CHAPTER 2

STUDY AREA

2.1 LOCATION AND SIZE

Marakele National Park is situated in the south-western corner of the Bushveld (Acocks 1988) in the Republic of South Africa. It is bounded by longitudes 27° 30' and 27° 45' E and latitudes 24° 15' and 24° 30' S. The study area covers approximately 29 051 ha (290,51 km^2). Thabazimbi is the nearest town, 20 km south west of the study area (Figure 2.1).

2.2 GEOMORPHOLOGY AND PHYSIOGRAPHY

The study area is situated on the Palala Plateaux (De Vries 1968/69), of the Waterberg in the Northern Province, and consists of the Kransberg Massif, plateaux, valleys, terraces, ridges, kloof and riverine areas, steep slopes and wetlands. The altitude ranges from 1 200 m on the valley plains to 2 100 m on the summit of Kransberg. The MNP is drained by the Matlabas, Mamba and Sterkstroom River systems, which are part of the Limpopo System.

The Matlabas and Mamba River systems flow in a north-western direction, whereas the Sterkstroom River system flows in a north-eastern direction. Smaller streams join the systems along the way and most of the streams are perennial. Perennial and annual springs occur throughout the study area.

2.3 GEOLOGY AND SOIL

2.3.1 Geology

The South African Commitee for Stratigraphy (SACS 1980) undertook a reclassification of the geology and according to this, the rocky outcrops in the study area are, therefore, named in terms of the new classification (SACS 1980; Westfall 1981; Gertenbach 1987; Table 2.1).

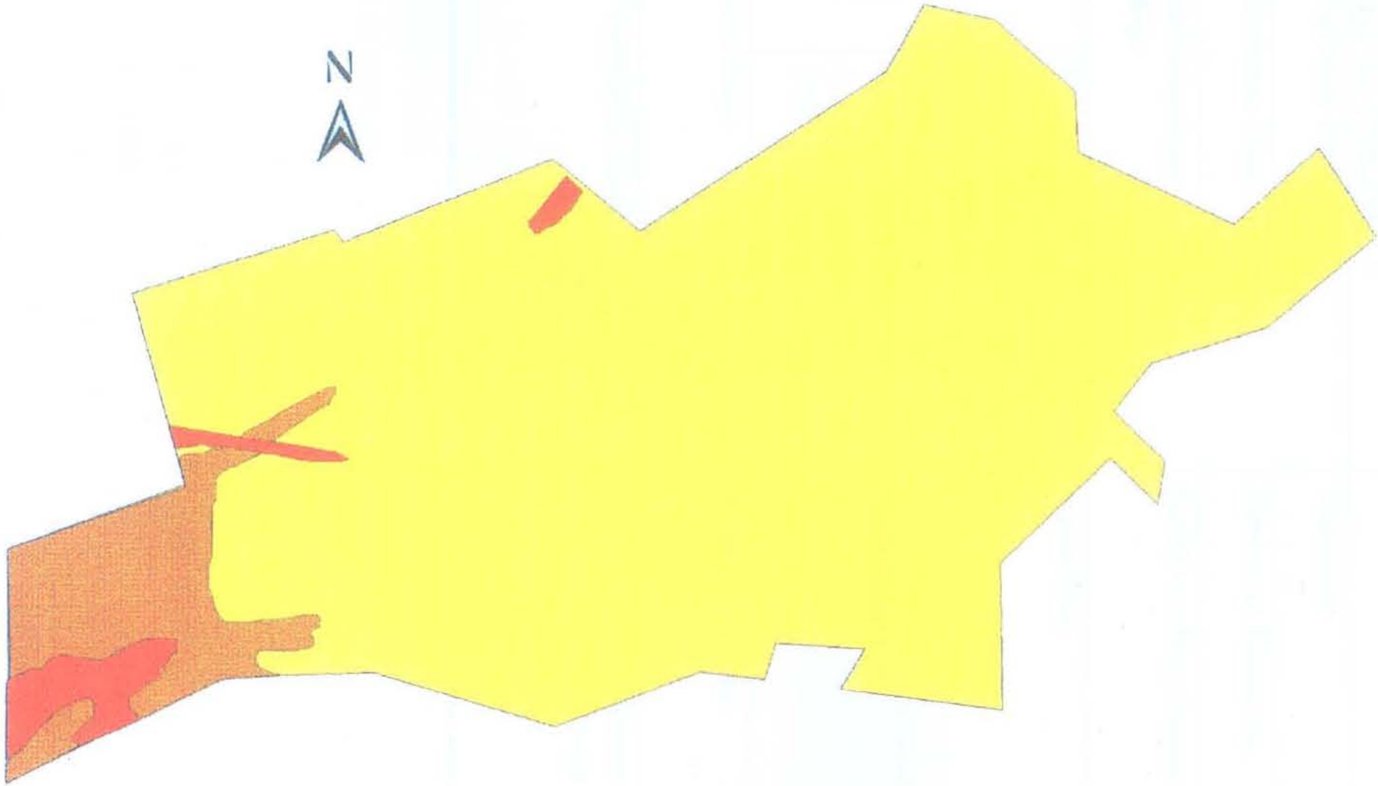
Sedimentary deposits of the Waterberg Group of the Mokolian Erathem (1 080 - 2 070 Ma) are found in the study area (Figure 2.2). Large part of the study area consists of sandstone of the Kransberg Subgroup, Sandriviersberg Formation (Figure 2.2). The south-western and southern parts of the study area consists of sandstone of the Matlabas Subgroup, Aasvoëlkop Formation overlying shale and mudstone of the Matlabas Subgroup, Aasvoëlkop Formation, Groothoek Mudstone Member. Shale outcrops occur where the overlying sandstone has been completely eroded. At the western boundary of the study area occur conglomerate outcrops of the Matlabas Subgroup, Aasvoëlkop Formation (Table 2.1, Figure 2.2). Post-Waterberg diabase dykes and sills of the Mokolian age are exposed in the south-western part and at the northern boundary of the study area (Figure 2.2; SACS 1980; Westfall 1981). In figure 2.3 a north-south profile of the geological formations and terrain morphology of the study area is presented.

The different geological formations erode to form spesific soil types with associated vegetation, which is clearly visible on aerial photographs (Gertenbach 1987).

2.3.2 Soil

The soil in the study area is related to the rocky outcrops from which it was derived, and therefore the soil can be discussed on the basis of their geological origin (Gertenbach 1987). The soils derived from sedimentary outcrops from the Waterberg Group, vary from a yellowish coarse-grained sandstone, locally gritty, with ferruginous laminae on cross bedding planes on the Sandriviersberg Sandstone Formation, to a reddish and brownish medium- and coarse-grained sandstone, pebbly in places with intercalated flows of trachytic lava, tuffaccous graywacke, siltstone, shale, pebble and boulder conglomerate on the Swaershoek Sandstone Formation (SACS, 1980).

According to the South-African Soil Classification (MacVicar et al. 1977), the A horizons can be qualified as orthic. The soil derived from diabase is reddish and brownish in colour with a higher clay content.



Scale: 1: 50 000

Figure 2.2 Geological map of the study area (adapted from Geological series, Thabazimbi 2426, Department of Mines).

Sandstone – Sandriviersberg Stage

Siltstone, shale, sandstone, conglomerate and grit – Langkloof Stage

Diabase

Table 2.1 Lithostratigraphy of the Waterberg Group in the study area (SACS 1980).

<table>
<tr><th></th><th colspan="2">Previous subdivision (DeVries 1968-69)</th><th>Subgroup</th><th>Formation</th><th>Member</th></tr>
<tr><td rowspan="3">Kransberg Series</td><td colspan="2">Vaalwater Stage</td><td rowspan="3">Kransberg ("Upper Waterberg")</td><td>Vaalwater</td><td>None</td></tr>
<tr><td colspan="2">Cleremont Stage</td><td>Cleremont Sandstone</td><td>None</td></tr>
<tr><td colspan="2">Sandriviersberg Stage</td><td>Sandriviersberg Sandstone</td><td>None</td></tr>
<tr><td rowspan="5">Nylstroom Series</td><td rowspan="3">Langkloof Stage</td><td rowspan="2">Upper Langkloof Substage</td><td rowspan="3">Matlabas ("Middle Waterberg")</td><td rowspan="2">Aasvoëlkop</td><td>None</td></tr>
<tr><td>Groothoek Mudstone</td></tr>
<tr><td>Lower Langkloof Substage</td><td>Skilpadkop Grit</td><td>None</td></tr>
<tr><td colspan="2">Alma Stage</td><td rowspan="2">Nylstroom ("Lower Waterberg")</td><td>Alma Graywacke</td><td>None</td></tr>
<tr><td colspan="2">Swaershoek Stage</td><td>Swaershoek Sandstone
Swaershoek Sandstone</td><td>None</td></tr>
</table>

The soils can be classified into the following soil forms: Mispah, Glenrosa, Cartref, Hutton, Clovelly, Inanda, Kranskop, Magwa, Griffin, Longlands, Dundee, Fernwood, Oakleaf, Katspruit, Avalon, Westleigh and Champagne (Land Type Survey Staff 1988; MacVicar et al. 1977).

2.4 LAND TYPES

A land type denotes an area that can be shown on a 1:250 000 scale map and displays a marked degree of uniformity with respect to terrain form, soil pattern and climate. One land type differs from another in terms of soil pattern or climate (Land Type Survey Staff 1988; Kooij et al. 1990).

Three different land types are recognised in the study area, namely the A, F and I land types (Figure 2.4). In figures 2.5, 2.6 and 2.7, 1 represents crest, 2 a scarp, 3 a midslope, 4 a footslope, and 5 a valley bottom (Land Type Survey Staff 1988). Each of these land types can be further sub-divided. The A land types refer to freely drained, yellow to red apedal soils with no water table.

Within the study area the A land type inludes only the Ad land type. This land type occurs in the western, north-eastern and eastern parts of the study area (Figure 2.4). Plinthic catenas do not occur in the Ad land type and one or more of the following soil forms occupy at least 40 % of the area, viz. Inanda, Kranskop, Magwa, Hutton, Griffin and Clovelly (Land Type Survey Staff 1988; Kooij et al. 1990). The entire A land type is suitable for agronomy (Kooij et al. 1990), and the north-eastern part of the study area has been ploughed for the cultivation of mainly maize. In the Ad land type yellow soils occupy less than 10 % of the area while dystrophic and/or mesotrophic soils occupy a larger area than the high base status red-yellow apedal soils. The Ad land type occurs mainly on sandstone of the Waterberg Group. The predominant soil form in this land type is the Clovelly Form with a soil depth between 300 - 1 200 mm and < 30 % clay in the B-horizon. The terrain units are 1, 3, 4 and 5 with terrain unit 3, (45 %) as the dominant unit in this land type (Land Type Survey Staff 1988; Figure 2.5).

Within the study area the F land type includes only the Fa land type. The Fa land type accommodates pedologically young landscapes that are not predominantly

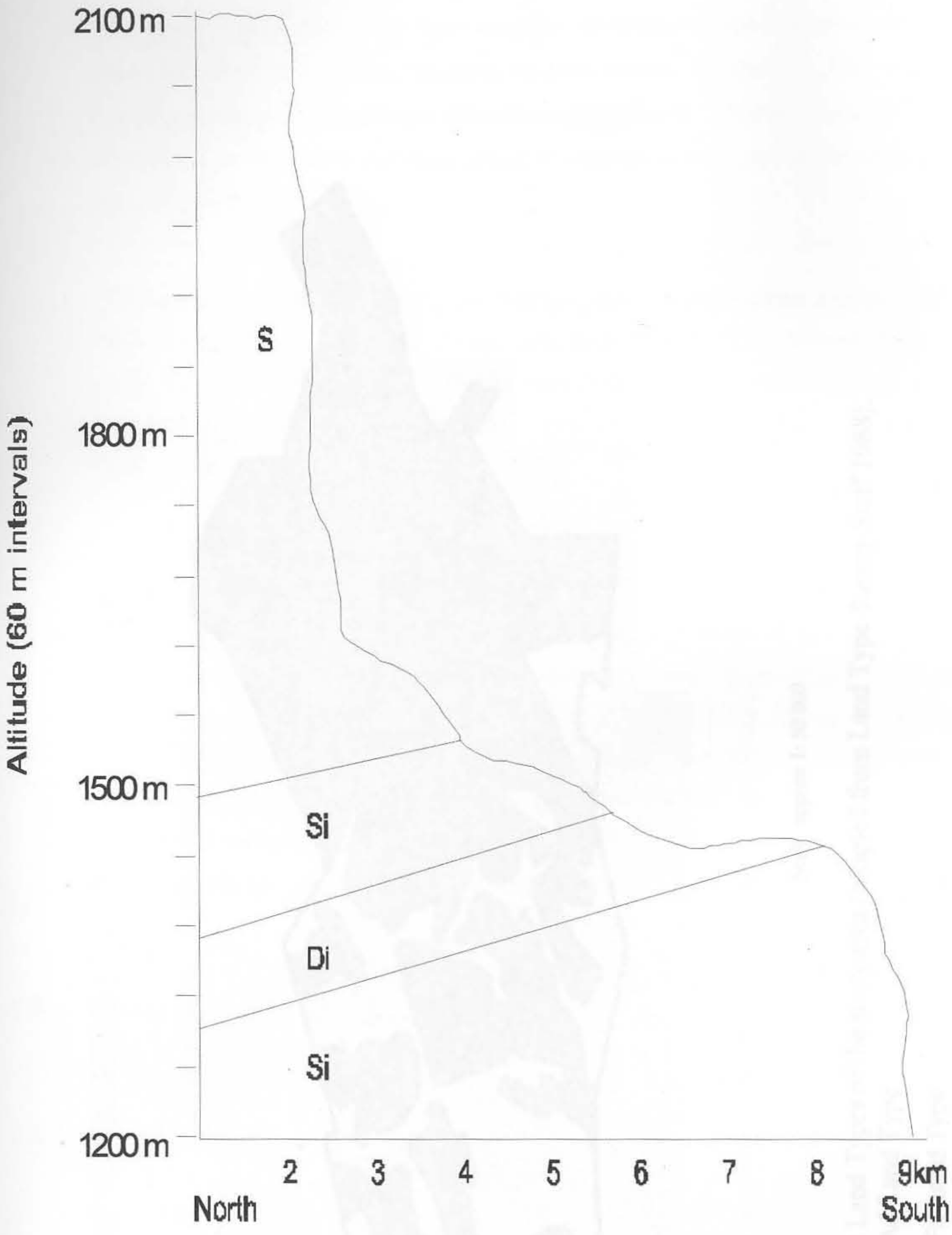


Figure 2.3 A North - South profile of geological formations of Marakele National Park.
S - Sandstone - Sandriviersberg Stage
Si - Siltstone, shale, sandstone, conglomerate & grit - Langkloof Stage
Di - Diabase

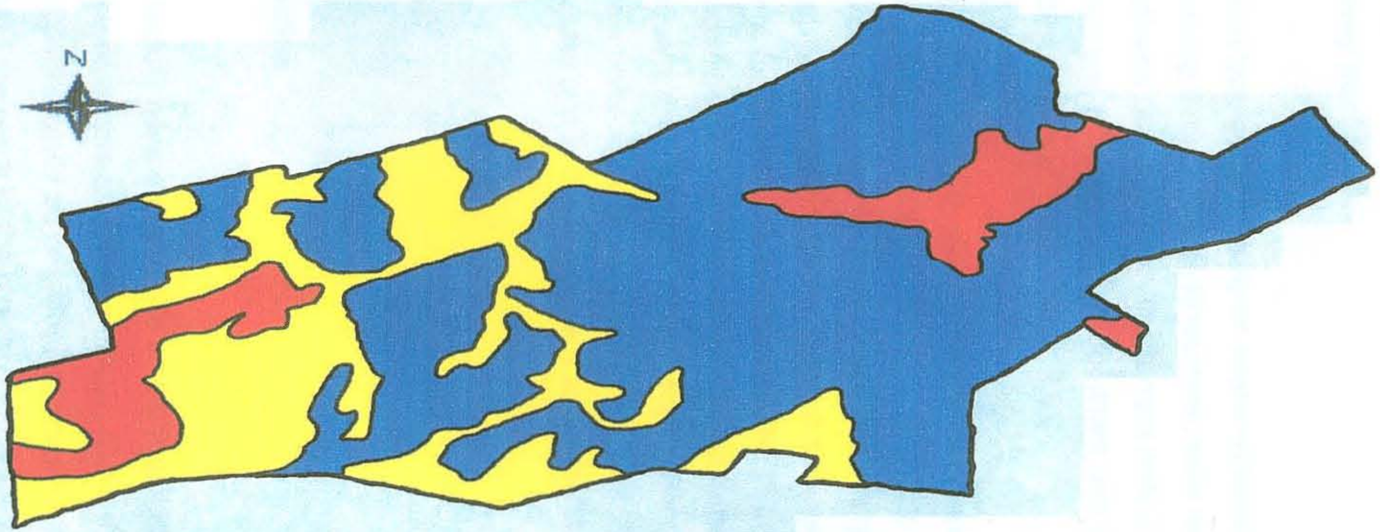


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Figure 2.4 The different Land Types of the study area (adapted from Land Type Survey Staff 1988).

- The Ad Land Type
- The Fa Land Type
- The Ib Land Type

rocky and not alluvial or aeolian, and in which the dominant soil forming processes have been rock weathering, the formation of orthic topsoil horizons and, commonly, clay illuviation, giving rise typically to lithocutanic horizons. The soil forms that epitomise these processes are Glenrosa and Mispah. This land type refers to land in which lime in the soil is not encountered regulary in any part of the landscape (Land Type Survey Staff 1988).

The Fa land type occurs mainly on coarse-grained yellow cross-bedded sandstone of the Waterberg Group. These lithocutanic soils represent the Mispah Form with a soil depth between 50 - 300 mm. The terrain units of the Fa land type are 1, 3, 4 and 5 with terrain unit 3, (69 %) as the dominant unit in this land type (Land Type Survey Staff 1988; Kooij et al. 1990; Figure 2.6).

The I land types refer to miscellaneous land classes and within the study area the I land type includes only the Ib land type. In the Ib land type exposed rock, stones and boulders cover 60 - 80 % of the area. The rocky portions of Ib may be underlain by soil which would have qualified the unit for inclusion in another broad soil pattern were it not for the surface rockiness. The Ib land type is found on coarse-grained yellow cross-bedded sandstone, shale, siltstone and grit of the Waterberg Group. The shallow rocky soils are of the Mispah Form with a soil depth of 50 - 300 mm. The terrain units of the Ib land type are 1, 2, 3, 4 and 5 with terrain unit 3, (65 %) as the dominant unit in this land type (Land Type Survey Staff 1988; Figure 2.7).

2.5 CLIMATE

2.5.1 Introduction

Abiotic factors have an influence on the regional distribution of vegetation, and of these abiotic factors climate is a primary factor (Schultze & McGee 1978; Gertenbach 1987). Climate could be described as the physical state of the atmosphere, and is considered the result of the radiation influence of the sun on the atmosphere which enfold the surface of the earth. This total physical state atmosphere namely climate, consists of certain elements of which temperature and rainfall are the most important (Gertenbach 1987).

According to Köppen's classification, the Waterberg area is classified as a Cwa climate (Schultze 1947). This climate zone receives approximately 730 mm rain per annum, mainly during the summer and autumn (Westfall 1981). Rainfall and temperature records have been kept for the study area since July 1988. Rainfall records have been kept by the South African Iron and Steel Industrial Corporation Ltd., (ISCOR) at
Thabazimbi (24° 38' S, 27° 24' E; altitude 945 m) since 1947 (Westfall 1981).

2.5.2 Temperature

According to Gertenbach (1987) the influence of temperature on the regional distribution of vegetation types is not significant. Temperature can however contribute to floristic variations on a meso- and microscale, but caution must be taken that the influence of temperature on the local distribution of vegetation must not be generalised.

Table 2.2 shows the mean daily maximum and minimum air temperature for three weather stations in the vicinity of the study area. In spite of a difference of 460 m above sea level between the weather stations, the differences in temperature are not significant.

Frost has been observed along the watercourses in the study area.

2.5.3 Rainfall

According to Gertenbach (1987), rainfall is the single most important component of climate, which can have an influence on the vegetation. The rainfall of a study area must be derived from a number of representative weather stations in and around the immediate vicinity of that specific area (Gertenbach 1987).

The area receives rain mainly during the summer months (October to April) in the form of heavy thunderstorms (Westfall 1981). Rainfall data for three weather stations are given in Table 2.3, according to which the study area is getting sufficient rain in the months October to April, where effective rain are considered to be sufficient for the active growth of vegetation.

Studies by Dyer (1976), Dyer & Tyson (1977) and Tyson & Dyer (1978) showed a cyclic phase in the rainfall of the summer rainfall areas in South Africa. The whole cycle lasts about 20 years with 10 years under average and 10 years above average rainfall. Gertenbach (1980) found a similar cycle of the rainfall data of the Kruger National Park. According to Gertenbach (1987), the peak of precipitation moves more to the end of the rainy season during dry cycles, and that the dry period (May to September) are more pronounced during wet cycles than dry cycles. The existence of these rainfall cycles is of great importance for long-term management planning (Gertenbach 1987).

Rainfall as such plays an important role, but in combination with temperature data, a better notion can be formulated on the implications of the climate in a certain area (Walter & Leith 1960; Gertenbach 1987).

Qualified climatic diagrams according to Walter & Leith (1960) of two weather stations namely, Thabazimbi and Waterhoutboom are shown in Figure 2.8. The mean monthly rainfall for Thabazimbi exceeds the 100 mm limit from December to March that is normally the very wet period. The wet period for Thabazimbi occurs from October to March and the dry period from May to July.

The climatic diagrams show that July is the driest month. December to February are the months with the highest rainfall and the highest temperatures, whereas the period May to August represents the dry cool months. Another important factor of the climate of the study area is the occurrence of "dry thunderstorms" just before the rainy season at the end of September and during October. Veld fires started by lightning usually occur during such "dry thunderstorms" and can reach high intensities, because of the high fuel load that accumulated since the previous rainy season. During the period 1988 to 1993, 90 % of the study area burned. This phenomena is important for management planning for MNP. These natural veld fires are a "natural fire regime" which contributed to the development of the vegetation of the Waterberg Mountains.

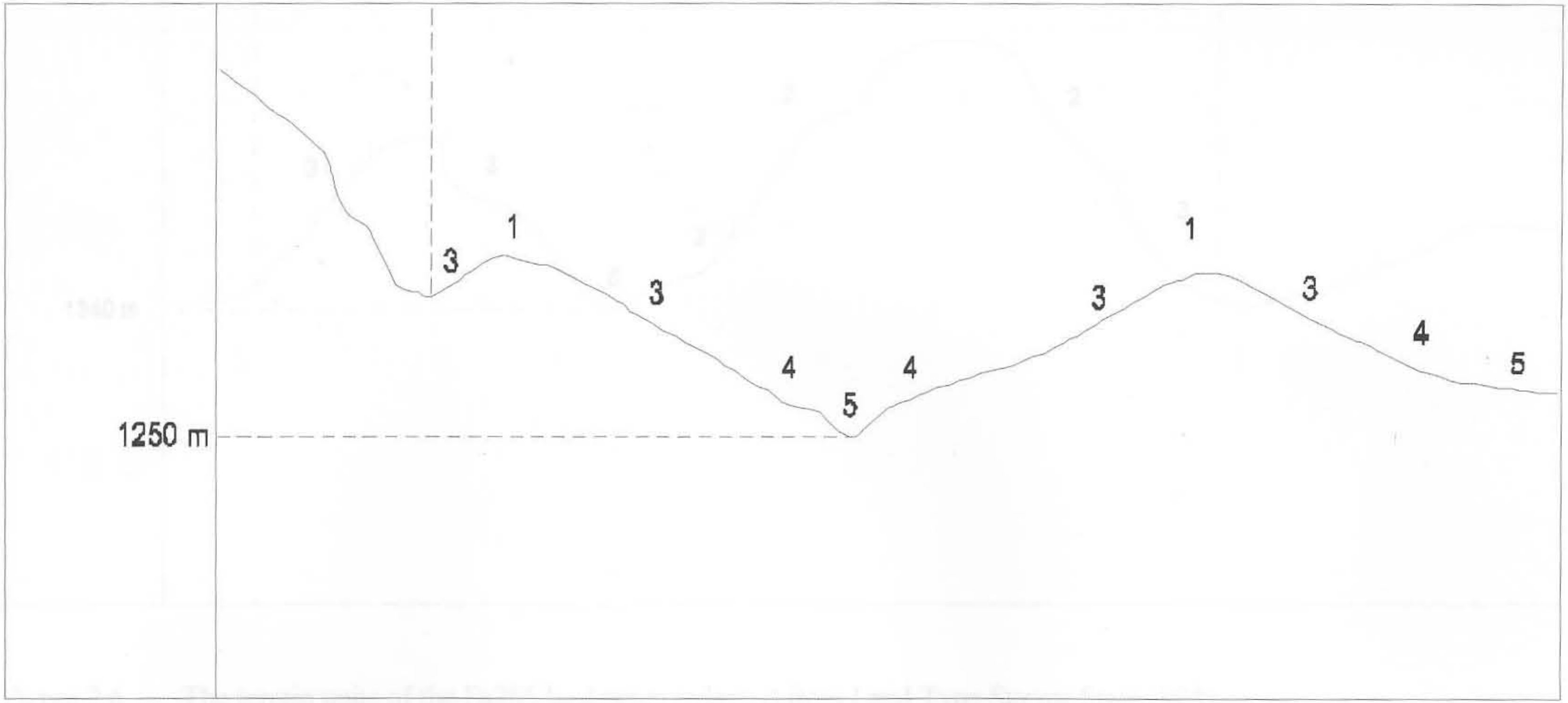


Figure 2.5 The terrain units of the Ad20 & -21 land type (adapted from Land Type Survey Staff 1988).

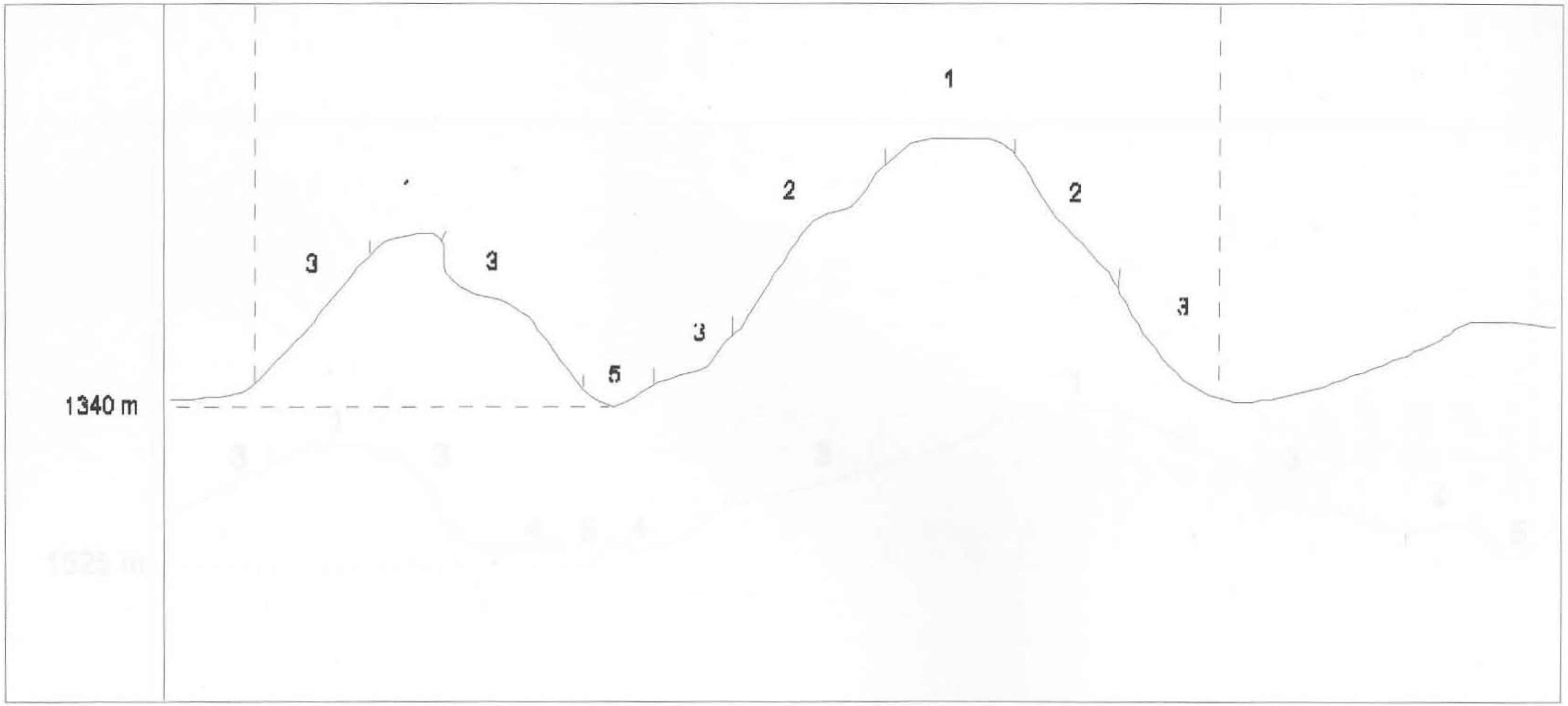


Figure 2.6 The terrain units of the Fa286 land types (adapted from Land Type Survey Staff 1988).

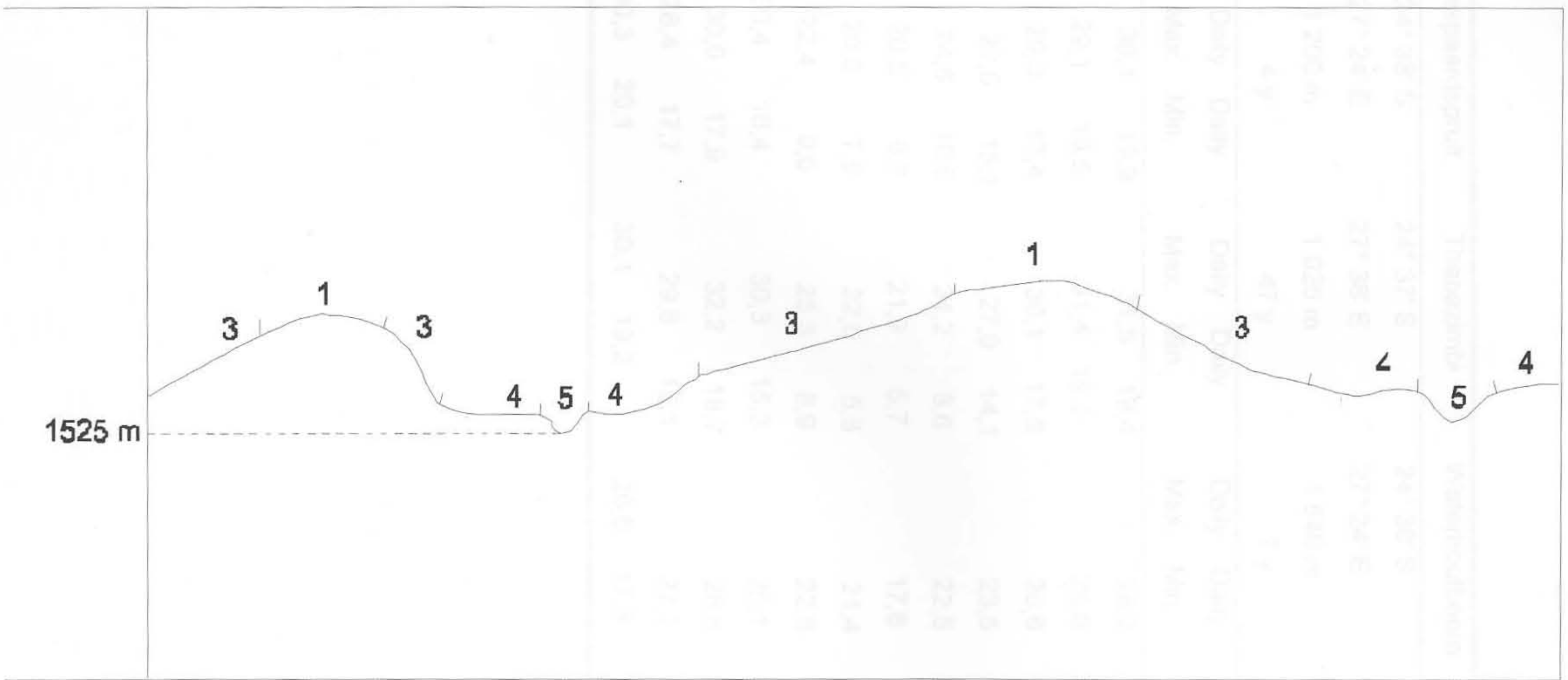


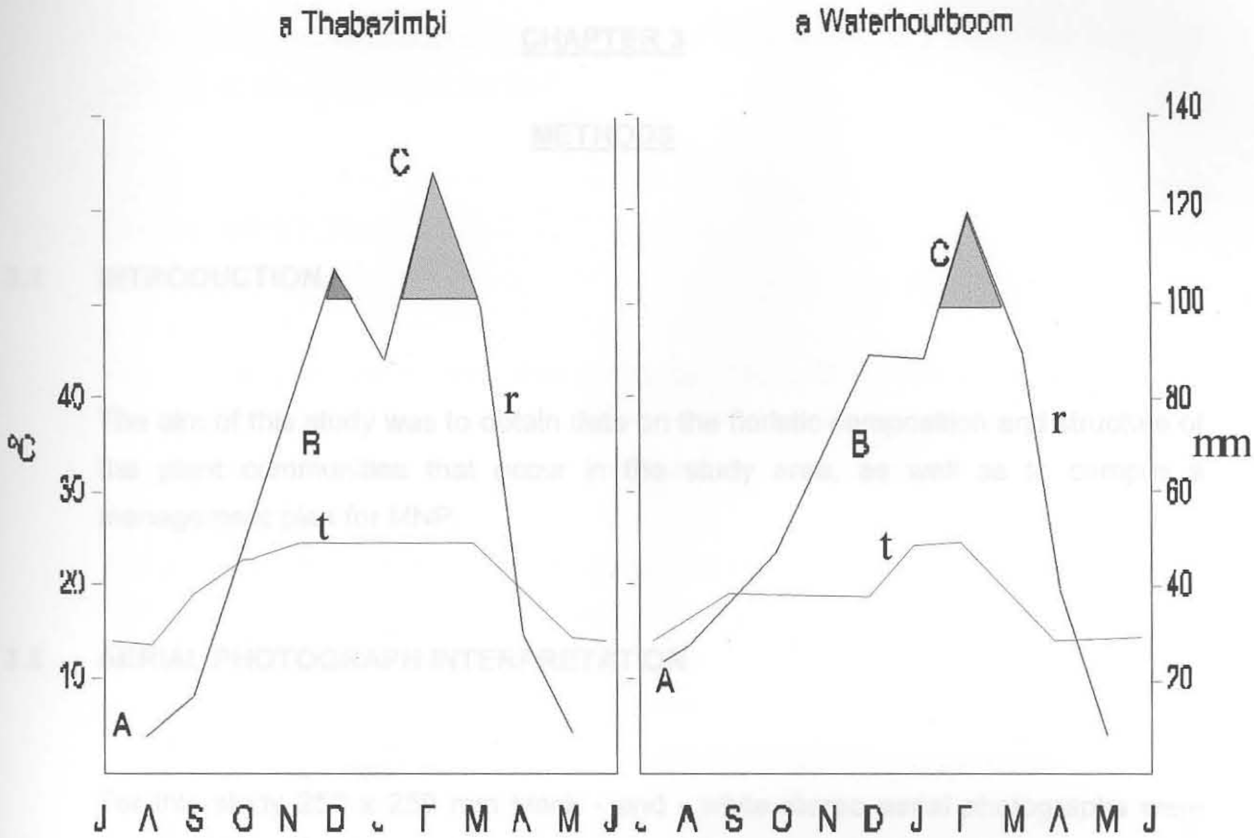
Figure 2.7 The terrain units of the Ib280, -305 & -310 land types (adapted from Land Type Survey Staff 1988).

Table 2.2 The mean maximum and minimum air temperature in °C for three weather stations in the vicinity of the study area.

Station	Blespaardspruit		Thabazimbi		Waterhoutboom	
Longitude	24° 38' S		24° 37' S		24° 38' S	
Latitude	27° 24' E		27° 38' E		27° 24' E	
Altitude	1 200 m		1 026 m		1 540 m	
Duration	4 y		47 y		7 y	
Month	Daily Max.	Daily Min.	Daily Max.	Daily Min.	Daily Max.	Daily Min.
January	30,1	19,9	31,5	19,4	28,2	19,4
February	29,1	19,5	31,4	19,3	28,6	19,6
March	29,3	17,4	30,1	17,6	26,6	16,6
April	27,0	15,1	27,0	14,1	23,5	14,9
May	24,6	10,6	24,2	8,6	22,5	12,2
June	20,5	6,7	21,9	5,7	17,8	9,6
July	20,6	7,8	22,0	5,8	21,4	10,4
August	22,4	9,0	25,3	8,9	22,8	10,5
September	30,4	16,4	30,3	15,3	25,1	13,4
October	30,0	17,9	32,2	18,7	26,6	16,3
November	28,4	17,7	29,8	18,1	27,7	17,5
December	30,3	20,1	30,1	19,2	26,6	17,3

Table 2.3 The total annual rainfall (mm) for three weather stations in the vicinity of the study area.

Weather tation	Blespaardspruit	Thabazimbi	Waterhoutboom
Longitude	24° 38'	24° 37'	24° 38'
Latitude	27° 24'	27° 24'	27° 24'
Altitude	1 200 m	1 026 m	1 540 m
1977	-	840,5	-
1978	-	765,0	-
1979	-	666,0	-
1980	-	661,0	-
1981	-	553,5	-
1982	-	656,4	-
1983	-	554,1	-
1984	-	609,4	-
1985	-	504,2	-
1986	-	632,5	-
1987	-	577,5	-
1988	-	776,0	547,7
1989	-	672,5	671,8
1990	-	460,4	713,9
1991	429,2	924,0	464,6
1992	506,7	451,1	388,0
1993	566,1	706,1	550,7
1994	439,4	440,2	633,5
Mean	485,4	636,1	567,2



a Weather station	Thabazimbi	Waterhoutboom
b Altitude (m)	1 026	1 540
c Period of observation (yr) First number for temperature and the second for precipitation	30 - 47	6 - 7
d Mean annual temperature (°C)	28,1	24,8
e Mean annual precipitation (mm)	631,0	556,0

A Dry period
B Wet period
C Very wet period
t Temperature curve
r Rainfall curve

Figure 2.8 Climatic diagrams (Walter & Lieth 1960) for two weather stations in the vicinity of the study area.