CHAPTER 2

THE STUDY AREA

LOCATION

The Kruger National Park occurs along South Africa's eastern and north-eastern boundaries (Fig. 1). It occupies the eastern parts of both the Northern and Mpumalanga Provinces which are separated by the Olifants River. The Lebombo Mountains form the eastern border of the Kruger National Park, and also separate South Africa from Mozambique. This range is prominent in the south of the park as far north as the Shingwedzi River. The northern boundary of the park as well as the international border with Zimbabwe is formed by the Limpopo River. The Crocodile River forms the southern boundary. The western boundary of the Kruger National Park is generally not demarcated by natural features although it does follow the courses of the Nsikazi, Sabie, Klein Letaba and Luvuvhu Rivers in some areas. The western and eastern boundaries of the reserve are fenced.

The Kruger National Park is situated along the upper reaches of the Mozambique coastal plain in the area known as the Lowveld. It lies between latitudes 22° 25′ S and 25° 32′ S and longitudes 30° 50′ E and 32° 02′ E. The reserve has a north to south distance of approximately 320 km and an average east to west distance of approximately 65 km. The Kruger National Park currently has an area of 1 948 528 ha.

Generally the topography of the Kruger National Park is flat with undulating plains. Mountainous areas occur along the eastern boundary, in the south-west corner and in the area north of Punda Maria. The altitude varies between 839 m at Khandizwe near Malelane and 122 m along the Sabie River. Drainage takes place from west to east by the nKomati river system in the south and the Limpopo river system in the north.

Baobabs have a geographical distribution limited to areas which receive frost on a maximum of one day per year and are therefore only common in the extreme north of the Kruger

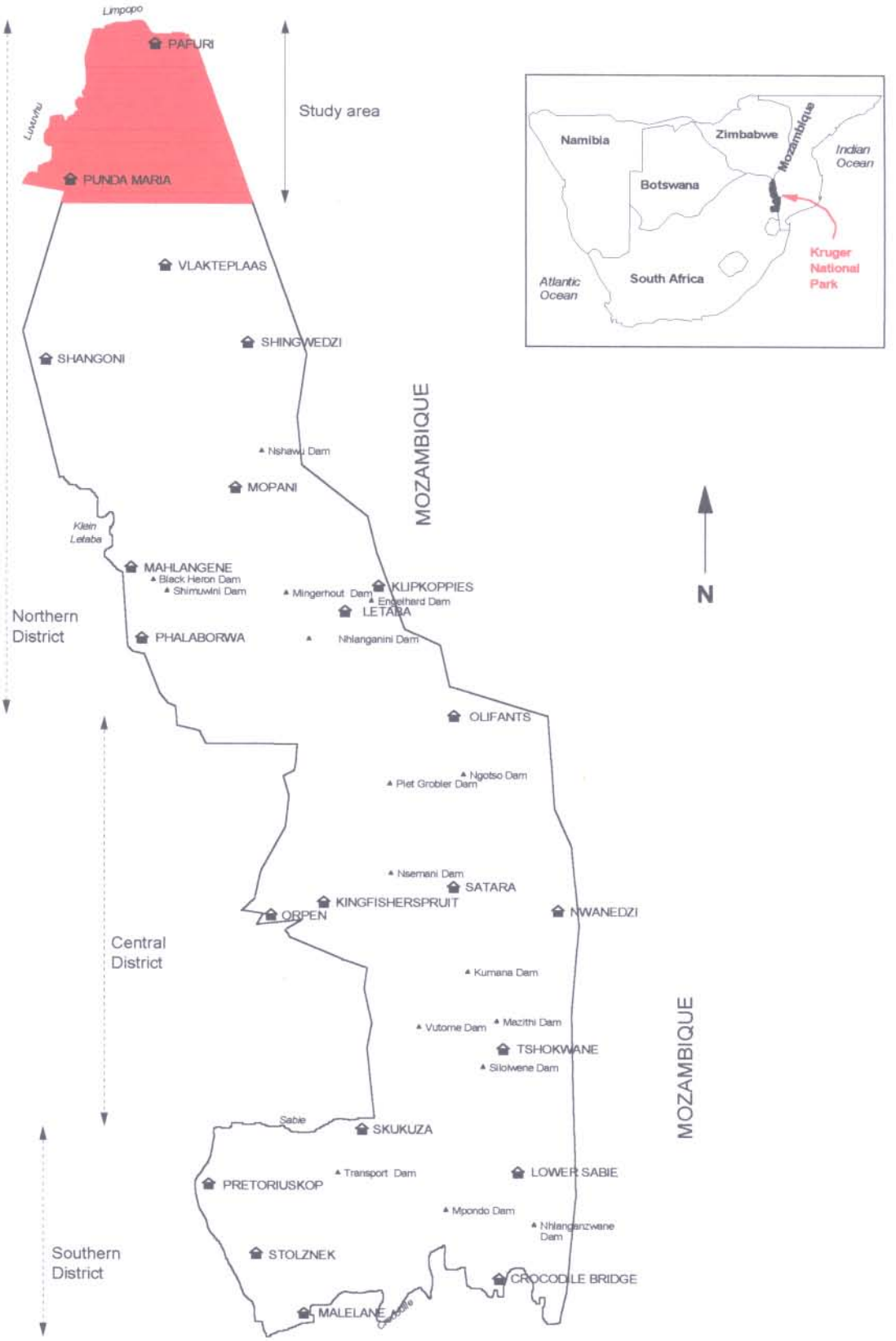


Fig. 1: Location of the study area in the Kruger National Park.

National Park. These trees are, however, not confined to this area and individuals are found almost as far south as Tshokwane. Similarly, the common star-chestnut, though present in suitable habitat throughout the reserve, is common only in the Pafuri region of the Kruger National Park. The study area was therefore, determined by the distribution of these two plant species. The study took place in the extreme northern part of the Kruger National Park (Fig. 1), in the area between the Punda Maria restcamp and the Limpopo River. A line with latitude 22° 45′ S formed the southern boundary of the study area. This area has a size of approximately 154 104 ha. The Luvuvhu River, which flows from west to east through the study area, divides the area into a northern and a southern section (Fig. 2). Plant populations in these two sections were compared as they have different histories of land-use.

HISTORY

The area in which the Kruger National Park is situated has been inhabited by people since the time of the nomadic bushmen and isolated settlements of the Early Stone Age inhabitants (Joubert 1986). The prevalence of diseases which affected both man and livestock prevented the establishment of high-density or extensive settlements. The numbers of people fluctuated considerably until the mid 1800's, their lifestyle, one of the hunter-gatherer. It was around 1840 that the first European settlers slowly began to move into the area, despite the climate, diseases and remoteness. The winter months, when the climate was more hospitable and diseases less prevalent, saw an insurgence of hunters, traders, farmers and adventurers (Joubert 1986).

Following the discovery of gold in the Lydenburg district in 1869 the popularity of the area as a hunting ground and winter pasture soared (Fourie & De Graaf 1992). The accessibility of the area improved greatly during the 1870's with the establishment of the Lydenburg-Delagoa Bay trading route and in the 1890's when the Selati railway line was built. The insurgence of hunters which invaded the area in the late 1800's, resulted in the decimation of the animal populations (Joubert 1986). The situation for the game worsened during the construction of the railway line when thousands of labourers were employed and were paid

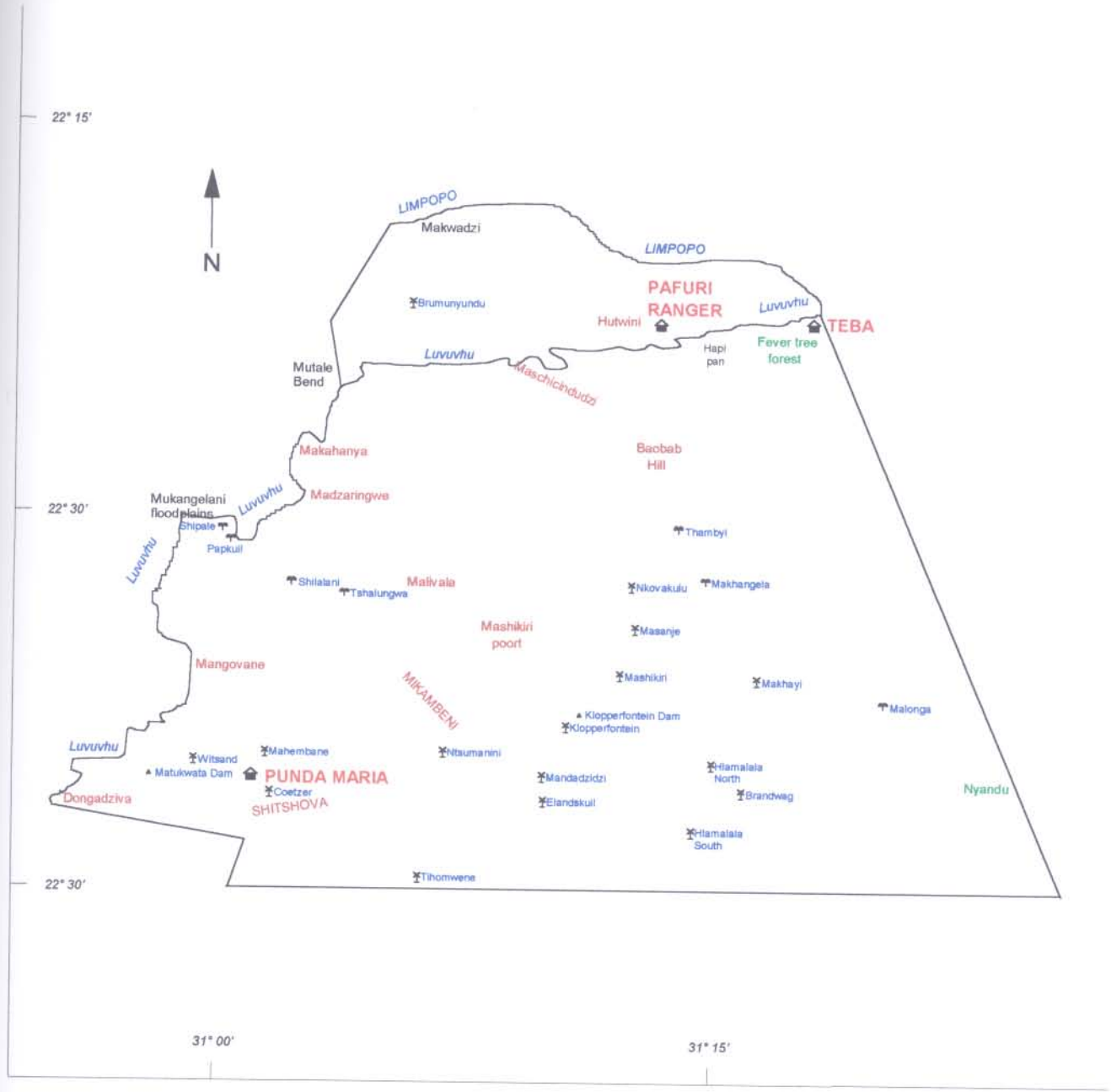


Fig. 2: The northern Kruger National Park.

mainly in game meat (Stevenson-Hamilton 1937). Game in the vicinity of the line, which had been numerous before was exploited to the utmost, and many men made a living solely by killing buck (Stevenson-Hamilton 1937). Species such as white rhinoceros (*Ceratotherium simum*) had been eliminated from the area, while other species were threatened with extinction (Joubert 1986).

This decline in game numbers led to President Kruger's proposal that a game sanctuary be established to protect the regions fauna. Eventually, 14 years later in 1898, some land between the Crocodile and Sabie Rivers was proclaimed as the Government Game Reserve (Fourie & De Graaf 1992; Joubert 1986). This area was reproclaimed in 1902 as part of the Sabi Game Reserve which stretched from the Crocodile River in the south to the Olifants River in the north (Joubert 1986). Although the Government Game Reserve had been established a number of years earlier, it was only after the appointment of Col. Stevenson-Hamilton as warden in 1902 that control of the area as a wildlife sanctuary began in earnest.

In 1903, a section of land between the Letaba and Luvuvhu Rivers was proclaimed as the Shingwedzi Game Reserve. Land to the west of the Sabi Game Reserve and an area between the Olifants and Letaba Rivers were later added. These areas were all included in the Kruger National Park which was formed in 1926 (Joubert 1986). The land between the Luvuvhu and Limpopo Rivers did not originally form part of the Kruger National Park, but was only incorporated into the reserve in 1969.

CLIMATE

Climate can be described as the physical state of the atmosphere and is a result of the sun's radiation on the atmosphere which surrounds the earth (Gertenbach 1987). Climate is one of the many abiotic factors that have a major influence on vegetation. Sunlight, temperature and moisture are important for vegetation but temperature and moisture have the greatest influence on plants.

Koppen's classification, places the study area entirely within the BShw-class (Schulze 1947), where:

B - arid climate
S - steppe
h - hot and dry
w - dry season in winter.

The major part of the study area lies in the DB'd-class according to Thornthwaite's classification although the area around Punda Maria is classed as DB'w. This means the study area has a semi-arid, warm (steppe) climate with the latter portion having a relatively dry winter (Schulze 1947).

The climate of the Kruger National Park is characterised by a hot wet summer from October to March/April and a dry relatively milder winter from April/May to August/September. Temperatures frequently exceed 40 °C. The mean annual rainfall for the region is 500 mm - 550 mm and is highest in the south-west and lowest in the north-east of the park (Joubert 1986).

The climate of the Lowveld and hence the Kruger National Park is influenced by anticyclonic systems moving semi-rhythmically from west to east over the subcontinent. During summer, hot and dry conditions are caused by the presence of anticyclonic conditions present in the interior of the country. A low pressure cell usually then develops over the interior, resulting in moist equatorial air moving in from the north and north-east causing thunder storms. Showers are also caused by equatorial low pressure troughs which become established over southern Africa. In such cases rain is continuous and widespread over the Lowveld and the occurrence of thunder is rare (Venter & Gertenbach 1986).

Rainfall also results from the occurrence of tropical cyclones which originate in the tropical regions of the Indian ocean, move south along the Mozambique channel and then move inland over the Lowveld. Tropical cyclones usually result in heavy rainfall and often cause flooding (Venter & Gertenbach 1986).

The anticyclonic conditions usually present over the countries' interior during winter result in fine and mild conditions over the Lowveld, but are occasionally replaced by cooler, cloudy conditions when cold frontal systems penetrate from the south (Venter & Gertenbach 1986).

Generally, rainfall in the Kruger National Park decreases from south to north and from west to east. This is due to the increasing distance from the Indian ocean and the decreasing altitude respectively. The high lying area surrounding Punda Maria is an exception to this (Gertenbach 1980; Venter & Gertenbach 1986).

In the study area, rainfall is recorded at Punda Maria and Pafuri, which receive an annual average of 556.5 mm and 423.2 mm respectively. Rainfall in the study area is highly seasonal, falling mainly during the summer. A rainfall map has been compiled for the Kruger National Park (Fig. 3); (Gertenbach 1980). This map shows a range in annual rainfall in the study area from less than 450 mm to more than 650 mm. This data may, however, be slightly inaccurate as there are insufficient rainfall recording stations in the Kruger National Park to enable the accurate plotting of rainfall isohyets (Gertenbach 1980).

The rainfall pattern in the summer rainfall areas of South Africa consists of regular fluctuations. This quasi twenty-year regional oscillation results in 10 years of above and 10 years of below average rainfall (Tyson 1978). Rainfall in the Kruger National Park also follows this pattern with the difference between the average annual rainfall of wet and dry cycles of approximately 26 % (Gertenbach 1980; Venter & Gertenbach 1986).

Air temperature plays a major role in photosynthesis and can affect growth rate, size, seed germination and flowering of plants. Temperatures in the Kruger National Park vary between 0 °C and 44 °C although temperatures beyond these extremes are occasionally recorded. Frost seldom occurs (Venter & Gertenbach 1986). The average temperature for Punda Maria is 23.2 °C, with a minimum and maximum of 17.1 and 29.3 °C, respectively. The lowest temperatures occur during June (average minimum = 12.2 °C) (Fig. 4), and the

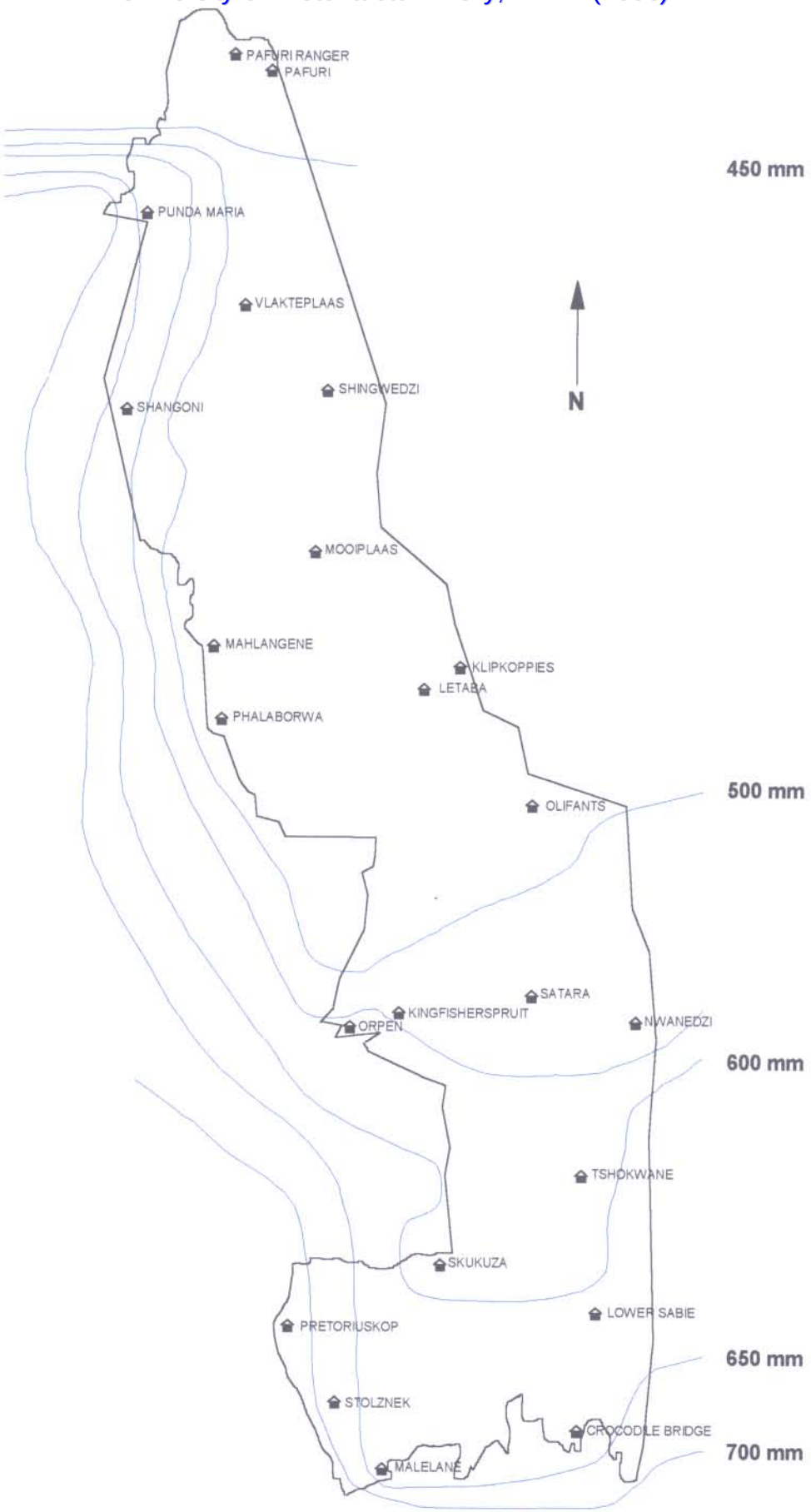
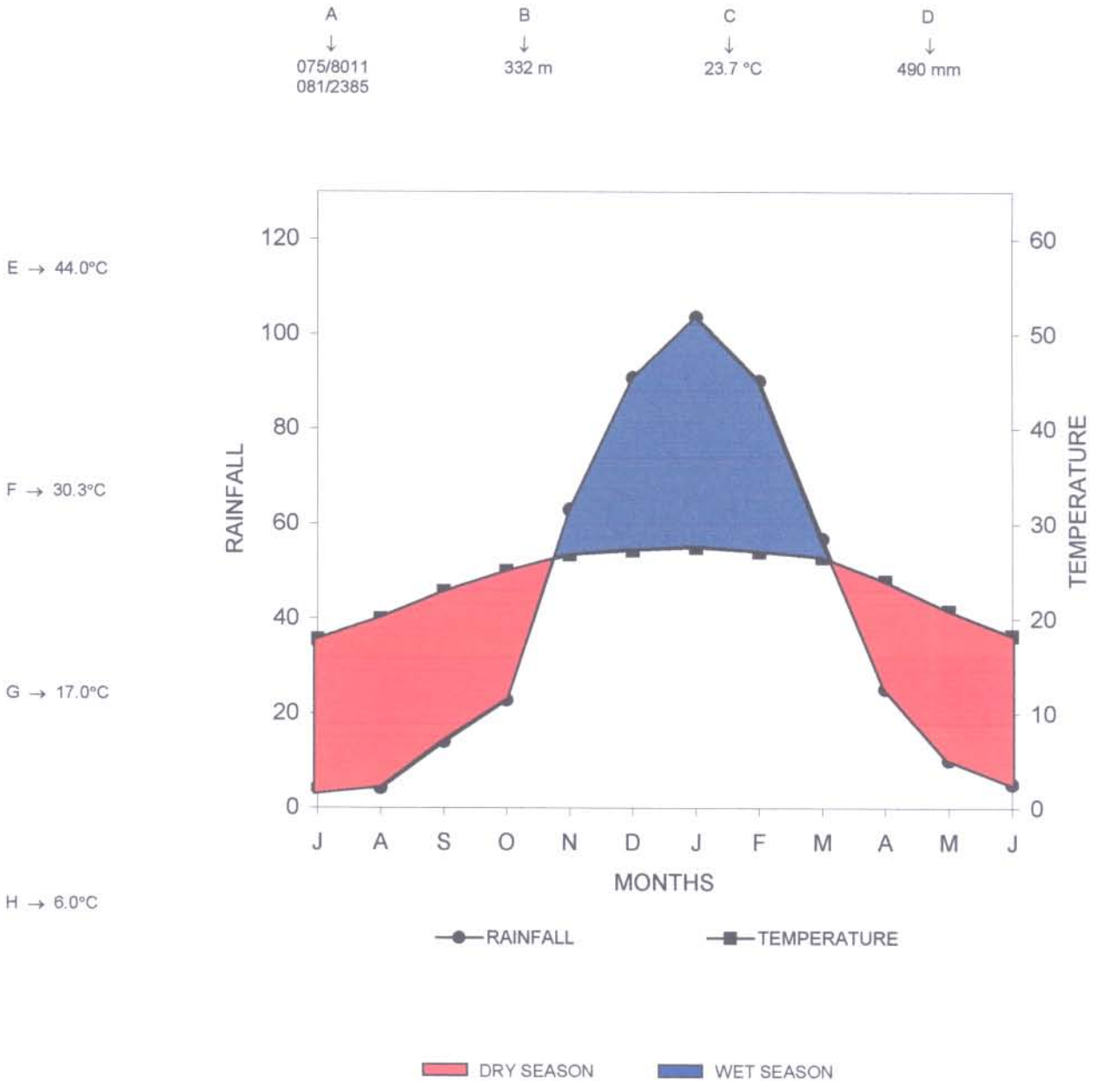


Fig. 3: Rainfall map of the Kruger National Park illustrating isohyets (Gertenbach 1980).



LEGEND: A-weather station; B-altitude; C-mean annual temperature; D-mean annual rainfall; E-highest recorded temperature; F-mean daily maximum; G-mean daily minumum; H-lowest recorded temperature

Fig. 4: Climate diagram for temperature (°C) and rainfall (mm) based on Walter's (1963) convention. Pooled data from Punda Maria (no. 0758011; 22° 41' S; 31° 01' E 462 m) and Pafuri (no. 0812385; 22° 27' S; 31° 19' E 202 m) weather stations were used.

highest during January (32.3 °C). The greatest temperature fluctuation occurs during August.

Pafuri has an average daily minimum temperature of 16.8 °C and an average daily maximum of 31.3 °C. The average temperature is 24.1 °C. The lowest temperatures occur during June (average minimum = 7.9 °C) and the highest during November (average maximum = 34.7 °C). The largest daily fluctuation in temperatures also occurs during June.

Due to the regions sub-tropical climate, summer months are usually hot and humid, while the winter is dry. The mean annual relative humidity for the Punda Maria weather station ranges between a minimum of 11 % and a maximum of 99 %.

GEOLOGY

The regions geological formations are important for the formation of soil, especially as the area has a semi-arid climate. In such a region, the parent material influences the type of profile that arises, the fertility of the soil and its stability against degradation.

The Kruger National Park is divided geologically into almost two equal sections with predominantly granitic formations in the western half and basalts in the eastern half. A narrow belt of shale and sandstone divides these two formations (Joubert 1986). The western granitic areas are undulating, while the east consists of fairly level plains, bordered on the east by the rhyolitic Lebombo Mountains. The sandstone reefs were formed by Karoo sediments and surface in patches throughout most of the reserve. In the region around Punda Maria, however, these reefs occur over a vast area. Dolerite intrusions are found throughout the park, but none of importance are present in the study area (Van Wyk 1984).

As can be seen from Figure 5, the geology of the study area is not highly complex and is represented by only four systems. These are the Karroo, Waterberg, Loskop and Dominion reef systems. Rocks of the Karroo System underlie most of the area, with the latter three

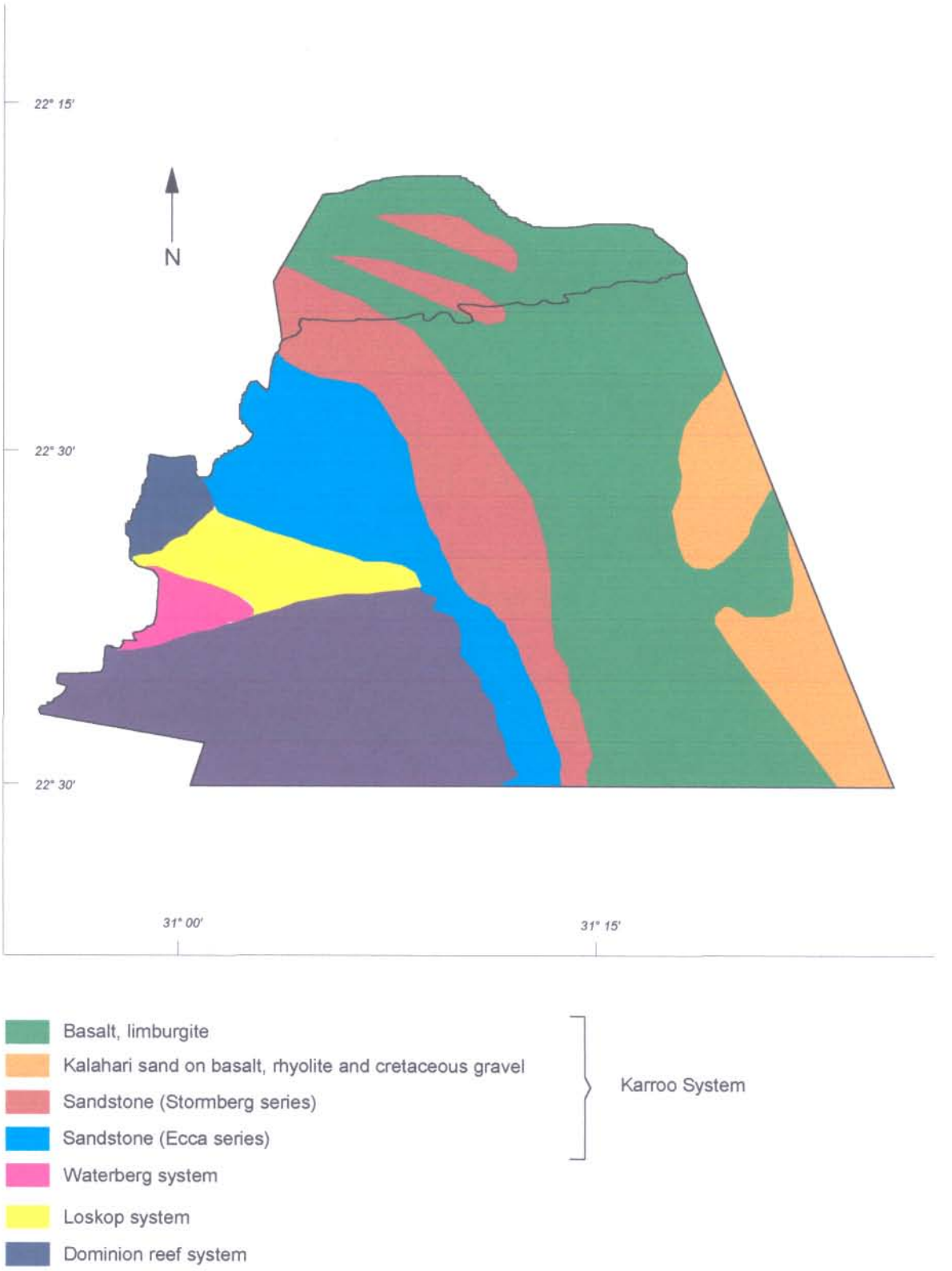


Fig. 5: Geology of the northern Kruger National Park.

systems only occurring in the south-western corner of the study area around the Punda Maria restcamp. Sandstone reefs of the Dominion Reef System occur to the west with intrusions of the Waterberg and Loskop Systems (Van Wyk 1984). The granite which runs along the western half of the rest of the Kruger National Park terminates just to the south of the study area. These systems are bordered by bands of the sandstone of the Stormberg and Ecca series' which run the length of the Kruger National Park. The geology of the northern and western half of the study area consists almost entirely of basalt and limburgite of the Stormberg series. It is, however, interrupted in the north by two sandstone patches (Stormberg series) which are associated with the two faults in this region. These two dykes run in a south-east direction. Along the eastern boundary, there is an area of Kalahari sand which lies on basalt, rhyolite and Cretaceous gravel of the Stormberg series. This sand is aeolian in origin, and up to 30 m deep in places (Gertenbach 1983). The vegetation which occurs in this area is known as the Nwambia Sandveld.

GEOMORPHOLOGY

The Lowveld forms the footslope of the Drakensberg escarpment and is classified as a pediplain with a gentle slope towards the east. The terrain morphology is determined by geological structures and differences in resistance of various rock formations against weathering. In the study area, rugged areas with low mountains have been formed by the sandstones and quartzites of the Clarens and Soutbansberg Formations (Venter & Bristow 1986).

The Lebombo mountains form the most outstanding topographic feature of the Kruger National Park, but north of the Shingwedzi River the range dwindles. In the study area, all that remains of the range is a broad platform that is about 90 m higher than the adjacent plains formed by the mafic lavas (Venter & Bristow 1986).

In the eastern part of the study area, unconsolidated conglomerates and coarse sands of coastal origin overlie rocks of the Malvernia Formation. This is the Nwambia Sandveld

which forms an extremely flat plain which continues towards the east (Venter & Bristow 1986).

DRAINAGE

The study area is drained by two perennial rivers, the Limpopo River and the Luvuvhu River, which flow from west to east. The Luvuvhu River originates in the Drakensberg along the Great Escarpment and feeds the Limpopo System on the eastern boundary of the park. A number of smaller streams also flow through the area, many of which only carry water after heavy rainfall. Some of these streams are the Nkovakulu, Madzaringwe, Thambyi, Shihahlandonga, Hlamalala, Shidzivane, Mangovane and Matukwala. The Mutale River flows into the Kruger National Park from the west and supplies a substantial amount of water to the Luvuvhu River. In the Nwambia Sandveld, a deranged pattern of pseudo drainage lines (elongated depressions) of extremely low density occur, occasionally linking some of the many pans which are found in the region (Venter & Bristow 1986).

VEGETATION AND SOIL

The study area includes three of Acocks' veld types. These are Number nine (Lowveld Sour Bushveld), Number 15 (Mopani veld) and Number 18 (Mixed Bushveld) (Acocks 1988). According to the classification of Low and Rebelo (1996) the Kruger National Park forms part of the savanna biome. Four veld types occur in the study area. These are Mopane Shrubveld, Mopane Bushveld, Soutpansberg Arid Mountain Bushveld and Sour Lowveld Bushveld (Low & Rebelo 1996).

The structure, texture, chemical composition and colour of the numerous soil types in the Kruger National Park shows considerable variation, but three major groups of soil can be differentiated based on their origin (Joubert 1976). Soils which are derived from granite are light in colour, generally sandy, with some clay elements in the subsoil, or depressions due to leaching or erosion. Soils of sandstone origin are usually deep and sandy, while dark

soils heavy in clay, which attain depths of up to a metre or more are derived from basalt (Joubert 1976).

The Kruger National Park is home to approximately 1968 different plant species on which several detailed studies have been conducted (Venter & Gertenbach 1986). Due to the size and number of plant communities which have been identified, practical use of the information is difficult which has resulted in the development of the landscape system. A total of 35 landscape types have been identified in the Kruger National Park based on both the biotic and abiotic components of the area. Gertenbach (1983) defines a landscape as an area with a specific geomorphology, macroclimate, soil and vegetation pattern and associated fauna. There are nine such landscapes which occur in the study area (Fig. 6) and due to their relevance to this study, are discussed in more detail below. The following descriptions are summarised from Gertenbach (1983).

15: *Colophospermum mopane* Forest

This landscape occurs in the southern part of the study area and is not represented at all in the north. Ecca shales underlie the flat to concave topography. Deep soils, rich in salts, with a strong structure in the subsoil occur in this landscape. The soils are mainly of the Swartland (orthic A, over pedocutanic B horizon, over saprolite) and Valsrivier (orthic A, over pedocutanic B horizon, over unconsolidated material) forms although Hutton (orthic A, over red apedal B horizon) and Sterkspruit orthic A, over prismacutanic B horizon) also occur. The vegetation is a high tree savannah, with *Colophospermum mopane* trees of between 10 and 15 m high making up the most important component of this landscape. The landscape is unique to South Africa and deserves special priority in conservation. The thick mopane forest is also ideal habitat for elephant breeding herds.

16: Punda Maria Sandveld on Cave Sandstone

The majority of this landscape occurs south of the Luvuvhu although a small section does occur just north of the river. The Cave Sandstone of the Clarens Formation forms koppies or outcrops which have sand plateaus and bottomlands. These plateaus and bottomlands have deep grey to yellow sandy soil of the Clovelly (orthic A, over yellow brown apedal B horizon) or Fernwood (orthic A, over E horizon) forms. The soils otherwise consist of

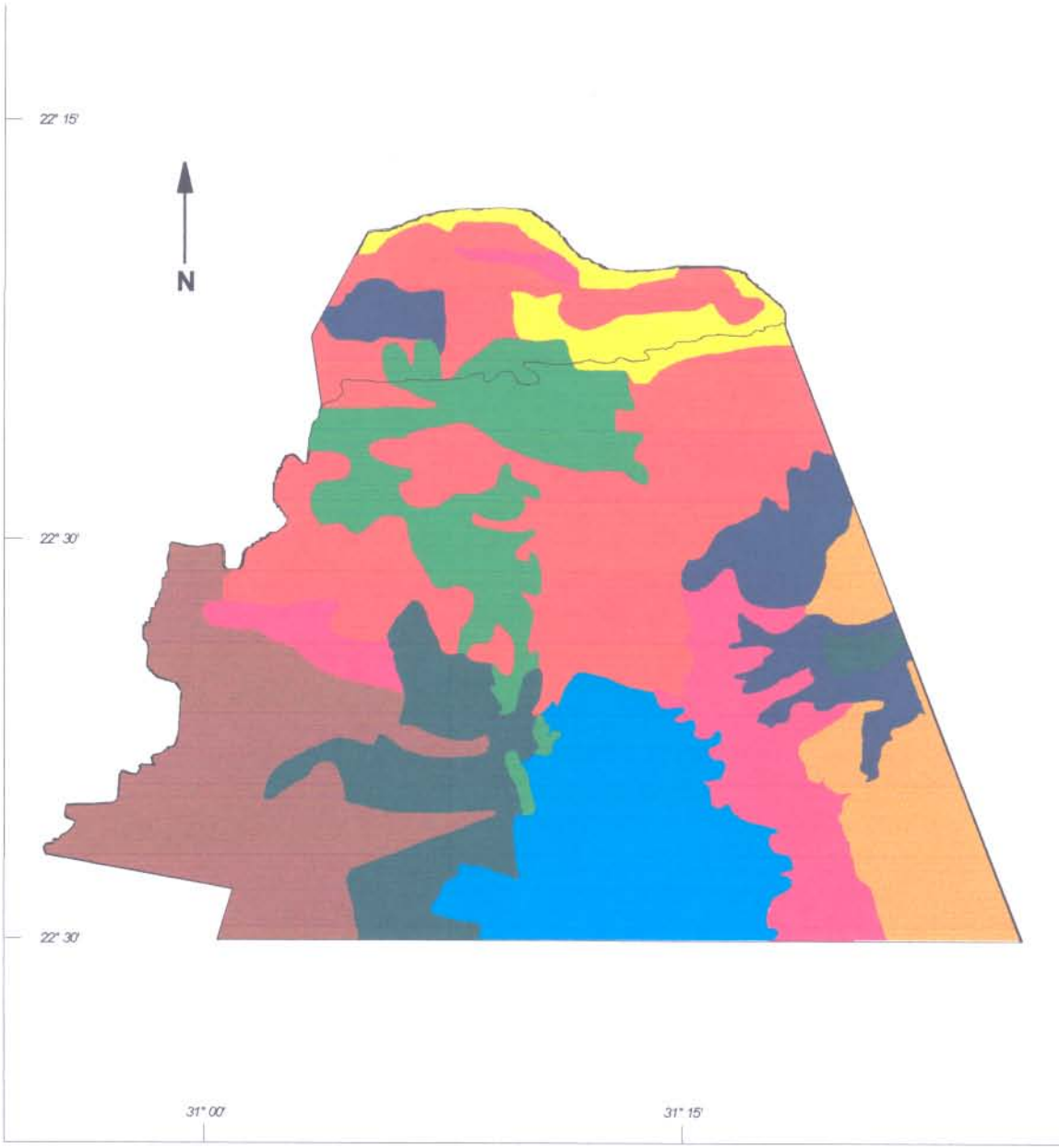


Fig. 6: Landscapes of the northern Kruger National Park (Gertenbach 1983).

lithosols or solid rock with a thin layer of soil (orthic A horizon) (Mispah) in the hollow places. The vegetation on the deep sandy soils consists of a tall shrub savannah

23: *Colophospermum mopane* Shrubveld on Basalt

This landscape only occurs in the south of the study area and consists of flat to concave plains with a number of drainage channels in the form of marshes or vleis. The basalt has dolerite intrusions in places. Where the topography is flat or even concave, soils with vertic properties occur. A large number of soil forms occur, including Milkwood (melanic A horizon over hard rock), Mayo (melanic A, over a lithocutanic B horizon), Mispah, Bonheim (melanic A, over a pedocutanic B horizon), Swartland, Arcadia (vertic A horizon over an unspecified G horizon) and Glenrosa (orthic A, over a lithocutanic B horizon). Multi-stemmed mopane shrubs 1 - 2 m high dominate the woody vegetation in this area. Stands of these *Colophospermum mopane* shrubs may be as dense as 600 individuals per hectare. Their dominance results in other woody species being relatively scarce. Elephant bulls are common in this landscape and breeding herds may occasionally occur while moving between other landscapes.

25: *Adansonia digitata / Colophospermum mopane* Rugged Veld

This landscape is included in its entirety in the study area, and parts of it are found both north and south of the Luvuvhu River. It occurs on Basalt. The terrain undulates strongly, has steep slopes and numerous koppies. The soil is dark in colour and has a relatively high clay content. The structure of the topsoil is sometimes poorly developed, with the Milkwood, Mayo, Mispah and Glenrosa forms being dominant. Shallow lithosols occur on the koppies. The vegetation structure is an open tree savannah, with the landscape deriving its name from the physiognomic dominance of baobab and mopane trees. *Sterculia rogersii* trees also occur regularly in this area. Elephant occur infrequently.

26: *Colophospermum mopane* Shrubveld on Calcrete

This undulating landscape occurs in two isolated areas, both within the study area. One section occurs on the eastern boundary of the Kruger National Park alongside the Nwambia Sandveld, while the other occurs on the western boundary between the Limpopo and Luvuvhu Rivers. Soil in this region is shallow and calcareous with a high occurrence of

lime concretions. These are as a result of decomposition of the underlying geological material of the Malvernia formations. The most common soil forms are Milkwood, Mayo, Mispah and Glenrosa. Lithosols are common. The sub-unit on the eastern boundary is mainly a shrub savannah, while the sub-unit on the western boundary is a tree savannah. *Sterculia rogersii* is one of the dominant woody species of this landscape. Elephant occur in this region in small numbers. This landscape is unique in South Africa and therefore, necessitates special conservation status.

27: Mixed *Combretum* spp. / *Colophospermum mopane* Woodland

Three isolated sections of this landscape occur in the study area. One section occurs in the far north of the Kruger National Park, alongside the Limpopo floodplain. The other two areas occur south of the Luvuvhu River. A small section is found near the parks western boundary and the larger section, is a narrow strip running along the west of the Nwambia Sandveld. The underlying geological material consists of Quaternary white sand mixed with gravel and basalt. This landscape is relatively flat, the soil is deep and sandy in places and usually well drained. Hutton, Shortlands (orthic A, over red structured B horizon), Bonheim, Valsrivier, Swartland, Mayo, Mispah and Glenrosa are the dominant soil forms. The vegetation consists of an open tree veld with a large quantity of medium shrubs. *Sterculia rogersii* is one of the many dominant woody species. Elephant occur regularly in this landscape.

28: Limpopo / Luvuvhu Floodplains

This landscape occurs on the banks of the Limpopo and Luvuvhu Rivers. The topography is flat and the soil consists of alluvium which has been deposited by the rivers. Koppies are absent. This landscape also has a number of pans which fill up when the rivers flood. The soils originate from granite, Waterberg sandstone, Cave sandstone, basalt and dolerite. Inhoek (melanic A horizon), Dundee (orthic A horizon over stratified alluvium) and Oakleaf (orthic A, over neocutanic B horizon) are the main soil forms, with Arcadia and Willowbrook (melanic A, over G horizon) soils found in the pans. *Adansonia digitata* is a dominant woody species in some parts of this landscape with almost homogenous stands occurring in isolated patches. Elephant bulls are abundant on these floodplains.

32: Nwambia Sandveld

This landscape occurs along the eastern boundary of the study area. The terrain is flat and consists of sand deposits which can be present to a depth of 30 m. The soil forms are Hutton and Clovelly. Well defined drainage channels are absent but a number of pans are present. The vegetation is in the form of a tall shrubveld with very few trees. *Adansonia digitata* is one of the dominant tree species in the western part of this landscape. As with most of the larger mammals, elephant only occur in relatively small numbers in this region.

34: Punda Maria Sandveld on Waterberg Sandstone

This landscape occurs in the south-western corner of the study area. The area consists of both mountains and plains with springs being a common feature. The underlying geology consists of Waterberg sandstone into which diabase sills and dykes have intruded. Soils vary from lithosols in the mountains to deep sandy soils on the middleslopes and brackish soils in the bottomlands. Dominant soil forms on the mountains are Mispah and Glenrosa, while Hutton, Clovelly, and Glenrosa dominate the middleslopes. Valsrivier, Sterkspruit, Hutton, and Swartland dominate the bottomlands. Elephant are present in small numbers.