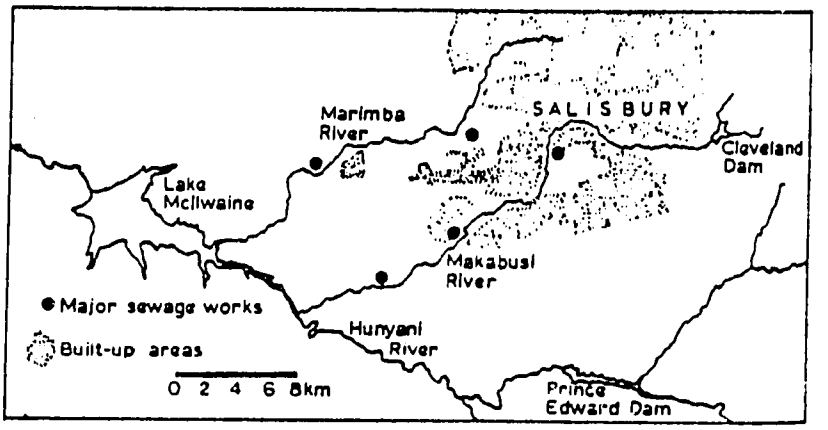

Figure 25a. Location of Lake McIlwaine in Relation to the City of Salisbury

Source: Marshall and Falcones. 1973a.

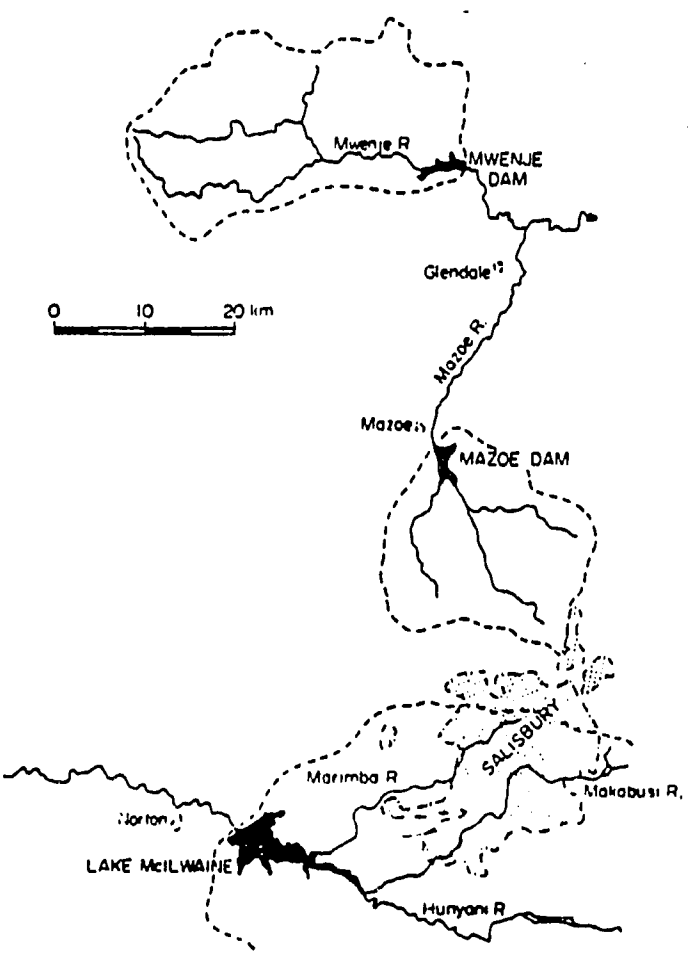

Figure 25b. Location of Three Major Reservoirs Near Salisbury

Source: Mitchell and Marshall. 1974.

Serious algal blooms first appeared in about 1960 and became increasingly severe after that time. This was caused by a rapid build-up of nutrients from the sewage effluent discharged into the Makabusi and Marimba Rivers. Water purification became difficult and more expensive and, worse still, it was suspected that toxins released from dead algae were responsible for outbreaks of gastroenteritis amongst children in Salisbury.

Ways of reducing nutrient input to the lake were considered, and the method chosen was the diversion of sewage effluent to irrigation of land. This appears to be having some effect and there has been a decline in total dissolved solids, a crude indication of nutrient status, since 1968. It is too early to tell whether this decline will continue or if the nutrient level will stabilize.

The situation in Lake McIlwaine is undoubtedly ameliorated by the high inflow to volume ratio and its theoretical replacement time of 0.8 years. Considerable amounts of nutrient are thus carried downstream--perhaps now to affect the new Darwendale Dam! The bottom sediments also trap enormous quantities of organic carbon, nitrogen and phosphorus. These sediments may influence the nutrient status of the lake for years to come, even after all sewage effluents have been diverted. For example, it has been estimated that the bottom sediments release 59 tons of nitrogen as NH3-N annually into the water.

Tables 41 a, b, c present data on three artificial lakes near Salisbury, and clearly demonstrate the magnitude of the eutrophication problem in McIlwaine.

Table 41a. Analysis of Lake Waters at Three Levels
Results, except pH, in mg/l

	Lake McIlwaine			Mazoe			Prince Edward		
	T	30 ft. M	60 ft. R	T	35 ft. M	65 ft. R	T	9 ft. M	18 ft. R
pH	8.8	7.0	6.8	8.5	7.5	7.4	7.0	6.9	6.90
Dissolved oxygen	7.4	0.8	Nil	6.9	Nil	Nil	5.1	4.9	0.90
Free NH_3	0.04	0.11	0.69	0.05	0.18	0.57	Trace	Trace	0.10
O-phosphate	0.02	0.11	0.24	0.04	0.06	0.09	0.003		0.015
Iron	0.36	1.24	1.92	0.20	0.60	1.96	0.80	0.84	3.00
Manganese	Nil	0.42	0.52	Nil	0.75	1.34	Nil	Trace	0.30

T = top M = middle B = bottom

Source: McKendrick and Williams. 1969

Table 41b. Estimated Nutrient Contributions of the Three Rivers Flowing into Lake McIlwaine (1967)

	HUNYANI	MAKABUSI	MARIMBA
Total flow ($m^3 \times 10^6$)	91.277	29.603	7.400
ortho-phosphate (metric tons)	3.2	183.5	101.4
nitrate-nitrogen (metric tons)	3.6	121.4	33.3
free ammonia (metric tons)	0.9	139.1	17.8

Source: Marshall and Falconer. 1969.

Table 41c. Phytoplankton Populations in Lake McIlwaine and Mazoe and Mewnje Dams (Figures are Colonies/l for Colonial Species and numbers/l for Non-colonial Species

	McIlwaine	Mazoe	Mwenje
Anacystis cyanea	2,947,413	42,720	50,338
Anabaena flos-aquae	725,340	600	138,176
Anabaenopsis tanganyikae	529,466	—	—
Melosira granulata	1,439,166	8,420	1,439
Botryococcus braunii	—	291,280	243,247
Ceratium hirundinella	—	8,630	720
Pediastrum clathratum	92,106	1,810	720
Staurastrum sp.	—	9,640	71,966
Cosmarium sp.	—	266,000	35,983
Tetradesmus sp.	—	—	1,439
Total	5,733,491	630,100	1,427,059

Source: Mitchell and Marshall. 1974.

Most sources believe that nitrogen and phosphate pollution resulting from agricultural use of fertilizers is relatively unimportant (cf. particularly Grant 1975). As mentioned above, sewage disposal has been the major source. Several municipalities, Salisbury, Bulawayo, Que Que and Fort Victoria, have used irrigation schemes as the tertiary treatment of sewage effluent for a number of years. However many disadvantages have occurred on these schemes. In Zimbabwe soil is often a limiting factor. Often the soils available for effluent disposal are either acid sands which retard the denitrifying process due to their low pH and are often subject to a fluctuating high water-table, or moderately shallow to very shallow red clays. The latter soils are more suitable since heavy textured soils or soils with a horizon of marked reduction in permeability give the greatest denitrification of NO_3^--N.

In the Salisbury scheme, run-off has caused a continuation of NO_3^--N and phosphate pollution of the Hunyani catchment, though on a reduced basis. Apart from the nitrogen and phosphate content of sewage effluent, a considerable sodium content is derived from soaps and detergents which has resulted in saline and sodic profiles developing in low lying parts of these schemes. Indeed, the discharge of sodium chloride from an abattoir came close to destroying an irrigation scheme put in by the Fort Victoria Municipality.

Bulawayo has been using its sewage for irrigation for over 20 years and until recently no adverse effects have taken place.

Serious nitrogen pollution has been recognized at a chemical factory at Que Que which produces ammonium nitrate. Research has been carried out for a number of years by the author and the company with a view to the reclamation of affected areas and biochemical disposal of the effluent. The pollution arises from two sources, the voiding of solid ammonium nitrate to the atmosphere and liquid effluent leaving various parts of the factory.

The solid ammonium nitrate has severely burned the fall-out area to the east of the plant and during the rains this solid goes into solution and runs off into the local catchment. Levels as high as 2,600 mg/l N have been recorded in one of the streams. This form of pollution should be controlled by the installation of scrubbers to recover the solid ammonium nitrate. It is felt that future rainy seasons will allow affected areas to revegetate as the NO_3^--N levels drop (Fullstone 1980).

Greichus et al (1978) show that other pollutants enter the lake as well. Concentrations of insecticide and PCB residues in the Lake McIlwaine ecosystem are given in Table 42, while Table 43a gives concentrations of metals. Table 43b shows concentrations of metals in cormorant carcasses taken from the lake. Robarts (1975) also notes that copper sulphate and sulphuric acid effluents sometimes enter surface water from copper mines in the low veld.

4.5 Wildlife Issues

As noted in Section 3.5.5, a number of mammals and one crocodile are considered endangered or rare in Zimbabwe. In the past, larger mammals have suffered heavily in tsetse control programs, but public opposition has largely halted the widespread killing of mammals for control purposes since the mid 1950s. Smaller scale and more selective shooting of game animals did continue into the 1960s (Cockbill 1967). Hunting and poaching may also still be problems locally, but nationwide do not seem to pose much of a threat to wildlife. The major factor affecting wildlife populations at present seems to be destruction of habitat as human activities expand. However, little data is available to detail the process.

4.6 Economic Development [20]

Zimbabwe is currently operating under a transitional plan which is outlined in the document provided for the Zimbabwe Conference on Reconstruction and Development (ZIMCORD). The broad outlines of the policies and strategies set forth in the ZIMCORD document are noted in U.S. AID (1981) as follows:

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[20] Sources: Africa Research Bulletin. June 15-July 14, 1980.
Africa Research Bulletin. July 15-August 14, 1980.
Africa Research Bulletin. February 15-March 14, 1981.
Africa Research Bulletin. March 15-April 14, 1981.
Europa. 1981a.
Europa. 1981b.
Legum. 1980
U.S. AID. 1981
World Bank. 1981.

Table 42. Average Concentrations of Polychlorinated Biphenyls and Insecticides in the Lake McIlwaine Ecosystem

		ppm (ug/g)[a]							
				PCB's					Insecticides
Description	No	1254[b]	1260[b]	Total	DDE	Dieldrin	DDD	DDT	Total
Water	10	<.001	<.001	<.001	0.0001	<.0001	<.0001	<.0001	<.0002
Bottom Sediment	10	0.05	0.07	0.12	0.015	0.004	0.040	0.002	0.061
Plankton	5[c]	0.13	0.05	0.18	0.01	<.01	0.02	0.02	0.06
Oligochaetes	1[c]	0.77	<.5	1.0	0.18	0.08	0.33	0.14	0.73
Benthic Insects	1[c]	1.3	<.5	1.6	0.13	<.01	0.12	0.11	0.36
Fish									
Dwarf Bream	5[d]	1.8	0.51	2.3	0.12	0.07	0.16	0.04	0.39
Spot Tail	5[e]	1.7	<.5	1.9	0.24	0.04	0.10	<.01	0.38
Greenheaded Bream	5[d]	0.98	<.5	1.2	0.08	0.03	0.10	<.01	0.22
Greenheaded Bream	5[f]	0.92	<.5	1.2	0.13	0.12	0.18	0.14	0.57
Cormorant									
Carcass	10	9.8	3.7	13.	11.	0.92	0.81	0.27	13.
Brains	10	1.8	2.0	3.8	2.5	1.4	0.06	0.15	4.1
Feathers	10	0.77	<.5	1.0	0.41	0.09	<.01	0.06	0.57

a. All samples analyzed on a dry weight basis except water.
b. The designation 1254 indicated those compounds having six or less chlorines and 1260 with six or more chlorines. See text for further explanation.
c. Each sample consists of a composite collected from all over the lake.
d. Each sample consists of a composite of 10 fish ranging from 23 to 40 g.
e. Each sample consists of a composite of 20 fish ranging from 6 to 9 g.
f. Individual fish ranging from 578 to 824 g.

Source: Greichus et al. 1978.

Table 43a. Average Concentrations of Metals in Lake McIlwaine

Description	Water[b]	Bottom Sediment[b]	Plankton[c]	Oligo-chaete[c]	Benthic Insects[c]	Fish[d]
	ppm (ug/g)[a]					
Arsenic	0.003	37.	2.9	6.0	1.3	1.4
Cadmium	0.001	0.39	1.5	0.05	0.08	0.12
Copper	0.010	38.	N.A.[e]	7.2	10.	5.4
Manganese	0.032	350.	220.	28.	8.8	27.
Lead	0.010	41.	78.	1.3	0.91	0.84
Zinc	0.012	100.	190.	130.	78.	48.
Mercury	<.001	0.28	0.26	0.08	N.A.[e]	0.23

a. All samples analyzed on a dry weight basis except water.
b. Three samples taken from three areas of the lake.
c. One composite sample collected from all over the lake.
d. Three individual fish weighing 661, 824, and 763 g.
e. Not analyzed.

Source: Greichus et al. 1978.

Table 43b. Average Concentration of Metals in Cormorants Collected from Lake McIlwaine

Description	Carcass	Brain	Feather
	ppm (ug/g)[a]		
Arsenic	1.4	0.94	1.2
Cadmium	0.04	0.10	0.38
Copper	3.1	9.0	8.7
Manganese	4.9	1.6	21.
Lead	2.7	1.3	2.4
Zinc	77.	33.	180.
Mercury	2.8	1.3	0.65

a. Values represent an average of three samples. Dry weight basis.

Source: Greichus et al. 1978.

Objectives. "The central objectives are to foster rapid economic growth, full employment, dynamic efficiency in resource allocation, and an equitable distribution of the ensuing benefits. In particular Government intends to re-establish justice and equity in the ownership of land which should be a common heritage for Zimbabweans of all races" (ZIMCORD Document).

In order to increase equity while at the same time encouraging growth, the government is planning to restructure the economy. Three primary foci of this plan are land redistribution, rural development, and employment generation. Each of these requires a substantial amount of capital, but domestic resources are presently inadequate for the task. A total of over US$ 6,000 million gross investment is envisaged over the next three years (Table 44). Of this, 51 percent is expected to be invested by the private sector and 49 percent by public sector. A large amount of the investment by the private sector will be for the replacement of old and outdated capital equipment especially in manufacturing, transport, communication, and civil engineering industries. The private sector is also expected to channel a significant amount of its resources into rural areas once the government's rural programs have stimulated the potential for rural growth. Of the US$ 3,050 million public sector investment, US$ 1,789 million is anticipated to come from multilateral and bilateral sources of foreign assistance.

This averages out to about US$ 600 million per year. The balance of US$ 1,261 million is to be financed from other international sources of development finance.

"Whilst the responsibility for the achievement of these objectives is essentially Zimbabwe's acting in the framework of self-reliance and self-help, it is not the intention to act in isolation. We feel that we have strong and just claim on the resources of our friends in the international community in the light of the peculiar and urgent problems we face" (ZIMCORD Document).

Strategy. Given the need to raise income levels and ease land pressure in the traditional economy, Zimbabwe has adopted a two-fold strategy with respect to rural economy. The first part of the strategy is to substantially redistribute land in the commercial areas to settlers from the tribal areas. Current plans over the three year period are to purchase two million hectares of commercial land on a willing seller/willing buyer basis. Almost all of this land is currently underutilized and thus the settlement program is expected to have a positive effect on total agricultural output.

Table 44. Zimcord Capital Funding Program

(Thousands of U.S. Dollars)

	1980/81	1981/82	1982/83	1983/84	TOTAL	PERCENTAGE DISTRIBUTION
REFUGEES	67,728	80,000	0	0	147,728	2.5
Food	38,787	0	0	0	38,787	0.6
Agricultural package	21,014	0	0	0	21,014	0.4
Other	7927	80,000	0	0	87,927	1.5
RECONSTRUCTION	90,558	100,694	67,382	0	258,634	4.3
Roads & Bridges	21,267	13,962	6,506	0	41,735	0.7
Water	8,181	11,675	3,982	0	23,838	0.4
Dipping Services	4,293	262	502	0	5,058	0.1
Schools	19,200	32,000	31,118	0	82,318	1.4
Health Facilities	3,787	1,600	237	0	5,624	0.1
Irrigation	1,400	1,320	0	0	2,720	-
Other	32,430	39,875	25,037	0	97,342	1.6
LAND SETTLEMENT & RURAL DEVELOPMENT	0	327,357	435,650	495,144	1,258,150	21.0
Dryland Resettlement	0	34,838	52,310	78,400	165,549	2.8
Irrigation Schemes	0	36,717	75,822	98,746	211,285	3.5
Urban Infrastructure	0	15,037	8,859	5,394	29,2[illegible]	0.5
Small Scale Enterprises	0	11,597	11,893	11,979	35,467	0.6
Intensive Rural Development Areas	0	6,400	8,000	8,000	22,400	0.4
Credit	0	41,198	56,554	75,544	173,296	2.9
Agricultural Services	0	27,618	28,674	25,408	81,699	1.4
Forestry	0	18,050	17,467	20,789	56,306	0.9
Rural Health	0	15,674	32,589	42,605	90,867	1.5
Rural Schools	0	37,613	54,491	39,648	131,752	2.2
Rural Roads	0	47,421	56,907	55,451	159,779	2.7
Rural Water	0	20,475	21,603	26,104	68,182	1.1
Other	0	14,722	10,480	7,077	32,279	0.5
TRAINING PROGRAMS.	0	149,941	132,362	92,784	375.086	6.2
Formal Education	0	85,584	76,723	52,785	215,157	3.6
Technical Training	0	45,157	45,867	29,838	120,862	2.0
Non Formal Education	0	19,226	9,771	10,070	39,067	0.7
NATIONAL INFRASTRUCTURE	0	1,134,699	1,393,146	1,431,613	3,959,634	66.0
Energy	0	480,128	640,000	640,000	1,760,128	29.3
Transport & Communications	0	221,333	239,005	238,054	698,392	11.6
Other	0	433,238	514,141	553,559	1,500,938	25.0
TOTAL	158,286	1,792,691	2,033,339	2,019,557	6,003,874	100.0

Source: U.S. AID. 1981.

The second part of the strategy is to increase the productivity of traditional agriculture by massive investments in all areas previously neglected. This includes roads and transport, marketing, credit irrigation, water supplies, extension, schools, and health care facilities. However, with the settlement schemes and the projected increases in agricultural productivity, population pressure is too great to permit farm sizes necessary for reasonable living standards for all present TTL inhabitants.

Therefore, there will be a substantive attempt to encourage families with urban ties to leave the land and become fully dependent on urban sources of income. As part of this effort substantial investments will be made in the development of small urban centers in the rural areas, some of which will have the potential for small-scale industrial development. In addition, the need to move substantial numbers of people to urban areas calls for a fairly large low-cost housing component.

The government recognizes that the source of domestic resources in the near term will be the modern economy. Consequently, half the total investments proposed will be in the private sector, or in public investments which will directly benefit the modern economy. In addition, efforts will be made to ensure that private investments will tend to be capital saving so as to generate as much employment as possible

Development in Zimbabwe will likely have direct impact upon environmental problems in the fields of agriculture, industrial and urban pollution, and public health. In agriculture, severe erosion and devegetation problems in the former Tribal Trust Lands will extend into previously European designated areas. Excessive population pressures on the land will not be solved by access to these new areas by the African population, because as noted above, there is simply not enough land to distribute to everyone. Expansion of irrigation may also temporarily increase the incidence of water borne disease, although Zimbabwe's experience with successful vector control programs may be sufficient to keep diseases such as bilharzia in check.

The trend toward urbanization is widespread in developing countries and Zimbabwe wishes to encourage the trend as a means of alleviating pressure on the land in rural areas. Thus the public health problems associated with the urban centers are likely to increase in the short term. The government will not be able to provide widespread sanitation services and health facilities for some time.

However, long-term prospects seem better. The health system previously available to Europeans only, despite initial strains, should eventually raise the health standards of much wider population segments.

The emphasis on industrial development is likely to increase local problems with industrial pollution, particularly since Zimbabwe's industrial base is already relatively well developed compared to most developing countries.

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Appendix I

Geography and Climate

Figure 1. Bioclimatic Regions and Natural Farming Regions

Figure 2. Rainfall Characteristics

Figure 3. Rainy & Dry Seasons in Southern Africa

Figure 4. Moisture Characteristics of Zambia and Zimbabwe

Figure 5. Mean Daily January and July Temperatures in Southern Africa

Figure 6. Mean Daily January Maximum & July Minimum Temperatures in Southern Africa

Figure 7. Incoming Radiation Patterns in Southern Africa

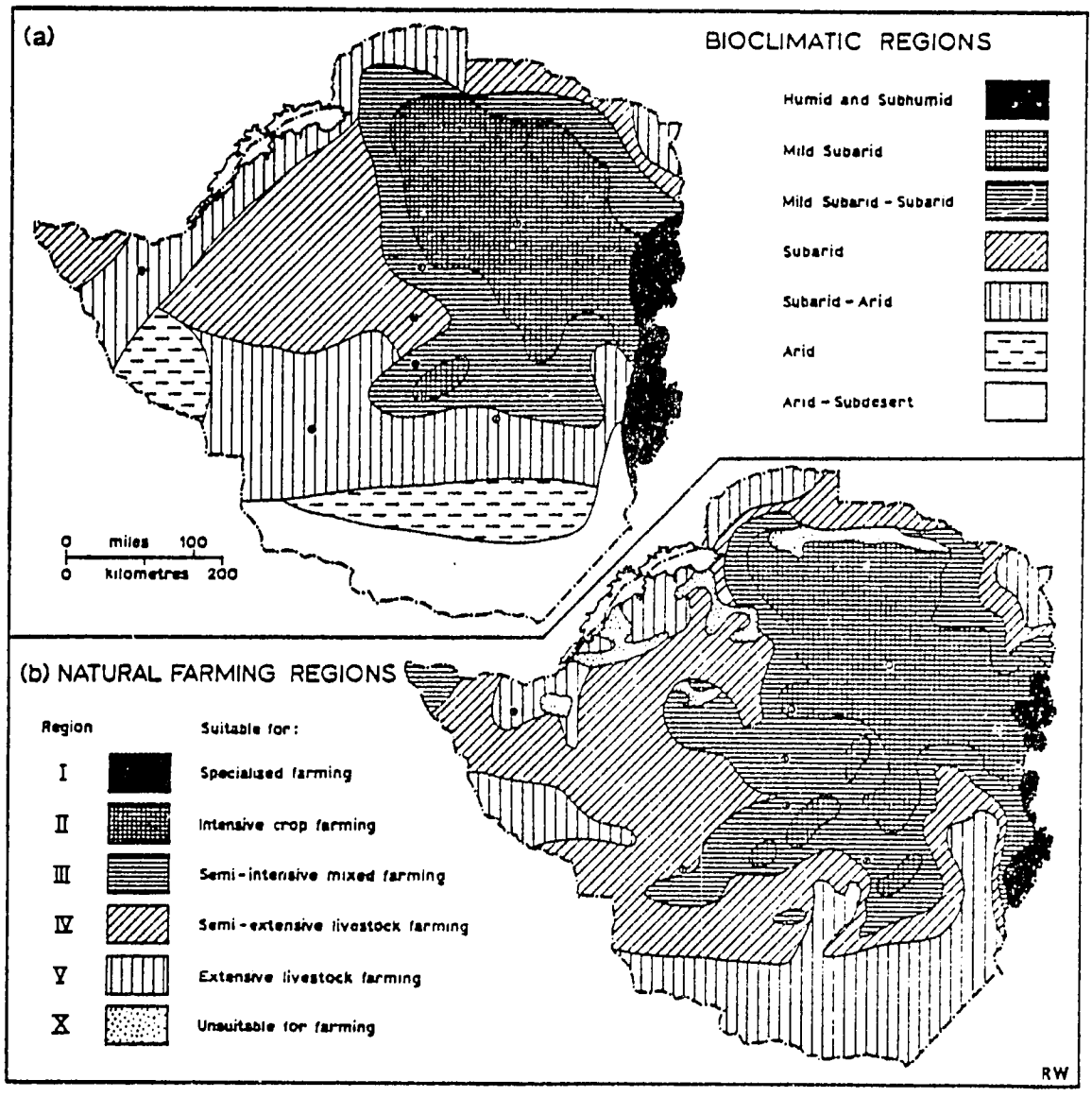

Figure 1. Bioclimatic Regions and Natural Farming Regions

Source: Kay. 1970.

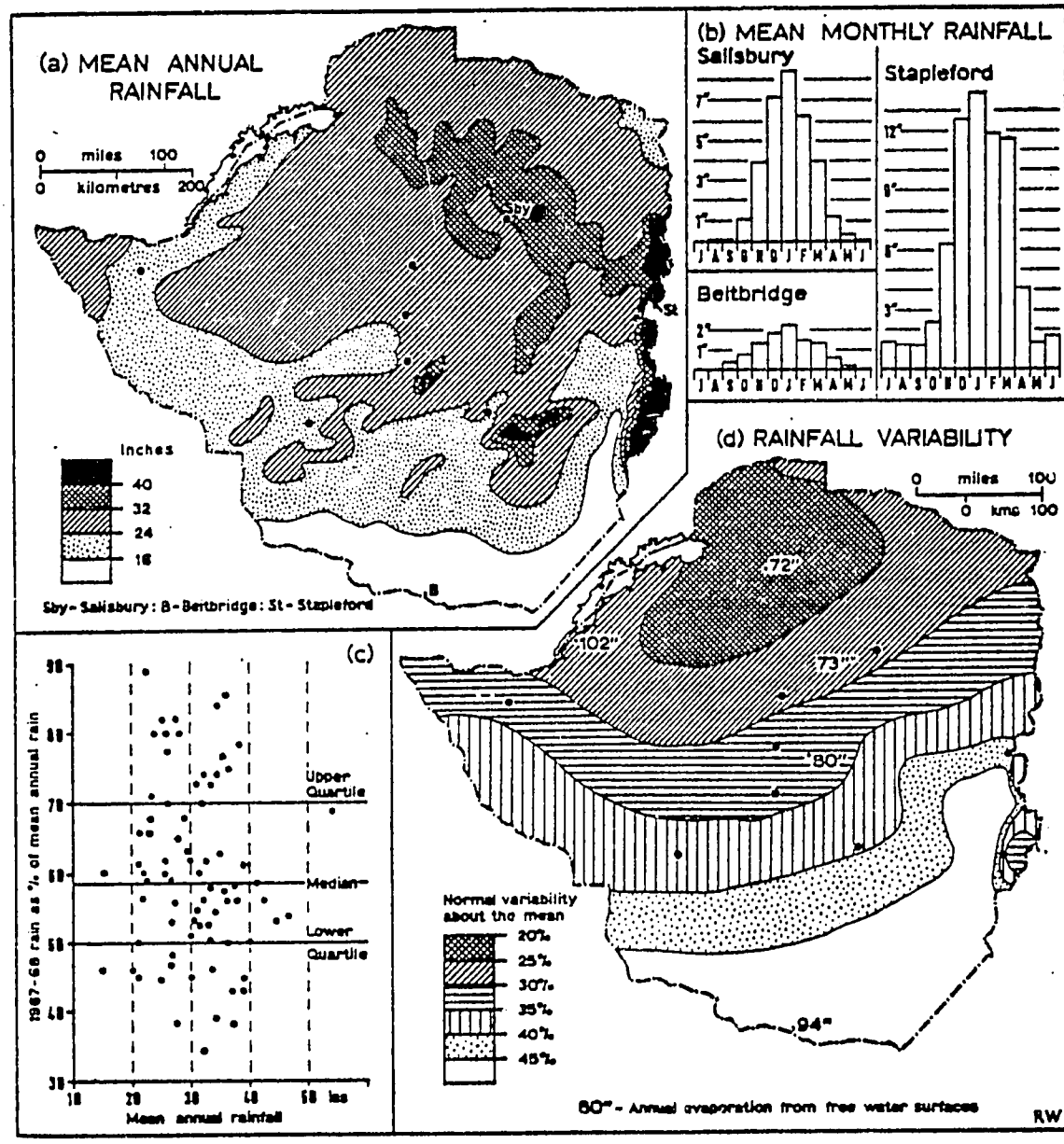

Figure 2. Rainfall Characteristics

Source: Kay. 1970.

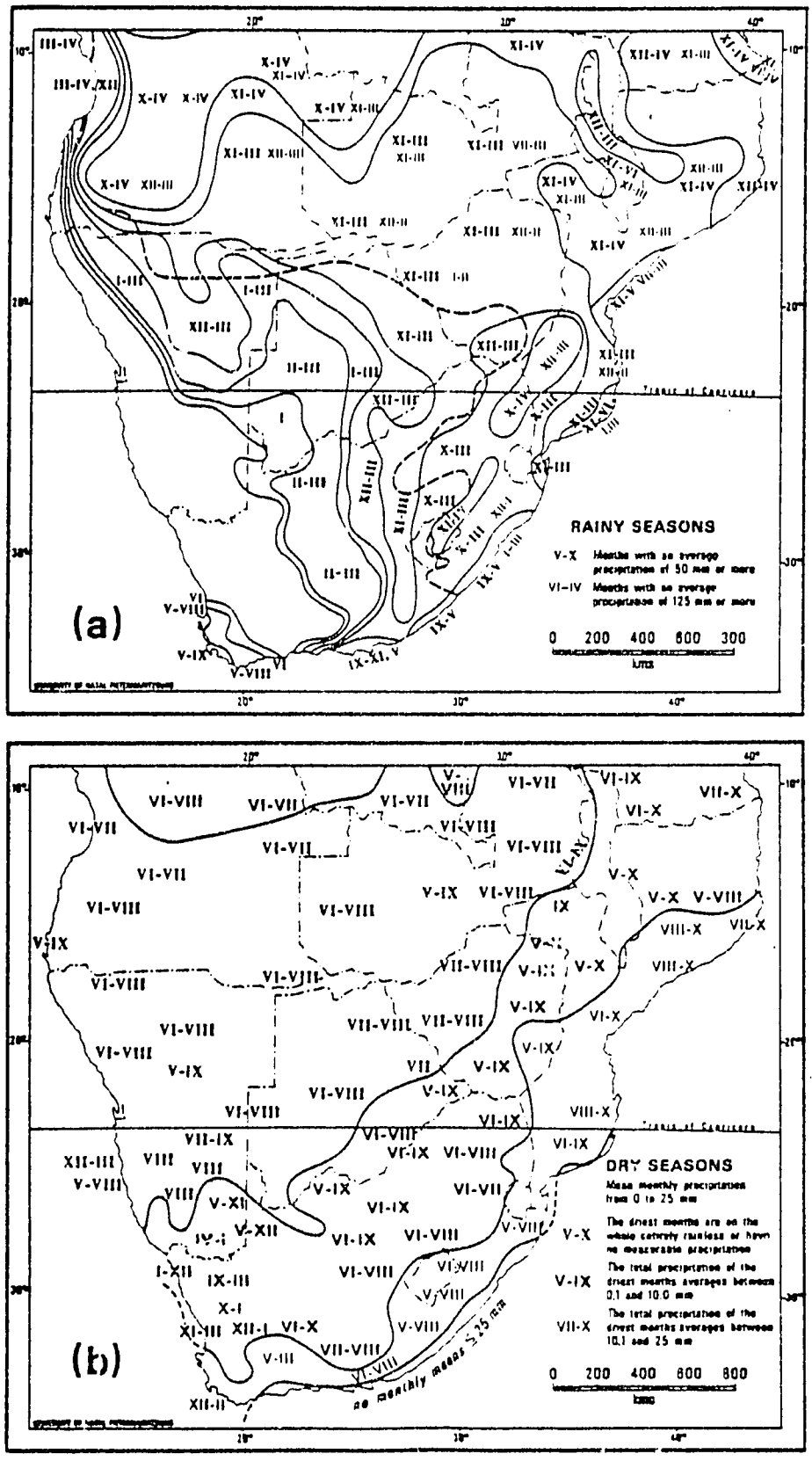

Figure 3. Rainy and Dry Seasons in Southern Africa

Source: Schulze and McGee. 1978.

A. Average annual potential evapotranspiration

B. Average annual water surplus

C. Average annual water deficiency

D. Moisture regions

E. Seasonal variation in effective moisture

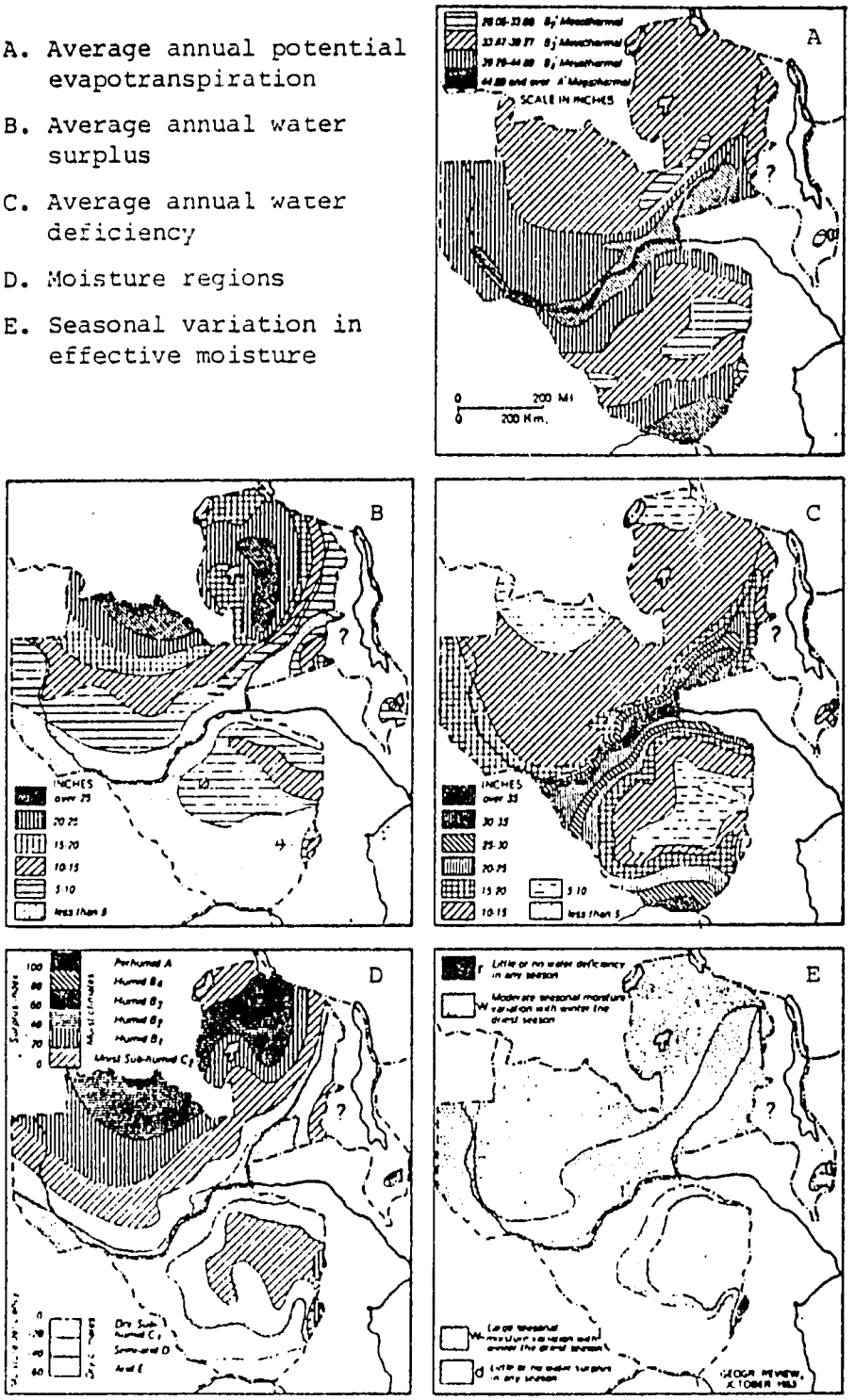

Figure 4. Moisture Characteristics of Zambia and Zimbabwe

Source: Howe. 1953.

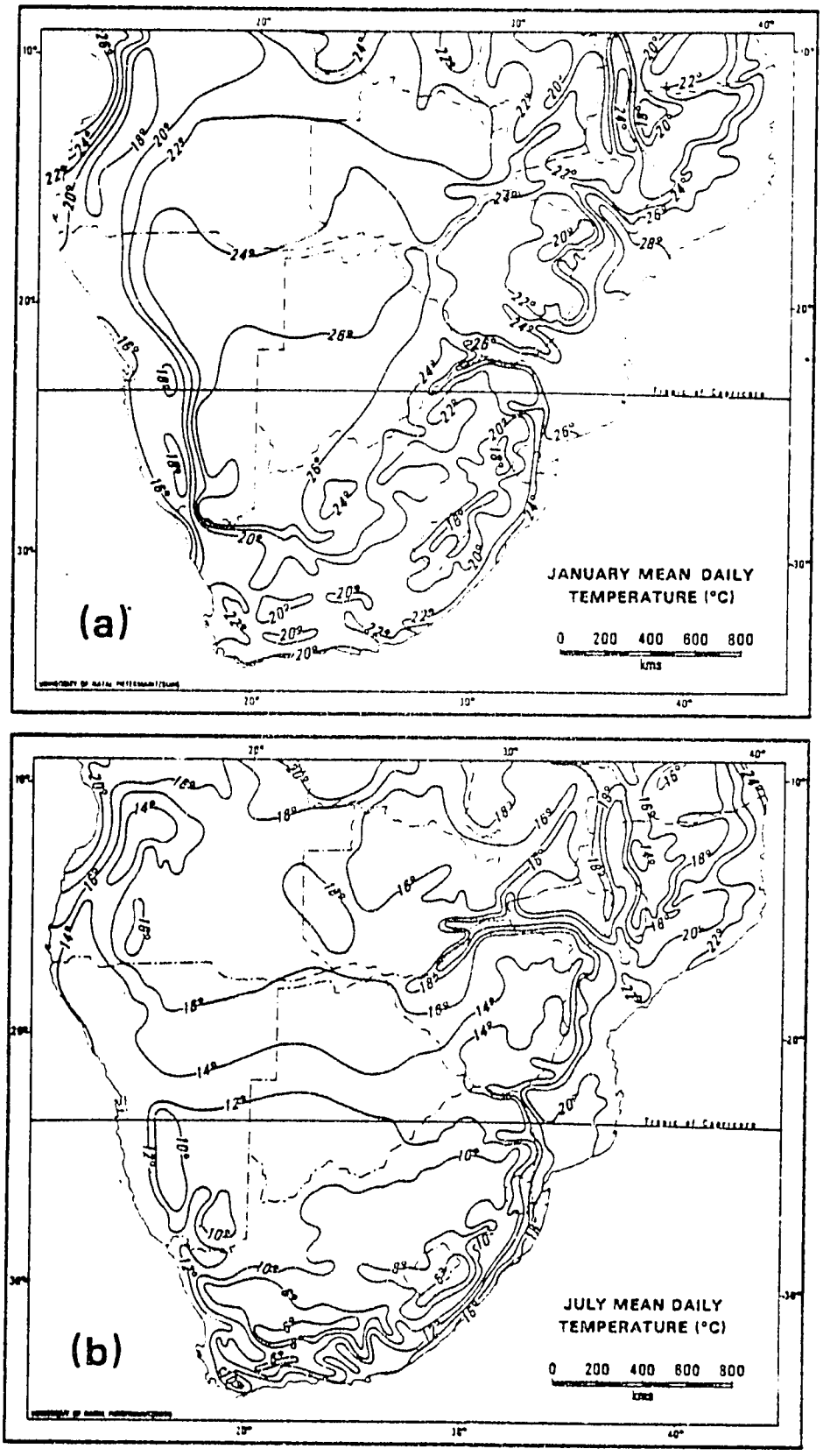

Figure 5. Mean Daily January and July Temperatures in Southern Africa

Source: Schulze and McGee. 1978.

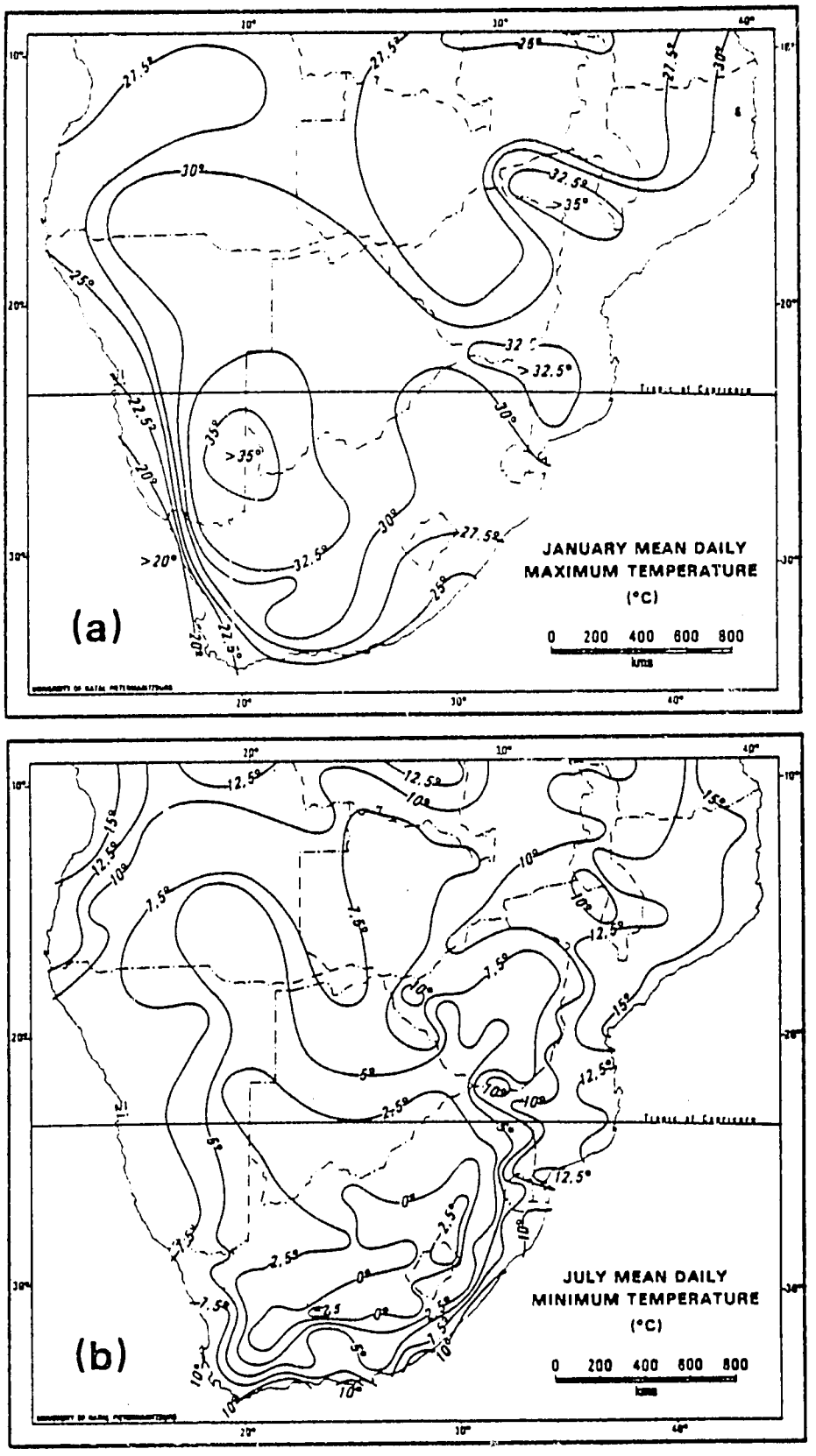

Figure 6. Mean Daily January Maximum and July Minimum Temperatures in Southern Africa

Source: Schulze and McGee. 1978.

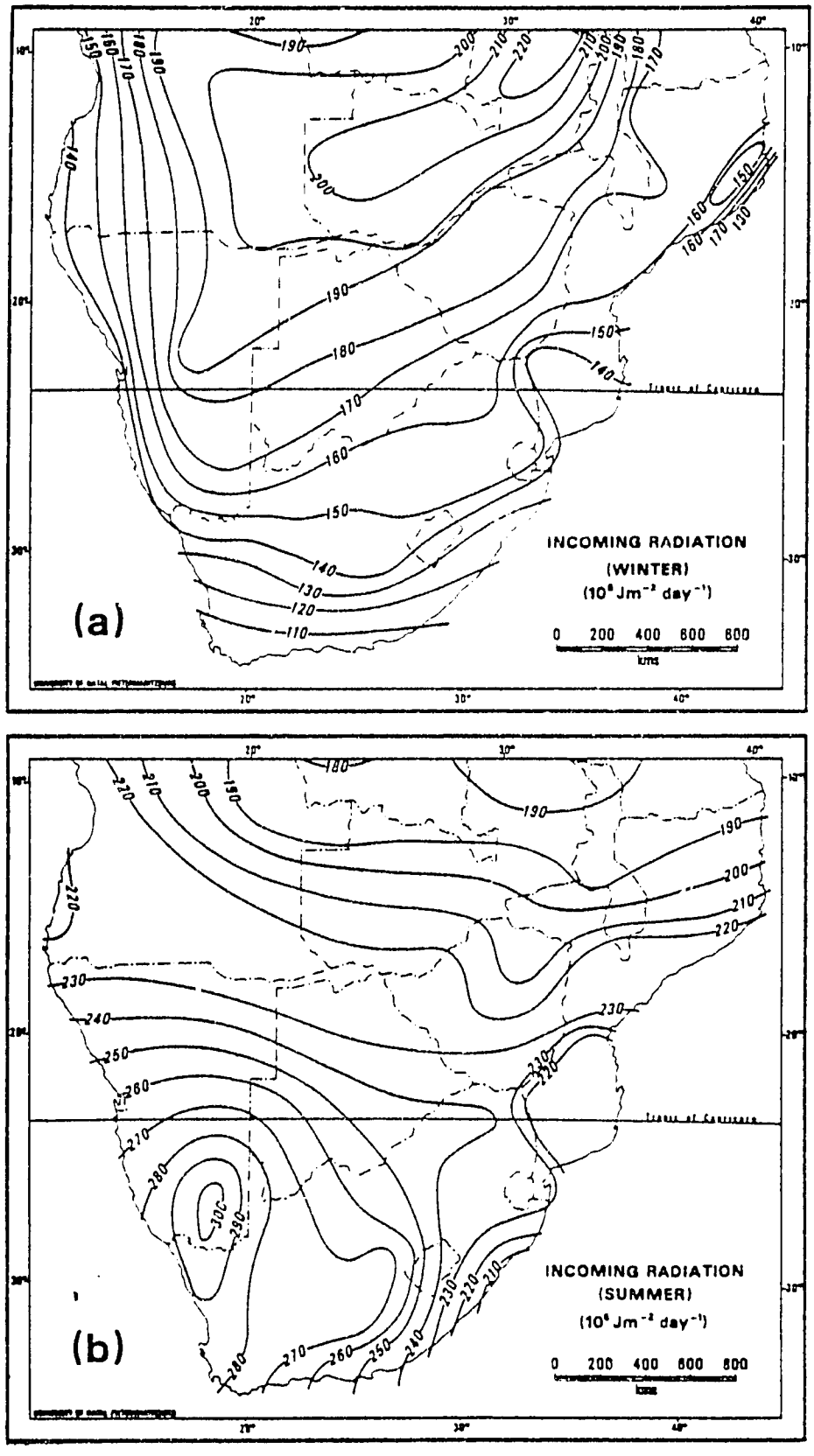

Figure 7. Incoming Radiation Patterns in Southern Africa

Source: Schulze and McGee. 1978.

Appendix II

Population and Public Health

Table 1. Miscellaneous Demographic Features

Table 2. African Population of Main Towns

Figure 1. Age Structure

Figure 2. African Population 1969

Figure 3. European Population 1969

Table 3. Utilization of Ministry Hospitals, 1964 and 1973

Table 4. Church-Related (Mission) Hospitals, 1964 and 1973

Table 5. Municipal Health Services 1973

Table 6. Medical and Paramedical Personnel, 1973

Table 1. Miscellaneous Demographic Features

		Year	Source
Population	7,429,000	1980	1
Density/sq. km.	17.7	mid-1970s	2
Density/sq. km. arable land	94.2	mid-1970s	2
Population growth rate	3.4	1979	1
Crude birth rate (per 1,000)	47.0	1979	1
Crude death rate (per 1,000)	13.6	mid-1970s	2
Life expectancy at birth	53.6	mid-1970s	2
Age structure (%)-14 yrs.	47.1	mid-1970s	2
15-64	50.2		
above 64	2.7		
Average daily caloric consumption (% of estimated requirement)	108	mid-1970s	2
Population per physician	7,106	1976	1
% Literate	39	1962	1
Per capita GNP (US$)	480	1978	1
Total labor force (1,000)	2302	mid-1970s	2
% Labor force in agriculture	60	1978	1
% Women in labor force	29.6	mid-1970s	2

Sources: 1. U.S.AID. 1980a.
2. World Bank. 1981.

Table 2. African Population of Main Towns (1,000)

	Official figure as of 30 June 1979	Updated Estimate accounting for recent influx - January 1981
Bindura	17	18
Bulawayo	363	400
Fort Victoria	24	24
Gatooma	33	33
Gwelo	70	72
Hartley	15	15
Marandellas	23	23
Que Que	51	51
Redcliff	19	19
Salisbury	627	1,000
Shabani	20	21
Sinoia	27	28
Umtali	63	65
Wankie	33	33
	1,385	1,802

Source: U.S. AID. 1981.

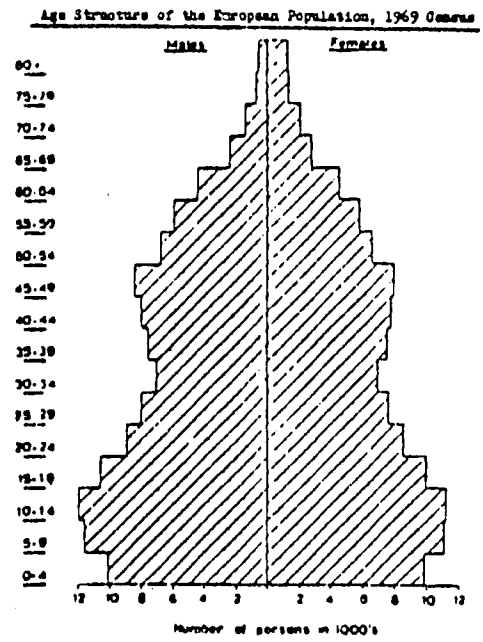

Figure - 4 -

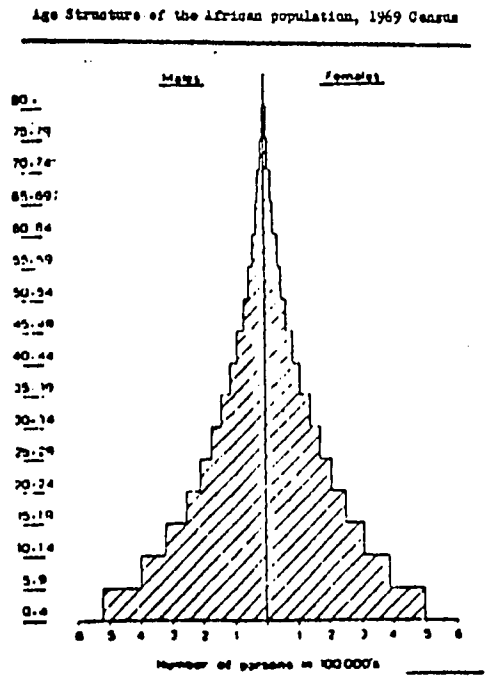

Figure 1. Age Structure

Source: Simson. 1979.

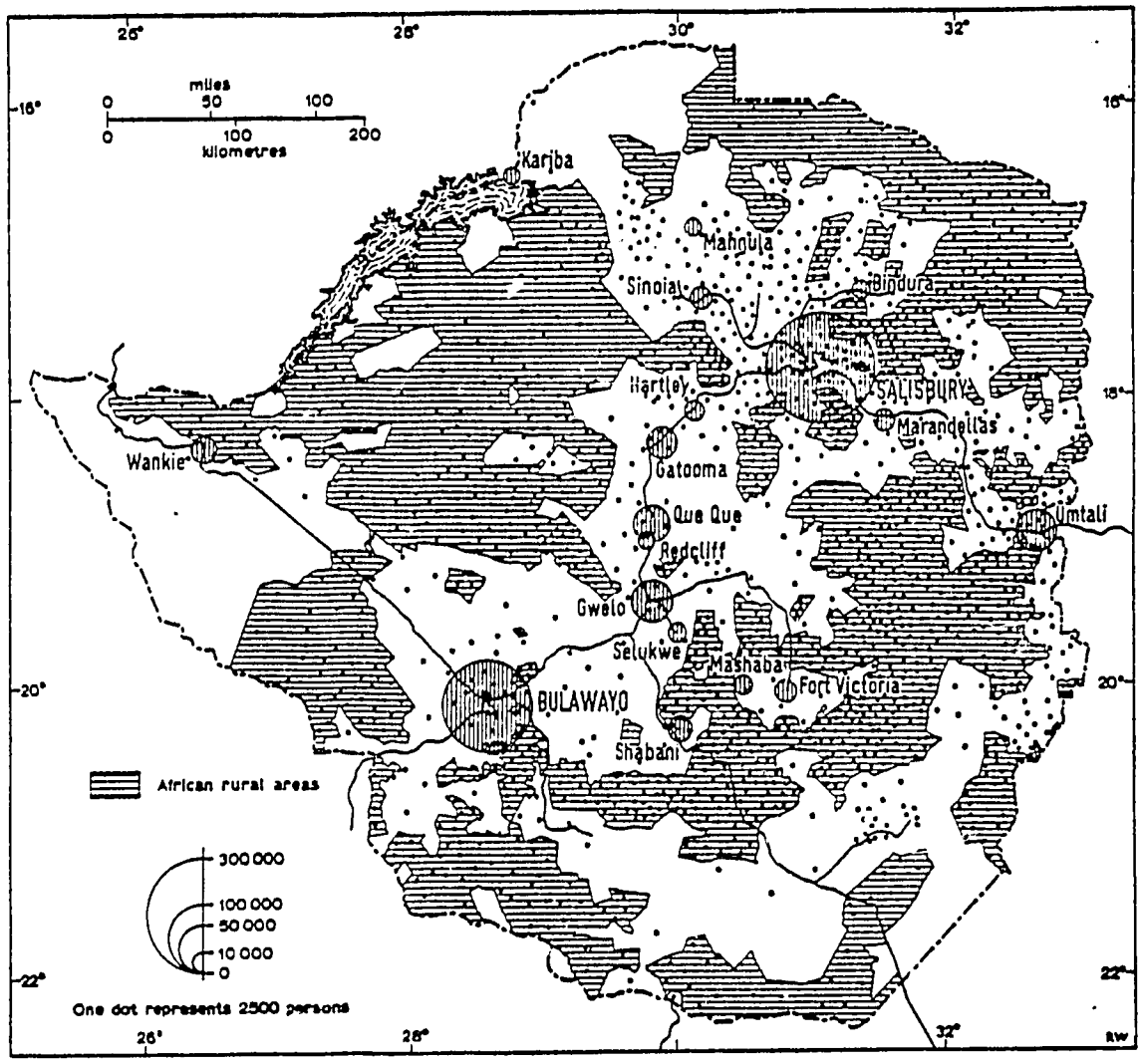

Figure 2. African Population, 1969.

Source: Kay. 1970.

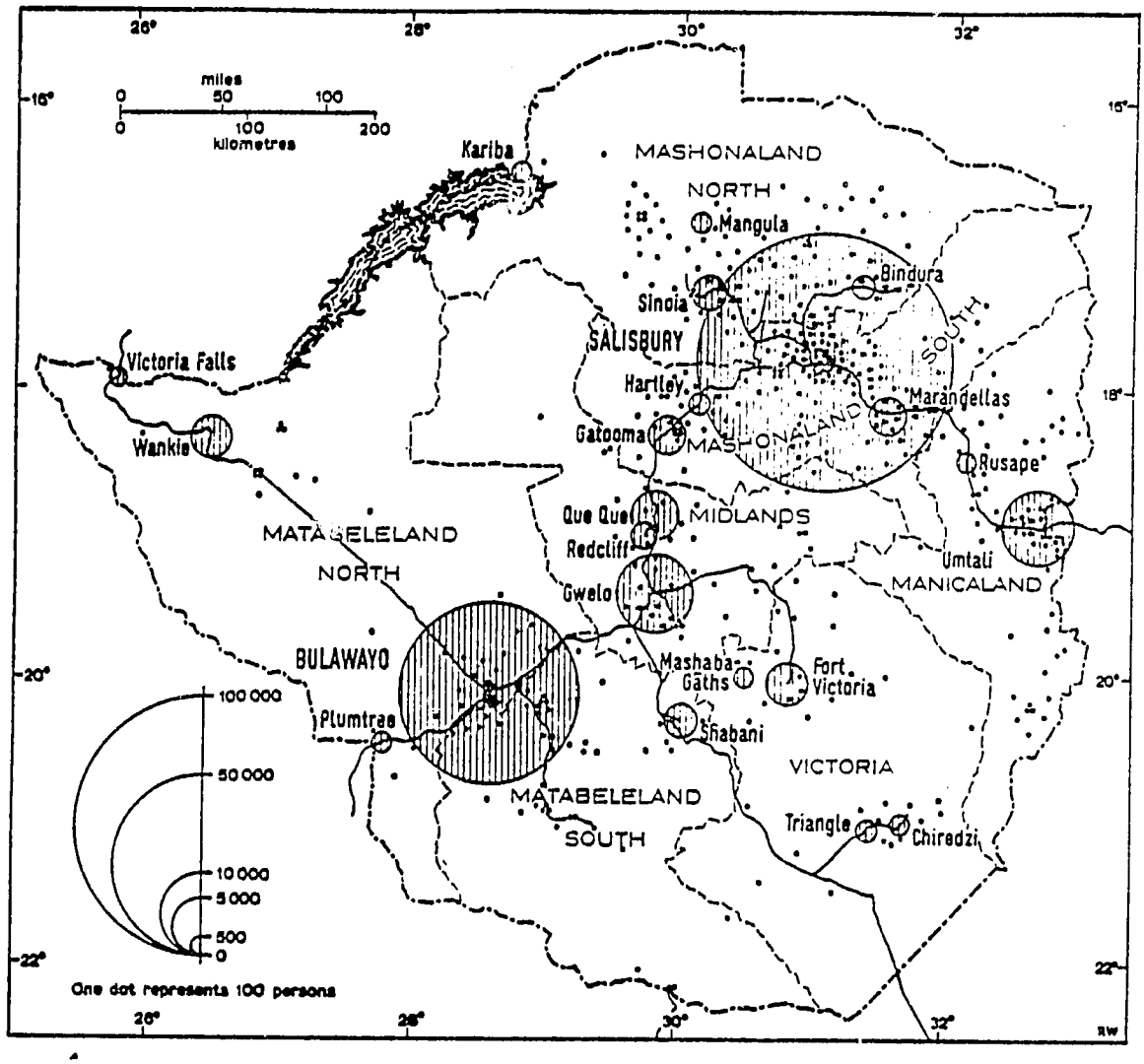

Figure 3. European Population, 1969.

Source: Kay. 1970.

Table 3. Utilization of Ministry Hospitals, 1964 and 1973

	Admissions		Out-patient Attendances	
	1964	1973	1964	1973
Central Hospitals	68,728	85,315	785,064	845,891
General Hospitals	52,136	54,019	439,587	392,451
District Hospitals	98,282	108,174	958,746	705,521
Rural Hospitals	144,940	75,097	2,149,341	968,530
TOTAL	364,086	322,605	4,332,738	2,912,393

Source: Family HealthCare adn AFRICARE. 1978.

Table 4. Church-Related (Mission) Hospitals, 1964 and 1973

	1964	1973
Numbers of Hospitals	64	66
Numbers of available beds	3,832	5,609
In-patient admissions	111,389	120,096
Out-patient attendances	1,950,405	1,414,191
STAFF: Medical	28	40
Nursing	127	170
Auxiliary	245	255

Source: Family HealthCare and AFRICARE. 1978.

Table 5. Municipal Health Services in Zimbabwe, 1973

Data	Salisbury	Bulawayo	Gwelo	Umtali	Queque	Ft. Victoria	Gatooma
Population	487,320	285,400	55,430	56,550	40,640	14,200	40,650
Admissions (Isolation Hospitals)	6,391	1,781	607	3,191	-	-	-
Beds	380	350	50	106	-	-	-
Clinics	19	10	4	4	2	2	2
Medical Examinations (Employed Africans)	130,431	8,621	13,480	10,221	-	99	1,495
Mother & Child Welfare Attendances	47,090	117,716	9,832	44,819	2,041	245	10,108
Diphtheria Immunizations	34,218	47,468	9,435	5,709	834	290	2,224
Poliomyelitis Immunizations	35,532	46,564	10,235	5,910	1,568	290	2,224
Smallpox Vaccinations	120,659	94,312	27,939	11,268	639	155	751
BCG Vaccinations	39,401	3,256	6,289	891	436	-	1,126
Chest X-ray Examinations	123,155	81,174	22,467	-	-	-	-
Health Visitor Case Visits	59,390	10,746	7,528	4,108	-	1,911	6,000
Health Inspector Visits	15,230	44,402	N.R.	8,115	590	500	N.R.
Staff: Medical	4	3	-	-	-	-	-
Medical (Part-time)	6	1	1	1	1	1	1
Health Inspectors	30	24	3	4	2	1	2
Public Health Nurses (Health Visitors)	14	10	2	1	1	1	2
Nurses	52	27	11	14	2	1	12
Auxiliaries	114	102	26	9	11	2	1

N.R. = Nil Return

Source: Family HealthCare and AFRICARE. 1978.

Table 6. Medical and Paramedical Personnel, 1973

REGISTERED WITH THE MEDICAL COUNCIL OF RHODESIA AS AT 31 DECEMBER 1973	
CATEGORY	NUMBER ON THE REGISTER
Medical practitioners	772
Medical practitioners (temporary register)	38
Medical practitioners (register of house officers)	9
Medical practitioners (provisional register)	34
Dental surgeons	136
Dental surgeons (temporary register)	11
Dental surgeons (provisional register)	4
Pharmaceutical chemists	315
Pharmaceutical chemists (temporary register)	5
Pharmaceutical chemists (provisional register)	5
Opticians	37
Opticians (temporary register)	0
Dispensing opticians	25
Psychologists	20
Physiotherapists	106
Physiotherapists (provisional register)	3
Radiographers	104
Occupational therapists	6
Prosthetists and orthotists	8
Medical laboratory technologists	100
Medical laboratory technologists (provisional register)	1
Health inspectors	78
Meat and other foods inspectors	2
Meat and other foods inspectors (health inspectors with meat and other foods)	64
Meat inspectors	14
Meat inspectors (provisional register)	1
Dental technicians	31
Dental technicians (provisional register)	4
Dental hygienists	3
Dental hygienists (provisional register)	1
Electroencephalographic technicians	1
State registered nurses	3,731
State registered nurses (provisional register)	73
State registered nurses (mental nurses)	140
State registered nurses (nurses for the mentally subnormal)	5
State registered nurses (mental nurses - provisional register)	1
State registered nurses (enrolled nurses, mental)	5
State registered nurses (enrolled nurses)	87
State registered nurses (enrolled nurses - provisional register)	3
State registered nurses (fever nurses)	70
State registered nurses (sick children's nurses)	11
State registered midwives	1,777
State registered midwives (provisional register)	8
State registered midwives (maternity nurses)	156
State registered midwives (maternity nurses - provisional register)	2
Medical assistants	1,719
Medical assistants (provisional register)	2
African nursing orderlies who have not transferred to the medical assistants register	408
Health assistants	298
African hygiene demonstrators who have not transferred to the health assistants register	63
Nursing assistants	76
Nursing assistants (provisional register)	2
Maternity assistants	445
Maternity assistants (provisional register)	5

Source: Family HealthCare and AFRICARE. 1978.

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Appendix III

Economic Characteristics

Table 1 World Bank Economic Data Sheet

Figure 1. Economic Activity

Table 2. Industry

Table 3. Budget Estimates

Table 4. Foreign Trade

Table 5. Trade with Selected Countries

Table 6. Employment and Earnings of Africans by Sector

Economic Data Sheet 1 - Population, National Accounts, and Prices
GNP Per Capita - 1977 (US$) 460

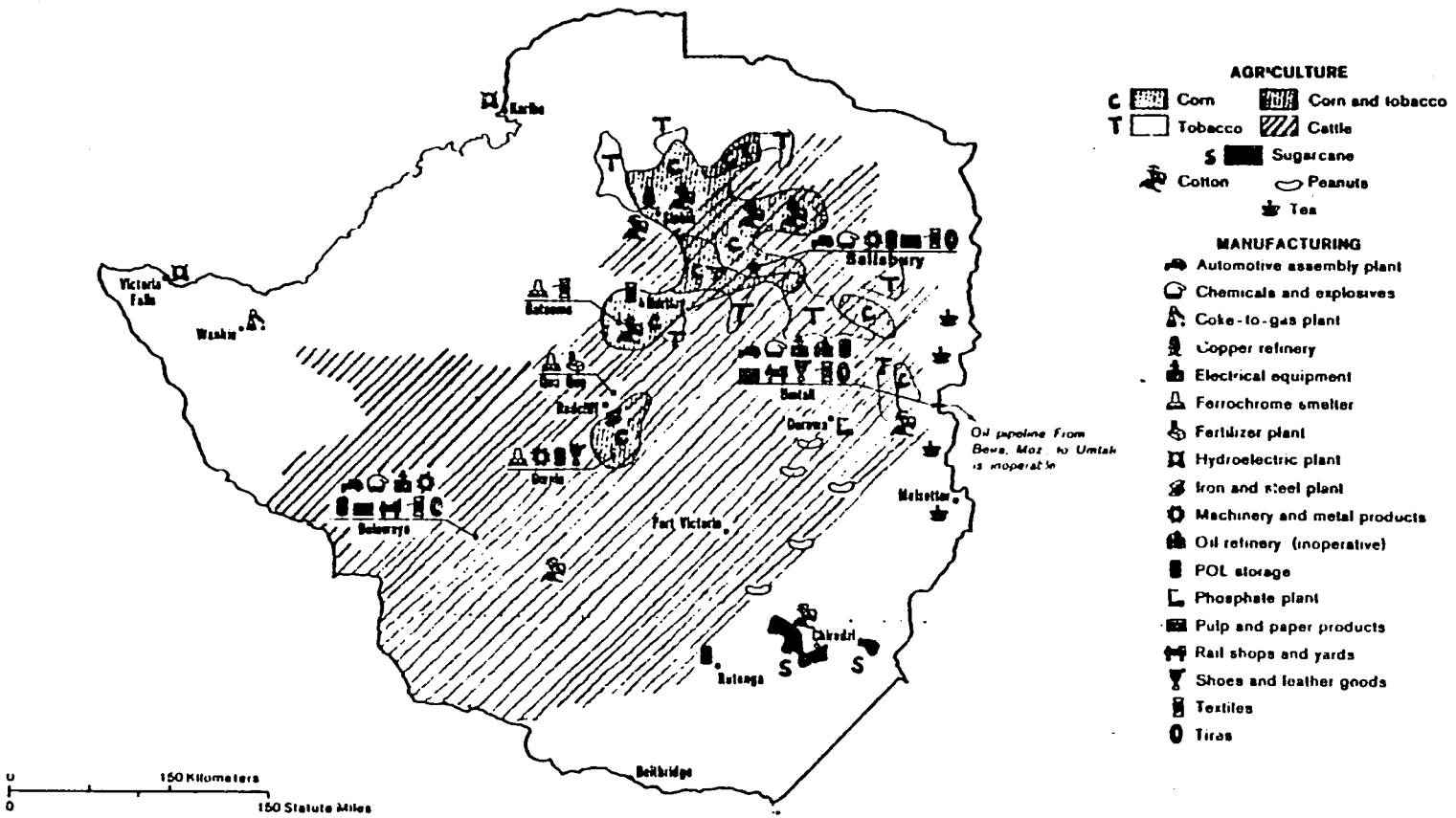
	1950	1955	1960	1965	1966	1967	1968	1969	1970	1971
Population										
(Total, midyear, thousands)	2415.0	2956.0	3605.0	4432.0	4595.0	4764.0	4939.0	5120.0	5308.0	5484.0
GDP by industrial origin									At current factor cost	
Agriculture	..	..	99.2	115.9	134.8	152.0	124.5	169.7	153.4	200.3
Mining	..	..	38.3	48.3	45.2	46.2	48.1	63.7	68.3	70.9
Manufacturing	..	..	93.3	134.7	122.9	142.1	152.4	177.2	212.1	252.4
Construction	..	..	44.9	31.9	32.6	40.5	43.9	52.0	54.3	57.4
Electricity, gas, and water	..	..	18.5	21.8	24.2	25.8	26.9	30.0	31.6	33.8
Transport and communications	..	..	49.4	60.2	54.5	50.5	74.1	88.0	85.5	95.8
Trade and finance	..	..	98.4	122.8	111.0	125.9	138.4	156.1	173.2	193.0
Public administration and defense	..	..	28.6	40.3	44.8	48.0	51.2	57.3	61.9	69.9
Other branches	..	..	87.2	108.9	117.6	123.4	122.4	135.7	149.1	164.5
GDP at factor cost	..	..	557.8	684.8	687.6	754.2	781.9	929.7	989.4	1138.0
Net indirect taxes	..	..	35.6	53.9	48.7	55.1	61.7	68.1	84.3	97.9
GDP at market prices	..	..	593.4	738.7	736.3	809.3	843.6	997.8	1073.7	1235.9
GDP by industrial origin (constant 1965 prices)									At constant factor cost	
Agriculture	..	..	..	..	..	..	..	..	..	..
Mining	..	..	..	..	..	..	..	..	..	..
Manufacturing	..	..	..	..	..	..	..	..	..	..
Construction	..	..	..	..	..	..	..	..	..	..
Electricity, gas, and water	..	..	..	..	..	..	..	..	..	..
Transport and communications	..	..	..	..	..	..	..	..	..	..
Trade and finance	..	..	..	..	..	..	..	..	..	..
Public administration and defense	..	..	..	..	..	..	..	..	..	..
Other branches	..	..	..	..	..	..	..	..	..	..
GDP at factor cost	..	..	584.1	684.8	703.1	758.8	782.1	877.1	901.9	1004.4
Net indirect taxes	..	..	37.3	53.9	50.0	55.5	60.0	64.0	76.7	86.6
GDP at market prices	..	..	621.4	738.7	753.1	814.3	822.1	941.1	978.6	1091.0
Resources and expenditures									At current market prices	
GNP	..	..	574.6	712.7	717.1	795.9	828.7	980.0	1052.7	1205.5
Factor payments to abroad (net)	..	..	-18.8	-26.0	-19.2	-13.4	-14.9	-17.8	-21.0	-30.4
GDP	..	..	593.4	738.7	736.3	809.3	843.6	997.8	1073.7	1235.9
Imports of goods and N.F.S.	..	..	..	..	..	..	..	..	..	..
Exports of goods and N.F.S.	..	..	..	..	..	..	..	..	..	..
Total resources	..	..	602.2	682.1	717.3	812.5	877.8	972.1	1064.1	1259.6
Private consumption	..	..	400.0	483.4	506.1	537.0	572.3	671.6	712.2	916.4
General government consumption	..	..	63.8	84.7	88.5	94.9	103.6	113.6	121.7	140.2
Gross domestic investment	..	..	138.4	114.0	122.7	180.6	201.9	186.9	230.2	303.0
Resources and expenditures (constant 1965 prices)									At constant market prices	
GNP	..	..	601.7	712.7	735.6	802.1	807.7	924.5	959.6	1064.0
Factor payments to abroad (net)	..	..	-19.7	-26.0	-17.5	-12.2	-14.4	-16.6	-19.0	-27.0
GDP	..	..	621.4	738.7	753.1	814.3	822.1	941.1	978.6	1091.0
Imports of goods and N.F.S.	..	..	..	..	..	..	..	..	..	..
Exports of goods and N.F.S.	..	..	..	..	..	..	..	..	..	..
Total resources	..	..	144.9	682.1	695.1	770.1	816.0	880.9	928.2	1052.0
Private consumption	..	..	..	483.4	492.3	511.9	533.7	617.4	627.8	703.2
General government consumption	..	..	..	84.7	84.2	90.3	94.9	98.1	103.7	106.1
Gross domestic investment	..	..	144.9	114.0	118.6	167.9	187.4	165.4	196.7	242.7
Investment financing									At current market prices	
Gross domestic investment	..	..	138.4	114.0	122.7	180.6	201.9	186.9	230.2	303.0
Gross national savings (excluding net current transfers from abroad)	..	..	110.8	144.6	122.5	164.0	152.8	194.8	218.8	248.9
Net balance of goods and services	..	..	-27.6	30.6	-0.2	-16.6	-49.1	7.9	-11.4	-54.1
Gross national savings (including net current transfers from abroad)	..	..	..	..	..	..	..	..	..	..
Domestic price indexes (1970=100)										
Consumer price (or retail price) index	..	..	..	91.2	94.0	95.4	97.6	98.0	100.0	103.0
Wholesale price index	..	..	..	84.2	87.3	89.7	92.4	95.8	100.0	103.1
Implicit GDP deflator	..	..	87.1	91.2	89.2	90.6	93.5	96.6	100.0	103.3
									Rhodesian dollars per US dollar	
Foreign exchange rate	..	..	0.714	0.714	0.714	0.714	0.714	0.714	0.714	0.714

a. 1960. b. 1970-78. c. Including ownership of dwellings. d. 1965-70. e. 1962-70. f. 1964-70.

1972	1973	1974	1975	1976	1977	1950-60	1960-70	1970-77	
						Average annual growth rate (percent)			
5665.0	5853.0	6047.0	6247.0	6462.0	6683.0	4.1	3.9	3.3	(Total, midyear, thousands)
(millions of Rhodesian dollars)						As percentage of GDP			
233.6	215.0	315.9	322.2	339.5	385.5	17.8[a]	18.5	17.0[b]	Agriculture
72.0	97.3	127.3	123.5	161.6	140.9	6.9[a]	6.4	6.9[b]	Mining
298.3	343.6	425.2	454.2	441.2	393.9	16.7[a]	18.6	23.2[b]	Manufacturing
73.4	81.0	81.0	94.5	76.0	93.1	8.0[a]	5.5	5.0[b]	Construction
37.7	41.1	41.5	50.0	54.5	48.7	3.3[a]	3.5	2.8[b]	Electricity, gas, and water
105.4	105.2	113.3	128.3	137.3	155.1	8.9[a]	8.6	7.4[b]	Transport and communications
226.0	259.3	311.3	341.3	347.6	410.8[c]	17.6[a]	17.1	17.7[b]	Trade and finance
78.0	91.2	106.7	126.6	160.1	180.8	5.1[a]	6.0	6.7[b]	Public administration and defense
175.1	196.6	213.9	236.5	251.8	122.1	15.6[a]	15.9	13.3[b]	Other branches
1299.5	1430.3	1736.1	1877.1	1969.6	1930.9	100.0[a]	100.0	100.0[b]	GDP at factor cost
101.6	112.8	109.6	127.8	153.0	149.0	6.4[a]	7.4	7.5[b]	Net indirect taxes
1401.1	1543.1	1845.7	2004.9	2122.6	2079.9	106.4[a]	107.4	107.5[b]	GDP at market prices
(millions of Rhodesian dollars)						Average annual growth rate (percent)			
..	..	..	..	..	..	..	..	..	Agriculture
..	..	..	..	..	..	..	..	..	Mining
..	..	..	..	..	..	..	..	..	Manufacturing
..	..	..	..	..	..	..	..	..	Construction
..	..	..	..	..	..	..	..	..	Electricity, gas, and water
..	..	..	..	..	..	..	..	..	Transport and communications
..	..	..	..	..	..	..	..	..	Trade and finance
..	..	..	..	..	..	..	..	..	Public administration and defense
..	..	..	..	..	..	..	..	..	Other branches
1104.1	1146.1	1265.4	1243.9	1198.8	1105.9	..	4.2	3.4	GDP at factor cost
86.2	89.9	80.0	84.4	93.2	85.2	..	6.3	1.1	Net indirect taxes
1190.3	1236.0	1345.4	1328.3	1292.0	1191.1	..	4.3	3.2	GDP at market prices
(millions of Rhodesian dollars)						As percentage of GDP			
1366.0	1504.6	1805.9	1968.2	2077.5	2035.3	96.8[a]	97.1	97.8	GNP
-35.1	-38.5	-39.8	-36.7	-45.1	-44.6	-3.2[a]	-2.9	-2.2	Factor payments to abroad (net)
1401.1	1543.1	1845.7	2004.9	2122.6	2079.9	100.0[a]	100.0	100.0	GDP
..	..	..	..	..	..	..	..	..	Imports of goods and N.F.S.
..	..	..	..	..	..	..	..	..	Exports of goods and N.F.S.
1362.4	1515.0	1869.8	2057.4	2030.7	1983.7	101.5[a]	97.6	98.8	Total resources
893.1	969.2	1144.9	1247.7	1330.1	1315.5	67.4[a]	66.9	63.3	Private consumption
152.6	174.8	211.6	252.5	323.8	273.7	10.8[a]	11.7	12.4	General government consumption
316.7	371.0	513.3	557.2	376.8	394.5	23.3[a]	18.9	23.0	Gross domestic investment
(millions of Rhodesian dollars)						Average annual growth rate (percent)			
1160.6	1205.6	1316.3	1304.3	1264.5	1165.7	..	4.6	3.2	GNP
-29.7	-30.4	-29.1	-24.0	-27.5	-25.4	..	..	..	Factor payments to abroad (net)
1190.3	1236.0	1345.4	1328.3	1292.0	1191.1	..	4.3	3.2	GDP
..	..	..	..	..	..	..	..	..	Imports of goods and N.F.S.
..	..	..	..	..	..	..	..	..	Exports of goods and N.F.S.
1093.7	1152.2	1305.8	1297.2	1162.8	1071.9	..	30.0	2.6	Total resources
749.4	779.9	857.9	863.8	838.1	773.1	..	6.0[d]	3.5	Private consumption
104.3	105.1	111.7	117.2	129.5	119.2	..	4.4[d]	2.9	General government consumption
240.0	267.2	336.2	316.2	195.2	179.6	..	4.8	-0.8	Gross domestic investment
(millions of Rhodesian dollars)						As percentage of GDI			
316.7	371.0	513.3	557.2	376.8	394.5	100.0[a]	100.0	100.0	Gross domestic investment
320.3	360.6	449.4	468.0	423.6	446.1	80.1[a]	97.6	95.9	Gross national savings (excluding net current transfers from abroad)
3.6	-10.4	-63.9	-89.2	46.8	51.6	-19.9[a]	-2.4	-4.1	Net balance of goods and services
..	..	..	..	..	..	..	..	..	Gross national savings (including net current transfers from abroad)
						Average annual growth rate (percent)			
106.0	109.3	116.5	123.1	143.0	160.1	..	2.3[e]	6.9	Consumer price (or retail price) index
106.6	114.0	132.6	151.6	168.2	195.8	..	3.3[f]	10.5	Wholesale price index
107.3	113.8	125.1	137.6	149.8	159.2	..	1.3	7.3	Implicit GDP deflator
(annual average)									
0.677	0.585	0.583	0.557	0.621	0.688				Foreign exchange rate

Source: World Bank. 1980.

Figure 1. Economic Activity



Source: Available from U.S. GPO, Map 503850 2-79 (54385)

Table 2. Industry

(gross output in Z$'000)

	1976	1977	1978
Mining and quarrying	265,368	280,928	279,383
Meat industry	102,548	119,657	119,620
Grain mill products	63,876	74,173	83,782
Bakery products	30,399	33,037	36,579
Dairy and other food products	99,099	100,541	111,326
Alcoholic beverages	51,275	53,691	62,893
Soft drinks	17,383	17,846	19,841
Tobacco manufacturing	34,491	33,498	38,468
Clothing and footwear	85,158	79,909	80,765
Other textiles	151,818	156,577	165,009
Wood industries, except furniture	18,093	17,111	18,327
Furniture, except metal	19,284	16,472	18,839
Pulp, paper and board	32,746	31,769	35,545
Printing and publishing	32,773	34,121	36,373
Fertilizers and pesticides	68,292	77,162	87,075
Soap preparations and pharmaceuticals	40,216	40,402	42,984
Other chemical products, including plastic and rubber	73,034	74,464	75,775
Cement, bricks and other non-metal products	45,121	41,473	38,295
Metal industries, including machinery, except electrical (other than vehicles)	290,616	267,012	298,680
Electrical machinery	35,738	39,157	40,037
Transport and equipment	45,050	46,707	42,870
Other industries	13,839	14,801	17,051
TOTAL MANUFACTURING INDUSTRIES	1,350,759	1,369,580	1,470,034
Electricity generation and distribution	96,193	107,359	118,665
Water supply	12,092	12,472	12,807
TOTAL ALL INDUSTRIES	1,724,412	1,770,839	1,880,889

Source: Europa. 1980.

Table 3. Budget Estimates

(Z$'000, year ending June 30th)

Revenue	1980/81
Income tax	387,000
Non-resident shareholders' tax	18,000
Branch profits tax	2,200
Sales tax	166,000
Customs duties	42,000
Excise duties	67,900
Betting tax	4,500
Stamp duties and fees	7,800
Estate duty	3,000
Interest, dividends and profits	53,900
Rents	2,600
Water supplies	1,000
Fees: Agriculture	600
Civil aviation	1,700
Education	5,500
Health	1,000
National parks	600
Roads and road traffic	1,050
Water development	550
Pension contributions of Government employees	20,000
Judicial fines	2,600
Sale of State property	3,300
Other revenue	70,411
Total	863,211

Expenditure	1980/81
Agriculture	58,932
Defence	233,275
Foreign affairs	9,200
Treasury	197,523
Commerce and industry	39,728
Mines and energy resources	4,024
Transport and power	52,347
Local government and housing	6,745
District administration	34,120
Vocational education and training	9,345
Lands, resettlement and rural development	34,392
Labour and social services	11,701
Health	83,072
University of Zimbabwe	12,915
Education and culture	183,922
Home affairs	6,256
Zimbabwe Republic Police	82,799
Prison service	13,732
Justice and constitutional affairs	5,353
Roads and road traffic, posts and telecommunications	42,341
Works	48,533
Public service	5,725
Information and tourism	5,715
Natural resources and water development	3,[illegible]
National parks and wild life management	5,921
Water development	15,524
Other expenditure	23,343
Total	1,227,324

Source: Europa. 1980.

Table 4. Foreign Trade

EXTERNAL TRADE
(Z$ '000)

	1976	1977	1978	1979
Imports	382,518	388,157	404,239	550,908
Exports and Re-exports	551,583	540,750	612,364	702,302

PRINCIPAL COMMODITIES
(Z$'000)

IMPORTS	1978
Petroleum products	79,016
Machinery	72,448
Transport equipment	29,670
Textiles	19,563
Steel products	17,099
Chemicals	15,449
Insecticides, fungicides, etc.	10,921
Medicine and drugs	9,660

EXPORTS	1978
Tobacco (unmanufactured)	116,519
Asbestos	57,344
Gold	49,800
Cotton lint	40,063
Steel	38,945
Nickel and nickel alloys	36,542
Meat	34,556
Ferro-chrome	31,600
Copper	26,857
Maize	25,433
Clothing	11,878

Source: Europa. 1980a.

Table 5. Trade with Selected Countries, 1965 - 1975

(U.S. $ Millions)

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Exports to:											
South African Customs Union	41.0	60.0	80.0	80.0	85.0	95.0	105.0	130.0	200.0	250.0	302.0
Switzerland	5.7	4.2	3.9	3.5	3.6	4.3	4.5	4.6	7.7	7.4	7.3
Malawi	20.8	17.3	14.7	12.6	12.5	18.6	16.1	21.2	21.3	24.[illegible]	29.5
Zambia	99.5	64.9	45.1	31.6	30.5	30.5	28.9	29.6	16.2	12.0	nil
West Germany	35.1	30.5	16.0	13.3	1.1	0.6	0.5	0.4	0.5	0.5	0.7
Australia	3.3	0.8	nil	nil	nil	nil	nil	nil	nil	nil	nil
Imports from:											
South African Customs Union	78.0	110.0	135.0	150.0	155.0	180.0	215.0	182.0	220.0	230.0	270.0
Switzerland	1.6	1.9	1.9	2.5	1.5	2.0	2.9	3.2	3.8	4.5	2.8
Malawi	4.4	3.0	2.7	2.9	3.8	5.0	5.3	5.8	7.2	8.4	9.5
Zambia	15.3	7.0	2.9	1.3	0.6	0.5	0.7	0.5	1.5	0.5	0.8
West Germany	10.9	11.2	12.3	12.9	1.2	1.2	1.6	2.0	2.2	2.6	2.5
Australia	4.5	4.1	5.7	5.9	3.5	4.9	4.8	4.1	nil	nil	nil

Source; Robbins. 1978.

Table 6. Employment and Earnings of Africans by Sector

Sector	Number of Employees 1966	1971	1977	Real Average Earnings 1966	1971	1977
	(thousands)			(Z$ 1974 prices)		
Agriculture and Forestry	272.0	305.3	342.3	119	114	129
Mining and Quarrying	45.7	54.1	57.4	286	305	366
Manufacturing	68.5	104.3	126.9	406	417	510
Electricity & Water	3.8	4.1	4.7	350	421	497
Construction	29.4	40.9	41.4	350	408	411
Finance, Insurance, Real Estate	2.3	2.5	4.0	579	656	956
Distribution	38.7	46.3	52.4	332	408	449
Transport and Communication	15.5	25.3	31.3	595	635	644
Public Administration	21.5	27.3	43.3	372	449	611
Education	24.5	24.4	29.5	482	655	706
Health	6.6	7.9	10.2	461	535	659
Private Domestic Service	95.7	114.0	123.0	231	250	236
Other Services	19.8	26.6	34.1	312	364	414
Total/Average	644.0	783.0	901.0	248	282	327

Source: U.S. AID. 1981.

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Appendix IV

Water and Soil Resources and Use

Figure 1. Moisture Characteristics of Selected Stations

Figure 2. Surface Runoff

Figure 3. Runoff from Catchments

Table 1. Water Balance of the Zambezi Basin

Figure 4. Reference Map of the Sabi Valley (Tables 2 & 3)

Table 2. Velocity and Direction of Groundwater Flow in the Sabi Valley

Table 3. Horizontal Flow Measurements

Figure 5. Reference Map of the Sabi Valley (Table 4)

Table 4. Groundwater Characteristics of the Sabi Valley

Table 5. Analytical Data of Soils near Dett Vlei (Matabeleland North)

Table 6. Analytical Data of Soils from Highveld

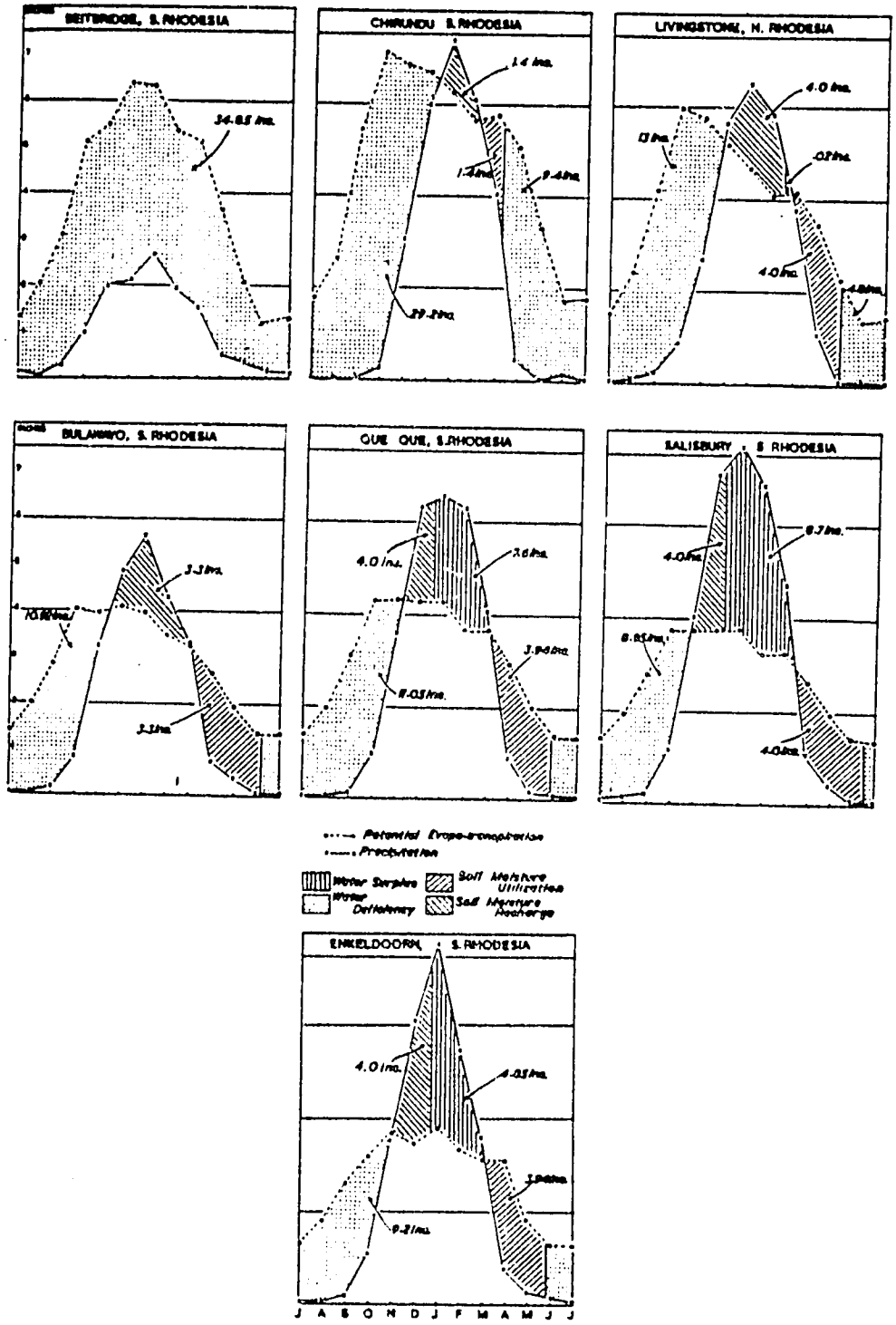
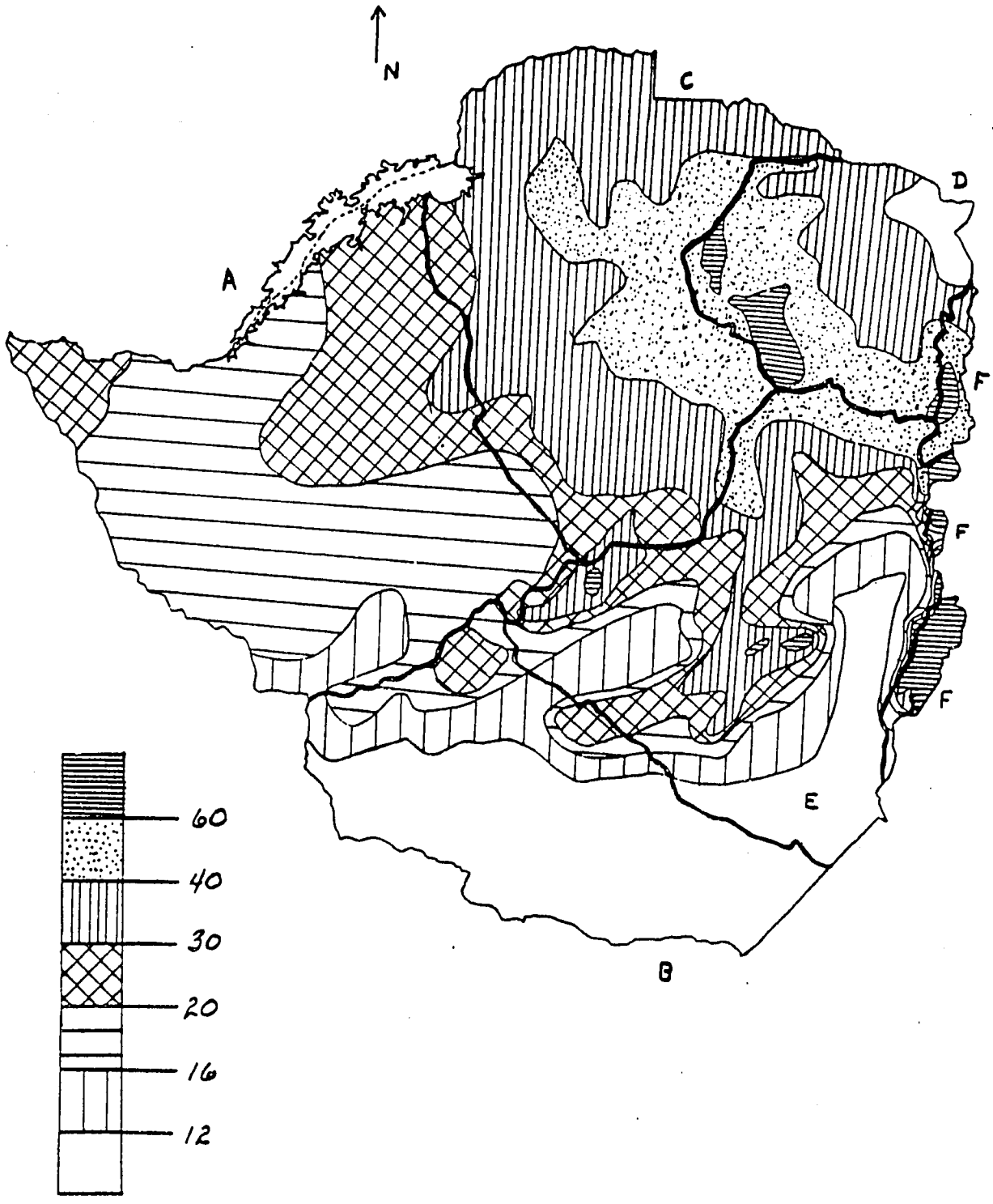


Figure 1. Moisture Characteristics of Selected Stations

Source: Howe. 1953.

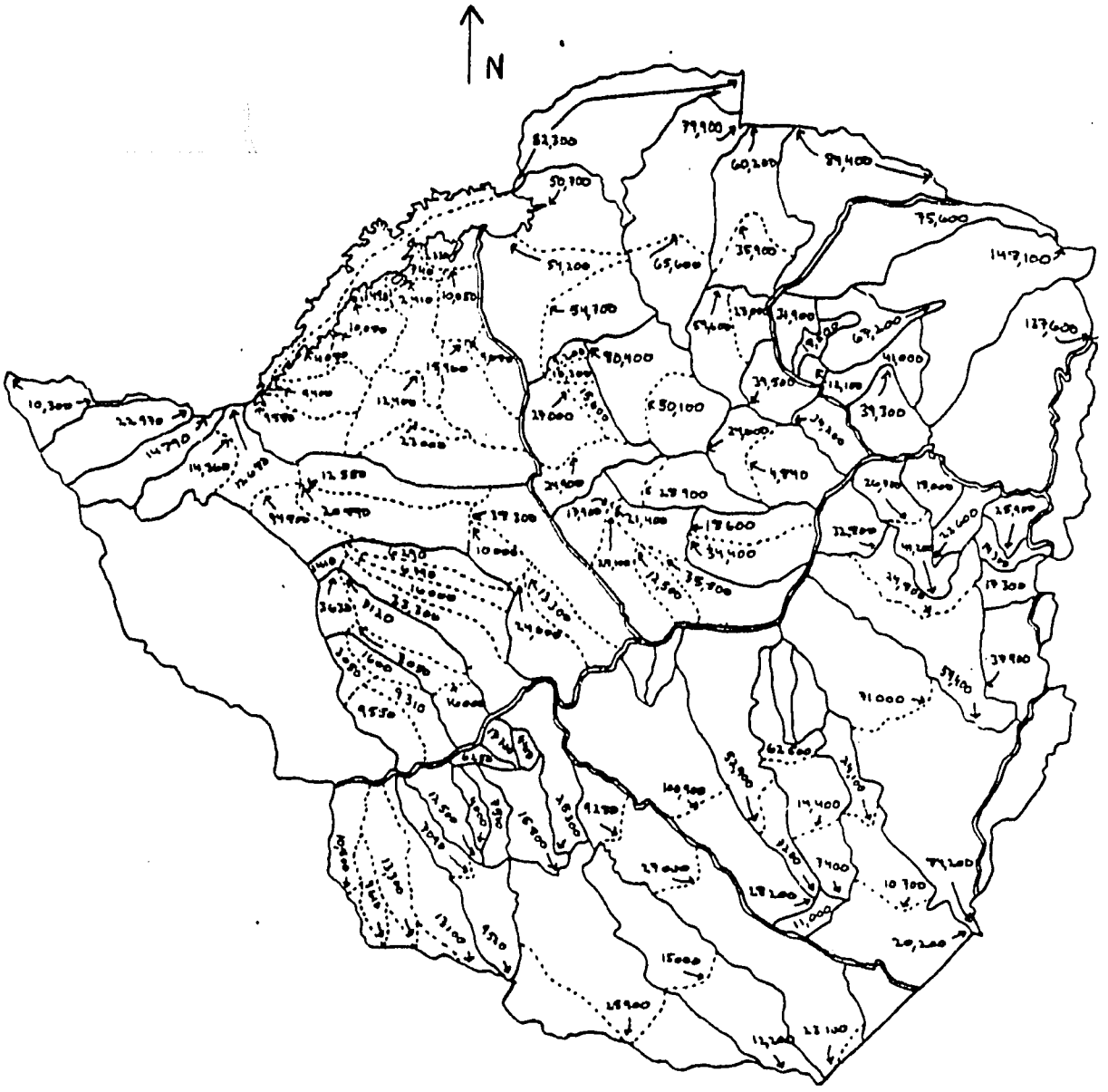


A Hydrological Zone

The isopleths show the run-off to be expected from a granite soil in millions of gallons per square mile under average conditions.

Figure 2. Surface Run-off

Source: Adapted from Collins. 1965.



Hydrological Zones

Hydrological Sub-Zones

Major River Catchment within the Sub-Zone

14,360 Average Run-Off in Millions of Gallons from the Catchment, Allowing for Variations of Soil Type (For simplicity only six general soil types have been considered)

Figure 3. Runoff from Catchments

Source: Adapted from Collins. 1965.

Table 1. Water Balance of Zambezi Basin

River	Location	Dr. area	Precipitation	Runoff	Evapotranspiration	Runoff coef.	Water yield	Mean annual discharge
Unit		km^2	mm	mm	mm	%	$l/s/km^2$	m^3/s
Zambezi	Chavuma Falls	75,967	1288	231	1057	0.18	7.3	555
Interbasin	Chavuma Falls-Chobe	284,538	1030	61	969	0.16	1.9	541
Zambezi	above Chobe	360,505	1085	95	990	0.09	3.0	1096
Chobe	mouth	870,758[1])	625[2])	3	622	0.01	0.1	135
Zambezi	below Chobe	1231,263	760	30	730	0.05	1.0	1231
Interbasin	Chobe-Vict. Falls	5,317	605	21	584	0.03	1.1	6
Zambezi	Victoria Falls	1236,580	759	30	729	0.04	1.0	1237
Interbasin	Victoria F.-Kafue	163,380	718	54	664	0.08	1.6	261
Zambezi	above Kafue	1399,960	754	34	720	0.05	1.1	1498
Kafue	mouth to Zambezi	154,856	1023	85	938	0.08	2.7	417
Zambezi	below Kafue	1554,816	782	38	744	0.05	1.2	1915
Interbasin	Kafue-Luangwa	19,091	1198	25	1173	0.02	0.8	151
Zambezi	above mouth Luangwa	1573,907	787	41	746	0.05	1.3	2066
Luangwa	mouth	148,326	925	91	834	0.10	2.9	436
Zambezi	below Luangwa	1722,233	799	44	755	0.06	1.4	2501

[1]) with Northern Kalahari
[2]) Chobe basin only, 798mm

Source: Balek. 1977.

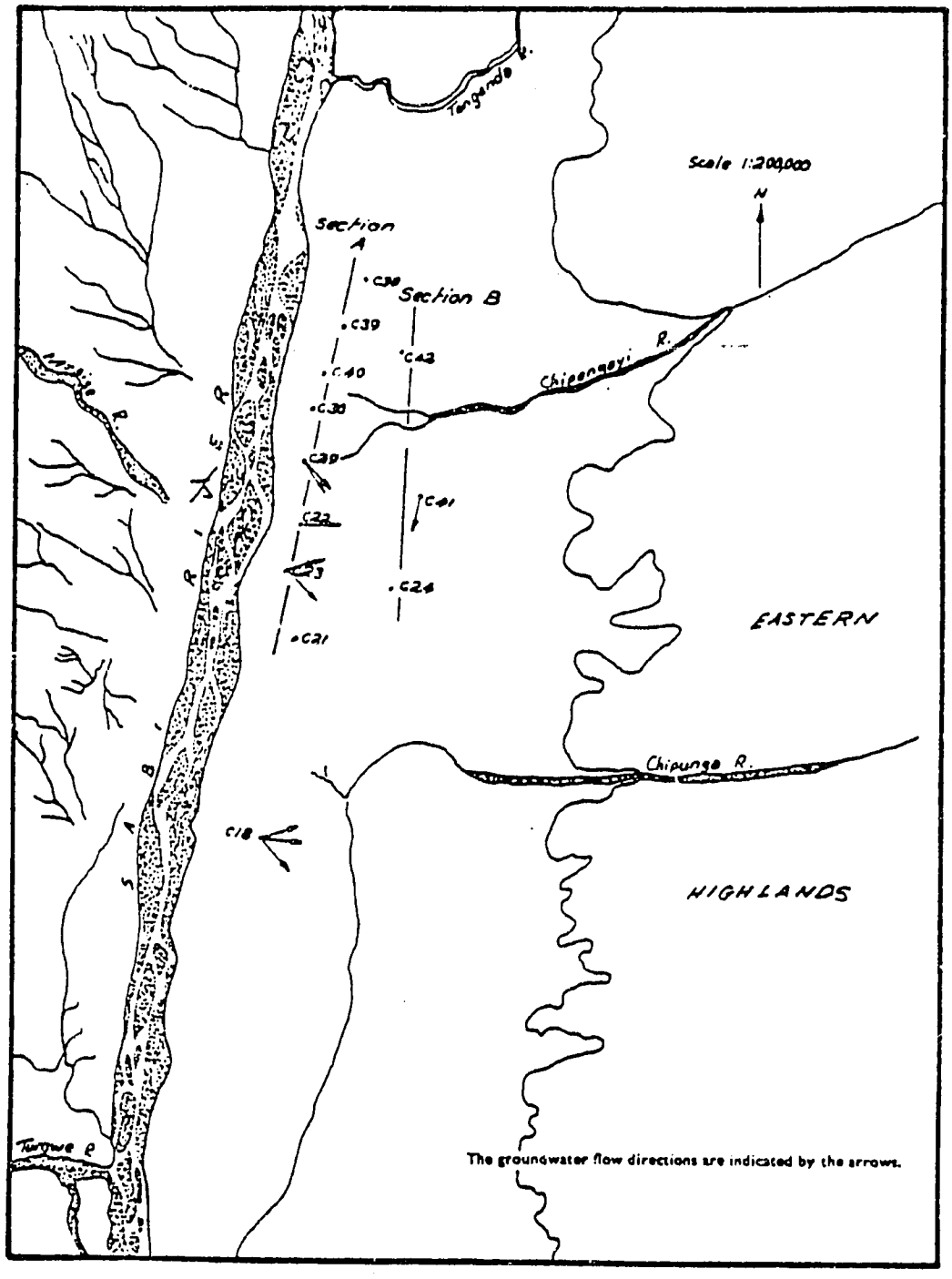


Figure 4. Reference Map of the Sabi Valley (Tables 2 & 3)

Source: Wurzel and Ward. 1967.

Table 2. Velocity and Direction of Groundwater Flow in the Sabi Valley, Preliminary Results

Borehole No.	Diameter	Horizon	Date	Horizontal Velocity[2]	Direction	Layer	Vertical Velocity
C18	6"	110 ft.	Nov. 1965	Zero			
		120 ft.	Nov. 1965	Zero			
		144 ft.	Nov. 1965	Zero	92°		
		254 ft.	Nov. 1965	1.3 ft./day	135°		
		300 ft.	Nov. 1965		72°		
		120 ft.	July 1967	Zero		120 ft.	22 ft./day
		144 ft.	July 1967	Zero		144 ft.	30 ft./day
C21	6"	133 ft.	Nov. 1965	Zero	Insig.		
		155 ft.	Nov. 1965	0.5 ft./day	Insig.		
		161 ft.	Nov. 1965	0.15 ft./day			
		175 ft.	Nov. 1965		Insig.		
C22	6"	125 ft.	Nov. 1965	1.1 ft./day	87°		
		150 ft.	Nov. 1965	0.7 ft./day			
C23	6"	90 ft.	Nov. 1965	2.4 ft./day	132°		
		110 ft.	Nov. 1965	Zero			
		132 ft.	Nov. 1965	Zero			
		153 ft.	Nov. 1965	0.4 ft./day	71°		
C24	6"	150 ft.	Jan. 1967	0.15 ft./day	Insig.		
		160 ft.	Jan. 1967	Zero			
		175 ft.	Jan. 1967	0.9 ft./day	Insig.		
Borehole	**Diameter**	**Horizon**	**Date**	**Horizontal Velocity[1]**	**Direction**	**Layer**	**Vertical Velocity**
C29	6"	140 ft.	Jan. 1967	2.6 ft./day	150°		
		155 ft.	Jan. 1967	2.5 ft./day	134°		
C30	6"	152 ft.	Jan. 1967	9.8 ft./day			
		166 ft.	Jan. 1967	3.7 ft./day			
C38	7.5 cm.	148 ft.	Jan. 1967	Insig.	Insig.		
		168 ft.	Jan. 1967	Zero			
C38A	6"	145 ft.	Jan. 1967	3.9 ft./day			
C39	6.3 cm.	75 ft.	July 1967	1.7 ft./day		63-72 ft.	12.7 ft./min. down
		101 ft.	July 1967			79-93 ft.	0.08 ft./min. down
C39B	6"	165 ft.	July 1967	Zero		108-120 ft.	31 ft./min. down
						146-157 ft.	4.2 ft./min. down
C40	6.3 cm.	54 ft.	July 1967	Vertical currents exist. Electronic failures prevented measurements.			
C41	6"	132 ft.	July 1967			132 ft.	Zero
		134 ft.	July 1967	0.9 ft./day		150-153 ft.	43 ft./day up
		142 ft.	July 1967	3.8 ft./day	0°	165 ft.	
		147 ft.	July 1967	4.2 ft./day			
		153 ft.	July 1967	3.4 ft./day	195°		
		165 ft.	July 1967	0.6 ft./day			
C42	6.3 cm.	170½ ft.	July 1967	4.0 ft./day		160½ ft.	69 ft./day
						165 ft.	4.4 ft./day
						178 ft.	21 ft./day
						185 ft.	Zero
						192 ft.	Zero

1. For the 6-inch boreholes, ϕ (the correction factor to allow for streamline distortion) = 2.45; for 6.3 and 7.5 cm. boreholes, $\phi \times 3.31$.

2. Corrected for Null Effect and for ϕ Factor

Source: Wurzel and Ward. 1967.

Table 3. Horizontal Flow Measurements

Borehole	Position of Aquifers	Thickness of Aquifer	Average filtration Velocity	Flow in Each Aquifer	Total flow through Aquifers intersected
	ft.	ft.	ft./day	cu. ft./day	cu. ft./day
C21	126–185	59	0.23	13.6	13.6
C23	82– 95	13	2.4	31.2	31.2
C22	123–130	7	1.1	7.7	24.5
C22	146–170	24	0.7	16.8	24.5
C29	120–178	58	2.5	148	148
C30	131–188	57	6.7	382	382.
C38	132–182	50	1.3	65	65

Soruce: Wurzel and Ward. 1967.

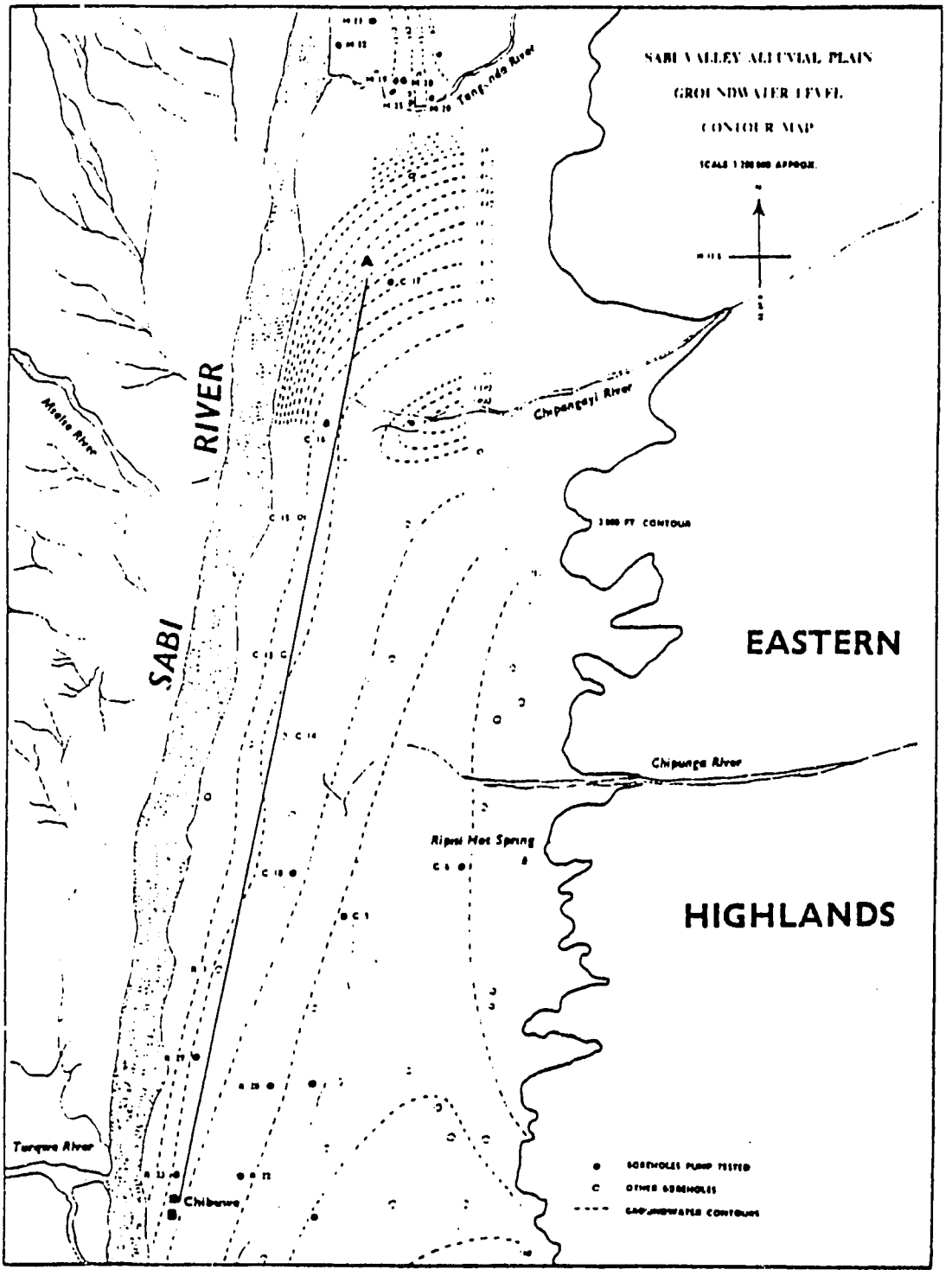


Figure 5. Reference Map of the Sabi Valley (Table 4)

Source: Hindson and Wurzel. 1963.

Borehole No.	Depth of Borehole (in ft.)	Method	T in Gallons per day per foot	S	Mean T	Mean S	Extent of penetration of the Alluvium
M19	121	Theis' Recovery Formula	220,000	—	220,000	—	Complete (111 ft.)
M20	113	" " "	27,280	—	27,280	—	Complete (98 ft.)
M22	126	" " "	254,000	—	254,000	—	Complete (107 ft.)
M25	133	" " "	150,000	—	150,000	—	Complete (123 ft.)
M28	111	Theis' Nonequilibrium on drawdown	221,800	0·11	—	—	Complete (111 ft.)
		Jacob's Modification on drawdown	240,700	0·077	—	—	—
		Chow's Modification on drawdown	222,400	0·137	228,300	0·108	—
C5	207	Theis' Recovery Formula	46,000	—	46,000	—	Partial
C6	217	" " "	194,000	—	194,000	—	Partial
C16	218	" " "	62,000	—	62,000	—	Partial
C17	241	" " "	147,000	—	147,000	—	Partial
C18	375	Theis' Non-Equilibrium on D/D	350,000	0·00052	—	—	Complete (371 ft.)
		Jacob's Modification on D/D	346,000	0·00059	—	—	—
		Jacob's Modification on Recovery	338,000	0·00046	—	—	—
		Chow's Modification on D/D	347,000	0·000158	—	—	—
		Chow's Modification on Recovery	338,000	0·000164	345,000	0·00038	—
R22	202	Computed by Groundwater Division, United States Geological Survey Dept.	—	—	57,500	0·00057	Partial
R23	146	Theis' Non-Equilibrium on D/D	13,400	0·00037	—	—	Partial
		Theis' Recovery Formula	13,390	0·00043	13,395	0·0040	—
R 28	152	Theis' Recovery Formula	51,400	—	51,400	—	Partial
R 29	300	Theis' Non-Equilibrium on D/D	148,000	0·00059	—	—	Complete (295 ft.)
		Jacob's Modification on D/D	125,000	0·000418	—	—	—
		Chow's Modification on D/D	149,000	0·000396	134,000	0·000468	—

T = Coefficient of transmissibility in gallons per day per foot
S = Coefficient of storage

Table 4. Groundwater Characteristics in Sabi Valley

Source: Hindson and Wurzel. 1963.

Table 5. Analytical Data of Soils near Dett Vlei (Matabeleland North)

A. —ANALYTICAL DATA* FOR PROFILE SAMPLES FROM AN ACID SULPHATE SOIL UNDER POOR, TUFTED GRASS

(a) Granulometric composition and free iron† content

Depth, cm	0–8	12–24	30–40	76–96
Coarse sand (2.0–0.5 mm), %	—	8	7	11
Medium sand (0.5–0.2 mm), %	—	42	44	36
Fine sand (0.2–0.02 mm), %	—	46	45	41
Silt (0.02–0.002 mm), %	—	1	3	1
Clay (<0.002 mm), %	—	3	1	1
Free iron as Fe_2O_3†, %	8.1	0.12	0.07	0.02

(b) pH (saturated paste) and specific conductivity and composition of the saturation extract

pH	3.13	3.30	3.38	3.50
Specific conductivity, millimhos/cm	6.0	3.5	3.6	3.8
Cations, me/litre:				
Ca^{2+}	28.7	26.0	24.5	21.7
Mg^{2+}	15.6	6.9	13.4	13.3
Na^{+}	9.71	2.75	2.89	5.31
K^{+}	1.46	0.52	0.41	0.32
Total	55.5	36.2	41.2	40.6
Anions, me/litre:				
SO_4^{2-}	78.7	45.4	51.7	48.3
Cl^{-}	6.2	0.9	0.1	1.3
Total	84.9	46.3	51.8	49.6
Inferred $H^{+}+Fe^{3+}+Al^{3+}$, me/litre	29.4	10.1	10.6	9.0

(c) Approximate composition of the peaty surface horizon (0–8 cm)

Total water soluble salts (mainly gypsum), %	26
Total organic material, %	45
Free iron as Fe_2O_3†, %	8
Mineral soil, %	21

* Expressed in terms of the sample dried at 105 C.
† Determined by the dithionite reduction method of Holmgren (1967).

B. —ANALYTICAL DATA* FOR TWO AUGER BORINGS IN BARE AREAS

	No. 1		No. 2	
Depth, cm	0–23	66–89	0–22	62–90
pH	2.60	2.40	2.50	2.80
Specific conductivity, millimhos/cm	c. 24	9.90	c. 70	5.0
Cations, me/litre:				
Ca^{2+}	25.9	21.0	29.1	12.9
Mg^{2+}	100.0	29.6	413.6	12.2
Na^{+}	11.12	1.70	51.1	1.74
K^{+}	0.88	0.06	1.09	0.10
Total	137.9	52.4	494.9	26.9
Anions, me/litre:				
SO_4^{2-}	356.6	138.6	1 078	62.3
Cl^{-}	4.7	3.1	20.1	1.3
Total	361.3	141.8	1 098.1	63.6
Inferred $H^{+}+Fe^{3+}+Al^{3+}$, me/litre	223.4	89.4	603.2	36.7

† Determined by the dithionite reduction method of Holmgren (1967).
* Expressed in terms of the sample dried at 105 C.

Source: Thompson. 1972.

Table 6. Analytical Data of Soils from Highveld (35km SSW of Salisbury)

	Inches	Percent						Milligram-equivalents per 100 g						
Profile	Depth	C.S.	M.S.	F.S.	Silt	Clay	pH	CEC	Ca	Mg	K	Na	E C Value	ESP
1	0–3	4	24	66	4	2	4·9	2·6	1·1	0·3	0·24	0·01		
	6–10	4	25	65	4	2	5·6	1·2	0·8	0·2	0·13	0·02		
	21–27	4	19	71	5	1	6·2	0·7	0·4	0·2	0·10	0·01		
	43–49	3	16	55	3	23	4·2	4·7	1·1	0·9	0·54	0·01	20	
	73–79	4	17	53	2	24	4·4	4·7	1·4	1·5	0·25	0·01	20	
	105–111	4	14	55	3	24	4·8	4·3	1·7	1·9	0·26	0·01	18	
2	0–5	9	30	57	2	2	4·3	1·1	0·2	0·1	0·09	0·01		
	5–13	10	27	59	2	2	4·4	0·8	0·2	0·1	0·06	0·01		
	13–19	9	27	60	2	2	4·5	0·8	0·1	0·1	0·05	0·00		
	19–26	8	24	57	2	9	4·3	2·2	0·5	0·5	0·17	0·05	25	
	26–29	8	24	54	2	12	4·2	3·5	0·5	0·8	0·19	0·04	29	
	29–33	9	24	48	3	16	4·1	5·0	0·5	1·2	0·24	0·07	31	
	33–40	8	21	51	3	17	4·1	4·5	0·5	1·4	0·24	0·15	27	
3	0–3½	6	24	63	5	2	4·9	2·8	0·9	0·4	0·24	0·20		[illegible]
	3½–8	7	25	62	4	2	4·8	2·0	0·6	0·3	0·16	0·20		10
	14–22	7	23	66	3	1	5·6	0·9	0·6	0·1	0·06	0·24		[illegible]
	28–35	9	26	52	2	11	5·6	3·4	1·8	1·0	0·20	0·17	31	5
	48–59	7	19	54	2	18	5·3	5·2	2·8	1·9	0·24	0·04	29	1
	60–66	8	19	59	3	11	4·0	3·6	1·2	1·1	0·23	0·08	33	2
4	1–3	6	20	67	4	3	4·6	2·6	0·6	0·2	0·07	0·01		
	4–9	8	26	61	2	3	4·9	1·6	0·4	0·2	0·05	0·05		3
	12–17	8	26	64	1	1	6·1	0·5	0·2	Tr.	0·05	0·20		40
	20–23	6	22	59	2	11	6·5	4·2	1·4	0·4	0·09	2·30	38	55
	24–31½	6	22	54	2	16	6·9	5·5	2·0	0·[illegible]	0·12	2·27	34	41
	37½–43½	8	19	54	2	17	6·6	5·8	2·0	0·[illegible]	0·11	3·18	34	55
	53–57	6	17	67	1	9	5·9	2·8	1·1	0·6	0·08	0·75	31	[illegible]
5	1–4	7	22	63	4	2	3·3	2·1	0·5	0·3	0·35	0·03		1
	4–9½	9	26	60	3	2	4·7	2·1	0·2	0·1	0·35	0·04		2
	11–16	9	23	65	2	1	6·1	0·9	0·2	0·1	0·05	0·10		11
	17–23	9	21	46	2	22	7·2	8·0	2·5	1·8	0·12	4·31	36	54
	42–48	8	18	52	2	20	7·0	6·7	2·5	1·6	0·10	2·71	34	40
	58–64	9	17	68	1	5	6·2	1·5	0·7	0·4	0·10	0·34	31	23
	70–76	10	19	59	2	10	5·9	3·3	1·5	1·0	0·16	0·43	33	13
	83–90	11	20	57	3	9	6·0	3·3	1·6	1·1	0·26	0·24	37	7
	96–102	9	20	54	2	15	6·0	5·7	2·6	1·6	0·20	0·16	38	3
	108–114	9	17	51	4	19	6·0	5·7	3·2	1·9	0·22	0·19	30	3
	117–127	8	15	50	4	23	6·2	8·1	4·4	2·6	0·26	0·29	35	4
	127–132	9	16	47	4	24	6·2	9·6	5·2	4·4	0·29	0·37	40	4
	137–145	9	16	45	5	25	6·2	10·4	5·5	3·3	0·30	0·38	42	4
6	0–4	9	25	58	4	4	4·6	2·3	0·7	0·2	0·11	0·10		4
	5–7½	10	24	59	3	4	4·2	1·9	0·3	0·1	0·10	0·11		6
	10–15	10	24	60	2	4	4·1	1·8	0·2	0·1	0·06	0·10		6
	16–24	12	27	58	2	1	5·1	0·4	0·2	0·1	0·04	0·09	35	23
	24–30	10	24	47	2	17	5·8	5·3	2·4	1·4	0·10	0·97	31	18
	40–46	11	18	58	1	12	5·8	3·3	1·7	0·8	0·10	0·68	28	21
	62–68	11	21	54	2	12	6·0	2·7	1·6	0·8	0·10	0·60	23	22
	85–91	11	20	51	2	16	5·9	4·8	2·8	0·6	0·27	0·63	31	13
	103–109	12	21	46	2	19	5·9	5·4	2·8	1·6	0·22	0·83	29	15
	133–139	14	19	39	2	26	5·9	8·8	4·2	3·3	0·26	0·97	34	11
7	0–2	11	23	53	4	9	4·6	4·6	1·3	0·3	0·18	0·10		2
	3–5	11	26	51	4	8	4·1		1·0	1·2	0·08	0·10		
	9–16	12	24	46	4	14	4·0	5·5	1·3	0·5	0·07	1·36	39	25
	16–20	14	26	42	3	15	4·3	7·1	2·0	0·7	0·04	0·26	47	9
	20–23	12	16	37	3	32	5·2	11·0	5·6	2·3	0·12	1·61	34	15
8	1–4	14	17	51	8	10	4·1	5·2	0·9	0·3	0·15	0·13		3
	6–8	14	17	45	7	17	4·1	6·6	1·3	0·4	0·08	0·09	39	1
	19–23	10	14	31	3	42	6·3	15·1	8·8	2·4	0·10	3·27	36	22

CEC = Cation exchange capacity oer 100g of soil
E/C Vlaue = Cation exchange capacity per 100g of clay
ESP = Exchangeable sodium percentage = 100 Na/CEC

Source: Purves and Blyth. 1969.

Appendix V

Fauna and Protected Areas

Table 1. Partial Listing of Zimbabwean Mammals

Table 2 Check List of Southern African River Fishes

Table 3. IUCN Data on Zimbabwean Endangered Species

Table 4. Data on Protected Areas

Table 1. Partial Listing of Zimbabwean Mammals

Scientific Name	Common Name
ARTIODACTYLA (Even-toed Ungulates)	
Potomochoerus porcus	Bush Pig (Red River Hog)
Phacochoerus aethiopicus	Warthog
Hippopotamus amphibius	Hippopotamus
Giraffa camelopardalis	Giraffe
Cephalophus monticola	Blue Duiker (Maxwell's Duiker)
Neotragus moschatus	Suni
Sylvicapra (Cephalophus) grimmia	Common Duiker (Grey Duiker)
Raphicerus campestris	Steinbok
Raphicerus (Nototragus) Sharpei	Sharpe's Grysbok (Northern)
Ourebia ourebi	Oribi
Oreotragus oreotragus	Klipspriner
Tragelaphus angasi	Nyala
Tragelaphus scriptus	Bushbuck
Tragelaphus spekii	Sitatunga
Tragelaphus strepsiceros	Kudu
Taurotragus oryx	Eland
Tragelaphus (Taurotgragus) oryx	
Oryx gazella	Gemsbok
Hippotragus equinus	Road antelope
Hippotragus niger	Sable antelope
Kobus ellipsiprymnus	Common waterbuck (Defassa waterbuck)
Kobus vardoni	Puku
Kobus leche	Lechwe
Redunca arundinum	Reedbuck (common reedbuck)
Damaliscus lunatus	Tsessebe
Alcelaphus buselaphus	Red Hartebeest
Alcelaphus lichtensteini	Lichtenstein's Hartebeest
Connochaetes taurinus	Blue Wildebeest
Aepyceros melampus	Impala
Syncerus caffer	Buffalo (African buffalo)
PERISSODACTYLA (Odd-toed Ungulates)	
Equus burchelli	Burchell's zebra
Diceros bicornis	Black rhinoceros
Ceratotherium simum	White rhinoceros

Scientific Name	Common Name
HYRACOIDEA (Hyraxes)	
Heterohyrax brucci	Yellow-spotted dassie
Procavia capensis	Rock dassie
PROBOSCIDEA (Elephants)	
Loxodonta africana	African elephant
TUBULIDENTATA (Aardvarks & Pangolins)	
Orycteropus afer	Aardvark
Manis temminchi	Pangolin
RODENTIA (Rodents)	
Paraxerus cepapi	Bush squirrel
Heliosciurus rufobrachium	Sun squirrel
Hystrix africaeaustralis	Porcupine
Cricetomys gambianus	Giant rat (Giant Gambian rat)
Pedetes capensis	Spring hare
Thryonomys sewinderianus	Cane rat
Lepus whytei	Hare (Whyte's hare)
CARNIVORA (Carnivores)	
Canus adustus	Side-striped jackal
Canis mesomelas	Black-backed Jackal
Octocyon megalotis	Bat-earred Fox
Lycaon pictus	Wild dog (Hunting dog)
Poecilogale albinucha	African striped weasel (White-naped weasel)
Ictonyx striatus	Zorilla (Striped polecat)
Mellivora capensis	Honey badger (Ratel)
Lutra (Hyarictis) maculicollis	Spotted-necked otter
Aonyx capensis	Clawless otter (Cape clawless otter)
Genetta spp.	Genet
Viverra civetta	Civet (African civet)
Ichneumia albicanda	White-tailed Mongoose
Atilax paludinosus	Marsh Mongoose
Herpestes icheumon	Large grey mongoose (Egyptian mongoose)
Herpestes (Gallerella) sanguineus	Slender mongoose

Scientific Name	Common Name
Mungos mungo	Banded mongoose
Helogale parvula	Dwarf mongoose
Paracynictis selousi	Selous' Mongoose
Proteles cristatus	Aard wolf
Hyaena brunnea	Brown Hyaena
Crocuta crocuta	Spotted hyena
Panthera leo	Lion
Panthera paraus	Leopard
Acinonyx jubatus	Cheetah
Felis caracal (*Caracal caracal*)	Caracal
Felis suval (*Leptailurus serval*)	Serval
Felis lybica (*Felis silvestris*)	African wild cat (Kaffir cat)
LEMURIDAE (Primates)	
Galago crassicaudatus	Bush baby (Greater bushbaby)
Galago senegalensis	Night ape (Lesser Galago, Senegal bushbaby)
CERCOPITHECIDAE (Primates)	
Papio ursinus	Chaema Babboon
Cercopithecus aethiops	Vervet monkey
Cercopithecus mitis	Blue Monkey
INSECTOVORA (Insectivores)	
Erinaceus frontalis	Hedgehog

Source: Hanks. 1974.

Table 2. Check List of Southern African River Fishes

	S.C.	Or.	Li.	E.C.	P.I.	S.L.	B.P.	L.Z.	M.Z.	U.Z.	Ka.	Cu.	
Carcharinidae													
Carcharinus leucas	·	·	+	·	·	+	·	+	+	·	·	·	
Pristidae													
Pristis microdon	·	·	+	·	·	+	·	+	·	·	·	·	
Lepidosirenidae													
Protopterus annectens brieni	·	·	+	·	·	+	+	+	+	·	·	·	
Elopidae													
Elops machnata	·	·	·	·	·	·	·	+	·	·	·	·	
Megalopidae													
Megalops cyprinoides	·	·	·	·	·	+	+	+	·	·	·	·	
Anguillidae													
Anguilla bicolor	+	·	+	+	+	+	+	+	·	·	·	·	
Anguilla marmorata	·	·	+	+	+	+	+	+	+	·	·	·	
Anguilla mossambica	+	·	+	+	+	+	+	+	·	·	·	·	
Anguilla nebulosa labiata	+	·	+	+	+	+	+	+	+	·	·	·	
Clupeidae													
Gilchristella aesturius	+	·	·	+	·	·	·	·	·	·	·	·	
Hilsa kelee													
Limnothrissa miodon	·	·	·	·	·	·	·	+	·	·	·	·	Ex.
Mormyridae													
Hippopotamyrus ansorgi	·	·	·	·	·	·	+	·	·	·	·	·	
Hippopotamyrus discorhyncus	·	·	·	·	·	·	+	+	+	+	·	·	
Marcusenius macrolepidotus	·	·	+	·	+	+	+	+	+	+	·	+	
Mormyrops deliciosus	·	·	·	·	·	·	+	+	+	·	·	·	
Mormyrus lacerda	·	·	·	·	·	·	·	·	·	+	·	+	
Mormyrus longirostris	·	·	·	·	·	+	+	+	+	·	·	·	
Petrocephalus catostoma	·	·	·	·	+	+	+	+	+	+	·	·	
Pollimyrus castelnaui	·	·	·	·	·	·	·	·	·	+	·	·	
Salmonidae													
Salmo gairdneri	+	+	·	+	·	·	+	·	·	·	·	·	Ex.
Salmo trutta	+	+	·	+	·	·	+	·	·	·	·	·	Ex.
Salvelinus fontanalis	+	·	·	+	·	·	+	·	·	·	·	·	Ex.
Galaxiidae													
Galaxias zebratus	+	·	·	·	·	·	·	·	·	·	·	·	
Kneriidae													
Kneria angolensis	·	·	·	·	·	·	·	·	·	·	·	+	
Kneria auriculata	·	·	·	·	+	+	+	+	·	·	·	·	
Kneria polli	·	·	·	·	·	·	·	·	·	+	·	·	
Parakneria fortuita	·	·	·	·	·	·	·	·	·	+	·	·	
Parakneria mossambica		·	·	·	·	·	+	·	·	·	·	·	
Characidae													
Alestes imberi	·	·	·	·	+	+	+	+	+	·	·	·	
Alestes lateralis	·	·	·	·	·	·	·	·		+	+	+	
Alestes sp.	·	·	·	·	+	·	+	+	+	·	·	·	
Hemigrammopetersius barnardi	·	·	·		·	·	+	+	·	·	·	·	
Hydrocynus vittatus	·	·	+	·	+	+	+	+	+	·	·	·	
Micralestes acutidens	·	·	+	·	+	+	+	+	+	+	+	+	
Rhabdalestes maunensis	·	·	·	·	·	·	·	·	·	+	·	·	
Rhabdalestes rhodesiensis	·	·	·	·	·	·	·	·	+	+	+	·	

	S.C.	Or.	Li.	E.C.	P.I.	S.L.	B.P.	L.Z.	M.Z.	U.Z.	Ka.	Cu.
Hepsetidae												
Hepsetus odoë	.	.	.	.	.	.	.	.	.	+	+	+
Distichodontidae												
Distichodus mossambicus	.	.	.	.	.	+	+	+	+		.	
Distichodus schenga	.	.	.	.	.		+	+	+	.	.	.
Citharinidae												
Hemigrammocharax machadoi	.	.	.	.	.	.	.	.	.	+	.	.
Nannocharax macropterus	.	.	.	.	.	.	.	.	.	+	.	.
Nannocharax multifasciatus	.	.	.	.	.	.	.	.	.	+	.	.
Cyprinidae												
Barbus afer	+	.	.	.	.	.	.	.	.	.	.	.
Barbus afrohamiltoni	.	.	+	.	+	+	+	+	+	.	.	.
Barbus afrovernayi	.	.	.	.	.	.	.	.	.	+	+	+
Barbus andrewi	+	.	.	.	.	.	.	.		.	.	.
Barbus annectens	.	.	+	.	+	+	.	.	+	+	+	.
Barbus anoplus	+	+	+	+	+	.	.	.	.	.	.	.
Barbus argenteus	.	.	.	+	+	.	.	.	.	.		+
Barbus asper	+		.	.	.	.	.	.	.	.	.	.
Barbus aurantiacus	.	.	.	.	.	.	.	.	.	+	+	+
Barbus barnardi	.	.	.	.	.	.	.	.	.	+	+	.
Barbus barotseensis	.	.	.	.	.	.	.	.	.	+	.	.
Barbus bellcrossi	.	.	.	.	.	.	.	.	.	+	.	.
Barbus burgi	+	.	.	.	.	.	.	.	.	.	.	.
Barbus bifrenatus	.	.	.	.	.	.	.	.		+	.	.
Barbus brevipinnis	.	.	+	.	.	.	.	.	.	.	.	.
Barbus burchelli	+	.	.	.	.	.	.	.	.	.	.	.
Barbus callidus	+	.	.	.	.	.	.	.	.	.	.	.
Barbus capensis	+	.	.	.	.	.	.	.	.	.	.	.
Barbus caudosignatus	.	.	.	.	.	.	.	.	.	+	.	.
Barbus codringtoni	.	.	.	.	.	.	.	.	.	+	+	.
Barbus erubescens	+	.	.	.	.	.	.	.	.	.	.	.
Barbus eutaenia	.	.	+	.	+	+	+	+	+	+	+	+
Barbus fasciolatus	.	.	.	.	.	.	.	+	+	+	+	+
Barbus gurneyi	.	.	.	+	.	.	.	.	.	.	.	.
Barbus haasianus	.	.	.	.	.	.	.	+	+	+	+	.
Barbus holubi	.	+	.	.	.	.	.	.	.	.	.	.
Barbus hospes	.	+	.	.	.	.	.	.	.	.	.	.
Barbus kimberleyensis	.	+	.	.	.	.	.	.	.	.	.	.
Barbus lineomaculatus	.	.	.	.	.	+	+	+	+	+	+	+
Barbus manicensis	.	.	.	.	.	.	+	+	+	+	.	.
Barbus marequensis	.	.	+	.	+	+	+	+	+	.	+	+
Barbus mattozi	.	.	+	.	.	.	.	.	+	.	.	
Barbus motebensis	.	.	+	.	.	.	.	.	.	.	.	.
Barbus multilineatus	.	.	.	.	.	.	.	.	.	+	+	.
Barbus natalensis	.	.	.	+	.	.	.	.	.	.	.	.
Barbus neefi	.	.	+	.	.	.	.	.		+	.	.
Barbus pallidus	+	.	+	+	.	.	.		.	.	.	.
Barbus paludinosus	.	+	+	+	+	+	+	+	+	+	+	+
Barbus phlegethon	+	.	.	.	.	.	.	.	.	.	.	.
Barbus poechii	.	.	.	.	.	.	.	.	.	+	+	.
Barbus polylepis	.	.	+	.	+	.	.	.	.	.	.	
Barbus puellus	.	.	.	.	.	.	.	.	+	+	+	+
Barbus radiatus	.	.	+	+	+	+	+	+	+	+	.	.
Barbus serra	+	.	.	.	.	.		.	.	.	.	.

	S.C.	Or.	Li.	E.C.	P.I.	S.L.	B.P.	L.Z.	M.Z.	U.Z.	Ka.	Cu.	
Barbus tangandensis	·	·	·	·	·	+	+	·	·	+	+	·	
Barbus tenuis	+	·	·	·	·	·	·	·	·	·	·	·	
Barbus thamalakanensis	·	·	·	·	·	·	·	·	·	+	·	·	
Barbus toppini	·	·	+	+	+	+	+	+	·	·	·	·	
Barbus treurensis		·	+	·	·	·	·	·	·	·	·	·	
Barbus trevelyani	+	·	·	·	·	·	·	·	·	·	·	·	
Barbus trimaculatus	·	+	+	+	+	+	+	+	+	·	·	+	
Barbus unitaeniatus	·	·	+	·	+	+	+	+	+	+	+	+	
Barbus viviparus	·	·	+	+	+	+	+	+	+	+	+	+	
Barillius zambezensis	·	·	+	·	+	+	+	+	+	+	·	·	
Carassius auratus	·	·	·	+	·	·	·	·	·	·	·	·	Ex.
Coptostomabarbus wittei	·	·	·	·	·	·	·	·	·	+	·	·	
Cyprinus carpio	+	+	·	+	·	·	·	·	·	·	·	·	Ex.
Engraulicypris brevianalis	·	+	+	+	+	·	·	·	·	+	·	+	
Labeo altivelis	·	·	·	·	·	+	+	+	+	·	·	·	
Labeo capensis	·	+	·	·	·	·	·	·	·	·	·	·	
Labeo congoro	·	·	·	·	·	+	+	+	+	·	·	·	
Labeo cylindricus	·	·	+	+	+	+	+	+	+	+	+	+	
Labeo lunatus	·	·	·	·	·	·	·	·	·	+	·	·	
Labeo molybdinus	·	·	+	+	+	+	+	+	+	·	·	·	
Labeo rosae	·	·	+	·	+	·	·	·	·	·	·	·	
Labeo rubromaculatus	·	·	·	+	·	·	·	·	·	·	·	·	
Labeo rubropunctatus	·	·	+	·	+	+	+	+	·	·	·	·	
Labeo ruddi	·	·	+	·	+	·	·	·	·	·	·	·	
Labeo seeberi	+	·	·	·	·	·	·	·	·	·	·	·	
Labeo umbratus	+	+	·	·	·	·	·	·	·	·	·	·	
Oreodaimon quathlambae	·	+	·	·	·	·	·	·	·	·	·	·	
Varicorhinus nelspruitensis	·	·	·	·	+	·	·	·	·	·	·	·	
Varicorhinus pungweensis	·	·	·	·	·	·	+	·	·	·	·	·	
Bagridae													
Auchenoglanis ngamensis	·	·	·	·	·	·	·	·	·	+	·	·	
Chrysichthys hildae	·	·	·	·	·	·	+	·	·	·	·	·	
Gephyroglanis gilli	+	·	·	·	·	·	·	·	·	·	·	·	
Gephyroglanis sclateri	·	+	·	·	·	·	·	·	·	·	·	·	
Leptoglanis rotundiceps	·	·	·	·	·	·	+	+	+	·	+	·	
Leptoglanis dorae	·	·	·	·	·	·	·	·	·	+	·	·	
Schilbeidae													
Eutropius depressirostris	·	·	+	·	+	+	+	+	+	·	·	·	
Eutropius yangambianus	·	·	·	·	·	·	·	·	·	+	·	·	
Schilbe mystus	·	·	·	·	·	·	·	·	+	+	+	+	
Amphiliidae													
Amphilius lampei	·	·	·	·	+	·	·	·	·	·	·	·	
Amphilius natalensis	·	·	·	+	+	·	+	·	·	·	·	·	
Amphilius platychir	·	·	+	·	+	+	+	+	+	+	+	·	
Clariidae													
Clariallabes platyprosopos	·	·	·	·	·	·	·	·	·	+	·	·	
Clarias cavernicola Dark sink-hole, South West Africa													
Clarias dumerilii	·	·	·	·	·	·	·	·	·	+	·	+	
Clarias gariepinus	·	+	+	+	+	+	+	+	+	+	+	+	
Clarias ngamensis	·	·	+	·	+	+	+	·	·	+	+	+	
Clarias submarginatus	·		·	·	·	·	·	·	·	+	·	+	
Clarias theodorae	·			·	+	+	+	+	+	+	+	·	
Heterobranchus longifilis	·	·	·	·	·	·	+	+	+	·	·	·	
Malapteruridae													
Malapterurus electricus	·	·	·	·	·	·	+	+	+	·	·	·	

	S.C.	Or.	Li.	E.C.	P.I.	S.L.	B.P.	L.Z.	M.Z.	U.Z.	Ka.	Cu.	
Mochokidae													
Chiloglanis anoterus		·	+	+	+	·	·	·	·	·	·	·	
Chiloglanis bifurcus		·	·	·	+	·	·	·	·	·	·	·	
Chiloglanis emarginatus	·	·	·	·	+	·	+	·	·	·	·	·	
Chiloglanis fasciatus	·	·	·	·	·	·	·	·	·	+	·	·	
Chiloglanis neumanni	·	·	·	·	·	+	+	+	+	+	+	·	
Chiloglanis paratus	·		+	·	+	·	·	·	·	·	·	·	
Chiloglanis pretoriae		·	+	·	+	·	+	·	+	·	·	·	
Chiloglanis swierstrai	·	·	+	·	+	·	·	·	·	·	·	·	
Synodontis leopardinus	·	·	·	·	·	·	·	·	·	+	·	·	
Synodontis macrostigma		·	·	·	·	·	·	·	·	+	+	+	
Synodontis nebulosus	·	·	·	·	·	·	·	+	+	·	·	·	
Synodontis nigromaculatus	·	·	·		·	·	·	·	·	+	·	+	
Synodontis woosnami	·	·	·	·	·	·	·	·	·	+	·	·	
Synodontis zambezensis	·	·	·	·	+	+	+	+	+	·	·	·	
Cyprinodontidae													
Aplocheilichthys hutereaui	·	·	·	·	·	·	·	·	·	+	·	·	
Aplocheilichthys johnstonii	·	·	+	·	+	+	+	+	+	+	·	+	
Aplocheilichthys katangae	·	·	+	·	+	+	+	+	+	+	·	+	
Aplocheilichthys myaposae	·	·	·	·	+	·	·		·	·	·		
Hypsopanchax jubbi	·	·	·	·	·	·	·	·	·	+	·	·	
Nothobranchius brieni	·	·	·	·	·	·	·	·	·	+	·	·	
Nothobranchius furzeri	·	·	·	·	·	+		·	·	·	·	·	
Nothobranchius kuhntae	·	·	·	·	·	·	+	·	·	·	·	·	
Nothobranchius orthonon	·	·	+	+	+	+	+	+	·	·	·	·	
Nothobranchius rachovii	·	·	+	·	+	·	+	·	·	·	·	·	
Nothobranchius taeniopygus	·	·	·	·	·	·	·	·	·	+	+	·	
Peociliidae													
Gambusia affinis	+	·	·	·	·	·	·	·	·	·	·	·	Ex.
Centrarchidae													
Lepomis macrochirus	+	·	·	·	·	·	·	·	·	·	·	·	Ex.
Micropterus dolomieu	+	·	·	·	·	·	·	·	·	·	·	·	Ex.
Micropterus punctulatus	·	·	·	+	·	·	·	·	·	·	·	·	Ex.
Micropterus salmoides	+	·	·	·	·	·	·	·	·	·	·	·	Ex.
Percidae													
Perca fluviatilis	+	·	·	·	·	·	·	·	·	·	·	·	Ex.
Cichlidae													
Chetia flaviventris		·	+	·	·	·	·	·	·	·	·	·	
Haplochromis albolabris		·	·	·	·	·	·	·	·	·	·	+	
Haplochromis angolensis	·	·	·	·	·	·	·	·	·	·	·	·	
Haplochromis brevis	·			·	+	·	·	·	·	·	·	·	
Haplochromis buysi	·	·	·	·	·	·	·	·	·	·	·	+	
Haplochromis callipterus	·	·	·	·	·	+	+	·	·	·	·	·	
Haplochromis carlottae	·	·	·	·	·	·	·	·	+	+	+	·	
Haplochromis codringtoni	·	·	·	·	·	·			+	+	+	·	
Haplochromis coulteri	·	·	·	·	·	·		·	·	·	·	+	
Haplochromis darlingi	·	·	·	·	·	·	·	+	+	+	+	+	
Haplochromis giardi	·	·	·	·	·	·	·	·	·	+	+	·	
Haplochromis greenwoodi	·	·	·	·	·	·	·	·	·	+	+	·	
Haplochromis jallae			·	·	·	·	·	·	·	+	·	·	
Haplochromis machadoi	·	·	·	·	·	·	·	·	·	·	·	+	
Haplochromis mortimeri	·	·	·	·	·	·	·	·	·	+	+	·	
Haplochromis steindachneri	·	·	·	·	·	·	·	·	·	·	·	+	
Hemichromis fasciatus	·	·	·	·	·	·	·	·	·	+	·	·	
Pseudocrenilabrus philander	·	+	+	+	+	+	+	+	+	+	·	+	

	S.C.	Or.	Li.	E.C.	P.I.	S.L.	B.P.	L.Z.	M.Z.	U.Z.	Ka.	Cu.
Serotherodon andersoni	·	·	·	·	·	·	·	·	+	+	+	+
Sarotherodon macrochir	·	·	·	·	·	·	+	·	+	+	+	+
Sarotherodon mortimeri		·	·	·	·	·	·	·	+	·	·	·
Sarotherodon mossambicus	·	·	+	+	+	+	+	+	+	·	·	·
Sarotherodon placidus	·	·	·	·	·	+	+	+	·	·	·	·
Serranochromis angusticeps	·	·	·	·	·	·	·	·	·	+	+	+
Serranochromis longimanus	·	·	·	·	·	·	·	·	·	+	·	·
Serranochromis macrocephalus	·	·	·	·	·	·	·	·	·	+	+	+
Serranochromis meridianus	·	·	·	·	+	·	·	·	·	·	·	·
Serranochromis robustus jallae	·	·	·	·	·	·	·	·	+	+	+	+
Serranochromis thumbergi	·	·	·	·	·	·	·	·	·	+	+	+
Tilapia guinosana Sink-holes Guinas and Otjikoto, South West Africa												
Tilapia rendalli rendalli	·	·	·	·	·	+	+	+	+	+	+	+
Tilapia rendalli swierstrae	·	·	+	+	+	·	·	·	·	·	·	·
Tilapia ruweiti	·	·	·	·	·	·	·	·	·	+	·	·
Tilapia sparrmanii	·	+	+	+	+	+	+	+	+	+	+	+
Sparidae												
Acanthopagrus berda	·	·	·	·	·	+	·	·	·	·	·	·
Gobiidae												
Croilia mossambica	·	·	·	·	+	·	·	·	·	·	·	·
Glossogobius giuris	+	·	+	+	+	+	+	+	·	·	·	·
Platygobius aeneofuscus	·	·	+	+	+	+	+	+	·	·	·	·
Silhouttea sibayi	·	·	·	·	+	·	·	·	·	·	·	·
Eleotridae												
Eleotris fusca	·	·	·	+	+	·	·	·	·	·	·	·
Hypseleotris dayi	·	·	·	+	+	·	·	·	·	·	·	·
Anabantidae												
Ctenopoma ctenotis	·	·	·	·	·	·	·	+	·	·	+	·
Ctenopoma multispinis	·	·	·	·	·	·	·	+	·	+	·	·
Sandella bainsii	+	·	·	·		·	·	·	·	·	·	·
Sandelia capensis	+		·	·	·	·	·	·	·	·	·	·
Mastacembelidae												
Mastacembalus mellandi	·	·	·	·	·	·	·	·	·	+	·	·
Mastacembalus mutombotombo	·	·	·	·	·	·	·	·	·	+	·	·

S.C. = South Coastal Drainage Basin
Or. = Orange River Drainage Basin
Li. = Limpopo River Drainage Basin
E.C. = Natal rivers south of the Pongolo to the Umtamvuna River
P.I. = Pongolo and Incomati Rivers
S.L. = Sabi and Lundi Rivers
B.P. = Buzi and Pungwe Rivers
L.Z. = Lower Zambezi River system
M.Z. = Middle Zambezi River system
U.Z. = Upper Zambezi River system including the Okavango and Mashi Rivers
Ka. = Kafue
Cu. = Cunene River

Source: Bowmaker, Jackson and Jubb. 1978.

Table 3. IUCN Data on Zimbabwean Endangered Species

AFRICAN WILD DOG

Lycaon pictus

Order: CARNIVORA Family: CANIDAE

STATUS: Depleted throughout its range. Vulnerable to continued persecution, shrinkage of range and reduction in numbers of natural prey.

DISTRIBUTION: Throughout the savanna regions of Africa south of the Sahara, but now restricted to non-farming areas, west as far as the Ivory Coast and eastern border of Guinea then north to Mali, Niger and the southern parts of Algeria.

POPULATION: Depleted throughout its range. An IUCN survey in 1971 revealed a fair number outside the nature reserves in South Africa, about 340 in Kruger National Park, but none in Natal, the Orange Free State and most of the Cape Province; absent from the northern part of Namibia and depleted elsewhere; widely spread in Botswana, common in their national parks and outside; persisting only in game reserves in Rhodesia; good populations within the protected areas of Zambia but controlled outside owing to predation on the domestic animals of the increasing human population; rare in Tanzania even in national parks. Uncommon in the Ouadi Rime-Ouadi Achim faunal reserve in Chad.

HABITAT: Open or wooded savanna.

CONSERVATION MEASURES TAKEN: They are relatively free from persecution in the large national parks and game reserves of most African states, but prejudice against them as killers still persists, and they are still sometimes killed in protected areas.

CONSERVATION MEASURES PROPOSED: They should be given full protection of the law; control measures should be carefully supervised and eased wherever possible.

REMARKS: They are primarily diurnal and hunt in packs of 6-20 - sometimes up to 40 in number. They are commonly regarded as harmful to game and domestic stock, but they play an important role in the balance of their environment.

BROWN HYAENA

Hyaena brunnea

Order CARNIVORA Family HYAENIDAE

STATUS Vulnerable; depleted throughout its range. Healthy populations survive only where protected in parks or reserves.

DISTRIBUTION Formerly throughout southern Africa as far north as Zimbabwe, Malawi, Mozambique, south-central Angola and possibly extreme southwestern Zambia. Survives now in deminished numbers in South Africa as far south as the Kalahari Gemsbok National Park, Kimberley District and the eastern Cape, also present in southern Mozambique, southern parts of Rhodesia, the Kalahari region of Botswana and the more remote areas of Namibia.

POPULATION No comprehensive figures. A 1969 estimate of 150 brown hyaenas in the Kruger National Park was virtually a guess. However, since 300 is the minimum genetically viable population in South Africa only the Etosha National Park appears to be large enough. Except where protected in parks and reserves it is depleted throughout its range. There is some trade in skins, but the main reason for persecution is protection of livestock.

HABITAT Generally confined to dry, open scrub and woodland savanna; open plains, bushland and open forest. Its habitat does not usually overlap that of the spotted hyaena (Crocuta crocuta), as it is better able to utilize drier and more arid terrain. In Botswana it occurs alongside the spotted hyaena, being commoner in the drier southwestern area while the spotted hyaena replaces it in the extreme north and in the Caprivi Strip.

CONSERVATION MEASURES TAKEN protected in national parks and game reserves where it occurs. Botswana has set aside an area west of the Tshane/Tshabong road as a game reserve which will later have national park status, and which is considered as the area where it is most likely to survive in the wild in the long-term. In the Parque Nacional de Iona and in Reserva de Mocamedes in Angola it is completely protected in an area of over 20,000 sq. km.; law enforcement is improving. Included in Class B of the African Convention (1969) i.e. it may be hunted or collected only under special authorization granted by the competent authority. Included in Appendix I of the Convention on International Trade in Endangered Specis of Wild Fauna and Flora, 1973; trade in these animals between acceding nations is subject to severe restruction, trade for primarily commercial purposes is banned.

CONSERVATION MEASURES PROPOSED Full implementation of the African Convention 1969, so that it may be hunted or collected only under special authorization granted by the competent authority. It may be that national parks and game reserves will provide a permanent safeguard for the brown hyaena, in view of the South African authorities recent decision to cull carnivores in the Kruger National Park, and the failure of the wolf to survive in the national parks of the lower United States. Some captive breeding is therefore indicated.

REMARKS Still officially classed as veramin in South Africa. Even though it may not be tolerated in areas where it can cause severe losses to livestock, it should not be molested in thinly populated or uninhabited regions.

LEOPARD

Panthera pardus

Order: CARNIVORA Family: FELIDAE

STATUS: Vulnerable. Exterminated from large parts of its former range and depleted elsewhere. In some areas persecution and loss of habitat have taken a severe toll; at least five geographic races are threatened with extinction. But it is still widespread and maintaining good numbers, even increasing when not persecuted.

DISTRIBUTION: Africa, and most of southern Asia from Turkey across the USSR and China to Korea, southwards to Arabia, Sri Lanka and Java. Now very local and rare in the desert areas of northern Africa and the Middle East. Once the most widespread of the felids; it is still common where prey is plentiful and protection assured, but has declined significantly and sometimes critically in about half of Africa. Exterminated from large parts of its former range in southern Africa, eastern Africa (notably Somalia and Ethiopia), and certain sectors of West Africa (especially in the coastal states). Depleted elsewhere, notably parts of Kenya, northern Tanzania, western Zambia, Ngamiland in Botswana, parts of Angola and Mozambique, also Chad, Mali and Senegal, and parts of the coastal states of West Africa.

POPULATION: The leopard has had to give way to the advance of agriculture, deforestation, and depletion of its prey. In areas taken over for agriculture and stock-raising it has been either exterminated or depleted; but it is still widespread and maintaining good numbers where it persists. During the 1960s leopards were relentlessly trapped to meet a worldwide demand for their furs, and some populations were severely reduced. Efforts were made to correct this situation in several countries, notably Tanzania, Zambia and Botswana, e.g. through national predator management policies. In parts of southern Africa, the leopard is still considered vermin. In the miombo woodland zone poaching pressure has varied greatly, and in large areas density rises to one animal per five sq km. Because of tsetse fly, and dry and infertile soils, the miombo biome will be little affected by human activities exept for the 10-15 percent which constitute alluvial floodplains or "dambo" drainage systems.

HABITAT: Leopards inhabit a variety of biomes, from tropical rain forest, miombo woodland, savanna and rocky areas with heavy or scattered vegetation to the high, cold regions of the Himalayas, and the suburbs of Nairobi. In general, they are still widely found in all biomes of Africa south of the Sahara except for outright desert. One important factor is cover, both for hunting and for lying-up to feed and rest. Human modification of savanna ecotypes tends to the removal of trees and bush, although the leopard has proved to be exceptionally resilient and tolerant of changes to its habitat.

CONSERVATION MEASURES TAKEN: The leopard is widely protected as a game animal; where not protected, as in Nigeria, South Africa and Namibia, it is fully protected in parks and reserves. Where it is still not protected or where it preys on man's increasing herds of domestic stock it has been persecuted severely. International action has been necessary to curb the drain on protected populations from illegal trapping and smuggling through these same countries into the world trade channels. The International Fur Trade Federation imposed a three-year voluntary ban on its members' use of leopard skins, from September 1971 to September 1974. However, in 1972, the demand for leopard skins was higher than ever before. Included in Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973; trade in these animals between acceding nations is subject to severe restriction, trade for primarily commercial purposes is banned.

CONSERVATION MEASURES PROPOSED: The leopard should remain in Appendix 1 of the International Convention until the livestock industry in Africa and Asia is prepared to admit that the wildlife conservationists have an interest as legitimate as that of the ranching community. It should likewise be banned to the international fur trade until major producer and consumer countries indicate their readiness to accept controls to regulate a sustained-yield offtake. In Africa much more severe penalties are required to deter poaching and preventive killing by livestock owners.

CHEETAH

Acinonyx jubatus

Order: CARNIVORA Family: FELIDAE

STATUS: Vulnerable. Severely reduced and faces a prospect of increasing attrition and even more limited distribution as the human population expands into its favoured habitats. Even inside national parks and game reserves its prospects cannot be regarded as good.

DISTRIBUTION: The African race, A. j. jubatus: south of the Sahara from Nigeria, Sudan and Somalia to southern Africa. At present, survives throughout much of its former range, but in much reduced numbers and seems to diminish even where protected in national parks and reserves. Its distribution is discontinuous and numbers vary from common to rare - or even absent in some areas where it was formerly common.

POPULATION: The remaining African populations may total less than 15,000, within a probable range of 8,000 - 25,000. Rough estimates of population sizes, based on informed local opinion and, for order of magnitude purposes only, indicate less than 2,000 in Kenya, less than 200 in Uganda, less than 1,000 in Tanzania, about 500 in Angola, less than 1,000 in Zambia, 200 in Mozambique, 50 in Malawi, 2,000 in Botswana, 400 in Rhodesia, 1,500 in South West Africa, 700 in South Africa, less than 1,000 throughout the Sahel zone, a few hundred in the savanna woodland zone of West Africa, rather more than 1,000 in Sudan, around 1,000 in Ethiopia, 300 or so in Somalia, and 300 or less in Zaire. In rough terms, these figures almost certainly represent half the cheetah totals in Africa in 1960, and present figures could well be reduced by one-half within another 10 years, perhaps by 1980, as a result of degradation or loss of habitat, and over-hunting, particularly by ranchers.

HABITAT: Open semiarid grasslands (but seldom areas of tall grass) scrubland (occasionally quite dense) and various types of savanna woodland, in all cases essentially in association with medium or small-sized herbivores; exceptionally, forest margins but never forest itself. These habitats are being reduced by agriculture, degradation or rangelands and competition from domestic stock following upon increasing occupation by human communities. Loss and degradation of habitat and associated depletion of prey species have been the principal factors in the cheetah's decline.

CONSERVATION MEASURES TAKEN: Totally protected in almost every country except South Africa and Namibia, where it is still considered vermin (amending legislation pending). Ranching interests in Kenya, Tanzania, Zambia, Rhodesia, Angola, Namibia and South Africa, however, often destroy cheetah suspected of marauding livestock. The cheetah occurs in less than half the parks and reserves of Africa, and totals no more than 3,000 animals in these protected areas. Moreover, when it is reduced to relict

Populations in isolation from each other, it becomes singularly susceptible to disease, carnivore competition, shifts in prey community makeup, changes in vegetation configuration, and other natural limiting factors. In the main, its stability in protected areas shows a decline. Included in Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973; trade in these animals between acceding nations is subject to severe restriction, trade for primarily commercial purposes is banned. The International Fur Trade Federation operated a three-year voluntary ban among its membership on the use of cheetah furs in 1971/74.

CONSERVATION MEASURES PROPOSED: In terms of adaptability to change, the cheetah is one of the most vulnerable mammals. Conservation requirements, particularly outside parks and reserves, include more careful enforcement of protective laws and regulations, supervision of control so that only individual nuisance animals are removed when depredation occurs, control of over-grazing, and protection of wild prey species to reduce risk of predation on domestic animals. At the same time, the legitimate interests of ranchland communities in Africa should be recognized especially in those areas where pastoralists are attempting upgraded livestock husbandry and sometimes need to protect themselves in the event of undue predation.

AFRICAN ELEPHANT

Loxodonta africana

ORDER: PROBOSCIDEA Family: ELEPHANTIDAE

STATUS AND SUMMARY: Vulnerable. Now restricted to Africa south of the Sahara. Numbers, which lowest current estimates put at 1.3 million, are declining over most of its range, primarily because of over-exploitation for ivory; somewhat over 100,000, for example, must have died to supply the 1976 African ivory exports. In the longer term the main threat is constriction of the elephant's range due to expanding human populations. Protected by law in most countries and found in many national parks and reserves; however, protection is usually difficult to enforce. Suppression of poaching and of illegal ivory dealing are clearly essential, combined with the setting aside of sufficiently large blocks of land for the elephant and other measures aimed at establishing a satisfactory basis for its coexistence with man.

DISTRIBUTION: Africa south of the Sahara. Within about the last 300 years it occupied virtually all sub-Saharan Africa except the very driest areas, viz. sub-desert steppes of the Sudanese Arid Zone, desert and sub-desert of the Somali Arid Zone, and the coastal desert and sub-desert of the South West Arid Zone. Today it is scarce and very local in South Africa, South West Africa/Namibia, Angola, Rhodesia, Ethiopia, Uganda and West Africa, long extinct in northern Somalia, and recently extinct in the Gambia, Guinea-Bissau, Lesotho and Swaziland. Existing populations are generally regarded as belonging to one of two races, nominate L. a. africana of the savannas and L. a. cyclotis of the forests (see under Remarks).

POPULATION: Data collected by the IUCN/SSC African Elephant Specialist Group in the first systematic enquiry into elephant numbers and trends throughout Africa, suggest that in 1976 there were not less than 1.3 million elephants spread over 34-36 countries. Informants cited 45 examples of declining populations and it is thought that elephants are undergoing an overall decline in 23 countries. In three countries - Tanzania (with approximately 300,000 elephants), Zaire and Somalia - trends are uncertain. In South Africa, Namibia, Botswana and Rhodesia populations are stable, having recovered from the low ebb to which they were reduced at the beginning of the century. Trends in the remaining 4-6 countries are unknown.

In general, despite the still apparently substantial size of the total African elephant population, the future of the species is by no means assured if one considers the rate at which elephant habitat is being occupied and elephants are being exploited; with more than half the populations declining, the African elephant is considered a vulnerable species. About 1,000 elephants are thought to exist in Zimbabwe.

HABITAT AND ECOLOGY: Habitats vary from desert-scrub, thorn-bush and savanna to dense lowland and montane dry and humid forests. The elephant is a very adaptable grazer and browser, feeding on grass, shrubs or trees and their leaves, twigs, terminal shoots, bark, roots or fruit. Where elephants are numerous, their habit of barking or felling trees may cause deforestation, but there is some evidence to suggest that this is a partial rather than the whole cause of this type of habitat change.

A social animal living in family units of 2-20 led by old females, but at times will form much larger aggregations. Bulls tend to live separately in small groups or alone, with occasional short term associations with family units when a female is in oestrus. A year round breeder; gestation about 22 months; puberty attained at 8-18 years of age; maternal care continues until puberty and may continue to be excercised indefinitely in respect of female calves within the family unit; potential longevity: 50-70 years.

THREATS TO SURVIVAL: Three main threats: (1) in the long-term, range reduction caused by an expanding human population and its subsequent demand for land, combined with the difficulty of reconciling the presence of wild elephants with human settlement and agriculture; (2) habitat changes induced by elephants being restricted to smaller and smaller areas, when their more concentrated impact on the vegetation may exceed its regenerative capacity, a problem sometimes aggravated by severe drought; the elephant's ability to survive successfully in areas set aside for its protection is, however, a matter of some controversy, depending on one's assessment of the speed at which it can respond to changes in resource availability; (3) in the short term the greatest threat is human predation arising from demands for ivory, for meat (particularly in West Africa) and for crop protection, the increased price of ivory and consequent boom in the ivory trade being the principal factor in the drastic decline of elephants in East Africa and elsewhere.

CONSERVATION MEASURES TAKEN: The African elephant is listed in Appendix 2 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), trade in it between acceding nations therefore being subject to regulation and monitoring. Most African countries have game laws which restrict shooting of elephants to licensed hunters or Game Departments, but the laws are often abused or poorly enforced. Poaching is also rife in many national parks and reserves in which the elephant is nominally protected.

CONSERVATION MEASURES PROPOSED: The IUCN/SSC Elephant Group has developed a four-point action programme for Research, Conservation, Economics and Education. Measures particularly needed include more effective enforcement of existing laws, reinforcement of anti-poaching units; a study of the ivory trade and new legislation to end illegal dealing; continual monitoring of the population dynamics of the African elephant; and, in the longer term, guarantees that large self-sufficient units of land

inhabited by elephant poulations will be reserved in perpetuity. That in turn will depend on developing effective methods of reconciling the interests of such reserves with those of the human occupants of neighbouring areas, for example by ensuring that the latter derive direct and substantial benefits from appropriate management of elephants as a wildlife resource.

REMARKS: Two subspecies are usually recognized, the savanna-dwelling nominate africana and the smaller forest-dwelling cyclotis. Intermediates occur where the two meet and taxonomists differ about whether recognition should be at superspecies or subspecies level.

BLACK RHINOCEROS

Diceros bicornis

Order: PERISSODACTYLA Family: RHINOCEROTIDAE

STATUS AND SUMMARY: Vulnerable. Distribution now very sporadic in its African savanna habitats. Population thought to be anywhere between 10,000 and 30,000 with the minimum figure perhaps the more realistic. Decline attributed to poaching for its horn and habitat loss. Protected by law and occurs in national parks and reserves, although protection is often inadequate. Main conservation need is an effective ban on trade in rhino horn and particularly on its importation to Asian countries.

DISTRIBUTION: African savanna zone. Formerly widespread from South West Africa/Namibia and southwestern Cape Province north through Botswana, Rhodesia, Mozambique, Malawi, Zambia, Angola, Zaire, Tanzania, Uganda and Kenya to Somalia, Ethiopia, and the Sudan, thence westwards to the Central African Empire, northern Cameroun and Chad; also in Nigeria and further west, but no longer. In general, the species is still to be found over most of the extensive area indicated, but has been locally exterminated, with the survivors scattered in remnant populations mostly in parks and reserves.

POPULATION: Not known with any precision but probably 10,000 - 30,000 and everywhere depleted.

HABITAT AND ECOLOGY: Transitional zone or ecotone between grassland and forest, preferably thick thorn bush or acacia scrub, but also more open country and occasionally evergreen forest. The black rhino is a browser and lives on a variety of bushes and shrubs; it is usually inactive during the heat of the day. The only stable social unit is the mother-child association. A calf is produced by the female about every 2½-3½ years, the gestation period being approximately 15 months.

THREATS TO SURVIVAL: Poaching for its horn which is considered by many Asian peoples to have aphrodisiac properties. World demand for rhino horn has increased in the last few years and as a consequence the price has increased. Progressive deterioration and loss of habitat due to rapidly increasing human populations poses another grave threat to the rhino's future. In some areas, e.g., Tsavo East National Park, habitat destruction by elephants, sometimes made worse by drought, has also been detrimental.

CONSERVATION MEASURES TAKEN: Listed in Appendix 1 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora, trade in it or its products subject to strict regulation by

ratifying nations, trade for primarily commercial purposes banned. Listed in Class B of the 1968 African Convention on the Conservation of Nature and Natural Resources, and as such may only be hunted or collected under special authorisation granted by the competent authority. Legally protected throughout its range and occurs in many national parks and reserves; but protection is often inadequate.

CONSERVATION MEASURES PROPOSED: Effective protection against poaching. Control of trade in rhino horn. A ban on the import of rhino horn to Asian countries would be extremely beneficial to the species.

NILE CROCODILE

Crocodylus niloticus

Order: CROCODYLIA Family: CROCODYLIDAE

STATUS: Vulnerable. Numbers have been drastically reduced almost everywhere, largely during the last 20 years to supply leather to meet a worldwide demand.

DISTRIBUTION: All of Africa except the northwest and central Sahara; also Malagasy Republic but probably few in the Comores. Formerly along the south coast of the Mediterranean and east to Syria; also in the Seychelles. Now extinct in Cape Province and rare in Natal south of Tugela river, South Africa.

POPULATION: Destruction of habitat, e.g., damming of rivers, draining of swamps and lakes, and other human pressures, militate against any rehabilitation of the species. All reports agree that populations can only be restored by stringent conservation measures.

HABITAT: Large rivers and lakes, fresh water marshes, river mouths and estuaries, rarely in mangrove swamps.

BREEDING RATE IN WILD: Extensive literature, not yet reviewed.

CONSERVATION MEASURES TAKEN: In Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Protected under class "B" by the African Conservation Convention of 1968. Protected in Uganda. However, in many African States the Nile Crocodile still has no legal protection, although it is legally protected in most national parks and game reserves. Importation into the United States is prohibited under provision of the Endangered Species Act.

CONSERVATION MEASURES PROPOSED: Enforced protective legislation should be in operation throughout the entire geographical range. The collecting of crocodiles and their eggs should be controlled. State Game Departments should assume responsibility for controlling crocodile rearing and restocking projects. The IUCN Survival Service Commission, through its Crocodile Specialists Group, offers advice to interested government agencies for such projects.

NUMBERS IN CAPTIVITY: Still to be reviewed.

BREEDING POTENTIAL IN CAPTIVITY: Rearing of Nile Crocodiles under controlled conditions has been shown to be quite feasible.

Source: IUCN. 1975.

Table 4. Data on Protected Areas

Protected Areas are numbered according to Tables 37-40 (from Tomlinson 1980).

IUCN (1971 and 1977) includes several protected areas which do not appear in Tomlinson, listed below. Some of these appear at the end of this Table. IUCN and Tomlinson do not always agree on the category of the protected area.

Kariba Game Reserve	130,000 ha
Malapati Game Reserve	16,200 ha
Zimbabwe National Park	746 ha

NAME Wankie National Park

TYPE NP

LEGAL PROTECTION Total

DATE ESTABLISHED 1930, confirmed by the Land Tenure Act, 1969

GEOGRAPHICAL LOCATION On border with Botswana, 170 km NW of Bulawayo: S 18°30'-19°53'; E 25°48'-27°27'

ALTITUDE 938-1152 metres

AREA 1,462,000 ha

LAND TENURE Nationally owned and used for conservation of wild plants, animals and fish in accordance with Land Tenure Act.

PHYSICAL FEATURES The centre and south are a uniformly flat region of aeolian Kalahari sands with no permanent water and few natural waterholes. Shallow clay pans are plentiful and seasonally flooded. Long wide parallel ridges of sand are a unique feature probably caused by erosion of longitudinal dunes. The north has more broken topography with basalts, gneissic rocks, sandstones and grits. Main rivers include the Deka, Lukosi and Inyantue draining north-eastwards into Gwai R. outside the park. Tropical climate with mean maxima from 32.5°C-35°C, minima from 3.5°C-17.6°C, with winter frost; mean rainfall of 655 mm falling almost entirely in the November/March hot season.

VEGETATION The Kalahari sands area has woodlands and open woodlands largely composed of Rhodesian 'teak' Baikiaea plurijuga, Guibourtia coleosperma, Terminalia sericea and Combretum spp., with thickets of Acacia spp. often fringing dry watercourses, and some open grasslands. The shallow basaltic sandstones and gneissic lithosols support woodland of Colophospermum mopane, Combretum spp. and Commiphora spp.. Deeper basaltic vertisols have open grasslands of Ischaemum afrum, Sataria spp. and Hyparrhenia spp.

NOTEWORTHY FAUNA Larger mammal species include bat-eared fox Otocyon megalotis, brown hyaena Hyaena brunnea, cheetah Acinonyx jubatus (classified as 'vulnerable' in the Red Data Book), elephant Loxodonta africana, white rhinoceros Ceratotherium simum and black rhino Diceros bicornis, both reintroduced, eland Taurotragus oryx, buffalo Syncerus caffer, roan and sable antelope Hippotragus equinus and H. niger, gemsbok Oryx gazella and red hartebeest Alcalaphus buselaphus, the two last-mentioned species and the hyaena being of rare occurrence. Over 400 species of bird have been listed, including many raptors, such as the martial eagle Polemaetus bellicosus and five vulture spp., also Bradfield's hornbill Tockus bradfieldi, a species almost confined to Baikiaea woodlands of the Kalahari sands. A peculiar stunted form of Tilapia mortimeri occurs in the warm saline springs and a wide variety of other fish species are present in rivers and pans.

ZONING 4 zones proposed: (i) restricted size special conservation areas; (ii) c.40% of area as wilderness area; (iii) wild areas for game viewing; and (iv) a development area for tourist facilities and administration.

DISTURBANCES OR DEFICIENCIES Artificial supply of permanent water has caused marked increase in some animal populations, notably elephant. Introduced barbel Clarias gariepinus have adversely affected aquatic invertebrate populations. Local habitat change and degradation due to fire and past land use practices. Threat of increased poaching and bush fires in the south; disturbance in western border areas from safari concessionaires' activities in Botswana.

TOURISM 3 camps, restaurants, shops, rail service, airport and 560 km of game viewing roads are all concentrated in the northern sector. The number of vehicles now permitted access is limited. Plans for development of the roads to all weather standard and of visitor facilities in the southern perimeter.

SCIENTIFIC RESEARCH Broadly based ecological, vegetation and species studies (especially on elephant and on rare and abundant species) undertaken by staff of 3 biologists and assistants, on short and long term bases.

SPECIAL SCIENTIFIC FACILITIES Research centre with laboratory, herbarium, library, general equipment and darkroom.

PRINCIPAL REFERENCE MATERIAL

AUSTEN, B. 1971. The history of Veld burning in Wankie National Park, Rhodesia. Proc. Tall Timbers Fire Ecology Conf. No. 11.

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HERBERT, H.J. and AUSTEN, B. 1972. Past and present distribution of the black and square-lipped rhinoceros in the Wankie National Park. Arnoldia 5(26).

WEIR, J.S. 1971. The effect of creating additonal water supplies in a central African park. Proc. 11th Symp. Brit. Ecol. Soc.

STAFF Regional warden, 5 wardens with 92 permanent field staff, 3 research officers, 6 other permanent research staff and casual labour.

BUDGET Approximately U.S. $ 620,000

LOCAL PARK ADMINISTRATION Regional Warden, Wankie, Private Bag DT.5776, Dett, Rhodesia.

NAME Gonarezhou Game Reserve

TYPE NP

LEGAL PROTECTION Total

DATE ESTABLISHED 1968, confirmed by Land Tenure Act, 1969

GEOGRAPHICAL LOCATION On south-eastern border with Mozambique: S 21°06'-22°12'; E 31°20'-32°25'

ALTITUDE 162-578 metres

AREA 496,400 ha

LAND TENURE Nationally owned in accordance with the Land Tenure Act

PHYSICAL FEATURES Rocks include Cretaceous sandstones, a considerable area of granophyre in the north and some basalt. The rivers Lundi, Sabi and Nuanetsi have carved gorges, that of the Lundi having spectacular red sandstone cliffs at Chilojo affording good views over lower ground. Soils are mostly derived from the sandstones and range from deeper regoliths to medium textured siallitic soils; also some basalt derived clays.

VEGETATION A wide variety of vegetation includes mixed Brachystegia glaucescens woodland on granophyre hills, with Kirkia, Commiphora and baobab Adansonia digitata on steeper slopes and Colophospermum mopane on basalt and alluvial soils. Guibourtia conjugata forms pure stands on edges of sands in the Lundi valley. Non-eroded sandstone soils support mixed communities of Combretum, Pteleopsis, Strychnos, Terminalia, Xeroderris (= Ostryoderris) and Pterocarpus. A relict riverine forest has several giant Chlorophora excelsa, otherwise rare in Rhodesia, together with other coastal species and the aloes Aloe suffulta and A. lutescens. Androstachys johnsonii of the monogeneric family Androstachydaceae is confined in Rhodesia to the SE corner of the park where it forms small dry thickets on sandstone and granophyre. Adenium obesum and Pachypodium saundersii are well represented.

NOTEWORTHY FAUNA Mammals include the red bush squirrel Paraxerus palliatus, an over-abundance of elephant Loxodonta africana (c. 3000), black rhino Diceros bicornis (of which 80 have been reintroduced after earlier extermination of this 'vulnerable' species in the area), hippo Hippopotamus amphibius (one of the two breeding populations in Rhodesia), the nyala Tragelaphus angasi, and a probably unique sympatric occurrence of grey duiker Sylvicapra grimmia, klipspringer Oreotragus oreotragus, oribi Ourebia ourebi, steenbok Raphicerus campestris, Sharpe's grysbok R. sharpei and Livingstone's suni Nesotragus moschatus. Lichtenstein's hartebeest Alcelaphus lichtensteini has been reintroduced from Mozambique. Other species of interest include crested guineafowl Guttera edouardi, a significant Crocodilus niloticus population in the Lundi river, a freshwater turtle Cycloderma frenatum, lung fish Protopterus annectens and rare top minnows Notobranchius spp.

ZONING 4 zones proposed: (i) special conservation areas; (ii) wilderness areas; (iii) wild areas served by roads for wildlife viewing; and (iv) development areas for tourists and administration.

DISTURBANCES OR DEFICIENCIES Serious poaching from tribal lands and from across the frontier. Wild fires, planned fires and bush clearing for tsetse fly control have degraded vegetation in some areas. An over-population of elephant has also been noticed. Extraction and pollution of water of the Lundi R. is adversely affecting its ecology. Inadequate staff for effective control of tourists and anglers.

TOURISM Two access points, at the Chipinda Pools on the Lundi R. in the north-east and at Mabalauta on the Nuanetsi R. in the south-west, with no link road. Limited accommodation and camps and a network of game viewing roads at each centre: a popular Wilderness Trail from Mabalauta along the river.

SCIENTIFIC RESEARCH Studies for management and on population structure, growth and reproduction. Monitoring. Fishery and fish ecology studies.

SPECIAL SCIENTIFIC FACILITIES None at present unless the research laboratory of which construction was due to begin in 1974 has been completed.

PRINCIPAL REFERENCE MATERIAL

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FARRELL, J.A.K. 1968. Vegetation of the lower Sabi/Lundi Basin. Kirkia 6: 223-247.

WILD, H. and FERNANDES, S. 1968. Vegetation map of the Flora Zambesiaca area. Flora Zambesiaca, Collins, Salisbury.

WRIGHT, A. 1972. Valley of the Ironwoods. Purnell, Cape Town.

STAFF 2 wardens, 28 other permanent field staff, research officer and one permanent research assistant, plus casual labour.

BUDGET Approximately U.S. $ 68,000

LOCAL PARK ADMINISTRATION Chipinda Pools: Warden in Charge, Private Bag 7003, Chiredzi; Mabalauta: Warden in Charge, Private Bag U5513, Bulawayo, Rhodesia.

NAME Mana Pools Game Reserve.

STATUS Uninhabited region in the Zambesi Valley, in which hunting and pasturing of livestock are forbidden, but sport-fishing is allowed in the river.

DATE ESTABLISHED 1963.

ALTITUDE 360 m.

AREA 121,200 ha.

VEGETATION Situated on an ancient arm of the Zambesi, grassy plains with relict pools of the old river bed; fine gallery forest (*Acacia* spp.) in these alluvial sectors, with thick mopane *Colophospermum* and *Dichrostachys* thorn bush on the higher ground to the south.

NOTEWORTHY FAUNA Elephant, buffalo, black rhinoceros, sable, eland, zebra, waterbuck, impala; lion, leopard, hyaena; crocodile; hippopotamus, bushpig; no giraffe; many species of birds.

TOURISM Not yet organized, but the area already attracts many visitors; access by road in the dry season; camping-site; fishing in the Zambesi.

STAFF 9 units (1964-1965).

BUDGET U.S.$ 5,600 plus salaries and transport costs, shared with No. 11 Chewore Reserve.

NAME Chizarira Game Reserve

TYPE NP

LEGAL PROTECTION Total

DATE ESTABLISHED 1963, confirmed by Land Tenure Act, 1969

GEOGRAPHICAL LOCATION About 35 km SE of the southern end of Lake Kariba: S 17°32'-18°01'; E 27°36'-28°14'

ALTITUDE 648-1433 metres (summit of Mt. Tundazi)

AREA 191,000 ha

LAND TENURE Nationally owned in accordance with the Land Tenure Act

PHYSICAL FEATURES A gently undulating plateau rising from the Zambezi valley and Lake Kariba in the north in a 500 m escarpment and falling away more gently in the south and south-west. Two ridges on a north-east/south-west alignment form watersheds; the rivers draining from them have cut gorges, some spectacular, through the scarps. The area is well waterd with numerous permanent springs and salt pans. The Ruziruhuru R. rises on the plateau flowing westwards to the Zambezi. Geologically part of the 'Sijarira system' of grits and sandstones. A small marshland area is known as the Manzituba.

VEGETATION The reserve forms an island of highveld surrounded by lowveld. Much of the plateau is dominated by Julbernardia globifera/Brachystegia spiciformis miombo woodland, with some patches of B. boehmi and Colophospermum mopane. Gorges have riverine vegetation and there is also some open grassland comprising a considerable diversity of species. The Potaliaceous tree Anthocleista grandiflora is of special biogeographical interest.

NOTEWORTHY FAUNA Aardwolf Proteles cristatus and cheetah Acinonyx jubatus (rated as 'vulnerable' in the Red Data Book) occur sparsely, as well as other large carnivores. The herbivores include black rhino Diceros bicornis, significant populations of roan antelope Hippotragus equinus, and tsessebe Damaliscus lunatus. Among the birds identified in the reserve is the Taita falcon Falco fasciinucha (classified as a 'rare' species) and several extensions in range of other species have been recorded and are probably connected with the 'island effect' referred to above. A small population of Nile crocodile Crocodilus niloticus (now also classified as 'vulnerable') is also present.

ZONING 4 zones proposed: (i) special conservation areas; (ii) wilderness areas without development; (iii) wild areas serviced by roads for game viewing; and (iv) a developed area for tourists and staff.

DISTURBANCES OR DEFICIENCIES Past cultivation and past and present fires have modified vegetation and water run-off. Poaching expected to increase with settlement of surrounding tribal areas.

TOURISM No facilities at present and poor road access. Functional accommodation will be provided eventually, but visitor usage will be strictly controlled and angling, for example, will not be permitted.

SCIENTIFIC RESEARCH Observation and experimental research for management purposes, especially on population dynamics and distribution of large herbivores, and on elephant and their use of Brachystegia boehmii.

SPECIAL SCIENTIFIC FACILITIES Research centre with herbarium, library, general equipment and darkroom.

PRINCIPAL REFERENCE MATERIAL

THOMSON, P.J. 1973. Field Work Sheet (IBP/CT. Rhodesia): CT Record Centre, Atlantica Ecological Research Station, P.O. Box 8305, Causeway, Salisbury.

THOMSON, P.J. 1973. The role of elephants, fire and other agents in the decline of Brachystegia woodland (ms. in press).

STAFF Senior ranger and 13 other permanent field staff, research officer and 2 other permanent research staff plus casual labour.

BUDGET Approximately U.S. $ 40,000

LOCAL PARK ADMINISTRATION Senior Ranger in Charge, Chizarira Game Reserve, Private Bag DT 5779, Dett, Rhodesia.

NAME Matusadoma Game Reserve.

STATUS An uninhabited area near the Kariba dam, in which a good number of the animals rescued from the floodwaters were released; hunting, wood-cutting and grazing prohibited.

DATE ESTABLISHED 1963.

ALTITUDE 540 m.

AREA 210,080 ha.

VEGETATION Situated on the shores of the dam, near Kariba itself; *Brachystegia boehmii*, *Colophospermum mopane* and *Julbernardia globiflora* woods in the hilly areas.

NOTEWORTHY FAUNA Black rhinoceros, elephant, buffalo, sable and roan antelope, kudu, bushbuck, waterbuck, hippopotamus, crocodile, lion, leopard, hyaena and bushpig; plentiful birdlife.

TOURISM Access mainly by boat (Kariba Dam) and by road only in the dry season; there is a network of motorable tracks in the Reserve for game-viewing.

STAFF 21 units, exactly corresponding to the criterion.

BUDGET U.S.$ 4,620 (1964-1965).

NAME Victoria Falls National Park.

STATUS Total protection.

DATE ESTABLISHED 1952, previously game reserve from 1939.

ALTITUDE 1,000 m.

AREA 58,440 ha.

VEGETATION The region is essentially composed of Kalahari sands, surrounding the famous Victoria Falls; the forest along the Zambesi is mainly *Colophospermum mopane*, and on the Kalahari sands *Baikiaea plurijuga*, *Burkea africana* and *Afzelia quanzensis*; the luxuriant rain forest facing the Falls contains ebony *Diospyros mespiliformis* and the figs *Ficus mallotocarpa* and *ingens*.

NOTEWORTHY FAUNA Elephant, hippopotamus, buffalo, giraffe, kudu *Tragelaphus strepsiceros*, bushbuck *Tragelaphus scriptus*, waterbuck *Kobus ellipsiprymnus*, roan and sable antelopes (the later in one of the largest concentrations anywhere in the world); lion and leopard; crocodile; innumerable baboons *Papio* sp. and vervet monkeys *Cercopithecus aethiops*; plentiful birdlife, especially along the Zambesi, including herons of many species and cormorants.

TOURISM Access by road, rail or air; a 56 km road along the Zambesi and 26 km of roads through the game areas, which are open from May to December only; plentiful accommodation; caravan sites.

STAFF 70 units (1964-1965).

BUDGET U.S.$ 32,000 (1964-1965).

NAME Chimanimani National Park

STATUS Total protection, but sport-fishing allowed.

DATE ESTABLISHED 1950.

ALTITUDE 1,800 m.

AREA 13,680 ha.

VEGETATION A good sample of the Chimanimani mountain range, the stony lower slopes clothed in montane species of acacia, dense *Philippia* heath or more open *Protea* scrub; along the rocky shores of the streams *Lobelia cobaltica*, the pincushion protea *Leucospermum saxorum*, tree ferns and *Strelitzia* occur; in the moss-hags and marshes many *Xyris* species and numbers of orchids in the open grasslands.

NOTEWORTHY FAUNA Large herds of eland; sable, bushbuck, klipspringer, kudu, duiker; leopard; baboon and various monkeys a well as many small animals and a good avifauna.

TOURISM Not accessible by car due to the very rugged country; there is a mountain "chalet"; mountaineering and trout-fishing.

STAFF 16 units (1964-1965).

BUDGET U.S.$ 1,260, plus salaries of staff.

NAME Rhodes Inyanga National Park.

STATUS Total protection, except in respect of sport-fishing ("modern trout hatcheries have been constructed and fishing research is carried out").

ALTITUDE 1,200-2,550 m.

AREA 34,609 ha.; this includes the 2,943 ha. of the Mtazari Falls National Park, a contiguous area formerly treated as distinct but not "considered to be a part" of the Rhodes Inyanga.

VEGETATION The west and south-west of the Park is a plateau averaging 1,700 m., which rises gradually towards the east; many waterfalls; extensive grasslands cover the hills, but there is some Mlanje cedar *Widdringtonia whytei* forest on the slopes of Inyanga mountain; the Mtarazi Falls sector is high plateau, its shoulders covered in evergreen forest and with many cliffs, from one of which the Falls drop nearly 600 m.

NOTEWORTHY FAUNA Kudu, waterbuck, bushbuck, klipspringer *O. oreotragus*, reedbuck, blue duiker *Cephalophus monticola*; hyaena, jackal, bushpig *Potomochoerus porcus*; leopard; secretary-bird *Sagittarius serpentarius*, various francolins.

TOURISM Access by road and a good road network in the Park; accommodation in the Inyanga but not Mtarazi Falls sector; much effort expended on tourist promotion and development of trout-fishing and water-sports ("a programme of dam construction is under way to provide recreational facilities"); open all the year round.

STAFF 70 units (1964-1965).

BUDGET U.S.$ 13,300 (1964-1965).

NAME Rhodes Matopos National Park.

STATUS Total protection, but in severe droughts the neighbouring people are occasionally permitted to pasture their stock for a limited period "as a special drought relief measure". Usually no one lives in the Park, though there are five large and many small dams or reservoirs in which sport-fishing is allowed; about 2,600 ha. of the Park are fenced to make a "game park".

DATE ESTABLISHED 1953.

ALTITUDE 1,350 m.

AREA 43,320 ha.; up till 1963 the Park was much larger (the figure given in the previous edition of the List is 383 sq. miles or 98,050 ha.), but was reduced by three-fifths when areas in human occupation were excluded, although somewhat increased again in 1966, when part of the Rhodes Matopos Estate owned by Cecil Rhodes and in which he is buried, was bequeathed by him to the Rhodesian people.

VEGETATION Granite hills, in which many other geological intrusions can be seen and caves, some with prehistoric cave paintings, are found; the area is generally covered by woody savannah, dominated by Brachystegia spicaeiformis, Isoberlinia globiflora Parinari mobola, Euphorbia ingens and Cyathea dregei; flame trees Erythrina caffra and Cape chestnut Calodendron capense also occur.

NOTEWORTHY FAUNA Impala Aepyceros melampus, kudu, bushbuck and sable antelope; numerous baboons; leopards; a wealth of birds, including Verreaux's eagle Aquila verreauxi; the animals to be seen have been much augmented by species translocated from Wankie National Park to the fenced Game Park, notably giraffe, buffalo, 'white' and black rhinoceros, eland, sable, wildebeest, reedbuck Redunca arundinum and ostrich.

TOURISM Access by road, only 48 km from Bulawayo; accommodation and camp-sites provided and sport-fishing allowed in the dams; Cecil Rhodes's grave is in the Park, which is also much visited for its interesting rock paintings.

STAFF 69 units (1964-1965).

BUDGET U.S.$ 33,600 (1964-1965).

NAME Robert McIlwaine National Park.

STATUS Total protection, but about half the Park is given over to a large lake, greatly developed for yachting and other water-sports for the people of Salisbury and in which even commercial fishing is permitted; hence the rather large staff and budget; an arboretum with some 200 labelled species has been established by the 'Tree Society of Rhodesia'.

DATE ESTABLISHED 1952.

ALTITUDE 1,380 m.

AREA 5,736 ha.

VEGETATION Lake surrounded by woods; the characteristic trees of the granitic soils are *Brachystegia spicaeiformis*, *Julbernardia globiflora* and *Combretum* spp.; along the watercourses *Rhus lancea*, *Salix subserrata* and *Syzygium*; also found *Burkea africana*, *Pterocarpus angolensis* and *P. rotundifolius*.

NOTEWORTHY FAUNA 250 species of birds including ostrich; a number of species from Wankie N.P. have been introduced into a fenced enclosure, including giraffe, zebra, wildebeest, buffalo, eland, impala, oribi, kudu, waterbuck, reedbuck, steinbok, duiker, tsessebe and sable; leopard; wart-hog *Phacochoerus aethiopicus*, monkeys, baboon; crocodile.

TOURISM Not far from Salisbury and actively exploited, with boating, "entertainment facilities", accommodation; open all the year round.

STAFF 69 units (1964-1965).

BUDGET U.S.$ 42,000 (1964-1965).

NAME Kyle Dam Game Reserve.

STATUS Total protection in a fenced area in which animals from Wankie National Park and the Zambesi Valley have been introduced; there is a fisheries research station.

DATE ESTABLISHED 1963 (recently upgraded to National Park status).

ALTITUDE 1,200 m.

AREA 4,040 ha.

VEGETATION A large expanse of "high veldt" grassland bordering Lake Kyle, interspersed with clumps of *Brachystegia* and thickly wooded ravines.

NOTEWORTHY FAUNA White rhinoceros (reintroduced from South Africa), giraffe, buffalo, kudu, Lichtenstein's hartebeest *Alcelaphus lichtensteini*, wildebeest, nyala, reedbuck, bushbuck, impala, sable, eland, oribi *Ourebia ourebi*, zebra, duiker, steinbok, hippopotamus, warthog, crocodile -- many of these species also reintroduced; plentiful birdlife.

TOURISM Large numbers of visitors are attracted by the bigger animals, notably white rhinoceros, introduced into this Fenced Reserve; Fort Victoria is only 48 km. away; a start was made with construction of accommodation in December 1965.

STAFF 21 units (1964-1965).

BUDGET U.S.$ 20,000.

NAME Ngezi National Park

TYPE NP BIOTIC PROVINCE 4.6.4

LEGAL PROTECTION Total

DATE ESTABLISHED 1956, confirmed by the Land Tenure Act, 1969

GEOGRAPHICAL LOCATION On a tributary of the Umniati R. 60 km SE of Gatooma: S 18°38'-18°44'; E 30°20'-30°27'

ALTITUDE 1220-1340 metres

AREA 5800 ha (of which 360 ha are water)

LAND TENURE Nationally owned under the Land Tenure Act

PHYSICAL FEATURES The principal features are the Ngezi R. and dam, the latter constructed on the eastern slope of the Great Dyke, an igneous intrusion extending for over 530 km in central Rhodesia. This section of the Dyke contains pyroxenites which have a marked effect on vegetation. The Mashaba hill, a section of the dyke, rises to 80 m - 100 m above the surrounding country in a series of broken summits. Otherwise the area includes two strips of gently sloping bush land bordering the man-made lake. The Ngezi R. ceases flowing for short periods and none of the subsidiary streams are perennial.

VEGETATION The pyroxenes of the dyke result in the absence of the Andropogon grasslands found elsewhere. The western slope is dominated by Brachystegia boehmii woodland, but the crest and the eastern slopes have a more open and varied savanna of B. spiciformis, Faurea saligna and Combretum zeyheri. To the east the flatter granitic sandveld is covered with B. spiciformis and Julbernardia globiflora woodland, interspersed by large grassy vleis or seasonal swamps, while a more mixed vegetation dominated by Sterculia sp., Kirkia acuminata and an occasional baobab Adansonia digitata occurs on granite ridges. Aloe species are common. Shoreline vegetation is well established on the dam, Phragmites mauritianus being the dominant species, especially at the upstream end.

NOTEWORTHY FAUNA A small number of hippo Hippopotamus amphibius occur but the area is noted for its easily visible waterbuck Kobus ellipsiprymnus, big population of reedbuck Redunca arundinum, sable antelope Hippotragus niger and impala Aepyceros melampus. Considerable numbers of duck frequent the dam seasonally and the osprey Pandion haliaetus has often been observed. A significant crocodile Crocodilus niloticus nesting area will be afforded special protection, in view of the new 'vulnerable' status of the species.

ZONING 3 zones are proposed: (i) development area for administration and tourist facilities; (ii) special conservation area (to include crocodile nesting area); and (iii) remaining wild area.

DISTURBANCES OR DEFICIENCIES Use of water results in fluctuating shoreline. Mining activity has left a two-metre-deep trench along the whole length of the dyke and mining claims outside the park have been pegged right up to the boundary. Use for cattle grazing during drought, past cutting and burning and sporadic poaching especially from the uncontrolled public roads traversing the park are other adverse factors.

TOURISM Popular for fishing and boating; 4 service lodges with 16 beds and 25 camp sites available for visitors (Salisbury is only 161 km away), the numbers of whom are to be controlled.

SCIENTIFIC RESEARCH Study of the biology of the tiger fish Hydrocynus vittatus is in progress.

SPECIAL SCIENTIFIC FACILITIES None

PRINCIPAL REFERENCE MATERIAL

GORDON, T.A.D. 1972. List of Trees and Shrubs at Ngezi National Park. Records of Department of National Parks and Wildlife Management.

OSBORNE, P.L. et al. 1972. Preliminary Report on Field Trip to Ngezi National Park. Rhod. Sci. News. 6(10)

WEST, O. 1971. Report on a visit to Ngezi and Sebakwe National Parks. Records of the Department of National Parks and Wildlife Management.

STAFF Senior ranger and 8 other permanent field staff with a small casual labour force.

BUDGET Approximately U.S. $ 18,000

LOCAL PARK ADMINISTRATION Senior Ranger in Charge, Ngezi National Park, Private Bag 207, Featherstone, Rhodesia.

NAME Sebakwe National Park

TYPE NP

LEGAL PROTECTION Total

DATE ESTABLISHED 1959, confirmed by the Land Tenure Act, 1969

GEOGRAPHICAL LOCATION About 60 km north-east of Gwelo: S 19°00'-19°04'; E 30°13'-30°17'

ALTITUDE 1230-1380 metres

AREA 2700 ha

LAND TENURE Nationally owned under the Land Tenure Act

PHYSICAL FEATURES The central feature is a man-made lake formed by a dam astride the Great Dyke, an intrusive feature of serpentine, pyroxenite and norite rocks important as a deposit of metallurgical chrome. In the west of the park the soils are derived from granitic rocks and doleritic intrusions. An area of from 0.5 km to 1.5 km surrounds the lake which occupies the bulk of the area, the hills of the dyke running on a north-south line to the centre of the lake.

VEGETATION The serpentine soils associated with the dyke in this area support a distinctive open Andropogon grassland and a great number of species which, while they are found elsewhere in Africa are restricted to this one locality in Rhodesia. These include Acacia chariessa, Pearsonia metallifera and Lotononis serpentinicola. In the granitic areas Kirkia acuminata is sometimes dominant on steep slopes below the crest-hugging Brachystegia glaucescens which forms the best example of this beautiful woodland to be found in the Rhodesian National Parks. Julbernardia globifera and Brachystegia spiciformis are also present on granite, also a few Sterculia africana trees, here approaching their southern limit. Aloe excelsa occurs in profusion and grows up to 6 m in height, also Euphorbia ingens. The vegetation is generally of great botanical and ecological interest.

NOTEWORTHY FAUNA The surrounding area is settled but some of the larger mammals of the region occasionally occur. In 1974, the granite boulder islands in the lake supported a large mixed heronry with no less than nine species nesting.

ZONING Zoning is planned as a method of reducing the conflicts arising from different forms of land use in the park and its vicinity.

DISTURBANCES OR DEFICIENCIES Mining for chrome and other heavy metals since 1929, has scarred the main hills with trenches and the mining continuing right up to the park boundary may well have an adverse effect in future. Two large granite quarries remaining from dam construction are a prominent feature on the southern shore. Unfenced boundaries result in over-grazing in some areas by cattle from neighbouring ranches, since the whole of the surrounding area is farmed.

TOURISM Limited accommodation, popular for bird-watching, fishing and boating, especially with visitors from Salisbury or Gwelo via Que Que (which is only 51 km away by the road which in the opposite direction leads to Umvuma).

SCIENTIFIC RESEARCH None

SPECIAL SCIENTIFIC FACILITIES None

PRINCIPAL REFERENCE MATERIAL

Departmental Annual Records: National Parks and Wildlife.
WEST, O. 1970. Report on a visit to Ngezi and Sebakwe. Departmental Records. National Parks and Wildlife.

STAFF Senior ranger and 7 other permanent field staff with a small casual labour force.

BUDGET Approximately U.S. $ 16,000

LOCAL PARK ADMINISTRATION Senior Ranger in Charge, Sebakwe National Park, P.O. Box 636, Que Que, Rhodesia.

NAME Mushandike National Park

TYPE NP

LEGAL PROTECTION Total

DATE ESTABLISHED 1955, confirmed by the Land Tenure Act, 1969

GEOGRAPHICAL LOCATION Eastern boundary is 10 km west of Fort Victoria: S 20°04' -20°09'; E 30°32'-30°44'

ALTITUDE 935-1310 metres

AREA 12,900 ha

LAND TENURE Nationally owned under the Land Tenure Act

PHYSICAL FEATURES The area lies across the valleys of 4 south flowing tributaries of the Sabi-Lundi system and a dam immediately below their confluence in the Mushandike R. has formed a 412 ha lake. In the north are granite whale-back 'dwala' and rock columns and numerous shear zones associated with quartz outcrops. The general land form consists of broken ridges dissected by many small seasonal watercourses. Soils are shallow and coarse. In the south the hills exhibit a great variety, with crystalline limestone, a banded ironstone massif and schists. The south-west corner has shallow red-brown clay soils formed over basic rock with ridges of shallow sands over gneiss.

VEGETATION Almost entirely covered with semi-deciducus woodland of trees not more than 10 m high and a thin ground cover of woody shrubs and perennial grass. Dominant trees on granite and gneissic sands are the 'miombo' species Julbernardia globiflora and, on better soils, some Brachystegia spiciformis. The southerly or coastal nature of this association is shown by the frequent presence of the handsome monotypic Polysanthus speciosus and of the mahogany bean Afzelia quanzensis. The typical species of the granite hills are Dyschystegia tamarindoides, Kirkia acuminata and Commiphora spp. while Colophospermum mopane occurs along sandy watercourses with restricted drainage. Combretum/Terminalia bush dominates the red soils in the south and a stand of Faurea saligna/Euclea linearis savanna characterizes one schistose grit hill.

NOTEWORTHY FAUNA Carnivores include side-striped jackal Canis adustus and leopard Panthera pardus (classified as 'vulnerable' in the Red Data Book). The herbivores include hippo Hippopotamus amphibius (which has been introduced), waterbuck Kobus ellipsiprymnus, sable antelope Hippotragus niger, klipspringer Oreotragus oreotragus and impala Aepycaros melampus (also introduced). A notable feature of the birdlife is the large number of raptors, with 9 species of eagle (all recorded as breeding in 1972/73), kites, hawks, buzzards, falcons and owls. A few crocodiles Crocodilus niloticus (also now classed as 'vulnerable') inhabit the dam.

ZONING In progress: a wild area and 2 or more development areas are designated at present but an integrated development plan will orient use towards ecological education.

DISTURBANCES OR DEFICIENCIES Past disturbance of vegetation due to cutting, cultivation and fire. Four old mine shafts within the park and mining operations near its borders still continue and may give rise to some poaching. Large-mouth bass and a cyprinid species have been introduced and sport fishing, in the alleged interest of which crocodiles were formerly controlled, remains a disturbing factor. Materials for park buildings are quarried within its borders.

TOURISM Permanent study centre for the Rhodesian Educational Courses in Conservation and Environmental Studies (R.E.C.C.E.). Day visits only for ordinary visitors except during the school holidays.

SCIENTIFIC RESEARCH A small mammal survey has been made and a detailed description of the park was prepared for the conservation of terrestrial communities section of the International Biological Programme.

SPECIAL SCIENTIFIC FACILITIES None

PRINCIPAL REFERENCE MATERIAL

WRIGHT, P.J. (in prep.) Survey of the small mammals of the Mushandike National Park.

Departmental reports with relevant information available on application to National Parks and Wild Life Management Department, P.O. Box 8365, Causeway.

STAFF Senior ranger, 13 other permanent field staff and a small casual labour force, plus staff at the special study centre.

BUDGET Approximately U.S. $ 14,000, excluding the costs of the special study centre.

LOCAL PARK ADMINISTRATION Senior Ranger in Charge, Mushandike National Park, Private Bag 9036, Fort Victoria, Rhodesia.

NAME Chewore Game Reserve.

STATUS Remote, uninhabited area; no hunting, fishing, woodcutting, grazing or occupancy allowed; restrictions on movement through the reserve (no roads), but sport-fishing allowed in the Zambesi.

DATE ESTABLISHED 1963.

ALTITUDE 600 m.

AREA 282,800 ha.

VEGETATION Part of the Zambesi valley, mainly mopani bush *Colophospermum mopane* with *Acacia* spp. on the hills.

NOTEWORTHY FAUNA Contains the largest concentration of black rhinoceros in Central and Southern Africa; also many buffalo and elephant, sable and roan antelope, kudu, waterbuck, nyala *Tragelaphus angasi*, bushbuck, impala, wart-hog and bushpig, baboon, several kinds of monkey; crocodile, hippopotamus; interesting avifauna.

TOURISM A motorable road to the borders of the Reserve is open from May to October, but movement inside this "wilderness area" is by foot only, no accommodation, but camping allowed; sport-fishing.

STAFF No information, except statement that "policing is effective, but there is no resident ranger".

BUDGET Combined with that of the Mana Pools Game Reserve (No. 14 q.v.) and neighboring "controlled hunting areas".

NAME Chirisa Game Reserve

TYPE NP BIOTIC PROVINCE 4.6.4

LEGAL PROTECTION Total

DATE ESTABLISHED 1969, in terms of the Land Tenure Act, 1969

GEOGRAPHICAL LOCATION Adjoining Chizarira reserve (q.v. - 2.3) on SE and 175 km west of Gatooma: S 17°39'-18°13'; E 28°00'-28°31'

ALTITUDE 680-1043 metres

AREA 171,300 ha

LAND TENURE Nationally owned in accordance with the Land Tenure Act

PHYSICAL FEATURES Most of the area lies below 900 m and is composed of Karroo grits and sandstones with some Kalahari sands. The broad sandy Sengwa R. flowing due north to enter the Kariba Lake at its mid-point, together with its flood plain, dominates the reserve. The other most striking feature is the occasional red sandstone 'inselberg' formation.

VEGETATION Miombo woodlands, dominated by Julbernardia and Brachystegia, with also fairly common areas of mopane Colophospermum mopane. The rivers are bordered by belts of Acacia tortilis and Grewia flavescens, but both these species have been reduced from their former abundance by elephant and indeed all the major vegetation types have been considerably modified by this factor. Kalahari sand 'gusu' woodlands of Rhodesian teak Baikiaea plurijuga and 'jesse' thickets of Combretum and Commiphora species also occur.

NOTEWORTHY FAUNA Many of the larger African mammals, including most Rhodesian species of antelope are found in the reserve. Black rhino Diceros bicornis has been reintroduced through translocation from other areas where its continued presence was threatened.

ZONING No detailed plan has as yet been implemented. In the south an area has been set aside as the 'Sengwa Wildlife Research Area'.

DISTURBANCES OR DEFICIENCIES Surrounded by tribal lands except where it borders the Chizarira Game Reserve to the west. Poaching is a problem and could increase, especially if tsetse eradication is successful.

TOURISM No facilities for visitors at the moment and roads are in poor condition, except for that to the Hostes Nicolle Institute.

SCIENTIFIC RESEARCH The Sengwa Wildlife Research Area (40,000 ha) is set aside for long term study of native flora and fauna. Elephant, kudu, and warthog are currently under biotelemetric study. Other studies are also under way on vultures and vegetation.

SPECIAL SCIENTIFIC FACILITIES The Hostes Nicolle Institute of Wildlife Research has laboratories, offices, herbarium, library/mapping room, and many other facilities.

PRINCIPAL REFERENCE MATERIAL

CUMMING, D.H.M. 1970. A contribution to the biology of the warthog (Phacochoerus africanus Gmelin) in the Sengwa region of Rhodesia. Unpublished Ph.D. dissertation, Rhodes University.

JACOBSEN, N.H.G. 1970. The range, behaviour and feeding patterns of bushbuck in the Lutope river valley. University of Rhodesia thesis for Certificate in Field Biology.

WARREN, H.B. 1974. Aspects of the behaviour of the Impala male, Aepyceros melampus during the rut. Arnoldia 6(27).

STAFF Senior research officer, 16 other research staff, 30 staff with responsibilities in the reserve and adjoining areas, casual labour.

BUDGET Approximately U.S. $ 21,000 on research alone. Other funds are also applied in the adjoining areas.

LOCAL PARK ADMINISTRATION Officer in Charge, Hostes Nicolle Institute for Wildlife Research, Private Bag 6002, Gokwe, and Secretary for Internal Affairs, Private Bag 7702, Causeway, Salisbury, Rhodesia.

NAME Chete Game Reserve

TYPE NR **BIOTIC PROVINCE** 4.6.4

LEGAL PROTECTION Total

DATE ESTABLISHED 1963, confirmed by the Land Tenure Act, 1969

GEOGRAPHICAL LOCATION Bordering the southern shore of Lake Kariba: S 17°11'-17°37'; E 27°37'-27°59'

ALTITUDE 485-930 metres

AREA 108,100 ha

LAND TENURE Nationally owned in accordance with the Land Tenure Act

PHYSICAL FEATURES A broken and undulating area dissected by numerous watercourses belonging to the river systems of the Ruziruhuru, which rises in Chizarira Game Reserve, the Senkwi/Murambare and the Mwanda. These flow seasonally but have numerous perennial pools. Several perennial springs are also present. The shore of Lake Kariba which forms the NW boundary is characterised by many bays formed by drowned valleys. Geologically the area is composed of ripple-marked flags of the Upper Karroo system with shallow stony soils containing much loose rock.

VEGETATION Most of the area is covered by open mopane *Colophospermum mopane* woodland with associated poor grass cover. Sandy ridges support a more varied miombo *Julbernardia globiflora*/*Brachystegia* spp. woodland. Watercourses have riverine vegetation with steeper slopes characterised by *Commiphora* and *Combretum* spp. and a scatter of baobab *Adansonia digitata*. Grass cover varies with soil and slope, with considerable species diversity. Bays on Lake Kariba are covered by a mat of water fern *Salvinia molesta*, often supporting secondary plant growth.

NOTEWORTHY FAUNA Most of the large herbivores and carnivores are present, including a population of black rhino *Diceros bicornis* (classified as a 'vulnerable' species), but roan and sable antelope *Hippotragus equinus* and *H. niger* are rare. Little is known of the avifauna but the fish eagle *Haliaetus vocifer* is conspicuous along the lake shore and marabou stork *Leptoptilos crumeniferus* has been found nesting. A significant population of Nile crocodile *Crocodilus niloticus* (another Red Data Book 'vulnerable' species) is present. Fish are abundant in the lake and rivers.

ZONING None

DISTURBANCES OR DEFICIENCIES Uncontrolled fires present a current problem and contribute to vegetation and run-off modification. Illegal hunting and fish poisoning are likely to increase with settlement of adjoining tribal lands.

TOURISM No facilities and entry only with permission

SCIENTIFIC RESEARCH Studies of interaction between terrestrial and aquatic ecosystems.

SPECIAL SCIENTIFIC FACILITIES A research station of the University of Rhodesia is on a leased portion of the reserve. Living and working facilities are available for research visitors.

PRINCIPAL REFERENCE MATERIAL Unpublished reports and papers

STAFF Senior ranger and 3 other permanent field staff with a small casual labour force.

BUDGET Approximately U.S. $ 9000

LOCAL PARK ADMINISTRATION Senior Ranger in Charge, Chete Game Reserve, c/o Private Bag DT 5776, Dett, Rhodesia

NAME Malapati Game Reserve

TYPE NP BIOTIC PROVINCE 4.6.4

LEGAL PROTECTION Total

DATE ESTABLISHED 1969, under the terms of the Land Tenure Act, 1969

GEOGRAPHICAL LOCATION Bordering the Gonarezhou Reserve (q.v. - 2.1) on south-east: S 21°49'-22°03'; E 31°21'-31°29'

ALTITUDE 253-396 metres

AREA 16,200 ha

LAND TENURE Nationally owned under the terms of the Land Tenure Act

PHYSICAL FEATURES An area of broken granophyre and rhyolite outcrops with sandy clay soils. The Nuanetsi R. forms the eastern boundary, with alluvial sands along the river.

VEGETATION Mainly Copaifera/Combretum scrub and woodland with large expanses of Androstachys thickat, this being a member of the monogeneric family Androstachydaceae which only occurs in Rhodesia in this and the neighbouring Gonarezhou area. Good patches of woodland occur in the main bed of the Nuanetsi R. also some degraded riverine forest. Aloe lutescens is common on rocky outcrops.

NOTEWORTHY FAUNA Many of the herbivores found in the Gonarezhou Game Reserve occur here also and population estimates for that reserve include the Malapati as this forms part of the Nuanetsi ecosystem. The nyala Tragelaphus angasi is perhaps the most important species.

ZONING None

DISTURBANCES OR DEFICIENCIES Serious poaching occurs from the tribal lands lying to the west.

TOURISM Wilderness trails from the Mabalauta section of Gonarezhou reserve enter into the Malapati reserve. A safari lodge has been constructed by a lessee.

SCIENTIFIC RESEARCH None

SPECIAL SCIENTIFIC FACILITIES None

PRINCIPAL REFERENCE MATERIAL

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WILD, H. and FERNANDES, A. 1968. Vegetation map of the Flora Zambesiaca area. Flora Zambesiaca. Collins, Salisbury.
WRIGHT, A. 1972. Valley of the Ironwoods. Purnell, Cape Town.
Various unpublished departmental reports are also available.

STAFF None; the area is patrolled from the adjoining reserve.

BUDGET None, the budget for the adjoining area includes this reserve

LOCAL PARK ADMINISTRATION The Secretary for Internal Affairs, Private Bag 7702, Causeway, Salisbury, Rhodesia.

NAME Zimbabwe National Park

TYPE NP **BIOTIC PROVINCE** 4.6.4

LEGAL PROTECTION Total

DATE ESTABLISHED 1952, confirmed by the Land Tenure Act, 1969

GEOGRAPHICAL LOCATION Near southern shore of Kyle Dam, about 25 km SW of Fort Victoria: S 20°16'-20°17'; E 30°55'-30°57'

ALTITUDE 1025-1300 metres

AREA 746 ha

LAND TENURE Nationally owned in accordance with the Land Tenure Act; the ruins have been declared a National Monument.

PHYSICAL FEATURES An area of undulating granite hills and batholiths on the south edge of the Rhodesian plateau, the hills being deeply dissected by tributaries of the Mtilikwe R., while the northern slopes drain to Lake Kyle. A great variety in topography, aspect and drainage make for an equally varied and scenic landscape. Climate is milder than in surrounding areas, frost being a rarity, and the winter dry season is regularly interrupted by orographic rainfall. Annual rainfall is c. 750 mm. The exfoliated granite blocks form convenient building stones, and were used in the construction of the famous Zimbabwe ruins which are the raison d'être of the park.

VEGETATION One of a series of mesic floral isolates, all presumed to be relicts of an earlier forest continuum along the scarps bounding the country on the south-east. There is a complex pattern of habitats and about 500 flowering plants and ferns have been recorded, including several unusual species for the locality. Notable trees are *Oricia swynnertonii* and *Ficus vogelii*; flowering *Aloe* spp. and *Erythrina* spp. are conspicuous. The resurrection plant *Myrothamnus flabellifolius* and others on the batholiths show interesting adaptations to varying moisture regimes. The plant succession distinctively reflects a long period of human settlement.

NOTEWORTHY FAUNA Over 50 mammal species have been recorded: thick-tailed galago (bush-baby) *Galago crassicaudata* and vervet monkey *Cercopithecus aethiops* are abundant and there is still a small population of bushbuck *Tragelaphus scriptus*. The avifauna is diverse with over 300 species identified, many of them winter visitors. The black rough-wing swallow *Psalidoprocne holomelaena* and swee waxbill *Estrilda* (= *Coccopygia*) *melanotis* are of biogeographical interest and linked to the floral isolates. A wide variety of lithophilic lizards occur, notably of the genera *Platysaurus* and *Gerrhosaurus*.

SPECIAL PURPOSE OF THE AREA Preservation of the world renowned Zimbabwe ruins, in which process it also serves to safeguard biota of great interest.

ZONING Not undertaken yet, to be drawn up.

DISTURBANCES OR DEFICIENCIES Almost total removal of woody vegetation by past human impacts produced a very open woodland. Subsequent fire-protection and control of cutting has enabled the vegetation to recover almost up to the limits imposed by climate. Recreational use is now the main cause of disturbance but water extraction, buildings and other construction and the introduction of exotic or ruderal plants are other serious factors.

TOURISM The ruins are a popular attraction and complemented by an archaeological museum. Limited accommodation available in the park; good facilities exist in the surrounding area.

SCIENTIFIC RESEARCH Primarily archaeological but some plant collecting and ornithological observation. Studies of mammals, vegetation and birds in progress.

SPECIAL SCIENTIFIC FACILITIES Archaeological museum and plans for environmental education programmes.

PRINCIPAL REFERENCE MATERIAL

GARLAKE, P.S. 1973. *Great Zimbabwe*. Thames and Hudson, London.

STAFF Senior ranger and 7 other permanent field staff with a small casual labour force.

BUDGET Approximately U.S. $ 24,000

LOCAL PARK ADMINISTRATION Senior Ranger in Charge, Zimbabwe National Park, Private Bag 9087, Fort Victoria, Rhodesia.

Appendix VI

Supplementary Bibliography

1. Climate
2. Geology, Minerals Soils
3. Flora and Fauna
4. Water Resources and Management
5. Land Use and Agriculture
6. Public Health, Socio-Economic Aspects, Development, Pollution

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