

THE MAIN VEGETATION TYPES OF
KAOKOLAND, NORTHERN DAMARALAND AND
A DESCRIPTION OF SOME TRANSECTS OF
OWAMBO, ETOSHA
AND
NORTH WESTERN SOUTH WEST
AFRICA

by
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June 1976

THE MAIN VEGETATION TYPES OF KAOKOLAND, NORTHERN DAMARALAND
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The general ecological conditions that influence the vegetation types of the study area have already been described in a previous report.

The main factor influencing vegetation here, is rainfall. Topography plays a very important parallel role related with an additional distribution of rainwater by the superficial drainage of hills and mountains to the neighbouring flats and slopes.

Concerning the soils, it appears that the physical structure is of more importance than the chemical composition, as this (the structure) determines the availability of water for root development.

In some specific instances the soil seems to have a marked effect on the vegetation such as the superficial calcareous layer in south-eastern Kaokoland.

The influence of the watersheds is also well marked in determining vegetation types, whether floristic or physiognomic. In addition both physiognomic features and floristic composition have been used to determine the boundaries of the various vegetation types as described.

Judicious use/.....

Judicious use was also made of "indicator" species, whether by its occurrence or by its absence.

The following have been used:

Baikaea plurijuga - Typical of red Kalahari sands in the median and higher rainfall areas (300 - 700 mm/2)

Spirostachys africana - Usually appears on the edge of pans (such as Owambo and Southern Angola) and along seasonal rocky or sandy dry water courses except in the desert country courses. Generally it represents the more mesophytic conditions of pre-desert conditions.

Terminalia sericea - The distribution of this species coincides with that of Baikaea and Spirostachys. Successionally it is more xerophytic than Spirostachys and also occurs on shallower sandy soils than Baikaea and in foamy soils with Spirostachys. It is usually absent from igneous soils and more common on calcareous soils with an abundance of water.

Burkea africana - The ecological value of B. africana is close allied to that of T. sericea, with some particulars:

In the Baikaea stand it used to appear at the lower step, side by side with T. sericea, along the dry sandy valleys. But at the light sandy deposits that occurs scattered on the basic grey soils of Owambo, it can occur at the top. So it does not occur on the pre-desert types. Otherwise Burkea can also thrive well on acid soils better than Terminalia, but that does not happen in this country.

Colophospermum mopane / Terminalia prunioides

The joint occurrence of C. mopane and T. prunioides, as is usual throughout the study area, demarcates the broad eco-

tone between/.....

tone between the mesophytic flora of the east and xerophytic conditions of the pre-Namib and Namib Desert. Furthermore, T. prunioides seems to be in a successional higher sere than C. mopane and the latter being more susceptible to frost than the former; however the absence of C. mopane in the western inhabited valleys and flats could very well be attributed to human influence. In these areas C. mopane is being gradually replaced by Acacia species, mainly, A. tortilis ssp. heteracantha.

Commiphora spp. - The various species of Commiphora are very good "indicator" species. At least four species, i.e., C. wildii, C. oblanceolata, C. giesii and C. virgata does not seem to occur in areas with a higher rainfall than 150mm p/a. C. mollis and C. angolensis on the other hand prefer rainfall conditions above that of 150 - 200 mm/a. This also seems to be the case with C. pyracanthoides and C. glauscescens.

Other existing species, i.e. C. crenato-servata and C. multijuga occur between that two groups co-existing with both at the ecotones.

C. annacardifolia have a special aptitude for desert rocky outcrops, and to some extent the same can occur with C. multijuga and even with C. glauscescens. At the southwestern part of the study area also C. saxicola and C. krauseliana use to occur.

Euphorbia-gregaria - This species distribution closely follows that of Commiphora wildii, C. giesii, C. virgata and C. oblanceolata, C. saxicola and C. krauseliana.

Adenolobus garimpensis - This is a very important ecological specie for defining the eastern boundaries of the desert steppe. It does not occur far inland, probably not more than the isohyet of 100 - 150 mm/a. It can occur on sandy flats, but it is far more usual on the gravelly or rocky hills and water courses.

Gossypium/.....

Gossyium anomallum - This specie has more or less the same ecological signifigance than A. Garimpoensis, although it tends to be more northern and western in distribution.

Under specific circumstances Bridelia macrantha, Pterocarpus antun&isii, Adansonia digitata (if attention is paid to anthropogenic distribution) Cathophractes alexandrii, Hyphaene ventricosa, Selerocarya birrea, Sterculea africana and Kinkia acuminata, are also very good indicator species.

Kinkia, does occur for almost all interland outcrops and some gravelly or stony soils, and also scattered into the pre-desert country, but usually not more westernly than the isoyet of the 150 mm/a and here only on the rocky outcrops.

Combretum apiculatum - This is not a good indicator species, as it has a very wide distribution. It does not, however, occur further west than the 150 mm/a isoyet.

The physiognomic classification is based largely on the height and basal distribution of the vegetation as well as the presence or absence of perennial and annual grass species. The perennial grasses Cenchrus ciliaris and Stipagrostis uniplumis for instances, are more mesophytic in its distribution.

~~As~~ Aristida stipitata is a definite indicator of Kalahari sandy soils and does occur as dominant in the sandy hills reported to No. 6 and 7 types, and is very abundant in No. 2 and some others close types (no. 1 - 3).

Digitaria polleevansii have a similar value, but it seems that prefer somewhat deeper sands.

Panicum sp. (of P. coloratum) sometimes follows the last species.

Grasses with a similar ecological preference are: Andropogon gayanus, var. squamulatus, a tropical species as well as Heteropogon melanocarpus, and do occur at the ecotone of type no. 2 and in no. 2. 3 and 4 types.

Rottboelia/.....

Rottboelia exaltata very scarcely follow the last one species.

Heteropogon contortus, although general having a wide distribution, and being closely related to stock distribution, does occur here only at some protected places, and on rocky outcrops in types no. 8, 9, 12 and 13, together with Triraphis remosissima and sometimes also with Eragrostis superba.

To the easternly types it only does occur at the ecotone of the sandy soils.

Cenchrus ciliaris and Eragrostis echinochloidea have a very wide distribution in all types except only for the no, 15, 16 and 17.

Kaokochloa nigrirostris and Entoplocamia aristulata are very typical for the types no. 12, 13, 14 and 15 where sometimes they can occur in pure stands. Meanwhile it seems that Entoplocamia can appear far inland than Kaokochloa do.

Jaequesfelia dinteri is very typical to the rocky hills of vegetation types no. 12, 13 and 14, usually where it does occur also Sterculia africana and Commiphora anacardifolia, Enneapogon spp., as well as others, Aristida and Rhynchelytrum spp., are less important according to their wide distribution and related to the stock existence and movements.

Stipagrostis hirtigluma, an annual species, have a more wide distribution among different types of vegetation, so that it occurs from desert grassland to the interland types. Otherwise its annual condition and so its pioneer condition, can be related with land use by stock, which spreads its distribution.

Stipagrostis sp. (dinteri? giesii?) a perennial species does occur side by side with the last one, in the western types only, but have a marked preference for the little drainage lines.

Stipagrostis/.....

Stipagrostis namaquensis as well as Danthonia mossamedensis use to occur in the margin and bed of the torrential sandy streams, in desert country, but they can occur scattered in all desert country (vegetation types no. 14 - 16). These two last species are sometimes followed by the very scarce Leuconhrys mesocoma.

Aristida meridionalis have a wide distribution in the inland types, but not in the pre-desert ones, where it is very rare. It occurs mostly in vegetation types no. 1 - 7 and also 10 and 11. In the no. 6 and 7 types its occurrence is confirmed to sandy, loamy hills and is ^{in the} looking from the grey hard soils.

Very little attention was paid to Welwitschia mirabilis, Cyphostema spp., Sterculea quinqueloba, Acacia robynsiana, A. montis-ultima

Although these species would be excellent subjects for an ecological study, it is doubtful whether they are of any general ecological importance.

VEGETATION TYPES:

Vegetation types 1 - 7 are Kalahari-type vegetation; 8 - 10 are transitional and 12 - 17 are Namib and pre-Namib.

Special transitional ecological conditions prevail in type 12, and in a different way, the same for no. 11, though this have been not full study.

TYPE 1:

Tree/shrub savanna of Terminalia sericea and Acacia giraffae:

Its delimitation is based on the non-occurrence of Colophospermum mopane and otherwise by the co-dominant presence of Terminalia sericea, Acacia giraffae, Combretum spp., Commiphora angolensis, C. pyracanthoides, and such species as

Croton/.....

Croton spp., Dichrostachys cinerea, Rhus tenuinervis, Burkea africana, Acacia fleckii, grewia flavescens, grewia bicolor, etc.

Less frequent but also typical of this type are Ricinodendron rautaneni, Adansonia digitata, Sclerocarya birrea and Berchemia discolor.

Baikaea plurijuga also could very well occur, but mainly in the east ecotone.

Characteristic grasses of this vegetation type are:

Digitaria poleevansii, Aristida stipitata, var. robusta, Rhynchelytrum villosum, Antheophora pubescens, Panicum coloratum, Schmidtia bulbosa, Aristida meridionalis, Heteropogon melanocarpus, H. Contortus, Pogonarthria squarrosa, Bothriochloa radicans, whilst Hypertelia dissoluta occurs at the ecotones.

This type is a true tree/shrub savanna that develops on Kalahari sands. Successionally it is more xerophytic than the Baikaea savanna and more mesophytic than the Scerocarya-Burkea-Spirostachys (with or without mopane) savanna. Occasional patches of grassveld with Cactophractes occur, but this is possibly due to local biotic and pedologic factors. Other important, but less conspicuous, species in this veld type are:

Melhamia forbesii, Hermania tomentosa, Caucas martinicensis, Abution fruticosum, Hibiscus micranthus, etc.

The average annual rainfall is approximately 500 mm.

TYPE 2:

Tree/shrub savanna of Baikaea plurijuga:

This is an almost pure stand of Baikaea plurijuga of approximately 400 Km² on red Kalahari sands within mopane veld.

The complete/.....

The complete absence of "mopane", which is a regular feature of Baikaea savanna, is noticeable. The absence of Terminalia prunioides and the occurrence of the shrub Baphia massaiensis spp. massaiensis should also be mentioned. The average annual rainfall is approximately 400 mm.

Associated species are: Cordia sp., Terminalia sericea, Rhus tenuinervis, Commiphora angolensis, D. C. pyracanthoides, Croton gratissimus, C. menyarthii, C. subgratissimus, Berchemia discolor, Grewia flavescens, G. bicolor, G. villosa, Grewia sp., Hippocratea sp., Combretum celastroides, Combretum spp., Boscia albitrunca, Mundulea sericea, etc.

The grass cover comprises of Rhynchoselytrum villosum, Digitaria ocleevansii, Aristida stipitata, A. meridionalis, A. adscensionis, Brachiaria deflexa, Panicum coloratum, Eragrostis antherstonei, Eragrostis spp.

TYPE 3:

Baikaea plurijuga, Colophospermum mopane savanna:

This veld type is transitional between types 2 and 4. It is situated on a mosaic pattern of soils ranging from sandy to loamy and shallow calcrete.

It is typified by the rather uncommon association of Colophospermum and Baikaea. The topography is slightly undulating with Baikaea occurring on the elevated areas and Colophospermum in the depressions. In larger and deeper depressions the vegetation is dominated by C. apiculatum, C. imberbe and Cathopactes alexandrii forming an open and dwarf savanna.

Associated woody species are:

Burkea africana, Terminalia sericea, Spirostachys africana, Terminalia prunioides, Commiphora angolensis, C. glauscescens, C. pyracanthoides, Berchemia discolor, Lanchochocarpus nelsii, Sclerocarya birrea, Acacia giraffae, A. Fleckii, Mundulea sericea, Baphia massaensis, Combretum imberbe, Kirkia acuminata, Croton gratissimus, C. menyarthii, C. subgratissimus, Euclea divinorum, Maytenus senegalensis, Rhus tenuinervis, Bauhinia

macrantha, Coralocarpus welwitschii, as well as Ricinodendron rautanenii and Adansonia digitata.

The more important grass species are:

Andropogon zayanus var. squamulatus, Heteropogon melanocarpus, H. contortus, Cenchrus ciliaris, Schmidtia bulbosa, Enneapogon cenchroides, Rhynchelytrum villosum, Aristida sp., Stipagrostis uniplumis, Anthehora pubescens, Eragrostis echi-nochloioidea, Cymbopogon excavatus and probably Rottboelia exaltata, Aristida meridionalis, A. stipitata and Digitaria poleevansii.

TYPE 4:

Colophospermum mopane and other tree species except for Baikaea plurijuga:

This savanna is marked by the complete absence of Baikaea and an increase in the incidence of Colophospermum.

The other plant species of this vegetation type remain virtually the same as Type 3, but in the grassveld does occur also:

Hypertelia dissoluta, Brachiaria deflexa, Schmidtia Kalahariensis, Aristida meridionalis, Eragrostis superba, E. rofifer, Urochloa brachyura, Diplachne fusca, Sporobolus sp. Triraphis namosissima, Monechlytrum luderitzianum, Anthehora schinzii, Panicum coloratum and Entolocamia aristulata.

There is also a marked increase in the occurrence of Cathophractis alexandrii on shallow calcareous soil, which enhances the mosaic like physiognomy.

Phragmites mauritianus occurs in marshy areas of Etosha, but could have been introduced.

Soils vary from sandy to loamy to calcareous and the rainfall is approximately 350 mm/a. at the western plot and higher at the eastern one.

TYPE 5:/.....

TYPE 5:

Mosaic of:

- a) Terminalia sericea savanna on yellow Kalahari sands;
- b) Colophospermum/Cathophractes/Terminalia prunioides/Combretum apiculatum/C. imberbe shrub savanna on greyish psammitic soils; and
- c) Patches of Sesamonthamnus guerinchii on calcareous soil.

(a): The usual constituents of Terminalia savanna on yellow sands are: Acacia fleckii, A. ataxacantha, A. detinens, A. reficiens, Peltophorum africanum, Grewia sp., Commiphora africana, Ozora sp., Mundulea sericea, Elephantorrhiza sp., etc. Important is the absence of Colophospermum, Terminalia prunioides and Cathophractes alexandrii.

(b): The soil is shallow and calcareous and is covered & by shrub Colophospermum, Terminalia prunioides,

(c): Combretum imberbe, C. apiculatum, Cathophractes alexandrii, Sesamonthamnus guerinchii, Acacia senegal, Euclea pseudebenus, Commiphora pyracanthoides, Dichrostachys cineria, Maytenus senegalensis, Grewia bicolor, Mundulea sericea, Cantana sp. and Lonchocarpus nelsii sporadically.

The western ecotone of type 5 is a mountain range parallel to the Joubertberg, through which the road between Ohopoho and Otjitjikua passes.

Common grass are: Aristida effusa, A. rhiniochloa, A. sp., Eragrostis sp. (cf E. antherstonei), E. echinochloidea, Eragrostis sp., Schmidtia kalahariensis, Schmidtia bulbosa, Enneapogon conchroides, Cenchrus ciliaris, Rhynchelytrum brevipillum, Cymbopogon excavatus and sometimes Sorghum verticilliflorum.

A remarkable/....

A remarkable feature of joint types 2,3,4 and 5 is that it belongs to the endorreic basin of drainage, between the east slopes of Ehombo- and Omungondabergs at north and Joubertberg at south, and the Owambo country, and being thus protected against direct contact of desertic conditions.

TYPE 6:

Colohospermum/Combretum/Terminalia sericea savanna in the "Oshanas" of Owambo:

The topography is mosaic-like on account of the seasonally flooded "Oshanas" and interspersed sandy dunes. The "Oshanas", "vleis" and hard shallow soils cover a much larger area than the dunes.

The grassveld on the "Oshanas" consists of: Echinochloa, holobii, E. stagnina, Panicum repens, Sporobolus smutsii, Diplachne fusca, Eragrostis rotifer, E. viscosa, Eragrostis spp., Brachiaria humidicola, Oryza longistaminata, Leersia hexandra, Megaloprotachne albescens, Acroceras macrum, Elytrophorus spicatus, E. globularis, Paspalum commersonii, Wilkomia sarmentosa.

The following species occur at the edge of the "Oshanas": Monelytrum luderitzianum, Wilkomia sarmentosa, Odyssea paucinervis, Microchloa sp. and sometimes Cynodon dactylon.

Woody plants typical of the edge of the Oshanas are: Gardenia sp., Securinega virosa, Hyphaene ⁿvetricosa, Ficus sycomorus, Berchemia discolor, Salvadora persica, (a pre-desert element), Colohospermum mopane. Diospyros mespiliiformis occurs mostly at the edge of pans ("talas"), as do Spirostachys afuena, at places.

Typical of the sandy "dunes" are: Combretum mechowianum, Combretum sp., Acacia fledkii, A. gerrardae, Terminalia sericea, Commiphora angolensis, C. africana, Grewia spp., Rhus tenuinervis, Berchemia discolor, Boscia sp., Burkea africana,

Spirostachys/.....

Scirostachys africana, Alexalobus monopetalus, Vangueria infausta, Pockea multiflora, Kheinea longiflora, Coralocarpus Welwitschii, Lonchocarpus nelsii, Euclea divinorum, Hermania tomentosa, etc.

The grass cover consists of Aristida stipitata var. robusta, A. meridionalis, Aristida sp., Stipagrostis uniplumis, Rhynchelytrum villosum, Eragrostis lehmaniana, E. antherstonei, Eragrostis spp., Digitaria poleevansii, Panicum Coloratum, Urochloa mossambicensis, U. brachyura, Schmidtia Kalahariensis and Schmidtia bulbosa.

The following grass species occur on the ecotone between sandy dunes and the "Oshanas": Heteropogon contortus, Eragrostis superba, Eragrostis spp., and rarely Cenchrus ciliaris and Cymbopogon excavatus.

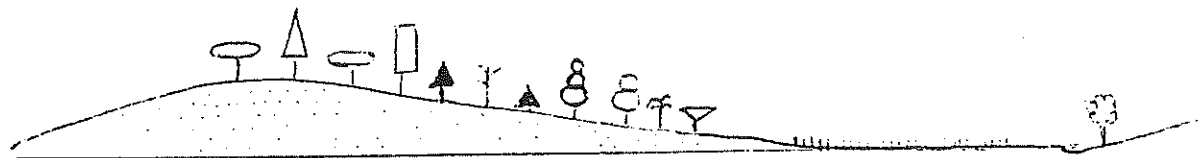


FIG.: Diagrammatic representation of the occurrence of various plant species in the Oshana/Dune association:

- | | |
|----------------------------------|------------------------------------|
| ○ - <u>Combretum mechowianum</u> | ♣ - <u>Spirostachys africana</u> |
| △ - <u>Burkea africana</u> | ⊙ - <u>Ficus sycomorus</u> |
| □ - <u>Acacia giraffae</u> | ⊙ - <u>Berchemia discolor</u> |
| ↑ - <u>Terminalia sericea</u> | ♣ - <u>Hyphaene ventricosa</u> |
| - <u>Oshana</u> | ⊙ - <u>Diospyros mespiliformis</u> |
| ☞ - "Tala" (pan) or pool | ♣ - <u>Cecropia peltata</u> |

TYPE 6:

Appendix;

Check list of plants in the vicinity of the Ogongo Agricultural College, Owambo:

DUNE/OSHANA ASSOCIATION:-

Combretum mechowianum
Combretum sp. (prob. C. collinum)
Combretum sp. (prob. C. hereroensis)
Terminalia sericea
Terminalia prunioides (very rare)
Acacia fleckii
Acacia giraffae
Acacia ataxacantha
Acacia milotica ssp. subalata
Acacia senegal
Acacia hebeclada ssp. tristis
Commiphora pyracanthoides
Commiphora mollis
Commiphora angolensis
Commiphora africana
Grewia bicolor
Grewia deserticola
Grewia sp.
Grewia flavescens
Rhus tenuinervis
Vangueria infausta
Gymnema silvestris
Fockea multiflora
Berchemia discolor
Asclepias fruticosum
Sclerocarya birrea
Cissus sp.
ximenia americana
Zyzyphus mucronata
Lonchocarpus nelsii
Rhigozum brevispinosum

Abutilon/.....

Abutilon fruticosum
Hernandia tomentosa
Hibiscus physaloides
Albizzia anthemintica
Solanum incanum
Solanum spp.
Waltheria indica
Pechuel-Loeshea kubnitziae
Fergularia extensa
Coralocarpus Welwitschii
Melhamia forbesii
Indigofera filipes
Indigofera spp.
Sarcostema viminale
Sida sp.
Boscia albitrunca
Elephantoriza sp.
Dicrostachys cinerea
Asparagus sp.
Colophospermum mopane
Fockea multiflora
Aristida stipitata var robusta
Eragrostis lehmaniana
Eragrostis trichophora
Eragrostis antherstonei
Eragrostis viscosa
Eragrostis superba
Eragrostis rotifer
Eragrostis spp.
Rhynchelytrum villosum
Rhynchelytrum spp.
Digitaria poleevansii
Panicum sp.
Urochloa brachyura
Urochloa massambicensis
Aristida meridionalis
Aristida adscenciones
Aristida sp.

Stipagrostis/.....

Stiparrostis uniolumis
Sporobolus sp. (annual)
Sporobolus smutsi
Tragus berterovianus
Triraphis fleckii
Schmidtia bulbosa
Schmidtia Malahariensis
Pogonarthria squarrosa
Anthehora schinzii
Chloris virgata
Brachiaria deflexa
Perotis patens
Dactyloctenium giganteum
Setaria verticillata
Perotis patens
Enneapogon cenchroides
Enneapogon scoparius
Megaloprotachne albescens
Pseudobrachiaria deflexa
Cymbopogon excavatus
Dicocaryum Zanguebarium
Harpagophyton procumbens
Cassia absus
Heliotropium spp.
Solanum incanum
Solanum sp.
Solanum sp.
Euphorbia spp.
Tephrosia oxygona
Indigofera spp.
Tribulus zeyheri
Crotalaria spp.
Amaranthus spp.
Phyllanthus
Citrulus naudinianus
Merrhemia tridentata
Boeraria sp.
Commelina sp.

Gynandropsis/....

Gynandropsis gynandra
Althernanthera pungens
Ceropegia sp.
Kalaharia uncinata
Salvadora persica
Terminalia prunioides
Maytenus senegalensis
Lantana sp.
Euclea divinorum
Diospyris pallens
Hoslundia verticillata
Achyranthes aspera
Vernonia poskeana
Haemanthus sp.
Gardenia spatulifolia
Hyphaene ventricosa
Cadaba aphylla
Helychrysum sp.
Adenia sp.
Gossypium anomalum
Coleus sp.
Rhynchosia sp.
Boscia microphylla
Picreus
Killinga
Picreus

TYPE 7:/.....

TYPE 7:

Colophospermum mopane/Combretum mechowianum savanna with pans and vleis:

This veld type is basically the same as Type 6, but the "Oshanas" cover a much smaller proportion of the topography.

TYPE 8:

Dwarf savanna on sheet calcrete:

This vegetation type is product of the shallow soils as well as man and his livestock which are attracted by numerous springs. The general physiognomy is that of a dwarf or shrub savanna.

More common species are: Colophospermum mopane, Combretum apiculatum, C. imberbe, Terminalia prunioides, Catophractes alexandrii, Sesamothamnus guerinchii, Petalidium spp.

The grass cover consists of Eragrostis echinochloidea, Eragrostis sp., Cenchrus ciliaris, Enneapogon cenchroides, E. brachystachyus, Aristida spp., Entoplocamia aristulata, Rhynchelytrum spp.

Patches of this vegetation type appears throughout the study area, but are not specifically mentioned (except in the case of Type 8) as they are usually insignificant in syze. Also because No. 8 type is situated in transtron zone of five different types.

TYPE 9:

This veld type is an intricate mosaic of:

- a) Tree Colophospermum/Spirostachys savanna;
- b) Grassveld;
- c) Shrubveld;
- d) Dwarf savanna on rocky mountains.

Generally/.....

Generally speaking the western limits is determined by the absence of xerophitic species of Commiphora such as Commiphora wildii, C. giesii, C. virgata and probably C. multijuga, as well as Euphobia gregaria, Salvadora persica, Adenolobus garimpensis and Gossypium anomallum, which generally occurs in the west and southerly types 12 and 13.

The eastern limits on the other hand is determined by the absence of Kalahari species such as Terminalia sericea as it is being replaced by Terminalia prunioides.

Sandy soils of the east are replaced westwards by loamy soils, whilst "Mopane" takes over complete dominance and the presence of Spirostachys africana is conspicuous.

The physiognomy is generally flat and featureless and forms the headwaters of some of the tributaries of the Cunene - to the north - as well as that of the "oarusib and Hoanib rivers. The above referred physiognomy is another difference to the western and southern types.

There seems to be an encroachment of desert conditions from the west which have probably been agravated by human pastoralists.

✦ Colophospermum/Spirostachys savanna:-

Colophospermum mopane, Spirostachys africana, Terminalia prunioides, Dichrostachys cinerea, Commiphora glaucescens, Combretum apiculatum, Boscia foetida, Grewia bicolor, Cadaba aphylla, Acacia tortilis, spp. heteracantha, Gossypium triphyllum, Tricalisia sp., Catophractes alexandrii, Helinus integrifolius, Petalidium spp., Hibiscis sp., Montinia caryophyllacea, Lantana sp., Rhynchosia sp., Melhamia forbesii, Leucas marīnicensis, Vernonia spp., Solanum sp., Anthephora schinzii, Eragrostis spp., Pogonarthria fleckii, Rhynchelly-

trum/.....

brevipillum, Stipagrostis uniplumis, Cenchrus ciliaris,

The soils are usually loamy and red or grey in colour.

On the western and northern ecotones as well as in hilly areas the following species also occur: Pterocarpus antunesii, Diplorrhynchos condylocarpus, Schlerocarya birrea, Adansonia digitata, (not very frequent), Strophantus amboensis, Hibocratea sp., Acacia nilotira ssp. subalata, A. ataxacantha, A. fleckii, Berchemia discolor, Rhigozum brevispinosum, Mundulea sericea, Commiphora mollis, Ptaeroxylon obliquum, Cathophractes alexandrii and Terminalia prunioides.

Common grasses in this veld type are: Eragrostis denudata, E. dinteri, Antheophora schinzii, Schizachrium exile, Aristida meridionalis, A. effusa, Cenchrus ciliaris, Stipagrostis uniplumis, ~~Terma~~ Triraphis ramosissima and Pogonarthria fleckii.

Towards the south the rare occurrence of Steganotaenia araliacea and Albizzia versicolor (?) in some rocky, deep, protected valleys should also be mentioned.

Towards the east the following species occur on small isolated hills: Sterculia africana, Feltophorum africanum, Fagara ovaifoliata, Terminalia prunioides, Colophospermum mopane, Grewia bicolor, Cathophractes alexandrii, Boscia foetida, Commiphora glauscescens, C. crenato-serrata, C. pyracanthoides, C. mollis, ~~Paere~~ Ptaeroxylon obliquum, Dich^cstachys cinerea, Montinia caryophyllaceae, Combretum apiculatum, Mundulea sericea, Rhygozum brevispinosum.

More common grass species are: Entoplocamia aristulata, Eragrostis annulata, Aristida spp., Enneapogon cenchroides, Stipagrostis uniplumis.

On the ecotone to the true "Mopane" savanna, on calcareous soils, a very good high and dense grass cover exists, comprising Cenchrus ciliaris, Cymbopogon excavatus, Eragrostis su-

perba/.....

2010

Sorghum sp., etc.

Combretum imberbe, Feltophorum africanum and Lonchocarpus nelsii also occur.

On the flat shallow soils exposed to overgrazing, the following species occur, forming a grassveld patch: Aristida rhiniochloa, Entolocamia aristulata, Eragrostis spp., E. superba, E. antherstonei, E. echinochloidea, E. annulata, Schmidtia kalahariensis, S. bulbosa, Enneapogon cenchroides, E. brachystachyus, Rhynchelytrum brevipillum, Stipagrostis hirtigluma and the forbs Ocimum cannum, Ocimum sp., Lotonis sp., Lantana sp. and some of the Acanthaceae.

Scattered on the edges of these grass swards the following species occur: Sesamothamnus guerichii, Kirkia acuminata, Combretum imberbe, C. apiculatum, Maytenus sp., Mundulea sericea, Dichrostachys cinerea, Grewia bicolor, Catophractes alexandrii, Montinia caryophyllacea, Colophospermum mopane, Acacia spp., Terminalia prunioides and Grewia sp.

As far as the shrub- and grassveld is concerned, it is difficult to ascertain whether the vegetation is a product of biotic or edaphic elements, being certain that both are acting.

TYPE 10:

Colophospermum mopane/Terminalia prunioides/Acacia spp. savanna with Terminalia sericea, Lonchocarpus nelsii, Combretum apiculatum, C. imberbe, and Kirkia acuminata:

This savanna is developed on an almost flat area with small scattered hills. The soil is loamy and rocky. Typical is the absence of Spirostachys africana and the occurrence of tree and shrub Acacia which could be a plagioclimax attributed to ~~Acacia~~ humans and stock though loamy soils are appropriated to Acacia. The Acacias most frequently encountered are: Acacia mellifera sp. detinens, A. hebeclada ssp. tristis, A. fleckii, A. reficiens.

Other/.....

Other common species are: Cathophractes alexandrii, Tarchonanthus camphorathus, Mundulea sericea, Rhigozum brevispinosum, Grewia spp., Combretum sp., Boscia foetida, Sesamonthamnus guerichii, Croton spp., Albizzia anthelmintica, Vangueria infausta, Commiphora glauscescens.

The grass cover is composed of Bothriochloa radicans, Heteropogon contortus, Kaokochloa nigrirostris (a desert element), Hypertellia dissoluta (a tropical element), Rhynchelytrum spp., Anthehora pubescens, Aristida sp., A. adscenciones, Stipagrostis uniplumis, Enneapogon cenchroides, Chloris virgata, Crotalaria sp. (an annual very abundant species).

It is obvious that both Kalahari and Namib elements occur in this transitional veldtype.

Colophospermum mopane disappears near Outjo.

The hills are covered by Kinkia acuminata, Combretum apiculatum, Commiphora crenato-serrata, C. glauscescens, etc.

TYPE 11:

Acacia giraffae savanna:

The complete floristic components of this type is by itself not yet known, and it is here reported only to complete the limits of Mopane distribution. It looks as if it is as well a plagioclimax as N° 10.

It is characterized by the occurrence of Acacia giraffae and the absence of Colophospermum when compared with the previous types.

Typical tree species are Acacia spp. Terminalia sericea and Lonchocarpus nelsii.

The grass cover comprises such species as Cenchrus ciliaris, Eragrostis echinochloidea, Stipagrostis uniplumis, Enneapogon cenchroides, Chloris virgata, Bothriochloa insculpta and Eragrostis superba./...

Eragrostis superba.

The most important being Cenchrus ciliaris, not only according to its abundance as well as by its interest as pasture.

TYPE 12:

Colophospermum mopane/Terminalia prunioides savanna:

Characteristic of this veld type is:

- a) Scattered patches of true Mopane savanna;
- b) A marked increase in xerophytic species and a more xerophytic feature of all vegetation;
- c) The occurrence of Spirostachys along streams only;
- d) The complete absence of Terminalia sericea;
- e) An increase in Commiphora species;
- f) The undulating and rocky physiognomy.

Common sub-desert species are: Adenolobus garimpensis, Gossypium anomalum, Euphorbia guerichiana, Pachypodium kalii, Salvadora persica, Rhigozum virgatum and Moringa ovalifolia, especially on the western ecotones where Euphorbia gregaria also appears occasionally.

General species are: Colophospermum mopane, Terminalia prunioides, Combretum apiculatum, Cathophractes alexandrii, Commiphora glaulescens, C. multijuga, C. crenato-serrata, C. mollis, C. angolensis, C. pyranthoides, Rhigozum brevispinosum, Ximenia americana, Kleinia longiflora, Croton gratisimus, A. hebeclada ssp., tristis, A. ataxacantha, Ptaeroxylon obliquum, Boscia spp., Maerua spp., Euphorbia guerichiana, Grewia spp., Montinia caryophyllacea, Sterculea africana, Pechuel-loeshea leubnitziae, Sarcostema viminale, etc.

Common grasses in the area are: Eragrostis annulata, E. superba, E. dennudata, E. dinterii, E. echinochloidea, Aristida rhinochloa, A. meridionalis, A. hordeacea, Aristida, sp.,

Stipagrostis/....

Stipagrostis uniplumis, S. gracilior, S. dinteri (?) (guiesii ?), Jacquesfelia dinteri, Enneapogon cenchroides, E. brachystachyus, Rhynchelytrum villosum, R. brevipillum, Cenchrus ciliaris, Schmidtia bulbosa, S. Kalahariensis, Monelytrum annum, Pogonarthra squarrosa, Chloris virgata, Cymbopogon excavatus, Heteropogon contortus, Entolocania aristulata, Anthehora schinzii and the herbs: Achyranthes aspera, Bidens sp., Crotalaria spp., Indigofera spp., Cleome spp., Heliotropium spp., Melhamia forbesii, Hibiscus micranthus and some of the Acanthacea.

A considerable number of more mesophytic and unusual species occur in protected valleys and slopes such as:

Adansonia digitata, Sclerocarya birrea, Spirostachys africana, Pterocarpus antunesii, Bridelia macrantha, Berchemia discolor, Peltophorum africanum, Euclea divinorum, Mundulea sericea, Cordia garaph, Montinia caryophyllacea, Hexalobus monopetalus, Kinkia acuminata, Albizia anthelmintica, Dichrostachys cinerea, Securinega virosa, Dispyros mespiliformis, Maytenus sp., Elephantorrhiza sufruticosa, Tinnea sp., Zyzyphus mucronata, Ormocarpon Kinkii, etc.

The following species occur along watercourses: Acacia albida, Acacia giraffae, Combretum imberbe, Hyphaene ventricosa, Euclea pseudebenus, E. divinorum, Salvadora persica and, especially at west side, Balanites Welwitschii, and Tamarix usneoides.

TYPE 13:

Sub-desert steppe to very dry dwarf savanna of Colophospermum mopane and Terminalia prunioides:

The vegetation is more shrublike and xerophytic than type 12. The grassveld flats that appear, although similar to the more western desert plains, are not natural and may have been caused by overgrazing. The grazing potential of these grasslands is however not the same on account of difference in

rainfall/.....

rainfall, depth of soil and content of organic matter.

Some of these flats referred, occur between Oytjō, Cmutati and Omuramba.

In well preserved veld the grass cover of these flats consists of: Cenchrus ciliaris, Eragrostis echinochloidea, E. superba, Schmidtia Kalahariensis, S. bulbosa, Enneapogon cenchroides, Stipagrostis uniplumis, S. Gracilor, Aristida spp., Triraphis ramosissima, etc.

If however overgrazed, the above mentioned species are replaced by: Stipagrostis hirtigluma, S. guiesii (?) (dinteri ?), Aristida rhiniochloa, A. hordeacea, A. spp., Enneapogon brachystachyus, Kaokochloa nigrirostris, Entopoclamia aristulata, Eragrostis annulata, Eragrostis spp., Anthe-phora schinzii, Chloris virgata, etc.

Other scattered species throughout the country are: Rhynchel-lytrum villosum, R. brevipillum, Anthe-phora pubescens.

On rocky hills Jacquesfelia dinteri, Heteropogon contortus, Triraphis ramosissima and Anthe-phora pubescens are common.

Along watercourses occur: Stipagrostis namaquensis, Danthonia mossamedensis, Panicum spp., Urochloa brachyura, Schmidtia Kalahariensis, Triraphis fleckii, etc.

The following woody plants occur throughout this area: Colophospermum mopane, Terminalia prunioides, Commophora multijuga, C. crenato-serrata, C. pyracanthoides, C. angolensis (?), C. mollis, Cathophractes alexandrii, Adenolobus garimpensis, Rhigozum virgatum (north), Maerua spp., Boscia foetida, B. microphylla, Combretum apiculatum, Sesamothamnus guerichii, Pachyposidium lealii, Adenium boehmianum, Gossypium anomalum, Sesamum tryphyllum, Crotalaria spp., Cleome spp., Indigofera spp., Tephrosia oxygona, Tribulus zeyheri, Hibiscus micranthus, Petalidium spp., etc.

While on/.....

While on rocky outcrops occur: Combretum apiculatum, Kirkia acuminata, Commiphora multijuga, Cordia garaph, Sterculia africana and S. quinqueloba, etc.

Common woody species along streams are: Balanites welwitschii, Euclea pseudebenus, E. crispa, Acacia albida, A. giraffae, Combretum imberbe, C. wattii, Salvadora persica, etc. Cucumis metuliferus is usual.

The country is undulating, with broad valleys, loamy soils and rocky outcrops.

TYPE 14:

Escarpment area with rocky hills, surrounding flats. The rocky hills supporting a dwarf shrubby desertic steppe and the flats are covered by grasses.

Common species are: Colophospermum mopane, Euphorbia gregaria, Commiphora wilkii, C. glaucescens, C. anacardifolia, C. crenatoserrata, Commiphora spp., Cryptolpis sp., (Curroria ?), Gossypium anomalum, Sesamothamnus guerichii, Acacia notis-ultis, A. reficiens, A. robynsianna (south), Sterculea africana, S. quinqueloba, Euphorbia guerichiana, Euphorbia sp., Orthanthusa albida, Cathophractes alexandrii, Balanites welwitschii, Terminalia prunioides, Adenolobus garimpensis, A. mossamedensis, Amphiasma benguellense, Boscia microphylla, Boscia spp., Cadabia sp., Hoodia parviflora, Cordia garaph, Cardiospermum halicacabum, Seddera schizantha, Parkinsonia africana, Sesamum sp., Geigeria sp., Barleria sp., Zygophyllum simplex, etc.

The most common grasses are: Schmidtia Kalahariensis, Kaoko-chloa nigrirostris, Enneapogon spp., Rhynchelytrum spp., Entoplocamia aristulata, Triraphis fleckii, Monelytrum annuum, Stipagrostis uniplumis, S. hirtigluma, S. guiesii, Eragrostis denudata, E. dinteri.

Along watercourses are common: Tamarix usneoides, Lyceum spp.,

Balanites/.....

Balanites Welwitschii, Hyphaene ventricosa, Salvadora persica, Acacia albida, A. giraffae, Combretum wattii, Combretum imberbe, etc.

TYPE 15:

Desert grassveld alternating with hills and gravelled flats of dwarf desertic steppe:

Colophospermum mopane, occurs mainly in watercourses. At the little gravelled drainage lines it occurs also and is usually followed by Terminalia prunioides, as well as on the gravelled flats.

On the hills, Colophospermum mopane occur usually followed by Commiphora virgata, C. guiesii and Cryptolepis sp.

Parkinsonia africana occurs at some flats and also along watercourses.

The rocky hills are covered by: Commiphora wildii, C. crenatoserrata, C. multijuga, C. guiesii, C. Virgata, C. oblanceolata, C. pyracanthoides, E. guerichiana, Calècorema capitata, Lyceum sp., Boscia sp., Petalidium spp., Adenolobus garimpensis, A. mossamedensis, Zygophyllum sp., Cryptolepis sp. (Curroria decidua ?).

Other species occurring throughout this veld type are:

Gossypium anomallum, Orthanthera albida, Sterculia africana, S., quinqueloba, Commiphora saxicola, C. krauseliana, Cathophractes alexandrii, Aptosimum decumbens, Rhynchosia memnonia, Heliotropium spp., Cleome spp., Trichodesma sp., Cyphostema spp., Sederra schizantha, "oringa ovalifolia.

Along watercourses the following species occur: Combretum wattii, C. imberbe, Euclea pseudebenus, Cyperaceae, Amarix usneoides, Leucophrys mesocoma, L. psamophylla, Stipagrostis namaquensis, Danthonia mossamedensis, etc.

The general/.....

The general grass cover consists of: Stipagrostis uniolumis (rare), Stipagrostis hirtigluma (the most frequent), S. giesii(?) Enneapogon spp., Kaokochloa nigrirostris, Entolocamia aris-tulata.

According the structure of the hills different species occur: On small, rounded or flat hills, without big rocks, dwarf Commiphora spp. are common. On larger hills, with big rocks and consequently kloofs, Sterculea and Boscia occur.

Differences also occur on different types of drainage courses and lines. On the smaller gravelled drainage lines Stipagros-tis spp., Heliotropium spp., Leucophrys mesocoma, etc., are common whilst Calicorema capitata, Tephrosia oxygona and Com-miphora spp. abound on medium sized water courses.

The larger watercourses are characterized by Acacia giraffae, A. albida, Colophospermum mopane, Combretum imberbe, C. wattii, etc.

TYPE 16:

Desert dwarf steppe on gravelled flat or undulated surfaces:

This veld type has hithero not been surveyed and has only been mapped by some short transects.

Common species are: Calicorema capitata, Commiphora wildii, Petalidium spp., Sarcocaulon mossamedensis, Adenia sp., Gos-sypium anomalum, Welwitschia mirabilis, Orphanthera albida, Euphorbia gregaria, Zygophyllum simplex, Sesamum sp., Rhyn-chosia memnonia, Salvadora persica, Aptosimum sp., Cleome spp., Hermannia spp., Petalidium spp., Trichodesma sp., etc.

The grass cover consists of: Eragrostis denudata, Stipa par-vula, Stipagrostis hirtigluma, S. dinteri (?)(giesii ?), Ka-Okochloa Nigrirostris, etc.

Along the/.....

Along the broad watercourses still occur: Combretum imberbe, C. wattii, Euclea pseudebenus, Colophospermum mopane, Tamarix usnioides (north), Phragmites mauritianus (north), Hyphaene ventricosa (north), Phylla nodiflora, Lyceum sp., Phaeoptillum spinosum, Salvadora persica, Salsola sp., Parkinsonia africana, etc.

TYPE 17: Sandy dunes.

This veld type also have not been surveyed and have only been mapped by virtue of edaphic conditions, and entirely based on the existing maps.



R. CORREIA

23 June 1976

Added

Enagrolis tenuis = E. nindensis

Euphorbia gregaria = E. damarana (pro parte)