

10. VEGETATION MAPPING

10.1. MAPPING OF SATELLITE CLASSIFICATIONS OF THE VEGETATION

Initially, the original TWINSpan groupings (all 53 - see dendogram Figure 16) were used for selecting groups of training sites on the rectified satellite images. These groups were further subdivided based on differences in spectral signatures. Some of the smaller groups had very uniform spectral signatures, e.g. for association 1, but for group 16 of association 7, eight different groups of relatively uniform spectral signatures could be separated. Outlier signatures and their training sites were excluded from the final classification. The initial classification of satellite data was done using the data of the study area only (with mountain ranges removed, as discussed earlier under methods), using all uniform spectral subgroups of the TWINSpan groupings.

The resultant classification - a separate classification for every satellite image - was mapped and compared to field data for correctness. As a next step all signature groups and TWINSpan groups were colour-coded according to their respective associations, as defined in section 9.2. This classification is shown for the southern section of the study area in maps 3 and 4 in Appendix 4.

Classification of the northern satellite image proved more difficult, as some farms have been drastically debused (removal of the entire shrub- and tree layer), on several farms there are planted pastures and, further, there is some "image-contamination" by occasional small clouds and their shadows. These elements had similar spectral signatures to either dense vegetation or pans, and their classification as separate entities resulted in a complete misclassification of the image. It was thus decided to leave these elements in the classification, but to take note of their true identity when viewing the final map. An example of such "problem areas" is shown in Figure 59.

Overall, the mapping of the separate associations proved relatively useful and well interpretable when looking at individual areas such as farms or individual pan-systems. On a smaller scale, however, this typical mosaic of vegetation types is impossible to map or even to transfer to a GIS data base.

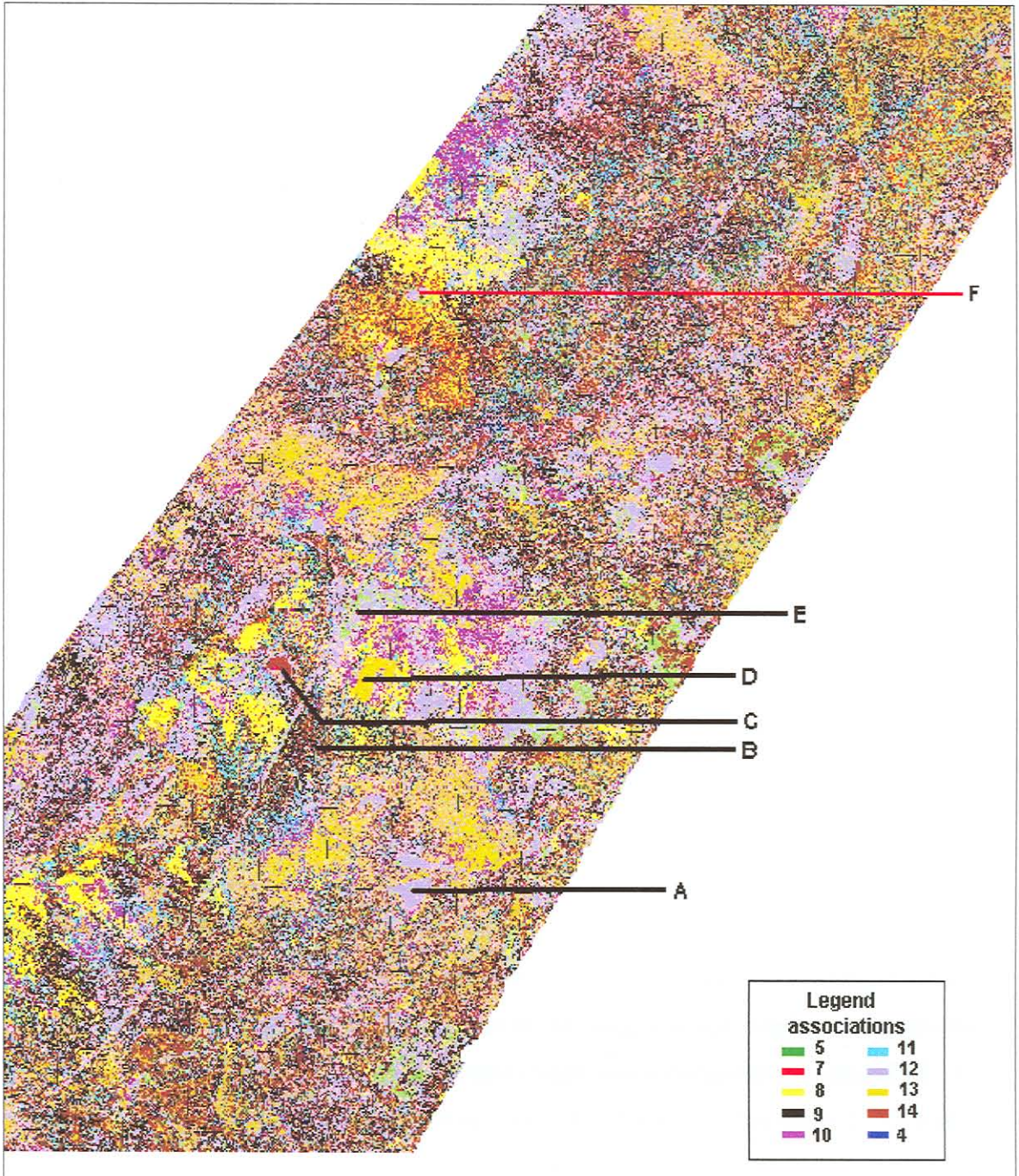


Figure 59: Classification of part of the northern satellite image according to the TWINSPAN associations. A and F refer to planted grazing lands, mostly *Cenchrus ciliaris*, which ERDAS classifies as association 12. C is a seasonal pan, recognised by ERDAS as association 14. D and E are areas that have been bulldozed around 1990 as a de-bushing exercise, but where a dense layer of 50 - 90 cm high shrub is currently re-emerging. ERDAS currently classifies D as association 13, but it is believed that the area originally resembled area B, which consists mostly of association 9 and 14.

It was thus decided to return to the TWINSPAN classification and see which associations could, on the basis of their floristic and structural composition, be further grouped together:

- Associations 1-4 were combined to represent erosion plains of the Omatako catchment area as well as small rivers and drainage channels. It would, at a later stage, be feasible to separate definite riverine vegetation. However, this will require intensive sampling of such vegetation as it is relatively variable.
- Associations 6 and 7 were combined to represent a mixed tree- and shrub savanna. This would represent the most typical form of the Thornbush Savanna described by Giess (1971).
- Associations 11 and 12 were combined to represent vegetation situated on soils overlying dolomitic rock banks. This could be seen as a transition between the Thornbush Savanna and the Karstveld as defined by Giess (1971).

To effectively map these vegetation types for the entire study area, the classifications of the two satellite images had to be merged - a process with many inherent problems. First, the above combinations of vegetation types were re-colourcoded on both images. Here it already became very clear that vegetation types, which occur predominantly on the southern satellite image and physically sampled there, were not accurately classified on the northern satellite image due to a lack of suitable training sites. The same occurred for the reverse situation. To try and curb this problem, the two images were merged, and additional training sites selected on the areas of the images which overlap - a narrow band between 20°40' S and 20°50' S. The merged image was subsequently re-classified. This classification of vegetation types can be seen on maps 5 and 6 in Appendix 2. Overall this classification can be regarded as relatively successful, but not yet perfect. Classifications of especially very dense vegetation on footslopes and ridges on undulating landscapes in the southern regions of the study area need to be sampled and compared to associations 13 and 14, into which these areas are currently grouped. Such sampling was omitted during the present study as the BIOTA focus for vegetation mapping thus far was strictly on plains. Associations 13 and 14 are able to persist on the plains in the northern regions of the study area, as the habitat there is sufficiently moist. In the southern regions of the study area, however, sufficiently moist habitats suitable for these associations are limited to the rocky environments of especially foot- and midslopes of the few mountains present.

Water is able to infiltrate between these rocks, where it is retained far longer than in soils on the plains.

10.2. COMPARISON OF THE SATELLITE -DATA MAP TO EXISTING VEGETATION MAPS

The preliminary mapping of the vegetation types according to satellite data facilitated a comparison with the vegetation-types described in the Homogenous Farming Areas Report (Figure 61). Basic similarities of the associations defined in this study could be established with vegetation types of the Report. On a first glance, the distribution of these associations (and combined vegetation types) did show some similarity with the maps of the Homogenous Farming Areas. However, a formal attempt at delineating the vegetation types defined in this study was not regarded feasible at this stage, as vegetation types extend beyond the study area. Such a vegetation map would be a generalisation in itself, and it will be advisable to first extrapolate the classification of the transect to the entire satellite image, establishing the wider boundaries of each vegetation unit. Then, again with the help of either the false-colour satellite images or aerial photography, as well as soil- and geological maps, boundaries of the vegetation units will have to be defined. This process will be relatively subjective, and will again have to be verified by specific field surveys.

An overview of the relationship between the vegetation types defined by Giess (1971) and the Homogenous Farming Areas Report (1979) is indicated in Figure 60.

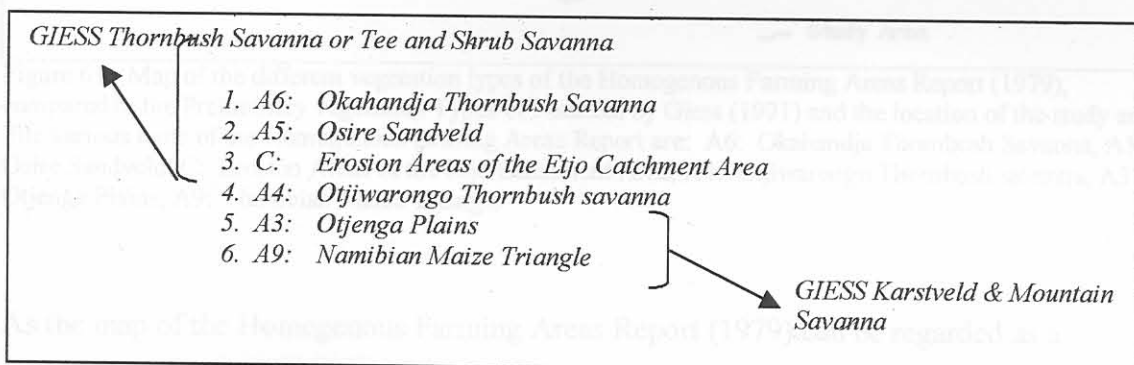


Figure 60: Relationship of the Preliminary Vegetation Map of Namibia by Giess (1971) and the Homogenous Farming Areas Report (Dept. Agricultural Technical Services 1979).

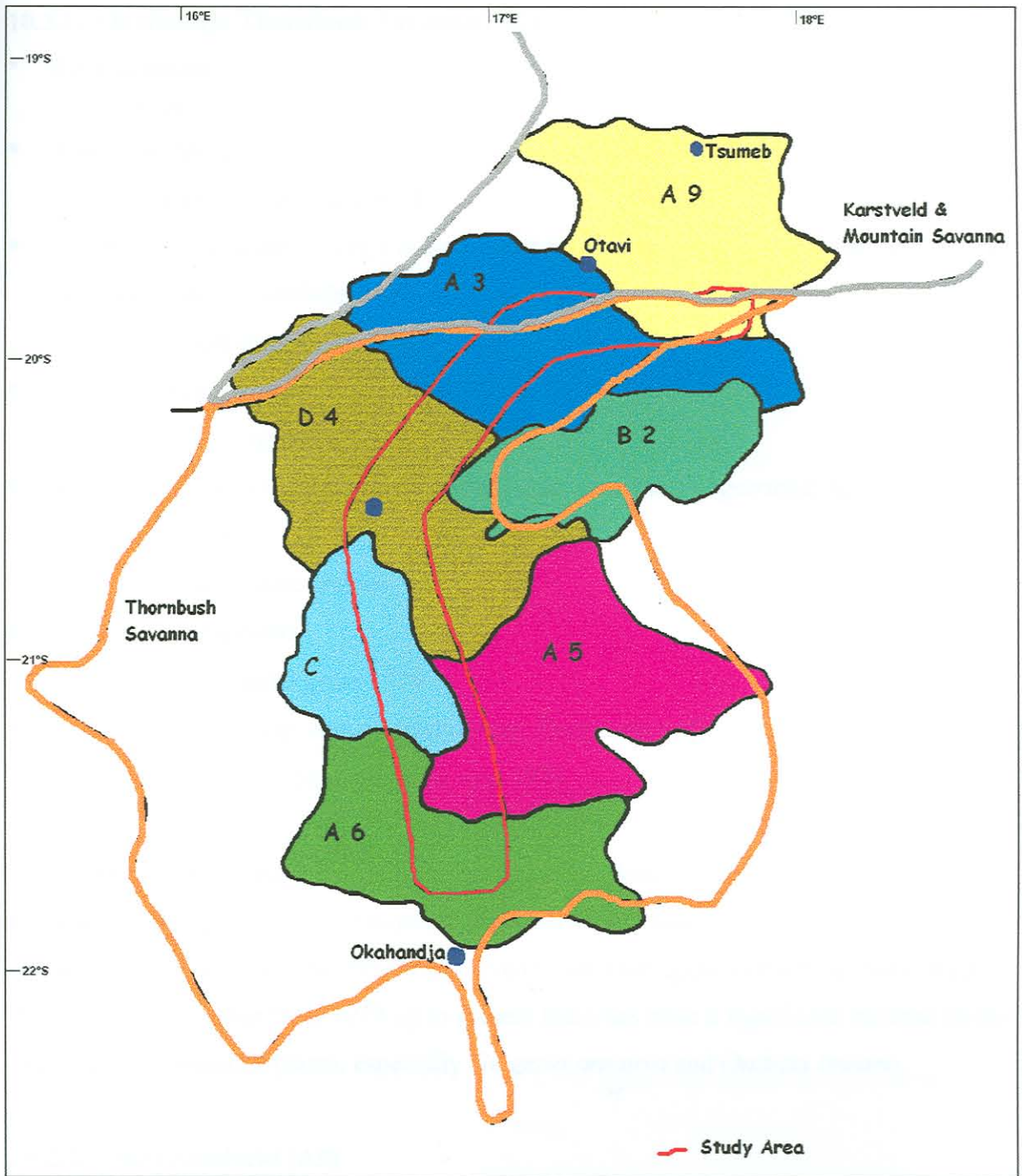


Figure 61: Map of the different vegetation types of the Homogenous Farming Areas Report (1979), compared to the Preliminary vegetation Types of Namibia by Giess (1971) and the location of the study area. The various units of the Homogenous farming Areas Report are: A6: Okahandja Thornbush Savanna, A5: Osire Sandveld, C: Erosion Areas of the Etjo Catchment Area, A4: Otjiwarongo Thornbush savanna, A3: Otjenga Plains, A9: Namibian Maize Triangle

As the map of the Homegenous Farming Areas Report (1979) can be regarded as a subdivision and re-delineation of the Giess (1971) map, the vegetation types classified and described in this study have been compared to vegetation types described in the Homegenous Farming Areas Report (1979).

10.2.1. Okahandja Thornbush Savanna (A6)

- dominant species
 - ⇒ notes
- *Acacia mellifera*
 - ⇒ causes bush encroachment
- *Tarchonanthus camphoratus*, *Leucosphaera bainesii*, *Monechma genistifolium*, *Boscia albitrunca*, *Albizia anthelmintica*
 - ⇒ common shrubs and trees
- *Combretum apiculatum*
 - ⇒ on rocky outcrops
- *Antephora pubescens*, *Brachiaria nigropedata*, *Urochloa oligotricha*, *Schmidtia pappophoroides*
 - ⇒ original climax grasses
- *Stipagrostis uniplumis*
 - ⇒ main perennial grass 1979
- annual *Eragrostis* spp, annual *Aristida* spp, *Eragrostis pallens*, *E. rigidior*
 - ⇒ major grasses on overgrazed veld 1979

The Okahandja Thornbush Savanna compares well to Associations 5, 6, 7 and 10. Notable is the almost complete lack of *Antephora pubescens*, *Brachiaria nigropedata* and *Urochloa oligotricha* from survey data. From data given in the Homogenous Farming Areas Report, it may be assumed that from 1979 up to present there has been a significant increase in the occurrence of poisonous plants, especially *Geigeria ornativa* and *Ondetia linearis*.

10.2.2. Osire Sandveld (A5)

- dominant species
 - ⇒ notes
- *Acacia mellifera*
 - ⇒ bush encroachment on sandy loams
- *Acacia tortilis*, *Dichrostachys cinerea*
 - ⇒ causes bush encroachment
- *Tarchonanthus camphoratus*, *Boscia albitrunca*, *Terminalia sericea*, *Grewia* spp, *Lonchocarpus nelsii*
 - ⇒ common shrubs and trees

- *Geigeria ornativa*, *Urginea sanguinea*
 - ⇒ main poisonous plants
- *Antephora pubescens*, *Brachiaria nigropedata*, *Cenchrus ciliaris*, *Panicum maximum*, *Panicum coloratum*, *Urochloa oligotricha*, *Dichanthium annulatum*, *Heteropogon contortus*, *Cymbopogon plurinodes*, *Schmidtia pappophoroides*, *Digitaria eriantha*
 - ⇒ original climax grasses
- *Stipagrostis uniplumis*
 - ⇒ major subclimax grass
- *Eragrostis rigidior*
 - ⇒ “invader” grass in 1979: problematic on many farms - hard and unpalatable, outcompeting other grasses, becoming a stable state which blocks veld improvement
- *Aristida meridionalis*, *Eragrostis lehmanniana*, *E. porosa*, annual *Aristida* spp
 - ⇒ major grass in the veld 1979

The association most similar to the Osire Sandveld would be Association 8. The distribution of this association is relatively patchy within the study area - indicating that these may be outliers of this vegetation type. Observations on *Eragrostis rigidior* made in the report are again confirmed by the study - an indication of how little this grass it utilized and how stable that state is once established (O'Connor 1995). Outliers of association 9 are also identified in this area by the satellite classification. The distribution of *Lonchocarpus nelsii*, which is considered characteristic for association 9, has been confirmed this far south (Coates Palgrave 1984), but the actual vegetation type needs further investigation to verify its distribution here.

10.2.3. Erosion Areas of the Etjo Catchment Area (C)

- dominant species
 - ⇒ notes
- *Acacia mellifera*, *Dichrostachys cinerea*
 - ⇒ causes bush encroachment
- *Tarchonanthus camphoratus*, *Boscia albitrunca*, *Terminalia sericea*, *Grewia* spp, *Lonchocarpus nelsii*, *Combretum apiculatum*
 - ⇒ common shrubs and trees

- *Geigeria ornativa*, *Crotalaria* spp
 ⇒ main poisonous plants
- *Antephora pubescens*, *Fingerhutia africana*, *Cenchrus ciliaris*, *Panicum maximum*,
Panicum coloratum, *Urochloa oligotricha*
 ⇒ original climax grasses, surveys in the 70's showed that this area is very sensitive to overgrazing-damage during drought years, erosion is a major problem

Associations 1,2 and 3 could be considered part of this unit. Association 4 can be included at this stage, although it will be feasible to separate riverine vegetation when vegetation is mapped beyond the boundaries of the study area. The distribution of these vegetation types also matches the distribution of the Etjo Erosion areas to a large extent (compare figure with maps 5 and 6. As mentioned above, association 9 has been mapped by the satellite data this far south as well, but more data should be collected to verify its actual distribution in the southern region of the study area.

Compared to the above species listing, *Crotalaria* spp were found to be relatively infrequent, but it can be accepted that this will vary from year to year. However, *Geigeria ornativa* and *Ondetia linearis* have increased significantly. Several farmers have reported incidences of poisoning of especially cattle in the early summer - but have stated that most poisonings are non-fatal.

10.2.4. Otjiwarongo Thornbush savanna (A4)

- dominant species
 ⇒ notes
- *Acacia mellifera*, *A. tortilis*, *Dichrostachys cinerea*
 ⇒ Bushencroachment a major problem in 1979 - reasons given are poor grazing management and overstocking, at least 25% of most farms affected
- *Tarchonanthus camphoratus*, *Boscia albitrunca*, *Terminalia sericea*, *Grewia* spp,
Lonchocarpus nelsii, *Combretum apiculatum*, *Leucosphaera bainesii*
 ⇒ common shrubs and trees
- *Geigeria ornativa*, *Urginea sanguinea*
 ⇒ main poisonous plants

- *Antephora pubescens*, *Brachiaria nigropedata*, *Dichanthium annulatum*, *Cenchrus ciliaris*, *Panicum maximum*, *Panicum coloratum*, *Urochloa oligotricha*, *Heteropogon contortus*, *Cymbopogon plurinodes*, *Eragrostis superba*
⇒ original climax grasses
- *Eragrostis trichophora*, *E. rigidior*, *E. lehmanniana*, *E. nindensis*, *E. porosa*, *Chloris virgata*, *Botriochloa radicans*, *Stipagrostis uniplumis*, *Aristida congesta*, *Schmidtia pappophoroides*, *Fingerhutia africana*, *Cymbopogon excavatus*, other *Aristida* spp
⇒ dominant subclimax 1979

Association 9 and 14 were regarded most similar to the above summary. Looking at maps 5 and 6 it does become clear that both vegetation types occur in a closely-knit mosaic, which will require additional sampling, also beyond the study area, for a clearer classification and delineation. In general, association 9 occurs on the plains south and north of Otjiwarongo, while association 14 occurs on footslopes of inselbergs as well as on ridges common around Otjiwarongo. The latter is thus similar to the Mountain Savanna of Giess (1971), which has not been adequately sampled in this study. Both associations merge strongly with the Otjenga plains described below.

Brachiaria nigropedata was not recorded in this vegetation type during the study. The incidence of poisonous plants in associations 9 and 14 has been found to be very low. The most frequently recorded species is *Geigeria acaulis*, while e.g. *Geigeria ornativa* or *Ondetia linearis* were very infrequent or not recorded at all. The presence of *Urginea sanguinea* could not be confirmed, as this plant usually emerges during early summer (November - January) and, if present, was not visible any more during the time of the survey.

10.2.5. Otjenga Plains (A3)

- dominant species
⇒ notes
- *Acacia mellifera*, *A. erubescens*, *Dichrostachys cinerea*, *Terminalia prunioides*
⇒ causes dense bush encroachment
- *Ficus sycomorus*, *Sclerocarya birrea*, *Kirkia acuminata*, *Albizia anthelmintica*, *Combretum imberbe*
⇒ common shrubs and trees on outcrops and mountains

- *Terminalia sericea*, *Lonchocarpus nelsii*
⇒ common shrubs and trees on plains
- *Peltophorum africanum*, *Acacia erioloba*, *A. karroo*, *A. tortilis*
⇒ common shrubs and trees on sandy plains
- *Antephora pubescens*, *Brachiaria nigropedata*, *Cenchrus ciliaris*, *Panicum coloratum*,
Urochloa oligotricha, *Heteropogon contortus*, *Fingerhutia africana*
⇒ original climax grasses
- *Eragrostis rigidior*, *E. porosa*, *Chloris virgata*, *Stipagrostis uniplumis*, *Schmidtia*
pappophoroides, *Enneapogon cenchroides*, annual *Aristida* spp
⇒ dominant subclimax 1979

The associations most similar here are 11 and 12, which have also been grouped into one vegetation type. Also similar is association 13. The distribution of both vegetation types is relatively patchy and very much integrated with association 14 as stated above.

10.2.6. Namibian Maize Triangle (A9)

- dominant species
⇒ notes
- *Kirkia acuminata*, *Acacia tortilis*, *A. karroo*, *Combretum imberbe*, *Sclerocarya birrea*,
Ficus spp, *Albizia anthelmintica*, *Peltophorum africanum*, *Lonchocarpus nelsii*,
Spirostachys africana, *Olea europaea*, *Berchemia discolor*, *Dombeya rotundifolia*,
Lannea discolor, *Ximenia* spp
⇒ common trees
- *Catophractes alexandri*, *Commiphora* spp, *Combretum apiculatum*, *Rhus* spp, *Grewia*
spp, *Acacia mellifera*, *Dichrostachys cinerea*, *Croton gratissimus*, *Ziziphus mucronata*,
Mundulea sericea, *Tarchonanthus camphoratus*
⇒ common shrubs
- *Cymbopogon excavatus*, *Hyparrhenia hirta*, *Andropogon gayanus*, *Botriochloa* spp,
Antephora pubescens, *Brachiaria nigropedata*, *Panicum* spp, *Urochloa oligotricha*,
Heteropogon contortus, *Fingerhutia africana*, *Aristida meridionalis*
⇒ grasses on “better” veld
- annual *Aristida* and *Eragrostis* spp
⇒ on degraded veld