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A BRAUN-BLANQUET SURVEY OF THE VEGETATION OF THE WELWITSCHIA PLAIN*

by
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ABSTRACT

A phytosociological survey of the vegetation of an area east of the confluence of Khan and Swakop Rivers, known as the Welwitschia Plain, was carried out to test the application of this method on desert vegetation. Five distinct plant communities were recognised, based on soil type and the kind of rock substrate.

*This report formed part of a project in the Department of Botany, University of Cape Town, completed in 1975.

INTRODUCTION

The vegetation of South West Africa may be classified into three major formations which are determined by climate, especially rainfall, and these are desert, savanna and woodland. The Namib Desert as such is subdivided into three main vegetation types termed the Northern, Central and Southern Namib. The area investigated was part of the Central Namib, bordering on the Semi-desert and Savanna transition zone, i.e. the Escarpment zone (Giess, 1971).

PHYSICAL FEATURES

Welwitschia Plain is situated in the Namib Desert Park (Fig. 1), at the confluence of the Khan and Swakop Rivers. The plain, which is not of marine origin, is covered by superficial sediments which have been formed by weathering under arid conditions of the Precambrian Abbabis formation which is transgressed by dolerite and marble ridges (Smith, 1965). The sand and gravel plains contain grains of felspar, calcite, mica and quartz. They are characterised by small and shallow depressions, with fine to coarse deflation remains forming short drainage runnels.

CLIMATE

The Namib is a true desert having an annual rainfall of less than 10 mm per annum (Walter, 1973). If rain does occur, it falls mainly during the summer months of January, February and March. Rain water does not easily penetrate the soils of the plain, but tends to run off into the sandy depressions where it can easily percolate into the soil.

The area investigated falls into the outer Namib region which is characterised as a misty desert, having an average number of some 220 misty days per year. With the southwest winds, the mist bank, which always hangs over the cold Benguela current, moves landwards during the night and only disappears during the day when the desert soil warms up.

Meteorological data for the last three years is available from the weather station on Welwitschia Plain. The average monthly maximum temperatures were 34,4°C, whereas the average monthly minimum temperatures were 8,8°C. January was the summer month with the highest temperature, and June/July the coldest winter months. The lowest minimum temperature that has been recorded was 2,6°C (August). Even during winter, high maximum temperatures may be recorded during the occasional east (or berg) winds which may last a few days.

SOILS

The soils of the outer Namib are brackish as a result of sea mist precipitation. If the sea surf is strong the water from the spray evaporates quickly and the remaining salt is carried in the mist landwards by the southwest wind. Thus the desert is brackish for as far as 60 to 100 km inland (Walter, 1973).

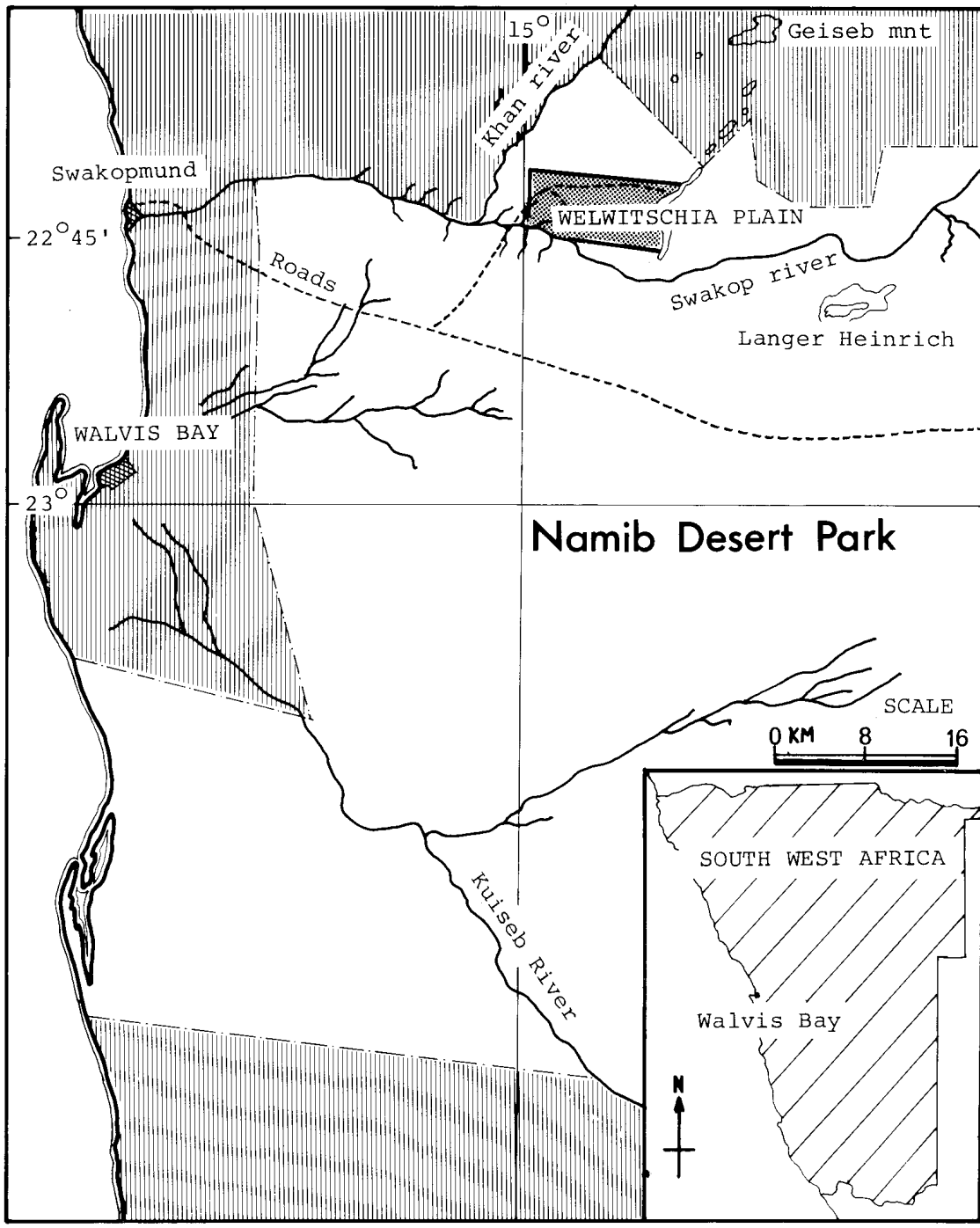

Figure 1: The Namib Desert Park showing the location of the Welwitschia Plain.

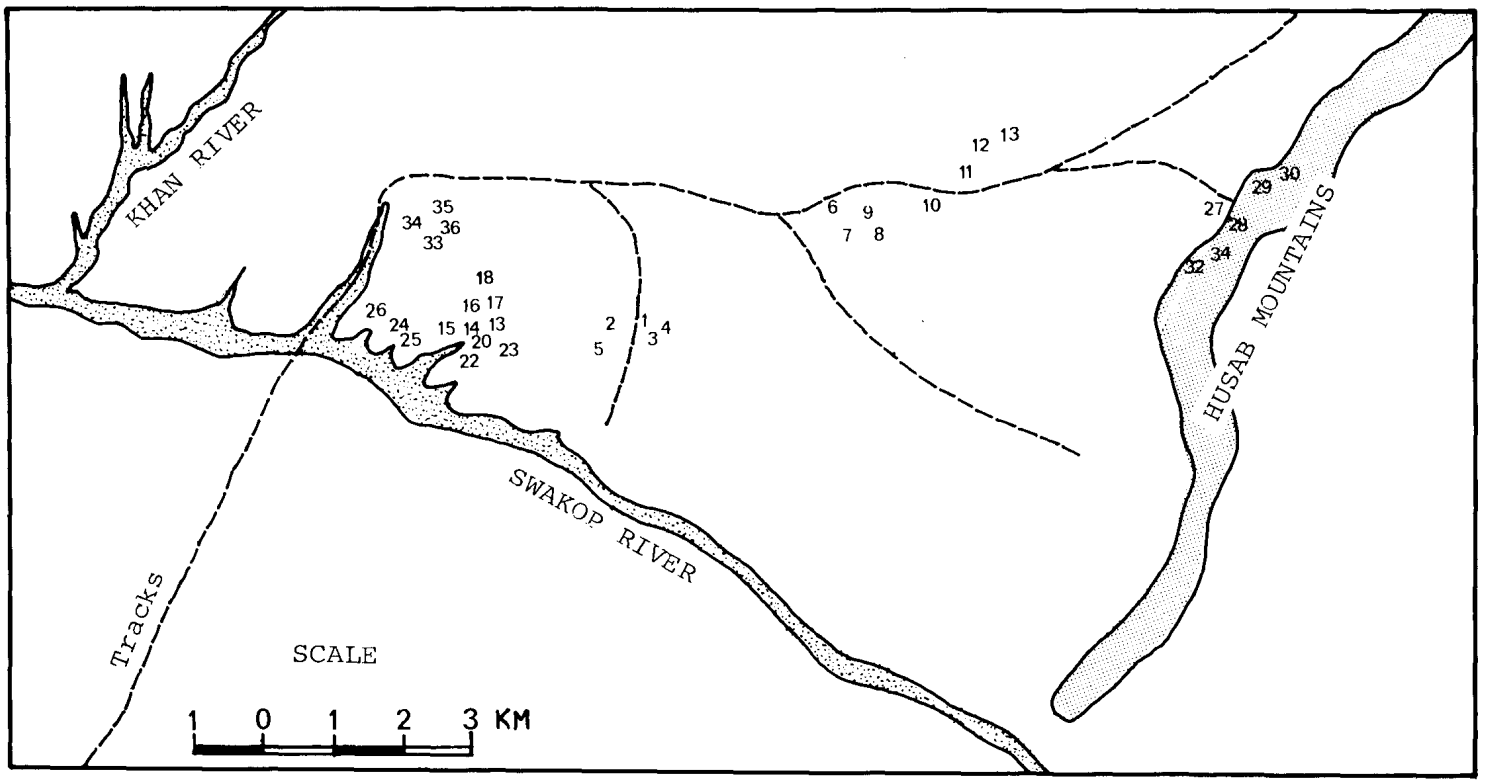

Figure 2: Sketch map of the Welwitschia Plain showing approximate location of relevés.

Soil formation in the generally accepted sense is absent in this region because of the low moisture status. The "soils" range from white to grey gravel to coarse or fine sand, with small concentrations of clay in some of the run-off channels giving them a slightly red or yellow-brown colour. The strong brackish soils of the low lying areas are brown to dark brown (see Table 1).

VEGETATION

Introduction

The desert has a sparse vegetation cover. The outer Namib is characterised by succulent plants, which decrease in importance towards the inner Namib and eventually are replaced by grasses. Giess (1962) suggests that four main ecological regions can be recognised in the Namib Desert, these are the red sand dunes (South of the Kuiseb River), the riverbeds, the Namib flats, and the mountains.

In the outer Namib the plants are confined to depressions on the plains, mountains and the riverbeds. On the barren gravel flats woody species such as *Arthraerua leubnitziae* and *Zygophyllum stapffii,* and others like *Z. simplex* (only occurring after some rain), *Salsola aphylla* and *S. tuberculata* are confined to the sandy depressions. On the mountains species of aloes (e.g. *Aloe dichotoma, A. asperifolia, A. namibensis*) and species of *Euphorbia* are common. *Arthraerua leubnitziae* and *Zygophyllum stapffii* also occur, but to a lesser extent than in the depressions on the plains. In riverbeds large trees like *Acacia erioloba, A. albida* and *Euclea pseudebenus,* and other plants such as *Salvadora persica* and *Sporobolus consimilis* occur.

Methods

The fieldwork was done during June/July 1975, and the phytosociological methods as outlined by Werger (1974) were used. Since this was in winter only the perennials were visible, but it was considered that in deserts these are better indicators of specific habitat factors than ephemerals (Botanouny and Abu El Souod, 1972).

Thirty-six relevés were sampled and their position are indicated in Fig. 2. Relevé size varied from 5×5 m to 10×10 m depending on total cover, and relevés were positioned subjectively to avoid floristic and environmental heterogeneity. Environmental data was recorded for each relevé, though soil samples for analysis of pH, Ca^{++}, K^{+}, Na^{+} and Mg^{++} were only taken from one representative relevé from each community. These data are given in a phytosociological table (Table 1).

Plant Communities

Five distinct communities were recognised, these were related to soil type; marble/-dolerite, granite, fine sand, gravel and brack.

TABLE 1: Phytosociological Table of the plant communities of Welwitschia Plain

	Marble/Dolorite Community						Granite Community						Gravel Community		
Relevé number	32	28	31	29	30	27	5	3	1	2	4	34	33	35	36
Plot size (m^2)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	50
Total number of species	4	4	5	8	6	8	4	5	6	7	7	2	2	1	2
Total cover %	3	5	7	8	7	7	5	7	10	15	19	7	5	3	3
Surface rock size (cm)	100	100	50	80	50	15	2,5	3	2,5	2,5	2,5	2,5	4	2,5	3
Surface rock cover: cover on BB scale	5	5	4	4	5	4	2	2	1	1	r	0	0	0	0
Soil depth (cm)	5	15	10	8	5	20	60	30	60	60	30	60	60	60	60
Soil litter: cover on BB scale	r	r	r	r	r	r	+	+	+	+	r	r	r	r	r
Soil texture: cSa=coarse sand, fSa=fine sand	cSa	cSa	cSa	cSa	cSa	cSa	cSa	cSa	cSa	cSa	cSa	cSa	cSa	cSa	cSa
Soil colour: g=grey, b=brown, y=yellow, w=white	g-w	g-w	g-w	g-w	g-w	g-w	g-w	g-w	g-w	g-w	g-w	b-w	b-w	b-w	b-w
Slope in degrees	5°	13°	13°	15°	13°	9°	3°	5°	3°	3°	4°	5°	8°	8°	7°
Aspect	NNW	NNW	NNW	NNW	N	NNW	NNW	NNW	NWW	NW	NW	SW	SW	SW	SW
Soil pH			8,5						9,0					8,8	
Ca^{++}(ppm)			980						30					56	
K^{+}(ppm)			6						82					20	
Na^{+}(ppm)			5						10					80	
Mg^{++}(ppm)			8						2					4	
Commiphora saxicola Community															
Differential species															
Commiphora saxicola	1	+	1	+	+										
Trianthema triquetra	1	1	1	1	1	1									
Adenolobus pechuelii	+	+	1	1	1	1									
Blepharis bossii				+	+	+									
Euphorbia virosa		1		+	1										
Euphorbia lignosa				+											
Aloe namibensis			+												
Sesuvium sesuvioides						+									
Sarcocaulon marlothii Community															
Differential species															
Sarcocaulon marlothii							1	1	+	+	1				
Monechma arenicola						1	1	1	+		1				
Trichocaulon clavatum									r	r	+				
Tephrosia dregeana											+				
Orthanthera albida										r					
Calicorema capitata						1				r					
Species common *Commiphora saxicola*, *Sarcocaulon marlothii* and *Salsola aphylla* Communities															
Zygophyllum stapffii		1		+		+	+	r	1	1					+
Stipagrostis sp.	+	+	+	+	+	+	+	+	+	+					
Welwitschia mirabilis Community															
Differential species															
Welwitschia mirabilis								+	+	+	+	1	1	1	1
Celosia spathulifolia															
Cleome leuderitziana															
Zygophyllum simplex															
Salsola aphylla Community															
Differential species															
Salsola aphylla															
Arthraerua leubnitziae											r	+	+		
Phragmitis-Juncus Community															
Differential species															
Phragmitis australis															
Juncus arabicus															
Tamarix usneoides															
Sporobolus virginicus															
Boscia foetida															

	Fine Sand Community												Brack Soil Community							
12	9	11	10	13	6	17	18	14	8	7	15	16	20	25	26	22	19	21	23	24
50	50	50	50	50	50	50	50	50	50	50	50	50	25	25	25	25	25	25	25	25
5	6	4	2	2	2	3	2	1	1	1	2	2	3	4	3	3	2	2	2	2
20	24	25	19	40	30	30	27	40	55	43	40	50	80	50	55	90	95	100	95	50
15	2,5	15	2,5	0	2,5	2,5	60	2,5	2,5	2,5	0	0	0	0	0	0	0	0	0	0
+	r	+	r	0	r	r	r	r	r	r	0	0	2	0	0	0	0	0	0	0
+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	+100	100	100	100	100	100
+	+	+	+	+	+	r	+	+	+	+	0	0	r	r	+	r	r	r	r	r
fSa	fSa	fSa	fSa	fSa	fSa	fSa	fSa	fSa	fSa	fSa	fSa	fSa	fSa	fSa	fSa	fSa	fSa	fSa	fSa	fSa
b-y	b-y	b-y	b-y	b-y	g-b	b	b	b	b-y	b-y	b-y	b-y	b	b	b	b	b	b	db	b
2°	+0°	2°	+0°	+0°	+0°	+0°	+4°	+0°	+0°	+0°	+0°	+0°	+0°	+0°	5°	7°	3°	+0°	+0°	3°
WSW	W	WSW	W	SE	W	SE	SE	ESE	W	W	ESE	ESE	SE	SE	SE	SE	SE	SE	SE	SE
8,3							8,0						7,5							
390							310						375							
50							150						56							
655							950						11250							
30							100						130							
1	2		1	2a	+	+														
1	r	+																		
1	+	+																		
	r																			
	r																			
1	2	2	2b	2a	3	2b	2a	2	4	3	2	2a	1	+						
						2a	2a													
													2	2b	3	3	3	5	4	
													3	+		4	4	2		2a
																			2	2a
											2	3		3	2	2				
															1					

1. **The marble/dolerite community.** This community is found on the Husab mountains, which consist of marble intruded by dolerite with a rock cover averaging 80 %. The plants are generally confined to the shallow run-offs of the mountain, which consist of coarse grey-white shallow sand, with a high Ca^{++} content. The plants themselves cover only some 5 % of the surface.

The characteristic species of the marble/dolerite community is *Commiphora saxicola* (a small tree with swollen trunk and branches, which is leafless for most of the year). Other differential species are *Trianthema triquetra* (creeping along the ground), *Adenolobus pechuelii, Blepharis* sp. (a spiny shrub), *Euphorbia virosa, E. lignosa* and *Aloe namibensis.*

Relevé 27 is somewhat intermediate between the marble/dolerite and granite communities as can be seen from Table 1. It was situated on the lower mountain slopes and had a somewhat deeper soil. The *Monechma arenicola* bushes that occurred were very much smaller than those that occur in the true granite community.

2. **Granite community.** This community occurs on granite outcrops and on coarse sandy soils derived from weathered granite, which are 30 to 60 cm deep. Rock cover is fairly low, less than 20 %, and the rocks are much smaller than in the previous community (see Table 1).

The total plant cover of this community is between 5 to 7 %, probably reaching slightly higher values after rain. *Sarcocaulon marlothii* is the characteristic species of this community and is confined to shallow soils on the flats. Other differential species are *Monechma arenicola, Trichocaulon clavatum* and *Tephrosia dregeana.* The last two have low cover-abundance values and occur infrequently, only being found on granite outcrops.

3. **Community on gravel.** The community consists almost exclusively of *Welwitschia mirabilis,* which is also the differential species. It grows on large high gravel plains that slope towards the Swakop River. *Arthraerua leubnitziae* and *Zygophyllum stapffii* occur here and there between the *Welwitschia* plants. The total plant cover is very low, i.e. between 3 to 7 %. An occasional plant of *Welwitschia* can be found on fine sand, calcrete and granite outcrops (see Table 1); large numbers of them, however, are found only on the gravel plains where the pH is 8,8 and the Na^{+} content (80 ppm) is fairly high as compared to the soils of the previous two communities, but not as high as the next two communities.

4. **Community on fine sand.** Plants of this community cover between 20–50 % of the surface. *Salsola aphylla,* with a cover value of more than 7 %, is the differential species of this community. This community includes a subassociation of *Zygophyllum simplex, Celosia spathulifolia, Cleome lüderitzii, Stipagrostis* sp., *Welwitschia mirabilis* and *Sesuvium sesuvioides.* This occurs in relevés 9, 10, 11, 13 and 12. The soil sample from relevé 12 has a lower Na^{+} content, i.e. less than the soil of relevé 18 where *Salsola aphylla* was found almost exclusively. Thus the distribution of the plants of the subassociation seemed to be determined by the soil cation concentration. Relevé 12 is seen to be somewhat intermediate between the true *Welwitschia* and true *Salsola* communities.

Zygophyllum stapffii and *Stipagrostis* sp. (probably *S. ciliata*) have a high range of salinity tolerance, thus they are found in many communities. For example, *Z. stapffii* occurs in four of the five communities sampled.

5. **Brack communities.** These communities occur where the tributaries of the Swakop River start. Water rising to the surface evaporates rapidly leaving a salt crust. This high saline content is reflected by the very high levels of Na^+ and Ca^{++} (see Table 1).

The plant cover ranges from 50–100 %. Where the plant cover is nearly 100 %, the water that rises to the surface does not evaporate immediately and some open water may occur here.

Phragmites australis and *Juncus arabicus* are the characteristic species of the community. *Tamarix usneoides* and *Boscia foetida* are differential species and *Sporobolus virginicus* has a high cover-abundance.

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