INDIRECT GRADIENT ANALYSIS OF THE MANGAL FORMATION OF GAZI BAY (KENYA)

HANS BEECKMAN*, ELS GALLIN, ERIC COPPEJANS**

SUMMARY

(1) Based on vegetation relevés of sample units along transects perpendicular to the coastline, the mangal ecosystem of Gazi Bay (Kenya) has been investigated.
(2) An indirect gradient analysis is performed by the ordination method Detrended Correspondence Analysis.
(3) The first ordination axis can be interpreted in terms of resistance of the different species to flooding.
(4) A similar zonation pattern is found as described by WALTER & STEINER (1936).
(5) Zonation is closely connected with morphological and eco-physiological features of the mangrove species. Therefore stomatal density has been measured. Sonneratia has by far the lowest stomatal density, Lumnitzera the highest.

---

* Laboratorium voor Plantecologie, State University of Ghent, Coupure links 653, B-9000 Gent, BELGIUM

** Laboratorium voor Morfologie, Systematiek en Ecologie van de Planten, State University of Ghent, Ledeganckstraat 35, B-9000 Gent, BELGIUM

TABLE OF CONTENTS

INTRODUCTION

Leaving the term mangrove for the individual genera and species, mangrove formations are best described as "mangal" (MACNAE, 1968; CHAPMAN, 1975).
Mangal reaches its optimal development in the tropics, but it does extend into the subtropics reaching its geographic limits in some warm temperate regions (New Zealand and southern Japan).
The total world acreage of mangal, being regarded as suitable repositories for city waste and for a wide range of reclamation projects, has been greatly reduced during the present century (CHAPMAN, 1977). The question is continually being asked whether we can afford to alienate any more acres and increasingly the answer seems to be "no". Mangal ecosystems are of extreme importance along tropical and subtropical sheltered coastlines for many reasons (GALLIN et al., 1989) : they filter land runoff, aid soil formation by trapping debris (DAVIS, 1940), are producers of detritus that will contribute to offshore productivity (HEALD, 1971), play an important role in fish production and in the maintenance of critical habitats for many species. On the other hand, mangroves are used by the local population as a source of food, fuel, wood, medicines, tannins and dyes.
ODUM (1971) defines ecology as "the study of structure and function of nature". He stresses the role of ecosystem research in relation to the use of nature by man. Applying this viewpoint to the Gazi Bay mangal ecosystem in Kenya, subsequent items should be taken into account : (1) zonation of the mangal vegetation ; (2) morphological and ecophysiological adaptations of the mangrove species ; (3) use of the mangrove by de local community.

MATERIAL AND METHODS

Description of the site

Kenyan mangals are located on several spots (Fig. 1) along the coast. The best developed ones are along the North Coast (Lamu, Mida Creek, Mtwapa) ; they also include the mangrove Heritiera littoralis (RUWA, pers. comm.) which is absent along the South Coast. The choice of Gazi, along the South Coast was mainly done for practical reasons (mainly the easy accessability).
A map of Kenya with the location of Gazi is reproduced in COPPEJANS & BEECKMAN (1989). A general description and map of Gazi Bay (=Maftaha Bay), approximately 50 km south of Mombasa is given in COPPEJANS & GALLIN (1989).
The Gazi Bay mangal is part of the major East African Group of mangal[3]. A mangal of this group is characterised by the

[3] According to CHAPMAN (1977) the major groups of mangals are (1) the New World Group ; (2) the West African Group ; (3) the East African Group ; (4) the Indo-Malesian Group ; (5) the Australasian Group and (5) the Oceanian Group.

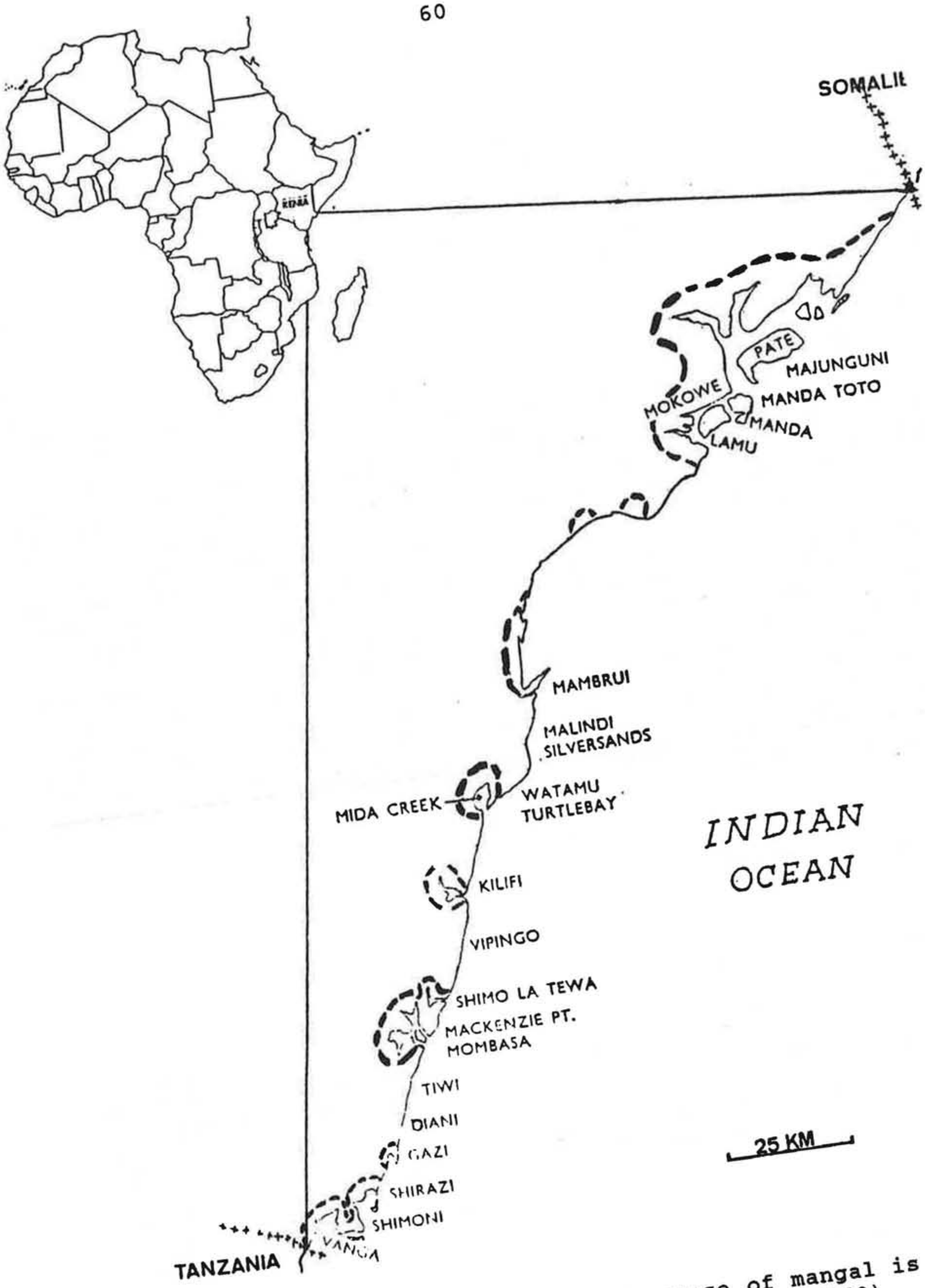

Fig. 1. Map of the Kenyan coast. Presence of mangal is marked by a dashed line. (after ISAAC & ISAAC,1968)

predominance of Rhizophora mucronata, Avicennia marina, Bruguiera gymnorrhiza, Sonneratia alba and Ceriops tagal and is not very rich in species.
The principal mangal associations of East Africa, in accordance with the Montpellier classification, are (CHAPMAN, 1977) :

RHIZOPHORETEA

- RHIZOPHORETALIA

Rhizophorion orientalis : Rhizophoretum mucronatae
Bruguierion : Bruguieretum gymnorrhizae
Ceriopion : Ceriopetum tagalae
Avicennion orientalis : Avicennietum marinae

- SONNERATALIA

Sonneration : Sonneratietum albae

COMBRETETEA

- COMBRETALIA

Lumnitzerion : Lumnitzeretum racemosae

- XYLOCARPETALIA

Xylocarpion : Xylocarpetum granatae, Xylocarpetum moluccensis[4], Xylocarpetum benadirensae.

Four vegetation types can be distinguished at Gazi Bay (Fig. 2) : the Sonneratia alba mangal near the coastline, the Avicennia marina mangal in the north of the area, the mixed mangal and the dune-depression system (dunes and depressions parallel to the coastline). A detailed description of these four vegetation types is given in GALLIN et al. (1989). The depressions are flooded from the northern side (where dunes are absent). The more inland depressions have a central permanent seawater pool.
The northern part of the dune-depression system is flooded during mean and spring high tide ; the most inland and the southern part are exclusively flooded at spring high tide.
Vegetation data have been collected in the dune-depression system and the Sonneratia alba mangal. Stomatal density was measured at three different spots : the wet mangal (coastline mangal which is flooded twice a day) ; the dry mangal (first seaward depression which is flooded only at spring high tide) ; the very dry mangal (northern mangal which is only flooded at extreme spring high tide).
Six mangrove species were involved in the gradient analysis (Xylocarpus granatum Koenig has been excluded, because merely three specimens were found in the transects) : Bruguiera gymnorrhiza Lamarck, Ceriops tagal (Perr.)Rob., Lumnitzera racemosa Van Steenis, Avicennia marina (Forsk.)Vierh., Sonneratia alba J. Smith and Rhizophora mucronata Lamarck.

---

[4] Madagascar

Vegetation on the dunes consists of herbaceous sand-fixing species, woody vegetation including <u>Casuarina equisetifolia</u>

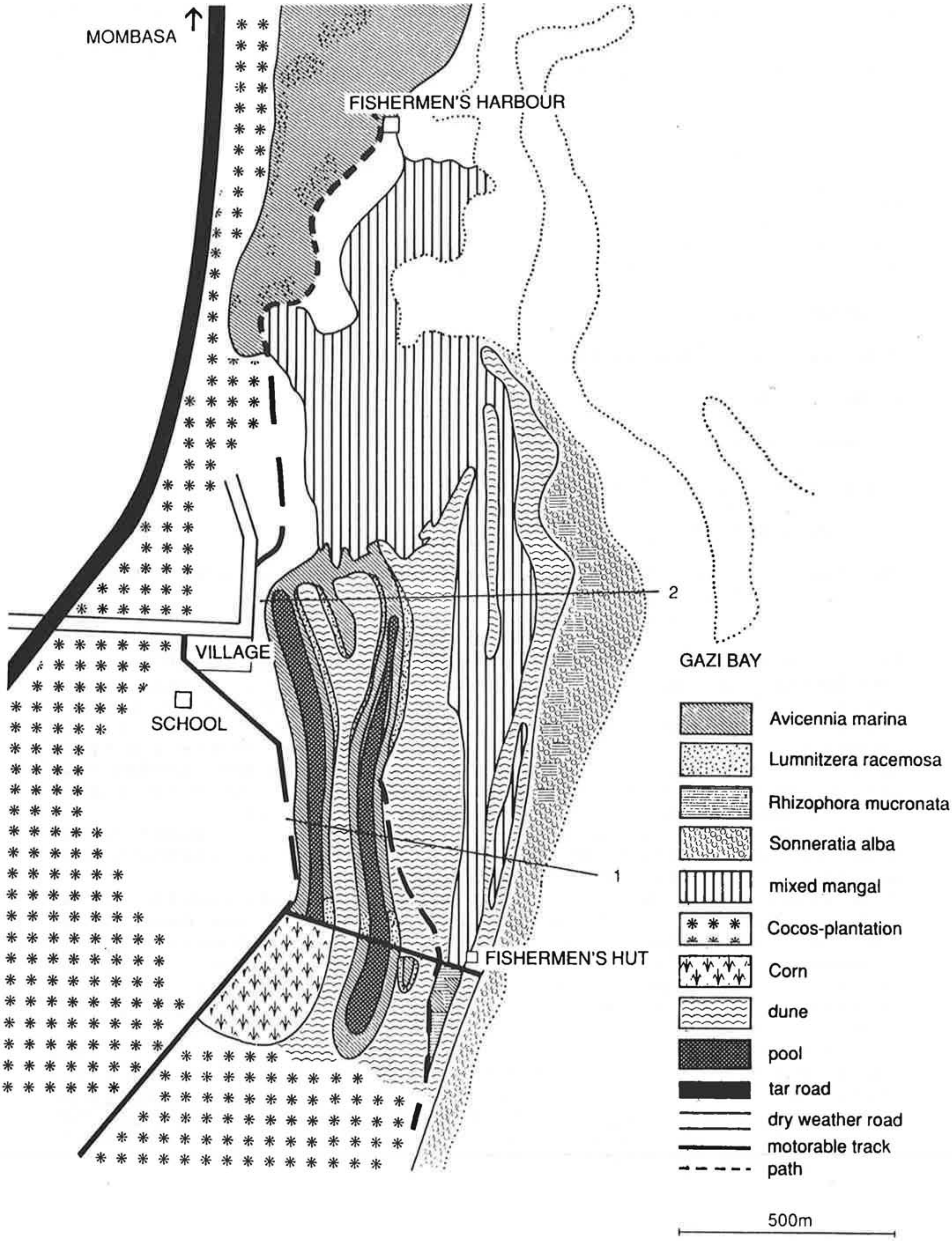

Fig. 2. The vegetation of Gazi Bay and position of the two transects.

Forst., Pandanus kirkii Rendle, Hyphaene coriacea Gaertn. and a dense shrubby vegetation, which is not studied in detail. Field work was carried out during July and August 1987.

Methodology

Vegetation data were obtained by means of phytosociological relevés of sample units (sites, vegetation quadrats), arranged along two transects perpendicular to coastline and dunes (Fig. 2 and Fig. 3). A sample unit was 10 m long and approximately 4 m wide. Sampling along the transects was executed, using a calibrated rope. Cover in each site was quantified following the Tansley scale (TANSLEY, 1939). Vegetation data classified by the classification algorithm TWINSPAN (Two Way Indicator Species Analysis) are given in Table 1.

Table 1. Two-Way Table of de vegetation data from the transects (processed by TWINSPAN).
(First two lines : sample numbers ; digital codes on the right : classification of taxa ; digital codes at the bottom : classification of samples)

```
                 54435441 41133311133   12422222222441554242 331133
                 056810209149962678375785770123456789323493861012543412

Hyphaene         455545---3----------------3---------------------------  11
Pandanus         -------33---------------------------------------------  1011
Poaceae & Cypera.4--4467668888655555366676-----------------3-----------  1010
Casuarina        --------------------3---------------------------------  1001
sandfixing plants--------------53335-66656-----------------3-----------  1000
Lumnitzera       6-----65------------------333------5666-------5-------  0111
Ceriops          -------5-----------------------------------3335533----  0110
Rhizophora       ---------------------------------------63634--563444--  01011
Sonneratia       -------------------------------------------2------6666  01010
Bruguieria       -------------------------------------------333--------  0100
Avicennia        -------------33-----------7888888888-77636333---------  00

                 000000000000000000000000011111111111111111111111111111
                 000000111111111111111111100000000000000000000000001111
                 011111000111111111111111100000000000000000111111110011
                  0011101100001111111111110000000000000000001110001111
                    001 01011100111111111110000000000001111011011 0011
                    01         010000011111011111111110001 01 010101
```

From a methodological point of view, ecological investigation into natural communities represents a complex area of research (BEECKMAN & LEMEUR, 1989). The ecologist often encounters all possible difficulties of empirical science at the same moment (JAGER & LOOMAN, 1987 ; BEECKMAN, 1989) : a wide variability in the variables studied ; a complex interaction between state variables

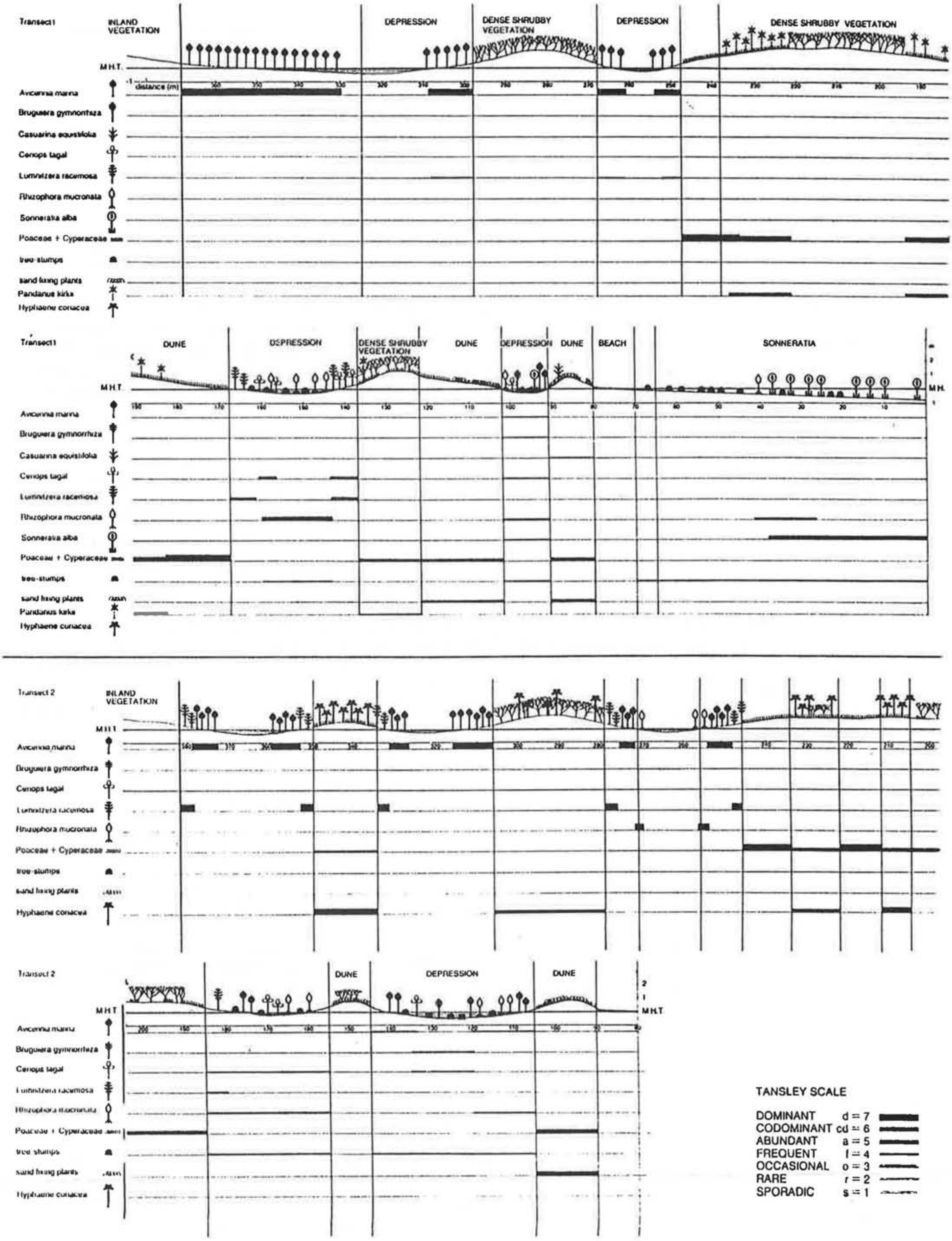

Fig. 3. Schematical representatation of the vegetation in the transects.

and driving variables ; uncertainty about the causes of the observed correlations. The great variability in the variables observed in the field is caused by the existence of many influencing, but also changing, biotic and abiotic factors. For instance, response variables of mangrove species are correlated with soil composition, salinity, level above low water, activities of local fishermen or impact of tourists.

Generally spoken most of these ecosystemvariables are affected mutually. Such phenomena result in correlations between variables, so that causal explanations are difficult to access and we have to look for multi-causality. Due to the numerous variables involved, the analysis of the mangal data requires the application of multivariate numerical techniques.
To depict the gradient of greatest variation along a "first" axis, the second largest gradient of variation along a second axis, and so on, the ordination method of DCA (Detrended Correspondence Analysis) has been used. DCA is an indirect gradient analysis. Indirect gradient analyses are based on data consisting of state variables (e.g. vegetation data). The ordination axes define for instance gradients in the vegetation, which are interpreted as environmental gradients. Direct gradient analysis, on the other hand, is defined as an ordination, based directly on concrete information about environmental factors. In direct gradient analysis the ordination axes are individual factors or are a combination of environmental factors obtained by definite mathematical procedures.
The greatest variation in mangals which is expected to be reflected on a first ordination axis, can usually be attributed to the level above low water, since monospecific zones parallel to the coast are often obvious. Such a pattern is caused by topography, which determines the extent of inundation by seawater, and by the nature of sediments (TOMLINSON, 1986). In Gazi Bay, this zonation is rather hidden by a complex mosaic pattern, due to important local substrate differences, input of fresh water or inundation creeks.
According to MACNAE (1968) mangal zonation can be studied from different viewpoints :
- depending on the frequency of inundation (flooding at each high tide to only flooding at extreme high tide) WATSON (1928) distinguishes five zones ;
- WALTER & STEINER (1936) distinguish zones in accordance with the dominant species.

Anyhow, zonation of mangal is determined by different morphological, anatomical and eco-physiological features of the mangrove species, which should be taken into account by eventual management plans.
To evaluate the transpiration process which is considered as a globalizing eco-physiological parameter, stomatal density of the mangrove species has been studied through the help of the so cold replica method (GALLIN et al., 1990). A layer of transparant nail varnish is spread over a tree leaf. After drying, the replica is removed with transparant gummed tape and sticked to a micro slide. Stomatal density can be counted by studying the replicas with a microscope.

RESULTS

The diagram of the first (eigenvalue 0.87) and the second (eigenvalue 0.47) ordination axis (Fig. 4) illustrates how the first axis can be interpreted in terms of resistance of the different species to flooding : on the right side mangrove species are found which can resist to two inundations a day, on the left side only inland species occur.

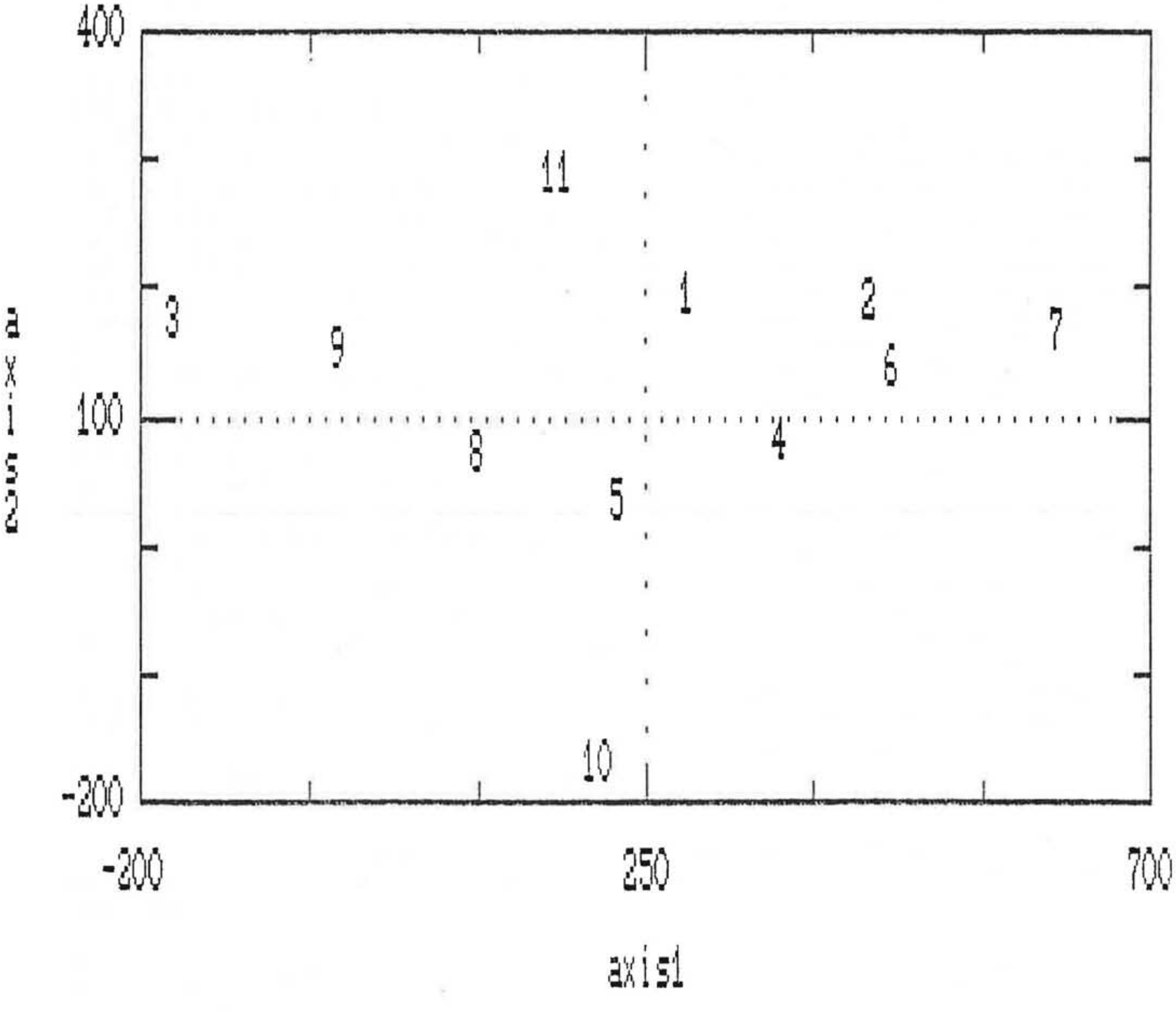

Fig. 4. Diagram of first two "species"ordination axes. (1 : <u>Avicennia</u>, 2 : <u>Bruguiera</u>, 3 : <u>Casuarina</u>, 4 : <u>Ceriops</u>, 5 : <u>Lumnitzera</u>, 6 : <u>Rhizophora</u>, 7 : <u>Sonneratia</u>, 8 : Poaceae & Cyperaceae, 9 : sand fixing plants, 10 : <u>Pandanus</u>, 11 : Hyphaene)

Stomatal density values are given in Table 2. Because of the thick hairy layer on the leaves, stomatal density of Avicennia was impossible to measure.

Table 2. Stomatal density of five mangrove species.

	habitat	location in crown	leaf side	repetitions	stomata density mean value (stomata/mm2)	standard deviation	WALTER & STEINER (1936)
Rhizophora	dry	upper	upper	144	126	28	
		lower	upper	144	111	27	100 - 117
	wet	lower	under	144	129	41	
Sonneratia	wet	upper	under	144	60	17	60 - 67
			upper	141	78	18	
Ceriops	dry	lower	under	144	118	26	100 - 107
Bruguiera	dry	breast height	under	25	148	15	134 - 150
Lumnitzera	dry	breast height	under	25	98	12	78
			upper	20	175	26	140
	very dry	breast height	under	45	111	7	78
			upper	20	262	47	140

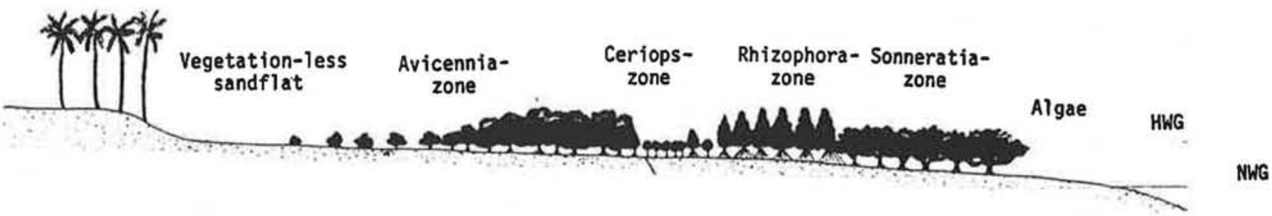

Fig. 5. Mangrove zonation at Tanga (after WALTER & STEINER, 1936).

DISCUSSION

1. Zonation

The zonation of the mangal is well expressed by the DCA ordination of the species and reveal an analogous pattern as found by WALTER & STEINER (1936) at Tanga (Tanzania) (Fig. 5).
Sonneratia which is only found near the coastline (flooded two times a day) is put at the right side of the first axis. According to TROLL (in CHAPMAN, 1976) Sonneratia generally prefers sandy loam soils, but corresponding to WALTER & STEINER (1936) and DE HAAN (in MACNAE, 1968) it also occurs on young soft mud soils. Sonneratia is the most important pioneer plant of open coast, nevertheless it can be replaced by Rhizophora in river mouths or by Avicennia on hard and sandy substrate.
Rhizophora, second species on the axis, occurs also close to the "coastline", but as well as on some banks of the permanent seawater pools in the depression and even in the first (most seaward) depression which is seldom flooded. Some specimens are still present in the mixed mangal up to 80 m inland. Rhizophora generally grows on soft muddy soils.
The two next species in the diagram, being Bruguiera and Ceriops, occupy a similar ecological niche. They are both found in the most seaward depression (without permanent pools) and inland in the mixed mangal. Such a mangal is also described for the north coast of Tanzania (WALTER & STEINER, 1936). At Gazi Ceriops shows dwarf growth (about 1 m tall). The reason for this is probably the limited freshwater supply and, as a consequence, the very salt soils (MACNAE, 1968).
On some other places along the East-African coast Bruguiera forms a seperate zone between Rhizophora and Ceriops. According to MACNAE (1968) Bruguiera occupies a zone between Rhizophora and the inland mangal in regions with high precipitation ; in drier regions a small strip of Bruguiera is found between Rhizophora and Ceriops. In some areas Bruguiera even grows in depressions with water of low salt content (CHAPMAN, 1976).
Avicennia has a very broad ecological amplitude. It can be found in the very dry northern mangal, as well as on the banks of the permanent seawater pools and even near the water level, as is the case for the mixed mangal. The first ordination axis points to an ecological optimum for Avicennia at drier spots. More inland trees are smaller and the stand becomes less dense till they disappear completely and make place for a site, only flooded at extreme high tide. Between the thin Avicennia-vegetation halophytes like Sesuvium portulacastrum L., Salicornia herbacea L. and Fimbristylis polytrichoides (Retz.) Vahl occur.
The next mangrove species, Lumnitzera, occurs in dry and very dry habitats only : the higher banks of the permanent seawater pools (between mangal and dunevegetation) and the very dry northern Avicennia marina mangal. According to MACNAE (1968) a mixed stand of Avicennia marina and Lumnitzera racemosa can be found on sites with an annual precipitation of 500 mm to 1500 mm (like it is the case for Gazi).
The next two non-mangrove species (Hyphaene coriacea Gaertn. and Pandanus kirkii Rendle) are both found on the dunes, although Pandanus occupies stands closer to the shore. They could in this

context, such as the Poaceae and the Cyperaceae (Fig. 4) be referred to as dune plants.
Casuarina equisetifolia Forst and the sandfixing plants (Ipomoea pes caprae (L.) R.Br. ; Canavalia rosea (Sw.) DC. ; Cyperus maritimus Poir.) occur exclusively on dry dunes.

2. Morphology and ecophysiology

The identification key for the seven mangrove species found at Gazi is based on DALE (1938), MOORJANI (1977) and personal observations (E.C.).

1.a. Upper leaves compound, consisting of 2-8 leaflets . . . . Xylocarpus granatum
  b. Upper leaves simple 2
2.a. Phyllotaxis alternate, leaf apex emarginate. . . . . .Lumnitzera racemosa
  b. Phyllotaxis opposite 3
3.a. Leaf apex acute 4
  b. Leaf apex rounded 6
4.a. Leaves never succulent, underside of leaves greyish, pneumatophores thin, flexible . . . . . . Avicennia marina
  b. Leaves usually succulent, both sides green 5
5.a. Leaves mucronate, large wide-angled stiltroots present . . . . Rhizophora mucronata
  b. Leaves not mucronate, small appressed stilt-roots as well as knee roots present . . . . Bruguiera gymnorrhiza
6.a. Leaves orbicular or oval, often fleshy ; pneumatophores thick, tough . . . . Sonneratia alba
  b. Leaves obovate, leathery, knee roots present . Ceriops tagal

The presence of pneumatophores and/or knee roots is not always an evident character to use in the field for the identification of a single tree, especially in mixed vegetations. The horizontal, subterranean cable roots are generally extremely well developed and may extent for several m from the trunk, possibly encircling species which do not possess this type of aerial roots. On the other hand stilt-roots are not exclusively present in Rhizophora mucronata : in this species they are large, wide-angled and generally looping. In Bruguiera gymnorrhiza they are also present but much thinner and appressed against the base of the tree trunk. In Gazi most of the Avicennia marina specimens on sandy substrate are devoid of stilt-roots, but older ones can develop them the same way as Bruguiera. So do the young trees growing in the muddy substrate around the permanent seawater pools in the depressions between the dunes. Xylocarpus granatum is not well developed in the Gazi mangal. The typical sinuous plank roots are rarely visible.

Presence/absence and dimensions of the viviparous seedlings can also help the identification of the mangroves. Bruguira, Ceriops and Rhizophora develop these propagules, the other genera in Gazi lack them. (see also the descriptions in TOMLINSON (1986)).

An evaluation and discussion of transpiration by Gazi Bay mangroves will be given in GALLIN et al. (1990). Generally speaking Sonneratia, growing closest to low water level has by far the lowest stomatal density and larger stomata (Table 2). Lumnitzera, growing on very dry stands, has the highest stomatal density and smaller stomata. Because of these combined characters Lumnitzera has a better control on the transpiration process than Sonneratia.

3. Use

The ecological and economical importance of mangrove has long been recognized. However, it was only recently that mangrove was given due importance as shown by the increasing number of research results published and/or symposia and workshops held related to mangrove resources and its management.
In mangal high amounts of primary production (8 g organic matter m^{-2} day^{-1} for a Rhizophora mangle stand in Puerto Rico - GOLLEY et al., 1962) are ranged. Mangrove formations are more productive than most marine and terrestrial communities. Moreover, a substantial part of the world fish production depends on mangal ecosystems and local shrimp production is also very significant (SNEDAKER, 1978). This is important for the Gazi fishermen community.
Mangal is considered as a protection zone against erosion (TOMLINSON, 1986) and as a buffer for water pollution. These ecological functions should be taken into account when thinking about cutting down mangal for maricultural or agricultural purposes.
For local economies mangal is useful for the wood. Important genera for wood production are Rhizophora mucronata, Bruguieria gymnorrhiza and Ceriops tagal. In Gazi, not-sawed wood is used for posts. However, some years ago the most useful specimen were cut by a soap factory. Now only big stumps and a lot of small trees remain.
Mangrove wood is exploited on a commercial base in the neighbourhood of Lamu (170 km North of Mombasa). Exploitation of Xylocarpus, which is a Meliaceae genus, provides good timber. On the other hand, the mechanical qualities of Avicennia-wood are not so good, for which reason commercial exploitation is not advantageous. Nevertheless Avicennia marina is considered as good firewood, for it smoulders for a long time. North of Lamu particularly Avicennia is used for firewood, South of Lamu a mixture of Avicennia, and other species (especially Rhizophora, Bruguiera and Ceriops). In the community Gazi rather the coconut shells are used for fuel ; mangrove wood is gathered to light the fire.
Charcoal and wood shavings could also be made from mangrove wood. The bark of Rhizophora, Bruguiera and Ceriops is used for the production of tannin (CHAPMAN, 1976). It can be used to render fishing nets more resistant to water and destructive organisms. However, intensive use of mangrove bark for tanning is now rather replaced by synthetic means.
Sonneratia alba trunks are used for boat building. The large pneumatophores are a good floating material for fishing nets.
Some other uses of rather local relevance can be enumerated : sap of young green Avicennia marina shoots to heal gangrene wounds, ashes of the whole plant for salt extraction, leaves as fodder ; a tincture of Lumnitzera racemosa leaves for mouth infections ; an infusion against diarrhoea is made from the wood of Rhizophora mucronata, a light wine is brewed with the seeds; leaves of Sonneratia alba for fodder.

Whatever the use of mangal should be, it is important that it is based on a management plan which takes into account relevant knowledge about structure and function of the ecosystem.

ACKNOWLEDGMENTS

We are grateful to following persons and institutions for the logistic support : Prof. Ph. Polk (VUBrussel), Mr. Allela, I. Wolfs, E. Martens, ABOS (Administratie voor Belgische Ontwikkelingssamenwerking) and NFWO (Nationaal Fonds voor Wetenschappelijk Onderzoek). Our gratitude also goes to Tom Beeckman and Mie De Wit for the help with the field work and laboratory research and to Walter Peeters for designing figures.

REFERENCES

BEECKMAN, H. (1989). Mathematische verwerking van fytosociologische gegevens. Groene Band 76, 1-36.

BEECKMAN, H. and LEMEUR, R. (1989). Ecology, science of complexity and interactions. Flanders Technology International 1989 Project Sheet Interface RUGent 9.

CHAPMAN, V. J. (1975). Mangrove Vegetation. Cramer Lehre, -425.

CHAPMAN, V. J. (1976). Mangrove Vegetation. Vaduz, J.Cramer,-447.

CHAPMAN, V. J. (1977). Wet coastal ecosystems. Ecosystems of the world 1 Elsevier Scientific Publishing Company Amsterdam Oxford New York, -428.

COPPEJANS, E. and BEECKMAN, T. (1989). Caulerpa section Sedoideae (Chlorophyta, Caulerpales) from the Kenyan coast. Nova Hedwigia.49, 381-393.

COPPEJANS, E. and GALLIN E. (1989). Macroalgae associated with the mangrove vegetation of Gazi Bay (Kenya). Bull. Soc. Roy. Bot.Belg.122, 46-60.

DALE, I. R. (1938). Kenya Mangroves. Zeitschrift Weltforstwirtschaft 5, 413-421.

DAVIS, J. H. (1940). The ecology and geological role of mangroves in Florida. Pap. Tortugas Lab. Carnegie Inst. Wash. Publ.517, 305-412.

GALLIN, E., COPPEJANS, E. and BEECKMAN, H. (1989). The Mangrove Vegetation of Gazi Bay (Kenya). Bull. Soc. Roy. Bot. Belg 122.

GALLIN, E., BEECKMAN, H. and LEMEUR, R. (1990). Stomatal resistance and transpiration of mangrove at Gazi Bay (Kenya). Journal of Applied Ecology. in preparation.

GOLLEY, F., ODUM, H. T. and WILSON, R. F. (1962). The structure and reproduction of a Puerto Rican red mangrove forest in May. Ecology 43 (1), 9-19.

HEALD, E. J. (1971). The production of organic detritus in a South Florida estuary. Univ. Miami Sea Grant Progr. Tech. Bull. 6.

ISAAC, W.E. and ISAAC, F.M. (1968). Marine botany of the Kenya coast. 3. General account of the environment, flora and vegetation. Journal East African natural history society national history society museum, 1 (116), 1-47.

JAGER, J.C. and LOOMAN, C.W.N. (1987). Data collection. In : JONGMAN et al. (1987).

JONGMAN, R.H., TER BRAAK, C.J.F. and VAN TONGEREN, O.F.R. (1987). Data-Analysis in community and landscape ecology. Pudoc Wageningen. 300 p.

MACNAE, W. (1968). A general account of the fauna and flora of mangrove swamp and forests in the Indo-West-Pacific Region. Advances marine biology 6, 73-269.

MOORJANI, S. A. (1977). The ecology of marine algae of the Kenya Coast. Ph. Narobi, -285.

ODUM, E. P. (1971). Fundamentals of ecology. Saunders Philadelphia. 571 p.

PAREYN, F. (1983). Anthropogene beïnvloeding en ontwikkeling van het mangrove-ecosysteem in de getijdengebieden van Suriname. Unpublished M. Sc. thesis , -109.

SNEDAKER, S. C. (1978). Mangroves, their value and perpetuation. Nature and Resources 14 (3), 6-13.

TANSLEY, A. G. (1939). The British Islands and their Vegetation. Cambridge University Press Cambridge.

TOMLINSON, P. B. (1986). The botany of mangroves. Cambridge university Press Tropical biology series.

WALTER, H. and STEINER, M. (1936). Die Oekologie der ostafrikanischer Mangrove. Zeitschrift Botanik 30, 65-193.

WATSON, J. G. (1928). Mangrove forests of the Malay Peninsula. Malayan forest Rec. 6, -275.