

Habitat preference, distribution and status of the Hartmann zebra *Equus zebra hartmannae* in South West Africa

by

Eugene Joubert

Division of Nature Conservation and Tourism, Windhoek

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I INTRODUCTION

Animals which, owing to their habits or life requirements come into competition with man and his livestock, aptly named "problem animals", rate a high priority in the scheduled research projects undertaken by the Nature Conservation and Tourism Division of the South West Africa Administration. With the Hartmann zebra the problem arises that it is both an endangered species as well as a problem animal. A research project was launched in 1969 to determine the status, distribution, ecology, behaviour and population dynamics of the Hartmann zebra. The results of this project was used to formulate a policy that will ensure the survival of a representative sample of the Hartmann zebra in South West Africa and also satisfy the farming community. This present paper deals only with the habitat preference, distribution and status of the Hartmann zebra in South West Africa.

The Hartmann zebra occur for the greater part of their distribution on the mountainous escarpment zone along the Namib desert. This area is extremely marginal. They still occur in reasonable numbers and especially during drought years, present serious competition to livestock for grazing. Stampeding herds of Hartmann zebra occasionally cause damage to fences. Although Hartmann zebra are declared Specially Protected Game and no hunting without permits is allowed, it was found that they were being illegally exterminated at an alarming rate. Furthermore, with the implementation of the Odendaal Commission's proposals, it so happened that the Hartmann zebra as a species was not properly protected in any of the existing game reserves. This was mainly due to the lack of suitable habitat in the existing game reserves.

II HABITAT PREFERENCE

Before one deals with the habitat preference of the Hartmann zebra in South West Africa it is important to know the physiography of this region.

1. Physiography of South West Africa

South West Africa may be divided into three major physiographic zones. They are:

a) the inland plateau to the east, which forms part of the greater sub-continental plateau of Southern Africa. The plateau region covers approximately $\frac{4}{5}$ of the whole of South West Africa. This inland plateau is drained mainly endoreically; in the north and north-west by various drainage lines into the Etosha salina; in the north-east by various omurambas into the Okavango River; and in the central and south-eastern parts by the Nossob and Auob Rivers — which both flow into the Molopo River.

Two other rivers, both seasonal, drain areas of this inland plateau into the sea: in the north the Ugab River and in the south the Fish River. The latter flows into the Orange River which in turn

flows into the Atlantic ocean. Perennial waterholes in this region are relatively scarce.

- b) the escarpment zone to the west of the inland plateau. This zone consists mainly of a mountainous transition area stretching from the inland plateau to the pre-Namib flats. Almost all of the rest of the rivers, all seasonal, in South West Africa originate in this transitional mountain zone. The larger of these rivers, such as the northern Koichab, Hoarusib, Huab, Omaruru, Swakop and Kuiseb Rivers, drain exoreically into the ocean. Most of the smaller ones, such as the Munutum, Sechomib, Tsondab, Tsauchab, Nam and southern Koichab Rivers, drain endoreically into inland vleis and pans or just disappear in the dunes. This mountainous zone also has relatively many perennial waterholes, situated mostly in the riverbeds.
- c) the Namib desert, which covers the region between the Atlantic Ocean and the foot of the escarpment zone. In its northern half the desert consists of pediplains, with dunes mainly in the proximity of the coast. South of the Kuiseb River, dunes cover the desert from the coast almost to the foot of the escarpment zone. The inland portion of the Namib desert, sometimes known as the pre-Namib, receives scattered showers during some summers. Perennial waterholes are virtually non-existent in this area.

2. Habitat preference

Hartmann zebra occur only in the abovementioned mountainous transition zone. No mention in reports or publications from as early as 1836 onwards could be found of them ever having been observed anywhere else but in this rather restricted area. This clearly illustrates a preference for this broken, mountainous zone. The reasons for this preference are not clear and several factors may contribute in varying degree to this. The more obvious of these are the following:

- a) As has already been mentioned, the mountainous zone is rich in permanent waterholes. It was determined during the study that the Hartmann zebra is confined to water and must drink at least daily during the summer months. It would seem that the availability of surface water is an important limiting factor in their distribution.
- b) The vegetation of the escarpment zone differs markedly from that of the plateau as well as from that found on the Namib flats. The vegetation types found on the escarpment zone may thus include most of the qualifying aspects regarding availability of preferred foodplants.
- c) The broken terrain offers protection against weather extremes and man. The Hartmann zebra has so many evolutionary adaptations to a broken habitat that it appears they were restricted to this area long before the advent of man. These adaptations include a heart which is on the average 0,97 kilogram heavier than the

heart of a Burchell zebra. The hoofs of the Hartmann zebra also grow extremely fast and if they are kept in captivity their hoofs must be trimmed regularly. It would therefore seem that the former is more applicable in this case. That they use the mountainous terrain to ameliorate the influence of climate is clearly seen in their behaviour and was discussed elsewhere (Joubert, 1972).

- d) No other large grazer reaches the same numbers as the Hartmann zebra in this arid mountainous zone. Other large mammals in this zone are kudu (mainly browsers) and klipspringers (also browsers to a large extent). Their only grazing competitors are the gemsbok and even they, being adapted to the plains on the plateau or Namib flats, never attain large numbers in this region.

Although Hartmann zebra occur from the Orange River in the south to north of the Kunene River in southern Angola, they reach their highest densities in the Khomas Hochland escarpment zone to the west of Windhoek. This, despite the fact that human interference owing to intensive farming in this region, was and is markedly higher here than anywhere else in the distribution zone. In the Khomas Hochland they have been hunted mercilessly during the last two decades. Despite this, they still are more than twice as numerous in the Khomas Hochland than in the rest of their distribution areas combined. This fact indicates that they must formerly have been much more numerous in the Khomas Hochland area than anywhere else. It appears that the Khomas Hochland escarpment is the centre of their distribution, with their numbers tapering off to the south and north. This in turn indicates a marked preference for this region. Again we are confronted with the problem as to the reasons for this preference.

Three factors may be important in this context namely topography, climate and vegetation.

- a) Topography. If one looks at a map showing the topography of South West Africa the following is noticeable. Whereas elsewhere, the escarpment zone is either a gradual change from pre-Namib to inland plateaus — such as the area to the north of Swakop River, or a quick change from almost true escarpment to inland plateau — such as the area from the Therons and Zaris mountains southwards, in the central region, between the Swakop River and the Naukluft mountains, the mountainous transition zone is backed up by a broken highland — the Khomas Hochland. It is possible that this virtual "hinterland" may have had an influence on the distribution pattern of the Hartmann zebra.
- b) In consideration of the fact that the distribution of the Hartmann zebra in South West Africa cover approximately a thousand miles from Latitude 17° S to Latitude 28° S, some differences in climate must exist. Marked fluctuations in temperature occur. Summers have very high temperatures in the sun, but strong radiational cooling occurs after sunset. Winter temperatures are fairly low often near freezing at dawn but rise rapidly after sunrise. The rainfall isohyets run

more or less parallel to the coast. No apparent macro-differences in climate from the Kunene River in the north to the Orange River in the south exist. It would therefore seem as though climate in itself is not a serious limiting factor.

- c) Vegetation is the only other factor that changes appreciably from north to south. To the north of the Ugab River the vegetation in the mountainous transition belt consists chiefly of *Colophospermum mopane* in various growth forms and in various associations with other plants. In the extreme south where the winter storms of the western Cape sometimes influence the climate drastically, another change in vegetation is apparent. The trees and woody shrubs of the central region give way to succulents and karroid shrubs.

III THE VEGETATION OF THE KHOMAS HOCHLAND

As the vegetation seems to be one of the most important factors in determining the distribution of the Hartmann zebra, and also because of the apparent preference of these animals to the Khomas Hochland and escarpment, some botanical surveys were carried out in this region and the results are discussed in the present paper. The Khomas Hochland lies to the west of Windhoek. Although the Naukluft

mountains are separate from the highlands they nevertheless form an integral part of this region. The vegetation of the Khomas Hochland is classified by Giess (1971) as a highland savanna and in the west, the escarpment vegetative zone. The use of the term savanna has been the source of disagreement amongst many botanists. In this study Giess is followed in his classification and use of this term. This is in accordance with Stocker (1964) who suggested that the term savanna should not be limited to a park landscape with single trees, but instead, should be used collectively for forest, parkland and grassland vegetation of tropical climates with pronounced dry periods.

The Khomas Hochland lies between the 100 mm and 350 mm isohyets. The 100 mm isohyet roughly follows the western lower edge of the mountainous escarpment zone whilst the 350 mm isohyet roughly passes through Windhoek. The precipitation occurs mostly in typical thunder showers during a short, sharply defined summer rainy season. This arid climate therefore produces vegetation types adapted to this environment.

1. The vegetative physiognomic groups

During the study it was observed that, although the vegetation of the Khomas Hochland is superficially homogenous, it is actually of a complex and varied



Plate 1. A well defined valley with steep slopes in the Khomas Hochland. Note the dense tree growth in the drainage line.

nature. The large variety of soils, derived from different parent materials and bedrock, the stratigraphical features of the surfaces, the water-retaining capacities of the various soils, as well as the climatological factors arising from the direction a slope faces and/or height and the angle of slope, all contribute in various degrees to the vegetative characteristics. For the sake of this paper the vegetation is broadly divided into four physiognomic groups and includes the inner edge of the pre-Namib plain because this is also utilized by the Hartmann zebra. The physiognomic groups can be listed as follows:

- a) The riparian vegetation.
- b) The highland savanna.
- c) The escarpment vegetation.
- d) The pre-Namib vegetation.

a) The riparian vegetation

In the area under discussion various types of drainage lines may be discerned. In the east one finds omuramba-like depressions which normally debauch into more sharply defined valleys with steep slopes. To the west, apart from clearly defined rivers such as the Tsauchab, Tsondeb, Kuiseb and the Swakop Rivers certain ill-defined drainage lines or washes also form part of the general scene. Despite the physiographic differences the vegetation along these drainage lines shows marked similarities.

The drainage lines are normally marked by the remarkably high and dense tree growth. In the omuramba-like depressions *Acacia karroo*, *A. giraffae* and *Ziziphus mucronata* are the dominant forms. They form a tree storey of anything up to 10 metres high. In the more sharply defined valleys the vegetation is much more varied, especially in areas where perennial water occurs. Apart from the abovementioned trees the following occur as well:

- Ficus cordata*;
- F. sycomorus*;
- Rhus lancea*;
- Euclea pseudebenus*; and
- Acacia tortilis heteracantha*

A second storey along the drainage lines is formed by:

- Acacia hebeclada hebeclada*;
- Phaeoptilon spinosum*;
- Rhus dinteri*;
- Tamarix usneoides*; and
- Salvadora persica*

No conspicuous ground storey exist but the following plants are the most common,

- Ficus guerichiana*;
- Sansevieria aethiopica*; and
- Asparagus nelsii*

Further to the west the abovementioned vegetation grows mostly in the riverbeds instead of lining the banks. One also finds grasses growing in the riverbeds. Along the sandy washes *Acacia tortilis* and *A. giraffae* are the dominant trees, while *Pechuel-Loeschea leubnitziae* also occurs in larger numbers. As an example of this type of vegetation the vegetation in the Tsondeb River bed on the farm Abbabis,

Table 1. The Riparian vegetation of the Tsondeb River.

Species	Height (metres)	Diameter of crown (metres)
Tall tree strata:		
<i>Acacia tortilis heteracantha</i>	10	6
<i>Ficus sycomorus</i>	10	12
<i>Ficus cordata</i>	8	5
Lower group of trees and arborescent shrubs:		
<i>Ziziphus mucronata</i>	5	10
<i>Adenolobus garipensis</i>	5	3
<i>Euclea pseudebenus</i>	5	10
<i>Boscia albitrunca</i>	4	6
<i>Acacia mellifera delinens</i>	4	3
<i>Tamarix usnoides</i>	4	6
<i>Maerua schinzii</i>	3	6
Shrubs:		
<i>Boscia foetida</i>	2,5	5
<i>Pechuel-Loeschea leubnitziae</i>	2,5	1
<i>Calicorema capitata</i>	0,8	2,5
<i>Rhigozum obovatum</i>	1	1,1
<i>Maytenus heterophylla</i>	2	2,8
Grasses:		
<i>Stipagrostis obtusa</i>		
<i>Stipagrostis namaquensis</i>		

south of Solitaire is given in Table 1. This is where this river opens on to the pre-Namib plain.

Other plants which occur are the epiphyte *Plicosephalus curviflorus* on *A. tortilis heteracantha* and a green climbing vine-like *Cadaba aphylla* in *Ficus sycomorus*.

b) The highland savanna

As already stated the taller tree growth normally only occurs along the drainage lines. Away from the drainage lines the vegetation is mostly stunted — with exceptions, and consist mostly of low scattered scrub separated by patches of bare ground and/or patches of grass. Small shrubs occur but are mostly non-succulent and the dominance of the various species varies from community to community. As can be expected, the vegetation, especially the taller trees and shrubs, shows a marked variation from the eastern part of the plateau towards the west. This variation consists mostly of a change in species composition.

The most prominent tree on the sloping hills of the Khomas Hochland is *Acacia hereroensis*. This tree is endemic to the Khomas Hochland and Waterberg areas and grows on the average about 4 metres high. Although most of the trees are stunted, in sheltered areas they grow higher. Other trees on the ridges towards the eastern side of the highland are: *Ozoroa crassinervia* and *Combretum apiculatum*. Both the



Plate 2. A view over an area with a typical Highland savanna vegetative cover. The tree in the left foreground is *Acacia hereoensis*.

Acacias and *Combretums* show a marked browse line as well as extensive damage caused mainly by kudu (*Tragelaphus strepsiceros*). Farther west *Acacia erubescens* occurs in large numbers. *Maerua schinzii*; *Albizia anthelmintica* and *Boscia albitrunca* are also present.

The tall shrub layer is formed by: *Acacia mellifera detinens*; *A. hebeclada hebeclada*; *A. reficiens* and *ciens* and *Euclea undulata* in coppice-like stands. Other shrubs that occur are:

Acacia senegal var. *rostrata*;
Croton subgratissimus;
Phaeoptilon spinosum;
Elephantorrhiza suffruticosa;
Boscia foetida;
Catophractes alexandri;
Rhigozum trichotomum and several others.

Smaller shrubs also occur, the most common one throughout the Khomas Hochland being *Monechma genistifolium*. Owing to the low humus content and lime richness of the soils in certain areas, the most common here are karroid-like shrubs *Leucosphaera bainesii*; *Leucas pechuelii*; further to the west *Eriocephalus ericoides*; *Walafrida paniculatum*; *Selago albida*; *Antizoma capensis*; *Pteronia mucronata*; and *Thesium lineata*. On certain slopes in the west the resurrection plant *Myrothamnus flabelifolia* is very conspicuous. *Asparagus nelsii* occurs in certain localities.

Some of the more common herbs are;

Sesamum capense;
Lantana dinteri;
Felicia muricata;
Euryops subcarnosa;
Pentzia calva;
Hermannia abrotanoides;
Blepharis obmitrata;
Geigeria ornivata;
Dicoma macrocephala;
Amaranthus thunbergii

Five aloes, *Aloe littoralis*; *A. sladiniana*; *A. karasbergensis*; *A. viridiflora* and *A. hereoensis* also occur on the Khomas Hochland.

The variety of grasses one encounters in this area is remarkable. More than 30 different species were found during the study. Wheelpoint surveys of 1 000 points each were carried out at both the Daan Viljoen Game Reserve and the Naukluft Mountain Zebra Park. Owing to the low basal density the nearest plant to the point was also noted. A further advantage of this method is that more of the grasses in the area are recorded than would have been the case if only strikes were recorded. This data were used to get an idea of the species composition. It was found that the most dominant perennials were *Rhynchelytrum repens* and *Anthephora pubescens*. The abnormally large size of the *Cenchrus ciliaris* tufts are the reason for the relatively high number of strikes on this species (see tables 2 and 3).

c) The escarpment vegetation

The broken, mountainous transition belt of the escarpment is appreciably drier than the two vegetation zones already discussed. The change in vegetation is therefore not unexpected. Although most of the components already mentioned in the two previous vegetative zones still occur, several others also make their appearance now. The more important is the larger variety of *Commiphora* species present whereas in the Highland savanna only *C. pyracanthoides* occur. The various slopes in the escarpment area present an even more diverse number of plant communities.

The most conspicuous plant species present here are *Moringa ovalifolia*; *Aloe dichotoma*; several *Commiphora* species viz. *Commiphora saxicola*; *C. angolensis*; *C. glaucescens*; *C. virgata*; and *Euphorbia virosa* which forms almost pure stands on certain slopes, *Adenolobus garipensis* and *Sterculia africana*.

Botanical surveys were carried out on various slopes in the Naukluft Mountain zebra Park. Tables 4; 5 and 6 give an idea of the trees and shrubs present as well as their growth form. A wheelpoint survey was also carried out on the lower slopes of the escarpment region in the Naukluft Mountain Zebra Park (see table 3). This gives one a good indication of the

Table 2. Species composition and basal cover of the ground layer in the Daan Viljoen Game Reserve.

Grasses	Conventional wheelpoint			Nearest plant	
	Basal strike	% Rel. frequency	% cover	No. times nearest	% Rel. frequency
<i>Enneapogon cenchroides</i>	15	13,8	1,5	134	13,4
<i>Rhynchelytrum</i> sp.	10	9,2	1,0	110	11,0
<i>Antheophora pubescens</i>	7	6,4	0,7	98	9,8
<i>Aristida meridionalis</i>	5	4,6	0,5	97	9,7
<i>Aristida adscensionis</i>	10	9,2	1,0	87	8,7
<i>Cenchrus ciliaris</i>	20	18,5	2,0	57	5,7
<i>Monelytrum luederitzianum</i>	3	2,7	0,3	55	5,7
<i>Stipagrostis uniplumis</i>	3	2,7	0,3	57	4,7
<i>Heteropogon contortus</i>	2	1,8	0,2	38	3,8
<i>Eragrostis echinochloidea</i>	5	4,6	0,5	28	2,8
<i>Pogonarthria fleckii</i>	0			25	2,5
<i>Fingerhuthia africana</i>	0			20	2,0
<i>Eragrostis rotifer</i>	2	1,8	0,2	18	1,8
<i>Microchloa caffra</i>	2	1,8	0,2	15	1,5
<i>Eragrostis trichophora</i>	0			13	1,3
<i>Schmidtia bulbosa</i>	2	1,8	0,2	12	1,2
<i>Cynodon dactylon</i>	1	0,9	0,1	10	1,0
<i>Eragrostis porosa</i>	0			9	0,9
<i>Eragrostis nindensis</i>	1	0,9	0,1	8	0,8
<i>Hyparrhenia hirta</i>	0			7	0,7
<i>Eragrostis machrochlamys</i>	0			7	0,7
<i>Triraphis</i> sp.	0			6	0,6
<i>Eragrostis superba</i>	0			5	0,5
<i>Digitaria eriantha</i>	1	0,9	0,1	5	0,5
<i>Eragrostis lehmanniana</i>	0			4	0,4
<i>Chloris virgata</i>	0			3	0,3
<i>Eragrostis scopelophyla</i>	0			2	0,2
Herbs.					
<i>Monechma genistifolium</i>	6	5,5	0,6	25	2,5
<i>Fimbristylis</i> sp.	3	2,7	0,3	18	1,8
<i>Gnidia polycephala</i>	2	1,8	0,2	9	0,9
<i>Oxalis</i> sp.	0			7	0,7
<i>Tribulus terrestris</i>	2	1,8	0,2	5	0,5
<i>Geigeria ornativa</i>	1	0,9	0,1	5	0,5
<i>Dicoma macrocephala</i>	1	0,9	0,1	4	0,4
<i>Amaranthus thunbergii</i>	1	0,9	0,1	3	0,3
<i>Trichoneura grandiglumis</i>	1	0,9	0,1	2	0,2
<i>Gomphocarpus tomentosus</i>	1	0,9	0,1	1	0,1
<i>Blepharis obmitrata</i>	1	0,9	0,1	1	0,1
<i>Juncus</i> sp.	0			1	0,1

Basal strikes recorded: 108

% basal cover: 10,8 per cent



Plate 3. An almost pure stand of *Euphorbia virosa* on a north facing slope.

basal cover and species composition of the grass layer. The higher percentage basal cover recorded as opposed to that recorded at Daan Viljoen Game Reserve can be ascribed to the very low animal biomass at present in this game reserve. This is further augmented by the fact that the Hartmann zebra have not yet utilized the lower slopes.

Other features are that several grass species occur here but not at the Daan Viljoen Game Reserve. Also that although the percentage relative frequency of the plants present in both areas differ considerable two species viz., *Enneapogon cenchroides* and *Eragrostis nindensis* are still quite prominent in the Naukluft Mountain Zebra Park. The grasses present in the latter Park are normally lower down on the succession phase and with the perennials, the tufts are smaller.

d) The pre-Namib vegetation

The pre-Namib stretches from the foot of the rocky slopes of the escarpment region westward for approximately 20 to 30 km. The western border of the pre-Namib zone is difficult to define, but it is approximately where the perennial vegetation between the sandy washes terminates.

Along the eastern sides of the pre-Namib plains one finds alluvial fans built up of coarse material washed down from the escarpment regions. In other areas large plains are formed with sheet calcrete just below the surface or broken up into calcrete rubble. The vegetation here consists mainly of shrubs and scattered trees. The dominant trees are *Maerua schinzii*; *Parkinsonia africana* and *Boscia albitrunca*. The shrubs are mainly *Catophractes alexandri*; *Commiphora virgata*; *Calicorema capitata*; *Boscia foetida*; *Rhigozum trichotomum*; *Kleinia longiflorus*; *Leucosphaera bainesii*; *Leucas pachuelli*; *Cadaba aphylla* and *Euphorbia lignosa*.

In good rainfall years grasses that one encounters on the plains are much the same as those listed in Table 3. On the sandy flats, however, one finds almost pure stands of *Stipagrostis uniplumis*; *S. ciliata* and *S. obtusa*.

IV DISTRIBUTION

The main distribution of the Hartmann zebra lies within the borders of South West Africa. No Hartmann zebra occur to the south of the Orange River in the Richtersveld apart from small parties that may infrequently cross the river. Sidney (1965) quoting Lang mentions that a small number of Hartmann zebra occurred at Kamieskroon, at approximately Latitude 31° S in 1912. This is approximately 260 km. south of the Orange River. No other records of the existence of this zebra further south could be found.

Sidney (1965) also considers the Kamiesberg as their most southern distribution limit. Considering their clearly preferred habitat in the Khomas Hochland, as well as the sharp decline in numbers from here towards the south (and north) it seems highly unlikely that they ever reached high numbers to the south of the Orange River.

The furthest north-west that the other subspecies, *Equus zebra zebra*, ever occurred according to available records (Sciater, 1900) was on the Cedarberg in Piquetberg. From this it would seem as though the two subspecies have been isolated for at least a century, probably much more.

Hartmann zebra have been reported as far north as Mossamedes in Angola (Bocage, 1890). Today their distribution in Angola is limited to the Iona Game Reserve immediately to the north of the Kunene River.

In South West Africa they are distributed at present in four more or less isolated localities. These localities will be discussed separately (also see map).

1. The northern concentration

Although politically the Kaokoveld only lies to the north of the Hoanib River and to the west of Ovamboland, the area to the north of the Ugab River can zoogeographically be considered the same entity.

Table 3. Species composition and basal cover of the ground layer in the lower slopes of the Naukluft Mountain Zebra Park.

Grasses	Conventional wheelpoint			Nearest plant	
	Basal strike	% Rel. frequency	% cover	No. times nearest	% Rel. frequency
<i>Eragrostis nindensis</i>	27	19,3	2,7	215	21,5
<i>Enneapogon cenchroides</i>	38	27,1	3,8	164	16,4
<i>Aristida adscensionis</i>	32	22,8	3,2	152	15,2
<i>Aristida effusa</i>	8	5,7	0,8	78	7,8
<i>Enneapogon brachystachyus</i>	13	9,2	1,3	75	7,5
<i>Eragrostis porosa</i>	3	2,1	0,3	69	6,9
<i>Eragrostis annulata</i>	5	3,5	0,5	63	6,3
<i>Rhynchelytrum</i> sp.	2	1,4	0,2	43	4,3
<i>Stipagrostis uniplumis</i>				42	4,2
<i>Antheophora pubescens</i>				26	2,6
<i>Stipagrostis ciliata</i>				13	1,3
<i>Tragus heteronianus</i>	3	2,1	0,3	8	0,8
<i>Stipagrostis obtusa</i>				8	0,8
<i>Fingerhuthia africana</i>				7	0,7
<i>Cenchrus ciliaris</i>				6	0,6
<i>Eragrostis echinochloidea</i>				3	0,3
<i>Aristida curvata</i>				2	0,2
<i>Pogonarthria fleckii</i>				2	0,2
<i>Digitaria eriantha</i>		0,7	0,1	2	0,2
<i>Heteropogon contortus</i>				1	0,1
<i>Hyparrhenia hirta</i>				1	0,1
Herbs					
<i>Monechma genistifolium</i>	3	2,1	0,3	8	0,8
<i>Blepharis obmitrata</i>	3	2,1	0,3	3	0,3
<i>Geigeria ornativa</i>	1	0,7	0,1	2	0,2
<i>Oxalis</i> sp.	1	0,7	0,1	2	0,2

Basal strikes recorded: 140 % basal cover: 14,0 per cent

Table 4. Species composition and differentiation of the shrub layer on the Naukluft mountain plateau.

Species	No. quadrats of occurrence	No. of plants	Relative frequency (F) %	Relative dominance (D) %	Importance value (F + D)
<i>Eriocephalus dinteri</i>	16	129	16,1	19,0	35,1
<i>Wellstedia dinteri</i>	12	285	12,1	41,9	54,0
<i>Barleria kaloxytona</i>	12	42	12,1	6,2	18,3
<i>Leucosphaera bainesii</i>	8	47	8,1	6,9	15,0
<i>Monechma genestifolium</i>	8	41	8,1	6,1	14,2
<i>Calicorema capitata</i>	6	42	6,1	6,3	12,3
<i>Maytenus heterophylla</i>	6	34	6,1	5,0	11,1
<i>Thesium laciniatum</i>	6	4	6,1	0,6	6,7
<i>Rhus volkii</i>	5	12	5,1	1,7	6,8
<i>Aptosimum lineare</i>	3	23	3,0	3,4	6,4
<i>Blepharis spinifex</i>	3	5	3,0	0,7	3,7
<i>Boscia foetida</i>	2	2	2,0	0,2	2,2
<i>Euclea asperrima</i>	1	3	1,0	0,4	1,4
<i>Asparagus nelsii</i>	1	2	1,0	0,2	1,2
<i>Kleinia longiflorus</i>	1	1	1,0	0,1	1,1
<i>Rhigozum obovatum</i>	1	1	1,0	0,1	1,1
<i>Indigofera candidissima</i>	1	1	1,0	0,1	1,1
<i>Cyphostemma</i> sp.	1	1	1,0	0,1	1,1
<i>Blepharis obmitrata</i>	1	1	1,0	0,1	1,1
<i>Antizoma capensis</i>	1	1	1,0	0,1	1,1
<i>Solanum</i> sp.	1	1	1,0	0,1	1,1
<i>Phaeoptilon spinosum</i>	1	1	1,0	0,1	1,1
Total	99	681	99,9	99,6	199,5

Table 5. Vegetation on a sixty degree north-facing slope of black dolomite in the Naukluft mountain.

Open woodland of small trees and scattering of brush.

Plant species	Height (metres)	Diameter of crown (metres)	% foliage density
<i>Commiphora species</i>	6,0	5,0	30
<i>Moringa ovalifolia</i>	7,0	7,0	10
<i>Boscia albitrunca</i>	3,0	2,0	40
<i>Monechma genistifolium</i>	0,3	0,5	60
<i>Montinia caryophyllacea</i>	1,0	1,0	20
<i>Adenolobus garipensis</i>	5,0	5,0	20
<i>Rhus marlothii</i>	2,0	3,0	30
<i>Thesium cf. lineatum</i>	1,0	0,3	30

Table 6. Vegetation on a forty to seventy degree south-facing slope, partly bedrock, partly thin soil lightly veneering the bedrock in the Naukluft mountain.

Open cover of low shrubs, with scattered taller, almost arborescent shrubs.

Plant species	Height (metres)	Diameter of crown (metres)	% foliage density
<i>Rhigozum trichotomum</i>	1,0	1,0	50
<i>R. obovatum</i>	3,0	3,0	60
<i>Phaeoptilon spinosum</i>	2,0	2,0	70
<i>Boscia albitrunca</i>	4,0	3,0	70
<i>Sansevieria aethiopica</i>	0,3	0,3	70
<i>Acacia hereroensis</i>	3,0	2,0	30
<i>Myrothamnus flabellifolia</i>	0,8	0,1	90
<i>Adenolobus garipensis</i>	0,2	2,0	30
<i>Euphorbia virosa</i>	2,0	2,0	60
<i>Boscia foetida</i>	3,0	2,0	50
<i>Ficus cordata</i>	3,0	2,0	50
<i>Catophractes alexandri</i>	2,0	2,0	30
<i>Monechma genistifolium</i>	5,0	8,0	70
<i>Acacia mellifera ssp. detinens</i>	2,0	2,0	40
<i>Montinia caryophyllacea</i>	1,0	1,0	20
<i>Kleinia longiflorus</i>	1,0	1,0	50
<i>Grewia bicolor</i>	1,0	1,0	40

The Ugab River forms a migration route to the east, for Hartmann zebra occur all along it as far as the farm Ozema, 138, close to Outjo, Longitude 16° E. Nowhere else do they occur so far inland as along the Ugab River. From the Ugab River they occur northwards along the escarpment zone to the Kunene River. South of the Hoanib River they are mostly restricted to the west of the farming areas.

2. Erongo mountains

The population of Hartmann zebra in the Erongo mountains is rather restricted. They occur all over the mountains but especially on the eastern and south-eastern slopes.

3. The central concentration

The bulk of the Hartmann zebra population in South West Africa occurs within the region from the Swakop River southwards along the escarpment as far south as Theronsberg in the Zaris mountain range. They only occur eastward onto the Khomas Hochland along the Kuiseb and Gaub drainage systems as far as the farms Jonkersgrab and Tara. A large concentration remains on the Naukluft mountain range.

4. The southern concentration

In the south the Hartmann zebra are almost exclusively limited to the Fish River Canyon and the Huns mountains immediately to the west.

V STATUS

No other large mammal in Southern Africa has been so ruthlessly persecuted during the last two decades in South West Africa as the Hartmann zebra. At one stage only 20 years ago it must have been one of the most numerous of the larger wild mammals still left in Southern Africa. According to 15 independent reliable sources, mostly farmers and Government officials, between 50 000 to 75 000 of these animals still occurred on the central concentration area during the early 1950's. They were systematically hunted and various stories of how one hundred or more were killed during hunts in this area are common.

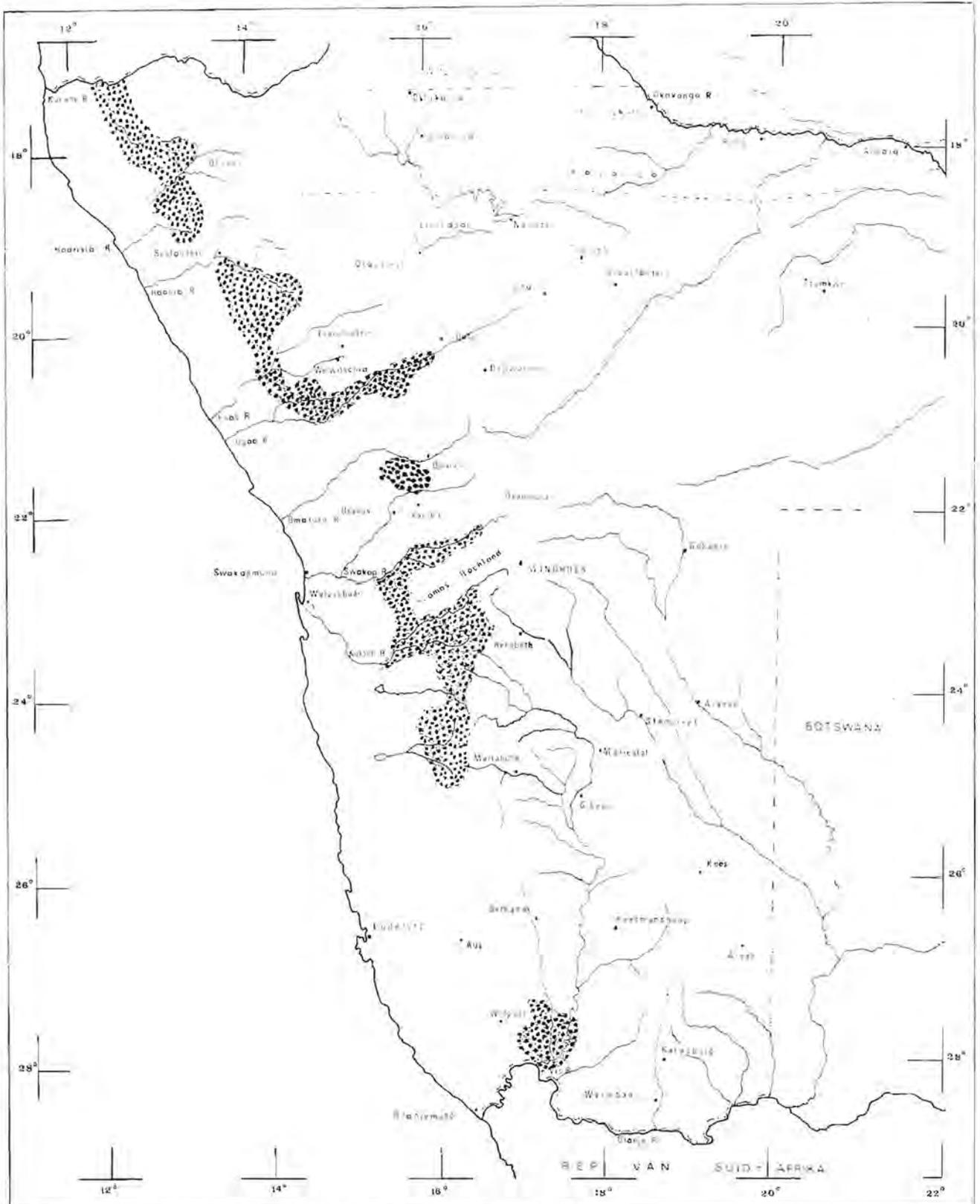
During 1960 the Nature Conservation and Tourism Division, with the help of the South African Police, made a survey of the status of game in South West Africa. This survey took the form of a questionnaire and showed that 10 700 Hartmann zebra were left on farming areas in South West Africa. In 1968 an aerial survey was carried out by the Nature Conservation and Tourism Division, from the Kunene River in the north to the Orange River in the south. During this survey only 5 500 Hartmann zebra were counted on farming areas. These figures include a 27 per cent correction factor which was determined by flying over the Daan Viljoen Game Reserve with its known number of Hartmann zebra. With the abovementioned figures in hand one may follow the trend shown by the Hartmann zebra population in South West Africa. The figure of 50 000 that was estimated in 1950 for the central concentration area (Khommas Hochland), can be taken for argument's sake as the total Hartmann zebra population for the whole of their distribution area on farms. In 1960, only ten years later, the figure of 50 000 had already dropped to 10 700 and by 1968, to only 5 500 in the farming area. This decline in Hartmann zebra numbers is especially disturbing if viewed against the fact that it was declared specially protected in 1933.

The total number of Hartmann zebra in South West Africa according to the 1968 survey was approximately 7 000. A breakdown of this figure shows the following distribution:

1. The northern concentration

In this region there were still approximately 1 500 left, the largest concentration of Hartmann zebra being south of the Hoanib River and west and south

of Otjojasandu. In this region there were still about 1 100 of the animals left, with another 360 north of the Hoanib River, mostly north of Hoarusib River. Farther south about 100 animals still occurred along the Ugab River on farming land.



Map 1. The present distribution of *Equus zebra hartmannae* in South West Africa.

2. The Erongo mountains

Here the animals are very much restricted by the isolated mountain and fences. No more than approximately 100 animals occur in this region.

3. The central concentration

As mentioned previously the bulk of the Hartmann zebra population in South West Africa occurs in this region. The 1968 survey showed approximately 5 300 of these animals in this area, distributed in the Khomas Hochland escarpment and a number in the Namib Desert Park. This figure includes the Naukluft mountains where 800 animals were counted with a further 300 in the Theronsberg area of the Zaris mountains.

4. The southern concentration

In this area only 200 Hartmann zebra, probably fewer, remain.

As can be seen from the distribution analysis of Hartmann zebra in South West Africa approximately 80 per cent of the total population, occur on farming land. Here they compete with livestock for living requirements and the serious problems they create during drought years, will increase in future. Measures to safeguard their survival was therefore urgently needed.

Following the completion of the main project a proposal to the Executive Committee of South West Africa to enlarge the existing Naukluft Mountain Zebra Park with an additional 143 000 ha was approved. This will ensure the survival of a representative sample of these endangered animals.

VI SUMMARY

The Hartmann zebra in South West Africa is a "problem animal" as well as an endangered species. A research project was launched to determine its distribution, status, habitat preference, ecology, behaviour and population dynamics. The results was used to determine a policy to ensure its survival as well as to satisfy the farming community.

The habitat preference of the Hartmann zebra is discussed. It was found that the main distribution area is situated in the Khomas Hochland. The vegetation of the Khomas Hochland is analysed and divided into four physiognomic groups viz. riparian vegetation, highland savanna, escarpment vegetation and pre-Namib vegetation. The results of botanical surveys are given and discussed. Other distribution

areas are the northern concentration which includes the area to the north of the Ugab River, the Erongo mountains, and the central concentration which includes the Khomas Hochland and the southern concentration in the Fish River Canyon and the Huns mountains. An aerial census was carried out during 1968, which covered the whole area from the Orange River in the south to the Kunene River in the north. The total number of Hartmann zebra in South West Africa according to this survey is approximately 7 000.

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