TRAINING PROJECT IN PEDOLOGY
KILIFI – KENYA

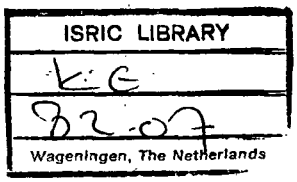
M. W. N. VAN LEEUWEN

VEGETATION AND LANDUSE MAP (SCALE 1:100,000) OF THE KILIFI-AREA

A LANDSCAPE GUIDED APPROACH

PRELIMINARY REPORT NO 3
(KILIFI SERIES)

RICULTURAL UNIVERSITY
GENINGEN - THE NETHERLANDS



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a landscape guided approach

by

M.W.N. van Leeuwen

preliminary report no. 3
(Kilifi series)
Januari 1982

Training Project In Pedology, Kilifi Kenya
Agricultural university, Wageningen - The Netherlands

CONTENTS

Preface (1)

This is a Preliminary Report of the Training Project in Pedology (T.P.I.P.) at Kilifi (Kenya), of the Section in Tropical Soil Science of the Department of Soil Science and Geology of the Agricultural University at Wageningen (the Netherlands).

The Training Project in Pedology was started in 1972 in the Kisii area. In 1979 the project was transferred to the Kilifi area at Kenya's Coast, and Project activities started in September. As in Kisii, this project has as its major aim the production of a mapsheet (Kilifi) on scale 1:100,000 in the frame of the Soil Map of Kenya in cooperation with the Kenya Soil Survey (Ministry of Agriculture). There are also links with the faculty of Agriculture of the University of Nairobi.

The project is meant for training of postgraduate students of the Agricultural University at Wageningen and for furnishing research opportunities of the staff. The activities of students and staff are directed to obtain a better knowledge of the soils, and the agricultural conditions of the project area to provide a basis for further agricultural development of the area.

The project at Kilifi is conducted by:

Dr.ir. T. de Meester (Principal)
Teaching and research

Ing. H.W. Boxem (Manager)
Management and teaching

Visiting specialists from the Agricultural University at Wageningen help to resolve special problems.

We hope to return with these reports a small part of the great debt we owe Kenya in general and to many Kenyans in particular for their valuable contributions to the project.

J. Bennema (Supervisor of the project,
Professor in Tropical Soil Science)

Preface (2)

Ecologists tend to complain that changes in use and management of land often are carried out in a way that will lad to deterioration, which could have been avoided if their expertise had been involved at an early stage of decision making. On the other hand, their own research programmes do not always show much concern with such urgent problems. If they appear to have mainly an interest in methods and techniques instead of results, or are working on a scale that is not relevant to practical problems, the result may be that others will tackle the really important ecological problems in their own, perhaps amateuristic way.

In the "Kilifi T.P.I.P.", thanks to the insight of the organisers, the necessary disciplines have been cooperating from the very beginning. It was clear that a detailed analysis of the constantly changing pattern of vegetation in this complicated and floristically rich region was out of reach. For the purpose of the project, this would not have been necessary or even desirable. Thanks to the use of aerial photographs (which show vegetation structure in the first place) and to the contribution of various plant taxonomists, we are nevertheless able to present now a map of "vegetation landscapes" and a description of plant communities which contains much more than the superficial information on native and man-made vegetation of the area that was available up to now.

Two Preliminary Reports are presented. Report nr. 3 presents a general survey of the project area, mainly consisting of a photo interpretation map, a description of the mapping units and of the plant communities (based on structure and floristic composition). Preliminary Report nr. 4 deals with a more detailed analysis of one of the main landscape types ("shale landscape"), with an emphasis on human influence on the vegetation.

Including the study on carrying capacity for stock of woody and herbaceous vegetation, which is to appear in the near future, our group of botanists feel that we have had a fair chance to make the kind of contribution, necessary to be incorporated in the final land evaluation which is to crown this project. However that may be, it was a fascinating project!

H. Doing (Senior Lecturer, Department of
Vegetation Science, Plant Ecology
and Weed Science)

SUMMARY

In a 6-month period, a vegetation and land use map (scale 1:100,000) was prepared of the Kilifi area, at the Kenya coast. This survey was part of a series of land surveys by the TPIP (Training Project in Pedology). The TPIP is a combined Dutch-Kenyan project, with soil science as the binding element between various disciplines.

The vegetation and land use map was prepared following the landscape guided approach (proposed by the ITC). According to this method, landscape guided air photo interpretation (API) of (1968, scale 1:49,500) air photos, resulted in a preliminary API map (scale 1:50,000). On this map a total of 7 main vegetation landscapes (LS) were recognized.

The preliminary API map was used as a basis of random stratified sampling of the area. The field samples were taken in the form of vegetation relevees. For each relevee, a complete (as far as possible) description of floristic composition and structure of the vegetation sample was compiled. Later on, it became necessary to change over to preferential sampling of the area, because of the enormous variety in vegetation formations (within the API units), many of which influenced by some kind of landuse. Floristic works available in Kenya are not complete, nor cover fully the Kenya coast. Hence, the floristic composition of the vegetation in our area was difficult to cover. This problem was solved as much as possible with the use of a quick herbarium and the aid of a local assistant with botanical knowledge. His vernacular names were translated later on, as much as possible, into the proper botanical names.

Over a two hundred relevees were made, and processed according to the Braun-Blanquet tabulation method (App. II). This resulted in the recognition of 16 plant communities, based on 37 sociological groups.

The floristic classification served as a basis, together with observations on landuse, for the legend of the final vegetation and landuse map. On this map, the 7 main LS are divided into units, ranging from original tropical monsoon forests to human induced formations (such as a coconut plantation).

After a general and a physiographic introduction in chapters 1 and 2, the working methods are presented in chapter 3. In chapter 4, notes on agriculture in the area, a description of the plant communities and of the land, and some remarks on the relationships between vegetation LS and factors such as climate and soil conditions are presented. In chapter 5, some space is used for discussion, and acknowledgements are presented in chapter 6.

In the 5 appendices, the map (App. I), the vegetation table (App. II), a synoptic vegetation table (App. III), a cross check table for preliminary API units and floristic classification (App. IV) and a list of plant species (App. V) are presented.

Preliminary Report nr. 4, by Mr. Jan Kuyper, deals with an investigation of the influence of human activities on the vegetation in the northern part of LS 3.

SAMENVATTING

In een periode van 6 maanden werd een vegetatie- en landgebruikskaart (schaal 1:100.000) gemaakt van het Kilifigebied aan de Kenyaanse kust.
Deze studie was er een in een reeks van facet-studies door het TPIP (Training Project in Pedology). Het TPIP is een gecombineerd Nederlands-Kenyaans project, met bodemkunde als bindend element tussen verscheidene disciplines.
De vegetatie- en landgebruikskaart werd voorbereid volgens de landschapsgerichte (landscape guided) benadering (zoals toegepast door het ITC). Volgens deze methode werd, met behulp van luchtfoto-interpretatie (API: Air Photo Interpretation) (luchtfoto-schaal 1:49.500, 1968) een voorlopige API-kaart bereid (schaal 1:50.000). Op deze kaart zijn 7 hoofd-vegetatielandschappen (LS) onderscheiden, onderverdeeld in API-eenheden. De voorlopige API-kaart maakte het mogelijk het gebied gestratificeerd-lukraak te bemonsteren (Random stratified sampling). De monsters werden genomen in de vorm van vegetatie-opnamen. Voor elke opname werd een volledige structurele en floristische analyse van het vegetatie-monster opgesteld. Later bleek het nodig, over te gaan op een bemonsteringsstrategie, waarbij de opnamen bij voorkeur van bepaalde formaties werden gemaakt (preferential sampling), vanwege de enorme verscheidenheid aan vegetatie-formaties (binnen de API-eenheden), die vaak sterk door de mens beïnvloed waren.
Flora's van Oost-Afrika zijn aanwezig. Deze zijn echter niet compleet, noch geheel geschikt voor de Kenyaanse kust, hetgeen de floristische analyse bemoeilijkte.
Dit probleem werd zo goed mogelijk opgelost door een veldherbarium aan te leggen en door de hulp van een inheemse assistent met botanische kennis. Zijn locale plantnamen werden later zoveel mogelijk vertaald naar wetenschappelijke namen.
Meer dan tweehonderd opnamen werden gemaakt en verwerkt volgens de tabelmethode van Braun-Blanquet (App.II). Het resultaat was de vorming van 16 plantengemeenschappen, gebaseerd op 37 sociologische soortengroepen.
Samen met waarnemingen m.b.t. landgebruik vormde de floristische classificatie de basis van de legenda voor de definitieve vegetatie- en landgebruikskaart. Op deze kaart zijn de 7 hoofd LS verdeeld in eenheden, die variëren van origineel tropisch moessonbos tot door de mens geïnduceerde formaties (zoals een cocosnoten-plantage).
Een algemene en een fysiografische inleiding staan in hoofdstukken 1 en 2. Dan volgt een beschrijving van de gevolgde werkmethode in hoofdstuk 3. Hoofdstuk 4 omvat een inleiding tot het landgebruik in het gebied (landbouw en veeteelt), een beschrijving van de plantengemeenschappen en van het land, en enige ideeën over de relatie tussen vegetatie en factoren als klimaat en bodemgesteldheid.

Hoofdstuk 5 is een discussie, hoofdstuk 6 is de verantwoording.
In de bijlage zijn achtereenvolgens te vinden: (App. I) de kaart, (App. II) de vegetatietabel, (App. III) een synoptische vegetatietabel, (App. IV) een tabel ter vergelijking van voorlopige API eenheden met de floristische classificatie, en (App. V) een lijst met plantennamen.

Het vervolg op dit rapport (Preliminary Report nr. 4) is geschreven door Mr. Jan Kuyper. Het omvat een onderzoek naar de menselijke invloed op de vegetatie in het noordelijk gedeelte van landschap 3.

MUHTASARI

Kwa mda wa miezi 6, ramani (kipimo 1:100.000) ya utumiaji wa ardhi na mimea ya eneo la Kilifi, Pwani ya Kenya ilitayarishwa. Upimaji huu ulifuatia safu za upimaji wa T.P.I.P. (Training Project in Pedology). T.P.I.P. ni muugano wa azimio la watu wa Kenya na wa Holland (the Netherlands) wa uchunguzi wa sayansi ya asili ya mchanga na mambo mengine.

Ramani ya mimea utumiaji wa arda ilitayarishwa kulengana na sanamu (picha) ya nchi ya kufanana na wongozi (Zilizizoazimiwa na I.T.C.) Kulengana na taratibu hii, picha za hewani (sanamu) ya nchi zilitafisiriwa na (Air Photo Interpretation: A.P.I.) katika (1968) (kipimo 1:49.500) ya mwanzo wa ramani (kipimo 1:50.000) ya A.P.I. Katika ramani hii aina 7 za mimea juu zikatukia ardhi ziligunduliwa.

Mwanzo ramani ya A.P.I. ilifanya mambo ya uchunguzi kujitokeza mara moja. Namna za mbugani zilichunguzwa vipande (sehemu sehemu) vya mahali, na ufafanuzi wa jamii ya mimea ilimalikazi (kama ilivyowezakana) pamoja na mimea yenyewe ilivyokuwa. Baada yake ilikuwa ni lazima kugeuza mifano yote kulengana na utumiaji wa ardhi.

Kwa sababu ya upungufu wa jamii mimea mizuri katika misiti ya Pwani ya Kenya, uchunguzi huu ulikuwa si rahisi kumalizika na kutambulika. Shida hii ilitatuliwa na kuanzishwa kwa haraka chumba cha kutambulilia mimea (Herbarium) na pia kwa usaidizi wa mkaaji wa eneo hilo aliye na ujuzi wa majina kitalemu. Majina yake yote ya kienyeji yalitafisiriwa kama ilivyowezakana kwa kitalamu.

Zaidi ya uchunguzi (Relevee) mia mbili ulifanywa na kutengenezwa kulengana na taritibu za Braun-Blanquet (App. II). Hii ilitokea kwa kutambulika kwa jamii ya mimea 16 yote ikiwa imelengana na utafitaji wa jamii ya mimea.

Huu upangikaji wa jamii za mimea ulisaidia kama msingi, pamoja na uchunguzaji na utumiaji wa ardhi, kwa hekaya za mwisho wa mimea na ramani ya utumiaji wa ardhi. Katika ramani hii, zile Landscape (LS) 7 mhimu zimegawanywa katika sehemu sehemu, kutoka kwa misiti ya joto ya asili hadi misitu ya kubunishwa na binadamu (kama vile shamba la minazi).

Baada ya utangulizi wa jumla katika sura 1 na ya 2, taratibu za kufanya kazi ulitayarishwa katika sura 3. Katika sura 4, mambo mhimu kuhusu ukulima katika eneo hili, ufafanuzi kuhusa ardhi, na mambo mengine yanayolengana baina ya mimea LS na mambo mengine kama vile hali ya anga na michanga yanaelezwa.

Katika sura ya 5 nafasi nyingine imetayarishwa kwa majadiliano, na shukrani katika sura ya 6.

Katika mwisho wa kitabu ni ramani (I), hesabu, ya mimea (II na III) crodha ya mwanzo A.P.I. na upangaji na jamii ya mimea (IV) na hesabu ya aina ya miti (V) yametayarishwa.

Sehemu ya pili ya kitabu kilitayarishwa na Jan Kuyper, na ina husu uchunguzi wa matokeo ya matendo ya binadamu juu ya mimea sehemu ya kaskazini ya LS 3.

(Translation English - Kiswahili: Rexton Karisa)

LIST OF FIGURES

LIST OF TABLES

NB: Figures and Tables, belonging to chapter 4.2.1, are not listed.

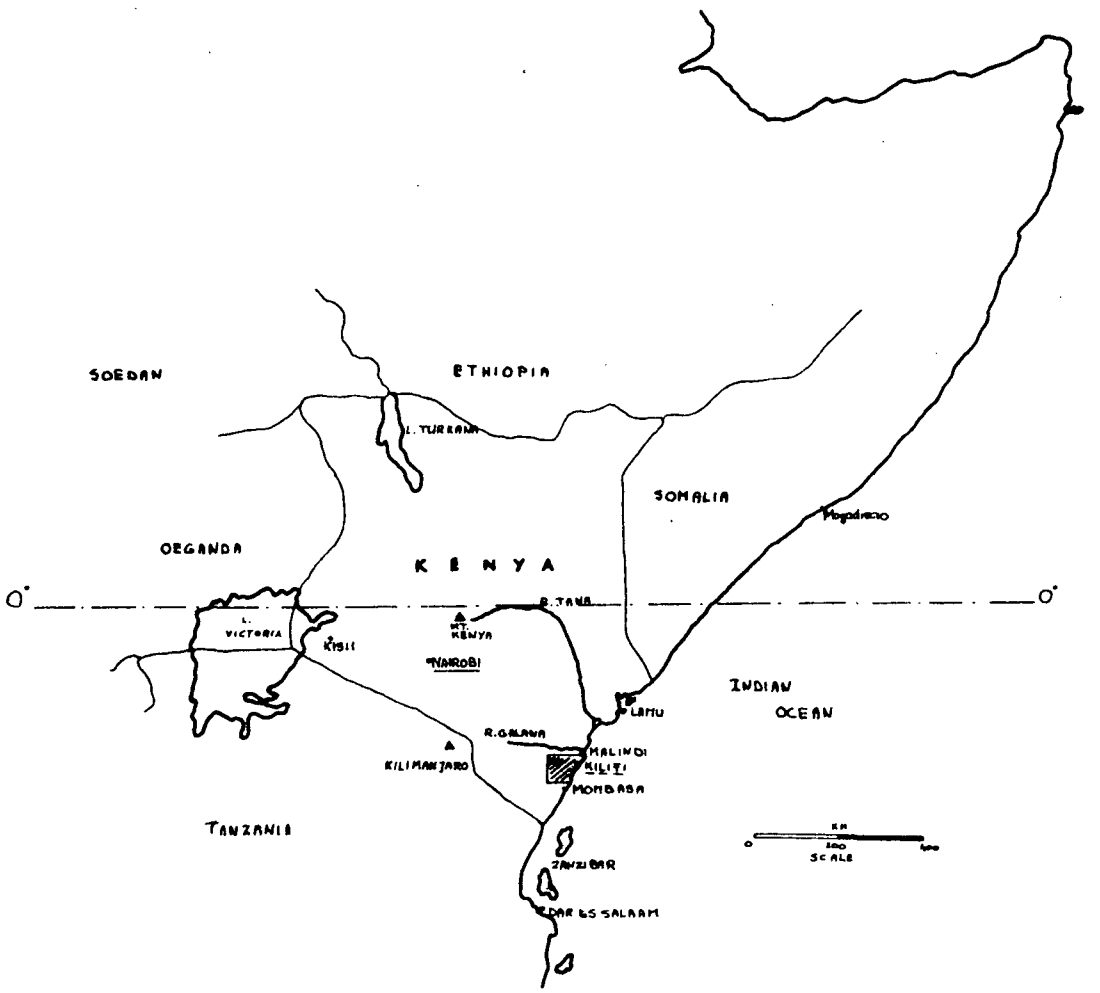


Fig. 1 : Situation of the Projects Area.

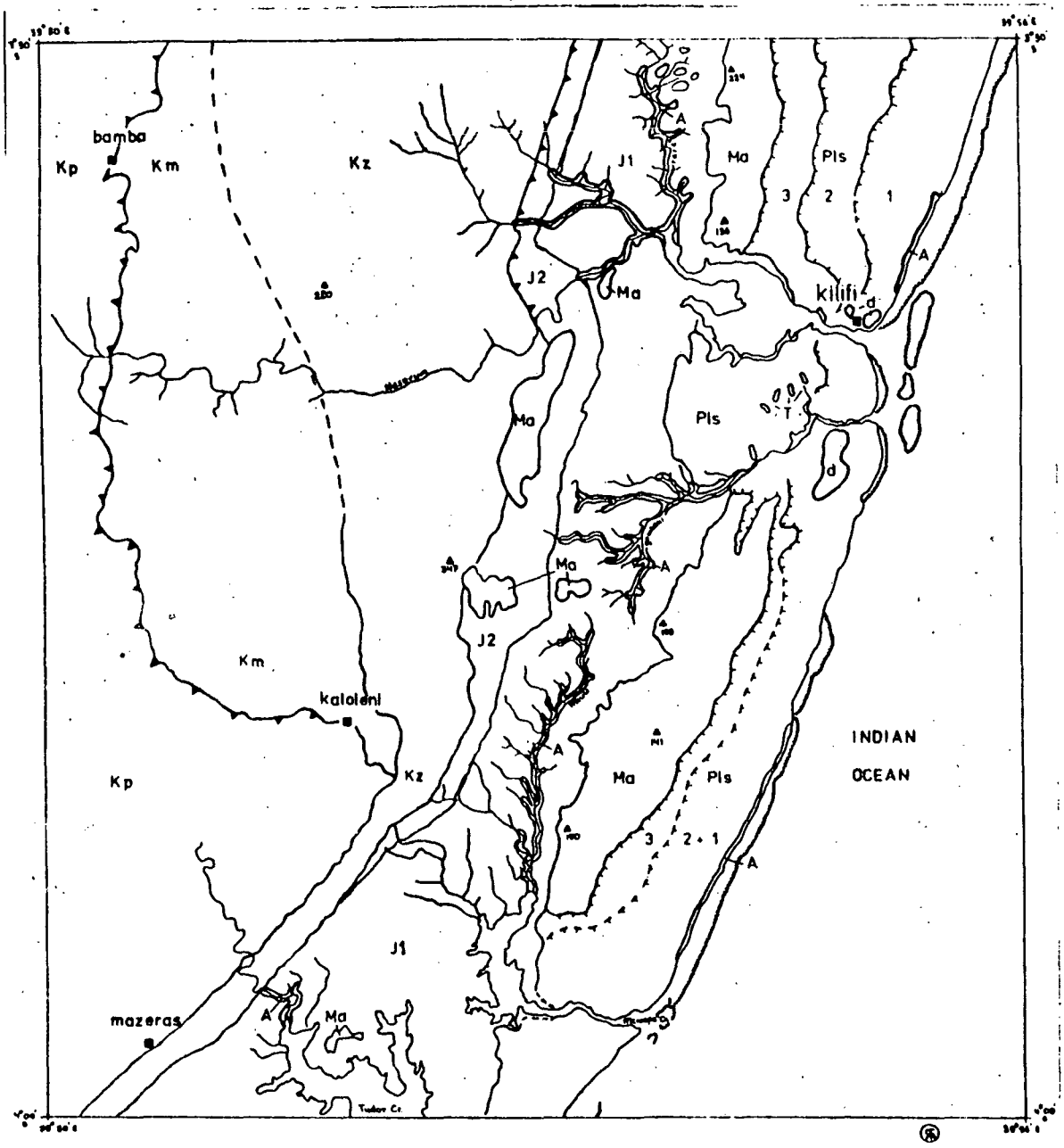
1 INTRODUCTION

This vegetation and land use study covers a small part of the Kenya coast (Topographic quarter-degree sheet K 198). The location of the area is presented in fig. 1. The study fits within a series of land surveys of this area by the Training Project in Pedology (TPIP). The TPIP is a project of the Agricultural University in Wageningen, the Netherlands, and the Kenya Soil Survey (KSS). It is an integrated project in which soils are the binding element.
The objects of the TPIP are three, viz.

1. Preparation of a soil map (scale 1:100,000) for the KSS, within its program to map all high and medium potential areas of Kenya;
2. Providing training facilities for postgraduate students with tropical specializations of various disciplines;
3. Integration of all studies and surveys carried out by participants of the project, to prepare a landevaluation of the area.

More information on the survey area is presented in other TPIP publications (Floor et al., 1980).

The present study was carried out as a practice period for vegetation science, in the MSc. course Biology at the Agricultural University of Wageningen. The study took place from April to October 1981. A vegetation and landuse map was prepared following the landscape guided method (Zonneveld et al., 1979). It provides an overview of actual landscapes; no potential situations (concerning hypothetic climax vegetation or -landuse) are taken into account. However, these matters are discussed in this report.
The preparation of a separate soil map has been of consequence for this mapping. Geological or pedological differences of little importance for actual vegetation and/or landuse are not used as differentiating elements.
Finally, it should be emphasized that 1968 air photographs served as a basis for this survey. For correction and updating of changes whithin the last 13 years, both time and facilities were lacking. Locally, these changes are considerably; they are dealt with in this report.



A	Alluvial deposits and coral sands	T	Baratumu - marls
Pls	Coastal sands (Kilindini sands)	J1	Jurassic - shales
d	Dunes	J2	Kambe - limestone
Kp	Bay - sediments on Mariakani - sandstone	Kz	Mazeras - sandstone
Ma	Magarini sands altitude (m)	Km	Mariakani - sandstone
			coral reef
			escarpment
			step
		2	coastal level

Fig. 2 Geological map of the Kilifi area (From: Preliminary Report nr. 1)

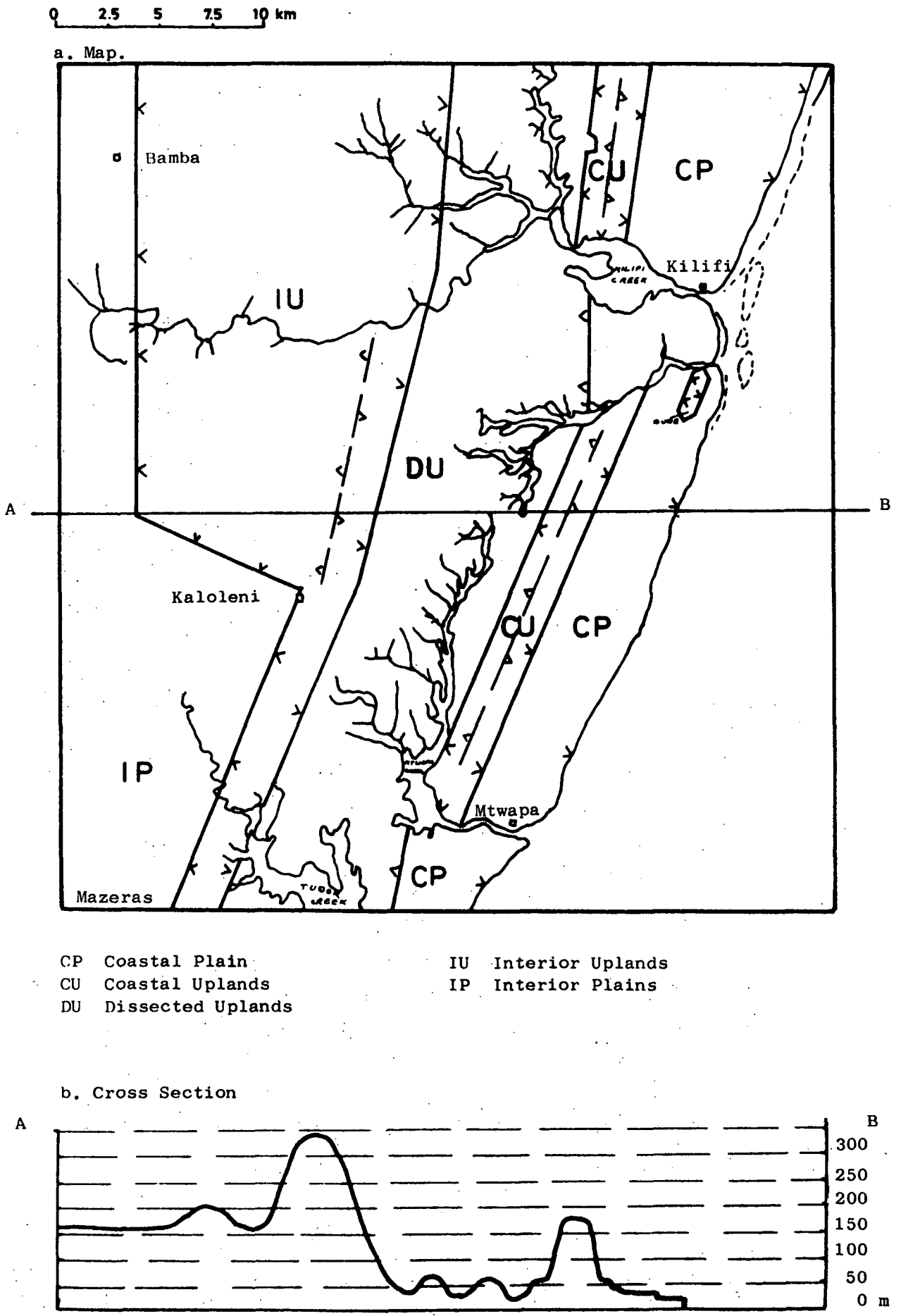
2 PHYSIOGRAPHY AND GEOGRAPHY OF THE AREA

Detailed information concerning these matters are presented in (Floor et al., 1980), and the references given there. In order to make this report readible for those, who have no access to this report, some of the contents are summarized below.

2.1 Geology

Geologically, the area consists mainly of a system of mesozoic sedimentary rocks, deposited against the African Shield. These deposits have a general NE-SW strike, sloping E-wards. In fig. 2 a simplified geological map is given.
The oldest sediments found within the area belong to the Duruma sandstone Series, i.e. the Mariakani and Mazeras sandstone Formations. The Mariakani Formation consists mainly of a well sorted, fine grained sandstone, with little weatherable minerals. The Mazeras Formation consists mainly of poorly sorted, coarse grained sandstone, with a variable amount of weatherable minerals. Both Formations are divided into several members by shale/silt bands.
Against and over the Duruma sands, limestone belonging to the Kambe limestone formation is deposited. It consists of thick beds of clean limestone ('wackestone') in which little small shell fragments can be found.
The Kambe limestone is overlayed by the Mto Mkuu shale Formation. It has a shale facies throughout, the fossil content being low.
Of little importance are the Baratumu marls, deposited upon the Mto Mkuu Formation.
Along the coast, stretching some 10 km landinwards, subrecent coral rock is found. These, the Baratumu marls, the Mto Mkuu shales, and the Kambe limestones are covered locally by the Magarini sands. These are well sorted, dark red coloured sands with little weatherable minerals.
The coral rock deposits at the coast are also covered by depositions of the Kilindini Formation; non-consolidated sediments of various texture.
In the western part of the area, the Duruma sands may be covered by another unconsolidated sediment, the pleistocene bay sediments. These are usually heavy textured, consisting of silty bay deposits mixed with a variable amount of basin material (the Mariakani or Mazeras sands).
Along the coast, recent dunes can be found. They are not extensive.

Fig,3. PHYSIOGRAPHIC DIAGRAM OF THE KILIFI AREA



2.2 Physiography

The physiography of the area will be described in an order, beginning at the shore of the Indian Ocean. A physiographic diagram is presented in fig. 3.
The actual shore is formed on a level of subrecent coral rock, limited on the landside by a yet higher level of coral rock. The boundary between the two levels is often formed by a minor scarp.
The second level of coral rock forms a nearly flat surface, extending landinwards. Together with a number of higher levels, (all corresponding with former relative sealevels) it forms the coastal plain. As stated above, most of the coastal plain is covered by the Kilindini Formation. Along the shore, recent dunes are found. Altitudes of the coastal plain lie between 8 and 50 m. The coastal plain usually has a wel defined boundary with a ridge of Magarini sands, forming the coastal uplands. It is a rolling landscape reaching up to 150 m. The ridge is deeply incised, baring underlying formations. The coastal uplands change abruptly into the dissected uplands, formed on the Mto Mkuu Formation. The dissected uplands form an undulating to rolling landscape, with (locally) small level parts, e.g. in flood plains of rivers. Distinctive are the remnants of Magarini sands, which form isolated hills on more elevated positions. The altitudes of the dissected uplands range from nearly zero to around 60 m, the Magarini tops being still higher.
The dissected uplands pass into the interior uplands. In the southern part of the Kilifi area, the boundary may consist of a steep sloping minor scarp. The interior uplands lie between 100 and 350 m. The relief is usually rolling in the southern, undulating to rolling in the nothern part of the area. The interior uplands are developed on Kambe limestone and on Duruma sandstone. In some valleys, bay sediments are found, while on some ridges, Magarini sands occur.
In the southern part of the interior uplands, isolated rock outcrops of Kambe limestone appear. Their size varies from several to over a hundred m in diameter, potruding several to (viz.) 20-30 m above the ground level. The interior uplands change into the interior plains. This is a nearly flat part, formed on bay sediments, with sandy hills. Altitudes lie between 180-200 m. The boundary with the interior uplands can be gradual, or clear, in which case it is formed by a minor scarp. The interior plains pass westwards into Tsavo National Park.
Large steep benched Creeks cut deeply landinwards from the coast, reaching into the dissected uplands. The shores of these creeks (drowned river valleys) can be formed by extensive tidal platforms.

2.3 Climate

Mean temperatures vary between 22 °C as an average minimum, 26-30 °C as an average maximum in the coastal belt and 30-34 °C average maximum in the environment of Bamba (in the interior plains).
Seasonal variation in daylength is small. As a consequence, hours of sunshine vary little, averaging between 7 and 8 hours per day. There is a bimodal pattern of annual rainfall, varying from over a 1000 mm at the coast, to around 600 mm in the NW part of the area. The bimodality of the rainfall is not prominent. The rainfall is unreliable; local differences in (annual) rainfall are high.
Annual potential evapotranspiration exceeds the annual rainfall by far; from an average of 2000 mm at the coast, to around 2300 mm near Bamba. Annual moisture deficits are increasing generally from SE to NW. This is also remarkable within the landscapes to be defined in following chapters. Water availability is a major limiting factor for agriculture in nearly all parts of the area.

3 WORKING METHODS

3.1 The ITC approach

Where large complex areas are to be surveyed in a relative short time (as in this case) a sound working method is of utmost importance. The ITC (International Institute for Aerial Survey and Earth Sciences at Enschede, the Netherlands) approach, emphasizing the use of air photo interpretation (API) in the landscape guided method, provides such a method. This method and its advantages are presented in full in (Zonneveld et al., 1979).
In short, landscape guided API is used to direct the survey(or), by means of preparing a API-map with a API legend. The result is, that several landscapes are recognized in the area, which can be subdivided according to (in our case) landuse and/or vegetation properties.
A landscape can be defined as follows:

> "Die Landschaft ist ein dynamisches, räumlich-strukturiertes Wirkungssystem aus den drei unterschiedlichen Gesetzlichkeiten erfassbaren Teilsystemen des Anorganischen, des Biotischen und des Nootischen" (Bobek und Smithüsen 1949, in Leser (1976) p.28).

In order to describe the API units, they will have to be sampled. In sampling, a choice can be made (amongst other things)

1. size-proportional sampling;
2. stratified sampling; an equal number of samples is allocated to each API legend unit element
3. preferential sampling; more important or more variable API legend unit elements are emphasized, while less important or already well defined API legend unit elements are consciously neglected.

3.2 The Kilifi approach

The ITC method provides a framework, allowing space for interpretation according to requirements of the employer, characteristics of the survey area, available facilities and personal appreciation of the surveyor. The method will be presented subsequently as applied in this particular survey.
The survey was prepared in 1979 with a first landscape guided API by Mr. Jelger van der Lek, followed by a field reconnaissaince. The available air photographs were made in 1968 scale appx. 1:49,500. This first work resulted in a preliminary API map (scale 1:50,000) and legend. In the same period, a floristic inventarisation and a herbarium were made by Mr. Jan Reitsma.

In april 1981 I started with random stratified sampling of the preliminary API legend unit elements. That is, sample plots were placed preferentially, where two or more API legend unit elements were neighbouring. The exact position of a sample plot (within an element in the field) was chosen at random.
During the visit of prof. dr. I.S. Zonneveld and dr.ir. H. Doing, the preparation of a new and more detailed API map (scale 1:50,000) and legend were decided. At that stage, it became obvious that for stratified sampling of the entire area, time was lacking. As a consequence, we decided to apply an intermediate form of stratified and preferential sampling.
In the same period fellow student Mr.Jan Kuyper started his research of the human influence on the vegetation in one of the landscapes recognized with the preliminary API.

3.3 Field sampling methods

3.1.1 General

In the Kilifi area, human influence on the vegetation is significant. As a result, natural vegetation is locally scarce. Little is known about the original vegetation of the area. It appears, that only small remnants of it are left.
As a consequence, the vegetation in the Kilifi area ranges from (supposed) almost original forests to completely artificially induced formations, such as a coconut plantation or a large scale sisal estate, with all kinds of semi-natural or semi-degenerated stages in between. On a scale of 1:50,000 of the air photographs, the same goes more or less for most of the API legend units, making them into complexes of two or more vegetation types. Because it was obvious, that not all vegetation types (corresponding with various degrees of human influence) could be sampled, it was decided to sample preferentially the (seemingly) least unnatural vegetation occuring in a certain API legend unit (element). The vegetation there was sampled by means of vegetation relevees, while notes on land-use and/or surrounding vegetation were taken.

3.3.2 Vegetation relevees

a. Data collected in vegetation relevees
Vegetation relevees were made according to principles of the Braun-Blanquet school (Braun-Blanquet, 1972). Within a certain relevee area, structure and floristic composition of the vegetation were described. Along with these, a soil profile description was given (by augering with an Edelman auger). For each relevee, notes on topography, geography and geology of the site were taken. These data were collected on a relevee data sheet, especially designed for this survey. An example of such a sheet is presented in fig. 4 (back cover).

b. Size of relevee area

The size of the relevee area varied according to the stucture of the vegetation, as presented in table III.I. The structural classification used here is derived from Lind & Morris (1974). In some cases, heterogenous formations could not be sampled in one relevee. The recognizable subformations were then sampled separately.

c. Vegetation structure description in relevees

Apart from a general structure description such as in table III.I, in each relevee, the structure of the vegetation was described in detail. Beforehand, a range of artificial strata were supposed: groundlevel; 0-3 cm; 3-12.5 cm; 12.5-25 cm; 25-50 cm; 50 cm-1 m; 1-2 m...etc... up to 64 m (Doing, 1979). The coverage of the vegetation within each stratum was estimated. At groundlevel, the area of bare ground (or -rock) or covered by dry leaves (litter) was taken in account.

The estimate was presented graphically on the relevee data sheets. Along with this, the occurrence of the life forms according to Raunkiaer (1934), and their coverage, were described.

Two parameters determine the real vegetation coverage, viz.

1. external coverage: the area underneath a certain species or group of species, estimated by vertical projection on a horizontal surface.
2. internal coverage: that percentage of the external coverage effectively occupied by parts of the plant species; that is, external coverage minus open space.

Out of (1) and (2) the real coverage (in percents) can be calculated, as follows:

$$\text{real coverage (\%)} = \frac{\text{external coverage (\%)} \times \text{internal coverage (\%)}}{100}$$

For coverage estimations, the decimal method was used. The coverage classes and notations for this method are presented in table III.II.

d. Description of floristic composition in vegetation relevees.

Of each species occurring in a relevee, coverage (as in 3.2.c) abundance, and sociability were estimated, along with the stage of development (like flowering or fruiting stage).

Abundancy = number of individual (stems) of a certain species within an area. The abundance was described by means of a logarithmic scale, presented in Table III.III.

Sociability = the tendency of individuals belonging to the same species (or other classification group) to form clusters. The scale used to describe sociability is given in Table III.IV.

TABLE III.I

VEGETATION STRUCTURE	RELEVEE AREA (m^2)
Woodlands Bushlands ----------	150
Shrublands Shrubby grasslands ----- Wooded grasslands	150 - 200
Arable land Sisal estates ------ Treecrop plantations	400
Grasslands ----------	25

Relevee area size varying according to vegetation structure.

TABLE III.II

NOTATION		RANGE OF COVERAGE
-		less than 2%
00	0	2 - 5%
01	1	5 - 15%
02	2	15 - 25%
03	3	25 - 35%
04	4	35 - 45%
05	5	45 - 55%
06	6	55 - 65%
07	7	65 - 75%
08	8	75 - 85%
09	9	85 - 95%
10	10	100%

Decimal method for coverage estimate. Notation for external coverage (first column) and internal coverage (2nd column) and their range are presented. The internal coverage can be notated as an exponent of the external coverage.

TABLE III.III

NOTATION	ABUNDANCY
1	10 per ha (1 ha = 2.5 acre)
2	1 per are (1 are = 100 m^2)
3	18 " "
4	1 per m^2
5	10 " "
6	1 per dm^2
7	10 " "
8	
etc...	

Abundancy classes and their notation as used for the description of floristic composition of vegetation relevees.

TABLE III.IV

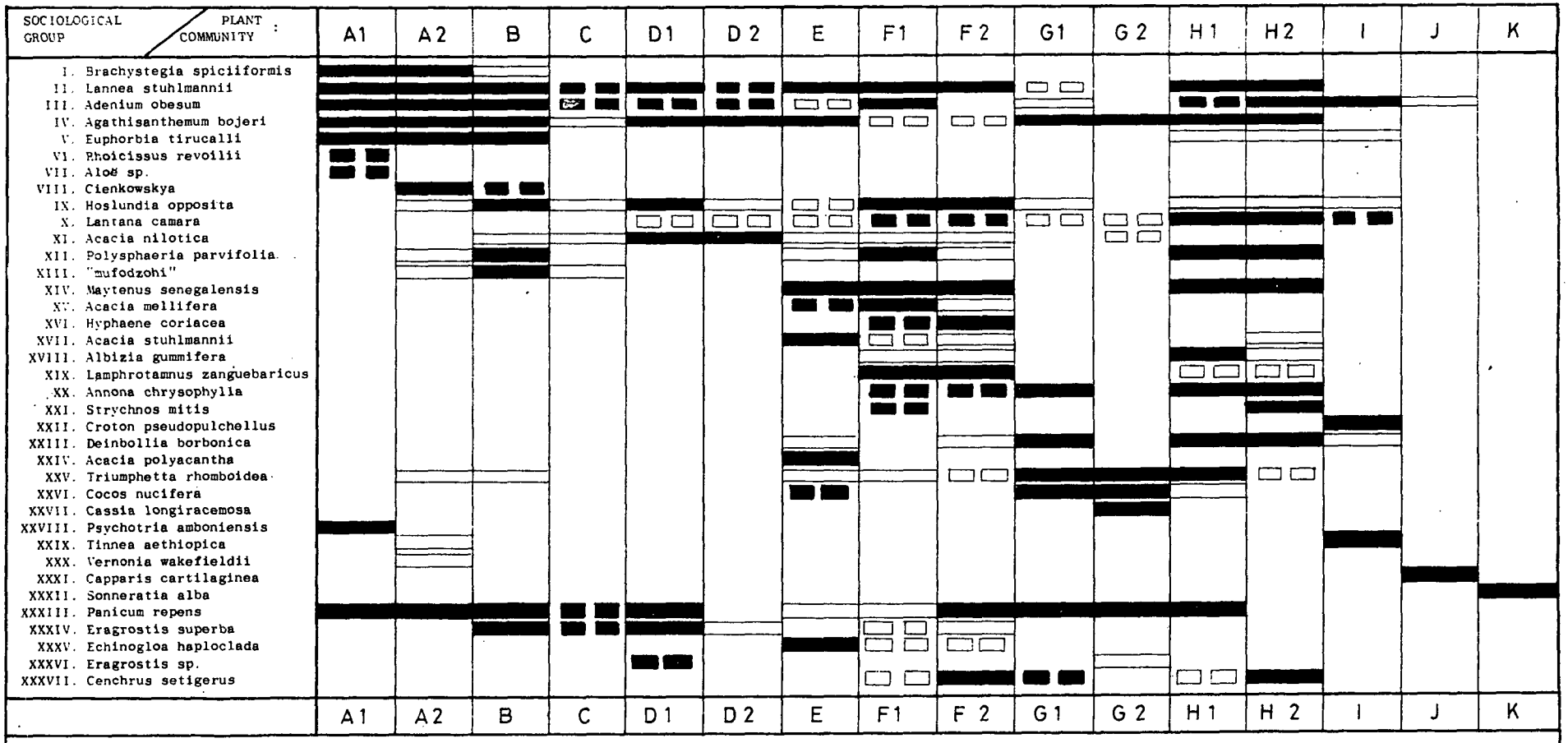
NOTATION	SOCIABILITY
1-	1 stem per group
1+	2 - 3 stems per group
2-	4 - 10 " " "
2+	11 - 33 " " "
3-	34 - 100 " " "
3+	100 - 330 " " "
4-	330 - 1,000 " " "
4+	1,000 - 3,300 " " "
5-	3,300 - 10,000 " " "
5+	> 10,000 " " "

Sociability classes and notations as used for the description of floristic composition in vegetation relevees.

Fig. 6

BAR DIAGRAM

OF PLANT COMMUNITIES (A - K) versus SOCIOLOGICAL GROUPS (I - XXXVII)



should occur, with high abundancy/coverage of the composing species

may occur, with high abundancy/coverage of the composing species

should occur, with low abundancy/coverage of the composing species

may occur, with low abundancy/coverage of the composing species

NO BAR: should not occur

PLANT COMMUNITIES:

A1 - Brachystegia spiciiformis - Rhoicissus revoilii
A2 - Brachystegia spiciiformis - Grewia forbesii
B - Dichrostachis cinerea - Panicum repens
C - Grewia microcarpa - Perotis hildebrandtii
D1 - Acacia nilotica - Salvadora persica
D2 - Acacia nilotica - Hoslundia opposita
E - Acacia stuhlmannii - Acalypha fructicosa
F1 - Lannea stuhlmannii - UPS 11
F2 - Lannea stuhlmannii - Panicum maximum
G1 - Cocos nucifera - Deinbollia borbonica
G2 - Cocos nucifera - Sida cuneifolius
H1 - Polysphaeria parvifolia - Triumphetta rhomboidea
H2 - Polysphaeria parvifolia - UPS 11
I - Croton pseudopulchellus - "mukambi"
J - Capparis cartilaginea - Cynanchum tetrapterum
K - Sonneratia alba - Rhizophora mucronata

from: M. van Leeuwen, vegetation of the Kilifi area

3.3.3 Naming plant species

According to the East African Herbarium (EAH), around 1500 (as a rough estimation) plant species occur in the surveyed area (personal communications with EAH direction).
Of these, around 500 are collected in a herbarium by Mr. Jan Reitsma (1979).
Furtheron, a collection of flora's useful in the area are available, like Kenya Trees and Shrubs by Dale and Greenway, and Agnew's Kenya Wild Upland Flowers, and the Flora of East Africa (unfinished) by the EAH.
In order to get acquainted with the flora of the area as quickly as possible, the following procedure was followed:

- In each relevee, unknown species were collected (roughly) and inserted in a quick herbarium in the field, and numbered;
- each number received the vernacular (Giriama or Swahili-)name if possible, if not, a nickname;
- vernacular names were (if possible) translated with lists such as in Kenya Trees and Shrubs, or as available at the EAH, with the quick herbarium material to check for synonyms; (a translation list adapted to our situation is presented in Appendix V).
- nicknamed numbers were grouped (doubles together) and either determinated using one of the floras, or shown to a consultant who might know the species, genus or family (just like that).

The vernacular names were given by Mr. Rexton Karisa, the field assistent.

3.4 Field sample processing

3.4.1 Floristic classification

The floristic classification serves as a base for the final map legend; it is a backbone for the vegetation and land use-map. The principles of floristic classification, based on full species description, was introduced by Braun-Blanquet (1972). Sociological groups, differentiating and specific species are used to define vegetation types.
For this survey, the vegetation relevee data were processed according to the Braun-Blanquet tabulation method. A diagonal matrix, including all species and sample plots (relevees) is formed. The initial columns (plots) and rows (plant species) are rearranged repeatedly, until a matrix of mutually discriminant clusters of both plots ('abstract' plant communities) and plant species (sociological species groups) are obtained (see App. II). The final diagonal matrix is compressed into a synoptic table (App. III), and interpreted into a bar diagram, (fig. 6), to facilitate the use of the plot classification as a determination key for the map legend (see App. I, IV).

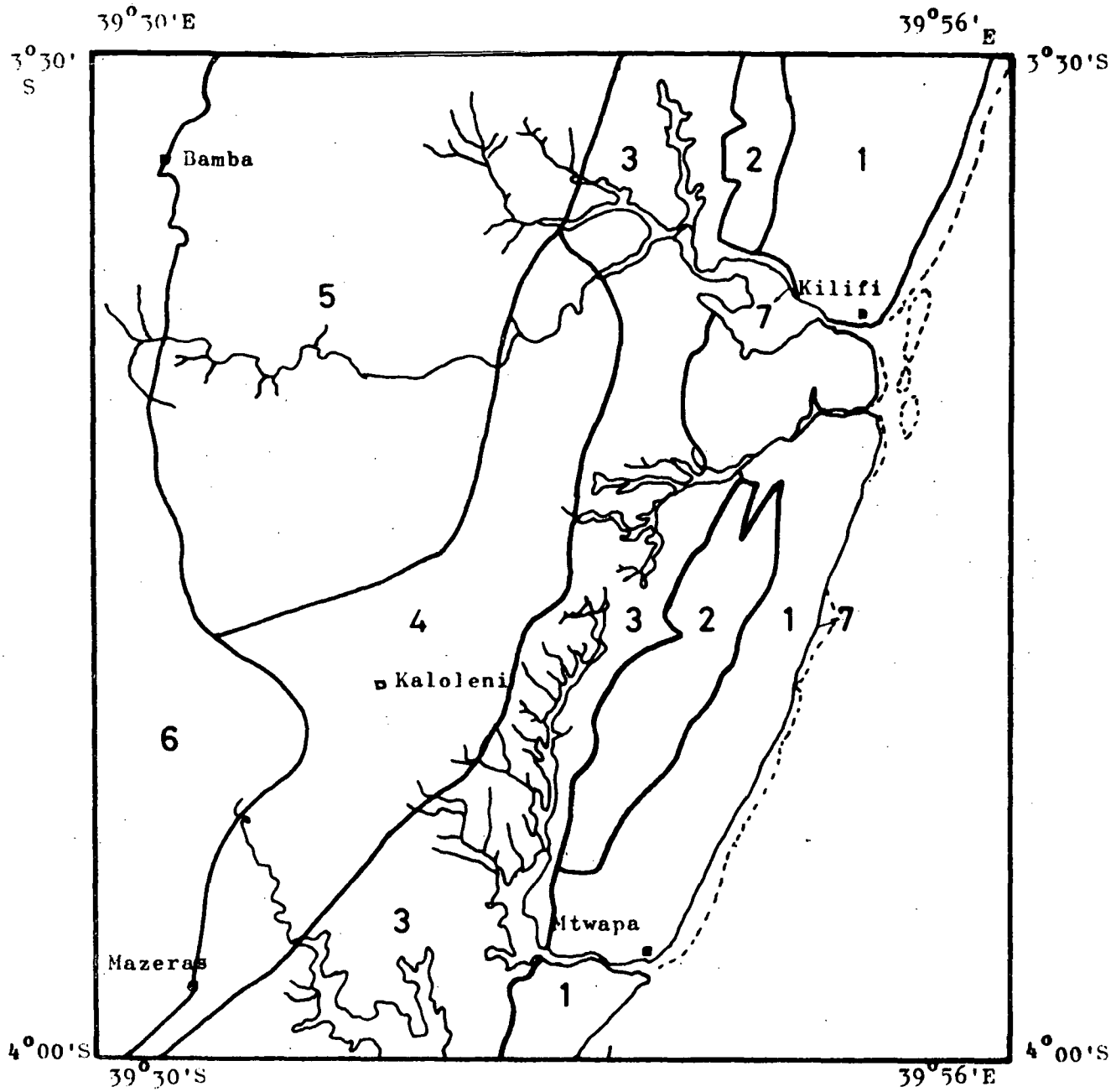
3.4.2 Final map legend preparation

In order to compare the preliminary API legend with the final floristic classification, a diagonal matrix is formed, in which the rows represent the plant communities, and the column the preliminary API legend units. (App. IV) With this matrix, combined with an annotated map, the final legend was prepared.

3.5 Cartographic methods

Preliminary API boundaries were drawn with chinagraph pencils (type 'China Marker') on the air photographs (scale 1:49,500). This API was taken over manualy on transparant topographic maps, scale 1:50,000, with Rotring pencils over a light-table. The transparants were printed, after which the phototypes could be coloured and corrected. The same procedure was followed after the final map legend was prepared and the final API was finished. In this case, however, the transparant (scale 1:50,000) sheets were reduced photographically to the final (1:100,000) scale.

FIG. 5 MAIN LANDSCAPES OF THE KILIFI AREA



1 = Sterculia appendiculata - Ceiba pentandra landscape

2 = Cynometra suaheliensis - Anacardium occidentale landscape

3 = Terminalia spinosa - Maytenus senegalensis landscape

4 = Cocos nucifera - Chlorophora excelsa landscape

5 = Brachystegia spiciiformis - Manilkara zanzibarica landscape

6 = Salvadora persica - Acacia nilotica landscape

7 = Ipomoea pes-capre - Rhizophora mucronata landscape

0 2.5 5 7.5 10 km

4 VEGETATION AND LANDUSE

4.1 General introduction

4.1.1 The seven main landscapes

In the Kilifi area, a total of 7 main landscapes (LS) are recognized. Their delineation is based upon API, the work of Mr. J. van der Lek and geological and geographical data. A simplified map with the 7 main LS is presented in fig. 5. The LS were named according to common or characteristic plant species, including important (introduced) tree crops. From the coast landinwards, they are the following:

1. Sterculia appendiculata - Ceiba pentandra LS (LS1)
   a much cultivated LS on the coastal plain, with large sisal plantations, many tree crops, characterized by the occurrence of Ceiba pentandra plantations and (locally) a large yellow-stemmed Sterculia appendiculata tree.
2. Cynometra suaheliensis - Anacardium occidentale LS (LS 2)
   developed on the coastal uplands, this LS consists mainly of cashewnut (with a few coconut-) plantations, a large (partly neglected) sisal plantation, and a few remnants of the original forests.
3. Terminalia spinosa - Maytenus senegalensis LS (LS 3)
   this landscape is developed on the dissected uplands. It is most cultivated in the central part of this area. More to the southern part, Hyphaene coriacea grasslands dominate, while to the north, vast ranging areas (Lannea stuhlmanni - Hibiscus aponeurus bushland) appear.
4. Cocos nucifera - Chlorophora excelsa LS (LS 4)
   This LS appears on the southern part of the interior uplands.
   It consists mainly of coconut plantations, and some arable land (especially in valleys).
   On hilltops, remnants of the original tropical monsoon forests may occur.
5. Brachystegia spiciiformis - Manilkara zanzibarica LS (LS 5)
   This LS developed on the northern part of the interior uplands; it has a gradual boundary with the former LS.
   Most of LS 5 is dominated by an open woodland where Brachystegia spicciiformis and Afzelia cuanzensis trees dominate. The woodland is alternated by secondary bush of various types, and arable land.

6. Salvadora persica - Acacia nilotica LS (LS 6)
appears in the driest part of the Kilifi area, on the interior plains. This LS is dominated by cattle ranging on thorny (Acacia spp.) bush and Salvadora persica grasslands. On sandy hills, a kind of Brachystegia-woodland may occur.

7. Ipomoea pes-capre - Rhizophora mucronata LS (LS 7)
appears on the shores of the Kilifi area. These are dominated by two formations, viz.
- Indian Ocean: a salt spray induced low shrub formation, where Capparis cartilaginea occurs, and the
- Creeks (and river mouths): Rhizophora mucronata swamps.

TABLE IV.1: Agricultural activities and their intensity in the main landsapes of the Kilifi area.

LANDSCAPE	INTENSIVE	SEMI - INTENSIVE	LOW INTENSITY	VERY LOW INTENSITY
LS 1	-Large scale Dairying -Irrigated horticulture Large scale Sisal production	Exploitation of Coconuts	Cashewnuts Bananas	Cashewnuts Mango Goats, Sheep, Cows.
LS 2		Coconuts Cashewnuts & Grazing	Timber	Cashew Mango Cows, Goats
LS 3	Medium scale Dairying	Maize - tractor ploughing		Goats
LS 4		Coconuts Cashcrops Rice (valleys)	Cashewnuts Bananas Citrus	Goats, Cows. Cashew, Mango
LS 5				Cashew Charcoal (Timber) Cows, Goats
LS 6	Agricultural Research Station		Cows, Goats, Sheep: Ranches Pineapple	
LS 7				Mangrove wood for house construction

RAINFED CULTIVATION of SUBSISTENCE CROPS — RANGING

TABLE IV.I : a simplified picture of the agriculture in the survey area.
Intensity in terms of labour/unit land.

4.1.2 Agriculture in the survey area

It is not the aim of this report to deal with agriculture in any detail. This chapter gives an overview of agriculture in the differring LS, to provide the general setting in which land use, and potential (improvements of-) landutilisation could be seen.
Detailed specialised studies involving farms, farmers, farming systems and farming economy in the survey area carried out by fellow-project participants (Floor et al., 1980). The results of these studies are not yet published.

GENERAL

Apart from a few medium to large scale modern farms at the coast, farming in the survey area is a undeveloped (small scale) affair. It is characterized by low capital inputs, hand (family-)labour, small (2-10 acre) farms. Most important tool is the hoe. The emphasis is on (rainfed) cultivation of subsistence crops. In some LS, (1,3,4) cashcrops are cultivated as well.
Fertilizers or pesticides are generally not used; the same goes for animal traction. Settlement schemes occur in some areas (LS 1,2) at the coast.
A list of agricultural activities is presented in Table IV.I. Produce is outlined in Table IV.II. Both tables are tentative, and should be reviewed when the above mentioned agriculture-studies are processed.

ANNUAL CROPS

Most important of all is maize (Zea mays) which is planted everywhere in all LS, regardless of possibilities or risks.
Maize serves as the basis of the peoples' most important food, a stiff porridge of maize flour (Ugali).
Although maize usually is cultivated twice a year, (long- and shortrains) yields (averaging at maximum* around 1,000 kg/ha) are generally not sufficient to match demands for a family thoughout the year.
Cassava, Manihot esculenta is much less important than maize. It serves as a food reserve (the roots), and as a vegetable (the leaves). Cassava is very susceptible to virus-diseases.
Rice, Oryza sativa ('dry land rice') is cultivated in valley bottoms, mainly in LS 4. It is not a very important crop.
Pulses are cultivated mostly in combination with maize, cassava or both.
Simsim, Sesamum indicum is the most important cash-crop. Main production comes from LS 4.

---

* Maximum yields of around 3,000 kg/ha can be reached in LS3.

TABLE IV.II AGRICULTURAL PRODUCE IN THE KILIFI AREA

NAME	BOTANIC NAME	FAMILY	SUBSISTENCE	CASH
ANNUAL CROPS:				
Maize	Zea mays	Graminae	++	-
Cassava	Manihot esculenta	Euphorbiaceae	+	±
Sesame	Sesamum indicum	Pedaliaceae	--	++
Cowpeas	Vigna unguiculata	Leguminosae	+	+
Beans	Phaseolus vulgaris	"	+	+
Pigeon peas	Cajanus cajan	"	+	+
Grams	Vigna aureus	"	+	+
	V. mungo	"	+	+
Rice	Oryza sativa	Graminae	+	±
Tobacco	Nicotiana tabacum	Solanaceae	±	+
Napier grass	Pennisetum purpureum	Graminae	Animal fodder	
Sweet potatoes	Ipomoea batatas	Convolvulaceae	+	±
Sugar cane	Saccharum officinarum	Graminae	±	±
Sorghum	Sorghum spp.	Graminae	+	+
Bitter Gourd	Momordica charantia	Cucurbitaceae	+	±
Tropical spinach	Amaranthus spp.	Amaranthaceae	+	±
	Phaseolus vulgaris	Leguminosae	+	±
Tomato	Lycopersicon esculentum	Solanaceae	+	+
Onion	Allium spp.	Liliaceae	-	+
Chillies	Capsicum annuum	Solanaceae	±	+
Bixa	Bixa annatto	Bixaceae		
Cotton	Gossypium spp.	Malvaceae	--	++
Okra	Hibiscus sabdariffa	"	±	+
PERRENNIAL CROPS				
Pineapple	Ananas comosus	Bromeliaceae	±	+
Sisal	Agave sisalana	Agavaceae	-	++
Passionfruit	Passiflora spp.	Passifloraceae	±	+
Castor	Ricinus communis	Euphorbiaceae	+	-
TREECOPS				
Coconut	Cocos nucifera	Palmae	+	++
Cashewnut	Anacardium occidentale	Anacardiaceae	+	+
Mango	Mangifera indica	"	+	±
Bananas	Musa spp.	Musaceae	+	+
Papaya	Carica papaya	Caricaceae	+	±
Citrus	Citrus spp.	Rutaceae	+	±
Calabash	Gescentia cujete	?		
Kapok	Ceiba pentandra	Bombacaceae	±	--

(Adapted from list 2.4.5; A preliminary reconnaissance soil survey of the Kilifi area (Floor et al., 1980).

The cultivation system in the Kilifi area is a complex matter. Subsequent to (a period of years of-) cultivation, land remains fallow for several years, so that a secondary bush may develop. This remains in use as rangeland (especially for concentrate selectors or 'browsers'). After the fallow period, the land is cultivated again.

This bush-fallow system should not be confused with shifting cultivation; there is a complex, but defined land-tenure. Each family has its own land; the land is generally cultivated by the same family each time.

The cultivation- and subsequent fallow periods vary from 1-7 years. Since there is no agricultural tradition among the coastral tribes (the Mijikenda), it is possible that these are not based upon a certain knowledge or experience of the farmer, but depend on direct demands or motivation of the moment.

Cultivation is raindependant in two ways:

- o crops are rainfed
- o cultivation activities (clearing, tillage, sowing) usually starts before the first rains. Although most farmers try to prepare their fields before the first rainfall, this is not always met, because of the unreliability of the rains. It has been observed many times, that clearing of land is started with sudden rainperiods.

  Often, cultivation is repeated several times each season (phased planting), which is a way to spread the risk of hazardous dry periods within rainy seasons.

PERENNIAL CROPS

Sisal, Agave sisalana, is produced for the international market in very large estates in LS 1 and 2. Large parts of these sisal estates are left fallow, or cultivated with annual or tree crops.

Pineapple, Ananas comosus, is produced on a small scale for the local market in the northern parts of LS 2, 5, 6. Ususally, cultivation of pineapple follows directly after clearing through burning of the bush.

TREE CROPS

Tree crops are very important in the survey area. They cover roughly a quarter of the total area, dominating in LS 1, 2, 4.

Their significance resulted in their classification in two plant communities, G1 and G2.

Most important is the coconut, Cocos nucifera, followed by cashewnut, Anacardium occidentale and mango, Mangifera indica. Usually, the tree crops occur in mixed plantations.

Coconut is used intensively:

- the fruits are consumed fresh or dried (local scale)
- copra is produced from the dried fruit-shells (national scale)
- a local liquor, Todi, is tapped from the trees (local scale)

An important pest to coconut trees is the Rhinoceros beetle (Oryctes rhinoceros). Trees die after the (single-)meristem is consumed by the adult insects. This resulted in the disappearance of nearly all coconuts form a large plantation in LS 2.

Anacardium occidentale, the cashewnut, also is an important tree crop. The nuts are gathered (sometimes in a very careless way) and sold on the local market, or to the Kenya Cashewnut LTD at Kilifi.

Major problem with cashewnut trees is the rapidly decreasing yield with age. This problem can be solved by pruning, (pers. com. van Eynatten). This is not practised often yet.

Mango, Magnifera indica, although planted nearly everywhere, is not a very important crop. The fruits are gathered haphazardly, sometimes sold on the local market. There is no production for the international market at this moment in the Kilifi area.

Kapok, Ceiba pentandra, occur single, or in small plantation, especially in LS 1. These are usually old trees, stemming from the first colonisation (by the Arabs) of the Kenyan coast. Since there is no demand for kapok on the international market, the trees are not exploitated anymore.

(The fruits of Bombax rhodognaphalon, a tree occurring in LS 3, 4 can be used in a similar way as those of Ceiba pentandra. They seem still to be used on a small scale by the Wagiriama (one of the Mijikenda tribes).)

Citrus spp. are interplanted mostly in LS 4 and 1, among other tree crops; common is C. sinensis. The fruits are for private consumption and for the local market.

Musa spp., bananas, are planted in nearly all LS wherever possible (moist soil conditions). They are for private use and for the local market. In the drier parts of the area, drought-resistant varities are used.

In some cases, tree crop plantations are combined with annual crops, such as maize, cassava and pulses. Mostly, however, the understore is left fallow and/or in use for grazing.

SETTLEMENT SCHEMES

Several settlement schemes were organised in the area. These are: Mtwapa, Vipingo, Teso Roka (LS1) and Ngenzenya (LS2) settlements. They are dealt within other Project Reports.

LIVESTOCK BREEDING AND DAIRYING

Ranging is an important (side-)activity in all landscapes, except LS 7. LS 1 has some large dairy farms, with modern management. Furthermore, there is ranging by goats and sheep on fallow land.

LS 2 has the usual goats browsing on the fallow land, but also cows grazing underneath cashewnuts, a special form of landuse. (unit 2.2b in the north).

LS 3 in the southern part (on the Hyphaene grasslands) medium size dairy farms. Their major problem are squatters, who also range their livestock (cows in the south, mainly goats in the north) in the surrounding areas.

LS 4 has also the goats ranging on fallow land, and few (non-grazing-)cows.

LS 5 holds goats and cows ranging on the various vegetation formations.

LS 6 goats and sheep, some cows, ranging on large areas, divided into (group- and Cie-)ranges.

Overgrazing is a major problem in LS 3 and 6, resulting in surface sealing and land degradation (vegetation and soil). This is also true, to a lesser extent, for LS 5.

The Kenyan government has a policy towards higher milk production. The Settlement schemes and a (Dutch) Dairy Programme make efforts to boost milk production in the area, emphasizing the introduction of zero-grazing in small farms.

4.2 Classification of vegetation and landuse

4.2.1 Sociological groups and plant communities

About 220 field samples (vegetation relevees) were taken and processed according to the method described in Chapter III.3 and 4.

This resulted in the formation of 37 sociological groups (Table IV.III) and 16 plant communities (Table IV.IV).

These were extracted from a vegetation table, presented in App. II. This table was compressed into a bar diagram (fig.6), and into a synoptic table (App.III).

Most of the sociological groups consist of at least 3 or more plant species, except the Lantana camara - Securinega virosa group, consisting of only these two species, and the Hyphaene coriacea group, a singleton.

The floristic type communities are described in detail subsequently.

TABLE IV.III LIST OF SOCIOLOGICAL GROUPS

I	Brachystegia spiciiformis
II	Lannea stuhlmannii
III	Adenium obesum
IV	Agathisanthemum bojeri
V	Euphorbia tirucalli
VI	Rhoicissus revoilii
VII	Aloë sp.
VIII	Cienkowskya sp.
IX	Hoslundia opposita
X	Lantana camara
XI	Acacia nilotica
XII	Polysphaeria parvifolia
XIII	'Mufodzohi'
XIV	Maytenus senegalensis
XV	Acacia mellifera
XVI	Hyphaene coriacea
XVII	Acacia stuhlmannii
XVIII	Albizia gummifera
XIX	Lamprothamnus zanguebaricus
XX	Annona chrysophylla
XXI	Strychnos mitis
XXII	Croton pseudopulchellus
XXIII	Deinbollia borbonica
XXIV	Acacia polyacantha
XXV	Cocos nucifera
XXVII	Cassia longiracemosa
XXVIII	Psychotria amboniensis
XXIX	Tinnea aethiopica
XXX	Veronia wakefieldii
XXXI	Capparis cartilaginea
XXXII	Sonneratia alba
XXXIII	Panicum repens
XXXIV	Eragrostis superba
XXXV	Echinochloa haploclada
XXXVI	Eragrostis sp.
XXXVII	Cenchrus setigerus

TABLE IV.IV LIST OF PLANT COMMUNITIES

A1.	Brachystegia spiciiformis	-	Rhoicissus revoilii
A2.	Brachystegia spiciiformis	-	Grewia cf. forbesii
B.	Dichrostachys cinerea	-	Panicum repens
C.	Grewia microcarpa	-	Perotis hildebrandtii
D1.	Acacia nilotica	-	Salvadora persica
D2.	Acacia nilotica	-	Hoslundia opposita
E.	Acacia stuhlmannii	-	Acalypha fructicosa
F1.	Lannea stuhlmannii	-	UPS 11
F2.	Lannea stuhlmannii	-	Panicum maximum
G1.	Cocos nucifera	-	Deinbollia borbonica
G2.	Cocos nucifera	-	Sida cuneifolius
H1.	Polysphaeria parvifolia	-	Triumfetta rhomboidea
H2.	Polysphaeria parvifolia	-	UPS 11
I.	Croton pseudopulchellus	-	'Mukambi'
J.	Capparis cartilaginea	-	Cynanchum tetrapterum
K.	Sonneratia alba	-	Rhizophora mucronata

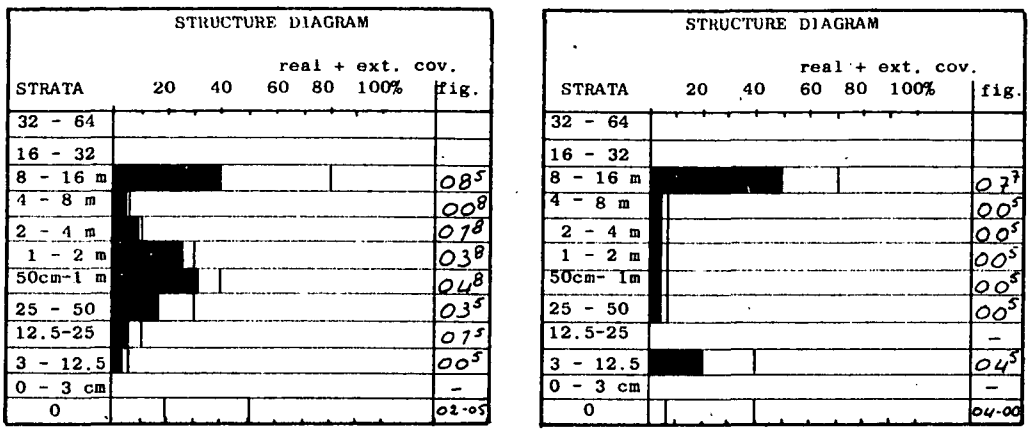


Fig. A 1 and 2: two characteristic structure diagrams of Brachystegia woodlands: with dense understory (R131, right fig.) and with open understorey (R177, left fig.)
Black bars: real vegetation cover; open bars: external vegetation cover.

TABLE A.I A LIST OF THE MOST IMPORTANT SPECIES OCCURRING IN THE BRACHYSTEGIA WOODLANDS

	NAME	FAMILY
TREES:	Brachystegia spiciiformis	Caesalpiniaceae
	Afzelia cuanzensis	"
	Manilkara zanzibarica	Sapotaceae
	Mutiri (Gir.)	?
SHRUBS & LIANAS:	Uvaria acuminata	Annonaceae
	Euphorbia grandicornis	Euphorbiaceae
	Suregada zanzibariensis	"
	Cissus rotundifolius	Vitaceae
	Enneastemon fornicatus	Annonceae
	Heeria mucronata	Anacardiaceae
	Aspargus racemosa	Liliaceae
	Ochna sp.	Ochnaceae
	Memecylon sp.	Melastomataceae
	UPS I	?
	Muria (Gir.)	?
SHRUBBY HERBS & HERBS:	Achyrothalamus marginatus	Compositiae
	Zanioculcas zaniifolius	Araceae
	Gonatopus boivinii	"
	Adenium obesum	Apocynanceae
	Commelina cf. africana	Commelinaceae
	Agathisanthemum bojeri	Rubiaceae
FERNS:	Phymatodes scolopendrium	Polypodiaceae

A1 Brachystegia spiciiformis - Rhoicissus revoilii woodland

A2 Brachystegia spiciiformis - Grenia cf. forbesii woodland

DESCRIPTION:

The Brachystegia spiciiformis woodlands (or Brachystegia woodlands) are open woodlands, evergreen (in contrast to their Tanzanian relative, the Miombo-forest, which is deciduous (Lind et al., 1974)), with tree heights of about 8-12 m; trees stand up to 10 m apart. Two types are recognized, differing in structure (fig.1 and 2) and in floristic composition:

A1- Brachystegia spiciiformis - Rhoicissus revoilii woodland with a dense understorey;

A2- Brachystegia spiciiformis - Grewia cf. forbesii woodland with a less well developed understorey.

It is possible that the difference between A1 and A2 is human induced; e.g. by more intensive ranging or charcoal production.

Table A.I shows a list of species occurring in the Brachystegia woodlands. It should be noted, that over 300 species are recorded in the Brachystegia woodlands during the survey (which is more than half of the total number of species recorded during the survey). Therefore, this list should be seen as an illustration, rather than a description.

OCCURRENCE:

The Brachystegia woodlands (communities A1 and A2) occur mainly in the drier parts of the area. They are found in landscape 5, where they form units 5.1 and 5.2 (not respectively) and in landscape 6 (unit 6.3).
Remnants of it are found in landscape 2 (unit 2.2b). More to the north in this landscape (outside the survey area) the Arabuko Sokoko forest occurs, large parts of which consist of Brachystegia woodland. Isolated spots are found in the drier parts of LS 4.

SOILS:

Brachystegia woodlands occur on sandy soils (or soils with a sandy topsoil) with generally low content of weatherable minerals, such as soils developed on Duruma sandstone or Magarini deposits.

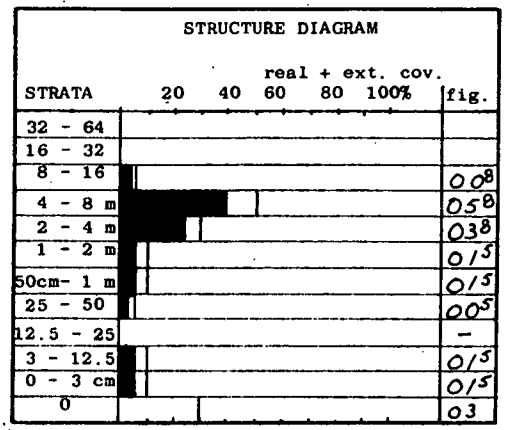


Fig. B.1: a characteristic structure diagram of the Dichrostachys bushland. (R 171)

TABLE B.I: A LIST OF THE MOST IMPORTANT SPECIES IN THE DICHROSTACHYS BUSHLAND

	NAME	FAMILY
SHRUBS & LIANAS:	Dichrostachys cinerea	Mimosaceae
	Cissus rotundifolius	Vitaceae
	Premna chrysoclada	Verbenaceae
	Hoslundia opposita	Labiatae
	Grewia bicolor	Tiliaceae
	Gonatopus boivinii	Araceae
	Ochna sp.	Ochnaceae
	Memecylon sp.	Melastomataceae
	Munyanga kitswa (Gir.)	?
	Muria (Gir.)	?
	UPS 2	?
SHRUBBY HERBS & HERBS:	Agathisanthemum bojeri	Rubiaceae
	Hibiscus aponeurus s.l.	Malvaceae
	Aerva lanata	Amaranthaceae
	Commelina africana	Commelinaceae
	Phyllanthus sp.	Euphorbiaceae
GRASSES & CYPERS:	Panicum repens	Graminae
	P. maximum	"
	Cyperaceae sp. 1	Cyperaceae

B. Dichrostachys cinerea - Panicum repens shrubbed bushland

DESCRIPTION:

The Dichrostachys cinerea - Panicum repens shrubbed bushland (Dichrostachys bushland) is closely associated with the Brachystegia woodland. It differs from it in structure (shrubbed bush up to 8 m) and in floristic composition. It is likely that it is derived from the Brachystegia woodland, or that it forms an intermediate stage towards it, e.g. after cultivation, or that both possibilities are valid. For this, the following arguments excist:

- The Dichrostachys bushland shows a high similarity in floristic composition with the Brachystegia woodland; the difference in structure can be explained by more extensive charcoal production, and ranging;
- the Dichrostachys bushland is found on similar soils as the Brachystegia woodlands, (often in its direct surroundings), be it at the wetter parts (which are likely to be cultivated first);
- the Dichrostachys bushland occurs mostly in the immediate vicinity of arable land, where intensive ranging can be observed.

A list of species is presented in Table B.I, while an example of a structure diagram is shown in fig. B1.

OCCURRENCE:

As stated above, the Dichrostachys bushland is found in the environment of the Brachystegia woodlands. In landscape 5, it occurs in units 5.3 and 5.4; it is found in valley bottoms of landscape 6 as well (unit 6.4).

SOILS:

Contrary to the Brachystegia woodlands, the Dichrostachys bushland occurs not only on sandy soils, but also on clayey soils.
On sandy soils, it is associated only with community C, on clayey soils also with D1. The Dichrostachys bushland seems to be confined to soils with low content in weatherable minerals.

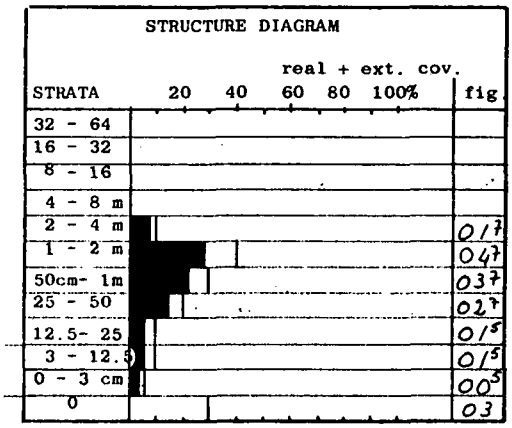


Fig. C.1 An example of a structure diagram of the Grewia shrubland (Relevee 60)

TABLE C.I A LIST OF THE MOST IMPORTANT SPECIES OF THE GREWIA BUSHLAND

	NAME	FAMILY
TREE:	Mutiri (Gir.)	?
SHRUBS & LIANAS:	Grewia microcarpa	Tiliaceae
	Erythrococca sp.	Euphorbiaceae
	Dichrostachys cinerea	Mimosaceae
	Manilkara sulcata	Sapotaceae
SHRUBBY HERBS & HERBS:	Commelina cf. africana	Commelinaceae
	Tephrosia sp.	Papillionaceae
	Vernonia hildebrantii	Compositae
	Hibiscus aponeurus s.l.	Malvaceae
GRASSES & CYPERS:	Perotis hildebrandtii	Graminae
	Panicum maximum	"
	SP 2	Cyperaceae
	SP 8	"
	SP 1	"

C. Grewia microcarpa - Perotis hildebrandtii shrubland

DESCRIPTION:

This small plant community is simple in structure as well as in floristic composition. It can be seen as a rest-group, where formations degenerated from both plant communities B abd D1 are classified.
The formations of the Grewia shrubland are relative open, (see structure diagram in fig. C.1) with shrubs generally not exceeding 4 m. in height. A list of the most important species is presented in Table C.I.

OCCURRENCE:

The Grewia shrubland occurs only in landscape 5, where it is confined to the most degenerated parts of units 5.3 and 5.4.

SOILS:

The Grewia shrubland is formed on sandy soils, or clayey soils with a sandy topsoil. In all cases, they are poor soils, with low weatherable mineral content.

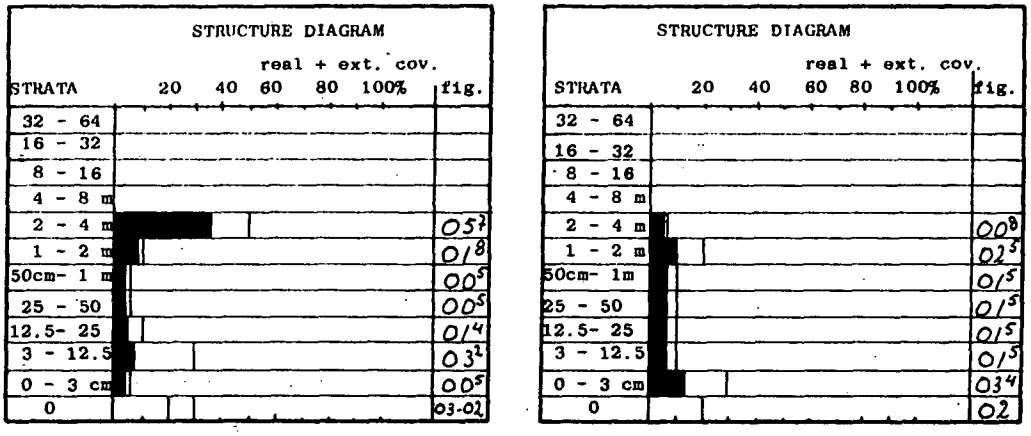


Fig.D1 and 2: two characteristic structure diagrams of the Acacia shrubland: fig. 1 (left, R163) is an example of the D1 community, while fig. 2 (right, R153) represents D2.

TABLE D.I: A LIST OF THE MOST IMPORTANT SPECIES OF THE ACACIA SHRUBLAND

	NAME	FAMILY	OCC.
TREES:	Salvadora persica	Salvadoraceae	D1
SHRUBS & LIANAS:	Acacia nilotica	Mimosaceae	
	A. zanzibarica	"	
	Thespesia danis	Malvaceae	
	Lantana camara	Verbenaceae	
	Premna chrysoclada	"	D1
	Securinega virosa	Euphorbiaceae	
	UPS 2	?	D1
	Hoslundia oppositia	Labiatae	
	Grewia bicolor	Tiliaceae	D1
HERBS & SHRUBBY HERBS:	Commelina cf. africana	Commelinaceae	
	Tephrosia sp.	Papilionaceae	D1
	Achyranthes aspera	Amaranthaceae	
	Pipalia lappaceae	"	
	Solanum incanum	Solanaceae	
	Endostemon tereticaulis	Labiatae	
	Ocimum hadiense	"	
	Tragiella natalensis	Euphorbiaceae	
	Edithcolea grandis	Asclepiadaceae	
GRASSES & CYPERS:	Panicum maximum	Graminae	D1
	Eragrostis sp.	"	"
	SP 6	Cyperaceae	"
	SP 7	"	"

D1 Acacia nilotica - Salvadora persica shrubland
D2 Acacia nilotica - Hoslundia opposita shrubland

DESCRIPTION:

The Acacia nilotica shrublands (Acacia - shrublands) are large communities. They occur in the driest western part of the survey area. They consist of shrublands, with shrubs generally not exceeding 3-4 m, ranging from a land with scattered shrubs to vast impenetrable formations.
The commonest shrub is Acacia nilotica, followed by Hoslundia opposita. In wetter parts, on sandy soils, Dichrostachys cinerea may dominate, while in the large bottomlands, Acacia zanzibarica is abundant.
There is a large seasonal variety in the understorey. In dry seasons, all grasses and herbs are consumed or dessicated, leaving the soil bare, with at the most a few Pipalia lappacea near the trunks of the shrubs. After the rains however, the surface may be covered with a variety of flowering herbs and grasses, such as are listed in Table D1.
Two communities, differing mainly floristically, are recognized.

D1: Acacia nilotica - Salvadora persica shrubland; rich in species, possibly because of less intensive ranging and a wetter position in the field.

D2: Acacia nilotica - Hoslundia opposita shrubland lacks a few sociological groups occurring in D1 (e.g. XXXIII and XXXVI), while others are less common (e.g. IX, XXXIV).

In Table D.I, species occurring especially in D1 are marked. In fig. D1 and 2, two examples of structure diagrams are presented.

OCCURRENCE:

The Acacia shrublands dominate landscape 6, in all units. D2 is confined to (the drier parts of) this landscape, while D1 is found in wetter parts (unit 6.4) and in unit 5.4 of landscape 5 as well.
In all cases, Acacia shrublands occur in dry areas (annual rainfall not exceeding 700 mm) with irregular heavy rains and flooding.

Soils:

The Acacia shrublands occur exclusively on heavy soils, mostly of poor structure, developed on the Bay sediments. The properties and problems connected with these soils are dealt with elsewhere (Floor et al., 1980).

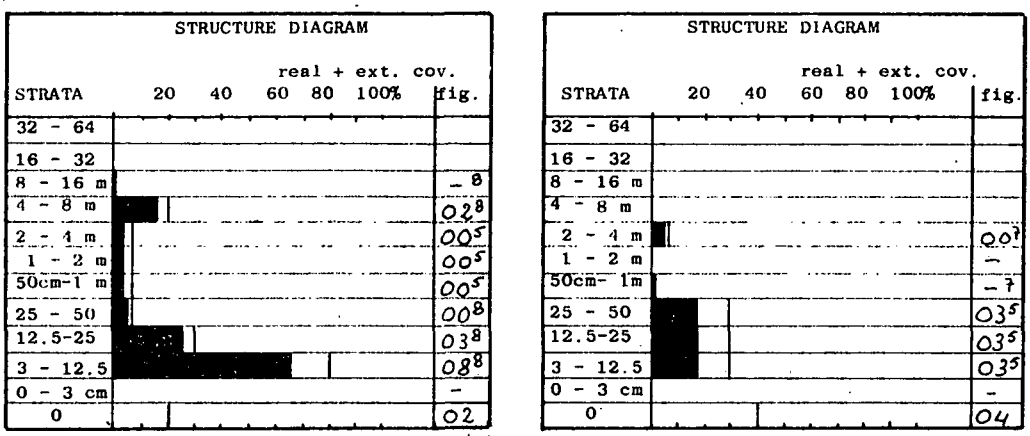


Fig. E1 and 2: two characteristic structure diagrams showing large variation. Left: R205, right: R147.

TABLE E.I: A LIST OF COMMON SPECIES TRUE TO THE Acacia stuhlmannii - COMMUNITY

	NAME	FAMILY
TREES:	Cocos nucifera	Palmae
	Parkia filicoidea	Mimosaceae
SHRUBS & LIANAS:	Acacia stuhlmannii	Mimosaceae
	Pluchea dioscorides	Compositae
	Thespesia danis	Malvaceae
	Lantana camara	Verbenaceae
	Securinega virosa	Euphorbiaceae
SHRUBBY HERBS & HERBS:	Acalypha fructicosa	Euphorbiaceae
	Deinbollia borbonica	Sapindaceae
	Sida cuneifolius	Malvaceae
	Commelina cf. africana	Commelinaceae
	Vernonia hildebrandtii	Compositae
GRASSES:	Echinochloa haploclada	Graminae
	Leptochloa pamica	"
	Imperata cilindrica	"

E. Acacia stuhlmannii - Acalypha fructicosa bush- and shrubland

DESCRIPTION:

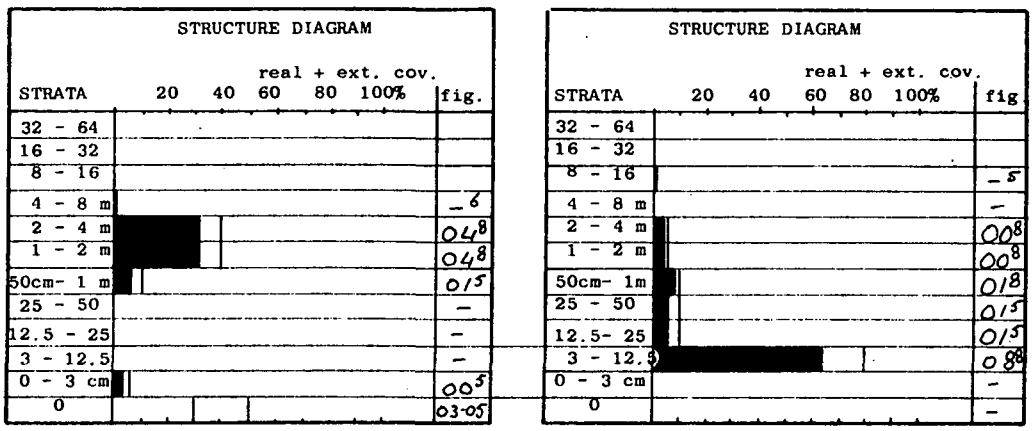
The Acacia stuhlmannii - Acalypha fructicosa bush- and shrubland encompasses all kinds of formations in wet positions, e.g. in river valleys. There is a strong variation both in structure (depending mainly on human influence) and in floristic composition. The species listed in Table E.I however, are true to the community.
In most cases, the community consists of low dense shrubland formations, with Acacia stuhlmannii and Pluchea dioscorides, and some single trees, such as Parkia filicoidea or Cocos nucifera. Common grasses are Echinochloa haploclada and Imperata cilindrica, and in many cases a variety of Sorghum spp. are encountered. Two diagrams, showing the possible variation in structure, are presented in figs. E1 and 2.

OCCURRENCE:

The Acacia stuhlmannii - Acalypha fructicosa bush- and shrubland community is found in river-valleys and other wet positions of all landscapes, except LS 5 (which is too dry) and 7 (which presents of course a very special case).

SOILS:

The community occurs on all kinds of soils, providing that they stay wet for a considerable period of the year, or have a shallow groundwaterlevel.
Since Acacia stuhlmannii is a salt resistent species, even salinity should not pose a problem.



Figs. F1 and 2: representative structure diagrams of Lannea communities: fig. 1 (R119, left, bush) F1; fig. 2 (R112, right, grasslands) F2.

TABLE F.I: A LIST OF THE MOST IMPORTANT SPECIES OF THE LANNEA COMMUNITY

	NAME	FAMILY	OCC
TREES:	Lannea stuhlmannii	Anacardiaceae	
	Terminalia spinosa	Combretaceae	N
	Adansonia digitata	Bombacaceae	
	Hyphaene coriacea	Palmae	S
SHRUBS AND LIANAS:	Maytenus senegalensis	Celastraceae	
	Acacia mellifera	Mimosaceae	
	A. stuhlmannii	"	
	Ormocarpum kirkii	"	
	Albizia anthelmintica	"	
	Lantana camara	Verbenaceae	
	L. viburnoides	"	
	Vernonia hildebrandtii	Compositae	
	Hoslundia opposita	Labiatae	
	Thespesia danis	Malvaceae	
	Securinega virosa	Euphorbiaceae	
	Asparagus sp.	Liliaceae	
	Bridelia cathartica ssp. melanthesoides	Euphorbiaceae	
	Lamprothamnus zanguebaricus	Rubiaceae	
	Annona chrysophylla	Annonaceae	F2
	Kleinia kleinioides	Compositae	N
	Munyanga kitswa (Gir.)	?	
SHRUBBY HERBS & HERBS:	Guizotia scabra	Compositae	
	Vigna triloba	Papilionaceae	
	Cissampelos sp.	Menispermaceae	
	UPS 11	?	
	UPS 42	?	
GRASSES:	Hyparrhenia rufa	Graminae	
	Panicum maximum	"	

F1. Lannea stuhlmannii - UPS 11 bush- and shrubland
Lannea stuhlmannii - Panicum maximum bush- and shrubland

DESCRIPTION:

These important plant communities are characterized by a large diversity in structure, ranging from bush to shrubland to isolated bushes in grassland formations ('bushmounds'). (The term 'bushmounds' refers to isolated, often impenetrable spots of bush, of complex structure and floristic composition, which form on slightly elevated parts of grassland formations. These elevations might be (sub-)recent termite mounds). The floristic composition of the Lannea-communities changes gradually from N to S, with the increase of rainfall in this direction. An example is the appearance of Hyphaene coriacea in the southern grasslands, and of Terminalia spinosa in the middle and northern formations belonging to the community.
Unfortunately, it has been impossible to reflect the N-S gradation in the floristic classification (F1 and F2) of the communities. The subdivision is based upon possibly human induced differences, both in structure and floristic composition.

F1 -Lannea stuhlmannii - UPS 11 bush- and shrubland; generally consists of formations with dense structure, induced by a slight pressure of burning and grazing.

F2 -Lannea stuhlmannii - Panicum maximum bush- shrub- and grassland appears in the more open formations, with a heavy pressure of burning and subsequent grazing.

Table F.I lists the most important species occuring in the Lannea-community, while figs. F1 and 2 represent characteristic structure diagrams of F1 and F2 respectively.

OCCURRENCE:

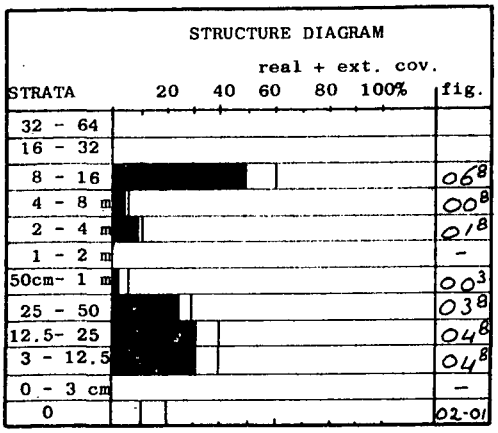
The Lannea-communities dominate LS 3, but include some of the Hyphaene coriacea grassland formation of LS 1 (unit 1.3) as well.

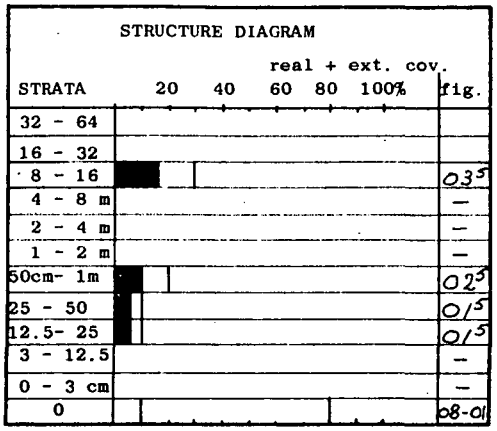
NB: Jan Kuypers report on the human influence on vegetation (Preliminary Report nr. 4) is dealing with (the northern part of) LS 3. Consequently, all plant communities described in his work should be seen as possible subdivisions of the Lannea-communities. As explained elsewhere, adoption of these subdivisions proved to be unuseful for this survey, because of difference in scale.

SOILS:

LS 3, which is dominated by the Lannea-communities, is developed on the Mto Mkuu FM (Jurassic shales). A scala of clayey soils, some with vertic properties, are developed on this geological formation. They belong to the richest soils of the survey area, but have a high erodibility.

The soils of the Hyphaene grasslands (unit 1.3) usually are clayey, badly drained, over coral rock.





Figs. G1 and 2: characteristic structure diagrams of tree crop plantations; fig. 1 (left, R207) a G1 formation, with a developed understorey; fig. 2 (right, R45) a G2 formation, with a very open understorey.

TABLE G.I: A LIST OF THE MOST COMMON SPECIES IN THE TREECROP PLANTATIONS

	NAME	FAMILY	OCC
TREES:	Cocos nucifera	Palmae	
	Anacardium occidentale	Anacardiaceae	
	Mangifera indica	"	
	Citrus spp.	Rutaceae	G2
	Ceiba pentandra	Bombacaceae	LS1
	Musa spp.	Musaceae	
SHRUBS AND LIANAS:	Gonatopus boivinii	Araceae	G1
	Hoslundia opposita	Labiatae	"
	Lantana camara	Verbenaceae	"
	Annona chrysophylla	Annonaceae	
	Gloriosa simplex	Liliaceae	G1
	Deinbollia borbonica	Sapindaceae	"
	Machembe gakuro	Liliaceae?	"
	Tetracera boiviana	Dilleniaceae	"
SHRUBBY HERBS & HERBS:	Triumfetta rhomboidea	Tiliaceae	
	Commelina cf. africana	Commelinaceae	
	Sida cordifolia	Malvaceae	
	S. cuneifolius	"	G2
	Phyllanthus sp.	Euphorbiaceae	
	UPS 42	?	G1
	UPS 43	?	
	Ocimum hadiense	Labiatae	G2
	Agathisanthemum bojeri	Rubiaceae	"
GRASSES & CYPERS:	Panicum repens	Graminae	
	P. maximum	"	G2
	Cenchrus ciliaris	"	
	SP 5	Cyperaceae	

G1. Cocos nucifera - Deinbollia borbonica plantations
G2. Cocos nucifera - Sida cuneifolius plantations

DESCRIPTION:

These communities, who consist of tree crop (mainly coconut) plantations, are as a matter of course, totally human induced.
Although the plantations vary considerably, most of them consist of coconuts - cashewnuts - mango in the proportion of, say 10:2:1, with a variable amount of Citrus spp. (mostly C. sinensis) and bananas. (Musa spp.) At the coast, in LS 1, old Kapok, Ceiba pentandra, plantations or single kapok trees, among coconut-plantations may be encountered.
In the northern part of LS 2, cashewnuts dominate the tree crop plantations, resulting in a proportion of coconut 2: cashewnut 10: mango 1.
The variation in the understorey (and thus in the structure) of the formations depends mainly on human activities. Three main types of (use of-) tree crop formations may be recognized:

-1: tree crops + annual crops (maize, cassava, pulses...) --- LS 4 esp.
-2: " + cleared understorey --- intensive grazing --- " " "
-3: " + neglected " --- extensive " --- LS 1,2 esp.

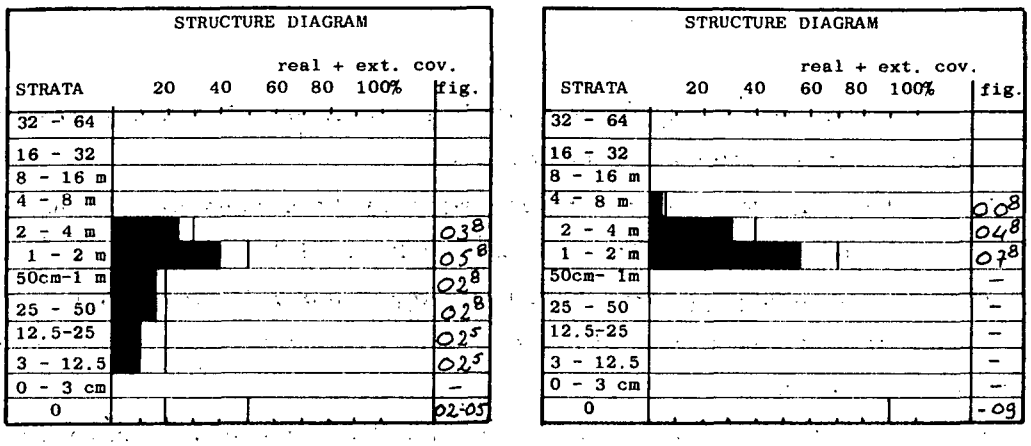
The formations with a 'neglected' (and thus denser and richer in species) understorey are classified as:
G1: Cocos nucifera - Deinbollia borbonica plantations; (cf. type 3) while all formations with a cleared or cultivated understorey are combined in:
G2: Cocos nucifera - Sida cuneifolius plantations. (cf. types 1, 2).
Figs. G1 and 2 present two characteristic structure diagrams of G1 and G2 plantations, while Table G.I outlines their floristic composition.

OCCURRENCE:

Tree crop plantations cover roughly a quarter of the survey area; so to speak, wherever possible.
Their importance, both economic and in extension, justifies their position in a plant community.
The G1 formations occur in LS 1 and 2; the G2 formations are confined to LS 4.

SOILS:

As stated above, tree crops are planted nearly wherever possible. Consequently, they are found on a scala of, preferably not to heavy textured soils (e.g. not in LS 3) with a favourable moisture regime.



Figs. H1 and 2: two structure diagrams reflecting developing stages of Polysphaeria bush. Left (fig.H1, R156) represents a Lantana stage; right (fig.H2, R184) a dense, more advanced stage.

TABLE H.I: A LIST OF THE MOST IMPORTANT SPECIES OF THE POLYSPHAERIA COMMUNITY

	NAME	FAMILY	OCC
TREES:	Azadirachta indica	Meliaceae	H2
	Hyphaene coriacea	Palmae	H2
SHRUBS & LIANAS:	Lantana camara	Verbenaceae	
	Securinega virosa	Euphorbiaceae	
	Markhamia zanzibarica	Bignoniaceae	
	Polysphaeria parvifolia	Rubiaceae	
	Annona chrysophylla	Annonaceae	
	Harrysonia abyssinica	Simaroubaceae	
	Dalbergia vaccinifolia	Papilionaceae	
	Albizia gummifera	Mimosaceae	H1
	Dichrostachys cinera	"	
	Commiphora africana	Burseraceae	
	Hoslundia opposita	Labiatae	
	Grewia bicolor	Tiliaceae	
	Bridelia cathartica ssp. melanthesoides	Euphorbiaceae	
	Fagara chalybea	Rutaceae	
	Ehretia bakeri	Boraginaceae	
	E. petiolaris	"	
	Premna chrysoclada	Verbenaceae	
	Memecylon sp.	Melastomataceae	
	Phyllanthus sp. 2	Euphorbiaceae	
	Munyanga kitswa (Gir.)	?	
SHRUBBY HERBS & HERBS:	Commelina cf. africana	Commelinaceae	
	Tephrosia sp.	Papilionaceae	
	Guizotia scabra	Compositae	
	Triumfetta rhomboidea	Tiliaceae	
	Cissampelos sp.	Menispermaceae	
GRASSES & CYPERS:	Panicum repens	Graminae	
	P. maximum	"	

H1. Polysphaeria parvifolia - Triumfetta rhomboidea and
H2. Polysphaeria parvifolia - UPS 11 bush- and shrubland

DESCRIPTION:

The Polysphaeria-communities consist of secondary bush and shrubland formations, which develop during (often extended) fallow periods after cultivation. Immediately after cultivation, a low but dense Lantana camara bush appears. (fig. H1.) The dominant position of Lantana camara is, after a couple of years, taken over by species such as Polysphaeria parvifolia, Markhamia zanzibarica, and others. (See Table H.I) A dense, impenetrable bush may then be formed, up to 5-6 m (fig. H2).
What happens subsequently is not known, for more advanced stages have not been observed. In my opinion, without further disturbance, gradually a thin-stemmed forest such as the Arabuko Sokoke forest and the Jadini forest may be formed at the coast, while a formation resembling the 'Kaya-forests' may develop in LS 4.

Two Polysphaeria communities are recognized:
-H1: Polysphaeria parvifolia - Triumfetta rhomboidea bush- and shrubland;
-H2: Polysphaeria parvifolia - UPS 11 bush and shrubland.

OCCURRENCE:

The H1-formations are confined to LS 2 and 4, while H2-formations dominate the secondary bushes of LS 1, but are found (associated with Agave sisalana-plantations) in LS 2 as well.

SOILS:
Most of the Polysphaeria-formations occur on red, deeply-weathered soils, such as Ultisols and Oxisols.
An exception should be made for (the coastal strip of-) LS 1, where they occur on shallow soils (Lithosols) over coral rock.

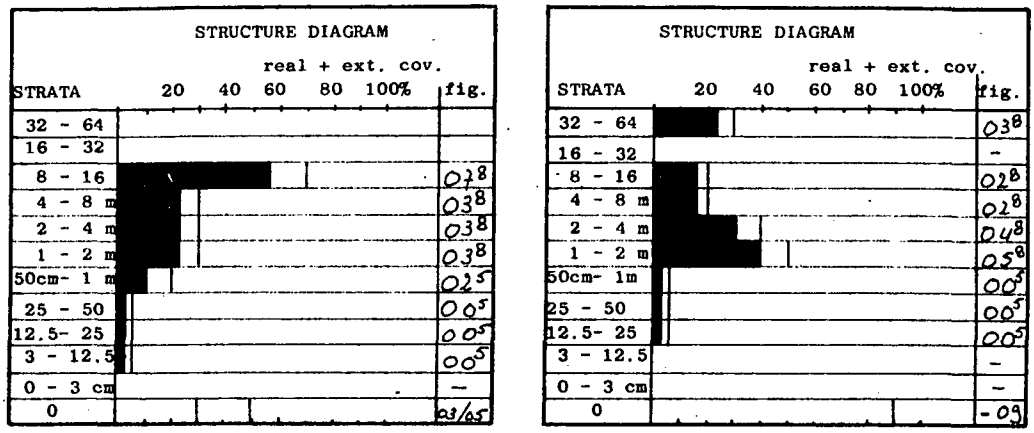


Fig.I.1 and 2: structure diagrams representing a coastal forest (fig.1, R 220, left) and a Kaya-type forest (fig.2, R 206, right).

TABLE I.I: A LIST OF SOME COMMON SPECIES IN ORIGINAL FORESTS IN THE SURVEY AREA

	NAME	FAMILY
TREES:	Sterculia appendiculata	Sterculiaceae
	Chlorophora excelsa	Moraceae
	Cynometra suaheliensis	Caesalpiniaceae
	Manilkara sulcata	Sapotaceae
	Bombax rhodognaphalon	Bombacaceae
	Trichillia roka	Meliaceae
SHRUBS & LIANAS:	Croton pseudopulchellus	Euphorbiaceae
	Euphorbia candelabrum	"
	Acalypha fructicosa	"
	Uvaria acuminata	Annonaceae
	Fernandoa magnifica	Bignoniaceae
	Combretum butyrosum	Combretaceae
	Deinbollia borbonica	Sapindaceae
	Epinetrum delagoensis	Menispermaceae
	Grewia forbesii	Tiliaceae
	Muria (Gir.)	?
SHRUBBY HERBS & HERBS:	Anchomanus dubium	Araceae
	Mukambi (Gir.)	?
GRASSES & CYPERS:	Panicum maximum	Graminae
COMMON EXOTICS & INTRUDERS:	Lantana camara	Verbenaceae
	Azadirachta indica	Meliaceae
	Adansonia digitata	Bombacaceae

I. Croton pseudopulchellus - 'Mukambi' forests.

DESCRIPTION:

This community encompasses all (seemingly) original forests of the survey area. Although a number of species are common (and nearly exclusive) to these forests, there is a great variation in their (rich) floristic composition. These forests are already well defined and described through their structure, so that only a few relevees were done to describe them. Their floristic composition differs completely from the surrounding formations. Moreover, it proved to be difficult to identify the composing plant species, also because a number of them are not(-well) described yet. Structurally, two main types may be recognized:

1. a thin-stemmed coastal forest, with trees up to 15-20 m; such as the Arabuko Sokoke forest north of the survey area, and the Jadini forest south of the area;
2. a well developed forest, with huge trees up to 50 m with several recognisable strata. (Tropical monsoon forest).
   Examples are the sacred 'Kaya' forests of LS 4.

Fig. I.1 presents a structure diagram of a coastal forest; fig. I.2 shows the structure of a Kaya-type forest.

Table I.I lists some species common in the original forests.

OCCURRENCE:

(Remnants of-) original forests are scarce in the survey area. Most of them are found on hilltops alongside a ridge in the interior uplands, in LS 4 (unit 4.1). These are the so-called 'Kaya'-forests.

LS 2 holds two kinds of original forest (together in unit 2.1):

- an extension of the Arabuko Sokoke forest, in the northern part of this LS;
- a sacred forest of the Kaya-type, near Gongoni in the central part of this LS.
- In LS 1, a few remnants of original forests are left (unit 1.1) viz.
  north of Mtwapa Creek
- Jumba ruins national monument
- Kurwitu

All these are very small spots, with exotic species such as Lantana camara and Azadirachta indica as intruders.

SOILS:

The (remnants of-) original forests are found on a scala of soils, (Oxisols and Ultisols) when they are sacred (LS 4,2). Other remnants occur on soils of marginal quality for agriculture, e.g. the shallowest lithosols over coral rock.

NB: Mr. Lesly Lap is working on botanical inventarisation of the original forests of the survey area. His report is not yet available (11/81).

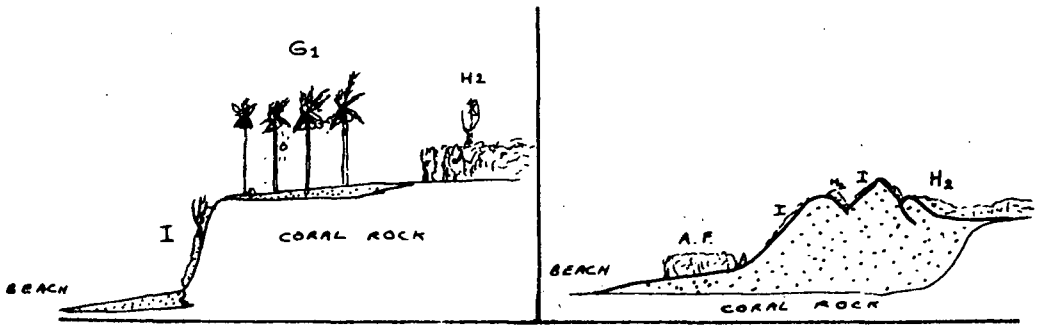
TABLE J.I: A LIST OF SPECIES OCCURRING IN Capparis cartilaginea SHRUB

NAME	FAMILY
Capparis cartilaginea	Capparidaceae
Cynanchum tetrapterum	Asclepiadaceae
Cissus rotundifolius	Vitaceae
Euphorbia candelabrum	Euphorbiaceae
Cordia subcordata	Boraginaceae
Rawsonia sp.	Flacourtiaceae
Aerva lanata	Amaranthaceae
Commelina cf. africana	Commelinaceae
Plectanthus flaccidus	Labiatae
Pentodon pentandrus	Rubiaceae
Atriplex farinosa	Chenopodiaceae
Ipomoea pes-capre	Convolvulaceae

TABLE K.I: A LIST OF THE MOST IMPORTANT MANGROVE TREES:

NAME	FAMILY
Sonneratia alba	Sonneratiaceae
Brugiuera gymnorrhiza	Rhizophoraceae
Rhizophora mucronata	"
Ceriops tagal	"
Avicennia marina	Verbenaceae
Xylocarpus benadirensis	Meliaceae

FIG. J.1 :two shore types at the Kenya Coast



J.1a :shore type with coral rock scarp, with a cocoonut plantation directly landinwards (Uhuru Farm,Kilifi)

J.1b:shore type with (calcareous) sand dunes,preceded by a zone of Atriplex farinosa (A.F.) Bofa beach,Kilifi.

J. Capparis cartilaginea - Cynanchum tetrapterum shrub-community

This community consists of dense low shrub-formations near the beach or on coral rock adjacent to the beach.
At the Kenya coast, two main shore types may be recognized:

- with a coral rock scarp
- with dunes.

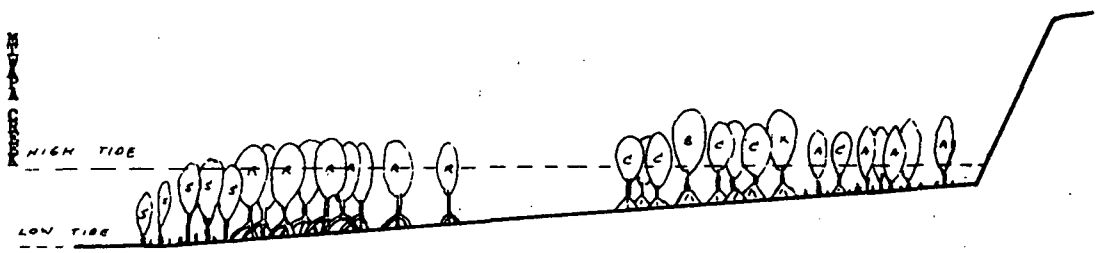
These situations are presented in fig. J.1. The communities there develop under influence of a strong salt spray. This is reflected in their floristic composition, which differs entirely from the inland communities.
Table J.I lists a few species occurring in Capparis cartilaginea shrub.

K. Sonneratia alba - Rhizophora mucronata mangrove swamps

Mangrove swamps form in tidal parts of all creeks of the survey area (and elsewhere at the Kenya coast). The formations may consist of low (2-5 m) trees, or, more landinwards, of higher trees up to 10-15 m.
In most cases the swamps are difficult to enter because of the immature soils and the intertwinning stilt-roots of the (common) Rhizophora mucronata trees.

Table K.I lists the common species of the mangrove swamps; fig. K.1 presents an often observed zonation of these species in the swamps.

FIG. K.1 : ZONATION IN MANGROVE SWAMP AT MTWAPA CREEK



S=Sonneratia alba
R=Rhizophora mucronata
C=Ceriops tagal
B=Brugiuera gymnorrhiza
X=Xylocarpus benadirensis
A=Avicennia marina

4.2.2 The final legend (see map, App. I)

An annotated map, and the (distribution of-) the plant communities among the landscapes served as a basis (see App.IV) for the composition of the final legend of the vegetation and landuse map, scale 1:100,000 (App.I A+B).
The final legend has the following construction:

1. first level: the 7 main landscapes
2. second level: structure and floristic composition
   - -original forests
   - -bush and shrubland
   - -plantations
3. third level: amount or intensity of arable land or grazing (c.q. browsing).

4.3 Vegetation and landuse, scale 1:100,000; a description of the land

Subsequently, a more detailed description of the land, divided into 7 landscapes (LS) will be given. Along with general notes, for each LS, the classification (as in the map-legend), remarks on original forests or other formations, and possible future developments will be presented.

4.3.1 LS 1: Sterculia appendiculata - Ceiba pentandra landscape (plant communities H1, H2, F2, G1, I)

HISTORICAL DEVELOPMENT

This LS, on the coastal plain, represents a part of the Kenyan coast which has been cultivated for a long time. Arab traders and settlers frequented the coast, resulting in the establishment of market towns, such as Mombasa, Takaungu and Malindi. Ruins of Arab settlements are found in Gede (near Malindi) and Jumba (near Mtwapa).
The coastal tribes, the Mijikenda, concentrated in their homesteads, the Kaya's, in LS 4. They organized and maintained trade caravans to and from the Kenyan Upland (and further), all converging at the coastal markets. Meanwhile, the Arab settlers raised kapok and sisal plantations, clearing the coastal forests. Intermixing with the coastal people resulted in a new culture: the Swahili.
With the arrival of European colonialists, and their construction of railways, the trading role of the Mijikenda ended. Their main activity shifted to agriculture. This, and the rapidly increasing population, forced them to leave their Kayas and spread out over the area. Migration to LS 1, where agriculture is well possible, (because of relative high rainfall and easy workable soils) predominated.

SUBDIVISION

As can be seen on the vegetation and landuse map, LS 1 is divided into

- original forests (unit 1.1): I (Croton pseudopulchellus - 'Mukambi' community)
- shrub- and bushland with increasing amounts of arable or grazing land (1.2); complex with H2 (Polysphaeria parvifolia - UPS 11) community
- a comparable, but more humid unit (1.3) where Hyphaene coriacea occurs; complex with H2 (Polysphaeria parvifolia - UPS 11) and F2 (Lannea stuhlmannii - Panicum maximum) communities
- Agave sisalana monoculture plantations (unit 1.4); complex with H2 (Polysphaeria parvifolia - UPS 11) community

- tree crop plantations (unit 1.5), intermixed with arable or grazing land (1.5a); complex with G1 (Cocos nucifera - Deinbollia borbonica), H1 (Polysphaeria parvifolia - Triumfetta Rhomboidea) and A2 (Brachystegia spiciiformis - Grewia cf. forbesii communities) or pure stands (1.5b); complex of G1 (Cocos nucifera - Deinbollia borbonica) and H1 (Polysphaeria parvifolia - Triumfetta rhomboidea).

Unit 1.2d comprises a large modern dairy farm, which has the outlook of an English park: large single (fruit) trees (mainly Mango) on wide grasslands (sown grass).

ORIGINAL FORESTS I: Croton pseudopulchellus - 'Mukambi' community)

Small remnants of original coastal forest (unit 1.1) are found at

- Mtwapa: - Jumba ruins (near Ocean sports, along the Mtwapa creek)
- Kurwitu (near Vipingo).

Maybe some of these are partly of secondary origin, because of intruders such as Lantana camara or Azadirachta indica which might occur.
Anyhow, these remnants do show high resemblance (be it mainly structurally) with (better described) original coastal forests, such as the Arabuko Sokoke forest and the remnants at Gede ruins, north of our area, and the Jadini forest, south of our area.

LANDSCAPE DYNAMICS : FUTURE DEVELOPMENTS

Since most of the land is in use presently, even with increasing population density, drastic change in the outlook of LS 1 are not expected. As a matter of course, the last remnants of original forest will disappear, except those near Jumba ruins, which are protected.
Elsewhere, fallow periods interrupting cultivation will diminish, resulting in lower yields and higher erosion hazards. This will probably pose a serious problem on the very shallow soils near the shore.
The activities of two large companies might influence the LS considerably:

- the Vipingo Sisal estate (the largest sisal company); because of the weak position of sisal on the international market, emphasis of this company's produce might shift to other crops, such as (irrigated) tree crops (i.c. Mango)
- the Bamburi Portland Cement factory (a large company, owning a large area in the southern part of LS 1): the proceeding excavation of the coral rock is likely to be followed by afforestation (pers. comm. with Haller, the farm-manager).

Furtheron, it is likely that tourism will increase in the near future, resulting in a greater number of tourist hotels and holiday cottages. Not all beaches however, are attractive for tourists. These beaches are rocky, not sandy; an example is the Kilifi (s.s.) beach.

4.3.2 LS 2: Cynometra suaheliensis - Anacardium occidentale landscape (plant-communities G1, H1, H2, I)

HISTORICAL DEVELOPMENT

This LS, on the coastal uplands, has been cultivated intensively only since early this century. The forests were then cleared, and most of the area was cultivated with tree crops.
In this area, relatively many cashewnuts were planted in comparison with coconuts. Hence, the LS could be divided into 3 parts, viz.

- a southern part (Tudor Creek to Gongoni) with even distribution of cashew- and coconut trees;
- a middle part (north of Gongoni to Kilifi Creek) where cashewnut trees outnumber coconut trees by, say, 10:1;
- a northern part (north of Kilifi Creek) which used to be a large plantation with even distribution (in rows) of coconut- and cashewnut trees.
Due to the activity of the Rhinoceros beetle (Oryctes rhinoceros) nearly all coconut trees there died.
In this part of the area, cashewnuts are combined with grazing cattle.

SUBDIVISION

On the vegetation and land use map, the LS 2 has been divided as follows:
- original forests (unit 2.1) I: (Croton pseudopulchellus - 'Mukambi') community
- cashew-coconut plantations (unit 2.2), mixed with arable or grazing land (unit 2.2a); complex with G1 (Cocos nucifera - Deinbollia borbonica), H1 (Polysphaeria parvifolia - Triumfetta rhomboidea) and A2 (Brachystegia spiciiformis - Grewia cf. forbesii) communities or pure stands (2.2b); complex of G1 (Cocos nucifera - Deinbollia borbonica) and H1 (Polysphaeria parvifolia - Triumfetta rhomboidea) communities
- secondary shrub- and bushlands (unit 2.3); complex with H1 (Polysphaeria parvifolia - Triumfetta rhomboidea) community
- sisal monoculture plantations (2.4); complex with H1 (Polysphaeria parvifolia - Triumfetta rhomboidea) and H2 (Polysphaeria parvifolia - UPS 11) communities.

As can be seen on the map, unit 4 (sisal) in both LS 1 and 2 are part of the same, very large, sisal plantation. The floristic composition of the fallow parts of the plantation differs slightly in the two landscapes.

ORIGINAL FORESTS (I: Croton pseudopulchellus - 'Mukambi' community)

Two kinds of original forest occur in LS 2:

- a very high, complex structured forest (near Gongoni) covering a cemetary; tropical monsoon forest
- a lower, slender stemmed coastal type of forest, part of the Arabuko Sokoke forest. In this relatively simply structured forest, Cynometra suaheliensis is abundant; coastal forest.

  In our area, only the very margin of the vast Arabuko Sokoke forest occurs. Within this forest, various formations are found. Most of it consists of the coastal type described above. The central part, however, represents an open Brachystegia spiciiformis woodland, resembling the one described as plant community A1, but richer in structure.

In wet parts of the forest, open 'vley's' with the large Acacia polyacantha and high cyper formations (Cyperus spp.) might be encountered.

FUTURE DEVELOPMENTS

The original forests are under a strong pressure of the growing population. The Arabuko Sokoke forest, although protected, is in exploitation for timber, firewood, and arable land.

Most of the cashew trees in LS 2 are old, low yielding trees. Their spontaneously breaking branches and twigs cover the surface under the neglected plantations. Production of cashewnuts could be boosted by renewing activities such as pruning. This would also yield a considerable amount of firewood. Unfortunately, these activities are rare at this moment.

4.3.3 LS 3: Terminalia spinosa - Maytenus senegalensis landscape (plant communities F1, F2, E, I)

GENERAL

This LS, developed on the heavy soils of the dissected uplands, (Mto Mkuu shale Formation) is changing rapidly due to developments of the last decade.

Burning at the end of the dry season traditionally is a regular activity especially in this LS, resulting in wide grassland formations. (The term 'savanna'

has been avoided because of the widespread misunderstandings about its correct usage). The grasslands are usually dominated by large isolated trees, such as Hyphaene coriacea, Terminalia spinosa, Lannea stuhlmannii, Adansonia digitata, Diospyros cornii. In some cases, they form the central part of isolated bushes. Generally, the LS can be divided into three parts, viz.

- a southern part, where Hyphaene coriacea grasslands dominate
- a middle part, where agriculture is intensive
- a northern part, with bush and shrub formations alternating with grasslands.

Agriculture used to be very restricted in this LS. The soils are not fit for tree crops, (except the sandy hilltops; these are then classified in LS 2, 4 or 5) and very heavy to till with the hoe.
Population density is (still) low, especially in the (driest) northern part.

SUBDIVISION

On a scale of 1:100,000, vegetation and landuse of LS 3 has been generalized as follows:

- forest (unit 3.1): I (Croton pseudopulchellus - 'Mukambi') community
- grassland (wooded, bushed, or shrubbed) unit 3.2) divided; complexes with:
  F1 (Lannea stuhlmannii - UPS 11),
  F2 (Lannea stuhlmannii - Panicum maximum) and
  E (Acacia stuhlmannii - Acalypha fructicosa) communities.
  Divided into:
  Diospyros cornii - Lannea stuhlmannii grasslands (north, 3.2a)
  Terminalia spinosa - Lannea stuhlmannii grasslands (central, 3.2b)
  Hyphaene coriacea - Lannea stuhlmannii grasslands (south, 3.2c)
- shrub- and bushland, with increasing amounts or intensity of arable land c.q. ranging (units 3.3); complexes with:
  F1 (Lannea stuhlmannii - UPS 11),
  F2 (Lannea stuhlmanni - Panicum maximum and (unit 3.3d, in valley bottoms):
  E (Acacia stuhlmanni - Acalypha fructicosa) communities
- river valleys, with complex patterns of bush, shrub and grasslands, or arable land. Locally, beautiful Acacia polyacantha forests occur, e.g. near Sokoke. (unit 3.4; complexes with:
  F1 (Lannea stuhlmannii - UPS 11) and
  E (Acacia stuhlmannii - Acalypha fructicosa).

FORESTS AND NATURAL CLIMAXES

It must be emphasized that wildlife, practically absent these days, probably was abundant in the past in this area. Therefore, the grasslands, alternated with shrub and bushlands, and the absence of vast forests, are probably rather close to the natural ecological climax of this LS. Forests would heave been confined to places difficult to attain, for grazing animals as well as for fires, as they are now, e.g. on very steep hillslopes. Natural fires would have maintained the grasslands just as well as human ignited fires.
Actually, two kinds of forests may be recognized in the LS:

- a well developed, high, large stemmed forest (on the slopes of a Kaya* near Jaribuni)
- forests in river valleys, consisting of pure stand of Acacia polyacantha.

The forests are mere remnants, small isolated spots of a few acre with a uncertain future.

FUTURE DEVELOPMENTS

Agriculture has been boosted in the middle part of LS 3 by the introduction of tractor ploughing (mainly for the cultivation of maize). This started in the seventies. Hence, the percentage of yearly cultivated arable land increased rapidly, which is still going on. It is likely that this development will see its way to the northern and southern parts of the LS. All this will result in an extension of units 3.2b and 3.3d on the vegetation and landuse map.
At this stage, it should be remembered that 1968 air photographs served as the basis for this map. Updating of the delineation of the units proved to be impossible. Therefore, especially in this area the map does not present an accurate picture of the actual situation.

HUMAN INFLUENCES ON THE VEGETATION

Mr Jan Kuypers report (Preliminary Report, nr. 4) on the human influence on the vegetation deals with the northern part of LS 3. Since he worked on a much more detailed basis, his classification of the vegetation there does not completely match with the one presented in this report.

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* The former homesteads of the Mijikenda are mostly found on elevated positions. They are often surrounded by dense forests. The complex of forest and homestead is here referred to as "Kaya".

4.3.4 LS 4: Cocos nucifera - Chlorophora excelsa landscape (plant communities G2, H1, E, D2, A2, I)

GENERAL

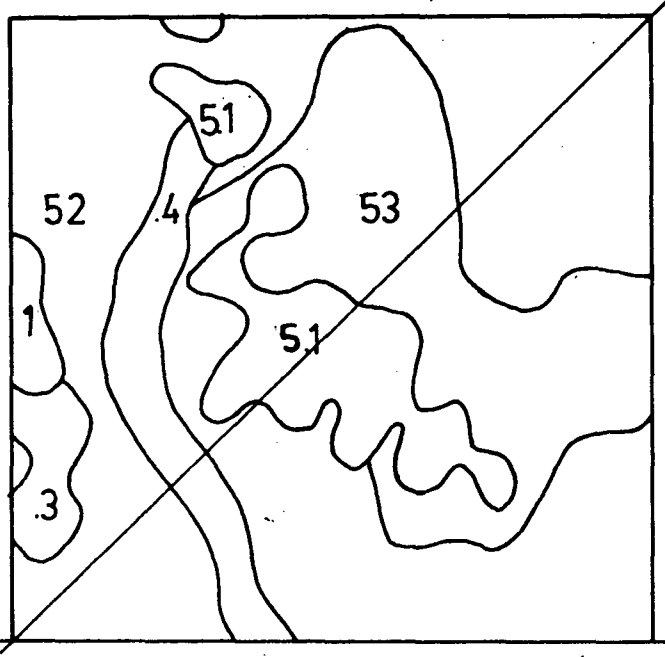
This LS, dominated by the abundance of coconut trees, developed on the southern half of the interior uplands.
It is the area where traditionally the homesteads of the coastal tribes, the Mijikenda, were concentrated (the so called Kayas).
It is a densely populated area, with intensive agriculture, probably because of the relatively high rainfall and the easily workable soils. Production of cash-crops, organised farming in cooperations and cultivation of coconuts (often combined with annual crops) are characteristic of this LS.

SUBDIVISION

This LS has been divided into:

- forests (on the slopes of the Kayas; tropical monsoon forest)
  ----unit 4.1; I (Croton pseudopulchellus - 'Mukambi') community
- river valley complexes, characterized by the cultivation of (dry land) rice, Oryza sativa (unit 4.2); with E (Acacia stuhlmannii - Acalypha fructicosa) community
- coconut plantations (mixed with cashewnut, mango, citrus and banana) (unit 4.3)
  - pure stands (4.3a); with G2 (Cocos nucifera - Sida cuneifolius) community
  - plantations (on hilltops and in valleybottoms) alternated with grassland or arable land (on the slopes) (4.3b); complex with
    H1 (Polysphaeria parvifolia - Triumfetta rhomboidea, and locally:
    A2 (Brachystegia spiciiformis - Grewia cf. forbesii) and
    D2 (Acacia nilotica - Hoslundia opposita communities.
    This is a very large unit, opening gradually and going over gradually into units of LS 5 and 6.
- bushland, mixed with arable and grazing land (unit 4.4); complex with
  H1 (Polyspaeria parvifolia - Triumfetta rhomboidea).
- woodland, alternated with arable land (unit 4.5); complex with
  H1 (Polyspaeria parvifolia - Triumfetta rhomboidea) and
  I (Croton pseudopulchellus - 'Mukambi') communities.
  This woodland borders the Brachystegia woodland (of LS 5) but differs from it both in structure and floristic composition.

FIG. 7a DETAIL OF THE VEGETATION AND LANDUSEMAP, SHOWING THE 4 UNITS OF LS 5.



5.1:Brachystegia woodland with dense undergrowth (A1,2/3;A2,1/3)
5.2:Brachystegia woodland with open understory.
5.3.Manilkara bushland (B,C,A2,arable land)
5.4.Manilkara bushland (B,C,D1,arable land)

FORESTS : THE KAYA FORESTS

Relatively large areas of tropical monsoon forests, surrounding the former homesteads or 'Kayas' (of the Mijikenda) are exclusive to LS 4. These remnants are protected by tribal laws. It is most likely that the entire area used to be covered by such forests. Most of it was cleared, to give way for the coconut plantations, leaving only some single Chlorophora excelsa trees.
The floristic composition of these forests has not been described properly yet (L. Lap, in preparation). It is clear, however, that they differ completely in all aspects from the neighbouring formations.
Forests and other undisturbed formations do occur on rock outcrops as well. These have a special status and are protected by tribal laws, as the Kaya forests. The tribal organisation and the culture of the Mijikenda is degrading under the influence of the western world. This renders the future of these last forests insecure.

FUTURE DEVELOPMENTS

Apart from the forests, the area is entirely cultivated. Therefore, drastic changes are not expected in the near future.

4.3.5 LS 5: Brachystegia spiciiformis - Manilkara zanzibarica landscape (plant communities A1, A2, B, C, D1)

GENERAL

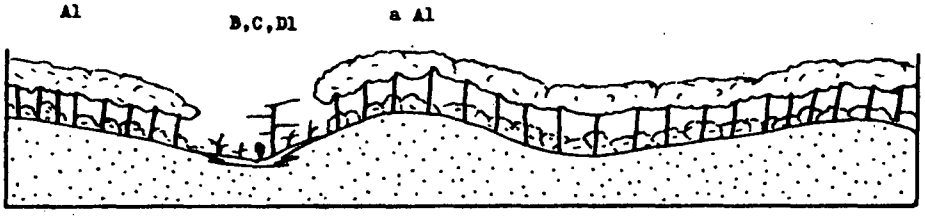
This LS developed on the dry, northern part of the interior uplands. It is a sparsely populated area, consisting of woodlands, alternated by various kinds of bush- and shrublands. Agriculture is only marginally possible: about 20 % of the land under shrub and bush vegetation is yearly cultivated. The woodlands are exploitated for timber and charcoal production, often in a non-commercial, uncontrolled way. Extensive ranging is common in the area, resulting locally in surface sealing.

SUBDIVISION

(based on plant communities A1, A2, B, C, D1) (fig. 7a)
LS 5 is divided into four units:

- Brachystegia woodland with dense understorey, on sandy soils (unit 5.1); complex of A1 (Brachystegia spiciiformis - Rhoicissus revoilii) and A2 (Brachystegia spiciiformis - Grewia cf. forbesii communities)

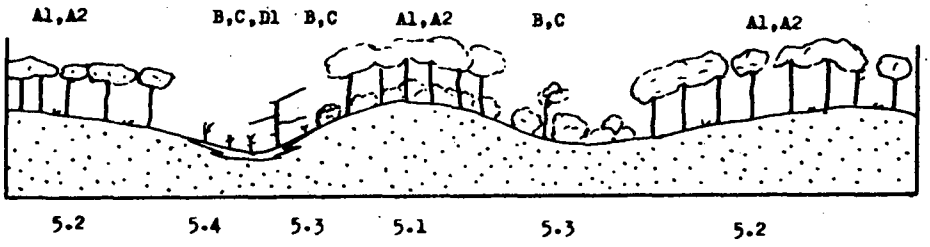
FIG. 7b DEVELOPMENT OF THE VEGETATION OF LS 5



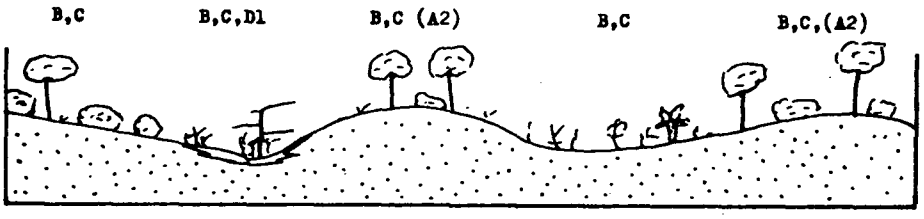
a.Probable situation in the past (of 200 jr BP)

sandy soils (on duruma sandstone)

clayey soils (on bay sediments)



b.Present situation,as shown on the vegetation and landuse map



c.Possible future:a furhter degradation of the landscape.

- Brachystegia woodland with open understorey, on sandy soils (unit 5.2); complex of A1 (Brachystegia spiciiformis - Rhoicissus revoilii) and A2 (Brachystegia spiciiformis - Grewia cf. forbesii communities).
- Secondary bush and shrubland, on sandy soils (unit 5.3); complex with:
  A2 (Brachystegia spiciiformis - Grewia cf. forbesii),
  B (Dichrostachys cinerea - Panicum repens) and
  C (Grewia microcarpa - Perotis hildebrandtii)
- Bush and shrubland on clayey (bay sediments) soils (unit 5.4); complex with:
  B (Dichrostachys cinerea - Panicum repens),
  C (Grewia microcarpa - Perotis hildebrandtii)
  D1 (Acacia nilotica - Salvadora persica) communities

ORIGINAL FORMATIONS

It is possible that the Brachystegia woodland represents the vegetation in the natural ecological climax of this LS, at least on the sandy soils. The difference between units 5.1 and 5.2 are probably human induced, e.g. by more intensive ranging or charcoal production. Unit 5.1 occurs mainly on more elevated positions, such as hilltops, while unit 5.2 is usually found on slopes.
Unit 5.3 occurs more in wetter locations such as valley bottoms, but on sandy soils. It clearly consists mostly of secondary formations, developed from the Brachystegia woodland, after a period of cultivation or clearing for timber and charcoal.
It is not clear whether the vegetation of unit 5.4 represents the natural ecological climax on these soils or not. Wildlife probably used to be abundant in these parts, prospecing on the richer, heavy soils in valley bottoms. Characteristic of this part is the arrangement of the vegetation in 'bushmounds'. These are isolated sites of shrub and bush, often inpenetrable, often with a central tree, mostly on slightly elevated positions such as termite mounds, and surrounded by more open grasslands. Bushmounds are probably induced by strong pressure of burning (bushfire) and grazing.
Fig. 7b presents the development of the LS as seen by the author.

FUTURE DEVELOPMENTS

Due to clearing for timber, charcoal, arable and grazing land, the Brachystegia woodlands are giving way to secondary bush rapidly. The secondary bush and shrub-formations on their part, degrade due to overgrazing.
In the southern part of the area, (poor) cashewnut plantations replace the woodlands.

TABLE IV.V:LANDQUALITIES OF THE BRACHYSTEGIA WOODLANDS

QUALITIES RELATED TO PLANT GROWTH

-availability of water:LOW

-availability of nutrients:-in the soil:VERY LOW

-in the standing vegetation: GENERALLY LOW

-availability of oxygen in the root zone:GENERALLY GOOD

-foothold for roots,salinity,temperature regime etc... do not pose special problems for plant growth in this area.

QUALITIES RELATED TO ANIMAL GROWTH

-availability of drinking water:LOW

-endemic pests and diseases:UNKNOWN (probably high pressure of thick fever)

-nutritive value of the vegetation:VERY LOW

-resistance to degradetion of the vegetation :LOW

-resistance to soil erosion under grazing conditions: RAPID SURFACE CRUSTATION

-accessibility of the terrain:GOOD

QUALITIES RELATED TO NATURAL RPODUCTS

-valuable wood species: Afzelia cuanzensis (highly regarded for furniture construction)

-local products:medicinal plants,ropes(from the bark of Brachystegia spiciiformis)etc...

-presence of fruits:some edible fruits troughout the year,but none of economic importance.

-game:practically absent.

QUALITIES RELATED TO MANAGEMENT PRACTICES

-possibilities for mechanisation:GOOD

-resistance to erosion:VERY LOW

-freedom for layout of (potential farms): (probably) NOT LIMITED

-trafficability:(from farm to land):GOOD

-vegetation cover:(in terms of favourable and unfavourable effects for cropping) NOT LIMITING

If the present pace in the developments described above perseveres, the Brachystegia woodlands will disappear completely within the next decade or so.

POSSIBLE IMPROVEMENTS

The Brachystegia woodlands in the Kilifi area differ from the related Miombo forests of Tanzania and Zambia. They are unique to East Africa.
It would be worthwhile to preserve at least parts of the woodlands for the future. This is only possible when an acceptable form of (preserving) landuse can be found for these woodlands. The landqualities of the Brachystegia woodlands are presented in Table IV.V.
Bearing these in mind, one could think of a combined use such as:

- rainfed cultivation of subsistence and fodder crops, based on a CHITEMENE system. This is a form of shifting cultivation where small areas are cultivated through clearing and burning, while extra wood from the surrounding parts is added. Fallow periods of something like 10 years would be necessary to support this kind of use.
- extensive ranging, with cattle, goats, combined with domesticated wildlife (such as elands and oryxes). This livestock could be partly non-grazing, partly migrating through the area, to and from the wetter river valleys.
- In the river valleys, leguminous drought resistent shrubs, such as Leucena leucocephala and Prosopis spp. could be planted, to support livestock and improve soil fertility (N).
- Timber exploitation of protected and improved parts of the woodland, with species such as Afzelia cuanzensis mixed with some fast growing trees.

4.3.6 LS 6: Salvadora persica - Acacia nilotica LS (plant communities B, C, D1, D2, E, A2)

GENERAL

This landscape lies in the driest, western part of the Kilifi area. It is developed on heavy, silty-clayey soils of very poor structure (on bay-sediments). These soils are alternated locally by soils on sandy hills and elevations. Agriculture is very difficult in this LS, because of the drought and the very heavy soils. In rainy seasons, flooding is regular.
Around villages, a pattern of diminishing intensity of cultivation may be recognized. This ranges from permanent cultivation of annual and perennial crops near the houses ('garden-cultivation') to fallow-agriculture with increasing fallow periods. This can clearly be seen around Bamba, a place in the northern part of

LS 6. The groundwater in LS 6 is very often brackish, only fit for animal consumption. Small, circular clayey sloughs, 'slick spots' serve as drinking water reservoirs, practically no other surface water being available. The 'slick spots' (probably originally generated by elephants) are filled in the rainy season. After some time, abundant beautiful mauve flowers of the water lily, Nymphaea micrantha, form a strong contrast with the barren surrounding areas. The pools gradually empty by the end of the dry season, leaving dark hexagonal patterned, cracked surfaces.

Characteristic of LS 6 are the single standing Salvadora persica ('tooth brush') trees and the abundance of Acacia nilotica. These sometimes form homogenous dense thickets, induced by overgrazing.

Dense succulent bushes, composed of species such as Adenia globosa, Cissus quadrangularis, C. rotundifolius and Opuntia sp. are scattered throughout the northern part of LS 6. These may form parts of live fences (together with Agava sisalana and thorny Acacia spp. branches) surrounding arable land in order to check livestock.

LS 6 extends far beyond the boundaries of the Kilifi area, and goes over into Tsavo National Park. The area is divided into group and company ranches, dividing the land among the members of these ranches. This is a way to prevent overgrazing. This policy is disturbed by the abundance of squatters in the area.

SUBDIVISION

LS 6 has been divided into:

- bushed grassland (unit 6.1); complex with:
  C (Grewia microcarpa - Perotis hildebrandtii),
  D1 (Acacia nilotica - Salvadora persica) and
  D2 (Acacia nilotica - Hoslundia opposita) plant communities
  --- with less than 1/5 arable land (6.1a; dryer positions)
  --- more than 1/5 arable land (6.1b; wetter positions)
- bush- and shrubland, with increasing amounts of arable land (units 6.2); complex with:
  D1 (Acacia nilotica - Salvadora persica) and
  D2 (Acacia nilotica - Hoslundia opposita) communities
- Brachystegia woodlands and thickets, on sandy hills and elevations (unit 6.3); complex with:
  A2 (Brachystegia spiciiformis - Grewia cf. forbesii),
  D1 (Acacia nilotica - Salvadora persica) and
  D2 (Acacia nilotica - Hoslundia opposita) communities

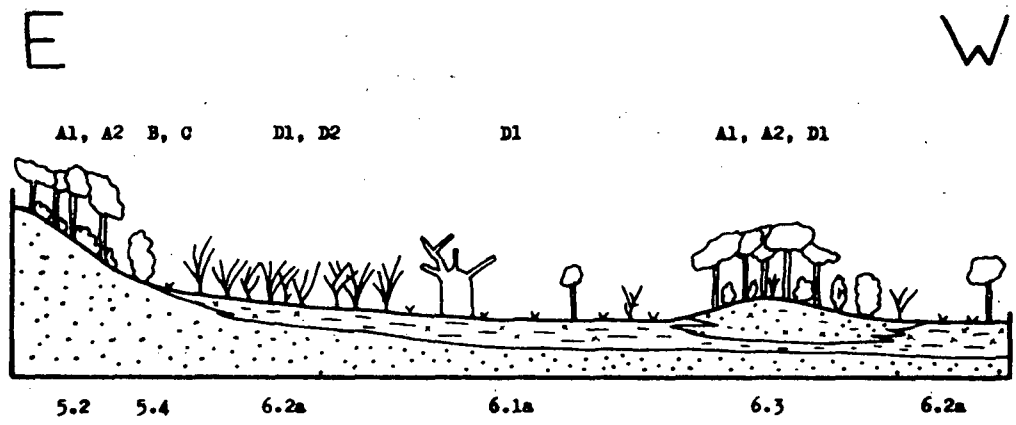


FIG.8 : (fictive) profile through LS 5 - 6, showing various communities (A - D), their relation with map units (5.2 - 6.3) and subetratum.

(soils developed on-) Pleistocene Bay sediments
(Luvisols)

(soils developed on-) Duruma sandstone
(Acrisols - Arenosols)

- River valley complexes (unit 6.4); complex with:
  B (Dichrostachys cinerea - Panicum repens),
  D1 (Acacia stuhlmannii - Acalypha fructicosa) communities.

Fig. 8 presents a fictive cross section through LS 6, showing the relationship between map units, plant communities and substratum.

LANDSCAPE DYNAMICS

Besides the Brachystegia woodlands of unit 6.3, no forest-like formations occur in LS 6. An exception should be made for the (remnants of) the Mwachi forest, in the southern part of LS 6. (unit 6.4). This forest (floristic type I) nowadays is dominated by planted Eucalyptus cf. camaldulensis trees.

4.3.7 LS 7: Ipomoea pes-capre - Rhizophora mucronata LS (plant communities J.K.)

This LS comprises the shoreline faces of the coast. These are the shores of-
- the Indian Ocean (unit 7.1)
- the Creeks (Kilifi-, Takaungu-, Mtwapa-, Tudor-Creeks) (7.2)

INDIAN OCEAN SHORES (J: Capparis cartilaginea - Cynanchum tetrapterum)

The vegetation at the shores of the Indian Ocean is characterized by floristic group J. Two types may be recognized, viz:
- shores delineated by a coral rock scarp (with Capparis cartilaginea shrub formations
- shores with (minor) dunes.

In both cases, a beach with calcareous sand is present. This beach is limited at the seaside by a vast coral rock platform, partly exposed at low tide. (There is a marked difference between low and high tide) This coral rock platform renders most of the Kilifi Coast unattractive for tourism.
Near the shore, along with the monsoon winds, a heavy salt spray determines the milieu, skimming the trees and shrubs.
In contrast with the coast north of Malindi, dunes are not abundant in the area. Some, placed more landinwards, are covered with a dense vegetation, which makes them not easily recognizable as such. More recent dunes, exposed to wind and salt spray, are only sparsely covered with vegetation. At the seaside of these, the cosmopolite Ipomoea pes-capre occurs as a characteristic, scandent shrub. Locally, the boundary of dunes and beach is marked by a zone of Atriplex farinosa which is a low, salt resistant shrub.
Surrounding houses and tourist hotels, in many places formations of Cocos nucifera or Casuarina equisetifolia mark the coastal line.

ECOLOGICAL TABLE OF THE KILIFI AREA

MAP LEGEND UNIT	PLANT COMMUNITY	PARENT MATERIAL: GEOLOGICAL FM	PARENT MATERIAL: FACIES (SOIL-)	HUMAN INFLUENCE	RELATIVE MOISTNESS
1.1	I	KILINDINI FM	MAINLY ROCK	LOW	MOIST
1.2a, 1.2b, 1.2c	H2		SAND / ROCK	LOW ↓ HIGH	DRY ↓ MOIST
1.2d, 1.3a, 1.3b, 1.3c, 1.3d	F2, H2		SAND, ROCK, CLAY	LOW ↓ HIGH	MOIST
1.4	H2		SAND/ROCK	HIGH	N.S.
1.5a	G1, H2, A2		SAND	HIGH	MOIST
1.5b	G1, H1				
2.1	I	MAGARINI SAND	SAND	LOW	MOIST
2.2a, 2.2b	G1, H1, A2; G1, H1			HIGH	
2.3	H1			LOW	N.S.
2.4	H1, H2			HIGH	
3.1	I	MTOMKUU SHALE FM	CLAY/R.R.	LOW	MOIST
3.2a, 3.2b, 3.2c	F1, F2; F1, F2, E		CLAYEY	MODERATE ↓ HIGH	DRY ↓ MOIST
3.3a, 3.3b, 3.3c, 3.3d	F1; F1, E			LOW ↓ HIGH	DRY ↓ MOIST
3.4				N.S.	MOIST
4.1	I	KL - DS	VARIOUS	LOW	V.MOIST
4.2	E	KL - BS		HIGH	MOIST
4.3a	G2	KL-DS-MS		MOD./HIGH	RATHER MOIST
4.3b	G2-H1 (A2,D2)	KL - DS			
4.4	H1	KL-MS DS		MOD./LOW	
4.5	H1, I				
5.1	A1, A2	DS (KL)	SAND	LOW	DRY/ R. MOIST
5.2					
5.3	C, B, (A2)	DS	SAND/CLAY	R. HIGH	DRY
5.4	B, D1, C	DS/BS	CLAY		
6.1a, 6.1b	D1, D2 C	BAY SEDIMENT	SILT CLAY	R.LOW ↳ R.HIGH	DRY ↳ MOIST
6.2a, 6.2b, 6.2c	D1, D2			LOW ↓ HIGH	DRY ↓ MOIST
6.3	A2, (D1, D2)		SAND	R. LOW	DRY
6.4	B1, D1, E		N.S.	N.S.	MOIST
7.1	J	KFM	C.SAND/ROCK	N.S.	MOIST SALT / TIDAL
7.2	K	-	C. SAND	R. LOW	

TABLE IV.VI: ECOLOGICAL TABLE OF THE KILIFI AREA, showing relationships between PARENT MATERIAL, (SOIL FACIES), HUMAN INFLUENCE and RELATIVE MOISTNESS on the one hand, and FLORISTIC VEGETATION TYPE and MAP LEGEND UNIT on the other hand.

FM = (Geological-) Formation
DS = Duruma Sands
BS = (Pleistocene-) Bay Sediment
KL = Kambe Limestone FM
KFM = Kilindini FM
MS = Magarini Sands
N.S.= Not Significant
C. = Calcareous ; R.R.= Rotten Rock
(-) = and; (/) = and,or,over
R. = Rather ; MOD. = Moderate

The off-shore vegetation (subject to tides), is characterized by marine angiosperms (represented by three families:

Potamogetonaceae
Hydrocharitaceae
Zosteraceae)

Along with these, Phaeophyta, Rhodophyta and Chlorophyta represent the seaweeds. The Chlorophyta seem to be in the majority.
The off-shore vegetation has not been studied; information is given in (Floor et al., 1980) and by pers. comm. with Mr. J. Reitsma.

CREEK SHORES (K. Sonneratia alba - Rhizophora mucronata)

The shores of the Creeks are characterized by mangrove swamps (floristic group K). The mangrove swamps serve as a habit and roosting place for birds. These are abundant in these formations.
The mangrove swamps are endangered, especially by the exploitation of the mangrove wood (for house construction). Presently, most of the mangrove near inhabited parts has disappeared or is brought down to poor, shrublike formations.
With increasing population pressure, it is likely that this development will carry through, which will drastically change the outlook of these East African Creeks.

4.4 Some remarks on interrelationships in landscapes

4.4.1 Introduction

The vegetation complex is determined by the following factors:

- climate
- soil and geology
- fauna and flora
- human activities

Some kind of homogenity or constancy in the activity of these factors makes a LS into an entity. As a matter of course, the delineation of a certain LS depends to a degree upon the appreciation of the surveyor. Boundaries between LS may be clear, but are in many cases very gradual.
Subsequently, some notes on the relationships between climate, soil and geology, fauna and human activities on the one side, and LS on the other side will be presented. It should be emphasized, that our LS are seen and defined from the standpoint of the vegetation; they are vegetation-landscapes.
The main ecological qualities of the vegetation (mapping-)units are outlined in Table IV.VI.

4.4.2 Vegetation and climate

In our area, the most important climatic factor is rainfall. The amount and distribution of the rain varies greatly thoughout the year, unfortunately in an unpredictable way.
Generally, rainfall decreases along a SE-NW line; this tendency is noticeable in the area as a whole, but also within the defined LS.
The rainfall determines land use in many ways. If e.g. soil conditions are suitable, coconuts are planted practically everywhere where rainfall is adequate.
The transition of LS 4 to 5 is determined completely by a difference in rainfall; nearly the same goes, e.g. for the transition of unit 2 to 3 of LS 1.
In the entire Kilifi area, rainfall (nor soil conditions) are really suitable for the growing of maize, which is nevertheless done everywhere. Rainfall then determines the (very big differences in) the yields.

4.4.3 Vegetation and soil

Moisture regime, one of the most important factors for plant life, is not only determined by the amount and distribution of the rainfall, but also by the conditions of the soil. This is only one of the many ways in which the soil plays a crucial role in determining the outlook of the vegetation and the land. Subsequently, some examples of the relationship between soil and vegetation (or land use) for each landscape will be presented.

LS 1

Near the coast, very shallow soils (Lithosols) occur. The possibilities of these soils are entirely different from the adjacent, comparable, deeper soils. This, however, is not reflected in the present (traditional) landuse yet, nor in the actual vegetation. Therefore, these areas are not separated on the vegetation and land use map.
The large sisal estate, extending from LS 1 into LS 2, is planted on two major soil groups; Acrisols (LS 1) and Ferralsols* (LS 2). The transition between the two is gradual. The fallow shrub formations (dominating neglected parts of the plantation) reflect the transition, with the introduction of floristic group H1 in LS 2, along with H2.

* These appear not to be true Ferralsols, because of textural requirements.

LS 2

The Magarini sands of the coastal uplands are locally cleared by incising rivers, baring the underlying Mto Mkuu Shale Formation.
The vegetation on the soils of these geological 'windows' is similar to that of LS 3, (developed on Mto Mkuu FM as well) and hence classified as such.

LS 3

LS 3 is developed on the Mto Mkuu Shale FM. The heavy clay soils (often with vertic properties) are generally not suitable for tree crops such as coconuts, cashewnuts and mangos. Hence, these are not found in this LS, (except a local tree in a river valley). However, on some hilltops in LS 3, these tree crops do occur abundantly (e.g. Lutsangani). It appears that these hilltops are covered with remnants of overlying geological Formations (such as Magarini sands). The soils developed on these remnants are suitable for the favoured tree crops.
In the northern, drier part of LS 3, Brachystegia woodland and derived secondary formations developed in such positions (e.g. Sokoke). These patches are classified in LS 5; the tree crop plantations mentioned above are classified in LS 2 or 4.

LS 4 and 5

The transition of LS 4 to LS 5 is determined in the first place by the (decrease of) rainfall. A scala of soils occur in both LS, of which some are common. LS 4 is covered almost entirely by human induced formations (tree crops, arable land) and secondary bush formations. On some drier, sandy parts, small patches of Brachystegia-woodland such as of LS 5 occur. This indicates that probably not the amount of rainfall as such, but landuse responding to it, determines the differences in the outlook of the land.
In the interior uplands (on which LS 4 and 5 are both formed) tongues of pleistocene bay deposits locally cover the Duruma sandstone. This is then reflected by the occurrence of floristic group D1 in such parts (which is elsewhere confined to LS 6).
The Duruma sandstone FM consists mainly of sandstone, alternated with belts of shale and siltstone. Soils developing on such belts are rather heavy and clayey, in contrast with the surrounding mainly sandy soils. The vegetation on these spots is very similar to that of LS 3. The patches are all to small on a scale of 1:100,000.

LS 6

LS 6 is developed on heavy soils of pleistocene bay deposits. These are locally overlayed by sandy patches. On these spots, Brachystegia woodland occurs. These woodlands however, differ from those of LS 5;they are intermixed with D1 and D2. Therefore, these formations are not classified in LS 5, (as has been done in similar cases in LS 3) but as a unit of LS 6 (6.3).

4.4.4 Other factors

If the influence of livestock on the land is classified under 'human activities', the influence of the fauna, at least of large mammals can be disregarded. The activity of insects (termites!) and of the micro-fauna (in the soil) plays a very important role, which should be studied much further.
On the human influence on the land - land use - much has been said in this report, and this will not be elaborated here any further.

5 DISCUSSION

An inventory has been made of the vegetation of the Kilifi area at the Kenyan coast. This inventory, both structurally and floristically, was based on (landscape-guided) API.

As a result, a vegetation and landuse map (scale 1:100,000) was prepared, for which the legend was based on a floristic classification, combined with observations on landuse.

The floristic classification has been compiled mainly to serve and support the vegetation and landuse map. It could be seen, however, as a first proposal for the classification of the vegetation of (a part of) the Kenyan coast.

The combination of vegetation and landuse for a survey like this, is not always consistent. Natural processes, out of which vegetation is born, generally tend to diversification, while human activities (land use) mostly work towards a simplification. In our area this can be seen e.g. in LS 1, when one compares the sisal plantation (1.4) (which is, in a way, the most advanced form of landuse in this LS) with the surrounding formations, or with the original forests of such area. The use of Zea mays as a field crop, in the entire area and practically regardless of the suitability of the land for this crop, is another example.

The vegetation and landuse map, and its legend, are not in all aspects logical. However, in my opinion, they are fit to serve their purpose, to present our inventory, providing a framework in which (possible improvements of) the landuse can be seen.

As stated earlier, the preparation of a separate soil map of the area has been of consequence for this mapping. Copying of the soil map has been avoided, and soil differences of little consequence for the present vegetation or landuse (which, however, might be of consequence for potential land use) are not taken in account. This makes a comparison of the vegetation and land use map with the soil map very useful.

In my opinion, the units of the vegetation and landuse map reflect ecological entities of the area. Comparison with a rainfall-evaporation map (Boxem, in preparation) is necessary to check the validity of this.

It should be born in mind, that 1968 airphotos served as a basis for this survey. Mainly regarding landuse, considerable changes took place in the last decade. This is especially important for planning on a larger scale (1:50,000, 1:10,000) for which this map can not serve as an accurate picture of the actual situation.

Much more work can be done on the vegetation in the area. Revision of floristic works for the coast is necessary. Classification of the vegetation could then be improved, and probably extended for the entire Kenyan coast.

Floristic inventory of original forests has not been attempted in this mapping for a number of reasons. Detailed study of these formations would however be very desirable, and indispensable for a sound landevaluation of the area. (L. Lap, in preparation).

6 Acknowledgements

This survey would have been unthinkable without the facilities provided by the TPIP. I am grateful to prof. Bennema, for giving me the opportunity to participate in the project; to dr. T. de Meester, for his hospitality and his guidance on my first steps in pedology, and to ing. W. Boxem, for the perfect arrangement and management during my stay at the project.
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I am indebted to dr. Henk Doing and prof. Zonneveld for their enthousiastic guidance and instruction during their visit.
The East African Herbarium at Nairobi, in the persons of miss C.H.S. Kabuye and mr. V.C. Gilbert, has been most helpful in the determination of some difficult plant species, and in checking and naming most of my field-herbarium.
Drs. V. de Meester-Manger Cats kindly lent me 4 relevees of coastal (salt-spray) shrub formations, and drew the front page for this report.
Mr. Herman Klees gave much of his time for the lay-out of the map, the vegetation table and the report.
Most of all, I am grateful to my friend Mr. Rexton Karisa; without his enthousiastic cooperation and his botanical knowledge, the floristic classification, and thus this work, would never have had any proportion.
With him, I thank the Kenyan people for their hospitality, wishing them a bright future. It is my sincere hope, that this work will help towards that future.
I thank Ing. Karel Pavlicek for revising the report and supporting the preparation for publication of this report.

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APPENDIX II: VEGETATION TABLE

The vegetation table consists of three parts (I, II, III) with each three sheets (1-3). On it, real coverage of about 380 plant spp. divided over 228 vegetation relevees are presented. (Each listed species has a 'presence' of at least 1.3 %). The real coverages (as derived from external- and internal coverage estimations) were rounded to 5 (1 and 2 downwards;3 and 4 upwards) except figures under 5. The plant species are presented, if known, with their botanic name; if possible, in full; if not, the genus or family name is given. If these are not known, the local name (Giriama or Swahili) is presented; entirely unnamed species have a number following UPS (Unidentified Plant Species). A list of plant species is given in App. V.
Relevee site data are presented at the bottom of (sheets '3 of-) the vegetation table. They are the following:

STRUCTURE DESCRIPTION:

Bare Ground	- : not appearing
Litter	S : less than 20 % (real cover)
Herb Layer (0 cm - 1 m)	O : 20 - 50 % " "
Shrub Layer (1 m - 8 m)	M : 50 - 80 % " "
Trees (more than 8 m)	C : more than 80 % " "

FLORISITIC COMPOSITION:

Total number of plant species (appearing in the Table) recorded in the Relevee

SITE DESCRIPTION:

- Relevee area (m^2)
- Soil 'Type':

RS : all kinds of sandy, loamy sand or sandy loam soils, lacking a textural B horizon, with red(dish) colour

YS : as RS, but with white, yellow or brown colours

RSC : as RS, but commonly overlying a clayey or sandy clayey layer, such as would probably qualify as a textural B horizon

YSC : as RSC, but with colours such as in YS

LS : shallow soils over (coral-) rock; Lithosols (FAO)

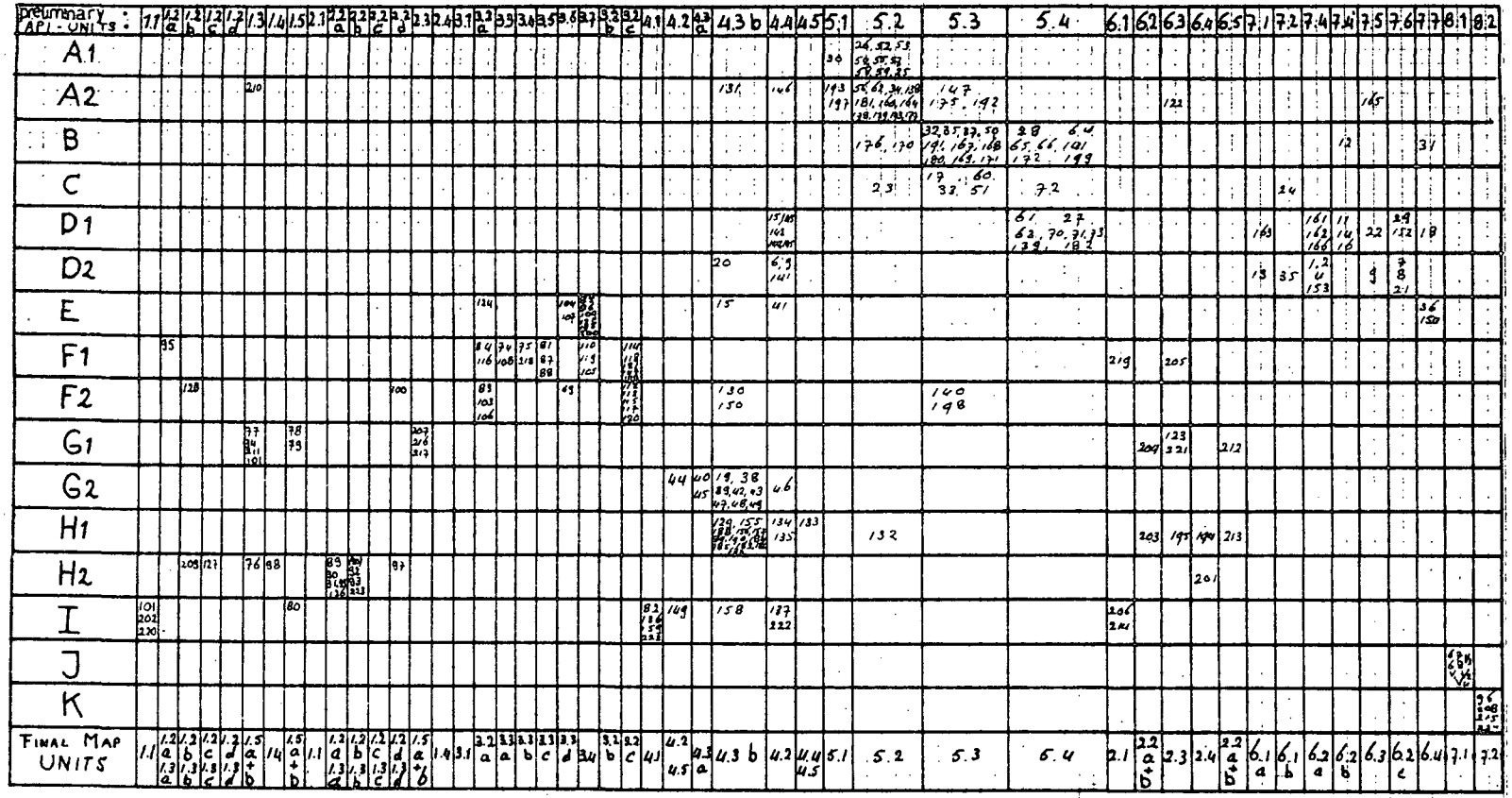
CS : (immature) soils on highly calcareous beach sand

BS : soils developed on pleistocene bay sediments

BC : clayey soils developed on shales.

- Final Map Unit
- Coordinates site: map coordinates of the relevee position. In some cases, detailed information is missing. This is e.g. the case with relevees VI - V5, borrowed from drs. De Meester-Manger Cats.

N.B.: The soil 'types' as defined above merely presents a grouping for practical purposes; they do not correspond with units of the soil map (in preparation).



APPENDIX IV: Cross Check Table for preliminary API - UNITS (above), floristic type communities (A - K), and final map units (below).

from:M. van Leeuwen - Vegetation of Kilifi.

APPENDIX V:LIST OF PLANT SPECIES:VERNACULAR ------- BOTANIC

VERNACULAR NAME	BOTANIC EQUIVALENT	FAMILY
Budzi-fuka	Celosia schweinfurthiana	Amaranthaceae
Chitadzi	Ormocarpum kirkii	Papilionaceae
Chivumbani	Endostemon tereticaulis	Labiatae
Dzadza lume	Commelina imberbis	Commelinaceae
Dzadza riche	Commelina africana	"
Handari	Adenia globosa	Passifloraceae
Kaashamoho	eg Alysicatpus glumaceus	Papilionaceae
Kabaruti tsaka	Psilotrichium scleranthum	Amaranthaceae
Kadera	div.	Cucurbitaceae
Kaaga sina	Cassytha	Lauraceae
Kakwaju (Mpingwa)	Dalbergia vaccinifolia	Papilionaceae
Kapupu	div.	div.
Kashero	Cissampelos spp.	Menispermaceae
Karisa pungu	Clerodendrum luseum	Verbenaceae
Kath'imi ka pala	Clausena anisata	Rutaceae
Kidunga-dunga	Bidens spp.	Compositae
Kikwata	Acacia senegal	Mimosaceae
Kinuka muhondo	Sesbania pubescens	Papilionaceae
Kiramatha	Pipalia lappaceae	Amaranthaceae
Kimbiri	Oxygonum saliciifolium	Polygonaceae
Kirunju	Nymphaea capensis	Nymphaeaceae
Kivuma nyuchi	Aerva lanata	Amaranthaceae
Komba	Talinum portulacifolium	Portulaccaceae
Konzi	Gonatopus boivinii	Araceae
Lubugu	Secamone spp.	Papilionaceae
Lwavi	Tragiella natalensis	Euphorbiaceae
Maambalo	Erythrococca kirkii	"
Mbaazi-mwitu	Pseudanthria confertiflora	Micranthaceae
Mbathe	Diospyros sp.	Ebenaceae
Mbavu-bavu	Clerodendrum capitatum	Verbenaceae
Mbavu-bavu wa mkone	Grewia glandulosa	Tilliaceae
Mbelenga	Deinbollia sp.	Sapindaceae
Mboga-boga	Asystasia gangetia	Acanthaceae
Mbono	Ricinus communis	Euphorbiaceae
Mchira ng'ombe	Strychnos mitis	Loganiaceae
Mdala mwaka	Deinbollia borbonica	Sapindaceae

VERNACULAR NAME	BOTANICAL EQUIVALENT	FAMILY
Mdimu tsaka	Suregada zanzibariensis	Euphorbiaceae
Mdunga-tundu	Maytenus senegalensis	Celastraceae
Mdudungu	Fagara chalybea	Rutaceae
Mdzala(Mbulushi)	Enneastemon fornicatus	Annonaceae
Mdzongodzongo	Xeromphis nilotica	Rubiaceae
Mfidzo fidzo	Lagynias littoralis	Rubiaceae
Mfudzo (Mumahi)	Tinnea aethiopica	Labiatae
Mfudzo mulume	Rytiginia cf loranthifolia	Rubiaceae
Mfunda	Monanthotiaxis trichanta	Annonaceae
Mfundu	Stadmannia sideroxylon	Sapindaceae
Mfune	Sterculia appendiculata	Sterculiaceae
Mfunga-tsanzu	Haplocoelum inoploeum	Sapindaceae
Mgalana (Mnywa madzi)	Teclea trichocarpa	Rutaceae
Mgandi	Ficus bussei	Moraceae
Mgugune	Ziziphus mucronata	Rhamnaceae
Mgwada paka (Mtoli)	Capparis stuhlmannii	Capparidaceae
Mgwale	Grewia truncata	Tilliaceae
Mhalanda	Terminalia catappa	Combretaceae
Mhandala	Markhamia zanzibarica	Bignoniaceae
Mjaji	Strychnos spinosa	Loganiaceae
Mkadi	Pandanus kirkii	Pandanaceae
Mkalakala	Bridelia cathartica sps melanthesoides	Euphorbiaceae
Mkakazi	Ageratum conyzoides	Compositae
Mkami	?	
Mkayukayu	Heeria mucronata	Anacardiaceae
Mkihanga	Secamone sp.	Asclepiadaceae
Mkilashangwe	Rhus sp.	Anacardiaceae
Mkimwemwe	Haplocoelum inoploeum	Sapindaceae
Mkindu	Phoenix reclinata	Palmae
Mkingiri	Dichrostachys cinerea	Mimosaceae
Mkirindi	Vernonia wakefieldii	Compositae
Mkironda	Ehretia bakeri	Boraginaceae
Mkoko	Sonneratia alba	Sonneratiaceae
Mkone	Grewia div.spp.	Tilliaceae
Mkonga	Mallotus oppositifolius	Euphorbiaceae
Mkuha (Mswaki)	Salvadora persica	Salvadoraceae

VERNACULAR NAME	BOTANICAL EQUIVALENT	FAMILY
Mkula-usiku	Clerodendrum glabrum	Verbenaceae
Mkulu	Diospyros cornii	Ebenaceae
Mkunazi	Ziziphus mauritania	Rhamnaceae
Mkuyu	Ficus sycomorus	Moraceae
Mkwaju	Tamarindus indica	Caesalpiniaceae
Mkwamba	Securinega virosa	Euphorbiaceae
Mkwakwa	Strychnos innocua	Loganiaceae
Mkwang'a	cf Celtis africana	Ulmaceae
Mkwembe	Clerodendrum acerbianum	Verbenaceae
Mlala (Mkoma)	Hyphaene coriacea	Palmae
Mlaza koma	Vernonia hildebrandtii	Compositae
Mmangi	Polysphaeria parvifolia	Rubiaceae
Mnago	Manilkara mochisia	Sapotaceae
Mng'ambo	Manilkara zanzibariensis	"
Mnyala	Fernandoa magnifica	Bignoniaceae
Mnyukufu	Lamphrothamnus zanguebaricus	Rubiaceae
Morya	Sterculia rhynchocarpa	Sterculiaceae
Mpepe	Trema orientalis	Ulmaceae
Mpera	Vizinia orientalis	Hypericaceae
Mporojo	Albizia anthelminthica	Mimosaceae
Mrembe ganga	Hibiscus aponeurus s.l.	Malvaceae
Mrihi	Brachystegia spiciiformis	Caesalpiniaceae
Mrinda zia	Scirpus articulatus	Cyperaceae
Msasa	Cordia ovalis	Boraginaceae
Mshinda-alume	Combretum butyrosum	Combretaceae
Msokote	cf Tarazzea sp.	Asclepiadiaceae
Msumari (Mnene kanda)	Lonchocarpus sp.	Papilionaceae
Mtanda mboo	Carisa bispinosa	Apocynaceae
Mtondo	Solanum incanum	Solanaceae
Mtongazi	Landolphia petersiana	Apocynaceae
Mtserere	Hoslundia opposita	Labiatae
Mtunda kula	Ximenia americana	Olacaceae
Mtunguru	Capparis cartilaginea	Capparidaceae
Mudhahabu	Notobuxus obtusifolia	Buxaceae
Mudzipo	Pleurostylia africana	Ulmaceae
Mweza mere	Achyrothalamus marginatus	Compositae
Muganga lungo	Cyphostemna adenocaulis	Vitaceae
Mugumo	Borassus aethiopum	Palmae

VERNACULAR NAME	BOTANICAL EQUIVALENT	FAMILY
Muhangusa mavi	eg Abutilon mauritanium	Malvaceae
Muhawa	Phyllanthes sp.	Euphorbiaceae
Muhowe	Thespesia danis	Malvaceae
Muhumba	Cassia sanguinea	Caesalpiniaceae
Mujundu	Brachylaenia hutchinsii	Compositae
Mulanza mwaruhe	Vitex stricheri	Verbenaceae
Mulanza mwiru	Blepharospernum zanguebaricum	Compositae
Mumbo	Myrica kilimandscharica	Myricariaceae
Munavu tsaka	Solanum nigrum	Solanaceae
Munwa madzi	Teclea trichocarpa	Rutaceae
Munyumbu	Lannea stuhlmanmii	Anacardiaceae
Mupashula anzie	Tarrena nigrescens	Rubiaceae
Murare	Clerodendrum cf acerbianum	Verbenaceae
Murori	Uvaria cf acuminata	Annonaceae
Mushero	?	Capparaceae
Musuka mambo	Memecylon sp.	Melastomataceae
Mutamba kiko	Meyna tetraphylla	Rubiaceae
Mutarae	Clerodendrum eriophyllum	Verbenaceae
Muthoro	Terminalia brevipes	Combretaceae
Mutsalafu	Cassia sp.	Caesalpiniaceae
Mutsatsa	Acalypha fructicosa	Euphorbiaceae
Mutsedzi	Manilkara sulcata	Sapotaceae
Mutsemeri	Acacia nilotica	Mimosaceae
Mutsengedzi	Xeromphis nilotica	Rubiaceae
Mutulama anzie	Helixanthera kirkii	Loranthaceae
Mushosho	Heinsia jasminiflora	Rubiaceae
Muvuma	Premna chrysoclada	Verbenaceae
Muviru	Vangueria tomentosa	Rubiaceae
Muyu	Adansonia digitata	Bombacaceae
Muzhondohera nguluwe	Asteranthe asterias	Annonaceae
Mvundza jembe	Allophylus pervellei	Sapindaceae
Mwadiga	Adenium obesum	Apocynaceae
Mwanga	Terminalia prunioides	Combretaceae
Mware	Bombax rhodognaphalon	Bombacaceae
Reza	Adenia cf wightiana	Passifloraceae
Vombo	Corchorus trilocularis	Tilliaceae
Vumba manga	Ocimum hadiense	Labiatae

APPENDIX V.b : LIST OF PLANT SPECIES: SCIENTIFIC NAMES & SOCIOLOGICAL GROUPS

NAME	FAMILY	SOCIOLOGICAL GROUP
Acacia cf etbaica	Mimosaceae	
A. mellifera	"	XV
A. nilotica	"	XI
A. polyacantha	"	XXIV
A. senegal	"	
A. stuhlmannii	"	XVII
A. zanzibarica	"	
Acalypha fructicosa	Euphorbiaceae	XXIV
Achyranthes aspera	Amaranthaceae	XI
Achyrothalamus marginatus	Compositae	I
Acridocarpus flaccidus (UPS 63)	Malpighiaceae	
Adansonia digitata	Bombacaceae	XIX
Adenia globosa	Passifloraceae	
Adenium obesum	Apocynaceae	III
Aerva lanata	Amaranthaceae	V
Afzelia cuanzensis	Caesalpiniaceae	I
Agathisanthemum bojeri	Rubiaceae	IV
Agave sisalana	Agavaceae	XXXI
Ageratum conyzoides	Compositae	XIII
Albizia anthelmintica	Mimosaceae	XI
A. gummifera	"	XVIII
Aloë sp.	Liliaceae	VII
Allophylus pervellei	Sapindaceae	XIX
Anacardium occidentale	Anacardiaceae	XXVI
Anchomanus dubium	Araceae	XXVIII
Annona chrysophylla	Annonaceae	XX
Annona sp.	"	XXI
Annonaceae sp.	"	
Aristida adjunsonius	Graminae	
Arum sp.	Araceae	
Asteranthe asterias	Annonaceae	XXI
Asparagus recemosa	Liliaceae	V
Asparagus sp.	"	XII
cf Asystasia gangetia	Acanthaceae	

NAME	FAMILY	SOCIOLOGICAL GROUP
Atriplex farinosa	Chenopodiaceae	
Avicennia marina	Verbenaceae	XXXII
Azedirachta indica	Meliaceae	XX
Blepharospernum zanguebaricum	Compositae	
Bombax rhodognaphalon	Bombacaceae	
Borassus aethiopium	Palmae	
Brachystegia spiciiformis	Caesalpiniaceae	I
Bridelia cathartica ssp melanthesoides	Euphorbiaceae	XII
Bruguiera gymnorhiza	Rhizophoraceae	XXXII
Canthium bibracteatum	Rubiaceae	III
Capparis cartilaginea	Capparidaceae	XXXI
C. stuhlmannii	"	VI
Capparidaceae sp.	"	
Carissa bispinosa	Apocynaceae	
Cassia longiracemosa	Caesalpiniaceae	XXVII
C. sanguinea	"	
Cassia sp.	"	
Cassytha sp.	Lauraceae	XXI
Celosia schweinfurthiana	Amaranthaceae	
Cenchrus ciliaris	Graminae	XXXVII
C. setigerus	"	XXXVII
Chloris roxburgiana	"	XXXIV
C. virgata	"	XXXIV
Cienkowskya sp.	Zingiberaceae	VIII
Cissampelos sp.	Menispermaceae	XXV
Cissus quadrangularis	Vitidaceae	III
C. rotundifolius	"	III
Citrus sinensis	Rutaceae	XXVII
Clausena anisata	"	
Clerodendrum eriophyllum	Verbenaceae	
C. glabrum	"	XIX
C. luseum	"	

NAME	FAMILY	SOCIOLOGICAL GROUP
cf Clitoria sp.	Papilionaceae	
Cocos nucifera	Palmae	XXVI
Combretum butyrosum	Combretaceae	XXII
Commelina sp.	Commelinaceae	IV
Commiphora africana s.l.	Burseraceae	IX
C. boiviana	"	XI
Conyza pyrrohopappa	Compositae	
Cordia somaliensis	Boraginaceae	XXXI
C. subcordata	"	
Croton pseudopulchellus	Euphorbiaceae	XXII
Cucurbitaceae sp.	Cucurbitaceae	VIII
Cynanchum tetrapterum	Asclepiadaceae	XXXI
Cynometra suaheliensis	Caesalpiniaceae	XXII
Cyperus articulatus	Cyperaceae	XXXVII
Cyperaceae spp 1 - 9	"	div.
Cyphostemna adenocaulis	Vitidaceae	XVIII
Dactyloctenium aegyptium	Graminae	XXXIV
D. geminatum	"	
Dalbergia vaccinifolia	Papilionaceae	XVIII
Deinbollia borbonica	Sapindaceae	XXIII
Deinbollia sp.	"	XVIII
Dichanthium radicans	Graminae	XXXVII
Dichrostachys cinerea	Mimosaceae	III
Digitaria abyssinia	Graminae	
D. macrobephara	"	
D. mombasana	"	
cf Dioscorea sp.	Dioscoreaceae	
Diospyros cornii	Ebenaceae	XIX
Diospyros sp.	"	XIX
Echinogloa haploclada	Graminae	XXXV
Edithcolea grandis	Asclepiadaceae	
Ehretia bakeri	Boraginaceae	XII
E. petiolaris	"	XII

NAME	FAMILY	SOCIOLOGICAL GROUP
Eleusine indica	Graminae	
Emilia javanica	Compositae	XIII
Encephalartos hildebrandtii	Cycadaceae	
Endostemon tereticaulis	Labiatae	XI
Enneastemon fornicatus	Annonaceae	V
Enteropogon macrostachyus	Graminae	XXXVI
Epinetrum delagoensie	Menispermaceae	XXI
Eragrostis ciliaris	Graminae	XXXIII
E. superba	"	XXXIV
Eragrostis sp.	"	XXXVI
Erythrococca kirkii	Euphorbiaceae	
Erythrococca spp. 1 - 2	"	
Euphorbia candelabrum	"	
E. grandicornis	"	I
E. tirucalli	"	V
Euphorbia sp. 3	"	I
Fagara chalybea	Rutaceae	XII
Fernandoa magnifica	Bignoniaceae	XVIII
Ficus bussei	Moraceae	
F. sycomorus	"	XXIV
Flagellaria guineense	Flagellariaceae	VII
Gesneria sp. (= Streptocarpus)	Gesneriaceae	XXX
Gloriosa simplex	Liliaceae	XXIII
cf Glycine wightii	Papilionaceae	XV
Gonatopus boivinii	Araceae	V
Graminae sp.	Graminae	
Grewia cf bicolor	Tiliaceae	IX
G. cf ectasicarpa	"	IX
G. cf forbesii	"	XIII
G. cf glandulosa	"	
G. cf holstii	"	XIII
G. cf microcarpa	"	XI
G. stuhlmannii	"	

NAME	FAMILY	SOCIOLOGICAL GROUP
Grewia villosa	Tiliaceae	XIX
Grewia spp 1 and 3	"	
Guizotia scabra	Compositae	XIV
Haplocoelum inoploeum	Sapindaceae	I
Harrysonia abyssinica	Simaroubaceae	XIV
Heeria mucronata	Anacardiaceae	V
H. reticulata	"	
Heinsia jasminiflora	Rubiaceae	II
Heliotropium sp.	Boraginaceae	XXIV
Helixanthera kirkii	Loranthaceae	
Heteropogon contortus	Graminae	XXXIV
Hibiscus aponeurus s.l.	Malvaceae	II
Holarrhena sp.	Apocynaceae	
Hoslundia opposita	Labiatae	IX
Hugonia sp.	Linaceae	
Hunteria zeylanica	Compositae	
Hyphaene coriacea	Palmae	XVI
Indigofera sp.	Papilionaceae	XXI
Imperata cilindrica	Graminae	XXXVII
Jasminum fluminens	Oleaceae	
Jatropha spicata	Euphorbiaceae	VI
Justicia - Ansellia	? Acanthaceae	
Kalanchoë sp.	Crassulaceae	VI
Kleinia kleinioides	Compositae	
Lagynias littoralis	Rubiaceae	V
Lamprothamnus zanguebaricus	"	XIX
cf Landolphia petersiana	Apocynaceae	I
Lannea stuhlmannii	Anacardiaceae	II
Lantana camara	Verbenaceae	X
L. viburnoides	"	

NAME	FAMILY	SOCIOLOGICAL GROUP
Leptochloa pamica	Graminae	XXXV
Leucas cf kilifiensis	Labiatae	
Lilium sp.	Liliaceae	
Mangifera indica	Anacardiaceae	XXVI
Manihot esculenta	Euphorbiaceae	
Manilkara mochisia	Sapotaceae	
M. sulcata	"	V
M. zanzibarica	"	III
Maytenus senegalensis	Celastraceae	XIV
Markhamia zanzibarica	Bignoniaceae	XX
Memecylon sp.	Melastomataceae	IV
Meyna tetraphylla	Rubiaceae	V
Monodora grandidieri	Annonaceae	V
Myrica kilimandscharica	Myricaceae	
Notobuxus obtusifolia	Buxaceae	XX
Nymphaea micrantha	Nymphaeaeceae	
Ochna sp.	Ochnaceae	III
Ocimum hadiense	Labiatae	XI
Ormocarpum kirkii	Papilionaceae	XIV
Oxygonum saliciifolium	Polygonaceae	XIII
Pandanus kirkii	Pandanaceae	
Panicum maximum	Graminae	XXXIII
P. repens	"	XXXIII
Papilionaceae sp.	Papilionaceae	XX
Parkia filicoidea	Mimosaceae	
Paspalum geminatum	Graminae	XXXVII
Pentodon pentandrus	Rubiaceae	XXXI
Perotis hildebrandtii	Graminae	
cf Phyllanthus reticulatus	Euphorbiaceae	II
Phyllanthus sp. 1	"	IV
Phyllanthus sp. 2	"	XX

NAME	FAMILY	SOCIOLOGICAL GROUP
Phymatodes scolopendria	Polypodiaceae	I
Piliostigma thonningii	Caesalpiniaceae	XIX
Pipalia lappacea	Lauraceae	XXV
Plectranthus flaccidus	Labiatae	XXXI
Pleurostylia africana	Celastraceae	XXIX
Pluchea dioscorides	Compositae	XVII
Polypodiaceae sp.	Polypodiaceae	XXX
Polysphaeria parvifolia	Rubiaceae	XII
Portulaca sp.	Portulacaceae	
Premna chrysoclada	Verbenaceae	IV
Pseudantha confertiflora	Micranthaceae	
Psychotria amboniensis	Rubiaceae	XXVIII
Rauvolfia mombasiana	Apocynanceae	XXIII
Rawsonia sp.	Flacourtiaceae	III
Rhizophora mucronata	Rhizophoraceae	XXXII
Rhoicissus revoilii	Vitidaceae	VI
Ricinus communis	Euphorbiaceae	
Salvadora persica	Salvadoraceae	XI
Sansevieria kirkii	Liliaceae	VII
Sansevieria sp.	"	XXIX
Schlechterina mitostemmatoides	Passifloraceae	VII
cf Scilla kirkii	Liliaceae	XXXI
Securinega virosa	Euphorbiaceae	X
Secamone sp. 1	Asclepiadaceae	XIX
Secamone sp. 2	"	XX
Sida cordifolia	Malvaceae	XI
S. cuneifolius	"	XI
Solanum incanum	Solanaceae	XI
Sonneratia alba	Sonneratiaceae	XXXII
Sorghum sp.	Graminae	XXXV
Sphenostylis briartii	Papilionaceae	XVII
Sporobolus marginatus	Graminae	
S. pyramidalis	"	XXXV

NAME	FAMILY	SOCIOLOGICAL GROUP
Sterculia appendiculata	Sterculiaceae	
S. rhynchocarpa	"	XVIII
Strychnos dysophylla	Loganiaceae	XIX
S. cf innocua	"	V
S. mitis	"	XXI
S. spinosa	"	
Suregada zanzibariensis	Euphorbiaceae	II
Talinum portulacifolium	Portulacaceae	
Tamarindus indica	Caesalpiniaceae	
Tarrena nigrescens	Rubiaceae	XXI
Teclea trichocarpa	Rutaceae	VIII
Tephrosia purpurea	Papilionaceae	XXXI
Tephrosia sp.	"	IV
Terminalia spinosa	Combretaceae	XI
Tetracera boiviana	Dilleniaceae	XXIII
Tetrapogon tenellus	Graminae	
Themeda triandra	"	XXXVII
Thespesia danis	Malvaceae	IX
Thevetia peruviana	Apocynaceae	XXVII
Tinnea aethiopica	Labiatae	XXIX
Tradescantia sp.	Commelinaceae	
Tragiella natalensis	Euphorbiaceae	XI
Trema orientalis	Ulmaceae	XXIX
Tribulus terrestris	Zygophyllaceae	
Tridax procumbens	Compositae	XXIII
Triumfetta rhomboidea	Tiliaceae	XXV
Uvaria acuminata	Annonaceae	II
Vangueria tomentosa	Rubiaceae	XIII
Veronica sp.	Scrophulariaceae	
Vernonia hildebrandtii	Compositae	II
V. wakefieldii	"	XXX
Vigna unguiculata	Papilionaceae	

NAME	FAMILY	SOCIOLOGICAL GROUP
Vitex doniana	Verbenaceae	
V. cf mombassae	"	XIII
V. stricheri	"	XIX
Xeromphis nilotica	Rubiaceae	XI
Ximenia americana	Olacaceae	XIII
Xylocarpus benadirensis	Meliaceae	
Zanioculcas zaniifolius	Araceae	I
Zea mays	Graminae	XXVII
Ziziphus mauritiana	Rhamnaceae	

TPIP (KILIFI - KENYA) --- AGRICULTURAL UNIVERSITY (WAGENINGEN - THE NETHERLANDS)

RELEVEE DATA SHEET

DATE:

NR:

M. van Leeuwen

Photo:.... Run:.....
AREA:.....
MAPSHEET: K 198/.....
COORDINATES: , N; , E

ALTITUDE (m)

VEGETATION DATA

STRATA	20	40	60	80	100%	real + ext.cov	fi
32 - 64							
16 - 32							
8 - 16							
4 - 8 m							
2 - 4 m							
1 - 2 m							
50cm-1m							
25 - 50							
12.5-25							
3 - 12.5							
0 - 3cm							
0							

DESCRIPTION OF SITE & LANDUSE

RELEVEE AREA (m):

'SPOT' AREA: (m)

TERRAIN DATA

GEOLOGICAL FM:

LITHOLOGY:

LANDFORM:

RELIEF TYPE: T/HS/D/V/P

- o Almost flat (0-2°)
- o Undulating (2-8°)
- o Rolling (8-16°)
- o Hilly (16-30°)
- o Steeply dissected (> 30°)

SLOPE

EXPOSITION

MICRO & MESORELIEF

EROSION - SURFACE SEALING

PROV. VEG. UNIT

SOIL DRAINAGE

- o Very Poorly
- o Poorly
- o Imperfectly
- o Moderately Well
- o Somewhat Excessively
- o Excessively

SOIL TYPE

SOIL MAP UNIT

LABORATORY DATA

REMARKS

Fig. 4

SOIL PROFILE

DEPTH (cm)	DRY COLOUR	MOIST COLOUR	TEXTURE	MOTTLING	CONCR	+/-
0 - 20						
20 - 30						
30 - 40						
40 - 50						
50 - 60						
60 - 70						
70 - 80						
80 - 90						
90 - 100						
100 - 110						
110 - 120						

FINAL VEGETATION CLASSIFICATI

FINAL MAP UNIT

RELEVEE DATA SHEET NR :: LIST OF SPECIES

Sy	Do	Ab	So	Nr	SPECIES	R	Sy	Do	Ab	So	Nr	SPECIES
TOTAL NR OF SPECIES:												

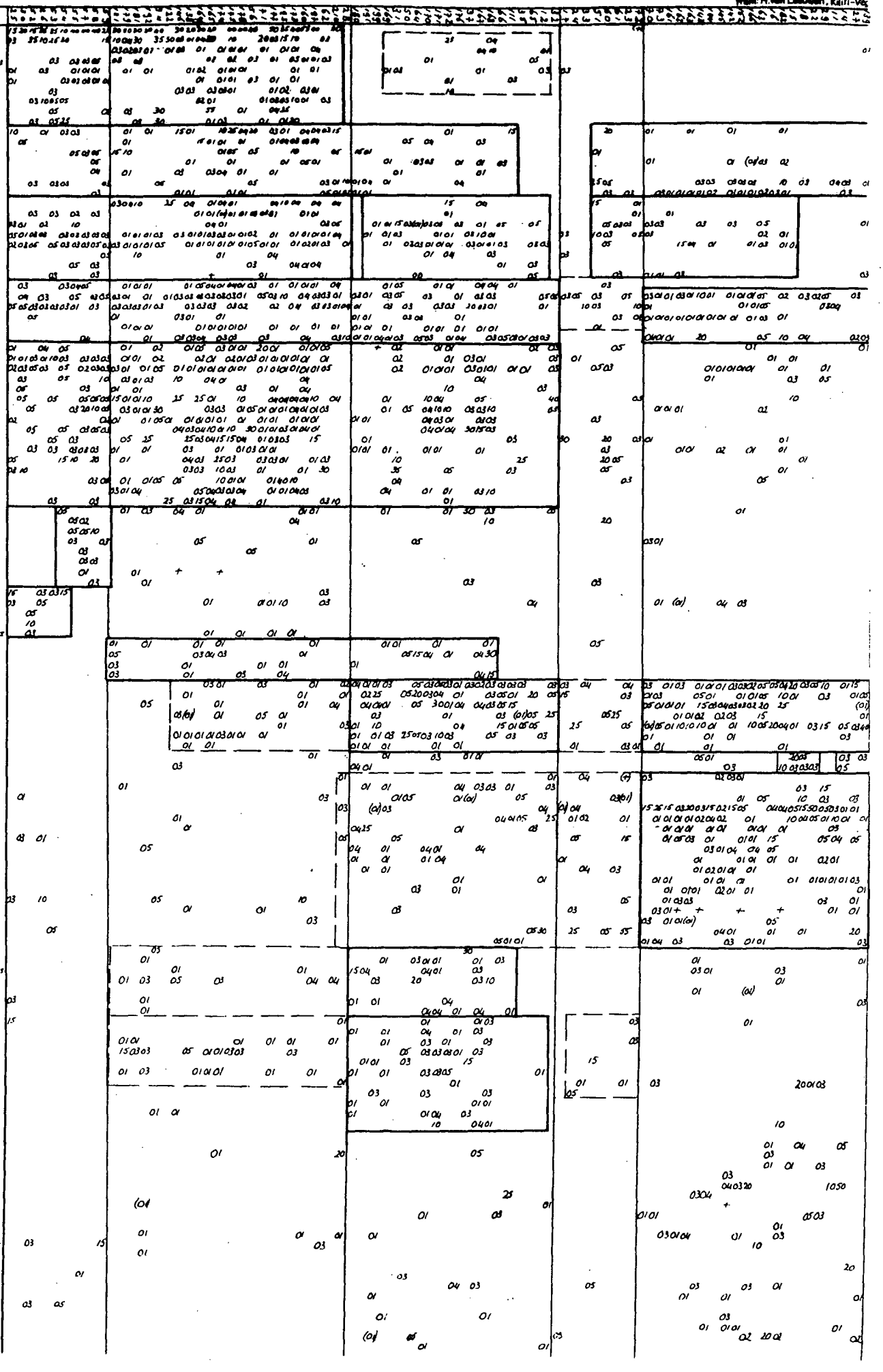
6393 a

VEGETATION TABLE

I. sheet 1

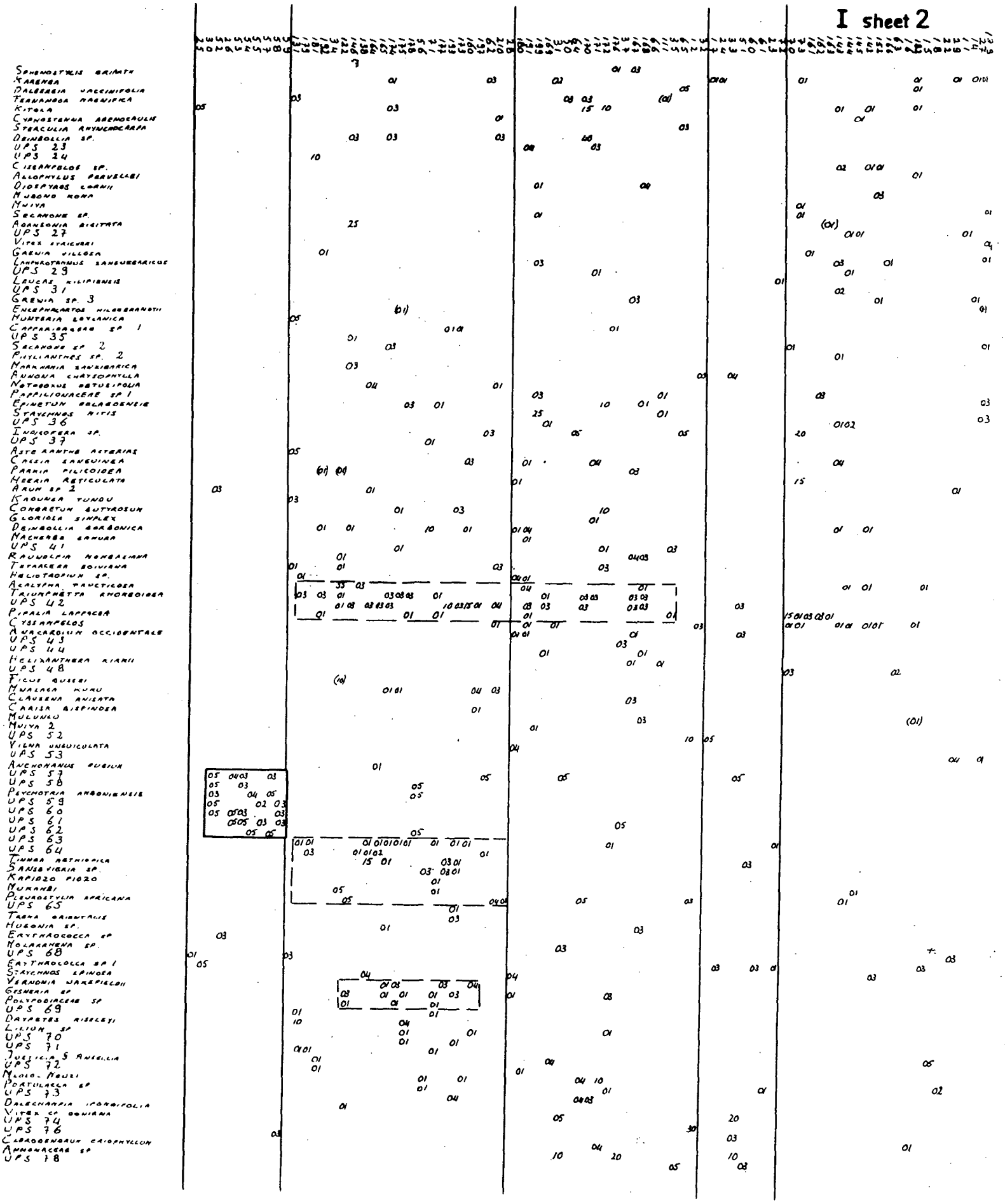
from: M. van Leeuwen, Kilifi-Ver

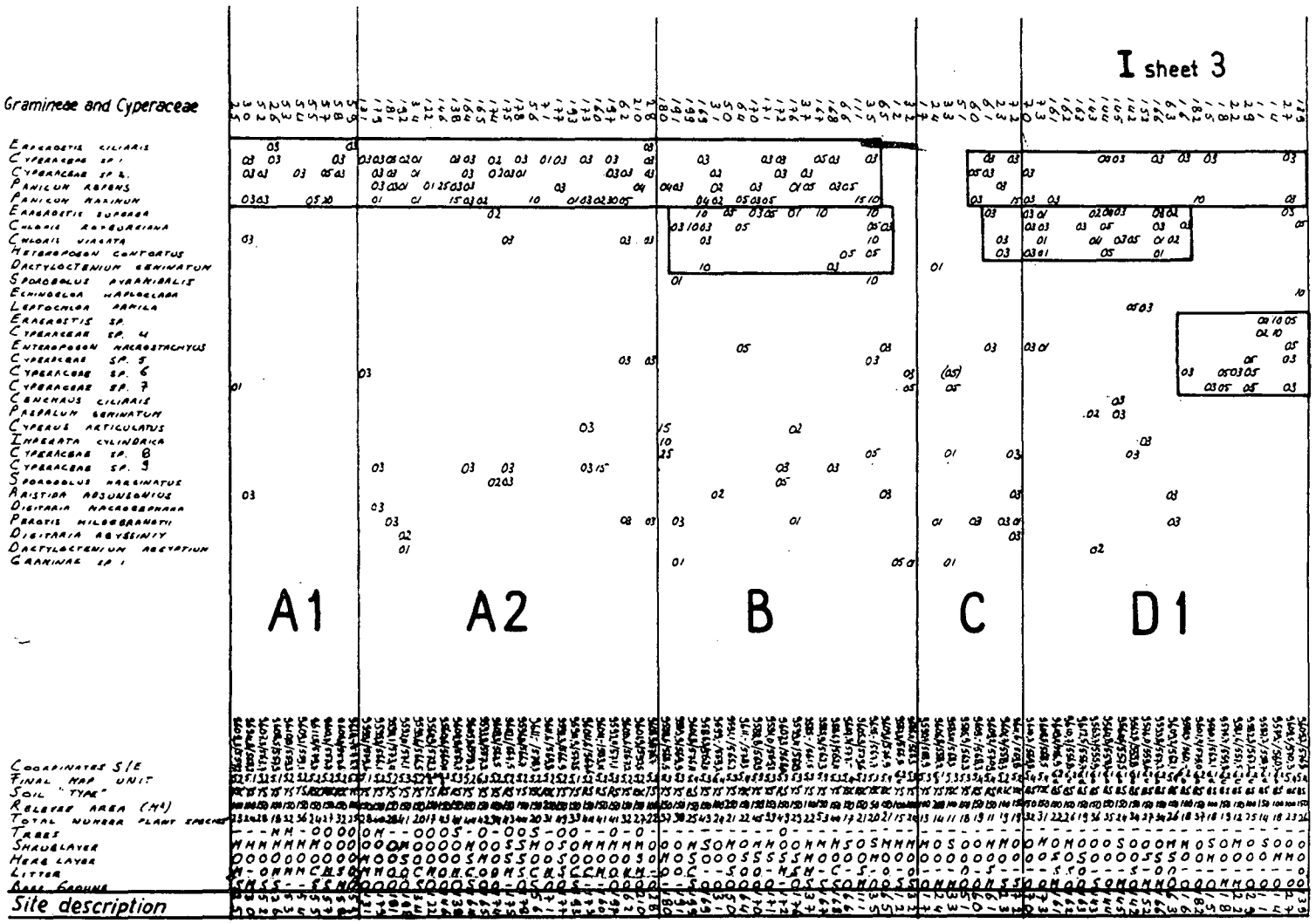
Plant species:



6393 b

I sheet 2



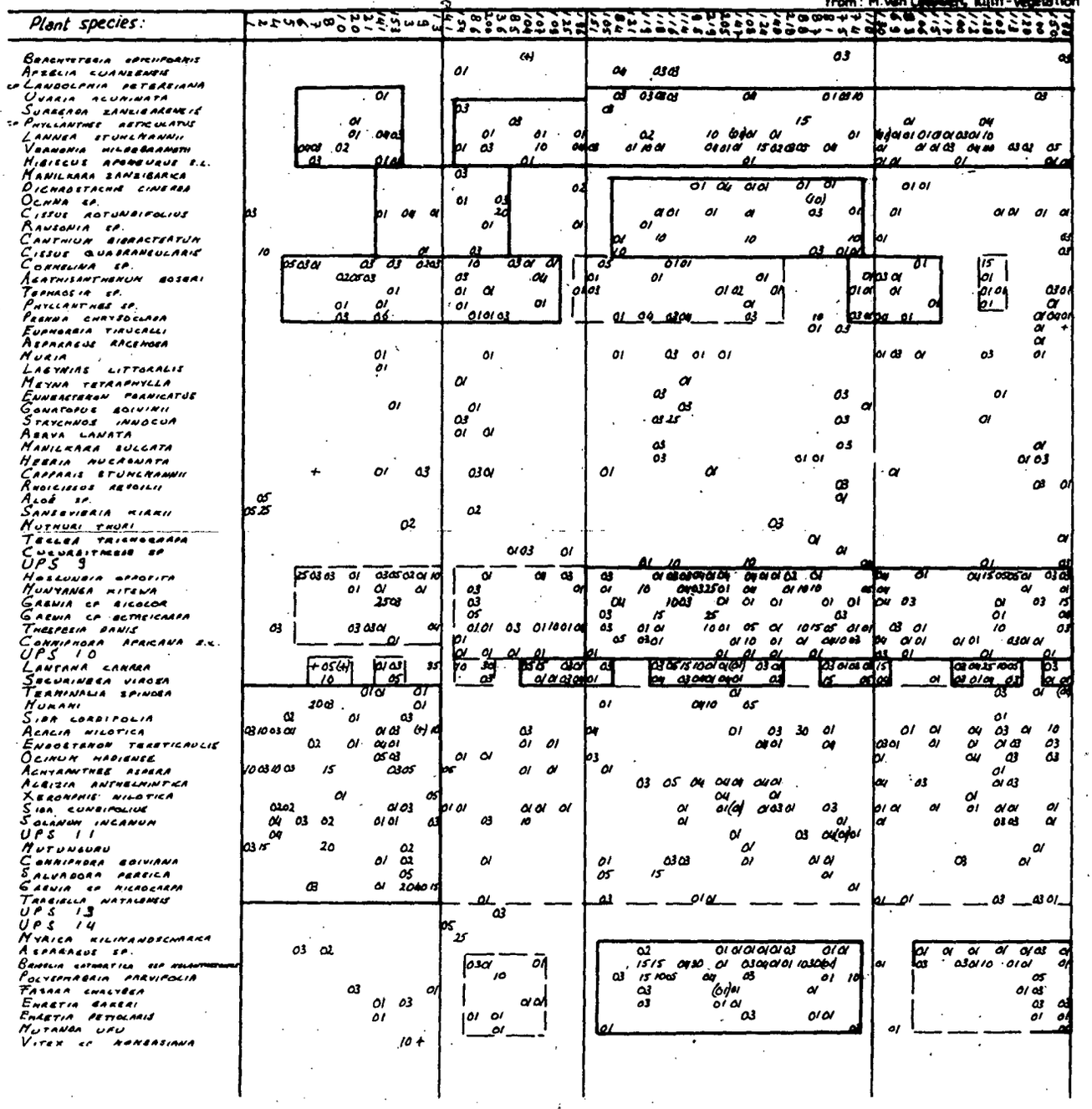

Gramineae and Cyperaceae
Eragrostis ciliaris
Cyperaceae sp 1
Cyperaceae sp 2
Panicum kobens
Panicum hainum
Eragrostis superba
Chloris roxburgiana
Chloris virgata
Heteropogon contortus
Dactyloctenium aeginatum
Sporobolus pyramidalis
Echinochloa haploclada
Leptochloa fascicularis
Eragrostis sp.
Cyperaceae sp. 4
Enteropogon macrostachyus
Cyperaceae sp. 5
Cyperaceae sp. 6
Cyperaceae sp. 7
Cenchrus ciliaris
Paspalum scrobiculatum
Cyperus articulatus
Imperata cylindrica
Cyperaceae sp. 8
Cyperaceae sp. 9
Sporobolus marginatus
Aristida adscensionis
Digitaria macroblephara
Brachiaria nilgiriensis
Digitaria abyssinica
Dactyloctenium aegyptium
Graminae sp 1
A1
A2
B
C
D1
Coordinates S/E
Final map unit
Soil "type"
Relevee area (m²)
Total number plant species
Trees
Shrublayer
Herb layer
Litter
Bare ground
Site description

6393 d

VEGETATION TABLE

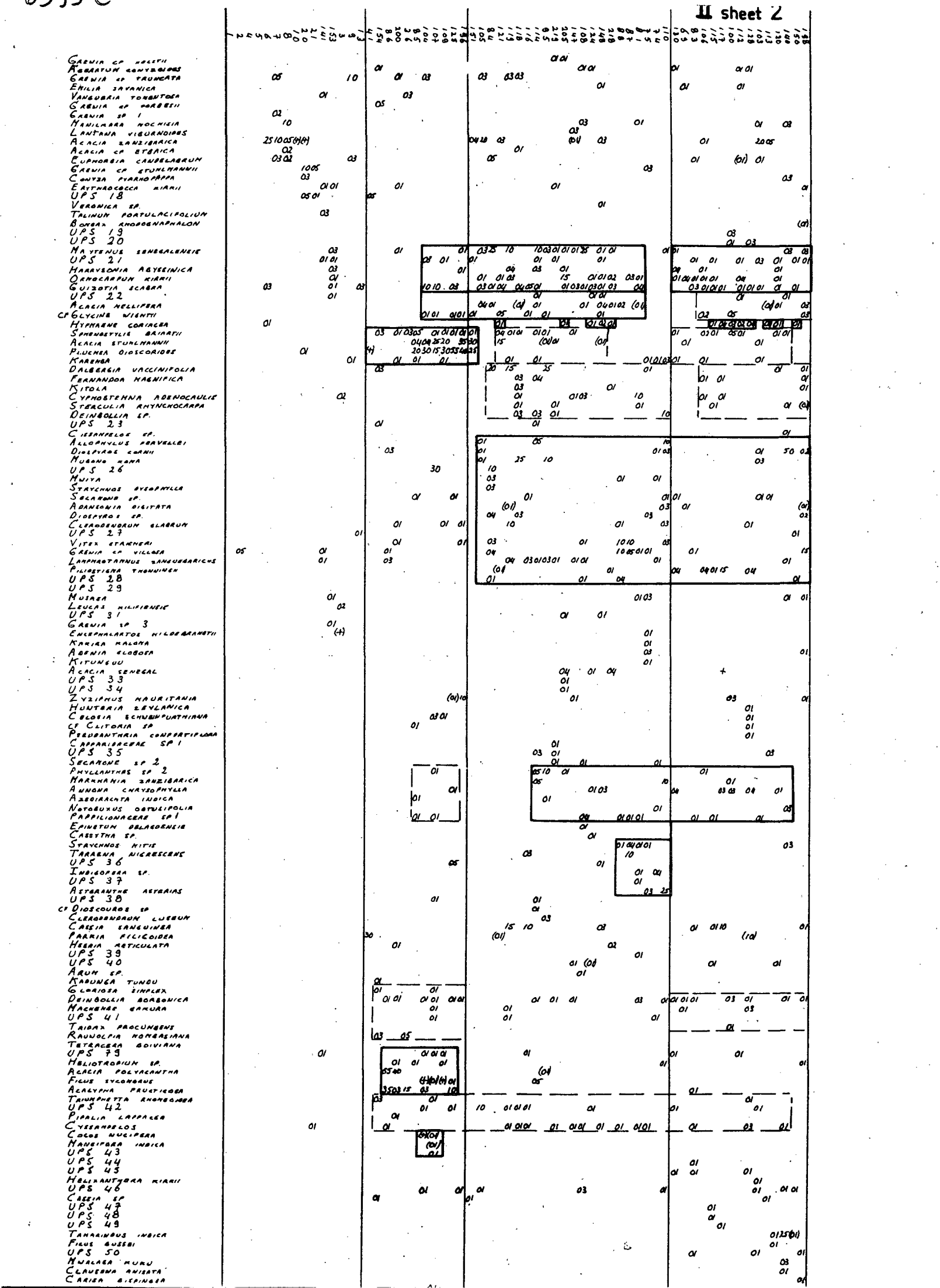
I sheet 1

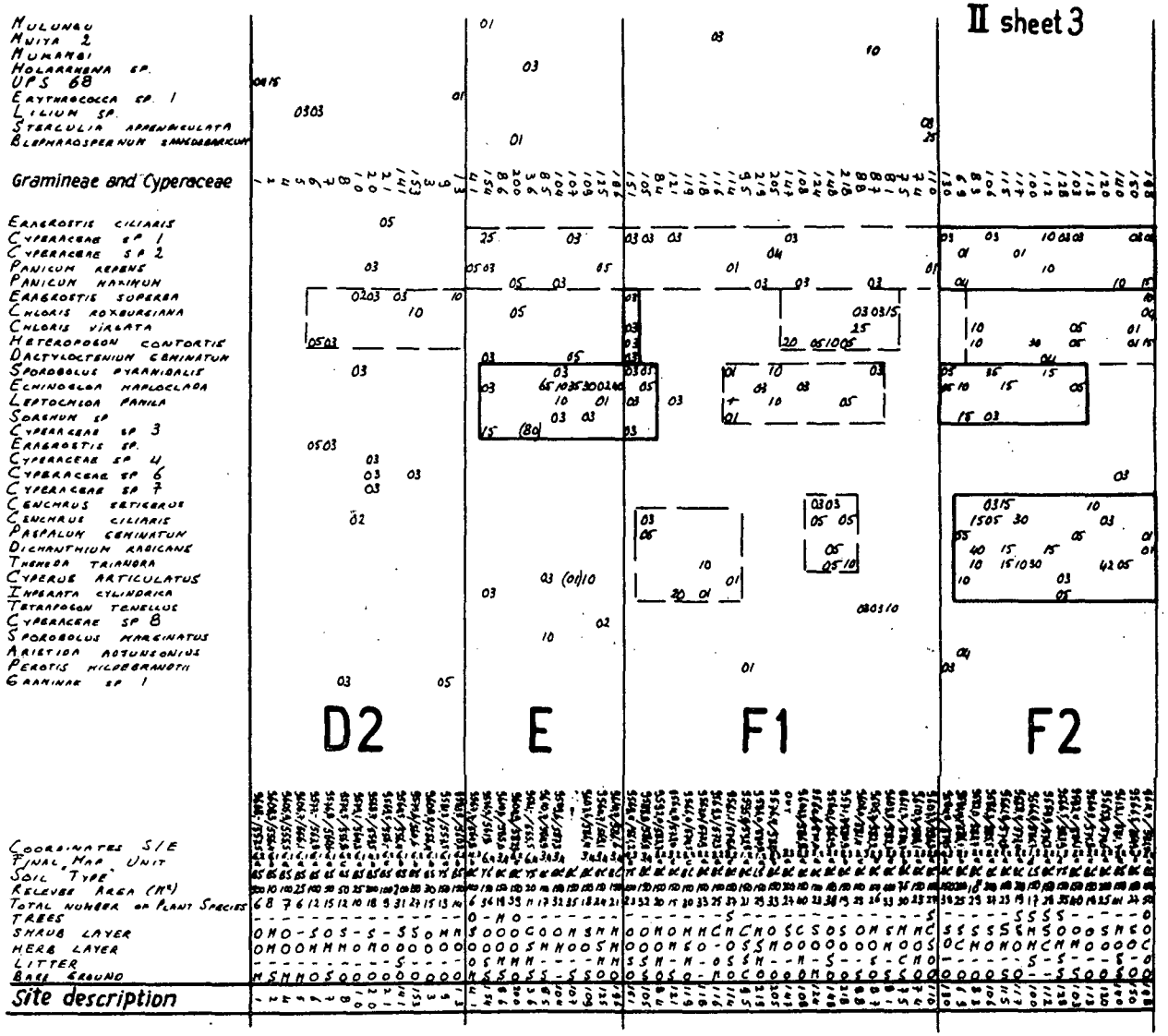
from: M. van Langevelde, Kilifi-Vegetation



6393 e

II sheet 2




II sheet 3
Mulungu
Muiya 2
Mumangi
Holarrhena sp.
UPS 68
Erythrococca sp. 1
Lilium sp.
Sterculia appendiculata
Blepharosperum smeeabarkum
Gramineae and Cyperaceae
Eragrostis ciliaris
Cyperaceae sp 1
Cyperaceae sp 2
Panicum repens
Panicum maximum
Eragrostis superba
Chloris roxburgiana
Chloris virgata
Heteropogon contortis
Dactyloctenium geminatum
Sporobolus pyramidalis
Echinochloa haploclada
Leptochloa panicea
Sorghum sp
Cyperaceae sp 3
Eragrostis sp.
Cyperaceae sp 4
Cyperaceae sp 6
Cyperaceae sp 7
Cenchrus setigerus
Cenchrus ciliaris
Paspalum geminatum
Dichanthium radicans
Themeda triandra
Cyperus articulatus
Imperata cylindrica
Tetrapogon tenellus
Cyperaceae sp 8
Sporobolus marginatus
Aristida adscensionis
Perotis hildebrandtii
Graminae sp 1
D2
E
F1
F2
Coordinates S/E
Final Map Unit
Soil Type
Relevee Area (m²)
Total number of Plant Species
TREES
SHRUB LAYER
HERB LAYER
LITTER
BARE GROUND
Site description

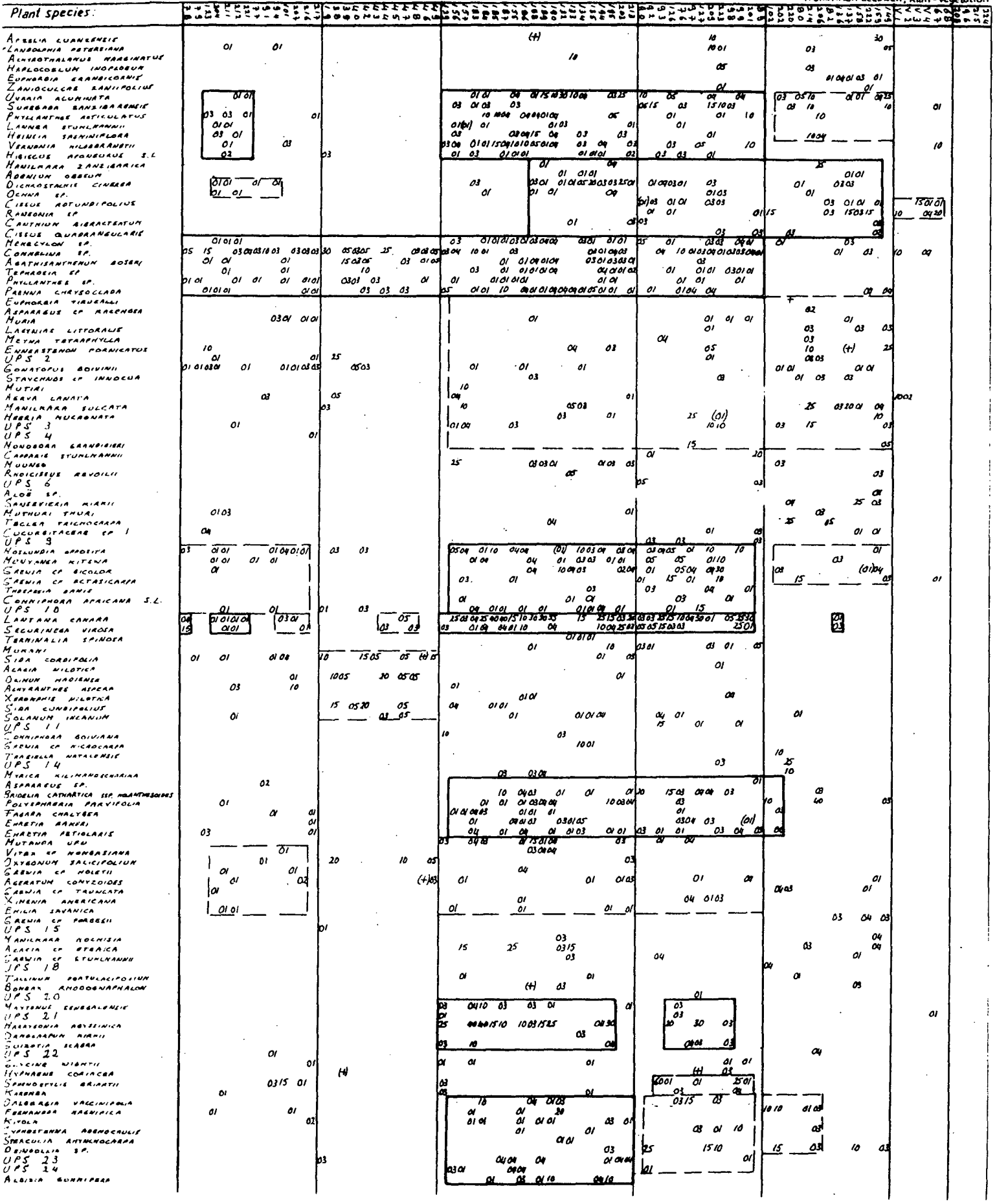
6393 f

6393 g

VEGETATION TABLE

III sheet 1

from: M. van Leeuwen, Kilifi - Vegetation



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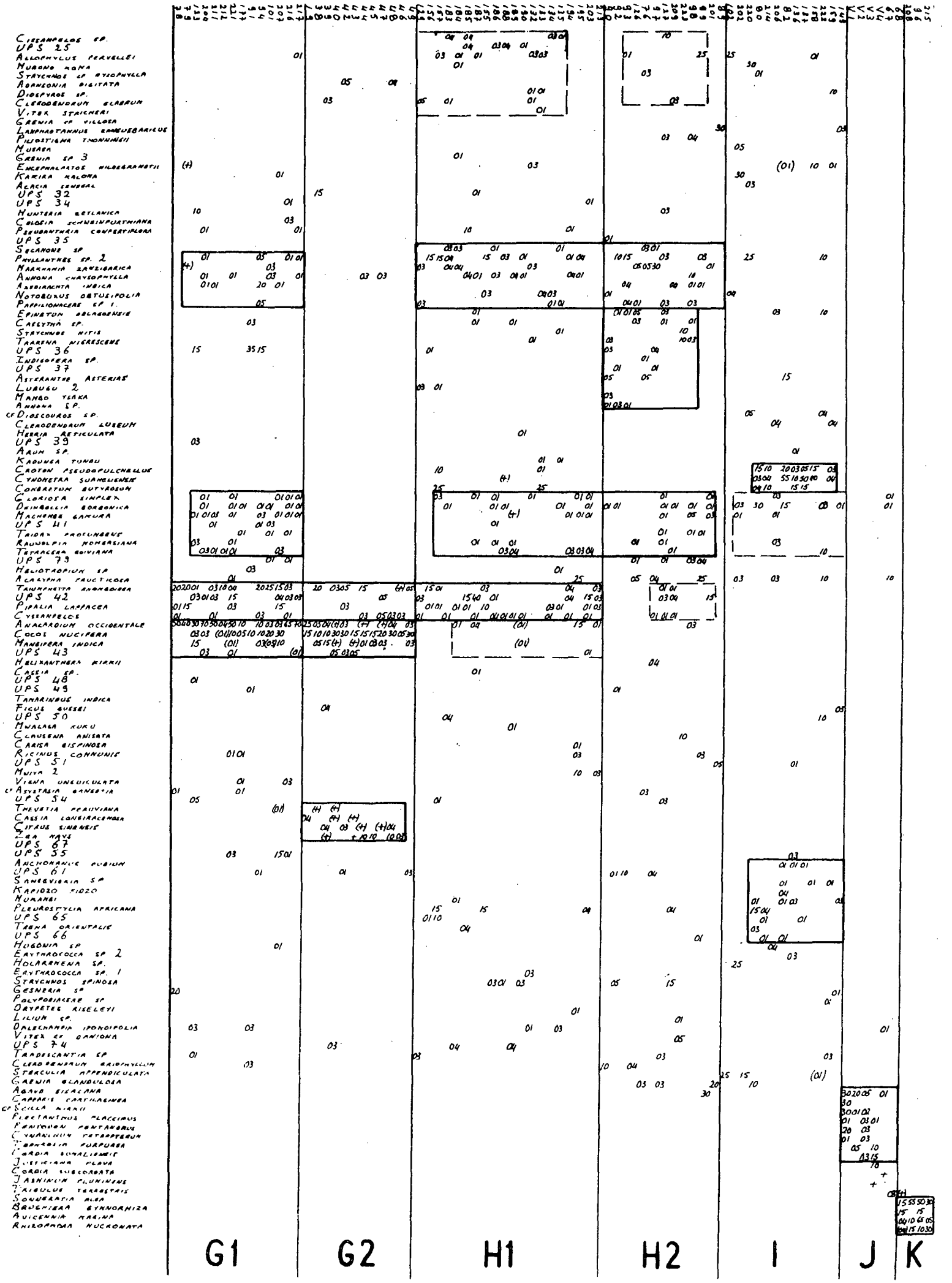
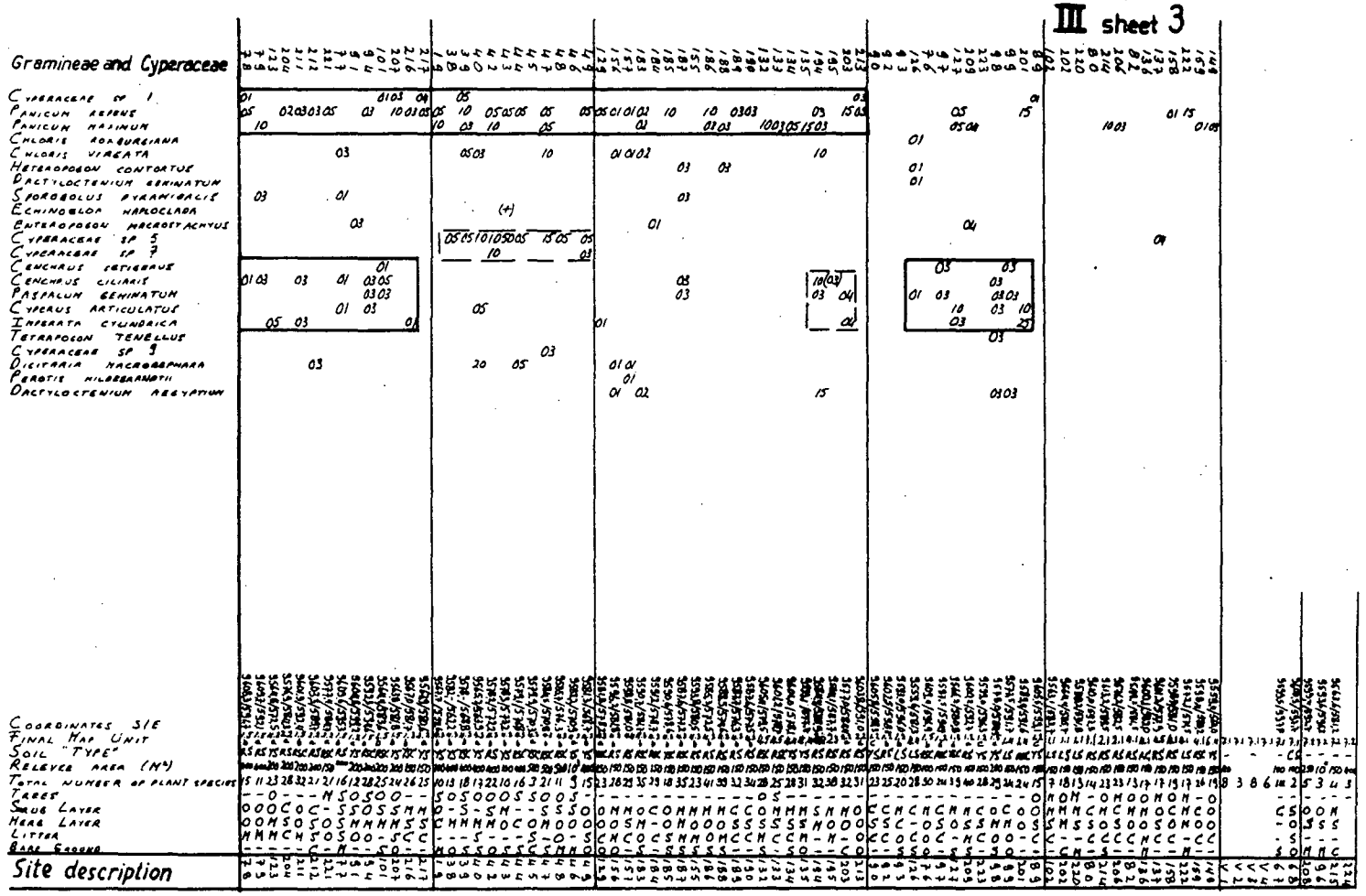
III sheet 2



III sheet 3



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SYNOPTIC VEGETATION TABLE

APP III

PLANT SPECIES \ PLANT COMMUNITIES	A1 (10)	A2 (23)	B (20)	C (8)	D1 (22)	D2 (15)	E (11)	F1 (22)	F2 (15)	G1 (14)	G2 (12)	H1 (20)	H2 (13)	I (13)	J (8)	K (4)
Brachystegia spiciiformis	10 27	8 36		1 +			1 +	A 3	A 3							
Afzelia cuanzensis	6 18	7 13	1 14.5				1 1	1 3.3				A +	1 10	1 30		
Landolphia petersiana		6 17	2 5	A 1						1 1			2 5.5	2 4		
Achyrothalamus marginatus	4 3.5	4 2.4	1 3									A 10				
UPS 1	5 1.4	4 1.1	2 2	1 0.3												
Euphorbia sp. 3	6 2	3 1.3	1 2													
Haplocoelum inoploeum	1 1.3	4 2.2	A 10										1 5	1 3		
Euphorbia grandicornis	4 5.8	3 3												4 2		
Zanioculcas zaniifolius	2 5	3 2												1 1		
Phymatodes scolopendria	3 1	3 8.4														
Uvaria acuminata	4 4.3	6 7.6	1 8	1 20	2 1	A 1		4 3.8	A 3	1 1		6 9.5	3 5.8	5 7		
Suregada zanzibarensis	1 5	4 3.4	2 4				1 3	A 3				2 2.5	5 8.5	2 7.7	2 1	
Phyllanthus reticulatus	3 4.3	3 7.2	1 8	1 0		A 1	1 3	A 15	1 2.5	3 2		4 5.3	2 1	1 10		
Lannea stuhlmannii	1 5	2 1.8	3 2		2 1.6	2 2.7	3 1	3 2.7	6 2.2	1 1.		3 1.3	1 1			
Hoinsia jasminiflora	1 4	3 2.2	1 1							1 2		4 5	1 1	2 7		
Vernonia hildebrandtii	4 3	2 4.8	2 2.5	3 15	5 3.6	2 3	4 4.5	5 4.2	6 6.7	1 2		7 4.9	2 6		2 10	
Hibiscus aponeurus s.l.	1 3	3 2.1	1 1	3 3	6 1.6	2 1.7	1 1	A 1	3 1	1 2	1 3	5 1.3	2 2.3			
Manilkara zanzibarica		6 6	1 9.5	3 8			1 3					1 2.5		1 25		
Adenium obesum	4 2.8	4 3	A 1	A 1								1 1		2 1		
Dichrostachis cinerea	4 4	2. 3.3	5 4	4 3.7	3 3		1 2	3 1.5	1 1	3 1		6 6	4 2.4	2 2.3		
Ochna sp.	9 3	7 1.7	4 2.6	5 4.3	1 1.5		2 2	A 10		1 1		2 1.8	2 2	1 1		
Cissus rotundifolius	9 3.6	8 1.7	6 2	1 5	3 3.7	3 2.3	1 20	6 1.3	3 1				5 2	3 1.5	5 5.7	
Rawsonia sp.	1 5	1 5	2 2.7	1 3			2 1	A 1					2 1	4 10.2	5 11.3	
Canthium bibracteatum	2 4	2 3	1 2					2 7.8	1 2			1 2	1 3	1 3		
Cissus quadrangularis	2 3	1 1	1 4.5	1 3	2 2	1 5.5	1 3	2 3.8	A 3				2 3	2 2.5		
Momecylon sp.	4 3.8	7 2	4 2.4	1 3						2. 1		6 2.1	5 2.8	2 2		
Commelina sp.	5 4	8 3	5 3.2	5 4	7 2.7	5 2.9	4 3.8	1 2.3	1 8	7 5.2	7 9.9	4 3.6	8 3.4	2 2	3 7	
Agathisanthemum bojeri	8 3.3	7 2.6	5 4.2	4 7.7	3 2.5	2 3.3	2 3.5	2 1	2 1.7	2 1	5 5.3	5 2.2	1 3			
Tephrosia sp.	1 5	2 1.5	3 1.8	3 2	5 1.2	A 1	3 1	3 1.5	3 1.4	1 1	1 10	5 1.9	5 1.3			
Phyllanthus sp. 1		5 1	4 1	1 1		1 1	2 1	A 1	2 1	5 1	3 2.5	3 2.5	3 1	2 1		
Premna chrysoclada	1 4	4 3.7	8 2.7		4 5.6	1 4.5	3 1.7	4 4.1	3 2.2	4 1	3 3	7 2.9	3 2.5	2 4		
Euphorbia tirucalli	3 3.3	5 3.5	3 1.8	1 5	1 1			1 2	1 1					1 +		
Asparagus cf racemosa	9 3.1	6 1.4	3 2	1 1	1 1				A 1					1 2		
muria	8 3.3	8 1.6	5 1.5	3 4	3 1	A 1	1 1	2 1.5	3 1.8	3 1.5		A 1	2 1	1 1		
Lagynias littoralis	3 6	3 3.3	1 4		1 3	A 1							1 1	2 3		
Meyna tetraphylla	2 4	2 2	1 6.5				1 1	A 1					1 4	1 3		
Enneastemon fornicatus	5 5	6 10	3 12	1 3	1 10			1 3	A 1	1 10		1 3 5	1 5	2 15.3		
UPS 2	5 8 6	7 3 9	5 5.4		2 1.3	A 1	1 1	1 2		1 1	1 25		1 1	1 3		
Gonatopus boivinii	2. 2	6 1.3	4 2.9	1 3			1 3	1 10.3	A 1	6 1.7	2 4	1 1		3 1		
Strychnos innocua	5 4.2	6 5.6	3 9.5				2 1					A 3	1 3	2 2.3		
mutiri	2 4	5 9.8	1 2	4 17.7	1 1							A 10				
Aerva lanata	5 3	3 1.5	3 1	1 3	2 1.2		2 1			1 3	1 5	1 2.5			3 6	
Manilkara sulcata	4 12.5	4 4.7	1 17.5	3 12.5	A 1			1 3	A 1		1 3	1 6		5 12.2		
Hoeria mucronata	2 6.5	3 3.5	2 14.3	1 5	A 1			1 1.7	1 2			1 2	2 13	1 10		
UPS 3	2 4	4 7.5	A 4	1 3	A 5					1 1		1 2.7	2 10	2 7		
UPS 4		5 3	5 3.8							1 1						
Monodora grandidieri	2 3	3 8.2	A 1										1 15	1 5		
Capparis stuhlmannii	1 5	2 2	3 8		A 1	2 1	2 2	1 1	A 1				2 10.5			
muungo	2 3.5	A 4	A 10	1 20								3 5.6		1 3		
UPS 5	3 6.7															
Rhoicissus revoilii	2 3	1 3	A 5		1 2			A 3	1 2			1 5		1 3		
UPS 6	1 3	A 5											2 4			
UPS 7	2 3															
Kalanchoë sp.	1 1	1 1														
Jatropha spicata	1 3	A 1	A 3	1 3												
Aloë sp.	4 9	A 3				A 5		A 1						1 1		
Sansevieria kirkii	2 4	2 3.2	A 4		2 2.3	1 15	1 2							2 10.7		
Flagaria guineense	1 5															
muthuri thuri	1 10					A 2		A 3		1 2		A 1		1 3		
Schlechterina mitostemmatoides	1 3	2 1														
Cienkowskya sp.		2 1	2 1	1 5												
Teclea trichocarpa		2 3.2	3 9.8					A 1	A 1			A 4		2 15		
Cucurbitaceae sp. 1		2 1.5		A 1			3 1.7	A		1 4			2 2	2 1		
UPS 9		2 28	1 9.5					2 6.3	1 2				2 3			
Hoslundia opposita		2 2	8 2.9	4 3.7	8 4.8	6 5.9	3 2.7	5 2.3	6 4.6	5 1.7	2 3	6 4.4	5 5.5	1 1		
munyanga kitswa		1 1	7 7.5	3 9	5 3	2 1	2 2	5 6 7	2 2	3 1		4 2.3	3 5.3	1 3		
Grewia cf bicolor		2 2.8	6 7		6 6.5	1 14	1 3	4 2.8	3 5.2	1 1		3 4.4	4 8.8	2 2.7		
Grewia cf ectasicarpa		2 2.2	3 6.3	3 15	3 3 6		1 5	2 11.5	1 2.5			1 2	3 6.8	2 9	2 1	
Thespesia danis		1 2	4 5.9	3 15	9 8.1	3 2.8	6 2.6	5 4.5	3 4.3			A 3	2 2.7			
Commiphora africana s.l.		3 1.3	5 5.6		2 1.5	A 1	1 1	1 1	5 3.9	5 1.6		1 1	2 2			
UPS 10		1 1	3 1	4 1.7	1 1		4 1	2 1	3 1.5	1 1	2 2	4 1.7	2 8			
Lantana camara		A 1	2 1.5		3 6.2	4 7.7	6 10.7	6 3.8	5 9.3	5 1.7	1 5	8 20.9	8 13.7	1 1		
Securinega virosa		A 3	1 2		3 4.5	1 7.5	5 2.4	4 4.3	5 2.3	3 4.5	2 3	5 6.3	5 8.1	1 3		
Terminalia spinosa		A 1	A 1	3 2	2 2.3	2 1		A 1	2 1.7			1 1				
mukami		A 1	4 2.1		1 9	2 8		2 5				1 10.5	4 2.6			
Sida cordifolia	1 1	A 3	3 2.6	3 2	2 4.4	2 2			A 1	3 1.8	5 8.5	1 2				
Aca ia nilotica		A 3	2 2.7	3 2.5	9 10.8	5 4.4	1 3	2 7.8	4 3.3				1 1			
Endostemon tereticaulis		A 1	2 8.8	4 1.3	7 3	3 2	2 1	1 3	5 1.9							
Ocimum hadiense		A 1	2 8.3		4 1.2	1 4	2 1	A 3	3 2.8	1 1	4 9	A 1				
Achyranthes aspera	2 2	A 5	A 5	3 10	5 4.1	5 7	3 2.3	A 1	A 1	1 6.5		A 1				
Albizia anthelmintica		A 5	3 2.8		2 3.4			3 3.6	3 2.8							
Xeromphis nilotica			2 1.8	1 1	3 1.1	1 3		1 2.5	A 1			1 1	1 4			
Sida cuneifolius			1 1	3 3.5	2 1.3	3 2	5 1	3 1.6	5 1		3 11.3	1 2				
Solanum incanum			1 1		5 1.2	4 2.3	2 6.5	1 1	3 2	1 1	2 4	2 1.8	2 2.5	1 1		
UPS 11			1 2		3 1.1	A 4		2 2					2 5.7			
mutunguru	2 6.5	1 7.5		1 5	2 2.2	3 10		A 1	A 1							
Commiphora boiviana		1 1	A 3	1 3	4 1	1 1.5	1 1	3 1.7	1 2			1 6.5				
Salvadora persica		A 3			2 2.2	A 5		1 7								
Greiwa cf microcarpa	1 5		1 17.5	4 28.3	2 5.4	3 15.8		A 1				1 10.5				
Tragiella natalensis			2 2.3		3 2.3		1 1	1 1.7	3 1.8					1 10		
UPS 13							1 3									
UPS 14		A 5	A 30				1 5						1 3	1 25		
Myrica kilimandscharica							1 25					1 3.3		1 10		
Asparagus sp.		A 1	3 1.7		1 1	1 2.5		4 1.3	5 1.3	1 2			1 1			
Bridelia cathartica ssp mel.		1 1	3 5.4		1 2.3		3 1.7	5 9.6	5 2.7			3 3.3	5 8.2	1 3		
Polysphaeria parvifolia		3 3.3	2 9		A 1		1 10	4 6.4	A 5	1 1		4 3.4	1 3	2 17.7		
Fagara chalybea						1 2		2 1.5	1 2	1 1		3 1.7	1 1	1 1		
Ehretia bakeri	1 3	A 1	2 2		A 3	1 2	2 1	1 1.7	1 3	1 1		3 2.6	3 2.8			
Ehretia petiolaris		A 1	3 2.8			A 1	2 1	1 1.7	1 1	1 2		4 2	5 2.5	1 4		
mufodzohi	A 15	A 1	2 1.7	1 3	A 1		1 1	1 2	1 1							
mutanda ufu			3 2			1 7						4 4.3	2 2.5			
Vitex cf mombassae		3 1	2 2	1 3						1 1		1 3.7				
Oxygonum saliciifolium		4 4.1	3 3							1 1	3 11.7	A 3				
Grewia cf holstii			2 5	A 15				1 1		1 1		A 4				
Ageratum conyzoides		3 1.3	3 2.3				1 1	1 1	2 1	1 1.5	2 1.5	2 2.5	1 1			
Grewia truncata		A 1	A 1	3 1	2 6.8	1 7.5	2 2	1 3		1 1				2 2.7		
Ximenia americana			2 3	1 5								A 1	2 2.7			
Emilia javanica			2 1					A 1	1 1			2 1				
Vangueria tomentosa		1 1	2 2.3			1 1	1 3									
Grewia orbesii			2 5		A 10		1 5							2 3.3		
UPS 15					1 3.3						1 1					
UPS 16		1 10	A 5		A 3											
Grewia sp. 1					1 1.7	1 2										
Manilkara mochisia					A 3	1 10		1 2	1 2			A 3		1 4		
Lantana viburnoides								A 3								
Acacia zanzibarica					2 17.4	3 8 4		2 6.2	2 8.6							
Acacia etbaica			A 25		1 3.5	1 2		A 1				2 14.5		2 3.5		
Euphorbia candelabrum		A 1	A 1		A +	2 2.7		A 5	2 1							
Grewia stuhlmannii			1 2		2 2.5	1 7.5		A 3				A 3	1 4	1 1		
Conyza pyrrhopappa					A 1	1 3			1 3							
Erythrococca kirkii		1 1	A 1		2 2.4	1 1	1 1	A 1	1 1							
UPS 18	2 9	A 3		A 10	1 3	1 5								1 4		
Veronica sp.								A 1								
Talinum portulaccifolium		A 1				1 3						1 1		1 1		
Bombax rhodognaphalon					A 20				1 1			1 2		1 3		
UPS 19									1 3							
UPS 20	1 1								1 2					1 1		
Lantana senegalensis								7 4	2 3			3 3.6	1 3			
UPS 21			A 1		1 1			3 1	3 1.3			A 1	1 3		2 1	
Harrysonia abyssinica	2 4					1 3	1 1	1 2.7	2 2			5 19.6	2 17.7			
Ormocarpum kirkii			1 1		A 3	1 1		4 3.1	5 1.9			A 3				
Guizotia scabra					2 1	2 2.3	3 7.7	6 2.6	6 1.2			1 5 7	2 3.3			
UPS 22						1 1		1 1	1 1	1 1				1 4		
Acacia mellifera			1 3	1 3	2 6 5			4 1 8	2 1.7							
cf Glycine wightii							4 1	2 1.8	2 3.3	1 1		1 1	2 1			
Hyphaene coriacea			1 1			1 1		2 1.2	5 2.7		1 +		2 2			
Sphenostylis briartii			1 2				7 2	6 1.4	5 1.7	2 6.3		A 3	4 17.6			
Acacia stuhlmannii							5 17.6	2 9.6	1 1							
Pluchea dioscorides						A 1	6 27.3	A 25								
karemba		2 2	A 2	3 1	2 1	A 1	3 1	2 1.4	2 1	1 1		1 2	2 3.5			
Dalbergia vaccinifolia			A 5		A 1		1 3	2 15.3	1 1			2 4.5	2 7			
Fernandoa magnifica		A 3	1 2.3					1 3.5	2 1	1 1		1 7.1		3 6		
kitola	1 5	A 3	1 12.5		1 1			1 2	1 1	1 2		3 1.3				
Cyphostemma adenocaulis		A 1			A 1	1 2		2 3.8	1 1			1 1	2 1.7	1 3		
Sterculia rhynchocarpa			A 3					1 1	2 1			1 1				
Deinbollia sp.		1 3	A 40					2 4.3				A 3	2 16.7	3 7.8		
UPS 23			1 3.5				1 1	A 1			1 3	3 3.5	1 1			
UPS 24		A 10										2 3	1 1			
Albizia gummifera												3 4.8				
Cissampelos sp.					1 1.3				1 1			2 3	1 10			
UPS 25												2 3				
Allophylus pervelliei					A 1			1 5.3		1 1		2 2.7	2 13	2 13		
Diospyros cornii			1 2.5				1 3	1 1.7								
mubono koma					A 3			1 12	1 3			A 1		1 30		
UPS 26							1 30	A 10								
mwiya					A 1			1 1.7								
Strychnos dysophylla								A 3					1 3	1 1		
Secamone sp. 1		A 1			1 1		2 1	1 1	2 1							
Adansonia digitata		A 25			A 1			1 2	1 1		2 3					
Diospyros sp.								1 3.3	1 2			1 1		1 10		
Clerodendrum glabrum							3 1	1 4.7	1 1		1 3	1 2.3	1 3			
UPS 27					1 1	1 1			1 1							
Vitex stricheri					A 4		2 1	2 5.4				A 1				
Grewia villosa		A 1			A 1	1 3	1 1	2 4.2	1 8							
Lamprothamnus zanguebaricus			A 3		1 1.3	1 1	1 3	3 1.7	1 1				1 30	1 3		
Piliostigma thonningii								1 1	3 5.6				2 3.5			
UPS 28								1. 2	A 1							
UPS 29			A 1		A 1											
musasa						1 1										
Leucas cf kilifiensis				1 1		1 2		1 2	1 1					1 5		
UPS 31					A 2											
Grewia sp. 3			A 3		1 1	1 1		1 1								
Encephalartos hildebrandtii		A 1			A +	1 +						A 1				
kakira kaloma								A 1		1 +		A 3		2 4		
Acacia globosa								A 1		1 1				1 30		
kitunguu								A 3	1 1							
Acacia senegal								A 1								
UPS 32								1 3	A +					1 3		
UPS 33											1 15	A 1				
UPS 34								A 1								
Zyziphus mauritania								A 1		1 1		A 1				
Hunteria zeylanica		A 5					2 5.5	A 1	1 2							
Celosia schweinfurthiana									1 1	1 10			1 3			
cf Clitoria sp.							2 2		1 1	1 3						
Pseudantha confertiflora							1 1		1 1							
Capparidaceae sp. 1		1 1	A 1						1 1	1 1		1 5.5				
UPS 35		A 1						A 1								
Secamone sp. 2		A 3						1 2	1 3				1 1			
Phyllanthus sp. 2					1 1			1 1				2 2	2 2			
Markhamia zanzibarica		A 3			A 1		1 1	1 5.3	1 1	3 2		4 7.3	3 7.8	2 17.5		
Annona chrysophylla			A 5	1 4				1 7.5	1 1	1 2		2 3.5	3 10.3			
Azedirachta indica							1 1	1 2	3 3	3 1.5	2 3	3 2.6	1 10			
Notobuxus obtusifolia		1 2.5					1 1	A 1		3 5.8			3 2.5			
Papilionaceae sp. 1								A 1	1 3			1 3.3	1 1	1 4		
Epinetrum delagoensis			1 2		1 3		2 1	2 1.8	2 1	1 5		1 1.7	3 2.8			
Cassia sp.		1 2	1 5.5					A 1				A 1	3 2.5	2 6.5		
Strychnos mitis								A 1		1 3		1 1	2 1.7			
Tarrena nigrescens			1 13		A 3			3 2.3	1 3			A 1	1 10			
UPS 36								1 6.5					2 5.3			
Indigofera sp.			A 1		1 1.5		1 5	A 1		2 21.7		A 1	2 5.3			
UPS 37		A 3	1 5		A 20			1 2.5					1 1			
Asteranthe asterias		A 1						A 1					2 1			
		A 5														

PLANT SPECIES / PLANT COMMUNITIES	A1 (10)	A2 (23)	B (20)	C (8)	D1 (22)	D2 (15)	E (11)	F1 (22)	F2 (15)	G1 (14)	G2 (12)	H1 (20)	H2 (13)	I (13)	J (6)	K (4)
UPS 38							1 1	A 1				1 2				
lubugu 2												1 3				
mambo tsaka												1 1.7				
Annona sp.								A 1						2 4.5		
cf Dioscorea sp.								A 3						2 4		
Clerodendrum luseum								1 9.3								
Cassia sanguinea		A 3	1 2.5		A 4		1 30	A 1	1 10							
Parkia filicoidea		1 1	A 3				1 1	A 2				A 1				
Heeria reticulata			A 11		A 15			A 1		1 3						
UPS 39								1 1	1 1							
UPS 40								A 1						1 1		
Arum sp. 2	1 3	A 1			A 1		1 1					1 1				
kadunga tundu		A 3										1 5.5		5 10.1		
Croton pseudopulchellus												A +		5 18.6		
Cynometra suahelliensis												1 25		3 11		
Combretum butyrosum		1 2	A 10			1 1				4 1		3 1.3	2 1	1 1	2 1	
Gloriosa simplex			A 1				4 1	2 1.4	5 1.3	5 1		2 1	5 1	4 10.4	2 1	
Deinbollia borbonica		2 3.3	1 2.5		1 1		1 1	A 1	1 2	6 1.5		2 1	2 3	2 1		
mschembe gakuro			A 1				1 1	A 1		2 1.7		A 1				
UPS 41		A 1	1 2						1 1	2 1			2 1			
Tridax procumbens							2 4			1 2		1 1	2 1	1 3		
Rauwolfia mombasiana		A 1	1 3.5							4 1.8		2 3.4	1 1	1 10		
Tetracera boiviana		1 1.3	A 3			1 1	3 1	A 1	1 1	1 1			3 2.3			
UPS 79							3 1	A 1	1 1	1 3		A 1				
Heliotropium sp.		A 1	1 2.5				2 47.5	A 1								
Acacia polyacantha							4 1	A 5								
Ficus comorus							5 13.2		1 1	1 1		A 25	2 11.3	2 5.3	2 10	
Acal fructicosa		1 29	1 2.5		1 1		2 2		1 1	7 11.1	5 8.2	2 5.2	2 1			
Triu[illegible]ta rhomboidea		3 2.4	2 2.6				2 1	2 2.8	1 1	5 4.6	1 5	3 11.6	2 7.1			
UPS 42		4 4.6	2 3	1 3			1 1			3 8.5	1 3	4 2.4				
Tipalia lappacea		1 1	1 1		2 4.6		1 1			3 1.5	3 3.5	5 1.3	2 1			
Cissampelos sp. 2		A 1	1 1.3		3 1	1 1	1 1	1 1	2 1.7	9 3.5	8 5.2	2 4.4	1 3			
Anacardium occidentale		A 1	1 1	1 3						6 10.2	10 18.8					
Cocos nucifera							2 1			4 6.4	7 4	A 1				
Mangifera indica							1 1			2 1.7	3 4.3	A 1				
UPS 43			A 3				1 1									
UPS 44			1 1						1 1							
UPS 45									2 1							
Helixanthera kirkii			1 1				1 1	1 1.7	1 1				1 4			
UPS 46							1 1	A 1	2 1							
Cassia sp. 2									1 1			A 1				
UPS 47									1 1							
UPS 48					1 2.5				1 1	1 1						
UPS 49									1 1	1 1			1 1			
Tamarindus indica									2 9							
Ficus bussei		A 10							1 1		1 4			1 3		
UPS 50									2 1			A 4		1 10		
mwaalaga kuku		2 2.3							1 3			A 1				
Clausena anisata			A 3						1 1				1 10			
Carissa bispinosa		A 1							1 1			A 1				
Ricinus communis							1 1			1 1		A 3	1 3			
UPS 51													1 5	1 1		
muiungu			A 3		A 1		1 1									
mwiya 2			A 1					A 3				1 6.5				
UPS 52			A 10	1 5												
Vigna unguiculata			A 4							1 2						
UPS 53					1 2.5											
cf Asystasia gangetis										1 1			1 3			
UPS 54										1 5		A 1	1 3			
Thevetia peruviana										1 1	2 +					
Cassia longiracemosa											3 2					
Citrus sinensis											4 2.6					
UPS 55										2 18.3				1 3		
Zea mays											5 5.8					
Anchomanus dubium		A 1												2 1		
UPS 57	4 3.8	A 5	A 5	1 5												
UPS 58	2 4	A 5														
Psychotria amboniensis	3 4	A 5														
UPS 59	3 3.3															
UPS 60	4 4															
UPS 61	4 4									1 1	2 2		2 5			
UPS 62	2 5	A 5														
Acridospernum flaccidus (UPS 63)		4 1	1 1													
UPS 64		2 1.6														
Tinnea aethiopica		2 5		1 3												
Sansevieria sp.		1 2.3												2 11		
kafidzo fidzo		A 1												1 4		
mukambi		1 3			A 1			A 10				A 1		3 2		
Pleurostylia africana		1 3.3	2 4		A 1							1 11.3	1 4	1 9.5		
UPS 65		A 1										1 5.5		2 1		
Trema orientalis		A 3										A 4		1 3		
UPS 66		A 1	A 3										1 1	2 1		
Hugonia sp.										1 1				1 4		
Erythrococca sp. 2	1 3		A 3		A +		1 3							1 3		
Hollarrhena sp.					A 3	1 9.5								1 25		
UPS 68	1 1	A 3		4 3.3	A 3	1 1						A 1				
Erythrococca sp. 1	1 5				A 3							1 2.3	2 10			
Strychnos spinosa		A 4	A 4													
Vernonia wakefieldii		2 2.8								1 20				1 1		
Gesneria sp.		2 1.8												1 1		
Polypodiaceae sp.		1 1														
UPS 69		1 1										A 1				
Dryopetis riseleyi		1 7											1 1			
Lilium sp.		1 1	A 1													
UPS 70		1 1														
UPS 71		1 1														
Justicia - Ansellia		A 1	A 4		A 5											
UPS 72		A 1	A 1													
mlolo mbuzi		1 1	1 7													
Portulacca sp.		A 1	A 1	1 1	A 2											
UPS 73		A 4	1 3.5							1 3		1 2			2 1	
Dalechampia ipomoifolia		A 1											1 5			
Vitex cf doniana			A 5	1 20							1 3	1 4				
UPS 74			A 30							1 1		A 3	1 3	1 3		
Tradescantia sp.																
UPS 76	1 3.		1 3													
Clerodendrum eriophyllum			A 4		A 1					1 3			2 7			
Annonaceae sp.			1 15	1 10												
UPS 78			A 5	1 3										2 13.7		
Sterculia appendiculata								A 3								
Blepharospernum zanguebaricum							1 1	A 25					2 8.7	1 10		
Grewia glandulosa													1 30		7 14	
Agave sisalana															2 30	
Capparis cartilaginea															5 11	
cf Scilla kirkii															5 1.7	
Plectanthus flaccidus															3 11.5	
Pentodon pentandrus															3 2	
Cynanchum tetrapterum															3 7.5	
Tephrosia purpurea															3 9	
Cordia somaliensis															2 10	
Justiciana flava															2 +	
Cordia subcordata															2 +	
Jasminum fluminens															2 3	3 +
Tribulus terrestris																10 37.5
Sonneratia alba																5 15
Brughueira gymnorhiza																10 21
Avicennia marina																10 14.8
Rhizophora mucronata																
GRAMINAE & CYPERACEAE																
Eragrostis ciliaris	2 3	A 3				1 5										
Cyperaceae sp. 1	3 3	6 2.6	3 3.3	2 3	3 3.2		2 14	2 3	5 4.3	3 2.3	1 5	A 3	1 1			
Cyperaceae sp. 2	5 3.4	4 2.5	1 2.7	2 4	A 3			A 4	1 1							
Panicum repens		4 5.1	4 3.3	1 3		1 3	2 4.3	1 1	1 10	6 4.1	6 5.7	5 4.3	2 10	2 8		
Panicum maximum	4 7.8	5 6.8	3 6.3	3 9	2 4.8		2 4	1 3	2 9.7	1 10	3 7	4 5.5	2 4.5	3 4.3		
Eragrostis superba		A 2	3 6.3	1 3	4 2.6	3 4.5		A 3	1 10							
Chloris roxburgiana			3 4.8		3 3.6	1 10	1 5	1 7	1 4				1 1			
Chloris virgata	1 3	1 3	1 6.5	1 3	3 2.7			1 14	2 5.3	1 3	3 6	2 3.5				
Heteropogon contortis			1 5	1 3	2 2.5	1 4		2 8.6	3 12.2			1 3	1 1			
Dactyloctenium geminatum			1 6.5	1 1			2 4	A 3	1 4				1 1			
Sporobolus pyramidalis			1 5.5			1 3	1 3	2 4.4	2 18.3	1 2		A 3				
Echinogloa haploclada					A 10		6 26.4	1 3.7	3 8.8		1 +					
Leptochloa panica					1 4		2 5.5	2 4.4								
Sorghum sp.							1 3	A 1	1 9							
Cyperaceae sp. 3							2 47.5	A 3								
Eragrostis sp.					1 6.3	1 4										
Cyperaceae sp. 4					1 6	1 3										
Enteropogon macrostachyus			1 4	1 3	1 3					1 3		A 1	1 4			
Cyperaceae sp. 5		1 3	A 3		1 4						8 12.2			1 4		
Cyperaceae sp. 6		A 3	A 3	1 5	2 4	1 3			1 3							
Cyperaceae sp. 7	1 1		A 5	1 5	2 4	1 3					2 6.5					
Cenchrus setigerus								1 3	2 9.3	1 1			1 3			
Cenchrus ciliaris					A 3	1 2		1 4.3	3 13.3	4 2.7		1 5.3	1 3			
Paspalum geminatum					1 2.5			A 5	3 20.3	2 3		1 3.3	3 2.5			
Dichanthium radicans								A 5	3 17.8							
Themeda triandra								1 8.3	4 18.7							
Cyperus articulatus		A 5	1 8.5				3 4.7	A 1	1 6.5	2 2	1 5		1 7.7			
Imperata cilindrica			A 10		A 3		1 3	1 10.5	1 5	2 3		1 2.5	1 14			
Tetrapogon tenellus								1 5.3					1 3			
Cyperaceae sp. 8			1 15	2 2	A 3		1 2									
Cyperaceae sp. 9		2 5.4									1 3					
Sporobolus marginatus		1 2.5	A 5				1 10									
Aristida adjunsonius	1 3		1 2.5	1 3	A 3				1 4							
Digitaria macrobephara		A 3								1 3	2 12.5	1 1				
Perotis hildebrandtii		1 3	1 2	5 2	A 3			A 1	1 3			A 1				
Digitaria abyssinia		A 2		1 3												
Dactyloctenium aegyptium		A 1	.		A 2							1 6	2 3			
Graminae sp. 1			1 2.3	1 1		1 4										

NOTES: - adapted from vegetation table (Appendix II).

- first figure per column : presence class: A -- occurs in less than 5 % of the relevee's (of the plant community)
  1 -- occurs in 5 to 15 % of the relevee's (of the plant community)
  2 -- " in 15 to 25 % " " " " " " "
  ... etc.

- second figure per column : mean real coverage of the occurring species (in the plant community)

- between brackets : number of vegetation relevee's per plant community

FROM : M. van Leeuwen : Vegetation of the Kilifi area, 1981.