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13. FORAGE AVAILABILITY AND UTILIZATION AND LARGE HERBIVORE DISTRIBUTION ON THE GRAVEL PLAINS

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INTRODUCTION

The study area includes those sections on which the biggest percentage of the larger herbivores on the gravel plains occur. The western boundary is a line which stretches from the mountain range Langer Heinrich east of Vogelvederberg to Gobabeb. The northern and eastern boundaries are the borders of the Namib-Naukluft Park, while the southern boundary is the Kuiseb River. The study area includes the following water points: Zebra Pan, Ganab, Gemsbokwater, Hotsas, Groot Tinkas, Springbokwater and Soutwater.

The fluctuations in quality and availability of forage on the gravel plains and dunes over time were investigated, as well as the reasons for the fluctuations. Preference of the larger herbivores regarding areas and plant species and the percentage utilization of the various plant species by larger herbivores were studied.

FORAGE AVAILABILITY AND UTILIZATION

Rainfall

The rainfall was monitored by means of 100 rain meters distributed over the whole study area, and rainfall distribution maps were compiled. The total rainfall per season for the experimental period is indicated in Table 1.

Vegetation composition and cover

Twenty-five transects with a total of 41 500 point readings were made in all the vegetation subtypes. Cover surveys were also made in the protected production plots in subtypes and surrounding areas. The average percentage basal coverage decreased considerably over the experimental period (see Table 2).

Herbage production

Representative areas of the main grazing regions and vegetation types were fenced off in 10 m x 50 m exclosures. Nineteen exclosures were

Table 1. The average monthly rainfall for the study period November 1978 - December 1981.

Month	Average
November 1978	0,0
December 1978	0,46
January 1979	6,98
February 1979	23,22
March 1979	0,0
April 1979	2,45
May 1979	26,29
June 1979	0,0
February 1980	12,50
March 1980	7,40
August 1980	7,10
October 1980	2,80
December 1980	0,80
January - December 1981	0,00

Table 2. Average percentage basal cover within a 10 km radius of different water points on the gravel plains, July 1978, 1979, 1980 and 1981.

Water point	1978	1979	1980	1981
Ganab	2,87	2,72	1,29	0,51
Hotsas	1,98	1,76	0,90	0,98
Gemsbokwater	3,85	3,35	2,01	0,80
Groot Tinkas	2,80	1,57	1,07	0,30
Zebra Pan	1,10	0,77	0,41	0,26
Springbokwater	1,57	0,57	1,11	0,74
Soutwater	1,28	0,23	0,14	0,20

constructed (see Table 3). The clipping technique applied is similar to that described by Grunow and Bosch (1978). Tuft production proved to be ineffective and only the quadratic technique was used.

Table 3. Distribution of exclosures in different vegetation types.

Vegetation type	Exclosure
Stipagrostis hochstetterana grassland	A
Eragrostis nindensis eastern grassland	G, J, K, H, O
Stipagrostis uniplumis drainage line grassland	L, B, R
Stipagrostis obtusa grassland	C, D
Shrub and tree savanna of the escarpment and inselbergs	S, R
Commiphora saxicola brokenveld	E, I
Petalidium canescens shrubland of the Kuiseb canyon	I
Salsola sp desertic dwarf shrubland	K, Q
Stipagrostis ciliata duneveld of the Southern Namib	M, N

Fodder production determinations were made five times during the season. The amount of forage available for the Pro-Namib gravel plains (plot A) for the experimental period is presented as an example in Figure 1.

A total rainfall of 94 mm in two showers of 60 mm in February 1979 and 34 mm in May 1979 resulted in total phytomass yield of 1 400 kg ha^{-1}. During the very dry period with less than 15 mm rainfall in 1980/81 the production within the exclosures dropped to below 200 kg ha^{-1} with a yield of only 107 kg ha^{-1} outside of the exclosures. Rainfall of less than 15 mm had very little or no influence on fodder production in this area. The amount of forage available in the study area from 1979 to 1981 is presented in Table 4.

The subtypes represented by enclosures M and N in the Southern Namib vegetated dunes and plot L in a drainage line produced the highest fodder yield, ie 5191 kg ha^{-1}, 2854 kg ha^{-1} and 1347 kg ha^{-1} respectively. The fodder yield on the other subtypes varied from 1347 kg ha^{-1} and 89 kg ha^{-1} for plots A and B (Namib gravel plain drainage lines) and 54,3 kg ha^{-1} for plot E (brokenveld) respectively.

Table 4 indicates that a total collapse of forage availability took place from 1981 to 1982. This applies particularly to the grass component. Shrubs and herbage do not indicate this drastic decline in forage availability, and they serve as forage reserves in periods of drought.

Table 4. Forage availability (in kg ha^{-1}) in and around the different exclosures during the period 1979 to 1981.

Exclosure	Grasses			Shrubs and herbs			Non-forage species			Total phytomass inside exclosure			Total phytomass outside exclosure		
	1979	1980	1981	1979	1980	1981	1979	1980	1981	1979	1980	1981	1979	1980	1981
A	669,5	292,0	36,7	27,5	22,5	31,5	355,5	257,7	202,0	1052,5	570,2	270,2	868,0	367,5	180,0
G	182,0	76,0	20,8	73,5	56,0	40,0	16,0	-	-	271,0	137,0	60,8	78,0	58,0	13,0
J	218,0	8,2	9,8	-	-	-	-	-	-	218,0	8,2	9,8	28,0	10,0	4,0
K	224,7	53,0	9,0	-	-	-	-	-	-	224,7	53,0	9,0	86,0	18,0	3,0
H	293,0	27,0	11,0	-	-	-	-	-	-	293,0	27,0	11,0	67,0	11,0	3,0
Q	773,0	359,0	130,0	326,0	212,0	89,0	71,0	33,0	6,0	1170,0	604,0	225,0	517,0	437,0	163,0
L	1347,0	632,0	399,0	-	-	-	126,0	6,0	0,0	1473,0	638,0	399,0	574,0	415,0	199,0
B	89,0	23,0	2,5	56,6	23,0	-	158,6	94,0	16,5	303,6	140,0	19,0	148,0	37,5	21,0
C	206,0	41,3	5,3	40,5	20,3	41,5	80,3	43,8	17,5	326,8	105,4	64,3	53,0	35,0	26,0
D	286,0	50,8	11,0	-	-	-	-	-	-	286,0	50,8	11,0	79,0	30,5	3,5
S	282,0	94,0	10,0	0,0	3,0	0,0	0,0	0,0	3,0	282,0	97,0	13,0	78,0	49,0	2,0
R	435,0	179,0	72,0	0,0	14,0	2,0	-	-	-	435,0	193,0	74,0	42,0	13,0	8,0
E	54,3	6,8	3,3	-	-	-	-	-	-	54,3	6,8	3,3	15,0	5,0	3,5
Q	136,0	14,0	8,0	-	-	-	-	-	-	136,0	14,0	8,0	17,0	3,0	3,0
M	5191,0	3938,0	2524,0	-	-	-	-	-	-	5191,0	3938,0	2524,0	3896,0	3287,0	1827,0
N	2854,0	1876,0	1317,0	-	-	-	-	-	-	2854,0	1876,0	1317,0	2052,0	1740,0	1110,00

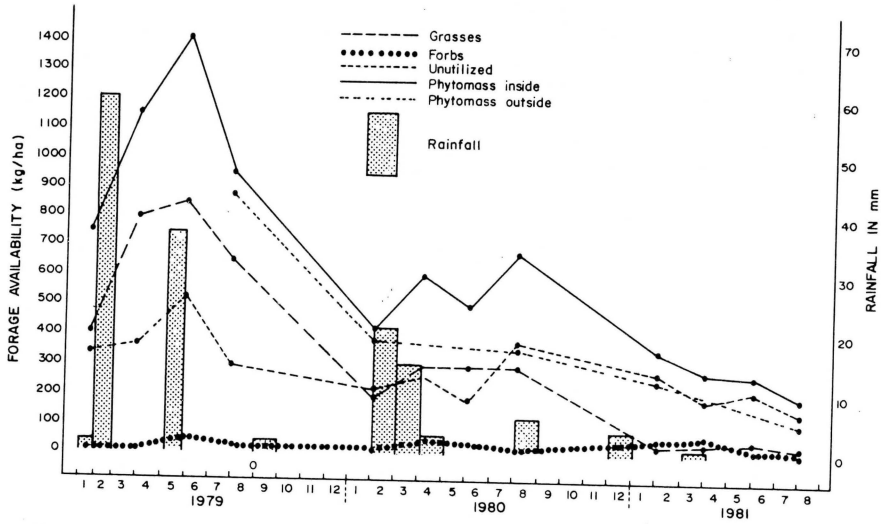

Figure 1. Forage availability in kg ha^{-1} for exclosure A for the period January 1979 to July 1981.

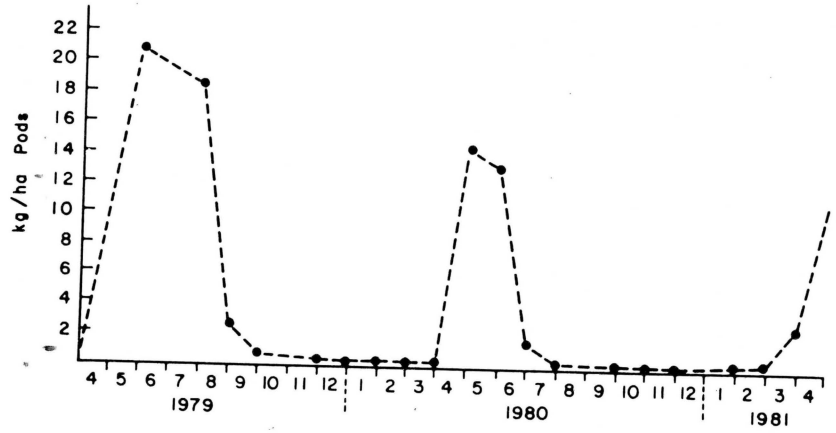

Figure 2. Pod availability, in kg ha^{-1}, of Acacia erioloba for the period March 1979 to July 1981.

Phytomass within plots is generally higher than phytomass outside plots. This can be ascribed to heavy utilization by game. Decline in phytomass within plots is caused by termite damage and wind erosion.

Leaf, shoot and pod availability of Acacia erioloba

There was a moderately constant shoot and leaf availability (0,13 kg ha^{-1}) during 1979/80 and a decline thereafter, ie 0,09 kg ha^{-1} in 1981. Pod availability data presented in Figure 2 show that a peak was reached during April/May of each year, which coincided with the prevailing east winds, which then started blowing strongly, as well as the ripening of the pods. A gradual decrease in pod availability occurred during the study period. It would appear as if trees go through a period of higher pod production, and then a resting period. Adjacent trees which originally produced very few pods, later produced maximally. Peak pod production decreased from 21 kg ha^{-1} during 1979 to 9 kg ha^{-1} during 1981.

Utilization and preference studies

The greatest concentration of herbivores occurred around the following water points in the study area: Zebra Pan, Ganab, Gemsbokwater, Hotsas, Groot Tinkas, Springbokwater, Soutwater and other isolated areas. The utilization study therefore was undertaken around these concentration points, even though with the decrease in forage availability the game only made use of Gemsbokwater, Ganab, the Gaub fountains and water points in the upper course of the Kuiseb River.

Utilization and plant preference surveys were done according to the method of Kruger and Edwards (1972), as modified by Grunow (1979 personal comm).

Point readings were noted every 50 m and the nearest plant to each key plant was identified and recorded within utilization classes. The percentage relative utilization of the vegetation in 2 km zones around each water point was calculated, as illustrated in Figure 3.

The relative utilization in the 1-2 km zone from the water point increased from 72 percent to 90 percent, while the whole area was utilized more than 90 percent during July 1981. This tendency was the same throughout for the whole study area.

The results further show the interesting tendency that certain zones, namely 1-2 km and 7-8 km from the water points initially were utilized most severely. The distribution pattern of the animals has also changed and zebras had moved onto the plains, whereas they were confined previously to the mountainous and surrounding areas. The January 1981 survey showed that at most water points, eg Zebra Pan, Soutwater and Hotsas the veld was utilized more than 90 percent. Termites and wind however played an important role in the total defoliation of the veld. Key forage plants occurring here are Stipagrostis ciliata, S obtusa, S uniplumis, Monechma arenicola and Petalidium setosum.

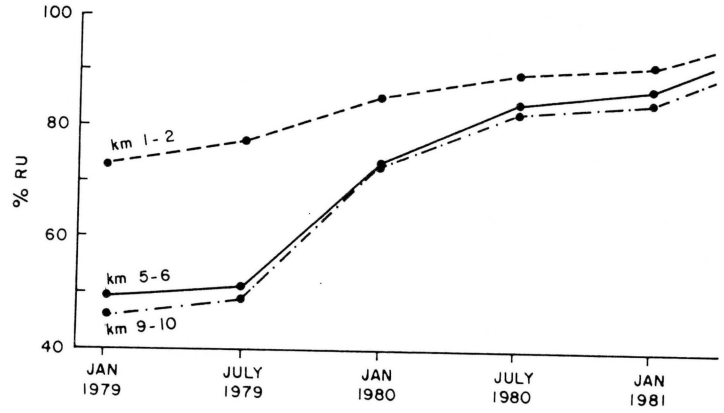

Figure 3. Percentage relative utilization of vegetation at different distances from the Hotsas waterpoint.

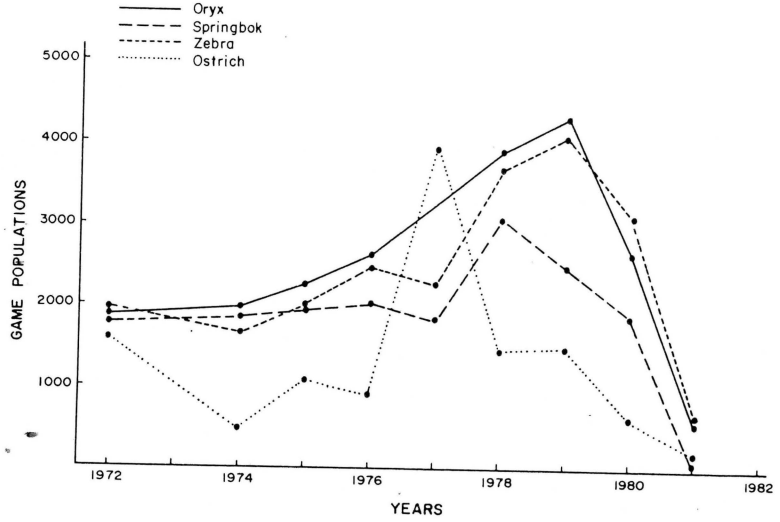

Figure 4. Large herbivore population estimates, Namib Naukluft Park, 1972 to 1981.

Chemical composition of forage

Samples of the key forage species were analysed chemically for percentage crude protein content and percentage digestible organic water. The nutritional value of the grass species Stipagrostis ciliata, S uniplumis and S obtusa declined considerably from the summer (percentage CP ± 8-14 percent, percentage DOM 60 percent) after the dry season and crude protein values of as low as 3 percent and percentage DOM values of only 30 percent were obtained.

Large herbivore population distribution and migration

Population estimates of the larger herbivores for the period 1972 to 1981 are presented in Table 5. The average increase of game from 1972 to 1979 was 48 percent. From 1979 to 1982 the average decline was 90 percent. Game populations from 1972-1981 are graphically presented in Figure 4. The seasonal migration of game is west to east and back. As soon as rain occurs on the gravel plains, there is a movement to the west and the game disperse over the gravel plains. The eastern park border fence line prevents the eastern migration route to be completed, which results in a local overpopulation of game. Destruction of vegetation, soil loss as a result of trampling and wind erosion, and game loss as a result of mortalities or movement of game out of the park then occur. Table 6 presents an estimate of maximum and minimum carrying capacities of different vegetation types within the Namib-Naukluft Park, while in Table 7 the estimated maximum and minimum stocking rates in numbers of animals for large herbivores is indicated.

Table 5. Estimated populations of large herbivores in the Namib-Naukluft Park during the period 1972 to 1981.

Date	Oryx	Springbok	Zebra	Ostrich	Total	Total as large stock units
June 1972	1 851	1 796	1 958	1 602	7 207	3 717
March 1974	1 945	1 848	1 620	486	5 899	3 062
July 1974	2 115	1 493	2 123	1 726	7 457	4 004
May 1975	2 274	1 888	1 976	1 115	7 253	3 799
January 1976	2 454	2 024	2 485	944	7 907	4 363
November 1976	2 403	1 733	2 312	3 926	10 377	5 110
December 1978	3 940	3 088	3 717	1 452	12 197	6 686
October 1979	4 375	2 552	4 079	1 560	12 566	7 212
October 1980	2 662	1 912	3 322	665	8 561	5 192
June 1981	591	86	666	199	1 542	1 039
% increase, 1972 to 1979	53	30	52	x 59 (1976)		
% decrease, 1979 to 1981	85	96	84	95		

(1) One large stock unit equals 1 Hartmann's zebra, 2 oryx, 3 ostrich, or 6 springbok.

Table 6. The estimated maximum and minimum carrying capacities, in large stock units, of different vegetation types within the Namib-Naukluft Park.

Vegetation type	Area, ha	Max grazing capacity, LSV	Min grazing capacity LSV
Stipagrostis hochstetterana grassland	11100	120	74
Eragrostis nindensis eastern grassland	230300	507	144
Stipagrostis obtusa grassland	15500	44	16
Shrub and tree savanna of the escarpment	120500	279	73
Commiphora saxicola brokenveld	93400	66	31
Petalidium canescens shrubland of the Kuiseb canyon	94500	216	48
Salsola sp desertic dwarf shrubland	40200	82	26
Stipagrostis ciliata duneveld of the Southern Namib	53900	1552	1107

Table 7. The estimated maximum and minimum stocking rates in numbers of animals and in large stock units, for different large herbivores in the Namib-Naukluft Park.

	Maximum		Minimum	
	Number	LSV+	Number	LSV
Oryx	2700	1350	1800	900
Springbok	2000	333	1500	250
Zebra	1000	1000	600	600
Ostrich	2100	700	750	250

LSV+ follows the definition of Meissner (1982).

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Meissner H H 1982. Substitution values of various classes of farm and game animals in terms of a biologically defined large stock unit. Pamphlet Beef Cattle C3 1982, Farming in South Africa, Department of Agriculture, Pretoria.

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