

NOTES ON THE VEGETATION OF THE KALAHARI GEMSBOK NATIONAL PARK WITH SPECIAL REFERENCE TO ITS INFLUENCE ON THE DISTRIBUTION OF ANTELOPES

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INTRODUCTION.

This preliminary report is based on observations made during December, 1957 and June, 1958. It has been made possible by the floristic explorations of Dr. R. Story and Mr. A. M. Brynard.

The area of the K.G.N.P. and the adjoining Bechuanaland Game Reserve has been tentatively divided into six zones (see map) which were delineated in accordance with botanical as well as geographical features.

Generally speaking the flora of zone I is the richest, the surface area covered by perennial vegetation largest and the mean annual rainfall highest. To the south, the flora of each consecutive zone becomes poorer, the area covered by perennial vegetation smaller and the rainfall lower. The landscape changes from undulating sandveld in zone I to irregular dunes and flats in II and III and from regular (NW — SE trending) dunes with more or less overgrown tops in IV to mainly regular dunes with relatively bare crests in VI. V is a heterogeneous transitional zone. The mean annual rainfall in I is estimated at above 250 mm, while that of VI is probably 140 mm and less.

The vegetation of each zone is not homogeneous. River banks, river beds, "river dunes" and sandveld will be treated separately. In the sandveld the following habitats are distinguished: dune-tops or rises, depressions and pans. The so-called "river dunes" are dunes running more or less parallel with the river courses, occupying strips half a mile to about five miles broad. They differ not only in position from the ordinary dunes of the sandveld but also to some extent in their vegetation. One reason for these differences is probably that the sand in the vicinity of the rivers is in many localities shallower than elsewhere as it overlies the calcrete layers that usually seem to be

nearer the surface along river courses. Consequently the lime content of the soils in the river dunes, especially in the *strate*, is higher than in the rest of the sandveld and conditions seem to be more favourable not only for plants preferring calcareous soil but also for deep-rooted woody species. *Straat* (plur. *strate*) is the term locally used for the valleys between dunes.

Before dealing in some detail with the vegetation of each zone, it must be emphasized that very little is as yet known about the ephemerals of this region, especially those of the sandveld. Most of the little information that was collected will be summarised in the discussion on zone VI.

The Roman numerals behind some of the species indicate the zone or zones to which this plant is restricted. In some cases rare specimens were also seen in other zones than those mentioned.

The plant lists are arranged roughly in order of frequency.

ZONE I

This zone falls entirely outside the area of the K.G.N.P. It consists of undulating sandveld which is generally densely covered by perennial grasses. Trees and shrubs are common but they are mainly found on rises. Thickets and small woods are an important feature of this zone.

The most typical perennial grasses are:

- | | |
|----------------------------------|------------------------------------|
| 1. <i>Eragrostis lehmanniana</i> | 4. <i>Eragrostis pallens</i> (I) |
| 2. <i>Aristida uniplumis</i> | 5. <i>Asthenatherum glaucum</i> |
| 3. <i>Aristida meridionalis</i> | 6. <i>Panicum kalahareense</i> (I) |

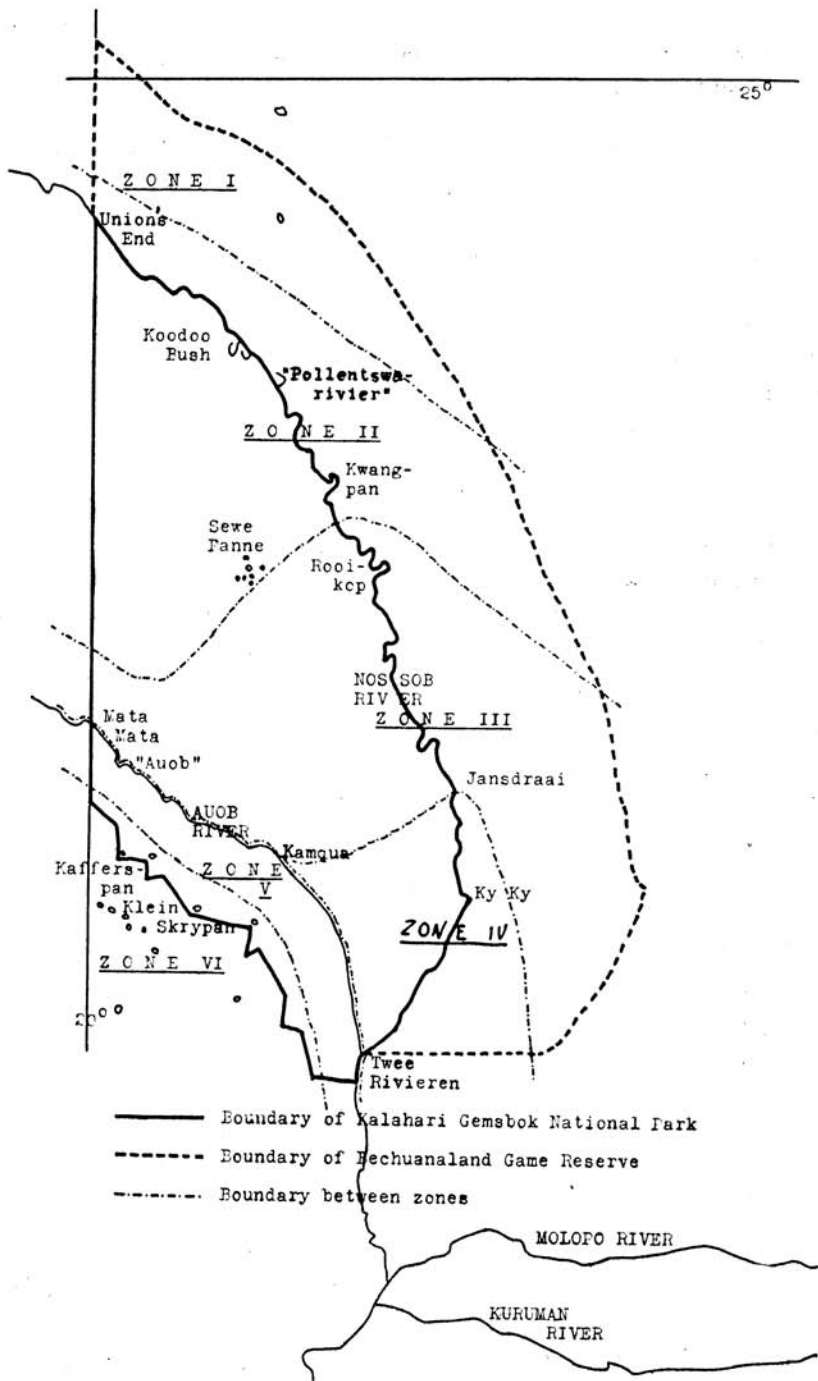
Eragrostis pallens and *Panicum kalahareense* are hard and rather unpalatable. They seem to increase towards the northern and eastern areas at the expense of grasses like *Asthenatherum glaucum* and *Aristida uniplumis* which are much more valuable from a grazing point of view.

As no rain had fallen previous to the visit to this area in June, most annuals were dry. The following were recorded:

- | | |
|--------------------------------|---|
| 1. <i>Brachiaria glomerata</i> | 6. <i>Celosia linearis</i> |
| 2. <i>Digitaria</i> sp. (I) | 7. <i>Aristida curvata</i> |
| 3. <i>Tribulus</i> sp. | 8. <i>Semonvillea fenestrata</i> |
| 4. <i>Gisekia miltus</i> | 9. <i>Acrotome inflata</i> |
| 5. <i>Fimbristylis exilis</i> | 10. <i>Sesamum</i> sp. prob. <i>S. schenkii</i> . |

With the exception of *Tribulus*, *Aristida* and *Fimbristylis*, the species mentioned above are regarded as typical summer ephemerals. The *Digitaria* sp. is apparently common throughout zone I.

Rises: The rises, found especially in the southern parts of this zone, are, technically speaking, dunes. They are only slightly higher than the surrounding



country but, like the tops of the dunes found in the other zones, they support most by far of the woody plants growing in the sandveld.

The following trees, shrubs and perennial grasses are typical of rises:

- | | |
|---------------------------------------|---|
| 1. <i>Aristida amabilis</i> | 6. <i>Acacia uncinata</i> (I, II) |
| 2. <i>Crotalaria spartioides</i> | 7. <i>Grewia flava</i> |
| 3. <i>Aristida graciliflora</i> (I) | 8. <i>Terminalia sericea</i> (I, II) |
| 4. <i>Rhus commiphoroides</i> (I, II) | 9. <i>Albizia anthelmintica</i> (I, II) |
| 5. <i>Acacia giraffae</i> | 10. <i>Grewia retinervis</i> (I, II) |

Other common perennials less specialized in their habits are:

- | | |
|--|-------------------------------------|
| 1. <i>Acacia haematoxylon</i> (tree on rises, otherwise shrubby) | 7. <i>Acacia detinens</i> |
| 2. <i>Hermannia tomentosa</i> | 8. <i>Ehretia rigida</i> |
| 3. <i>Tephrosia sphaerosperma</i> | 9. <i>Boscia albitrunca</i> |
| 4. <i>Hermannia</i> sp. prob. <i>H. grandiflora</i> var. <i>burchellii</i> | 10. <i>Plinthus sericeus</i> |
| 5. <i>Citrullus naudinianus</i> | 11. <i>Indigofera</i> sp. (I) |
| 6. <i>Elephantorrhiza elephantina</i> | 12. <i>Grewia</i> sp. (I) |
| | 13. <i>Orthanthera jasminiflora</i> |

Depressions: The following plants are commonly found on calcareous sand in depressions:

- | | |
|--------------------------------------|--|
| 1. <i>Schmidtia kalahariensis</i> | 4. <i>Aristida ciliata</i> |
| 2. <i>Rhigozum trichotomum</i> | 5. <i>Monechma incanum</i> |
| 3. <i>Catophractes alexandri</i> (I) | 6. <i>Acacia hebeclada</i> var. <i>stolonifera</i> |

It is interesting that *Catophractes alexandri* and *Rhigozum trichotomum* are both found in this area. These shrubs are closely related and are very similar in their ecological requirements. They are, however, seldom seen growing together as *Catophractes* is more or less confined to tropical regions and *Rhigozum* is mainly found further south.

Pans: One of the bigger pans in this zone was visited. In contrast to most pans in the K.G.N.P., it supports a number of perennials over most of its surface. The commonest of these are:

- | | |
|---------------------------------------|-------------------------------------|
| 1. <i>Eragrostis truncata</i> (I, II) | 4. <i>Sporobolus rangei</i> . |
| 2. <i>Aristida obtusa</i> | 5. <i>Plinthus sericeus</i> |
| 3. <i>Salsola rabieana</i> (I, II) | 6. <i>Leucosphaera bainesii</i> (I) |

The annual grass *Enneapogon brachystachyus* was also common in June, though mostly in a dry state.

Woods: A number of thickets and small woods occur in this zone. They consist mainly of the following trees and shrubs:

- | | |
|-----------------------------------|---|
| 1. <i>Acacia detinens</i> | 6. <i>Rhus commiphoroides</i> (I, II) |
| 2. <i>Grewia flava</i> | 7. <i>Terminalia sericea</i> (I, II) |
| 3. <i>Acacia giraffae</i> | 8. <i>Albizia anthelmintica</i> (I, II) |
| 4. <i>Acacia uncinata</i> (I, II) | 9. <i>Grewia retinervis</i> (I, II) |
| 5. <i>Acacia haematoxylon</i> | 10. <i>Grewia</i> sp. (I) |

ZONE II

This zone is transitional between the Bechuanaland-type savannah and the extremely open savannah as found in the semi-arid regions further south.

RIVER BANKS OF NOSSOB: No calcrete outcrops occur in this area. Wherever the banks slope gently towards the river-bed and consist of fine, clayey sand rich in lime (Louw, unpubl.), they are dominated by *Aristida obtusa*. In some localities mixed stands of this grass and *Rhigozum trichotomum* occur.

This veld covers large areas, especially on the river bends, and can be up to half a mile wide. Banks with coarser, less calcareous sand (Louw, unpubl.) are usually dominated by *Schmidtia kalahariensis* and *Rhigozum trichotomum*.

In the transitional zone between the veld adjoining the river and the sandveld, the soil is a mixture of red and white calcareous sand and has usually a pinkish colour. The following plants are commonly found here:

- | | |
|--|-----------------------------------|
| 1. <i>Schmidtia kalahariensis</i> | 8. <i>Plinthus sericeus</i> |
| 2. <i>Rhigozum trichotomum</i> | 9. <i>Monechma hereroense</i> |
| 3. <i>Tribulus</i> spp. | 10. <i>Barleria rigida</i> |
| 4. <i>Eragrostis porosa</i> | 11. <i>Lycium austrinum</i> |
| 5. <i>Aristida ciliata</i> | 12. <i>Cucumis hookeri</i> |
| 6. <i>Dicoma capensis</i> | 13. <i>Eragrostis lehmanniana</i> |
| 7. <i>Limeum argute-carinatum</i> var. <i>kwebense</i> | |

RIVER-BED OF NOSSOB: Except at the confluence with the Auob, the bed of the Nossob is wider in zone II than anywhere further south. It is dominated by *Acacia giraffae*, the only tree occurring in the river in this area.

The only common perennial grasses are *Panicum coloratum*, and *Eragrostis bicolor*.

Cenchrus ciliaris is apparently rare. Some perennial grasses, that seem to grow mainly around depressions in the river, are: *Diplachne fusca*, *Dichanthium papillosum* and *Eragrostis rotifer*.

Other common perennials are:

- | | |
|----------------------------------|----------------------------|
| 1. <i>Osteospermum muricatum</i> | 5. <i>Grewia flava</i> |
| 2. <i>Aristida congesta</i> | 6. <i>Ehretia rigida</i> |
| 3. <i>Salvia spathulata</i> | 7. <i>Lycium austrinum</i> |
| 4. <i>Radyera urens</i> | |

The following annuals have been recorded in the dry season:

- | | |
|-------------------------------------|--|
| 1. <i>Chloris virgata</i> | 7. <i>Setaria verticillata</i> |
| 2. <i>Enneapogon brachystachyus</i> | 8. <i>Tragus racemosus</i> |
| 3. <i>Tribulus</i> spp. | 9. <i>Enneapogon cenchroides</i> |
| 4. <i>Geigeria pectidea</i> | 10. <i>Eragrostis annulata</i> |
| 5. <i>Aristida curvata</i> | 11. <i>Limeum argute-carinatum</i> var.
<i>kwebense</i> |
| 6. <i>Eragrostis porosa</i> | |

Striking by its absence from the river bed is *Salsola rabieana*. The only specimens seen in the river bed itself were growing on a man-made mound at Kwangpan. A tentative explanation is given below.

The bed of the Nossob forms three blind side arms in this zone (see map). The biggest of these, which is commonly known as "Pollentswarivier", seems to be the end of a fossil river that linked the Nossob with a pan in zone I. The soil in these side arms differs widely from that in the Nossob itself. The most obvious difference is the absence of micaceous silt in the arms. From this it may be concluded that the flood waters that carried the micaceous silt with them did not enter far into the side arms. This silt, which has possibly had its origin in the Auas Mountains, is found mainly in zone II and the northern parts of III. While trees and tall shrubs are absent from the side arms, the following plants, not found in the Nossob itself, are common:—

- | | |
|---------------------------------------|---|
| 1. <i>Eragrostis truncata</i> (I, II) | 3. <i>Salsola rabieana</i> (I, II) |
| 2. <i>Aristida obtusa</i> | 4. <i>Sporobolus</i> sp. cf. <i>S. ioclados</i> |

The species of *Salsola* and *Eragrostis* mentioned above are otherwise confined to pans in I and II. Like the other two plants listed they are known to grow mainly on soil rich in lime. The absence of these species from the river bed may thus be explained by the scarcity of lime and possibly by the presence of rather heavy, badly drained micaceous silt.

SANDVELD. The sandveld of this zone has different aspects. For the largest part it consists of relatively low, irregular dunes. Complexes of very loose dunes covered by sparse vegetation are locally common, especially in the vicinity of pans. An interesting feature of this zone and the northern parts of III are large flats dominated by a shrubby form of *Acacia haematoxy-lon*.

Irregular dunes: This area is for the greatest part well covered by perennial grasses. The following are the commonest:

- | | |
|--|---------------------------------|
| 1. <i>Eragrostis lehmanniana</i> forma | 3. <i>Asthenatherum glaucum</i> |
| 2. <i>Aristida uniplumis</i> | 4. <i>Aristida meridionalis</i> |

Aristida graciliflora, which is apparently confined to I and II, is rather rare. Some perennials that are common on and between dunes are:

- | | |
|---|--|
| 1. <i>Acacia haematoxylon</i>
(Mainly in the shrubby form) | 5. <i>Elephantorrhiza elephantina</i>
(I, II, ?) |
| 2. <i>Hermannia tomentosa</i> | 6. <i>Hermannia</i> sp. prob. <i>H. grandiflora</i> var. <i>burchellii</i> |
| 3. <i>Tephrosia sphaerosperma</i> | 7. <i>Citrullus naudinianus</i> |
| 4. <i>Plinthus sericeus</i> | |

The following annuals were seen in most localities:

- | | |
|--------------------------------|--|
| 1. <i>Brachiaria glomerata</i> | 5. <i>Acrotome inflata</i> |
| 2. <i>Gisekia miltus</i> | 6. <i>Dicoma capensis</i> |
| 3. <i>Oxygonum alatum</i> | 7. <i>Celosia linearis</i> |
| 4. <i>Tribulus</i> spp. | 8. <i>Sesamum</i> sp. prob. <i>S. schenkii</i> |

Dune crests and rises: Most woody plants and some perennial grasses are found mainly in elevated localities in the sandveld:

- | | |
|---------------------------------------|---|
| 1. <i>Aristida amabilis</i> | 7. <i>Boscia albitrunca</i> |
| 2. <i>Crotalaria spartioides</i> | 8. <i>Terminalia sericea</i> (I, II) |
| 3. <i>Eragrostis atherstonei</i> | 9. <i>Albizia anthelmintica</i> (I, II) |
| 4. <i>Acacia detinens</i> | 10. <i>Lycium austrinum</i> |
| 5. <i>Grewia flava</i> | 11. <i>Grewia retinervis</i> (I, II) |
| 6. <i>Rhus commiphoroides</i> (I, II) | |

As far as the sandveld is concerned *Grewia flava* is rare except in I and II. It occurs, however, in the river-beds and on the river dunes in III and IV.

Flats: It has been said earlier that in the sandveld of the K.G.N.P. most woody plants are found on rises or on top of dunes. The flats in zone II are, however, quite level, except for an occasional depression. As would be expected, these areas are completely devoid of trees, their flora is very poor and the vegetation they support is strikingly homogeneous though rather dense. Due to the lack of variety these flats are not frequented by game. The following is a complete list of plants found in an area of about 25 by 25 meters during the dry season:

- | | |
|--|---------------------------------------|
| 1. <i>Eragrostis lehmanniana</i> forma | 5. <i>Aristida amabilis</i> |
| 2. <i>Aristida meridionalis</i> | 6. <i>Acacia haematoxylon</i> (shrub) |
| 3. <i>Aristida uniplumis</i> | 7. <i>Crotalaria spartioides</i> |
| 4. <i>Asthenatherum glaucum</i> | 8. <i>Brachiaria glomerata</i> |

- | | |
|----------------------------------|-----------------------------------|
| 9. <i>Hermannia tomentosa</i> | 13. <i>Plinthus sericeus</i> |
| 10. <i>Fimbristylis exilis</i> | 14. <i>Indigofera alternans</i> |
| 11. <i>Heliotropium nelsonii</i> | 15. <i>Semonvillea fenestrata</i> |
| 12. <i>Aristida graciliflora</i> | 16. <i>Limeum</i> sp. |

The following were recorded in a depression on the flats:

- | | |
|-----------------------------------|----------------------------|
| 1. <i>Schmidtia kalahariensis</i> | 3. <i>Monechma incanum</i> |
| 2. <i>Rhigozum trichotomum</i> | |

River dunes: *Acacia uncinata*, which is common in zone I, is confined to the river dunes in II and absent from the rest of the Park.

Dense stands of shrubs and trees are found locally in this area and make it a favourite haunt for certain of the larger antelopes and lions, especially females with cubs. The following woody plants are common:

- | | |
|-------------------------------|-------------------------------------|
| 1. <i>Acacia detinens</i> | 5. <i>Boscia albitrunca</i> |
| 2. <i>Grewia flava</i> | 6. <i>Acacia uncinata</i> (I, II) |
| 3. <i>Acacia giraffae</i> | 7. <i>Grewia retinervis</i> (I, II) |
| 4. <i>Acacia haematoxylon</i> | |

The soil in the river dune regions is richer in lime than elsewhere in the sandveld. The best indication for this is the presence of *Aristida obtusa* in the strata. This grass and *Monechma hereroense* are invariably found on soil rich in calcareous material.

For the first eight to nine miles along the track from Mata-Mata to Union's End the vegetation is dominated in many parts by *Rhigozum trichotomum*. This was taken as an indication of the presence of lime in the soil. Mr. C. le Riche confirmed this by stating that in most of this area the layer of sand over the underlying calcrete formation was not much more than five feet thick.

Pans: The importance of pans in the Park, which is mainly covered by sandveld, can hardly be overestimated. Firstly the vegetation on the pans and in their vicinity differs widely from that of the sandveld and is probably rich in minerals which the sandveld lacks. Secondly every pan has its koppe, complexes of loose dunes on the southern or south-eastern side which invariably support a greater variety of species than ordinary dunes. Thirdly many pans provide natural licks. In the Sewe Panne area, where during most of the year no surface water is found, game is usually plentiful and all tracks lead to the pans.

On small pan-like depressions the following plants were noticed:

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|--|--|
| 1. <i>Schmidtia kalahariensis</i> | 6. <i>Monechma incanum</i> |
| 2. <i>Tribulus</i> spp. | 7. <i>Dicoma capensis</i> |
| 3. <i>Chrysocoma tenuifolia</i> sens. lat. | 8. <i>Triraphis fleckii</i> |
| 4. <i>Geigeria africana</i> | 9. <i>Acrotome inflata</i> |
| 5. <i>Rhigozum trichotomum</i> | 10. <i>Asparagus bechuanensis</i> (I, II, ?) |

The large pans in this zone support only little perennial vegetation on the pan surface itself. In the marginal zones the following plants (annuals and perennials) were recorded:

- | | |
|---------------------------------------|---|
| 1. <i>Eragrostis truncata</i> (I, II) | 11. <i>Geigeria africana</i> |
| 2. <i>Sporobolus rangei</i> | 12. <i>Monechma incanum</i> |
| 3. <i>Aristida obtusa</i> | 13. <i>Aristida ciliata</i> |
| 4. <i>Schmidtia kalahariensis</i> | 14. <i>Plinthus sericeus</i> |
| 5. <i>Rhigozum trichotomum</i> | 15. <i>Aptosimum albomarginatum</i> |
| 6. <i>Enneapogon brachystachyus</i> | 16. <i>Barleria rigida</i> |
| 7. <i>Salsola rabieana</i> (I, II) | 17. <i>Tragus racemosus</i> |
| 8. <i>Eragrostis annularis</i> | 18. <i>Trianthema</i> sp. cf. <i>T. crystallina</i> |
| 9. <i>Osteospermum muricatum</i> | 19. <i>Sporobolus discosporus</i> |
| 10. <i>Heliotropium lineare</i> | 20. <i>Lycium austrinum</i> |

ZONE III

The northern boundary of this zone coincides with the southern distributional limits of perennials like *Terminalia sericea* and *Rhus commiphoroides*. In the south the line along which the irregular and the regular (NW—SE trending) dunes meet was chosen as border. It is noteworthy that this line agrees very well with the 3000' contour. In the south-west the Auob River separates this zone from the adjoining V.

RIVER BANKS OF NOSSOB. As the bed of the Nossob descends slowly towards sea level it cuts into the "continuous sheet of calcareous rock which seemingly underlies the sandveld over nearly all the southern Kalahari" (du Toit, 1954). This becomes apparent for the first time in the K.G.N.P. in this zone. Small outcrops of calcrete can be seen along the river, the bed of the Nossob becomes narrower and the banks steeper. Floristic elements of an Arid Karoo type (Acocks, 1953), which generally prefer hard, calcareous soils, become more important. Much less area is covered by dense stands of *Aristida obtusa*.

The transitional zone between the veld next to the river and the sandveld is on the whole narrower than in II but the vegetation found on it is very similar. The following plants are typical:

- | | |
|-----------------------------------|-------------------------------|
| 1. <i>Schmidtia kalahariensis</i> | 4. <i>Monechma incanum</i> |
| 2. <i>Rhigozum trichotomum</i> | 5. <i>Plinthus sericeus</i> |
| 3. <i>Aristida obtusa</i> | 6. <i>Monechma hereroense</i> |

Acacia hebeclada var. *stolonifera* which was not noticed on the river banks in zone II, is not uncommon here.

RIVER-BED OF NOSSOB. The river-bed in this zone differs only slightly from that in II. Certain perennials, however, which were first noticed in the

Kwangpan area, become a common sight. They grow mainly in a narrow strip in the lowest part of the bed. Examples of these are *Galenia africana* and *Asclepias fruticosa*. *Blumea gariepina* and *Pentzia incana* forma were not noticed north of this zone.

SANDVELD. This area is only poorly known. Like the sandveld of zone II it consists of irregular dunes and flats. The flats are, however, not as common, and smaller in extent. The dunes are on the whole higher and less densely covered by perennial vegetation. The best way of showing up differences between the sandveld of zones II and III may be by enumerating a number of plants that are fairly common in II but apparently absent from III.

- | | |
|---------------------------------------|------------------------------|
| 1. <i>Elephantorrhiza elephantina</i> | 4. <i>Terminalia sericea</i> |
| 2. <i>Aristida graciliflora</i> | 5. <i>Ehretia rigida</i> |
| 3. <i>Rhus commiphoroides</i> | 6. <i>Grewia retinervis</i> |

Grewia flava seems to be confined to the northern part of this zone and the river dunes of the Nossob.

Numerous specimens of *Tetragonia arbuscula* were seen on the dune above the windmill at "Auob". This is only the second locality in which this shrub has been noticed in the Park, the first being on the western border of zone II. It was surprising to see that none of the specimens had been touched by game, especially as the area around the "Auob" windmill is possibly subjected to heavier grazing pressure than any other in the K.G.N.P. *Tetragonia arbuscula* "is generally regarded as a most excellent pasture plant" and "compares very favourably in nutritive value with lucerne" (Botha, 1939).

No pans of any importance seem to exist in this zone.

RIVER BANKS OF AUOB. For the greatest part the banks of the Auob consist of calcrete. Gentle slopes of calcareous sand covered by dense stands of *Aristida obtusa* are much less common and smaller in extent than along the Nossob. The calcrete outcrops are heavily grazed in most parts and it is difficult to form an idea of what their vegetation should be. Plants commonly found here are:

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|-------------------------------------|-----------------------------------|
| 1. <i>Enneapogon brachystachyus</i> | 9. <i>Tribulus</i> spp. |
| 2. <i>Schmidtia kalahariensis</i> | 10. <i>Aristida obtusa</i> |
| 3. <i>Eragrostis porosa</i> | 11. <i>Geigeria africana</i> |
| 4. <i>Fingerhuthia africana</i> | 12. <i>Eragrostis annulata</i> |
| 5. <i>Barleria rigida</i> | 13. <i>Limeum</i> sp. |
| 6. <i>Aptosimum albomarginatum</i> | 14. <i>Heliotropium lineare</i> |
| 7. <i>Monechma hereroense</i> | 15. <i>Aptosimum marlothii</i> |
| 8. <i>Tragus racemosus</i> | 16. <i>Aptosimum leucorrhizum</i> |

The general scarcity of succulents in the K.G.N.P. has been commented on by previous observers (Story, unpubl.; Brynard, 1958). There seem to be several reasons for this. Very few succulents grow on deep sandy soils devoid of stones or rocks as their root-systems are generally rather superficial and the top layers of well drained sandy soils, especially in semi-arid regions, are practically always dry. In the K.G.N.P. rocky habitats are mainly found near the rivers and cover probably less than 2% of the total area of the Park. Furthermore the river banks are heavily grazed, especially by springbok which are very fond of succulents. It is thus quite possible that succulent plants occur in the Park which have not yet been recognised or spotted.

RIVER-BED OF AUOB. This area supports only a small number of perennial species. The commoner ones are:

- | | |
|--------------------------------------|---|
| 1. <i>Panicum coloratum</i> | 8. <i>Lycium hirsutum</i> . |
| 2. <i>Psoralea obtusifolia</i> | 9. <i>Acacia giraffae</i> |
| 3. <i>Stachys spathulata</i> | 10. <i>Kohautia</i> sp. prob. <i>K. cynanchica</i> |
| 4. <i>Radyera urens</i> | 11. <i>Lycium austrinum</i> |
| 5. <i>Osteospermum muricatum</i> | 12. <i>Heliotropium lineare</i> |
| 6. <i>Eragrostis lehmanniana</i> | 13. <i>Acacia hebeclada</i> var. <i>stolonifera</i> |
| 7. <i>Acacia haematoxylon</i> (tree) | 14. <i>Cucumis hookeri</i> |

Some perennials that are common or occasional in the Nossob but that were only rarely or never seen in the Auob are:

- | | |
|---------------------------------|-------------------------------|
| 1. <i>Cenchrus ciliaris</i> | 6. <i>Galenia africana</i> |
| 2. <i>Aristida congesta</i> | 7. <i>Asclepias fruticosa</i> |
| 3. <i>Dichantium papillosum</i> | 8. <i>Grewia flava</i> |
| 4. <i>Diplachne fusca</i> | 9. <i>Ehretia rigida</i> |
| 5. <i>Plinthus sericeus</i> | 10. <i>Blumea gariepina</i> |

A number of small, circular thickets are found here. They consist of *Acacia hebeclada* var. *stolonifera*, *Lycium hirsutum*; *Asparagus* sp. cf. *A. plumosus* and sometimes also *Acacia giraffae*.

Little is known about the annuals in this area for it has not been seen in a good season. The following species were listed:

- | | |
|-----------------------------------|------------------------------------|
| 1. <i>Chloris virgata</i> | 8. <i>Setaria verticillata</i> |
| 2. <i>Schmidtia kalahariensis</i> | 9. <i>Eragrostis annulata</i> |
| 3. <i>Geigeria pectidea</i> | 10. <i>Amaranthus thunbergii</i> |
| 4. <i>Tribulus</i> spp. | 11. <i>Lotononis schwanssiana</i> |
| 5. <i>Eragrostis porosa</i> | 12. <i>Argemone mexicana</i> |
| 6. <i>Tragus racemosus</i> | 13. <i>Portulaca oleracea</i> |
| 7. <i>Geigeria africana</i> | 14. <i>Dimorphotheca polyptera</i> |

ZONE IV

This zone is characterised by its regular dunes trending north-west to south-east. There are certain indications that these very regular dunes are confined to sandveld areas in which the sand is relatively shallow and the mean annual rainfall below 250 mm.

RIVER BANKS OF NOSSOB. The Nossob in this zone has the aspect that one has come to associate with the Auob: A relatively narrow river bed and rather steep banks consisting mainly of calcrete. The vegetation is very similar to that on the banks of the Auob but may be of an even more karroid nature. The following perennials recorded from this area were very rarely or never seen along the Auob:

- | | |
|---|----------------------------------|
| 1. <i>Pteronia mucronata</i> | 3. <i>Eriocephalus pubescens</i> |
| 2. <i>Sporobolus ioclados</i> var.
<i>usitatus</i> | 4. <i>Zygophyllum</i> sp. |
| | 5. <i>Salsola</i> sp. |

RIVER-BED OF NOSSOB. The boundary of this zone is well marked in the river-bed by the appearance of the first specimens of *Acacia haematoxylon*. Certain perennials, most of which are rather rare further north, are very common in parts:

- | | |
|--------------------------------|-----------------------------|
| 1. <i>Cenchrus ciliaris</i> | 4. <i>Plinthus sericeus</i> |
| 2. <i>Pentzia incana</i> forma | 5. <i>Blumea gariepina</i> |
| 3. <i>Galenia africana</i> | |

As in the Auob (Story, unpubl.), trees are confined to the margins of the river bed. Woody plants are well represented not only by *Acacia haematoxylon* but also by *Acacia giraffae* and occasional specimens of:

- | | |
|---------------------------|----------------------------|
| 1. <i>Lycium hirsutum</i> | 3. <i>Ehretia rigida</i> |
| 2. <i>Grewia flava</i> | 4. <i>Lycium austrinum</i> |

In the southern half almost treeless stretches are found, extending sometimes for a mile or more. These can probably be partly ascribed to chopping-out. It is suggested, however, that conditions for the development of trees are less favourable than they are further north. In the nearly treeless areas of this zone woody plants seem to grow best on bends in the river where the water-content of the soil is said to be higher than on the straights. Furthermore it is not only trees that are rarer but also other woody perennials, such as the four species mentioned above, that would hardly be used for firewood.

Parts of the river-beds in the vicinity of the confluence of the Nossob and Auob are dominated by two perennials with a rather peculiar distribution in the K.G.N.P. One of these is *Pituranthos aphyllus* which is abundant along a three mile stretch. This shrub was noted nowhere else in the Park. The area covered by a dense stand of *Lebeckia linearifolia* extends northwards

from Twee Rivieren for about four miles in the Nossob and for about eight miles in the Auob. The only other locality in which this shrub was seen is at Klein Skrij Pan. Here it grows on the kop of the pan which is relatively rich in lime.

Another interesting feature of the distribution of the two perennials mentioned is that their areas do not overlap although they border on each other about four miles north of Twee Rivieren.

A single specimen of *Parkinsonia africana* is known in the Park. It grows in the river bed at Twee Rivieren.

SANDVELD. This area has not been investigated. Judging by what has been seen on an aerial photo covering part of this region and in neighbouring zones, the following conditions would be expected: The vegetation is relatively dense and rather uniform. Trees are rare but stunted specimens of *Boscia albitrunca* and especially *Acacia haematoxylon* are common. *Grewia flava* is probably absent from the greatest part of the sandveld. Like *Aristida meridionalis* and *Acacia detinens* it is mainly found on the river dunes.

Fewer ephemerals would be expected in this zone than e.g. in VI.

No pans are found in zone IV.

RIVER BANKS OF AUOB. Although the banks in this zone are on the whole steeper than in III, it is doubtful whether there is much difference in the vegetation.

RIVER-BED of AUOB. The river-bed in this zone supports even fewer perennials than in III. The more important of these are:

- | | |
|---|--|
| 1. <i>Panicum coloratum</i> | 7. <i>Heliotropium lineare</i> |
| 2. <i>Psoralea obtusifolia</i> | 8. <i>Acacia haematoxylon</i> (tree) |
| 3. <i>Stachys spathulata</i> | 9. <i>Acacia giraffae</i> |
| 4. <i>Eragrostis lehmanniana</i> | 10. <i>Acacia hebeclada</i> var.
<i>stolonifera</i> |
| 5. <i>Osteospermum muricatum</i> | 11. <i>Cucumis</i> sp. prob. <i>C. hookeri</i> |
| 6. <i>Kohautia</i> sp. prob. <i>K. cynanchica</i> | |

After good rains a dense stand of annuals should appear. They would probably be more or less the same as those listed for zone III.

ZONE V.

This is the most artificial of the six zones into which the Park has been divided. It is merely transitional between zones III and IV on the one hand and VI on the other. Most of the differences between V and its neighbouring zones can probably be ascribed to the presence of the Auob. The river-beds have apparently not only an influence on the composition of the soil but

also on the climate (wind, rainfall and temperature). The boundary between zones V and VI coincides more or less with the distributional limits of *Aristida meridionalis* in the south-west of the K.G.N.P. Three different types of dunes can be distinguished in this zone: River dunes in a strip about two to four miles wide along the Auob, irregular dunes north of an imaginary line joining Kamkwa and Kafirs Pan and regular dunes in the south.

Trees, most of which are *Acacia haematoxylon* and *Boscia albitrunca*, are present throughout the area. They are, however, rare and confined to the tops or slopes of dunes. *Acacia giraffae* is very rare. On dune-crests *Boscia albitrunca* often develops into a low, hemispherical shrub. This is probably caused by browsing as well as by the action of wind and sand.

The area is generally well covered by perennial grasses such as:

1. *Eragrostis lehmanniana* forma
2. *Aristida uniplumis*
3. *Aristida amabilis*
4. *Asthenatherum glaucum*
5. *Eragrostis atherstonei*

Aristida meridionalis and *Aristida ciliata* are rather rare except on the river dunes.

Other perennials that are common in this area are:

1. *Crotalaria spartioides*
2. *Hermannia tomentosa*
3. *Acacia detinens*
4. *Tephrosia sphaerosperma*
5. *Plinthus sericeus*
6. *Lessertia macrostachya* var. *atomaria*
7. *Hermannia* sp. prob. *H. grandiflora* var. *burchellii*

and mainly in valleys between dunes:

1. *Rhigozum trichotomum*
2. *Monechma incanum*
3. *Lycium hirsutum*

Little is known about the annuals in this zone. *Schmidtia kalahariensis* can be abundant in *strate* with pinkish sand and *Brachiaria glomerata* is common on dunes.

No pans occur and perennials like *Monechma hereroense* and *Aristida obtusa* are thus probably confined to the river banks.

ZONE VI

This zone is characterised by a scarcity of perennial plants. Not counting annuals, many areas probably have a basal cover of less than one per cent. Except for the northern tip of this zone and the vicinity of pans the dunes generally trend north-west to south-east.

The crests of most dunes are relatively bare. So-called *driedoringstrate* are often found between regular dunes. On many of these *strate*, *Rhigozum*

trichotomum (commonly called *driedoring*) is the only perennial of any importance, most of the rest of the surface being at the disposal of ephemerals.

On the whole, trees are rare and become probably extremely rare towards the south-west. *Acacia haematoxylon* sometimes grows into a tree, especially on top of dunes. It is, however, much more commonly found as a shrub growing in the *strate*. *Boscia albitrunca* occurs as a tree as well as a shrub. *Acacia giraffae* is very rare.

The following perennial grasses were recorded but they are rarely common where found:

1. *Eragrostis lehmanniana* forma
2. *Aristida amabilis*
3. *Asthenatherum glaucum*

Aristida uniplumis is rare and there are indications that it is practically absent in the south-west. *Aristida obtusa* and *A. ciliata* are locally common and will be mentioned later.

Other perennials that are widely distributed but rarely common are:

1. *Crotalaria spartioides*
2. *Plinthus sericeus*
3. *Tephrosia sphaerosperma*
4. *Hermannia tomentosa*
5. *Colocynthis naudiniana*
6. *Monechma incanum*
7. *Acacia detinens*
8. *Lycium austrinum*
9. *Lycium hirsutum*
10. *Hermbstaedtia odorata*
11. *Pollichia campestris*
12. *Hermannia* sp. prob. *H. grandiflora* var. *burchellii*

The following perennials were noticed only in this zone where they are rare to very rare:—

1. *Plinthus laxifolius*
2. *Kohautia ramosissima*
3. *Crotalaria* sp. cf. *C. leubnitziana*
4. *Melolobium macrocalyx* var. *longifolium*

Sandveld ephemerals: At almost any time of the year the vegetation of the Kalahari will show some reaction to rain, especially if two showers of 12 mm or more should follow each other within two to three weeks. The main change in aspect will be brought about by innumerable ephemerals germinating and coming into flower within two to three weeks. Generally speaking two groups of ephemeral plants can be distinguished: Summer ephemerals, the seeds of which germinate mainly in summer, and winter ephemerals that develop mainly in winter. Even if moisture conditions should be ideal, seeds of many annuals will not germinate unless they are exposed to

a certain, rather critical temperature (Shreve, 1951). The following annuals were observed in a fresh state at the end of June after a light shower in May:

- | | |
|---|-----------------------------|
| 1. <i>Helichrysum argyrosphaerum</i> | 5. <i>Lotononis</i> sp. |
| 2. <i>Indigofera</i> sp. prob.
<i>I. alternans</i> | 6. <i>Senecio arenarius</i> |
| 3. <i>Hermannia</i> sp. prob. <i>H. modesta</i> | 7. <i>Geigeria africana</i> |
| 4. <i>Dimorphotheca polyptera</i> | 8. <i>Tribulus</i> sp. |
| | 9. <i>Chascanum pumilum</i> |

Needless to say, this list gives only a slight indication of what could be found after good rains. From the collections made by other botanists, it appears that many species that were regarded as summer ephemerals can also be found in winter. These have not been included in the above list. Furthermore there is a number of species the seeds of which will germinate at practically any time of the year provided they have sufficient moisture.

Annuals recorded from the sandveld in summer include the following:

- | | |
|-----------------------------------|------------------------------------|
| 1. <i>Schmidtia kalahariensis</i> | 7. <i>Semonvillea fenestrata</i> |
| 2. <i>Limeum arenicolum</i> | 8. <i>Gisekia miltus</i> |
| 3. <i>Tribulus</i> spp. | 9. <i>Gynandropsis pentaphylla</i> |
| 4. <i>Brachiaria glomerata</i> | 10. <i>Cassia obovata</i> |
| 5. <i>Oxygonum alatum</i> | 11. <i>Aptosimum depressum</i> |
| 6. <i>Sesamum schenkii</i> | 12. <i>Nolletia arenosa</i> |

There are indications that the ephemeral sandveld species are very much the same in all zones.

Pans. A great number of pans are found in this zone. The pans themselves support hardly any perennial vegetation and it is doubtful whether many annuals would be able to develop on them. The areas around the pans, however, are covered by a vegetation that differs distinctly from that of the sandveld:

- | | |
|-------------------------------------|--|
| 1. <i>Sporobolus rangei</i> | 9. <i>Geigeria africana</i> |
| 2. <i>Enneapogon brachystachyus</i> | 10. <i>Monechma hereroense</i> |
| 3. <i>Schmidtia kalahariensis</i> | 11. <i>Tribulus</i> sp. |
| 4. <i>Triraphis fleckii</i> | 12. <i>Oligomeris capensis</i> |
| 5. <i>Aristida obtusa</i> | 13. <i>Aptosimum albomarginatum</i> |
| 6. <i>Rhigozum trichotomum</i> | 14. <i>Crassula natans</i> |
| 7. <i>Monechma incanum</i> | 15. <i>Asparagus</i> sp. prob.
<i>A. suaveolens</i> |
| 8. <i>Aristida ciliata</i> | |

FOOD PLANTS IN THE K.G.N.P.

The plants mentioned in the following list are widely distributed and occur in all zones. There was evidence that all of them are eaten by antelopes. The visual observations were made by Prof. F. C. Eloff.

Acacia detinens (Swarthaak, Gnoibos):

Leaves of this shrub were found in the droppings of eland collected in the Park and in the stomach of a springbok shot in the Kimberley area. According to the Game Warden, flowers and pods are eaten by most antelopes and springbok are often seen browsing the leaves.

Acacia giraffae (Kameeldoring):

Seeds of this tree or of *Acacia haematoxylon*, but probably of both, (they are difficult to distinguish), were found in droppings of eland and gemsbok. The pods of these two *Acacia* species are very palatable.

Acacia haematoxylon (Vaalkameel):

Leaves were found in the stomach of a gemsbok and in eland droppings. The pods have been referred to above.

It is the commonest woody plant in all zones.

Aristida amabilis (Steekriet):

This grass was seen to be eaten by a gemsbok.

Aristida obtusa (Kortbeenboesmangras):

Springbok and red hartebeest were observed feeding on this grass. Leaves of *A. obtusa* constituted more than 50% of the stomach contents of a gemsbok examined in winter.

It is the commonest and most valuable perennial grass found on calcareous soils, especially on the Nossob river banks in zone II and the northern parts of III.

Asthenatherum glaucum (Ghagras):

Well grazed specimens of this grass were often seen. Remains, probably referable to it, were noticed in eland droppings and in the stomach of a gemsbok.

Boscia albitrunca (Witgat):

Leaves were observed in the droppings of eland and in the stomachs of springbok (Kimberley area) and gemsbok.

This tree or shrub is green at all seasons and specimens that have not been browsed are rare. The flowers, which appear in October, are said to be much favoured by antelopes.

Colocynthis citrullus (Tsamma):

The Park was visited during what was called "a bad tsamma-year". Not a single plant or fruit was seen. Nevertheless seeds were found in fairly fresh eland droppings collected in June at Kamkwa and Rooikop.

Tsamma is said to occur in all parts of the sandveld.

Cucumis hookeri (Wilde komkommer):

Seeds were found repeatedly in eland droppings in different areas of the Park. The only specimen with ripe fruit was found in a thicket under a camelthorn.

Limeum areniculum:

This common summer annual was twice seen to be grazed by springbok.

Oxygonum alatum (Suring):

Parts of this plant were found in the stomach contents of a gemsbok. It is one of the most sought-after summer annuals in the Park.

Plinthus sericeus (Sandganna):

A springbok was seen feeding on this shrub. It is widely distributed on both sand and calcareous soils.

Rhigozum trichotomum (Driedoring):

It was observed that this shrub, one of the commonest in the Park, was browsed by springbok.

Schmidtia kalahariensis (Suurgras):

Dry specimens were seen to be grazed by springbok and gemsbok. Numerous spikelets occurred in eland droppings from different areas of the Park. This grass is said to be well grazed when young and again after it has dried up and fallen over, when it is commonly known as "bloudak" owing to its purplish colour.

It is the commonest annual grass in the K.G.N.P.

Tephrosia sphaerosperma:

Leaves were found in the stomach of a gemsbok in summer.

Tribulus spp. (Dubbeltjies):

Two or probably three species of this genus occur in the Park. They are treated as one since they are very similar and difficult to distinguish unless complete specimens are available. Springbok were seen feeding on the plant and leaves were present in the stomach of a gemsbok. Parts of the

fruit of a *Tribulus* species (probably *T. cristatus*) were repeatedly found in eland droppings in summer.

The food plants listed below are confined to limited areas in the Park. Their presence or absence may thus help to explain certain distributional patterns of game. For two of the species no direct evidence of their being eaten was found.

Catophractes alexandri (Gabbabos):

This shrub is confined to zone I. According to the Game Warden young shoots, flowers and fruit are eaten by antelopes.

Elephantorrhiza elephantina (Bas, Elandsboontjie):

The roots of this perennial are usually swollen and juicy. They are said to be dug up by gemsbok and eland. *E. elephantina* was only noticed in the sandveld of zones I and II.

Grewia flava (Rosyntjiebos):

According to Boss (1934) this is the most valuable fodder bush of the eastern parts of South West Africa. Even in very dry seasons it usually retains some of its leaves; these were found in the stomach of a springbok shot in the Kimberley area in winter.

Except for rare specimens in the Auob and the southern Nossob *G. flava* is practically confined to zones I and II and the river dunes of III.

Pentzia incana forma:

Numerous branches of this shrub occurred in the stomachs of springbok from the Kimberley area. In the K.G.N.P. it is more or less confined to the river areas of the Nossob in zones III and IV.

Psoralea obtusifolia (Rivierklawer):

This prostrate perennial was seen to be eaten by springbok. It is confined to the river-beds where it is rather common.

Salsola rabieana (Rivierganna):

Branches of the closely related *Salsola glabrescens* were found in the stomach of a springbok from the Kimberley area. It is very likely that *S. rabieana* is greatly favoured by springbok as well as red hartebeest in the Park.

S. rabieana is confined to the vicinity of rivers and pans in zones I and II.

Needless to say, not all the important food plants found in the K.G.N.P. have been named above. On the other hand, not all plants seen to be eaten have been mentioned as they are not regarded as being of general importance.

THE INFLUENCE OF VEGETATION ON GAME DISTRIBUTION

Blue wildebeest:

These antelopes were seen most frequently in zones II and III and the northern parts of V. In no case were they far from water. No direct observations on the feeding habits were made.

For the last few years a herd of blue wildebeest has stayed permanently in the vicinity of the "Auob" windmill. It can be assumed that such a limited area offers only very little green feed during dry seasons, especially as this antelope is said to browse but little. This may indicate that blue wildebeest can exist for limited periods on dry veld provided they have daily access to water.

Eland:

Most eland were encountered in zone II, the river dunes along the Nossob in III and in zone VI. Judging by spoor and droppings, their favourite abode seems to be the Rookop area where dense stands of shrubs and trees occur. Around the Rookop windmill numerous seedlings of *Acacia giraffae*, obviously developed from seed in eland droppings, were noticed.

Parts of the following plants occurred in droppings collected in June:

- | | |
|---|---|
| 1. <i>Acacia giraffae</i> | 6. <i>Eriocephalus pubescens</i> (leaves) |
| 2. <i>Acacia haematoxylon</i> (leaves) | 7. <i>Schmidtia kalahariensis</i> (spikelets) |
| 3. <i>Boscia albitrunca</i> (leaves) | 8. <i>Solanum</i> sp. (seeds) |
| 4. <i>Colocynthis citrullus</i> (seeds) | 9. <i>Tribulus</i> sp. (fruits) |
| 5. <i>Cucumis hookeri</i> (seeds) | |

Numerous fruits of a species of Composite and seeds resembling those of *Ficoideae* could not be identified with certainty. From these findings it would appear that the eland is essentially a browser in the dry season.

Although there is evidence that they often resort to water in the K.G.N.P., it is doubtful whether they drink regularly. The impression was gained that eland much prefer taking in the moisture they require in form of fruit and other juicy plant material. This may be one reason why they are rather migratory and one of the first species to leave the Park in search of greener veld.

Gemsbok:

This antelope seems to frequent mainly the sandveld and to feed principally on grasses during the summer. The stomach of a specimen shot in December contained about 98% grass. They have also been seen grazing the vegetation typical of calcareous soils. This they probably do mainly in winter when the sandveld is dry. Approximately 60% of a stomach sample taken in winter consisted of *Aristida obtusa* leaves.

Gemsbok were seen in all zones of the Park, often in the vicinity of pans

or drinking places. Especially in summer they were frequently seen at „brak” licks. If there were one zone in the Park that could be called a special favourite with this animal, it would be zone VI. Reasons for this may be the following:

- (1) Variety of grazing: Sandveld and veld on calcareous soils around pans;
- (2) “Brak” licks on pans;
- (3) high dunes with little vegetation on the crests offering a good view;
- (4) the particular abundance of ephemerals after rains;
- (5) occasional dense trees giving shade.

Kudu:

This animal is mainly a browser and prefers woods and thickets to open plains. There are thus few areas in the K.G.N.P. that suit it. These are confined to the river dunes in zone II and the northern parts of III. (Note the area “Koodoo Bush”). Dense stands of trees and shrubs have been seen in zone I and are said to be widespread. It is therefore understandable that kudu do not appear to be permanent residents in the Park.

Red hartebeest:

This antelope was seen mainly in the vicinity of the Nossob in zone II. In summer numerous animals were observed in the river-bed, apparently grazing annuals. In June the greatest number of hartebeest was encountered in the area of the “Pollentswarivier”.

The commonest plants found there were the following:

- | | |
|-------------------------------------|------------------------------------|
| 1. <i>Eragrostis truncata</i> | 5. <i>Salsola rabieana</i> |
| 2. <i>Aristida obtusa</i> | 6. <i>Rhigozum trichotomum</i> |
| 3. <i>Schmidtia kalahariensis</i> | 7. <i>Eragrostis echinocloidea</i> |
| 4. <i>Enneapogon brachystachyus</i> | 8. <i>Plinthus sericeus</i> |

Of these, *Salsola rabieana* and *Eragrostis truncata* are confined to zones I and II while *Aristida obtusa* has its widest distribution in the latter.

From this it appears that hartebeest favour the short vegetation found on light calcareous sand. The fact that the greatest expanse of this veld is found in zone II may be one reason why the animals show preference for this area.

On and around a pan in zone I, the vegetation of which has been listed earlier, numerous spoors of hartebeest were seen. According to the Game Warden a number of similar pans exist in zones I and II of the Bechuanaland Reserve.

Springbok:

These animals are well known to prefer the short vegetation as it is usually found on calcareous soils. In the K.G.N.P. they were either seen in river-beds, on river banks or in sandveld rich in ephemerals shortly after

rains. In winter the best "springbokveld" is apparently found along the Nossob in zone IV, where the vegetation is of a typically karroid nature. Furthermore, only few other antelopes seem to graze here during winter.

Among the plants springbok were seen to feed on, are the following:

- | | |
|--------------------------------|-----------------------------------|
| 1. <i>Aristida obtusa</i> | 4. <i>Rhigozum trichotomum</i> |
| 2. <i>Plinthus sericeus</i> | 5. <i>Schmidtia kalahariensis</i> |
| 3. <i>Psoralea obtusifolia</i> | 6. <i>Tribulus</i> sp. |

The stomach contents of several springbok shot in the Kimberley area in July were examined and parts of the following plants, also found in the K.G.N.P., identified:

- | | |
|--|-----------------------------------|
| 1. <i>Acacia detinens</i> | 5. <i>Ehretia rigida</i> |
| 2. <i>Asparagus</i> sp. prob. <i>A. suaveolens</i> | 6. <i>Eragrostis lehmanniana</i> |
| 3. <i>Boscia albitrunca</i> | 7. <i>Pentzia incana</i> forma |
| 4. <i>Chenopodium album</i> | 8. (<i>Salsola glabrescens</i>) |

The species of *Salsola* mentioned above does not occur in the Park but is represented there by the closely related *Salsola rabieana*. In two of the stomach contents examined, no remnants of grass were found. Springbok are known to be extremely fond of succulents, especially in the dry season. Three of the animals shot in the Kimberley area had consumed appreciable amounts of a *Kalanchoe* sp. as well as some leaves of a *Ruschia* sp., both of which were locally rare.

According to the Game Warden and other observers, the present springbok population in the K.G.N.P. is much smaller than it was a few years ago. Seeing that the "springbokveld" in this area is not only rather limited in extent but also heavily grazed and at the moment in a very poor condition, it seems unlikely that the Park could, in its present state, support many more springbok.

It is not surprising, therefore, that these animals will trek as soon as they perceive any improvement of the veld outside the Park, especially as they are more or less independent of surface water. In most cases they seem to move eastwards into the area between the Molopo and the Kuruman River. Reasons for this may be the following: As one proceeds from the Park in the direction of Vryburg the mean annual rainfall increases rapidly and appreciably. Indications of this fact were seen in the vegetation and are confirmed by reports from the Meteorological Office. Furthermore, the banks of the Molopo River support a rich karroid flora that was found to be in quite a good condition during August, 1958.

Steenbok:

These antelopes appear to be common in the sandveld of all zones. They have never been seen near water and only rarely in areas with calcareous soils. Steenbok can probably exist without open water and the sandveld seems to offer satisfactory grazing to them during all seasons.

GENERAL REMARKS AND RECOMMENDATIONS

1. The Bechuanaland Game Reserve, especially zones I and II, is of vital importance to the Park.

2. The value of zone VI has been stressed repeatedly. It would be a great gain if the area of the K.G.N.P. could be increased in this zone.

3. It is regarded as inadvisable at present to erect windmills in the Nossob between Rooikop and Grootkolk, especially in the area of Koodoo Bush and "Pollentswarivier". This region is well grazed during all seasons. If water were to be provided here, game from other parts of the Park would be attracted to this area with the result that the veld would be overgrazed. Red Hartebeest might then be even more inclined to move into Bechuanaland and over the border of South West Africa.

On the other hand much of the sandveld in the Park is undergrazed. If the windmills that are to be erected near the western border in zone II should prove to be popular with game, water should be provided between the Auob and Nossob in zones II, III and IV.

4. "Brak" licks seem to be important for the well-being of certain antelopes, especially for those that, like gemsbok, graze mainly in the sandveld. Red Hartebeest were also seen making use of natural licks while pieces of calcareous rock were found in the droppings of eland. Springbok, which feed mainly on vegetation growing on calcareous soils, seem to be least dependant on licks.

To ensure more even use of the grazing in the Park it is suggested that artificial licks should be provided at the windmill sites mentioned in paragraph 3.

5. Far too little is known about the climate of the K.G.N.P. It is suggested that raingauges be put up at Mata-Mata, Union's End, Rooikop, in the Kijki area and on a pan in zone VI. If it is at all practicable, automatic apparatus recording temperature and relative humidity should be installed at the same stations.

6. The vegetation on calcrete outcrops along the rivers is heavily grazed and often overgrazed. As it would be most interesting to study a spared sample of this veld, it is suggested that an area be fenced off in the vicinity

of Kijkij. If possible, this camp should include calcareous sand, hard calcrete and a small section of the river-bed.

7. The K.G.N.P. covers such a vast area that it is quite impracticable to visit every part of it. It would be a great help to have a complete set of aerial photos of the Park.

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REFERENCES

- Acocks, J. P. H. (1953): Veld types of South Africa. Mem. Bot. Surv. S. Afri. No. 28. Government Printer, Pretoria.
- Boss, G. (1934): *Aus dem Pflanzenleben Südwestafrika's*. John Meinert, Windhoek.
- Botha, J. P. (1939): The Digestibility and Nutritive Value of Karroo Pasture Plants. Fmg. in S. Afr., Feb. to Oct., 1938. Government Printer, Pretoria.
- Brynard, A. M. (1958): Verslag insake voorlopige ondersoek rakende toestande in die Nasionale Kalahari-gemsbokpark. Koedoe 1: 162-183.
- du Toit, A. L. (1954): *Geology of South Africa*. 3rd ed. Oliver and Boyd, Edinburgh.
- Louw, P. A. (Unpubl.): 'n Ontleding van grond-, water- en brakmonsters versamel in die Nasionale Kalahari-gemsbokpark. Report to the National Parks Board of Trustees, May, 1956, Pretoria.
- Shreve, P. (1951): *The Vegetation of the Sonoran Desert*. Carnegie Institution of Washington Publication, 591.
- Story, R. (Unpubl.): Botany Report to the National Parks Board of Trustees, May, 1956, Pretoria.