

Vegetation of the lower Kuiseb River

by

G. K. Theron,

N. van Rooyen

and

Margaretha W. van Rooyen

Department of Botany,
University of Pretoria.

Cleared: August 1979

CONTENTS

1 Introduction	328
2 The study area	328
3 Method	331
4 Results and discussion	331
4.1 <i>Acacia albida</i> community	331
4.2 <i>Acacia erioloba</i> community	331
4.3 <i>Tamarix usneoides</i> community	337
4.4 <i>Salvadora persica</i> community	337
4.5 <i>Salvadora persica</i> — <i>Acacia erioloba</i> — <i>Tamarix usneoides</i> — <i>Euclea pseudebe-</i> <i>mus</i> dune community	337
4.6 <i>Suaeda plumosa</i> community	337
4.7 <i>Eragrostis spinosa</i> community	337
4.8 <i>Pechuel-loeschea leubnitziae</i> com- munity	337
4.9 Knob dune ("Knopduin") community .	337
4.10 <i>Acanthosicyos horrida</i> community	337
4.11 <i>Psilocalon</i> sp. cf. <i>salicornioides</i> com- munity	338
4.12 <i>Zygophyllum simplex</i> and <i>Zygophyllum</i> <i>stapfii</i> communities	338
4.13 <i>Odyssea paucinervis</i> community	338
4.14 Dead plant areas	338
5 General	338
6 Acknowledgements	338
7 Summary	338
8 References	339

ABSTRACT

The withdrawal of water from the lower Kuiseb River for mining and industrial purposes may influence the vegetation along the river. The maintenance of this vegetation is not only essential to the Kuiseb River ecosystem as a whole, but the vegetation acts as a barrier checking the northwards movement of the Namib dune-sea. Physiognomic-structural areas were distinguished on aerial photographs and these areas were investigated in the field for homogeneity and woody species composition. A vegetation map of the area between Nareb and Rooibank was compiled and 14 different communities were distinguished. Some of these communities were subdivided into variations and a total of 40 variations were distinguished. Four additional units, consisting mainly of dead herbaceous species were mapped between Gobabeb and Rooibank.

UITTREKSEL

Die onttrekking van water uit die laer Kuisebrivier vir myn- en industriële doeleindes kan moontlik die plantegroei langs die rivier beïnvloed. Die instandhouding van hierdie plantegroei is egter nie slegs noodsaaklik vir die Kuisebrivierekosisteem as 'n geheel nie, maar die plantegroei dien ook as 'n hindernis wat die noordwaartse beweging van die Namib duinesee stuit. Fisionomies-strukturele gebiede was op lugfoto's onderskei en in die veld vir homogeniteit en houtagtige spesiesamestelling nagegaan. 'n Plantegroeikaart van die gebied tussen Nareb en Rooibank is saamgestel en 14 verskillende gemeenskappe is onderskei. Sommige van hierdie gemeenskappe is in variasies onderverdeel en in totaal is 40 variasies onderskei. Vier addisionele eenhede, wat hoofsaaklik uit dooie kruidagtige spesies bestaan het, is tussen Gobabeb en Rooibank uitgekarteer.

1 INTRODUCTION

The Kuiseb River rises in the Khomas Hochland, near Windhoek, and with the relatively high rainfall in its catchment area it is the largest river in the coastal belt between the Orange and the Kunene (Myburgh, 1967). For the first 230 km the course of the Kuiseb is south-westerly until it reaches the foot of the escarpment (Gamsberg) where the Kuiseb River Canyon begins. For the next 130 km the river has carved its way deeply into the schist formations and follows a narrow, winding path until approximately 45 km upstream from Gobabeb at Nareb (Fig. 1). From Nareb the river gradually widens and sand-banks and/or flood-plains occur on one or both sides of the river-bed. Down-stream from Gobabeb the river-bed widens still further (Plate 1) and meanders between the Namib dune-sea on its southern side (Plate 2) and the Namib gravel plains on its northern side (Fig. 2). Down-stream from Gobabeb, about 27 km from the coast, the river forks into two main branches and ends in the so-called Kuiseb Delta, which is cut off from the sea by sand-dunes.

The Kuiseb River flows infrequently as this depends on the seasonal rainfall of the catchment area. Floods do not reach the lower Kuiseb River annually and are insufficient to maintain an open outlet to the sea (Robinson, 1976). Since 1837 floods have reached the sea only 15 times even though the river flows past Gobabeb for periods of a few days to several months (three months in 1974) in most years (Robinson, 1976). Down-stream from Gobabeb the river flows relatively slowly and plants are seldom uprooted and carried along in the flood, with the result that the river-bed is almost entirely overgrown with *Eragrostis spinosa* down-stream from the Narra Valley outcrops. Although the water from these floods is important to the vegetation along the river, especially to the herbaceous species, it is probably the large quantity of underground water that is essential for maintaining the vegetation along the river.

The mean annual rainfall at Gobabeb in the Namib Desert Park is 18,7 mm and thus the run-off from the gravel plains does not contribute much to the water supply of the lower Kuiseb River. Smaller rivers and streams from the gravel plains, however, probably carry large amounts of soluble salts into the Kuiseb.

Large amounts of water are at present being pumped from the lower Kuiseb between Swartbank and Rooibank. This water is used for town, industrial and mining development. To what extent this withdrawal of water will influence the vegetation along the river is still an open question. The maintenance of the vegetation is, however, not only essential to the Kuiseb River ecosystem as a whole but possibly also acts as a barrier which checks the northwards movement of the Namib dune-sea.

The objectives of this study were to distinguish and map the plant communities so as to provide a basis for

future monitoring of vegetational changes in relation to changes in the water status.

2 THE STUDY AREA

The part of the Kuiseb River that was studied stretches from Nareb in the east to Rooibank in the west (Fig. 1 and 4). The largest part of this area is situated in the Namib Desert Park (South West Africa/Namibia) but a small section reaches into the Walvis Bay area (Republic of South Africa).

An overall picture of the climate of Gobabeb over a period of 10 years (1962 to 1972) is given in the climatic diagram in Fig. 2 (Robinson, 1976). The climatic data for Gobabeb (Schulze, 1965; Seely and Stuart, 1976; Robinson, 1976) indicate the general climatic conditions of the area but do not exactly represent conditions that are experienced along the river.

The average annual cloud cover for Gobabeb is 3,3 octas at 08h00 contrasted to 1,3 octas at 14h00 and 1,4 octas at 20h00. Maximum cloud cover occurs during January and February and for the longest part of the year (214 days) the sunshine periods cover 80 % to 90 % of the possible duration.

During the ten years (1962 to 1972) the absolute maximum temperature recorded at Gobabeb was 42,3°C and the absolute minimum temperature 2,1°C (Fig. 5). March is usually the hottest month with a mean temperature of 24,8°C whereas July is the coldest with a mean temperature of 18,4°C. The mean annual aperiodic range (maximum minus minimum) for Gobabeb is 17,3°C.

Rainfall over the entire Namib Desert is very irregular. The mean annual rainfall for Gobabeb is 18,7 mm with the highest monthly mean (5,6 mm) during March. Fog is an important factor in the study area as the fog penetrates 30 to 40 km inland. Incidence of fog decreases eastwards and Walvis Bay experiences 60 days of fog per year (3 year observation period) whereas Gobabeb experiences 38,7 days of fog per year (10 year observation period).

During the summer months Gobabeb receives wind mainly from the north, north-west, west and south-west at mean velocities of 18 km per hour. In winter the predominant direction is east or south-east and wind velocities are, on average, higher. At Gobabeb sandstorms occur throughout the year (on average 7,7 days per year) although they appear to be more common between May and November.

According to the Köppen index (Schulze, 1947) the Namib is a hot desert with a BWh-climate. Thornthwaite classifies the area as a mesothermic region with a water shortage in all seasons (EB'd) (Schulze, 1947).

Although the vegetation is certainly influenced by prevailing climatic conditions, the availability of underground water probably has the most pronounced effect

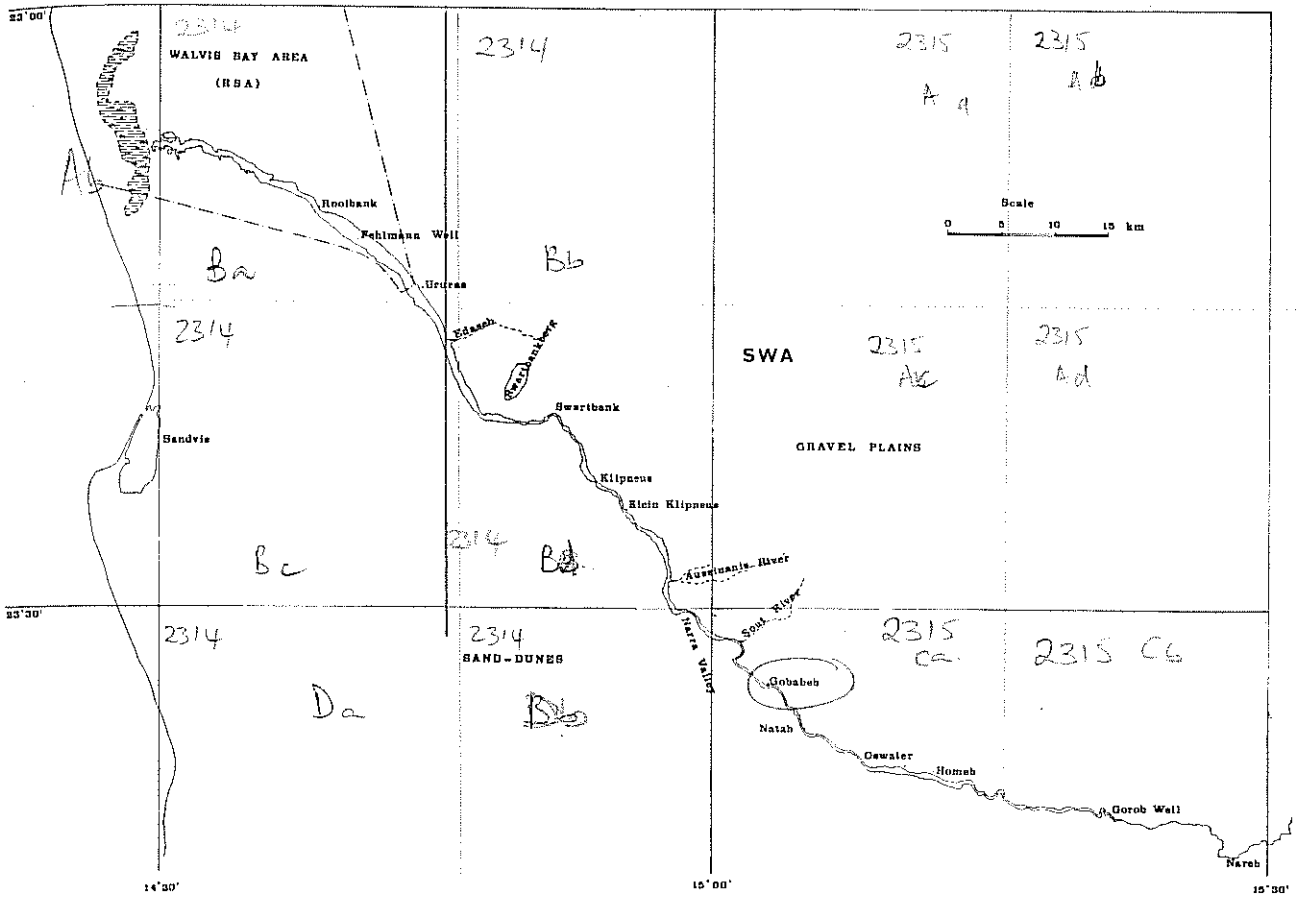


FIGURE 1: Map of the lower Kuiseb River.

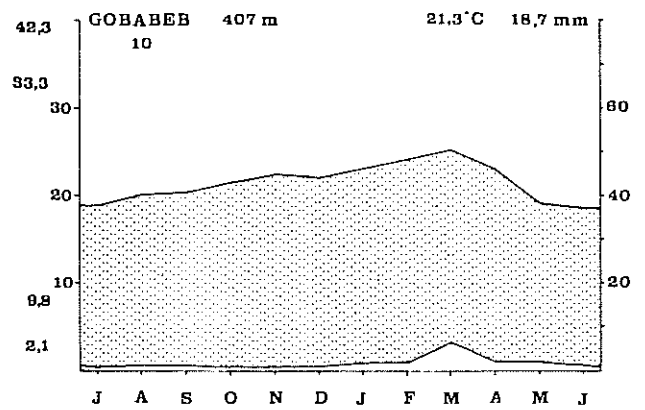


FIGURE 2: Climatic diagram for Gobabeb (Robinson, 1976).

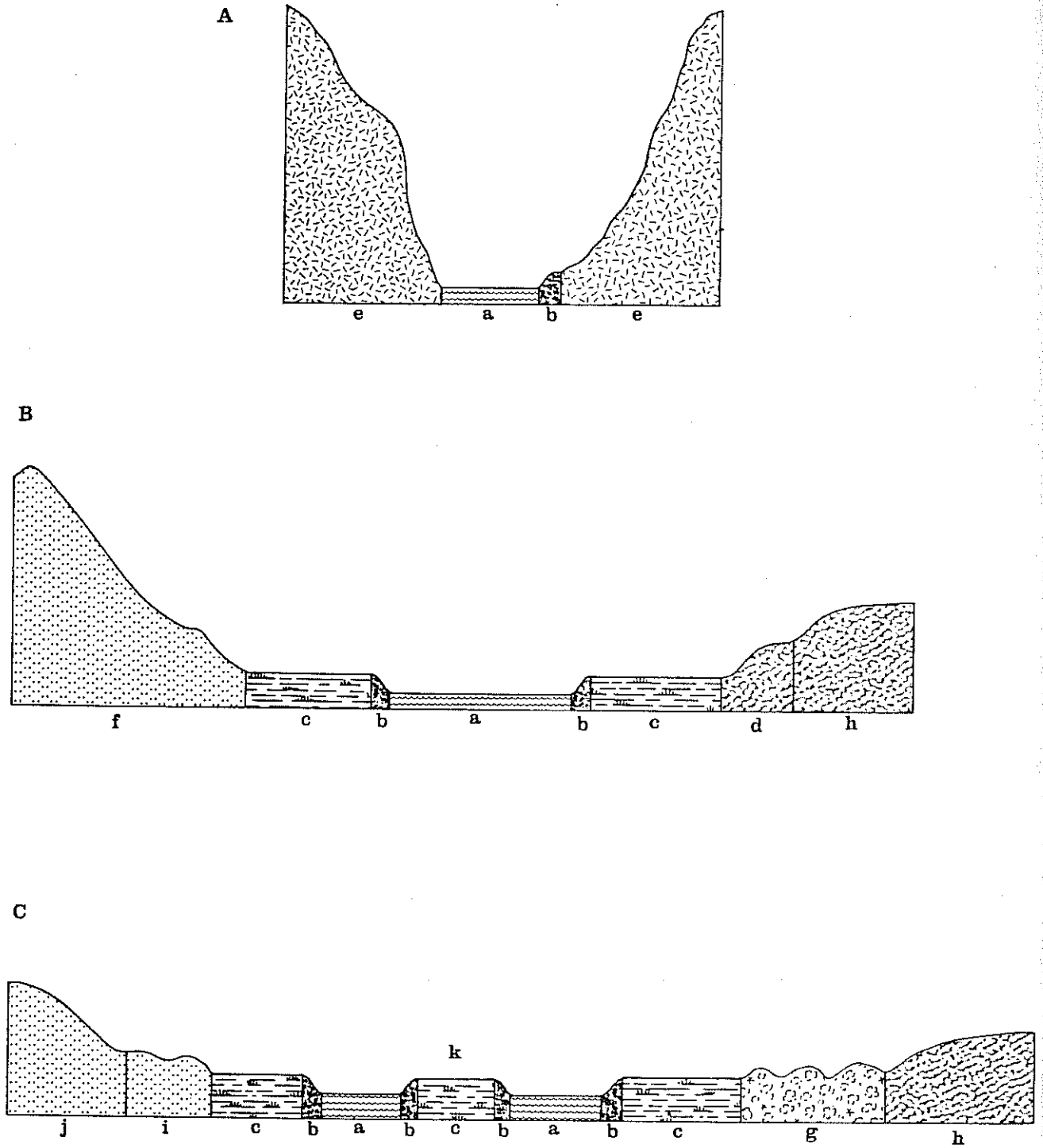


FIGURE 3: Diagrammatic presentation of cross-sections through the Kuiseb River: A = Nareb to Homeb; B = Homeb to Swartbank; C = Swartbank to Rooibank. a = river-bed; b = embankment; c = flood plain; d = terrace; e = cliffs/outcrops; f = steep, high dune; g = knob dunes; h = gravel plains; i = small dunes; j = less steep, high dune; k = island.

on the habitat of the different plant species along the river.

The sandy river-bed varies in width and is fringed by silt and sand-banks. From Nareb down to Homeb (Fig. 3 and Plate 4) the river-bed is relatively narrow and the flood-plains are often absent on one or both sides of the river. In some places the river-bank can be exceedingly steep and in these cases there is an abrupt transition from the river-bed to the steep high sand-dunes, cliffs or rocky outcrops.

From Homeb down to Swartbank (Fig. 3) the river-bed gradually widens and the flood-plains usually occur on both sides of the river. Between Swartbank and Rooibank the river-bed is at its widest and small or large islands occur. In the case of the larger islands a central flood-plain can be distinguished (Fig. 3). In the area down-stream from Swartbank a zone of knob dunes ("knopduine") or small dunes can be distinguished between the flood-plains and high sand-dunes on the southern side. On the northern side of the river the zone of knob dunes occurs between the flood-plains and the gravel plains.

3 METHOD

Physiognomic-structural areas were distinguished on aerial photographs of October 1976. These areas were investigated in the field for homogeneity and woody species composition. Units with the same structure and species composition formed a variation and several variations were grouped into a community. With the exception of a few herbaceous species e.g. *Eragrostis spinosa*, *Stipagrostis sabulicola*, *Odysea paucinervis* and *Zygophyllum simplex*, only woody species were used for the characterisation of the vegetation units.

4 RESULTS AND DISCUSSION

A vegetation map of the area between Nareb and Rooibank (Fig. 4) was compiled and 14 different communities were distinguished. Some of the communities were subdivided into variations and a total of 40 variations were distinguished (Table 1). Four additional units, consisting mainly of dead herbaceous species were mapped between Gobabeb and Rooibank (Fig. 4).

4.1 *Acacia albida* community

This community, characterised mainly by large trees, occupies the river-banks (Plate 5), although a number of large *Acacia albida* individuals often occur in the river-bed (Plate 6). The *Acacia albida* community is well-developed between Nareb and Swartbank (Plate 5), whereas from Swartbank to Rooibank, *Acacia albida* often occurs as solitary individuals (Plate 6). In the vicinity of the Fehlmann Well, along the southern bank, relatively young individuals form a dense stand. Many of these plants have a low vitality and are dying.

Dense stands of *Suaeda plumosa* and *Cyperus marginatus* in this area also show signs of a lowered vitality. The deterioration of the vegetation in this area can possibly be attributed to a lowering of the water table.

The *Acacia albida* variation, consisting of virtually pure stands of *A. albida*, is well-represented up-stream of the Narra Valley outcrops. In the vicinity of Homeb trees often reach 21 m in height. The *Acacia albida* – *Salvadora persica* variation is mainly found between Nareb and Natab where the flood-plains are very narrow or absent. The *Acacia albida* – *Tamarix usneoides* variation (Plate 7) is more conspicuous up-stream from Gobabeb where it occurs in narrow outstretched strips along the river-bank. Down-stream from Gobabeb this variation consists mainly of young individuals of both species. These often occur up-stream of rocky outcrops or water barriers across the river-bed. The other variations of the *Acacia albida* community are mainly found down-stream from Gobabeb. Although some of these variations such as the *Acacia albida* – *Pechuel-loeschea leubnitziae* variation and the *Acacia albida* – *Eragrostis spinosa* – *Pechuel-loeschea leubnitziae* variation appear as clearly distinguishable units on the aerial photographs, they are not always so clearly delineated in the field and should perhaps be grouped together.

4.2 *Acacia erioloba* community

The *Acacia erioloba* community is a characteristic of the silt flood-plains but also occurs in the central area on the larger islands (Plate 8). This community is represented by only a few individuals in the Nareb area, whereas down-stream from the Gorob Well, where the flood-plains become wider, more extensive stands of this community occur. From Homeb down-stream to the Narra Valley outcrops, the community is represented primarily by large old trees. In this area the number of large dead *A. erioloba* trees is very conspicuous. The explanation for this is not clear but it is doubtful whether the withdrawal of water from the river-bed can be the cause. Down-stream from Swartbank relatively young plants of *A. erioloba* form dense stands.

According to Fig. 4 the *Acacia albida* community is the predominant type of vegetation in the upper part of the study area where the flood-plains are very narrow. Further down-stream where the flood-plains become progressively broader the *Acacia erioloba* community predominates as vegetation type.

As in the case of the *Acacia albida* community all the variations within the *Acacia erioloba* community between Swartbank and Rooibank are not clearly delineated in the field, nevertheless they show up as distinct physiognomic-structural units on aerial photographs.

Acacia erioloba is not confined to the flood-plains, but is also found on the dunes on the southern side of the river (Plate 9) as well as on the knob dunes



PLATE 1: The gravel plains on the left and the Namib dune-sea on the right side of the Kuiseb River.



PLATE 2: The Namib dune-sea on the southern side of the Kuiseb River.



PLATE 3: In the foreground the Namib gravel plains on the northern side of the Kuiseb River (1) and the Namib dune-sea on the horizon.

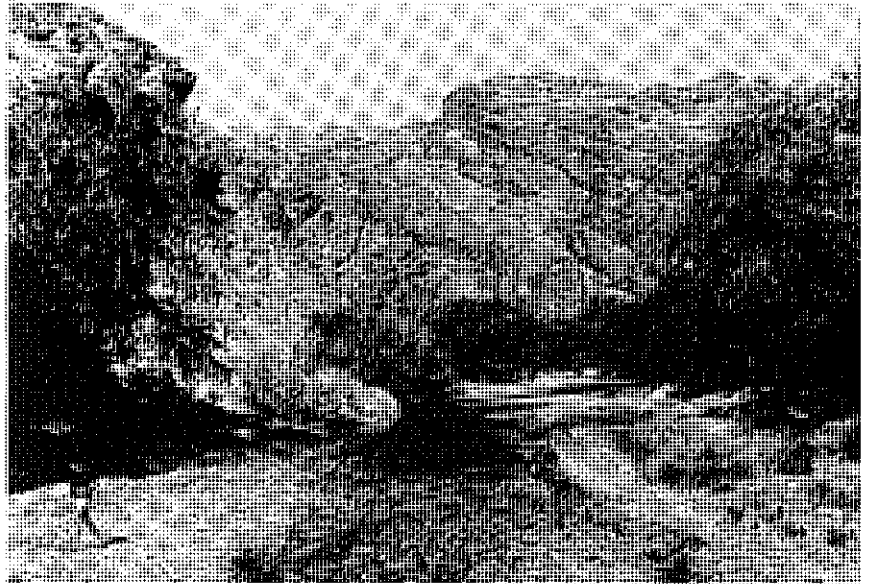


PLATE 4: The Kuiseb River near Nareb with *Acacia albida* on the embankment along the canyon walls.

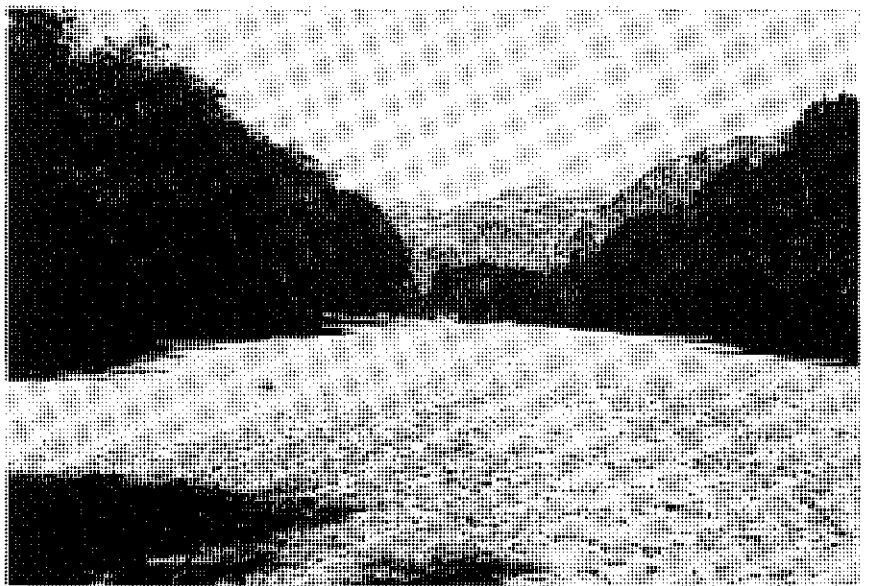


PLATE 5: The *Acacia albida* community along the river-bed near Homeb.

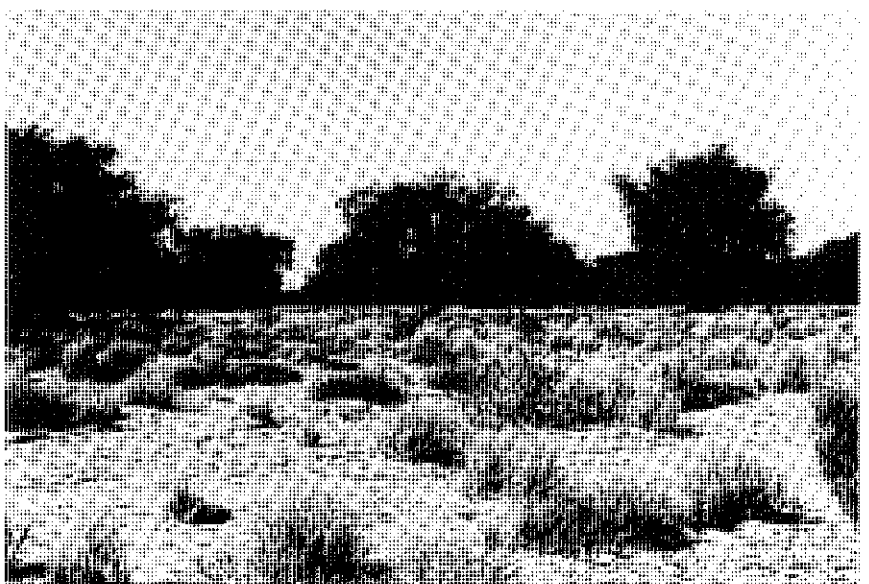


PLATE 6: Large *Acacia albida* individuals with the dominant grass *Eragrostis spinosa* in the river-bed near Swartbank.

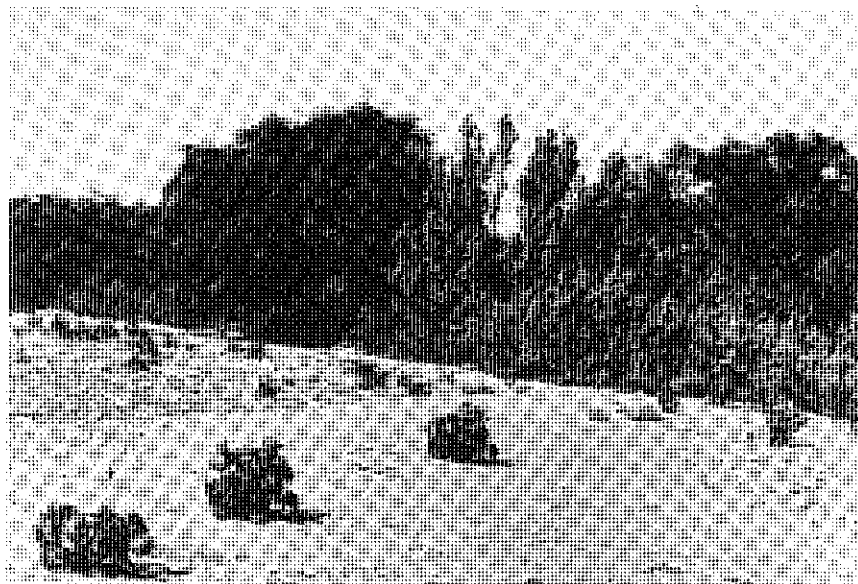


PLATE 7: The *Acacia albida* - *Tamarix usneoides* variation on the embankment near Gobabeb.

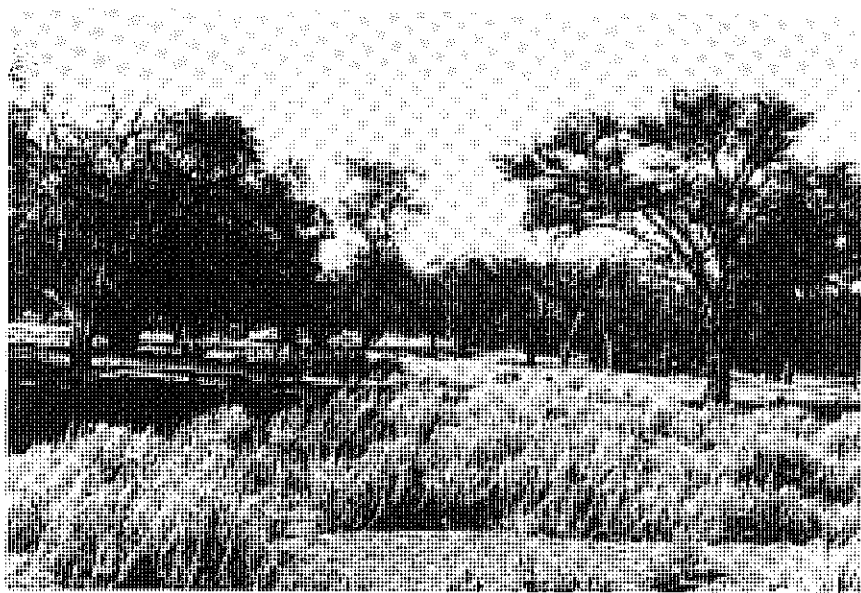


PLATE 8: The *Acacia erioloba* community with *Eragrostis spinosa* in the foreground.



PLATE 9: The *Salvadora persica* - *Acacia erioloba* (1) - *Tamarix usneoides* - *Euclea pseudebenus* (2) dune community near Gobabeb with *Stipagrostis sabulicola* in the foreground.

PLATE 10: The knob dune ("knopduin") community near Swartbank with *Acacia erioloba* on the dunes and *Eragrostis spinosa* and *Stipagrostis sabulicola* in the foreground.

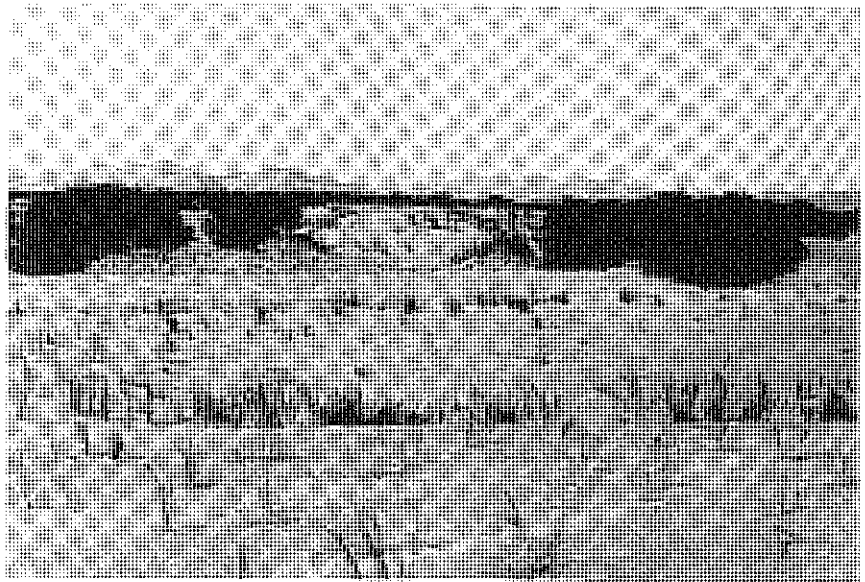


PLATE 11: A dense stand of *Suaeda plumosa* (1) with *Acacia erioloba* and *A. albida* in the background.

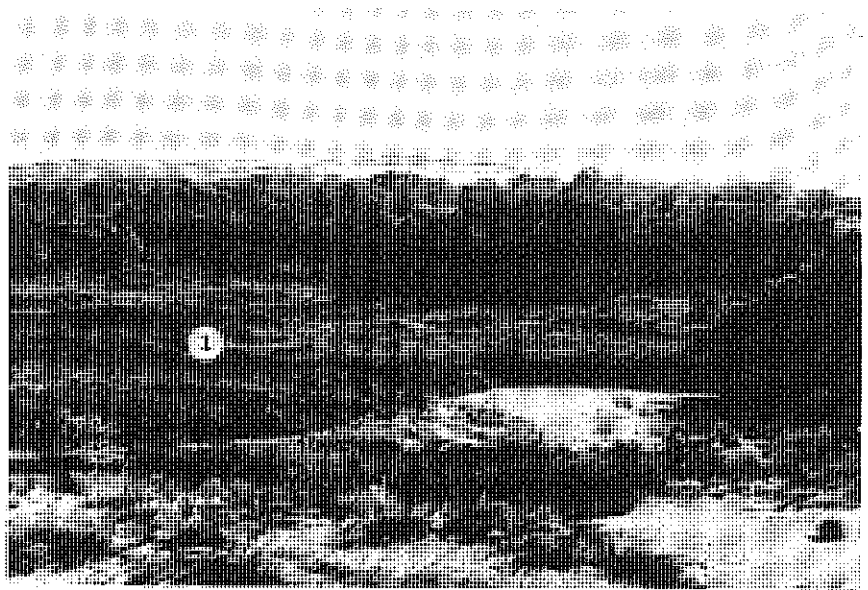
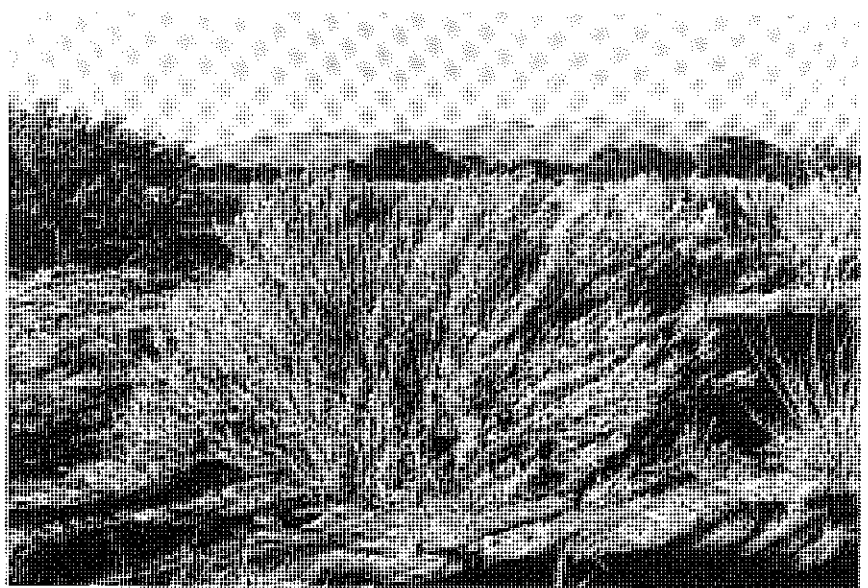


PLATE 12: *Pechuel-loeschea leubnitziae* in the *P. leubnitziae* community on the outstretched flood-plains near Fehlmann Well.



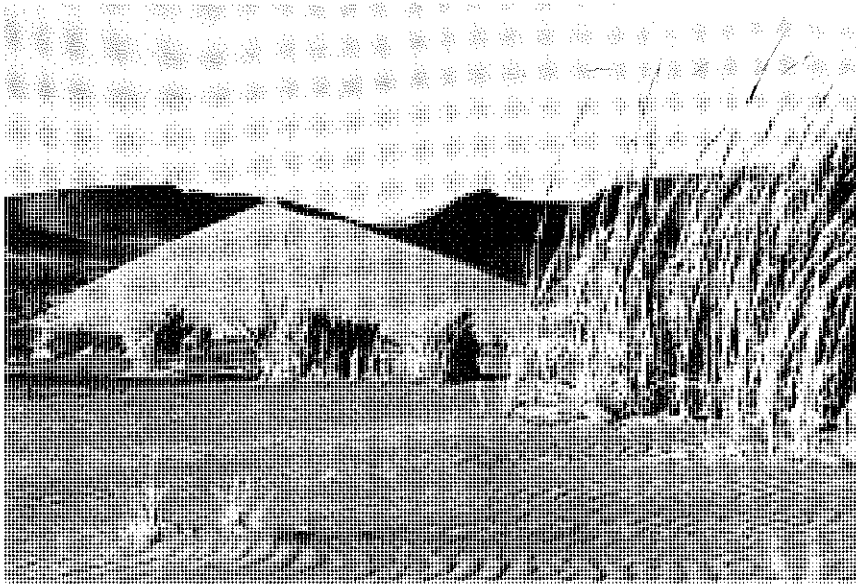


PLATE 13: *Stipagrostis sabulicola* on the sand-dunes south of the Kuiseb River.

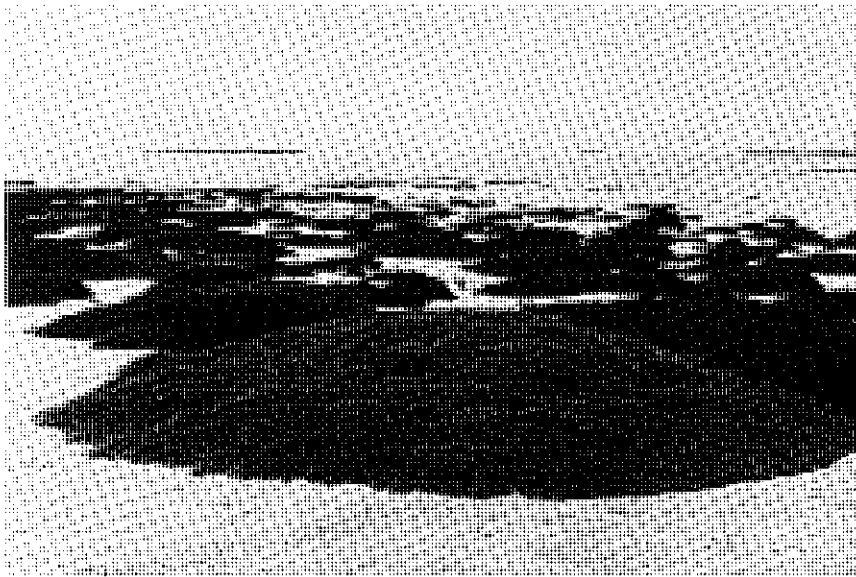


PLATE 14: *Psilocalon* sp. cf. *salicornioides* in the bed of the Soutrivier.

(Plate 10) on both sides of the river in the Rooibank area.

In spite of the reasonably good rains during 1976 to 1978, seedlings of *A. erioloba* are almost absent. The lack of these seedlings can possibly be ascribed to the large numbers of livestock kept by the local Topnaar population.

4.3 *Tamarix usneoides* community

Besides the two above-mentioned communities the *Tamarix usneoides* community is among the most striking of the lower Kuiseb River and occurs on the river-banks (compare Plate 7), flood-plains as well as the foot of the dunes. Immediately above the outcrops jutting out into the river, dense stands of relatively young plants of *Tamarix usneoides* are found in the river-bed. On the flood-plains *T. usneoides* appears as individual plants or as dense impenetrable stands. Big old plants of *T. usneoides* are found on the knob dunes and also at the foot of large sand-dunes.

Between Gobabeb and Swartbank groups of young *Tamarix usneoides* plants grow directly down-stream of *Acacia albida* individuals in the river-bed. Silt accumulation between these dense stands of *T. usneoides* gradually leads to the formation of an island.

Seedlings of *Tamarix usneoides* are found in large numbers in the river-bed and it appears that they are dependant for establishment on the moist conditions inherent in the river-bed. If this is so, the older individuals and thickets of *T. usneoides* occupying the flood-plains possibly indicate an earlier course of the river.

4.4 *Salvadora persica* community

Although this community is seldom present as extensive stands, *Salvadora persica* forms localised mats. The community consists of pure stands of *S. persica* which occur on the steep dunes between Nareb and Gobabeb and in isolated patches down to Swartbank. It is also found on the flood-plains, outcrops and occasionally on the knob dunes on the northern side of the river.

4.5 *Salvadora persica* – *Acacia erioloba* – *Tamarix usneoides* – *Euclea pseudeben* dune community

This community occurs mainly on the southern side of the river, on the sand-dunes (Plate 9). The individual plants are widely spaced and each plant usually forms a large clump with numerous stems. All the above-mentioned species do not occur in each of the mapped units of this community – sometimes only two of these species occur within a unit.

4.6 *Suaeda plumosa* community

The *Suaeda plumosa* community occurs down-stream from Homeb and is especially well-represented in the vicinity of the Aussinanis River, Klipneus, Swartbank and up-stream of the Fehlmann Well. The community consists of almost impenetrable thickets of *Suaeda plumosa* (Plate 11) reaching 2 m in height. However, in more open patches *Cyperus marginatus* and *Pechuel-loeschea luebnitziae* are frequently found in association with *Suaeda plumosa*. The *Suaeda plumosa* community is often found where brackish conditions exist and small rivers or streams from the gravel plains join the Kuiseb River. In the Fehlmann Well area, stands of this community are dying and in some places 80 % to 90 % of the plants have died. The deterioration of the vegetation is probably attributable to a lowering of the water table.

4.7 *Eragrostis spinosa* community

This community covers the river-bed from the Narra Valley outcrops to Rooibank (compare Plate 6). In this area the flood-water is apparently not strong enough to sweep the plants away. Other species that are locally conspicuous in this community are *Psoralea obtusifolia* and *Heliotropium ovalifolium*.

4.8 *Pechuel-loeschea luebnitziae* community

This community occurs on the flood-plains especially between the Klipneus area and Rooibank. Although *P. luebnitziae* (Plate 12) can form pure stands it usually grows in association with *Eragrostis spinosa* and/or *Blumea gariepina*. Where this community borders on the knob dune community *Stipagrostis sabulicola* is frequently found among the other species. The species in this community are probably associated with a high-water table and it was noted that plants of *P. luebnitziae* have a higher vitality in the Klipneus area than further down-stream near Rooibank.

4.9 Knob dune (“knopduin”) community: *Stipagrostis sabulicola*, *Acanthosicyos horrida*, *Acacia erioloba*, *Adenolobus gariepensis*, *Lycium tetrandrum*

This group of plants occurs mainly between Swartbank and Rooibank on the knob dunes (Plate 10) on both sides of the river. The community is characterised by *Stipagrostis sabulicola*, *Acanthosicyos horrida*, *Acacia erioloba*, *Adenolobus gariepensis* and *Lycium tetrandrum*, occurring individually or in groups on a knob dune. Between these dunes *Stipagrostis sabulicola* and *Eragrostis spinosa* are frequently found.

4.10 *Acanthosicyos horrida* community

Strictly speaking this community does not form part of the river communities, but can be regarded as a pure

dune community (Robinson, 1976). The possibility does, however, exist that the roots of *A. horrida* reach the underground water reserves of the river. The community occurs on the dunes on the southern side of the river, occasionally on the knob dunes on both sides of the river as well as in the dune streets at Narra Valley and also opposite Ururas. *Acanthosicyos horrida* is important as a sand binder and occurs on its own or in association with *Stipagrostis sabulicola*. In certain areas *S. sabulicola* predominates (Plate 13) but these units were not mapped as separate units or variations.

4.11 *Psilocalon* sp. cf. *salicornioides* community

This community, consisting of pure stands of *Psilocalon* sp. cf. *salicornioides* (Plate 14) has a limited distribution and is found mainly in the river-bed of the Aussanis River as well as in the area up-stream from Ururas. This community, like the *Suaeda plumosa* one, favours brackish conditions. The existence of this community probably depends on local rainfall to provide a run-off from the gravel plains.

4.12 *Zygophyllum simplex* and *Zygophyllum stapfii* communities

Both communities are found between Ururas and Rooibank along the border of the knob dunes and the gravel plains. They depend largely on the run-off from the gravel plains.

4.13 *Odysea paucinervis* community

This community occurs on the northern side of the river in the Ururas area and is found sporadically down stream to Rooibank. According to Robinson (1976) *O. paucinervis* is associated with marshy conditions. In certain areas it appears that this community indicates previous moist conditions. In areas rich in silt, *Suaeda plumosa* occurs together with *O. paucinervis*, whereas *Lycium tetrandrum* is found with *O. paucinervis* on small sand heaps.

4.14 Dead plant areas

Such areas occur on the flood-plains and in the river-bed and are characterised by the remains of species such as *Datura* spp., *Ricinus communis*, *Nicotiana glauca*, *Eragrostis spinosa* and *Cynodon dactylon*.

5 GENERAL

Although this was not a quantitative study, the different communities and variations were easily distinguishable on the basis of their floristic composition, because of the very limited number of species involved. In most cases the variations consist only of the species included

under the name of the variation. Some of the variations are closely related to one another but differ only in the relative dominance of the different species. These variations are nevertheless all clearly distinguishable on aerial photographs.

The large number of variations distinguished can possibly aid the monitoring of vegetational changes to assess the influence of the withdrawal of water for other purposes from the lower Kuseb River.

6 ACKNOWLEDGEMENTS

The authors have pleasure in thanking the CSIR, the Division of Nature Conservation and Tourism of the SWA Administration as well as the staff and botany students of the Botany Department of the University of Pretoria for their help during this project.

7 SUMMARY

The Kuseb River rises in the Khomas Hochland and with the relatively high rainfall in its catchment area it is the largest river in the coastal belt between the Orange and the Kunene. The river flows infrequently as this depends on the seasonal rainfall in the catchment area. Floods do not reach the lower Kuseb River annually and are insufficient to maintain an open outlet to the sea.

The mean annual rainfall at Gobabeb in the Namib Desert Park is 18,7 mm and this rainfall is very irregular. Fog is an important factor in the study area as it penetrates 30 km to 40 km inland.

The part of the Kuseb River that was studied stretches from Nareb in the east to Rooibank in the west. The withdrawal of large amounts of water from the Lower Kuseb River for town, mining and industrial purposes may have an influence on the vegetation. The maintenance of the vegetation is essential to the Kuseb River ecosystem as a whole, but the vegetation possibly also acts as a barrier which checks the northwards movement of the Namib dune-sea.

Physiognomic-structural areas were distinguished on aerial photographs and these areas were investigated in the field for homogeneity and woody species composition. Units with the same structure and species composition formed a variation and several variations were grouped together in a community. A vegetation map of the area between Nareb and Rooibank was compiled and 14 different communities were distinguished with the *Acacia albida* and *Acacia erioloba* communities as the most important. A total of 40 variations were distinguished. Four additional units, consisting mainly of dead herbaceous species, were mapped between Gobabeb and Rooibank.

The large number of variations distinguished can possibly aid the monitoring of vegetational changes to assess the influence of the withdrawal of water from the lower Kuseb River.

8 REFERENCES

- MYBURGH, R. I. D., McC.
1971: The water projects of the Namib Desert. *J. S. Afr. Sci.* 76: 152 – 158.
- ROBINSON, E. R.
1976: *Phytosociology of the Namib Desert Park, South West Africa*. M.Sc. thesis. University of Natal, Pietermaritzburg.
- SCHULZE, B. R.
1947: The climates of South Africa according to the classifications of Köppen and Thornthwaite. *S.Afr. Geogr. J.* 29: 32 – 42.
- SCHULZE, B. R.
1965: *Climate of South Africa*. Part 8. *General Survey*. Pretoria: Government Printer.
- SEELY, Mary K., and STUART, P.
1976: The climate of Gobabeb, ten year summary, 1962 – 1972. *Namib Bulletin* 1 (Suppl. to Transvaal Mus. Bull. Aug. 1976).

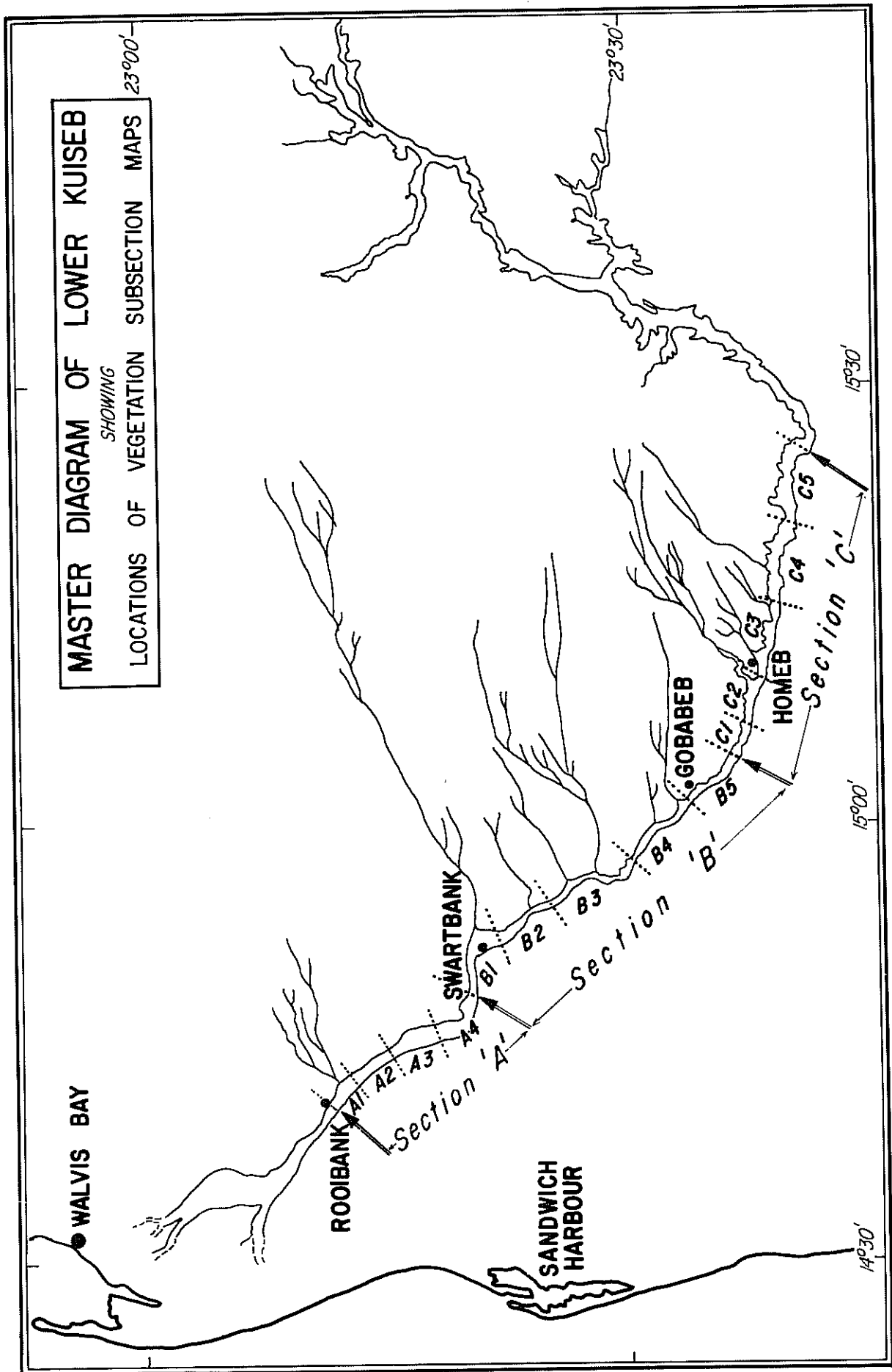
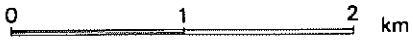


FIGURE 4.

VEGETATION MAP LOWER KUISEB RIVER

Scale Skaal



- BEACON BAKEN ●
- WELL PUT ○

Subsection A1

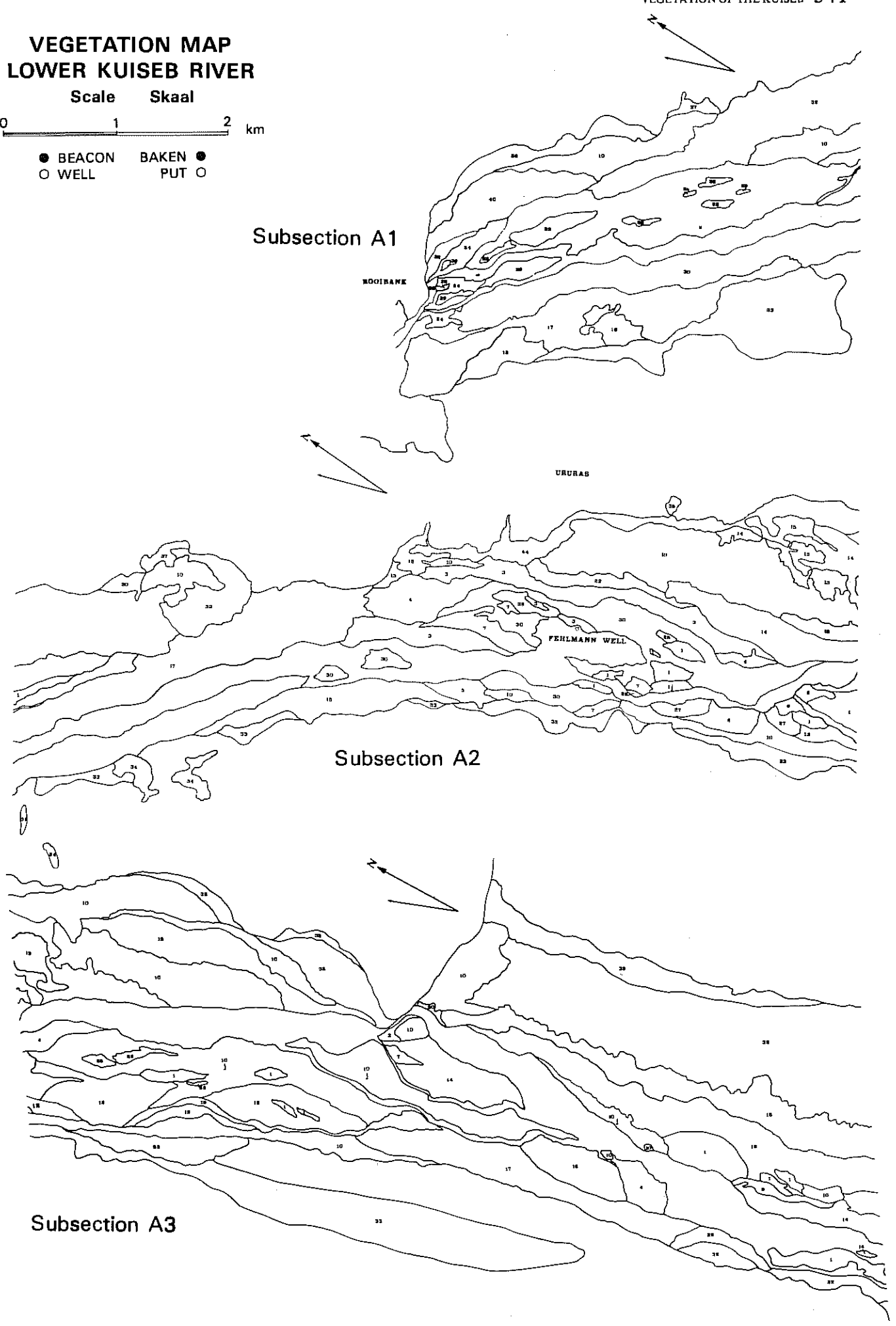
XOOISANE

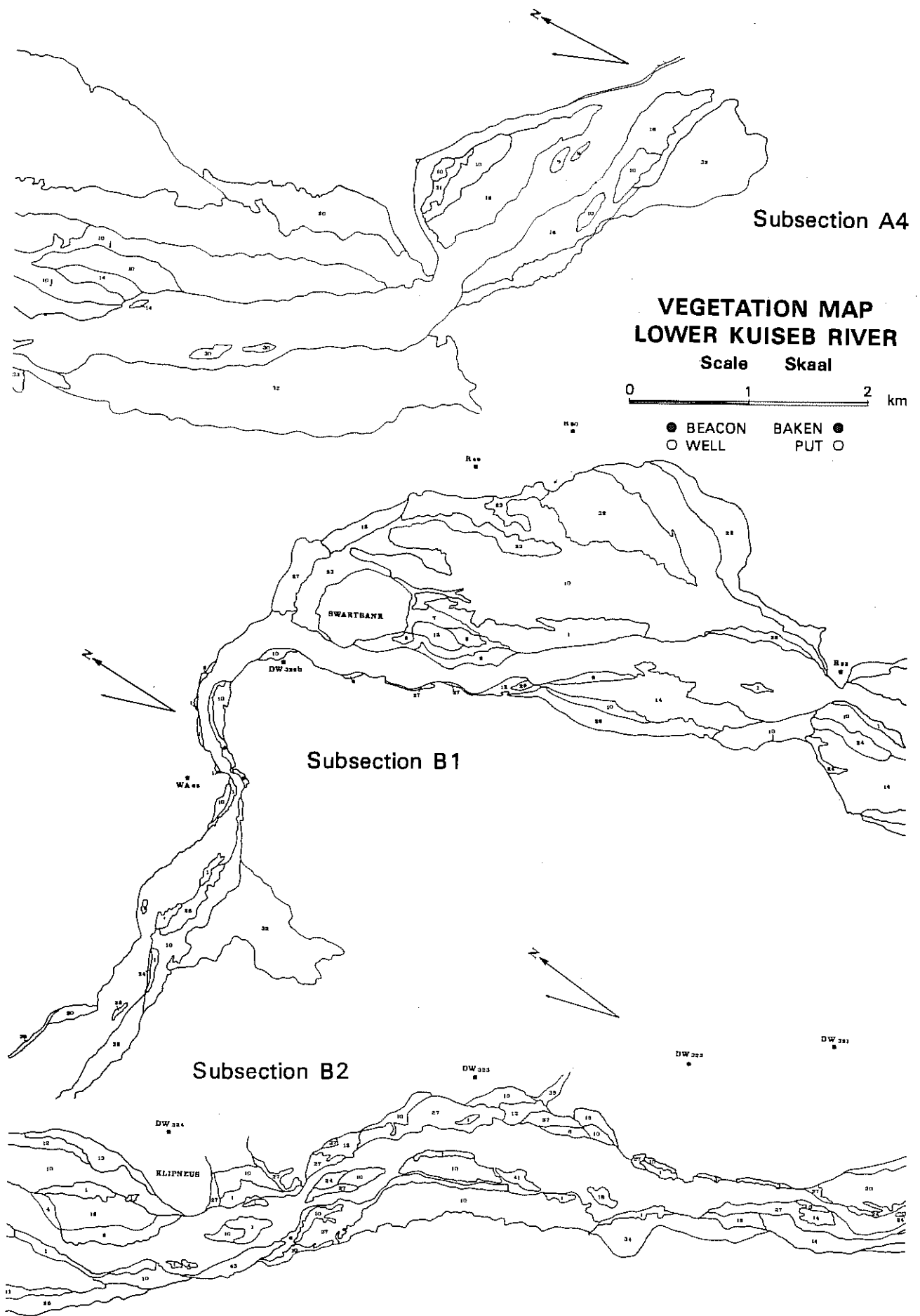
URURAS

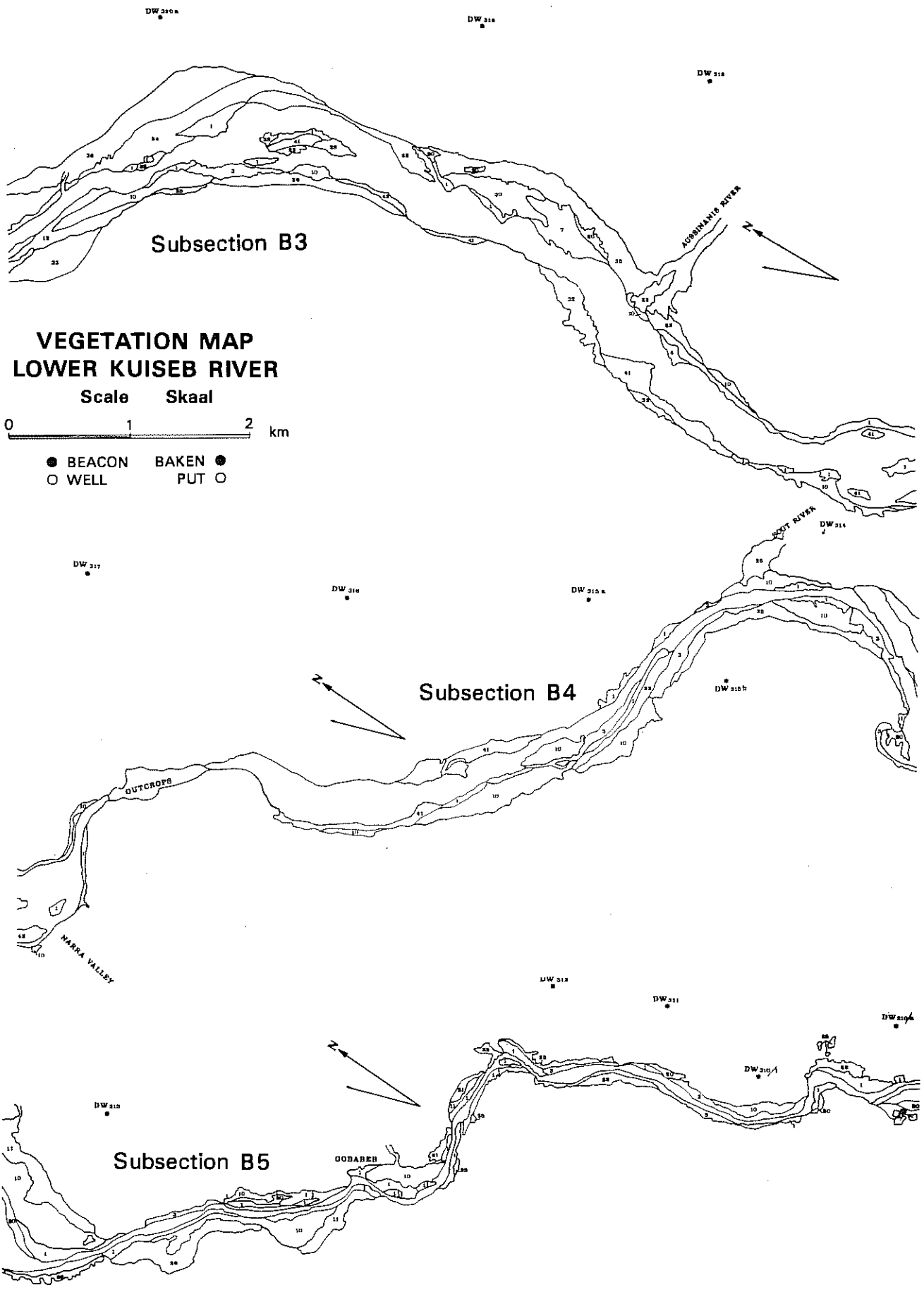
FEHLMANN WELL

Subsection A2

Subsection A3

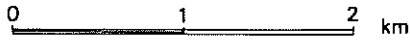




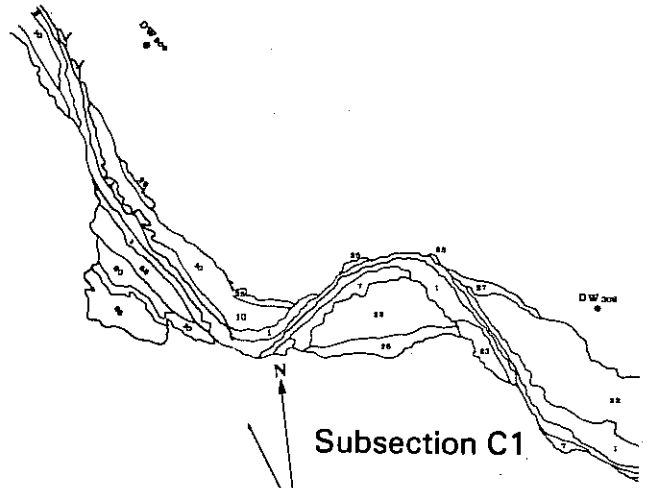


VEGETATION MAP LOWER KUISEB RIVER

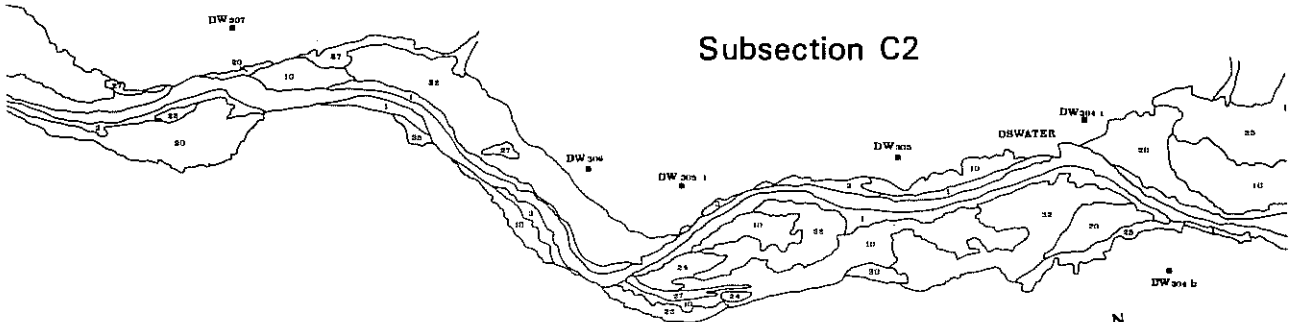
Scale Skaal



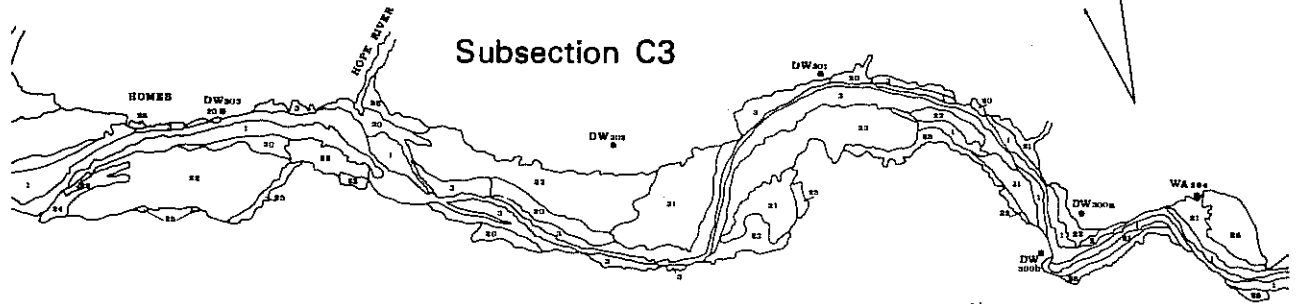
- BEACON ● BAKEN
- WELL ○ PUT



Subsection C1



Subsection C2



Subsection C3

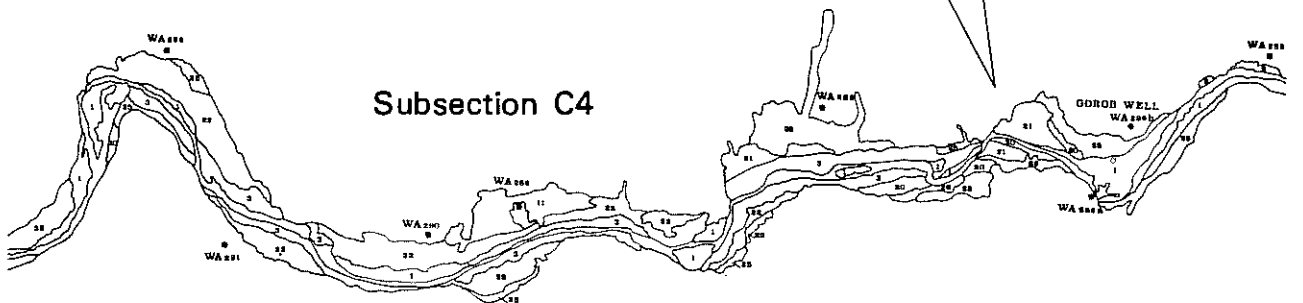


TABLE 1: (Legend to Fig. 4) Plant communities of the lower Kuseb River.

-
- ACACIA ALBIDA COMMUNITY**
1. *Acacia albida* variation
 2. *Acacia albida* – *Salvadora persica* variation
 3. *Acacia albida* – *Tomarix usneoides* variation
 4. *Acacia albida* – *Eragrostis spinosa* variation
 5. *Acacia albida* – *Stipagrostis sabulicola* variation
 6. *Acacia albida* – *Suaeda plumosa* variation
 7. *Acacia albida* – *Tamarix usneoides* – *Acacia erioloba* variation (sometimes with *Eragrostis spinosa* or *Suaeda plumosa*)
 8. *Acacia albida* – *Eragrostis spinosa* – *Pechuel-loeschea leubnitziae* variation
 9. *Acacia albida* – *Pechuel-loeschea leubnitziae* variation
- ACACIA ERIOLOBA COMMUNITY**
10. *Acacia erioloba* variation
 11. *Acacia erioloba* – *Salvadora persica* variation
 12. *Acacia erioloba* – *Suaeda plumosa* variation
 13. *Acacia erioloba* – *Suaeda plumosa* – *Pechuel-loeschea leubnitziae* variation
 14. *Acacia erioloba* – *Pechuel-loeschea leubnitziae* variation
 15. *Acacia erioloba* – *Stipagrostis sabulicola* variation
 16. *Acacia erioloba* – *Eragrostis spinosa* – *Pechuel-loeschea leubnitziae* variation
 17. *Acacia erioloba* – *Acacia albida* – *Pechuel-loeschea leubnitziae* variation
 18. *Acacia erioloba* – *Acacia albida* variation
 19. *Acacia erioloba* – *Eragrostis spinosa* variation
- TAMARIX USNEOIDES COMMUNITY**
20. *Tamarix usneoides* variation
 21. *Tamarix usneoides* – *Salvadora persica* variation
 22. *Tamarix usneoides* – *Acacia erioloba* variation
 23. *Tamarix usneoides* – *Acacia erioloba* – *Salvadora persica* variation
 24. *Tamarix usneoides* – *Suaeda plumosa* variation
- SALVADORA PERSICA COMMUNITY**
26. *SALVADORA PERSICA* – *ACACIA ERIOLOBA* – *TAMARIX USNEOIDES* – *EUCLEA PSEUDEBENUS* DUNE COMMUNITY
- SUAEDA PLUMOSA COMMUNITY**
27. *SUAEDA PLUMOSA* COMMUNITY
- ERAGROSTIS SPINOSA COMMUNITY**
28. *ERAGROSTIS SPINOSA* COMMUNITY
- PECHUEL-LOESCHEA LEUBNITZIAE COMMUNITY**
29. *Pechuel-loeschea leubnitziae* variation
 30. *Pechuel-loeschea leubnitziae* – *Eragrostis spinosa* variation
 31. *Pechuel-loeschea leubnitziae* – *Eragrostis spinosa* – *Stipagrostis sabulicola* variation
- 32. KNOB DUNE COMMUNITY: STIPAGROSTIS SABULICOLA, ACANTHOSICYOS HORRIDA, ACACIA ERIOLOBA, ADENOLOBUS GARIEPENSIS, LYCIUM TETRANDRUM**
- ACANTHOSICYOS HORRIDA DUNE COMMUNITY**
33. *Acanthosicyos horrida* variation
 34. *Acanthosicyos horrida* – *Stipagrostis sabulicola* variation
- 35. PSILOCAULON sp. cf. SALICORNIOIDES COMMUNITY**
- 36. ZYGOPHYLLUM STAPFII COMMUNITY**
- 37. ZYGOPHYLLUM SIMPLEX COMMUNITY**
- ODYSSEA PAUCINERVIS COMMUNITY**
38. *Odyssea paucinervis* variation
 39. *Odyssea paucinervis* – *Suaeda plumosa* variation
 40. *Odyssea paucinervis* – *Lycium tetrandrum* variation
- DEAD PLANT AREAS**
41. *Eragrostis spinosa*, *Datura* spp., *Nicotiana glauca*, *Ricinus communis*
 42. Dead *Eragrostis spinosa* with living *Acacia erioloba*
 43. Dead *Eragrostis spinosa* with living *Acacia albida*
 44. *Eragrostis spinosa*, *Zygophyllum simplex*, *Suaeda plumosa*
-