JB ADAMS

Peat resources in northern Kwazulu-Natal wetlands: Maputaland

P-L. Grundling, H. Mazus and L. Baartman



Research Report Series

South African Wetlands Conservation Programme

Department of Environmental Affairs and Tourism
Pretoria

G.P.-S. 022-9016

Peat resources in northern Kwazulu-Natal wetlands: Maputaland

Project leader: Piet-Louis Grundling

Organization: Council for Geoscience

Address: Council for Geoscience
Private Bag X112
Pretoria
0001
South Africa

Report on a project executed on behalf of the Department of Environmental Affairs and Tourism as part of the *South African Wetlands Conservation Programme*.

This publication should be cited as:

Grundling, P-L., Mazus, H. & L. Baartman, 1998. *Peat resources in northern Kwazulu-Natal wetlands: Maputaland*. Department of Environmental Affairs and Tourism, Pretoria.

Ordering address:

Department of Environmental Affairs and Tourism
Private Bag X447
PRETORIA
0001
South Africa

Disclaimer:

The views presented in this publication are those of the authors and do not necessarily represent those of the Department of Environmental Affairs and Tourism.

ISBN: 0-621-27960-9

INDEX

LIST OF TABLES vii

LIST OF FIGURES viii

ACKNOWLEDGEMENTS xi

MANAGEMENT SUMMARY xii

INTRODUCTION 1

KEY QUESTIONS 4

RESEARCH APPROACH 4

METHODOLOGY 5

PEAT OCCURRENCES IN MAPUTALAND 7

INTRODUCTION 7

STUDY AREA 7

LOCATION, VEGETATION AND GEOMORPHOLOGY 7

PEATLAND OCCURRENCES: DESCRIPTION AND UTILISATION 8

PEATLAND CHARACTERISATION: 8

Peat 8

Basin factor 8

Vegetation 9

Utilisation 9

Ash content 9

C^{14} ages 9

THE IMPLICATION OF C^{14} AND POLLEN-DERIVED PEAT AGES ON THE CHARACTERISATION OF THE PEATLANDS OF THE ZULULAND-MOZAMBIQUE COASTAL PLAIN, SOUTH AFRICA. 40

INTRODUCTION 40

RESULTS AND DISCUSSION: 40

C^{14} ages 40

Exotic pollen ages 40

Accumulation rates 41

Compaction 41

Ecological development 41

Sustainable utilisation 43

CONCLUSION 43

POLLEN ANALYSES OF SOME LATE HOLOCENE PEAT DEPOSITS FROM THE NATAL MIRE COMPLEX, MAPUTALAND. 45

INTRODUCTION 45

POLLEN RESULTS: 45

Majiji Mire 45

Pollen data 45

History of vegetation 47

Mgobezeleni swamp 47

Pollen data 47

History of vegetation 49

Muzi-Oos mire 49

Pollen data 49

History of vegetation 49

Nhlangu peatland 51

Pollen data 51

History of vegetation 51

Mfabeni swamp 51

Pollen data 53

History of vegetation 53

CONCLUSION 55

PLANT SPECIES COMPOSITION IN PEATLANDS IN MAPUTALAND, KWAZULU-NATAL. 56

INTRODUCTION 56

STUDY AREA 56

RESULTS 57

Muzi-Wes Swamp 57

Matitimane Peatland - Cultivated 57

Matitimane Peatland - Uncultivated 57

Nhlangu Peatland 58

Kwa Sonto 612 Peatland 58

Mgobezeleni-Oos 58

Mkuze Swamp 888 58

Mkuze Swamp 906 58

Mfabeni Swamp 59

Nkazana Swamp Forest 59

Vasi Pan Noord 59

Majiji Peatland 59

CONCLUSION 61

THE VARIABILITY IN THE CHARACTERISTICS OF MAJIJI, A PEAT DEPOSIT IN KWAZULU-NATAL, SOUTH AFRICA. 67

INTRODUCTION 67

METHODS 67

CHARACTERISTICS: 67

Physical Characteristics 67

Colour 67

Fibre length 67

Fibre content and humification 74

Physio-chemical Characteristics 74

Ash content 74

Pollen studies 75

Comparison Between Majiji and Lake Mgobezeleni 75

Ash content 75

CONCLUSION 75

TRADITIONAL SUSTAINABLE UTILISATION OF PEAT IN MAPUTALAND, NORTHERN KWAZULU-NATAL, SOUTH AFRICA. 76

INTRODUCTION 76

UTILISATION 76

Horticulture 76

Water 78

Stock farming 78

Biomass 80

Conservation and tourism 83

Commercial exploitation 83

CONCLUSION 85

PEAT FIRE IN THE VASI PAN PEATLAND IN THE MANZENGWENYA PLANTATION, MAPUTALAND, KWAZULU-NATAL. 86

INTRODUCTION 86

LOCATION & GEOMORPHOLOGY 86

RESULTS & DISCUSSION: 86

Geological 86

Drying-out cracks 87

Dry peat layer 90

Peat fire 92

Botanical 92

Plant species composition 92

Young pine invasion 94

Sustainable utilisation 94

CONCLUSION 97

SYNTHESIS 98

EXTENT OF PEAT OCCURRENCES 98

PROXIMATE ANALYSIS AND C^{14} DATING 98

PALYNOLOGY 98

RECOMMENDATIONS 99

CONCLUSION 99

REFERENCES 99

LIST OF TABLES

Table 1: Proximate Analyses Classification 6

Table 2: Basin Factor 9

Table 3: Peatland Characterisation 10

Table 4: Location, species number and environmental attributes of study sites. 60

Table 5: Plant species observed in peatlands in Northern KwaZulu-Natal. 62

LIST OF FIGURES

Fig. 1: Location of studied peatlands in Maputaland. 3

Fig. 2: Russian peat sampler in action. 5

Fig. 3: C^{14} Dating results and accumulation rates for peatlands in the study area. 42

Fig. 4: Pollen accumulation rates for peatlands in the study area. 43

Fig. 5: Rate of peat accumulation, Maputaland, basis of C^{14} dates against depth. 44

Fig. 6: Rate of peat accumulation, Mfabeni, basis of C^{14} dates against depth. 44

Fig. 7: Pollen diagram of Majiji; forest. 46

Fig. 8: Pollen diagram of Majiji; herbs and aquatic plants. 46

Fig. 9: Pollen diagram of Mgobezeleni; forest. 48

Fig. 10: Pollen diagram of Mgobezeleni; aquatic plants. 48

Fig. 11: Pollen diagram of Muzi-Oos; forest. 50

Fig. 12: Pollen diagram of Muzi-Oos; aquatic plants. 50

Fig. 13: Pollen diagram of Nhlangu; forest. 52

Fig. 14: Pollen diagram of Nhlangu; aquatic plants. 52

Fig. 15: Pollen diagram of Mfabeni; forest and dryland plants. 54

Fig. 16: Pollen diagram of Mfabeni; aquatic plants. 54

Fig. 19: Map of sample sites of Majiji. 68

Fig. 20: Map of sample sites of Mgobezeleni. 68

Fig. 21: Majiji stratigraphy: colour. 69

Fig. 22: Majiji stratigraphy: fibre length. 70

Fig. 23: Majiji stratigraphy: fibre content. 71

Fig. 24: Majiji stratigraphy: ash content. 72

Fig. 25: Majiji: pollen diagrams. 73

Fig. 26: Mgobezeleni: ash content. 73

Fig. 27: Raised plots of peat with sweet potatoes. 76

Fig. 28: Raised gardens with bananas and cabbage on the edge of a peatland. 77

Fig. 29: Old raised gardens in centre of peatland with newly raised plots on edge. 77

Fig. 30: A fenced-off well on the edge of a peatland. 78

Fig. 31: A close-up of the well. 79

Fig. 32: Cattle at a well on a peatland with 50 cm of peat. 79

Fig. 33: Harvesting of Typhia rushes. 80

Fig. 34: Phragmites reeds harvested as building material 81

Fig. 35: A common traditional thatched hut with reed walls. 81

Fig. 36: Baskets woven from sedges and reeds at a market near Sodwana Bay. 82

Fig. 37: Carpets woven from grasses and sedges for sale as curios at Sodwana Bay. 82

Fig. 38: The Southern part of the Nhlangu swamp, near Black Rock. 83

Fig. 39: The Muzi lake, near the Mkuze Nature Reserve. 84

Fig. 40: Lake Mgobezeleni near Sodwana Bay. 84

Fig. 41: Erosion caused by the degradation of a wetland near Tembe Elephant Reserve. 85

Fig. 42: Vasi pan: extensive mudcracks cover the surface of the peatland. 87

Fig. 43: Mudcracks are 20 to 50 cm wide and up to 1.0 to 1.5 m in depth. 88

Fig. 44: Trigonal junction points of cracks were found to be dry with wilted suface vegetation. 88

Fig. 45: Mudcracks still visible after the recent peat fire in the Vasi Pan. Note the white ash. 89

Fig. 46: Prominent mudcracks on the still unburned Vasi Pan Noord 89

Fig. 47: Moisture content for Vasi Pan and Vasi Pan Noord 91

Fig. 48: Ash content for Vasi Pan and Vasi Pan Noord. 91

Fig. 49: Burning peat layer: note the smoke out of the mudcrack. 93

Fig. 50: The northern part of the main peatland after extensive rains: note red ash. 93

Fig. 51: Fire spread along mudcracks: note white ash. 94

Fig. 52: Dense stands of young pines on Vasi Pan North. 94

Fig. 53: Invasion of a wetland by young pines, northern boundary of Manzengwenya. 95

Fig. 54: Green growth on the burning peat and ash layer. 96

Fig. 55: A trapped cow. 96

ACKNOWLEDGEMENTS

The authors wish to express their gratitude to:

- the Department of Environmental Affairs and Tourism and the Council for Geoscience for co-funding this project .
- the Natal Parks Board and the KwaZulu Department of Nature Conservation for their logistical support and permission to work in their respective conservation areas, in particular to Jake Alletson, Scotty Kyle, Katherine Hanekom, Andy Blackmore and Peter Goodman.
- the KwaZulu Department of Forestry for permission granted to do research in the Manzengwenya and Mbazwana plantations and to the local tribal authorities of Tembe, Mbila and Mbaso for permission and support to work in their respective areas.
- Mr M Dent is thanked for his assistance in rainfall data produced by the Department of Agricultural Engineering, University of Natal, through a Water Research Commission funded project.
- the Natal Herbarium, National Botanical Institute and Prof. Gordon-Gray at the Beds Herbarium at the University of Natal, Pietermaritzburg, for their assistance in plant identification
- Dr. J.C. Vogel of the CSIR for his support and advice on the radiocarbon dating.
- the support personnel of the Council for Geoscience: Simon Molefe in the field, Martha Vuma in the laboratory and Nicky McIlrae and especially Beth Broekaert for all the very important odd jobs.
- Mrs A.T. Grundling and Mr G Baartman - their support and enthusiasm were most appreciated.

MANAGEMENT SUMMARY

The objectives of this project were to map, characterise and document the peat resources of Maputaland in terms of:
- description of peat types,
- proximate analysis, energy content & C^{14} dating,
- peat-forming flora and contained pollen.

Peat is a natural organic resource presently being deposited in certain wetlands in South Africa. It forms an active part of the filter and storage capabilities of wetlands and plays a vital role, in the daily lives of local communities, as a water and horticultural resource. Peat is formed when decaying organic matter accumulates in moist, reducing and low energy environments, as in swamps.

The research was conducted in Maputaland, northern KwaZulu-Natal. This region was chosen as it hosts the most extensive wetlands and best developed peat deposits in South Africa. It is an underdeveloped region and rates as a RDP priority in terms of determining natural resources and has an apparent potential for peat mining.

Maputaland is part of the southern area of the Mozambique Coastal Plain (MCP), and is an area of high bio-diversity. It has a high concentration of endemic species, and has been classed as typical southern African Coastal Bushveld/Grassland Biome.

The Holocene peat deposits of Maputaland on the MCP are controlled by the underlying coastal dune topography of late Pleistocene age. This results in elongated peat bodies being deposited in interdune valleys, which parallel the current coastline. Wetlands are mainly ground water fed, with perched aquifers within the dunes draining to the interdune valley floors. Previous research by the Council for Geoscience (CGS) showed that peatlands occur in areas where the rainfall exceeds 600 mm/year and at elevations between sea level and 50 m above mean sea level.

266 peatlands occur within the MCP. Their thickness varies from 0.5 to 10 m and wetlands vary in size from a few hectares up to 8 800 ha. The peat resource is inferred to be 158 million m^3 moist peat and it comprises 60% of South Africa's peat. Present estimates of peat volumes are as much as 30 - 50 % lower than previously reported.

More than 70 % of Maputaland's peatlands are located in proclaimed conservation areas. Most peatlands outside and even some inside conservation areas are utilised by local inhabitants as a water, horticultural and biomass resource. Peat forms an active part of wetlands. In turn wetlands are an important source of fresh water, fodder and biomass for the local communities.

Uncontrolled commercial and domestic afforestation poses a threat to peatlands by disturbing the ecological balance. The manifestation of this disturbance is the drying out of wetland areas, which has a direct result on the viability of peat accummulation and preservation.

The physical characteristics and the ash content found throughout the peatland at Majiji, as well as at Lake Mgobezeleni indicate that in the past significant variations in environmental

conditions did prevail. These variations are ascribed to long-term climatic changes. The observed trends suggest that variations in proximate analyses could be a common feature of all peatlands of the MCP. The conclusion drawn is that if too little sampling is done on a individual peatland, this could result in incorrect resource estimations and inaccurate classification of the commodity.

More than 50 % of the peatlands have a high ash content (more than 30 %), about 30 % have a medium content (15 - 30 %) and 15 % a low content. (les than 15 %) . This implies that the bulk of Maputaland peat has a low calorific value when compared to the low ash peats exploited in the Northern Hemisphere. Thus, compared to wood, South African peat does not really represent an alternative energy resource. This is especially true as Maputaland has an abundance of indigenous and exotic wood (woodlots).

Twenty-eight C^{14} ages at various depths have been determined for a selection of these peatlands. Maximum ages for individual peatlands vary from 770 years before present (BP) for the Mseleni peatland to 45 000 years BP for the Mfabeni peatland. Linear curves of depth v/s time for Mfabeni and Maputaland do not indicate compaction. Average accumulation rates for Maputaland and Mfabeni over the past 7 000 and 45 000 years are 1.06 and 0.45 mm/year respectively. If it is accepted that these two values are representative of the range of accumulation rates, a Maputaland peat layer of a certain depth can be dated roughly.

The linear curves of depth v/s time for Mfabeni indicate a clear break point at 10 000 years, which corresponds with the Holocene-Pleistocene boundary. This also corresponds with a sandy peat layer of 4 - 5 m, indicating a higher energy flow during the development of this wetland.

Botanical studies on twelve selected sites indicate that peat-forming flora tends to be mono-specific. No uniformity exists in the vegetation cover of the selected peatlands and each site exhibits its own character. The most common peat-forming species are reed and/or papyrus with bulrush, sedges and ferns, swamp forest, grasses and sedges, mangroves and raffia palms. No endemics were noted on the peatlands. Papyrus/reed/sedge peatlands comprise 55 %, swamp forests 30 % and grass/sedge mires only about 15 % of the peatlands of Maputaland.

The pollen-based generation rates vary from 0.26 - 18.5 mm/year and compare relatively well with the minimum and maximum C^{14} accumulation rates of 0.22 and 6.54 mm/year. These rates differ significantly with previously indicated current accumulation rates (Smuts, 1992).This current finding on accumulation rates implies that the renewable resource potential of the Maputaland peatlands is negligible.

Pollen and spores of the examined profiles indicate that at the beginning of the Holocene hydromorphous forests existed and expanded in Maputaland. The forests were composed of *Podocarpus, Celtis, Olea, Syzigium, Myrica* and other trees and shrubs. These forests attained their maximum expansion about 5 000 BP. Since then the forests retreated northwards out of the area.The retreat of the forests possibly corresponds with climatic and hydrological fluctuations in the coastal region. The pollen data of the Mfabeni peatland show that a similar, hydromorphous forest occupied the area in the Pleistocene, about 43 000 BP. Forest retreats are noted in the dry and cold climatic phase between 33 000 and 20 800 BP.

The assemblages of pollen and spores of peat-forming plants in the examined profiles show successions from open water conditions through reed/sedge vegetation to swamp forest (Mazus, 1997).

The following management guidelines are recommended:

- Conservation and management of sensitive peatlands (swamp forests and raffia peatlands), by:
  - prohibiting commercial exploitation of peat,
  - controlling commercial and domestic afforestation around wetlands,
- Establishment of functional working/liaison committees between local communities, conservation bodies, forestry and agriculture, to:
  - establish the need of local communities to utilise peatlands (cost benefit analyses),
  - educate in wise and careful peatland utilisation and alternative horticultural practices, e.g. trench method and composting,
  - put conservation and tourism principles into practice to benefit local communities, and in doing so relieve pressure on the wetlands.
- Establishment of:
  - research on alternatives for peat (bulk composting of organic material, e.g. bagasse and sawdust)
  - detailed peatland research in order to understand these wetlands better (e.g. the Mfabeni peatlands)
  - research on the regional distribution of other peatland resource areas, like the Highveld and Escarpment

The peat in South Africa occurs in ecologically sensitive wetland areas. Peat as a resource for clean drinking water is probably much more important than any of the other uses, especially in remote rural parts. Its value, in terms of commercial exploitation, must be weighed up against the value of permanent and clean water.

INTRODUCTION

The peat resources associated with the wetlands of northern KwaZulu-Natal (Maputaland) were investigated by the South African Council for Geoscience (CGS) for the Department of Environment Affairs and Tourism (DEAT) under contract as a joint project between the two organizations (contract A25/13/4/2/6). The work under discussion represents the first phase of DEAT's effort to cover all the areas in KwaZulu-Natal where peatlands may be present and was conducted during the period June 1995 to March 1997. Following the first phase, peat investigations are planned along the KwaZulu-Natal North and South Coast as well as in the Drakensberg highlands. These following projects still have to be formulated and fall outside the scope of the present investigation.

Since 1989 the Council has been actively involved in the mapping and characterization of peat resources of northern KwaZulu-Natal. The peatland survey at that time formed part of the Department of Mineral and Energy's energy evaluation of the country. It was, however, soon realised by the Council, at that time still the Geological Survey of South Africa, that the limited extent of our peat resources and the ecologically sensitive nature of the peatlands did not warrant the exploitation of the peat as an energy resource. A sound understanding of the factors influencing the accumulation and preservation of peat deposits has been developed by this initial research. Good relationships have been established with tribal authorities in KwaZulu-Natal, the Natal Parks Board and the KwaZulu Department of Nature Conservation.

Peat is composed of humified organic matter, which, as a biofuel, has characteristics that lie between wood and lignite. If dried, peat is a combustible material, which may be used for fuel and which can ignite spontaneously. Peat is associated with wetlands, but not all wetlands contain peat. It is utilized in horticulture as a growing medium for flowers, vegetables and for mushroom cultivation and represents a sustainable source of potable water.

In Maputaland peatlands are under pressure as:

- local communities invade peatlands to plant vegetable gardens,
- peat represents a mineable commodity for which there is a growing demand in horticulture, especially in the mushroom industry,
- peatlands are encroached by plantations (forestry & cane) and
- conservation authorities and local communities regularly burn the veld to manage grassland types for the herbivore population (domestic and wildlife).

Environmentally the consequence of these activities affects the hydrology of the associated wetland and thus impacts on the availability of a clean and sustainable source of fresh water. As the destruction of a peatland is usually irreversible, a better understanding of the extent of this natural resource, its effect on the ecosystem (hydrology) and the sensitivity of peatlands to present-day pressures, is essential for the preservation of peatlands.

At present peat is not protected under the Minerals Act (No. 50 of 1991) and there is a danger of uncontrolled exploitation. Peat is, however, protected under the Agriculture Act (No. 43 of 1983); which is administered by the Resource Conservation Division of the Department of Agriculture.

Under Recommendation 6.1 of the 6th Conference of the Contracting Parties of the Convention on Wetlands of International Importance, especially as a Waterfowl Habitat (Ramsar 1971), South Africa has an obligation to maintain an inventory of its peatlands. It must also evaluate and manage them according to guidelines to be drawn up and support research programmes on the functioning of peatlands, as well as the restoration of degrading peatlands. In the planning of this project the Ramsar obligation has been one of the motivating factors.

As peatlands are part of larger systems and do play a significant role in wetlands, this project is specifically designed to catalogue, map (1:50 000 and 1:250 000 scale) and characterise peatlands in Maputaland. Characterisation of the peatlands is in terms of size, thickness of peat, peat type, proximate analysis (to gauge the unit energy content of the peat), peat accumulation processes and surrounding wetland flora, C^{14} dating and contained pollen study (for palaeoclimatology and accumulation rates). This research is complemented by existing data from the Council's database. Recommendations on the viability of peat exploitation, as well as how best to manage and conserve the resource, are based on the resutls of this study. Proposals are made on alternatives to peat in the farming industry.

The study area, Maputaland, is situated on the coastal plain of northern KwaZulu-Natal. Here the best developed peatlands in South Africa are found. Peat accumulation is controlled by a high rainfall and low relief. The wetlands containing the peat have formed within valleys of a palaeo-dune landscape and are the result of a very shallow water table.

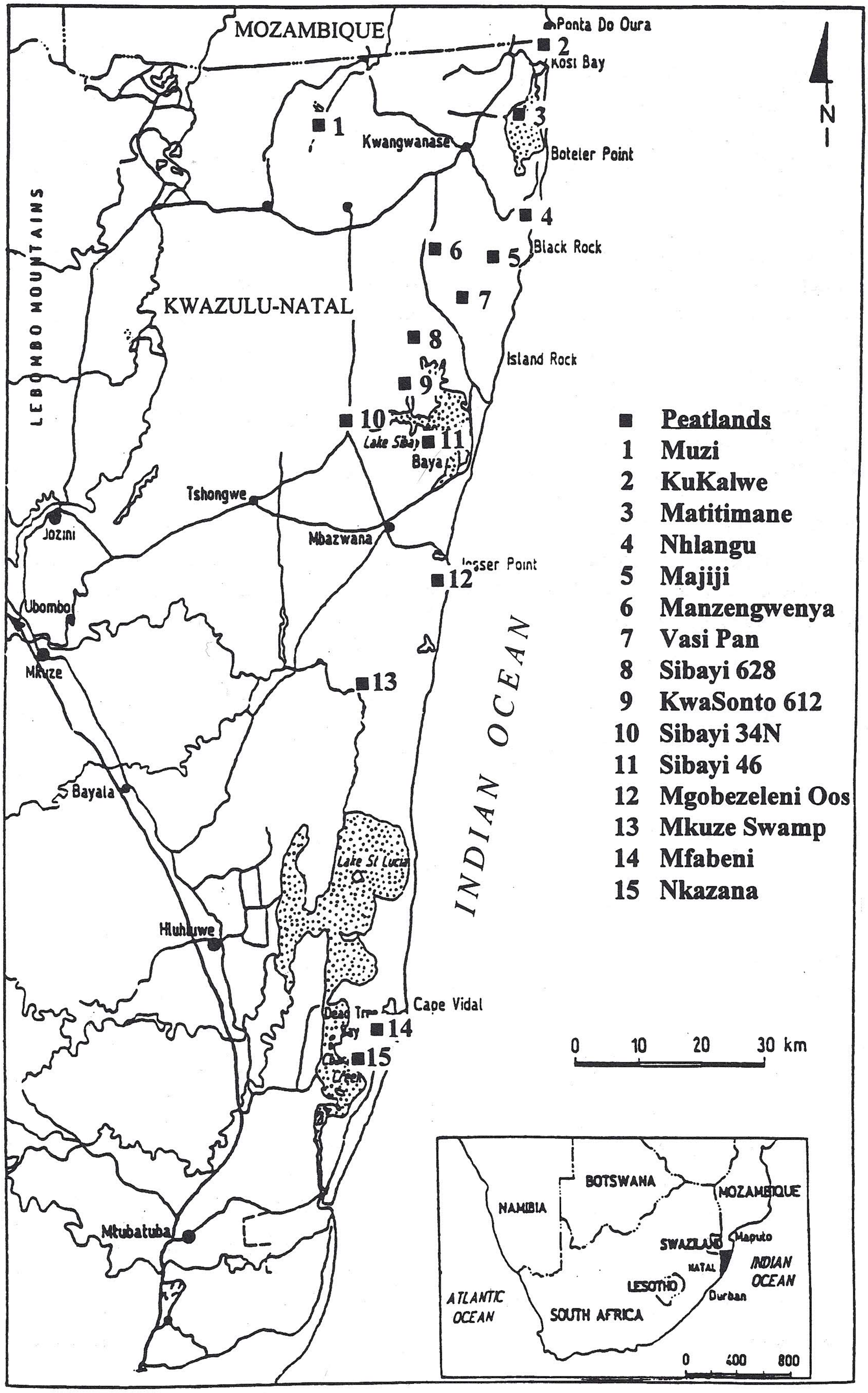


Fig. 1: Location of studied peatlands in Maputaland.

KEY QUESTIONS

Peatlands only cover a very small portion of South Africa's surface. They play an important part in the hydrological cycle of affected areas, especially as far as the supply of fresh water is concerned. With the decline of the South African Rand against the currencies of the country's trading partners there is a growing demand by horticulture (mainly by the nursery and mushroom industries) to procure its peat requirements from local sources.

The growing population of South Africa is impacting negatively on wetlands and the contained peatlands. In urban areas wetlands are drained to create space for industries, schools and infrastructure, as well as for the mining of peat. In tribal and conservation areas this trend is manifested by the rapidly increasing practice of in situ gardening on peat. Organised agriculture (e.g. sugar cane), forestry practices and woodlots pose a threat to peatland in rural areas. These practices may lead to prolonged damage of the wetlands, due to the lowering of the watertable.

South African peatlands are at present still poorly studied as far as:

- their accumulation rates
- their flora
- and the impact of exploitation

  is concerned.

Under the Ramsar Convention South Africa has an obligation to:

- maintain an inventory of its peatlands.
- valuate and manage its peatlands according to guidelines to be drawn up.
- support research programmes on peatland functioning and restoration of degrading peatlands.

.

RESEARCH APPROACH

The research approach for this project is to answer the abovementioned issues by mapping, characterisation and documentation of the peat resource of Maputaland in terms of:

- areal extent of the individual peatland.
- thickness of the peatbed.
- proximate analysis of the peat in order to determine the energy content of the peat.
- carbon dating of the peat in order to establish the age of the deposit as well as accumulation rates.
- identification of the contained pollen, in order to determine the palaeo flora and by pinpointing the first appearance of pollens from exotic species in a profile, to obtain an idea of recent accumulation rates.
- identification of the present-day peat forming flora.

METHODOLOGY

On a regional scale peatlands were identified with the aid of 1:50 000 maps and aerial photographs. Parameters used in the elimination of less prospective areas have been the recognition of the 50m amsl contour (above which experience has shown that peat formation is infrequent), areas with less than 800mm rain per annum (with a few exeptions) and areas where there is an obvious oversupply of clastic material.

Peat is cored with the aid of a Russian Peat Sampler (Fig. 2). This device allows the collection of samples from the top to the bottom of the peat bed. The accuracy with which a sample can be pinpointed in the profile is of the order of a decimeter. Each core increment is inspected in the field and sub-sampled. Samples are described in the field according to colour, moisture content (qualitative), fibre length and content and compared with the Von Post humification scale. Samples are then placed into labelled 120 ml plastic bottles and sealed with airtight caps. For each peatland the main surface floral species and the maximum thickness of the peat at each sample site are recorded.



Fig. 2: Russian peat sampler in action

The following analyses are subsequently carried out in the laboratory:

- calorific value (MJ/kg) (air-dried samples),
- proximate analysis i.e. moisture, ash, fixed carbon, and volatile matter (air-dried samples),
- pollen/botanical analysis (on selected samples), and
- C^{14} age determinations (on selected samples),

Moisture, ash content and pollen analyses are determined in the Pretoria laboratories of the CGS. Calorific value, proximate analyses and C^{14} age determinations are determined at the CSIR in Pretoria. Laboratory moisture analysis is based on weight loss after 12 hours at 105°C in an Optolab Term-o-mat 321 oven. Ashing is conducted at 815°C for 3 hours in open ceramic crucibles in a Carbolite CSF furnace. This laboratory procedure has been described in detail by Smuts (1992).

Pollen analysis is according to the method of Faegri & Iversen (1989). Sample preparation for pollen analysis consists of boiling the sample in 10% KOH, followed by mineral separation in $ZnBr_2$. Microscope slides of the treated peat are mounted in glycerine jelly and microscopically compared with known specimens for identification and classification. Pollen/botanical analysis and C^{14} age determinations were only carried out on selected samples due to the high cost of and the time-intensive nature of these analyses.

During the late 1980's and early 1990's proximate analyses were conducted on more than 200 peat samples as part of an energy potential evaluation of the peat. Subsequent to the realisation that the energy application of South African peat was limited, only moisture and ash contents were determined. However based on, the original proximate analysis a relationship between calorific value and ash content was established for the Maputaland peats (Table 1).

***Table 1: Proximate analyses classification**

Classifi-cation: Ash	Ash Content (%)	Moisture Content (%)	Calorific Value (MJ/kg)	Volatiles (%)	H_20 (%)	Fixed Carbon (%)
Low	< 15	78	18	47	14	29
Medium	15 - 30	75	16	48	11	23
High	30 - 50	64	12	34	8	16
Inorganic	> 50	50	6	22	5	11

* adapted from Grundling, 1994

PEAT OCCURRENCES IN MAPUTALAND

INTRODUCTION

During the investigation most of the wetlands in the study area were covered. Close to 2 000 sites were visited. Wetlands were chosen according to topographical position and annual rainfall (see methodology).

STUDY AREA

For the first phase of this research project (subject of this report), Maputaland was selected as research area as:

- it contains the most extensive wetlands which in turn host the best developed peat deposits in KwaZulu-Natal (and for that matter in South Africa). Wetlands range in size from a few hectares to 8 800 ha. Some 266 peatlands are known. In these, the thickness of peat ranges between 0.5 and 10 m. Some 60% of South Africa's estimated peat resource is located here (Smuts, 1992, Grundling, 1994).
- Maputaland is an underdeveloped area and rates as a RDP priority in as far as the determination of natural resources is concerned.
- there exists an apparent potential for peat mining in the area (Department of Mineral and Energy Affairs Report No. EO9417).

Areas not covered in detail are:
- the Dukuduku State Forest south of the tarred road between Mtubatuba and St. Lucia, due to political instability and violence, and
- the northern part of the Tewati Wilderness area near Cape Vidal and the Mkuze Swamps, due to inaccessibility.

LOCATION, VEGETATION AND GEOMORPHOLOGY

The study area is situated in Maputaland, on the northern KwaZulu-Natal and is confined by the RSA-Mozambique boundary in the north, the Indian Ocean in the east, the Mfolozi River in the south and the Lebombo Mountains in the west. It forms part of the greater Mozambique Coastal Plain (MCP). The area has a high bio-diversity with a dominant proportion of endemic species (Taylor, 1991). It is situated mostly within the Coastal Bushveld/Grassland Biome of Southern Africa (Low and Rebelo, 1996).

The Holocene peat deposits of Maputaland and the greater MCP are controlled by:

- low energy conditions, the result of a low topography (generally less than 50 m above mean sea level).
- the high rainfall (+800 mm pa) resulting in a copious perennial water supply and a consequent oversupply of biomass.
- the topography of the underlying Pleistocene *KwaBonambi coastal dunes. This dune topography results in elongated interdune valleys, usually orientated parallel to the present coastline. In these valleys peat deposits (belonging to the *Sibayi Formation) may form.

(* - These stratigraphical names have not yet been approved by South African Committee of Stratigraphy (SACS))

The peatlands and enclosing wetlands are groundwater fed. Perched aquifers within the sand dunes are a prominent source of water for the wetlands.

PEATLAND OCCURRENCES: DESCRIPTION AND UTILISATION

Maputaland peatlands vary in size from a few hectares up to thousands of hectares and about 266 peatlands occur within the Mozambique coastal plain in Maputaland. Peat thickness varies from 0.5 to 10 m. The Mkuze Swamp, about 8 800 ha in size, is the largest wetland containing peat with a maximum thickness of 6 m and the Mfabeni peatland has the thickest peat with a maximum thickness of 10 m (Table 3).

Resource estimation is on an inferred level, based on the area of the wetland containing the peat and mostly only on one auger hole per wetland. The reason for this is that this project was executed on a regional level due to the vastness of the area. The estimated profile shape of the wetland basin was also taken into account (Table 2 & 3). The peat reserves are inferred at 158 million m^3 moist peat and this is considerably less than the previously quoted figures of Smuts, 1992 and Smuts and Kirstein, 1995. Less than 10 % of the peatlands have an ash content less than 15 %, more than halve has an ash content of more than 30 %, and for a third the ash content varies between 15 and 30 %. Maximum ages for individual peatlands vary from 770 years before present (BP) for the Mseleni peatland to 45 000 years BP for the Mfabeni peatland.

Genetically two types of peat can be distinguished on the basis of causative vegetation, namely the papyrus-reed-sedge fen, grass-sedge fen and the swamp forest type. Papyrus-reed-sedge peatlands comprise 55 %, swamp forests 30 % and grass-sedge peatlands only about 15 % of the peatlands. More than 70 % of the peatlands are located in proclaimed conservation areas. Peatlands outside and even inside conservation areas are utilised by local inhabitants as a water, horticultural and biomass resource.

PEATLAND CHARACTERISATION

The individual Maputaland peatlands are described in this chapter in table form (Table 3). The following aspects as are covered in this table:

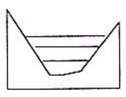
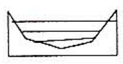
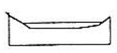
Peat

Peatland thickness is based on mostly one sample site per peatland. The peatland area and peat volume is based on the wetland area in which the peat occurs. The symbol # refers to for example: # 570 - The area or volume of a part of a peatland that forms part of the total peatland area or volume of (for example) peatland number 570.

Basin factor

A factor given to take the shape of a basin into account, when estimating the volume (m^3) of a peatland based on the area and one or a restricted number of peat thicknesses. For example: an interdune basin with very steep slopes will have a smaller factor (1/2) than a shallow basin with shallow slopes (3/4):

Table 2: Basin Factor

Basin Shape	**Peat-**	**Basin Factor**	**Formula:** $A \times t \times BF = m^3$ **A = area; t = thickness**
Deep Basin: basin with very steep, high slopes/dunes		1/2	$A \times t \times 1/2 = 1/2\ m^3$
- *Medium Depth Basin:* basin with steep, high slopes/dunes		2/3	$A \times t \times 2/3 = 2/3\ m^3$
- *Shallow Basin*: basin with shallow slopes/dunes		3/4	$A \times t \times 3/4 = 3/4\ m^3$
- *Very Shallow Basin*: Relative height and slope of slopes/ dunes meaningless in terms of the extent of the width of the basin		1	$A \times t \times 1 = 1 m^3$

Vegetation

The main vegetation types covering peatlands are mentioned. The vegetation is described in more detail later in this document (page ...)

R - Phragmites Reeds
P - Papyrus
S - Sedges
G - Grasses
SF - Swamp Forest (etc. *Syzigium cordatum*, Ficus sp)
B - Bulrush (*Typhia capensis*)
V - Ferns

Utilisation

Various activities are exercised on the peatlands, from subsistence farming to tourism activities in conservation areas. The term biomass refers to the application of the contained biomass in the wetland utilised by man, e.g. reeds for building material and beast, e.g. fodder. The traditional utilisation is described in more detail later in this document (page ...)

Ash Content

See Table 1 for the classification of the ash content into low, medium and high. N/A indicates that the ash content is not available.

C^{14} ages

C^{14} ages at various depths have been determined for a selection of peatlands.

Table 3: Peatland Characterisation.

Peatland Name/No	Position	Peat Thick-ness (m)	Wetland Utilisa-tion	Vega-tation Cover	Area (ha)	Basin Fac-tor	Volume (m^3)	Maximum Known Age (BP)	Ash Content (%)	Elevation (a.s.l) (m)	Comments
Muzi-Oos 31	S26°55'54" E32°36'05"	0.80	Gardens, water	R/S	#570	3/4	#570		High-medium	45	
Muzi-Oos 564	S26°55'24" E32°36'05"	Org Sand	Gardens, water	R/S	-	-	-		High	40	Organic Sand
Muzi-Oos 50	S26°54'50" E32°36'	3.50	Biomass, gardens, water	R/S	900	3/4	1 957.5	4 200 ± 50	N/A	40	
Muzi-Oos Drif 54	S26°53'30" E32°35'45"	Sand	Gardens, water	R/S	-	-	-		High	30	Sand
Muzi-Oos 569	S26°56'00" E32°35'45"	1.40	Gardens, water	G/S						45	
Muzi-Oos 104	S26°53'11" E32°36'02"	2.70	Biomass, water	R/S	80	2/3	144		High	30	
Muzi-Oos 570	S26°56'03" E32°35'57"	1.00	Gardens, water	R/S	300	3/4	225		N/A	45	
Muzi-Oos 572	S26°56'26" E32°36'09"	2.00	Gardens, water	R/S	600	2/3	720		N/A	50	

Muzi-Oos 573	S26°56'47" E32°36'28"	1.50	Gardens, water	R/S	#572	2/3	#572		N/A	50	
Muzi-Oos 574	S26°57' E32°36'30"	1.90	Gardens, water	R/S	#572	2/3	#572		N/A	50	
MUZI-OOS TOTAL							3 046.5				
Muzi-Oos-Trib. 568	S26°55'55" E32°35'08"	0.70	Water	R/S	10	3/4	0.525		N/A	45	
Muzi-Noord 106	S26°52'52" E32°36'21"	1.70	Gardens, water	R/S	140	1	238		N/A	30	
Muzi-Noord 108	S26°52'16" E32°37'04"	1.20	Gardens, water	R/S	200	3/4	180		Medium	30	
Muzi-Noord 193	S26°52'09" E32°37'41"	2.30	Gardens, water	R/S	260	3/4	448		High-me-dium-high	30	
Muzi-Wes 119	S27°01'55" E32°29'45"	3.20	Gardens, water	R/S	30	2/3	64		High	30	Organic Sand/Clay
Lukwakwani 85	S27°04'30" E32°31'05"	1.85	Gardens, water	G/S	50	3/4	69		N/A	55	

Mloli 183	S26°54'01" E32°37'29"	2.10	Gardens, water	SF	80	3/4	111		N/A	30	
Mloli 182	S26°53'48" E32°37'28"	1.60	Gardens, water	SF	#183	3/4	#183		N/A	30	
Mloli-Oos 180	S26°54'07" E32°37'51"	1.80	Gardens, water	SF	80	3/4	111		N/A	40	
Gazini 171	S26°52'30" E32°38'36"	2.00	Gardens, water	SF	100	3/4	150		N/A	45	
Cele 279	S26°52'11" E32°46'14"	0.40	Gardens, water	SF	#293	3/4	#293		N/A	35	
Cele 293	S26°52'23" E32°46'25"	0.70	Gardens, water	SF	150	3/4	79		N/A	35	
Cele 281	S26°52'18" E32°46'33	Sand	Gardens, water	SF	-	-	-		High	35	Sand
Cele 280	S26°51'52" E32°46'52	1.00	Gardens, water	SF	#293	-	#293		Medium	35	
Ndlovu 294	S26°52'23" E32°45'45"	2.00	Gardens, water	SF	50	3/4	75		N/A	40	
KuNkanini 222	S26°56'58" E32°46'41"	0.80	Gardens, water	SF	80	2/3	43		N/A	20	

Enkathweni Wes 250	S27°00'07" E32°45'29"	1.80	Gardens, water	SF	40	2/3	48		Medium	30	
Enkathweni Oos 261	S27°00'34" E32°46'30"	1.60	Gardens, water	SF	30	3/4	36		N/A	30	
Sileza 461	S27°07'41" E32°34'55"	1.30	Water	R/S	75	3/4	73		N/A	75	
Majiji(58) 346	S27°08'06" E32°40'	3.40	Gardens, water	S/G	40	2/3	85	2 140 ± 70	Low-medium	70	
Ntombeni (16) 477	S27°06'04" E32°39'18"	0.50	Water	S/G	60	3/4	22		N/A	70	
Ntombeni (16) 388	S27°06'10" E32°39'20"	0.50	Water	S/G	730	1	-		High	70	Organic Sand
Ntombeni (16) 375	S27°06'22" E32°39'23"	0.20	Water	S/G	#388	1	-		High	70	Organic Sand
Mahashe 478	S27°05'51" E32°39'43"	2.60	Water	S/G/P	150	2/3	260		Low-high	70	
Mvelabusha Noord 484	S27°05'30" E32°41'50"	0.80	Gardens, water	SF	310	2/3	207		N/A	55	
Mvelabusha Noord 485	S27°06'58" E32°42'33"	1.20	Gardens, water	SF	#484	2/3	#484		High	55	

Siyadla 486	S27°07'15" E32°42'	1.20	Gardens, water	SF	45	1	54		N/A	40	
Siyadla 503	S27°05'18" E32°44'34"	1.00	Gardens, water	SF	630	1/2	347		N/A	35	
Siyadla 495	S27°07'55" E32°44'07"	1.20	Gardens, water	SF	#503	1/2	#503		Medium-High	35	
Mvelabusha Sentr 366	S27°07'58" E32°42'05"	2.30	Gardens, water	SF	120	1	276		Low	45	Name: Man-zengwenya
Mvelabusha Sentr 393	S27°08'52" E32°42'41"	0.50	Gardens, water	SF	200	1	100		N/A	50	
Mvelabusha West 397	S27°08'41" E32°43'23"	0.80	Gardens,	G/S	120	1	96		N/A	45	Organic Sand
Mvelabusha West 398	S27°09'32" E32°43'20"	1.20	Gardens, water	SF	60 000	1	72		N/A	50	
Vasi-Noord 425	S27°10'35" E32°42'59"	3.40	Planta-tion	G/S	49	2/3	111		Low	55	
Vasi 424	S27°11'22" E32°42'05"	3.40	Planta-tion	G/S SF?	#422	2/3	#422		Medium-high	55	
Vasi 423	S27°11'22" E32°42'15"	1.50	Planta-tion	G/S	#422	2/3	#422		# 424-1	55	Ash: see 424-3

Vasi 422	S27°11'22" E32°42'20"	2.50	Planta-tion	G/S	2 100	2/3	3 453		Medium-high	55	
Vasi 1231	S27°11'56" E32°41'51"	3.80	Gardens, water	G/S/RSF?	#422	2/3	#422		# 424-1	55	Ash: see 424-1
KuMzingwane 446	S27°14'33" E32°41'01"	0.60	Gardens, water	SF	#637	1/2	#637		High	35	
Tsongwe-Muzi 1676	S27°27'45" E32°24'50"	0.50	Gardens, water	R/S	-	-	-		High	50	Organic sand
Muzi-Suid 1275	S27°34'15" E32°24'37"	0.85	Gardens, Biomass	R/S	2 400	2/3	1 360		High	20	Organic Sand
SILEZA Sileza 461	S27°07'40" E32°34'58"	1.30	Gardens	G						70	
Sileza 554	S27°07'43" E32°36'	3.00	Conser-vation	G/S	75	3/4	169		N/A	70	
Sileza 555	S27°08'50" E32°35'55"	0.50	Conser-vation	G/S	-	-	-		N/A	70	Organic Sand

TEMBE ELEPHANT PARK											
Muzi-Wes 79	S26°53'07" E32°35'	3.10	Biomass, Conser-vation	R/S	180	2/3	372		Medium-high	35	
Muzi-Wes 76	S26°54'35" E32°33'15"	2.00	Biomass	R/S	825	2/3	110		High	35	
Muzi-Wes 117	S26°58'25" E32°30'47"	2.80	Biomass	R/S	1 060	2/3	1979		Medium	30	
Muzi-Wes 118	S26°59'59" E32°30'08"	3.50	Biomass	R/S	800	2/3	1867		N/A	30	Ash: see # 117
Muzi-Wes 116	S27°01' E32°29'57"	1.85	Biomass	R/S	180	2/3	153		High	50	
MUZI-WES TOTAL							**4 481**				
MAPUTA LAND COASTAL RESERVE											
KuKalwe 317	S26°52'45" E32°50'30"	3.60	Gardens, water,	SF	110	1/2	217		Low-medium	5	

KuKalwe 318	S26°53'19" E32°50'33"	4.30	Gardens, water,	SF	#317	1/2	#317	4 640 ± 60	Medium	5	
Ngweve 319	S26°53' E32°51'23"	4.70	Gardens, water	SF?	30	1/2	70		High	10	
Kosibaai 288	S26°53'25" E32°51'53"	0.50	Conser-vation	SF	-	-	-		High	15	Organic Sand
Kosibaai 289	S26°52'30" E32°52'40"	1.50	Conser-vation	R/S	70	1/2	52		N/A	15	
Kosibaai 287	S26°53'50" E32°51'50"	0.50	Conser-vation	S/G	-	-	-		High	15	Organic Sand
Mtando 321	S26°56'48" E32°50'23"	0.50	Conser-vation	SF	80	1	40		N/A	10	
Apiesdraai 462	S26°57'13" E32°49'45"	1.00	Water	SF	40	3/4	30		High	20	
Matitimane 244	S26°57'10" E32°48'56"	6.10	Gardens, Water	SF	260	2/3	832		N/A	15	
Matitimane 233	S26°57'30" E32°49'00"	3.50	Gardens, Water	SF	#244	3/4	#244		N/A	15	
Swamanzi-trib.228	S26°57'35" E32°47'55"	0.40	Gardens, Water,	SF	#240	1/2	#240		N/A	15	

Swamanzi-trib.236	S26°57'48" E32°48'	3.25	Conser-vation	SF	#240	1/2	#240		N/A	15	
Swamanzi-trib.240	S26°58'03" E32°48'05"	1.50	Conser-vation	SF	50	1/2	43		N/A	15	
Swamanzi 241	S26°58'10" E32°48'10"	1.65	Conser-vation	SF	35	2/3	38		N/A	15	
Raffia Woud 327	S27°00'10" E32°48'40"	1.30	Biomass	Raffia Palms	200	3/4	195		Low	5	
Emyutshini-O 332	S27°00'44" E32°47'25"	4.90	Gardens, water	SF	120	2/3	392		Medium	15	
Emyutshini-W 331	S27°00'49" E32°47'19"	1.50	Gardens, water	S/G	20	3/4	23		N/A	30	
KuShengeza 518	S27°01'25" E32°47'	0.90	Gardens, water	R/S	80	3/4	54		Medium	30	
KuShengeza 521	S27°03'07" E32°46'54"	1.10	Gardens, water	S/G	80	3/4	66		High	30	
Siyadla 522	S27°04'53" E32°47'12"	0.65	Conser-vation	SF	35	2/3	15		Medium-High	15	
Umphimbini-N.wes 590	S27°04'43" E32°48'15"	2.50	Conser-vation	R/S	10	3/4	19		N/A	15	

Umphimbini-wes 589	S27°05'10" E32°48'5"	0.70	Gardens, water	S/G	-	-	-		High	15	Organic Sand
*Umphi*mbini 562	S27°04'42" E32°48'28"	0.70	Conser-vation	R/S	50	1/2	17		High	15	
Umphi. 561	S27°04'55" E32°48'27"	1.00	Conser-vation	R/S	#562	2/3	#562		Medium	15	
Umphi. 559	S27°05'37" E32°48'30"	1.70	Conser-vation	R/S	3	2/3	5		N/A	15	
Umphi. 560	S27°05'47" E32°48'30"	0.80	Conser-vation	R/S	#562	2/3	#562		High	15	Organic Sand
Umphi. 557	S27°05'50" E32°48'29"	0.90	Gardens, water	R/S	#562	2/3	#562		High	15	Organic Sand
Umphi. 556	S27°06'45" E32°48'05"	1.20	Conser-vation	R/S	2.5	1/2	2		N/A	15	
Umphi. 591	S27°04'20" E32°45'15"	0.25	Conser-vation	R/S						15	
UMPHIMBI-NI TOTAL							**24**				
Umphimbini S.Oos 588	S27°06'16" E32°48'20"	3.50	Conser-vation	R/S	80	2/3	187		N/A	15	

Usilahla 592	S27°04'47" E32°48'56"	2.00	Gardens	S/G	20	3/4	30		High	10	
Usilahla 593	S27°04'55" E32°49'33"	5.30	Gardens, water	S/G	30	1/2	79		Low-high	10	
***N*langu *M*ire *C*omplex- NMC: 583	S27°05'40" E32°49'12"	6.30+	Conser-vation	R/S	150	2/3	630		N/A	15	
NMC: 587	S27°05'50" E32°48'46"	5.20	Conser-vation	R/S	25	1/2	65		Medium	15	
NMC: 584	S27°06' E32°49'	2.70	Conser-vation	R/S	60	2/3	108		Medium	15	
NMC: 581	S27°05'55" E32°49'24"	2.35	Conser-vation	R/S	70	1/2	82		Medium	15	
NMC: 586	S27°06'10" E32°49'32"	1.00	Conser-vation	R/S	15	2/3	10		N/A	15	
NMC: 579	S27°06'20" E32°49'34"	4.20	Conser-vation	R/S	20	2/3	57		Medium	15	
NMC: 578	S27°06'22" E32°49'40"	1.50	Conser-vation	R/S	40	2/3	40		N/A	15	

NMC: 577	S27°06'35" E32°49'32"	6.25	Conser-vation	R/S	160	1/2	500		N/A	15	
NMC: Nhlangu 575	S27°06'40" E32°49'05"	8.65+	Biomass, Conser-vation	R/S	400	1/2	1 730	7 000 ± 80	Medium-high	15	
NMC TOTAL							**3 222**				
KuWzndini 526	S27°07'35" E32°47'	2.80	Gardens, water	R/S SF	160	2/3	299		Low-medium	15	Clayey?
Ngxabano-Noord 537	S27°09'15" E32°47'15"	2.40	Water	S/G	80	1/2	96		N/A	30	
Ngxabano-Suid 536	S27°10' E32°46'38"	1.70	Gardens, Water	S/G	85	2/3	96		N/A	30	
Sibayi Mabibi 648	S27°19'16" E32°43'43"	3.20	Gardens	S/P	150	2/3	320		Medium-high	15	
Mabibi 656	S27°19'14" E32°44'05"	1.00	Gardens, water	R/S	360	3/4	270		High	15	Organic Sand
Mabibi 651	S27°18'50" E32°43'55"	1.90	Gardens, water	S/G	20	2/3	25		N/A	15	

Mabibi 653	S27°18'15" E32°44'30"	0.90	Conser-vation	S/G	25	2/3	15		N/A	10	
*Mab*ibi-*w*es 643	S27°18'55" E32°42'	0.50	Conser-vation	S/P	50	3/4	19		N/A	30	
Mab-w. 644	S27°18'40" E32°42'30"	0.60	Conser-vation	S/G	2.5	3/4	1		N/A	30	
Mab-w. 642	S27°18'40" E32°42'20"	2.50	Gardens	R/S/P SF	60	2/3	100		High	30	
Mab-w. 641	S27°18'05" E32°42'	1.40	Gardens, Water	S/G	125	1/2	87		N/A	35	
*KwaMji*ji 639	S27°17'10" E32°41'05"	0.80	Gardens	R/S	10	3/4	6		N/A	20	
KwaMji. 638	S27°16'30" E32°41'08"	1.60	Gardens	R/S/P	80	1/2	64		High	20	
KwaMji. 636	S27°15'35" E32°41'50"	1.00	Gardens	R/S	130	2/3	87		N/A	40	
KuMzin-gwane 637	S27°16'05" E32°40'55"	2.50	Gardens, water	SF	460	1/2	575		N/A	35	
*KwaNsu*kum-bili 635	S27°16'27" E32°40'48"	1.60	Garden, water	R/S/P SF	100	2/3	107		High	20	

KwaNsu. 713	S27°16'27" E32°40'48"	1.80	Conser-vation	P/B	15	2/3	18		N/A	15	
KwaNsu. 634	S27°16'20" E32°40'03"	2.90	Gardens	R/S/P SF	100	2/3	193		High	15	
Velindlovu 628	S27°16'05" E32°39'05"	5.30	Gardens	P	450	1/2	1 192	2 820 ± 45	High	20	
KwaSonto 624	S27°16'15" E32°38'40"	0.70	Gardens, water	R/S	35	2/3	16		High	30	Organic Sand
KwaSonto 629	S27°17'20" E32°38'58"	1.00	Conser-vation	P	30	3/4	22		N/A	30	
KwaSonto 712	S27°17'50" E32°39'30"	2.00	Conser-vation	P	30	2/3	40		High	20	Clayey
KwaSonto 617	S27°19'20" E32°38'40"	1.20	Conser-vation	P	15	2/3	12		High	30	Organic Sand
KwaSonto 612	S27°18'05" E32°37'35"	2.70	Gardens	P/R/S	300	1/2	405		High	30	
KwaSonto 711	S27°19'08" E32°37'	2.15	Conser-vation	B	20	2/3	29		High	20	
KwaSonto 611	S27°19'02" E32°36'04"	0.90	Gardens, water	B/S/P	100	1/2	45		N/A	30	

KwaSonto 600	S27°19'13" E32°35'38"	2.60	Gardens	R/B SF	300	1/2	390		High	30	
Mseleni 599	S27°20'45" E32°34'05"	2.20	Garden	R/S	100	2/3	147		High	20	
Mseleni 597	S27°20'47" E32°33'50"	2.10	Gardens	P/R SF	100	1/2	105		N/A	35	
Mseleni Sib-34	S27°21'06" E32°32'50"	1.50	Gardens, water	SF, P/R/S	1 000	3/4	1 125	770 ± 50	High	15	
Mseleni 709	S27°22' E32°34'04"	0.60	Conser-vation	B	-	-	-		High	30	Organic Sand
Mseleni 708	S27°21'42" E32°34'30"	1.00	Conser-vation	S/B/P	25	3/4	19		N/A	20	
Mseleni 710	S27°21'30" E32°35'	0.50	Conser-vation	S/G	-	-	-		High	20	Organic Sand
Mseleni 707	S27°21'50" E32°35'10"	4.50	Gardens	P/R/S	25	1/2	56		High	20	
KwaMboma 706	S27°21'30" E32°36'35"	1.20	Conser-vation	S/B/P	30	2/3	24		N/A	20	
KwaMboma 705	S27°21'20" E32°36'50"	0.80	Conser-vation	R/P/S/ B	40	3/4	24		N/A	20	

KwaMboma Sib-46	S27°22'30" E32°37'30"	5.50	Conser-vation	P/R/S	150	1/2	412	4 120 ± 60	High	25	
KwaMboma 702	S27°22'20" E32°38'49"	2.45	Conser-vation	P	75	2/3	122		N/A	20	
KwaMboma 701	S27°22'15" E32°39'30"	0.50	Conser-vation	P	-	-	-		High	15	Organic Sand
Mpini Sib-51	S27°24'05" E32°39'05"	1.20	Conser-vation	SF	200	2/3	160		High	25	
KuSibayi 714	S27°23'07" E32°40'09"	4.20	Conser-vation	P	40	2/3	112		Medium-High	15	
KuSibayi Sib-53	S27°23'56" E32°40'45"	0.50	Conser-vation	R/S	10	3/4	4		Medium	15	
KuSibayi Sib-55	S27°23'55" E32°41'05"	1.00	Conser-vation							20	
KuSibayi Sib-56	S27°23'48" E32°41'20"	1.80	Conser-vation	P/S	70	2/3	84		High	15	
KuSibayi Sib-59	S27°25'14" E32°41'05"	1.40	Gardens, water	P/R/S	50	2/3	47		# Sib-60	20	Ash: # Sib 60
KuSibayi Sib-60	S27°25'25" E32°41'02"	1.00	Gardens	P/R/S	40	2/3	27		High	20	

Shazibe Sib-67	S27°29'08" E32°40'08"	1.60	Water	R/S	10	2/3	11		High	15	
Shazibe Sib-68	S27°29'30" E32°40'04"	1.20	Gardens	P/R/S	100	2/3	80		Medium	15	
Shazibe 805	S27°30'48" E32°39'50"	2.85	Water	SF	1 500	1/3	1 425		Low	15	
Siphudwini 1008	S27°30'59" E32°38'00"	0.70	Gardens	S/R	#1008	1/2	#1008		High	15	Organic Sand
Siphudwini 1010	S27°32'08" E32°37'31"	1.60	Conser-vation	SF/S/V /P	375	1/2	412		Low-medium	15	
Siphudwini 1011	S27°32'03" E32°37'38"	3.25	Gardens	SF	#1008	1/2	#1008		Low	15	
Siphudwini 1012	S27°31'51" E32°38'22"	2.10	Gardens	SF	#1008	1/2	#1008		Medium-high	15	

GREATER ST LUCIA WETLAND PARK Water, Biomass Siphudwini 749	S27°33'45" E32°38'12"	2.10	Conser-vation	SF/S	#1008	1/2	#1008		Medium	30	
Mgobezeleni-Oos 785	S27°32'25" E32°39'38"	2.40	Gardens	SF	160	1/2	152	1 100 ± 40	Low-medium	10	
Mgobezeleni-Noord 801	S27°31'13" E32°39'55"	0.40	Water, Biomass, Gardens	G/S	75	3/4	22.5		Medium	10	
Mgobezeleni-Wes 1050	S27°32'05" E32°38'55"	1.50	Water, Biomass, Gardens	G/S	375	1/2	281		Low	10	
Sodwana 803	S27°31'01" E32°40'02"	1.50	Conser-vation	SF	#784	2/3	784		Low	10	
Sodwana 802	S27°31'07" E32°40'06"	1.00	Conser-vation	SF	#784	2/3	#784		Medium	10	
Sodwana 784	S27°32'06" E32°40'15"	1.85	Conser-vation	SF/S/R	700	2/3	910		Low-medium	10	

Sodwana 783	S27°32'35" E32°40'25"	0.70	Conser-vation	SF/S/R	#784	2/3	# 784		Medium	10	
Mbazwana Sib-70	S27°29'45" E32°34'55"	1.35	Gardens, water,	SF	700	2/3	630		Medium	50	
Mbazwana 808	S27°33'42" E32°35'17"	2.10	Conser-vation	SF	450	2/3	630		Low	20	
Mbazwana 816	S27°36'44" E32°33'22"	1.10	Conser-vation	SF	700	2/3	513		High	15	
Mbazwana 1044	S27°34'15" E32°33'28"	4.25	Gardens	SF	250	1/2	531		Medium	30	
Mkuze Swamp 886	S27°38'01" E32°32'38"	3.00	Conser-vation	R/P/S	2 000	3/4	4 500		Low	10	
Mkuze Swamp 887	S27°37'59" E32°32'33"	1.80	Conser-vation	P/R/S	#886	3/4	#886		# 886	10	
Mkuze Swamp 888	S27°37'57" E32°32'33"	2.80	Conser-vation	R/P/S	#886	3/4	#886		# 886	10	
Mkuze Swamp 889	S27°37'58" E32°32'30"	2.60	Conser-vation	R/P/S	#886	3/4	#886		# 886	10	
Mkuze Swamp 890	S27°38'02" E32°32'41"	2.20	Conser-vation	R/S	#886	3/4	#886		# 886	10	

Mkuze Swamp 899	S27°39'24" E32°31'48"	4.60	Conser-vation	P/S	#904	3/4	#904		#904	10	
Mkuze Swamp 900	S27°39'27" E32°32'08"	0.70	Conser-vation	B/S/P	#904	3/4	#904		#904	10	
Mkuze Swamp 901	S27°39'25" E32°32'06"	1.60	Conser-vation	R/P	#904	3/4	#904		#904	10	
Mkuze Swamp 902	S27°39'25" E32°32'02"	2.00	Conser-vation	R/P	#904	3/4	#904		#904	10	
Mkuze Swamp 903	S27°39'24" E32°31'59"	3.80	Conser-vation	R/P/V	#904	3/4	#904		#904	10	
Mkuze Swamp 904	S27°39'25" E32°31'56"	5.90	Conser-vation	R/P/V	6 645	3/4	2 940		Low-medium	10	
Mkuze Swamp 905	S27°39'24" E32°31'52"	4.40	Conser-vation	R/P/V	#904	3/4	#904		#904	10	
Mkuze Swamp 906	S27°39'23" E32°31'48"	4.60	Conser-vation	R/P/V	#904	3/4	#904		#904	10	
Mkuze Swamp 907	S27°39'23" E32°31'45"	4.10	Conser-vation	R/P/V	#904	3/4	#904		#904	10	
Mkuze Swamp 908	S27°39'23" E32°31'43"	3.80	Conser-vation	R/P/V	#904	3/4	#904		#904	10	

Mkuze Swamp 989	S27°41'50" E32°32'08"	5.50	Conser-vation	P/R	# 992	3/4	# 992		# 992	10	
Mkuze Swamp 991	S27°41'50" E32°32'06"	5.50	Conser-vation	P	# 992	3/4	# 992		# 992	10	
Mkuze Swamp 992	S27°41'48" E32°32'05"	5.40	Conser-vation	P/R	9 000	3/4	37 125		High	10	Clay 540 - 740
Mkuze Swamp 998	S27°44'45" E32°32'30"	1.30	Conser-vation	P/V	#1004	3/4	#1004		#1004	10	Clay 130 - 150
Mkuze Swamp 999	S27°44'44" E32°32'26"	1.50	Conser-vation	P/V	#1004	3/4	#1004		#1004	10	Clay 150 - 350
Mkuze Swamp 1000	S27°44'42" E32°32'22"	1.20	Conser-vation	P/R/V	#1004	3/4	#1004		#1004	10	Clay 120 - 280
Mkuze Swamp 1001	S27°44'41" E32°32'19"	1.70	Conser-vation	P/V	#1004	3/4	#1004		#1004	10	Clay 170 - 300
Mkuze Swamp 1002	S27°44'44" E32°32'15"	1.70	Conser-vation	P/R	#1004	3/4	#1004		#1004	10	Clay 170 - 300
Mkuze Swamp 1003	S27°44'42" E32°32'14"	1.70	Conser-vation	P/R	#1004	3/4	#1004		#1004	10	Clay 170 - 430
Mkuze Swamp 1004	S27°44'41" E32°32'11"	2.10	Conser-vation	P	20 000	3/4	31 500		Medium-high	10	Clay 210 - 440

Mkuze Swamp 1014	S27°47'18" E32°32'27"	0.70	Conser-vation	R/P/V	#1017	3/4	# 1017		# 1016	10	Clay 70 - 260
Mkuze Swamp 1015	S27°47'18" E32°32'23"	0.70	Conser-vation	R/V/P	#1017	3/4	# 1017		# 1016	10	Clay 70 - 260
Mkuze Swamp 1016	S27°47'22" E32°32'18"	1.15	Conser-vation	R/P	#1017	3/4	# 1017		Medium	10	Clay 115 - 250
Mkuze Swamp 1017	S27°47'21" E32°32'10"	1.50	Conser-vation	R/P/V/ S	20 000	3/4	22 500		# 1016	10	Clay 150 - 240
Mkuze Swamp 1018	S27°47'22" E32°32'03"	0.90	Conser-vation	P/V/S	# 1017	3/4	# 1017		# 1016	10	Clay 90 - 250
Mkuze Swamp 1019	S27°47'25" E32°31'56"	0.70	Conser-vation	V/P	# 1017	3/4	# 1017		# 1016	10	Clay 70 - 200
Mkuze Swamp 1020	S27°47'30" E32°31'45"	0.70	Conser-vation	R/S	# 1017	3/4	# 1017		# 1016	10	Clay 70 - 200
Mkuze Swamp 1037	S27°50'11" E32°30'50"	0.40	Conser-vation	P	# 1038	3/4	# 1038		# 1038	10	Clay 150 - 240
Mkuze Swamp 1038	S27°50'11" E32°30'46"	1.00	Conser-vation	P/S	15 000	3/4	11 250		N/A	10	Clay 90 - 250
Mkuze Swamp 1039	S27°50'09" E32°30'43"	0.60	Conser-vation	P/S	# 1038	3/4	# 1038		N/A	10	Clay 60 - 100

Mkuze Swamp 1040	S27°50'08" E32°30'40"	0.50	Conser-vation	P/S	# 1038	3/4	# 1038		# 1038	10	Clay 50 - 150
Ozabeni 729	S27°34'57" E32°35'53"	0.50	Conser-vation	S	8		40			25	
Ozabeni 764	S27°35'12" E32°37'50"	0.50	Conser-vation	R/S	1 380	3/4	690		Low	30	
Ozabeni 807	S27°33'84" E32°35'48"	0.80	Conser-vation	G/S	10	3/4	6		High	25	Organic sand
Ozabeni 838	S27°40'55" E32°34'25"	0.60	Conser-vation	S	56	3/4	34		High	25	Organic Sand
Ozabeni 844	S27°39'22" E32°34'24"	1.10	Conser-vation	S	90	3/4	74		High	25	
Ozabeni 846	S27°38'49" E32°34'23"	1.30	Conser-vation	S	20	3/4	20		High	25	
Ozabeni 866	S27°36'07" E32°36'03"	1.00	Conser-vation	S	10	3/4	7.5		High	25	
Ozabeni 871	S27°37'04" E32°35'43"	0.75	Conser-vation	S	10	3/4	4		Medium	25	
Ozabeni 872	S27°36'46" E32°36'21"	1.70	Conser-vation	S	15	3/4	19		N/A	25	

Ozabeni 880	S27°37'46" E32°33'28"	1.35	Conser-vation	G/S	20	2/3	18		Medium-high	10	
Ozabeni 883	S27°38'27" E32°32'48"	0.80	Conser-vation	S/SF	13	2/3	7		Medium	10	
Ozabeni 884	S27°38'15" E32°32'51"	1.30	Conser-vation	G/S/SF	12	2/3	10		High	10	Organic Sand
Bangazi-N 1199	S27°39'30" E32°37'38"	4.75	Conser-vation	R/S	15	2/3	47		High-medium	15	
Bangazi-N 780	S27°37'55" E32°37'28"	0.80	Conser-vation	S	45	2/3	24		High	20	
Bangazi-N 781	S27°38'05" E32°37'45"	2.00	Gardens, water	SF	40	2/3	53		Medium	20	
Bangazi-N 1201	S27°37'53" E32°37'45"	0.80	Conser-vation	R/S	50	2/3	27		N/A	10	
Bangazi-N 1202	S27°37'52" E32°37'42"	3.20	Conser-vation	SF	35	2/3	84		N/A	10	
Bangazi-N 1203	S27°37'49" E32°37'40"	2.30	Conser-vation	SF	#1202	2/3	#1202		N/A	10	
Bangazi-N 1204	S27°38'42" E32°37'00"	0.80	Gardens, water	S/R	5	2/3	3		N/A	15	

Bangazi-N 1205	S27°38'41" E32°36'55"	2.10	Gardens, water	SF	75	2/3	105		High	20	Organic Sand
Bangazi-N 1206	S27°38'40" E32°37'32"	2.40	Gardens, water	S/R	62	2/3	100		N/A	10	
Bangazi-N 1207	S27°38'54" E32°37'19"	1.50	Gardens, water	S/R	75	2/3	75		N/A	15	
Bangazi-N 1208	S27°38'49" E32°37'11"	1.70	Gardens, water	S/R	3	2/3	3		N/A	15	
Bangazi-N 1193	S27°38'52" E32°36'13"	1.40	Gardens, water	SF	70	2/3	65		Medium	25	
Bangazi-N 1194	S27°39'21" E32°36'42	6.20	Gardens, water	SF	100	2/3	413		Medium-high	15	
Bangazi-N 1195	S27°39'21" E32°37'03"	3.00	Gardens, water	SF	25	2/3	50		N/A	15	
Bangazi-N 1196	S27°39'21" E32°37'07"	2.20	Gardens, water	SF	25	2/3	37		N/A	15	
Bangazi-N 1197	S27°39'22" E32°37'14"	1.20	Gardens, water	S/R	20	2/3	16		Medium	15	
Bangazi-N 1199	S27°39'30" E32°37'38"	4.75	Gardens, water	R/S	20	2/3	63		High-medium	15	

Manzibomvu 1049	S27°35'25" E32°26'37"	2.00	Conser-vation	R/V	75	3/4	112		Medium	30	
Manzibomvu 1055	S27°35'44" E32°28'25"	0.50	Conser-vation	S	#1056	2/3	#1056		High	30	Organic Sand
Manzibomvu 1056	S27°36'21" E32°28'25"	1.50	Gardens	SF	125	2/3	125		High	30	
Manzibomvu 1057	S27°36'43" E32°28'47"	1.00	Gardens	SF/S	125	2/3	83		High	25	Organic Sand
Manzibomvu 1059	S27°36'41" E32°29'42"	0.50	Conser-vation	S	75	2/3	38		High	25	Organic Sand
Manzibomvu 1060	S27°37'40" E32°30'37"	2.90	Conser-vation	SF/P	187	2/3	363		Medium	15	
Mdlanzi 1226	S27°38'26" E32°28'07"	2.70	Gardens, water	P	1 500	2/3	2 700		High	15	Water 0 - 200 cm
Mdlanzi 1262	S27°38'25" E32°28'55"	2.70	Gardens, water	P	600	2/3	1 500		N/A	15	Water 0 - 200 cm
Ntshangwe 1229	S27°39'12" E32°29'20"	1.00	Gardens, water	P	25	3/4	19		High	15	Organic Sand
Mbotsheni 1235	S28°01'10" E32°31'05"	0.70	Conser-vation	R/S	10	3/4	5		High Org. Sand	10	Wet/peat-land Mosaic

MbotsheCni 1236	S28°01'05" E32°31'20"	1.00	Conser-vation	R/S	75	3/4	56		N/A	10	Wet/peat-land Mosaic
Mbotsheni 1238	S28°00'59" E32°31'42"	1.00	Conser-vation	R/S	75	3/4	56		High	10	Wet/peat-land Mosaic
Kulaleni 1166	S28°02'40" E32°31'15"	1.30	Conser-vation	R/S	75	3/4	73		Medium	10	Wet/peat-land Mosaic
Kulaleni 1168	S28°02'40" E32°31'28"	1.00	Conser-vation	R/S	75	3/4	56		N/A	10	Wet/peat-land Mosaic
Kulaleni 1169	S28°02'49" E32°31'47"	0.50	Conser-vation	P/B/S	75	3/4	28		High Org. Sand	10	Wet/peat-land Mosaic
Kulaleni 1170	S28°02'44" E32°31'49"	1.30	Conser-vation	R/S	75	3/4	73		Medium	10	Wet/peat-land Mosaic
KwaDlembe 1157	S28°04'23" E32°31'17"	2.25	Conser-vation	R/S/P	187	2/3	281		Medium	10	Wet/peat-land Mosaic
KwaDlembe 1156	S28°04'40" E32°31'25"	2.00	Conser-vation	S/R	3	2/3	4		N/A	10	Wet/peat-land Mosaic
KwaDlembe 1152	S28°05'52" E32°31'43"	1.5O	Conser-vation	R/S	10	3/4	11		High Org. Clay	10	Wet/peat-land Mosaic

KwaDlembe 1150	S28°06'15" E32°31'42"	2.00	Conser-vation	R/S	10	3/4	15		N/A	10	Wet/peat-land Mosaic
Sabhuku 1145	S28°05'28" E32°30'50"	0.50	Conser-vation	SF	75	3/4	28		High	10	Organic Sand
Sabhuku 1129	S28°06'39" E32°30'38"	1.30	Garden	SF	500	3/4	487		High	10	Organic Sand
Bangazi-S 1163	S28°06'27" E32°32'27"	0.70	Conser-vation	R	56	2/3	26		High	10	Organic Sand
Mfabeni 1113	S28°07'15" E32°30'50"	1.50	Conser-vation	R/S/P	50	2/3	50		Medium	10	
Mfabeni 1114	S28°07'28" E32°30'55"	3.25	Conser-vation	R/S/G	1 200	2/3	2 600		Medium	10	
Mfabeni 1126	S28°08'32" E32°32'05"	0.40	Conser-vation	S	25	2/3	6		N/A	10	
Mfabeni 1125	S28°09'02" E32°31'30"	10.00	Water	G/S	7 000	1/2	35 000	45 100 + 4900 - 3000	Low-high	10	
Mfabeni 1064	S28°10'22" E32°30'35"	2.00	Conser-vation	G/S/R	1 000	2/3	1 333		N/A	10	
Mfabeni 1124	S28°09'10" E32°32'18"	1.50	Conser-vation	S/R/P/ V	20	2/3	20		Medium	10	

Mfabeni 1123	S28°09'27" E32°31'54"	1.00	Conser-vation	S	35	2/3	23		High	10	Organic Sand
Nkazana 1108	S28°08'35" E32°30'23"	4.60	Conser-vation	SF	600	2/3	1 840		N/A	10	
Nkazana 1066	S28°10'33" E32°30'02"	4.00	Conser-vation	SF	1 600	2/3	4 266		Low-high	10	
Nkazana 1068	S28°11'22" E32°29'39"	0.50	Conser-vation	S	125	2/3	41		High	10	Organic Sand
Nkazana-east 964	S28°12'55" E32°29'20"	2.40	Conser-vation	SF	80	2/3	128		High	10	
St. Lucia 798	S28°18'25" E32°26'55"	1.90	Conserv/ plantat.	S	6	3/4	5		High	15	
St. Lucia 789	S28°19'10" E32°25'48"	1.20	Conserv/ plantat.	S	80	2/3	101		High	10	
St. Lucia 928	S28°21'40" E32°25'50"	0.40	Conser-vation	S	10	3/4	3		N/A	10	
St. Lucia 1179	S28°21'04" E32°25'11"	0.50	Conser-vation	S	10	3/4	4		High	10	Organic Sand
St. Lucia 1122	E28°22'55 S32°24'50"	0.70	Conser-vation	SF	37	2/3	17		N/A	10	

St. Lucia	S28°22'35" E32°35'30"	5.00 Clay	Conser-vation	R						10	Clay
St. Lucia 933	S28°23'01" E32°24'49"	1.80	Conser-vation	R/S/P	100	2/3	120		High	10	
Futululu 1250	S28°23'50" E32°16'21"	4.75	Conser-vation	P	#1251	1/2	#1251		Medium-high	15	
Futululu 1251	S28°24'28" E32°15'55"	6.50	Conser-vation	P	875	1/2	437		N/A	15	
Dukuduku 1182	S28°22'35" E32°22'22"	1.00	Conser-vation	SF	50	2/3	33		N/A	30	
Nyalazi 959	S28°14'33" E32°22'52"	1.00	Planta-tion	SF	30	2/3	20		High	40	Organic Sand

Peatland Characterisation

Peatlands with unknown thicknesses (about 5 % of the total) in the Tewati Wilderness area and Dukuduku were not taken into account in the inferred resource estimation. This study was executed on a regional scale. Whilst every effort was made to locate as many as possible of the wetlands, it is possible that individual wetlands could have been missed during the survey. Small deposits of peat in the bigger wetlands could also have been overlooked.

THE IMPLICATION OF C^{14} AND POLLEN-DERIVED PEAT AGES ON THE CHARACTERISATION OF THE PEATLANDS OF THE ZULULAND-MOZAMBIQUE COASTAL PLAIN, SOUTH AFRICA.

INTRODUCTION

In the recent past the wetlands and peatlands of Maputaland on the MCP have come increasingly under pressure. Local inhabitants, entrepreneurs, conservationists and scientists have all staked their claims. This has resulted in a lot of dialogue and research. Amongst others, sustainable utilisation of peat as a domestic energy resource was suggested and has been debated for the past few years (Smuts, 1992; Grundling, 1994).

Smuts (1992) indicated that peat accumulated at 100 mm/year in modern reed-sedge peats in Southern Africa. Smuts, 1992 and Smuts & Kirstein, 1995 also suggested that C^{14} data, together with various decompaction factors, from Maputaland supported this observation. Mazus & Grundling, 1995 and Thamm *et al*, 1996 have however expressed their doubt on this accumulation rate. These authors used the presence of exotic pollen in the top layer of the peatland to establish present day accumulation rates of 0.26 - 18.5 mm/year and support it with C^{14} accumulation rates over a relatively short geological time span: 1.3 mm/year over 1100 years and 0.2 mm/year over 33 000 years.

More C^{14} data is now available and it will be shown that the present day accumulation rates of peat in Maputaland are indeed lower than suggested by Smuts, 1992 and Smuts & Kirstein, 1995, and that they support the previously quoted pollen accumulation rates in Mazus & Grundling, 1995 and Thamm *et al*, 1996 and that compaction factors play a minor role in accumulation rate determinations in Maputaland peats.

RESULTS & DISCUSSION

C^{14} ages

Twenty-eight C^{14} ages (Fig 2) at various depths have been determined for nine of the peatlands of Maputaland (Fig 1). On the basis of these ages, peatlands have been divided into two groups: the younger Maputaland peats of Holocene age and the older Mfabeni peat of Pleistocene to Holocene age (Fig 2). The C^{14} ages of the Maputaland peats range from 130 ± 45 years BP at a depth of 0.85 m to 7 000 ± 80 years BP at 8.58 m. C^{14} ages of Mfabeni vary from 2 450 ± 50 at 1.13 m to 43 100 (+ 3 900 , - 2 600) years BP at 9.93 m, with an older reworked peat of 45 100 (+ 4900, - 3000) years BP at 8.43 m.

Exotic pollen ages

The presence of exotic pollen species in the peat cores, created the opportunity to determine presentaccumulation rates over the past thirty years. Pine, Casuarina and Blue Gum were introduced *en masse* into the region by commercial forestation in the mid sixties. These exotic pollens were identified in the first 10 - 50 cm of cores from five peatlands. C^{14} ages for four of these peatlands are available. The pollen-based accumulation rates vary from 0.26 mm/year to 18.5 mm/year (Thamm *et al*, 1995) with the interval sample depth averages varying from 2.8 mm/year to 14.3 mm/year (Fig 3). They compare relatively well with the C^{14} ages' accumulation rates of 0.23mm/year to 6.54 mm/year).

Accumulation rates

The average C^{14} accumulation rate for eight Maputaland peats (Fig 2) over the past 130 - 7 000 years is 1.06 mm/year with a minimum of 0.28 mm/year at 0.67 m to a maximum of 6.54 mm/year at 0.85 m. The Mfabeni C^{14} accumulation rates (Fig) indicate an accumulation rate of 0.23 mm/year during the Pleistocene and a higher rate of 0.43 mm/year during the Holocene. The minimum rate during the Pleistocene was 0.19 mm/year at depths of 7.73 m and 8.43 m while a maximum of 0.34 mm/year was determined at a depth of 3.93 m. During the Holocene the minimum accumulation rate for Mfabeni was 0.34 mm/year at 3.23 m depth and a maximum of 0.46 mm/year was determined for the depth 1.13 m (Grundling, 1996).

Compaction

Plots of C^{14} age against thickness for the Maputaland peats and the Mfabeni peat (Pleistocene and Holocene peats separately) follow a linear curve (Fig 4 & 5). The regression value for the Maputaland plot is 0.94, the regression value for the Mfabeni Pleistocene part of the plot is 1.00 and for the Holocene part 0.99. The plot for Maputaland represents eight different peatlands and the Mfabeni plot represents only one peatland. The rate of peat accumulation (or peat increment) is more than 95% reliable in all plots.

A concave curve would have indicated compaction of the peat with an increase in depth (Ikonen, 1993). These linear curves of the Maputaland and Mfabeni peats indicate that no compaction took place during the period of accumulation or that the accumulation of peat totally dominated any compaction. The "compaction" observed on the peatlands is mostly restricted to the top 0.5 m. This is not compaction in the true sense, i.e. actually the cell walls of the plant material are slowly destroyed during anaerobic decay. The decay of active biomatter takes place in the catotelm (the active surface layer) followed by peat accumulation in the acrotelm (the anoxic waterlogged peat) after the decay. Results from the study on accumulation rates of the Pesänsuo peat in Finland support the latter, where results for vertical growth also follow a straight curve (Ikonen, 1993). This is further substantiated by the presence of undamaged, delicate shells of fresh water snails, below peat thicknesses of more than 3 m.

It is possible to estimate a reasonable age for certain types of peatland at depth over this accumulation period in Maputaland by using the linear curves in the plots of C^{14} age against depth (Grundling, 1996).

Ecological development

Palynological and ash studies of the peat core obtained are still being conducted and only some results are discussed. The linear curves of depth v/s time for Mfabeni indicate a clear break point at about 11 000 years. This corresponds with the Pleistocene/Holocene boundary. It also corresponds with a sandy peat layer of about 1 m in thickness, starting at a depth of 3.95 m, which indicates a higher energy environment during the development of this wetland, corresponding to the Pleistocene/Holocene boundary (Grundling, 1996).

The reversal of ages in the C^{14} dating close to the bottom of the Mfabeni peat profile (Fig 2 & 5) is interpreted as the accumulation of older reworked peats. Higher energy flows, such as floods, could be associated with this reversal of ages. Palynological studies of this peat core, now in progress, will hopefully shed some new light on the development of the Greater St. Lucia Wetland System.

Fig. 3: C-14 Dating results and accumulation rates for peatlands in the study area.

Maputaland Peat No.	Anal. No.	Depth (cm)	C14 Age (BP)	AgeRate (mm/year)
9	*Pta-5250	-85	130	6.54
9	*Pta-5254	-93	450	2.07
1	Pta-7078	-95	690	1.38
3	Pta-7084	-125	1 390	0.90
7	Pta-6373	-140	770	1.82
9	*Pta-5253	-143	1 100	1.30
3	*Pta-5256	-235	4 840	0.49
1	Pta-7074	-238	4 200	0.57
2	Pta-7082	-242	3 590	0.67
6	Pta-7079	-243	1 280	1.90
4	Pta-6752	-275	2 140	1.29
1	Pta-7080	-333	3 240	1.03
3	Pta-7085	-388	4 160	0.93
2	Pta-7083	-413	4 640	0.89
6	Pta-7087	-518	2 820	1.84
8	Pta-6370	-550	4 120	1.33
3	Pta-6745	-750	6 080	1.23
3	Pta-7086	-858	7 000	1.22

* Smuts, 1992

Mfabeni Peat No.	Anal. No.	Depth (cm)	C-14 Age(BP)	Age Rate (mm/year)
10	Pta-7143	-112.5	2 450	0.46
10	Pta-7146	-237.5	5 290	0.45
10	Pta 7153	-322.5	8 730	0.37
10	Pta-7140	-392.5	11 570	0.34
10	Pta-7145	-502.5	20 800	0.24
10	Pta-6743	-675	33 000	0.20
10	Pta-7145	-772.5	44 500	0.19
10	Pta-7150	-842.5	45 100	0.19
10	Pta-7160	-915	41 000	0.22
10	Pta-7138	-992.5	43 000	0.23

Fig. 4: Pollen accumulation rates for peatlands in the study area (after Mazus and Grundling, and Thamm *et al*, 1996)

Peatland	Exotic Pollen	Average Depth(cm)	Pollen age	Rate(mm/year)
Majiji	Pinus	25	27	9.3
Manzengwenya	Pinus	7.5	27	2.8
Nhlangu	Pinus	30	27	11.1
Mgobezeleni	Pinus/Casuarina	25	25	10.0
Mfabeni	Pinus	40	28	14.3

Indigenous pollen data in some of the Maputaland peatlands suggest the existence of some *Podocarpus spp.* forest in the proximity of these peatlands. The *Podocarpus spp.* in this hydromorphous forest, were well-represented in the middle Holocene and started to retreat from the area about 5 100 years BP (Mazus, 1996) and are currently totally absent from the area. More palynological studies of the peatlands of Maputaland are currently in progress.

Sustainable utilisation

Sustainable utilisation of the peat as a domestic energy resource has been suggested for the past five years. These suggestions were based on a supposedaccumulation rate of 100 mm/year (Smuts, 1992 and Smuts & Kirstein, 1995). It is, however, quite clear that the accumulation rates as described in this text and reported earlier by Mazus & Grundling, 1995 and Thamm *et al*, 1996, do not support the sustainable utilisation of peat as an energy resource nor for other commercial applications.

The peatlands have been used for generations for subsistence and small scale farming. Peat forms an active part of wetlands in this area and is also an important water, fodder and biomass (mainly for thatching, weaving and braiding) resource for the local communities.

CONCLUSION

The pollen-based accumulation rates vary from 0.28 mm/year to 18.5 mm/year and compare relatively well with the C^{14} accumulation rates of 0.23 mm/year to 6.54 mm/year. These rates differ significantly from previously indicated current accumulation rates of up to 100 mm/year. Certain factors such as drought, veld fires, biomass harvesting and subsistence farming on the peatlands could influence these estimations and should be included in any future accumulation rate determination of peatlands in this region.

It is clear that accumulation rates do not support the sustainable utilisation of peat as an energy resource nor for other commercial applications. The peatlands are already in use for subsistence and small scale farming practices. Wetlands play a fundamental role in the local economy of the region. Preliminary C^{14} age data of Highveld peatlands indicate accumulation rates of about 0.46 mm/year and it thus seems that sustainable utilisation of peat in South Africa as a whole, is not viable.

Fig. 5: Rate of peat accumulation, Maputaland, basis of C^{14} dates against depth.

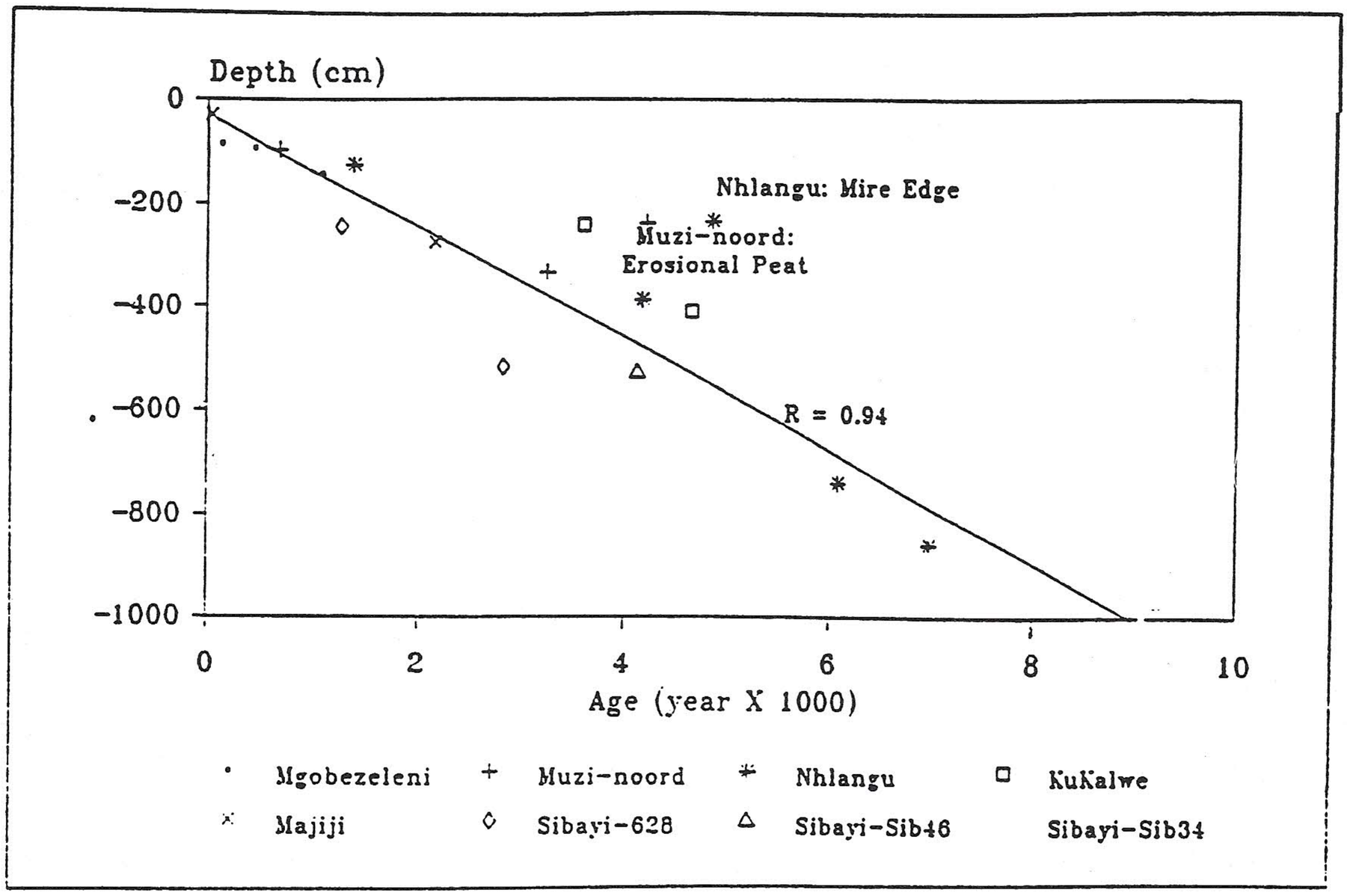
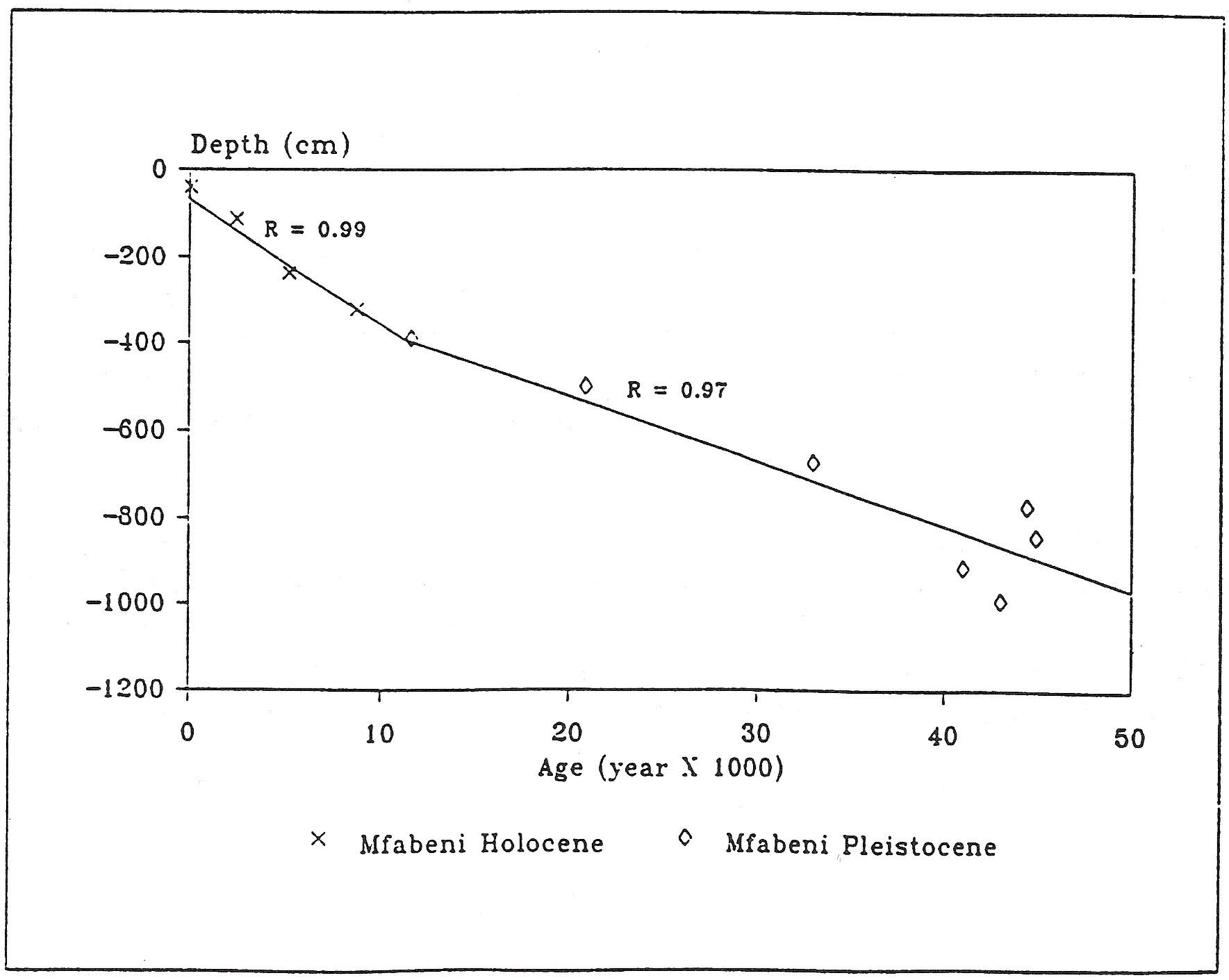


Fig. 6: Rate of peat accumulation, Mfabeni, basis of C^{14} dates against depth.



POLLEN ANALYSES OF SOME LATE HOLOCENE PEAT DEPOSITS FROM NATAL MIRE COMPLEX, MAPUTALAND.

INTRODUCTION

Due to the time-intensive nature of palynological analyses, only a limited number of peatlands were selected to be studied. The palynological analysis of samples from five peatlands in the Maputaland allows the reconstruction of the botanical history of these peatlands during the Pleistocene and Holocene.The pollen spectra include a total pollen sum of 300 grains, except for the samples of very low pollen content. The pollen diagrams include only the main groups of plants, which are important for the palaeofloristic interpretation.

POLLEN RESULTS

Majiji mire

The Majiji is situated near the top of the Kosi Lake drainage system, about 1.5 km north of the Majiji Plantation.The mire is composed of mixed communities of many different species of sedges (*Cyperaceae*) and other swamp plants such as *Dissotis canescena, Phragmites australis, Asclepiadaceae, Polygonaceae*, ferns and bulbous plants. Towards the central part some scattered, dwarf waterberry trees (*Syzigium cordatum*) are found.

Water lilies (*Nymphaea*) only develop in the outer part, where open water accumulates during the wet seasons. Samples for pollen and ash analyses were taken from the three sites marked 3/2, 2/1, 4/2. The longest core (2/1) from the central parts of the mire extends to a depth of 350 cm.The radiocarbon dating of 2 140+-70 years BP was obtaining from the depth of -230 cm in the core 3/2.

Pollen data

On the basis of identified pollen of trees, shrubs and herbs the peat profile can be divided into three zones (Fig 7):

(1) 120-350 cm - In the lower parts of presented pollen diagrams the pollen of *Podocarpus, Celtis, Myrica, Syzigium* and other trees are present. The "other trees" group includes all identified woody taxa that occur in very low percentages. The most common taxa are *Rhus, Canthium, Spirostachys, Kiggelaria, Apodytes, Euclea, Diospyros, Mimusops* and *Ficus*. The pollen of aquatic plants consists of pollen of *Cyperaceae, Graminaceae, Nymphaea* and ferns (Fig 8).

(2) 60-120 cm - The woodland species are very important. *Celtis* and *Myrica* show very low values. *Podocarpus* declines. *Nymphaea* pollen and spores of ferns decrease.

(3) 0-60 cm - The woodland species are still present but show gradual decrease. *Syzigium, Cyperaceae* and other peat plant pollen tend to increase.

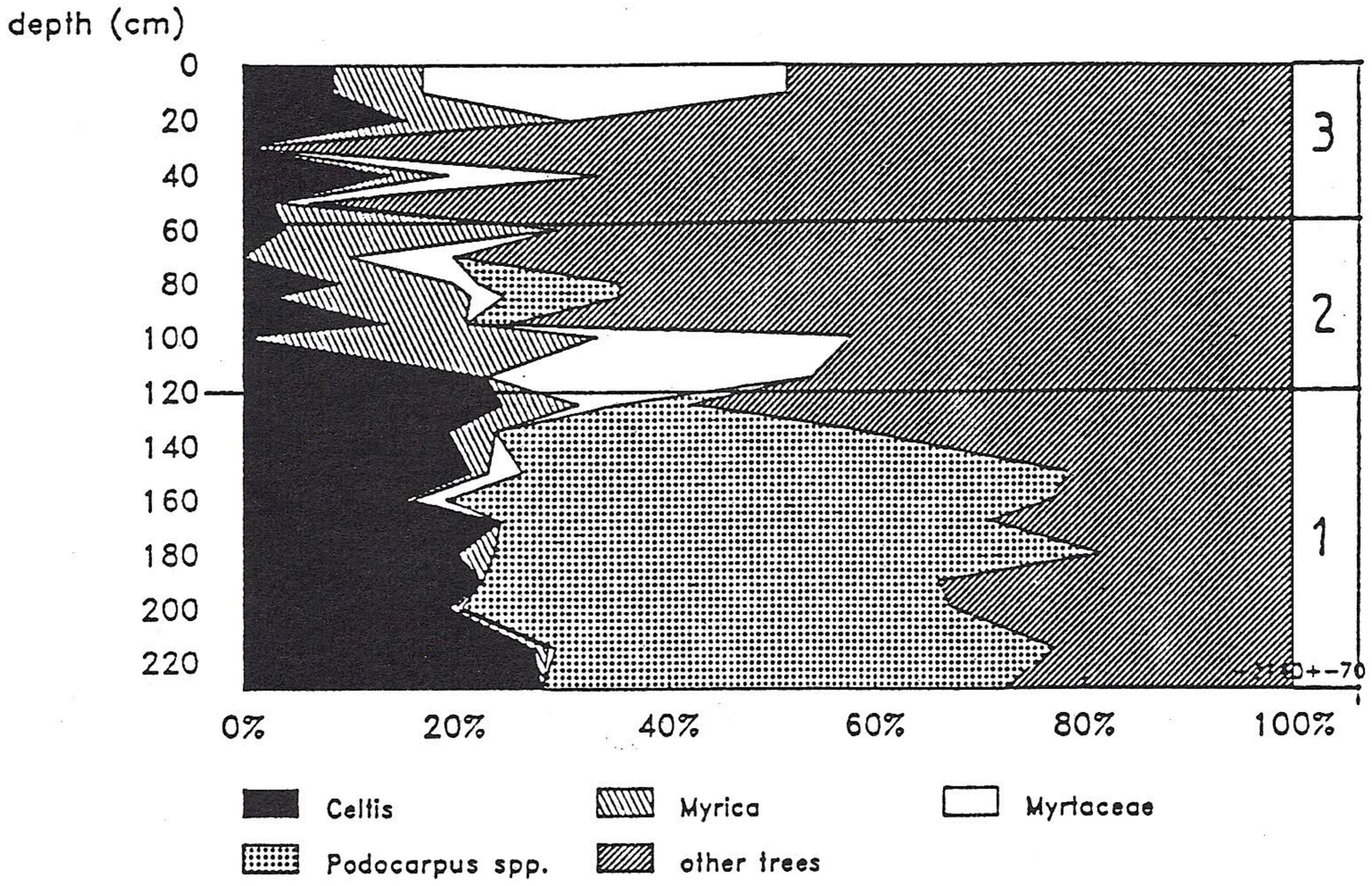


Fig. 7: Pollen diagram of Majiji; forest.

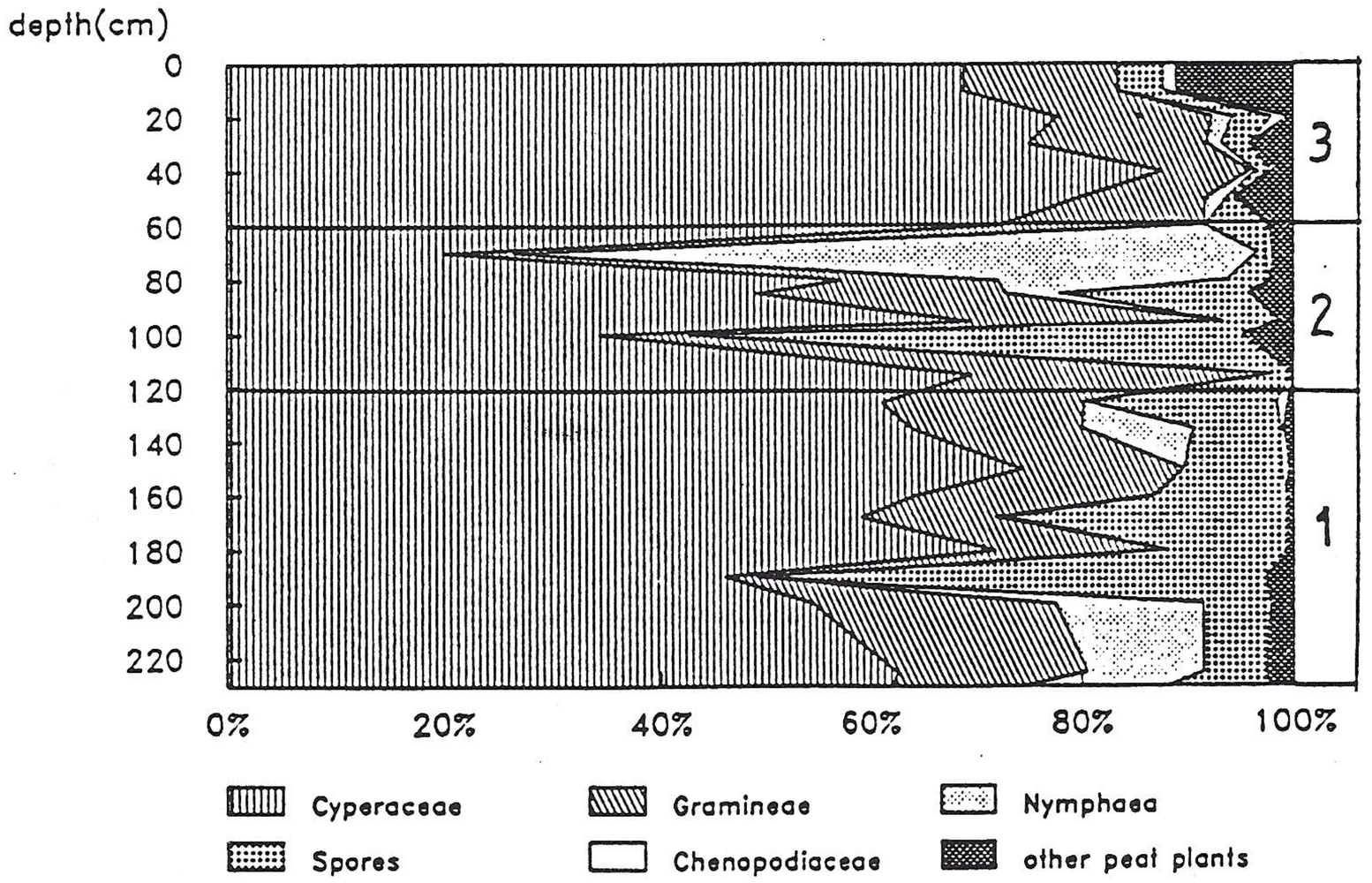


Fig. 8: Pollen diagram of Majiji; herbs and aquatic plants.

History of vegetation

Pollen data from examined cores is indicative of the presence of a hydromorphous forest about 2 140 years ago in the proximity of Majiji mire. *Podocarpus, Celtis, Oleaceae*, and *Syzigium* were the most important taxa in this forest. The percentage of *Podocarpus*, which does not reach a value of 20, and the gradual decrease of this tree towards the top of the profile suggest the migration of this forest from the area. A similar hydromorphous podocarpus forest was detected near another mire in the Kosi Lake catchment: the Nhlangu mire. The forest occupied a large area near Black Rock about 7 000 years BP and started to retreat about 5 000 years BP.

The upper part of the pollen profile of Majiji mire shows that *Podocarpus spp.* retreat from the vicinity of the mire, giving way to other tree species (e.a. *Syzigium cordatum*). *Celtis and Myrica,* indicators of wet conditions are also retreating from the area. It may suggest that conditions became drier at the site. Herbs and small shrubs belonging to the family *Compositae* are presently developing around the mire. The development of these plants may indicate slightly drier or cooler conditions (Coetzee, 1957; Scott, 1981). The pollen of aquatic plants also indicate that conditions were wetter at the beginning of peat accumulation. The high *Nymphaea* percentages suggest the presence of open water and a relatively high water level. The water must have been too deep for macrophyte such as *Typha*, *Phragmites* or *Cyperaceae* to have grown.

Towards the present day, with the lowering water level, the presence of *Cyperaceae, Gramineae* and other peat plants is increasing, replacing *Nymphaea* and ferns. The increase in the number of *Syzigium* pollen is a result of overgrowing of the central part of the mire by this species.

Mgobezeleni swamp (Mgobezeleni-Oos)

The Mgobezeleni Lake is situated on the Maputaland coast, at the Sodwana Bay National Park. Samples for analyses were taken in the swampforest on the south-eastern shore of the lake to a depth of 240 cm. The most common trees in the swampforest are *Syzigium cordatum, Myrica conifera, Rauvolfia caffra, Hibiscus tiiliaceus, Voacanga thouarsii, Ficus sp.* and *Strelizia nicolai.* The herbaceous grond layer contains various species of ferns, grasses and sedges. One carbon dating of 1 100+-40 yearss BP is obtained from a depth of 140 cm.

Pollen data

The Mgobezeleni 1 profile can be divided into five pollen zones (Fig 9, 10):

(1) 210-240 cm - Pollen of aquatic plants are dominant (mostly *Nymphaeae* spp.). The *Gramineae* family represented by species with big and small grains (50 - 10 u) is also important. Dinophlagellata and diatoms were noted.

(2) 200-210 cm - No pollen

(3) 120-200 cm - Pollen analyses show the dominance of *Syzigium,* monolete spores, *Gramineae* and high percentages of *Cyperaceae*. Pollen of *Celtis* also occurs.

(4) 60-120 cm - *Syzigium* shows a decrease, but is dominant. Other trees such as *Canthium*, *Mimusops, Rhus, Spirostachys, Olea, Apodytes* etc. are important in this zone. Curves of *Cyperaceae* and *Celtis* decline. The composition of the forest is changing. *Syzigium* is gradually replaced by *Myrica* and other trees. Ferns are growing in the understorey and as a creeper.

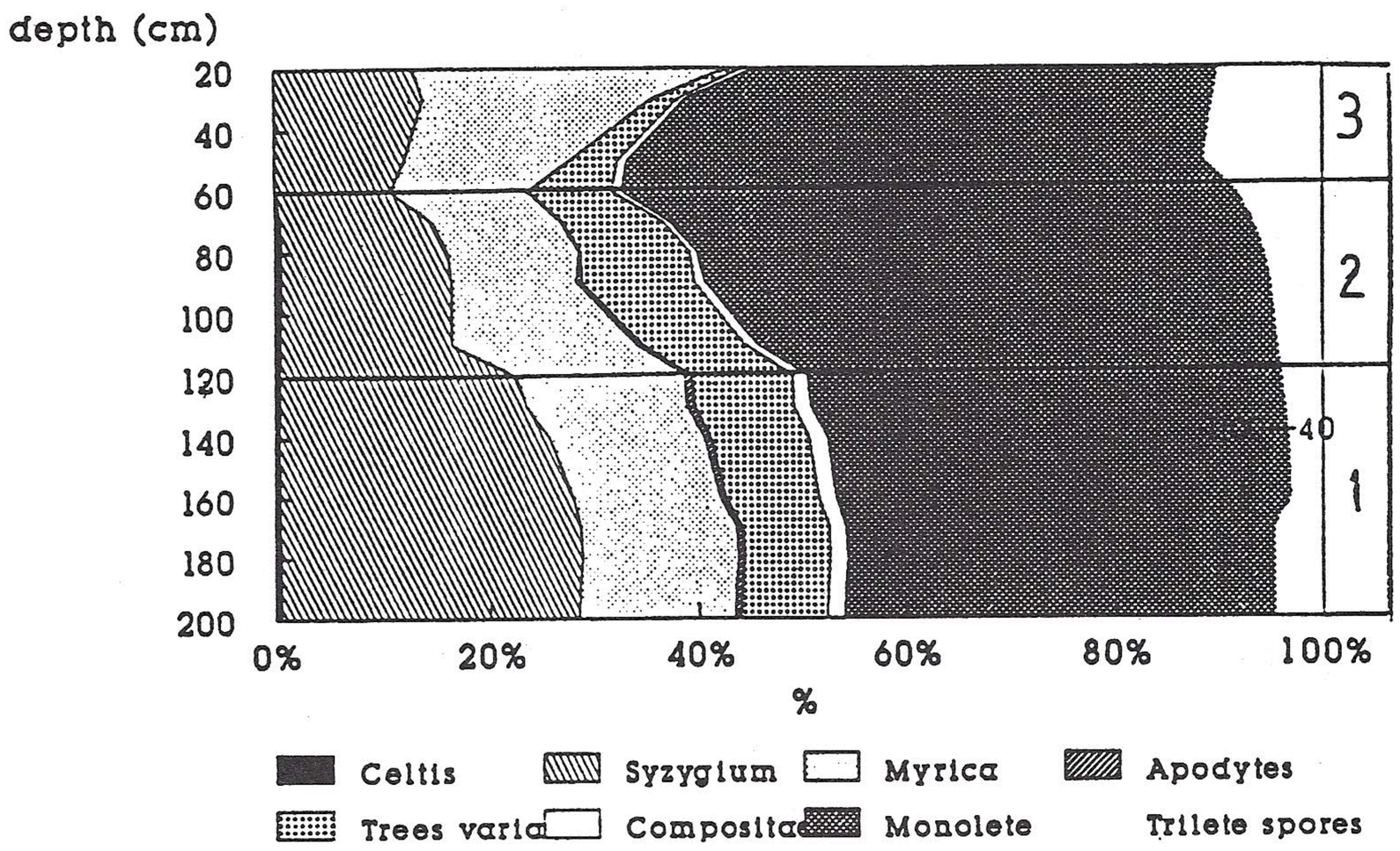


Fig. 9: Pollen diagram of Mgobezeleni; forest.

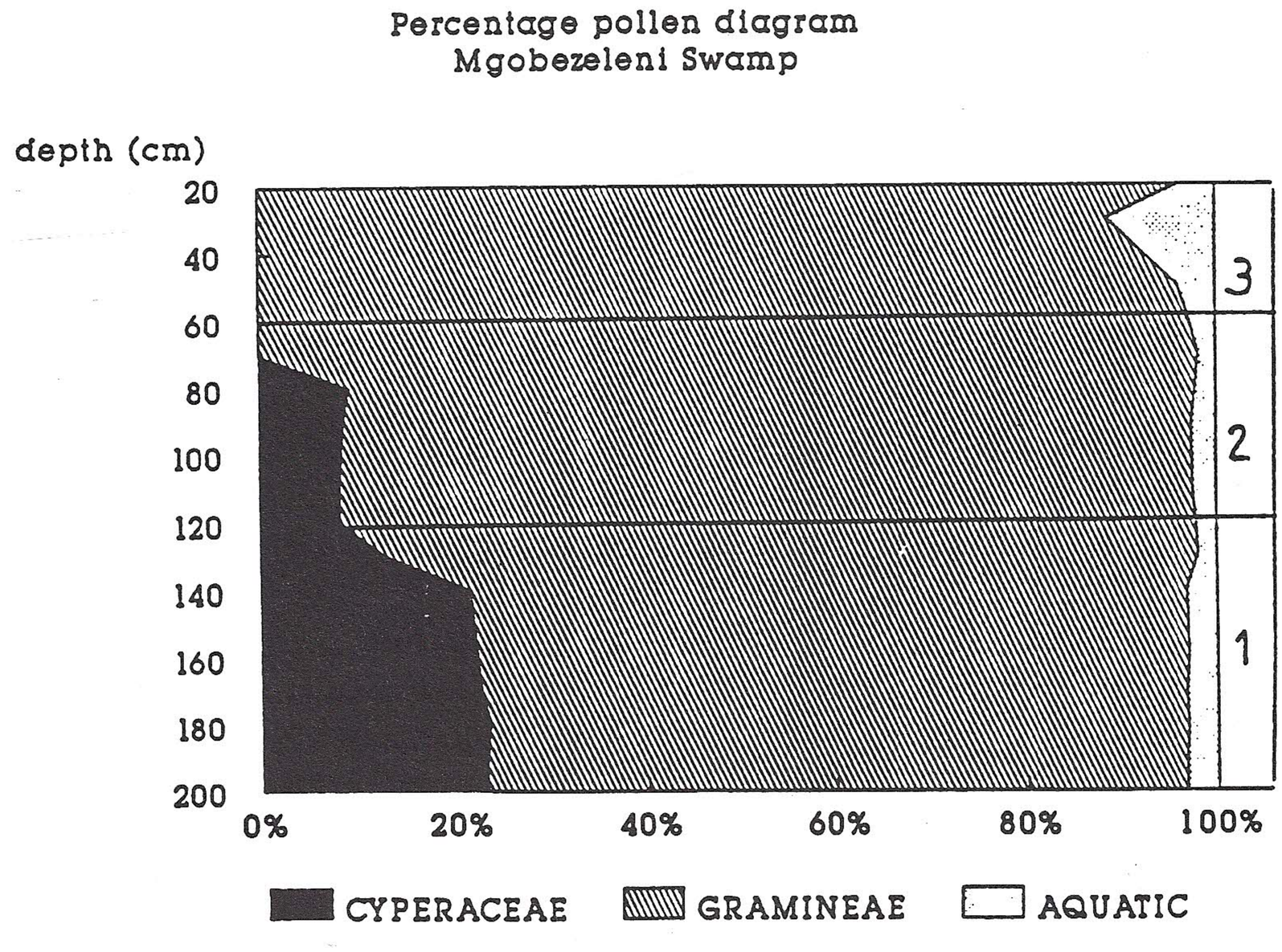


Fig. 10: Pollen diagram of Mgobezeleni; aquatic plants.

(5) 0-60 cm - The *Myrica* curve inclines. Monolete spores are very abundant. Trilete spores *Lycopodium* occur for the first time. Diatoms and Dinophlagellata occur at 60 cm. In the group "Trees varia" taxa such as *Ficus, Hibiscus* and *Grewia* are present.

History of vegetation

About 1 870 years ago a swampy grassland with free and open water patches existed on the site. The lack of pollen in samples from the depth 200-210 cm, dated by estimation at about 1 300 years BP, may be explained by the marine influence. However, except for few dinophlagellata found in the sediment there is no clear evidence. After 1 300 years BP a forest cover, mostly by *Syzigium* and *Myrica*, developed in the area. Reeds and sedges overgrew the mire.

From about 1 100 years BP *Syzigium* was gradually replaced by other trees. The present form of the swamp forest started to develop. Ferns were growing in the understorey and as a creeper. The occurrence of diatoms and dinophlagellata in the sample from a depth of 60 cm indicates the rise of the water level in the swamp.The significant apparent increase of *Myrica* pollen in this zone can be as a result of the planting of *Casuarina* trees in the nearby plantation in 1957 - 1961. The pollen of these two genera are similar and during routine analysis are included in the Myrica group.

Muzi-Oos mire

The Muzi swamp system lies some 40 km from the Indian Ocean coast. The herbaceous genera such as *Phragmites, Typha* and *Cyperaceae* are well developed. The woody swamp community is generally poorly developed. On the northern side of the Muzi system there is an open woodland which is related to woodland matrix of the sand forest.The samples for the pollen analysis were taken from the surface to a depth of 360 cm in the eastern part of the system.

Pollen data

(1) 240-360 cm - Pollen of *Gramineae* and spores of ferns are dominant in the lowermost part of the profile (Fig 11, 12). *Nymphae, Typha* and *Cyperaceae* are also present. Woody species are well represented by *Celtis, Podocarpus* and other trees. *Anthospermum* and *Asparagus*-type pollen are also present.

(2) 60-240 cm - The curve of *Gramineae* declines while *Cyperaceae* and monolete spores of ferns show an increase. *Podocarpus* and *Asparagus* are not present. *Compositae* is important in this zone.

(3) 0-60 cm - Pollen of *Celtis* and other trees such as *Syzigium*, *Myrica, Ficus, Mimusops*, *Rhus, Spirostachys* etc. are present. *Compositae* and *Anthospermum* decline. Monolete and trilete spores of ferns are dominant in this zone.

History of vegetation

Pollen data from the Muzi-Oos swamp indicates that the same conditions have been prevailing in the swamp during the time of peat accumulation. Only at about 4 200 years BP conditions became slightly drier. The relatively high percentages of *Anthospermum* and *Compositae* suggest that dry grassland surrounded the swamp before 4 200 years BP. A very low percentage of *Podocarpus* pollen suggest the absence of the podocarpus forest in the close proximity of the swamp. After about 690 years BP, fern communities developed on the swamp. At present ferns, sedges, reeds and other aquatic plants cover the site. A swamp forest appears close to the swamp.

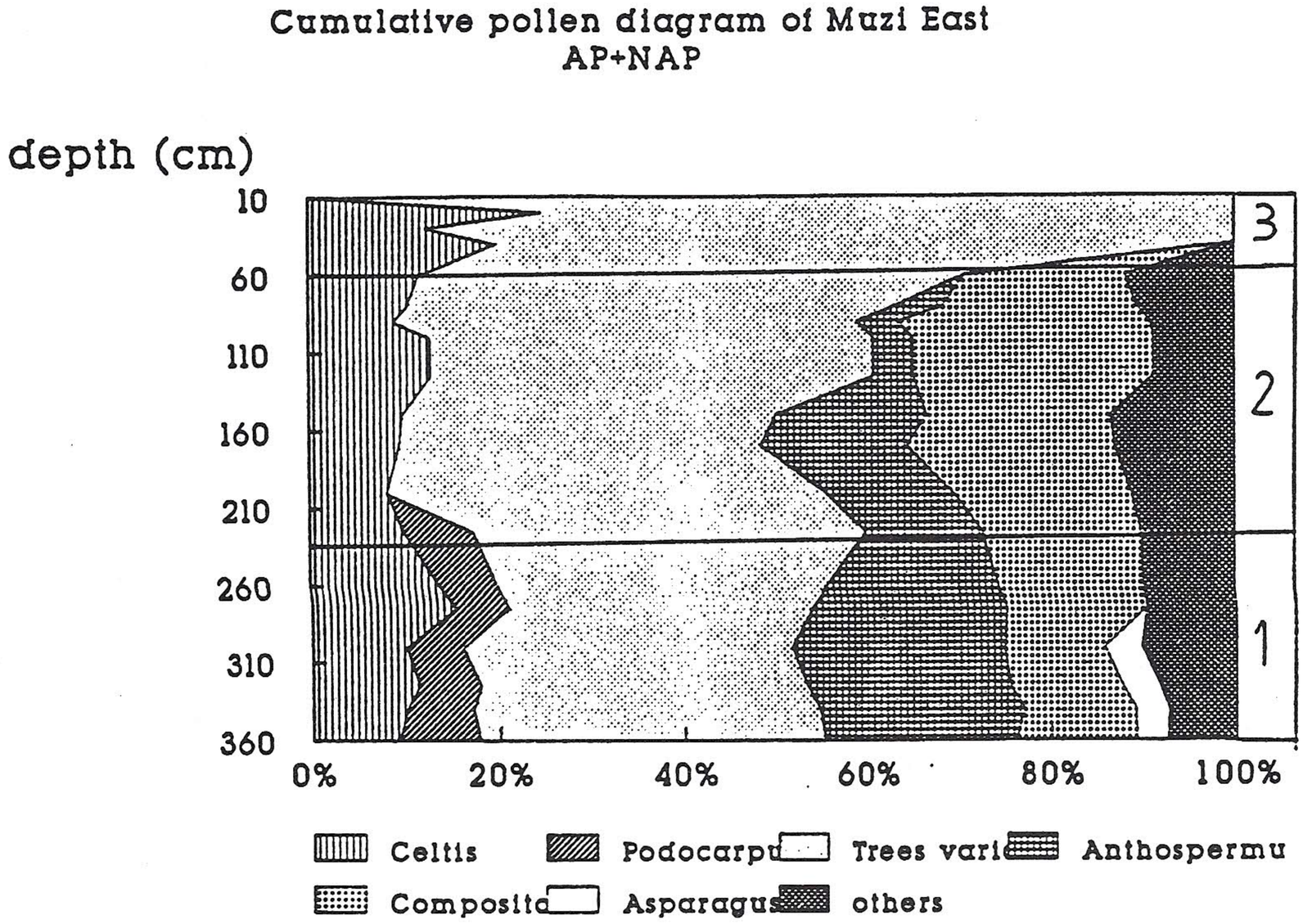


Fig. 11: Pollen diagram of Muzi-Oos; forest.

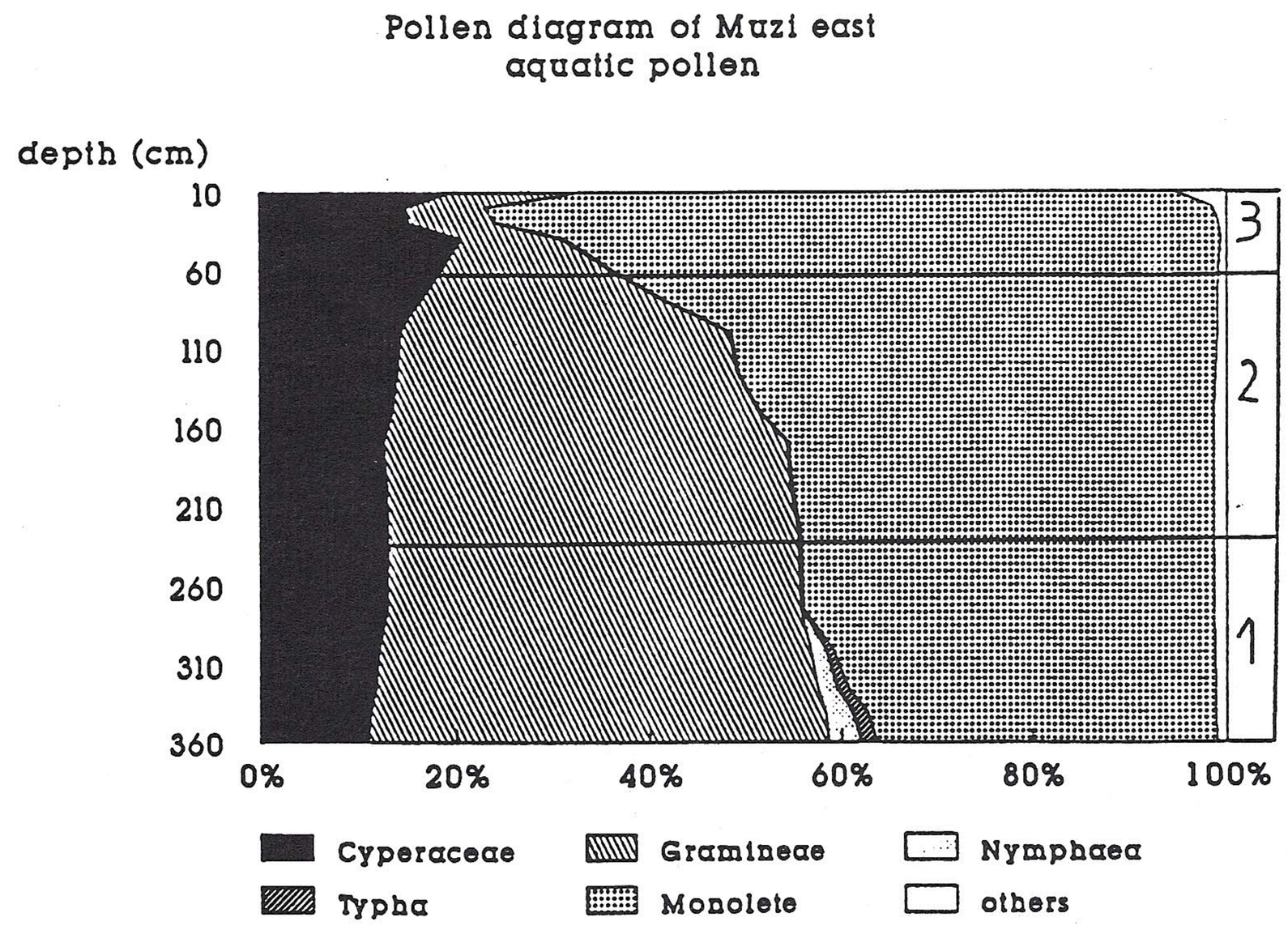


Fig. 12: Pollen diagram of Muzi-Oos; aquatic plants.

Nhlangu peatland

Nhlangu peatland is situated at the lower level of the Kosi Lake catchment basin, close to the coast, and is one of the typical interdune mires. The vegetation ofn the mire is dominated by sedges and reeds. Water lilies and bulrush stands occupy an open water area in the central part of the mire. The isolated trees such as *Syzigium cordatum* are scattered on the surrounding dunes. Samples were taken to a depth of 7,5 m.

Pollen data

(1a) 6,5-7,5 m - Forest elements such as *Myrica, Celtis, Myrtaceae* and other trees are well represented (Fig 13). Pollen of *Podocarpus* is also present but in low percentages. Herbaceous taxa consist mostly of reeds and sedges (Fig 14).

(1b) 5,0-6,5 m - *Podocarpus* percentages greatly increase and reach up to 20% of the total pollen. Pollen of *Olea* and other trees is also well represented, while percentages of *Myrica, Celtis* and *Myrtaceae* decrease. The herbaceous taxa and swampy components are present in low percentages. At a depth of 5,5 m *Podocarpus* starts to decline. This point can be dated by estimation at around 5 100 years BP.

(2) 1,25-5,0 m - This interval is characterised by the gradual deterioration of the forest elements. The curves of *Celtis* and *Myrtaceae* incline in the lower part of this zone, but decline towards the top of the profile. The curve of *Myrica* declines as well. The pollen of aquatic plants - water lilies and sedges are very numerous.

(3) 0,0-1,25 m - *Cyperaceae* pollen is dominant, with relative percentages reaching 85% of the total pollen sum, whereas the percentages of grass pollen average only 10%. The pollen of trees and shrubs is very scarce.

History of vegetation

Pollen records of the Nhlangu mire profile show that the main feature of the history of the local vegetation is expansion and retreat of the *Podocarpus* forest.At about 6 080 years BP the swamp forest with abundant *Syzigium* and *Myrica* trees existed on the site. *Podocarpus* developed and together with *Olea* became the main component of the forest. In the peatland hardwood peat accumulated. At approximately 5 100 years BP a hydromorphous forest started to retreat from the site. Between 5 100 and 4 160 years BP pollen data show the development of open-water conditions, indicated by well-represented *Nymphaea.*

Before 1 390 years BP the role of the forest elements in the local vegetation further decreased. The open area communities rose distinctly in importance. The development of the communities with sedges and reeds indicate the beginning of the overgrowing of the open-water area. The final stage of peat accumulation, from about 1 390 years BP onwards, was characterised by the domination of *Cyperaceae*, which became the main peat-forming plant on the mire. Recently *Myrica, Syzigium* and other trees and shrubs developed in the vicinity of the mire.

Mfabeni Swamp

The Mfabeni peatland is an active part of the wetlands on the eastern shore of the Greater St Lucia Wetland Park. This wetland lies between the lake and the range of tall, coastal dunes. The dunes are covered by forests and dry grassland. The peatland vegetation is composed of sedges,

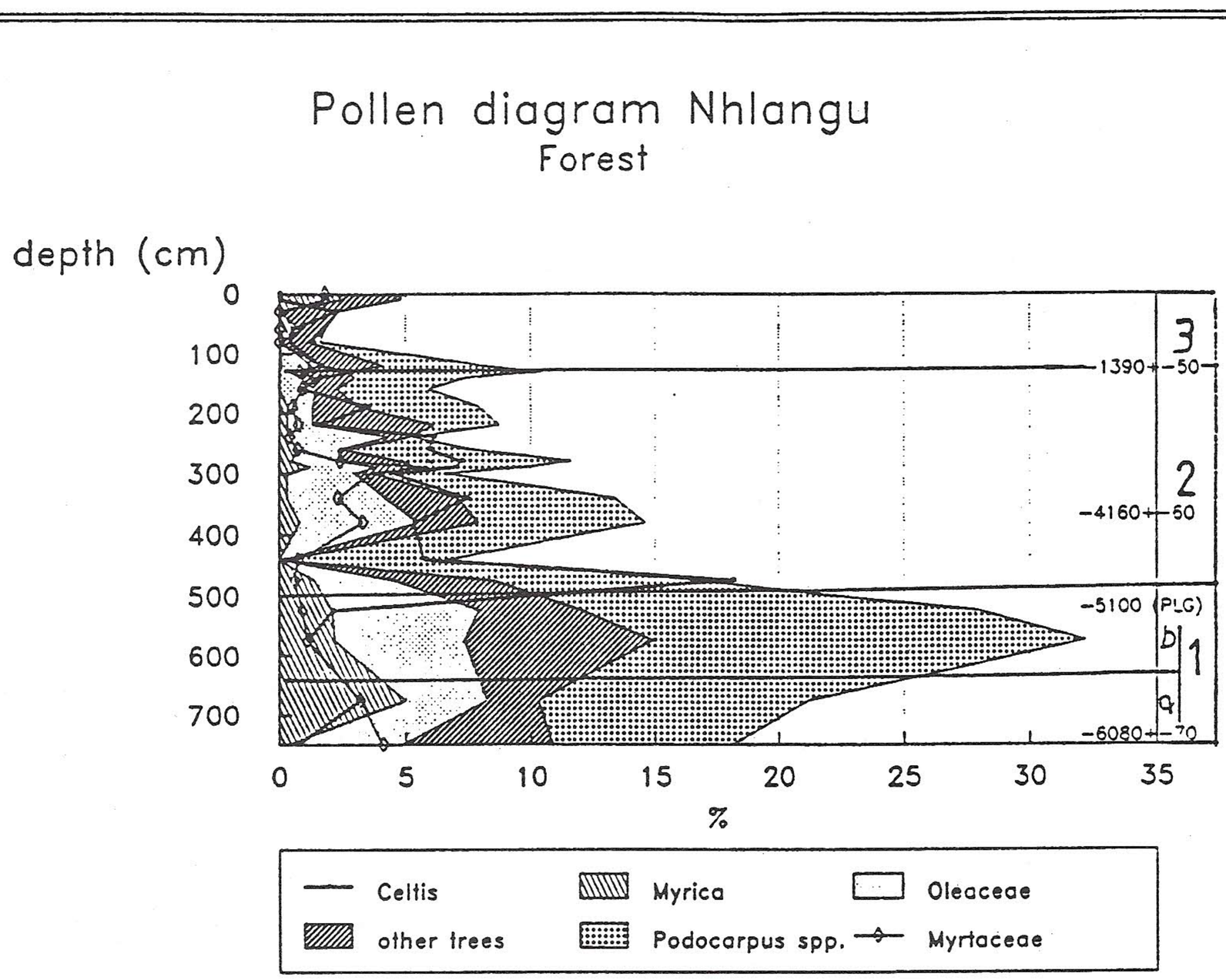


Fig. 13: Pollen diagram of Nhlangu; forest.

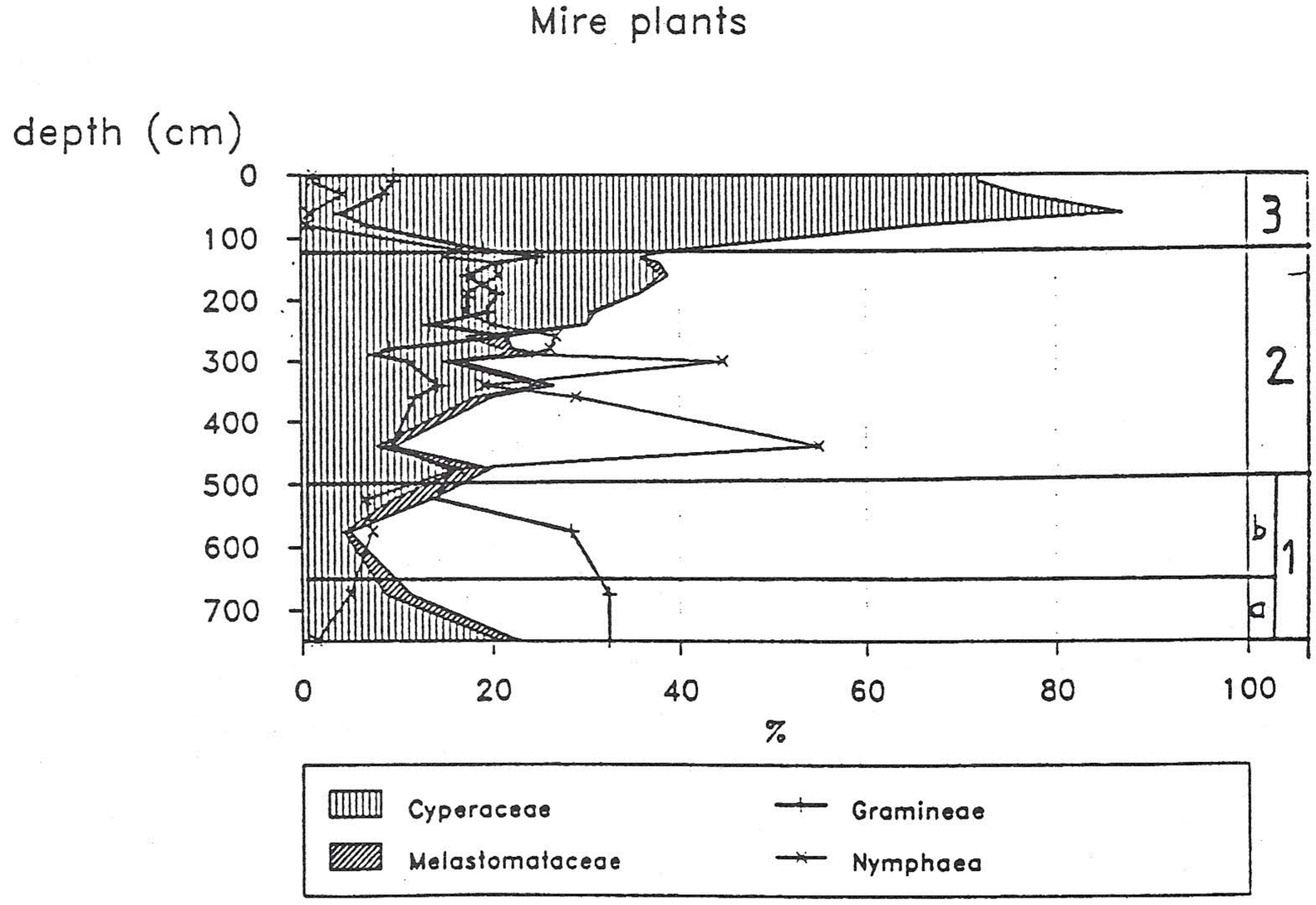


Fig. 14: Pollen diagram of Nhlangu; aquatic plants.

reeds and other hydrophilous grasses and bulb plants. A swamp forest exists along the Nkazana stream on the western edge of the wetland. Peat samples were taken to a depth of 10 m. More than a hundred samples were prepared and analysed.

Pollen data

(1) 10,00-9,80 m - There was no pollen found in this zone. In the bottom sample two spiral foraminifers were noted.

(2) 8,90-9,80 m - Arboreal pollen such as *Podocarpus, Celtis, Syzigium, Myrica* and *Olea* are numerous in the lower part of the zone (Fig 15). They decrease towards the top of the zone. Herbs are represented by the *Compositae* family with prominent *Stoebe* and *Anthospermum.* Pollen of aquatic plants such as *Nymphaea, Typha, Cyperaceae* and *Gramineae* are present as well as plants from damp habitats (Fig 16).

(3) 8,00-8,90 m - Arboreal taxa increase again. *Erica* and *Artemisia* appear among the dryland herbs. *Liliaceae* and *Plantaginaceae* families occur for the first time in this zone.

(4) 4,50-8,00 m - Arboreal pollen is very scarce. The curves of all trees incline below the value of 5% of the total sum. Pollen of *Stoebe, Artemisia* and other *Compositae, Anthospermum* and *Erica* are the most important components of the dryland vegetation. *Cyperaceae, Liliaceae* and trilete spores of ferns show an increase and reach the highest value in the whole profile. The aquatic pollen is very scarce. Only in the top part of the zone *Nymphaea* pollen percentages rise rapidly. In the sample from the depth 6,70 to 6,00 m single pollen grains of *Ceriops* and *Avicennia* are noted.

(5) 1,10-4,50 m - The arboreal pollen percentages greatly increase in this zone. Pollen of *Celtis, Syzigium, Myrica, Podocarpus, Olea* and other trees (*Apodytes, Spirostachys, Kiggelaria, Rhus* etc.) are very abundant. *Compositae* and *Anthospermum* decrease. Trilete spores of ferns are numerous.

(6) 0,00-1,10 m - The pollen composition shows a significant change. *Celtis, Syzigium, Myrica* and *Olea* decrease. The high percentages of arboreal taxa in this zone is due to the cultivation of the pine plantation next to the swamp. The herbaceous taxa are represented by grasses, sedges and plants belonging to the Daisy family.

History of vegetation

The lack of pollen and presence of foraminifers in the lowermost part of the profile suggest that at about 43 000 years BP the site was exposed to the open sea. Between 43 000 and 41 000 years BP the dryland vegetation appeared. It was a hydromorphous forest covered by *Podocarpus, Celtis* and other trees. The presence of *Typha* among the aquatic community indicates fresh-water conditions as bulrush stands don't tolerate salt water. Between 41 000 and 33 000 years BP pollen data still show the existence of a hydromorphous forest. However, samples from the part of the profile correlated with this period represent older, reworked peat. It is then possible that the vegetation showed by the pollen was not the vegetation that existed around the site between 41 000 and 33 000 years BP.

After 33 000 years BP the vegetation changed significantly. The podocarpus forest retreated. Extensive grassland with numerous herbs and bulb plants occupied the eastern shore. The most

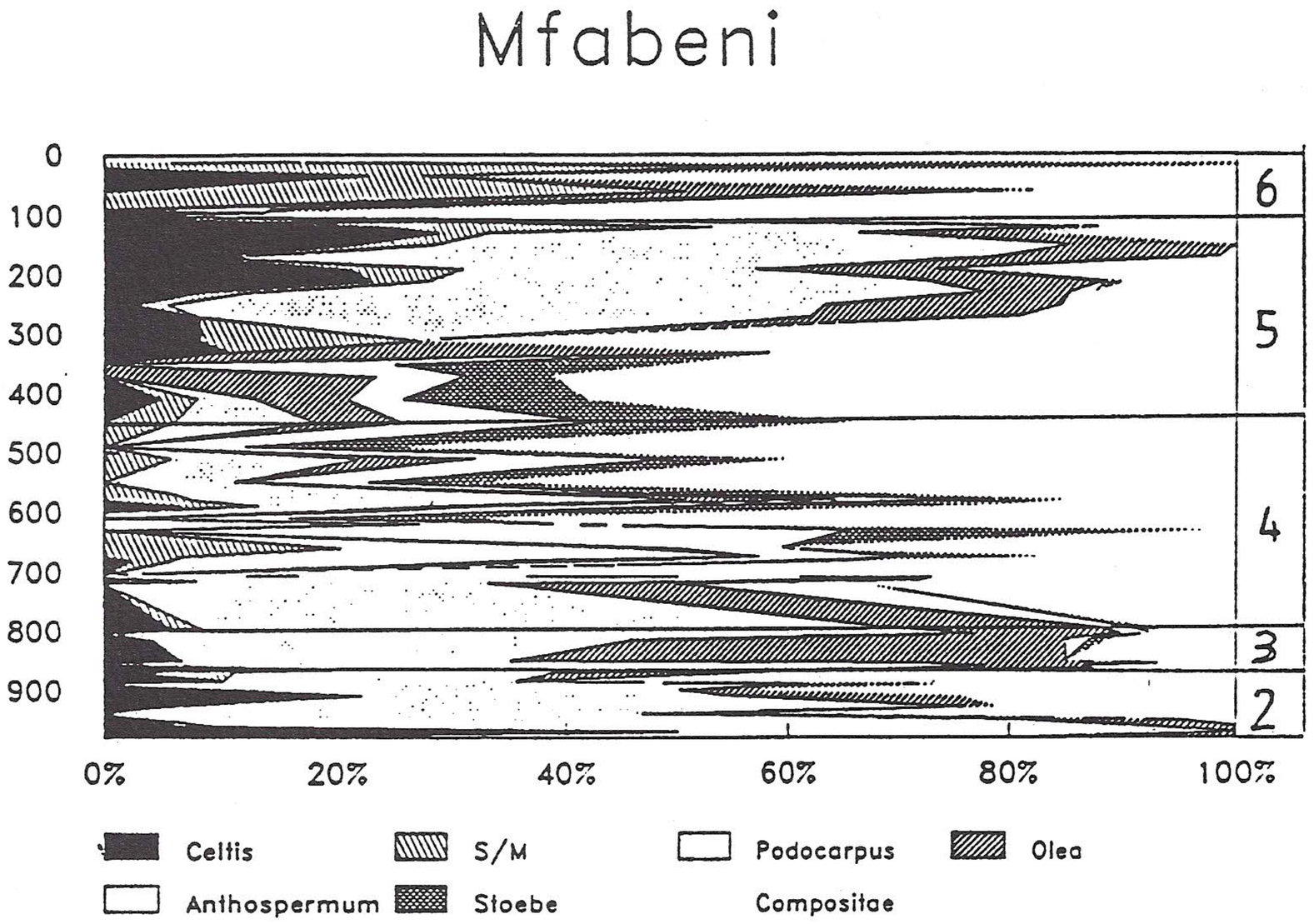


Fig. 15: Pollen diagram of Mfabeni; forest and dryland plants.

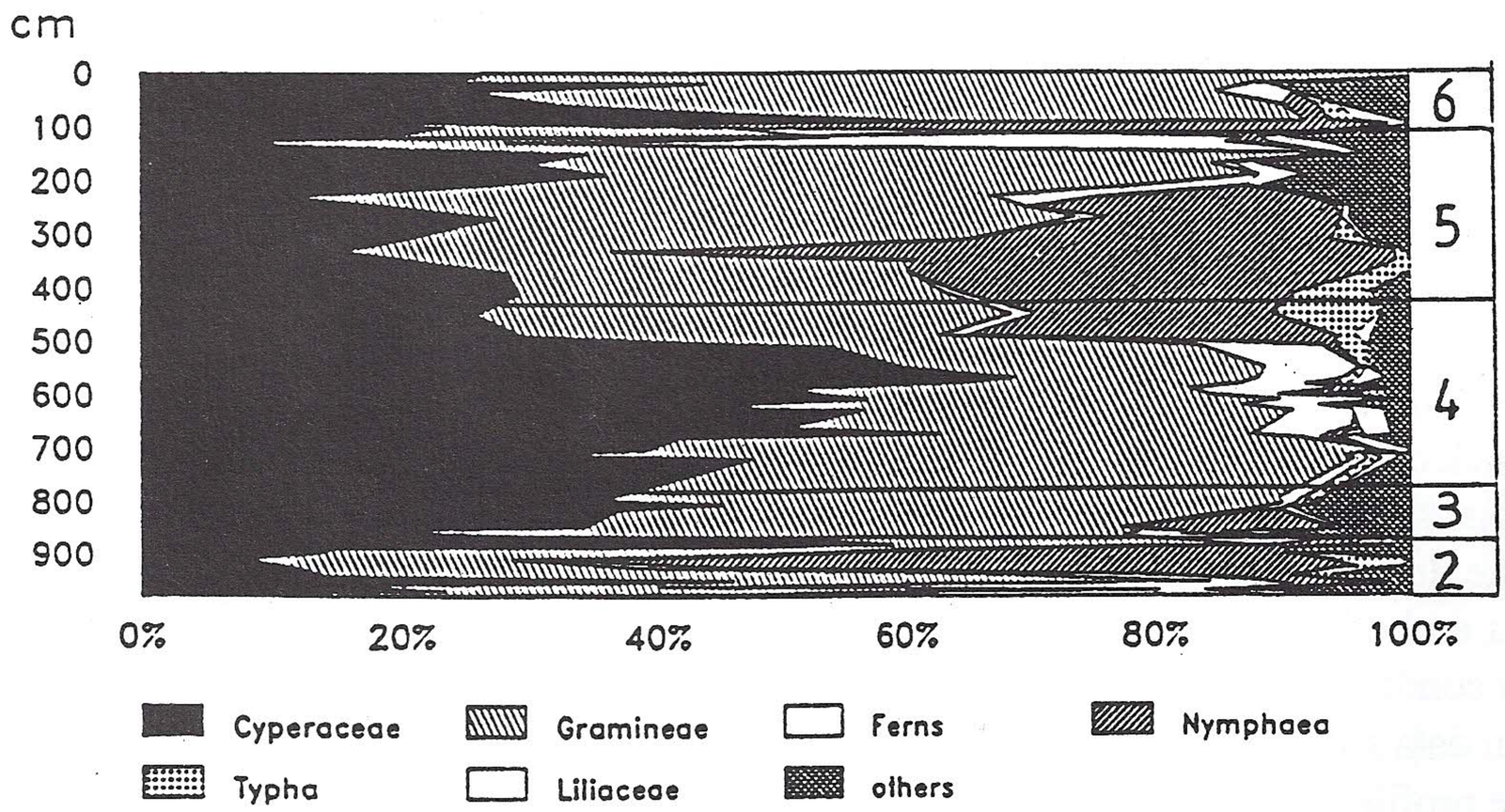


Fig. 16: Pollen diagram of Mfabeni; aquatic plants.

common elements of this community were *Anthospermum, Erica, Stoebe, Artemisia* and other *Compositae*. Such floristic composition indicates a dry, cool climate. The present-day *Erica* occurs commonly on the highland plateau, above 1 372 m. Its pollen in the Mfabeni peat suggests that the Ericaceous belt lowered in the Late Pleistocene.

Between 20 800 years BP and 11 570 years BP the conditions became wetter than earlier. The rapid increase in aquatic pollen suggests the rise of the water level on the mire. After 11 570 years BP the hydromorphous forest with the dominant *Podocarpus* accompanied by *Olea, Syzigium, Myrica, Celtis* and other trees expanded the area. The herbaceous ground layer was dominated by ferns.After about 5 000 years BP the *Podocarpus* started to emigrate from the area. At about 2 450 years BP forest and dryland herbs decreased, giving way for hydrofilous grasses and sedges. The swamp forest appeared at about 600 years BP, with species such as *Syzigium, Myrica, Ficus* and others.

CONCLUSION

The pollen diagrams (Fig 7 - 16) exhibit the expansion of a hydromorphous forest on the Maputaland area at the beginning of the Holocene. The forest, composed of *Podocarpus, Celtis, Olea, Syzigium, Myrica* and other trees and shrubs reached the maximum expansion at about 5 000 years BP After this time the forest retreated from the area, migrating to the north. The last occurrence of the *Podocarpus* pollen was noted at about 2 410 years BP in the south of the region (Mfabeni) and at about 1 390 years BP on the north (Nhlangu and Majiji). In the Sodwana region (Mgobezeleni) the podocarpus forest disappeared before ca. 1 500 years BP as no *Podocarpus* pollen were found in the profile. Presently a similar swamp forest exists in the Kosi Lake area.

The retreat of the forest possibly corresponds with climatic and hydrological fluctuation in the coastal region. The pollen data of the Mfabeni peatland show that similar, hydromorphous forest occupied the area in the Pleistocene, about 43 000 years BP. The forest retreated during the dry and cold climatic phase between 33 000 and 20 800 years BP. The vegetation dominated by cold-resistant elements developed. The occurence of *Erica* pollen in the profile of Mfabeni may a result of the lowering of vegetation belts in the Late Pleistocene.

A palaeoclimatic study in Southern Africa (Partridge et al, 1990) indicates that widespread dryness and temperatures lower than today prevailed between 40 000 and 17 000 years ago. The assemblages of pollen and spores of peat-forming plants in the examined profiles show succesions from open water conditions through reed/sedge vegetation to the swamp forest.

PLANT SPECIES COMPOSITION IN PEATLANDS IN MAPUTALAND, KWAZULU-NATAL

INTRODUCTION

Wetlands are distinguished by their hydrological regimes which maintain the water level at or above the land surface for long enough to promote the formation of waterlogged soils or sediments and the growth of wetland adapted plants (Rogers, Rogers & Buzer, 1985). In South Africa peat occurs in some wetlands in the eastern and southern regions; ranging from the sub-tropical interdune mires of the Zululand Mozambique Coastal Plain, interdune valleys along the south coast to the highveld sponges (Grundling, 1996).

The Zululand peatlands, observed in this study, occur in ecologically sensitive wetlands. The various uses of peat, medicinal, horticultural and commercial, are outweighed by the ability of wetlands to maintain and improve the quality of water. The quality and availability of potable water is important in rural areas such as Northern KwaZulu-Natal, where there are no or limited wastewater treatment systems, rivers are continuously being polluted and wetlands degenerated.

Peat accumulation is a slow process; plant species existing at present on peatlands may not reflect the vegetation that formed the peat. A clearer understanding of the natural dynamic processes in peatlands can be achieved by comparing the present species composition with the composition as determined in paleoecological studies. Once this understanding is achieved, inferences may be made on the impact of various management and exploitation strategies.

The observations in this study form part of the Wetland Inventory for the Department of Environment Affairs and Tourism. The primary aim of this study was to establish which plant species are presently contributing to peat formation. However, inferences can be made, from this study, on the conservation status of these wetlands by considering how the present utilization of peat is affecting the integrity of the wetland.

STUDY AREA

Twelve wetlands along the Mozambique Coastal Plain were selected, based on accessibility and representing a variety of papyrus/reed/sedge, swamp forest and sedge/grass peatlands. These peatlands include: Muzi swamp in the Tembe Elephant Park, an undisturbed and cultivated Swamp Forest at Kosi Bay, Nhlangu pan near Black Rock, a swamp at Lake Sibaya, three areas in the Greater St Lucia Wetland Park, the Mfabeni swamp and Nkazana swamp forest near Cape Vidal, a small pan north of Vasi Pan in the Manzengwenya Plantation and a wetland north of Majiji Plantation (Fig 1).

The study sites were all located in the Coast Lowlands Bioclimatic Group where the mean annual temperature ranges from 20 to 22,5 °C and the humidity fluctuates between highly humid to subhumid (Phillips, 1969). The mean annual rainfall ranges between 600mm and 1100mm (Dent,Lynch & Schulze, 1989). The moisture regime is moist to wet indicative of swamp conditions. The depth of peat in these wetlands ranges between 150cm-1000 cm (Grundling, 1996). All the wetlands have a peat substrate underlaid by Aeolian sands of marine origin.

RESULTS

The following describe observations made at each of the twelve study sites. The location, species number, altitude, mean annual rainfall and the peat depth at each of the sites is described in Fig 2. Given that the study period was limited to November 1996 toMarch 1997, the species composition listed in Appendix A represents only those species present during this period.

Muzi-Wes Swamp

The swamp is dominated by *Phragmites australis* (Common Reed). A dry ridge, on which woody species occur, runs parallel within this otherwise wet reed swamp. Observations were limited to the reed bed where peat occurs. In comparison to other peatlands observed, the absence of undergrowth was significant. During the observation period, undergrowth was limited to the edges of the swamp and along the ridge within the swamp. Within the reed bed the undergrowth was minimal and increased slightly in January with the appearance of the grass species *Leersia hexandra*.

Prior to proclamation in 1983, the Tembe Elephant Park was utilized on a small scale by local communities for cultivation and cattle grazing. At present, there is controlled harvesting of reeds. Harvesting occurs throughout the year, where locals remove as much as they can carry (Hanekom, 1995). According to Matthews (1997, pers.comm.) the area has not been burnt for the past 8 to 10 years. The area is frequented by elephants (particularly on the higher lying ridge), hippopotami, bushpig and small antelope.

A unique feature of this swamp was the abundance of gastropod-shaped shells in the peat which may, according to Grundling (1996, pers. comm.), be of brackish or fresh water origin. However, further study on the origin and significance of this occurrence is needed.

Matitimane Peatland - cultivated

It was observed that this area was previously a swamp forest; as it runs alongside the western boundary of Kosi Bay Camp which borders on swamp forest. It has subsequently been cleared for cultivation by the local community with few remaining swamp forest trees. The peat was moist in cultivated areas and dry on footpaths and reaped or fallow areas. Cultivated species (namely, sugar cane, banana and elephant ear), are noticeably vigorous. For example, elephant ear grow to a height of 2 - 2.5m.

Matitimane Peatland - uncultivated

This section of the swamp forest at Kosi Bay falls within the control of the KwaZulu Department of Nature Conservation and is therefore not under cultivation. The forest was visually dominated by *Ficus trichopoda, Syzygium cordatum* and *Voacanga thouarsii* with a dense understorey. Unlike the forests at Sodwana Bay and Mfabeni where one can walk within the forest with ease, this forest is not easily penetrated due to the dense undergrowth. The forest floor is dominated by *Desmodium setigerum* and in the very wet areas by *Leersia hexandra*.

Nhlangu Peatland
This pan was dominated by sedges, predominately *Cyperus sphaerospermus.* During the observation period the pan was very wet, however it has been noted by Grundling (1996 pers.comm.) that because the water levels fluctuate according to rainfall, the pan is at times dry with only a patch of water in the centre. *Phragmites australis* and *Cladium mariscus* are harvested by the local community. According to Matthews (1997, pers.comm.), the surrounding grasslands and pans are burnt annually by the local communities.

KwaSonto 612 Peatland
This swamp was dominated by *Cyperus papyrus* (papyrus) with Thelypteris interrupta and moss forming the undergrowth. The peat was wet and spongy with numerous small clumps of decaying papyrus stalks. Papyrus and Typha capensis are harvested by the local community.

Mgobezeleni-Oos
This Swamp Forest is dominated by *Ficus trichopoda* and *Syzigium cordatum*; the undergrowth consists mainly of ferns and herbaceous climbers. Of particular interest in this swamp forest is the occurrence of *Psilotum nudum.* This plant is unique in that it is a living representative of a seedless vascular plant. *P.nudum* lacks both leaves and roots. The aerial portion or sporophyte is dichotomously branched with scalelike outgrowths arising from a subterranean rhizome (Raven, Evert & Eichhorn, 1886). *P.Nudum* is widespread in tropical and subtropical regions but rarely seen.

In some areas on the Lake shore, the vegetation has been removed by slash burning to make way for vegetable gardens. There is also evidence of tree felling.

Mkuze Swamp 888
This swamp is dominated by reeds with a dense grass cover of *Ischaemum fasciculatum* and *Trichopteryx dregeana*, forming the undergrowth. The floor of the swamp was observed to be dry due to the dense grass cover but below the surface the peat is moist to wet. There appears to be a species zonation in the swamp; where reeds occur at the edges and large patches of papyrus in the centre. Woody species associated with swamp conditions were observed in patches in the drier regions of the swamp.

The area is undisturbed and although there is a burning programme, burning is usually uncontrolled and occurs each year. No harvesting is permitted but small scale illegal harvesting of reeds does occur (Baartman, 1997, pers.comm.)

Mkuze Swamp 906
There is a distinct species zonation in this swamp. The edges are dominated by *Typha capensis* with patches of reeds or papyrus. Beyond the bulrushes, reeds predominate with large stands of papyrus in the centre of the swamp. The undergrowth is prolific, dominated by sedges at the edge and *Mikania natalensis* and *Thelypteris interrupta* in the reed and papyrus zones. *Scleria sobolifer*, which occurs in this area, is endemic to KwaZulu-Natal and the Transkei (now part of the Eastern Cape) (Gordon-Gray,1997, pers.comm.).

The area is protected and hence undisturbed. There is, however, small scale illegal harvesting of reeds. There is no burning programme but according to Baartman (1997 pers. comm.), arson fires do occur on a yearly basis.

Mfabeni Swamp

This swamp was dominated by sedge with a patchy species distribution. The very wet patches appeared to be monospecific with the sedge species *Fimbristylis longiculmis*. The moist to wet areas were dominated by *Rhynchospora holoschoenoides* with stands of *Rhynchospora corymbosa.* There were also stands of *Cladium mariscus* within the wet areas surrounding one or more woody species such as *Syzygium cordatum*, *Ficus verruculosa* and *Ficus trichopoda*. The higher lying islands were dry on the surface and dominated by grass. *Scleria sobolifer* (endemic to KwaZulu-Natal) also occurs in this swamp. No harvesting is permitted in this area.

Nkazana Swamp Forest

This swamp forest was dominated by *Syzygium cordatum* (Umdoni) in the northern parts and *Barringtonia racemosa* in the south. The forest edges were dominated by *Thelypteris interrupta* and *Smilax anceps* making access into the forest difficult. The undergrowth within the forest is dominated by the fern species *Stenochlaena tenuifolia* . In areas in the northern parts this fern species is seen to cover the entire trunks of trees. The forest floor is covered by decomposing leaf material with saplings emerging, noticeably *Myrica serrata* in the Umdoni dominated region. *Psilotum nudum* has been observed by Wessels (1997) in the Barringtonia dominated region of the forest. The moss species *Sphagnum spp.,* commonly associated with peatbogs in Ireland, was observed by Wessels (1997, pers. comm.) in the northern parts of the forest.

Buffalo, waterbuck, reedbuck and bushpig frequent this area. There is no burning programme for the forest, however when the Mfabeni sedge swamp burns, the northern parts of the forest have been affected (Blackmore, 1997, pers.comm.). No harvesting is permitted in this area.

Vasi Pan Noord

The northern part of the pan was dominated by grass while in the southern part *Syzygium cordatum* and *Ficus verruculosa* predominate. This pan has dried up as a result of the pine plantation that surrounds the pan.. The area encompassing the pan was hot and humid and the peat was very hot underfoot, with numerous cracks up to 1.5m deep. This peatland may be in danger of burning by spontaneous combustion or ignition.

There is an abundance of ants, grasshoppers and pepperticks. The pan is strongly influenced by man. The pine plantation is encroaching and livestock (cattle and goats) utilize the area heavily.

Majiji Peatland

This wetland was dominated by grass species. The low lying areas were wet but the surface of the rest of the wetland was dry. The surface was spongy and cool underfoot unlike Vasi Pan Noord. The area is utilized by cattle and within this wetland bioturbation was observed. The northern parts of the wetland are utilized for cultivation by the local community.

Table 4: The Location, species number and environmental attributes of the peatland study sites in KwaZulu-Natal

Study Site	Muzi-Wes 70	Matitimane 233	Matitimane 244	Nhlangu Pan	KwaSonto 61	Mgobezeleni Oos	Mkuze Swam 888	Mkuze Swa 906	Mfabeni	Nkazana	Vasi Pan Noord	Majiji 346
Location												
Major:	Ngwavuma	Ngwazuma	Ngwazuma	Ngwazuma	Ngwazuma border	uBombo	uBombo	uBombo	Hlabisa	Hlabisa	Ngwavuma	Ngwavuma
Minor:	Tembe Elephant	Kosi Bay camp	Kosi Bay Camp	Siyandla	Lake Sibaya	Sodwana Bay	Manzibomvu	Ntshangwe	Bhangazi	Bhangazi	Manzengwenya	Mvelabusha
Precise:	Park ,KwaMsomi area. Eastern side of the swamp	Cultivated area next to western boundary fence.	Swamp forest along side the western boundary fence	Nhlangu Pan,2km north-west of Black Rock	Swamp at the end of channel south-west of KwaSonto	South-eastern side of Lake Mbobezeleni	South of where the Mbazwane stream enters the swamp.	1 km north-west of Ntshangwe Guard Camp	24km from the Mfabeni entrance to Cape Vidal	Forest north of Nkazana stream	Small pan north of Vasi Pan	North of Majiji Plantation ,South of Ntombeni Pan
Grid reference:	S 27 00'36" E 32 30'26"	S 26 57'38" E 32 49'11"	S26 57'10" E32 48'56"	S27 06'40" E32 49'05"	S27 18'30" E32 37'40"	S27 32'07" E32 39'38"	S27 38'09" E32 32'66"	S27 39'15" E32 30'65"	S28 09'44" E32 31'64"	S28 10'16" E32 29'96"	S 27 10'35" E32 42'59"	S27 08'06" E32 40'00"
Observation period	Nov. 1996 & Jan. 1997	Jan. 1997	Mar.1997	Dec.1996	Dec. 1996	Dec.1996& Jan. 1997	Dec.1996	Jan. 1997	Feb.1997	Feb. 1997	Dec. 1996	Jan 1997
Species Numb	21	41	43	26	20	41	26	32	35	41	41	28
Ferns	0	2	3	1	1	4	0	1	1	5	1	1
Bulrush	1	0	1	0	1	1	0	1	0	1	0	0
Grasses	3	5	1	1	2	3	3	6	7	3	6	5
Sedges	4	4	6	11	7	5	7	8	11	3	5	6
Orchids	0	0	0	1	0	0	1	0	0	1	0	1
Herbs	12	12	14	10	7	12	12	14	12	14	18	13
Trees & Shrubs	1	10	18	2	0	15	3	2	3	13	10	2
Parasites	0	0	0	0	0	0	0	0	1	1	1	0
Altitude	40m	40m	40m	30m	20m	20m	20m	20m	20m	20m	50m	30m
Mean Annual Rainfall (Dent et al, 1989)	645	938mm	938mm	798mm	703mm	842mm	954mm	997mm	1062mm	1141mm	822mm	785mm
Depth of Peat (Grundling, 1996)	310	350cm	610cm	865	270cm	240cm	280cm	590cm	1000cm	400cm	340cm	340cm

CONCLUSION

It was concluded from observations on species composition that peatlands in KwaZulu-Natal may be classified into three broad categories based on the plant communities occurring on the wetlands. The main categories were: Swamp Forest, Reed/Papyrus/Bulrush swamp and Grass/Sedge swamp. The latter two categories were relatively homogenous with the appearance of forbs and woody species subject to rainfall and land-use. The swamp forests have a greater species diversity which may not be apparent in these observations due to a limited study period.

The main species contributing to peat formation are *Cyperus papyrus, Phragmites australis,* a combination of sedge species and *Syzygium cordatum*. Many of the sedge species in Northern KwaZulu-Natal have not been extensively studied, thus the maintenance of their habitats is important for further taxonomic studies.

At present the use of peatlands by local communities is threefold: drinking water, harvesting naturally occuring plant material and growing vegetables. Unsustained harvesting of plant resources and utilizing peat for vegetable gardens will lead to the degeneration of the wetlands. Consequently not only will there be a decline in the quantity and quality of potable water in KwaZulu-Natal, but also the use of wetlands for structural materials, as a medicinal resource and subsistance agriculture.

Table 5: . Plant species observed on Peatlands in Northern KwaZulu-Natal,November 1996- Cn = Collection number , # = Introduced species for horticultural practices, Species names as p Arnold & de Wet (1993). Locations, refer to text : 1- Musi-Wes , 2- Matitimane 233, 3- Matitim 4- Nlangu, 5- KwaSonto, 6- Mgobezeleni , 7- Mkuze swamp 888, Mkuze swamp 906, 9- Mfab (refer to Wessels (1997) for additional species found at this site), 11- Vasi Pan Noord, 12- Majiji

Cn	Species Name	Location											
		1	2	3	4	5	6	7	8	9	10	11	12
	Pteridophyta												
	Psilotaceae												
92	Psilotum nudum (L.) Beauv.						*						
	Schizaeaceae												
154	Lygodium microphyllum (Cav.)R.Br.			*							*		
	Polypodiaceae												
84	Microsorium punctatum (L.)Copel						*				*		
91	Microsorium scolopendrium (Burm.f.) Copel						*						
	Davalliaceae												
	Nephrolepis bisserata (Swartz) Schott										*		
	Thelypteridaceae												
64	Thelypteris interrupta (Willd.) K.Iwats		*	*	*	*	*		*	*	*	*	*
	Blechnaceae												
85	Stenochlaena tenuifolia (Desv.)T.Moore		*	*			*				*		
	Gymnospermae												
	Pinacea												
	Pinus elliotti Engelm. #											*	
	Angiospermae												
	Monocotyledons												
	Typhaceae												
	Typha capensis (Rohrb.)N.E.Br.	*		*		*	*		*		*		
	Poaceae												
55	Andropogon eucomis Nees								*	*		*	*
	Cynadon dactlon(L.) Pers.												*
56	Digitaria eriantha Steud.					*							
61	Digitaria didactyla Willd.											*	
34	Eragrostis inamoena K.Schum.									*		*	*
2	Imperata cylindrica (L.) Raeuschel	*											
47	Ischaemum fasciculatum Brongn.		*			*		*			*		
109	Leersia hexandra Swartz	*	*	*			*		*	*		*	*
86	Panicum aequinerve Nees						*		*	*	*	*	*
121	Panicum hymeniochilum Nees								*				
110	Paspalum urvillei Steud.		*										
8	Phragmites australis (Cav.) Steud.	*	*		*		*	*	*	*			
	Saccharum officinarum L. #		*										
153	Setaria sphacelata (Schumach.) Moss var.sericea (Stapf)Clayton										*		
166	Sorghastrum stipoides (Kunth) Nash								*				
111	Sporobolus africanus (Poir.) Robyns & Tournay		*										
104	Trichopteryx dregeana Nees							*		*			
142	Unknown sp1											*	
168	Unknown sp2									*			
	Zea mays L.#	*											

Cn	Species Name	Location 1	2	3	4	5	6	7	8	9	10	11	12
	Cyperaceae												
48	Bulbostylis burchelli (Ficalho &Hiern) C.B.Clarke					*							
79	Carex cognata Kunth var. cognata						*						
7	Cladium mariscus (L.)Pohl ssp. jamaicense (Crantz) Kuekenthal	*			*		*	*		*		*	*
108	Cyperus dives Delile		*										
40	Cyperus fastigiatus Rottb.											*	
49	Cyperus natalensis Hochst.					*							
46	Cyperus papyrus L.					*		*	*				
1	Cyperus prolifer Lam.	*	*	*	*	*	*	*	*	*	*	*	*
22	Cyperus spaerospermus Schrad.				*	*							
24	Cyperus X turbatus Baijnath				*								
150	Cyperus sensilis Baijnath									*			*
163a	Eleocharis dulcis (Burm.f.) Hensch				*								
149	Fimbristylis complanata (Retz.) Link									*			
4	Fimbristylis ferruginea (L.) Vahl	*											
41	Fimbristylis longiculmis Steud.				*					*			
170	Fimbristylis sp. (comp. F.complanata (Retz.) Link)								*				*
158	Fuirena obcordata P.L. Forbes				*			*	*	*			*
116	Fuirena umbellata Rottb.		*	*									
3	Juncus kraussii Hochst.	*											
102	Mariscus solidus (Kunth) Vorster							*					
62	Pycreus mundii Nees				*	*		*	*	*			
51	Pycreas nitidus (Lam.) J. Raynal		*					*				*	*
151	Pycreas polystachyos (Rottb.)P.Beaux		*	*		*				*			*
133	Rhynchospora corymbosa (L.) Britton									*			
21	Rhynchospora holoschoenoides (Rich.) Herter				*					*			
143	Scleria angusta Nees ex Kunth			*	*		*				*		
165	Scleria melanomphala Kunth								*				
31	Scleria poiformis Retz.				*		*		*		*	*	
130	Scleria sobolifer E.F.Franklin								*	*			
	Arecaceae												
94	Hyphaene coriacea Gaertn.						*					*	
	Phoenix reclinata Jacq.		*								*		
	Araceae												
	Colocasia spp (comp. C.esculenta(L.)Shott #	*					*						
	Xyridaceae												
23	Xyris anceps Lam.				*				*	*	*		*
	Commelinaceae												
35	Commelina diffusa Burm.f subsp.diffusa	*	*		*	*					*	*	
	Asparagaceae												
30	Protoasparagus setaceus (Kunth)Oberm.											*	
	Smilaceae												
32	Smilax anceps Willd.	*	*			*	*			*	*	*	
	Musaceae												
	Musa acuminata Colla #	*											
	Orchidaceae												
	Cyrtorchis arcunta (Lindl.) Schltr.										*		
20	Eulophia spp. (comp. E.angolensis (Reichb.F.)Summerh)				*			*					*

Cn	Species Name	Location 1	2	3	4	5	6	7	8	9	10	11	12
	Dicotyledonae												
	Myricaceae												
076	Myrica serrata Lam.	*		*			*	*	*		*		*
	Ulmaceae												
127	Trema orientalis (L.) Blume		*										
	Moraceae												
	Ficus lutea Vahl			*									
28	Ficus natalensis Hochst. subsp.natalensis											*	
	Ficus sur Forssk.						*				*		
39	Ficus trichopoda Bak.		*	*	*		*	*	*	*	*	*	
29	Ficus verruculosa Warb.				*					*		*	
	Polygonaceae												
58	Polygonum plebeium R.Br.	*		*	*	*		*	*		*	*	*
	Amaranthaceae												
101	Achyranthes spp.					*							
	Menispermaceae												
99	Cissampelos torulosa E.Mey. ex Harv.			*								*	
	Capparaceae												
36	Capparis fascicularis DC. var. zeyheri (Turcz.)Tolken						*					*	
	Rosaceae												
71	Rubus rigidus J.E.Sm.	*						*					
	Fabaceae												
37	Abrus precatorius L.subsp. africanus Verdc.		*				*					*	
27	Albizia adianthifolia (Schumach.)W.F.Wight		*	*								*	
132	Aspalanthus spp.(Comp. A.gerrardii H.Bol.)									*			
93	Canavalia rosea (SW.) DC.						*				*		
52	Chamaecrista mimosoides (L.) Greene		*			*			*	*			
182	Dalbergia obovata E.Mey.			*									
113	Desmodium dregeanum Benth.		*	*						*			*
88	Desmodium setigerum (E.Mey.) Benth. ex Harv.			*			*				*		
50	Eriosema parviflorum E.Mey.			*		*		*	*	*			
155	Eriosema ssp. (comp. E. superpositum CH Strirton)										*		
	Euphorbiaceae												
157	Antidesma venosum E.Mey. ex Tul.			*							*		
82	Bridelia micrantha (Hochst.) Baill						*				*		
124	Macaranga capensis (Baill.) Benth.ex.Sim		*	*							*		
	Manihot esculenta Crantz #		*										
	Anacardiaceae												
	Mangifera indica L. #		*										
112	Rhus nebulosa Schonl.		*	*			*				*		
	Rhus pyroides Burch.			*			*						
	Icacinaceae												
	Apodytes dimidiata E.Mey. ex Arn. subsp. dimidiata			*							*		
	Tiliaceae												
60	Grewia flavenscens Juss. var. flavescens												*
	Malvaceae												
73	Hibiscus surattensis L.							*	*				
80	Hibiscus tiliaceus L.						*						
106	Hibiscus spp.		*										
	Clusiaceae												
134	Hypericum lalandii Choisy									*			
	Passifloraceae												
126	Passiflora subpeltata Ortega.	*											

Cn	Species Name	Location 1	2	3	4	5	6	7	8	9	10	11	12
	Thymelaeaceae												
177	Peddiea africana Harv.						*				*	*	
	Lythraceae												
72	Nesaea tolypobotrys Koehne							*					
53	Nesaea spp.											*	
	Lecythidaceae												
81	Barringtonia racemosa (L.) Roxb.			*			*				*		
	Myrtaceae												
	Syzygium cordatum Hochst.		*	*			*			*	*	*	*
	Melastomataceae												
122	Dissotis canescens (E.Mey.ex R.A.Grah.)Hook.f.								*				
	Araliaceae												
181	Schefflera umbellifera (Sond.) Baill.			*									
	Apiaceae												
14	Centella asiatica (L.) Urban	*	*	*	*		*	*		*		*	*
12	Hydrocotyle bonariensis Lam.	*					*	*			*		*
	Primulaceae												
5	Samolus valerandi L.	*											
	Loganiaceae												
100	Strychnos spinosa Lam.											*	
	Apocynaceae												
95	Carissa bispinosa (L.) Desf.ex Brenan subsp. zambesiensis Kupicha											*	
	Tabernaemontana elegans Stapf			*									
	Tabernaemontana ventricosa Hochst. ex A.DC.		*										
77	Voacanga thouarsii Roem.&Schult.		*	*			*				*		
	Rauvolfia caffra Sond.						*				*		
	Periplocaceae												
75	Tacazzea apiculata Oliv.							*					
	Asclepiadaceae												
9	Asclepias physocarpa (E.Mey.) Schltr.	*			*			*	*	*			*
	Convolvulaceae												
	Cuscuta campestris Yunck.									*	*	*	
107	Hewittia spp.		*										
172	Hewittia sublobata (L.f.) Kuntse			*							*		
	Ipomoea batatas (L.)Lam.#		*										
83	Ipomoea mauritiana Jacq.		*	*			*				*		
171	Ipomoea spp.										*		
129	Ipomoea spp.						*						
135	Ipomoea spp.											*	
	Verbanaceae												
	Lantana rugosa Thunb.	*											
10	Phyla nodiflora (L.) Greene var.nodiflora	*											
	Solanaceae												
38	Solanum spp. (comp. S.coccineum Jacq.)											*	
33	Solanum sisymbrifolium Lam.		*									*	
	Scrophulariaceae												
17	Alectra sessiliflora (Vahl) Kuntze var.sessiliflora			*				*	*	*			
	Halleria lucida L.											*	
117	Torenia thouarsii (Cham. & Schlechtd.)Kuntze		*										
	Acanthaceae												
173	Asystasia gangetica (L.) T. Anders			*									
	Rubiaceae												
178	Keetia gueinzii (Sond.) Bridson			*									

Cn	Species Name	Location 1	2	3	4	5	6	7	8	9	10	11	12
	Rubiaceae												
	Kraussia floribunda Harv.						*						
18	Pentadon pentandrus (Schumach.&Thonn.)Vatke var. minor Brem.				*	*						*	*
	Richardia brasiliensis Gomes											*	
19	Spermacoce natalensis Hochst.				*				*	*		*	*
183	Tarenna pavettoides (Harv.) Sim subsp. pavettoides			*									
	Curcurbitaceae												
	Cucurbita moschata (Duchesne)Poir.#		*										
16	Mukia maderaspatana (L.)M.J.R.Roem.	*											
	Lobeliaceae												
25	Lobelia flaccida (Presl.)A.DC.subsp.mossiana (R.Good)Thulin	*			*				*	*	*	*	*
	Asteraceae												
	Bidens pilosa L.		*										
57	Blumea spp.		*			*			*				
	Conyza chilensis Spreng.		*										
69	Conyza spp. (comp. C.obscura DC.)			*				*	*			*	
67	Gerbera spp.					*							
138	Helichrysum decorum DC.												*
140	Helichrysum nataliticum DC.				*				*				*
6	Melanthera scandens (Schumach. & Thonn)	*											
74	Mikania natalensis DC.				*			*	*				*
89	Unknown spp. (comp. Mikania cordata DC.)			*			*				*	*	
141	Unknown spp.												*
	Unknown Species												
68	Unknown spp. 1					*							
87	Unknown spp. 2						*						

THE VARIABILITY IN THE CHARACTERISTICS OF MAJIJI, A PEAT DEPOSIT IN KWAZULU-NATAL, SOUTH AFRICA

The purpose of this study was to determine the variability of the characteristics of peatlands on the northern Zululand Mozambique Coastal Plain (MCP). A known peatland, Majiji (No.58), was chosen for this purpose.

INTRODUCTION

Majiji is a small peatland that forms part of the MCP and is situated at latitude 27°08'S and latitude 32°42'E just north of the Majiji Plantation, KwaZulu-Natal (Fig 1). This peatland, with a surface cover of sedges, ferns and reeds is an elongated interdune deposit parallel to the coast and typical of the MCP. It has an area of 80 000 m^2, a maximum thickness of 3.4 m (Mazus & Grundling, 1995)and an estimate volume of 130 000 m^3 of wet peat .

METHODS

Nine holes were sunk to sample Majiji along three traverses across the length of the peatland. Additional data was obtained from work done by previous personnel of the Council for Geoscience of South Africa (e.g. Smuts, 1994). This results were then compared, to a limited degree, to results from a swampforest just south of Lake Mgobezeleni (Fig 1). The results from the peatland at Lake Mgobezeleni were obtained from a report by Smuts, 1992 and two additional holes sunk in the deposit. Methods as described in the main introduction.

CHARACTERISTICS

Physical Characteristics

Colour

The layering according to the colour of the peat is reasonably consistent throughout the peat deposit (Fig 21). The colour of the peat varies from surface to bottom as follows: a top reddish brown peat, followed by a dark peat, followed by a dark peat with reddish nodules and a lower dark peat layer. A reddish dark peat forms the bottom at the deeper part of the peatland (Fig 21).

There is a tendency in the layering of thinning out to the shallower end in the northern part of the deposit while the top red layer differ in this by thinning out to the deeper end (Fig 21d). The bottom two layers are missing in traverse no 3 (Fig 21c) and the bottom red layer from traverse no 2 (Fig 21b).

Fibre Length

In depth the peatland could be divided into four main zones according to the fibre length (Fig 22). These zones decrease generally in fibre length from > 15 mm (top zone) to 3 between 15 - 5 mm (middle zone) to < 5 mm (bottom zone) and are continuous throughout the deposit (Fig 22). A zone with a fibre length < 5 mm exists between the top and middle zone in the northern (Fig 22c) and the southern (Fig 22a) part of the peatland but is absent from the middle part (Fig 22b & d).

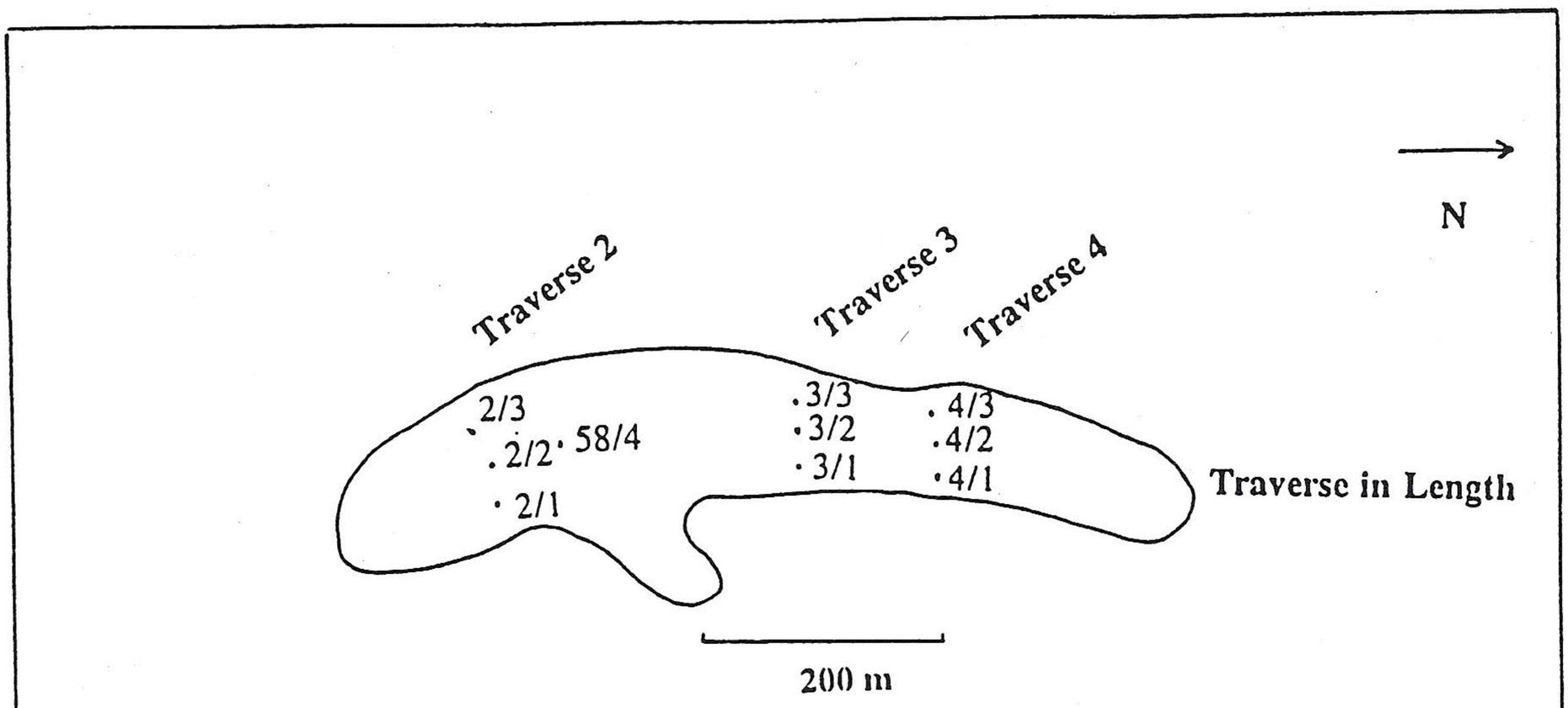


Fig. 19: Map of sample sites of Majiji.

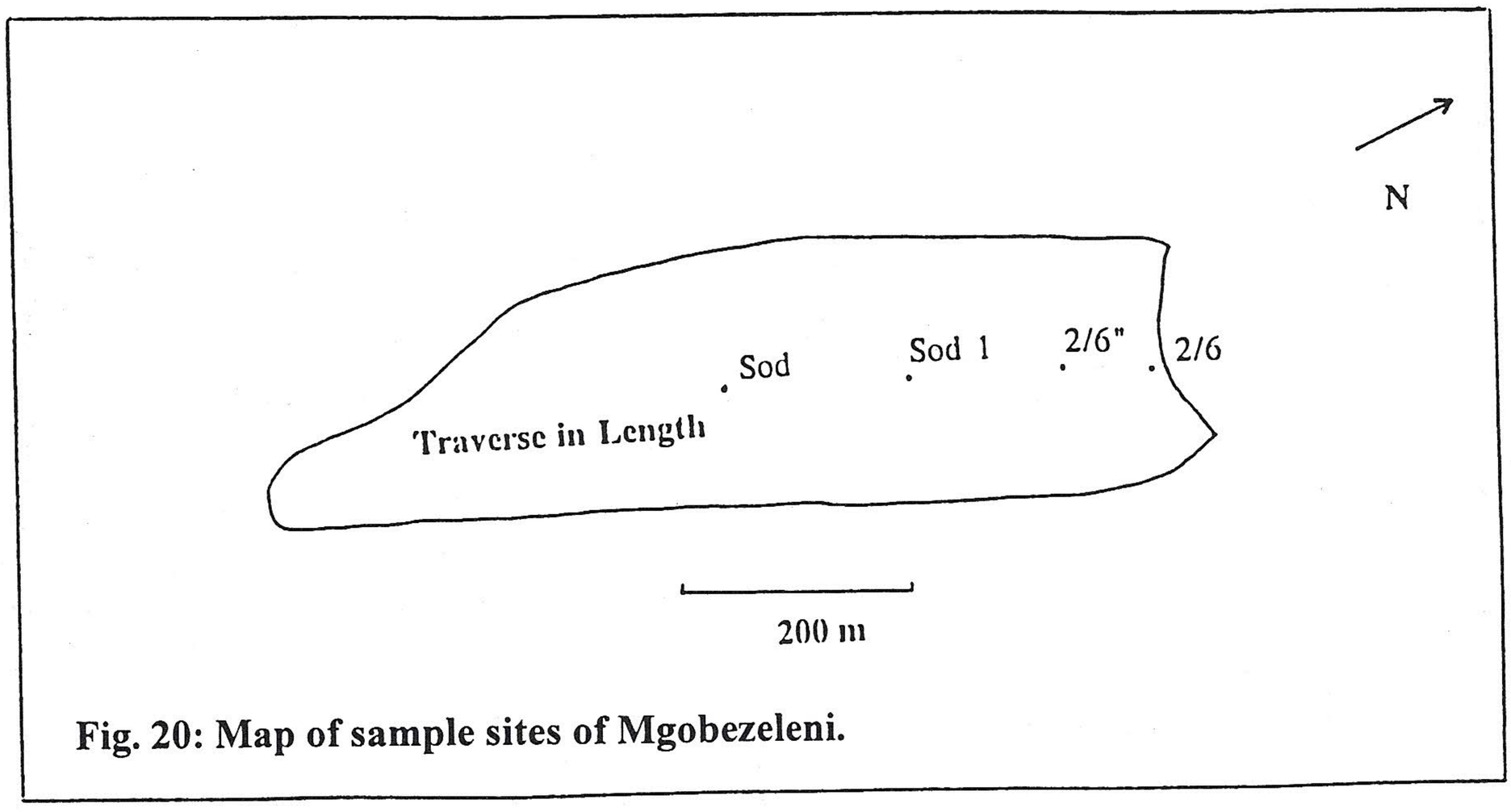
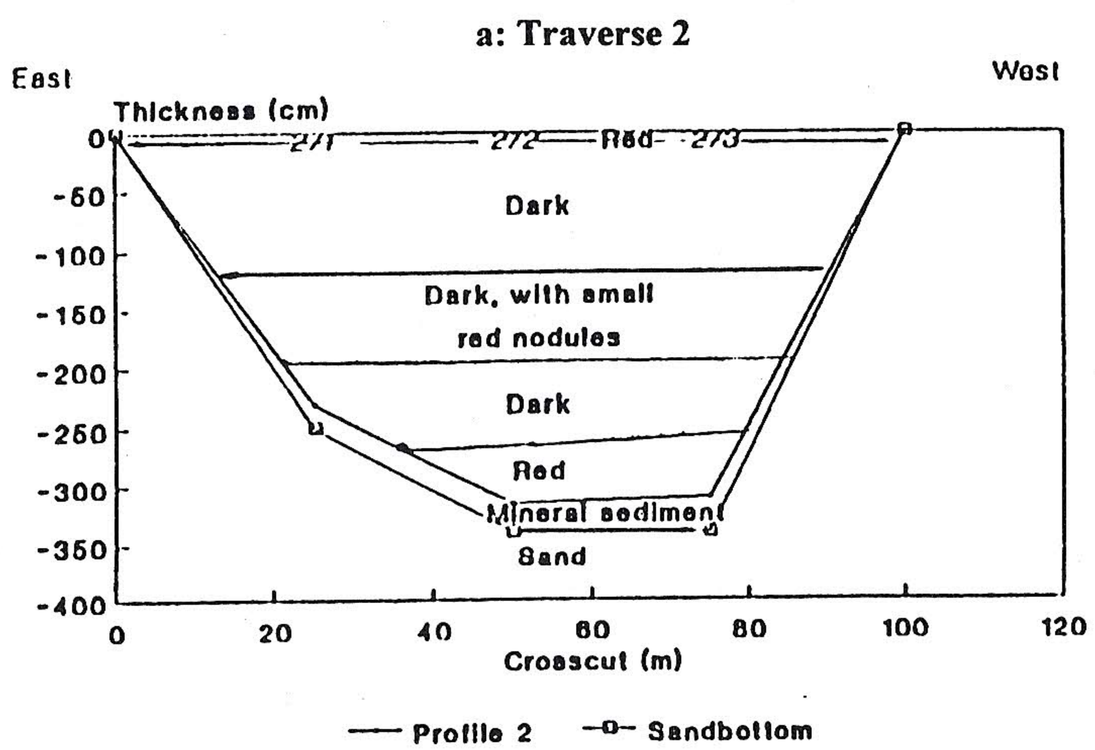
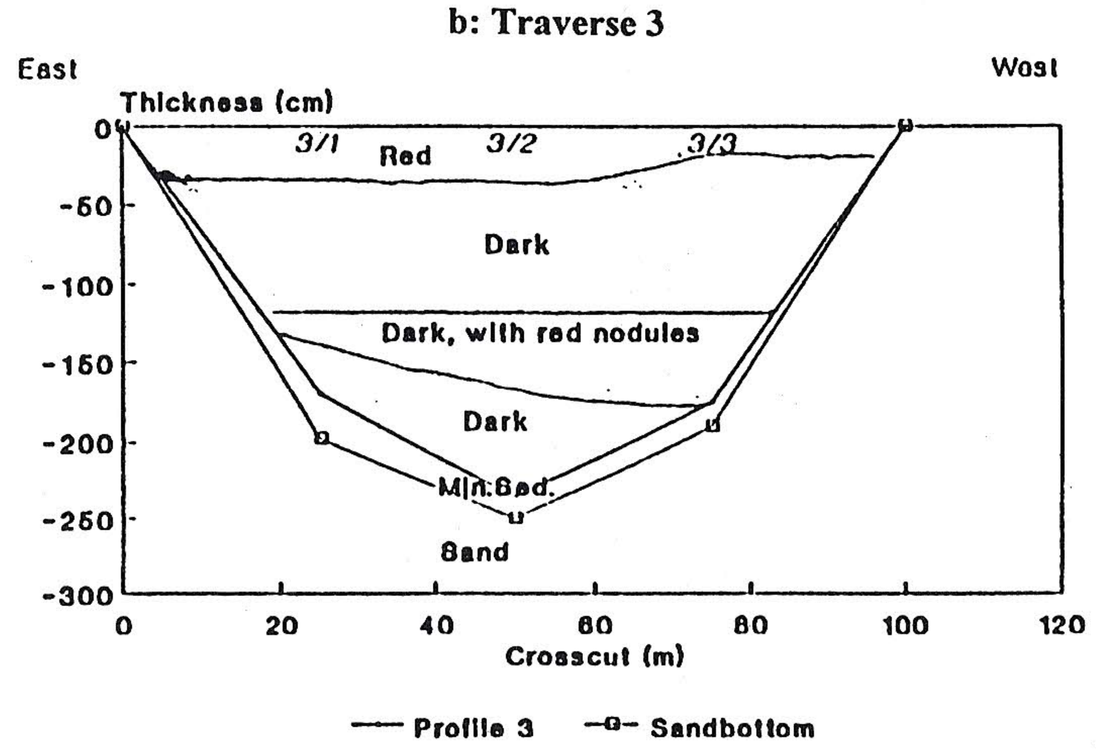
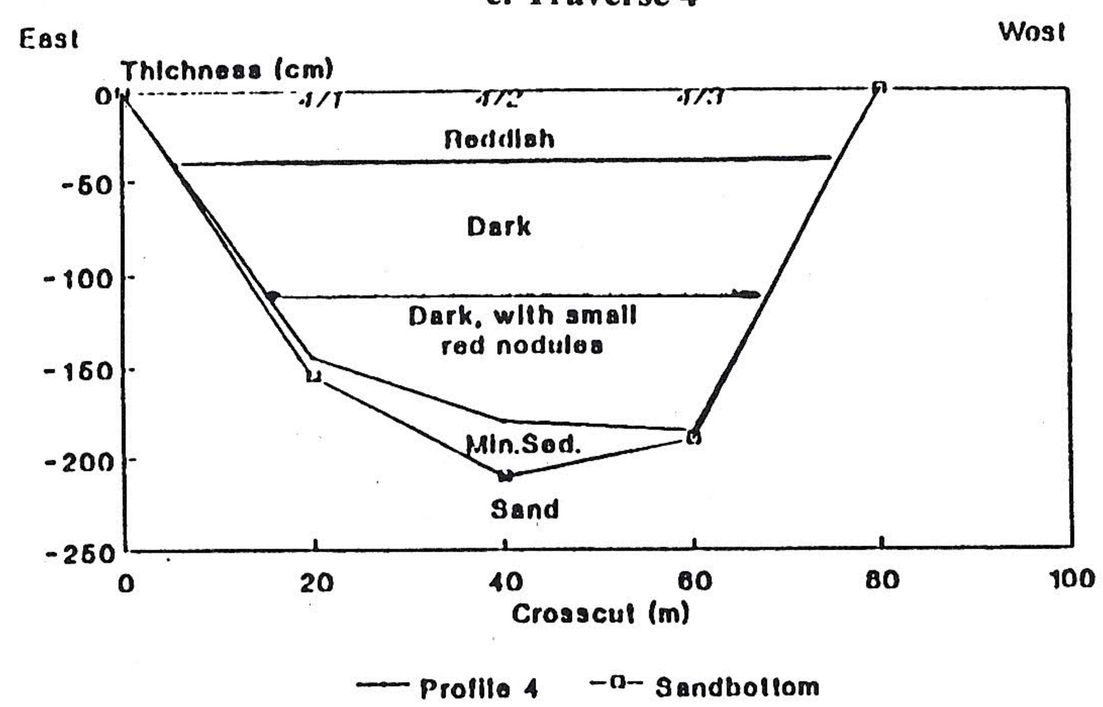


Fig. 20: Map of sample sites of Mgobezeleni.







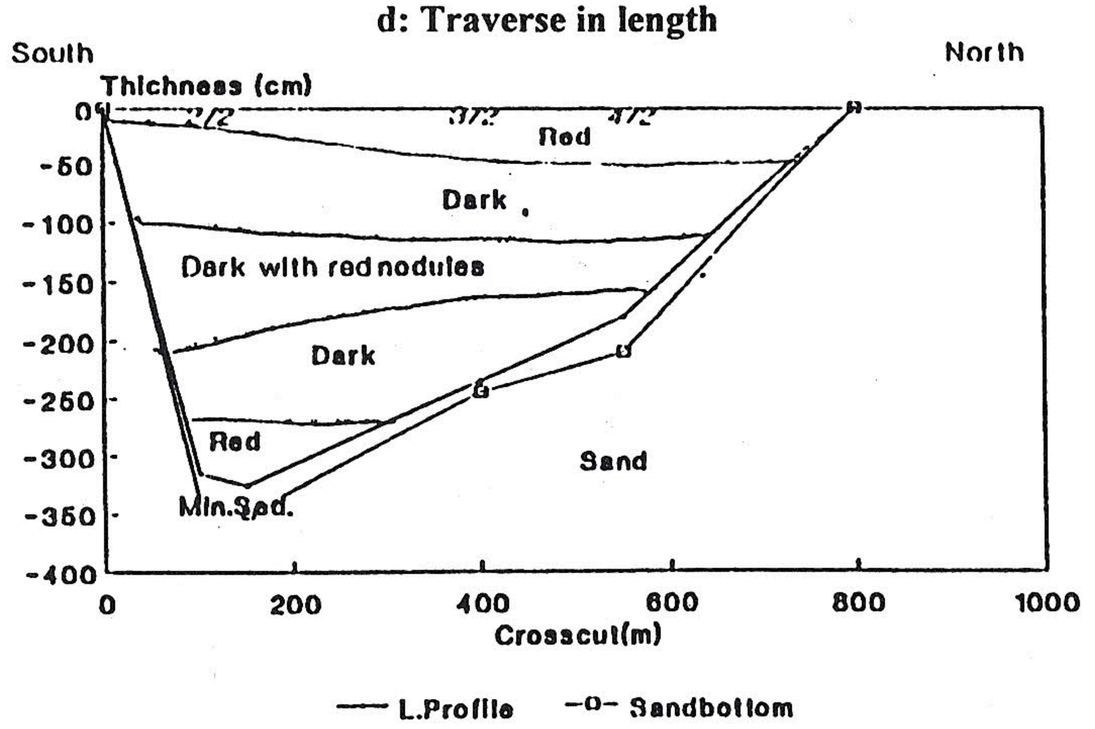
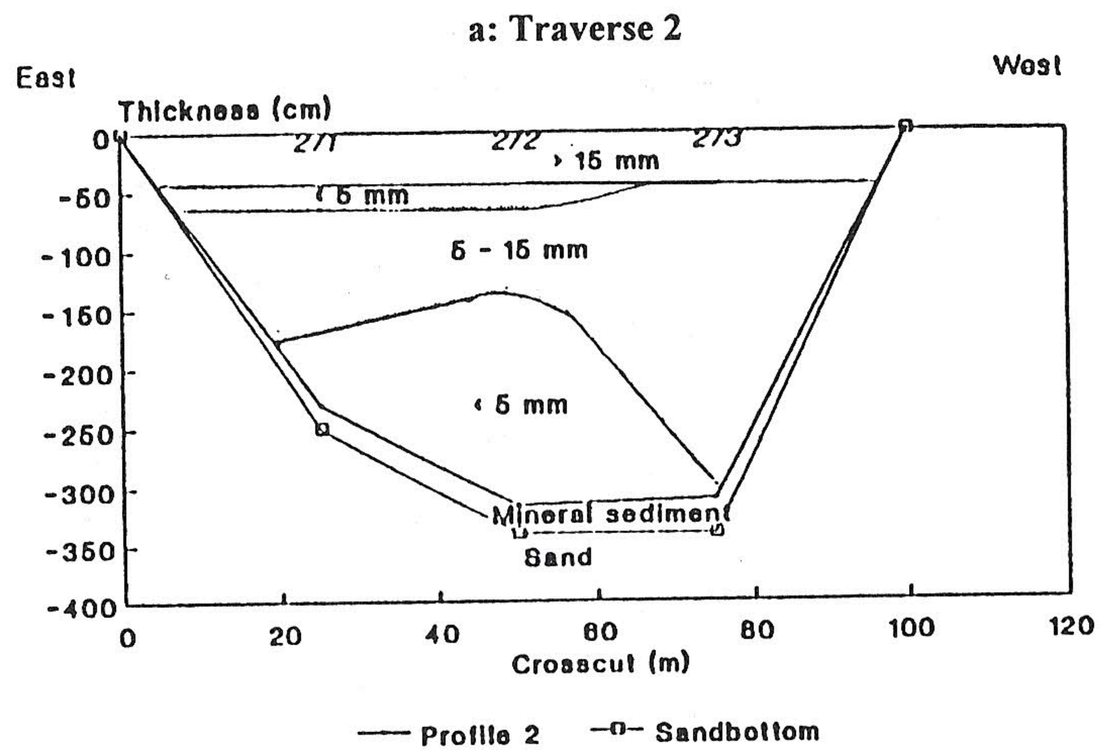
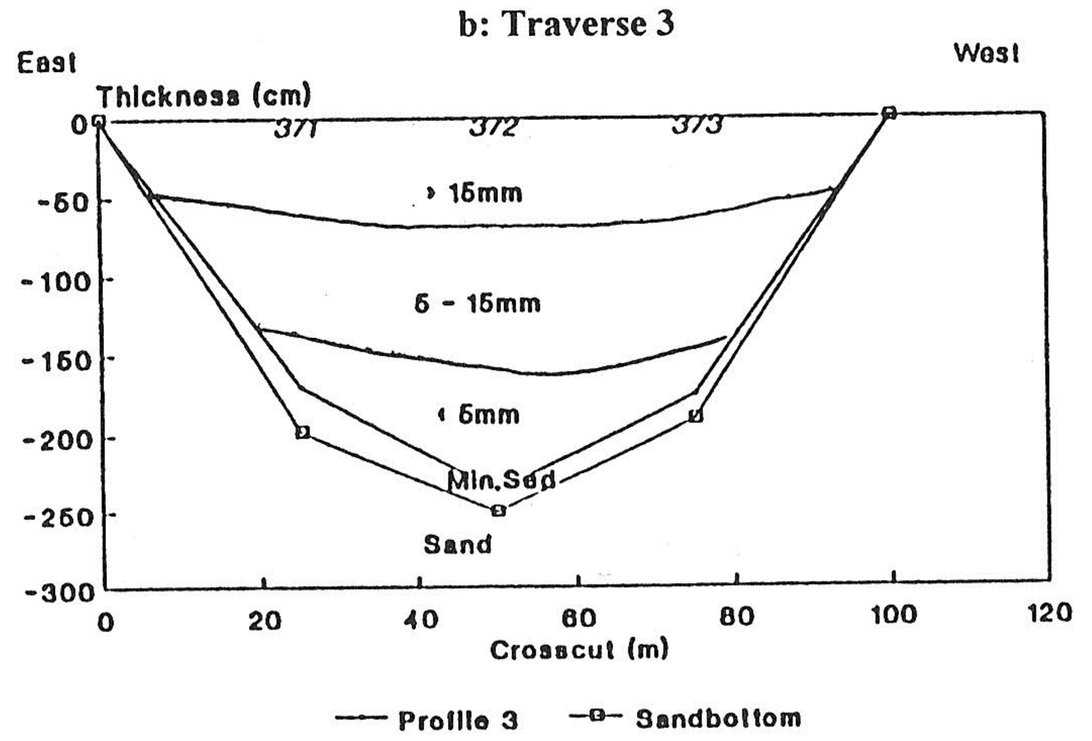
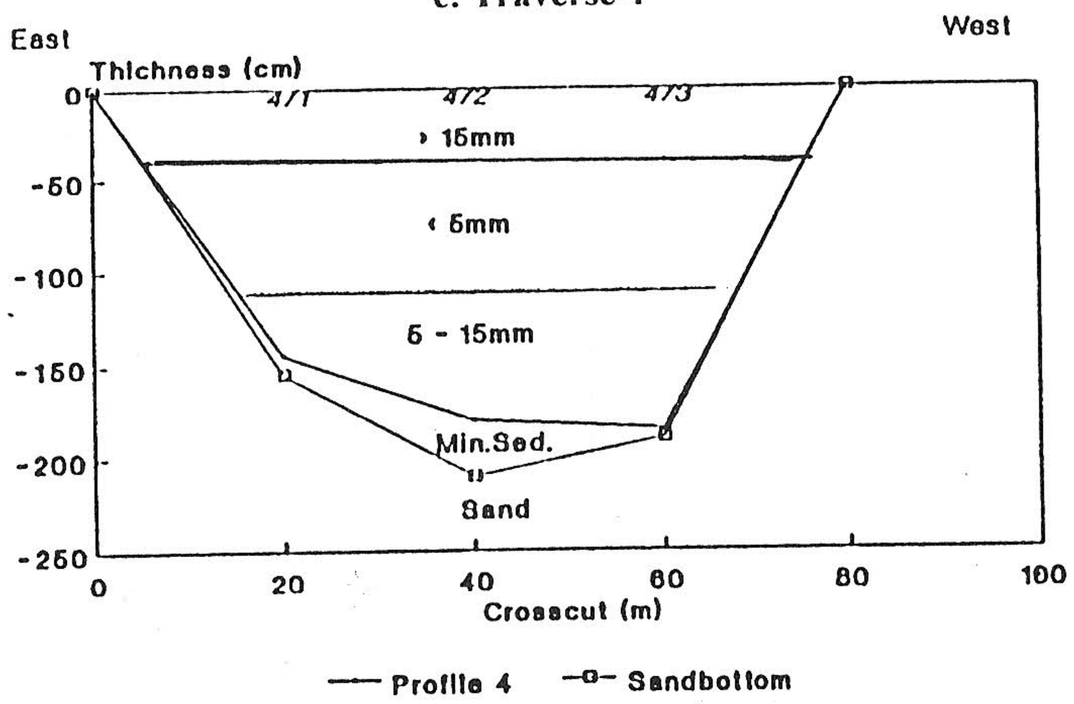


Fig. 21: Majiji stratigraphy: colour.







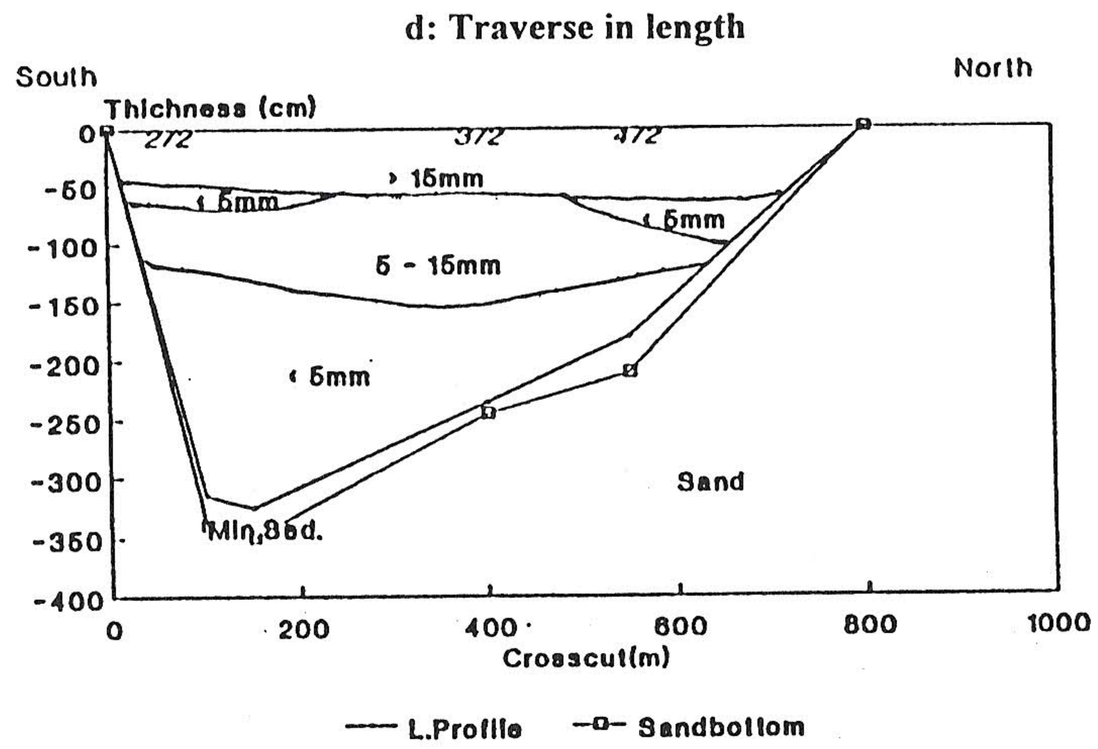
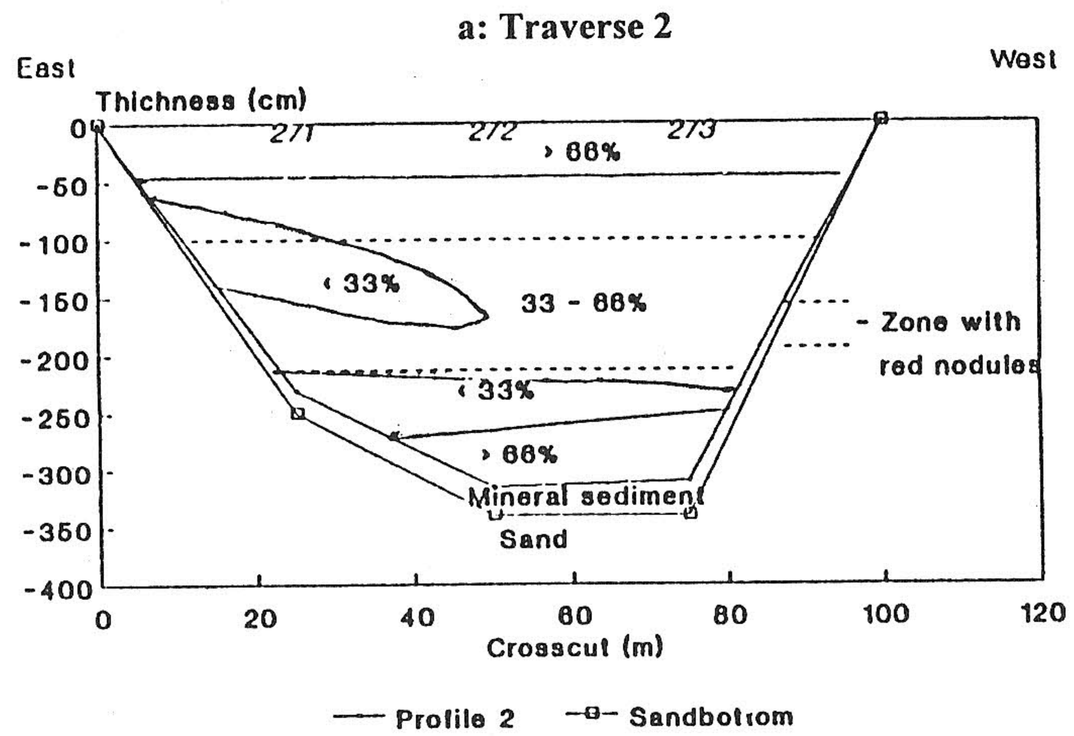
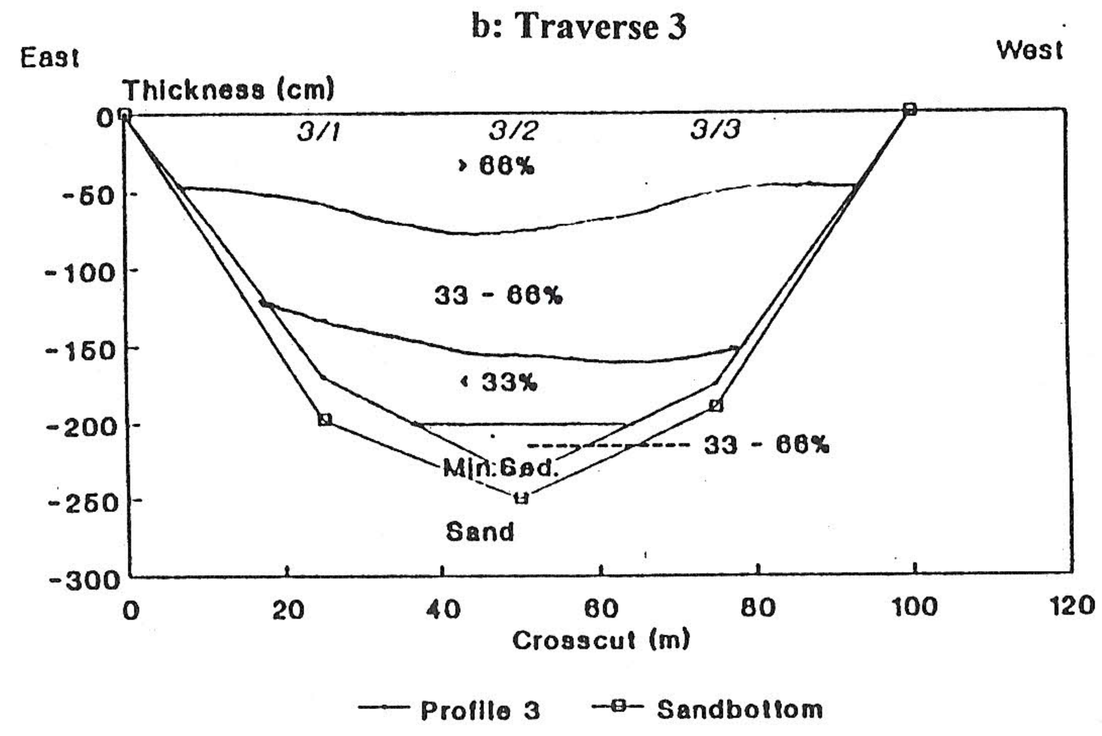
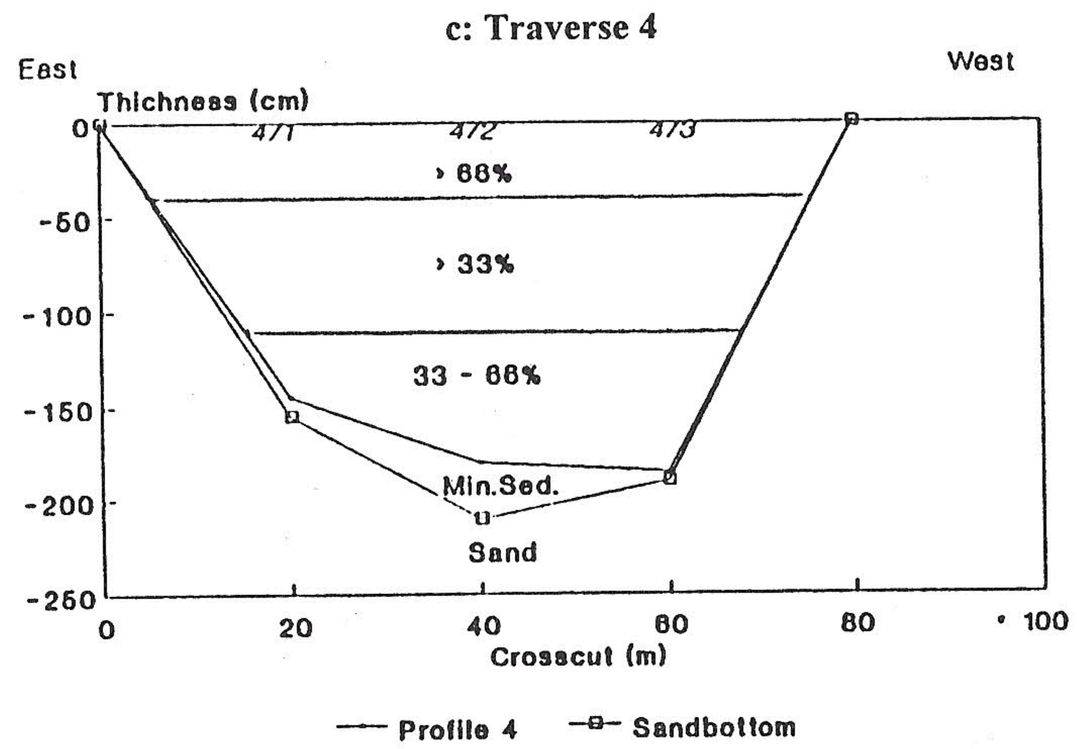


Fig. 22: Majiji stratigraphy: fibre length.







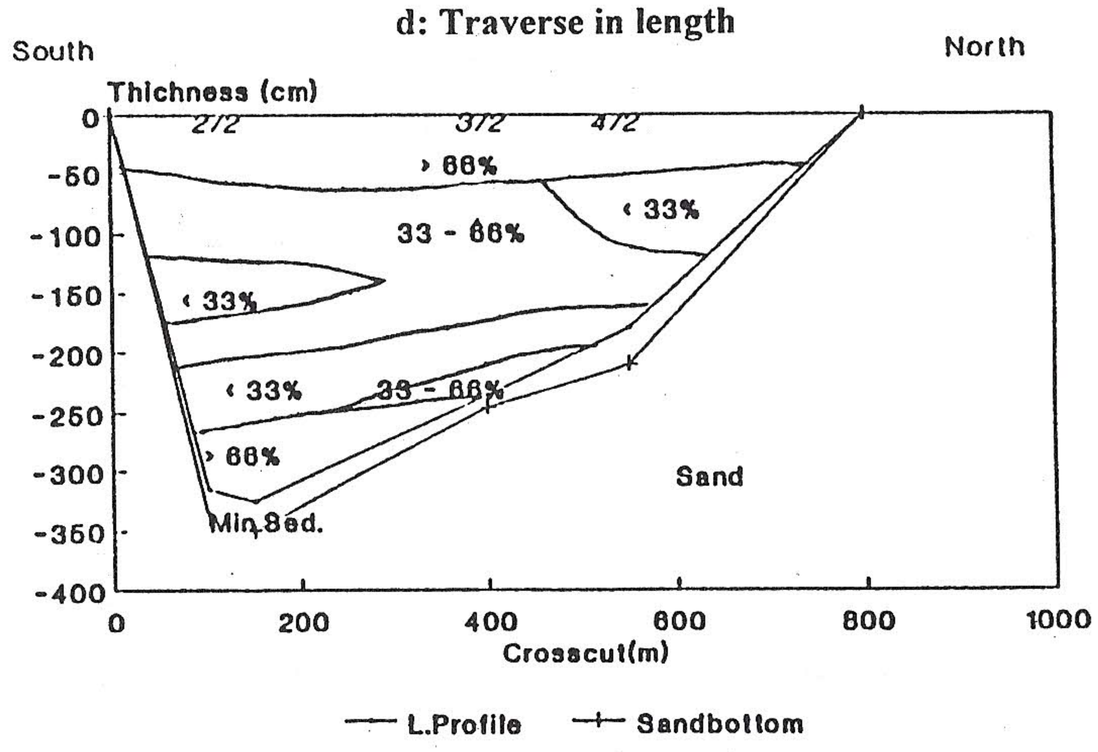
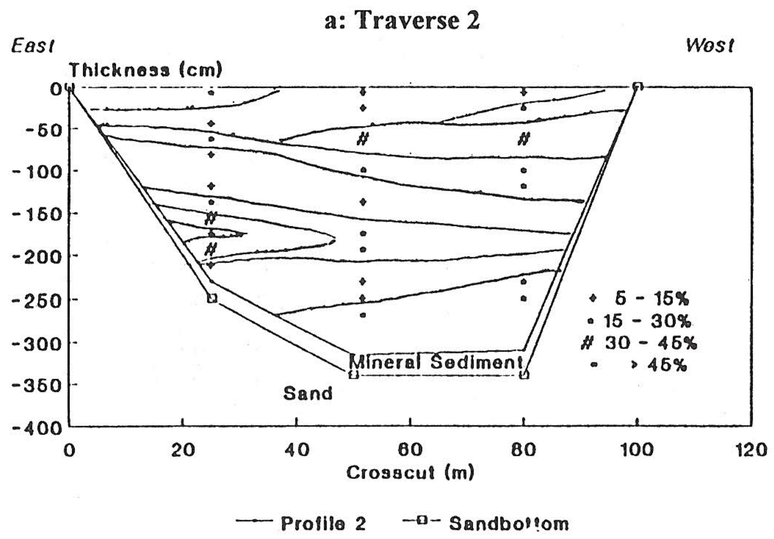
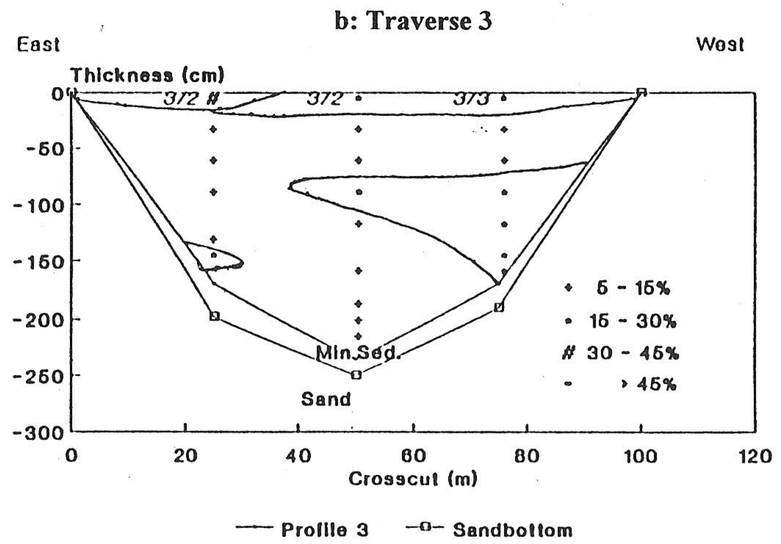
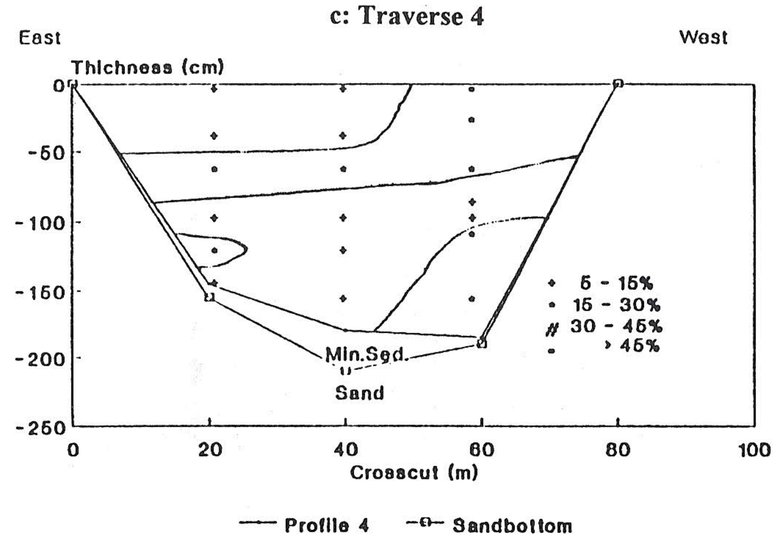


Fig. 23: Majiji stratigraphy: fibre content.







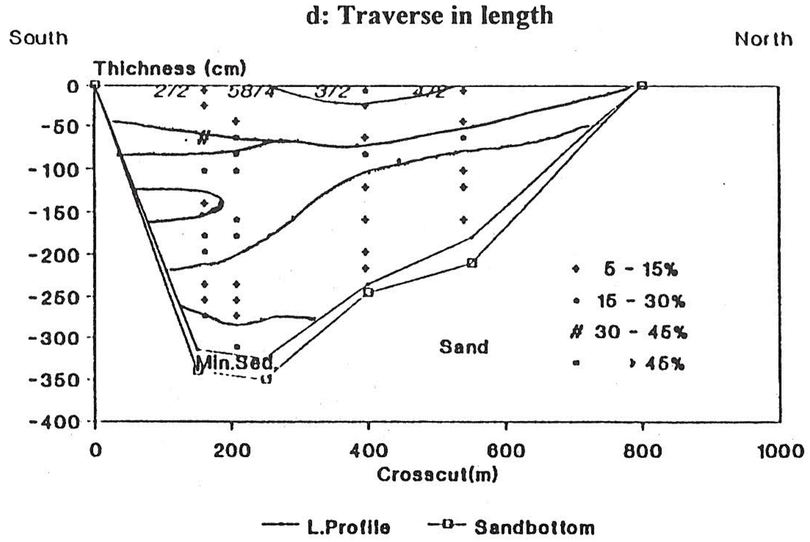
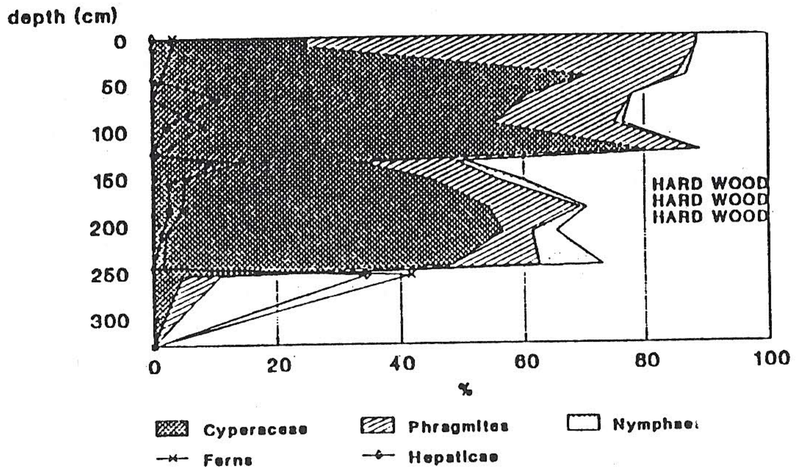
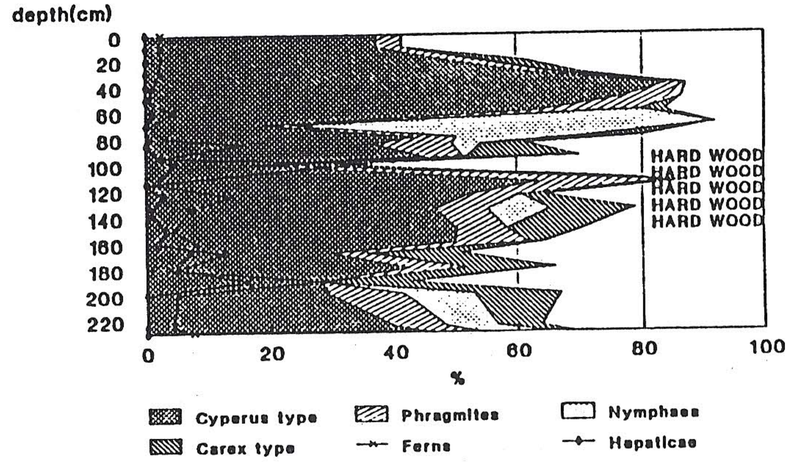


Fig. 24: Majiji stratigraphy: ash content.





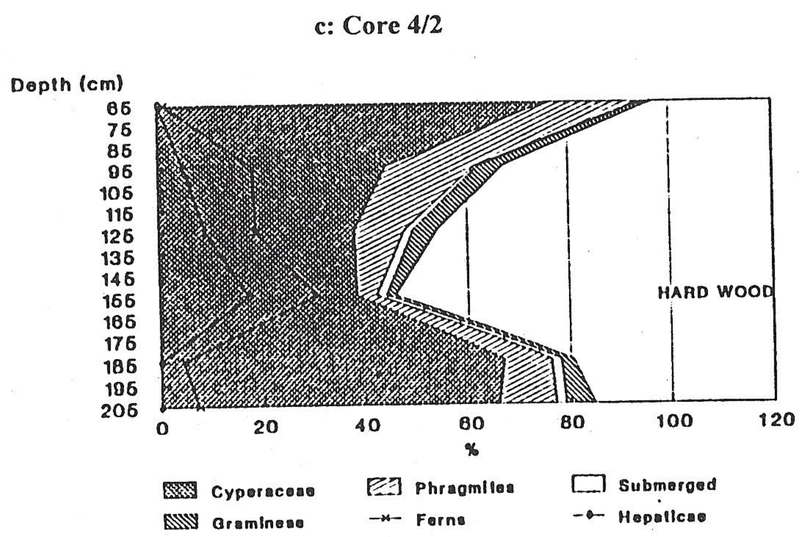


Fig. 25: Majiji: pollen diagrams.

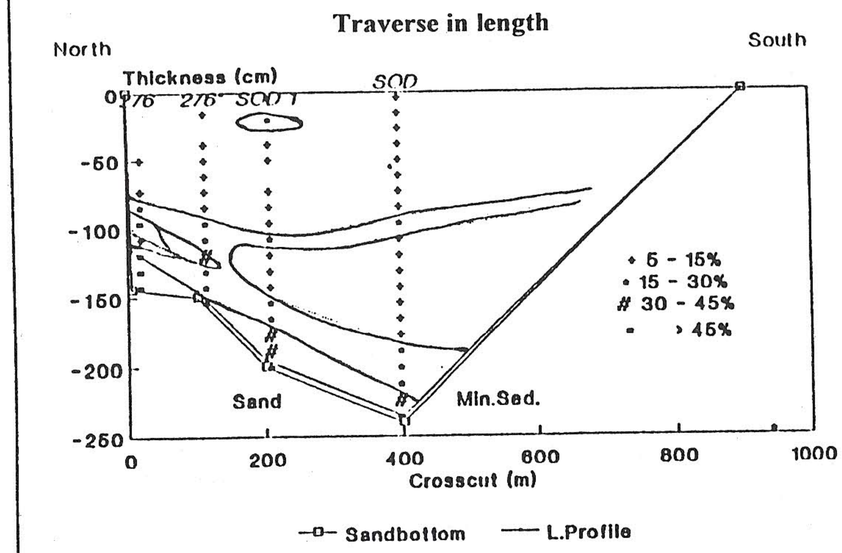


Fig. 26: Mgobezeleni: ash content.

Fibre Content and Humification

The fibre content (Fig 23) and the humification (the lower the fibre content the higher the decomposition and humification) varies throughout the peatland. The fibre content decreases on the whole from the surface towards the bottom but increases near the bottom (Fig 23) and the different zones thickens towards the thicker part of the peatland (Fig 23d).

The upper part, from the surface to 50 - 70 cm in depth has a uniform, very high fibre content (>66%), (Fig 23) that corresponds with long fibre length (Fig 22) and the reddish colour (Fig 21) of the peat. It is followed by a zone of intermediate fibre content (66 - 33%) with a thickness that varies from 120 - 180 cm (Fig 23).

This zone contains two enclosed zones of low fibre content (< 33%); one of about 50 cm in the south-western part (Fig 23a) and the other one of about 80 cm in the northern part of the peatland (Fig 23c). Both are absent from the middle parts of the deposit and the northern one follows directly on the upper zone of high fibre content (Fig 23d).

The intermediate fibre content zone is followed by a zone of low fibre content of about 50 cm in thickness that is absent from the north (Fig 23d). Beneath this zone is a 30 - 50 cm thick bottom zone with a higher fibre content with an intermediate content in the middle part and a high content in the northern part of the deposit (Fig 23d).

The fibre content zones correlates to some extend with the layering according to the colour as do the top fibre length zone of the peatland. This correlation is much better defined in the shallower northern part (Fig 21c, 22c & 23c) of the peatland than the deeper southern part (Fig 21a, 22a & 23a).

Different plant species will decompose differently under the same environmental conditions and the various fibre content and fibre length zones could represent a variety of plant communities and environmental conditions.

Physio-chemical Characteristics

Ash Content

There is a tendency in the ash content to increase near the bottom (Fig 24) and to change throughout the peatland (Fig 25). The variation in the northern shallower parts (Fig 25b, 25c & 25d) is not as prominent as in the deeper southern part (Fig 25a & 25d) of the deposit.

Eight alternating low and high ash content zones occur in the centre part along the north-south profile (Fig 25d) of the peatland that correlate to some extent with the layers according to colour and the fibre content (Fig 21d & 23d). This correlation is also evident from the east-west traverses, especially from the deeper southern part (Fig 21a, 23a & 25a).

The relatively high ash peaks (Fig 24) could be because of sediment influx (aeolian or washed in from the sides of the dunes), burning of the peat or the inherent ash contents of different plant communities. The presence of charcoal indicates that fires at the edges of the peatland (Fig 24a, c, & d) during dry seasons could be responsible for the relative high ash value peaks as well as in the deeper parts (Fig 24b) of the peatland.

The concurrence between the ash and the fibre content zones indicate that the occurrence of different plant communities at different parts of the peatland (e.g. the shallower parts at the edges) and at different environmental and ecological conditions (Mazus & Grundling, 1995) are more likely the reason for the alternating high and low ash zones. Coarse grained charcoal that correlates with the high fibrous nodule zones support this.

Pollen Studies

Three cores examined for pollen profiles show significant differentiation in the plant succession. The peat-forming plants first appeared and began to accumulate under open water conditions in the southern (core 2/1) and central (core 3/2a) part of the basin. Open water conditions are marked by the presence of floating-leaved plants as *Nymphae* and emergent *Phragmites* spp. The open water plant communities were constantly present in the south of the peatland, while they were gradually replaced in the central part by ferns and *Hepaticae* - plants of shady, damp habitats. In the northern part (core 4/2) pollen of floating-leaved plants were not recorded. The plant succession in this profile consist mainly with flora of damp conditions. At a depth of 1.40 m in the central (core 3/2a) and at 1.80 m in the southern (core 2/1) part pollen of the swamp shrubs and trees like *Myrica* spp., *Myrtaceae* (*Syzigium cordatum*) and *Melastomataceae* appear.

High percentages of these pollen in the diagrams indicate relatively dry conditions in the whole area of the peatland. In core 4\2 very few trees pollen were recorded. Pollen of ferns and *Hepaticae* dominate in this zone. The occurrence of the hard wood pollen continues in the central part (core 3/2a) up to a depth of 0.90 m. In the northern and southern parts it was replaced by emergent plants (reeds and sedges) at a depth of 1.15 m and 1.40 m. From this fact one can conclude that the peatland was domed in the central part at that time. Above the point 0.90 m *Nymphae* and *Phragmites* appear again in the central part indicating the existence of an open water pool in this part. Towards the surface the vegetation changes into sedges all over the peatland.

Comparison between Majiji and Lake Mgobezeleni

Ash Content

Work previously done (Smuts, 1992 & 1994) shows that the there is an uneven distribution of the ash content in the Lake Mgobezeleni peatland. This is confirmed by the two additional cores obtained from the peatland (Cores SOD and SOD1). The ash content, as in Majiji, increases to the bottom of the deposit. Ash zones are irregular and tend to thicken towards the deeper part of the deposit (Fig 26). It is clear from this limited comparison that there is a variability in ash content within the deposit at Lake Mgobezeleni, as in Majiji, and between the two deposits. Research carried out on peatlands of Lake Sibayi, between Majiji and Lake Mgobezeleni, by Grundling (1994) supports the variability in the characteristics of individual peatlands and the region as a whole.

CONCLUSION

The variability in all the characteristics throughout the peatland at Majiji, as well as in the ash content at Lake Mgobezeleni, suggests that this could be a common feature of peatlands of the MCP. This implies that too little sampling of individual peatlands could result in inaccurate commodity classification (e.g. peat as an energy or horticultural resource) or incorrect resource estimations.

TRADITIONAL SUSTAINABLE UTILISATION OF PEAT IN MAPUTALAND, NORTHERN KWAZULU-NATAL, SOUTH AFRICA

INTRODUCTION

Recently several views have been expressed about the extent, development and utilisation of the peat resources of the (Mazus, 1992; Smuts, 1992; Grundling, 1994; Smuts, 1994 and Mazus and Grundling, 1995). Various opinions and concerns have been expressed by government departments, e.g.: Department of Environmental Affairs and Tourism, Parastatal Councils and NGO's.One of the areas that probably has not received much attention thus far is the utilisation of peat by the local communities of KwaZulu-Natal. Traditionally, peat in Maputaland (Fig 1; at page 10) has been mainly utilised as a subsistence resource by the indigenous inhabitants of this region.

UTILISATION

Horticulture

Inhabitants of the coastal plain of northern KwaZulu-Natal grow their fresh produce directly on the peat because of the nutrient-poor nature of the sandy, acid and calcic soils. The people heap the peat together, 30 - 50 cm above the water level, and make gardens on these raised plots (approximately 3 x 4 m), with water flowing in channels between the plots (Fig. 27). Crops which are cultivated are: vegetables like sweet potatoes, tomatoes, cabbage and spinach; fruit like bananas (Fig.28) and sugar cane. The people seem to live in harmony with wetlands, for they rotate their gardens on a chosen peatland.



Fig. 27: Raised plots of peat with sweet potatoes



Fig. 28: Raised gardens with bananas and cabbage on the edge of a peatland.



Fig. 29: Old raised gardens in the centre of the peatland (foreground) with newly raised plots on the edge.

Gardening is confined to the edges of the peatland in wet seasons, while there is a rotation towards the centre in dry seasons (Fig. 29). When the peatland is depleted or crop yields fall, gardening is moved to another peatland, thus giving the previous peatland a chance to regenerate.

Water

These peatlands are one of the most important water resources for the people (Fig. 30 & 31) and their livestock. The soil of this region is very sandy as a result of the underlying Quaternary dune, beach and redistributed sands, and any surface water drains away very quickly.

Peatlands retain surface water and water released from perched aquifers in the dunes, thus acting as an important source of water and an effective agent in retarding soil erosion. The filtering properties of peat- and wetlands are well known and so the peatlands thus provide clean drinking water as well.

Stock Farming

Cattle (Fig. 32) play an important role in the culture of the local tribes and are seen as an important status symbol. Furthermore, cattle form an important source of protein, together with goats, and fish from the wetlands. The carrying capacity of the Zululand Palm veld is not very good and during winter months the peatlands are used as a fodder bank for cattle. The cover vegetation is burnt off during winter to provide sprouts for the cattle.



Fig. 30: A fenced-off well on the edge of a peatland

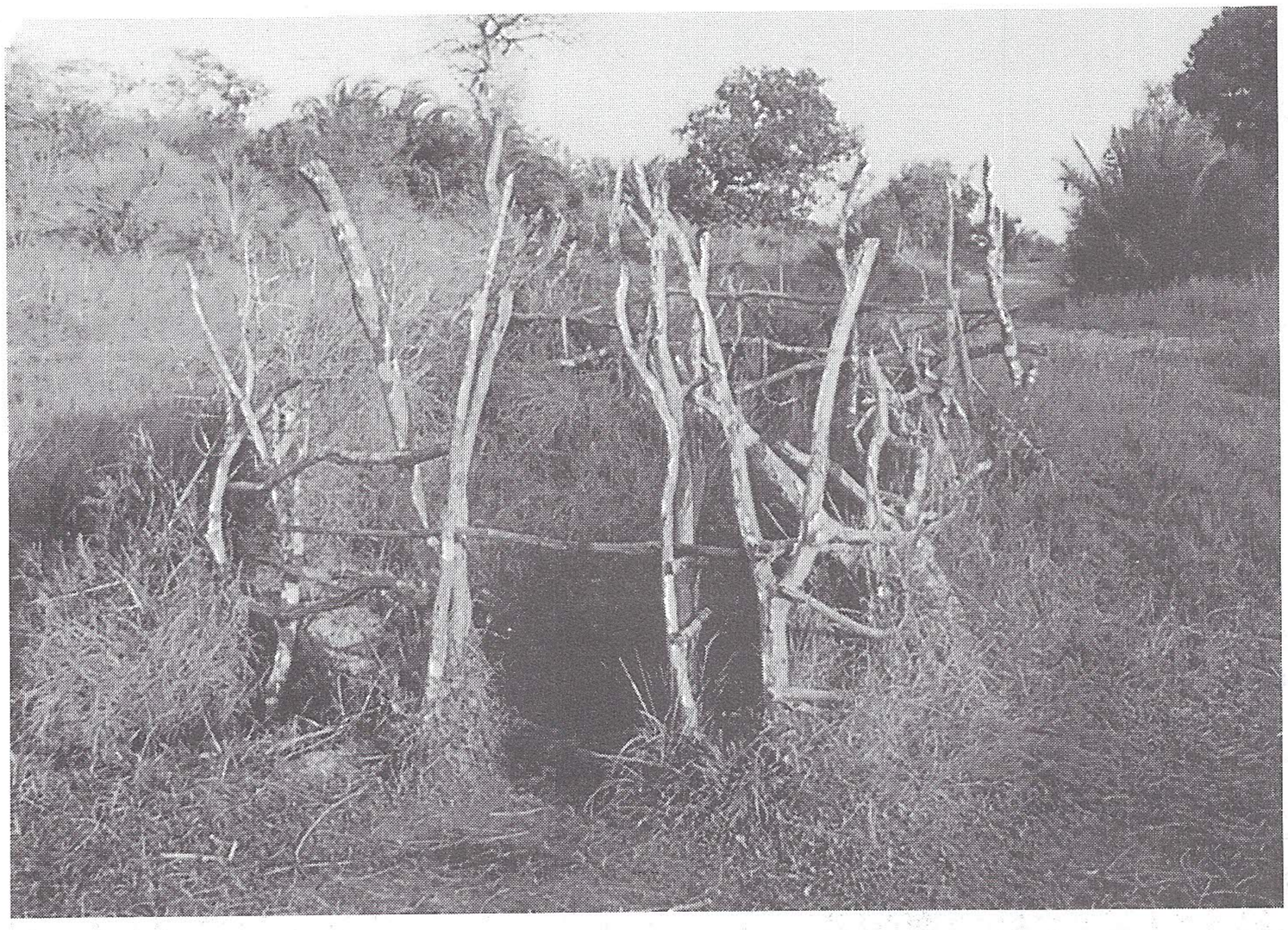


Fig. 31: A close up of the well. Note the organic soil in the foreground and the white sands in the background.



Fig. 32. Cattle at a well on a peatland with 50 cm of peat.

Biomass

The contained biomass is an important source of building material, e.g. reeds for walls of huts (Fig.33) and thatching-reed for roofing (Fig. 34). Woven and braided products, e.g. baskets and carpets (Fig. 35 & 36), from grasses and sedges are used for household purposes and are sold as curios at tourist destinations like Sodwana Bay.

Peat has not been utilised as an energy resource either because of a traditional preference for wood and the abundance of wood from exotic plantations and indigenous woodlands, or because of a lack of knowledge.



Fig. 33: Harvesting of Typhia rushes.



Fig. 34: Phragmites reeds harvested as building material.

Fig. 35: A common traditional thatched hut with reed walls.



Fig. 36: Baskets, woven from sedges and reeds, at a market near Sodwana Bay.

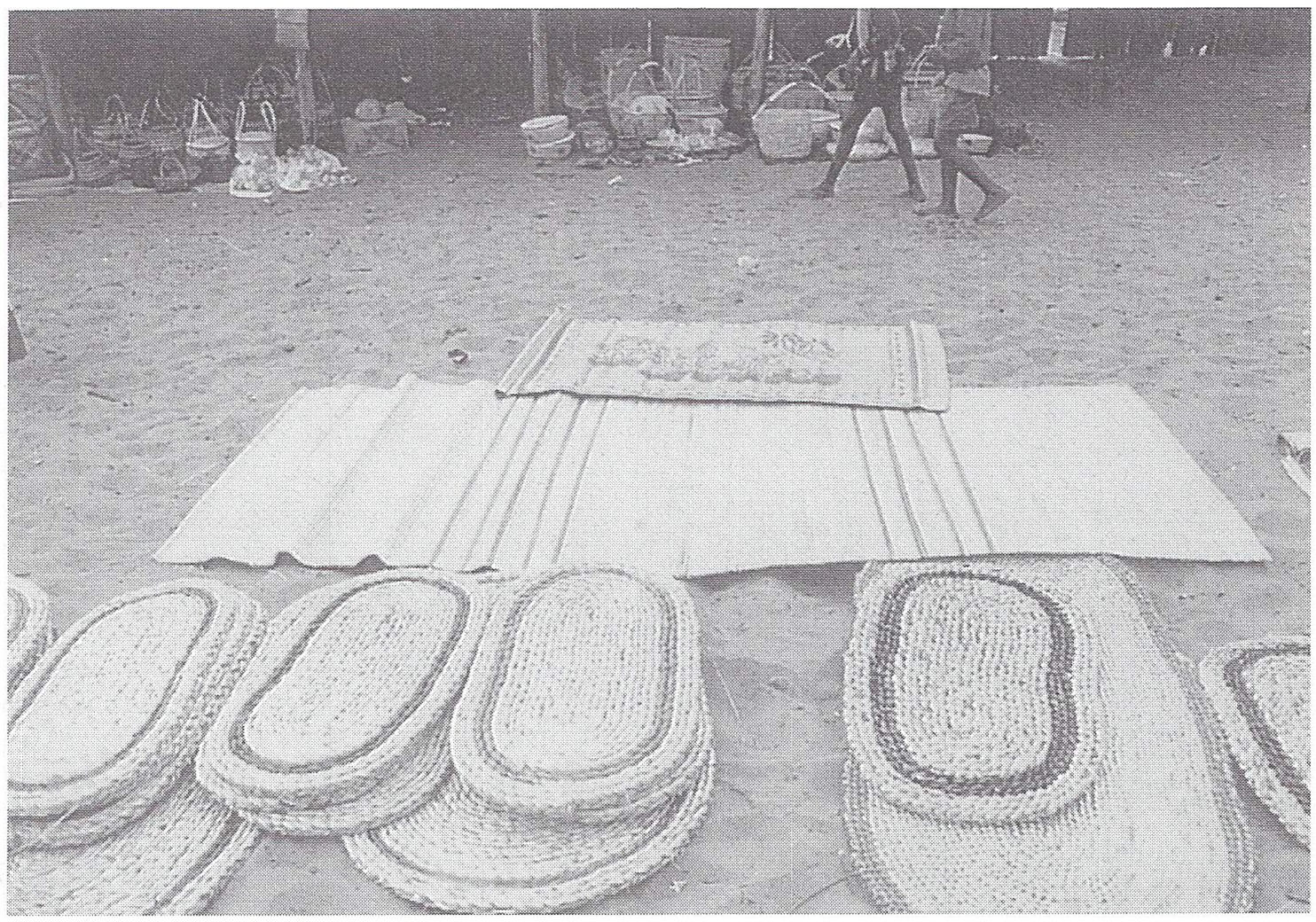


Fig. 37: Carpets woven from grasses, sedges and rushes for sale as curios at Sodwana Bay.

Conservation and Tourism

Population pressure is taking its toll and the more sensitive hardwood swamp forests have been cut down in densely populated areas. Tourism in this largely pristine area (Fig. 38, 39 & 40) is playing an increasingly important role in the local economy. It is clear that the local inhabitants know how to manage the wetlands for their own benefit, and a reconciliation between their traditional practices and Western-style conservation could really boost ecotourism and the local economy.

Commercial Exploitation

It is doubtful that the rate of accumulation of peatlands will keep up with large-scale commercial utilisation for domestic energy or horticultural use. The latter use (especially as a compost mix and growing medium for large-scale nurseries and mushroom producers) could present a serious ecological problem (Fig. 41). Present accumulation rates based on the presence of exotic pollen in the peat, indicate a current growth rate of between 4 - 19 mm per year (Mazus and Grundling, 1995).

The commercial value of the peat must be weighed against the in situ value of the peat as a traditional horticultural, water and biomass resource and ecotourism.



Fig. 38: The southern part of the Nghlangu swamp, near Black Rock.



Fig. 39: The Muzi Lake near the Mkuze Nature Reserve

Fig. 40: Lake Mgobezeleni near Sodwana Bay.



Fig. 41: Erosion caused by the degradation of a wetland near Tembe Elephant Reserve.

CONCLUSION

Peat resources of KwaZulu-Natal have historically been utilized by local communities for subsistence agriculture and these practices seem to have been sustainable.The peat occurrences are mostly suitable for horticultural purposes and make an important contribution to food production in the area, through in situ gardening. Population densities have, however, increased since, bringing these systems under increassed pressure.

Peat is a rare commodity in Southern Africa. It forms only under special hydrological conditions. Degradation of these conditions due to human activities can result in irrepairable damage. The importance of fresh water springs in Maputaland should not be underestimated as they float on a body of saline water. If the peat bodies are damaged or removed this valuable source of fresh water will have to be replaced at high cost. Commercial exploitation could create an even poorer community. The solution probably lies somewhere between traditional practices, conservation and tourism.

PEAT FIRE IN THE VASI PAN PEATLAND IN THE MANZENGWENYA PLANTATION, MAPUTALAND, KWAZULU-NATAL

INTRODUCTION

The wetlands of Maputaland on the MCP in northern KwaZulu-Natal are coming increasingly under pressure, due to an increase in population density, subsistence and commercial farming and forestry. The effect of these factors, except forestry, on the accumulation of peat in wetlands has been debated by various authors (Smuts, 1992; Grundling, 1994; Mazus & Grundling, 1995; Smuts & Kirstein, 1995 and Grundling, 1996).

Over the years conservationists have claimed that exotic plantations are diminishing the ground and surface water and damaging the hydrological balance of an area covered, surrounded or in the proximity of such a plantation (Blackmore & Mulqueeny, 1996; Marais, 1996 & Pithers, 1996). These viewpoints have been opposed mostly by the forestry industry, or are defended on the basis of the economic importance of afforestation (Scotcher, 1996). This report is not aimed at taking sides between these two views, but rather to inform on the basis of scientific observations on the character of the Vasi Pan peatlands (peatland is a wetland containing peat).

LOCATION & GEOMORPHOLOGY

The Vasi Pan peatlands consist of a dominating large wetland (Vasi Pan), with a much smaller wetland (Vasi Pan Noord) just to the northeast of it (Fig 1). They are located in the Manzengwenya Plantation, and form part of the mosaic of Maputaland wetlands on the southern edge of the MCP. The Maputaland vegetation falls mostly within the Coastal Bushveld/Grassland Biome of Southern Africa (Low & Rebelo, 1996) and is an area of high bio-diversity and with a high concentration of endemic species (Taylor, 1991). Vasi Pan forms part of the northern Sibayi catchment area bordering on the Siyadla catchment area just to the north, which drains into the Kosi Bay Lakes.

RESULTS & DISCUSSION

Geological

Vasi Pan and Vasi Pan Noord cover areas of about 210 ha and 5 ha respectively. Both peatlands were surveyed as part of a regional peat mapping program and sampling sites are thus limited. Vasi Pan has a peat thickness of 4 m and Vasi Pan Noord a thickness of up to 3.4 m, based on one sampling site for Vasi Pan Noord and three for Vasi Pan. The three sampling sites for Vasi Pan formed part of a traverse of about 800 m across the northern part of the wetland. Thicknesses varied from 3.4 m in the west, to 2.5 m in the central part of the wetland, and 1.5 m between the western and central part (measured before the fire). Preliminary sampling after the fire indicated an original thickness of 3.4 m in the central-western part, with an average thickness of about 0.5 m in the southern and eastern parts of the wetland.

Drying-out cracks

The development of extensive "mudcracks" (Fig 42) were noted on the surface of the peatland. These cracks are 20 to 50 cm wide (Fig 42), up to 1.0 - 1.5 m in depth (Fig 43) and cover the whole peatland area. They are very similar to the cracks of the desiccated peat beds of the Okavango Delta, Botswana as described by Ellery *et al.*, (1989). Trigonal junction points of cracks were found to be opened even wider. Here the effect of drying out of the peatland was accentuated by wilting of the surface vegetation (Fig 44). Some of these cracks are still visible after the recent peat fire in the Vasi Pan peat (Fig 45) and are very prominent on the unburned Vasi Pan Noord (Fig 46).

In geological terms cracks are a clear indicator of drying-out conditions. No evidence of cracks was found on 5 other peatlands around the plantation, although the surfaces of the peatlands were dry in times of drought. Over the past three years these peatlands were visited on the same occasions as the Vasi Pan wetlands.



Fig. 42: Vasi pan: extensive mudcracks cover the surface of the peatland.



Fig. 43: Mudcracks are 20 to 50 cm wide and up to 1.0 - 1.5 m in depth.



Fig. 44: Trigonal junction points of cracks were found to be dry with wilted surface vegetation.



Fig. 45: Mudcracks still visible after the recent peat fire in the Vasi Pan. Note the white ash.

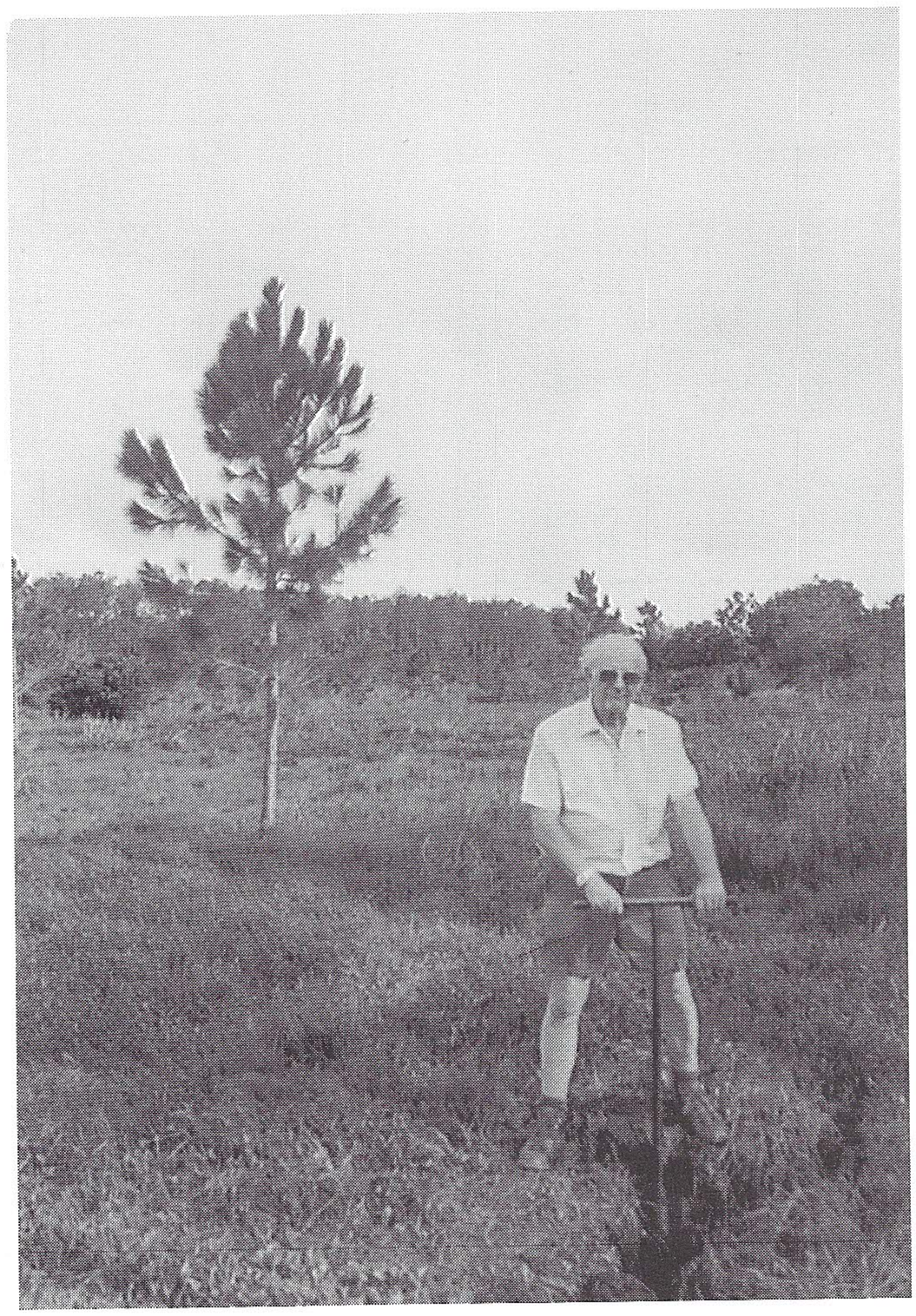


Fig. 46: Prominent mudcracks on the still unburned Vasi Pan Noord.

Dry peat layer

The top 50 cm layer of the peat was dried out and hardened, especially around the cracks. Moisture content of the peat cores taken on surface (the top 5 - 10 cm) for the main Vasi Pan wetland is as low as 8.29 % and 12.89 % for Vasi Pan Noord (Fig 47). The ash content for the 0 - 5 cm depth increment was elevated to 54.23 %, but dropped to as low as 14.41 % at 35 cm (Fig 48). This is probably due to oxidation in the uppermost part of the drying peat layer. Vasi Pan Noord has very low ash contents: 18.39 % in the first 10 cm with the lowest ash content of 5.37 % at 70 cm in depth. The Moisture content in the top 50 cm for both wetlands is very low compared with values of other peatlands surrounding the plantation, especially for Vasi Pan Noord. Values for the other 5 peatlands vary from 80 - 95% (Grundling, 1994).

Moisture values at depth were more normal (Fig 47), indicating that the surface layer of the peat was most affected. It is thus very likely that the next layer of peat exposed under the current ash layer, will dry out and probably ignite next. This can continue until most of the peatland is destroyed. The comparison of Vasi Pan and Vasi Pan Noord (surrounded by exotic forest) with 5 other peatlands (in natural balance with their surroundings) indicates that the pine plantations have a detrimental effect on the hydrological balance of the former two systems. Already in the last quarter of 1995 the probability of a fire in the peatland was predicated by the author and this was brought to the attention of the respective nature conservation officials.

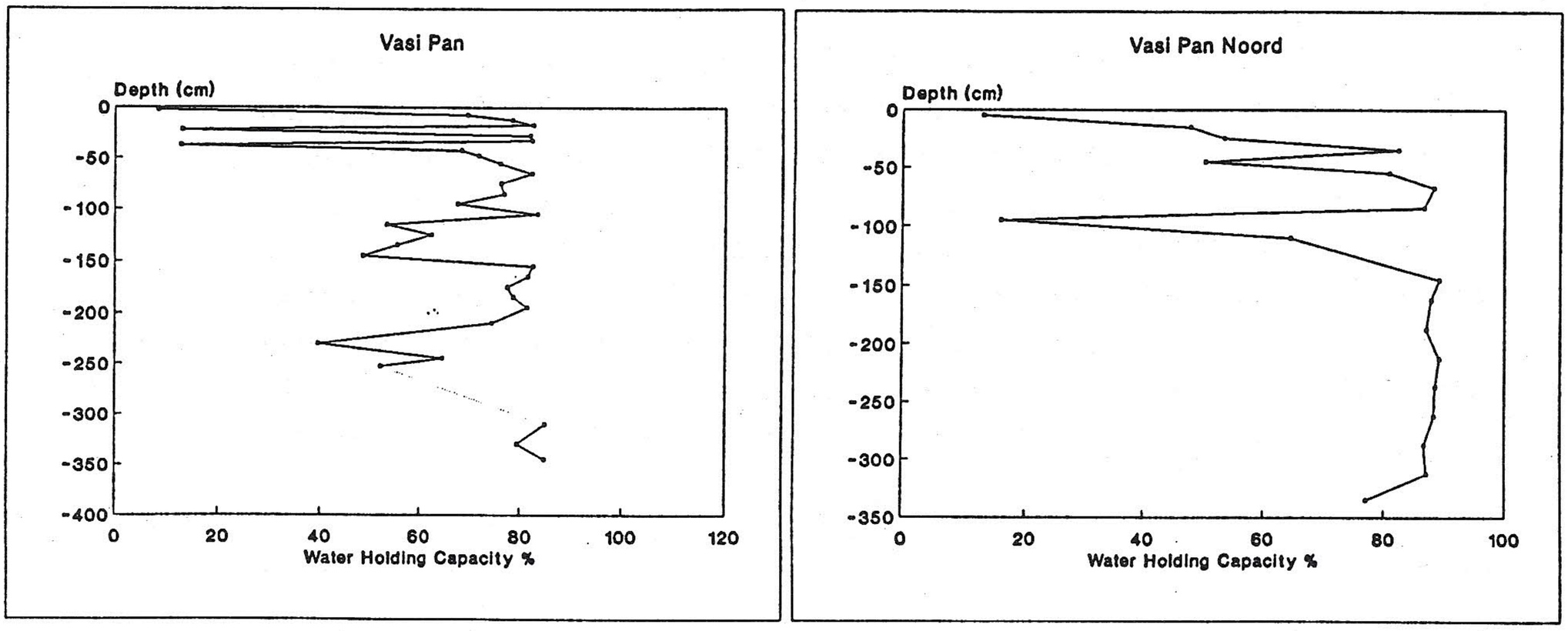


Fig. 47: Moisture content for Vasi Pan and Vasi Pan Noord.

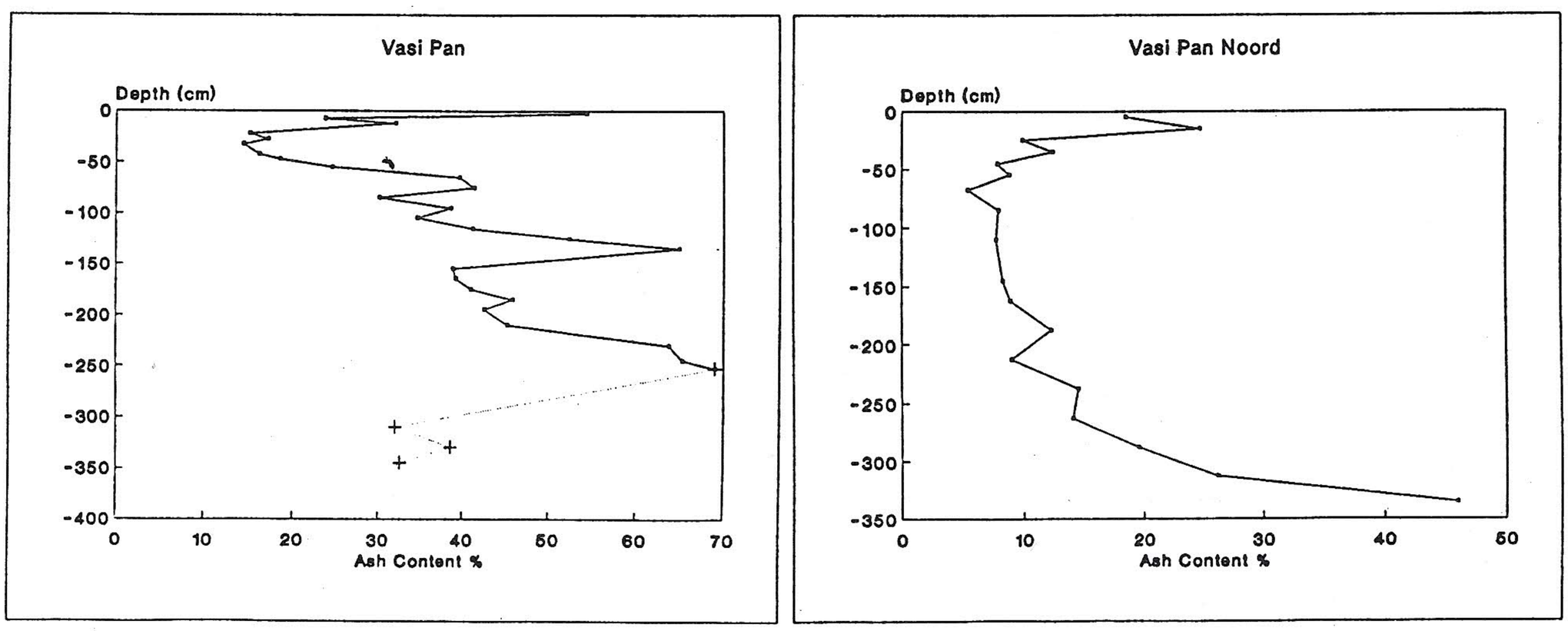


Fig. 48: Ash content for Vasi Pan and Vasi Pan Noord

Peat fire

Part of the surface vegetation of the drying peatland was set alight in May 1996 by the local forestry department (Msweli, pers.comm.). It formed part of a routine veld management program, but the dried out peat layer ignited (Fig 49). The northern part of the main peatland was still burning, despite extensive rains (Fig 50), during a field visit towards the end of January 1997.

As a result of more than 60 % moisture loss in the top 50 cm of the peatland the veld management fire was able to ignite the top portion of the peat. It also resulted in a loss of its moisture-holding capabilities. The fire expanded, as in the Okavango Delta (McCarthy *et al.*, 1988) along the cracks, resulting in a mosaic burning pattern, leaving areas, enclaves of elevated, unburned peat, amongst depressions of collapsed ash in the Vasi Pan peatland (Fig 51). The peat in the northern area has burned to a reddish ash (Fig 50) while in the southern area a whitish ash resulted (Fig 45 & 51).

McCarthy *et al.* (1988) and Ellery *et al.* (1989) observed that the depth and areal extent to which peat beds burned depend on the oxygen availability in and the moisture content of the peat and the presence of an incombustible substrate. The same apply for Vasi Pan with the exception that perched water tables in the surrounding dunes drives the hydrology of these interdune wetlands. The desiccation of the peat because of a water deficiency is here as a result not of channel switching as in the Okavango Delta (McCarthy *et al.*, 1986), but of a lowering of perched and regional water tables by the surrounding plantation's pine trees. A more detailed survey is required to determine the depth extent of the dried-out peat layer, the degree of moisture loss and depth to which the peat has burnt-out.

Botanical

Plant species composition

Plant species composition on the northern lobe of the Vasi Pan, Vasi Pan Noord, with 3.4 m of peat, now represents, in part, a mixed bushveld community (Baartman, 1997), which is further being invaded by exotic pines. Comparison with peatlands in the vicinity, where the dominant vegetation type consists of papyrus, reeds, sedges or swamp forest, indicates that the transformation to a mixed bushveld community is the result of desiccation by the surrounding pine forests, i.e. the wetland has dried out to such an extent, that its surface can now support these species of mixed bushveld communities.



Fig. 49: Burning peat layer. Note the smoke out of the mudcrack.



Fig. 50: The northern part of the main peatland after extensive rains: note the red ash.



Fig. 51: The fire spread along cracks. Note the white ash.

Young pine invasion

Young pine trees do not favour waterlogged soil conditions. Both parts of the Vasi Pan peatlands have been invaded by dense stands of young pine growth (Fig 52). Once again this is only possible if the wetland has dried out enough to favour the growth of pine. This invasion of wetland by young pine is evident in virtually all the wetlands within the plantation (Fig 53). This is further support for the drying-out effect by the plantation. Signs of drying-out to this extent are absent from peatlands just north and south of the plantation, despite periods of drought.

Sustainable utilisation

The wetlands, those with or without peat, have been used for generations for subsistence and small scale farming. Peat forms an active part of wetlands in this area. It represents an important water, fodder and biomass resource for the local communities. Poorly planned and uncontrolled commercial and domestic forestry is having a negative impact on the sustainability of the wetlands in terms of ecological processes and utilisation by the local population of Maputaland.

Peat fires endanger the lives of local communities, stock and wildlife. An ash crust can form on top of the burning peat and only light rain is needed to enhance the growth of grasses and other plants (Fig 54). Cattle graze on to the still burning wetland and are either caught up in the cracks or fall through the crust (Fig 55). It also poses a fire hazard to the surrounding plantations.



Fig. 52: Dense stands of young pine growth on Vasi Pan North.



Fig. 53: An invasion of a wetland by young pines on the northern boundary of Manzengwenya.



Fig. 54: Green growth on the burning peat and ash layer.



Fig. 55: A trapped cow.

CONCLUSION

Geological and botanical changes on the Vasi peatlands point to a drying out effect caused by the pine trees of the Manzengwenya plantation on the Vasi peatlands. Vasi Pan Noord is in danger of either accidental or spontaneous combustion. Peat fires pose a fire hazard to the surrounding plantations and endanger the lives of local communities, stock and wildlife that utilise these wetlands.

Wetlands play a very important part in the daily lives of the local communities as water, horticultural and biomass resources. Forestry is making a positive contribution to the local economy, but cannot alone support the regional population. Local inhabitants need to have access to traditional and sustainable resources. The unwise and uncontrolled expansion of commercial and domestic forestry is impacting negatively on the wetlands of Maputaland. Further research is necessary to determine the true extent of the layer of dried-out and burnt peat.



SYNTHESIS

EXTENT OF PEAT OCCURRENCES

- About 266 peatlands are known within the Mozambique coastal plain in Maputaland. Their thickness varies from 0.5 to 10 m. Reserves are inferred at 158 million m^3 moist peat.
- Present estimates of peat volumes are as much as 30 - 50 % lower in places than previously reported figures.
- Peat-forming flora tends to be mono-specific. No endemics were noted on the peatlands.
- Papyrus/reed/sedge peatlands comprise 55 %, swamp forests 30 % and grass/sedge peatlands only about 15 % of the peatlands.
- Peatlands are an important resource for horticulture, fodder, biomass and water source for the local communities. Uncontrolled commercial and domestic afforestation poses a threat to the ecological processes in peatlands by drying out wetland areas.
- At the data density available at the moment it becomes apparent that there is a considerable variability in analytical values. This implies that if the sample density on an individual peatland is too low, this could result in incorrect resource estimation and inaccurate classification of the commodity.

PROXIMATE ANALYSES AND C^{14}-DATING

- More than 50 % of the peatlands have a high (more than 30 %) ash content. This means that the majority of the Maputaland peats have a lower calorific value when compared with the low ash peats of the Northern Hemisphere.
- When compared to wood these medium to high ash peats do not really represent an alternative energy resource, especially seen in the light that Maputaland has abundant indigenous woodlands and exotic plantations.
- Maximum ages for individual peatlands varies from 770 years BP (Mseleni) to 45 000 years BP (Mfabeni) peatland.
- Linear curves of depth v/s time for Mfabeni and Maputaland do not indicate compaction.
- The average accumulation rate, as established from depth v/s time curves, for Maputaland over the past 7 000 years is 1.06 mm/year and 0.45 mm/year for Mfabeni over the past 45 000 years.
- These accumulation rates do not support the sustainable utilisation of peat as an energy resource nor for most other commercial applications.
- It is possible to estimate a reasonable age of certain types of peatland at a certain depth by comparison with the accumulation rate established for Maputaland.

PALYNOLOGY

- Pollen-based accumulation rates vary from 0.26 - 18.5 mm/year and compare relatively well with the C^{14} ages (0.22 - 6.54 mm/year).
- Assemblages of pollen and spores in the examined profiles show that a hydromorphous forest existed and expanded in the Maputaland area at the beginning of the Holocene.
- The retreat of the forest possibly corresponds with climatic and hydrological fluctuation in the coastal region.
- The assemblages of pollen and spores of peat-forming plants in the examined profiles

show successions from open water conditions through reed/sedge vegetation to swamp forest.

- The pollen data of the Mfabeni peatland show that a similar, hydromorphous forest occupied the area in the Pleistocene, about 43 000 BP.

RECOMMENDATIONS

- Conserve and manage sensitive peatlands, for example swamp forests and raffia peatlands, by:
  - prohibiting commercial exploitation of peat,
  - controlling commercial and domestic afforestation around wetlands,
- Establishing functional working/liaison committees between local communities, conservation and agriculture, to:
  - establish the need of local communities to utilise peatlands (cost benefit analyses),
  - educate in alternative horticultural practices, e.g. trench method and composting,
  - put conservation and tourism principles into practice to benefit local communities, in this way relieving the pressure on the wetlands.
- Initiate:
  - research on alternatives for peat (like bulk composting of organic material, e.g.: bagasse, bark and sawdust)
  - detailed peatland research to understand these wetlands better, e.g.: the Mfabeni peatlands
  - expansion of the research to also cover the regional distribution of peatlands in other areas, like the Highveld and Escarpment.

CONCLUSION

Peat reserves for South Africa are inferred at between 250 and 280 million m^3 moist peat, with more than 60% of inferred reserves in KwaZulu-Natal. It is impossible for the accumulation rate of peatlands to keep up with large-scale commercial utilisation for either energy or horticultural use. Over exploitation of peatlands by draining of water, peat mining, in situ horticulture and the burning of the biomass on the wetland hinders the accumulation of peat. These measures and the resulting drying-out effect of afforestation may accelerate the deterioration of peatlands, in extreme cases by spontaneous combustion of the peat.

The peat in South Africa occurs in ecologically sensitive wetland areas. Peat as a resource for clean drinking water is probably much more important than the other uses, especially in remote rural parts. Its value, in terms of commercial exploitation, must be weighed up against the value of permanent and clean water.

REFERENCES

Acocks, J.P.H. (1975). Veld types of South Africa. *Mem. Bot. Surv. S. Afr.* ***40.***

Arnold, T.H. & de Wet, B.C. ed. 1993. *Plants of Southern Africa Names and Distribution.* National Botanical Institute, Pretoria, 825pp.

Bélanger, A., Potvin, D., Cloutier, R., Caron, M. and Theriault, G. (1988). Peat a resource of the

future. *CQVB*.

Blackmore, A. & Mulqueeny, C. (1996). Towards developing a model for the integration of afforestation and wetland conservation within the Zululand Coastal Plain. *Natal Parks Board Annual Research Symposium: Programme & Abstracts*.

Bruton, M.N.,1979. Studies on the Ecology of Maputaland: Rhodes University, Grahamstown.

Coetzee J.A.,1967. Pollen Analitical Studies in East and Southern Africa: A.A. Balkema, Cape Town.

Dent, M.C., Lynch, S.D. & Schutze, R.E. 1989 . Mapping Mean Annual and Other Rainfall Statistics Over Southern Africa. *Report to Water Research Commission by Department of Agricultural Engineering, University of Natal. WRC Rep. 109/1/89.*

Ellery, W.N., Ellery, K., McCarthy, T.S., Cairncross, B. & Oelofse, R. (1989). A peat fire in the Okavango Delta, Botswana, and its importance as an ecosystem process. *Afr. J. Ecol*. **27**, 7 - 21.

Faegri, K., Kaland, P.E. & Krzywinski, K. (1989). Textbook of pollen analysis. *IV Edn. John Wiley & Sons*. 328

Grundling, P. (1996). Sustainable Utilisation of Peat in Maputaland, KwaZulu-Natal, South Africa. In Lüttig, G.W.(Ed.) *Abstracts of the 10th International Peat Society Congress*. May 1996, Bremen. **1**. 6.

Grundling, P. (1996). Traditional Sustainable Utilisation of Peat in Maputaland, KwaZulu-Natal, South Africa. (poster). 10th *International Peat Society Congress*. May 1996, Bremen.

Grundling, P-L. (1996). Peat Database of South Africa. *Council for Geoscience, Int. Rep. 1996-0064.*

Grundling, P. & Mazus, H. (1996). The Variability in the data of Majiji, a peatland in Maputaland,KwaZulu-Natal, South Africa. In Lüttig, G.W.(Ed.) *Proceedings of the 10th International Peat Society Congress*. May 1996, Bremen. **2**. 39-48.

Grundling, P. (1994). 'n Regionale studie van die veenafsettings net suid van Sibayi-meer, Noord Kwa Zulu/Natal. *Council for Geoscience, Int. Rep. 1994-0122.*

Grundling, P. (1996). Implication of C^{14} and pollen derived ages on the characterisation of the peatlands of Maputaland, northern KwaZulu-Natal. *Council for Geoscience, Int. Rep. 1996-0119.*

Hanekom, C.C. 1995. *Phragmites australis* utilization within the Tembe-Ndumo Game Reserve Complex. *KwaZulu Department of Nature Conservation, Int. Rep. 1995 Oct.*

Ikonen, L.(1993). Holocene development and peat growth of the raised bog Pesänsuo peat in southwestern Finland. *Geological Survey of Finland Bulletin 370.*

Levee, J. (1993): A Complete Guide to Walks and Trails of Southern Africa: 184; Cape Town.

(Struik Publishers).

Lindsay, R. (1996). Themes for the future: A Special Intervention on "Wetlands in the Coastal Zone and Peatlands - A Key Role for Ramsar". *The 6 TH Meeting of the Conference of the Contracting Parties, Brisbane, Australia: 19 - 27 March 1996.*

Low, A.B. & Rebelo, A.G. (eds).(1996). Vegetation map of South Africa, Lesotho and Swaziland. Department *of Environmental Affairs and Tourism.*

Mazus, H. (1996). Pollen records from Nglangu Peatland on the Zululand Coastal Plain. *Council for Geoscience Internal Report no. 1996 - 0234.*

Mazus, H. (1992). A Preliminary palaeotological study of some peatlands in Maputaland. *7th PSSA Conference, September 1992.*

Mazus, H. and Grundling, P. (1995). A preliminary interpretation of pollen and proximate analyses in the study of the ecology of a late Holocene peat deposit in Northern KwaZulu-Natal. *Centennial GSSA Geocongress, April 1995.* Cent. Geol. Soc. S. Afr. GeoCongr., April 1995. Poster. Johannesburg.

McCarthy, T.S., Ellery, Rogers, K.H., W.N.,, Cairncross, B. & Ellery, K. (1986). The roles of sedimentation and plant growth in changing flow patterns in the Okavango Delta, Botswana. *S. Afr. J. Sci*. **82**, 579 - 584.

McCarthy, T.S., Stanistreet, I.G., Cairncross, B., Ellery, W.N., Ellery, K., Oelofse, R. & Grobicki, T.S.A. (1988). Incremental aggradation on the Okavango Delta-fan, Botswana. *Geomorphology*. **1**, 267 - 278.

Partridge, T.C., Avery, D.M., Botha, G.A., Brink, J.S., Deacon, J., Herbert, R.S., Maud, R.R., Scnoltz, A., Scott, L., Talma, A.S., Vogel, J.C., 1990. Late Pleistocene and Holocene climatic change in Southern Africa: South African Journal of Science, 86, p.302-305.

Partridge, T.C.,1993. Warming Phases in Southern Africa During the Last 150 000 Years: an Overview: Palaeogeography, Palaeoclimatology, Palaeoecology, 101, p.237-244.

Phillips, J. (1969). Map *o*f Bioclimatic Subregions.

Pithers, L. (1996). Wattles and Water Affairs. *Veld & Flora. **82(4)**. 120 - 121.*

Recommendation 6.1. *The 6 TH Meeting of the Conference of the Contracting Parties, Brisbane, Australia: 19 - 27 March 1996.*

Raven, P.H., Evert, R.F., Eichhorn, S.E. 1986 . *Biology of Plants.* Worth Publishers, New York, 775pp.

Rogers, F.E.J., Rogers, K.H. & Buzer, J.S. 1985. *Wetlands for Wastewater Treatment.* Witwatersrand University Press, Johannesburg, 122pp.

Scotcher, J. (1996). Sustainable Forestry Management and Biodiversity. *Natal Parks Board Annual Research Symposium: Programme & Abstracts*.

Scott, L.,1981. Late Quaternary Fossil Pollen Grains from the Transvaal, South Africa: Review of Palaeobotany and Palynology, 36, p. 241-278.

Smuts, W.J. (1992). Peatlands of the Natal Mire Complex: geomorphology and characterization. *S. Afr. J. Sci., **88,** 474 - 483.*

Smuts, W.J. (1994). Characteristics of South African peats and their potential exploitation. Council for Geoscience, Int. Rep. 1994-0206.

Smuts, W.J. & Kirstein, L.S. (1995). Peat and related biofuels as potential renewable alternative energy option in part of KwaZulu-Natal . *DMEA Report no: EO9417*

Taylor, R. (1991). The Greater St Lucia Wetland Park. *Natal Parks Board.*

Thamm, A.G., Grundling, P., & Mazus, H. (1996). Holocene and recent peat growth on the Zululand coastal plain. *Journal of African Earth Science. 23/1. 119 -124*

Van Vuuren, C.J. (1976). Other carbonaceous fuels. **In:** Mineral Resources of South Africa, Handbook 7, Geol. Surv. of S.Afr., 331. 22

Wessels, N. 1997. Aspects of the Ecology and Conservation of Swamp Forests in South Africa. *Dissertation Technikon Port Elizabeth, unpublished.*