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REPUBLIC OF SOUTH AFRICA

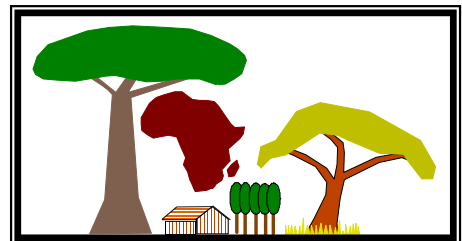
CLASSIFICATION SYSTEM FOR SOUTH AFRICAN INDIGENOUS FORESTS

An objective classification for the Department of Water Affairs and Forestry



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Table of Contents

1. INTRODUCTION	1
1.1 SUBJECT AND AIMS OF THIS REPORT	1
1.2 ENVIRONMENTAL CHARACTERISTICS OF INDIGENOUS FORESTS OF SOUTH AFRICA	2
1.3 FOREST USE AND MANAGEMENT	3
1.4 FOREST PROTECTION AND CONSERVATION STATUS	4
2. OVERVIEW OF PREVIOUS INDIGENOUS FOREST CLASSIFICATIONS	6
2.1 AFROTEMPERATE/AFROMONTANE AND INLAND FOREST TYPES	6
3. METHODOLOGY	11
3.1 OVERVIEW OF THE PROCESS	11
3.2 MAPPING AND SPATIAL DISTRIBUTION OF FORESTS	11
3.3 CLIMATE AND SOIL CLASSIFICATION	12
3.4 VEGETATION DATA SOURCES.....	13
3.4.1 <i>Number of parameters sampled</i>	15
3.4.2 <i>Taxonomic reliability and nomenclature</i>	15
3.4.3 <i>Structural and textural definitions</i>	15
3.4.4 <i>Completeness of taxon lists</i>	15
3.4.5 <i>Sampling intensity</i>	15
3.5 DATA TRANSFORMATIONS AND DATABASING.....	15
3.6 NUMERICAL DATA HANDLING OF VEGETATION DATA.....	16
3.6.1 <i>Computer-assisted derivation of forest types</i>	16
3.6.2 <i>Analysing similarity patterns among derived forest types</i>	17
3.7 FAUNAL ANALYSES.....	17
3.7.1 <i>Characteristics and sources of faunal data</i>	17
3.7.2 <i>Analyses</i>	18
3.8 CONSULTATION AND PARTICIPATION	19
4. CLIMATIC AND EDAPHIC PATTERNS	20
4.1 PRECIPITATION.....	20
4.1.1 <i>Mean precipitation</i>	20
4.1.2 <i>Seasonality of precipitation</i>	20
4.2 TEMPERATURE	20
4.2.1 <i>Maximum temperature</i>	20
4.2.2 <i>Minimum temperatures of the coldest month</i>	21
4.4 SOIL FERTILITY	21
4.5 CLIMATE CLASSIFICATION.....	21
5. MAJOR VEGETATION PATTERNS	28
5.1.1 OVERVIEW OF THE HIERARCHICAL SYSTEM	28
5.2 GENERAL NATURE OF THE UNITS	31
5.2.1 <i>Zonality, intrazonality, and azonality patterns</i>	31
5.3 GENERAL CLASSIFICATION PATTERNS	32
5.3.1 <i>Position of azonal forest types</i>	32
5.3.2 <i>Position of Western Cape forests</i>	33
5.3.3 <i>Position of Drakensberg and Highveld forests</i>	33
5.3.4 <i>Position of the Northern Escarpment forests</i>	34
5.3.5 <i>Position of the Scarp Forests, Eastern Cape and Midlands mistbelt forests</i>	34
5.3.6 <i>Position of the Coastal forests</i>	35
5.4 CONCLUSIONS.....	40
6. MAJOR FAUNAL PATTERNS	41
6.1 BIRDS	41
6.2 REPTILES.....	43
6.3 FROGS.....	45
6.4 MAMMALS	47
6.5 COMPARISON WITH FLORAL CLASSIFICATION	48

6.5.1	<i>Southern Afrotemperate group</i>	48
6.5.2	<i>Northern Afrotemperate Group / Northern Mistbelt Group</i>	49
6.5.3	<i>Southern Mistbelt Group</i>	49
6.5.4	<i>Scarp Group</i>	49
6.5.5	<i>Northern Coastal Group</i>	49
6.5.6	<i>Southern Coastal Group</i>	50
7.	FOREST GROUPS	51
I:	SOUTHERN AFROTEMPERATE GROUP	51
II:	NORTHERN AFROTEMPERATE GROUP	53
III:	NORTHERN MISTBELT GROUP	54
IV:	SOUTHERN MISTBELT GROUP	56
V:	SCARP GROUP	58
VI:	NORTHERN COASTAL GROUP.....	60
VII:	SOUTHERN COASTAL GROUP.....	62
	REFERENCES (CHAPTER 1 – 7)	63
8.	FOREST TYPES	73
I1:	WESTERN CAPE TALUS FORESTS	73
I2:	WESTERN CAPE AFROTEMPERATE FORESTS	80
I3:	SOUTHERN CAPE AFROTEMPERATE FORESTS.....	88
II1:	MAREKELE AFROMONTANE FORESTS.....	99
II2:	NORTHERN HIGHVELD FORESTS.....	105
II2A:	NORTHERN HIGHVELD KLOOF FORESTS	108
I3:	DRAKENSBERG MONTANE FORESTS	114
II4:	NORTHERN KWAZULU-NATAL MISTBELT FORESTS	123
III1:	NORTHERN MISTBELT FORESTS	132
III2:	MPUMALANGA MISTBELT FORESTS	143
IV1:	EASTERN MISTBELT FOREST.....	155
IV2:	TRANSKEI MISTBELT FOREST	165
IV3:	AMATOLE MISTBELT FORESTS	172
V1:	EASTERN SCARP FOREST	181
V2:	PONDOLAND SCARP FOREST	189
V3:	TRANSKEI COASTAL SCARP FORESTS.....	197
V11:	KWAZULU-NATAL COASTAL FORESTS	205
V12:	KWAZULU-NATAL DUNE FOREST.....	215
VII1:	EASTERN CAPE DUNE FORESTS	225
VII2:	ALBANY COASTAL FORESTS.....	233
VII3:	WESTERN CAPE MILKWOOD FORESTS	240
A1:	LOWVELD RIVERINE FORESTS.....	244
A2:	SWAMP FORESTS	253
A3:	MANGROVE FOREST.....	258
A4:	LICUATI SAND FORESTS.....	268

1. INTRODUCTION

The forests of South Africa are highly fragmented and are considered one of the most vulnerable vegetation types. Extending from the Cape Peninsula eastwards through the Outeniqua and Tsitsikamma Mountains of the southern Cape, indigenous forests have a discontinuous distribution through the midlands of the Eastern Cape and KwaZulu-Natal. Northwards, forests are distributed along the Drakensberg Mountains of KwaZulu-Natal, the eastern Free State, Mpumalanga and into the Limpopo Province, where the northern-most forests are located in the Soutpansberg Mountains. The temperate inland forests are generally small, patchy in distribution and usually located on the south to south-eastern aspect of mountain ranges. Lowland forests extend along the coast from Port Elizabeth in the Eastern Cape through KwaZulu-Natal to Mozambique. These forests of the subtropical coastal zone have a discontinuous distribution in the south, but are fairly continuous in northern KwaZulu-Natal. Lowland forests are usually associated with specific topographic features such as coastal dunes, rivers, ravines and wetland areas. The tremendous variation in climate, altitude, latitude and topography across the region and over time, has resulted in a diversity of forest types in southern Africa. Forests typically occur in the moist areas of the country, but specialised forest types are also found fringing rivers or within protected kloofs within some arid areas. In spite of the small spatial extent (less than 0.3% of land surface – 0.25% in Rutherford and Westfall, 1994; but 0.56% according to calculations in Low and Rebelo 1996), the forest biome is extensively utilised and provides highly valued resources, also for biodiversity.

In response to the need to combine sustainable development and management of forests with their conservation, the National Forests Act (Act No 84 of 1998) requires the South African government, among its other obligations in terms of the natural forest sector, to:

- monitor and report on the state of the forest resources; and
- protect all natural forests (on private, communal and state land).

The government's goal for forestry in the country is to promote a thriving forestry sector that will be developed, managed and utilised for the lasting benefit of the nation and the protection of the environment. The White Paper on Sustainable Forest Management in South Africa (1996) commits the government to reporting regularly to the nation, and the international community, on the state of the country's forest resources and progress toward sustainable forest management.

There is currently no one classification that is nationally accepted for indigenous forests. In addition, existing classifications have not been objectively derived from biological information. Without an objective classification, the government is not able to meaningfully report on the state of the forest resources within the country, nor set conservation priorities. To effectively monitor, evaluate and protect forests, the types of forests must be clearly defined and their distributions accurately mapped. Understanding the floristics of the forest types and linking this to an understanding of their ecology, is also important for the setting of wise management practices. A forest type cannot be adequately protected without knowing its key characteristics, general location, and common and endemic species.

1.1 Subject and aims of this report

This report presents a new, formalized biogeographic-floristic classification of the South African indigenous forests.

We define indigenous forest, for the purposes of this classification system, as:

A generally multilayered vegetation unit dominated by trees (largely evergreen or semi-deciduous) whose combined strata have overlapping crowns (i.e. the crown cover is greater than or equal to 75 %), and where graminoids in the herbaceous stratum (if present) are generally rare. Fire does not normally play a major role in forest function and dynamics except at the fringes.

This definition is based on a review of existing definitions of forest used within South and southern Africa, and elsewhere (Shackleton et al. 1999).

This report has been developed for the Department of Water Affairs and Forestry (DWAFF) by a team of forest specialists. The classification was based on rigorous numerical (computer-assisted) analysis of currently available data, supported by specialist's knowledge from a wide spectrum of forest ecologists. The focus was on floristic data, however faunal data and site characteristics were also considered. Although the dataset was limited in some areas, such as the scarp forests and Albany region, project managed to use over 4500 releves from 427 sites/forests.

1.2 Environmental characteristics of indigenous forests of South Africa

Forests have specific environmental requirements for their establishment. Within South Africa, forests are limited by water availability. Within the summer rainfall area forests normally occur in areas of above 725mm of rainfall. In the winter rainfall regions with their lower potential evaporation during the growing season, forests occur down to 525 mm of rain (Rutherford and Westfall 1986). Forests may also be found fringing rivers and in protected kloofs (gorges) in lower rainfall areas. South African forests are largely found in areas with nutrient poor substrates though forests are to some extent, able to modify their own substrate. However, forests are quite capable of growing on more nutrient rich substrates. Disturbance factors, and especially the occurrence of fire, have a major impact on forest distribution. Many forest patches are limited to protected fire refugia (Geldenhuys 1994). Forests are able to grow over a wide range of temperatures and are found from the snow and frost prone Drakensberg to the hot KwaZulu-Natal coastal plain.

The distribution and species composition of forests does not remain constant over geological time, and may change even more rapidly as a result of management interventions. Individual species slowly move outwards from their centre of origin (endemism) into suitable neighbouring habitats. The rate of dispersion is governed largely by the mechanisms of seed dispersal and the proximity of suitable habitats. The current patterns of distribution and composition of forest species are the result of many factors, including:

- History: The length of time for dispersal from centres of origin; the timing of forest radiation events (Hamilton 1981; White 1981; Meadows and Linder 1989; Lawes 1990);
- Dispersal pathways: Mountain ranges, escarpments, river valleys and coastal dunes have provided dispersal pathways, whilst wide dry river valleys have prevented dispersal (Moreau 1966; Tinley 1985; Lawes 1990; Maley 1991; Geldenhuys 1992; Scott et al. 1997);
- Management: Especially as a result of selective harvesting or changes to disturbance regimes (e.g., McCracken 1986; Obiri et al. in press);
- Successional stage: Young forests will have different species composition to mature forests. This is especially true of the coastal forests where there is a more defined successional pathway (Van Wyk et al. 1996) than in Afrotropical forests;
- Dispersal mechanisms: Bird and animal dispersed seeds are more likely to travel long distances than wind dispersed seeds (e.g., Foord et al. 1994);
- Habitat requirements: Forests can only establish in areas with suitable climate (Lawes 1990; Taylor and Hamilton 1994; Hulme et al. 1995; Eeley et al. 1999);
- Establishment requirements: Forest seedlings will only establish and survive in suitable habitats. For many of the later succession species, the existence of an early successional forest may be a pre-requisite. Early successional species may establish within grasslands, savanna or fynbos subject to the impact of disturbances such as fire and herbivore that destroy the seedlings (e.g., Midgley and Cowling 1993; Chapman and Chapman 1996; Duncan and Duncan 2000);
- Biotic interactions; and
- Disturbance: Fire, tree falls, animal damage and human exploitation can change the status and species mix of forests, or even reduce forests to open grassland. The forest species recolonizing these open patches typically do this through a succession sequence (Everard and von Maltitz 1991; Marshall and Swaine 1992; Brokaw and Busing 2000).

Forest types may owe their persistence and resilience to fundamentally different processes of plant regeneration ecology (Bond and Midgley 2001). Late succession (non-pioneer) species typically have seeds that can germinate and establish under a forest canopy, whilst early succession species typically establish in larger forest gaps or at the forest fringe (Midgley et al. 1995; Brokaw and Busing 2000). This change between early and late successional species might be cyclical if new gap generating disturbances occur on a reasonably regular basis (Denslow 1987). In such forests the species composition should reach a dynamic equilibrium between early and late successional species. If the natural disturbance regime changes, new man made disturbances added, or existing disturbances removed, then the equilibrium between pioneer and late succession species will be altered. Forests dominated by large-scale gap dynamics typically have a large degree of spatial heterogeneity in species composition, which is linked to the size and age of disturbance events (Everard et al. 1994). These forests will be referred to as course-grained forests. By contrast, forests where there is limited disturbance, and /or disturbed areas are not colonised by early successional species, have late succession species germinating under parent trees of the same species. In these forests, species distribution is relatively homogeneous and these will be referred to as fine-grained forests (Everard et al. 1995). Understanding the processes driving a system is imperative for making wise management decisions as it relates to the degree to which different forest types will be resilient to different types of disturbance.

1.3 Forest use and management

Man induced disturbances such as those created by the heavy selective logging of the eighteenth and nineteenth century will have had long-term impacts on forest species composition (e.g., Johns 1983; Skorupa 1986; Struhsaker 1997; Obiri 2002). Ironically, the total protection of forest in South Africa from 1939 onwards (when harvesting from indigenous forests was outlawed) and the reduction of disturbance regimes resulting from the introduction of exotic plantations, may have resulted in successional change at a rate that would have been unlikely in a natural environment without this protection. Equally, there is growing evidence that pre-historic man was interacting with forests for possibly thousands of years, creating gap disturbances that would have resulted in specific forest structure (Scott and Steenkamp 1996; Scott et al. 1997; West et al. 2000). The subsistence and medicinal use of forest products such as lathes, poles, bark and fuel is probably one of the major disturbances now faced by forests (Obiri 2002). Indigenous forests contain a wide range of traditional medicinal plants (trees, shrubs, climbers, epiphytes and parasites) (Lawes et al. 2000); the most popular of which are sold commercially (Mander 1998). This use is often 'illegal', takes place in an indiscriminate and destructive manner and occurs both within and outside of protected areas. Although this type of use has probably occurred for hundreds of years, it is only recently that the increased intensity of this use has had a major impact on the forest. The way forests respond to any of these disturbance types is dependent on the ecology of the specific forest, and the forest grain model (see above) is one way of predicting this.

Despite this level of use, for many of these resources, not a great deal is known in South Africa about the number of people involved, the amounts harvested, where the harvesting is taking place and, the value (especially value at the point of harvest).

The indigenous furniture trade is a very important small business generator of income in South Africa. The bulk of the timber is produced from state and private forests in the George-Knysna-Tsitsikamma forests. Small quantities of timber (mainly yellowwood) are also produced from the Amatole forests. The resource is very limited and the industry has little room for expansion, therefore, the number of viable enterprises that can exist is also limited (Bailey et al. 1999). Tree harvesting for this resource is based on the mortality pre-emption model (maturity condition criteria yield regulation method; Seydack 2000) and has relatively minor impacts on species composition.

1.4 Forest protection and conservation status

Forests in South Africa range from forests under private and tribal ownership (some in excellent condition and others nearly destroyed) to forests in conservancies and natural heritage sites, through to state forests, forests in nature reserves and wilderness areas. There are many privately owned and communal forests outside of proclaimed areas that are conserved but which have insecure conservation status. Ownership largely determines the type and quality of forest management and possible impacts on the vegetation. However, the state does not have the capacity to adequately manage all its forests, especially the numerous small forest patches that were demarcated in the previous homelands and independent states.

The conservation status of forests and the degree to which they are utilised or protected varies between forests and regions. In 1989, Geldenhuys & MacDevette listed the protected forest areas under the control of public authorities. Since then, many changes have occurred in the control of forests. Management of much of the state forest occurring within mountain catchment areas has been transferred to provincial conservation authorities. Other state forests that were not declared as Prime Conservation Areas, were transferred to SAFCOL (South African Forestry Company Limited). Areas under the control of the former homelands were mostly transferred to the control of DWAF. The exotic timber production operations from plantation forests on both SAFCOL and much of the DWAF land transferred from the former homelands are currently being privatised. Small forest patches within these privatised areas are likely to become the management responsibility of the new private owners, while larger blocks of indigenous forest will remain the management responsibility of DWAF. Forests are conserved within the National Parks as well as provincial parks from at least five provinces as well as in State forests. In addition, some municipal and private parks also contain forests. As pointed out by Geldenhuys & MacDevette (1989), many of the forest patches and the corridors that exist between them, and which may be vital for the continued conservation of the forest species within the conserved areas, are not protected.

This document discusses the conservation status of each forest type and provides some details on the threats and management considerations relevant to each type. It must, however, be pointed out that data on the true conservation status and condition of forests is poorly researched, with most intensive assessments relating back to the early 1990's and the work conducted by Cooper (Cooper 1985, Cooper and Swart 1992). Recent work in KwaZulu Natal by Goodman and others as a component of the stream flow reduction strategic environmental assessment (SEA) has provided better and more up to date data for this province. Results obtained by overlaying boundaries of conserved areas onto maps of forest distribution can provide very misleading results of the degree of the on-the-ground protection that is actually being afforded to the forests. This is especially true of areas such as the former Transkei where a large number of forests were gazetted as state forests. There is however limited institutional capacity to manage these forests, and in many cases forests are protected by nothing more than a set of white painted beacons or rocks that demarcate the state forest land from the communal ground surrounding it. Figure 1.1 gives a size class distribution of demarcated state forest land containing forest patches in this region. At the other extreme, the extensive forest areas such as those in the Southern Cape are well conserved with extensive infrastructure in place for their management.

Until recently, a predominantly protectionist attitude was applied to forest conservation. Forest within National and Provincial reserves as well as in State forests was almost exclusively maintained and managed using a total protection approach. Even eco-tourism was relatively undeveloped in most of these areas. Management was vested exclusively in the management authority with limited or no public involvement in either policy or practice. Changes brought about by the National Forests Act (1998) make provision for more participative involvement by stakeholders in forest management, and make provision for joint usage and management.

Figure 1.1 Size class distribution of state forests in KwaZulu-Natal and Eastern Cape Forestry Regions. Most of the KwaZulu-Natal region's forest patches are in the Eastern Cape Province.

Size in ha	Number of forests	Cumulative number of forests less than specified size
0 – 10	192	192
10 – 25	183	375
25 – 50	326	701
50 – 100	234	935
100 – 250	138	1073
250 – 500	77	1150
500 – 1000	30	1180
1000 – 2000	17	1197
> 2000	12	1210

2. OVERVIEW OF PREVIOUS INDIGENOUS FOREST CLASSIFICATIONS

The classification of indigenous forests into specific types has been primarily subjective. The earliest classifications were based on the amount and quality of merchantable timber that could be extracted from them, such as cedar forests, mixed yellowwood and broad-leaved forests, coastal forests of the East Coast, and subtropical forests of Natal (Robertson 1924; Laughton 1937). Where objective techniques have been applied, the spatial scale has usually been too narrow for meaningful interpretation within a wider context. Forests of KwaZulu-Natal, the Eastern Cape and, to a lesser extent, the Western Cape have all been classified by parochial systems (Edwards 1967; White 1983; Cooper 1985; MacDevette et al. 1989; Cooper and Swart 1992; Low and Rebelo 1996). Interest in Mpumalanga and the Limpopo Province has been limited. Until now, there has been no attempt to co-ordinate an objective classification system for all forests in South Africa (Shackleton, Cawe and Geldenhuys 1999).

It is generally accepted that South African forests are associated with two phytochoria, the Afromontane archipelago-like regional centre of endemism and the Tongaland-Pondoland regional mosaic (White 1983). Almost all existing forest classifications recognise this main difference in forest types based on their origin and characteristic species. The small area (in South Africa) of sand forests are considered to contain species indicating their origin from the Zanzibar-Inhambane region, and as such are seen a distinctly different from other South African forests (see Low and Rebelo 1996). A number of azonal forest types such as mangrove forests and some of the riverine forests are also distinctly different and have been excluded from many of the existing forest classifications. Areas where the two main forest types meet, that area defined by the so-called scarp forests, are areas where there has been the least agreement on classification. Largely because these scarp forests contain a confusing complement of both Afromontane and Indian Ocean coastal belt forest elements.

Most early accounts of indigenous forests separate the northern coastal forests from those located inland (Acocks 1953, Edwards 1967, Laughton 1937, Moll & White 1978, Werger 1978, White 1978). Despite their proximity to the coast, the large forests of the Outeniqua and Tsitsikama mountains were included with inland montane forests based on their floristic composition. The southerly temperate latitudes compensate for the altitude of forests further inland (White 1978) resulting in similar montane climatic conditions and forests with similar floristic conditions. Coastal forest in KwaZulu-Natal was distinguished from Uplands *Podocarpus* Forest by the presence of certain common coastal tree species and the generally higher tree species diversity at the coast (Edwards 1967).

2.1 Afrotemperate/Afromontane and inland forest types

In a southern African context, White (1978) referred to the inland forests as an archipelago-like region of extreme floristic impoverishment, part of the Afromontane archipelago-like regional centre of endemism (White 1983). Despite the uniform nature of the tree flora, the Afromontane forests were grouped subjectively into five local systems extending from the Soutpansberg to the Knysna region on the basis of tree species composition (White 1978). Overlapping substantially, the groups reflected broad geographic divisions and emphasised a trend of decreasing tree species diversity southwards. Elements of these forests indicate a strong affinity to the Capensis Floral Region further to the west (Werger 1978). Geldenhuys (1987) classified Afromontane forests according to Acocks Veld Types (1953). They essentially mirror geographic divisions extending from Knysna, through the Eastern Cape and KwaZulu-Natal midlands into northern KwaZulu-Natal and the Soutpansberg. Forests of the Amatole Mountains, the former Transkei, the KwaZulu-Natal Drakensberg, Mpumalanga and the Northern Province were reported to show little differences and were floristically similar to the large forests of the southern Cape (Geldenhuys 1992).

In the north there is no regional classification of the forests along the escarpment and Soutpansberg. Cooper (1985) recognized the floristic differences between KwaZulu-Natal and the more northern Afromontane forests and categorised these forests as Transvaal Drakensberg Escarpment Forest and Soutpansberg Forest. Scheepers (1978) gave a floristic description of the

montane forest belt and the scrub forest belt of the northeastern escarpment. Van der Schijf and Schoonraad (1971) described the forests in the Mariepskop area.

The Uplands *Podocarpus* Forest in KwaZulu-Natal was subdivided into Mist Belt Mixed *Podocarpus* Forest and Mountain *Podocarpus* Forest on the basis of altitude (Edwards 1967). The higher altitude Mountain *Podocarpus* Forests were shorter in stature and a species depauperate subset of the Mist Belt Mixed *Podocarpus* Forest. Semi-coast forest (categorised as Coastal forest but later referred to as Coast Scarp; Cooper 1985) was separated by altitude but was not floristically distinct from the two inland forest types (Edwards 1967). In a study aimed at the conservation of forests in KwaZulu-Natal, Cooper (1985) adopted the earlier classification of inland forests for the Tugela catchment proposed by Edwards (1967). Using a hierarchical classification technique (TWINSPAN, Hill 1979) based on tree species presence/absence data, MacDevette *et al.* (1989) were the first to produce an objective classification for forests in KwaZulu-Natal. Although the methods of data collection, level of sampling intensity and data reliability varied substantially among forests sampled, the broad classification system generated by these workers conforms with the intuitive classification adopted by Cooper (1985). Coastal forests were clearly distinguished from inland forests although, strangely, swamp forests were more floristically similar to inland forests. The division of KwaZulu-Natal inland forests by altitude (Mountain *Podocarpus* Forests, Mist Belt Mixed *Podocarpus* Forest) was supported, albeit weakly, by MacDevette *et al.* (1989).

Cooper & Swart (1992) did not consider the inland forests of the Eastern Cape (the area earlier known as the Transkei) to be floristically distinct from those in KwaZulu-Natal and consequently classified them as Mist Belt Mixed *Podocarpus* Forest. Cawe (1986) recognised three phytosociological associations indicating the dominance of certain tree species along a moisture gradient within these inland forests. Story (1952) provided a floristic description of the Keiskammahoek forests in the Amatole mountains, and Everard & Hardy (1993) recognized two main forest types related to a moisture gradient.

Knysna forests have been classified subjectively according to soil moisture status and physiognomy for management purposes (Geldenhuys 1987, Phillips 1931, Von Breitenbach 1974). The classification is based on local knowledge and is difficult to interpret within a broader southern African context. Geldenhuys (1993) used complete floristic data for the southern Cape forests, and showed that the mountain forests, the coastal platform forests, and the coastal scarp forests are floristically distinct, even when tree and understorey data are used separately.

2.2 Coastal forest types

Working specifically in the Tugela catchment of KwaZulu-Natal, Edwards (1967) separated coastal forests into Coastal Lowlands Forest and Semi-coast Forests by altitude. Coastal Lowlands Forest was located below 500m above sea level. Semi-coast Forest, located between 500m and 1000m above sea level, was similar to inland forests in structure but showed closer floristic affinities with Coastal Lowlands Forest (Edwards 1967). Adopting a regional perspective, Moll & White (1978) defined four forest types along the coast that occupy specialised sites (sand, dune, swamp, riverine) and one widely distributed forest type referred to as 'undifferentiated lowland forest'. Defined only by their special location, there was broad overlap between the types in plant species composition. Collectively referred to as forests of the Indian Ocean Coastal Belt, these coastal forests were also not entirely floristically distinct from the Afromontane forests.

Sand Forest is a dry semi-deciduous to deciduous forest type distributed on the sandy soils of Maputaland (Matthews *et al.* 1999). Forest located on the dunes immediately inland of the coast was referred to as Dune forest (Weisser 1978, 1980). As their names imply, Riverine and Swamp forests were located along rivers and lowland wetland sites of the coastal plain respectively (Wessels 1991).

The classification system generated by MacDevette *et al.* (1989) provided an objective test for the coastal forest types proposed by Moll & White (1978) and modified by Cooper (1985). Sand forest

was shown to be floristically distinct from all other coastal forest types and was further subdivided into Eastern and Western forms. The tree species composition of Riverine, Swamp and Mangrove forest was sufficiently different for these types to be assigned to distinct categories. Forests earlier referred to as Dune and Lowland forest by Cooper (1985) were incorporated into an Undifferentiated Coastal Forest category that showed strong floristic differences along the north-south gradient. Dune forest at Cape Vidal and Mapelane, for example, was grouped with Dukuduku forest, traditionally referred to as Lowland forest (Cooper 1985). Further subdivisions of the Undifferentiated Coastal Forests category emphasised floristic differences among coastal forests from Zululand, the Durban area and the KwaZulu-Natal south coast. Coastal Scarp forests were shown to have closer affinities to inland forests than to coastal forests supporting the earlier assertion by Edwards (1967). Following a similar pattern to that produced by the Undifferentiated Coastal Forests, the Coastal Scarp Forests show a diversity gradient decreasing southwards and forests were further separated on that basis. Geldenhuys (1992) reports a similar trend of decreasing diversity from north to south for both inland and coastal forests in South Africa.

The coastal forests of the Eastern Cape are diverse, supporting a rich flora with high endemism (Van Wyk 1989, Werger 1978). Four forest types, based on abiotic and floristic criteria, were recognised by Cawe (1990). In addition to Dune forest, the three types (Wet forests, Moist Pondoland forests, Dry South Coast forests) reflect the decreasing moisture gradient from north to south. Following a similar classification adopted for KwaZulu-Natal, Cooper & Swart (1992) recognise the same specialist forest categories (Dune, Swamp, Mangrove) but separate the 'undifferentiated coastal forests' into Pondoland Coast Forest (between Umtamvuna and Mngazana rivers) and South Coast Forest (between Mngazana and Kei Mouth) based on plant and animal species differences. The Pondoland Coast forests were considered unique for their biological composition. Coastal Scarp forests were considered transitional between the Afromontane and Coastal forests but with closer affinities to Coastal forests based on plant and animal species composition (Cooper & Swart 1992).

The results from the MacDevette et al. (1989) study illustrate some of the problems associated with developing a classification system based solely on plant species composition. One might expect forest groupings assigned by the classification to be geographically distinct, a result confirmed by Geldenhuys (1992). Yet forests of the KwaZulu-Natal midlands show no such pattern. Certain forest patches within the Karkloof range (e.g., Mbona, Blinkwater) were not included within the main Karkloof block while Mpetsheni (Weza) and Qudeni (Zululand) were. These inconsistencies may not result from data limitations, as the authors suggest, but might reflect sampling in forests of different successional age. This implies that disturbance regime and successional status will strongly influence these results.

The development of computer software designed specifically to analyse large datasets for pattern has initiated a flood of interest in forest classification (Bartholomew 1989, Cawe & McKenzie 1989, Geldenhuys & Murray 1993, Geldenhuys & Pieterse 1993, Gordon & Bartholomew 1989, MacDevette 1989, MacDevette & Gordon 1989a,b, MacDevette & MacDevette 1989, Morgenthal & Cilliers 2000, Van Wyk & Everard 1992, 1993a,b, Eckhardt, Van Rooyen & Bredenkamp 1997). Almost all these studies were done within a single forest or within a constrained geographic range and consequently it is impossible to interpret the relevance of these studies within a national context. Nevertheless, these data have been included in the present project to classify indigenous forests in South Africa.

The greatest diversity of forest types in South Africa is located in KwaZulu-Natal and the Eastern Cape. Most research effort into forest classification also happens to be focussed in this region (Table 1). Classification systems have been largely descriptive and reflect the distinct elevation or topographic zones in which forests are located. Where objective classification techniques have been applied, the focus has usually been too narrow for meaningful interpretation within a Southern African context. The recurring theme when classifying Southern African forests is the major division into inland temperate Afromontane forests and coastal subtropical Indian Ocean types (Huntley 1984, Low & Rebelo 1996, Midgley et al. 1997). Based on tree species composition, Afromontane forests appear distinct from coastal forests, but certain Afromontane forests in

Mpumalanga share tree species with coastal forests as far south as Umtamvuna (Geldenhuys 1992, Morgenthal & Cilliers 2000). There has been insufficient work of this nature in the Western Cape, Mpumalanga and the Northern Province. Lack of consensus on finer subdivisions within Afromontane and coastal subtropical Indian Ocean types may result from a number of factors, such as no co-ordinated attempt, uneven research effort according to province and the mostly subjective approach.

Table 1. Summary of forest classifications for KwaZulu-Natal and Eastern Cape (Transkei). The types and subtypes first mentioned are the names currently in most use. The types and subtypes in square brackets are synonyms for the above type or subtype. The authors who proposed the names for the types and subtypes appear in brackets after the names (modified from Everard 1991).

AFROMONTANE FOREST (Cooper 1985, White 1978)

[Temperate, Transitional and Scrub Veld Types (Acocks 1953)]

[Uplands Vegetation (Edwards 1967, Moll 1976)]

[Interior Forests (MacDevette et al. 1989)]

- 1a. Montane Podocarpus Forest (Cooper 1985, Edwards 1967, Moll 1976)
[Highland Sourveld (Acocks 1953)]
 - 1b. Mist Belt Mixed Podocarpus Forest (Cooper 1985, Edwards 1967, Moll 1976)
[Natal Mist Belt Ngongoni Veld (Acocks 1953)]
-

TONGALAND-PONDOLAND UNDIFFERENTIATED FOREST (Werger 1978, White 1978)

[Coastal Tropical Forest Veld Types (Acocks 1953)]

[Coast Vegetation (Edwards 1967)]

[Coast Forest and Palm Veld (Moll 1976)]

[Indian Ocean Coast Belt Forests (Cooper 1985, Cooper & Swart 1992, Moll & White 1978)]

[Coastal Forests (MacDevette et al. 1989)]

- 2a. Dune Forest (Acocks 1953, Cooper 1985, Cooper & Swart 1992, Edwards 1967, Moll 1976, 1978)
- 2b. Swamp Forest (Cooper 1985, Cooper & Swart 1992, Edwards 1967, MacDevette et al. 1989, Moll 1976)
[Typical Coastbelt Forest (Acocks 1953)]
- 2c. Sand Forest (Cooper 1985, Moll 1978)
[Dry Tropical Forest (MacDevette et al. 1989)]
- 2d. Riverine Forest (Cooper 1985, Edwards 1967, MacDevette et al. 1989)
[Fringing Forest (Moll, 1976, 1978)]
- 2e. Coast Lowlands Forest (Cooper 1985, Edwards 1967)
[Undifferentiated Lowland Forest (Moll 1978, MacDevette et al. 1989)]
[Typical Coastbelt Forest (Acocks 1953)]
- 2f. Coast Scarp Forest (Cooper 1985, Cooper & Swart 1992, MacDevette et al. 1989)
[Pondoland Plateaux Sourveld (Acocks 1953)]
[Semi-coast Forest (Edwards 1967)]
- 2g. Mangrove Forest (Acocks 1953, Cooper & Swart 1992, MacDevette et al. 1989, Moll & Werger 1978)]
- 2h. Pondoland Coast Forest (Cooper & Swart 1992)
[Moist Forests - Pondoland (Cawe 1990)]
- 2i. South Coast Forest (Cooper & Swart 1992)
[Dry Forests – South Coast (Cawe 1990)]

MacDevette et al. (1989) place Coast Scarp Forest in their Interior Forest Types.

3. METHODOLOGY

3.1 Overview of the process

The classification was dependant primarily on the extensive secondary data that has been collected on forests. Limited primary data was, however, collected to fill important gaps that were identified in the available data. In addition, the classification process was structured in such a way as to ensure interaction with forest specialists with local knowledge of the different forest areas.

The overall activities in approximate order were as follows:

- Get GIS maps of forest distribution
- Gathering as much data (faunal and floral) as possible from published and unpublished sources;
- Enter the data into a computer format suitable for the classification and ordination software;
- Run an ordination on faunal data;
- Run a classification of climatic data;
- Run a preliminary classification on the floral data;
- Workshop the preliminary classification;
- Workshop the population of descriptive information for each forest type based on the specialists knowledge of the forest type;
- Gather additional forest data;
- Write draft forest chapters;
- Send draft forest chapters to specialists for additional input;
- Rerun forest classification based on additional data gathered; and
- Write up report.
- Have report reviewed.

3.2 Mapping and spatial distribution of forests

No definitive spatially explicit map exists of indigenous forest distribution. The most detailed maps are the maps produced by Cooper (1985) and the forest biome program (1987), generally known as the Forest Biome Map. These maps are, however, not available in GIS format and their basic resolution (approximately 1:1 000 000) makes accurate digitising from these maps impractical and inaccurate. A map derived from a combination of LANDSAT and field data indicated plantation forestry (main focus) and indigenous forests on a portfolio of 31 map sheets on a scale of 1:250 000, based on a minimum mapping unit of 25 ha for plantations and 50 ha for indigenous forests (Van der Zel 1988). This map has questionable spatial accuracy. Low accuracy was assigned to the mapping of indigenous forests because of a wide range of spectral reflectances, shadows, the gradual transitions between forest and bushveld, and confusion of spectra with those from plantations. Nevertheless, this map is probably the best GIS map available of true forest distribution.

An alternative map of indigenous forests is the National Land Cover (NLC) project map (Thompson 1999). This map is spatially accurate, but there is some concern over the accuracy with which it identifies forest patches. It has missed some known forests such as Island forest and other Eastern Cape dune forests, and it is possible that thick exotic wattle infestation and dense woodland and thicket may have been classified as forest in some areas (e.g. the Soutpansberg).

Hunting's Technical Services have produced a map of forest distribution. This map has, as yet, not been ground truthed, and in its current form was found to have too many misclassifications to be useful. Once cleaned this may well be the most accurate map available.

For the distribution maps a combined map based on the Van der Zel (1988) and land cover maps were used. Since forest patches in these two maps are not always identical, this map will over-represent forests, because forest patches identified by either of these maps are included. This over-representation will aid the visual interpretation of images. However, it will have limited or no

impact in interpretation at the scale at which maps are being produced in this report. This forest coverage has been used in determining forest climatic variables. Some known forests have been added to the map, and in some areas the forests depicted on the map have been removed (or reduced) where it is known that forests have been over-represented (particularly in the Blouberg and Hanglip region of the Limpopo province and in the western-most section of the Albany forest).

For KwaZulu-Natal (KZN) a detailed forest map, based initially on the National Land Cover map, has been produced and classified into forest types by the KwaZulu-Natal Wildlife Services as part of the stream flow reduction strategic environmental assessment (SEA). This map has been used for the KwaZulu-Natal province.

No definitive GIS coverage exists for conservation areas. The CSIR has over time combined a number of coverages to create conservation area coverage for the country. In addition the Department of Water Affairs and Forestry provided a GIS coverage of DWAF forests. These two coverages were used to determine the extent of conservation of each forest type. These values must be seen as approximations due to the limitations of the spatial data. This analysis, together with analysis on the extent of forest types, was done independently on the Van der Zel (1988) and NLC datasets.

The new forest types have been indicated on the map as areas within a polygon (bubble). This has been used to aid analysis and to aid in indicating likely locations for individual forest types. These polygons were drawn based on best estimates of the extent of individual forest types, and where possible biophysical barriers, such as major river systems or changes in geology, were used to determine the boundaries between the polygons. However, it must be remembered that forest types change over gradients and it is therefore incorrect to assume that these 'hard' boundaries will be clearly reflected in the composition and structure of the forest types. There is bound to be much debate over the exact positioning of these boundaries. In addition, floristic data from the majority of small forest patches are not available. It is also quite conceivable that one forest patch may contain sections that are typical of different forest types, especially if the patch covers a wide environmental gradient such as a large altitude range (e.g. Ngome forest). The research team debated whether or not the distribution polygons should be unique or overlapping. Overlapping polygons allowing one area on the map to have more than one forest type would be more biologically correct and more closely reflect the ecological realities on the ground. However, the decision to use unique polygons was made, since this would be most useful for DWAF's short-term needs, and would allow more meaningful spatial analysis. In the long term individual forest patches should be allocated to forest types based on their floristics.

3.3 Climate and Soil Classification

National climatic surfaces (Computer Center for Water Research, University of Natal Pietermaritzburg) that have been modelled based on long-term rainfall and temperature records and altitude, form the basis for the climatic analysis. These data are given in a one-minute by one-minute of arc grid for the entire country in a GIS format. The basic mean monthly data have been used to derive a number of climatic surfaces that have been shown to be good predictors of biome distribution (Eeley et al. 1999). The climatic coverages used in this analysis are:

- Mean annual rainfall
- Mean summer rainfall – rainfall for October through to March
- Mean winter rainfall – rainfall from April to September
- Mean annual temperature
- Mean temperature of the hottest month
- Mean temperature of the coldest month
- Mean maximum temperature of the hottest month
- Mean minimum temperature of the coldest month
- Growth days – the number of days in the year when there is sufficient moisture for growth (this is computed on a monthly basis based on precipitation and evaporation).
- Growth temperature – the mean temperature during growth days.

- Non-growth temperature – the mean temperature during periods of no growth (as defined by growth days).

These climatic data must be interpreted with caution due to the way in which it was derived. Both the rainfall and temperature models are strongly driven by altitude. Mountainous areas with steep altitudinal gradients tend to have localised microclimates. These mountains are also poorly serviced by weather stations. The modelling approach used may, therefore, lead to inaccuracies within the mountains. Furthermore, forest patches are often very small and located within micro-habitats such as protected kloofs. Spatial alignment between the climatic grid and small forest patches could also result in errors, especially in areas with steep environmental gradients.

Soil fertility was derived from geology into two categories, high and low fertility. The 1:1 000 000 geological coverage was used for this purpose. This is a crude approximation of soil fertility, and local fertility could be very different. It does, however, show large-scale fertility as they relate to forest types. In addition, a GIS coverage of the Msikaba Sandstone complex was used to assist in defining the boundary of the scarp forests in the Port St Johns area.

The ArcInfo isocluster and maximum likelihood classification routines were used to classify the climatic data. This was done on only the climatic variables and a combination of the climatic and soil fertility variables. All variables were standardised prior to the analysis i.e. reduced to the same scale with each variable having equal weighting. The true range of climatic values was determined for each climatic type as defined by the analysis.

Climatic limits of forest types were determined using the CCWR climatic data. Minimum, mean and maximum values of the one-minute grid were determined for all forest patches per forest type. Forest types with limited spatial data were excluded from the analysis.

3.4 Vegetation data sources

The vegetation data collected were primarily plot-based and hence in the form of vegetation samples (relevés). Each sample consists of a list of taxa, where each taxon was assigned an estimate (usually cover-abundance value on a certain ordinal or mixed ordinal-nominal scale) or direct measurements (DBH and/or basal area values) or counts (number of stems per plot). A vegetation sample can be seen as a simplified model of the vegetation stand.

Sampling designs varied. Forest data of mostly stems ≥ 10 cm DBH were collected from a single forest. The locations of sample plots were determined from the intersections of a map grid overlay. Examples are the data from Hanglip (Geldenhuys & Murray 1993), Wonderwoud (Geldenhuys & Pieterse 1993), and Roodewal, Ratombo, Essenbosch and Samangobos in the Northern Province (unpublished DWAF data). Some data come from long-term growth study plots where stems were measured down to 5 cm DBH (Geldenhuys 1998). Other data sets come from sampling along environmental gradients, and often included a combination of tree stems down to 5 cm DBH and Braun-Blanquet (BB) cover-abundance values for all other species (Everard & Hardy 1993, Geldenhuys 1993), or BB cover-abundance values for all species (MacDevette et al. 1989). Most of the data used in this classification are based on stems by species and DBH from 400 m² plots, mostly down to 10 cm DBH, but in some cases also down to 5 cm DBH. Details on sampling procedure leading to a vegetation releve using cover-abundance estimates are found in Braun-Blanquet (1964), Westhoff & Van der Maarel (1973) and Kent & Coker (1992).

In total over 4 500 relevés (vegetation samples) were used. Most of the data were not published and provided by courtesy of many colleagues (see a list of those in Acknowledgements). For the full list of all data used see Appendix 1.

Table 2. Distribution of forest releve data by broad forest types

I: SOUTHERN AFROTEMPERATE GROUP	Forests	Releves
I1: Western Cape Talus Forests	7	81
I2: Western Cape Afrot temperate Forests	56	518
I3: Southern Cape Afrot temperate Forests	12	463
II: NORTHERN AFROTEMPERATE GROUP	Forests	Releves
II1: Marekele Afromontane Forests		
II2: Northern Highveld Forests	6	80
II3: Drakensberg Montane Forests	4	103
II4: Northern KwaZulu-Natal Mistbelt Forests	3	54
III: NORTHERN MISTBELT GROUP	Forests	Releves
III1: Northern Mistbelt Forests	29	442
III2: Mpumalanga Mistbelt Forests	11	349
III2a: Mariepskop Area Forests	3	187
III2b: Barbeton Area Forests	5	108
IV: SOUTHERN MISTBELT GROUP	Forests	Releves
IV1: Eastern Mistbelt Forests	21	1081
IV2: Transkei Mistbelt Forests		
IV3: Amatole Mistbelt Forests	5	161
V: SCARP FOREST GROUP	Forests	Releves
V1: Eastern Scarp Forests	7	57
V2: Pondoland Scarp Forests	25	73
V3: Transkei Coastal Scarp Forest	171	297
V3a: Transkei Inland Scarp Forest	99	159
V3b: Transkei Coastal Forest	72	138
VI: NORTHERN COASTAL GROUP	Forests	Releves
VI1: KwaZulu-Natal Coastal Forests	6	348
VI1a: Northern KwaZulu-Natal Coastal Forests	4	310
VI1b: Southern KwaZulu-Natal Coastal Forests	2	38
VI2: KwaZulu-Natal Dune Forests	6	161
VII: SOUTHERN COASTAL GROUP	Forests	Releves
VII1: Eastern Cape Dune Forests	10	22
VII2: Albany Coastal Forests	8	30
VII2a: Albany Coastal Forests	4	21
VII2b: Albany Scarp Forests	4	9
VII3: Western Cape Milkwood Forests	20	44
AZONAL FOREST TYPES	Forests	Releves
A1: Lowveld Riverine Forests	7	45
A2: Swamp Forests	4	78
A3: Mangrove Forests	4	39
A4: Licuati Sand Forests	8	44
TOTAL	427	4516

The samples varied in quality as they differ in a number of features summarized below:

3.4.1 Number of parameters sampled

Cover-abundance estimation scales are usually used to collect plot-based data in vegetation science. Among these the 7-grade scale of Braun-Blanquet (1964) or the 10-grade scale of Domin (see Kent & Coker 1992 for details) are widely used. Some researchers prefer to collect the cover data directly in % values.

In forestry research, samples for specific silvicultural and ethnobotanical aims (timber and bark production, stand demography, monitoring of growth etc.) usually provide data on DBH and/or basal area of trees and shrubs of DBH over 5 collected (or 10) cm, and are sometimes complemented by counts of stems of woody species.

The DBH values were converted to basal area (m²) using the formula ($\pi \cdot \text{DBH}^2 / 40000$), where DBH is in cm. The data were converted to basal area per species per plot. The basal areas per species per plot were then converted into percent of the total basal area per plot, and the percentages were then converted into Braun-Blanquet (BB) cover-abundance values as follows: + = <1%; 1 = 1-5%; 2a = 5.01 - 12%; 2b = 12.01 - 25%; 3 = 25.01 - 50%; 4 = 50.01 - 75%; 5 = 75.01 - 100%.

Very few samples provide data on soil, local climate, disturbance and management regimes.

3.4.2 Taxonomic reliability and nomenclature

Due to differences in age of the source material the researchers may differ in nomenclature of plant taxa used, and also in taxonomic concepts. The latter refers particularly to misinterpretations of some taxon concepts, splitting and lumping of taxa on level of species and the like.

3.4.3 Structural and textural definitions

Traditionally South African phytosociologists do not record data on vertical layering, in other words they do not record the data for different strata e.g. tree, shrub, herb and other strata. This practice often causes interpretation problems, particularly when one cannot distinguish data for mature trees from seedling data. Data collected for silvicultural purposes usually recognize the tree strata, such as emergent, canopy, sub-canopy and shrubs. The definition of tree and shrub layers are, however, based primarily on life-form (growth-form) (see Geldenhuys et al. 1988), which can be a source of discordance among various workers.

3.4.4 Completeness of taxon lists

Phytosociological relevés, particularly those primarily collected for purposes of vegetation classification, usually contain full taxon lists. Most of the sampling for silvicultural purposes (see above) relies on targeting of only woody species, leaving the herbaceous layer and epiphytes out. Mosses and lichens (terrestrial and epiphytic) are recorded only selectively, and if at all.

3.4.5 Sampling intensity

Some areas or forest patches, and mainly those that were the targets of silviculture and nature conservation agencies, were sampled very intensively (often repeatedly in cases of vegetation-dynamic or monitoring studies). Other forests are for the most part under-sampled. The methods used to account for this problem are explained below.

3.5 Data transformations and databasing

In order to assure compatibility of the data, various data transformations were performed prior to capture into a database. The classification adopted in this study primarily relies on floristic data (relative cover-abundance) related to a plot (cover-abundance). Therefore the data sources

containing DBH and/or basal area values as well as stem counts were transformed into cover-abundance categories (popularly known as Braun-Blanquet values).

The vegetation samples containing cover-abundance estimates were captured into a number of databases using the database software package TvWin 2.0 (Turboveg). This software was developed for the purposes of storage, transformation, retrieval, and numerical-data handling of vegetation plot-based data (Hennekens & Schaminee 2001). Turboveg allows storage of data originally collected using different estimation (and counting) scales. Translation between various cover-abundance scales is allowed through code-replacement (each cover-abundance category is assigned a representative cover %). This feature assures compatibility of the data (see point 3.3.1. above).

In Turboveg a checklist of the flora of Southern Africa, now containing over 72.000 items (correct names and major synonyms), is used to filter entry and export of data. Turboveg also allows data to be stored according to their structural (vertical vegetation layering) information to complement the floristic information. This information can be masked out during data retrieval (see point 3.3.3. above). While understanding the vertical layering assigned by various researchers remains controversial, we believe that this problem does not represent a major obstacle, since (a) most of published data do not contain any information on layering, and (b) the unpublished data come from sources which have obviously been tightly linked in their understanding of life-forms (Geldenhuys et al. 1988).

Where available, various environmental parameters on soil, climate, hydrology, disturbance and management regimes, as well as various sampling parameters (scale used, size of plot, cover and height of vegetation, locality, geographic coordinates etc.), were captured as well. Emphasis was placed upon on the location of the samples, in particular the correct name of the forest patch and/or forest complex.

More than 4000 vegetation samples have been captured and these data have become part of the National Vegetation Database (Mucina et al. 2000). Information on the origin and extent of the data sources are found in *Appendix 1*.

3.6 Numerical data handling of vegetation data

The vegetation data were subjected to computer-assisted formalized classification and ordination procedures with the aim of delimiting the major forest types (classification) and defining the position of these types along major environmental gradients (ordination).

3.6.1 Computer-assisted derivation of forest types

The relevé data were exported as one file using the format-fitting package Megatab2.0. Megatab2.0. which is a part of the TvWin2.0 (Turboveg) package is designed to handle basic shuffling procedures with phytosociological tables. TWINSpan (Hill 1973), a clustering algorithm is one of the tools imbedded within Megatab2.0. A series of iterative steps involving global TWINSpan analyses (including all relevés), and local analyses (limited to parts of the handled table) were performed. Further TWINSpan analyses were used to identify outliers (usually placed on edges of the table). These outliers, representing either non-forest or very aberrant samples, were discarded.

In summary the initial sorting of the total data set included the following steps:

- 1) TWINSpan on total data set with selected pseudo-level functions;
- 2) Identification of outlying clusters (non-forest relevés) and deletion of these;
- 3) Repeating of Steps 1 & 2 a number of times until no new outlying clusters could be identified;
- 4) TWINSpan of partial clusters resulting from TWINSpan analysis of whole data set;
- 5) Investigation of the internal homogeneity of the resulting clusters and decisions (aided by internal homogeneity, synoptic table, plausibility using locality and/or environmental data) on

retaining them or new partial TWINSpan analysis; and 6) repetition of Steps 4 & 6 until a final cluster pattern was established.

3.6.2 Analysing similarity patterns among derived forest types

Each of the forest types derived through the procedure described above was represented as vector of combined weighted cover-abundance values (range: 0-9) for each species. The computations were performed using Megatab 2.0 (Hennekens 1996); the description of procedure can be consulted in the latter source. Because many of the data sources did not contain information on herbaceous layer, only woody species (trees, shrubs, sub-shrubs, woody climbers) were considered in the analyses.

In order to investigate the resemblance patterns among the forest types (24 in total), in other words, to derive hierarchy of groupings of these forest types, we adopted several numerical strategies:

- Average linkage clustering was selected as the clustering technique for its space-conserving properties. The resemblance used in our analyses was Chord Distance for quantitative data and the Jaccard coefficient for qualitative (presence-absence) data. The choice of the Chord Distance was determined by the uneven total number of species, in particular species vectors. The differences in species richness had to be remedied by applying normalization (vector transformation). Chord Distance is basically the modified Euclidean Distance incorporating normalization (Podani 1994, 2001). The same clustering technique was applied in analysis of qualitative data; here we used Jaccard Coefficient as the measure of resemblance. This coefficient, by putting emphasis on positive co-occurrence, is easy to interpret as it spans the values 0 (total dissimilarity) to 1 (identical).
- Principal Coordinate Analysis was selected as the ordination technique. This is basically a scaling technique, and unlike Principle Components Analysis or Correspondence Analysis (or its derivations), allows the use of almost any type of data. We again used Chord Distance as the resemblance index for comparing the clusterings and ordinations directly. The ordinations were not used to derive floristic coenoclines from the data, but to visualize the resemblance patterns of the predetermined forest types.
- Minimum spanning tree (see Podani 1994) using Chord Distance was used to visualize the reticular resemblance patterns within the data as well.

Two data sets were generated – one containing all 24 forest types and the other containing only 20 of the zonal and intrazonal forest types. The analyses were performed using the program SYNTAX 2000 (Podani 2001).

3.7 Faunal analyses

3.7.1 Characteristics and sources of faunal data

A digital map showing the distribution of indigenous forest in South Africa was obtained from Environmentek (CSIR, Thompson 1999). The indigenous forest coverage was derived from LANDSAT™ satellite imagery and mapped at the 1:250 000 scale. Large forest patches throughout the geographic range of forests and incorporating the diversity of known forest types (Cooper 1985) were selected. The selected forests were then intersected with the quarter-degree of arc grid cells (hereafter, quarter-degree cell) for South Africa and binary data (species presence or absence) for certain animal taxa compiled for the selected quarter degree cells.

Bird data were provided by the South African Bird Atlas Project (Harrison et al. 1997) and consisted of species by quarter degree cell. Where single forest blocks intersected more than one quarter-degree cell, the reporting rates (number of atlas cards submitted) were compared and that

cell with the highest reporting rate was retained. The mammal and reptile data sets comprised quarter-degree cell locality records from museum and institutional collections (Durban Natural Science Museum, Transvaal Museum, Kaffrarian Museum, South African Museum, KwaZulu-Natal Wildlife). A crude method was used to determine frog distribution in indigenous forests. The coverage for indigenous forest was overlaid by general frog distribution patterns from two sources (Passmore & Carruthers 1979, Carruthers 2001). Distribution patterns for 19 forest-dependent (see below) frog species (Carruthers 2001) were compiled. The distribution of forest frog species by quarter degree cell was then determined by intersecting the forest coverage with the quarter degree grid for South Africa.

Forest-dependent and forest-associated animal taxa were included in the analyses. Forest-dependent species are those that breed within the forest habitat only. Species that inhabit other habitats besides forest and do not necessarily breed in forests are referred to as forest-associated. Species were assigned to one of these two categories using taxon-specific identification guides and verified by experts. The following assumptions applied to the animal distributional data: (1) the distributional data for all taxa were geographically complete and (2) forest species (associated and dependent) recorded from a quarter degree cell were distributed within forest patches located in that quarter degree cell. The data for each taxon were arranged in a matrix with forest sites (quarter degree cell) as column headings and species as rows.

Operating at the quarter degree cell imposes certain constraints. For example, Dune, Scarp, Riverine, Swamp and Lowland forest (*sensu* Cooper 1985), or combinations thereof, can all occur within one quarter-degree cell. For the purposes of this project it is impossible to reliably differentiate coastal forests, particularly those located on the coastal plain of Maputaland, by animal taxon. Refined species lists, specific to each forest, would be required to do this.

3.7.2 Analyses

Relationships between forests according to animal species composition were tested using Correspondence Analysis (CA, CANOCO, version 4.02, Ter Braak & Smilauer 1999). Forest sites were named according to geographical position (Table 3). By constructing minimum convex polygons around the ordination points for forests from the same geographical region, the variation and differences in animal assemblage composition in forests was compared. Forests were compared for similarity in animal species composition using cluster analysis based on the Jaccard similarity index, which uses binary data (BioDiversity Professional, McAleece 1997). Canonical Correspondence Analysis (CCA) was performed to determine the relationship between forests, as determined by their animal species composition, and selected environmental variables. The environmental variables used for the analyses reflected rainfall (winter rainfall, summer rainfall, mean annual rainfall) and temperature (no grow temperature, growing temperature, number of growing days, mean temperature for hottest and coldest month, maximum temperature for hottest month, minimum temperature for coldest month). The environmental data were obtained from Environmentek, CSIR (D. Vink, pers. com. 2001).

The distributional data for birds (South African Bird Atlas Project) were considered complete and therefore only forest-dependent species were included in the analyses. Data derived from museum records (mammals and reptiles) were incomplete for forests in South Africa resulting in a matrix dominated by zeros. Forest-dependent and forest-associated species were consequently combined for the reptile and mammal ordinations. For frogs, only forest-dependent species were included because the distribution for these species was considered complete despite the constraints of the method used to derive distribution patterns.

Table 3. Number of sites from which faunal data was obtained

Geographical location of forest	No. of sites (quarter degree cell)
Western Cape (W of Knysna to Peninsula)	4
Southern Cape (Tsitsikama / Knysna)	4
Alexandria	1
Somerset East	1
Amatole	2
Eastern Cape coast	4
Eastern Cape midlands	4
KZN coast (S)	3
KZN midlands (S & C)	7
KZN Drakensberg (S, C, N)	4
KZN coast	2
Ongoye	1
Qudeni	1
Nkandla	1
Ngome	1
Zululand coast	4
Maputaland coast	6
Maputaland inland	9
Mpumalanga Drakensberg	3
Limpopo Province Drakensberg (Magoebaskloof)	1
Soutpansberg	3

3.8 Consultation and participation

The initial classification was presented at a workshop to which most key forest ecologists, all provincial conservation departments and the Department of Water Affairs and Forestry national and provincial representatives were invited. This workshop was facilitated by an independent facilitator using the syntegrity process (Beer 1994). The workshop objective was to gain consensus on the classification as well as to gather initial data for the population of the forest chapters within the report. Following on from the workshop, individual forest chapters were circulated back to the workshop participants, and to a larger selection of forest ecologists for additions and review.

4. CLIMATIC AND EDAPHIC PATTERNS

4.1 Precipitation

Water availability to forest vegetation is a function of amount of precipitation, seasonality of precipitation, evapotranspiration, soil structure and availability of groundwater. Rutherford and Westfall (1986) have suggested that a summer aridity index may be a better predictor of forest distribution than rainfall *per se*. They have shown that forests grow in lower rainfall in winter rainfall areas than is possible in summer rainfall areas.

4.1.1 Mean precipitation

Forest is limited to regions with high water availability. This is mostly determined by high rainfall, though riverine and kloof forests exist outside of the normal rainfall envelopes associated with forests. Mist may also be an important contributor of additional moisture in a number of forests. Figure 4.1 shows mean annual precipitation linked to forest distribution.

Most afforested areas are linked to orographic precipitation. These mountainous areas show steep gradients in precipitation and localised rain shadows. Spatial patterns of total precipitation do not show a clear correlation with forest type distribution. Most afforested areas of the country show local gradients in rainfall. The following are noted from the rainfall distribution.

- Azonal types, and especially riverine forest, occur in areas of lower rainfall than is typical for forests;
- The highest rainfall areas are found in the Mpumalanga and Soutpansberg areas;
- The Alexandria (Albany) forests have lower rainfall than most forest types;
- The Southern Cape forests have a range of rainfall levels, with some areas receiving low rainfall (Geldenhuys (1991) indicated a range from 500 mm near Great Brak River to 1200 mm in Jonkersberg, Diepwalle and Storms River).

4.1.2 Seasonality of precipitation

Two discernable gradients exist in seasonality of precipitation. There is a trend from west to east following the coastline from the western Cape coast with exclusively winter rainfall in to all year rainfall in the Knysna region. Most of the remaining coast has predominantly summer rainfall, though the northern KwaZulu Natal coast also receives rainfall all year. From Port Elisabeth eastwards there is a gradient from the coast inland, of increasingly greater summer dominance of rainfall.

4.2 Temperature

A number of factors influence temperature within forests. Temperature decreases with both latitude and altitude. Proximity to the coast has a moderating influence on temperature and tends to reduce the range in temperature extremes.

4.2.1 Maximum temperature

Maximum temperature is most extreme on the KwaZulu-Natal north coast where mean maximums for the hottest month are in the region of 30°C and mean annual temperature is 22°C. Temperature decreases south westwards along the coast to a mean maximum temperature of the hottest monthly of about 25°C in the Afrotropical forests of the Knysna area. Inland areas tend to be cooler, especially in the mistbelt and high mountains of KwaZulu-Natal. The inland Eastern Cape region has higher maximum temperatures than other inland forests.

4.2.2 Minimum temperatures of the coldest month

The coastal influence moderates minimum temperature in the coastal region. Along the coast there is decreasing temperature from the Northern Zululand coast through to the George-Knysna area. Inland minimum temperatures decline rapidly from the coast toward the mountains as altitude increases. There is also a discernable decrease in temperature with latitude (figures 4.2 and 4.3).

4.3 Altitude

Forest range in altitude from sea level to about 2000m (figure 4.4). Individual forest types are often well defined by an altitudinal band. Altitude should be viewed as a proxy for temperature (and to an extent rainfall) as it does not directly influence forest distribution. It is generally accepted that latitude compensates for altitude in allowing the Afrotemperate forest species to reach the coast in the George - Knysna area.

4.4 Soil fertility

Our analysis divides soil into two simple classes, high and low, based on the geology of the parent material. As can be seen from Figure 4.5 soil fertility is closely linked with some of the forest types. The geology of the Msikaba Formation sandstones with its associated low nutrients is closely linked with the division between Pondoland scarp forests and the Eastern Cape and Eastern mistbelt forests. The influence of this outcrop of sandstone on vegetation is documented by Van Wyk (1989, 1990). However, the importance of the underlying geology and edaphic conditions to the persistence of these relictual floras is questioned because many scarp forests and their endemics persist on non-sandstone substrata. Climate and topography are thought to be more important explanatory factors (Everard 1992; Cawe 1994).

4.5 Climate classification

The classification of climatic variables obtained from areas where forests are located was run, including and excluding soil nutrients, and by both limiting the number of classes to six or allowing the software to decide on the number of classes. In all cases a number of clearly defined climatic groupings occur. The forest masks for the forest types identified from the floristic classification have been overlaid to show the similarity between the vegetation classification and the classification of climatic factors.

When only climatic variables are used in the classification, the major factor driving the classification output is the temperature gradient. This mirrors the major divide in the floristic classification between temperate and tropical forests. Introduction of a soil nutrient variable creates greater diversity of classes and may help explain some of the floristic trends (figure 4.6).

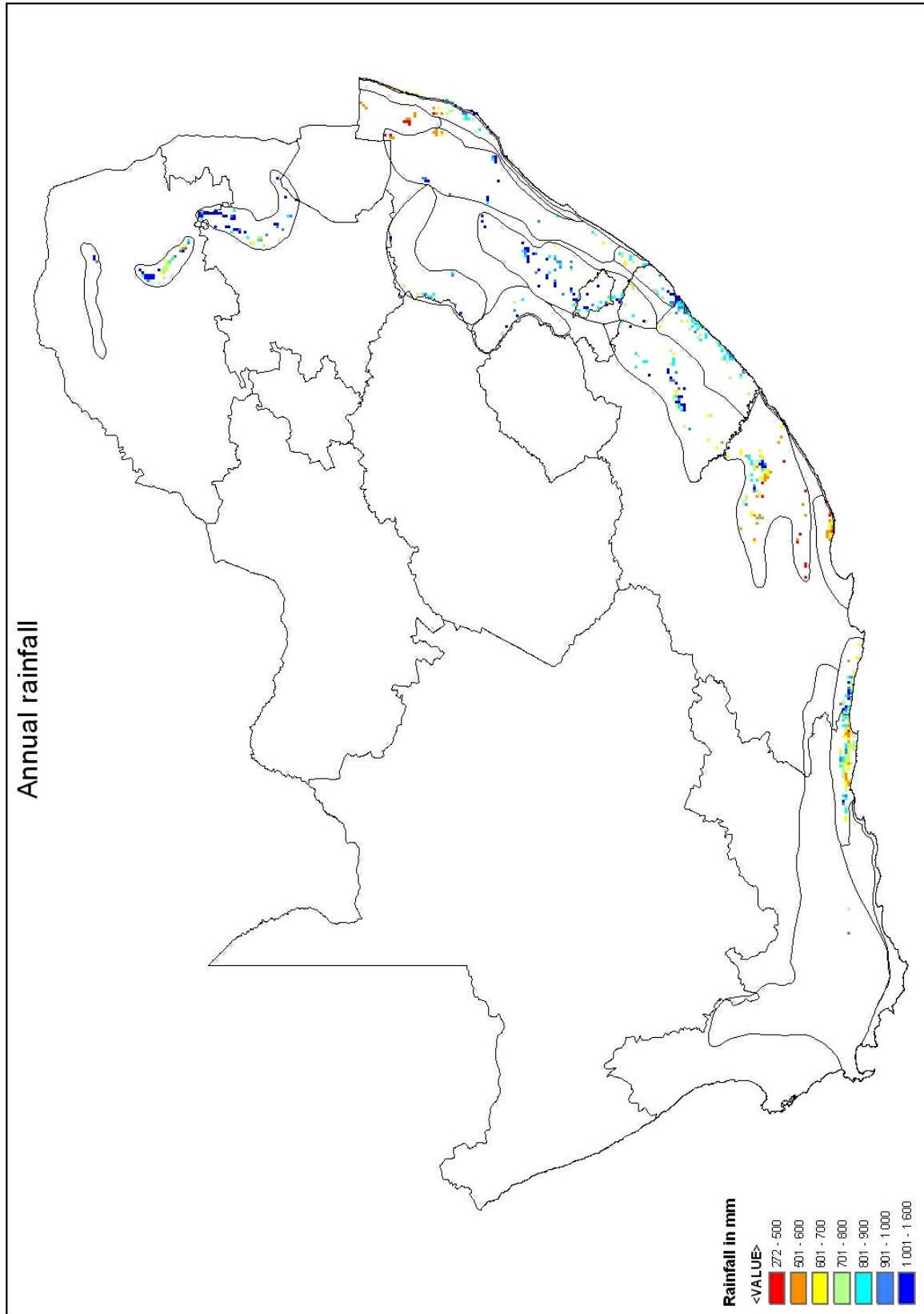


Figure 4.1 Mean annual rainfall in forests

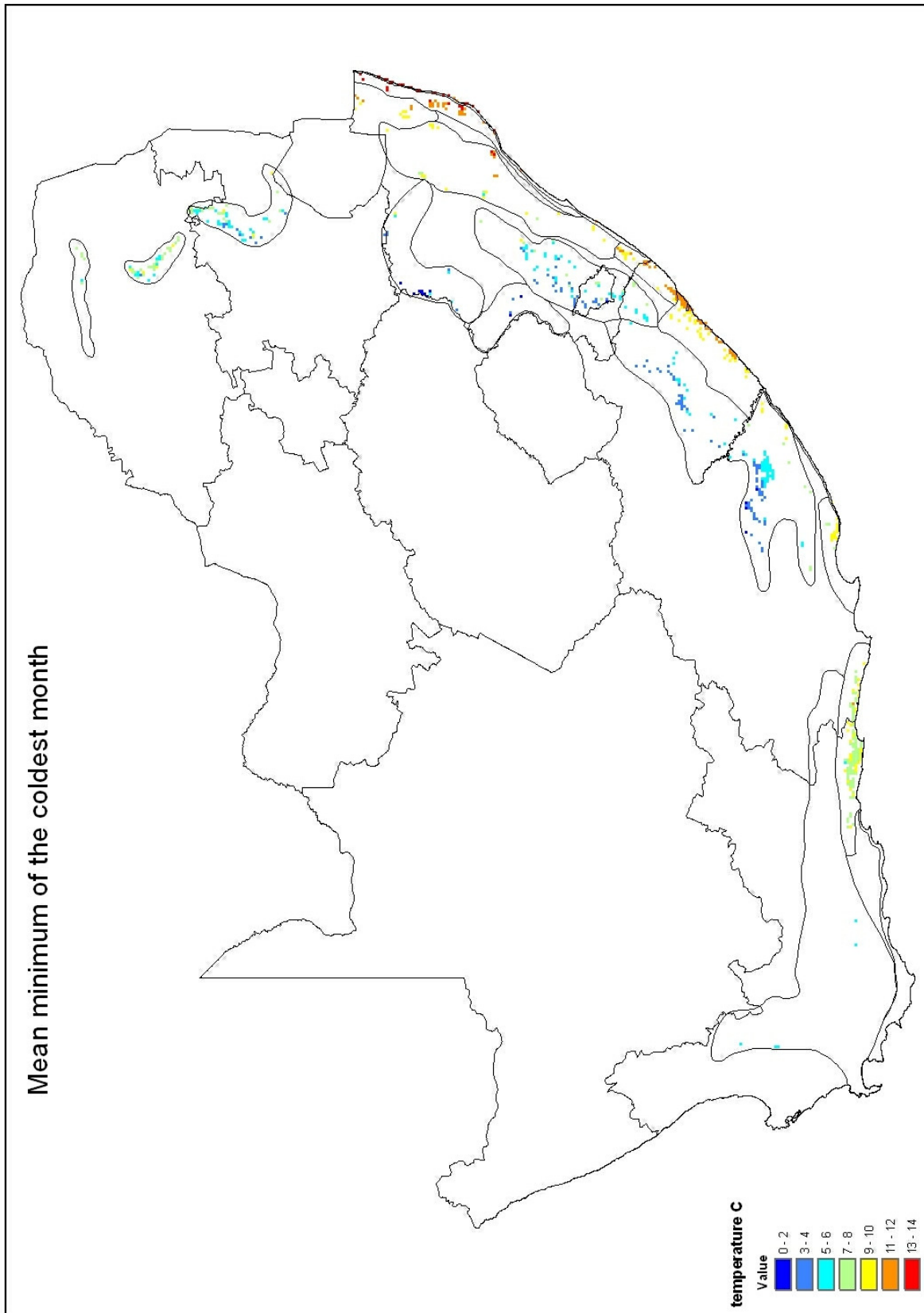


Figure 4.2 Mean minimum temperature of the coldest month

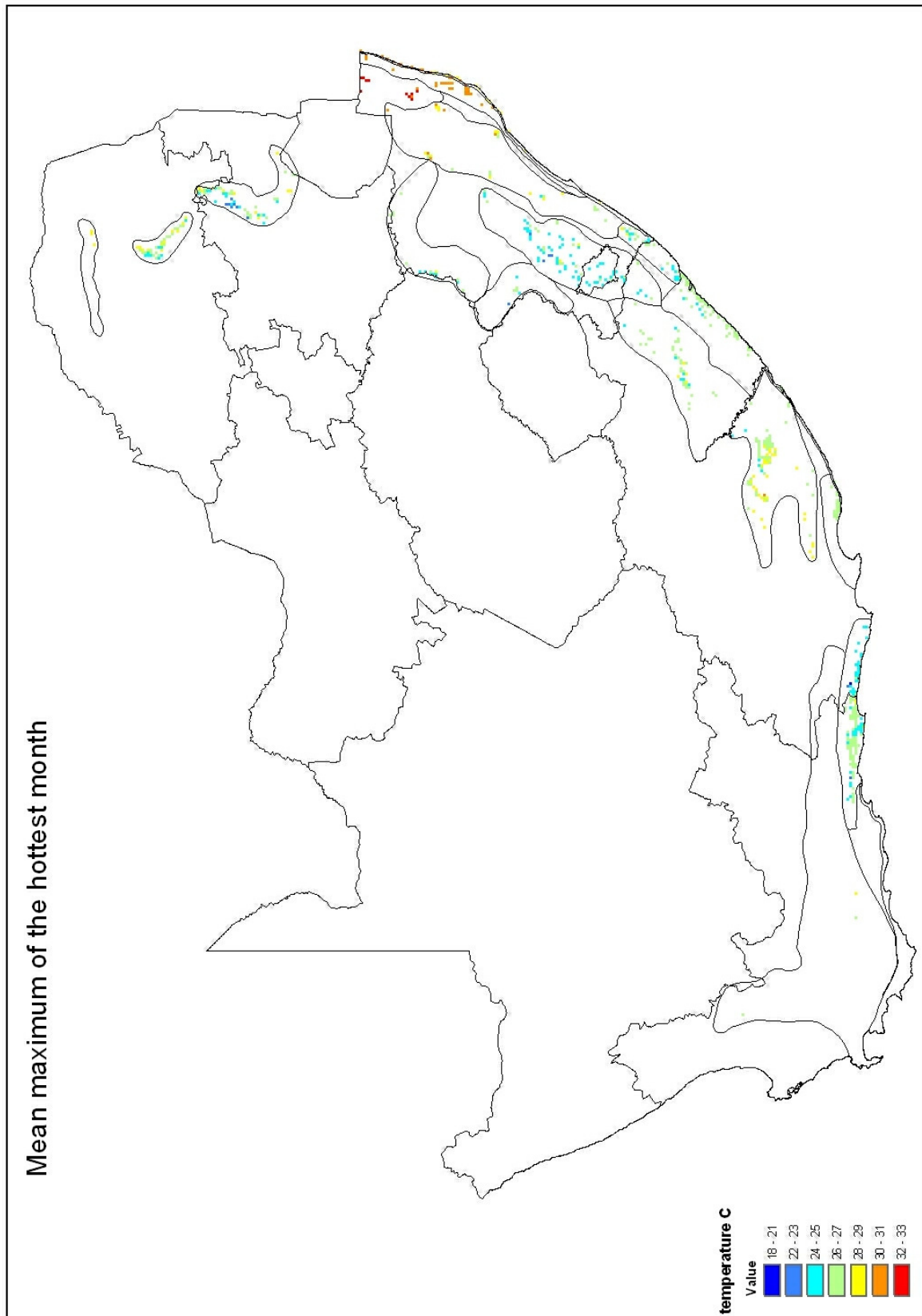


Figure 4.3 Mean maximum temperature of the hottest month

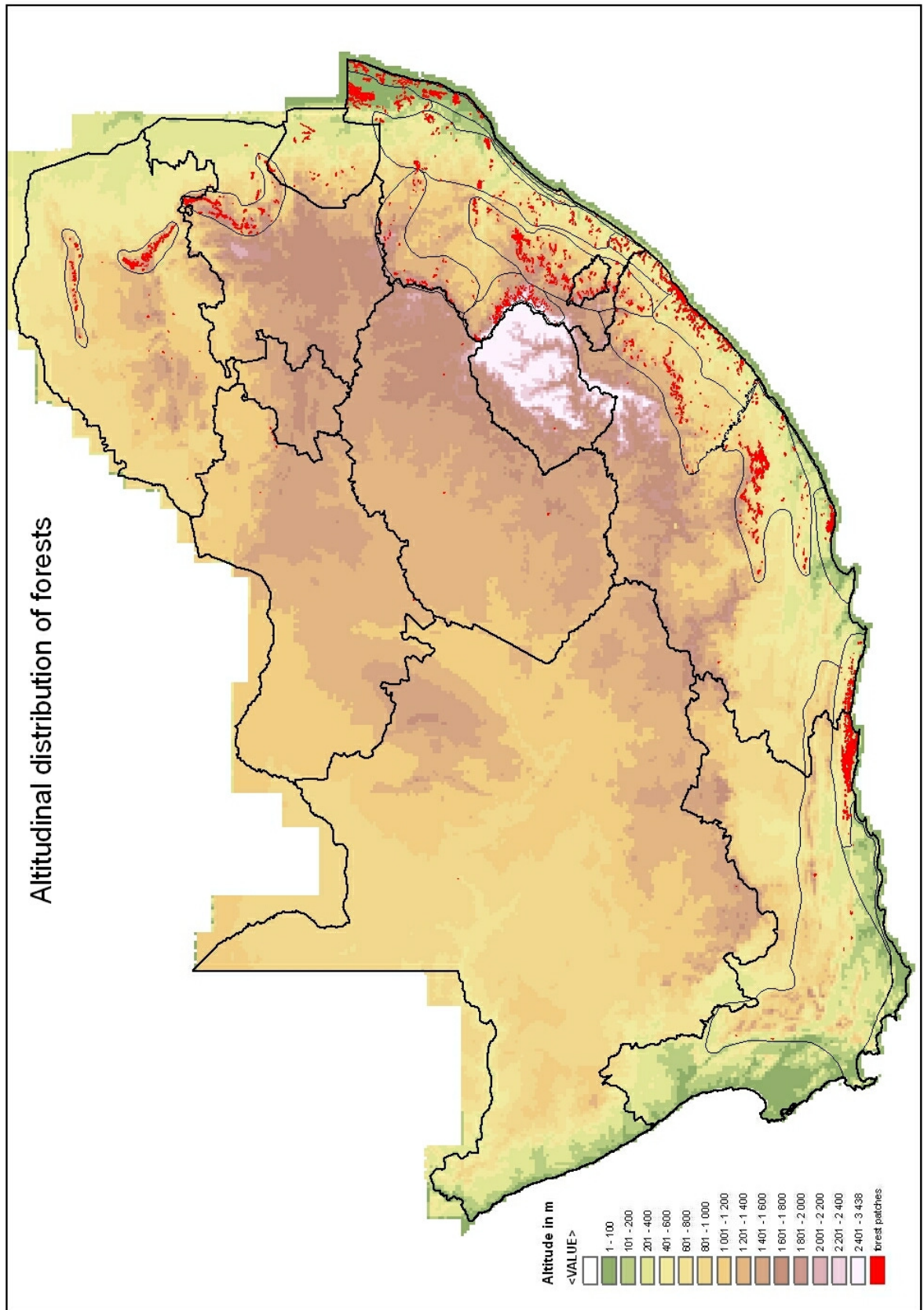


Figure 4.4 Altitudinal distributions of forest patches

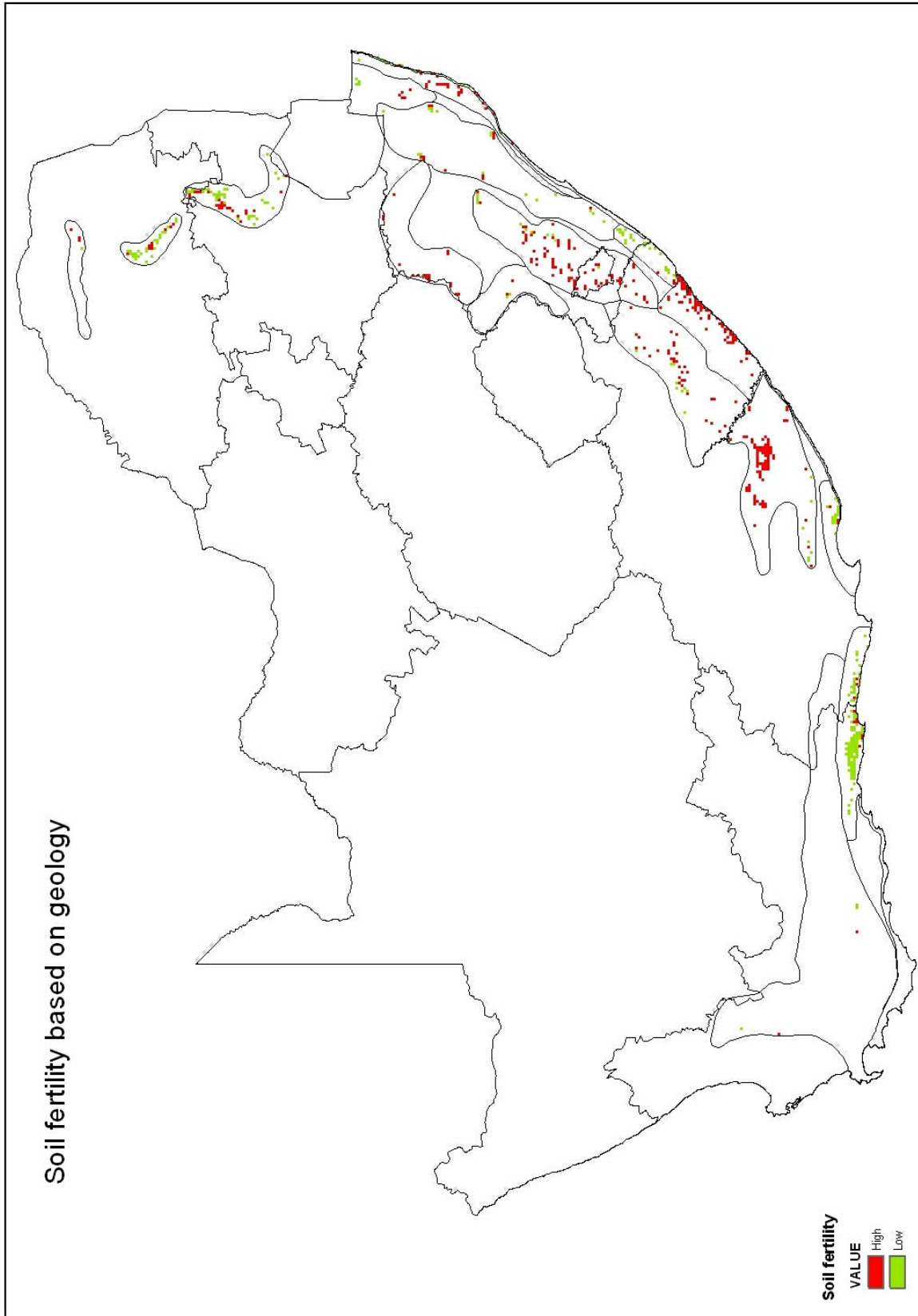


Figure 4.5 Broad based soil fertility of forest patches based on parent geology

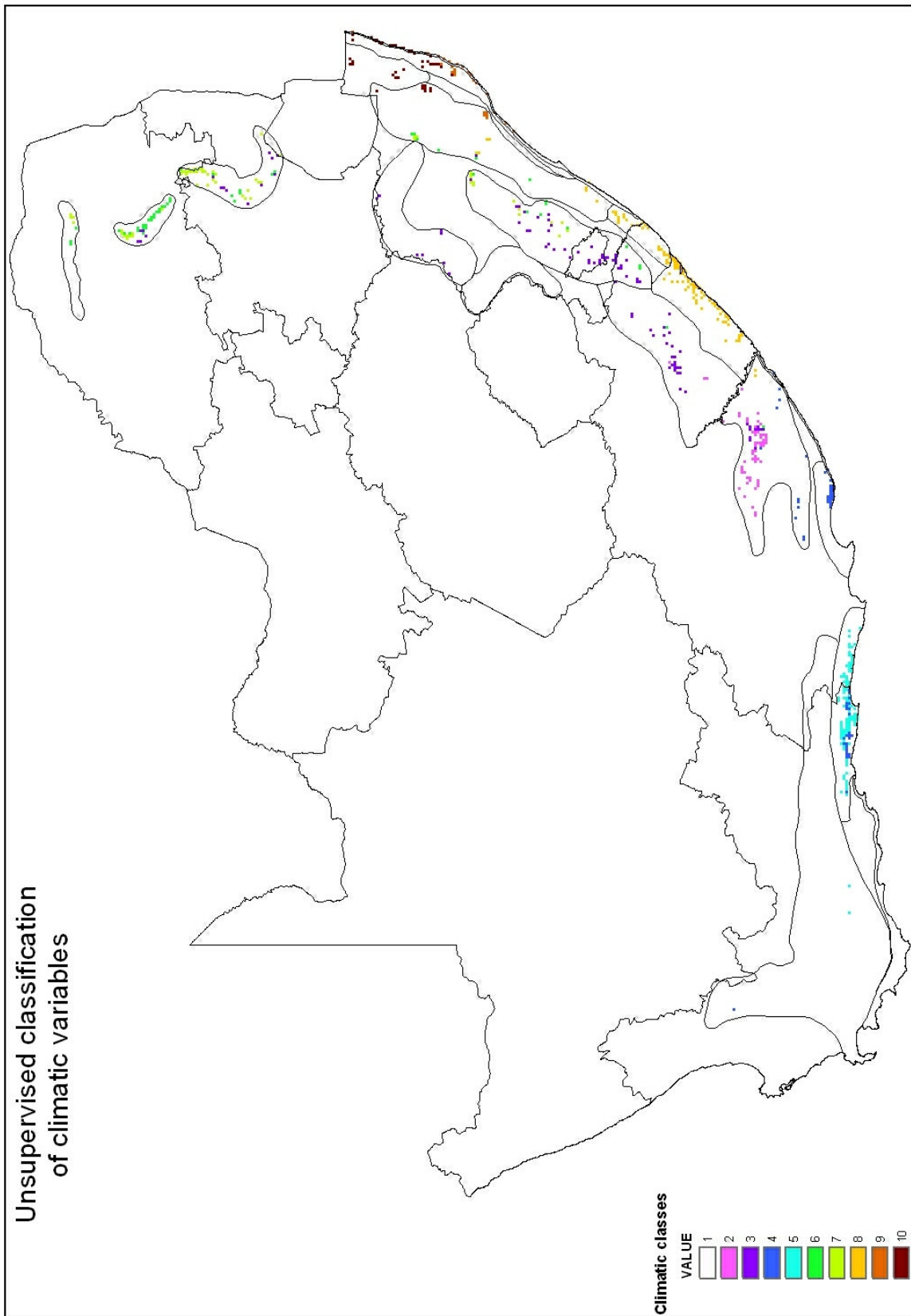


Figure 4.6 Unsupervised classification of climatic variables of forest patches

5. MAJOR VEGETATION PATTERNS

5.1.1 Overview of the hierarchical system

A series of computer-assisted analyses (for technical details see Chapter 3.4.) yielded the following hierarchical system of 7 groups (1st level of system: coded by Latin numerals) comprising 20 zonal and intrazonal forest types (2nd level of system: coded by combined Latin/Arabic numerals). In addition, 4 azonal forests types were recognized (Figures 5.1 and 5.2): In all our further deliberations we shall concentrate on the Forest Types (24 in total) as the major units of interest.

Table 4. Major forest groups and forest types belonging to them

Zonal & Intrazonal Forests

- I: Southern Afrotropical Group
 - I1: Western Cape Talus Forests
 - I2: Western Cape Afrotropical Forests
 - I3: Southern Cape Afrotropical Forests

- II: Northern Afrotropical Group
 - II1: Marekele Afromontane Forests
 - II2: Northern Highveld Forests
 - II3: Drakensberg Montane Forests
 - II4: Northern KwaZulu-Natal Mistbelt Forests

- III: Northern Mistbelt Group
 - III1: Northern Mistbelt Forests
 - III2: Mpumalanga Mistbelt Forests

- IV: Southern Mistbelt Group
 - IV1: Eastern Mistbelt Forests
 - IV2: Transkei Mistbelt Forests
 - IV3: Amatole Mistbelt Forests

- V: Scarp Group
 - V1: Eastern Scarp Forests
 - V2: Pondoland Scarp Forests
 - V3: Transkei Coastal Scarp Forests

- VI: Northern Coastal Group
 - VI1: KwaZulu-Natal Coastal Forests
 - VI2: KwaZulu-Natal Dune Forests

- VII: Southern Coastal Group
 - VII1: Eastern Cape Dune Forests
 - VII2: Albany Coastal Forests
 - VII3: Western Cape Milkwood Forests

Azonal Forest Types

- A1: Lowveld Riverine Forests
 - A2: Swamp Forests
 - A3: Mangrove Forests
 - A4: Licuati Sand Forests
-

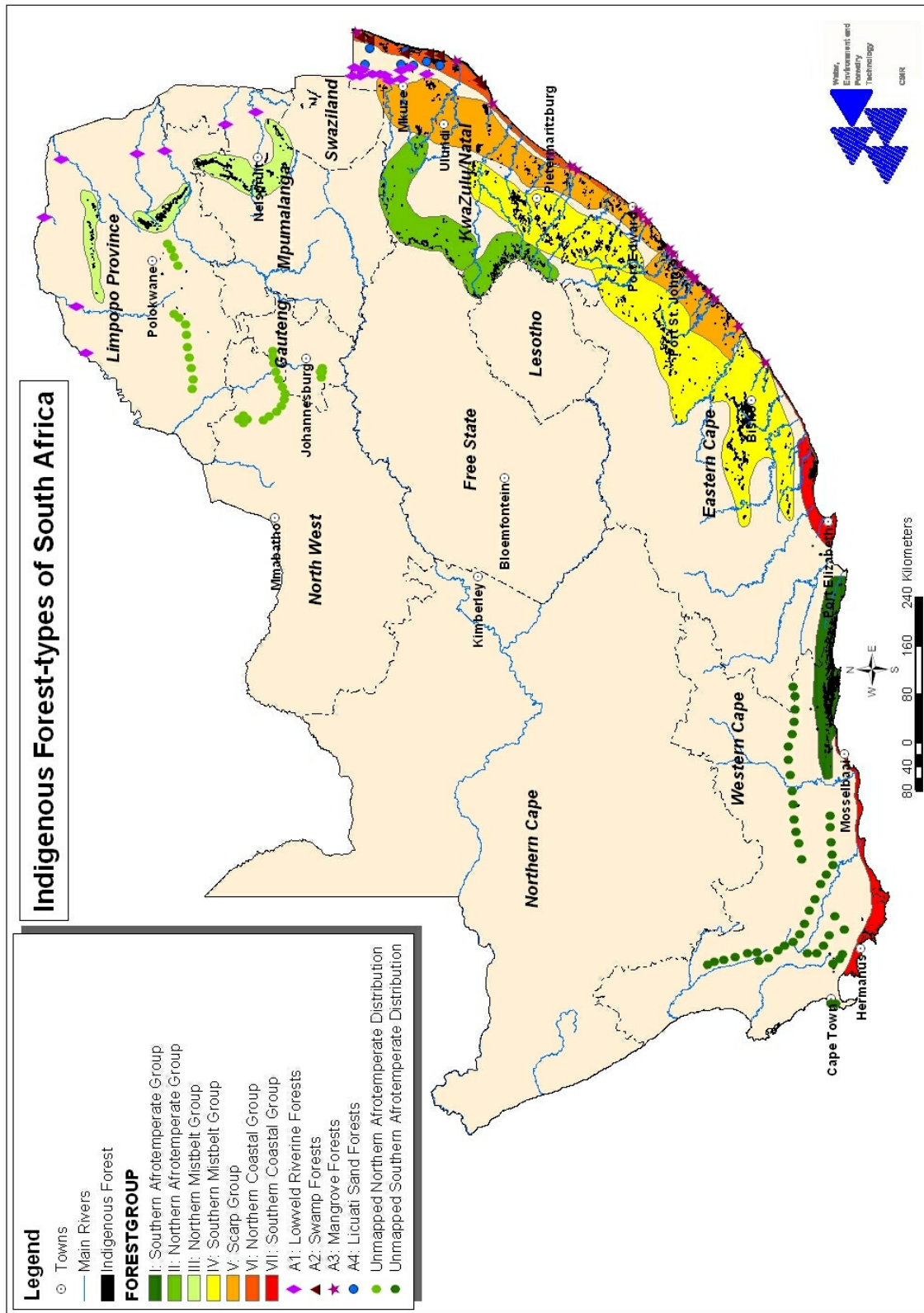


Figure 5.1 Forest groups in South Africa

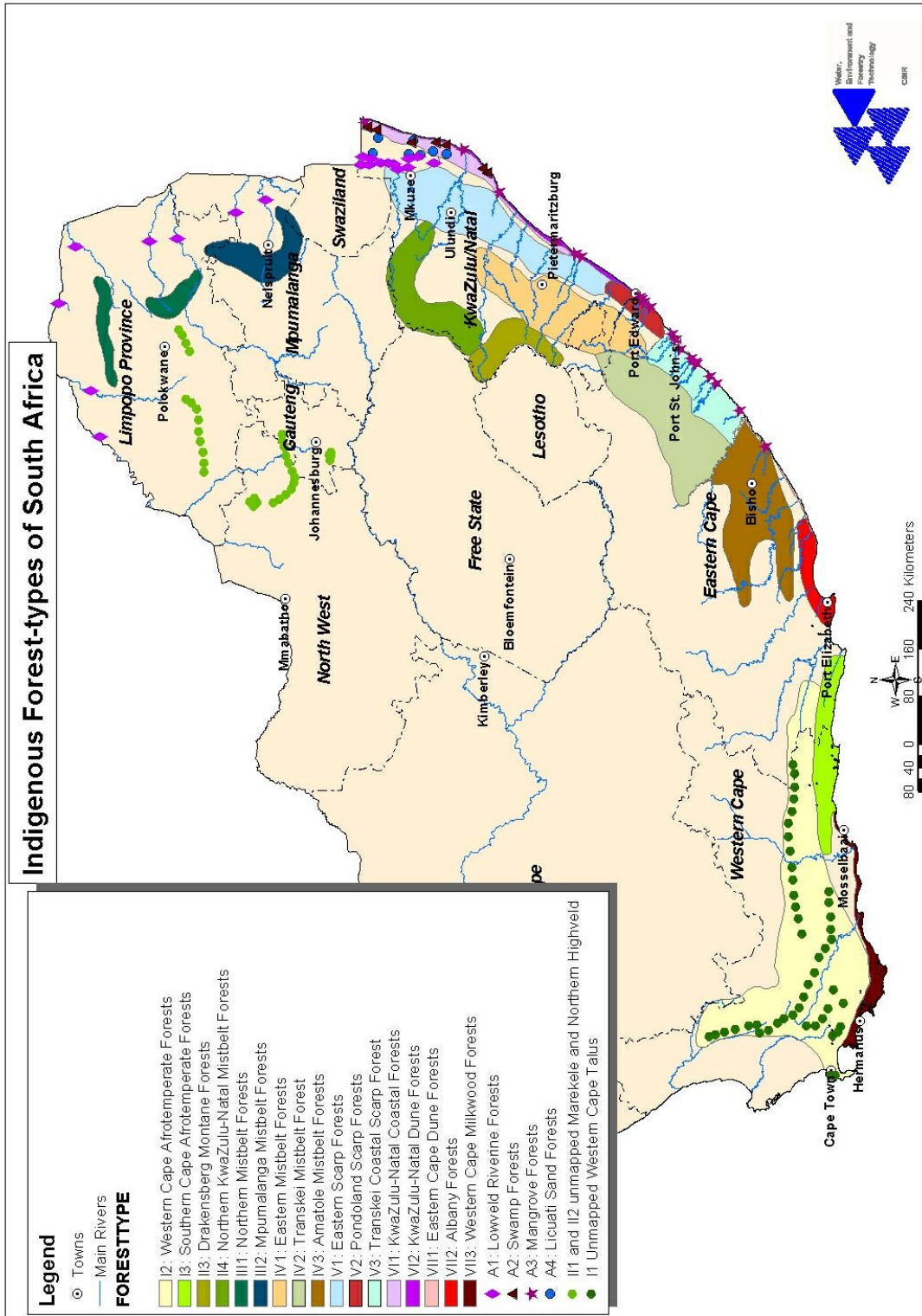


Figure 5.2 Forest types in South Africa

5.2 General Nature of the Units

5.2.1 Zonality, intrazonality, and azonality patterns

South African indigenous forests show an interesting distributional pattern. They form an archipelago of scattered forest patches that vary in size and are arranged in several longitudinal belts running either parallel to the coast or following the main escarpment or some of its lower-lying steps, or arching mountain ranges. It is an archipelago of isolated pieces of a formerly more continuous distribution of forest. Although this extensive archipelago was probably fairly fragmented even at the height of its distribution in the past (c. 40 000 years BP; Eeley et al. 1999), it has been subjected to a further series of fragmentation events in more recent times (i.e., since 40 000 years BP) such as climate changes (Deacon et al. 1983, Scholtz 1985, 1986, Lawes 1990, Scott et al. 1997), large-scale fires (Geldenhuys 1994), or lately through destructive exploitation by Man (Cooper 1985, Feely 1980, 1986). Man has played an important role in the fragmentation of Indian Ocean Coastal Belt forests (Scott and Steenkamp 1996, Mazus 2000). The patchy distribution of some forest types reflect natural features of isolated (and ecologically very specialized) habitat complexes such as mangroves, swamps, screes and river alluvia.

The vegetation units recognized in our report are of biogeographic nature in the first instance and floristic in the second. Naturally, both biogeography and floristics reflect two sides of the same phenomenon. Therefore, and unsurprisingly, the floristic similarity (measured in terms of shared occurrence of taxa and their relative cover values) is greater between forests that are topographic neighbours.

Due to the fragmented distribution of forests, the concept of zonality (as defined by Walter 1976) can be applied only to a limited extent. The notion of a “zone” relates (by definition) to biome (see Mucina 2000 for a definition). In the past the indigenous forests of South Africa were classified broadly into either two biomes (Afromontane, Coastal Belt; the latter concept appeared in earlier literature in various forms) as in White (1978) or Huntley (1984), or just one 1 biome (Forest Biome) as in Low & Rebelo (1998). The classification of forests within biomes is complicated by the definition of a biome (see Walter & Breckle 1991, Mucina 2000) and the fragmented distribution of the forests in South Africa.

In the case of the so-called Afromontane (better “Afrotemperate”; see Meadows & Linder 1993) forests only a few forest types would qualify as a piece of a biome in their own right. An example is Forest Type I3 (Southern Cape Afrotemperate Forests), which is a representative of the evolutionarily old Warm-Temperate Forest Biome. Here this evolutionary old warm-temperate forest descend to the sea level at 34° S latitude, setting a mirror image to the distribution pattern of warm-temperate forests of the Northern Hemisphere (Kloetzli 1988), to the largest patches of such forests in Eastern Asia (e.g. Ohsawa 1993) and southwestern United States (Christensen 1988, Fujiwara & Box 1994, Haeupler 1994) in particular. The rest of the Afrotemperate “forest archipelago” should be seen as “wreckage” of a warm-temperate biome occupying albeit narrow, but probably formerly continuous belt along the steps of the Escarpment. These forests are imbedded (surrounded) by various temperate biomes such as Fynbos and Grassland or straddle ecotones between the Grassland and Savanna Biomes.

The evolutionary young Coastal Subtropical Forest Biome, recognized (and called different names) in the past also (see for instance Bews 1920, Moll & White 1978, Huntley 1984 etc.) was most probably dominated by a subtropical forest of which only fragments classified as Forest Type VI1 (KwaZulu-Natal Coastal Forests) remain. The other forest types rich in subtropical elements (the remainder of the Forest Groups VI and VII) are basically intrazonal – hence forming specific vegetation units imbedded within (and unique to) well-defined vegetation zones (biomes).

There are 3 clearly hydrologico-edaphic azonal forest types typical of habitats controlled by specific hydrological regimes. These include:

- a) Lowveld Riverine Forests (gallery forest fringing rivers and water-filled pans in subtropical regions of South Africa and neighbouring countries),
- b) Swamp Forests (forest showing evolutionary and ecological links to tropical swamp forests of Central Africa),
- c) Mangrove Forest (specific intertidal forests of subtropical and tropical coasts, reaching the southernmost distribution along South African coast of Indian Ocean).

Admittedly not having a better solution at hand, we also classify Licuati Sand Forests as an azonal type. The Licuati Sand Forests are enigmatic in many respects. The Licuati Sand Forests rest on some of the older dune sets in Maputaland. They can be regarded as late Holocene relicts. Sand forest/woodland mosaics on the Ndumu hill, western Pongola valley, Mkuze and western False Bay areas are on old, Neogene (~10-~3Ma) dune sands that have been mainly degradational landsurfaces for much of the Pleistocene. Red sand is constantly eroding from these areas and apart from the eastern ridge at Mkuze the surface is devoid of dune structures. Eastern ridge at Mkuze could be a locally remobilized surface relative to the old surface under the camp.

The Tshongwe-Sihangwane sand megaridge is a composite feature where old red sand has been remobilized and dunes extending north have transported sand into the Tembe area forming a compound aeolian sand cover. Individual dunes show different periods of accretion during the terminal Pleistocene and Holocene. The luminescence dating of Dr N.Porat (Geological Survey of Israel) shows that the surfaces of adjacent dunes covered by sand forest and grassland/woodland respectively can differ by up to 10 000 years and that some dunes dated have been intermittently active for periods of between 6000 years and 25000 years. The luminescence dating of a wide range of dune systems has revealed, contrary to existing beliefs, that much of the coastal plain was reactivated during the Pleistocene/Holocene transition period. Accumulation of peat deposits only occurred in numerous interdune mires once the regional dune systems had stabilized after the most recent pulse of sand movement in the early to mid Holocene. The substrate on which the Tembe sand forest grows is very irregular and dune remobilization and accretion has been patchy in time and space over the past 40 000 years with the last recorded accretion of the upper 3m during the early Holocene at two sites (Botha et al. 1992, Botha and Porat 2000). The dunes in the areas of much of the sand forest have not been sufficiently stable over the last 12 000 years for forest to have persisted for longer than 2000-3000 years at any one site. Nevertheless, this would make these forests amongst the oldest of the tropical coastal forest types.

Floristically the sand forests are clearly of tropical provenance, as shown by a number of genera shared with tropical forests and woodlands. Still they have a very high (specific and subspecific) endemism, which emphasizes their special position even more. Today they are entirely surrounded by various woodland and grassland communities of the Savanna Biome and show floristic links to these communities as well. The Licuati Sand Forests are not an edaphic (or hydrologico-edaphic) azonal phenomenon; they are a case of "relictual azonality".

5.3 General classification patterns

Here we describe the structure of the major Forest Groups (see the system in sub-chapter 5.1) and discuss their complex similarity relationships. The forests of South Africa have been classified into 24 forest types based on their woody species composition. In what follows we refer to analyses using combined weighted-average frequency-abundance data (and ratio-scale resemblance) as "quantitative analyses", and those analyses based on presence-absence data as "qualitative analyses".

Classification of Forest Types into Forest Groups (or their qualification as Azonal) was primarily based upon floristic resemblance patterns. In some cases, however, some biogeographically motivated adjustments were introduced as well.

5.3.1 Position of azonal forest types

Licuati Sand F., Lowveld Riverine F., Swamp F., and Mangrove F. separated out as outliers in a quantitative clustering (**Fig. 5.3**). The latter two forest types formed a single cluster suggesting some shared taxa. A quantitative ordination (**Fig. 5.4**) revealed the same pattern: the above-mentioned azonal types form an outlier group while the remainder of the forest types span a horseshoe-shaped coenocline ranging from subtropical coastal forests (KZN Coastal F. and KZN Dune F.) at one end to the Western Cape Talus F. at the other. In a qualitative clustering (**Fig. 5.5**) the group of outliers was enlarged by addition of Western Cape Milkwood F. and Western Cape Talus F. Lowveld Riverine, Swamp and Mangrove forests have been recognized as “azonal” types (White 1983).

5.3.2 Position of Western Cape forests

In a quantitative analysis of the zonal forests all Western Cape forests appear as a compact cluster (**Fig. 5.6**). The cluster includes two forest types, the Southern Cape Afrotperate F. and Western Cape Afrotperate F. (both with clear Afrotperate affiliation) and these are joined by Western Cape Talus F. (occupying specific habitat, but of clear Afrotperate origin) and Western Cape Milkwood F. All these forest types were placed in Forest Group (FG) I (the **Southern Afrotperate Group**). This group is comprised of comparatively species poor, high-latitude Afrotperate forest types. The low woody species diversity of these forests reflects the general north-south decrease in species richness possibly plant migration patterns (Geldenhuys 1992, Midgley et al. 1997) or significant climatic filtering (extinction associated with Pleistocene climate changes) at high latitudes.

The fact that Western Cape Milkwood F. clustered with the rest of the Western Cape forests (**Fig. 5.6**) can be ascribed to a mass effect (Shmida & Ellner 1984) since they share a suite of taxa encroaching from the surrounding Fynbos biome. Floristic similarity alone is suggesting classification of the Milkwood F. within the Southern Afrotperate Group. Biogeographically, however, their species poor nature and composition places them as the westernmost impoverished form of the subtropical coastal group of forests, dominated by *Sideroxylon inerme* (rarely also *Celtis africana*) – a tree of subtropical provenance. We have elected to place the Milkwood Forests into FG VII (Southern Coastal Group).

5.3.3 Position of Drakensberg and Highveld forests

The Afrotperate forests that are found as patches surrounded by grasslands at high altitudes in the Drakensberg, and those found in northern Highveld and here largely straddle the tension zones between Grassland and Savanna Biomes, form another comparatively species-poor group of Afrotperate forest types – here called **Northern Afrotperate Group** (FG II). The ordination (**Fig. 5.7**) reveals that the FG I and FG II separate from the other indigenous forests along Axis 1 and are clearly separated on Axis 2.

The **Northern Afrotperate Group** comprises the Drakensberg Montane F., Northern KwaZulu-Natal Mistbelt F., Marekele Afromontane F. and Northern Highveld Forests. The Highveld forests are the most controversial of the types in this group. The Highveld forests are probably the most “biogeographically eroded” type, as they contain a very small portion of the typical Afrotperate elements. We speculate that they were originally linked (floristically and also physically) to species-rich Afrotperate forest, still found in remnants today along the Northern (Mpumalanga) Escarpment (and possibly also to those of the Soutpansberg range). This link is suggested by the anomalous occurrence of a number of Afrotperate elements (both woody species and herbaceous flora) – a phenomenon that White (1978, Fig. 4) singled out as the “Magaliesburg Extension”. After the (hypothetically nearly-continuous) Afrotperate belt underwent fragmentation, these forests retreated either into deep kloofs where they lost much of their Afrotperate character through encroaching woodland (savanna) flora (Northern Highveld F.), or found refugia in relictual scarp situations on elevated ranges such as Waterberg Mts. (Marekele Afromontane F.).

5.3.4 Position of the Northern Escarpment forests

The forests of the Soutpansberg and Northern (Mpumalanga) Escarpment show high floristic similarity and have been classified within two forest types – the Northern Mistbelt Forests (comprising Soutpansberg and part of the Magoebaskloof area of the Escarpment: III1) and the Mpumalanga Mistbelt Forests: III2). These two types consistently clustered together in all quantitative and qualitative analyses (Figs. 5.3, 5.4 & 5.5) and held similar positions in the ordination (Figs. 5.4 & 5.6). These two types are a clear forest group (FG III: **Northern Mistbelt Group**). Biogeographically this group is Afrotropical in nature with considerable local levels of woody endemism. Three centers of endemism form the geographic backdrop of this forest group: the Soutpansberg Center, Wolkberg centre and the Barberton Centre. The Northern Mistbelt Group is an Afrotropical forest at its best and houses a number of relict species that reach their southern distributional limit in this group. Dry facies of these forests are enriched by subtropical woodland element.

5.3.5 Position of the Scarp Forests, Eastern Cape and Midlands mistbelt forests

The Scarp Forests form a discontinuous belt of forest patches along low-lying scarps extending from northern Swaziland (a considerable distance from the coast), to more proximal top the coast in southern KwaZulu-Natal, to coastal positions along the Eastern Cape coast. These forests are a valuable biodiversity asset to South Africa and are comparatively rich in woody endemics, at both the species and genus level. Pondoland Scarp F, arguably the most unique forest in Africa, supports an endemic family (*Rhychocalycaceae*).

Two traditional Scarp forest types (Eastern Scarp F. and Pondoland Scarp F.) link well in both the clusterings (Figs. 5.3 & 5.6) and ordinations (Figs. 5.4 & 5.7). Also a minimum spanning tree analysis (Fig. 5.8) confirms their high similarity. Another two forest types are highly similar to the scarp forest types, namely the Transkei Coastal Platform F. and Eastern Mistbelt F. (comprising Transkei and Midlands Afrotropical mistbelt forests) – these two forest types form a group in the clusterings (Figs. 5.3, 5.5, 5.6 & 5.9) and ordinations (Figs. 5.4 & 5.7). On the other hand, the Amatole Mistbelt F. and Transkei Coastal Valley F. together form a separate group in quantitative clustering (Fig. 5.3 & 5.6) as well as in ordination space (Fig. 5.7). Minimum spanning tree (Fig. 5.8) analysis supports this interpretation. In qualitative analyses (Figs. 5.5 & 5.9) the Amatole Mistbelt F. groups with forest of the Southern Afrotropical Group.

This group displays an intricate similarity pattern involving two traditional mistbelt forest types (Eastern Mistbelt, Amatole Mistbelt), traditional scarp forests (Eastern Scarp, Pondoland Mistbelt), one traditional coastal type (Transkei Coastal Platform F.) and one transitional forest type (Transkei Coastal Valley F.) that is located topographically between the Transkei Coastal Platform F. and the mistbelt forests of Eastern Cape and KwaZulu-Natal (Eastern Mistbelt F. and Amatole Mistbelt F.).

The above may be summarised as follows:

1. Although the Transkei Coastal Platform F. is situated along the southern subtropical Transkei coast, it shows clear floristic links to Scarp Forest rather than to subtropical coastal groups (see below). Therefore, we group the Eastern Scarp F., Pondoland Scarp F. and Transkei Coastal Platform F. into the Scarp Forest Group (FG V). The Scarp Forests are often called “transitional” (i.e., falling between Afrotropical and subtropical coastal forests) in character. This may lead some forest ecologists to interpret the distributional patterns of South African indigenous forests in terms of a continuum (see Midgley et al. 1997). However, the Scarp Forests, are not composed of merely a mixture of elements of the two above-mentioned major forest groups – they possess their own ecological character, own species combinations, and are characterised by high endemism.
2. The pair-wise similarity patterns (Tabs. 5 & 6) of the Amatole Mistbelt F. with other regionally close forest types, precludes clear-cut resolution of similarity patterns within the discussed group of forest types. The Amatole Mistbelt F. includes large patches of forest deep inland

(along the Escarpment), as well as a number of patches on low-altitude inland ridges in the Albany region. In the vicinity of East London this type comes into contact with forests of scarp character (Transkei Coastal Platform F.) or clearly subtropical character (Eastern Cape Dune F.). The forest patches along the low-steppe inland ridges (from Zuurburg as far as East London) are undersampled and therefore their relationship with the Albany Coastal F. and Transkei Coastal Valley F. remains to be clearly determined.

3. The position of the Eastern Mistbelt F. is another problem, as it is floristically closer to the Transkei Coastal Platform Forest than to the Amatole Mistbelt F.

Our analyses may be improved with further data especially from regions linking the Amatole Mistbelt F. and the coastal areas of the Eastern Cape. After separating the Scarp Forest Group, we take the pragmatic biogeographic approach of linking the remaining traditional mistbelt forests to form Forest Group IV - the Southern Mistbelt Group.

5.3.6 Position of the Coastal forests

The coastal forests are represented by a series of forest types of which KwaZulu-Natal Coastal F. and KwaZulu-Natal Dune F. form a consistent cluster in all analyses (Figs. 5.3, 5.5, 5.6 & 5.9), including ordination (Figs. 5.4 & 5.7) and on the minimum spanning tree (Fig. 5.8). The cluster is interpreted here as a forest group in its own right – Forest Group VI (Northern Coastal Group). The latter group is found on the narrow, geologically young coastal strip along the Maputaland and Zululand coasts. Both forest types summarized in this group are of subtropical character and limited strictly to the Indian Ocean Coastal Belt.

Albany Coastal F. and Eastern Cape Dune F. are, from a biogeographic point of view, impoverished forms of the Northern Coastal forests. They are found outside the Indian Ocean Coastal Belt (or Coastal Subtropical Forest Biome) and are surrounded either by subtropical Albany Thickets or (at the westernmost limits of distribution) by a complex of grassy fynbos and coastal thickets. In quantitative clusterings (Figs. 5.3 & 5.6) the Eastern Cape Dune F. was most closely linked to the cluster comprising the Northern Coastal Group. Albany Coastal F. (Figs. 5.3 & 5.6) joined a major cluster composed of species rich forest groups (FGs III, IV, V and IV) as a local outlier. However, in ordinations (Figs. 5.4 & 5.7), Albany Coastal F. and Eastern Cape Dune F. appear to be very close in floristic terms. Therefore, we have classified both discussed coastal forest types as the Forest Group VII (Southern Coastal Group). Minimum spanning tree (Fig. 5.8) brings a new interesting insight into resemblance patterns of the coastal forest types of the Eastern and Western Cape Province. The Eastern Cape Dune F. is linked to Transkei Coastal Platform F. (they both co-occur along the Transkei coast) and the Albany Coastal F. is linked to Amatole Mistbelt F. (they co-occur in Albany region). This last forest type, which we classify within the Southern Coastal Forests – Western Cape Milkwood F. (see above), is the most impoverished type of coastal forest, closely linked to Southern Cape Afrotropical F. Indeed, the coastal-bound subtypes of this Afrotropical forest do contain some flora elements of prevalently subtropical provenance (Geldenhuys 1986).

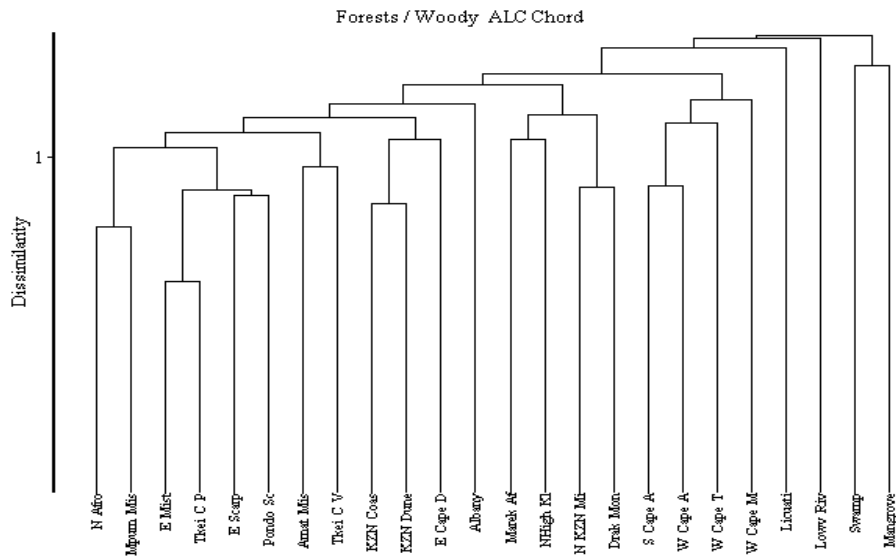


Figure 5.3 Average Linkage Clustering using Chord Distance (normalized Euclidean Distance) using quantitative data of all 24 forest types. Legend: Albany: Albany Coastal F., Amat Mis: Amatole Mistbelt F., Drak Mon: Drakensberg Montane F., E Cape D: Eastern Cape Dune F., E Mist: Eastern Mistbelt F., E Scarp: Eastern Scarp F., KZN Coas: KwaZulu-Natal Coastal F., KZN Dune: KwaZulu-Natal Dune F., Licuati: Licuati Sand F., Lowv Riv: Lowveld Riverine F., Mangrove: Mangrove F., Marek Af: Marekele Afromontane F., Mpum Mis: Mpumalanga Mistbelt F., N Afro: Northern Mistbelt F., N KZN Mi: Northern KwaZulu-Natal Mistbelt F., NHigh Kl: Northern Highveld Kloof F., Pondo Sc: Pondoland Scarp F., S Cape A: Southern Cape Afrotperate F., Swamp: Swamp F., Tkei C P: Transkei Coastal Platform F., Tkei C V: Transkei Coastal Valley F., W Cape A: Western Cape Afrotperate F., W Cape M: Western Cape Milkwood F., W Cape T: Western Cape Talus F.

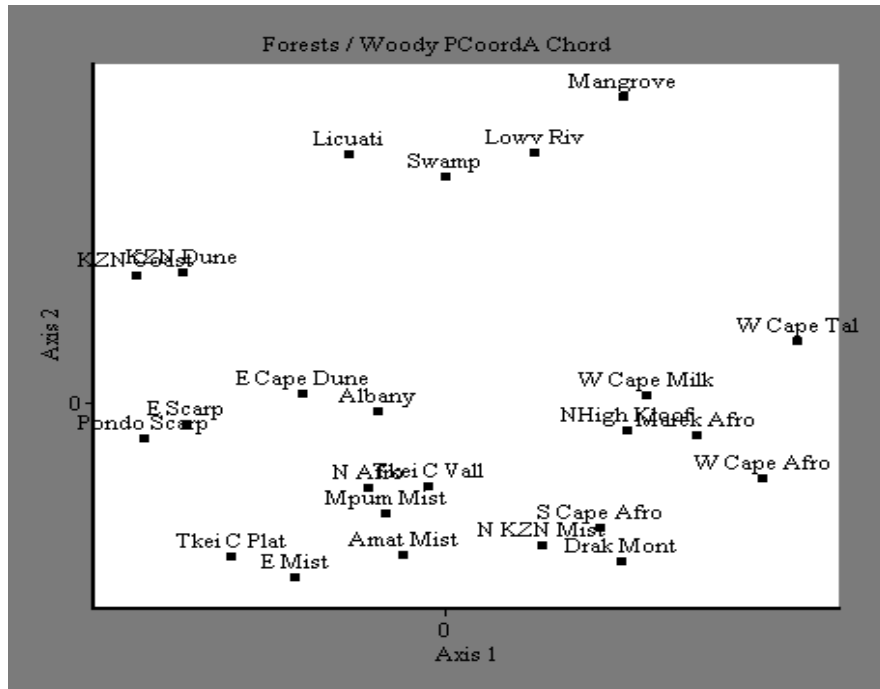


Figure 5.4 Ordination using Principal Coordinate Analysis (metric scaling) and Chord Distance of all 24 forest types. The first two axes account for 12 and 11 % of variability, respectively. For legend see Fig. A.

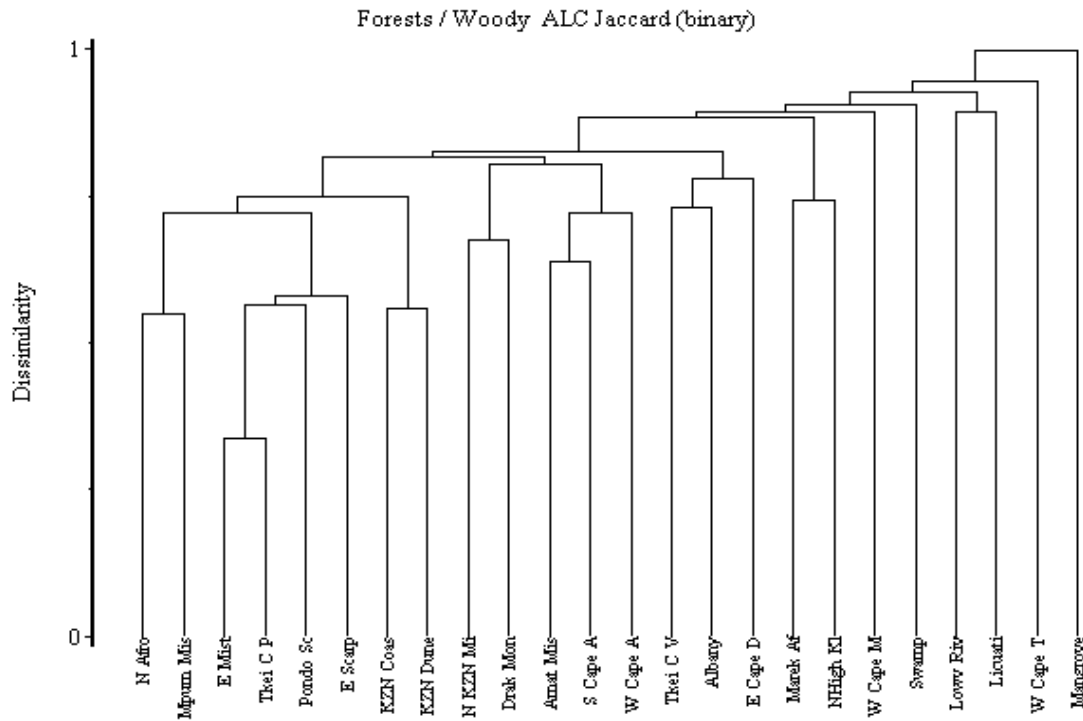


Figure 5.5 Average Linkage Clustering using Jaccard Similarity Coefficient (hence presence-absence data) of all 24 forest types. For legend see Fig. A.

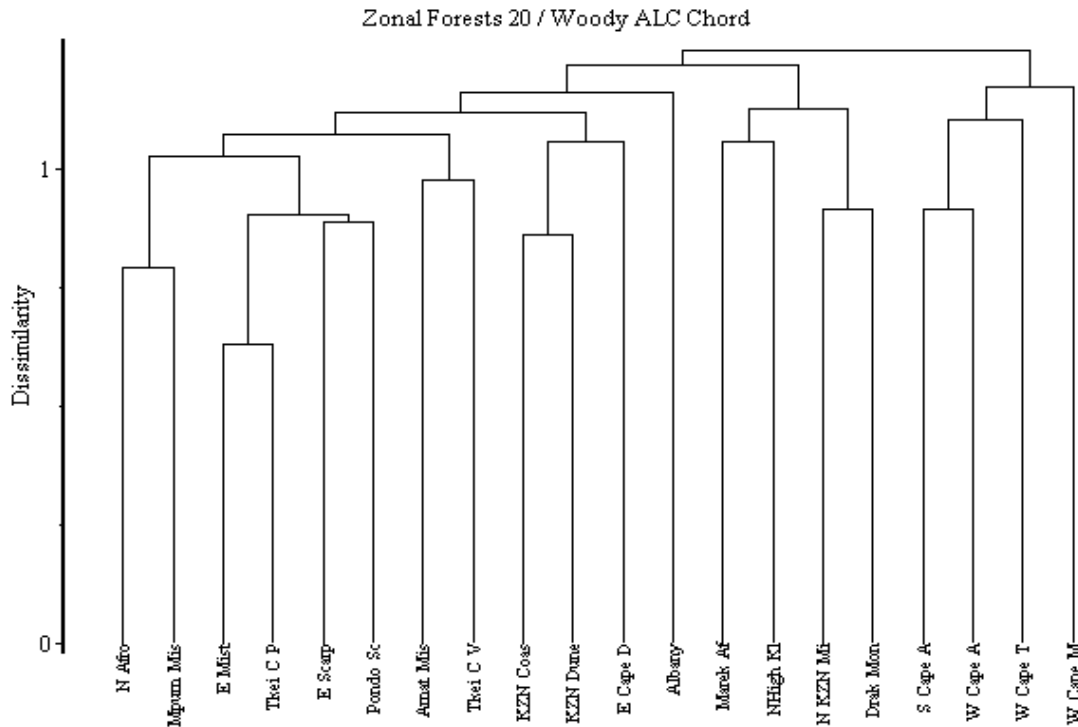


Figure 5.6 Average Linkage Clustering using Chord Distance (normalized Euclidean Distance) using quantitative data of 20 zonal and intrazonal forest types. For legend see Fig. A.

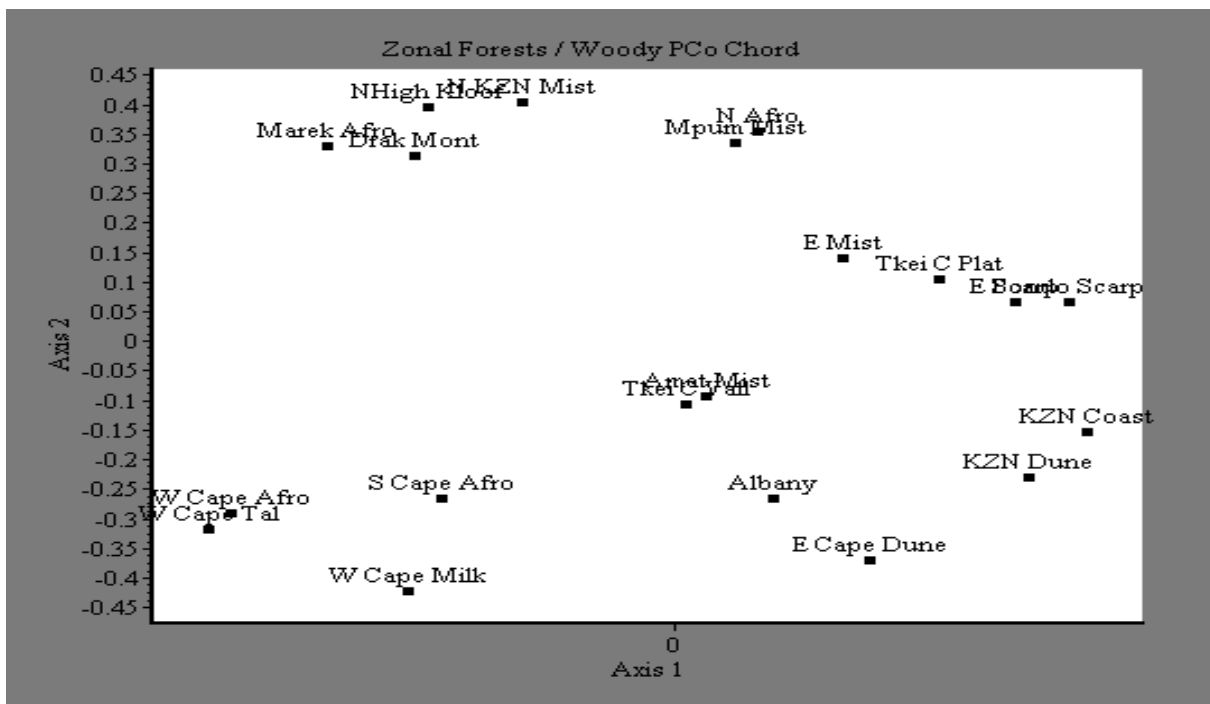


Figure 5.7 Ordination using Principal Coordinate Analysis (metric scaling) and Chord Distance of 20 zonal and intrazonal forest types. The first two axes account for 16 and 12 % of variability, respectively. For legend see Fig. A.

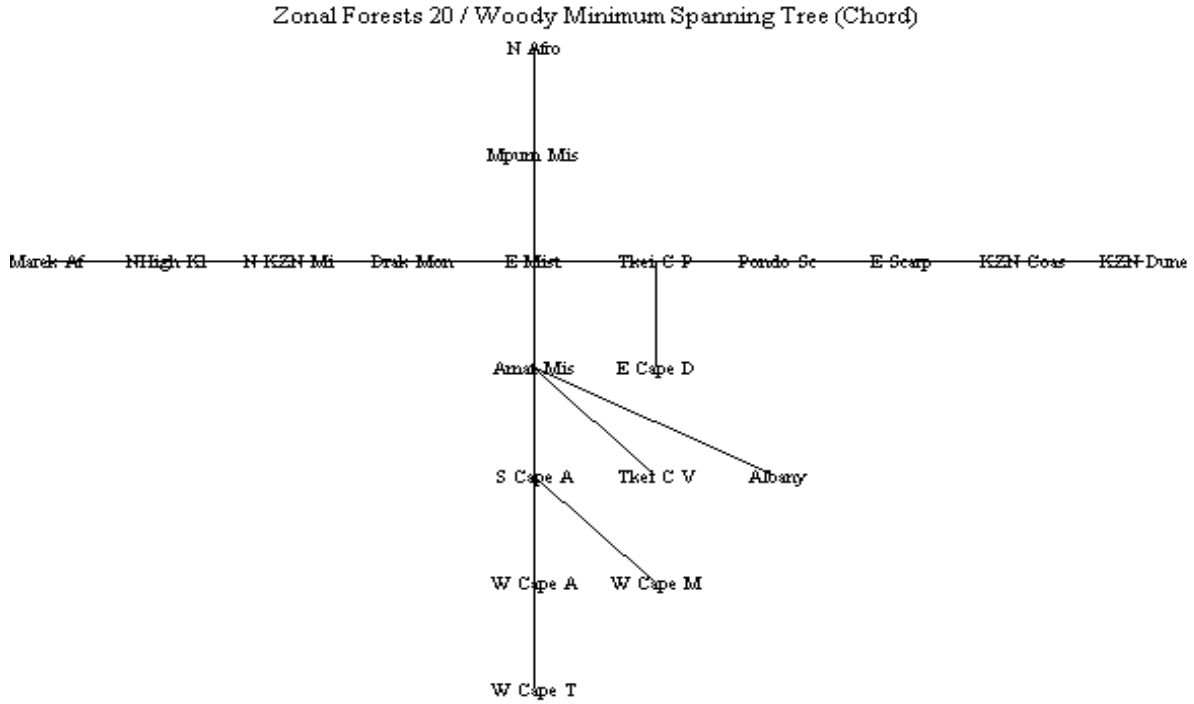


Figure 5.8 Minimum spanning tree (Chord distance, quantitative data) of 20 zonal and intrazonal forest types. For legend see Fig. A.

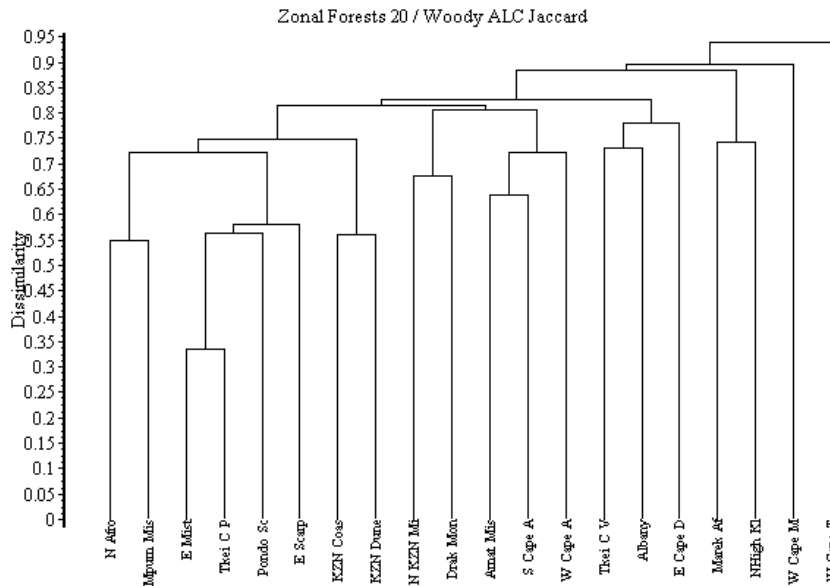


Figure 5.9 Average Linkage Clustering using Jaccard Similarity Coefficient (hence presence-absence data) of 20 zonal and intrazonal forest types. For legend see Fig. A.

5.4 Conclusions

- 1) Most of the South African indigenous forests are Afrotropical in character, hence linking these forests with the global Warm-Temperate Forest Biome.
- 2) There are two distinct groups of impoverished Afrotropical forests and two mistbelt groups. The latter are more species rich and contain a number of endemics, relic species as well species linking these primarily Afrotropical forests with those of subtropical character. This emphasizes the continuum or spatial variation in floristic character of indigenous forests in South Africa.
- 3) The Scarp forests are clearly of intermediate character linking the Afrotropical forests with the Coastal (subtropical) groups. The origin of this forest group is still unclear. However, the Scarp forests do not form a group on their own (on the same level as traditional Afrotropical and Coastal Subtropical forests). In fact, the intricate pattern of pairwise resemblances suggests that the Scarp forests are more closely linked to the Southern Mistbelt Group than to any other.
- 4) There are a number of plausible ways to group the Forest Groups into high-level units, but neither the traditional two-group model (Model 1: "Afrotropical" versus "Coastal"), nor the recent three-group model (Model 2: "Afrotropical", "Scarp", Coastal") is entirely supported by the classification scheme presented here. We propose the multi-group reticular continuum model here. The essence of this model is that each of Forest Groups shows a number of floristic and biogeographically plausible links to other groups and the amalgamation of the forest groups into higher units would follow a reticular rather than linear pattern.
- 5) This is the first formalized and comprehensive analysis of floristic data from indigenous forests of South Africa. Despite an impressive number of samples involved in these analyses (4500) we are aware of major gaps in our field knowledge. Regions such as Albany, the northern Highveld, and the northern regions of Western Cape Province are undersampled. Lack of data on herbaceous flora in vegetation samples is a major drawback in drawing clear patterns of floristic and biogeographic relationships between South African indigenous forests.

6. MAJOR FAUNAL PATTERNS

A few general comments are pertinent here before dealing with the taxon specific accounts:

1. Because of the spatial scale and sampling design of the fauna analyses, these analyses seek to emphasise the broad scale associations among forest groups of their fauna. Furthermore, it was not possible to classify the fauna using the forest types identified in the floral analyses, because of the coarse grain of the data;
2. The main patterns to arise from these analyses are the generally unique nature of the Western Cape faunas, the separation of Afrotropical faunas from coastal faunas, and the intermediate position of the scarp group forests and their fauna;
3. The position and affinities of the Soutpansberg faunas to other forest types is interesting, since in most cases it appears to be closer to the faunas of coastal Maputaland than Afrotropical forests immediately to the south;
4. A surprising result is, with the exception of the birds, the low degree of similarity (<50%) among the forest groups in their faunal content (i.e., reptile, frog and mammal faunas). These latter faunas are more sedentary than the birds and still reflect in their composition the effects of past biogeographic events, particularly the timing and extent of radiation of forests and their fauna in relation to climate fluctuation of the late Holocene (Lawes 1990).

6.1 Birds

The CA-ordination diagram for birds separates forest sites into three distinct and recognisable groupings, inland or Afrotropical forests, coastal forests and forests of the Western Cape (including the large Knysna - Tsitsikama block and the small patches extending westwards towards the peninsula, Figure 6.1). The gradient on the first ordination axis is altitudinal, separating inland from coastal forests. The second ordination axis represents a latitudinal gradient. The first two axes of the ordination diagram account for 40.9% of the variance in species data. On the first ordination axis coastal forests separate Eastern Cape, and southern and central KwaZulu-Natal coast from the more northern Zululand and Maputaland regions. The analysis indicates that Ongoye forest has affinities with the Zululand coastal regions but this might result from the scale constraints considered earlier. The large forest blocks of Ngome, Nkandla and Qudeni are included within the Afrotropical group. The high Drakensberg forests of KwaZulu-Natal are a fairly discrete grouping within the Afrotropical forests. The Eastern Cape and KwaZulu-Natal mistbelt forests show affinities, as do the Mpumalanga, Northern Province and Soutpansberg forests. The Soutpansberg forests, however, appear to share elements with forests of the KwaZulu-Natal coast. Alexandria's position within ordination space follows its geographic location between the southern Cape Afrotropical and Eastern Cape coastal forests.

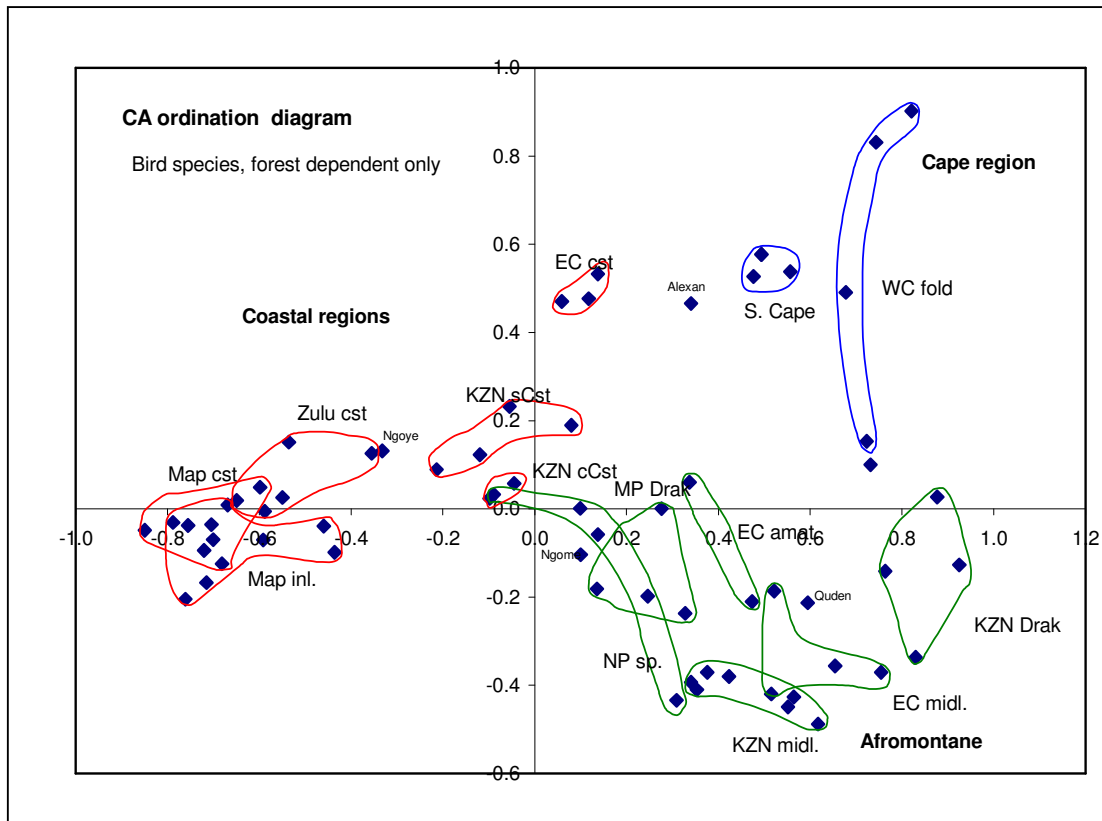
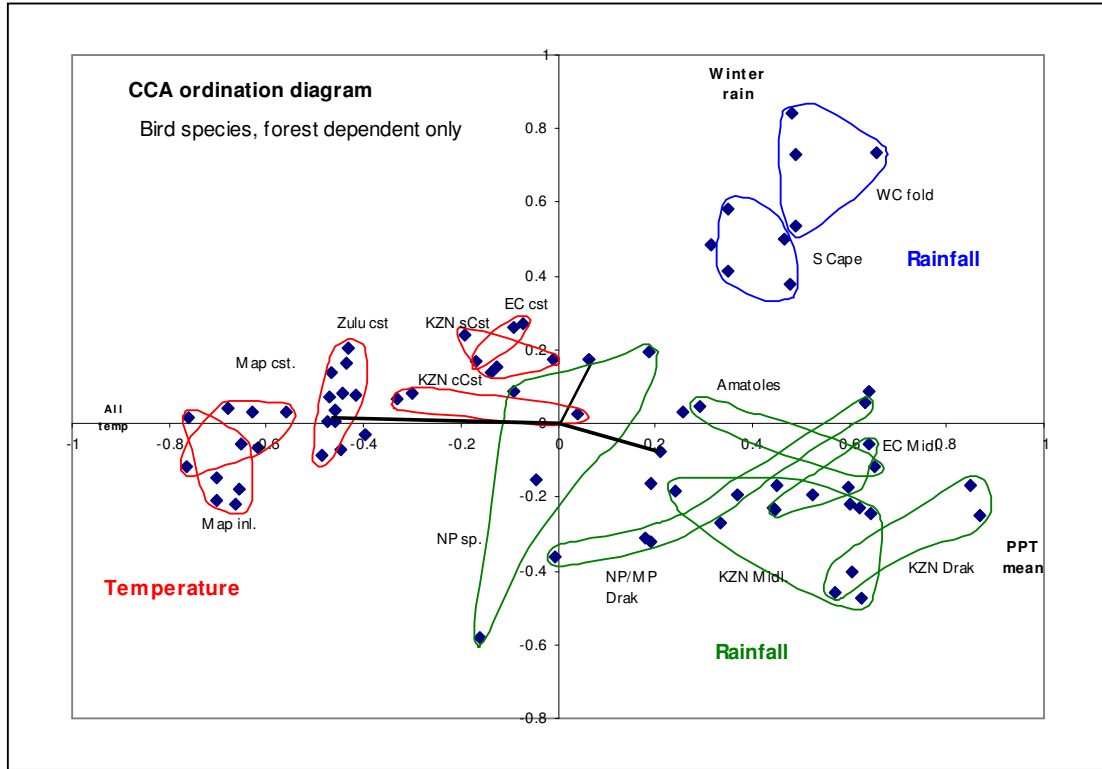


Figure 6.1 CA ordination of forest dependant bird species

The cluster analysis using the Jaccard similarity coefficient separated sites into coastal and inland (Afrotemperate) forests (Figure 6.1). The major scarp forests (Ngome, Ongoye, Nkandla) were clustered with the Eastern Cape and southern KZN coastal sites that were separate from the northern coastal forests of Zululand and the Maputaland coastal plain. Qudeni forest was an outlier of the coastal forests. Coastal forests displayed a 50%, or better, similarity. The Western Cape forests showed a clear separation from all other inland forests. Forests of the Southern Cape, KwaZulu-Natal, Eastern Cape and Mpumalanga mistbelt areas produced a loose grouping that was separate from the forests of the KwaZulu-Natal Drakensberg. The inland forests of the Eastern Cape, KwaZulu-Natal and Mpumalanga showed a similarity of 50%, or better. The Soutpansberg sites were outliers to the general inland forest cluster.

The CCA biplot for forest-dependent bird species indicates that the temperature variables account for most of the variation in species richness in coastal forests (Figure 6.1). All temperature related environmental variables (except average temperature for the hottest month) had very high variance inflation factors, thus indicating close to perfect correlation with the other variables and thereby contributing negligibly to the observed pattern. Most Afrotemperate forests fall within a strongly seasonal (summer) rainfall region and the Western Cape forests separate from the rest by receiving winter rainfall. The relationship between forest sites and the environmental variables was significant for all canonical axes (F-ratio = 5.003, $p < 0.005$). One shortcoming of CCA is that species that are unrelated to ordination axes tend to be positioned within the centre of the diagram and are not distinguished from species that lie there by virtue of relationships (Ter Braak 1987). Soutpansberg forest sites were positioned within the centre of the ordination diagram.

6.2 Reptiles

The Western Cape (including the southern Cape) forest sites were strong outliers on the first CA ordination axis for reptile species resulting in no discernable pattern for all other forest sites. The Western Cape sites were removed and the data reanalysed to produce results similar to those obtained for bird species (Figure 6.2). On the first ordination axis, the two major recognisable groupings separate Afrotemperate from coastal forests although there is some overlap between Eastern Cape inland forests and the Eastern Cape / southern KwaZulu-Natal coastal regions. There is no clear distinction between Zululand and both Maputaland regions. However, there are discrete groups for the inland Afrotemperate forests with the Soutpansberg shown as a subset of the Mpumalanga and Northern Province Drakensberg regions. Ongoye and Qudeni forests showed close affinities with the KwaZulu-Natal Drakensberg sites, while Ngome and Nkandla were positioned close to the KwaZulu-Natal southern coastal forests. The first two axes of the ordination diagram account for only 17.7% of the variance in species data and thus these inferences drawn from the CA are weak at best. Environmental gradients on the first two ordination axes are not well defined and appear to be a combination of latitude and altitude.

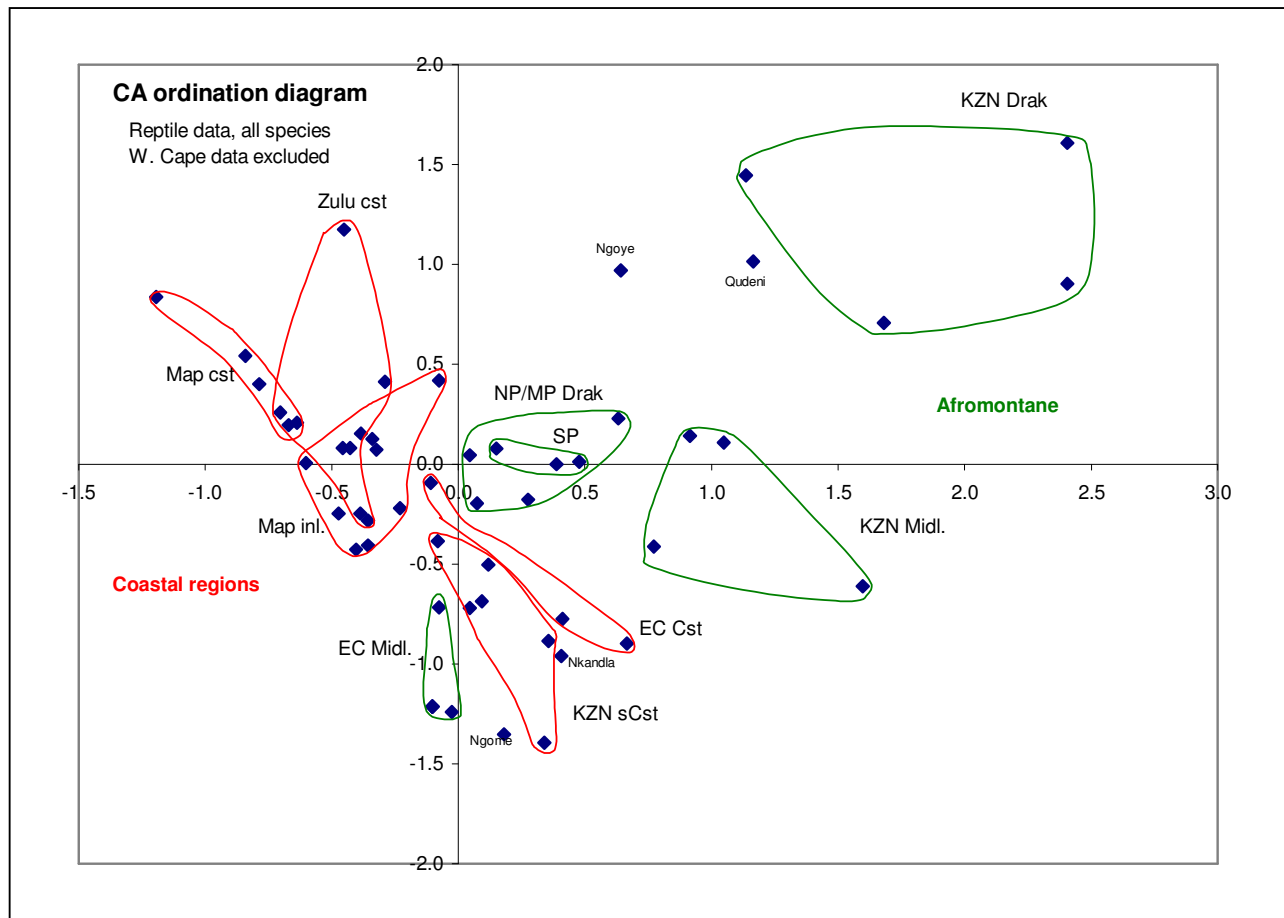


Figure 6.2 CA ordination of reptile species

The cluster analysis for reptiles produced three major groups and an outlier consisting of Ongoye forest and a few sites from the Zululand coast (Figure 6.2 and 6.3). The clusters all branch at about 20% or worse similarity. The Western Cape and Southern Cape forests were clustered with the Amatoles and the Eastern Cape midland mistbelt sites. Ngome forest was closely aligned with the Eastern Cape mistbelt forests. The second major group was that of the KwaZulu-Natal Drakensberg, Mpumalanga mistbelt and the northern mistbelt forests of Magoebaskloof and the Soutpansberg. Qudeni (scarp forest) was included in this last group. The final major group was dominated by coastal and scarp elements of KwaZulu-Natal. Certain mistbelt forests of the KZN midlands showed affinities to the southern KZN coastal regions (Pondoland Scarp). The KZN midlands group (Northern Mistbelt forests) was associated with forests of the Zululand coast and Maputaland coastal plain.

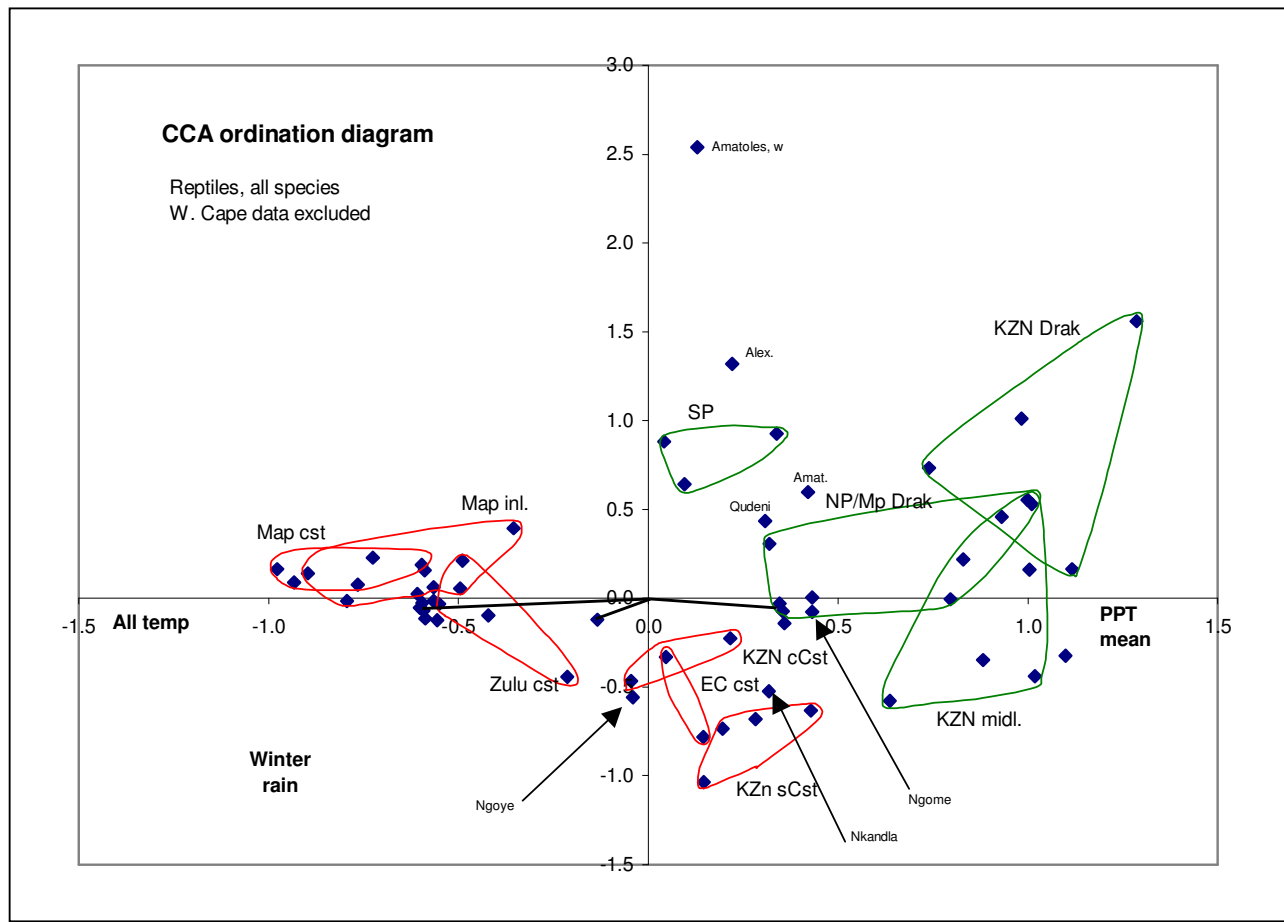


Figure 6.3 CCA reptile ordination of reptiles with Western Cape data excluded

The CCA biplot did not differ substantially from that obtained for bird species except that summer rainfall accounts for the variation in species richness in the Eastern Cape and KwaZulu-Natal south and central coastal regions, in addition to all other Afrotropical forests (Figure 5). With the Western Cape forest sites removed, winter rainfall was weakly associated with the Zululand and Maputaland regions indicating rainfall in these areas is less seasonal than the inland (Afrotropical) and Eastern Cape / south and central KwaZulu-Natal coast. As before, there was a high level of redundancy with the temperature related variables. The relationship between forest sites and the environmental variables was significant for all canonical axes (F-ratio = 1.683, $p < 0.005$).

6.3 Frogs

Forest-dependent frogs show high levels of endemism in the Western Cape. This was revealed in the first CA ordination axis where both Western Cape sites were strong outliers and all other forests were represented by a single point. Replotting these data on the third and fourth ordination axes clearly separates the Western Cape (including southern Cape) forests and the KwaZulu-Natal northern coastal regions (Zululand and Maputaland) from all other forest sites. The proportion of variance accounted for by the first four component axes was 61.7% (Axis 1 = 19.0%, axis 2 = 19.1%, axis 3 = 12.7%, axis 4 = 10.9%). The Western Cape and Zululand / Maputaland forest sites were removed from the matrix and the data reanalysed. On the first two ordination axes of the second CA, the Amatoles and Soutpansberg forest sites were outliers with all other forest sites clustered around the origin. Replotting these data on the third and fourth axes resolved forest sites into coastal and inland Afrotropical groups (Figure 6.4). The Amatoles and Soutpansberg forest sites, however, show closer affinities to the coastal forest sites. Aside from the position of the

Amatoles and the Soutpansberg in ordination space, the third ordination axis represents an altitudinal gradient. The proportion of variance accounted for by the first four component axes was 82.5% (Axis 1 = 32.0%, axis 2 = 24.3%, axis 3 = 16.8%, axis 4 = 9.4%).

The cluster analysis of frog distributional data indicates that forests of the Western Cape show little similarity to the other sites, emphasising the high degree of endemism in these forests (Figure 6.4). Coastal forests of north-eastern KZN (Zululand coast, Maputaland coastal plain) separated from all other forests and their frog faunas are essentially subtropical to lowland tropical forest in character. Coastal forests of the Eastern Cape and southern KwaZulu-Natal (a combination of dune forest, Pondoland Scarp and Transkei Coastal Platform) showed a closer affinity to mistbelt forests (i.e., Afrotemperate forests) of the Eastern Cape and KwaZulu-Natal Midlands (Eastern Mistbelt Forests) than to the Zululand/Maputaland group. Ongoye forest showed affinities to the Eastern Cape and KZN coastal regions. The Southern Cape forests appear transitional between the Eastern Cape/KZN midlands mistbelt and coastal regions and a relatively tight grouping (between 35 and 40% similarity) comprising the KZN Drakensberg, the Amatoles, Mpumalanga mistbelt, Limpopo Province forests (Magoebaskloof, Soutpansberg) and certain important scarp forests (Nkandla, Qudeni).

As before, the CCA results for forest-dependent frog species indicates the temperature variables account for most of the variation in coastal forests although the southern KwaZulu-Natal forest sites were neatly clustered around the origin (Figure 7). All temperature related environmental variables (except average temperature for the hottest month) were closely correlated. Forests of the KwaZulu-Natal Drakensberg and midlands fall within the summer rainfall zone. The relationship between forest sites and the environmental variables was significant for all canonical axes (F-ratio = 3.258, $p < 0.005$).

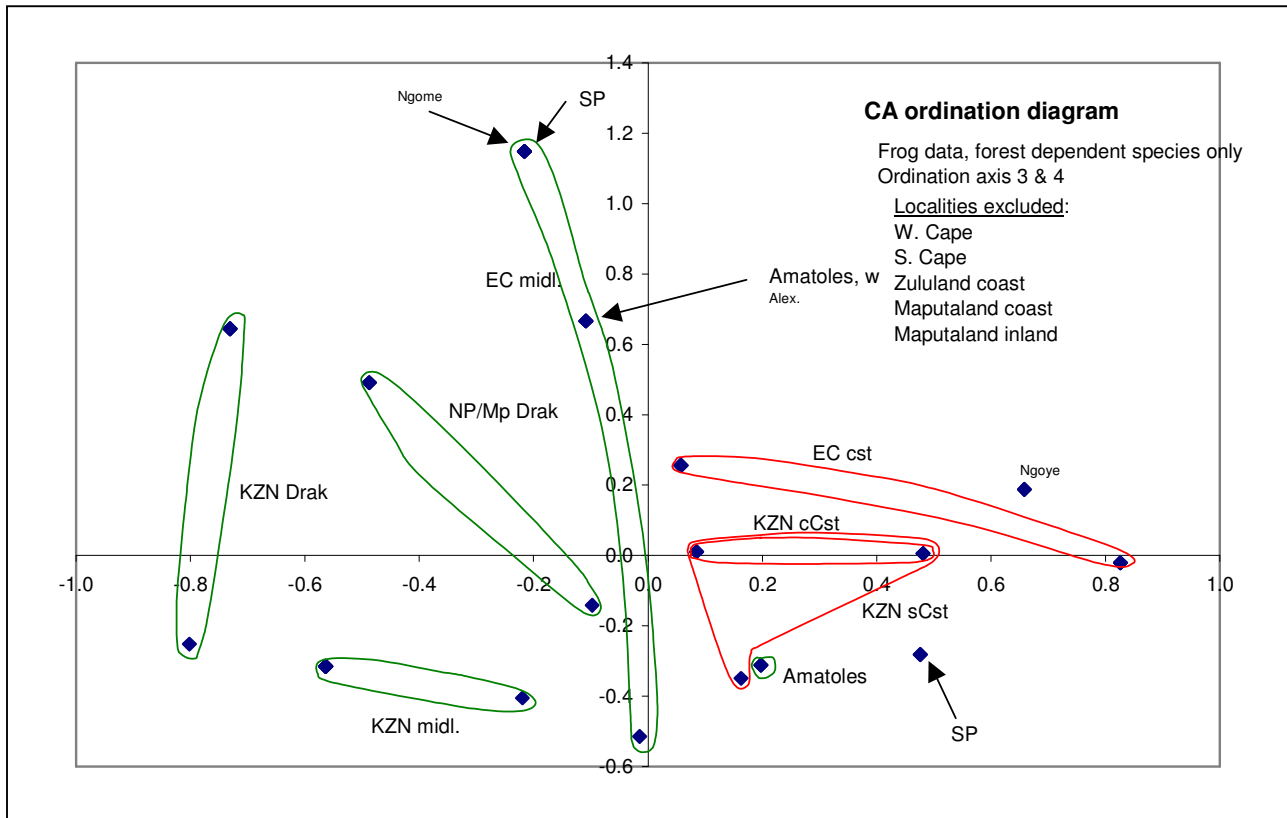


Figure 6.4 CA ordination of frog species

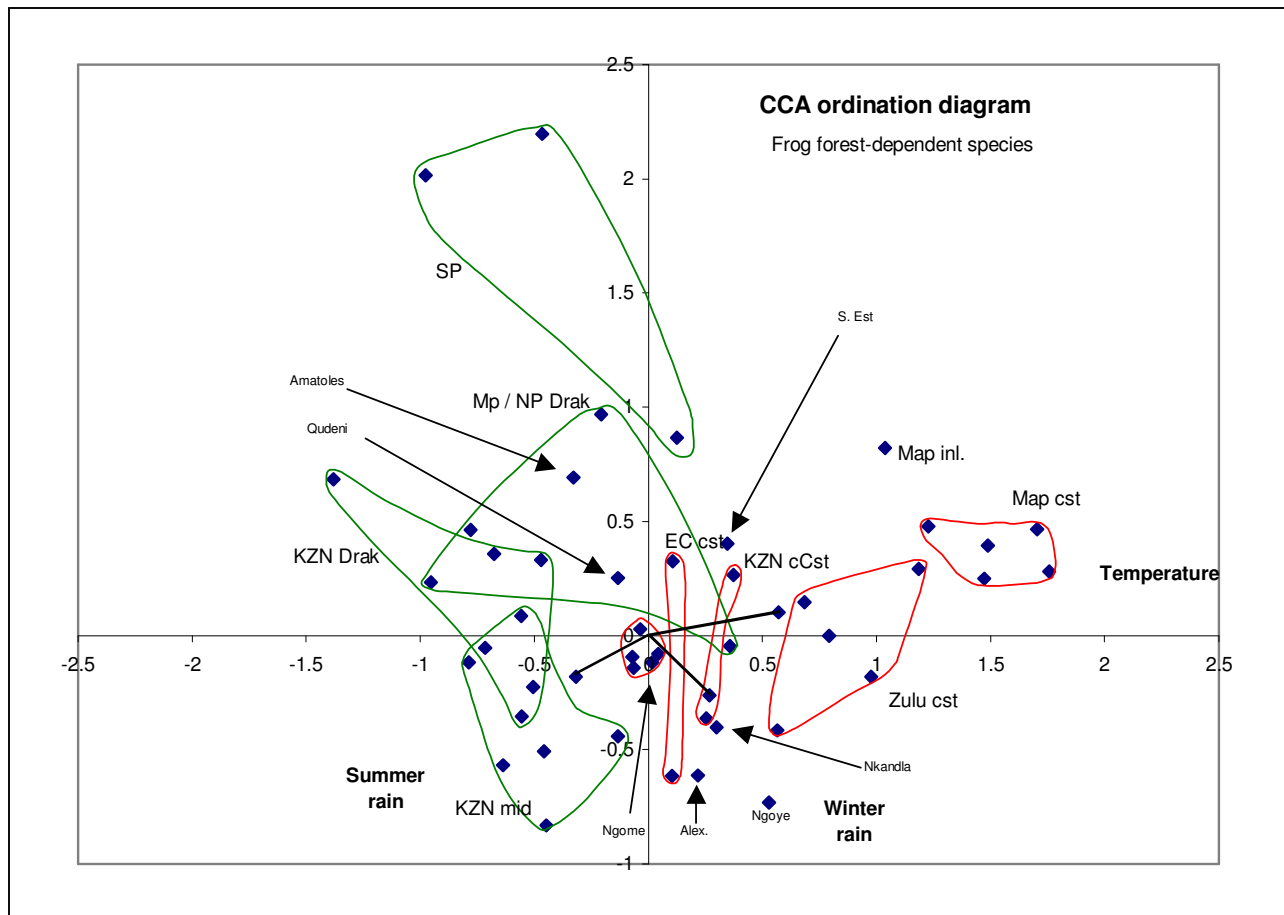


Figure 6.5 CA ordination of frog species

6.4 Mammals

Three Eastern Cape forest sites (Amatoles, midlands (2)) were strong outliers on the first two ordination axes with all other sites clustered around the origin. The first two axes of the ordination diagram account for only 12.1% of the variance in species data. Removal of the three sites and reanalysis yielded a more interpretable, yet indistinct, ordination diagram (Figure 6.6). The first two axes of the second CA account for only 12.2% of the variance in species data. A weak altitudinal gradient exists on the first ordination axis. The position of the Western Cape / southern Cape forests on the first axis indicates a latitudinal compensation for altitude. Unlike the other forest taxa, geographically similar forest sites do not form discrete groups. This lack of clear pattern is, in our opinion, a result of incomplete data-sets.

Results from the cluster analysis are difficult to interpret because forest sites from similar geographic localities, representing the same forest types, did not always clump together (Figure 6.6). Of the four animal taxa examined, the mammal data consistently produced patterns that show no expected grouping. For example, sites from the Mpumalanga mistbelt, the Eastern Cape midlands and the Eastern Cape coast cluster on opposite extremes of the dendrogram (Figure 6.6). Forests of the Zululand coast and the Maputaland coastal plain showed the greatest similarity and were associated with the Eastern Cape coast and KwaZulu-Natal south coast, together with the Mpumalanga mistbelt. Qudeni and Nkandla forests and sites from the Soutpansberg were outliers to this general grouping. Nevertheless, the cluster classification for mammals is more hierarchical in structure than for the other faunal group. A general trend of decreasing similarity from north to south along a latitudinal gradient is consistent with a trend in declining species richness along this gradient. Mammals are a fairly sedentary group that would

not have responded by major dispersal or radiation away from adverse climate, and although data are weak, it is possible that the observed patterns reflect the effect of climatic filtering (*sensu* Balmford 1996) on mammal assemblages (Lawes et al.2000).

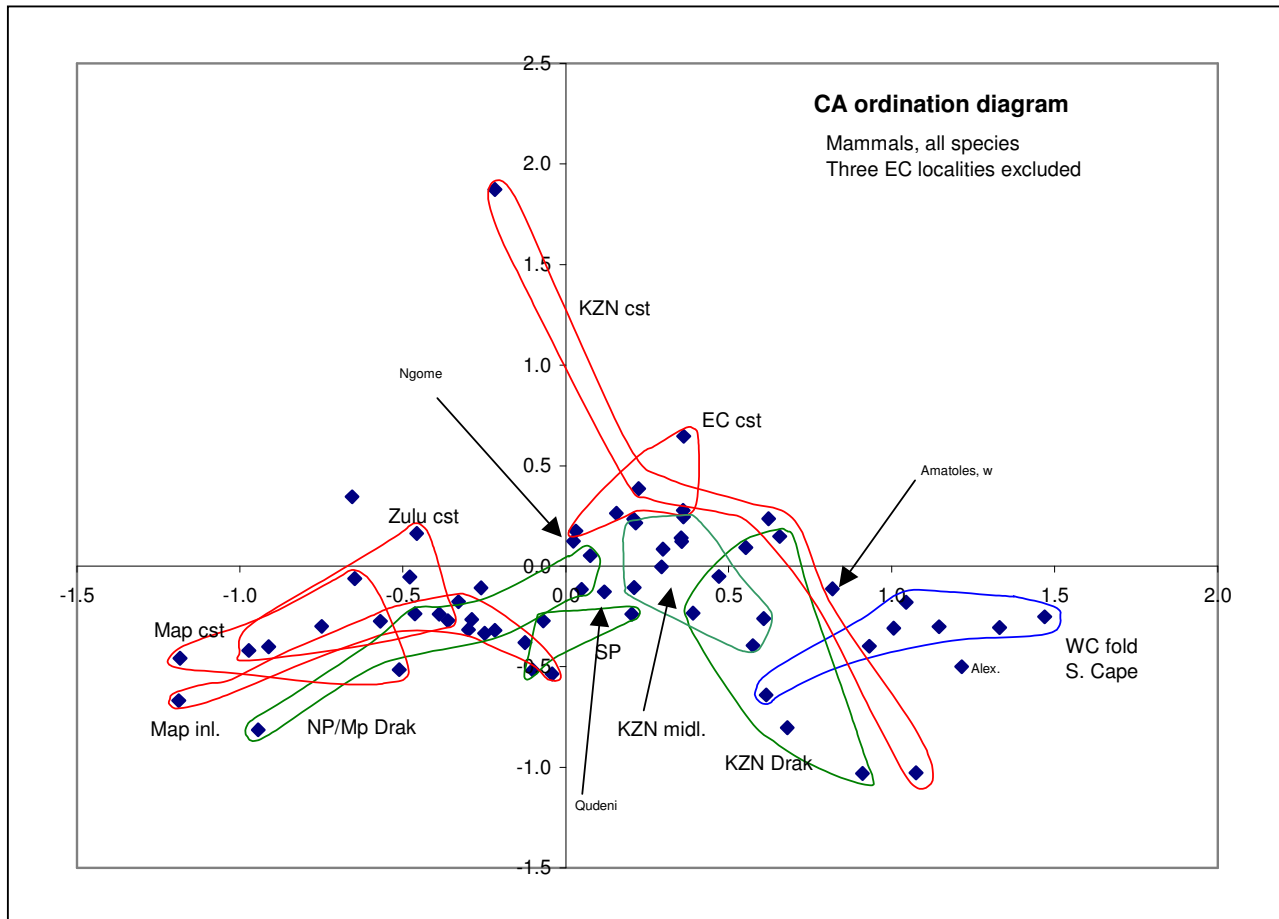


Figure 6.6 CA ordination of mammal species

6.5 Comparison with floral classification

Making a direct comparison with the floral classification is difficult and impractical because of the different scales at which the faunal and floral data were collected. The results of the animal classification are strongly influenced by the level of sampling within each quarter-degree cell. The absence of a species from a cell is more likely a reflection of poor sampling than the animal's absence from the area (i.e. an error of omission). The azonal forest types, whose distribution is determined by specific topographic or microclimatic conditions (sand, swamp, riverine, mangrove forests), were not considered for comparison because their fauna would not be accurately represented at the quarter-degree cell scale. Most of the discussion centers on the broad forest groups although, where possible, comparisons are made with forest types.

6.5.1 Southern Afrotemperate group

The bird classification shows a major inland-coastal dichotomy. Within the inland forest grouping, the Western Cape Afrotemperate forests separate clearly from all other forests. Unlike the floral classification, the Southern Cape Afrotemperate Forests group shows affinities with the Amatoles, Albany forests and the inland mistbelt forests of the KZN midlands, Mpumalanga and

Magoebaskloof. Not surprisingly, for frogs the Western Cape Afrotemperate regions were distinctly different from all other regions. Several endemic frog species were distributed in the mountains of the Western Cape. For the Southern Cape Afrotemperate Forests, frogs show a pattern not unlike that obtained for birds and were grouped with the Amatoles, KZN scarp forests, Mpumalanga mistbelt and Magoebaskloof. Following the floral classification, the Western Cape and Southern Cape Afrotemperate Forests show close affinities for mammals and reptiles.

6.5.2 Northern Afrotemperate Group / Northern Mistbelt Group

The animal classification was unable to adequately resolve the Northern Afrotemperate Group and the Northern Mistbelt Group and will therefore be discussed as one. For birds, the KZN Drakensberg (Drakensberg Montane Forests) was separate from the mistbelt forests of Mpumalanga and Magoebaskloof. The Soutpansberg sites were outliers to this general clustering. At high altitude, the bird fauna of the KZN Drakensberg is a depauperate subset of the other inland mistbelt forests, hence its separation. The classification derived for birds deviates significantly from the floral classification in that the Southern Cape and Amatoles show a closer affinity to the Soutpansberg and Magoebaskloof (Northern Mistbelt Forests) and the Mpumalanga Mistbelt Forests. Clusters obtained for frogs and reptiles were in agreement with the floral classification by grouping the Drakensberg Montane Forests and some sites of the Northern KwaZulu-Natal Mistbelt Forests with the Mpumalanga Mistbelt Forests and the Northern Mistbelt Forests.

6.5.3 Southern Mistbelt Group

There was little agreement between patterns produced by birds, reptiles and frogs for the Southern Mistbelt floristic grouping. The classification produced by birds follows the floristic patterns by grouping the Amatole Mistbelt Forests with the Eastern Cape and KZN midlands forests (Eastern Mistbelt Forests). This group, however, also showed affinities with the Southern Cape forests and the Soutpansberg and Mpumalanga mistbelt. For frogs, the Eastern Cape and KZN midlands (Eastern Mistbelt Forests) produced a tight cluster but had closer affinities to the Eastern Cape and KZN coast than to the Amatoles. Similarly, for reptiles, the KZN midlands (mistbelt forests) showed a closer association with the KZN south coast (Pondoland Scarp Forests), the Zululand coast and Maputaland coastal plain than to the Eastern Cape midlands.

6.5.4 Scarp Group

The Eastern Scarp Forests were represented by four major forest sites; Qudeni, Ongoye, Nkandla and Ngome forests. Aside from Qudeni, the Eastern Scarp Forests form a tight cluster with the sites from the Eastern Cape coast (Transkei Coastal Platform Forests) and the KZN south coast (Pondoland Scarp Forests). The grouping shows close concordance with the floristic classification and is distinct from the Zululand coast and the Maputaland coastal plain. The pattern produced by the frog distributional data is less convincing. Ongoye forest forms a tight group with the Eastern Cape coastal sites (Transkei Coastal Platform Forests) that are linked with the KZN south (Pondoland Scarp Forests) and central coast. The Transkei Coastal Platform Forests and Pondoland Scarp Forests are more closely aligned with the Eastern Mistbelt Forests than with the other Eastern Scarp Forests (Nkandla, Qudeni). Nkandla and Qudeni, in turn, show closer affinities to the Amatoles, the Drakensberg Montane Forests and Mpumalanga Mistbelt. The reptile data for scarp forest sites are inconclusive and appear to show affinities with inland and coastal forests. Nkandla forest forms a group with the Pondoland Scarp Forests. Not surprisingly, Ongoye forest shows affinities with the Zululand coast. Qudeni forest clusters with midland and montane forests (Drakensberg Montane Forests, Eastern Mistbelt Forests, Northern Mistbelt Forests) while Ngome is loosely associated with Alexandria (Albany Forests), the Amatoles and the Eastern Cape midlands (Eastern Mistbelt Forests).

6.5.5 Northern Coastal Group

The Northern Coastal Group consisting of KwaZulu-Natal Coastal Forests and KwaZulu-Natal Dune Forests formed a consistent cluster in all floristic analyses. Likewise, for the animal taxa

used to classify forests, the two groups consistently grouped together. This might, in part, reflect a scale problem where coastal forests and dune forests fall within the same quarter-degree cell. For birds, the coastal sites separated clearly into a northern cluster (Maputaland coastal plain, Zululand coast) and a southern group consisting of sites from the Eastern Cape coast and KwaZulu-Natal south coast. Similarly, after removing the Western Cape outliers from the frog distribution data, Zululand coast and the Maputaland coastal plain separate out from all other sites. The reptile distributional data produced similar patterns for the Zululand coast and Maputaland coastal plain.

6.5.6 Southern Coastal Group

Animal distribution data was not gathered at an appropriate scale to reflect Eastern Cape Dune Forests or the Western Cape Milkwood Forests. A single site at Alexandria represented the Albany Coastal Forests. The site showed a close affinity to the Amatoles (birds, frogs) and the Eastern Cape midlands (reptiles).

7. FOREST GROUPS

I: Southern Afrotemperate Group

Preliminary Code: F I

Name: Southern Afrotemperate Forest Group

Synonyms: Knysna Forests (Acocks 1988); Southern Cape Forests (Phillipson & Russell 1988); Afrotemperate Forest p.p. (Low & Rebelo 1996); Knysna-Tsitsikamma Forests, Swellendam Area Forests, Cape Peninsula Forests & Southwestern Cape Forests (Bailey et al. 1999)

Profile: These are tall-grown, multi-layered afrotemperate forests dominated by *Podocarpus falcatus*, *P. latifolius*, *Ocotea bullata*, *Olea capensis* subsp. *macrocarpa*, *Pterocelastrus tricuspidatus*, *Platylophus trifoliatus*, *Nuxia floribunda*, *Gonioma kamassi*, *Cassine peragua* and *Canthium inerme*, in scree habitats by *Heeria argentea*, *Rapanea melanophloeos* and *Podocarpus elongatus*, and in riverine situations by *Cunonia capensis*, *Metrosideros angustifolia* and *Podocarpus elongatus*. Shrub understorey (*Trichocladus crinitus*, *Burchellia bubalina*, *Cyathea capensis*) and herb layer (*Oplismenus hirtellus*, *Dietes iridioides*, *Blechnum capense*, *B. tabulare*, *Rumohra adiantiformis*) are well-developed especially in mesic habitats.

Floristically Southern Afrotemperate Forests are species-poorer than the forests of the mistbelt groups (FIII & FIV), but they still support some woody (paleo)endemic elements such as *Platycarpus trifoliatus*, *Metrosideros angustifolia*, *Heeria argentea*, *Podocarpus elongatus*, *Cassine schinoides* and *Cryptocarya angustifolia*.

Generally surrounded by fynbos vegetation the Southern Afrotemperate forests occur on quartzitic sandstone and shale derived soils. Their distribution is related to a combination of factors, including soil nutrient status, rockiness, soil moisture and fire. They are usually found on slope-feet, plateaus (Knysna-Tsitsikamma region), in kloofs (gorges), where they are protected from fire or on south-facing, steep slopes of river catchments. Sometimes they are found on boulder scree - a habitat serving well as fire-protected refugium.

The largest complex is found in the Southern Cape along the narrow (250 km long) coastal strip between Humansdorp in the east and Mossel Bay (Knysna-Tsitsikamma forest region). The easternmost outlier forest patches occur near Port Elizabeth (Loeriebos), while westwards floristically impoverished forms of this forest occur along feet of south-facing and east-facing slopes and in deep kloofs and ravines of the Cape Folded Mountains as far as Cape Peninsula and Matsikamma Mts.

Geology & Soils: Soils varying from shallow (and skeletal) Mispah, Glenrosa and Houwhoek forms to sandy humic Fernood form (in alluvial situations), derived from Table Mountain Sandstone, shale bands and partly also Cape Granite

Important Species (all d): *Podocarpus falcatus*, *P. latifolius*, *Podocarpus elongatus*, *Cassine peragua*, *Canthium inerme*, *Cunonia capensis*, *Gonioma kamassi*, *Heeria argentea*, *Metrosideros angustifolia*, *Ocotea bullata*, *Olea capensis* subsp. *macrocarpa*, *Nuxia floribunda*, *Platylophus trifoliatus*, *Pterocelastrus tricuspidatus*, *Rapanea melanophloeos*, *Trichocladus crinitus*, *Burchellia bubalina*, *Cyathea capensis*, *Oplismenus hirtellus*, *Dietes iridioides*, *Blechnum capense*, *B. tabulare*, *Rumohra adiantiformis*

Endemic Species: *Heeria argentea* (d), *Podocarpus elongatus* (d), *Platycarpus trifoliatus* (d), *Cassine schinoides*, *Cryptocarya angustifolia*, *Metrosideros angustifolia*, *Virgilia oroboides* subsp. *ferruginea*, *Strelitzia alba*, *Clivia mirabilis*, *Schoenoxiphium album*, *Amauropelta knysnaensis*, *Polystichum incongruum*, *Breutelia elliptica* (moss), *B. tabularis* (moss), *Distichophyllum mniifolium* (moss), *Fissidens fasciculatus* (moss), *Macromitrium macropelma* (moss), *Ulota ecklonii* (moss), *Wardia hygrometrica* (moss), *Zygodon leptobolax* (moss)

Key References: Von Breitenbach (1974), Campbell & Moll (1977), McKenzie et al. (1977), McKenzie (1978), Geldenhuys (1982, 1989, 1992, 1993a, b, 1994), Scriba (1984), Masson & McKenzie (1989), Masson (1990), Vermeulen (1995), Taylor (1996)

II: Northern Afrotemperate Group

Preliminary Code: F II

Name: Northern Afrotemperate Forest Group

Synonyms: Mountain *Podocarpus* Forest (Edwards 1967); Kloof Forest (Coetzee 1974); Afromontane *Podocarpus* Forest (Cooper 1985); Highland Sourveld p.p. (Acocks 1988); Montane *Podocarpus* Forests (Everard 1992)

Profile: This group comprises species-poor, low-grown forests of afromontane origin (and especially Drakensberg and Low Escarpment in part also in Waterberg of extant afromontane character). The Drakensberg and Low Escarpment forests are dominated by *Podocarpus latifolius*, *P. falcatus*, *Halleria lucida*, *Olinia emarginata* and *Scolopia mundii* while in dry kloofs of the northern Highveld *Pittosporum viridiflorum*, *Combretum erythrophyllum* and *Celtis africana* are the structural determinants. At high altitudes of the Waterberg relictual forests dominated by *Podocarpus latifolius* and *Widdringtonia nodiflora* are found. These forests are found as small-sized patches in deep fire-sheltered kloofs or on steep scarps just below the ridges, at altitudes spanning 1500-1900 m.

These forests are restricted to mountains and low ridges (Strydpoortberg, Waterberg, Pilanesberg, Witwatersrand, Magaliesberg, Suikerbosrand, Sekhkukhuneland) interrupting the relatively flat northern Highveld. The unit also comprises forests found in kloofs on the northern and eastern flanks of the Drakensberg and those found on the slopes and scarps of the Low Escarpment between Van Rheeën Pass and Pongola Bush near Piet Rertief. The westernmost localities of these forests are found on the Koranaberg (close to Thaba Nchu); the remnants of the afromontane forest in southern Lesotho might belong to this vegetation unit as well.

Geology & Soils: Shallow acidic soils over sandstones (Clarens Sandstone, Sandrivierberg Sandstone), quartzites and rarely also volcanic rocks of the Ventersdorp System and intrusive diabases of Pretoria Igneous Complex

Important Species: *Podocarpus elongatus* (d), *P. falcatus* (d), *Rothmannia capensis* (d), *Scolopia mundii* (d), *Widdringtonia nodiflora* (d), *Celtis africana* (d), *Combretum erythrophyllum* (d), *Halleria lucida* (d), *Ilex mitis* (d), *Maytenus undata* (d), *Olea europaea* subsp. *africana* (d), *Olinia emarginata* (d), *Pittosporum viridiflorum* (d), *Xymalos monospora* (d), *Acalypha glabrata* (d), *Buddleja salviifolia* (d), *Calpurnia aurea* (d), *Diospyros lycioides* (d), *D. whyteana* (d), *Euclea crispa* subsp. *crispa* (d), *Myrsine africana* (d), *Rhus lancea* (d), *Leucosidea sericea*, *Bowkeria ciliata*, *Canthium ciliatum*, *Dais cotinifolia*, *Cliffortia nitidula*, *Greya sutherlandii*, *Cassinopsis ilicifolia* (d), *Isoglossa grantii* (d), *Plectranthus fruticosus* (d), *Steprocarpus pusillus*, *S. haygarthii*, *Peperomia retusa*, *Blechnum attenuatum* (d), *Asplenium aethiopicum*, *Carex spicato-paniculata* (d), *Oplismenus hirtellus* (d), *Thamnocalamus tessellatus*

Endemic Species: *Scolopia flanagani*, *S. oreophila*, *Weisiopsis pulcheretis* (moss)

Key References: Schelpe (1943), Roberts (1961), Van Vuuren (1961), Killick (1963), Van Vuuren & Van der Schijff (1970), Coetzee (1974, 1975), Bredenkamp & Theron (1978, 1980), Van der Meulen (1979), Westfall (1981), Cooper (1985), Westfall et al. (1985), Everard (1986), Behr & Bredenkamp (1988), Du Preez & Bredenkamp (1991), Du Preez et al. (1991), Smit et al. (1993), Hill (1996), Eckhardt et al. (1997), Robesson (1999), Ellery et al. (2001), Siebert (2001), Van Staden (2002)

III: Northern Mistbelt Group

Preliminary Code: F III

Name: Northern Mistbelt Forest Group

Synonyms: Soutpansberg Forests & Transvaal Drakensberg Escarpment Forests (Cooper 1985); Transvaal Forests (Phillipson & Russell 1988); Afromontane Forest p.p. (Low & Rebelo 1998)

Profile: These are tall-grown, evergreen Afrotropical forests occurring primarily in east facing fire-protected refugia such as sub-ridge scarps and moist sheltered kloofs where they form small-sized, very fragmented patches. The most common canopy trees include *Xymalos monospora*, *Podocarpus latifolius*, *Combretum kraussii*, *Cryptocarya liebertiana*, *Curtisia dentata*, *Rhus chirindensis*, *Schefflera umbellifera*, *Syzygium gerrardii*, *Acacia ataxacantha*, *Albizia adianthifolia*, *Olea capensis* subsp. *macrocarpa*, *Rothmannia capensis*. In the understory endemic *Psychotria zombamontana*, *P. capensis*, *Psydrax obovata* subsp. *elliptica*, *Pterocelastrus echinatus*, *Canthium kuntzeanum*, *Englerophytum magalismsontanum*, *Peddiea africana*, *Pavetta kotzei*, *Macaya bella*, *Sclerochiton harveyanus* and many others are found. Herb layer is dominated by *Acanthaceae*, *Lamiaceae* (*Plectranthus*, *Stachys*), *Rubiaceae* (*Galopina*), geophytic herbs (*Aristea*, *Clivia*, *Dietes*) and ferns. Lianas and climbers (*Dalbergia armata*, *Cryptocarya transvaalensis*, *Keetia gueinzii*) are very common too. Scandent grass *Prosphytochloa prehensis* is a typical feature of these forests.

The distribution area of Northern Mistbelt Forests spans Blouberg, Soutpansberg and North Eastern Escarpment (Limpopo Province), as well as forests of Mariepskop (Mpumalanga Escarpment) and Barberton regions.

These forests border on sourveld grasslands at their upper boundary, while their low-altitude limits coincide with borders of bushveld. These mistbelt forests are typically species rich, containing a mixture of afrotropical elements and species of subtropical provenience, indicating a floristic (and possibly also biogeographic-evolutionary) link of these forests to the Scarp Forest Group. This phenomenon becomes obvious especially in the Barberton region.

Many indigenous mistbelt forests have been replaced by commercial pine and gum tree plantations.

Geology & Soils: highly weathered, high-clay fraction soils mainly Avalon and Hutton soil forms), derived from shales (Pretoria Group), quartzite (Black Reef), dolomite (Chuniespoort), granite (Nelspruit Basement) and diabase (Transvaal)

Climate: important climatic trait is high incidence of mist precipitating from ascending moisture-laden air masses from the adjacent Lowveld

Important Species: *Xymalos monospora* (d), *Podocarpus latifolius* (d), *Brachylaena discolor* var. *transvaalensis* (d), *Combretum kraussii* (d), *Curtisia dentata* (d), *Drypetes arguta* (d), *D. gerrardii* (d), *Kiggelaria africana* (d), *Ocotea kenyensis* (d), *Schefflera umbellifera* (d), *Syzygium gerrardii* (d), *Acacia ataxacantha* (d), *Albizia adianthifolia* (d), *Olea capensis* subsp. *macrocarpa* (d); *Chionanthus battiscombei*, *C. foveolatus* subsp. *major*, *Faurea galpinii*, *Ochna arborea* subsp. *oconnorii*, *Psydrax obovata* subsp. *elliptica* (d), *Oxyacanthus speciosus* subsp. *gerrardii* (d), *Pterocelastrus echinatus*, *Canthium kuntzeanum*, *Englerophytum magalismsontanum*, *Peddiea africana*, *Macaya bella*, *Sclerochiton harveyanus*, *Tarenna zimbabwensis*, *Ensete ventricosum*, *Cryptocarya transvaalensis* (d), *Keetia gueinzii* (d), *Dalbergia armata*, *Duvernoia adhatodoides*, *Oplismenus hirtellus* (d), *Prosphytochloa prehensis* (d), *Begonia sonderiana*, *Clivia miniata*, *Asplenium aethiopicum*, *A. boltonii*, *A. splendens*, *Elaphoglossum conforme*, *Polystichum macleae*, *Thelypteris madagascariensis*

Endemic Species: *Cryptocarya liebertiana* (d), *Pavetta kotzei* (d), *Psychotria zombamontana* (d), *Dombeya pulchra*, *Rhus magalismontana* subsp. *coddii*, *Plectranthus swynnertonii*, *Clivia caulescens* (d), *Crocasmia aurea*, *Streptocarpus wilmisii*, *S. fenestra-dei*, *Hymenophyllum capillare*, *Dicranoloma entabeniense* (moss)

Key References: Van der Schijff & Schoonraad (1971), Scheepers (1978), Cooper et al. (1989), Deall et al. (1989), Von Breitenbach (1990), Matthews et al. (1992), Geldenhuys & Murray (1993), Geldenhuys & Pieterse (1993), Morgenthal & Cilliers (1999), Stalmans et al. (1999), Geldenhuys & Venter (2002)

IV: Southern Mistbelt Group

Preliminary Code: F IV

Name: Southern Mistbelt Forest Group

Synonyms: Mist Belt Mixed *Podocarpus* Forests (Edwards 1967); Transkei and Natal Montane Forests p.p. & Eastern Cape Montane Forests (Phillipson & Russell 1988); High Altitude Afrotperate Forests, Middle Altitude Afrotperate Forests, Mistbelt Afrotperate Forests, Moist Afrotperate Forests (Cawe 1996); Afromontane Forests p.p. (Low & Rebelo 1998); Amatole Forests Complex (Bailey et al. 1999)

Profile: These forests comprise forest patches varying in size located along the Main Escarpment encompassing large areas spanning the surroundings of Sommerset East, Amatole Mts., scarps of Transkei and KwaZulu-Natal Midlands as far east as Ulundi. Here they occur in fire-shadow habitats on south-facing and southeast-facing slopes at altitudes of between 850-1600m. In KwaZulu-Natal these forest are found in a wide band sandwiched between the Drakensberg Montane Forests and Northern KwaZulu Natal Mistbelt Forests at higher altitudes and Eastern Scarp Forests at lower altitudes. Belts of forest patches belonging to this forest group are spanning some forest patches found in the Baviaanskloof Mts., Zuurberg, from the surroundings of Grahamstown towards King William's Town. A group of afrotperate forest found on slopes of deeply incised valleys in the hinterland of the Transkei Coast was classified within this forest group as well. All of those are confined to the territory of the Eastern Cape.

On the Main Escarpment (Amatole, Transkei-Escarpment and KwaZulu-Natal Midlands) these forests are tall grown (15–20 m tall), multi-layered (having two layers of trees, a dense shrubby understorey and a very well developed herb layer). The forests of low-lying scarps are low grown (in places having the character of scrub forest), and although less structured into different tree layers, they are still very species-rich. The tall-grown forests show a mix of coarse grain, canopy gap/disturbance driven dynamics and fine-grained, regeneration characteristics. The Amatole mistbelt forests are dominated by emergent trees of *Podocarpus falcatus* and a range of deciduous and semi-deciduous species, such as *Celtis africana*, *Calodendrum capense*, *Vepris lanceolata* and *Zanthoxylum davyi*. Further east (Transkei, KwaZulu-Natal Midlands) *Podocarpus henkelii* becomes prominent in the canopy layer. Deciduous trees play an important structural role here as well.

Geology & Soils: some of the soils are well-developed, deep, loamy and with high nutrient status - developed on weathered dolerite intrusions or mudstones, shales and sandstones of Balfour Formation (on Main Escarpment); the soils supporting forests of low-lying scarps are shallower as they developed on Witteberg quartzitic sandstones or various rocks of Karoo sequence geology

Climate: incidence of heavy summer mist is a most striking climatic characteristic of these forests

Important Species: *Podocarpus latifolius* (d), *Podocarpus henkelii* (d), *Podocarpus falcatus* (d), *Protorhus longifolia* (d), *Apodytes dimidiata* (d), *Celtis africana* (d), *Chionanthus foveolatus* (d), *C. peglerae* (d), *Cunonia capensis* (d), *Curtisia dentata* (d), *Olea capensis* subsp. *macrocarpa* (d), *Rapanea melanophloeos* (d), *Rhus chirindensis* (d), *Scolopia mundii* (d), *S. zeyheri* (d), *Vepris lanceolata* (d), *Xymalos monospora* (d) *Calodendrum capense*, *Combretum kraussii*, *Diospyros whyteana*, *Elaeodendron croceum*, *E. zeyheri*, *Halleria lucida*, *Kiggelaria africana*, *Maesa alnifolia*, *Mimusops obovata*, *Mystroxydon aethiopicum*, *Ochna arborea* subsp. *arborea*, *Ocotea bullata*, *Pleurostyliya capensis*, *Psydrax obovata*, *Rinorea angustifolia*, *Zanthoxylum davyi*, *Burchellia bubalina* (d), *Canthium ciliatum* (d), *C. inerme* (d), *Clausena anisata* (d), *Eugenia capensis* (d) *Ptaeroxylon obliquum* (d), *Trimeria grandifolia* (d), *Azima tetraacantha* (d), *Carissa bispinosa* subsp. *zambesiaca* (d), *Gymnosporia buxifolia* (d), *Maerua racemosa* (d), *Ochna serrulata* (d), *Grewia occidentalis* (d), *Scutia myrtina* (d), *Trichocladus ellipticus* (d), *Allophylus dregeanus*,

Hyperacanthus amoenus, *Hypoestes aristata* (d), *Isoglossa woodii* (d) *Dietes iridioides* (d),
Oplismenus hirtellus (d), *Dryopteris inequalis* (d), *Polystichum pungens* (d)

Endemic Species: *Eugenia zuluensis* (d) *Cassipourea flanaganii* (d), *Diospyros scabrida* var.
cordata, *Plectranthus elegantulus*, *Bartramia compacta* var. *macowaniana* (moss), *Orthotrichum*
armatum (moss)

Key References: Story (1952), Edwards (1967), Moll (1967), Cooper (1985), Phillipson (1987),
Everard (1992), Geldenhuys (1992), Everard & Hardy (1993), Geldenhuys (1993), Everard et al.
(1995), Cawe (1996), Geldenhuys & Rathogwa (1997), Low & Rebelo (1998)

V: Scarp Group

Preliminary Code: F V

Name: Scarp Forest Group

Synonyms: Semi-Coast Forest (Edwards 1967); Tongaland-Pondoland Undifferentiated Forest p.p. (White 1983); Coast Scarp Forest (Cooper 1985); Pondoland Coastal Plateau Sourveld p.p. & Transitional Coastal Forest (Acocks 1988); Natal and Transkei Coastal Forests p.p. (Phillipson & Russell 1988); Ngoye Group Forests p.p. (MacDevette et al. 1989); Pondoland Coast Forest & South Coast Forest (Cooper & Swart 1992); Moist Subtropical Forest (Cawe 1996); Coastal Forest p.p. (Low & Rebelo 1998)

Profile: The forests of the Scarp Group are tall-grown (15-25 m) and species-rich, found mainly on sandstone outcrops (Msikaba Group in Pondoland), syenitic granite and rhyolite. Their occurrence is often associated with coastal gorges, krantzies, scarps or coastal platforms. These forests are structurally diverse (multi-layered), usually with an obviously well-developed canopy and understorey tree layers, but a poorly developed herb layer. Buttressed stems are a common sight in the Scarp Forests. The most conspicuous tree-species are *Drypetes gerrardii*, *Milletia grandis*, *M. sutherlandii*, *Orcia bachmannii*, *Rinorea angustifolia*, *Rothmannia globosa*, *Buxus macowanii*, *B. natalensis*, *Memecylon natalense*, *Englerophytum natalense*, *Harpephyllum caffrum*, *Heywoodia lucens* and *Umtiza listeriana*.

They form an archipelago of scattered patches (some of them large, such as Ongoye) spanning southern Mpumalanga (Crocodile River Gorge), southern part of Lebombo Mountains, Zululand, Pondoland and reaching nearly as far as Kei River Mouth on the Transkei coast. Patches of this forest lie as far as 140 km inland (Mpumalanga), but get increasingly closer to the sea in a southwards direction - in Pondoland and southern Transkei they lie at the coast or in deep gorges in close vicinity of it.

Biogeographically (and from the point of view of biodiversity) this is probably the most valuable forest in South Africa housing many endemic species; 6 endemic genera and one endemic family (*Rhynchocalycaceae*) of trees. The endemism in the herbaceous understorey is also high, in particular in genera *Plectranthus* and *Streptocarpus*. The Pondoland Scarp Forest forms the core of the Pondoland Centre of Endemism as defined by Van Wyk & Smith (2001).

Geology & Soils: Sandstone outcrops (Msikaba Group in Pondoland), syenitic granite and rhyolite

Important Species: *Drypetes gerrardii* (d), *Rinorea angustifolia* (d), *Rothmannia globosa* (d), *Buxus macowanii* (d), *Harpephyllum caffrum* (d), *Heywoodia lucens* (d), *Commiphora harveyi*, *C. woodii*, *Drypetes arguta*, *Eugenia natalitia*, *Nectaropetalum capense*, *Nuxia congesta*, *Ochna natalitia*, *Olinia ventosa*, *Ptaeroxylon obliquum*, *Pterocelastrus tricuspis*, *Strychnos henningsii*, *S. mitis*, *Piper capense*, *Thunbergia alata*, *Begonia dregei*, *B. homonyma*, *Flagellaria guineensis*

Endemic Species: *Milletia grandis* (d), *M. sutherlandii* (d), *Orcia bachmannii* (d), *Umtiza listeriana* (d), *Buxus natalensis* (d), *Memecylon natalense* (d), *Englerophytum natalense* (d), *Alberta magna*, *Apodytes abbotii*, *Canthium vanwykii*, *Cavacoa aurea*, *Celtis mildbraedii*, *Colubrina nicholsonii*, *Cryptocarya wylei*, *C. myrtifolia*, *Dahlgrenodendron natalense*, *Jubeopsis caffra*, *Maytenus oleosa*, *Metarungia galpinii*, *Oxyanthus pyriformis*, *Pleudosclopia polyantha*, *Rinorea domatiosa*, *Rhynchocalyx lawsoniana* (representative of endemic family), *Encephalartos laevifolius*, *E. ngoyanus*, *E. villosus*, *E. woodii*, *Eugenia verdoorniae*, *E. simiii*, *Gerrardanthus tomentosus*, *Gymnosporia bachmannii*, *Podranea ricasoliana*, *Helixanthera woodii*, *Actinanthella wylei*, *Justicia bolusii*, *J. petiolaris* subsp. *bowiei*, *Plectranthus ernstii*, *P. hilliardiae*, *P. sscatus* var. *longitubus*, *Streptocarpus johannis*, *S. kentanensis*, *Asplenium chrisii*, *Bolusiella maudiae*, *Fissidens wageri* (moss).

For more comprehensive lists of edemic species consult Van Wyk & Smith (2001) and Mucina et al. (2002).

Key References: Huntley (1965), Nicholson (1982), Whateley & Porter (1983), Cooper (1985), Acocks (1988), MacDevette et al. (1989), Cawe (1990, 1996), Lawes (1990), Cooper & Swart (1992), Everard et al. (1995), Van Wyk & Smith (2001)

VI: Northern Coastal Group

Preliminary Code: F VI

Name: Northern Coastal Group

Synonyms: Coast Forest & Psammophilous Bush (Bews 1920); Coastal Dune Forest & Coast Lowland Forest (Edwards 1967); Dune Forest & Undifferentiated Lowland Forest (Moll & White 1978); Tongaland-Pondoland Undifferentiated Forest p.p. (White 1983); Typical Coastal-belt Forest (Acocks 1988); Typical Coast Lowland Forest (Bartholomew 1989); Mozambique Coastal Plain Forest (MacDevette et al. 1989); Dune Forest (Cooper & Swart 1992)

Profile: These are species-rich, tall/middle grown subtropical coastal forests occurring on coastal (rolling) plains built by geologically young sediments of Indian Ocean seaboard of KwaZulu-Natal as well as on accompanied cordons of stabilized coastal dunes. They are particularly well-developed on deep sandy soils of Maputaland. Beyond South Africa they might be encountered throughout the Mozambican coastal plain as far as southern Tanzania.

Forests of the coastal (rolling) plains are dominated by *Drypetes natalensis*, *Englerophytum natalense*, *Albizia adianthifolia*, *Diospyros inhacaensis*, *Acokanthera oblongifolia*, *Trichilia emetica*, *Buxus natalensis*, *Chrysophyllum viridiflorum* and *Celtis gomphophylla*. The low-tree and shrubby understoreys are species rich and comprise *Drypetes reticulata*, *Cola natalensis*, *Deinbollia oblongifolia*, *Dovyalis rhamnoides*, *Hyperacanthus amoenus*, *Peddiaea africana*, *Tapura fischeri*, *Turraea floribunda*, *Xylothea kraussiana* and many other shrubs of (sub)tropical provenience. On dunes, these forests have well-developed tree, shrub and herb layers. The tree canopy is composed of *Mimusops caffra*, *Sideroxylon inerme*, *Dovyalis longispina*, *Acacia karroo* ("kosibaaiensis") and *Psydrax obovata* subsp. *obovata*. In the understorey one finds *Brachylaena discolor* var. *discolor*, *Chrysanthemoides monilifera* subsp. *rotundata*, *Carissa bispinosa* subsp. *bispinosa*, *Euclea natalensis*, *E. racemosa*, *Eugenia capensis*, *Gymnosporia nemorosa*, *Kraussia floribunda*, *Peddiaea africana*, *Strelitzia nicolai* and *Dracaena alectriformis*. The herb layer (poorly developed in southern parts of the distribution area) is dominated by tall herbs such as *Isoglossa woodii* and *Asystasia gangetica*, fern *Microsorium scolopendrium*, and by graminoids *Oplismenus hirtellus* and *Cyperus albostrigatus*. Vines and climbers (*Acacia kraussiana*, *Artabotrys monteiroae*, *Dalbergia armata*, *Landolfia kirkii*, *Monanthes caffra*, *Rhoicissus tomentosa*, *Rhus nebulosa*, *Scutia myrtina*, *Uvaria caffra*, *Gloriosa superba*) are important structural determinants in these forests.

No endemic trees can be scored for this forest group within borders of South African distribution of these forest, however many tropical species reach their southern distribution here.

Geology & Soils: Marine sediments of Holocene age (around 10-15.000 yrs old), supporting deep sandy soils.

Important Species: *Albizia adianthifolia* (d), *Mimusops caffra* (d), *Sideroxylon inerme* (d), *Drypetes natalensis* (d), *Dovyalis longispina* (d), *Acacia karroo* ("kosibaaiensis") (d), *Diospyros inhacaensis* (d), *Buxus natalensis* (d), *Celtis gomphophylla* (d), *Chrysophyllum viridiflorum* (d), *Englerophytum natalense* (d), *Psydrax obovata* subsp. *obovata* (d), *Inhambanella henriquesii*, *Manilkara concolor*, *Trichilia emetica*, *Brachylaena discolor* var. *discolor* (d), *Cavacoa aurea* (d), *Coffea racemosa* (d), *Dracaena alectriformis* (d), *Drypetes reticulata* (d), *Erythroxylon emarginatum* (d), *Eugenia capensis* (d), *Gymnosporia nemorosa* (d), *Kraussia floribunda* (d), *Peddiaea africana* (d), *Strychnos henningsii* (d), *Acokanthera oblongifolia*, *Carissa bispinosa* subsp. *bispinosa*, *Chrysanthemoides monilifera* subsp. *rotundata*, *Cola natalensis*, *Deinbollia oblongifolia*, *Dovyalis rhamnoides*, *Encephalartos ferox*, *Eppipiocarpa orientalis*, *Erythrococca berberidea*, *Euclea natalensis*, *Euclea racemosa*, *Haplocoelum gallense*, *Hyperacanthus amoenus*, *Pancovia goulungensis*, *Putterlickia verrucosa*, *Strelitzia nicolai*, *Strychnos decussata*, *Tapura fischeri*, *Teclea*

gerrardii, *Turraea floribunda*, *Xylotheca kraussiana*, *Acacia kraussiana* (d), *Rhoicissus tomentosa* (d), *Rhus nebulosa* (d), *Artabotrys monteiroae*, *Dalbergia armata*, *Landolfia kirkii*, *Monanthes caffra*, *Scutia myrtina*, *Uvaria caffra*, *Gloriosa superba*, *Achyranthes aspera* (d), *Asystasia gangetica* (d), *Isoglossa woodii* (d), *Laportea peduncularis* (d), *Cyperus albostriatus* (d), *Oplismenus hirtellus* (d), *Microsorium scolopendrium* (d)

Key References: Bews (1920), Breen (1971), Venter (1976), Weisser (1978, 1980, 1987), Ward (1983), MacDevette (1987, 1993), MacDevette et al. (1989), Cooper & Swart (1992), Weisser et al. (1992), Weisser & Cooper (1993), Lubbe (1996), Van Wyk et al. (1996), von Maltitz et al. (1996)

VII: Southern Coastal Group

Preliminary Code: F VII

Name: Southern Coastal Forest Group

Synonyms: Coastal Forest (Taylor 1961, Knight 1989); Coastal Dune Bush (Comins 1962); Alexandria Forest (Phillipson & Russell 1978); Alexandria Forest p.p. (Acocks 1988); Mature Dune Forests (Burns & Raal 1993); Coastal Forest p.p. (Low & Rebelo 1998)

Profile: This forest group comprises low/middle-grown subtropical forests on coastal dunes of Eastern Cape, forests covering undulating coastal plains S of Alexandria and occurring as far west as Van Stadens River canyon (W of Port Elizabeth). Some forests found at feet of deep river valleys in the Albany District surrounded by subtropical succulent thickets are classified within this group as well. The westernmost forest type of this group is the Western Cape Milkwood Forest found on stabilized coastal dunes and limestone outcrops in an interrupted belt along southern seaboards between Nature's Valley (Plettenberg Bay) and Llandudno (Cape Town). The dominating floral element is subtropical, although some afrotemperate elements occur in these forests as well. The tree layer is dominated by *Sideroxylon inerme*, *Mimusops caffra* and *Dovyalis rotundifolia* (on dunes) and *Celtis africana* (in coastal-plain and valley forests).

Geology & Soils: Generally well-drained sandy soils over sedimentary rocks of Alexandria and Nanaga Formations, loamy skeletal soils supported by Karoo sediments of various quality; deep, nutrient-rich sandy soils over aelinities or limestones of Bredasdorp Formation

Important Species: *Celtis africana* (d), *Sideroxylon inerme* (d), *Mimusops caffra* (d), *Dovyalis rotundifolia* (d), *Alophylus natalensis* (d), *Diospyros natalensis* (d), *Erythrina caffra* (d), *Nuxia congesta* (d), *Podocarpus falcatus* (d), *Rhus chirindensis* (d), *Vepris lanceolata* (d), *Brachylaena discolor* var. *discolor* (d), *Carissa bispinosa* subsp. *bispinosa* (d), *Dracaena alectrifomis* (d), *Euclea natalensis* (d), *Euclea racemosa* (d), *Ficus thonningii* (d), *Gymnosporia buxifolia* (d), *Hyperacanthus amoenus* (d), *Maytenus undata* (d), *Mystroxydon aethiopicum* (d), *Schotia latifolia* (d), *Strychnos decussata* (d), *Trichocladus ellipticus* (d), *Aloe ciliata*, *Atalaya capensis*, *Brachylaena ilicifolia*, *Deinbollia oblongifolia*, *Encephalarctos altensteinii*, *Euphorbia grandidens*, *Maytenus lucida*, *Olea exasperata*, *Phyllanthus heterophyllus*, *Rhus glauca*, *Behnia reticulata* (d), *Rhoicissus tomentosa* (d), *Cissampelos capensis*, *Cynanchum obtusifolium*, *Tecoma capensis*, *Euphorbia kraussiana* (d), *Hypoestes aristata* (d), *Isoglossa woodii* (d), *Laportea grossa* (d), *Oxalis pes-caprae* (d), *Sansevieria hyacinthoides* (d), *Cyperus albostriatus* (d), *Ehrharta erecta* (d), *Oplismenus hirtellus* (d)

Endemic Species: *Encephalarctos latifrons*, *Smelophyllum capense*, *Sterculia alexandri*

Key References: Taylor (1961), Phillipson & Russell (1978), Acocks (1988), Cowling et al. (1988), Lubke & Strong (1988), Knight (1989), Lubke & De Villiers (1991), Cooper & Swart (1992), Avis (1995)

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8. FOREST TYPES

I1: Western Cape Talus Forests

Synonyms

Oewerwoud	Van der Merwe (1966)
Dasbos	Van der Merwe (1966)
Rivierbos	Le Roux (1977)
Scree Forest	Hattingh et al. (1980)
Afromontane Forest p.p.	Low & Rebelo (1998)

Profile

Forest type endemic to Capensis, represented by small-sized patches of low-stature or middle-stature Afrotemperate forests, constrained either to riverine sediments in the upper-reaches of rivers (here dominated by *Brabejum stellatifolium*, *Cassine schinoides*, *Apodytes dimidiata*, *Metriosideros angustifolia*, *Cunonia capensis*, *Ilex mitis* and *Kiggelaria africana*) or on sandstone screes (here typically dominated by *Heeria argentea* or *Rapanea melanophloeos*).

Map

We do not have a map of forest patches, but they occur in the same general area as demarcated for the Western Cape Afrotemperate forests

Distribution

This is an endemic forest type to Capensis, occurring mainly in the Western Cape (Hottentots Holland, Dutoitskloof, Hexrivier, Jonhershoeck, Cedarberg Mts.; Van der Merwe 1962, 1966, Werger et al. 1972a, b, Campbell & Moll 1977, Moss & Metelkamp 1980, McDonald 1983, 1985, 1988, Van Wilgen & Kruger 1985, Taylor 1996, Sieben 2002). The northernmost patches of this forest occur on the northern scarp of the Matsikamma Mts. on the farm Waterval near Van Rhynsdorp (Van Jaarsveld 1982), at Van Rhynspass and in Oorlogskloof Canyon near Nieuwoudville (Rourke 2002). The latter is the only known patch of forest in the Northern Cape Province.

Known Forests

Assegaaibos (Jonkershoeck)	Oorlogskloof (Nieuwoudville)
Boegoe Kloof (Hottentots Holland)	Pakhuis Pass (Cedarberg)
Boesmanskloof (Hottentots Holland)	Riviersonderend Kloof (Hottentots Holland)
Dutoitskloof Mts. (complex of patches)	Taaiboskraal River Kloof (Cedarberg)
Fortyn-se-Kloof (Cedarberg)	Van Rhynspass (near Van Rhynsdorp)
Hexrivier Mts. (complex of patches)	Vogelgat (Kleinrivierberge Mts.)
Kliphuis River Kloof (Cedarberg)	Waterval (near Van Rhynsdorp)
Krakadouspoort (Cedarberg)	Wesselsgat (Hottentots Holland)
Lourensriver Kloof (Hottentots Holland)	Zachariashoeck (Paarl)

Vegetation Structure & Texture

Stand Structure

The Cape riverine forests (Afrikaans: oewerbosse) are usually dominated by *Metrosideros angustifolia*, *Brabejum stellatifolium*, *Cassine schinoides*, *Apodytes dimidiata*, *Cunonia capensis*, *Ilex mitis* and *Kiggelaria africana*. Throughout their distribution the height of the tree canopy does not vary much – it is of low-stature, 5-8 m tall (Taylor 1996, Sieben 2002). Shrubs are usually the same species as those dominating the tree canopy. *Apodytes dimidiata* and *Cassine schinoides* are especially common in the understorey. Sparse ground layer is characteristic of the type.

The Cape scree forests (Afrikaans: dasbosse) classified within this forest type are typically not more than 8 m tall. However, on more sheltered screes they may reach 20 m and here there is usually more than one tree stratum (Van der Merwe 1962, 1966, McDonald 1983, 1985, 1988, Werger et al. 1972a, b) dominated by *Rapanea melanophloeos*, *Ilex mitis*, *Olinia ventosa* and *Cassine schinoides*. The forest on dry, exposed screes have a single tree stratum usually dominated by *Heeria argentea* or rarely *Podocarpus elongatus* (especially in the northern parts of the distribution area of the Western Cape Talus Forests). The scree forests are easily recognizable at a distance as they usually form a broad band along the edges of the boulder screes.

The tree species of both scree and riverine forests are characterised by considerable seed protection and a high germination rate. Wind distribution and distribution by birds are the common dispersal strategies.

Diversity Patterns

Both scree and riverine forests have a species-poor tree canopy, however, the total number of species (incl. all strata) can be remarkably high. Some 27-33 species (on 50 sq.m) were recorded by Van Wilgen & Kruger (1985) in scree and riverine forests of the Zachariashoek catchment near Paarl. Many Cape endemics are found in this forest type.

Ecology

Altitude & Geomorphology

The Western Cape Talus Forests are confined to extreme topography such as narrow gullies and stream-banks of perennial watercourses in open kloofs or screes. These habitats are impervious to fire due to the wet habitat conditions, protective position and lack of built-up dry biomass (on screes) which would support fires.

They range in altitude from 400 m (some riverine forests found at the entrances to large mountain valleys) to about 1500 m (some screes).

Geology & Soil

In both scree and riverine Western Cape forests the substrate is well-drained, but possesses percolating water in the skeletal, well-aerated soils.

Because of their locality along high energy rivers the sediments supporting these forests are built of large boulders, stones and gravel. The origin of the soil skeleton is autochthonous – usually from the Table Mountain Sandstone (both Peninsula and Nardouw Series) or Cape Granite. Soils are poorly developed because of exposure to heavy rainfall in winter (see Sieben 2002 for account on hydrology of these habitats). Outside the direct influence of rainfall, sandy and sandy-humic alluvial soils (usually Fernwood form) with low litter cover develop (Van Wilgen & Kruger 1985, Taylor 1996).

The scree habitats supporting several communities of this Forest Type are comprised of large boulders (invariably Table Mountain Sandstone) and in some places are still mobile. The conglomerate lithosols (Glenrosa, Houwhoek forms) can have pockets of shallow sandy loams of weathered sandstone with minor podzolization.

Climate

These forests are limited to regions with pronounced seasonality, typical of Mediterranean climates – dry and hot summers, cooler (to colder) and wet winters. The rainfall may vary from 300 mm (Cederberg; Taylor 1996) in the driest regions to 1600 mm in wettest regions (Jonkershoek Mts., Hottentots Holland Mts.). In Swartboskloof (Jonkershoek) 50% of rain falls in May-August (McDonald 1983, 1985, 1988).

Local exposure (contrasting south-facing versus north-facing slopes) and the resulting differences in temperature regime and total sun exposure are reflected in the structure of scree forests – the tall forms of this forest type occur in sheltered habitats on south-facing slopes (Werger et al. 1972a, b, McDonald 1983, 1985, 1988)

Disturbance & Regeneration

The Western Cape Talus Forests are a disturbance-driven system, undergoing periodic (sometimes catastrophic) flooding (in riverine habitats) or slow but steady movement of scree. Mechanical disturbance of roots resulting from down-slope movement of the substrate and anoxic conditions in the riverine sediments, are the major stresses faced by these forests. Multi-stemming is frequent along forest margins. Because of the highly flammable surrounding vegetation (fynbos) the forest margins are regularly scorched. As the soil is not affected by the fires, the wet forest regenerates quickly.

Biogeographic Affinities

Western Cape Talus Forests and Western Cape Afrotropical Forests are sympatric – they co-occur in Capensis to a large extent. The former type is not found beyond the Breede River (*Podocarpus elongatus*) or Gouritz River (*Brabejum stellatifolium*, *Metrosideros angustifolia*), which serve as limits to the distribution of several diagnostic species. The talus type does not occur on the Cape Peninsula (Campbell & Moll 1977).

Riparian thickets such as *Brabejum-Rhus* Riverine Scrub, *Berzelia-Metrosideros* Tall Fynbos of Rocky Streams (Boucher 1978) or other types described by Sieben (2002) are floristically close to this forest type. The riparian thicket is a seral community of the riparian forests. The understorey of the forests contains many thicket elements.

Brabejum stellatifolium (Proteaceae) and *Cunonia capensis* (Cunoniaceae) are textbook examples of continental disjunction patterns of the evolutionary ancient Gondwanaland flora. *Brabejum stellatifolium* is the only South African representative of the otherwise Australian subfamily *Grevillioideae* (Rourke 1998) with still another monotypic genus found on Madagascar. *Cunonia capensis* is the only representative of the family *Cunoniaceae* with many more species of the same genus occurring as far east as New Caledonia in the Pacific Ocean. *Metrosideros angustifolia* is another example of a Cape-Australasian disjunction – it is the only African member of the *Myrtoideae* (Goldblatt & Manning 2000). *Cunonia* and *Platylophus* (monotypic genus of *Cunoniaceae* endemic to Capensis) as well as the Cape endemic genera *Heeria*, *Laurophyllus*, *Maurocena*, *Smellophyllum* and *Metrosideros* exemplify paleoendemic components of the depauperate tree flora that derived from a greater extent of forests in the early Cenozoic (Goldblatt & Manning 2000).

A biogeographically important example of a relictual endemic is *Clivia mirabilis*, only recently described (Rourke 2002) from the Oorlogskloof Nat. Res. (Nieuwoudville). This amaryllid is a possible representative of past Miocene/Pliocene distribution of dense (subtropical) forests that largely retreated during the recent climatic changes in the Quaternary (reference). All the other members of the genus are typically found in a narrow forest belt from the Soutpansberg in the north, to the Eastern Cape coast in the south. *Clivia* grows in Oorlogskloof with *Podocarpus elongatus*, *Maytenus oleoides*, *M. acuminata*, *Cassine schinoides*, *Halleria lucida*, *Phylica oleaefolia* and *Olea europaea* subsp. *africana*.

Communities/Subunits

I1a: Western Cape Riverine Forests

Oewerwoude
Oewergemeenskappe (galleria)
Brabejum stellatifolium Community

Van der Merwe (1962)
Van der Merwe (1966)
Werger et al. (1972a)

<i>Brabejum stellatifolium</i> -Gesellschaft	Werger et al. (1972b)
<i>Metrosideros angustifolia</i> scrub-forest association	Campbell & Moll (1976)
<i>Metrosideros angustifolia</i> Association	Campbell & Moll (1977)
Rivierbos	Le Roux (1977)
Oewer- en kloofgemeenskappe	Hattingh et al. (1980)
<i>Halleria elliptica</i> - <i>Brabejum stellatifolium</i> Short Forest	McDonald (1985, 1988)
<i>Restio gaudichaudianus</i> - <i>Metrosideros angustifolia</i> Closed Woodland Community	Van Wilgen & Kruger (1985)
<i>Olea europaea</i> subsp. <i>africana</i> - <i>Metrosideros angustifolia</i> Community	Taylor (1996)
<i>Pteridium aquilinum</i> - <i>Brabejum stellatifolium</i> Community	Taylor (1996)
<i>Pteridium aquilinum</i> - <i>Todea barbata</i> Community	Taylor (1996)
<i>Platylophus trifolius</i> Forest	Sieben (2002)
<i>Todea barbata</i> - <i>Diospyros whyteana</i> Forest	Sieben (2002)

I1b: Western Cape Scree Forests

Dasbosse of woude op talus	Van der Merwe (1966)
<i>Heeria argentea</i> Community	Werger et al. (1972a)
<i>Heeria argentea</i> -Gesellschaft	Werger et al. (1972b)
<i>Rapanea melanophloeos</i> Community	Werger et al. (1972a)
<i>Rapanea melanophloeos</i> -Gesellschaft	Werger et al. (1972b)
<i>Heeria argentea</i> scrub-forest association	Campbell & Moll (1976)
Scree Forest	Linder (1976)
* <i>Olea europaea</i> subsp. <i>africana</i> - <i>Myrsine africana</i> Community	Taylor (1996)
<i>Heeria argentea</i> association	Campbell & Moll (1977)
Dasbos	Le Roux (1977)
Scree Forest	Hattingh et al. (1980)
Forest community (typified by <i>Heeria argentea</i>)	Moss & Metelkamp (1980)
<i>Disopyros glabra</i> - <i>Rapanea melanophloeos</i> Tall Forest	McDonald (1985, 1988)
<i>Rapanea melanophloeos</i> - <i>Heeria argentea</i> Short Forest	McDonald (1985, 1988)
<i>Restio gaudichaudianus</i> - <i>Heeria argentea</i> Open Woodland Community	Van Wilgen & Kruger (1985)
<i>Heeria argentea</i> - <i>Olea europaea</i> subsp. <i>africana</i> Closed Woodland Community	Van Wilgen & Kruger (1985)

Dominant & Diagnostic Plant Species

Notes: * nomenclature according to Glen & Hardy (2000). D indicates differential species against other Forest Types within the Forest Group I. The data on Capensis endemism follow Goldblatt & Manning (2000).

L	S	D	Latin Name	Note
Tc	d	C	<i>Brabejum stellatifolium</i>	endemic gen. to Capensis
Tc	d		<i>Cunonia capensis</i>	
Tc	d	C	<i>Heeria argentea</i>	endemic gen. to Capensis
Tc	d	C	<i>Podocarpus elongatus</i>	endemic to Capensis
ST	d	C	<i>Brachylaena neriifolia</i>	endemic to Capensis
ST	d	D	<i>Metrosideros angustifolia</i>	endemic to Capensis
ST		C	<i>Cryptocarya angustifolia</i>	endemic to Capensis
S	d	D	<i>Rhus undulata</i>	
S			<i>Cassine schinoides</i>	endemic to Capensis
S		D	<i>Erica caffra</i>	
S		D	<i>Podalyria calyptrata</i>	endemic to Capensis
Ssuc		D	<i>Aloe perfoliata</i> *	endemic to Capensis
Cw			<i>Asparagus scandens</i>	endemic to Capensis
Cw			<i>Secamone alpini</i>	

H		D	<i>Chironia baccifera</i>	
H			<i>Knowltonia vesicatoria</i>	
Hf	d		<i>Blechnum capense</i>	
Hf	d		<i>Todea barbata</i>	
Hf		D	<i>Hymenophyllum peltatum</i>	
Hf		D	<i>Pteridium aquilinum</i>	
Hg		D	<i>Aristea major</i>	endemic to Capensis
Hg		C	<i>Clivia mirabilis</i>	endemic to Oorlogskloof (NC)
Hg			<i>Zantedeschia aethiopica</i>	
Gr	d	D	<i>Ischyrolepis subverticillata</i>	endemic to Capensis
Gr		D	<i>Calopsis paniculata</i>	
Gr		D	<i>Elegia capensis</i>	endemic to Capensis
G		D	<i>Ehrharta rehmannii</i>	endemic to Capensis
G		D	<i>Isolepis digitata</i>	endemic to Capensis
G		D	<i>Juncus lomatophyllum</i>	
G		D	<i>Pronium serratum</i>	subendemic fam. to Capensis
G			<i>Schoenoxiphium lanceum</i>	endemic to Capensis

Typical & Endemic Animals

We do not have specific data for this.

Conservation & Management

Use & Value

These forests fulfil an important ecosystem function in catchment run-off regulation and prevention of erosion. They are of moderate socio-economic value especially to tourism – they are popular hiking ways. Possible value in terms of harvesting of medicinal plants is probably high.

Conservation Status

Many of the patches of this Forest Type are protected within nature reserves managed by Western Cape Nature Conservation Service (Hottentots Holland N.R., Limietberg N.R., Cederberg Wilderness, Assegaaibos N.R. etc.) as well as Northern Cape Nature Conservation Service (Oorlogskloof N.R.).

The occurrence of many endemic species (exclusive to this Forest Type being *Cryptocarya angustifolia* and *Clivia mirabilis*) and many forest palaeoendemics are of eminent conservation (biodiversity) interest.

Main Threats

- ⇒ alien plant invasion (especially *Acacia mearnsii*);
- ⇒ fire is a threat associated with mismanagement of the surrounding fynbos, however location in steep kloofs renders them less vulnerable to fire than expected;
- ⇒ most of these forests occur in catchment areas and consequently have some form of protection; although as with the Western Cape Afrotropical forests, water abstraction may be a problem;
- ⇒ ecotourism can be a threat if people are not properly managed;
- ⇒ medicinal plant and bark harvesting is increasingly becoming a threat.

Other Management Considerations

- ⇒ ecotourism value of the Fynbos Biome;
- ⇒ at high altitude not affected by downstream water pollution – hence potential source of drinking water.

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I2: Western Cape Afrotemperate Forests

Synonyms

Undifferentiated Afromontane Forest p.p.	White (1983)
Southern Cape Forests p.p.	Phillipson & Russell (1988)
Afromontane Forest p.p.	Low & Rebelo (1998)
Cape Peninsula Forests	Bailey et al. (1999)
Southwestern Cape Forests	Bailey et al. (1999)
Swellendam Area Forests	Bailey et al. (1999)

Profile

Western Cape Afrotemperate Forests are generally small forest patches found in sheltered kloofs (gorges), south-facing slopes of river catchments and boulder scree where they are protected from fire. They generally occur on soils derived from quartzitic sandstone, but also from shale or granite, from the Baviaanskloof, Kammanassie and Swartberg Mts. (all southern Cape inland mountains), the Langeberg and Riviersonderend Mts. and the Cape Peninsula. The forests are generally surrounded by fynbos vegetation. Their distribution is related to a combination of factors, mainly protection from fire, but also rockiness, low soil nutrient status, and winter to all-year rainfall. The stands are generally low to high (5 – 18 m), depending on the amount of protection and substrate conditions. Various species can dominate the canopy, such as *Cassine peragua*, *C. schinoides*, *Cunonia capensis*, *Curtisia dentata*, *Ilex mitis*, *Kiggelaria africana*, *Olinia ventosa* and *Rapanea melanophloeos*, and the sub-canopy, such as *Halleria lucida*, *Maytenus acuminata* and *Diospyros whyteana*. The understorey is generally sparse with sedges (*Schoenoxiphium lanceum*), ferns and herbaceous vines (*Asparagus scandens*) in scattered clumps.

Map

Only a general area in which these forests are known to occur is mapped as we do not have detailed distribution maps for this forest type

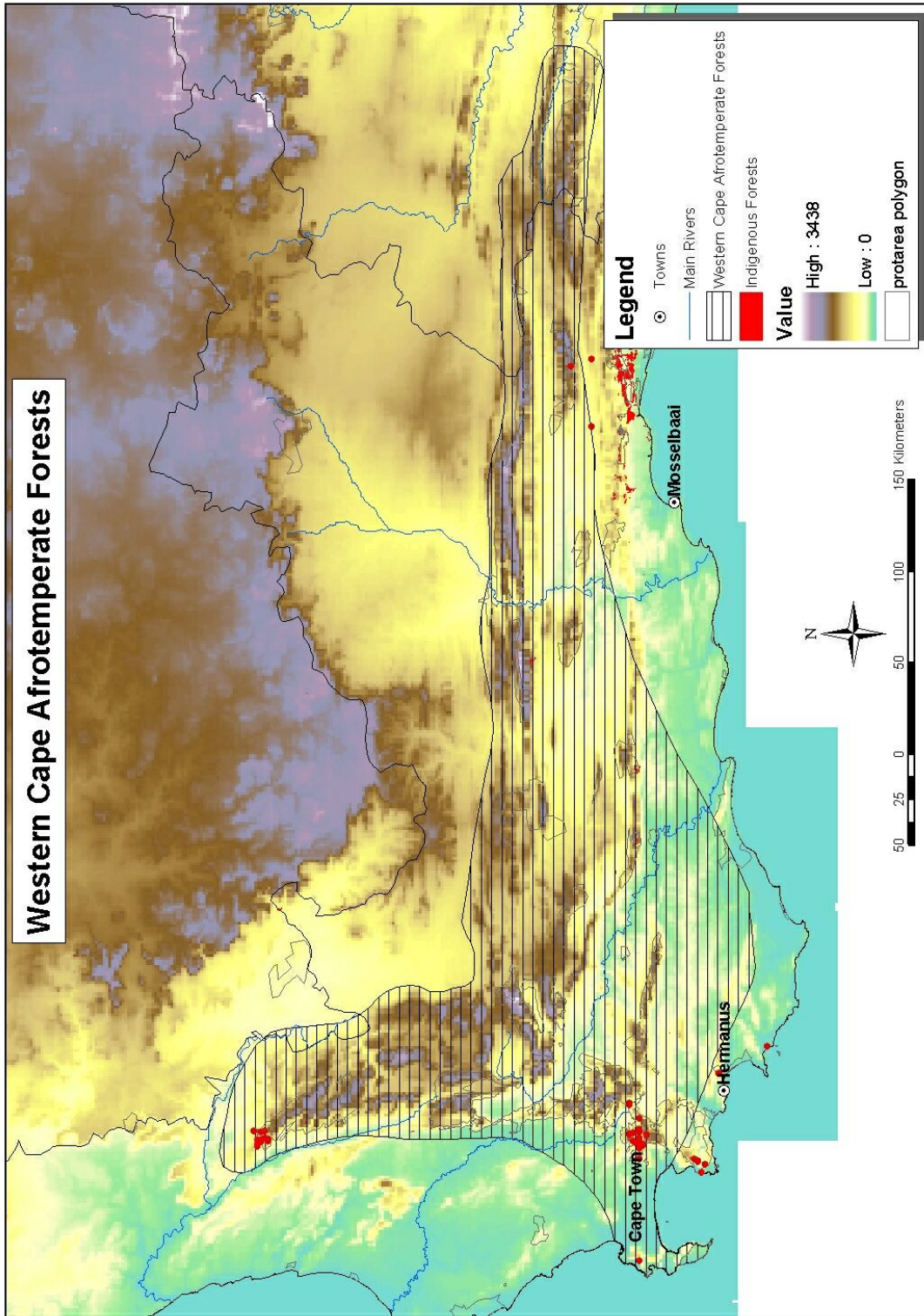
Distribution

This Forest Type is known only from the Western Cape and westernmost regions of the Eastern Cape, where it had been studied especially on the Cape Peninsula (Campbell & Moll 1976, 1977, McKenzie et al. 1977, Glyphis et al. 1978, Jeffery & Wilson 1987, Masson 1990, Masson & Moll 1987, Geldenhuys & Rathogwa 1995), Hottentots Holland (Werger et al. 1972a, b, McDonald 1983, 1985, 1988, Sieben 2002), Langeberge (Taylor 1955, McKenzie 1978, McDonald 1993a, b), Kogelberg (Boucher 1972, 1978, Botha 1992), Kleinrivierberge (de Lange 1992), and a number of other southwestern Cape mountains (McKenzie 1978). Further east these forests occur in the Rooiberg, Swartberg, Kammanassie, Kouga, and Baviaanskloof Mountains (Geldenhuys 1997).

Known Forests

Baviaanskloof Mts. (complex)	Koloniebosch (Langeberge)
Boosmansbos (Langeberge)	Kouga Mts. (complex near Joubertina)
Du Toit's Kloof (complex)	Limietberge (complex)
Grootvadersbosch (Langeberge)	Riviersonderend Mts. (complex)
Hottentots Holland Mts. (complex)	Rooiberg Mts. (complex near Calitzdorp)
Kammanassie Mt. (complex near Oudtshoorn)	Groot Swartberg Mts. (complex near Oudtshoorn)
Kleinberge Mts. (complex near Hermanus)	Swartboschkloof/Jonkershoek
Kogelberg complex (incl. Wynand Louwsbos, Platbos, Oudebos)	Table Mountain complex (incl. Kirstenbosch, Newlands, Noordhoek, Orange Kloof)

Map



Vegetation Structure & Texture

Stand Structure

Stand structures vary, depending on the exposure and substrate conditions. In sheltered sites (such as Grootvadersbosch on shale, Boosmansbos, Newlands on granite and parts of Orangekloof) the stands are tall (15 – 22 m) with well-developed strata and long, straight stems. In exposed and rocky sites (such as Oubos in Riviersonderend Mts., Donkerkloof in Du Toit's Kloof on boulder scree, and upper parts of Orangekloof forest, Spes Bona forest in Silvermine area), the forest stature is low with closely interlocked crowns, crooked multi-stem trees, often with a sparse understorey (shrubs, herbs, vines and ferns in scattered clumps). The standing stock of trees μ 10 cm DBH in the Orangekloof long-term plot is 1770 stems/ha (8,8% μ 30 cm DBH) and 56,3 m²/ha (30% μ 30 cm DBH), with a mean stem diameter of 18,6 cm DBH (Geldenhuys & Rathogwa 1995). Newlands forest has a mean basal area of 24 m²/ha (maximum is 67 m²/ha) for trees μ 10 cm DBH (L du Toit unpubl. data).

Diversity Patterns

Species richness is generally low. The data from Newlands forest (L du Toit, unpubl. data) produced on average 3-4 tree species per 400 m² plot (maximum 8 species) for trees μ 10 cm DBH. In the Orangekloof long-term plot, on average 9-10 species (maximum 11 species) of tree stems μ 5 cm DBH were recorded per 400m² plot. The Cape Peninsula forests, in general, have much lower species richness (both woody and non-woody species) than forests to the east and north (Geldenhuys 1992). Mast-fruiting occurs (periodic mass fruiting events such as in *Cassine peragua* and *Olinia ventosa*) and it is difficult for animals to survive and faunal species richness is low.

1) Ecology

Altitude & Geomorphology

The Western Cape Afrotropical Forests grow from near sea-level (<100 m) to high altitudes (in eastern end of distribution in the Swartberg and Baviaanskloof Mts.), in sheltered kloofs (gorges), southerly-facing slopes of river catchments and boulder scree.

Geology & Soils

These forests occur on soils derived from mainly quartzitic sandstones. In such cases the substrate generally consists of large boulders, stones and shallow soils. In some areas the substrate is deeper soils derived from shale (Grootvadersbosch) and Cape Granite (Newlands). For example, Orangekloof forest in the valley floor grows on basement granite overlain by colluvial deposits derived from Table Mountain Group Quartzites (TMGQ) and on the mountain slopes on TMG shale and TMGQ (Masson 1990). Leaf litter tends to accumulate and nutrient cycling is slow due to winter rainfall regime. The soils in general have very low nutrient status.

Climate

The forests occur within the winter rainfall zone (mainly), and extend eastwards into the all-year rainfall area. For example, at Orangekloof, (Geldenhuys & Rathogwa 1995) the mean annual rainfall is 1227 mm (mainly between May and September). Summer temperatures range from a mean maximum of 34^o C and mean minimum of 11^o C. Winter temperatures are cool, with a mean maximum and minimum of 25^o C and 5^o C respectively. The cold, wet winters and summer drought probably has a limited effect or constraint on the forests in the sheltered locations of forest patches. However, these climatic conditions may impact on the exposed forest patches and patches on boulder scree. The summer drought probably has a greater effect through preventing the forests to spread into the fire-prone fynbos environment outside the protected area (Masson 1990, Masson & Moll 1987) than it has to do with temperature or moisture requirements of the forest species.

Disturbance

Human impact is high close to settlements and populated areas, such as the Cape Peninsula, because of coastal and urban development, and high-density hikers. Spot fires into the gorges occasionally cause damage to the forests, and wild fires in the surrounding fynbos impact on the forest margins. Invader plants are limited to the forest margins, forest gaps, and frequently disturbed forest (floods along streams and infrastructure development). In general, the location of these forests in the mountains protects them from frequent large-scale disturbances.

Biogeographic Affinities

Western Cape Afrotropical Forest is at the southern extreme of the Afrotropical forests (sensu White 1983), and has lost many of the species of the forests to the east and north (Geldenhuys 1992). It is an impoverished form of the Southern Cape Afrotropical Forest and forests such as at Newlands, Grootvadersbosch and Boosmansbos could possibly be considered as part of the latter type. Many species occurring in the latter could also occur in the Western Cape but simply have not extended their distribution this far (lack of seed transfer). In 1954 a stand of about 50 forest species from the southern Cape and Amatole forests were planted in a small valley in the mountains east of Grabouw, with the minimum of care. The stand developed into a small forest with many trees >40 cm DBH by 1988, with tree seedling regeneration and forest understorey development, and recovery after a fire (Geldenhuys 1989). However, the Western Cape Afrotropical Forests and the Western Cape Talus Forests are sympatric – they co-occur in Capensis to a large extent, and share a number of species that are examples of continental disjunction patterns of the evolutionary ancient Gondwanaland flora (see description of Western Cape Talus Forests). Such species include *Brabejum stellatifolium*, *Cunonia capensis*, *Platylophus trifolius*, *Metrosideros angustifolia* as well as Cape endemic genera *Heeria*, *Laurophyllum*, *Maurocena*, *Smellophyllum* and *Metrosideros*. Another example is *Apodytes geldenhuysii*, with its closest relatives in the genus along the east coast of Australia, and not Africa (Van Wyk & Potgieter 1994).

Communities/Subunits

<i>Kiggelaria africana</i> - <i>Rapanea melanophloeos</i> Association	Campbell & Moll (1977)
<i>Cunonia capensis</i> - <i>Apodytes dimidiata</i> Community	McKenzie et al. (1977)
<i>Cunonia capensis</i> - <i>Ilex mitis</i> Community	McKenzie et al. (1977)
<i>Cunonia capensis</i> - <i>Rapanea melanophloeos</i> Community	McKenzie et al. (1977)
<i>Maurocena frangularia</i> - <i>Olea africana</i> Community	McKenzie et al. (1977)
<i>Maytenus heterophylla</i> - <i>Kiggelaria africana</i> Community	McKenzie et al. (1977)
<i>Maytenus oleoides</i> Community	McKenzie et al. (1977)
<i>Olea africana</i> - <i>Podocarpus latifolius</i> Community	McKenzie et al. (1977)
<i>Scutia myrtina</i> Community	McKenzie et al. (1977)
<i>Cussonia</i> - <i>Olea</i> Scree Forest	Boucher (1978)
<i>Cunonia</i> - <i>Alsophila</i> Kloof Forest	Boucher (1978)
<i>Podocarpus</i> - <i>Rapanea</i> Shale Forest	Boucher (1978)
<i>Ilex</i> - <i>Blechnum</i> Forest Community	Glyphis et al. (1978)
<i>Rapanea melanophloeos</i> - <i>Hartogia schinoides</i> - <i>Podocarpus latifolius</i> Forest Association	McKenzie (1978)
<i>Rapanea melanophloeos</i> - <i>Cunonia capensis</i> High Forest	McDonald (1985)
<i>Canthium mundianum</i> - <i>Ocotea bullata</i> Community	Jeffery & Wilson (1987)
<i>Maytenus oleoides</i> - <i>Chasmanthe aethiopica</i> Community	Jeffery & Wilson (1987)
<i>Rapanea melanophloeos</i> - <i>Cunonia capensis</i> High Forest	McDonald (1988)
<i>Rapanea melanophloeos</i> - <i>Hartogia schinoides</i> - <i>Podocarpus latifolius</i> Forest Association	McDonald (1993)

Dominant & Diagnostic Plant Species

L	S	D	Latin Name	Note
Tce	d		<i>Podocarpus latifolius</i>	
Tc	d		<i>Chionanthus foveolatus</i> subsp. <i>foveolatus</i>	
Tc	d		<i>Cunonia capensis</i>	
Tc	d		<i>Curtisia dentata</i>	
Tc	d		<i>Ilex mitis</i>	
Tc	d		<i>Kiggelaria africana</i>	
Tc	d		<i>Olea capensis</i> subsp. <i>capensis</i>	
Tc	d		<i>Olea europaea</i> subsp. <i>africana</i>	
Tc	d		<i>Olinia ventosa</i>	
Tc	d		<i>Pterocelastrus rostratus</i>	
Tc	d		<i>Pterocelastrus tricuspidatus</i>	
Tc	d		<i>Rapanea melanophloeos</i>	
Tc	d	C	<i>Virgilia oroboides</i> subsp. <i>oroboides</i>	E limit west of Mossel Bay
Tc			<i>Ocotea bullata</i>	disjunct localities
Tc			<i>Olea capensis</i> subsp. <i>macrocarpa</i>	
Tc			<i>Podocarpus falcatus</i>	W limit at Grootvadersbosch
Tcu		C	<i>Maurocena frangularia</i>	endemic
Tcu			<i>Maytenus oleoides</i>	
Tu	d		<i>Canthium inerme</i>	
Tu	d		<i>Cassine schinoides</i>	endemic to Capensis
Tu	d		<i>Diospyros whyteana</i>	
Tu	d		<i>Halleria lucida</i>	
Tu	d		<i>Maytenus acuminata</i>	
Tu		C	<i>Apodytes geldenhuysii</i>	endemic
Tu			<i>Canthium mundianum</i>	
Tu			<i>Gymnosporia buxifolia</i>	
Tf			<i>Cyathea capensis</i>	
S	d		<i>Myrsine africana</i>	
S			<i>Rubus pinnatus</i>	
Cw	d		<i>Asparagus aethiopicus</i>	
Cw	d		<i>Asparagus scandens</i>	
Cw	d		<i>Scutia myrtina</i>	
Cw	d		<i>Secamone alpini</i>	
H	d		<i>Knowltonia capensis</i>	endemic to Capensis
Hf			<i>Amauropelta bergiana</i>	type: Kirstenbosch
Hf			<i>Blechnum tabulare</i>	type: Table Mountain (Dark Gorge)
Hf			<i>Cheilanthes bergiana</i>	
Hf			<i>Histiopteris incisa</i>	type: Grootvadersbosch
Hf			<i>Hypolepis sparsisora</i>	
Hf			<i>Polypodium ensiforme</i>	type: Grootvadersbosch
Hf			<i>Polystichum incongruum</i>	endemic (Koloniebos in Marloth N.R.)
Hf			<i>Polystichum monticola</i>	type: Table Mountain
Hf	d		<i>Rumohra adianthifolia</i>	
Hf			<i>Sphraerocionium aeruginosum</i>	
Hf			<i>Vittaria isoetifolia</i>	
G	d		<i>Schoenoxiphium lanceum</i>	endemic to Capensis
M		C	<i>Breutelia elliptica</i>	endemic (Prince Alfred Pass)
M		C	<i>Breutelia tabularis</i>	endemic
M		C	<i>Ulota ecklonii</i>	endemic
M		C	<i>Wardia hygrometrica</i>	endemic (Table Mountain)
M		C	<i>Zygodon leptobolax</i>	endemic (Table Mountain)

Typical & Endemic Animals

Table. Forest dependent bird, mammal, frog and reptile species in the Western Cape Afrotropical Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, E – endemic, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Buffspotted flufftail	<i>Sarothrura elegans</i>	C	Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Olive woodpecker	<i>Mesopicos griseocephalus</i>	Cf	Birds	Widespread
Barthroated apalis	<i>Apalis thoracica</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Forest canary	<i>Serinus scotops</i>	Cl	Birds	LP, Mp, KZN, EC
Strawberry rain frog	<i>Breviceps acutirostris</i>		Frogs	WC
Villiers's chirping frog	<i>Arthroleptella villiersi</i>		Frogs	Hottentots-Holland mountains

Conservation & Management

Use & Value

Biodiversity value is low as Western Cape Afromontane Forest represents a species poor version of the Southern Cape Afrotropical Forest. Socio-economic value is high in terms of non-timber forest products and the harvesting of medicinal plants, and moderate in terms of recreation (not as high as Fynbos or Southern Cape forests). These forests possibly play a role in stream bank maintenance.

Conservation Status

This forest type is generally conserved in conjunction with fynbos rather than being a focus in itself. Those forest patches that are less accessible tend to be better protected, as are those in private nature reserves (e.g. Vogelgat Nature Reserve, Hermanus) and those in restricted areas such as Kogelberg State Forest. The capacity to manage these forests is relatively good.

Main Threats

- ⇒ Medicinal plant and bark harvesting is increasingly becoming a threat, especially at Newlands forest and the Cape Peninsula.
- ⇒ Alien plant invasion (*Lantana camara*, *Ligustrum* spp., *Pittosporum undulatum*, *Solanum mauritianum* and other garden plant escapees), is a problem in lower-lying areas. In catchment areas *Acacia mearnsii*, *A. melanoxylon* and other invader species may impact on the forests.
- ⇒ Fire is a threat and surrounding Fynbos must be properly managed. However, forests occurring in steep kloofs may be less vulnerable. During the devastating fires on the Cape Peninsula in January 2000, many forest patches escaped the fire or were affected by spot fires.
- ⇒ Ecotourism can be a threat through soil compaction, soil erosion and littering, since hikers often find it cooler to walk through the forests compared to the kloofs.
- ⇒ Most of these forests occur in catchment areas and consequently have some form of protection. However, construction of dams or reservoirs may flood some forests in riverine areas.

Other Management Considerations

- ⇒ ecotourism: park management, hiking trails;
- ⇒ heavy utilisation and high human impact close to settlement areas;
- ⇒ encroachment of aliens (*Acacia* spp., *Lantana camara*, *Ligustrum* spp., *Pittosporum undulatum*, *Solanum mauritianum*);
- ⇒ water extraction.

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13: Southern Cape Afrotropical Forests

Synonyms

Undifferentiated Afrotropical Forest p.p.	White (1983)
Knysna Forest	Acocks (1988)
Southern Cape Forests p.p.	Phillipson & Russell (1988)
Afrotropical Forest p.p.	Low & Rebelo (1998)
Knysna-Tsitsikamma Forests	Bailey et al. (1999)
Swellendam Area Forests	Bailey et al. (1999)

Profile

Southern Cape Afrotropical Forests are small (<1 ha) to very large forests (1000 – 25800 ha) in the Southern Cape between Mossel Bay and Port Elizabeth (Geldenhuys 1991). They occur in three distinct zones with distinct stand structure and species composition, i.e. upper mountain slopes, coastal platform, as well as scarps along the coast and river valleys. The mountain forests on the upper mountain slopes are high (>15 m), relatively species-poor, dominated by *Cunonia capensis* and *Ocotea bullata* with a fern understorey often dominated by *Cyathea capensis*, and have very few epiphytes and lianes. The coastal platform forests are high (15-25 m) species-rich forests dominated by a mixture of canopy tree species (*Olea capensis* subsp. *macrocarpa*, *Podocarpus latifolius*, *Pterocelastrus tricuspidatus*, *Curtisia dentata* and *Apodytes dimidiata*), several typically sub-canopy tree species (often *Gonioma kamassi*) and a sparse to dense shrub layer dominated by *Trichocladus crinitus*. The scarp forests along the river valleys and coastal scarps are short to high (5-15 m) species-rich forest, often stunted with closely interlocked crowns and crooked, multi-stem trees, with many lianas and vines, and many thorny trees and shrubs.

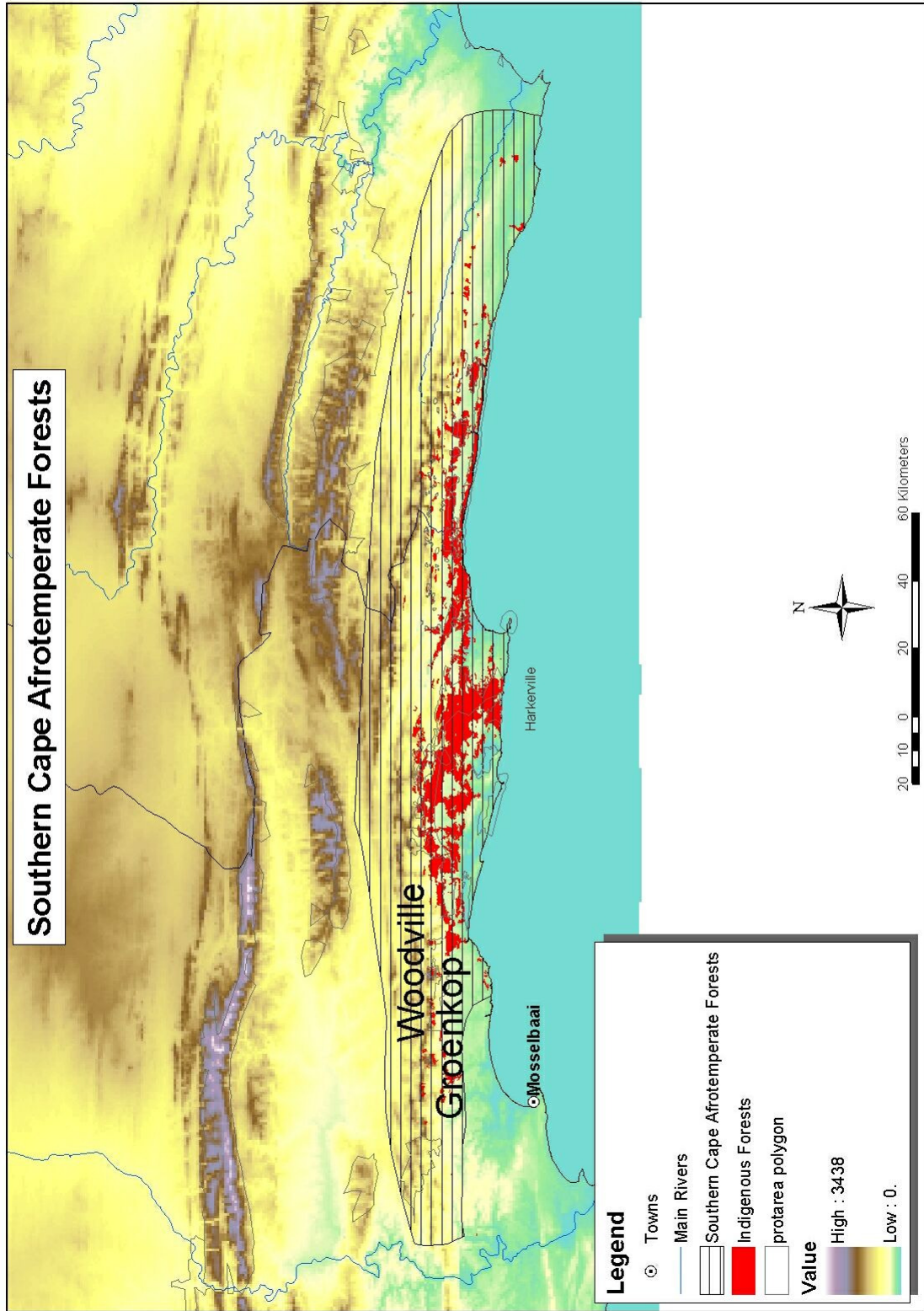
Distribution

The Southern Cape Afrotropical Forests is the largest forest complex in southern Africa (60.500 ha; Geldenhuys 1991). It occurs in the Southern Cape along the narrow coastal strip of about 250 km between Humansdorp in the east and Mossel Bay in the west. It forms a fragmented belt south of the Tsitsikamma-Outeniqua mountain ranges in distinct zones. Outlier forest patches occur in the mountains west of Port Elizabeth (Loeriebos; Cowling 1984), and in the inland mountains north of the Tsitsikamma-Outeniqua ranges (Geldenhuys 1997).

Known Forests

Diepwalle Forest Estate (incl. Harkerville, Fisantehoek, Diepwalle and Gouna State Forests)
 Farleigh Forest Estate (incl. Goudveld, Karatara, Bergplaas and Groenkop State Forests)
 Loeriebos
 Parkes Forests (largest area of private forest in the southern Cape)
 Tsitsikamma Forest Estate (incl. Witelsbos, Blueliliesbush, Stormsriver, Lottering and Bloukrans State Forests)

Map



Vegetation Structure & Texture

Stand Structure

Three distinct sub-types occur in this vegetation type and the prominent features of each sub-type is shown in the table below (Geldenhuys 1993a):

The Southern Cape mountain forests are relatively small and species-poor as a result of more frequent disturbance by fire (Geldenhuys 1994). They are dominated by *Cunonia capensis* and *Ocotea bullata*, and sometimes also *Virgilia divaricata* (and *Virgilia oroboides* subsp. *ferrugineus* between George and Mossel Bay) particularly along forest margins. Other canopy species are *Rapanea melanophloeos*, *Podocarpus latifolius*, *Pterocelastrus tricuspidatus*, *Platylophus trifoliatus*, *Curtisia dentata* and *Ilex mitis*. Sub-canopy trees are *Gonoima kamassi*, *Halleria lucida*, *Olea capensis* subsp. *capensis*, *Canthium inerme* and *Cassine eucleiformis*. The understorey is dominated by ferns, either the tree fern *Cyathea capensis*, or extensive fern clumps dominated by either *Blechnum tabulare*, *B. capense* or *Rumohra adiantiformis*. The shrubs *Sparmannia africana* and *Clutia pulchella* are prominent in places. Climbers are generally rare, but *Secamone alpini* is a prominent liane, and *Asparagus scandens* a prominent vine. Some areas are dominated by the sedge *Schoenoxiphium lanceum*.

Variable		Mountain forests	Platform forests	Scarp forests	
Stand height (range) m		20 (12 – 28)	21 (9 – 35)	12 (5 – 22)	
Stems 1-5 cm DBH, per ha		1610	2892	1568	
Stems 5-10 cm DBH, per ha		460	757	1218	
Stems >10 cm DBH, per ha (% >30 cm)		750 (30%)	910 (22%)	926 (6,8%)	
Basal area m ² /ha, trees >10 cm DBH (% >30 cm)		51 (68%)	49 (60%)	27 (26%)	
Mean stem diameter (trees >10 cm DBH)		26,9	23,4	17,3	
Number species per 400 m ² plot	Woody plants >5 cm DBH	6,6	14,4	14,9	
	Understorey plants (<1 cm DBH)	Shrubs	1,4	4,2	5,8
		Climbers	1,0	3,2	7,5
		Epiphytes	1,9	3,5	2,0
		Ferns	7,0	3,3	2,3
		Geophytes	0,3	1,4	2,2
		Graminoids	1,6	3,2	3,6
		Forbs	0,4	1,8	1,8

The Southern Cape coastal platform forests are relatively large and rich in species. *Podocarpus falcatus* is the only truly emergent tree. The canopy is dominated by a mixture of canopy tree species. In general, canopy dominants are *Olea capensis* subsp. *macrocarpa*, *Podocarpus latifolius*, *Pterocelastrus tricuspidatus*, *Curtisia dentata*, *Apodytes dimidiata*, *Nuxia floribunda* and *Psydrax obovata*. Moist sites include *Ocotea bullata*, *Platylophus trifoliatus*, *Ilex mitis* and *Olea capensis* subsp. *capensis*. Drier sites include *Olinia ventosa*, *Cassine peragua* and *Scolopia mundii*. Typical sub-canopy tree species include *Gonioma kamassi*, *Diospyros whyteana*, *Canthium mundianum*, *C. inerme*, *Burchellia bubalina*, *Rothmannia capensis* and *Ochna arborea*. The pigmy tree *Tricholcadus crinitus* dominates the understorey with dense to sparse stands, generally 1 to 2 m tall, but sometimes up to 4 m tall. In some places, the understorey may be dominated by ferns, such as *Rumohra adianthiformis* (showing past fire disturbance) or *Blechnum capense* (moist depressions), or the grass *Oplismenus hirtellus*, or in moist sites the sedges *Schoenoxiphium lanceum* and *Scleria natalensis* (in Tsitsikamma). *Pyrenacantha scandens* is a widespread vine, but nowhere common, and *Secamone alpini*, *Scutia myrtina* and *Rhoicissus* spp. are important lianas. Epiphytes are prominent, but nowhere common.

The Southern Cape scarp forests are relatively large and species-rich. The stands are often stunted with closely interlocked crowns and crooked, multi-stem trees, with many lianas and vines, and many thorny trees and shrubs. The canopy is dominated by a mixture of species, depending on the specific locality. Species include *Cassine peragua*, *Mystroxydon aethiopicum*, *Sideroxylon inerme*, *Apodytes dimidiata*, *Podocarpus*

falcatus, *Pterocelastrus tricuspidatus*, *Olea capensis* subsp. *macrocarpa*, *Olea capensis* subsp. *capensis* and *Gonioma kamassi*. Thorny trees, shrubs and lianas include *Scolopia zeyheri*, *Canthium inerme*, *Maytenus nemorosa*, *Carissa bispinosa*, *Dovyalis rhamnoides* and *Scutia myrtina*. Vines and lianas are prominent to common and include a variety of species. Epiphytes, geophytes and graminoids are prominent.

Diversity Patterns

The general species-richness patterns are depicted in the table given above. Within the area, species have been related to substrate conditions (geology) and disturbance regime (mainly fire and gap size) in different parts of the landscape (Geldenhuys 1993a; Geldenhuys & MacDevette 1989). The total number of 465 species is relatively high for the southern latitude of these forests, and can be attributed to the range of diverse habitat types and dispersal corridors that link these forests to the east over a very long time (Geldenhuys 1992b). There are many species that drop out along different zones from the east to west within the southern Cape, and many species have a disjunct distribution within the area, or have disjunct localities within the area but wider distributions outside of this area, likely because of Pleistocene sea-level changes (Geldenhuys 1992a).

Ecology

Altitude & Geomorphology

The mountain forests occur mainly on the mountain slopes and foothills of the Tsitsikamma-Outeniqua mountains (above the coastal platform at 190 to 240 m), with altitude ranging from 60 to 840 m (mean 575 m), on steep slopes, foot-slopes above streams, and sheltered gullies in fire refugia. The mean slope is 25° and aspect is predominantly south, but ranges between southeast and west. The coastal platform forests occur on the undulating landscape of the dissected plateau north of Knysna, and the coastal platform in the Tsitsikamma and to the west of Knysna, with altitude ranging from almost sea level to 650 m (mean 265 m). The mean slope is 12° and the slopes are predominantly facing south to southwest. The coastal scarp forests occur on the slopes along the river valleys and coastal scarps, i.e. generally drier sites, both in terms of rainfall, drainage, aspect and substrate, and along the river beds. Altitude ranges between almost sea level and 380 m (mean 100 m). The mean slope is 20° and aspect is predominantly southeast to southwest, but cover all aspects.

Geology & Soils

The mountain forests occur almost exclusively on the Peninsula Formation of the Table Mountain Sandstones. The soils are generally moist to wet and the pH is low, ranging between 3.9 and 4.6. The platform forests occur on geological formations of the Cape Supergroup (quartzitic sandstones and shales of Peninsula, Goudini, Skurweberg, Baviaanskloof, Cedarberg and Gydo Formations), the Knysna Sands (old dunes) and part of the Kaaimans Formation (shales, schists and phyllites). The soils are shallow to deep, but root activity is often confined to the upper 30 cm of the soil profile due to relatively high water tables. The pH ranges from 4.3 to 5.6. The scarp forests occur on the Kaaimans Formation, recent stabilized dunes, Enon conglomerates, and quartzitic sandstones and shales of Peninsula, Goudini, Skurweberg and Gydo Formations. The sites are well-drained or physiologically dry, because of the high clay content, and generally have a high nutrient status. The pH is relatively high - ranging from 5.4 to 6.9.

Climate

The climate is moist, warm temperate. The southern Cape receives orographic rain throughout the year, but with definite peaks during autumn and early summer. Average rainfall varies between 500 mm in the west and at the coast to 1200 mm in the mountains in the heart of the forest complex. Most of the area of these forests falls within a region of year-round rainfall and only in the extreme west of the area winter rainfall would prevail. The mean daily maximum temperature ranges between 23.8° C in February to 18.2° C in August, and the mean daily minimum between 19.7° C and 8.9° C. Bergwinds (local mountain winds) ahead of cold fronts during winter cause major fluctuations in temperature and moisture conditions. These climatic variables cause steep moisture and temperature gradients from the coast to the mountains. The mountain forests are generally moist to wet, the platform forests generally moist to dry, and the scarp forests dry to very dry.

Climate estimates from the CCWR modeled data set

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	470	6	23	14
Maximum	1100	10	32	19

Disturbance & Regeneration

The mountain forests are coarse-grained with infrequent large-scale disturbance by fire. The coastal platform forests are fine-grained with regular single-tree deaths. Disturbance is confined mainly to windfalls of one or few trees, lightning gaps, small landslides on steep slopes and sporadic small fires during extreme weather conditions (primarily ground fires caused by lightning or spot fires). On the scarp, disturbance is of intermediate intensity. Fires from adjacent fire-adapted fynbos vegetation cause disturbance on the forest edges. This is a natural phenomenon and not a threat to the forest as long as the fynbos is burnt on a natural fire regime, and the forest edge is not heavily invaded by alien plants.

Regeneration is generally good. Mast fruiting occurs in several species, such as *Apodytes dimidiata*, *Podocarpus falcatus*, *Olea capensis* subsp. *macrocarpa* and *Olinia ventosa*.

Biogeographic Affinities

The Southern Cape Afrotropical forests have floristic affinities with the Western Cape Afrotropical Forests and the Amatole Mistbelt Forests. It contains floristic elements of the Western Cape Milkwood Forests. For example it shares 63% of its woody species and 67% of its herbaceous species with the Amatole forests, and 85% of the Cape Peninsula woody forest species and 87% of the herbaceous species occur in the Southern Cape Afrotropical Forests (Geldenhuys 1992b). It shares about 40% of the woody species with the forests along the north-eastern escarpment near Tzaneen. In addition, several of the species typical of the coastal forest types are present.

Communities/Subunits

In the Southern Cape there are three clearly defined ecological subtypes (mountain forests, coastal platform forests and scarp forests) between which transition zones were distinguished (Geldenhuys 1993a).

Further communities/subunits were described in the literature (§ indicates herbaceous stratocoenons (*sensu* Barkman 1978), i.e. abstract vegetation units derived solely on basis of understorey vegetation).

<i>Rapanea melanophloeos-Canthium inerme</i> Otterford Afrotropical Forest	Cowling (1984)
<i>Rapanea melanophloeos-Ocotea bullata</i> Loerie Afrotropical Forest	Cowling (1984)
Very Dry Scrub Forest	Von Breitenbach (1974)*
Dry High Forest	Von Breitenbach (1974)*
Medium-Moist High Forest	Von Breitenbach (1974)*
Moist High Forest	Von Breitenbach (1974)*
Wet High Forest	Von Breitenbach (1974)*
Very Wet Scrub Forest	Von Breitenbach (1974)* *based on Phillips (1931) & Laughton (1938)
<i>Sideroxylon inerme-Cassine aethiopica</i> Scrub Forest	Geldenhuys (1993a)
<i>Olea capensis macrocarpa-Gonioma kamassi-Canthium inerme</i> Tall Dry Forest	Geldenhuys (1993a)

<i>Rapanea melanophloeos</i> - <i>Canthium inerme</i> - <i>Olinia ventosa</i> Bottomslope Forest	Geldenhuys (1993a)
<i>Trichocladus crinitus</i> - <i>Curtisia dentata</i> - <i>Apodytes dimidiata</i> Platform Forest	Geldenhuys (1993a)
<i>Pterocelastrus tricuspidatus</i> - <i>Olea capensis capensis</i> - <i>Olea capensis</i> <i>macrocarpa</i> - <i>Cassine papillosa</i> - <i>Podocarpus latifolius</i> - <i>Psydrax obovata</i> - <i>Chionanthus foveolata</i> Mixed Platform Forest	Geldenhuys (1993a)
<i>Pterocelastrus tricuspidatus</i> - <i>Olea capensis capensis</i> - <i>Platylophus</i> <i>trifoliatus</i> Moist Platform Forest	Geldenhuys (1993a)
<i>Gonioma kamassi</i> - <i>Rapanea melanophloeos</i> Mountain Forest	Geldenhuys (1993a)
<i>Halleria lucida</i> Mountain Forest	Geldenhuys (1993a)
<i>Protasparagus aethiopicus</i> - <i>Acokanthera oppositifolia</i> Scrub Forest Understorey	Geldenhuys (1993a)
<i>Trichocladus crinitus</i> - <i>Asplenium lunulatum</i> - <i>Oplismenus hirtellus</i> Tall River Valley Forest Understorey	Geldenhuys (1993a)
<i>Blechnum giganteum</i> - <i>Peperomia tetraphylla</i> - <i>Cyathea capensis</i> - <i>Asplenium protensum</i> - <i>Peperomia retusa</i> Wet High Forest Understorey	Geldenhuys (1993a)
<i>Trichocladus crinitus</i> - <i>Dietes iridioides</i> - <i>Schoenoxiphium</i> <i>lehmannii</i> Platform Forest Understorey	Geldenhuys (1993a)
<i>Ficinia complex</i> - <i>Ehrharta calycina</i> - <i>Rumohra adiantiformis</i> Moist Regrowth Forest Understorey	Geldenhuys (1993a)
<i>Ficinia complex</i> - <i>Rumohra adiantiformis</i> - <i>Blechnum</i> <i>punctulatum</i> - <i>Ehrharta calycina</i> Mountain Regrowth Forest Understorey	Geldenhuys (1993a)
<i>Elaphoglossum angustatum</i> - <i>Cyathea capensis</i> - <i>Microsorium</i> <i>ensiforme</i> Mountain Forest Understorey	Geldenhuys (1993a)

Dominant & Diagnostic Species

Note: The notion 'endemic' applies to the region of the distribution of the Southern Cape Afrotropical Forests, whereas the notion 'endemic to Capensis' applies to the region of Cape Floristic Region (Kingdom) - the data for the latter come from Goldblatt & Manning (2000). The data on distribution limits of species follow Geldenhuys (1992a).

L	S	D	Latin Name	Note
Te	d		<i>Podocarpus falcatus</i>	trees reaching 40 m height
Tc	d		<i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	
Tc	d		<i>Cassine peragua</i>	
Tc	d		<i>Cunonia capensis</i>	
Tc	d		<i>Curtisia dentata</i>	
Tc	d		<i>Mystroxydon aethiopicum</i>	
Tc	d		<i>Nuxia floribunda</i>	
Tc	d		<i>Ocotea bullata</i>	
Tc	d		<i>Olea capensis</i> subsp. <i>macrocarpa</i>	
Tc	d		<i>Platylophus trifoliatus</i>	E limit (Kromrivier)
Tc	d		<i>Podocarpus latifolius</i>	
Tc	d		<i>Pterocelastrus tricuspidatus</i>	
Tc	d		<i>Rapanea melanophloeos</i>	
Tc	d		<i>Sideroxydon inerme</i>	
Tc			<i>Buddleja saligna</i>	
Tc			<i>Ilex mitis</i>	
Tc			<i>Maytenus peduncularis</i>	W limit
Tc			<i>Olea capensis</i> subsp. <i>capensis</i>	
Tc			<i>Olinia venosa</i>	
Tc			<i>Psydrax obovata</i> subsp. <i>obovata</i>	
Tc			<i>Schefflera umbellifera</i>	W limit

Tc			<i>Scolopia zeyheri</i>	W limit
Tc			<i>Vepris lanceolata</i>	
Tc			<i>Virgilia divaricata</i>	W limit
Tc		C	<i>Virgilia oroboides</i> subsp. <i>ferruginea</i>	endemic
Tcu	d		<i>Canthium inerme</i>	
Tcu	d		<i>Elaeodendron croceum</i>	
Tcu	d		<i>Gonioma kamassi</i>	W limit
Tcu			<i>Canthium mundianum</i>	
Tcu			<i>Halleria lucida</i>	
Tcu			<i>Robsonodendron eucleiforme</i>	
Tu	d		<i>Diospyros whyteana</i>	
Tu			<i>Ochna arborea</i> var. <i>arborea</i>	W limit
Tu			<i>Allophylus decipiens</i>	W limit
Tu			<i>Chionanthus foveolatus</i> subsp. <i>foveolatus</i>	
Tu			<i>Diospyros dichrophylla</i>	
Tu			<i>Euclea racemosa</i>	
Tu			<i>Euclea schimperi</i>	
Tu			<i>Gymnosporia nemorosa</i>	
Tu			<i>Lachnostylis hirta</i>	endemic to Capensis
Tu			<i>Olea europaea</i> subsp. <i>africana</i>	
Tu			<i>Rhus lucida</i>	
Tu			<i>Trimeria grandifolia</i>	W limit
Tf	d		<i>Cyathea capensis</i>	
ST	d		<i>Burchellia bubalina</i>	
ST	d		<i>Trichocladus crinitus</i>	
ST			<i>Acokanthera oppositifolia</i>	
ST			<i>Clutia affinis</i>	
ST			<i>Sparmannia africana</i>	
S			<i>Carissa bispinosa</i> subsp. <i>zambesiaca</i>	
S			<i>Dovyalis rhamnoides</i>	
S			<i>Laurophyllus capensis</i>	endemic to Capensis
Sp			<i>Viscum obscurum</i>	
SCw			<i>Grewia occidentalis</i>	
SCw			<i>Rubus pinnatus</i>	
Cw	d		<i>Pyrenacantha scandens</i>	
Cw	d		<i>Rhoicissus tomentosa</i>	
Cw			<i>Asparagus macowanii</i>	
Cw			<i>Asparagus scandens</i>	E limit (Kromrivier)
Cw			<i>Capparis sepiaria</i> var. <i>citrifolia</i>	
Cw			<i>Cassine tetragona</i>	
Cw			<i>Rhoicissus digitata</i>	
Cw			<i>Scutia myrtina</i>	
Cw			<i>Secamone alpini</i>	
Ch			<i>Asparagus aethiopicus</i>	
Ch			<i>Asparagus setaceus</i>	
Ch			<i>Cissampelos torulosa</i>	W limit
Ch			<i>Kedrostis nana</i>	
Ch			<i>Oncinema lineare</i>	endemic to Capensis
Ch			<i>Senecio angulatus</i>	
Ch			<i>Senecio deltoideus</i>	
Ch			<i>Senecio quinquelobus</i>	
Chp			<i>Cuscuta africana</i>	endemic to Capensis
Csuc			<i>Sarcostemma viminale</i>	
Ssoft	d		<i>Plectranthus fruticosus</i>	
Hbab	d	C	<i>Strelitzia alba</i>	endemic
H			<i>Drymaria cordata</i> subsp. <i>diandra</i>	W limit
H			<i>Galopina circaeoides</i>	
H			<i>Gerbera cordata</i>	W limit
H			<i>Hypoestes grantii</i>	W limit
H			<i>Lobelia cuneifolia</i>	endemic to Capensis
H			<i>Sanicula elata</i>	
H			<i>Streptocarpus rexii</i>	W limit
H/Eh			<i>Peperomia retusa</i>	

H/Eh		<i>Peperomia tetraphylla</i>	
Hf	d	<i>Blechnum attenuatum</i>	
Hf	d	<i>Blechnum capense</i>	
Hf	d	<i>Blechnum tabulare</i>	
Hf	d	<i>Polystichum pungens</i>	
Hf	d	<i>Rumohra adiantiformis</i>	
Hf		C <i>Amauropelta knysnaensis</i>	endemic
Hf		<i>Asplenium lunulatum</i>	
Hf		<i>Asplenium protensum</i>	W limit
Hf		<i>Asplenium rutifolium</i>	
Hf		<i>Blechnum punctulatum</i>	
Hf		<i>Blotiella glabra</i>	W limit
Hf		<i>Cheilanthes hirta</i>	W limit
Hf		<i>Crepidomanes melanotrichum</i>	type: Plettenberg Bay
Hf		<i>Dryopteris inaequalis</i>	
Hf		<i>Elaphoglossum angustatum</i>	
Hf		<i>Histiopteris incisa</i>	
Hf		<i>Hypolepis sparsisora</i>	
Hf		<i>Lepisorus schraderi</i>	
Hf		<i>Pleopeltis macrocarpa</i>	
Hf		<i>Polypodium ensiforme</i>	
Hf		<i>Pteris buchananii</i>	
Hf		<i>Todea barbata</i>	
Hf/He		<i>Selaginella kraussiana</i>	
Hg	d	<i>Dietes iridioides</i>	
Hg	d	<i>Oxalis incarnata</i>	
Hg		<i>Calanthe sylvatica</i>	W limit
Hg		<i>Chlorophytum comosum</i>	
Hg		<i>Disperis lindleyana</i>	W limit
Hg		<i>Disperis thorncroftii</i>	W limit
Hg		<i>Liparis capensis</i>	endemic to Capensis
Hg		<i>Monadenia bracteata</i>	E limit
Hg		<i>Scadoxus puniceus</i>	W limit
Hsc		<i>Ceropegia africana</i>	W limit
Ef		<i>Hymenophyllum marlothii</i>	E limit
Ef		<i>Mystacidium capense</i>	W limit
Ef		<i>Pleuopodium simianum</i>	W limit
Eo		<i>Angraecum conchiiferum</i>	W limit
Eo		<i>Angraecum pusillum</i>	
Eo		<i>Angraecum sacciferum</i>	
Eo		<i>Cyrtorchis arcuata</i>	W limit
Eo		<i>Polystachya ottoniana</i>	
Eo		<i>Tridactyle bicaudata</i>	W limit
Gcr	d	<i>Oplismenus hirtellus</i>	
G	d	<i>Schoenoxiphium lanceum</i>	
G		C <i>Schoenoxiphium altum</i>	endemic
G		<i>Schoenoxiphium lehmannii</i>	
G		<i>Brachypodium flexum</i>	
G		<i>Carex aethiopica</i>	
G		<i>Ehrharta calycina</i>	
G		<i>Oplismenus undulatifolius</i>	
G		<i>Panicum deustum</i>	
M		<i>Distichophyllum mniifolium</i> var. <i>mniifolium</i>	near-endemic; WC Afrotemeperate F.
M		C <i>Distichophyllum mniifolium</i> var. <i>taylorii</i>	endemic
M		<i>Fissidens fasciculatus</i>	near-endemic; WC Afrotemeperate F.
M		C <i>Leucobryum rehmannii</i>	endemic
M		<i>Mniomitrium macropelma</i>	near-endemic; WC Afrotemeperate F.
M		<i>Pyrrhobryum vallis-gratiae</i>	near-endemic; WC Afrotemeperate F.

Typical & Endemic Animals

Note: R: species of Red List.

* remnant of local forest race of elephant

<i>Cephalopus monticola</i>	Blue Duiker	R
<i>Cercopithecus aethiops</i>	Vervet Monkey	
<i>Loxodonta africana</i>	Elephant	2 last individuals
<i>Mellivora capensis</i>	Honey Badger	R
<i>Panthera pardus pardus</i>	Leopard	R
<i>Potamochoerus larvatus</i>	Bushpig	
<i>Tragelaphus scriptus</i>	Bushbuck	
	White-Tailed Rat	R
	Spectacled Dormouse	R
<i>Myxus capensis</i>	Freshwater Mullet	R
<i>Pseudobarbus tenuis</i>	Slender Redfin	R

A detailed list of fauna species (mammals, birds, reptiles, amphibians, fish and insects) are available from the Knysna Area Office, Private Bag X12, Knysna 6570; see also Von Breitenbach 1974, Seydack 1984 & Van der Merwe undated).

Conservation & Management

Use & Value

The socio-economic value of these forests is undoubtedly high. Commercial use includes timber for furniture making and fern-harvesting for the floral industry. The harvesting of non-timber forest products, such as bark and medicinal plants is increasing. Outdoor recreation and forest-based ecotourism is becoming increasingly important. The biodiversity value is moderate to high as these afrotemperate forests are species-poorer than the subtropical forests of KwaZulu-Natal. The conservation value of these forests is however very high as they are structurally unique, representing the largest (nearly continuous) afrotemperate forest complex in southern Africa.

Conservation Status

The largest portion of Southern Cape Forest is State Forest and is well protected and managed (von Breitenbach 1968, Geldenhuys 1982, Vermeulen 1993) within a system of 'strict' nature reserves and areas for sustainable exploitation. It is the most formally conserved forest in South Africa and management capacity and infrastructure are on a high level of sophistication and efficiency. Outside the strict reserves the forest is subject to controlled harvesting using pre-emptive mortality selection techniques to identify trees worth harvesting (Seydack et al. 1995). The forest is in the process of being FSC certified (Kok and Vermeulen 2002).

The NLC puts the extent of this forest type as 77 500ha with 57% conserved. The forest biome data records it as 69 000 ha and 61% conserved. About 8 000 ha is on provincial land. Geldenhuys (1991) reports on a detailed study of the forests in the area, based on mapping from aerial photographs, transferred to 1:50.000 topographic maps, of forests down to 0.5 ha (still the most reliable information on forest distribution, size and ownership in the area).

Main Threats

- ⇒ Fragmentation and isolation particularly of coastal scrub forest patches through housing and other development such as commercial plantations
- ⇒ Unsustainable and uncontrolled resource harvesting of timber and non-timber forest products;
- ⇒ Fire can have a critical impact if the fynbos is not well managed, especially on mountain forests;
- ⇒ Alien invaders, such as *Acacia* spp. of Australian origin can be a problem, however if correctly managed, they can facilitate forest recovery (see Geldenhuys 1996; Seydack 2000; Seydack 2002).

Other Management Considerations

- ⇒ Management objectives vary according to ecological subtype (mountain, platform or scarp). Dry and wet forest types are more sensitive to disturbance, while scrub forests have lower utilization potential. There is also more development within the scrub and coastal forest subtypes;
- ⇒ Multiple use, including consumptive (e.g. traditional medicines, timber, and florists greenery) and non-consumptive (ecotourism and recreation);
- ⇒ Services to local cabinet making industry;
- ⇒ Knysna elephants, a remnant (non-viable) herd forced into the forests as a refuge area now facing extinction (Seydack et al. 2000) ;
- ⇒ Fire management critical in forest margin areas;
- ⇒ Conservation management, including invader plant control and forest edge management;
- ⇒ Maintaining yield regulation in place to ensure continuance of present sustainable consumptive use, and with regard to non-consumptive use proper planning and zoning to guide outdoor recreation development.

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II1: Marekele Afromontane Forests

L. Mucina & P.J. van Staden

Synonyms

Hypoestes verticillaris-Mimusops zeyheri Forests p.p.
Olea europaea subsp. *africana-Diospyros whyteana*

Coetzee (1975)
Major Community p. van Staden (2002)

Profile

Unique Afromontane forest found in small patches on steep scarps and in deep moist kloofs on Waterberg and Magaliesberg, Dominating trees are *Widdringtonia nodiflora*, *Podocarpus latifolius* and *Pittosporum viridiflorum*. Presence of Afromontane (and montane fynbos) elements and lack of woodland elements are further typical features.

Distribution

Very local forest type found only on Waterberg (Marekele National Park) and some kloofs of Magaliesberg (Rustenburg Nature Reserve). It is found imbedded within sourveld grasslands/montane fynbos complex (Waterberg) or straddling sourveld/bushveld ecotone (Bankenveld of Magaliesberg).

Known Forests

Marekele National. Park (Waterberg Mts.)
Rustenburg Nature Reserve (Magaliesberg Mts.)

Vegetation Structure & Texture

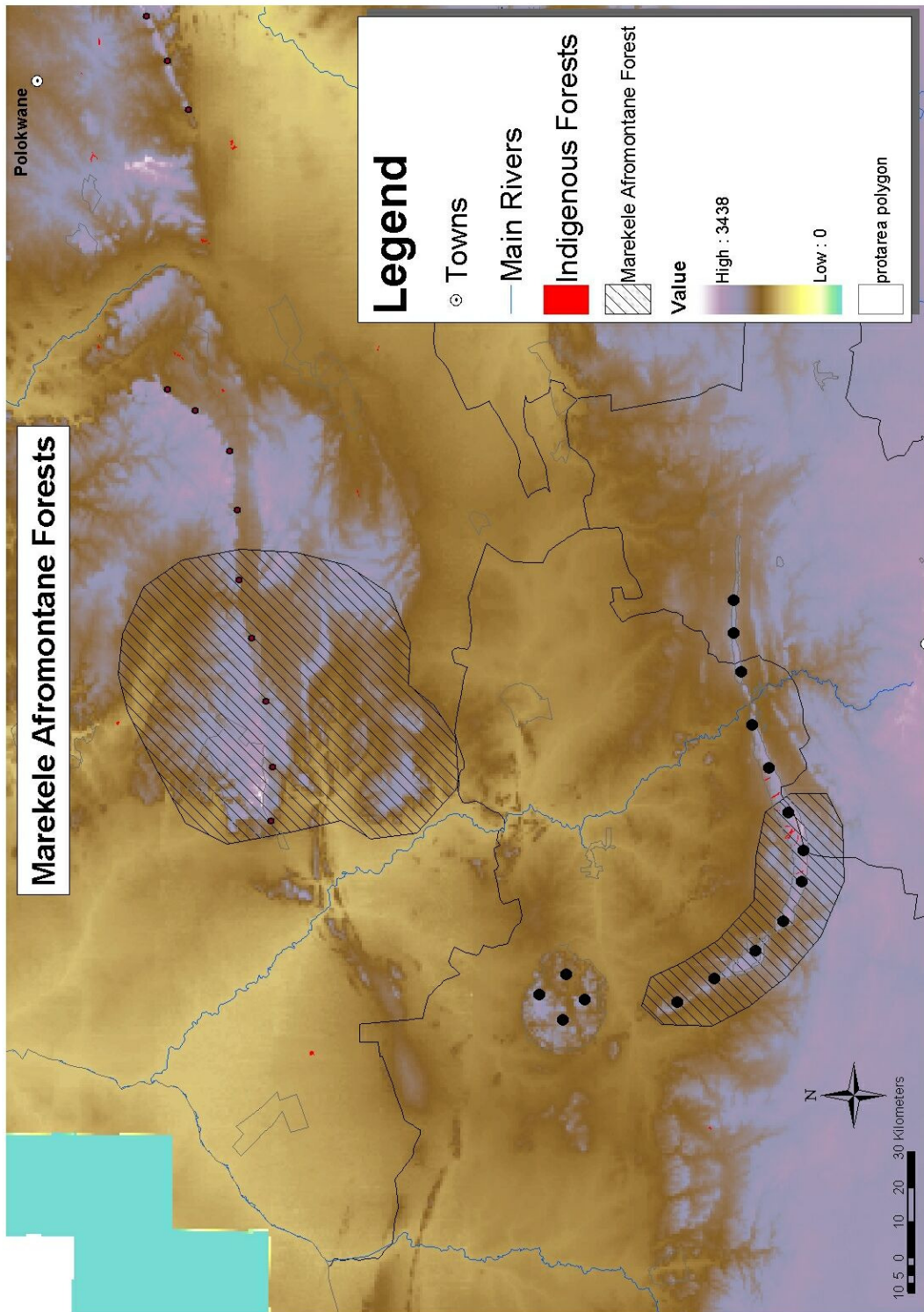
Stand Structure

The *Widdringtonia nodiflora-Podocarpus latifolius* Forests (Van Staden 2002) are dense (around 80 % of canopy cover), approx. 8 m tall and with *Widdringtonia nodiflora*, *Podocarpus latifolius*, *Curtisia dentata*, *Canthium gilfillanii*, *Olea capensis*, *Syzygium cordatum*, *Cliffortia linearifolia* and *Ilex mitis* the dominant trees. The shrub layer is approx. 1.5 m tall. The most prominent shrubs forming this layer include *Myrsine africana*, *Ochna holstii* and *Osyris lanceolata*. The woody liana *Secamone alpinii* is frequently found in both tree and shrub layers. The herbaceous layer is sparse (10 % cover) and dominated by ferns such as *Blechnum giganteum*, *Pteridium aquilinum* and *Asplenium splendens*.

The *Podocarpus latifolius-Rothmannia capensis* Forests (Van Staden 2002) are taller than the previous community (up to 12 m) and the average cover is around 80 %. Other prominent canopy tree species are *Pittosporum viridiflorum*, *Podocarpus latifolius*, *Rothmannia capensis*, *Curtisia dentata*, *Cussonia paniculata*, *Ficus thonningii*, *Calodendron capensis*, *Olea europaea* subsp. *africana*, *Euphorbia ingens*, *Mimusops zeyheri*, *Ficus sur*, *Olea capensis*, *Syzygium cordatum* and *Ilex mitis*. The shrub layer is dense -approx. 50% cover. Prominent shrubs occurring in this community are *Myrsine africana*, *Canthium gilfillanii*, *Ochna pretoriensis*, *Acacia ataxacantha*, *Calpurnia aurea*, *Maytenus undata*, *Pappea capensis*, *Zanthoxylum capense*, *Ochna holstii*, *Osyris lanceolata*, *Diospyros whyteana*, *Grewia occidentalis*, *Rhoicissus tridentata* and *Euclea natalensis*. Woody lianas such as *Secamone alpinii* and *Cryptolepis transvaalensis* are also frequent. The herbaceous layer has an average height of 0.5 m and an average cover of 22 % It is dominated by *Cyperus albostrigatus*, *Tetradenia brevispica*, *Solanum giganteum* and *Oplismenus hirtellus*.

Map

We do not have detailed mapped forests of this forest type. The included map simply indicate the approximate areas where we believe this type to occur.



The Magaliesberg community (*Ilex mitis*-*Pittosporum viridiflorum* Forest (Coetzee 1975) is floristically similar to the *Podocarpus latifolius*-*Rothmannia capensis* Forests (see above). The tree canopy is high (13 m), dense (up to 100% of cover) and dominated by *Ilex mitis*, *Pittosporum viridiflorum*, *Rothmannia capensis*, *Halleria lucida* and locally also by *Englerophytum magalimontanum*. The latter species is a typical element of the surrounding mountain bushveld complex classified by Coetzee (1975) as the *Eustachys mutica*-*Acacia caffra* Woodland. *Blechnum attenuatum* and *Cyperus albostratus* are the dominant forbs of the herbaceous layer; notable is the occurrence of *Cyathea dregei*, otherwise known from open grassland drainage sites of the Highveld.

Diversity Patterns

The samples of the Magaliesberg community (*Ilex mitis*-*Pittosporum viridiflorum* Forest; Coetzee 1975) were the species poorest - having only 16 and 18 species per relevé. The *Widdringtonia nodiflora*-*Podocarpus latifolius* Forest and the *Podocarpus latifolius*-*Rothmannia capensis* Forest (Van Staden 2002) yielded on average 22 and 30 species per relevé, respectively.

Ecology

Altitude & Geomorphology

The Waterberg (Marekele) forests are found along perennial streams and in deep moist kloofs on slopes facing E, NE and E. *Widdringtonia nodiflora*-*Podocarpus latifolius* Forest is found at altitudes of 1500 m to 1730 m, while the *Podocarpus latifolius*-*Rothmannia capensis* Forest is found at altitudes of 1300 m to 1660 m. Examples of the Magaliesberg forests come from east-facing slopes of kloofs at an altitude of ca. 1600 m (Coetzee 1975).

Geology & Soil

The forest of the Marekele National Park occurs on shallow soils of Ib land type classified as Mispah Form derived from sandstones of the Sandriviersberg Formation (Van Staden 2002). Large rocks cover 70-76 % of the soil surface. During the rainy season and for some time thereafter water seeps from the sandstone, creating moist habitat.

The *Ilex mitis*-*Pittosporum viridiflorum* Forest from the Magaliesberg is found on skeletal soils derived partly from intrusive diabases of the Pretoria Igneous Complex and partly of quartzites of the Transvaal System (Coetzee 1975).

Climate

Disturbance

Although *Widdringtonia nodiflora*-*Podocarpus latifolius* Short Forest is not entirely protected from fire, the woody vegetation and structure are seldom damaged by fire because the poorly developed grass layer and extensive rock cover provides protection against fire. *Widdringtonia* is a typical Afrotropical-Cape element and it is known to occur throughout the Fynbos biome in stunted shrubby form, largely as consequence of frequent fire. When found in fire-protected habitats, it may attain tree stature and become dominating. Such *Widdringtonia* forests have been recorded from the Mulanje Massif in Malawi as well as the Mariepskop area (White 1978).

Biogeographic Affinities

Unlike the sympatric Northern Highveld Forests, this forest type is undoubtedly of Afrotropical character with no notable woodland elements. Its pronounced Afrotropical character is reinforced by montane fynbos elements such as *Widdringtonia nodiflora*, *Phyllanthus paniculata*, *Clusia pulchella* and *Cliffortia linearifolia*.

Marekele Afromontane Forest exemplifies the best-preserved relict of the formerly more extensive Afrotemperate forest of the "Magaliesburg Extension" (White 1978; see also I12: Northern Highveld Forests). It is linked to the Northern Mistbelt Forests (Soutpansberg, Northern Escarpment) by species such as *Ochna holstii*, *Faurea saligna*, *Cryptocarya transvaalensis*, *Phyllica paniculata*, *Asparagus virgatus*, *Combretum moggii* and *Canthium gilfillanii*. Species such as *Pavetta gradeniifolia* and *Asparagus virgatus* provide a link with the Northern KwaZulu-Natal Mistbelt Forests.

Communities/Subunits

<i>Ilex mitis</i> - <i>Pittosporum viridiflorum</i> Forest	Coetsee (1975)
<i>Widdringtonia nodiflora</i> - <i>Podocarpus latifolius</i> Short Forest	Van Staden (2002)
<i>Podocarpus latifolius</i> - <i>Rothmannia capensis</i> Tall Forest	Van Staden (2002)

Dominant & Diagnostic Plant Species

L	S	D	Latin Name	Note
Tc	d		<i>Podocarpus latifolius</i>	
Tc	d		<i>Widdringtonia nodiflora</i>	montane fynbos
Tc			<i>Canthium gilfillanii</i>	Transvaal endemic
Tc			<i>Curtisia dentata</i>	
Tc			<i>Faurea saligna</i>	
Tc			<i>Nuxia congesta</i>	
Tc			<i>Olea capensis</i> subsp. <i>macrocarpa</i>	
Tc			<i>Syzygium cordatum</i>	
Tc			<i>Zanthoxylum capense</i>	
Tu	d		<i>Ilex mitis</i>	
Tu	d		<i>Pittosporum viridiflorum</i>	
Tu	d		<i>Rothmannia capensis</i>	
Tu			<i>Calodendrum capense</i>	
Tu			<i>Prunus africana</i>	
Tu			<i>Pterocelastrus echinatus</i>	
Tf			<i>Cyathea dregei</i>	
ST	d		<i>Halleria lucida</i>	
ST			<i>Combretum moggii</i>	Transvaal endemic
ST			<i>Diospyros whyteana</i>	
ST			<i>Englerophytum magalimontanum</i>	
ST			<i>Ochna holstii</i>	
ST			<i>Strychnos usambarensis</i>	
ST			<i>Acacia ataxacantha</i>	
S	d		<i>Myrsine africana</i>	
S			<i>Cliffortia lineariifolia</i>	montane fynbos
S			<i>Clutia pulchella</i>	montane fynbos
S			<i>Ochna pretoriensis</i>	Transvaal endemic
S		D	<i>Phyllica paniculata</i>	montane fynbos
S			<i>Rhus dentata</i>	
S			<i>Solanum giganteum</i>	
Ssoft			<i>Tetradenia brevispicata</i>	Transvaal endemic
Cw			<i>Asparagus setaceus</i>	
Cw			<i>Asparagus virgatus</i>	
Cw			<i>Secamone alpini</i>	
Hf	d		<i>Blechnum attenuatum</i>	
Hf	d		<i>Pteridium aquilinum</i>	
Hf			<i>Asplenium splendens</i>	
Hf			<i>Cheilanthes hirta</i>	
Hf			<i>Cheilanthes viridis</i>	

Hf		<i>Pellaea calomelanos</i>
Hg		<i>Scadoxus multiflorus</i>
G	d	<i>Cyperus albostratus</i>
Gcr		<i>Oplismenus hirtellus</i>

Typical & Endemic Animal Species

Table. Forest dependent bird, mammal, frog and reptile species in the Northern Afrotropical Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, E – endemic, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Buffspotted flufftail	<i>Sarothrura elegans</i>	C	Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Tambourine dove	<i>Turtur tympanistria</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Cape parrot	<i>Poicephalus robustus</i>	Cl	Birds	LP, Mp, inland EC & KZN
Knysna lourie	<i>Tauraco corythaix</i>	C	Birds	EC, KZN, MP, NP
Emerald cuckoo	<i>Chrysococcyx cupreus</i>	Cm	Birds	LP, Mpu, KZN, EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape
Scalythroated honey guide	<i>Indicator variegatus</i>	Cf	Birds	e. Mp, coastal EC & KZN
Olive woodpecker	<i>Mesopicos griseocephalus</i>	Cf	Birds	Widespread
Grey cuckooshrike	<i>Coracina caesia</i>	U	Birds	Widespread
Squaretailed drongo	<i>Dicrurus ludwigii</i>	C	Birds	Mp, coastal EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Yellowstreaked bulbul	<i>Phyllastrephus flavostriatus</i>	Cf	Birds	Ngoye forest north to e.Mp
Yellowbellied bulbul	<i>Chlorocichla flaviventris</i>	C	Birds	Coastal n. EC & KZN
Orange thrush	<i>Zoothera gurneyi</i>	Cf	Birds	LP, Mp, KZN, EC
Chorister robin	<i>Cossypha dichroa</i>	Cl	Birds	LP, Mp, KZN, EC
Starred robin	<i>Pogonocichla stellata</i>	Cl	Birds	LP, Mp, KZN, EC
Brown robin	<i>Erythropgia signata</i>	Cl	Birds	e. Mp, coastal EC & KZN
Yellowthroated warbler	<i>Seicercus ruficapillus</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Barthroated apalis	<i>Apalis thoracica</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>	Cl	Birds	LP, Mp, KZN, EC, S.Cape
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Green twinspot	<i>Mandingoa nitidula</i>	Cl	Birds	LP, Mp, KZN, EC
Forest canary	<i>Serinus scotops</i>	Cl	Birds	LP, Mp, KZN, EC
Samango monkey	<i>Cercopithecus mitis</i>		Mammals	LP, EC, KZN
Giant rat	<i>Cricetomys gambianus</i>		Mammals	LP
Woodland mouse	<i>Grammomys dolichurus</i>		Mammals	LP, Mp, KZN, EC
Woodland dormouse	<i>Graphiurus murinus</i>		Mammals	Widespread
Dark-footed forest shrew	<i>Myosorex cafer</i>		Mammals	LP, Mp, KZN, EC
Natal ghost frog	<i>Heleophryne natalensis</i>		Frogs	LP, Mp, KZN, EC
Transvaal forest rain frog	<i>Breviceps sylvestris</i>		Frogs	LP
Clicking stream frog	<i>Strongylopus grayii</i>		Frogs	Widespread

Giant legless skink	<i>Acontias plumbeus</i>	E	Reptiles	LP, e. Mp, n. KZN, East London
Natal purple-glossed snake	<i>Amblyodipsas concolor</i>	E, R	Reptiles	e. Mp, KZN

Conservation & Management

Use, Value & Conservation Status

This unique forest type is well preserved in the only two localities that it is common -Rustenburg N.R. and Marekele N.P.

Main Threats

⇒ occasional hot woodland fires

Other Management Considerations

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II2: Northern Highveld Forests

Synonyms

Kloof Forest	Coetzee (1974)
Riparian Forest	Coetzee (1974)
<i>Hypoestes verticillaris-Mimusops zeyheri</i> Forests p.p.	Coetzee (1975)
Undifferentiated Atromontane Forest p.p.	White (1983)

Profile

Low-stature, species-poor forest occurring in patches. In dry kloofs of the quartzite mountain ridges from Suikerbosrand in the south, Dullstroom in the east, through Magaliesberg, Waterberg and Strydpoortberg mountains in the west and NW. Narrow riparian forest within the central Bushveld was classified within this type as well. An abundance of bushveld elements characterises this forest type.

Distribution

These forests are restricted to Suikerbosrand (Bredenkamp & Theron 1978, 1980), the surroundings of Dullstroom (M. Lötter, pers. comm.), Witwatersrand (Behr & Bredenkamp 1988, Ellery et al. 2001), Magaliesberg (Coetzee 1974, 1975), Pilanesberg, Waterberg (Westfall 1981, Westfall et al. 1985, Van Staden 2002), Sekhukhuneland (Siebert 2001), Strydpoortberg (G. von Maltitz, pers. comm.) and some other ridges occurring throughout the western Central Bushveld region (Van Vuuren 1961, Van Vuuren & Van der Schijff 1970, Van der Meulen 1979). These forest patches are imbedded within an ecotone between sourveld grasslands and subtropical savannas of the Central Bushveld.

Known Forests

Dullstroom (surroundings)
 Jack Scott Nature Reserve (Magaliesberg) complex
 Marekele Natl. Park (Waterberg) complex
 Melville Ridge (Johannesburg)
 Pilanesberg
 Rustenburg Nat. Res. (Magaliesberg) complex
 Sekhukhuneland (complex)
 Strydpoortberg
 Suikerbosrand complex
 Witwatersrand National Botanical Garden

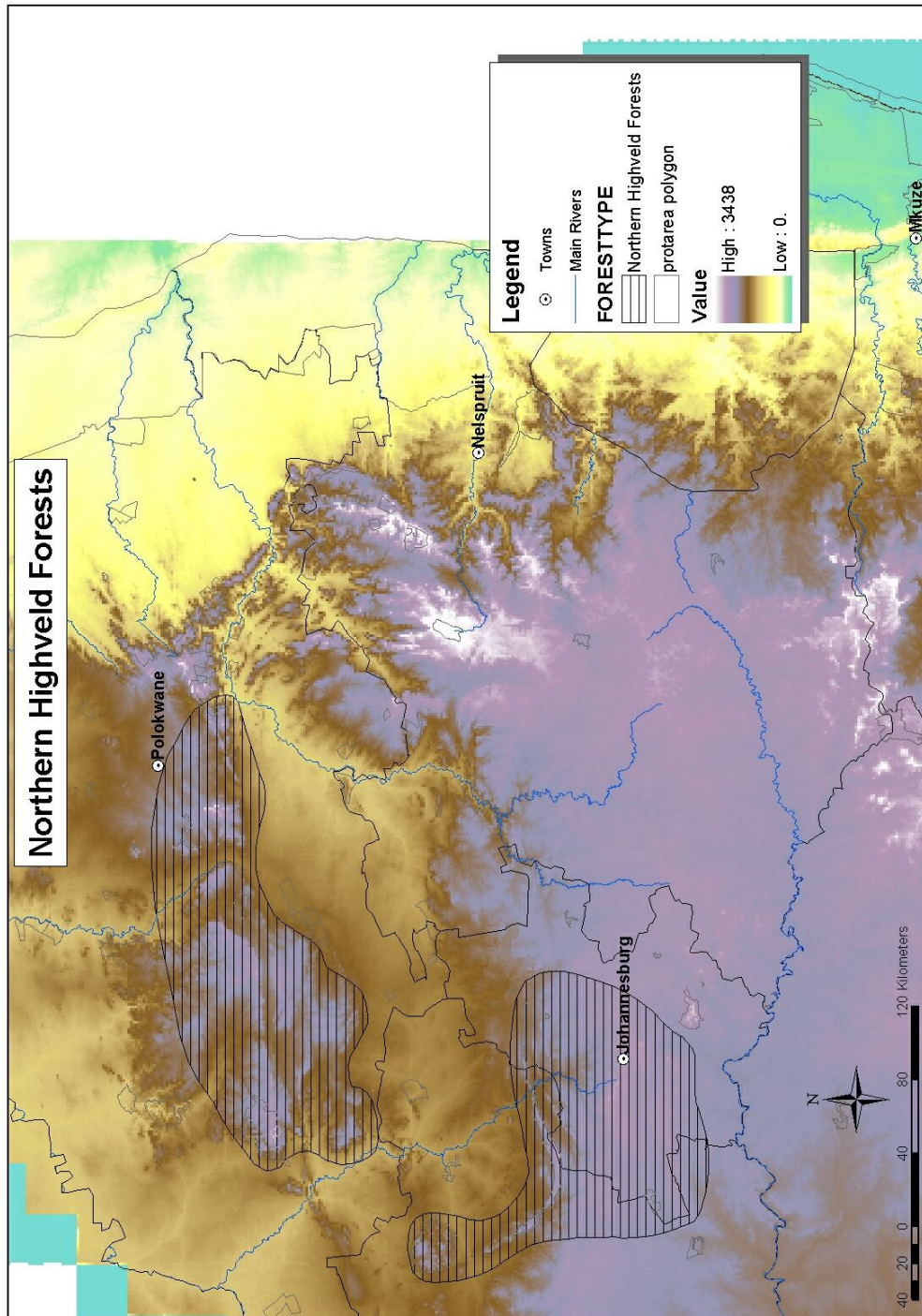
Vegetation Structure & Texture

Stand Structure

Generally 8-15 m tall depending on local community; dominated by *Celtis africana*, *Olea europaea* subsp. *africana*, *Rhus lectodyctya*, *R. lancea*, *Kirkia wilmsii* and *Combretum erythrophyllum* (especially in riverine habitats). Shrubs and small trees such as *Abrus laevigatus*, *Buxus macowanii*, *Calpurnia aurea*, *Canthium gilfillanii*, *Diospyros whyteana*, *Euclea natalensis*, *Grewia occidentalis*, *Maytenus undata*, *Myrsine africana*, *Ochna holstii*, *Osyris lanceolata*, *Pterocelastrus rostratus*, *Tricalysia lanceolata*, *Zanthoxylum capense* are characteristic of the understorey and shrub strata. The most common lianas include *Secamone alpini*, *S. filiformis*, *Rhoicissus tridentata* and biogeographically important *Cryptolepis transvaalensis*. *Achyranthes aspera*, *Asplenium spendens*, *Cheilanthes viridis*, *Cyperus leptocladus*, *Hypoestes forskaolii*, *Pellaea calomelanos*, *Plectranthus fruticosus*, *Setaria lindenberiana* and *Solanum giganteum* are important constituents of the herb layer. Drought-tolerant ferns often dominate this layer.

Map

We do not have detailed mapped forests of this forest type. The included map shows the general area where this type is likely to occur. Most of the area does not provide suitable habitat, and the dots indicate the mountain ranges where the forest type is most likely to find suitable habitats.



Diversity Patterns

Westfall et al. (1985) noted that the Waterberg forests are relative species poor (11-23 species per plot; plot size needed otherwise relatively meaningless statistic). However, Van Staden's data (2002) from the same region show higher species diversity – 28 and 34 species in plots of the *Buxus macowanii*-*Kirkia wilmsii* Low Forest and the *Olea europaea*-*Calpurnia aurea* Tall Closed Woodland, respectively.

Ecology

Altitude & Geomorphology

The Northern Highveld Forests are found in climatic refugia such as deep kloofs and steep slopes facing SW and S (e.g., *Olea europaea*-*Calpurnia aurea* Tall Closed Woodland; Van Staden 2002) or N and NW (*Ficus pretoriae*-*Urera tenax* Forest; Coetzee 1975. *Buxus macowanii*-*Kirkia wilmsii* Low Forest; Van Staden 2002). The kloof streams are mostly non-perennial. These habitats provide fire protection and/or a favourable water regime. These forests are most frequently found at altitudes between 1500-1600 m, however they are also found at higher altitudes in the Waterberg (1850 m) and Suikerbosrand (1750 m), and at lower altitudes, such as 1000-1100 m in the Waterberg (Westfall et al. 1985, Van Staden 2002). Floristically very similar forests are found on narrow, flat alluvia of some Central Bushveld rivers (Van der Meulen 1979, Van Staden 2002).

Geology & Soil

The Northern Highveld Forests are variously located on sandstones (Westfall et al. 1985, Van Staden 2002), diabases (Coetzee 1975, Westfall et al. 1985), quartzites (Coetzee 1974, 1975, Bredenkamp & Theron 1978, Behr & Bredenkamp 1988, Ellery et al. 2001), and volcanic rocks of the Ventersdorp System (Bredenkamp & Theron 1980). The sandstones support shallow and skeletal (30-50 % surface rocks) Mispah soils, while diabases support soils of the Shortlands Form.

Climate

The scale of distribution of this forest type makes it difficult to generate general climatic profiles. The forests are in summer rainfall areas with hot days, but cool nights, particularly in winter. Their distribution is in relatively arid areas for forests.

Disturbance

No data was obtained for this poorly defined forest type.

Biogeographic Affinities

The Northern Highveld Forests are a relictual forest type in a progressed stage of "erosion" from the original Afromontane composition. They are considered remnants of the so called "Magaliesburg Extension" (White 1978) - an Afromontane (forest) intrusion linking the forests of Northern Escarpment to those found in sheltered sites of the Central Bushveld and Northern Highveld regions. *Calpurnia aurea* subsp. *aurea* (see Beaumont et al. 1999), many species of *Plectranthus* (Codd 1985), moss *Racopilum capense* (Magill & Van Rooy 1998), fern *Cheilanthes viridis* (Schelpe & Antony 1986), *Cryptocarya transvaalensis* and *Acacia ataxacantha* (just to name few) are good indicators of this former connection. These forests are Afrotropical (Afromontane) in character, however Holocene climate changes have caused their confinement to fire-sheltered habitats and a concomitant decline in forest elements, but an increase in woodland elements.

The classification of this fragmentary Afromontane type is controversial due to its marginal position straddling the Afrotropical forests and highveld woodlands. There is a continuous transition between the kloof and alluvial forests with *Combretum erythrophyllum* and savanna thickets occurring close to larger water bodies ("*Berchemia zeyheri*-*Combretum erythrophyllum*-bosgroep", Van Rooyen 1983). There is also high floristic similarity between some kloof forest communities described by Van Staden (2002) and thickets (or bush clumps as they are called sometimes) found on termitaria ("*Rhus leptodictya*-*Mimusops zeyheri* Termitaria

Thickets", Van Staden 2002). Termitaria are known to increase water infiltration and percolation, as well as nutrient availability, compared to the surrounding savanna woodlands (Van der Meulen 1979). Therefore, termitaria tend to support dense vegetation (thickets) in which the woodland elements prevail; however some forest elements are found as well.

Low diversity of woody element places this type close to Drakensberg Montane Forests and Northern KwaZulu-Natal Mistbelt Forests, and in particular to the floristic vicinity of the sympatric Marekele Afromontane Forests.

The distribution of the shrub *Buxus macowanii* is of biogeographic interest. This species is restricted to coastal forests of the Eastern Cape (Alexandria, Murray by East London) and forms an outlying population in the Waterberg region (Coates Palgrave 1983).

Communities/Subunits

A formal analysis yields two sub-types to which we assign the preliminary labels: **II2a Northern Highveld Kloof Forests** and **II2b Central Bushveld Riverine Forests**. Although obviously found in different landscape settings (the former more in deep kloofs, while the latter on narrow river alluvia), the floristic similarity of the sub-types is high. The protected kloofs serve as drainage lines of intermittent (in some cases also permanent) water courses and provide similar ecological conditions to narrow alluvia along some rivers of the Central Bushveld area. As a result, both subtypes share a number of forest woody elements as well as sciophyllous (shade-tolerant) species typical of forest understorey.

II2a: Northern Highveld Kloof Forests

<i>Mimusops-Chrysophyllum</i> Community	Van Vuuren (1961)
<i>Acalypha glabrata</i> Community	Van Vuuren (1961)
<i>Croton</i> Community	Van Vuuren (1961)
Kloof Forest	Coetzee (1974)
<i>Acalypha glabrata-Dombeya rotundifolia</i> Forest	Coetzee (1975)
<i>Ficus pretoriae-Urera tenax</i> Forest	Coetzee (1975)
<i>Rhus pyroides-Buddleia salviifolia-Celtis africana</i> Forest	
<i>Rhus pyroides-Buddleia salviifolia</i> Forest	Bredenkamp & Theron (1978) Bredenkamp & Theron (1978)
<i>Rhus pyroides-Rhamnus prinoides</i> Forest	Bredenkamp & Theron (1980)
<i>Diospyros whyteana-Myrsine africana</i> Kloof Forest	Van der Meulen (1979)
<i>Erythrina lysistemon-Celtis africana</i> Kloof Forest	Westfall et al. (1985)
<i>Oxyris lanceolata-Celtis africana</i> Kloof Forest	Westfall et al. (1985)
<i>Asplenium splendens-Celtis africana</i> Kloof Forest	Westfall et al. (1985)
<i>Combretum erythrophyllum-Celtis africana</i> Major Community	Behr & Bredenkamp (1988)
<i>Celtis africana</i> Forest	Ellery et al. (2001)
<i>Buxus macowanii-Kirkia wilmsii</i> Low Forest	Van Staden (2002)
<i>Olea europaea-Calpurnea aurea</i> Tall Closed Woodland	Van Staden (2002)

II2b: Central Bushveld Riverine Forests

Riparian Forest	Coetzee (1974)
<i>Combretum erythrophyllum-Acacia karroo</i> Association	Van der Meulen (1979)
<i>Celtido africanae-Combretum eruthrophylli</i>	Siebert (2001)

Dominant & Diagnostic Plant Species

Notes: Afrotperate: typical Afrotperate elements; alluvia: dominant on alluvial soils of rivers within Savanna Biome; Bushveld: found predominantly in savanna woodlands; Subtropical: found in both subtropical forests and woodlands.

L	S	D	Latin Name	Note
Tc	d		<i>Celtis africana</i>	
Tc	d		<i>Combretum erythrophyllum</i>	Bushveld, alluvia
Tc	d	D	<i>Kirkia wilmsii</i>	Bushveld
Tc	d		<i>Olea europaea</i> subsp. <i>africana</i>	
Tc	d	D	<i>Rhus lancea</i>	
Tc	d		<i>Nuxia congesta</i>	
Tu	d		<i>Calodendrum capense</i>	
Tu	d	D	<i>Rhus leptodyctya</i>	Bushveld
Tu			<i>Acacia ataxacantha</i>	Afrotperate
Tu			<i>Acacia karroo</i>	
Tu			<i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	Afrotperate
Tu			<i>Berchemia zeyheri</i>	Bushveld
Tu			<i>Cussonia paniculata</i>	Bushveld
Tu			<i>Dombeya rotundifolia</i>	Bushveld
Tu			<i>Dovyalis zeyheri</i>	Bushveld
Tu			<i>Mimusops zeyheri</i>	Bushveld
Tu			<i>Pappea capensis</i>	
Tu			<i>Pittosporum viridiflorum</i>	Afrotperate
Tu			<i>Zanthoxylum capense</i>	Afrotperate
TuSt			<i>Ficus sur</i>	
TuSt			<i>Ficus thonningii</i>	
TSuc			<i>Euphorbia ingens</i>	Bushveld
ST	d		<i>Acalypha glabrata</i>	
ST	d		<i>Buddleja salviifolia</i>	Afrotperate
ST	d		<i>Buxus macowanii</i>	Subtropical
ST	d		<i>Calpurnia aurea</i> subsp. <i>aurea</i>	
ST	d		<i>Diospyros lycioides</i>	
ST	d		<i>Diospyros whyteana</i>	Afrotperate
ST	d		<i>Erythrina lysistemon</i>	Bushveld
ST	d		<i>Euclea crispa</i>	
ST	d		<i>Gymnosporia buxifolia</i>	
ST	d		<i>Heteromorpha arborescens</i>	Afrotperate
ST	d		<i>Rhus pyroides</i>	
ST	d		<i>Ziziphus mucronata</i> subsp. <i>mucronata</i>	
ST			<i>Acacia caffra</i>	Bushveld
ST			<i>Acokanthera oppositifolia</i>	
ST			<i>Buddleja saligna</i>	Afrotperate
ST			<i>Heteropyxis natalensis</i>	
ST			<i>Leucosidea sericea</i>	Afrotperate
ST			<i>Maytenus undata</i>	
ST			<i>Obetia tenax</i>	Bushveld
ST			<i>Ochna pretoriensis</i>	Bushveld
ST			<i>Rhamnus prinoides</i>	
ST			<i>Vangueria infausta</i>	Bushveld
S	d	D	<i>Achyroopsis avicularis</i>	Bushveld
S	d	D	<i>Osyris lanceolata</i>	Bushveld
S	d		<i>Myrsine africana</i>	Afrotperate

S	d		<i>Tricalysia lanceolata</i>	Afrotemperate
S			<i>Carissa bispinosa</i> subsp. <i>zambesiaca</i>	
S			<i>Croton gratissimus</i>	Bushveld
S			<i>Grewia occidentalis</i>	
S		D	<i>Sida dregei</i>	Bushveld
Ssuc			<i>Euphorbia tirucalli</i>	
SCw			<i>Rubus rigidus</i>	Afrotemperate
Cw		D	<i>Abrus laevigatus</i>	Bushveld
Cw			<i>Asparagus suaveolens</i>	
Cw			<i>Asparagus virgatus</i>	
Cw			<i>Clematis brachiata</i>	
Cw			<i>Cryptocarya transvaalensis</i>	Afrotemperate
Cw		D	<i>Neotonia wrightii</i>	Bushveld
Cw			<i>Rhoicissus tridentata</i>	
Cw			<i>Secamone alpini</i>	
Cw			<i>Secamone filiformis</i>	
Ssoft	d		<i>Isoglossa grantii</i>	
Ssoft	d		<i>Plectranthus fruticosus</i>	
Ssoft			<i>Hypoestes aristata</i>	
Ssoft			<i>Hypoestes forskoolii</i>	
Ssoft			<i>Pavonia burchellii</i>	
Ssoft			<i>Schisostephium heptalobum</i>	
Ssoft			<i>Teucrium trifidum</i>	
H			<i>Achyranthes aspera</i>	
H			<i>Agrimonia procera</i>	
H		D	<i>Cynoglossum lanceolatum</i>	
H			<i>Galopina circaeoides</i>	
Hcr			<i>Dolichos falciformis</i>	
Hf			<i>Asplenium spendens</i>	
Hf			<i>Cheilanthes viridis</i>	
Hf			<i>Pellaea calomelanos</i>	
Hg			<i>Scadoxus puniceus</i>	
Ch		D	<i>Asparagus transvaalensis</i>	Bushveld
Ch		D	<i>Rubia petiolaris</i>	
Ehp			<i>Cuscuta campestris</i>	
G	d		<i>Carex spicato-paniculata</i>	
G	d		<i>Cyperus leptocladus</i>	
G	d		<i>Ehrharta erecta</i>	
G			<i>Cyperus albostriatus</i>	
G			<i>Panicum maximum</i>	Bushveld
G			<i>Paspalum urvillei</i>	
G			<i>Schoenoxiphium lehmannii</i>	Afrotemperate
G			<i>Setaria linderbergiana</i>	
G			<i>Setaria megaphylla</i>	
Gcr			<i>Oplismenus hirtellus</i>	

Common aliens

Tc	d	A	<i>Melia azedarach</i>
Tc		A	<i>Populus alba</i>
H		A	<i>Bidens pilosa</i>
H		A	<i>Oenothera rosea</i>
H		A	<i>Tagetes minuta</i>
H		A	<i>Xanthium strumarium</i> complex

Typical & Endemic Animal Species

Table. Forest dependent bird, mammal, frog and reptile species in the Northern Afrotemperate Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, E – endemic, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Buffspotted flufftail	<i>Sarothrura elegans</i>	C	Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Tambourine dove	<i>Turtur tympanistria</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Cape parrot	<i>Poicephalus robustus</i>	Cl	Birds	LP, Mp, inland EC & KZN
Knysna lourie	<i>Tauraco corythaix</i>	C	Birds	EC, KZN, MP, NP
Emerald cuckoo	<i>Chrysococcyx cupreus</i>	Cm	Birds	LP, Mpu, KZN, EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape
Scalythroated honey guide	<i>Indicator variegatus</i>	Cf	Birds	e. Mp, coastal EC & KZN
Olive woodpecker	<i>Mesopicos griseocephalus</i>	Cf	Birds	Widespread
Grey cuckooshrike	<i>Coracina caesia</i>	U	Birds	Widespread
Squaretailed drongo	<i>Dicrurus ludwigii</i>	C	Birds	Mp, coastal EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Yellowstreaked bulbul	<i>Phyllastrephus flavostriatus</i>	Cf	Birds	Ngoye forest north to e.Mp
Yellowbellied bulbul	<i>Chlorocichla flaviventris</i>	C	Birds	Coastal n. EC & KZN
Orange thrush	<i>Zoothera gurneyi</i>	Cf	Birds	LP, Mp, KZN, EC
Chorister robin	<i>Cossypha dichroa</i>	Cl	Birds	LP, Mp, KZN, EC
Starred robin	<i>Pogonocichla stellata</i>	Cl	Birds	LP, Mp, KZN, EC
Brown robin	<i>Erythropygia signata</i>	Cl	Birds	e. Mp, coastal EC & KZN
Yellowthroated warbler	<i>Seicercus ruficapillus</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Barthroated apalis	<i>Apalis thoracica</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>	Cl	Birds	LP, Mp, KZN, EC, S.Cape
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Green twinspot	<i>Mandingoa nitidula</i>	Cl	Birds	LP, Mp, KZN, EC
Forest canary	<i>Serinus scotops</i>	Cl	Birds	LP, Mp, KZN, EC
Samango monkey	<i>Cercopithecus mitis</i>		Mammals	LP, EC, KZN
Giant rat	<i>Cricetomys gambianus</i>		Mammals	LP
Woodland mouse	<i>Grammomys dolichurus</i>		Mammals	LP, Mp, KZN, EC
Woodland dormouse	<i>Graphiurus murinus</i>		Mammals	Widespread
Dark-footed forest shrew	<i>Myosorex cafer</i>		Mammals	LP, Mp, KZN, EC
Natal ghost frog	<i>Heleophryne natalensis</i>		Frogs	LP, Mp, KZN, EC
Transvaal forest rain frog	<i>Breviceps sylvestris</i>		Frogs	LP
Clicking stream frog	<i>Strongylopus grayii</i>		Frogs	Widespread
Giant legless skink	<i>Acontias plumbeus</i>	E	Reptiles	LP, e. Mp, n. KZN, East London
Natal purple-glossed snake	<i>Amblyodipsas concolor</i>	E, R	Reptiles	e. Mp, KZN

Conservation & Management

Use, Value & Conservation Status

There are insufficient data to assess either the extent of use or conservation status of this forest type. Many of these forest patches are, however, found within conservation areas (Magaliesberg, Marekele, Pilanesberg N.P., Merville Ridge N.R., Suikerbosrand N.R.) and serve as important recreation areas especially in Gauteng Province (some of them are found within the metropolitan regions of Johannesburg and Pretoria).

Main Threats

- ⇒ development of sub-urban settlements
- ⇒ occasional woodland fires
- ⇒ bark stripping and other types of harvesting for medicinal purposes

Other Management Considerations**Key References**

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II3: Drakensberg Montane Forests

Synonyms

<i>Podocarpus</i> Forest	Roberts (1963)
Mountain <i>Podocarpus</i> Forest	Edwards (1967)
Montane <i>Podocarpus</i> Forest	Moll (1967, 1976)
Undifferentiated Afromontane Forest p.p.	White (1983)
Montane <i>Podocarpus</i> Forest	Cooper (1985)
Highland Sourveld p.p.	Acocks (1988)
Transkei and Natal Montane Forests p.p.	Phillipson & Russell (1988)
Western Forests - Montane Forests	MacDevette et al. (1989)
Montane <i>Podocarpus</i> Forest	Everard (1992)
Montane <i>Podocarpus</i> Forest	Everard et al. (1995)
Mountain <i>Podocarpus</i> Forest	Hill (1996)
Afromontane Forest p.p.	Low & Rebelo (1998)
Drakensberg Montane Forests	Bailey et al. (1999)

Profile

The Drakensberg Montane Forests are afromontane forests of high-altitude (roughly between 1500-1800 m), with a relatively species-poor canopy dominated usually by *Olinia emarginata*, *Podocarpus latifolius* and *Scolopia mundii* (in drier facies also by *Pittosporum viridiflorum*). They are found as small-sized patches in fire refugia such as the narrow gorges, lower scarps and slopes, and just below the cliffs below table lands or plateaux of the Drakensberg (KwaZulu-Natal and Free State). In the latter location (below cliffs) they appear as hanging forests below the cliffs between a ridge on either side. All are surrounded by vegetation of the Grassland Biome (grasslands, riparian thickets, shrublands, wetlands).

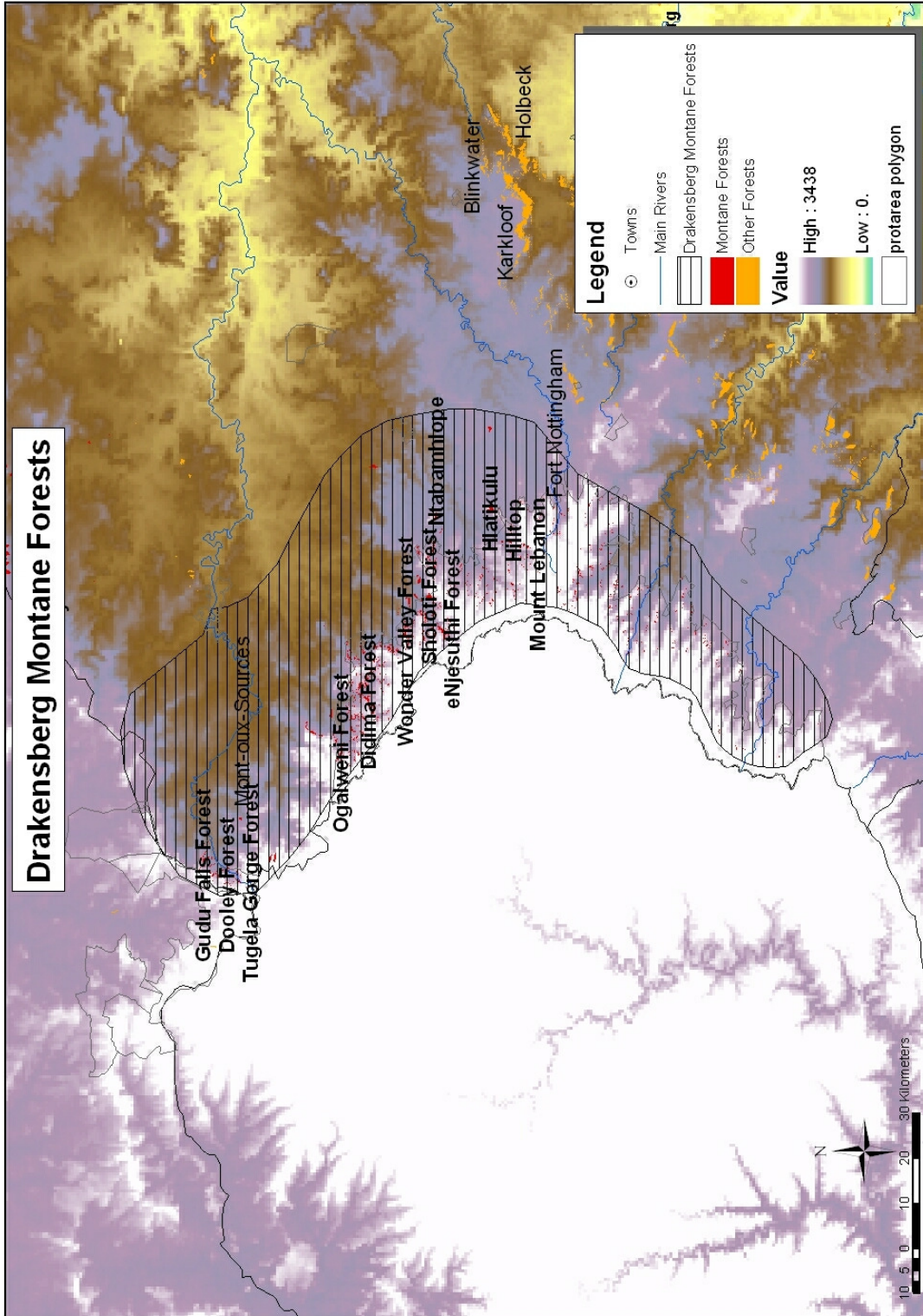
Distribution

Forests of this Forest Type are found at the foot of the Drakensberg (uKhahlamba) Mountains in the form of a widely scattered archipelago, roughly from the Underberg region in western KwaZulu-Natal towards the northern slopes of the Free State Drakensberg (Maluti). The northern areas (Royal Natal, Cathedral Peak and Monks Cowl in the Bergville area) have considerably more and larger forest patches than the southern areas (Cobham to Bushmen's Nek in the Underberg area). Drakensberg Montane Forests occur further along the Low Drakensberg escarpment including forest patches between Oliviershoek Pass and Van Rheenen's Pass.

Known Forests

Bezuidenhout's Pass	KwaNdema (Cathkin Park) (complex)
Cathedral Peak (complex)	Leopard Dale
Danger Point (Korannaberg)	Little Switzerland
Giant's Castle Reserve (complex)	QwaQwa (complex)
Hlatikulu (complex) near Kamberg	Mdlankomo (complex)
Injasuti (complex)	Mpokelana

Map



Mweni	Solitude
Ndidima (Dedema)	Sterkwater
Nelson's Kop	Still Kranz
Ntabamhlope (Thabamhlope)	Van Rheenen's Pass (complex)
Platberg (at Harrismith)	Wonder Valley
Royal Natal Park complex (incl. Gudu bush)	Wonderhoek (Golden Gate N.P.)

Vegetation Structure & Texture

Stand Structure

Drakensberg Montane Forests have a relatively uneven canopy surface due to the steepness of the terrain where they grow. Generally there is one tree layer, and an absent shrub layer. When present, the shrub layer is open to dense. The canopy is dominated by *Podocarpus latifolius* and a mixture of other species such as *Olinia emarginata*, *Rapanea melanophloeos*, *Scolopia mundii* and *Kiggelaria africana*. Trees are often multi-stemmed with crooked stems. The ground vegetation consists of sparse to dense cover of graminoid (grass and/or sedges) or *Asparagus plumosus/setaceus*, or ferns. The underlying rocky ground is generally covered with moss.

Diversity Patterns

The number of species in the canopy is generally lower than forests lower down (Eastern Mistbelt Forests), and even the understorey has a low number of species in any one site (Geldenhuys & MacDevette 1989). The mean number of species per 0,1 ha plot of 59 (range 46 – 68) was lower than the mean of 79 (range 62 – 91) for the Eastern Mistbelt Forests. Species richness per 0,1 ha plot of different growth forms was also lower – the numbers for the Drakensberg Montane Forests are as follows: trees and shrubs, 21-29; lianes, 4-6; vines, 5-7; forbs, 7-11; epiphytes, 2-3; and ferns, 4-14. However, very little specific plot-based data are available.

Trap success of small mammals was lower in forest than in any of the scrub habitats in the Giants Castle Game Reserve (Rowe-Rowe & Meester 1982).

Ecology

Altitude & Geomorphology

Drakensberg Montane Forests occur at high altitudes (1200 to 2000 m). They occur below the tablelands and plateaux of the Little Berg, below the cliffs formed by the Cave Sandstone (Clarens Formation), on steep, mainly south-facing and southeast-facing slopes, often between the ridges running down into the lowlands, and in the sheltered kloofs (gullies) in fire shadows. To a lesser extent they also occur on some sheltered north-facing slopes. The Nelson's Kop forest near Harrismith is the highest altitude forest in South Africa, just below the highest point of Nelson's Kop (a Cave Sandstone hill) at 2230 m above mean sea level (Cooper 1985). This forest island is 50 ha, and in 1985 was in a good condition, and dominated by *Podocarpus latifolius*, *Leucosidea sericea*, *Kiggelaria africana*, *Olinia emarginata* and *Dais cotinifolia*. Some species typical of these Drakensberg Montane Forests were absent from this forest.

Geology & Soils

The northern part (Royal Natal National Park to Golden Gate) is underlain by the Beaufort, Molteno, Elliot and Clarens Formations of the Karoo Sequence, with the Drakensberg Formation of basaltic lava on top (Du Preez et al 1991). The first three are alternate layers of silt- and mudstone, and medium- to coarse-grained sandstone. The Clarens Formation constitutes the characteristic yellowish Cave sandstone cliffs of fine- to medium-grained sands. The Karoo Sequence is intruded by numerous dolerite dykes and sills and their rapid weathering formed the narrow gorges. The soils are sandy, acid, and shallow, often on bolder scree. This description most likely also applies, in general terms, to the southern part of the Drakensberg towards Bushman's Nek.

Climate

These are high altitude forests and as such are relatively cool, but with great variability in temperature. Temperate and seasonal, with summer rainfall and occasional winter snowfall. Often occur in protected micro-climate that may be moister than surrounding areas.

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	830	2	22	14
Maximum	910	6	26	16

Disturbance

The forests are frost tolerant in the short-term but periodic disturbance occurs in the form of heavy snowfalls, causing canopy breaks. Rock falls, land slides and spot-fires occasionally clear large areas in the forest. Fire (natural and arson, and poor management of surrounding grasslands) causes abrupt forest margins and the occasional total burning of forest patches. If the area is protected against fire, forest communities start to regrow (Westfall, et al. 1983). Other human-induced disturbance is caused by cattle-grazing, ecotourism activities (paths and trails), and fuel wood collection.

Communities/Subtypes

* The classification of marked community within this forest type is uncertain.

*Xerocline Kloof Forest	Roberts (1961)
*Buddleja-Leucosidea Kloof Forest	Roberts (1961)
<i>Ehrharto-Eucleetum crispae</i>	Van Zinderen Bakker (1973)
<i>Peperomio-Carissetum</i>	Van Zinderen Bakker (1973)
Montane <i>Podocarpus</i> Forest	Cooper (1985)
<i>Ileci-Oleetum europaeae</i>	Du Preez & Bredenkamp (1991)
<i>Olea europaea-Euclea crispa</i> Forest Community	Du Preez & Bredenkamp (1991)
<i>Plumbago-Kiggelarietum africanae</i>	Du Preez & Bredenkamp (1991)
<i>Rhoo-Stipetum dregeanae</i>	Du Preez & Bredenkamp (1991)
<i>Scolopia mundii-Ilex mitis</i> Forest Community	Du Preez & Bredenkamp (1991)
<i>Clauseno-Podocarpetum latifolii</i>	Du Preez et al. (1991)
<i>Ehrharto-Eucleetum crispae</i>	Du Preez et al. (1991)
<i>Peperomio-Carissetum</i>	Du Preez et al. (1991)
Montane <i>Podocarpus</i> Forest	Everard (1992)
Montane <i>Podocarpus</i> Forest	Everard et al. (1995)
Mountain <i>Podocarpus</i> Forest	Hill (1996)

Biogeographic Affinities

The Drakensberg Montane Forests represent sites of extreme cold during winter. The species present here would be species from the southern African forest species pool that can tolerate such extreme temperature conditions. Most of the species listed are also present in the Mistbelt group of forests, as well as Scarp and some Coastal forests, i.e. species of wide tolerance ranges/limits. The Drakensberg Montane Forests share 63% of woody species (based on the data of Killick 1963) with the Southern Cape Forests, 78% with the Amatole Mistbelt Forests, 68% with the Eastern Mistbelt Forests (data of Cawe 1986), and 50-60% with the forests in the Mpumalanga and North-eastern Escarpment (Geldenhuys 1992).

Dominant & Diagnostic Plant Species

L	S	D	Latin Name	Note
Tce	d		<i>Olinia emarginata</i>	
Te			<i>Podocarpus falcatus</i>	
Tc	d		<i>Ilex mitis</i>	
Tc	d		<i>Podocarpus latifolius</i>	
Tc	d		<i>Scolopia mundii</i>	
Tc			<i>Apodytes dimidiata</i>	
Tc			<i>Celtis africana</i>	
Tc			<i>Ekebergia capensis</i>	
Tc			<i>Kiggelaria africana</i>	
Tc			<i>Rapanea melanophloeos</i>	
Tc			<i>Calodendrum capense</i>	
Tu	d		<i>Maytenus acuminata</i>	
Tu	d		<i>Maytenus undata</i>	
Tu	d		<i>Olea europaea</i> subsp. <i>africana</i>	
Tu	d		<i>Pterocelastrus rostratus</i>	
Tcu	d		<i>Halleria lucida</i>	
Tcu	d		<i>Pittosporum viridiflorum</i>	
Tcu			<i>Maytenus peduncularis</i>	
Tu			<i>Canthium mundianum</i>	
Tu			<i>Pterocelastrus echinatus</i>	
Tu		C	<i>Scolopia flanaganii</i>	near-endemic
Tu			<i>Trimeria grandifolia</i>	
ST	d		<i>Diospyros whyteana</i>	
ST	d		<i>Euclea crispa</i> subsp. <i>crispa</i>	
ST	d	D	<i>Leucosidea sericea</i>	
ST			<i>Acokanthera oppositifolia</i>	
ST			<i>Bowkeria verticillata</i>	
ST			<i>Burchellia bubalina</i>	
ST			<i>Canthium ciliatum</i>	
ST			<i>Cryptocarya woodii</i>	
ST			<i>Dais cotinifolia</i>	
ST			<i>Erythroxyllum emarginatum</i>	
ST			<i>Greya sutherlandii</i>	
ST			<i>Gymnosporia buxifolia</i>	
ST			<i>Heteromorpha trifoliata</i>	
ST			<i>Hippobromus pauciflorus</i>	
ST		C	<i>Myrsine pillansii</i>	near-endemic
ST			<i>Osyris lanceolata</i>	
ST			<i>Rhamnus prinoides</i>	
ST			<i>Trimeria trinervis</i>	
S			<i>Acalypha punctata</i>	
S			<i>Buddleja salviifolia</i>	Pioneer on forest margins
S			<i>Carissa bispinosa</i> subsp. <i>zambesiaca</i>	
S		D	<i>Cliffortia nitidula</i>	near-endemic
S			<i>Myrsine africana</i>	
S			<i>Rubus rigidus</i>	
S			<i>Clutia pulchella</i>	
SCw	d		<i>Cassinopsis ilicifolia</i>	
Ssoft	d		<i>Plectranthus grallatus</i>	
Cw			<i>Asparagus asparagoides</i>	
Cw			<i>Clematis brachiata</i>	
H			<i>Begonia sutherlandii</i>	
H		D	<i>Senecio oxyriifolius</i>	
H			<i>Streptocarpus gardenia</i>	
H			<i>Streptocarpus haygardii</i>	
H			<i>Streptocarpus pentherianus</i>	

H	C	Streptocarpus polyanthus subsp. Dracomontanus	endemic
H		Streptocarpus pusillus	
Hcr		Diclis reptans	
H(e)		Peperomia retusa	
Hf		Adiantum capillus-veneris	
Hf		Asplenium aethiopicum	
Hf		Asplenium cordatum	
Hf		Asplenium monanthes	
Hf		Blechnum punctulatum	
Hf		Dryopteris inaequalis	
Hf		Dryopteris pentheri	type: Van Rheenen's Pass
Hf		Lepisorus schraderi	
Hf		Mohria caffrorum	
Hf	C	Mohria nudiuscula	endemic (Mnweni)
Hf		Pleopeltis macrocarpa	
Hf		Polystichum luctosum	
Hf		Polystichum pungens	
Hf		Polystichum transvaalense	
Hf		Polystichum X saltum	type: Royal Natal N.P. (Gudu Bush)
Hf		Pteris catoptera	
Hf		Pteris dentata	
Hg		Dietes iridioides	
Hg		Haemanthus humilis	
Hg		Scadoxus puniceus	
Hg		Oxalis depressa	
Hsuc	D	Crassula pellucida	
G		Ehrharta erecta	
G		Stipa dregeana	
G		Schoenoxiphium sparteum	
Gcr	d	Oplismenus hirtellus	
Gb	D	Thamnocalamus tessellatus	
M		Weissiopsis pulcheretis	endemic (Gudu Bush)

Typical & Endemic Animals

Table. Forest dependent bird, mammal, frog and reptile species in the Drakensberg Montane Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution	
Crowned eagle	<i>Stephanoaetus coronatus</i>		Birds	C	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>		Birds	C	Widespread
Buffspotted flufftail	<i>Sarothrura elegans</i>		Birds	C	WC, coastal & inland KZN, EC
Rameron pigeon	<i>Columba arquatrix</i>		Birds	Cl	Widespread
Cinnamon dove	<i>Aplopelia larvata</i>		Birds	C	LP, Mp, KZN, EC, WC
Wood owl	<i>Strix woodfordii</i>		Birds	Cf	Widespread
Olive woodpecker	<i>Mesopicos griseocephalus</i>		Birds	Cf	Widespread
Grey cuckooshrike	<i>Coracina caesia</i>		Birds	U	Widespread
Bush blackcap	<i>Lioptilus nigricapillus</i>		Birds	U	LP, Mp, inland EC & KZN
Chorister robin	<i>Cossypha dichroa</i>		Birds	Cl	LP, Mp, KZN, EC
Starred robin	<i>Pogonocichla stellata</i>		Birds	Cl	LP, Mp, KZN, EC
Yellowthroated warbler	<i>Seicercus ruficapillus</i>		Birds	C	LP, Mp, KZN, EC, S.Cape
Barthroated apalis	<i>Apalis thoracica</i>		Birds	C	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>		Birds	C	LP, Mp, KZN, EC, S.Cape

Common name	Scientific name	Status	Taxon	Distribution
Olive bush shrike	<i>Telophorus olivaceus</i>		Birds CI	LP, Mp, KZN, EC, S.Cape
Forest canary	<i>Serinus scotops</i>		Birds CI	LP, Mp, KZN, EC
Woodland dormouse	<i>Graphiurus murinus</i>		Mammals	Widespread
Natal ghost frog	<i>Heleophryne natalensis</i>		Frogs	LP, Mp, KZN, EC
Plaintive rain frog	<i>Breviceps verrucosus</i>		Frogs	KZN, EC
Natal chirping frog	<i>Arthroleptella hewitti</i>		Frogs	Inland s.KZN
Clicking stream frog	<i>Strongylopus grayii</i>		Frogs	Widespread

Conservation & Management

Use & Value

Drakenberg Montane Forest generally has a low biodiversity value due to the typical impoverishment of the tree layer. In the herb layer, however, several biogeographically interesting taxa of *Streptocarpus* (*Gesneriaceae*) are found. Its socio-economic value is increasing as local communities are harvesting more indigenous fuel wood since the Working for Water Programme has removed much of the alien woody vegetation in the region of distribution of this Forest Type. It has a relatively high ecosystem value in terms of catchment and stream headwater protection and by providing refuge areas for wildlife from surrounding habitats during periods of snowfall and fires.

Conservation Status

Drakensberg Montane Forests are generally well preserved in nature reserves of Ezemvelo KZN Wildlife uKhahlamba-Drakensberg Park. Here they are managed largely by default (the surrounding grassland being more actively managed) under a protectionist paradigm. Larger patches occur also on private or community land. In the Free State some of these forests are found within Golden Gate Highlands National Park and QwaQwa National Park. The extent of this forest type ranges from 900 ha (forest biome map) to 2600 ha NLC. Of this, 57% to 51% is conserved for the two data sets respectively.

Main Threats

- ⇒ Community harvesting of timber and non-timber forest products, particularly fuel wood since the Working for Water programme has removed much of the woody alien vegetation that previously provided a ready supply.
- ⇒ Inappropriate fire management and overgrazing by cattle in the surrounding grassland.

Other Management Considerations

- ⇒ Management of the surrounding grassland (especially fire management) can impact on these forest patches. Many of the forest margins are abrupt (hard), making the forests more vulnerable to fire penetration;
- ⇒ Ecotourism: Primarily trail design and control of people numbers to control erosion on the steep terrain, and trampling of feeder roots and soil compaction on the shallow soils;
- ⇒ Harvesting of fuel wood, poles and laths by local communities and cattle grazing on surrounding grassland and inside the forests;
- ⇒ These forests occur on the main drug trade routes and lower strata may be cleared in some areas for dagga (*Cannabis sativus*) growing under the forest canopy.
- ⇒ In general, Drakensberg Montane forests are probably under less pressure than Eastern Mistbelt forests as their location on steep slopes makes them less accessible.

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II4: Northern KwaZulu-Natal Mistbelt Forests

Synonyms

Mist Belt Mixed <i>Podocarpus</i> Forest p.p.	Edwards (1967)
Mistbelt Mixed <i>Podocarpus</i> Forest p.p.	Moll (1972)
Undifferentiated Afromontane Forest p.p.	White (1983)
Transkei and Natal Montane Forests p.p.	Phillipson & Russell (1988)
Mist Belt Mixed <i>Podocarpus</i> Forest p.p.	Cooper (1985)
Afromontane Forest p.p.	Low & Rebelo (1998)

Profile

Northern KwaZulu-Natal Mistbelt Forests are found along Low Drakensberg escarpment between Van Rheenen's Pass (near Harrismith) and Piet Retief as well as in southern Mpumalanga and northern KwaZulu-Natal (Vryheid region). These forests are usually dominated by *Podocarpus latifolius*, *P. falcatus*, *Dombeya burgessiae* (tall-grown types) or by *Xymalos monospora*, *Greyia sutherlandii*, *Canthium mundianum*, *Acacia caffra* (low-grown types). Co-occurrence of species such as *Acacia caffra*, *Barleria obtuse*, *Celtis africana*, *Cephalanthus natalensis*, *Clematis oweniae*, *Dais cotinifolia*, *Dalbergia obovata*, *Diospyros lycioides*, *Dombeya burgerssiae*, *Erythrina latissima*, *Greyia radlkoferi*, *G. sutherlandii*, *Heteromorpha trifoliata*, *Leucosidea sericea*, *Myrsine africana*, *Oxyacanthus speciosus* subsp. *gerrardii*, *Prosphytochloa prehensilis*, *Seemannaralia gerrardii* and *Sparmannia ricinocarpa* is a typical floristic feature of this Forest Type.

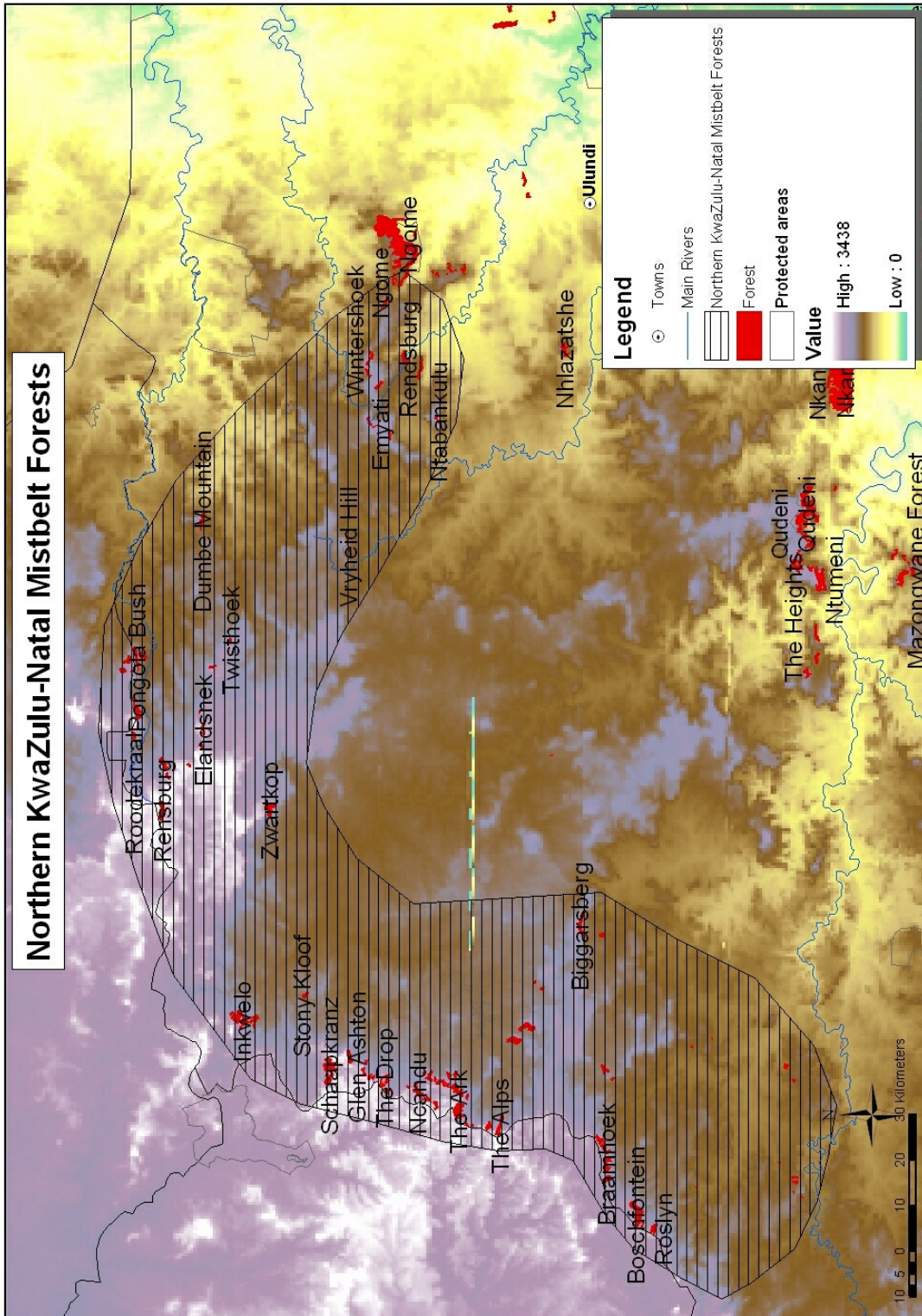
Distribution

Northern KwaZulu-Natal Mistbelt Forests form a widely scattered archipelago of isolated forest patches located at Low Drakensberg escarpment found between Van Rheenen's Pass (near Harrismith) and Piet Retief straddling the borders between Free State as well as southern Mpumalanga and KwaZulu-Natal. A group of forests in northern KwaZulu-Natal in the surroundings of Vryheid (Eckhardt et al. 1997). The Qudeni Forest and high-elevated parts of the extensive Ngome Forest of belong to this type probably as well. The occurrence of this Forest Type in Swaziland has not been confirmed so far, but can be considered as a possibility.

Known Forests

Amatiwani Gorge	Elandshoek
Amberley	Elandskop
Bazini	Engcobo
Benvie	Fafa
Biggarsberg	Ferncliff
Boschbokkloof	Flemington
Boschfontein North complex	Gala
Boscombei	Guquka
Braamhoek	Hamilton
Bush Kop	Hawkstone
Camden	Hlokozi
Carlisle	Hopedale
Clairmont/Mossbank complex	Ingudwini
Clundy Cleugh complex	Ingwe
Collins Pass	Jolivet
De Beer's Pass	Kwa Heri
Deluge	KwaCeza (Ceza)
Donkerhoek complex	KwaYili

Map



Liff	Qudeni
Lion's Bush	Qulashe
Majuba	Rensburg forest complex
Mandlangampisiberg	Request
McSorley	Rockcliff
Mikhanzeni	Sica
Mkombela Bush	Sikaka
Moyeni	Simakade
Mvuleni	Soada
Ncandu	Suurfontein
Ndanyana	Swartkop
New Forncett complex	The Alps
Newborough Grange	The Ark
Ngome (high-altitude parts)	Tintwa
Nhlazatshe	Tooihoogte
Nkhobeni	Trewirgie
Normandien	Underbush
Osgodsby	Vaalhoek
Overbury	Vryheid complex
Pinewoods	Willowstream Park
Pondwana/Mnyati complex	Xotsheyake
Pongolo Bush complex	Zingceka

Vegetation Structure & Texture

Stand Structure

High, multi-layered forest (approximately 15–20 m tall), comprising two layers of trees, a full, dense understorey and a very well developed herb layer. Species are predominantly single stemmed. These relatively species rich forests show a mix of coarse grain, canopy gap/disturbance driven dynamics and fine-grained, regeneration characteristics.

Diversity Patterns

Eckhardt et al. (1997) and Eckhardt (1998) found that some of the forest communities belonging to this Type (see the list of Communities/Subunits below) have 22 – 32 species per plot (200 m²). The Northern KwaZulu-Natal Forests appear to be the species-poorest mistbelt forest type of all.

Ecology

Altitude & Geomorphology

The communities of tall-grown forests classified within this mistbelt type occur mainly in fire shadows on steep south and southeast facing slopes, while the low-grown forest occurs in kloofs facing northward. The Northern KwaZulu-Natal Forests were found to occur at altitudes between 1200-1600 m (Eckhardt 1993, Eckhardt et al. 1997).

Geology & Soils

The geologic substrate of the forests on the Low Drakensberg and northern KwaZulu-Natal in the broad surroundings of supporting these forests are sandstones, shales and mudstones of Vryheid and Volksrust Formations. Soils forming under these circumstances are shallow (usually less than 20 cm deep) of Glenrosa and Mispah forms; surface of soils is covered often with thick layer of decaying humus and huge boulders – the surface skeleton can cover 20-80 % (Smith et al. 1995, Eckhardt et al. 1997, Eckhardt 1998).

Climate

The regions housing this Forest Type have a temperate climate with an annual rainfall of approximately 1100-1700 mm. Temperature and rainfall are seasonal, particularly in the more northerly regions and in KwaZulu-Natal these forests may experience 3–4 months without rain in winter and an average of 600 mm in summer. Heavy mists are characteristic in spring and summer, and occasional winter snow can also be a factor.

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	620	1	24	13
Maximum	1100	6	30	17

Disturbance

Most of the patches of these forests are small-sized, hence their edges suffer from frequent fires originated in surrounding grasslands. In places, grazing cattle seeks the protection of the forests and causes damage to soil and understorey (Smit et al. 1995).

Biogeographic Affinities

Floristic links of this Forest Type exists towards Mpumalanga Mistbelt Forest (I2), Eastern Scarp Forest (II1), and Drakensberg Montane Forest (I4). An important characteristic differentiating this Forest Type from the Eastern Mistbelt Forests is the presence of many elements typical of Scarp Forests, which qualifies this Forest Type as a member of the Northern Afrotropical Subgroup. Important species shared between the Mpumalanga Mistbelt Forests and the Northern KwaZulu-Natal Forests include: *Catha edulis*, *Greyia radlkoferi*, *Psyrax obovata* subsp. *elliptica*, *Prophytochloa prehensilis* and *Rhus transvaalensis*. *Xymalos monospora* is shared by this Forest Type and both the Eastern Mistbelt Forests and Mpumalanga Mistbelt Forests. *Podocarpus henkelii* (typical element of the Eastern Mistbelt Forests) reaches the Northern KZN Mistbelt Forest only marginally. The dominance of *Podocarpus latifolius* and important cover of species such as *Diospyros whyteana*, *Myrsine africana* and *Olinia emarginata* link this Forest Type and neighbouring Drakensberg Montane Forests.

This Forest Type is home of one endemic (*Scolopia oreophila*) species of tree and one near-endemic (*Scolopia flanaganii*; shared with Drakensberg Montane Forests).

Eckhardt et al. (1997) noted, that some of the forest communities of this Type have a strong “tropical” element. Among these species such as *Catha edulis*, *Dalbergia obovata*, *Ekebergia capensis*, *Erythrina latissima*, *Heteropyxis natalensis*, *Psyrax obovata* subsp. *elliptica*, *Ptaeroxylum obliquum* and *Trimeria grandiflora* deserve to be mentioned.

Subunits/Communities

Plectranthus hereroensis-Poa annua Low Closed Woodland	Eckhardt et al. (1993)
<i>Dais cotinifolia</i> - <i>Maytenus heterophylla</i> Forest	Smit et al. (1993)
<i>Podocarpus latifolius</i> - <i>Diospyros whyteana</i> Tall Forest	Smit et al. (1993)
<i>Diospyros lycioides</i> subsp. <i>lycioides</i> - <i>Myrsiphyllum ramosissimum</i> Tall Forest	Smit et al. (1995)
<i>Diospyros lycioides</i> subsp. <i>lycioides</i> - <i>Scadoxus puniceus</i> Short Forest	Smit et al. (1995)
<i>Diospyros lycioides</i> subsp. <i>lycioides</i> - <i>Dombeya burgersiae</i> Tall Forest	Smit et al. (1995)
<i>Rhamno prinoidis</i> - <i>Podocarpum latifolium</i>	Eckhardt et al. (1997)
<i>Buddleja salviifoliae</i> - <i>Podocarpum latifolium</i>	Eckhardt et al. (1997)
<i>Plectrantho grallati</i> - <i>Dalbergietum obovatae</i>	Eckhardt et al. (1997)
<i>Plectrantho grallati</i> - <i>Canthietum mundianum</i>	Eckhardt et al. (1997)
<i>Combretum kraussiana</i> - <i>Greyietum sutherlandii</i>	Eckhardt et al. (1997)
<i>Plectrantho fruticosi</i> - <i>Trimerietum grandifoliae</i>	Eckhardt et al. (1997)

Rapano melanophloeae-Greyietum sutherlandii
Clauseno anisatae-Greyietum sutherlandii

Eckhardt et al. (1997)
 Eckhardt et al. (1997)

Dominant & Diagnostic Plant Species

Note: Species also occurs in named forest type. Mistbelt: several types of mistbelt forest; "Scarp" indicates of subtropical elements in general (occurring mainly in both Scarp as well as Subtropical Coastal forests)

L	S	D	Latin Name	Note
Tce	d		<i>Podocarpus falcatus</i>	
Tce	d		<i>Podocarpus latifolius</i>	
Tc	d		<i>Celtis africana</i>	
Tc	d		<i>Curtisia dentata</i>	
Tc	d		<i>Cussonia spicata</i>	Mistbelt types
Tc	d		<i>Ekebergia capensis</i>	Scarp
Tc	d		<i>Scolopia mundii</i>	Drakensberg Montane
Tc	d		<i>Xymalos monospora</i>	Mpum. Mistbelt
Tc			<i>Calodendrum capense</i>	Eastern Mistbelt
Tc			<i>Combretum kraussii</i>	
Tc			<i>Gymnosporia peduncularis</i>	
Tc			<i>Ilex mitis</i>	Draken. Mont., E. Mistbelt
Tc			<i>Kiggelaria africana</i>	
Tc			<i>Ocotea bullata</i>	Eastern Mistbelt
Tc			<i>Podocarpus henkelii</i>	Eastern Mistbelt
Tc			<i>Rapanea melanophloeae</i>	
Tc			<i>Rhus chiridensis</i>	
Tc			<i>Rothmannia capensis</i>	
Tc			<i>Vepris lanceolata</i>	Scarp
Tu			<i>Acalypha glabrata</i>	Scarp
Tu			<i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	
Tu		C	<i>Scolopia oreophila</i>	endemic
Tu			<i>Clausena anisata</i>	
Tu			<i>Clerodendron glabrum</i>	
Tu			<i>Cryptocarya myrtifolia</i>	
Tu			<i>Cryptocarya woodii</i>	
Tu			<i>Erythrina latissima</i>	Scarp
Tu			<i>Euclea crispa</i> subsp. <i>crispa</i>	Drakensberg Montane
Tu			<i>Halleria lucida</i>	Drakensberg Montane
Tu			<i>Maesa lanceolata</i>	Scarp
Tu			<i>Maytenus undata</i>	
Tu			<i>Pittosporum viridiflorum</i>	Drakensberg Montane
Tu			<i>Prunus africana</i>	
Tu			<i>Psydrax obovata</i> subsp. <i>elliptica</i>	Scarp, Mpum. Mistbelt
Tu			<i>Ptaeroxylum obliquum</i>	Scarp, E. Mistbelt
Tu			<i>Pterocelastrus echinatus</i>	Eastern Mistbelt
Tu			<i>Pterocelastrus rostratus</i>	Eastern Mistbelt
Tu			<i>Scolopia flanaganii</i>	near-endemic; Draken. Montane
Tu			<i>Seemannaralia gerrardii</i>	Mistbelt types
Tu			<i>Zanthoxylum capense</i>	
ST	d		<i>Acacia caffra</i>	
ST	d		<i>Canthium mundianum</i>	
ST	d		<i>Dais cotinifolia</i>	Drakensberg Montane
ST	d		<i>Diospyros lycioides</i> subsp. <i>lycioides</i>	
ST	d		<i>Leucosidea sericea</i>	Drakensberg Montane
ST			<i>Allophylus africanus</i>	
ST			<i>Bowkeria verticillata</i>	
ST			<i>Buddleja salviifolia</i>	

ST		<i>Canthium ciliatum</i>	
ST		<i>Canthium kuntzeanum</i>	
ST		<i>Cassine eucleiformis</i>	
ST		<i>Catha edulis</i>	Mpum. Mistbelt
ST		<i>Cliffortia nitidula</i>	
ST		<i>Clutia pulchella</i>	
ST		<i>Diospyros whyteana</i>	
ST		<i>Dombeya tiliacea</i>	
ST		<i>Greyia sutherlandii</i>	Drakensberg Montane
ST		<i>Greyia radlkoferi</i>	Mpum. Mistbelt
ST		<i>Gymnosporia buxifolia</i>	
ST		<i>Gymnosporia mossambicensis</i>	
ST		<i>Heteromorpha trifoliata</i>	Draken.Mont., Mistbelt
ST		<i>Heteropyxis natalensis</i>	Scarp
ST		<i>Maytenus acuminata</i>	
ST		<i>Morella pilulifera</i>	
ST		<i>Morella serrata</i>	
ST		<i>Ochna holstii</i>	Mistbelt
ST		<i>Ochna natalitia</i>	
ST		<i>Oxyacanthus speciosus</i> subsp. <i>gerrardii</i> Scarp,	Mistbelt
ST		<i>Pavetta inandensis</i>	Scarp
ST		<i>Rhamnus prinoides</i>	Drakensberg Montane
ST		<i>Rhus rehmanniana</i>	
ST		<i>Rhus transvaalensis</i>	Mpum. Mistbelt
ST		<i>Tricalysia lanceolata</i>	Scarp
ST		<i>Trimeria grandifolia</i>	
ST		<i>Trimeria trinervis</i>	Eastern Mistbelt
S	d	<i>Dombeya burgessiae</i>	
S	d	<i>Myrsine africana</i>	Drakensberg Montane
S		<i>Asparagus virgatus</i>	
S		<i>Buddleja auriculata</i>	Drakensberg Montane
S		<i>Carissa bispinosa</i> subsp. <i>zambesiaca</i>	
S		<i>Hypericum revolutum</i>	Eastern Mistbelt
S		<i>Rhus dentata</i>	Drakensberg Montane
S		<i>Rhus pyroides</i>	Drakensberg Montane
S		<i>Sparmannia ricinocarpa</i>	Mistbelt
SCw		<i>Asparagus ramosissimus</i>	
SCw		<i>Cassinopsis ilicifolia</i>	
SCw		<i>Cephalanthus natalensis</i>	
SCw		<i>Cyphostemma natalitium</i>	
SCw		<i>Dalbergia obovata</i>	
SCw		<i>Halinus integrifolius</i>	
SCw		<i>Rhoicissus digitata</i>	
SCw		<i>Rhoicissus tridentata</i>	
Smon		<i>Aloe arborescens</i>	
Ssoft	d	<i>Plectranthus grillatus</i>	
Ssoft	d	<i>Plectranthus hereroensis</i>	
Ssoft		<i>Dicliptera zeylanica</i>	
Ssoft		<i>Hypoestes aristata</i>	
Ssoft		<i>Plectranthus fruticosus</i>	
Cw		<i>Asparagus setaceus</i>	
Cw	D	<i>Clematis oweniae</i>	
Cw		<i>Dioscorea sylvatica</i>	
Cw		<i>Scutia myrtina</i>	
Cw		<i>Strophanthus speciosus</i>	
Ch		<i>Senecio tamoides</i>	
H		<i>Lobelia vanreenensis</i>	
H		<i>Printzia pyrifolia</i>	
H		<i>Stachys kuntzei</i>	
H		<i>Steptocarpus candidus</i>	
H		<i>Steptocarpus daviesii</i>	
H		<i>Steptocarpus gardenii</i>	Eastern Mistbelt
H		<i>Steptocarpus pentherianus</i>	

H		<i>Steplocarpus pusillus</i>	
H	D	<i>Thalictrum rhynchocarpum</i>	
Hcr	d	<i>Barleria obtusa</i>	
Hg		<i>Scadoxus puniceus</i>	
Hg	D	<i>Zantedeschia albomaculata</i>	
Hsc		<i>Achyranthes aspera</i>	
Hpar		<i>Alectra oronabchoides</i>	
Hf		<i>Asplenium aethiopicum</i>	
Hf		<i>Asplenium lobatum</i>	
Hf		<i>Cheilanthes viridis</i>	
Hf		<i>Dryopteris inaequalis</i>	
Hf		<i>Mohria caffrorum</i>	
Hf		<i>Pteris buchananii</i>	
Gcr	d	<i>Oplismenus hirtellus</i>	
Gsc	d	<i>Prosphytochloa prehensilis</i>	Mpum. Mistbelt
G		<i>Hyparrhenia cymbaria</i>	
G		<i>Stipa dregeana</i>	
Ga		<i>Poa annua</i>	

Typical & Endemic Animals

Table. Forest dependent bird, mammal, frog and reptile species in the Northern KwaZulu-Natal Mistbelt Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, E – endemic, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Tambourine dove	<i>Turtur tympanistria</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Olive woodpecker	<i>Mesopicos griseocephalus</i>	Cf	Birds	Widespread
Grey cuckooshrike	<i>Coracina caesia</i>	U	Birds	Widespread
Bush blackcap	<i>Lioptilus nigricapillus</i>	U	Birds	LP, Mp, inland EC & KZN
Orange thrush	<i>Zoothera gurneyi</i>	Cf	Birds	LP, Mp, KZN, EC
Chorister robin	<i>Cossypha dichroa</i>	Cl	Birds	LP, Mp, KZN, EC
Starred robin	<i>Pogonocichla stellata</i>	Cl	Birds	LP, Mp, KZN, EC
Yellowthroated warbler	<i>Seicercus ruficapillus</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Barthroated apalis	<i>Apalis thoracica</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Olive bush shrike	<i>Telophorus olivaceus</i>	Cl	Birds	LP, Mp, KZN, EC, S.Cape
Forest canary	<i>Serinus scotops</i>	Cl	Birds	LP, Mp, KZN, EC
Woodland dormouse	<i>Graphiurus murinus</i>		Mammals	Widespread
Natal ghost frog	<i>Heleophryne natalensis</i>		Frogs	LP, Mp, KZN, EC
Clicking stream frog	<i>Strongylopus grayii</i>		Frogs	Widespread

Conservation & Management

Use & Value

Conservation Status

The extent of this Forest Type ranges from 4 000 ha (forest biome) to 8 400 (NLC) with 26% and 20% conserved respectively. None of this forest is on DWAF land. These forests are protected in a number of nature reserves found along the Low Drakensberg (Normandien, Pongola Bush N.R.) and in Ngome N.R.

Main Threats

- ⇒ plantation forestry (*Eucalyptus* spp., *Acacia mearnsii*);
- ⇒ mismanagement of fire and burning regimes in surrounding grasslands;
- ⇒ grazing in forest patches.

Other Management Considerations

- ⇒ land claims;
- ⇒ invasive weeds and alien plants;
- ⇒ ecotourism;
- ⇒ illegal hunting in forest.

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III1: Northern Mistbelt Forests

Synonyms

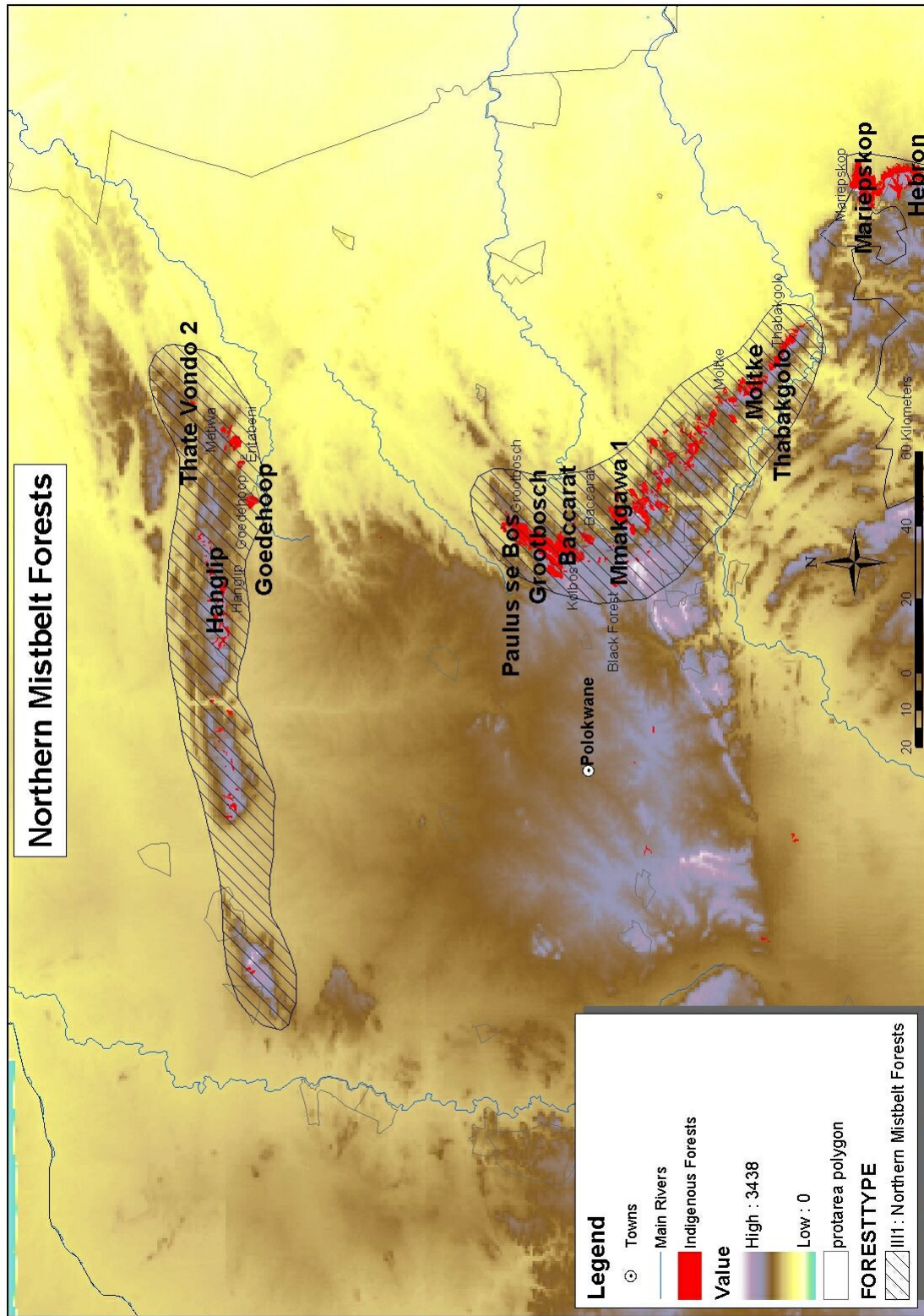
Undifferentiated Afromontane Forest p.p.	White (1983)
Soutpansberg Forest	Cooper (1985)
Transvaal Drakensberg Escarpment Forest	Cooper (1985)
Transvaal Forests p.p.	Phillipson & Russell (1988)
Afromontane Forest p.p.	Low & Rebelo (1998)
Northeastern Escarpment Forests	Bailey et al. (1999)
Soutpansberg Forests	Bailey et al. (1999)

Profile

Northern Mistbelt Forests are small to large forests and forest complexes occurring along the Soutpansberg Mountains (including the western isolated Blouberg mts) and North Eastern Escarpment in the Limpopo Province. Two ecological subtypes were identified: (1) Moist Evergreen Forest in the mistbelt, typically at higher altitudes and with a closed canopy and moist interior, and dominated by *Xymalos monospora*, and a variable open to dense understorey of ferns, graminoids or shrubs; (2) Semi-deciduous Forest in various structural and floristic combinations. Scrub forest, often regrowth forest in former woodland or grassland, or on the lower slopes, has a lower canopy and is dominated by *Acacia ataxacantha* mixed with woodland tree species, and a grassy understorey. Riverine forest is found in the lower-lying areas and at the higher reaches of the main river systems, has a low to tall canopy, is dominated by *Bridelia micrantha* and often associated with *Albizia adianthifolia*, and has a mixed understorey.

Distribution

Northern Mistbelt Forests occur in two separate and disjunct areas. In the Soutpansberg they occur on a west-east zone, and as small moist evergreen forests in the west (the isolated Blouberg, the farm Dundee, Hanglip and Goedehoop) to the large Entabeni-Mafela-Thathe Vondo complex, surrounded and connected by small to large areas of semi-deciduous scrub/regrowth forest up to the Gaba area (Samandou Plateau) in the east. Along the North Eastern Escarpment the forests occur in a north-south zone, from the northern end of the Escarpment near Duiwelskloof to the Olifants River in the south, with the largest complex in the Grootbos-Magoebaskloof area (Woodbush-De Hoek), mainly moist evergreen forest with semi-deciduous forest on the lower fringes. The forests are found from the top of the mountains (1800 m) down into the foothills and extending along the river systems into the savanna vegetation (700 m). Fire along the southern portion of the North Eastern Escarpment confined the forests to kloofs.



Known forests

Blouberg

Along the Soutpansberg (west to east): Dundee (Letjume & Ottoshoek), Hanglip, Roodewal, Joubertstroom, Goedehoop, Entabeni, Ratombo, Thathe Vondo, Mafela, Phiphidi and Gaba

Along the North Eastern Escarpment (north to south): Grootbos complex (Woodbush-De Hoek), Samangobos, Essenhoutbos, Baccarat, Black forest, Forest Glens, Swartbos, Mmakgowa (New Agatha), Wonderwoud, Malta, Cyprus, Moltke, Thabakgolo)

Vegetation Structure & Texture

Stand Structure

Two ecological subtypes occur along the altitudinal gradient (Geldenhuys & Venter 2002): (1) Moist evergreen forest, typically at higher altitudes; (2) Semi-deciduous forest, in two forms: scrub forest, often regrowth forest, surrounding moist evergreen forest and on the lower slopes and drier areas; and riverine forest found at the higher reaches of the main river systems.

Moist evergreen forests generally are well-defined in the landscape. They are dominated by *Xylocarpus monospora*, and characterised by scattered, large strangler figs *Ficus craterostoma*. *Podocarpus falcatus* occasionally form emergents, only in Blouberg and western Soutpansberg, and parts of the Grootbos-Wonderwoud forests. Associated prominent canopy trees in different areas (some common in places) are *Combretum kraussii*, *Croton sylvaticus*, *Cussonia spicata* complex, *Cryptocarya liebertiana*, *Kiggelaria africana*, *Nuxia congesta*, *Nuxia floribunda*, *Olea capensis* subsp *macrocarpa*, *Podocarpus latifolius*, *Prunus africana*, *Rapanea melanophloeos*, *Schefflera umbellifera*, *Syzygium gerrardii*, *Trichilia dregeana*, and *Zanthoxylum davyi*, with sub-canopy trees *Aphloia theiformis*, *Cassipourea malosana*, *Dovyalis lucida*, *Halleria lucida*, *Micrococca capensis*, *Ochna arborea* subsp *oconnorii*, *Ochna holstii*, *Oxyanthus speciosus* subsp *gerrardii*, *Peddiea africana*, *Rothmannia capensis* and *Tricalysia lanceolata*. The shrub layer, in places, is dominated by *Mackaya bella*, *Piper capense*, *Plectranthus fruticosus* or *Sclerochiton harveyanus*. The composition of the ground layer varies, from open to dense layers of various fern species (particularly *Asplenium rutifolium*), the soft shrub *Isoglossa cooperi*, the sedge *Cyperus albostrigatus* or the grass *Oplismenus hirtellus*. Epiphytic clivias, *Streptocarpus* spp. and the fern *Polypodium polypodioides* are common. The closed canopy is relatively high (15–30 m) with at least 1–2 sub-canopy tree layers. The stem diameter distribution shows a wide range of stem diameters but a relatively low stem density below 30 cm DBH (except in stands of regrowth forest) and above 50 cm DBH. Total stem density for trees μ 10 cm DBH varies between 480 and 760 stems/ha. Basal area for the different sub-communities within this subtype ranges between 31,5 m²/ha and 60 m²/ha, with 40% to 60% in trees >30 cm DBH.

Semi-deciduous Forests vary according to the site conditions and stand development status, and it is sometimes difficult to distinguish between closed woodland and regrowth forest. The canopy height ranges from <10 m to 25 m. The forests have a high proportion of deciduous trees and several typical woodland trees. Trees are mostly single stemmed. The shorter forests do not have a clear sub-canopy, but have a definite shrub and herb layer consisting of a high proportion of grasses. The important canopy trees are *Acacia ataxacantha* (early regrowth), *Albizia adianthifolia*, *Aphloia theiformis*, *Bridelia micrantha* (riverine), *Catha edulis* (regrowth), *Croton sylvaticus*, *Englerophytum magalimontanum*, *Heteropyxis natalensis* (regrowth), *Parinari curatellifolia*, *Rhus chirindensis*, and *Syzygium cordatum* (riverine). *Anthocleista grandiflora* is an emergent tree in riverine sites. There is at least one sub-canopy layer, as well as both shrub and herb layers. *Behnia reclinata*, *Keetia gueinzii*, *Rhoicissus rhomboidea* are common climbing plants. Important understory species are *Oplismenus hirtellus* in high cover, *Schoenoxiphium madagascariensis*, and *Cheilanthes viridis*. The stem diameter distribution shows a smaller range than the moist evergreen forest, and >85% of the stems are below 30 cm DBH. Total stem density for trees μ 10 cm DBH varies between 450 and 695 stems/ha. The scrub/regrowth forest has a low basal area (13 – 16 m²/ha), and the riverine forest a slightly higher basal area (19 – 22 m²/ha).

Diversity Patterns

The Northern Mistbelt Forests fall within a zone of southern range limits of more tropical species and northern range limits of more southern species. They are also enclosed within the woodlands and grasslands. Geldenhuys & Venter (2002) recorded 450 plant species during a rapid survey, composed of 195 trees, 79 shrubs, 34 lianes, 21 vines, 43 ferns, 13 graminoids, 9 geophytes, 20 epiphytes, 32 herbs and

4 other growth forms. The list included 68% woody species, but the percentage varied between different forests. Geldenhuys (1992) recorded 324 species for the North Eastern Escarpment, excluding the Soutpansberg forests.

Ecology

Altitude & Geomorphology

The forests occur on the undulating plateaux and gentle to steep slopes (mainly eastern to south-western aspect) of the mountains and escarpment, or below cliffs, or in narrow gullies to open valleys. The Semi-deciduous riverine forests occur along the banks and lower slopes of the streams. The altitudinal range is between 700 m and 1800 m.

Geology & Soils

In the Entabeni area in the Soutpansberg, basalt occurs in the southern part and mainly quartzitic sandstone of the Soutpansberg Formation in the northern part, and the soils are mostly highly weathered, red ferrallitic soils with a high clay fraction (Louw et al 1994). In the Hanglip forest area north of Louis Trichardt (Von dem Bussche 1984), the Musekwa Formation forms the sandstone cliffs and rocky outcrops (weathering into stony, shallow and infertile soils), and the Sibasa Formation (basaltic lava with high manganese and iron content, weathering into red fertile soils). Along the Woodbush-De Hoek area of the North Eastern Escarpment, the forests occur on Biotite-bearing Archaean granite-gneiss (Visser & Verwoerd 1960) with highly weathered schistose xenoliths at higher altitudes (Scheepers 1978). In the Wolkberg-Wonderwoud area, the thick quartzites of the Wolkberg Formation form the upper cliffs, and include conglomerate layers, lava, tuff, agglomerate and shale.

Climate

The Northern Mistbelt Forests cover a gradient from the cool escarpment and upper mountain plateaux to the warm lowveld. Most of the annual precipitation occurs during the summer months from November to April. Mean annual precipitation varies from 1800 mm at higher altitudes to 600 mm at lower altitudes. At altitudes above 1050 m where mist is frequent forest plants rely on 'fog drip' for moisture. Temperatures range from below 0 °C in winter to above 30 °C in summer and increases from higher altitudes to the foothills.

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	460	4	26	17
Maximum	1500	9	29	20

Disturbance

The location pattern of the forests indicates that the forests have been confined to fire refugia, even the large forest complexes. Recent devastating fires in the Entabeni Plantation confirmed this by burning the plantation zones and not the adjacent forests. Occasionally fires do penetrate the forest, either directly or with flying sparks. Forests below the cliffs are prone to rock falls and landslides on steep slopes damage forests. Lightning strikes occasionally cause patch deaths. Commercial forestry contributed to the protection of forests against fire and many areas of former grassland and woodland are regrowing back to forest (Geldenhuys & Venter 2002), and forest species become established underneath the plantation stands (Geldenhuys 1997). Human disturbances include timber harvesting in the past (many sawpits in the evergreen forest), harvesting of poles and fuelwood by rural communities (domestic and commercial purposes), and clearing for agricultural crops and dagga.

Biogeographic Affinities

Northern Mistbelt Forests have both afrotemperate and afrotropical elements, and a strong woodland species component in the semi-deciduous forests. These forests have a 43% share of the woody species and 47% share of the herbaceous species with the Southern Cape Afrotemperate forests (and the other Afrotemperate forest types in between), and a 30% to 47% share of woody species with the northern KwaZulu-Natal forests (the reverse for the coastal forests is much lower) (Geldenhuys 1992). There is also a sharing of species between the semi-deciduous forests and the Licuati Sand Forests. The total list of tree and shrub species of the Northern Mistbelt Forests (Geldenhuys & Venter 2002) contained 34% woodland and intermediate species, with Gaba (49%), Roodewal (41%) and Ratombo (29%) having a relatively high number of these species. Several species, mainly tree and shrub species, are endemic to these forests (13), or have a disjunct presence here (29), or at the northern (35) or southern (15) range limit of the species, or are potentially new species (3).

Subunits

*Xeroclinal Mistbelt <i>Acacia ataxacantha</i> Open Scrub	Scheepers (1978)
High Scrub Forest	Scheepers (1978)
<i>Ficus capensis</i> -Other Species Kloof Forest	Scheepers (1978)
<i>Maytenus peduncularis</i> Open Forest	Scheepers (1978)
* <i>Syzygium cordatum</i> Gallery Forest	Scheepers (1978)
<i>Cussonia spicata</i> - <i>Ficus capensis</i> Kloof Forest	Scheepers (1978)
<i>Trichilia dregeana</i> - <i>Cussonia spicata</i> - <i>Cryptocarya liebertiana</i> Forest	Scheepers (1978)
* <i>Syzygium gerrardii</i> -Other Species Riverine Forest	Scheepers (1978)
Seral Montane Scrub Forest	Scheepers (1978)
Seral Shrubby Montane Forest	Scheepers (1978)
<i>Curtisia dentata</i> Forest	Scheepers (1978)
<i>Cussonia spicata</i> Forest	Scheepers (1978)
<i>Cussonia spicata</i> - <i>Cryptocarya liebertiana</i> Forest	Scheepers (1978)
<i>Climax Trichilia dregeana</i> - <i>Croton sylvaticus spicata</i> Forest	Scheepers (1978)
<i>Syzygium gerrardii</i> -Other Species Forest	Scheepers (1978)
Transitional Mixed Montane Forest	Scheepers (1978)
Typical Upper Montane Forest	Scheepers (1978)
<i>Greyia radlkoferi</i> -Other Species Elfin Forest	Scheepers (1978)
<i>Cussonia spicata</i> -Other Species Forest	Scheepers (1978)
Soutpansberg Forest	Cooper (1985)
<i>Acacia ataxacantha</i> Early Regrowth Forest	Geldenhuys & Murray (1993)
<i>Ocotea kenyensis</i> Mature Forest	Geldenhuys & Murray (1993)
<i>Rapanea melanophloeos</i> Advanced Regrowth Forest	Geldenhuys & Murray (1993)
<i>Rhoicissus tomentosa</i> Mature Forest	Geldenhuys & Murray (1993)
<i>Rhus chirindensis</i> Mature Forest	Geldenhuys & Murray (1993)
<i>Rothmannia capensis</i> Mature Forest	Geldenhuys & Murray (1993)
<i>Cussonia spicata</i> - <i>Orcia bachmannii</i> - <i>Trichilia dregeana</i> Forest Type	Geldenhuys & Pieterse (1993)
<i>Oxycanthus speciosus gerrardii</i> - <i>Pterocelastrus echinatus</i> - <i>Tricalysia inandensis</i> - <i>Trichilia dregeana</i> Forest Type	Geldenhuys & Pieterse (1993)

Syzygium gerrardii-*Rinorea angustifolia* Forest Type
Forest type 4 (*Bersama transvaalensis*) Geldenhuys & Pieterse (1993)
Geldenhuys & Pieterse (1993)

Forest type 1: *Xymalos monospora* Moist Evergreen Forest Geldenhuys & Venter (2002)
Community 1.1 *Rothmannia capensis* – *Syzygium gerrardii* Forest
Sub-community 1.1.1 *Olea capensis macrocarpa* Forest
Sub-community 1.1.2 *Rothmannia capensis* Forest
Sub-community 1.1.3 *Syzygium gerrardii* Forest
Community 1.2 *Rapanea melanophloeos* – *Halleria lucida* Forest
Community 1.3 *Rhus chirindensis* – *Vepris lanceolata* Forest
Sub-community 1.3.1 *Celtis africana* Forest
Sub-community 1.3.2 *Rapanea melanophloeos* Forest

Forest type 2: *Acacia ataxacantha* – *Bridelia micrantha* Semi-deciduous Forest Geldenhuys & Venter (2002)

Community 2.1 *Catha edulis* – *Heteropyxis natalensis* Forest
Community 2.2 *Rhus chirindensis* – *Acacia ataxacantha* Forest
Community 2.3 *Bridelia micrantha* – *Brachylaena transvaalensis* Forest
Sub-community 2.3.1 *Acacia ataxacantha* Forest
Sub-community 2.3.2 *Albizia adianthifolia* Forest
Community 2.4 *Coddia rudis* Forest

* The classification of marked community within this forest type is uncertain.

Dominant and diagnostic species

Plants

L	S	D	Latin Name	Note
Te	d		<i>Anthocleista grandiflora</i>	Lowveld Riverine
Te	d		<i>Podocarpus falcatus</i>	Western Soutpansberg,
Tc	d		<i>Bridelia micrantha</i>	
Tc	d		<i>Celtis africana</i>	
Tc	d		<i>Combretum kraussii</i>	
Tc	d		<i>Croton sylvaticus</i>	
Tc	d		<i>Cryptocarya liebertiana</i>	MpumMist, Eastern Scarp
Tc	d		<i>Curtisia dentata</i>	
Tc	d		<i>Cussonia spicata</i> complex	
Tc	d		<i>Drypetes gerrardii</i>	
Tc	d		<i>Kiggelaria africana</i>	
Tc	d		<i>Nuxia congesta</i>	
Tc	d		<i>Olea capensis</i> subsp. <i>macrocarpa</i>	
Tc	d		<i>Parinari curatelifolia</i>	Savanna
Tc	d		<i>Podocarpus latifolius</i>	
Tc	d		<i>Rhus chirindensis</i>	
Tc	d		<i>Schefflera umbellifera</i>	
Tc	d		<i>Syzygium gerrardii</i>	
Tc	d		<i>Trichilia dregeana</i>	
Tc			<i>Chionanthus foveolatus</i> subsp. <i>major</i>	
Tc			<i>Ficus sur</i>	
Tc			<i>Homalium dentatum</i>	Eastern Scarp
Tc			<i>Ilex mitis</i>	
Tc			<i>Ocotea kenyensis</i>	Eastern Scarp
Tc			<i>Prunus africana</i>	
Tc			<i>Pterocarpus angolensis</i>	Savanna
Tc			<i>Rapanea melanophloeos</i>	Swamp
Tc			<i>Vepris lanceolata</i>	
Tc			<i>Zanthoxylum davyi</i>	

Tcu	d	<i>Aphloia theiformis</i>	Eastern Scarp
Tcu	d	<i>Cassipourea malosana</i>	
Tcu	d	<i>Englerophytum magalimontanum</i>	
Tcu	d	<i>Xymalos monospora</i>	MpumMist
			Eastern Mistbelt
			Savanna
Tcu		<i>Mimusops zeyheri</i>	
Tcu		<i>Psyrax obovata</i> subsp. <i>elliptica</i>	
Tcu		<i>Pterocelastrus echinatus</i>	
Tu	d	<i>Brachylaena discolor</i> var. <i>transvaalensis</i>	Eastern Scarp
Tu	d	<i>Drypetes arguta</i>	
Tu	d	<i>Maytenus undata</i>	
Tu	d	<i>Micrococca capensis</i>	
Tu	d	<i>Oxyacanthus speciosus</i> subsp. <i>gerrardii</i>	
Tu	d	<i>Peddiaea africana</i>	
Tu	d	<i>Rinorea angustifolia</i>	
Tu		<i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	
Tu		<i>Bersama transvaalensis</i>	
Tu		<i>Breonadia salicina</i>	Savanna
Tu		<i>Canthium inerme</i>	
Tu		<i>Combretum collinum</i> subsp. <i>gazense</i>	Savanna
Tu		<i>Diospyros whyteana</i>	
Tu		<i>Elaeodendron croceum</i>	
Tu		<i>Eugenia natalitia</i>	
Tu		<i>Faurea galpinii</i>	MpumMist
			Eastern Scarp
Tu		<i>Halleria lucida</i>	
Tu		<i>Hymenocardia ulmoides</i>	Licuati Sand
Tu		<i>Margaritaria discoidea</i>	
Tu		<i>Maytenus acuminata</i>	
Tu		<i>Mymecylon natalense</i>	
Tu		<i>Ochna arborea</i> subsp. <i>oconnori</i>	
Tu		<i>Pseudolachnostylis maprouneifolia</i>	Savanna
Tu		<i>Rothmannia capensis</i>	
Tu		<i>Rothmannia fischeri</i>	Licuati Sand
Tu		<i>Sericanthe andongensis</i>	also Zimbabwe
Tu		<i>Trimeria grandifolia</i>	
TuSt	d	<i>Ficus craterostoma</i>	
ST	d	<i>Acacia ataxacantha</i>	MpumMist
ST	d	<i>Tricalysia capensis</i>	
ST		<i>Duvernoia adhatodooides</i>	
ST		<i>Antidesma venosum</i>	
ST		<i>Clausena anisata</i>	
ST		<i>Combretzum erythrophyllum</i>	
ST		<i>Combretum moggii</i>	endemic to Eastern Escarpment
ST		<i>Dovyalis lucida</i>	
ST		<i>Elephantorrhiza burkei</i>	
ST		<i>Friessodielsia obovata</i>	
ST		<i>Gerrardina foliosa</i>	MpumMist
			EastMistbelt
ST		<i>Gymnosporia mossambicensis</i>	
ST		<i>Maesa lanceolata</i>	
ST		<i>Mundulea sericea</i>	Savanna
ST		<i>Ochna holstii</i>	
ST		<i>Pavetta lanceolata</i>	
ST		<i>Psychotria capensis</i>	
ST		<i>Psychotria zombamontana</i>	MpumMist
ST		<i>Psyrax locupes</i>	Licuati Sand
ST		<i>Pteleopsis myrtifolia</i>	Savanna
ST		<i>Rawsonia lucida</i>	
ST		<i>Rhus tumulicola</i>	MpumMist
ST		<i>Schrebera alata</i>	
ST		<i>Syzygium legati</i>	MpumMist

ST			<i>Tabernaemontana elegans</i>	Savanna, Licuati Sand
ST			<i>Tarenna zimbabwensis</i>	also Zimbabwe
ST			<i>Tricalysia lanceolata</i>	
ST			<i>Vangueria cyanescens</i>	Savanna
ST		C	<i>Xylopi odoratissima</i>	endemic
S	d		<i>Macaya bella</i>	
S	d		<i>Plectranthus fruticosus</i>	
S	d		<i>Sclerochiton harveyanus</i>	
S		C	<i>Rhus magalismontana</i> subsp. <i>coddii</i>	endemic
S		C	<i>Vernonia wollastonii</i>	endemic
Cw	d		<i>Cephalanthos natalensis</i>	
Cw	d		<i>Keetia gueinzii</i>	
Cw			<i>Behnia reticulata</i>	
Cw		C	<i>Jasminum multipartitum</i>	endemic
Cw			<i>Rhoicissus rhomboidea</i>	
Cw			<i>Rhoicissus tomentosa</i>	
Cw			<i>Secamone alpini</i>	
Cw			<i>Secamone filiformis</i>	
Cw			<i>Smilax anceps</i>	
Cw			<i>Strophanthus speciosus</i>	
Hbab		C	<i>Ensete ventricosa</i>	southern limit
H	d		<i>Isoglossa cooperi</i>	
H	d		<i>Impatiens hochstetteri</i>	
H	d		<i>Impatiens silvicola</i>	
H			<i>Jasminum abyssinicum</i>	MpumMist
H		C	<i>Plectranthus swynnertonii</i>	endemic (Soutpansberg)
H		C	<i>Streptocarpus caerulens</i>	endemic (Soutpansberg)
H			<i>Streptocarpus cyaneus</i>	MpumMist
H		C	<i>Streptocarpus longiflorus</i>	endemic (Blauuwberg)
H		C	<i>Streptocarpus parviflorus</i>	endemic
Hf	d		<i>Cheilanthes viridis</i>	
Hf			<i>Asplenium aethiopicum</i>	
Hf			<i>Asplenium rutifolium</i>	
Hf			<i>Polystichum macleae</i>	MpumMist Eastern Scarp
Hf			<i>Pteris catoptera</i>	
Gcr	d		<i>Oplismenus hirtellus</i>	
Gsc	d		<i>Prosphytochloa prehensilis</i>	

Animals

Table. Forest dependent bird, mammal, frog and reptile species in the Northern Mistbelt Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, E – endemic, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Buffspotted flufftail	<i>Sarothrura elegans</i>	C	Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Tambourine dove	<i>Turtur tympanistris</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Cape parrot	<i>Poicephalus robustus</i>	Cl	Birds	LP, Mp, inland EC & KZN

Common name	Scientific name	Status	Taxon	Distribution
Knysna lourie	<i>Tauraco corythaix</i>	C	Birds	EC, KZN, MP, NP
Emerald cuckoo	<i>Chrysococcyx cupreus</i>	Cm	Birds	LP, Mpu, KZN, EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape
Scalythroated honey guide	<i>Indicator variegatus</i>	Cf	Birds	e. Mp, coastal EC & KZN
Olive woodpecker	<i>Mesopicos griseocephalus</i>	Cf	Birds	Widespread
Grey cuckooshrike	<i>Coracina caesia</i>	U	Birds	Widespread
Squaretailed drongo	<i>Dicrurus ludwigii</i>	C	Birds	Mp, coastal EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Yellowstreaked bulbul	<i>Phyllastrephus flavostriatus</i>	Cf	Birds	Ngoye forest north to e.Mp
Yellowbellied bulbul	<i>Chlorocichla flaviventris</i>	C	Birds	Coastal n. EC & KZN
Orange thrush	<i>Zoothera gurneyi</i>	Cf	Birds	LP, Mp, KZN, EC
Chorister robin	<i>Cossypha dichroa</i>	Cl	Birds	LP, Mp, KZN, EC
Starred robin	<i>Pogonocichla stellata</i>	Cl	Birds	LP, Mp, KZN, EC
Brown robin	<i>Erythropygia signata</i>	Cl	Birds	e. Mp, coastal EC & KZN
Yellowthroated warbler	<i>Seicercus ruficapillus</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Barthroated apalis	<i>Apalis thoracica</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>	Cl	Birds	LP, Mp, KZN, EC, S.Cape
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Green twinspot	<i>Mandingoa nitidula</i>	Cl	Birds	LP, Mp, KZN, EC
Forest canary	<i>Serinus scotops</i>	Cl	Birds	LP, Mp, KZN, EC
Samango monkey	<i>Cercopithecus mitis</i>		Mammals	LP, EC, KZN
Giant rat	<i>Cricetomys gambianus</i>		Mammals	LP
Woodland mouse	<i>Grammomys dolichurus</i>		Mammals	LP, Mp, KZN, EC
Woodland dormouse	<i>Graphiurus murinus</i>		Mammals	Widespread
Dark-footed forest shrew	<i>Myosorex cafer</i>		Mammals	LP, Mp, KZN, EC
Natal ghost frog	<i>Heleophryne natalensis</i>		Frogs	LP, Mp, KZN, EC
Transvaal forest rain frog	<i>Breviceps sylvestris</i>		Frogs	LP
Clicking stream frog	<i>Strongylopus grayii</i>		Frogs	Widespread
Giant legless skink	<i>Acontias plumbeus</i>	E	Reptiles	LP, e. Mp, n. KZN, East London
Natal purple-glossed snake	<i>Amblyodipsas concolor</i>	E, R	Reptiles	e. Mp, KZN

Conservation and Management

Use and value

The biodiversity value is high as these forests provide a link between subtropical and Afrotemperate elements. They have direct use value for rural communities for poles and firewood, for crafts (woodcarving and florist baskets), and in the past timber was harvested for construction and furniture. As ecosystems they conserve the soils and water in the catchments, for down-stream farmers, rural communities and towns. Culturally they contain grave sites (especially in the Soutpansberg), and have high value as ecotourism destinations, particularly the hiking trails in Soutpansberg and Magoebaskloof.

Conservation status

The Northern Mistbelt Forests are well conserved in the areas under DWAF management and within the plantation estates and private farms, both along the North Eastern Escarpment and Soutpansberg. In some areas of communal land the forests are threatened, such as along the North Eastern Escarpment in previous Lebowa areas, and the eastern part of the Soutpansberg, particularly where subsistence agriculture and firewood collection is not controlled. Management capacity within DWAF is adequate to control state forests under their control, but not forests that fall on private and communal land. No capacity exists in the Limpopo

Province Department of Environment Affairs. The lack of non-state capacity to conserve the forests is of great concern. Forest management and conservation should form part of regional land use planning. The forest biome map gives an extent of 19 000 ha to this forest type with 61% conserved of which just under half is on DWAF land. The NLC data overestimated this forest type (36 000 ha and 34% conserved) by including large patches in the Blouberg and Hanglip areas, both of which are considered to have relatively small forest patches.

Main threats

- ⇒ Subsistence agriculture and firewood collection in communal areas.
- ⇒ Lack of regional land use planning.

Other management considerations

- ⇒ Invader plants is not a problem in moist evergreen forest, but can be a problem in semi-deciduous and degraded forests;
- ⇒ Close association with timber plantations
- ⇒ Sustainable use of non-timber forest products and values (cattle grazing, medicinal plants, basketry)
- ⇒ Control of forest clearing for crops and dagga growing;
- ⇒ Fire management is necessary to reduce loss of grassland and woodland growing to forest, and uncontrolled fires
- ⇒ Controlled ecotourism developments, such as access rights and servitudes
- ⇒ Settlement of Land claims on important forests.

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III2: Mpumalanga Mistbelt Forests

C. Geldenhuys, M.C. Lötter & L. Mucina

Synonyms

Montane Forest	Van der Schijff & Schoonraad (1971)
Undifferentiated Afromontane Forest p.p.	White (1983)
Transvaal Drakensberg Escarpment Forest	Cooper (1985)
Transvaal Forests p.p.	Phillipson & Russell (1988)
Afromontane Forest p.p.	Low & Rebelo (1998)
Mariepskop Escarpment Forest	Bailey et al. (1999)
Sabie forests complex	Bailey et al (1999)

Profile

Mpumalanga Mistbelt Forests are tall, mixed evergreen Afrotropical forests occurring primarily in east-facing fire refugia and moist sheltered kloofs along the Mpumalanga Escarpment, and semi-deciduous forests on the lower slopes towards the lowveld. They occur between 900 m and 1800 m. The forests in the northern section are relatively large and continuous along the escarpment north of Graskop, but mostly small and very fragmented to the south. They were previously surrounded by grassland on the plateaux and upper slopes and savanna lower down near the lowveld, but most of this has now been replaced by pine and eucalypt plantations. The forests are dominated by *Xymalos monospora*, associated with other species such as *Ocotea kenyensis*, *Ilex mitis*, *Curtisia dentate*, *Rapanea melanophloeos*, *Pterocelastrus echinatus*, *Syzygium gerrardii*, *Schefflera umbellifera* and *Cussonia spicata* complex in the mistbelt and *Bridelia micrantha*, *Brachylaena transvaalensis*, *Rhus chirindensis*, *Celtis africana* mixed with species such as *Sclerocarya birrea* and *Pterocarpus angolensis* on the lower slopes. Mpumalanga Mistbelt Forest species occupy a central position in a temperate to subtropical gradient. The area is also characterized by many waterfalls such as Bridal Veil, Horseshoe and other lesser-known falls such as those in Wonderkloof forest.

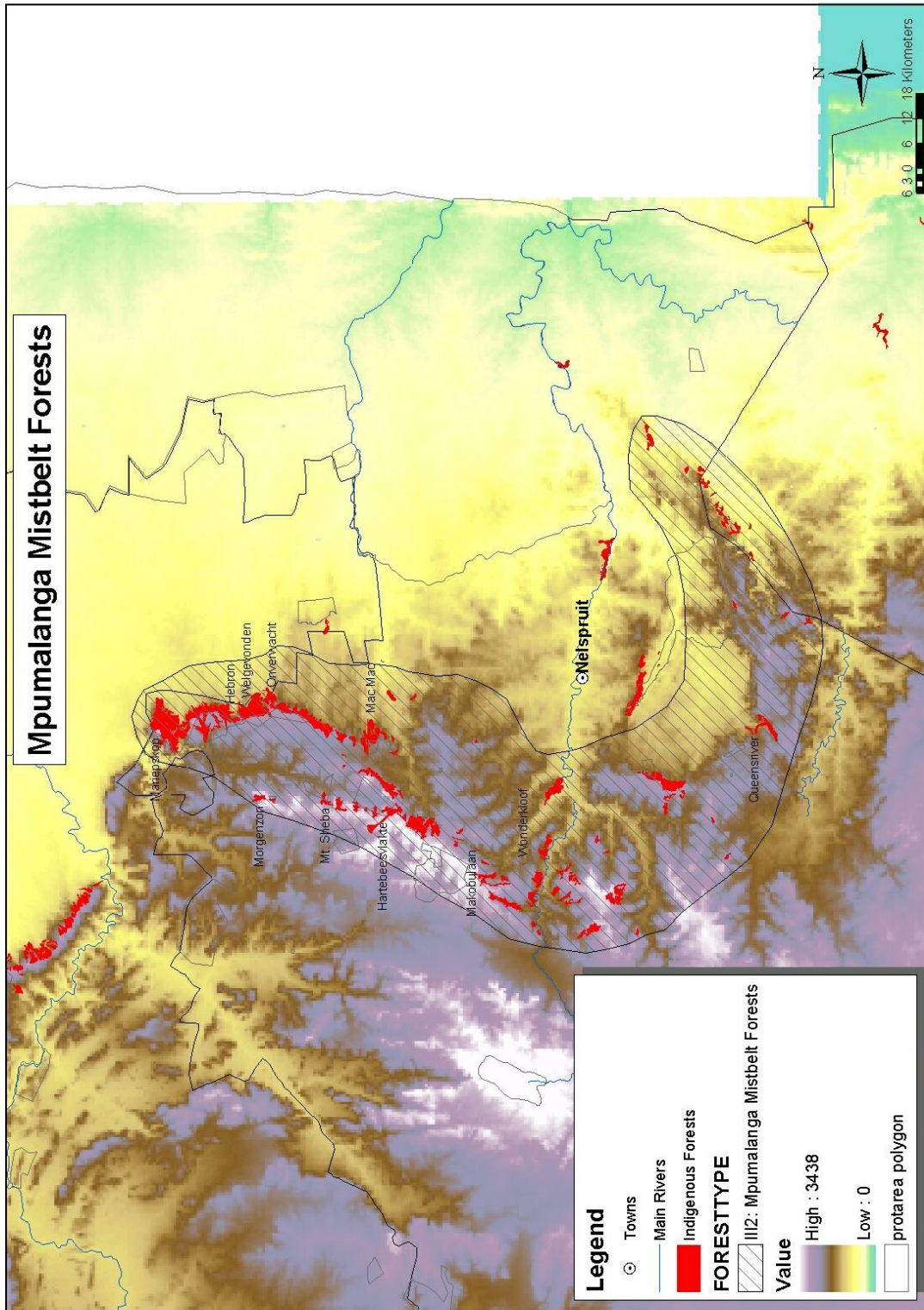
Distribution

The forests are distributed along the Mpumalanga Escarpment from Badplaas/Barberton in the south (small to large, widely scattered forest patches) to the Abel Erasmus Pass (Olifants River) in the north (relatively large forests along the escarpment (Cooper 1985)). They grow along the altitudinal gradient from the mistbelt on the plateau down the eastern slopes in the lowveld. The forests at mid and higher altitude plateaux, slopes and valleys were previously surrounded by grassland, and at lower altitudes by woodland. The grassland and woodland had been replaced by pine and eucalyptus plantations, or by extensive settlements.

Known Forest

Blyde complex	Klipkraal (Sabie area)
Blyfstaanhoogte (Long Tom Pass area)	Koedoeshoek (Schoemanskloof area)
Blystaanboschspruit (south of Long Tom Pass)	Kowynpass (Graskop area)
Buffelskloof Nature Reserve (Lydenburg area)	Mac Mac
Ceylon (Sabie area)	Mariepskop
Coetzeestroom (Ngodwana area)	Maritzbos (Long Tom Pass area)
Doornhoek (Pilgrim's Rest area)	Mashonimini (Ngodwana area)
Dullstroom forests (complex)	Matleloge (Mpulaneng)
Elandshoogte complex. (Ngodwana – Schoemanskloof area)	Mooiplaats (Schoemanskloof area)
Eldorado (Pilgrim's Rest area)	Morgenzon (Pilgrim's Rest area)
Fairyland (Graskop)	Mt Sheba (Pilgrim's Rest area)
Goedgelegen (Machadodorp area)	Peddler's Bush (Twello - Barberton)
Groethoek complex.	Peech Tree (Pilgrim's Rest area)
Houtbos (Blyde NR area)	Queen's River (Nelshoogte area)
In-De-Diepte (Mauchsberg area)	Rotunda Creek (Pilgrim's Rest area)
Kaapsehoop	Tweefontein (Sabie area)
	Uitsoek (south of Long Tom Pa

MAP



Vegetation Structure & Texture

Stand Structure

Mpumalanga Mistbelt Forests are generally tall (15–20 m) with two to three tree strata, a shrub layer (5 m) and a medium (evergreen forest) to poorly developed herb layer (semi-deciduous forest) (0.25–0.5m). They grade from cool evergreen forest in the mistbelt into semi-deciduous forest on the lower slopes near the woodland in the lowveld. The trees are primarily single-stemmed. The herb layer is composed of grasses, ferns and forbs, depending on moisture availability and rockiness. Basal area and stem density for trees μ 10 cm DBH varied as follows: 35,4 m²/ha to 69,8,4 m²/ha and 480 stems/ha to 1640 stems/ha in the Kaapsehoop forests; and 22,0 m²/ha to 105,4 m²/ha and 400 stems/ha to 1390 stems/ha in the Uitsoek forests (Von Breitenbach 1990). The Kaapsehoop and Uitsoek upper montane forests (Von Breitenbach 1990) are dominated by *Curtisia dentata* or *Schefflera umbellifera* and *Pterocelastrus echinatus*, and other species such as *Xymalos monospora*, *Scolopia mundii* and *Nuxia congesta*, with a range of sub-canopy species, including *Trimeria grandifolia*, *Rothmannia capensis*, *Dovyalis lucida* and *Tricalysia capensis*, a herbaceous layer dominated by *Pteris catoptera*, *Asparagus africanus* and *Oplismenus hirtellus*. The lower montane forests are dominated by *Syzygium gerrardii*, *Pterocelastrus echinatus*, *Combretum kraussii* or *Cryptocarya transvaalensis*, *Kiggelaria africana* and/or *Celtis africana* and some *Curtisia dentata*. The subcanopy trees are similar but vary in importance, and the herbaceous layer is dominated by the fern *Cheilanthes viridis*, and other species such as *Asparagus africanus*, *Aristea ensifolia*, *Prosphytochloa prehensilis*, *Hypoestes triflora* and/or *Cyperus albostriatus*.

Diversity Patterns

No proper analysis of diversity patterns are available but Von Breitenbach (1990) provide some data:

Growth forms	Kaapsehoop upper montane	Kaapsehoop lower montane	Uitsoek (1) upper montane	Uitsoek (2) Upper montane	Uitsoek Lower montane
Trees	22	21	28	28	30
Shrubs	1	-	6	3	3
Ferns	6	2	6	3	8
Monocot herbs	7	4	7	5	7
Dicot herbs	3	-	5	3	6
Lianes	7	1	8	4	9

Ecology

Altitude & Geomorphology

Mpumalanga Mistbelt Forests are found in fire refugia and cooler sheltered areas of the plateau (low rocky ridges and outcrops), scarp, upper steep slopes and deep kloofs of the Mpumalanga Escarpment. The altitude ranges from approximately 900 to 1800 m above sea level. The slopes are predominately southeast facing, along the north-south trending escarpment.

Geology & Soil

The whole of the escarpment forms the eastern rim of the Bushveld Igneous Complex (see Deall et al 1989). Four different geological systems are present. The Nelspruit Granites form the undulating terrain of the Escarpment slopes and foothills. The Wolkberg Group is composed of the Black Reef Quartzite Formation forming the Escarpment plateau with its numerous waterfalls, and Sekororo and Selati shales, forming the stream courses and the contact with the overlying dolomites of the Chuniespooert Group. Above this group are the shales of the Pretoria Group. The different geological substrates give rise to different typical soil forms (see Deall et al. 1989; Von Christen 1964).

Climate

The area has steep climatic gradients. Annual precipitation is generally 900 - 2000 mm, but lower in places and in these areas aspect is important. The climate is seasonal with summer rainfall (Nov - Mar) and a high intensity of thunderstorms. There is a high occurrence of mist and frost in upper scarp and plateau. Mean temperatures vary between 12 and 21° C in the higher scarp to 16 and 25°C towards the Lowveld.

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	500	3	24	15
Maximum	1500	10	30	20

Disturbance

The forests are almost confined to fire refugia. Fire disturbance occurs at the forest edge (along grassland or bushveld tension zones) or from fire spotting during strong winds. Disturbance also occurs in the form of slip scars and rock falls, grazing and browsing. There is a long history of disturbance as many forest patches were severely utilised in the early 1900s for building and mining material (Von Breitenbach 1990).

Biogeographic Affinities

The Mpumalanga Mistbelt Forests have floristic affinities with the forests to the north (Northern Mistbelt Forests), to the south along the Escarpment and further south (Eastern Mistbelt to Southern Cape Afrotropical), the Scarp and Coastal forests, and the Savanna vegetation in the Lowveld (see list of species below). For example, Geldenhuys (1992) showed that the forests in the Sabie area (Deall et al. 1989) shared 63% of its woody species with the Southern Cape Afrotropical Forests, 78% with the Amatole Mistbelt Forests, 53% with the Umtamvuna Gorge forests (Pondoland Scarp Forests), but only 59% and 51% respectively with the Mariepskop area and the Northern Mistbelt Forests (North-eastern Escarpment area), and about 30% with the KwaZulu-Natal Coastal Forests (Richards Bay and Maputland coast). The Barberton Afrotropical forests area situated within the Barberton Centre of Endemism and is characterized by the occurrence of a number of species unique to this area, or shared with Mozambique or KwaZulu-Natal (Morgenthal & Cilliers 1999, 2000; Van Wyk & Smith 2001).

Communities/Subunits

* The classification of the marked community within this forest type is uncertain.

<i>Clematis brachiata</i> - <i>Acacia ataxacantha</i> Short Thicket	Deall et al. (1989)
<i>Clerodendron myricoides</i> - <i>Syzygium gerrardii</i> Tall Forest	Deall et al. (1989)
<i>Ekebergia pterophylla</i> - <i>Psychotria zombamontana</i> Tall/Short Forest	Deall et al. (1989)
<i>Hypoestes triflora</i> - <i>Dovyalis lucida</i> Tall/Short Forest	Deall et al. (1989)
<i>Pavetta</i> sp.- <i>Celtis africana</i> Tall Forest	Deall et al. (1989)
<i>Pittosporum viridiflorum</i> - <i>Acacia ataxacantha</i> Short Thicket	Deall et al. (1989)
<i>Pycnostachys urticifolia</i> - <i>Acacia ataxacantha</i> Short Thicket	Deall et al. (1989)
<i>Ochna arborea</i> var. <i>arborea</i> - <i>Combretum kraussii</i> High Forest	Deall et al. (1989)
<i>Streptocarpus cyaneus</i> - <i>Dovyalis lucida</i> Short Forest	Deall et al. (1989)
<i>Tetradenia</i> 'complex'- <i>Syzygium gerrardii</i> Short Thicket	Deall et al. (1989)
<i>Cryptocarya liebertiana</i> Climax Forest	von Breitenbach (1990)
<i>Curtisia dentata</i> Climax Forest	von Breitenbach (1990)
<i>Cussonia spicata</i> var. <i>triptera</i> - <i>Heteropyxis canescens</i> False Climax Forest	von Breitenbach (1990)
<i>Pterocelastrus echinatus</i> Pre-climax Forest	von Breitenbach (1990)
<i>Schefflera umbellifera</i> Climax Forest	von Breitenbach (1990)
<i>Syzygium gerrardii</i> Climax Forest	von Breitenbach (1990)
<i>Xymalos monospora</i> False Climax Forest	von Breitenbach (1990)
<i>Psychotria zombamontana</i> - <i>Xymalos monospora</i> Forest	Matthews et al. (1991)

<i>Acacio ataxacanthae-Celtidetum africanae</i>	Matthews et al. (1992)
<i>Cola greenwayi-Xymalos monospora</i> Community	Morgenthal & Cilliers (1999)
<i>Pterocelastrus echinatus</i> - <i>Syzygium gerrardii</i> Community	Morgenthal & Cilliers (1999)
* <i>Acacia caffra-Dombeya rotundifolia</i> Short Thicket	Stalmans et al. (1999)
<i>Buddleja saligna-Aloe arborescens</i> Short Forest	Stalmans et al. (1999)
<i>Dalbergia armata-Keetia gueinzii</i> Tall Forest	Stalmans et al. (1999)
* <i>Diospyros whyteana-Hippobromus pauciflorus</i> Short Thicket	Stalmans et al. (1999)
<i>Rapanea melanophloeos-Trimeria grandifolia</i> Short Forest	Stalmans et al. (1999)
<i>Ptaeroxylon obliquum-Panicum maximum</i> Short Thicket	Stalmans et al. (1999)
<i>Syzygium gerrardii-Xymalos monospora</i> Tall Forest	Stalmans et al. (1999)

Dominant & Diagnostic Plant Species

L	S	D	Latin Name	Note
Tce	d		<i>Podocarpus falcatus</i>	
Tc	d		<i>Combretum kraussii</i>	
Tc	d		<i>Cryptocarya transvaalensis</i>	
Tc	d		<i>Curtisia dentata</i>	
Tc	d		<i>Cussonia spicata</i> complex	incl. <i>C. sphaerocephala</i>
Tc	d		<i>Ficus sur</i>	
Tc	d		<i>Kiggelaria africana</i>	
Tc	d		<i>Olea capensis</i> subsp. <i>macrocarpa</i>	
Tc	d		<i>Olinia radiata</i>	
Tc	d		<i>Podocarpus latifolius</i>	
Tc	d		<i>Rapanea melanophloeos</i>	
Tc	d		<i>Schefflera umbellifera</i>	
Tc	d		<i>Scolopia mundii</i>	
Tc	d		<i>Syzygium gerrardii</i>	
Tc			<i>Albizia versicolor</i>	Savanna
Tc			<i>Calodendrum capense</i>	
Tc			<i>Celtis africana</i>	
Tc			<i>Chionanthus foveolatus</i> subsp. <i>foveolatus</i>	
Tc			<i>Chionanthus foveolatus</i> subsp. <i>major</i>	
Tc			<i>Chionanthus peglerae</i>	
Tc			<i>Ekebergia capensis</i>	
Tc			<i>Erythrina lysistemon</i>	
Tc			<i>Faurea macnaughtonii</i>	
Tc			<i>Homalium dentatum</i>	Eastern Scarp
Tc			<i>Ilex mitis</i>	
Tc			<i>Kirkia acuminata</i>	Savanna
Tc			<i>Ocotea kenyensis</i>	Eastern Scarp, N. Afrotemp.
Tc			<i>Pterocarpus angolensis</i>	Savanna
Tc			<i>Trichocladus grandiflorus</i>	
Tc			<i>Vepris lanceolata</i>	
Tcu	d		<i>Cassipourea malosana</i>	
Tcu	d		<i>Parinari curatellifolia</i>	Savanna
Tcu	d		<i>Pittosporum viridiflorum</i>	
Tcu	d		<i>Protorhus longifolia</i>	
Tcu	d		<i>Prunus africana</i>	
Tcu	d		<i>Psydrax obovata</i> subsp. <i>elliptica</i>	
Tcu	d		<i>Pterocelastrus echinatus</i>	
Tcu	d		<i>Rothmannia capensis</i>	
Tcu	d		<i>Xymalos monospora</i>	Eastern Mistbelt
Tcu	d		<i>Zanthoxylum davyi</i>	

Tcu		Apodytes dimidiata subsp. dimidiata	
Tcu		Faurea rochetiana	
Tcu		Zanthoxylum thorncroftii	
Tu	d	Acacia ataxacantha	Northern Afrotemp.
Tu	d	Brachylaena discolor var. transvaalensis	
Tu	d	Diospyros whyteana	
Tu	d	Englerophytum magalismsontanum	Savanna
Tu	d	Eugenia natalitia	
Tu	d	Faurea galpinii	Eastern Scarp
Tu	d	C Heteropyxis canescens	endemic
Tu	d	Maytenus acuminata	
Tu	d	Ochna arborea subsp. oconnori	
Tu	d	Oxyacanthus speciosus subsp. gerrardii	
Tu	d	Peddiea africana	
Tu	d	Robsonodendron eucleiforme	
Tu		Bersama transvaalensis	
Tu		Bersama tysoniana	
Tu		Catha edulis	
Tu		Chionanthus foveolatus subsp. major	type: Mariepskop
Tu		Combretum collinum subsp. gazense	Savanna
Tu		Combretum collinum subsp. suluense	Savanna
Tu		Combretum molle	Savanna
Tu		Combretum zeyheri	Savanna
Tu		Commiphora marlothii	
Tu		Dombeya rotundifolia	Savanna
Tu		Dovyalis lucida	
Tu		Elaeodendron croceum	
Tu		Faurea saligna	Savanna
Tu		Gonioma kamassi	Southern Cape Afrotemperate
Tu		Halleria lucida	
Tu		Lannea discolor	Savanna
Tu		Maytenus undata	
Tu		Oricia bachmannii	Scarp forests
Tu		Peltophorum africanum	Savanna
Tu		Sterculia murex	endemic to Mpumalanga
Tu		Trema orientalis	
Tu		Vangueria infausta	Savanna
Tf		Cyathea dregei	
TuSt		Ficus craterostoma	
TuSt		Ficus thonningii	
ST	d	Canthium kuntzeanum	
ST	d	Gymnosporia mossambicensis	
ST	d	Pavetta inandensis	Scarp forests
ST	d	Psychotria cepensis	
ST	d	Psychotria zombamontana	S limit; N. Afrotemp.
ST	d	Tricalysia capensis	
ST		Acacia davyi	Savanna
ST		C Allophylus chaunostachys	
ST		Annona senegalensis	
ST		Antidesma venosum	
ST		Aphloia theiformis	Eastern Scarp
ST		Bowkeria cymosa	Eastern Scarp
ST		Calpurnia aurea	
ST		Canthium ciliatum	
ST		Cassinopsis tinifolia	
ST		Choristylis rhamnoides	
ST		Clausena anisata	
ST		Cola greenwayi	
ST		Diospyros lycioides var. lycioides	
ST		Dombeya pulchra	Eastern Scarp
ST		Dovyalis rhamnoides	
ST		Ekebergia pterophylla	
ST		Greyia radlkoferi	

ST			<i>Gymnosporia buxifolia</i>	
ST			<i>Heteropyxis natalensis</i>	
ST			<i>Lanea edulis</i>	
ST			<i>Maesa lanceolata</i>	
ST			<i>Ochna gamostigmata</i>	
St			<i>Pachystigma macrocalyx</i>	
ST			<i>Pavetta cooperi</i>	
ST			<i>Rawsonia lucida</i>	
ST			<i>Rhus transvaalensis</i>	Northern Afrotemp.
ST			<i>Rhus tumulicola</i>	Northern Afrotemp.
ST			<i>Senna petersiana</i>	
ST			<i>Syzygium legati</i>	endemic (N. Escarpment)
ST			<i>Tarchonanthus trilobus</i> var. <i>galpinii</i>	
ST			<i>Trimeria grandifolia</i>	
ST			<i>Tylosema fassoglense</i>	
ST			<i>Vangueria cyanescens</i>	Eastern Scarp
ST			<i>Vepris reflexa</i>	Savanna
ST			<i>Vernonia amygdalina</i>	Savanna
ST			<i>Ziziphus mucronata</i>	Savanna
S	d		<i>Carissa bispinosa</i> subsp. <i>zambesiaca</i>	
S	d		<i>Macaya bella</i>	Eastern Scarp
S	d	C	<i>Pavetta kotzei</i>	endemic
S	d		<i>Sclerochiton harveyanus</i>	
S			<i>Clutia monticola</i>	
S			<i>Crotalaria capensis</i>	
S			<i>Dalechampia capensis</i>	
S			<i>Desmodium dregeanum</i>	
S			<i>Desmodium gangeticum</i>	
S			<i>Desmodium repandum</i>	
S			<i>Duvernoia adhatoides</i>	Eastern Scarp
S			<i>Euchaetis cristagalli</i>	
S			<i>Gnidia caffra</i>	
S			<i>Gnidia kraussiana</i>	
S			<i>Indigofera swaziensis</i>	
S			<i>Indigofera tristoides</i>	
S			<i>Lauridia tetragona</i>	
S			<i>Lippia wilmsii</i>	
S			<i>Passerina montana</i>	
S		C	<i>Pavetta barbetonensis</i>	endemic
S			<i>Phaulopsis imbricata</i>	
S			<i>Polygala uncinata</i>	
S			<i>Rhus grandidens</i>	Eastern Scarp
S			<i>Rhus pyroides</i> var. <i>pyroides</i>	
S			<i>Rhus rehmanniana</i>	
S			<i>Stylosanthes fruticosa</i>	
S			<i>Vaccinium exul</i>	
S			<i>Vernonia myriantha</i>	
S			<i>Vernonia tigna</i>	
S			<i>Vernonia wollastonii</i>	
Smon			<i>Dracaena aletriformis</i>	
Ssoft	d		<i>Piper capense</i>	
Ssoft	d		<i>Plectranthus fruticosus</i>	
Ssoft			<i>Endostemon obtusifolius</i>	Northern Afrotemp.
Ssoft			<i>Eriosema psoraleoides</i>	
Ssoft			<i>Hypoestes aristata</i>	
Ssoft			<i>Isoglossa eckloniana</i>	
Ssoft			<i>Justicia petiolaris</i> subsp. <i>petiolaris</i>	
Ssoft			<i>Plectranthus dolichopodus</i>	Eastern Mistbelt
Ssoft			<i>Plectranthus grallatus</i>	Northern Afrotemp.
Ssoft			<i>Plectranthus rubropunctatus</i>	Northern Afrotemp.
Ssoft			<i>Plectranthus tetragonus</i>	Northern Afrotemp.
Ssoft			<i>Pycnostachys urticifolia</i>	Northern Afrotemp.
Ssuc		C	<i>Aloe dyeri</i>	

SCw		<i>Abrus laevigatus</i>	
SCw	d	<i>Adenopodia spicata</i>	
SCw	d	<i>Bauhinia galpinii</i>	
SCw		<i>Cassinopsis ilicifolia</i>	
SCw		<i>Grewia occidentalis</i>	
SCw		<i>Rhynchosia komatiensis</i>	
SCw		<i>Scutia myrtina</i>	
Ch		<i>Jasminium abyssinicum</i>	Northern Afrotemp.
Ch		<i>Cissampelos torulosa</i>	
Ch		<i>Dioscorea cotinifolia</i>	
Ch		<i>Jasminum angulare</i>	
Ch		<i>Mucunia coriaca</i> subsp. <i>irritans</i>	
Ch		<i>Rhynchosia caribaea</i>	
Ch		<i>Rhynchosia sordida</i>	
Cw	d	<i>Dalbergia armata</i>	
Cw	d	<i>Rhoicissus rhomboideus</i>	
Cw		<i>Adenia digitata</i>	
Cw		<i>Adenia gummifera</i>	
Cw		<i>Asparagus africanus</i>	
Cw		<i>Asparagus angusticladus</i>	
Cw		<i>Asparagus lignosus</i>	
Cw		<i>Asparagus rigidus</i>	
Cw		<i>Asparagus setaceus</i>	
Cw		<i>Asparagus virgatus</i>	
Cw		<i>Behnia reticulata</i>	
Cw		<i>Cephalanthus natalensis</i>	
Cw		<i>Cnestis polyphylla</i>	
Cw		<i>Combretum edwardsii</i>	
Cw		<i>Cyphostemma anatomicum</i>	
Cw		<i>Cyphostemma simulans</i>	
Cw		<i>Hippocratea crenata</i>	
Cw		<i>Jasminum streptopus</i>	
Cw		<i>Keetia gueinzii</i>	
Cw		<i>Pyrenacantha grandifolia</i>	
Cw		<i>Quisqualis parviflora</i>	
Cw		<i>Rhoicissus tomentosa</i>	
Cw		<i>Rhoicissus tridentata</i>	
Cw		<i>Secamone alpini</i>	
Cw		<i>Secamone gerrardii</i>	
Cw		<i>Secamone parvifolia</i>	
Cw		<i>Toddalia asiatica</i>	
Cw		<i>Tylophora flanaganii</i>	
Ef		<i>Pleopeltis macrocarpa</i>	
H	d	<i>Galopina circaeoides</i>	
H	d	<i>Hypoestes triflora</i>	
H		<i>Abutilon sonneratianum</i>	
H		<i>Acalypha villicaulis</i>	
H		<i>Cardamine africana</i>	
H		<i>Cardamine africana</i>	
H		<i>Dicliptera clinopodia</i>	
H		<i>Flemingia grahamiana</i>	
H		<i>Gerbera jamesonii</i>	Eastern Scarp
H		<i>Gerbera jamesonii</i>	Eastern Scarp
H		<i>Impatiens hochstetteri</i>	
H		<i>Impatiens hochstetteri</i>	
H		<i>Impatiens silvicola</i>	
H		<i>Impatiens silvicola</i>	
H		<i>Justicia campylostemon</i>	
H		<i>Pilea rivularis</i>	Northern Afrotemp.
H		<i>Pilea rivularis</i>	Northern Afrotemp.
H		<i>Pouzoltia parasitica</i>	Northern Afrotemp.
H		<i>Pouzoltia parasitica</i>	Northern Afrotemp.
H		<i>Pseudarthria hookeri</i>	

H		<i>Ruttya ovata</i>	
H		<i>Schistostephus heptalobus</i>	
H		<i>Stachys caffra</i>	Eastern Mistbelt
H		<i>Stachys caffra</i>	Eastern Mistbelt
H		<i>Streptocarpus cyaneus</i>	Northern Afrotemp.
H		<i>Streptocarpus daviesii</i>	
H	C	<i>Streptocarpus davyi</i>	endemic (Swaziland)
H	C	<i>Streptocarpus decipiens</i>	endemic
H	C	<i>Streptocarpus denticulatus</i>	endemic (Barbeton area)
H	C	<i>Streptocarpus dunnii</i>	endemic
H	C	<i>Streptocarpus fenestra-dei</i>	endemic (God's Window)
H	C	<i>Streptocarpus galpinii</i>	endemic (Barbeton area)
H		<i>Streptocarpus meyeri</i>	
H		<i>Streptocarpus pentherianus</i>	
H	C	<i>Streptocarpus micranthus</i>	endemic
H	C	<i>Streptocarpus wilmsii</i>	Eastern Scarp
Hbab		<i>Strelitzia caudate</i> S limit	
Hcr		<i>Peperomia retusa</i>	
Hcr		<i>Peperomia tetraphylla</i>	
Hf	d	<i>Cheilanthes viridis</i>	
Hf	d	<i>Pteridium aquilinum</i>	
Hf	d	<i>Pteris catoptera</i>	Northern Mistbelt
Hf		<i>Asplenium aethiopicum</i>	
Hf		<i>Asplenium boltonii</i>	
Hf		<i>Asplenium friesiorum</i>	Eastern Scarp
Hf		<i>Asplenium lobatum</i>	
Hf		<i>Asplenium rutifolium</i>	
Hf		<i>Asplenium sandersonii</i>	Northern Mistbelt
Hf		<i>Asplenium splendens</i>	
Hf		<i>Blotiella natalensis</i>	
Hf		<i>Dryopteris inaequalis</i>	
Hf		<i>Elaphoglossum aubertii</i>	
Hf		<i>Elaphoglossum conforme</i>	Northern Mistbelt
Hf	C	<i>Hymenophyllum capillare</i>	endemic
Hf		<i>Lycopodium lycopodioides</i>	Northern Mistbelt
Hf		<i>Polypodium polypodioides</i>	
Hf		<i>Polystichum macleae</i>	Northern Mistbelt
Hf		<i>Selaginella kraussiana</i>	
Hf		<i>Trichomanes melanotrichum</i>	
Hg	d	<i>Aristea ensifolia</i>	
Hg	d	<i>Dietes iridioides</i>	
Hg		<i>Begonia sonderiana</i>	
Hg	C	<i>Crocasmia aurea</i>	
Hge	d	C <i>Clivia caulescens</i>	
Gcr	d	<i>Oplismenus hirtellus</i>	
Gsc	d	<i>Prosphytochloa prehensilis</i>	
G	d	<i>Carex spicato-paniculata</i>	
G	d	<i>Cyperus albostriatus</i>	
G		<i>Cyperus pseudoleptocladus</i>	
G		<i>Panicum comorense</i>	
G		<i>Setaria megaphylla</i>	

Typical & Endemic Animals

Table. Forest dependent bird, mammal, frog and reptile species in the Mpumalanga Mistbelt Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, E – endemic, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Buffspotted flufftail	<i>Sarothrura elegans</i>	C	Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Tambourine dove	<i>Turtur tympanistria</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Knysna lourie	<i>Tauraco corythaix</i>	C	Birds	EC, KZN, MP, NP
Emerald cuckoo	<i>Chrysococcyx cupreus</i>	Cm	Birds	LP, Mpu, KZN, EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape
Trumpeter hornbill	<i>Bycanistes bucinator</i>	Cl	Birds	LP, Mpu, KZN, EC
Scalythroated honey guide	<i>Indicator variegatus</i>	Cf	Birds	e. Mp, coastal EC & KZN
Olive woodpecker	<i>Mesopicos griseocephalus</i>	Cf	Birds	Widespread
Grey cuckooshrike	<i>Coracina caesia</i>	U	Birds	Widespread
Squaretailed drongo	<i>Dicrurus ludwigii</i>	C	Birds	Mp, coastal EC & KZN
Bush blackcap	<i>Lioptilus nigricapillus</i>	U	Birds	LP, Mp, inland EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Yellowstreaked bulbul	<i>Phyllastrephus flavostriatus</i>	Cf	Birds	Ngoye forest north to e.Mp
Yellowbellied bulbul	<i>Chlorocichla flaviventris</i>	C	Birds	Coastal n. EC & KZN
Orange thrush	<i>Zoothera gurneyi</i>	Cf	Birds	LP, Mp, KZN, EC
Chorister robin	<i>Cossypha dichroa</i>	Cl	Birds	LP, Mp, KZN, EC
Starred robin	<i>Pogonocichla stellata</i>	Cl	Birds	LP, Mp, KZN, EC
Brown robin	<i>Erythropygia signata</i>	Cl	Birds	e. Mp, coastal EC & KZN
Bearded robin	<i>Erythropygia quadrivirgata</i>	Cf	Birds	n. Zululand
Yellowthroated warbler	<i>Seicercus ruficapillus</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Barthroated apalis	<i>Apalis thoracica</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>	Cl	Birds	LP, Mp, KZN, EC, S.Cape
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Green twinspot	<i>Mandingoa nitidula</i>	Cl	Birds	LP, Mp, KZN, EC
Forest canary	<i>Serinus scotops</i>	Cl	Birds	LP, Mp, KZN, EC
Red duiker	<i>Cephalophus natalensis</i>		Mammals	LP, n. Zululand
Samango monkey	<i>Cercopithecus mitis</i>		Mammals	LP, EC, KZN
Woodland mouse	<i>Grammomys dolichurus</i>		Mammals	LP, Mp, KZN, EC
Woodland dormouse	<i>Graphiurus murinus</i>		Mammals	Widespread
Dark-footed forest shrew	<i>Myosorex cafer</i>		Mammals	LP, Mp, KZN, EC
Natal ghost frog	<i>Heleophryne natalensis</i>		Frogs	LP, Mp, KZN, EC
Plaintive rain frog	<i>Breviceps verrucosus</i>		Frogs	KZN, EC
Clicking stream frog	<i>Strongylopus grayii</i>		Frogs	Widespread
Giant legless skink	<i>Acontias plumbeus</i>	E	Reptiles	LP, e. Mp, n. KZN, East London

Conservation & Management

Use & Value

The socio-economic value of these forests is high in terms of ecotourism (e.g., Sabie Grasskop, MacMac, God's Window area) and the harvesting of medicinal plants (bark, herb & bulbs), and also in terms of cultural activities such as initiation ceremonies. The biodiversity value is moderate due to a limited number of endemic species. However, these forests provide for east-west mixing of lowveld and highveld species, and a north-south migration route along the escarpment. Isolated pockets of rare species e.g., *Ocotea bullata*, *O.*

kenyensis, *Faurea macnaughtonii*, *Olinia radiata* and *Heteropyxis canescens* occur on rocky outcrops and in forested sinkholes on Berlin. The ecological value is high in that these forests help stabilise streams, controlling erosion and water retention in major Mpumalanga river catchment areas i.e. Kaap, Sabie, Mac Mac & Sand rivers. Also the side streams of Crocodile, Blyde, and Olifants rivers and most streams feeding the Kruger National Park, as well as large agricultural and subsistence communities.

Conservation Status

Most Mpumalanga Mistbelt forests occur on state land and are protected. Some of those occurring on private land have been declared Natural Heritage Sites (In-De-Diepte Reserve, Mondi Indigenous Forest Reserve, Buffelskloof Private Nature Reserve, Sudwala Rain Forest) or nature reserves (Mt Sheba). These forests include a variety of large and small fragments and riverine ribbons. Most are being patrolled by Komati Forests (Safcol), DWAF, Global Forest Products, Mondi or Mpumalanga Parks Board. However, management capacity is mostly unable to cope especially with the large shift from personal to commercial exploitation of medicinal plants.

The NLC data gives 46 000 ha of this forest type with xx% conserved. The forest biome data is almost identical with 41 000 ha and xx% conserved. The majority of the conserved forest is on DWAF land with an additional about 3 000 ha on non-DWAF conservation land.

Main Threats

- ⇒ the selective harvesting of bark is a severe threat;
- ⇒ increased pressure from medicinal plant trade, aided by increased accessibility due to forestry road infrastructure;
- ⇒ alien plant invasion in areas of disturbed forest (e.g., Bugweed, Lantana, *Eucalyptus sp.* Black & Silver Wattle, Blackwood);
- ⇒ cattle grazing has possible impacts on regeneration processes in the understorey and gaps;
- ⇒ reduced dispersion of propagules due to localised extinction of large dispersers.

Other Management Considerations

- ⇒ Many of the forests are for the most part entirely surrounded by timber plantations, which have well documented positive and negative impacts. Positive impacts are protection from fire, forest expansion, reduced use of indigenous firewood and lath and pole cutting. Negative impacts (see Everard et al. 1994) are ecotone/plantation mergence, extinction of ecotone fauna, increased erosion due to road systems, alien weed invasion and fire damage due to wildfires entering forests due to altered ecotonal functioning. Harvesting activities could harm the forests by physical damage (trees felled into ecotones). Stacking of timber in forest margins cause physical damage and could pose fire hazard.
- ⇒ Activities within these forests, including ecotourism through unguided trails, collection of medicinal and magical forest products, bush-meat hunting, grazing of cattle, honey collection and the use of the forest for initiation rituals.

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IV1: Eastern Mistbelt Forest

Synonyms

Mist Belt Mixed <i>Podocarpus</i> Forest	Edwards (1967)
Mistbelt Mixed <i>Podocarpus</i> forest	Moll (1972)
Undifferentiated Afromontane Forest p.p.	White (1983)
Transkei and Natal Montane Forests p.p.	Phillipson & Russell (1988)
Mist Belt Mixed <i>Podocarpus</i> Forest	Cooper (1985)
Mistbelt Mixed <i>Podocarpus</i> Forest	Everard et al. (1995)
High Altitude Afrotropical Forest	Cawe (1996)?
Middle Altitude Afrotropical Forest	Cawe (1996)?
Mistbelt Afrotropical Forest	Cawe (1996)?
Moist Afrotropical Forest	Cawe (1996)?
Afromontane Forest p.p.	Low & Rebelo (1998)
Southern KwaZulu-Natal Mistbelt Forests	Bailey et al. (1999)

Profile

Eastern Mistbelt Forests are small (<1 ha) to large (>1500 ha) forests. They occur in an extensive band at middle altitudes (850-1600 m above sea level) often on steep eastern to western slopes of the mountains or escarpments (fire refugia) from the Kokstad - Mount Ayliff - Bizana area in the Eastern Cape to the midlands of KwaZulu-Natal. The habitat is characterized by heavy summer mist. The forests are dominated by *Xymalos monospora*, *Podocarpus henkelii*, *P. latifolius*, *P. falcatus*, *Celtis africana*, *Kiggelaria africana* and *Ocotea bullata* in the canopy. Understorey species vary in importance and include tree/shrub species such as *Eugenia zuluensis*, *Trichocladus ellipticus* (not as common as in the Amatole and Transkei Mistbelt forests), *Maytenus mossambicensis* and *Peddiea africana*, and a range of fern species often at high density. There are a number of deciduous and semi-deciduous species such as *Celtis africana*, *Calodendrum capense*, *Ptaeroxylon obliquum*, *Kiggelaria africana* and *Zanthoxylum davyi*. The forests are generally moist. Historically they were surrounded by grassland, but in many areas are now surrounded by commercial timber plantations.

Distribution

The Eastern Mistbelt Forests extends over a wide latitudinal range at medium altitude from the KwaZulu-Natal midlands near Ulundi in the north to the mountains around Kokstad – Mount Ayliff - Bizana in the Eastern Cape in the south. The forests are fragmented within the grasslands and are confined to fire shadows on south and southeast facing slopes.

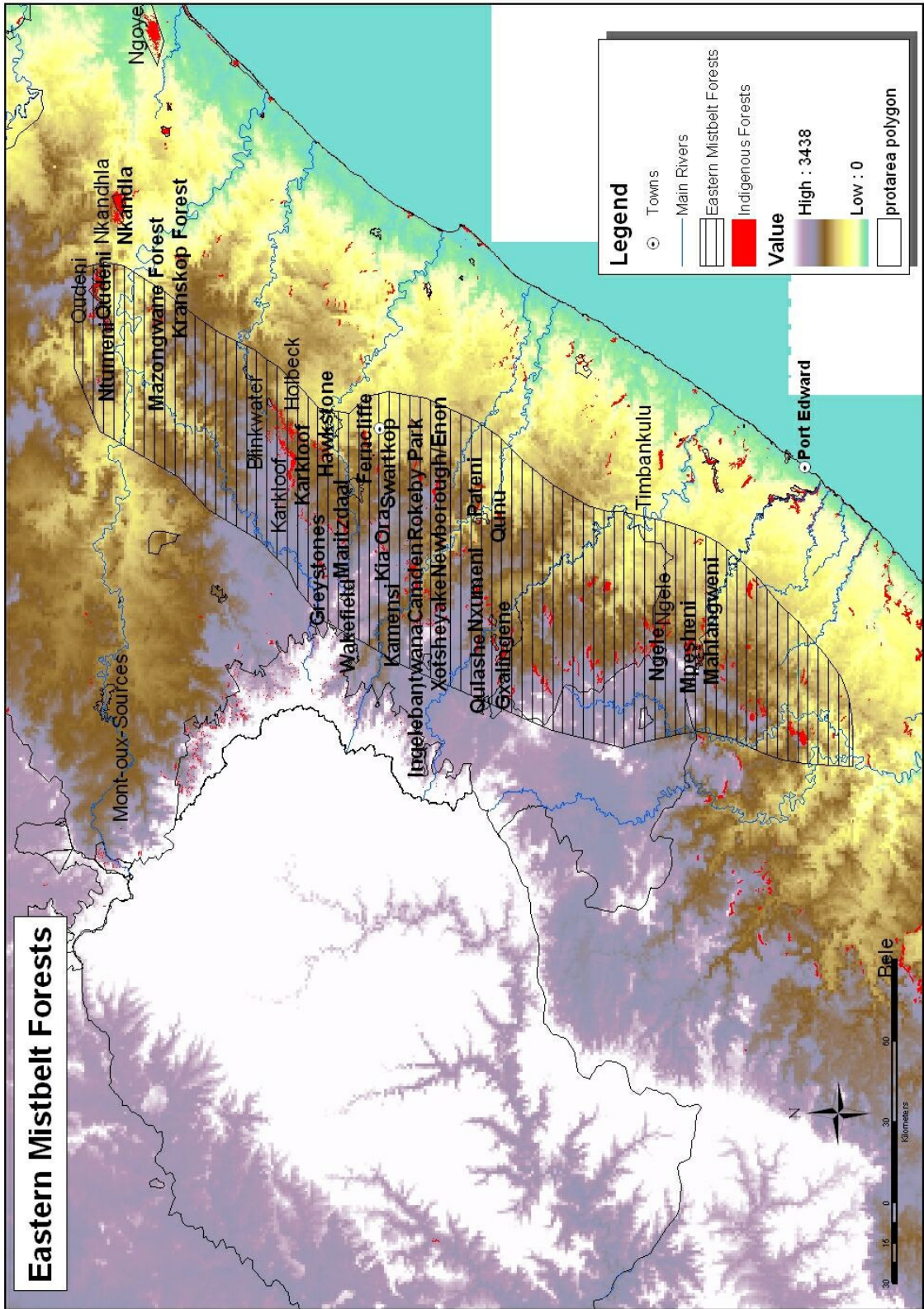
Known Forests

KwaZulu-Natal:

Amberley	Boschoek complex (Balgowan)
Bangeni (Weza complex)	Bush Kop
Bazini	Camden (Bulwer)
Benvie	Carlisle
Blinkwater (Seven Oaks)	Clairmont/Mossbank (complex)
Boschbokkloof	Clundy Cleugh (complex)
Boschfontein North (complex)	Dargle (complex)
Boschfontein South (complex)	Deluge
Donkerhoek	Enon (Richmond)
Elandshoek	Ferncliff
Elandskop	Flemington (Boston)

Fort Nottingham	Newborough Grange (Richmond)
Gala	Ngome (upper part)
Guquka	Nhlazatshe (Dingaanstad)
Hamilton	Nhlosane complex
Hawkstone	Nkhobeni
Hlabeni	Nxumeni
Holbeck (Howick)	Osgodsby
Hopedale	Overbury
Ingelabatwan	Pateni
Ingeli (Ngele) (Weza complex)	Pinewoods
Ingudwini	Pondwana/Mnyati (complex)
Ingwe	Qulashe (near Ili)
Karkloof (Howick)	Qunu Falls (Eastwolds)
Kia Ora (Boston)	Rensburg (complex)
Kildair	Request
KwaCeza (Swart folozi)	Rockcliff
KwaHeri	Rockeby Park
KwaYili (complex)	Rooihoogte
Liff (Seven Oaks)	Sica
Linwood (Howick)	Sikaka
Lion's Bush	Simakade
Lovedale (complex)	Soada
Maritzdal (Dargle)	Swartkop
Marutswa/Marwaqa	The Alps
McSorley	The Start
Mikhanzeni	Tintwa
Milestone	Trewirgie
Mkombela Bush	Umgeni Poort
Moyeni (Richmond)	Underbush (near Creighton)
Mpesheni (Weza complex)	Vaalhoek
Mt. Shannon (Boston)	Willowstream Park
Mvuleni (near Ili)	Xalingena (complex)
Ndanyana	Xotsheyake
New Forncett complex (Boston)	

Map



Eastern Cape:

Adam (Umzimkulu complex)	Myembe
Bantam (Umzimkulu complex)	Ntsikeni (Umzimkulu complex)
Bulembu	Nzimankulu (Umzimkulu complex)
KwaHoha (Umzimkulu complex)	Qunjini (Umzimkulu complex)
Malowe (Umzimkulu complex)	Sihleza (Umzimkulu complex)
Mhlonga	Sneezewood (Umzimkulu complex)
Mpola	Tonti
Nqutu	Xama
Mount Ayliff.	

Vegetation Structure & Texture

Stand Structure

Eastern Mistbelt Forests are high and multi-layered forest (approximately 15–30 m tall), comprising two layers of trees, a full, dense understorey and a very well developed herb layer. Species are predominantly single stemmed, but *Xymalos monospora* is typically multi-stemmed. The majority of trees are evergreen, but many deciduous trees are present that gives the impression of an open forest canopy during the winter (dry) months. They are dominated by a range of species that vary in importance in different parts of the forest: *Xymalos monospora*, *Podocarpus henkelii*, *Podocarpus falcatus*, *Podocarpus latifolius*, *Ocotea bullata*, *Celtis africana*, *Calodendrum capense*, *Apodytes dimidiata*, *Curtisia dentata*, *Cussonia spicata* complex, *Kiggelaria africana*, *Prunus africana* (nowhere common), *Ptaeroxylon obliquum*, *Rapanea melanophloeos*, *Rhus chirindensis*, *Vepris lanceolata* and *Zanthoxylum davyi*. The strangler fig, *Ficus craterostoma*, occurs in many of the forests. Important sub-canopy trees and shrubs include *Allophylus dregeanus*, *Calpurnia aurea*, *Clausena anisata*, *Cryptocarya woodii*, *Diospyros whyteana*, *Eugenia zuluensis*, *Halleria lucida*, *Maytenus mossambicensis*, *Pterocelastrus rostratus*, *Rothmannia capensis*, *Trichocladus ellipticus* and *Trimeria grandifolia*. A fern layer is well developed in many parts of the forests, and include a variety of species. The two long-term growth plots in the Weza forest complex (Geldenhuys 1999) gave the following structural data:

Site	DBH class, cm	5,0 - 9,9	10,0 - 29,9	30,0 +	Total
Ngeli	Stems/ha	489,1	487,5	135,9	1112,5
	Mean DBH, cm	11,4	25,1	68,0	24,3
	Basal area, m ² /ha	2,1	10,8	24,0	36,9
Mpesheni	Stems/ha	409,4	310,9	148,4	868,8
	Mean DBH	11,2	25,1	88,4	29,4
	Basal area, m ² /ha	1,7	7,1	42,5	51,3

Diversity Patterns

In the Umzimkulu District, Geldenhuys et al. (2001) recorded a total of 95 tree and shrub species, and the number of species recorded per plot varied between 1 and 13. In the long-term growth plots of 0,64 ha each, trees were recorded down to 5 cm DBH, and 39 species were recorded in the Ingeli plot, and 24 species in the Mpesheni plot (Geldenhuys 1999).

Ecology

Altitude & Geomorphology

The forests occur on gentle to steep SW to SE slopes of the mountain foothills and midland escarpments, and also in gullies along these slopes. The altitude varies between 850 m and 1600 m above sea level.

Geology & Soils

The area is underlain by the Ecca Group (black shales, mudstones and sandstones deposited during Permian to early Triassic during a cold temperate period) and the Beaufort Group (mudstones, sandstones and shales deposited during the Triassic under warm conditions) (Cawe 1986). The soils are generally doleritic, highly weathered and iron-rich, but relatively nutrient rich and loamy.

Climate

The mean annual rainfall in the area varies between 804 and 1123 mm, with the wet period between October and March (mean rainfall 91 to 197 mm per month), and June-July (7 to 24 mm per month) the driest period (Cawe 1986).

A temperate climate with an annual rainfall of approximately 1100-1700 mm. Temperature and rainfall are seasonal, particularly in the more northerly regions and in KwaZulu-Natal these forests may experience 3–4 months without rain in winter and an average of 600 mm in summer. Heavy mists are characteristic in spring and summer, and occasional winter snow.

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	700	2	23	14
Maximum	1500	12	27	20

Disturbance

Natural disturbances include lightning strikes, single-tree deaths and landslides during rain storms in summer and some snowfall in winter. Fire spotting occurs inside the forests from wild fires in the grassland on the ridges, and the fires and sometimes burn into the forest margins, both naturally and human-induced. Eastern Mistbelt forests have a history of logging disturbance (Cawe & McKenzie 1989; King 1941; Taylor 1961), and recently also canopy disturbance caused by ringbarking of several trees species for bark for medicinal use. Small sized trees of *Ptaeroxylon obliquum* and *Podocarpus* species are cut for poles.

Biogeographic Affinities

The Eastern Mistbelt Forests occur between the Drakensberg Montane Forests at higher altitude, the Coastal and Scarp Forests at lower altitude and the other Mistbelt forests to the north and south. In places these different forest types may overlap in the same forest complex. Many of the species are shared between the different forest types. The forests are similar in species composition to the Transkei Mistbelt Forests, but contain the following species that are absent from the latter: *Syzygium gerrardii*, *Ficus craterostoma*, *Cryptocarya myrtifolia* and *Eugenia zuluensis*. Furthermore, the ratio of the three *Podocarpus* species vary much between the two forest types: *P. falcatus* has a much lower density and dominance, and to some extent also *P. latifolius*, in the Eastern Mistbelt Forests, whereas *P. henkelii* is much more common in these forests. *Trichocladus ellipticus* is present in both, but in abundance only in the western end of Eastern Mistbelt Forests.

Communities/Subunits

<i>Diospyros whyteana</i> Association	Cawe & McKenzie (1989)
<i>Eugenia capensis</i> subsp. <i>natalitia</i> - <i>Peddiea africana</i> Association	Cawe & McKenzie (1989)
<i>Xymalos monospora</i> - <i>Ocotea bullata</i> Association	Cawe & McKenzie (1989)
Midlands Forest - The Hella Hella Group	MacDevette et al. (1989)
General Midlands Forests - The Dargle Group	MacDevette et al. (1989)
General Midlands Forests - The Karkloof Group	MacDevette et al. (1989)
Boschhoek Group Forests	MacDevette et al. (1989)

Xymalos monospora-*Ocotea bullata* Association
Ptaeroxylon obliquum-*Eugenia zuluensis* Association

Geldenhuys et al. 2001
 Geldenhuys et al. 2001

Dominant & Diagnostic Plant Species

L	S	D	Latin Name	Note
Tce	d		<i>Podocarpus falcatus</i>	
Tce	d	C	<i>Podocarpus henkelii</i>	
Tc	d		<i>Calodendrum capense</i>	
Tc	d		<i>Celtis africana</i>	
Tc	d		<i>Combretum kraussii</i>	
Tc	d		<i>Curtisia dentata</i>	
Tc	d		<i>Kiggelaria africana</i>	
Tc	d		<i>Ocotea bullata</i>	
Tc	d		<i>Podocarpus latifolius</i>	
Tc	d		<i>Rapanea melanophloeos</i>	
Tc	d		<i>Vepris lanceolata</i>	
Tc			<i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	
Tc			<i>Canthium mundianum</i>	
Tc			<i>Chionanthus peglerae</i>	
Tc			<i>Cryptocarya myrtifolia</i>	
Tc			<i>Cussonia spicata</i> complex	incl. <i>C. sphaerocephala</i>
Tc			<i>Ekebergia capensis</i>	
Tc			<i>Harpephyllum caffrum</i>	
Tc			<i>Maytenus peduncularis</i>	
Tc			<i>Nuxia congesta</i>	
Tc			<i>Nuxia floribunda</i>	
Tc			<i>Olea capensis</i> subsp. <i>macrocarpa</i>	
Tc			<i>Olinia radiata</i>	
Tc			<i>Protorhus longifolia</i>	
Tc			<i>Prunus africana</i>	
Tc			<i>Ptaeroxylon obliquum</i>	
Tc			<i>Rhus chirindensis</i>	
Tc			<i>Schefflera umbellifera</i>	
Tc			<i>Scolopia mundii</i>	
Tc			<i>Scolopia zeyheri</i>	
Tc			<i>Syzygium gerrardii</i>	
Tc			<i>Zanthoxylum davyi</i>	
TcSt			<i>Ficus craterostoma</i>	
Tcu	d		<i>Psydrax obovata</i>	
Tcu	d		<i>Xymalos monospora</i>	
Tcu			<i>Cassipourea malosana</i>	
Tcu			<i>Pittosporum viridiflorum</i>	
Tcu			<i>Pterocelastrus echinatus</i>	
Tu	d	C	<i>Eugenia zuluensis</i>	
Tu	d		<i>Halleria lucida</i>	
Tu	d		<i>Rinorea angustifolia</i>	
Tu			<i>Bersama swynnyi</i>	
Tu			<i>Casearia gladiiformis</i>	
Tc			<i>Cassipourea gummiflua</i>	
Tc			<i>Chionanthus foveolatus</i> subsp. <i>foveolatus</i>	
Tu			<i>Clausena anisata</i>	
Tu			<i>Cryptocarya woodii</i>	
Tu			<i>Elaeodendron croceum</i>	
Tu			<i>Ochna arborea</i> var. <i>arborea</i>	
Tu			<i>Pavetta inandensis</i>	
Tu			<i>Pavetta kotzei</i>	

Tu		<i>Pterocelastrus rostratus</i>	
Tu		<i>Rothmannia capensis</i>	
ST	d	<i>Allophylus dregeanus</i>	
ST	d	<i>Trichocladus ellipticus</i>	
ST		<i>Andrachne ovalis</i>	
ST		<i>Bersama tysoniana</i>	
ST		<i>Buddleja auriculata</i>	
ST		<i>Calpurnia aurea</i> subsp. <i>aurea</i>	
ST		<i>Canthium ciliatum</i>	
ST		<i>Canthium inerme</i>	
ST		<i>Canthium kuntzeanum</i>	
ST		<i>Choristylis rhamnoides</i>	
ST		<i>Dais cotinifolia</i>	
ST		<i>Diospyros whyteana</i>	
ST		<i>Dombeya tiliacea</i>	
ST		<i>Dovyalis lucida</i>	
ST		<i>Dovyalis rhamnoides</i>	
ST		<i>Englerodaphne pilosa</i>	Amatole Mistbelt
ST		<i>Gardenia thunbergia</i>	coastal forests
ST		<i>Gerardina foliosa</i>	Eastern Scarp
ST		<i>Grewia lasiocarpa</i>	Eastern Scarp
ST		<i>Greya radlkoferi</i>	
ST		<i>Gymnosporia buxifolia</i>	
ST		<i>Gymnosporia mossambicensis</i>	
ST		<i>Heteromorpha trifoliata</i>	
ST		<i>Hyperacanthus amoenus</i>	coastal forests
ST		<i>Ochna holstii</i>	
ST		<i>Ochna natalitia</i>	
ST		<i>Oxyacanthus speciosus</i> subsp. <i>gerrardii</i>	Eastern Scarp
ST		<i>Pavetta lanceolata</i>	
ST		<i>Peddiea africana</i>	coastal forests
ST		<i>Solanum giganteum</i>	
ST		<i>Tricalysia lanceolata</i>	
ST		<i>Trimeria grandifolia</i>	
ST		<i>Trimeria trinervis</i>	
S		<i>Carissa bispinosa</i> subsp. <i>zambesiaca</i>	
S		<i>Myrsine africana</i>	
S	C	<i>Ochna gamostigmata</i>	endemic
Ssoft		<i>Plectranthus ciliatus</i>	
Ssoft		<i>Plectranthus dolichopodus</i>	
Ssoft		<i>Plectranthus ecklonii</i>	
Ssoft	C	<i>Plectranthus elegantulus</i>	endemic
Ssoft		<i>Plectranthus fruticosus</i>	
Ssoft		<i>Plectranthus laxiflorus</i>	
Ssoft	C	<i>Plectranthus rehmannii</i>	endemic (Natal Midlands)
SCw		<i>Cassinopsis ilicifolia</i>	
SCw		<i>Strophanthus speciosus</i>	
Cw		<i>Combretum edwardsii</i>	Eastern Scarp
Cw		<i>Quisqualis parviflora</i>	Eastern Scarp
Cw		<i>Scutia myrtina</i>	
H	C	<i>Streptocarpus bolusii</i>	endemic (Transkei)
H	C	<i>Streptocarpus candidus</i>	endemic
H		<i>Streptocarpus comptonii</i>	
H		<i>Streptocarpus daviesii</i>	
H	C	<i>Streptocarpus fanniniae</i>	endemic
H		<i>Streptocarpus haygartii</i>	
H		<i>Streptocarpus johannis</i>	
H		<i>Streptocarpus polyanthus</i> subsp. <i>polyanthus</i>	
H		<i>Streptocarpus pentherianus</i>	
H		<i>Streptocarpus pusillus</i>	
H	C	<i>Streptocarpus silvaticus</i>	endemic
H		<i>Streptocarpus verecundus</i>	
Hf		<i>Microsorium pappei</i>	type: Richmond

Hf		<i>Pyrrhosia africana</i>	endemic to Transkei
Gcr	d	<i>Oplismenus hirtellus</i>	

Typical & Endemic Animals

Table. Forest dependent bird, mammal, frog and reptile species in the Eastern Mistbelt Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Crested guineafowl	<i>Guttera pucherani</i>	Cl	Birds	LP, e. Mp, KZN midlands, n. KZN coast
Buffspotted flufftail	<i>Sarothrura elegans</i>	C	Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Tambourine dove	<i>Turtur tympanistris</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Cape parrot	<i>Poicephalus robustus</i>	Cl	Birds	LP, Mp, inland EC & KZN
Knysna lourie	<i>Tauraco corythaix</i>	C	Birds	EC, KZN, MP, NP
Emerald cuckoo	<i>Chrysococcyx cupreus</i>	Cm	Birds	LP, Mpu, KZN, EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape
Trumpeter hornbill	<i>Bycanistes bucinator</i>	Cl	Birds	LP, Mpu, KZN, EC
Scalythroated honey guide	<i>Indicator variegates</i>	Cf	Birds	e. Mp, coastal EC & KZN
Olive woodpecker	<i>Mesopicos griseocephalus</i>	Cf	Birds	Widespread
Grey cuckooshrike	<i>Coracina caesia</i>	U	Birds	Widespread
Bush blackcap	<i>Lioptilus nigricapillus</i>	U	Birds	LP, Mp, inland EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Orange thrush	<i>Zoothera gurneyi</i>	Cf	Birds	LP, Mp, KZN, EC
Chorister robin	<i>Cossypha dichroa</i>	Cl	Birds	LP, Mp, KZN, EC
Starred robin	<i>Pogonocichla stellata</i>	Cl	Birds	LP, Mp, KZN, EC
Yellowthroated warbler	<i>Seicercus ruficapillus</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Barthroated apalis	<i>Apalis thoracica</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>	Cl	Birds	LP, Mp, KZN, EC, S.Cape
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Forest weaver	<i>Ploceus bicolor</i>	Cl	Birds	Coastal EC & KZN
Green twinspot	<i>Mandingoa nitidula</i>	Cl	Birds	LP, Mp, KZN, EC
Forest canary	<i>Serinus scotops</i>	Cl	Birds	LP, Mp, KZN, EC
Samango monkey	<i>Cercopithecus mitis</i>		Mammals	LP, EC, KZN
Woodland mouse	<i>Grammomys dolichurus</i>		Mammals	LP, Mp, KZN, EC
Woodland dormouse	<i>Graphiurus murinus</i>		Mammals	Widespread
Dark-footed forest shrew	<i>Myosorex cafer</i>		Mammals	LP, Mp, KZN, EC
Natal ghost frog	<i>Heleophryne natalensis</i>		Frogs	LP, Mp, KZN, EC
Plaintive rain frog	<i>Breviceps verrucosus</i>		Frogs	KZN, EC
Natal chirping frog	<i>Arthroleptella hewitti</i>		Frogs	Inland s.KZN
Bush squeaker	<i>Arthroleptis wahlbergi</i>		Frogs	KZN, EC

Common name	Scientific name	Status	Taxon	Distribution
Clicking stream frog	<i>Strongylopus grayii</i>		Frogs	Widespread

Conservation & Management

Use & Value

Eastern Mistbelt Forests have a high socio-economic value in terms of timber (including poles) and non-timber forest products, including medicinal plant species. The biodiversity value is high because of their relatively high species richness and the fact that they represent some of the more extensive Afrotemperate forests. They have great scenic value and contribute to sustainability of water supply.

Conservation Status

Many of the Eastern Mistbelt Forests, and the larger forests, in the Eastern Cape ((Umzimkulu area), and parts of southern KwaZulu-Natal, fall within formally protected areas (DWA Primary Conservation Areas and Nature Reserves, and KwaZulu-Natal Wildlife Reserves). In many of these areas, commercial timber plantations under private management provide additional protection of the forests against fire and unlawful access. Some of the unprotected forests are in a very degraded state and many that are theoretically protected are vulnerable, especially in the former Transkei regions (Cooper 1985; Cooper & Swart 1992). The forests vary in size with some forest complexes being fairly extensive (over 1000 ha) and others small and highly fragmented.

The estimated extent of this forest type is 33 000 and 37 000 ha from the NLC and forest bio data respectively.

Main Threats

- ⇒ over-exploitation of non-timber forest products especially poles (*Podocarpus* species and *Ptaeroxylon obliquum*) and bark harvesting (*Ocotea bullata*, *Curtisia dentata*, *Prunus africana* and *Rapanea melanophloeos*);
- ⇒ mismanagement of fire and burning regimes in surrounding grasslands.

Other Management Considerations

- ⇒ increase in harvesting of fuel wood since the removal of wattle by Working for Water Programme;
- ⇒ land claims;
- ⇒ invasive alien plants on the forest margins and adjacent plantations, which spread into forest gaps;
- ⇒ potential for more extensive ecotourism development;
- ⇒ heavy, unsustainable winter grazing in the forest for cattle belonging to local, rural communities;
- ⇒ clearing of patches under the forest canopy for dagga growing, particularly in the past;
- ⇒ illegal hunting in forest;
- ⇒ Some species occupy a relatively wide range. They are adapted to living in a fragmented landscape and it is important to maintain mobility and dispersal links. The communities are also relatively robust.

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IV2: Transkei Mistbelt Forest

Synonyms

Transkei and Natal Montane Forests p.p.	Phillipson & Russell (1988)
High Altitude Afrotropical Forest	Cawe (1996)
Middle Altitude Afrotropical Forest	Cawe (1996)
Mistbelt Afrotropical Forest	Cawe (1996)
Moist Afrotropical Forest	Cawe (1996)
Afromontane Forest p.p.	Low & Rebelo (1998)
Transkei Montane Forests	Bailey et al. (1999)

Profile

Transkei Mistbelt Forests are small (<1 ha) to medium-sized (1000 ha). They occur in a fragmented band at middle altitudes (850-1600 m above sea level) often on steep eastern to western slopes of the mountains or escarpments (fire refugia) from the Kei River to Mount Frere, Mount Ayliff and Tabankulu areas in the Eastern Cape. The forests are dominated by *Podocarpus falcatus*, sometimes as emergent, *Scolopia mundii*, *Podocarpus latifolius*, *Xymalos monospora*, *Rapanea melanophloeos*, *Kiggelaria africana* and a range of other associated species in the canopy. It differs from the Eastern Mistbelt Forests in the large number of *P. falcatus* and *P. latifolius* and small number of *P. henkelii* in the Transkei Mistbelt Forests and particularly the lower number of *P. falcatus* and higher density of *P. henkelii* in the Eastern Mistbelt Forests. Understorey species vary in importance and include tree/shrub species such as *Eugenia capensis*, *Trichocladus ellipticus* (abundant only in some forests in southern part of Eastern Mistbelt Forests), *Maytenus mossambicensis* and *Peddiea africana*, and a range of fern species often at high density. There are a number of deciduous and semi-deciduous species such as *Celtis africana*, *Calodendrum capense*, *Ptaeroxylon obliquum*, *Kiggelaria africana* and *Zanthoxylum davyi*. The forests are generally moist. Historically they were surrounded by grassland, but in many areas are now surrounded by commercial timber plantations.

Distribution

The Transkei Mistbelt Forests occur mainly in the zone from northeast (Mount Ayliff area) to north to southwest (Kei River) of Umtata. The forests are fragmented within the grasslands and are confined to fire shadows on south, southwest and southeast facing slopes. They are associated with the western end of the Eastern Mistbelt Forests, in the Mount Frere, Mount Ayliff and Tabankulu areas. The 439 forest patches that were mapped and recorded for the former Transkei (including East Griqualand in the Umzimkulu Districts), give the following size class frequency (W. Swart, personal communication, 1989): 0,5 – <10 ha, 110 patches; 10 - <50 ha, 178 patches; 50 - <100 ha, 62 patches; 100 - <500 ha, 78 patches; 500 - <1000 ha, 9 patches; 1000+ ha, 2 patches.

Known Forests

Amanzamnyama	Gqaka Peak
Baziya	Gulandoda
Bele	Hewukile
Camtsholo	Kambi
Cefane	Langeni
Ceka	Lower Nqumakala complex
Dedelo	Ludaka
Didwayo	Mahlungulu
Esikobeni	Mbabalakazi
Etna	
Gomo	

Mbombombo	Qabangeni
Mfabantu	Qebe
Mhleleni	Qelani Point
Mhlopokazi	Rorozi
Mkonkoto	Rubuxa
Mpaxa	Sigubudu
Mtinthlone	Sixanti
Ndlunkulu complex	Tewu
Ngela	Tsitsa Falls
Ndhlovu	Tsojana
Nkandla (Transkei)	Vete
Nkongoloshe	Waka
Nqadu	Xilinx
Ntaboduli	Zabasa
Ntsukumbeni complex	Zixinene

Vegetation Structure & Texture

Stand Structure

Transkei Mistbelt Forests are high (15 – 30 m) and multi-layered. The forests are dominated by the emergent *Podocarpus falcatus*, also with its high frequency of occurrence, stem density and basal area. Other important canopy trees are *Scolopia mundii*, *Celtis africana*, *Podocarpus latifolius*, *Xymalos monospora*, *Rapanea melanophloeos*, *Kiggelaria africana*, *Nuxia floribunda*, *Olea capensis* subsp. *enervis* and *Cussonia spicata* complex. Several other species grow into the canopy. *Trichocladus ellipticus*, *Diospyros whyteana*, *Cryptocarya woodii*, *Scolopia zeyheri* and *Trimeria grandifolia* are important subcanopy trees. *Maytenus mossamicensis* is a common shrub and is associated with a range of other shrubs. *Scutia myrtina* is a prominent climber. Cawe & McKenzie (1989) reported a range of 33,4 to 53,2 m²/ha in basal area for the different communities, and 527 to 917 stems/ha for trees μ 10 cm DBH. The mean of 44,6 m²/ha has 30% in trees less than 30 cm DBH and 47% more than 50% DBH. The mean stem density of 725 stems/ha has 81% of the stems less than 30 cm DBH, and 7% more than 50 cm DBH. A number of the species are deciduous or semi-deciduous, including *Celtis africana*, *Kiggelaria africana*, *Zanthoxylum davyi*, *Rhus chirindensis*, *Calodendrum capense*, *Vepris lanceolata*, *Ptaeroxylon obliquum* and *Ekebergia capensis*. In many parts of the forest ferns form an important part of the understorey.

Diversity Patterns

A total of 108 tree and shrub species were recorded in 149 plots sampled by Cawe & McKenzie (1989) in the Transkei Mistbelt Forests. A mean number of 10,5 species was recorded per plot of 400 m², and the number varied between 4 and 18 woody species per plot for plants μ 10 cm DBH.

Ecology

Altitude & Geomorphology

The forests occur on gentle to steep southwestern to southeastern slopes of the mountain foothills and midland escarpments, and also in gullies along these slopes and major river valleys. The altitude varies between 850 m and 1600 m above sea level.

Geology & Soils

The area is underlain by the Ecca Group (black shales, mudstones and sandstones deposited during Permian to early Triassic during a cold temperate period) and the Beaufort Group (mudstones, sandstones and shales deposited during the Triassic under warm conditions) (Cawe 1986). The soils are generally doleritic, highly weathered and iron-rich, but relatively nutrient rich and loamy.

Climate

The mean annual rainfall in the area varies between 600 and 1200 mm, with the wet period between October and March.

A temperate climate. Heavy mists are characteristic in spring and summer, and occasional winter snow occurs.

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	600	2	24	14
Maximum	1200	6	28	18

Disturbance

Natural disturbances include lightning strikes, single-tree deaths and landslides during rainstorms in summer and occasionally some snowfall in winter. Fire spotting occurs inside the forests from wild fires in the grassland on the ridges, and the fires sometimes burn into the forest margins, both naturally and human-induced. Eastern Mistbelt forests have a history of logging disturbance (Cawe & McKenzie 1989; King 1941). Small sized trees of *Ptaeroxylon obliquum* and *Podocarpus* species are cut for poles.

Communities/Subunits

Diospyros whyteana Association

Cawe & McKenzie (1989)

Scolopia mundii Association

Cawe & McKenzie (1989)

Xymalos monospora-Ocotea bullata Association

Cawe & McKenzie (1989)

Biogeographic Affinities

Transkei Mistbelt Forests is almost a southwestern extension of the Eastern Mistbelt Forests, and contain much the same species in the canopy, but in different abundances. Forty five per cent of the woody species in the Cawe & McKenzie (1989) study of the Transkei Mistbelt Forests are shared with those in the North-eastern Escarpment (Northern Mistbelt Forests), 51% with the Southern Cape Forests, 68% with the Amatole Mistbelt Forests, and 30% with the Drakensberg Montane Forests at Cathedral Peak (Geldenhuys 1992). The forests are similar in species composition to the Amatole Mistbelt Forests and Eastern Mistbelt Forests, but contain the following species that are absent from the Amatole Mistbelt Forests, and in higher abundance in the Eastern Mistbelt Forests: *Podocarpus henkelii*, *Ocotea bullata* (only few scattered stems in the Amatole forests). A number of important species in the Eastern Mistbelt Forests are absent from the Transkei Mistbelt Forests: *Syzygium gerrardii*, *Ficus craterostoma*, *Cryptocarya myrtifolia* and *Eugenia zuluensis*. *Trichocladus ellipticus* is present in all three, but at a much higher density and more widespread in the Amatole Mistbelt Forests. The species *Cassipourea flannaganii*, *Englerodaphne pilosa* and *Trimeria trinervis* are shared by the Transkei and Amatole Mistbelt Forests

Dominant & Diagnostic Plant Species

L	S	D	Latin Name	Note
Tce	d		<i>Podocarpus falcatus</i>	
Tc	d		<i>Podocarpus latifolius</i>	
Tc	d		<i>Calodendrum capense</i>	
Tc	d		<i>Celtis africana</i>	
Tc	d		<i>Chionanthus peglerae</i>	

Tc	d	<i>Curtisia dentata</i>	
Tc	d	<i>Cussonia spicata</i> complex	
Tc	d	<i>Kiggelaria africana</i>	
Tc	d	<i>Nuxia floribunda</i>	
Tc	d	<i>Ocotea bullata</i>	
Tc	d	<i>Olea capensis</i> subsp. <i>macrocarpa</i> (<i>enervis</i> ?)	
Tc	d	<i>Rapanea melanophloeos</i>	
Tc	d	<i>Scolopia mundii</i>	
Tc	d	<i>Zanthoxylum davayi</i>	
Tc		<i>Cunonia capensis</i>	
Tc		<i>Ekebergia capensis</i>	
Tc		<i>Harpephyllum caffrum</i>	
Tc		<i>Maytenus peduncularis</i>	
Tc		<i>Nuxia congesta</i>	
Tc		<i>Pittosporum viridiflorum</i>	
Tc		<i>Podocarpus henkelii</i>	
Tc		<i>Ptaeroxylon obliquum</i>	
Tc		<i>Pleurostyliia capensis</i>	
Tc		<i>Protorhus longifolia</i>	
Tc		<i>Psyrdrax obovata</i>	
TC		<i>Prunus africana</i>	
Tc		<i>Olinia emarginata</i>	
Tc		<i>Rhus chirindensis</i>	
Tc		<i>Scolopia zeyheri</i>	
Tc		<i>Vepris lanceolata</i>	
Tcu		<i>Cassipourea flanaganii</i> near-endemic;	Amatole Mistbelt
Tcu	d	<i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	
Tu	d	<i>Trichocladus ellipticus</i>	
Tcu	d	<i>Chionanthus foveolatus</i> subsp. <i>foveolatus</i>	
<i>Tcu</i>	<i>d</i>	<i>Xymalos monospora</i>	
Tu		<i>Elaeodendron croceum</i>	
Tu		<i>Rothmannia capensis</i>	
Tu		<i>Eugenia zeyheri</i>	
Tu		<i>Mimusops zeyheri</i>	
ST	d	<i>Allophylus decipiens</i>	
ST	d	<i>Buddleja saligna</i>	
ST	d	<i>Burchellia bubalina</i>	
ST	d	<i>Canthium ciliatum</i>	
ST	d	<i>Canthium inerme</i>	
ST	d	<i>Canthium kuntzeanum</i>	
ST	d	<i>Diospyros scabrida</i>	
ST	d	<i>Diospyros whyteana</i>	
ST	d	<i>Gymnosporia buxifolia</i>	
ST	d	<i>Pleurostyliia capensis</i>	
ST	d	<i>Suregada africana</i>	
ST		<i>Bowkeria verticillata</i>	
ST		<i>Clerodendrum glabrum</i>	
ST		<i>Dovyalis rotundifolia</i>	
ST		<i>Englerodaphne pilosa</i>	Amatole Mistbelt
ST		<i>Gardenia thunbergia</i>	
ST		<i>Psychotria capensis</i>	
ST		<i>Strychnos henningsii</i>	
ST		<i>Trimeria trinervis</i>	Amatole Mistbelt
ST****		<i>Maytenus nemorosa</i>	
ST****		<i>Oxyanthus speciosus</i>	

The data do not contain herbaceous understory species for these forests.

Typical & Endemic Animals

No specific data available

Conservation & Management

Use & Value

Transkei Mistbelt Forests have a high socio-economic value in terms of timber (including poles) and non-timber forest products, including medicinal plant species. The biodiversity value is high because of their relatively high species richness and the fact that they represent some of the more extensive Afrotropical forests. They have great scenic value and contribute to sustainability of water supply and maintain water quality in the catchments and prevent soil erosion.

Conservation Status

Many of the Transkei Mistbelt Forests form the larger forests in the Transkei part of the Eastern Cape, fall within formally protected areas (DWA Primary Conservation Areas and Nature Reserves). In many of these areas, commercial timber plantations under private management provide additional protection of the forests against fire and unlawful access. Some of the unprotected forests are in a very degraded state and many that are theoretically protected are vulnerable (Cooper & Swart 1992). The forests vary in size with some forest complexes being fairly extensive (over 1000 ha) and others small and highly fragmented. The NLC and forest bio data estimate the extent of this forest as 14 000 and 11 000 ha respectively.

Main Threats

- ⇒ over-exploitation of non-timber forest products especially poles (*Podocarpus* species and *Ptaeroxylon obliquum*) and bark harvesting (*Ocotea bullata*, *Curtisia dentata*, *Prunus africana* and *Rapanea melanophloeos*);
- ⇒ clearing of forest for the growing of crops;
- ⇒ mismanagement of fire and burning regimes in surrounding grasslands.

Other Management Considerations

- ⇒ increase in harvesting of fuel wood since the removal of wattle by Working for Water Programme;
- ⇒ land claims;
- ⇒ invasive alien plants on the forest margins and adjacent plantations, which spread into forest gaps;
- ⇒ potential for more extensive ecotourism development;
- ⇒ heavy, unsustainable winter grazing in the forest for cattle belonging to local, rural communities;
- ⇒ clearing of patches under the forest canopy for dagga growing, particularly in the past;
- ⇒ illegal hunting in forest;
- ⇒ Some species occupy a relatively wide range. They are adapted to living in a fragmented landscape and it is important to maintain mobility and dispersal links. The communities are also relatively robust.

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IV3: Amatole Mistbelt Forests

Synonyms

Undifferentiated Afromontane Forest p.p.
 Eastern Cape Montane Forests
 Afromontane Forest p.p.
 Amatole Forests Complex

White (1983)
 Phillipson & Russell (1988)
 Low & Rebelo (1998)
 Bailey et al. 1999

Profile

Amatole Mistbelt Forests range from tall forest to scrub forest along a gradient from cool mountain slopes with heavy summer mists, to lowland areas in the Eastern Cape Province. Two subtypes have been recognized. The Amatole Escarpment Forests are relatively large, species rich, middle altitude forests found mainly in the Amatole Mountains. They are dominated by emergent trees of *Podocarpus falcatus*, and characterized by a mixture of evergreen species (e.g. *Podocarpus latifolius*, *Xymalos monospora*, *Harpephyllum caffrum*, *Rapanea melanophloeos* and *Protorhus longifolia*), and deciduous and semi-deciduous species (e.g. *Celtis africana*, *Calodendrum capense*, *Vepris lanceolata*, *Rhus chirindensis* and *Zanthoxylum davyi*). These forests are surrounded by grassland and wooded grassland, many of which had been planted to pine plantations. The Albany Scarp Forests are a complex of scattered small forest patches along the lower west-east quartzite ridges found between the Zuurberg Mts. and the surroundings of King Williams' Town. They are invariably surrounded by a grassy fynbos on the upper ridges and thicket vegetation at the foot of the mountains. These forests are drier and shorter than the escarpment mistbelt subtype. The most prominent canopy trees are *Podocarpus falcatus*, *Rhus chiridensis* and *Vepris lanceolata*.

Distribution

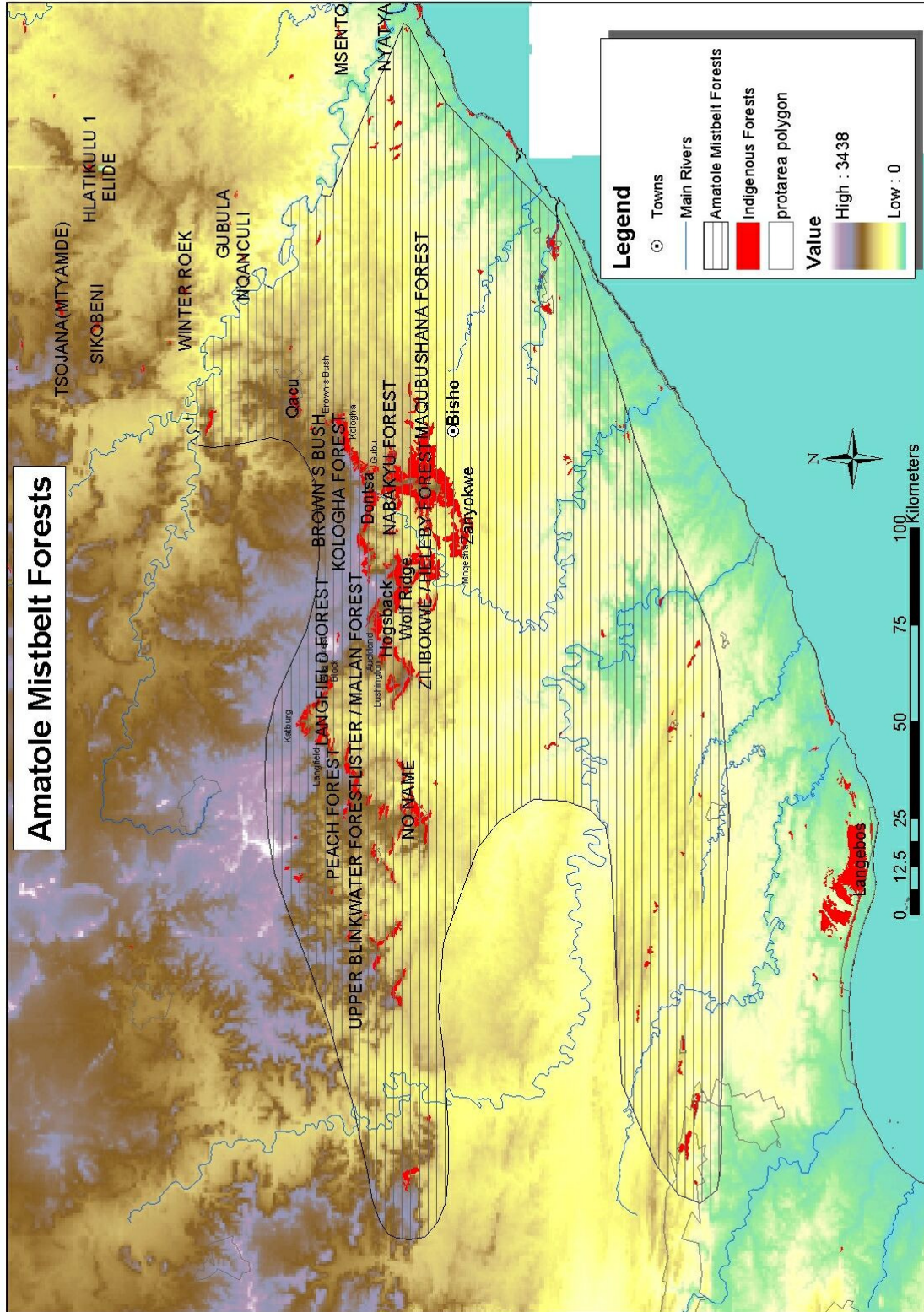
The largest complex is Amatole Escarpment Forests of about 35 000 ha at 500 to 1600 m altitude in the Amatole Mountains of the Eastern Cape between Stutterheim in the east and Hogsback in the west. Outlier forests occur towards the Kei River in the east and the Boschberg at Somerset East in the west. The Albany Scarp Forests are small and scattered from the Sundays River (western part of Zuurberg National Park) and east of Grahamstown. At their lower limit they grade into the Albany River Valley Forests (VII2: Albany Coastal Forests). The delineation of these forests needs verification.

Known Forests

Beggars Bush (Grahamstown)
 Boschberg (extreme W outlier at Somerset East)
 Cwencwe
 Dontsa
 Fern Kloof (Grahamstown)
 Fort Fordyce
 Gxulu
 Hogsback
 Isidenge
 Izeleni

Juanasberg
 Katberg
 Kologha
 Lenye
 Piri
 Quacu
 Thomas Baines Nature Reserve (Grahamstown)
 Zanyokwe
 Zingcuka
 Zuurberg (complex)

Map



Vegetation Structure & Texture

Stand Structure

The typical features of the Amatole Mistbelt Forests are described from available literature and such information is not available for the Albany Scarp Forests. Canopy height in the Amatole Escarpment Forests varies between 15 to 30 m. The standing stock of trees in the studied 4 long-term plots was as follows (Geldenhuys & Rathogwa 1995):

Stand Variable	Site	DBH class, cm			Total
		5.0-9.9	10.0-29.9	30.0+	
Stand density Stems/ha	Pirie	1293.8	657.8	164.1	2115.6
	Isidenge	870.3	668.8	150.0	1689.1
	Sandile Kop	606.5	554.3	226.1	1387.0
	Kologha	1235.0	582.5	92.5	1910.0
Mean DBH, cm	Pirie	7.3	16.3	41.6	21.7
	Isidenge	6.9	16.8	38.2	20.6
	Sandile Kop	7.2	17.3	41.5	22.0
	Kologha	7.4	16.6	42.1	22.1
Basal area, m ² /ha	Pirie	5.0	15.5	23.2	43.7
	Isidenge	3.5	16.0	24.5	44.1
	Sandile Kop	2.5	14.9	40.0	57.4
	Kologha	6.0	12.3	14.1	32.3
Number of species per plot (plot size 0,64 ha)	Pirie 0,64 ha	43 tree species (mean 6.5 species/0.01 ha sub-plot, max 12 species)			
	Isidenge 0,64 ha	37 tree species (mean 6.2 species/0.01 ha sub-plot, max 11 species)			
	Sandile Kop 0,46 ha	38 tree species (mean 6.8 species/0.01 ha sub-plot, max 11 species)			
	Kologha 0,80 ha	36 tree species (mean 6.5 species/0.01 ha sub-plot, max 12 species)			

It is a multi-layered forest comprising tall, emergent trees of *Podocarpus falcatus*, a tall, relatively open to closed upper canopy of a mixture of evergreen (e.g. *Podocarpus latifolius*), semi-deciduous (*Vepris lanceolata*) and deciduous trees (*Celtis africana*), a dense understorey dominated by *Trichocladus ellipticus* trees, and a very well developed herb layer. Species are predominantly single stemmed. In the large dolerite boulder zone (moist to wet sites) *Xymalos monospora* dominates the canopy. These relatively species rich forests show a mixture of large and small canopy gap-disturbance driven regeneration dynamics.

Diversity Patterns

Geldenhuys (1992) listed a total of 390 species for the Amatole Escarpment Forests, comprising 188 woody species (89 trees, 83 woody and soft shrubs, 16 lianas) and 202 herbaceous species (29 vines, 45 terrestrial ferns, 17 epiphytes, 21 geophytes, 23 graminoids, and 67 forbs). The survey by Everard & Hardy (1993) produced 233 plant species: 74% woody and 26% herbaceous. The woody species comprised 39% trees, 21% shrubs and 14% creepers. Ferns formed 7% of the herbaceous species. No data are available on diversity patterns along environmental gradients, but the table above shows no definite trend from drier to moist forest.

Ecology

Altitude & Geomorphology

The Amatole Escarpment Forests extends from the dry, lower southern slopes at about 500 m, across a succession of terraces to the mountain scarps at about 1400 m, including broad intermountain valleys. The Albany Scarp Forests generally occur on southern slopes and gullies in fire refugia.

Geology & Soil

Mudstones, shales and sandstones of the Balfour Formation with Dolerite intrusions underlie most of the Amatole Escarpment Forests. Soil depth varies according to superficial dolerite sheets in places. The soils have a high proportion of coarse silt and high clay content. PH is relatively high (5,8 to 6,8). The heavy,

weathered iron-rich soils are relatively nutrient rich and loamy. The Albany Scarp Forests are confined to the deeper soils in depressions along the slopes and in gullies in the ridges built by Witteberg quartzites.

Climate

A temperate climate with an annual rainfall of approximately 800-1800 mm. Temperature and rainfall are seasonal, although the Amatole region receives both summer and winter rainfall, with a winter rainfall average of 400 mm. Heavy mists are characteristic in spring and summer, and occasional winter snow.

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	350	1	24	14
Maximum	1500	10	29	19

Disturbance

Natural disturbances include dramatic storms during summer and some snowfall in winter. Species size class distributions suggest that, although this forest is predominantly fine grained, gap dynamics are important for the establishment of some species. Fire spotting occurs inside the forests from wild fires in the grassland/fynbos on the ridges, and the fires from the neighbouring grasslands and fynbos burn into the forest margins, both naturally and human-induced. The Amatole Forests have a history of man-induced disturbance through timber harvesting, in particular for *Podocarpus latifolius* and *P. falcatus* for furniture timber, and *Ptaeroxylon obliquum* for poles, wagons and railway sleepers.

Biogeographical Affinities

The Amatole Escarpment Forests have the highest similarity (expressed by Czekanowski Index) of the woody species with the Transkei Mountain Forests (IV1: Eastern Mistbelt Forests) and the Southern Cape Afrotropical Forests (Type I3) (Geldenhuys 1992). They have more than 40 % similarity with forests at Swellendam to the west (I2: Western Cape Afrotropical Forests), forests along the East London coast (VII1: Eastern Cape Dune Forests), the Drakensberg Montane Forests (Type II2), and the Northern Mistbelt Forests (Type III1 and III2). Amatole Mistbelt Forests lack *Podocarpus henkelii*, a dominant component of Eastern Mistbelt Forests, and have a few scattered plants of *Ocotea bullata*, a common species in both the Eastern Mistbelt and Southern Cape Afrotropical Forests. Amatole Mistbelt Forests share phytogeographically important species such as *Cassipourea flanaganii*, *Englerodaphne pilosa* and *Trimeria trinervis* with the Transkei Coastal Valley Forests (IV2).

Communities/Subunits

On a preliminary basis we can recognize two subtypes, such as **IV3a: Amatole Escarpment Forests** (large, species rich, middle altitude forests found mainly in the Amatole Mountains and Boschberg near Somerset East) and **IV3b: Albany Scarp Forests** (a complex of scattered small forest patches along the lower mountains of quartzites between the Zuurberg National Park and Grahamstown and surrounded by a grassy fynbos on the upper ridges and thicket vegetation at the foot of the mountains). More data are needed to ascertain if the latter subtype would qualify as an own Forest Type.

Further types have been described:

Dry Forest	Story (1952)
Moist Forest	Story (1952)
<i>Cassipourea flanaganii</i> - <i>Eugenia capensis</i> Community	Everard & Hardy (1993)
<i>Olea capensis</i> subsp. <i>macrocarpa</i> - <i>Diospyros whyteana</i> Community	Everard & Hardy (1993)
<i>Podocarpus latifolius</i> - <i>Xymalos monospora</i> Community	Everard & Hardy (1993)
<i>Secamone alpinum</i> Community	Everard & Hardy (1993)

Dominant & Diagnostic Plant Species

L	S	D	Latin Name	Note
Te	d		<i>Podocarpus falcatus</i>	
Tc	d		<i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	
Tc	d		<i>Calodendrum capense</i>	
Tc	d		<i>Celtis africana</i>	
Tc	d		<i>Chionanthus peglerae</i>	
Tc	d		<i>Cunonia capensis</i>	E limit for mistbelt
Tc	d		<i>Curtisia dentata</i>	
Tc	d		<i>Kiggelaria africana</i>	
Tc	d		<i>Olea capensis</i> subsp. <i>macrocarpa</i>	
Tc	d		<i>Podocarpus latifolius</i>	
Tc	d		<i>Ptaeroxylon obliquum</i>	
Tc	d		<i>Rapanea melanophloeos</i>	
Tc	d		<i>Rhus chirindensis</i>	
Tc	d		<i>Scolopia mundii</i>	
Tc	d		<i>Vepris lanceolata</i>	
Tc	d		<i>Xymalos monospora</i>	W limit
Tc	d		<i>Zanthoxylum davyi</i>	
Tc			<i>Brachylaena glabra</i>	
Tc			<i>Cussonia spicata</i>	
Tc			<i>Ekebergia capensis</i>	
Tc			<i>Harpephyllum caffrum</i>	
Tc			<i>Ilex mitis</i>	
Tc			<i>Maytenus peduncularis</i>	
Tc			<i>Nuxia floribunda</i>	
Tc			<i>Olea europaea</i> subsp. <i>africana</i>	
Tc			<i>Protorhus longifolia</i>	
Tc			<i>Pterocelastrus tricuspidatus</i>	
Tc			<i>Schotia latifolia</i>	
Tc			<i>Scolopia zeyheri</i>	
Tc			<i>Sideroxylon inerme</i>	
Tc			<i>Tarchonanthus camphoratus</i>	E limit
Tcu	d		<i>Chionanthus foveolatus</i> subsp. <i>foveolatus</i>	
Tcu	d		<i>Elaeodendron croceum</i>	
Tcu	d		<i>Mimusops obovata</i>	W limit
Tcu	d		<i>Mystroxydon aethiopicum</i>	
Tcu	d		<i>Pleurostyliia capensis</i>	
Tcu	d		<i>Psyrdrax obovata</i>	
Tcu	d		<i>Rothmannia capensis</i>	
Tcu			<i>Cassine peragua</i>	
Tcu			<i>Commiphora woodii</i>	W limit
Tcu			<i>Elaeodendron zeyheri</i>	
Tcu			<i>Ficus sur</i>	
Tcu			<i>Olea woodiana</i>	W limit?
Tcu			<i>Pittosporum viridiflorum</i>	
Tcu			<i>Strychnos henningsii</i>	W limit
Tu	d		<i>Burchellia bubalina</i>	
Tu	d		<i>Canthium ciliatum</i>	
Tu	d		<i>Canthium inerme</i>	
Tu	d	C	<i>Cassipourea flanagani</i>	E Cape endemic
Tu	d		<i>Diospyros whyteana</i>	
Tu	d		<i>Eugenia capensis</i>	
Tu	d		<i>Ochna arborea</i> var. <i>arborea</i>	
Tu	d		<i>Trichocladus ellipticus</i>	
Tu	d		<i>Trimeria grandifolia</i>	
Tu			<i>Acokanthera oppositifolia</i>	
Tu			<i>Allophylus decipiens</i>	

Tu		<i>Canthium mundianum</i>	
Tu		<i>Clausena anisata</i>	
Tu		<i>Cryptocarya woodii</i>	W limit
Tu		<i>Diospyros lycioides</i>	
Tu		<i>Dovyalis caffra</i>	
Tu		<i>Dovyalis zeyheri</i>	W limit
Tu		<i>Euclea natalensis</i> subsp. <i>natalensis</i>	
Tu		<i>Euclea schimperi</i>	
Tu		<i>Gymnosporia acuminata</i>	
Tu		<i>Gymnosporia nemorosa</i>	
Tu		<i>Halleria lucida</i>	
Tu		<i>Hippobromus pauciflorus</i>	
Tu		<i>Maerua caffra</i>	
Tu		<i>Maytenus undata</i>	
Tu		<i>Pavetta lanceolata</i>	W limit
Tu		<i>Psychotria capensis</i>	
Tu		<i>Teclea natalensis</i>	W limit
Tu		<i>Trichocladus crinitus</i>	
Tu		<i>Trimeria trinervis</i>	Transkei Coastal Valley F.
Tu		<i>Zanthoxylum capense</i>	
ST	d	<i>Gymnosporia buxifolia</i>	
ST	d	<i>Hyperacanthus amoenus</i>	
ST	d	<i>Maerua racemosa</i>	
ST	d	<i>Ochna serrulata</i>	
ST		<i>Brachylaena elliptica</i>	
ST		<i>Calpurnia aurea</i> subsp. <i>aurea</i>	
ST		<i>Chaetacme aristata</i>	
ST		<i>Diospyros scabrida</i> var. <i>cordata</i>	E Cape endemic
ST		<i>Dovyalis lucida</i>	
ST		<i>Ehretia rigida</i>	
ST		<i>Englerodaphne pilosa</i>	W limit
ST		<i>Gardenia thunbergia</i>	
ST		<i>Heteromorpha trifoliata</i>	
ST		<i>Lachnostylis hirta</i>	E limit
ST		<i>Maytenus procumbens</i>	
ST		<i>Putterlickia pyracantha</i>	
S	d	<i>Azima tetracantha</i>	
S	d	<i>Carissa bispinosa</i> subsp. <i>zambesiaca</i>	
S		<i>Dovyalis rhamnoides</i>	
S		<i>Excoecaria simii</i>	
S		<i>Ochna natalitia</i>	
S		<i>Plumbago auriculata</i>	Albany
S		<i>Rhamnus prinoides</i>	
S		<i>Suregada africana</i>	W limit
Ssoft	d	<i>Isoglossa woodii</i>	
Ssoft		<i>Euphorbia kraussiana</i>	
Ssoft		<i>Isoglossa eckloniana</i>	
Ssoft		<i>Plectranthus fruticosus</i>	
Smon		D	
SCw	d	<i>Dracaena alectrifomis</i>	
SCw		<i>Grewia occidentalis</i>	
SCw		<i>Capparis sepriaria</i>	
SCw		<i>Diospyros villosa</i>	W limit
SCw		<i>Senecio brachypodus</i>	
SCw		<i>Senecio tamoides</i>	
SCw		<i>Strophanthus speciosus</i>	
Cw	d	<i>Scutia myrtina</i>	
Cw		<i>Asparagus asparagoides</i>	
CW		<i>Asparagus densus</i>	
Cw		<i>Asparagus setaceus</i>	
Cw		<i>Asparagus virgatus</i>	
Cw		<i>Behnia reticulata</i>	
Cw		<i>Dioscorea retusa</i>	
Cw		<i>Jasminium angulare</i>	

Cw		<i>Rhoicissus digitata</i>	E limit
Cw		<i>Rhoicissus tomentosa</i>	
Cw		<i>Rhoicissus tridentata</i>	
Cw		<i>Secamone alpini</i>	
Cw		<i>Vernonia mespilifolia</i>	
Ch		<i>Cynanchum ellipticum</i>	
Ch		<i>Cyphia digitata</i>	
Ch		<i>Senecio quinquelobus</i>	
Ch		<i>Senecio deltoideus</i>	
H	d	<i>Hypoestes aristata</i>	
H		<i>Galopina circaeoides</i>	
H		<i>Ranunculus multifidus</i>	
H		<i>Sanicula alata</i>	
H		<i>Streptocarpus rexii</i>	
Hcr		<i>Centella eriantha</i>	
Hf	d	<i>Dryopteris inaequalis</i>	
Hf	d	<i>Polystichum pungens</i>	
Hf		<i>Adiantum aethiopicum</i>	
Hf		<i>Asplenium aethiopicum</i>	
Hf		<i>Asplenium erectum</i>	
Hf		<i>Asplenium lunulatum</i>	
Hf		<i>Asplenium rutifolium</i>	
Hf		<i>Asplenium simii</i>	
Hf		<i>Blechnum punctulatum</i> var. <i>atherstonii</i>	type: Grahamstown
Hf		<i>Cheilanthes bergiana</i>	
Hf		<i>Cheilanthes viridis</i>	
Hf		<i>Hypolepis sparsisora</i>	
Hf		<i>Polypodium luctosum</i>	type: Katrivierberg
Hf		<i>Pteris buchananii</i>	
Hf		<i>Pteris cretica</i>	
Hf		<i>Rumohra adiantiformis</i>	
Hg	d	<i>Dietes iridioides</i>	
Hg		<i>Chlorophytum comosum</i>	
Hg		<i>Commelina africana</i>	
Hsucc		<i>Aptenia cordata</i>	
G		<i>Cyperus albostriatus</i>	
G		<i>Panicum deustum</i>	
G		<i>Schoenoxiphium lanceum</i>	
G		<i>Schoenoxiphium lehmannii</i>	
Gcr	d	<i>Oplismenus hirtellus</i>	
M	C	<i>Barthramia compacta</i> var. <i>macowaniana</i>	endemic (Boschberg)
M	C	<i>Orthotrichum armatum</i>	endemic (Hogsback)

Typical & Endemic Animals

Table. Forest dependent bird, mammal, frog and reptile species in the Amatole Mistbelt Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Buffspotted flufftail	<i>Sarothrura elegans</i>	C	Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Tambourine dove	<i>Turtur tympanistris</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC

Cape parrot	<i>Poicephalus robustus</i>	Cl	Birds	LP, Mp, inland EC & KZN
Knysna lourie	<i>Tauraco corythaix</i>	C	Birds	EC, KZN, MP, NP
Emerald cuckoo	<i>Chrysococcyx cupreus</i>	Cm	Birds	LP, Mpu, KZN, EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape
Trumpeter hornbill	<i>Bycanistes bucinator</i>	Cl	Birds	LP, Mpu, KZN, EC
Scalythroated honey guide	<i>Indicator variegatus</i>	Cf	Birds	e. Mp, coastal EC & KZN
Knysna woodpecker	<i>Campethera notata</i>	U	Birds	Coastal WC, EC & s.KZN
Olive woodpecker	<i>Mesopicos griseocephalus</i>	Cf	Birds	Widespread
Grey cuckooshrike	<i>Coracina caesia</i>	U	Birds	Widespread
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Chorister robin	<i>Cossypha dichroa</i>	Cl	Birds	LP, Mp, KZN, EC
Starred robin	<i>Pogonocichla stellata</i>	Cl	Birds	LP, Mp, KZN, EC
Brown robin	<i>Erythropygia signata</i>	Cl	Birds	e. Mp, coastal EC & KZN
Yellowthroated warbler	<i>Seicercus ruficapillus</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Barthroated apalis	<i>Apalis thoracica</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>	Cl	Birds	LP, Mp, KZN, EC, S.Cape
Blackbellied glossy starling	<i>Lamprotornis corruscus</i>	C	Birds	e. Mp, coastal EC & KZN
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Forest weaver	<i>Ploceus bicolor</i>	Cl	Birds	Coastal EC & KZN
Forest canary	<i>Serinus scotops</i>	Cl	Birds	LP, Mp, KZN, EC
Woodland mouse	<i>Grammomys dolichurus</i>		Mammals	LP, Mp, KZN, EC
Dark-footed forest shrew	<i>Myosorex cafer</i>		Mammals	LP, Mp, KZN, EC
Plaintive rain frog	<i>Breviceps verrucosus</i>		Frogs	KZN, EC
Hogsback frog	<i>Anhydrophryne rattrayi</i>		Frogs	Amatola mountains
Clicking stream frog	<i>Strongylopus grayii</i>		Frogs	Widespread

Conservation & Management

Use & Value

The Amatole Mistbelt forests have a high socio-economic value in terms of timber and non-timber forest products, including medicinal plant species. This is the only area other than the southern Cape where commercial logging from natural forests takes place. Its biodiversity value is also high as these forests are relatively species rich and represent some of the more extensive Afrotemperate forests. It is also useful in terms of fire protection and sustainability of water supply and has great scenic value.

Conservation Status

Most of the forests of the Amatole region are under some form of protection (State Forests and Nature Reserves). High human density close to these forests however places a high pressure on them for non-timber products including medicinal use. The Forest Biome and the NLC data sets give very different spatial extents for the Amatole Escarpment Forests of 43.000 ha and 34.000 respectively. The Forest Biome maps and data are based on mapping from aerial photographs and field verification, and planimetry from the 1:50.000 mapped map sheets. Almost all of the protected forests of 51% (based on the Forest Biome data) are on DWAF land.

Main Threats

- ⇒ Uncontrolled harvesting of timber, poles and firewood;
- ⇒ over exploitation of non-timber forest products, especially poles and bark harvesting (*Curtisia dentata* and *Cassipourea flanaganii*); and
- ⇒ mismanagement of fire and burning regimes in surrounding grasslands.

Other Management Considerations

- ⇒ Increase in harvesting of fuelwood since the removal of wattle by the Working for Water Programme;
- ⇒ land claims;
- ⇒ invasive weeds and alien plants;
- ⇒ ecotourism;
- ⇒ erosion, including heavy, unsustainable cattle grazing in the forest;
- ⇒ winter grazing for cattle belonging to local, rural communities; and
- ⇒ illegal hunting in the forest.

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V1: Eastern Scarp Forest

Version 0527

Synonyms

Semi-Coast Forest	Edwards (1967)
Coast Scarp Forest	Cooper (1985)
Transvaal Forests p.p.	Phillipson & Russell (1988)
Transkei and Natal Coastal Forests p.p.	Phillipson & Russell (1988)
Natal Coastal Forests	MacDevette et al. (1989)
Arcadia Group Forests	MacDevette et al. (1989)
Ngoye Group Forests p.p.	MacDevette et al. (1989)
Afromontane Forest p.p.	Low & Rebelo (1998)

Profile

Tall (15-25m) and species-rich forests found mainly, but not exclusively, on sandstone outcrops (some forests on syenitic granite) along the coastal scarp. Often associated with hilly topography (e.g., Dhlinda, Ongoye, Vernon Crooks) and/or coastal gorges (e.g. Krantzkloof, Rosslers Gorge). Structurally diverse with multiple strata; usually an obvious high canopy and understorey tree stratum, but a poorly developed herb layer. Buttressed stems are common.

Distribution

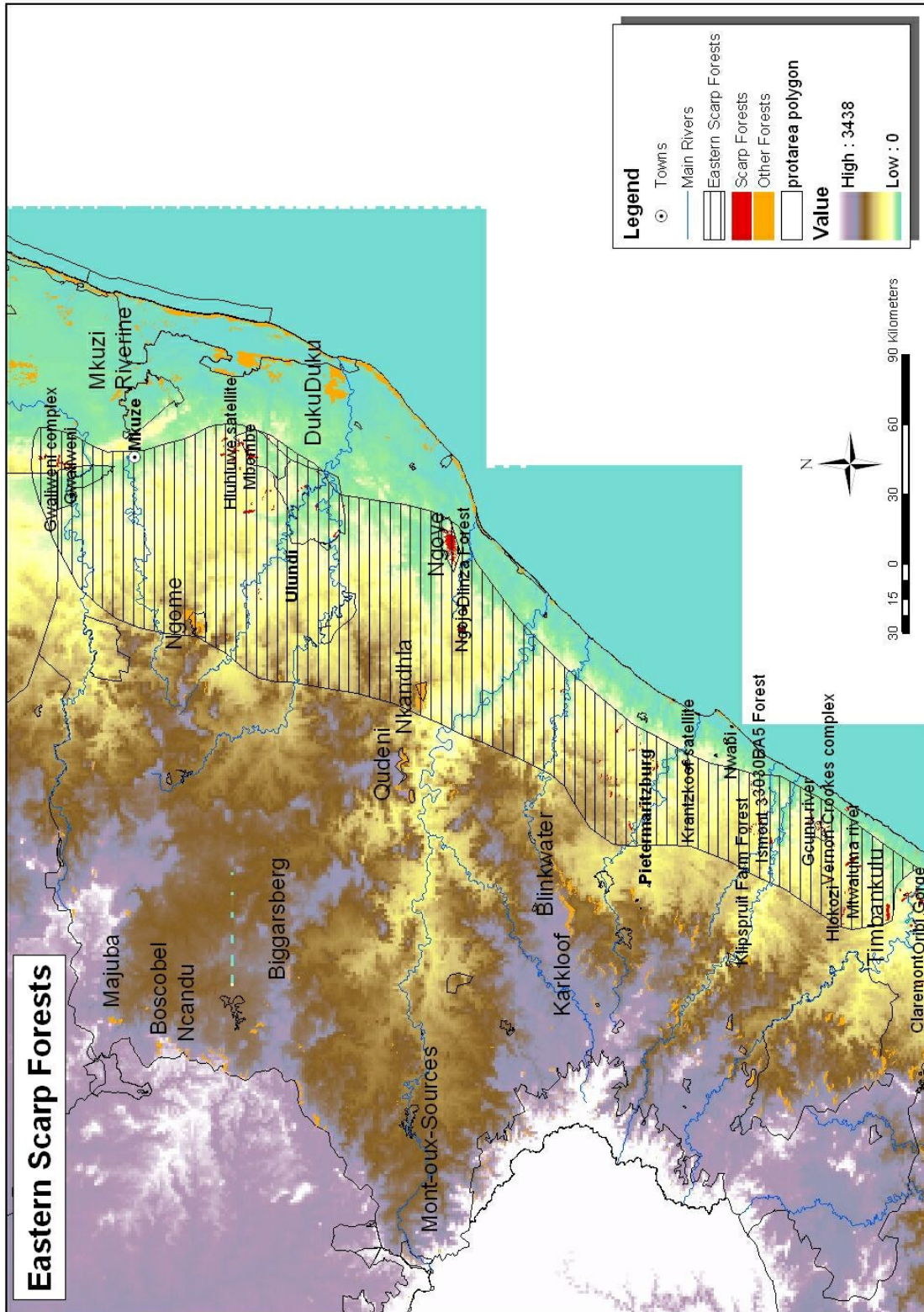
Transitional, occurring between the Subtropical Coastal Forest Group and the Afrotropical Forest Group (Lawes 1990). Located on the coastal scarp from northern KwaZulu-Natal (Lebombo Mountains) to southern KwaZulu-Natal (0 to 1300 m). Also northward through Swaziland and into southern Mpumalanga. Patches occur in coastal gorges in southern KwaZulu-Natal.

Eastern Scarp Forests are the northward continuation of the Pondoland Scarp Forests and are sited on Natal Sandstones that follow the coastal scarp that extends inland and northward from the Umtamvuna River gorge at the coast. This coastal scarp lies between 5 and 70 km from the coast in this forest type. The scarp is closer to the sea in the south and most distant from the sea in the north.

Known Forests

Burntwood	Krantzkloof
Craigadour Farms	Kwa Nyuswa (Noordsburg)
Dhlinda	KwaMashiya
Dududu	Longshadows
Edwaleni Mission	Low's Creek
Entumeni	Matabetule/Mzinyati (Inanda)
Folweni	Mbizane
Giba Gorge.	Mehlomnyama forest complex
Gwaliweni (Hlatikulu)	Mfembe forest complex
Hlabisa complex	Millstream
Hluhluwe	Mona
Izinja	Nanda Kwa-Matabata
Izotsha Falls	Ndulinde (Nyoni) complex

Map



Ngoje
 Nhlwathi
 Ntimbankulu
 Nungwane falls
 Nwabi
 Ongoye (Ngoye)
 Oqaqeni (Mapumulo)

Prospect group forests
 Rossler's Gorge
 Sani Gorge
 Telezi Hill
 Upper Mdloti
 Vernon Crookes Reserve

Vegetation Structure & Texture

Stand Structure

Medium to high forest (15-25 m) comprising at least three distinct strata, including a well-developed seedling and sapling stratum, understorey tree stratum, and a poorly developed herb layer. Underneath the canopy the forest is relatively open and trees are mostly single stemmed.

Ecology

Altitude & Geomorphology

Very fragmented, and found among hilly topography along the coastal scarp ridge. Situated mainly on seaward or east-facing slopes at intermediate altitudes, between 100 m to 1000 m, often on watersheds and also on the tops of massifs (e.g. Ongoye).

Geology & Soil

Primarily found on outcrops of Natal Group sandstones and siltstones, with some forests, such as Ongoye forest, found on granulite-gneiss outcrops (Natal thrust belt). Lebombo forests occur on rhyolites, while the Mpumalanga/Swaziland forests occur on soils derived from the archaic Barberton craton. Soils are generally nutrient poor, leached and shallow. Many large trees have buttressed stems as a consequence of the shallow soils.

Climate

Found in the summer rainfall subtropical climate zone, although generally cooler and more seasonal than at the coast. Many Eastern Scarp Forests occur in envelopes of high though seasonal rainfall. The coastal scarp is subject to frequent strong winds (August to October), more so than other forest types. They experience some orographic rainfall as they are situated on first range of hills inland from the coast. The variety of substrates that support this forest type suggest that its distribution is under stronger climatic than substrate/edaphic control (Everard 1992).

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	440	4	24	17
Maximum	1400	13	32	22

Disturbance

Medium to coarse-grained spatial scale of regeneration of woody plants indicates that this forest is gap or event driven (Everard et al. 1994), and most tree species require reasonably large areas of forest to replace themselves. Primary disturbance is windthrow caused by a combination of strong coastal winds and shallow soils. Fire is also implicated in some forests. Harvesting for pole-sized stems is also potentially affecting forest structure.

Biogeographical Affinities

Some elements of Pondoland Scarp Forest (II2), Eastern Mistbelt Forest (I5), KwaZulu-Natal Coastal Forest (III2) are all found in the Eastern Scarp Forest. Scarp forests are most probably of Afrotemperate origin, but due to their proximity to the subtropical coastal forest types, they have experienced an influx of these elements during more recent radiation of coastal forests (after 4000 yrs BP) and now have a close affinity to these latter forest types (Macdevette et al. 1989, Lawes 1990). The many endemic species suggest isolation in the gorges and on hilltops along the coastal scarp. This forest type shares many genera with East African lowland forests (Huntley 1965).

Dominant & Diagnostic Plant Species

Note: Species also occurs in named forest type or biome.

L	S	D	Latin Name	Note
Tc	d		<i>Drypetes gerrardii</i>	
Tc	d		<i>Englerophytum natalense</i>	
Tc	d		<i>Harpephyllum caffrum</i>	
Tc	d		<i>Heywoodia lucens</i>	
Tc	d		<i>Millettia grandis</i>	
Tc	d		<i>Millettia sutherlandii</i>	
Tc	d		<i>Olea capensis subsp. macrocarpa</i>	
Tc	d		<i>Protorhus longifolia</i>	
Tc		C	<i>Celtis mildbraedii</i>	
Tu	d	C	<i>Orcia bachmannii</i>	
Tu		C	<i>Alberta magna</i>	endemic
Tu		C	<i>Albizia zuluensis</i>	endemic (Hlabisa Dist.)
Tu		C	<i>Atalaya natalensis</i>	
Tu		C	<i>Cavacoa aurea</i>	
Tu		C	<i>Cryptocarya wyliei</i>	
Tu		D	<i>Cussonia zuluensis</i>	Savanna
Tu		D	<i>Faurea saligna</i>	Savanna
Tu		D	<i>Ficus glumosa</i>	Savanna
Tcyc		C	<i>Encephalartos laevifolius</i>	endemic
Tcyc		C	<i>Encephalartos ngoyanus</i>	endemic
Tcyc		C	<i>Encephalartos villosus</i>	endemic
Tcyc		C	<i>Encephalartos woodii</i>	endemic, extinct in wild.
Tmon		C	<i>Aloe barberiae</i>	
ST		C	<i>Acalypha sonderiana</i>	
ST		C	<i>Alchornea hirtella</i>	
ST		C	<i>Allophylus chaunostachys</i>	
ST		C	<i>Canthium suberosum</i>	
ST		C	<i>Cassinopsis tinifolia</i>	
ST		C	<i>Cassipourea swaziensis</i>	endemic
ST		C	<i>Erythrococca berberidea</i>	
ST		C	<i>Gymnosporia filiformis</i>	
ST		C	<i>Homalium rufescens</i>	
ST		C	<i>Indigofera frutescens</i>	
ST		C	<i>Indigofera natalensis</i>	
ST		C	<i>Maytenus cordata</i>	
ST		C	<i>Micrococca capensis</i>	
ST		C	<i>Oxyanthus pyriformis</i>	endemic
ST		C	<i>Pachystigma bowkeri</i>	
ST		C	<i>Pseudoscopia polyantha</i>	
ST		C	<i>Rinorea ilicifolia</i>	endemic
ST		D	<i>Strychnos usambarensis</i>	savanna
S		C	<i>Dombeya burgersiae</i>	
S		C	<i>Duvernoia aconitifera</i>	endemic (Barbeton)

S	C	<i>Heterosamara galpinii</i>	endemic
SCw	C	<i>Barleria gueinzii</i>	
Cw	C	<i>Gerardanthus tomentosus</i>	endemic (Durban)
Cw	C	<i>Tinospora caffra</i>	
H	C	<i>Plectranthus saccatus</i> var. <i>longitubus</i>	endemic
H	C	<i>Syncolostemon latidens</i>	endemic (Kranskop)
Hf	C	<i>Asplenium christii</i>	endemic
Eo		<i>Angraecum conchiferum</i>	
Eo	C	<i>Angraecum pusillum</i>	
Eo	C	<i>Bolusiella maudiae</i>	endemic

Communities/Subunits

Lebombo Forest	Moll (1978)
<i>Celtis africana</i> - <i>Euclea schimperi</i> Forest	Whateley & Porter (1983)
<i>Celtis africana</i> - <i>Harphephyllum caffrum</i> Forest	Whateley & Porter (1983)
Natal Coastal Forests - Silverglen Group Forests	MacDevette et al. (1989)
Natal Coastal Forests - Krantzkloof Group Forests	MacDevette et al. (1989)
Natal Coastal Forests - The Hluhluwe-Mfolozi Group Forests	MacDevette et al. (1989)
Arcadia Group Forests - Southern Forests	MacDevette et al. (1989)
Arcadia Group Forests - Central Forests	MacDevette et al. (1989)
Ongoye Group Forests - Upper Scarp Forest Type	MacDevette et al. (1989)
Ongoye Group Forests - Lower Scarp Forest Type (p.p.)	MacDevette et al. (1989)
<i>Cola greenwayi</i> - <i>Xymalos monospora</i> Community	Morgenthal & Cilliers (1999)
<i>Pterocelastrus echinatus</i> - <i>Syzygium gerrardii</i> Community	Morgenthal & Cilliers (1999)
LIANAS - <i>Scutia myrtina</i> , <i>Acridocarpus natalitius</i> , <i>Monanthataxis caffra</i> , <i>Keetia gueinzii</i> , <i>Secamone alpinii</i> , <i>Rhoicissus tormentosa</i> .	
HERBS - <i>Oplismenus hirtellus</i> , <i>Setaria megaphylla</i> , <i>Prosphytochloa prehensilis</i> , <i>Cyperus albostrigatus</i> , <i>Behnia reticulata</i> , <i>Smilax anceps</i> , <i>Dietes iridioides</i> , <i>Impatiens hochstetteri</i> , <i>Piper capensis</i> , <i>Mackaya bella</i> , <i>Hypoestis aristata</i> .	

Typical & Endemic Animals

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Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Buffspotted flufftail	<i>Sarothrura elegans</i>	C	Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Delegorgue's pigeon	<i>Columba delegorguei</i>	R	Birds	EC, KZN, e. Mp
Tambourine dove	<i>Turtur tympanistria</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Emerald cuckoo	<i>Chrysococcyx cupreus</i>	Cm	Birds	LP, Mpu, KZN, EC
Green coucal	<i>Ceuthmochares aereus</i>	Cf	Birds	Coastal KZN & EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape

Common name	Scientific name	Status	Taxon	Distribution
Trumpeter hornbill	<i>Bycanistes bucinator</i>	Cl	Birds	LP, Mpu, KZN, EC
White-eared barbet	<i>Stactolaema leucotis</i>	C	Birds	Coastal Zululand
Green barbet	<i>Stactolaema olivacea</i>	R	Birds	Ngoye forest
Goldenrumped tinker barbet	<i>Pogoniulus bilineatus</i>	C	Birds	e. Mp, coastal n. EC & KZN
Scalythroated honey guide	<i>Indicator variegatus</i>	Cf	Birds	e. Mp, coastal EC & KZN
Olive woodpecker	<i>Mesopicos griseocephalus</i>	Cf	Birds	Widespread
Grey cuckooshrike	<i>Coracina caesia</i>	U	Birds	Widespread
Squaretailed drongo	<i>Dicurus ludwigii</i>	C	Birds	Mp, coastal EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Yellowstreaked bulbul	<i>Phyllastrephus flavostriatus</i>	Cf	Birds	Ngoye forest north to e.Mp
Yellowbellied bulbul	<i>Chlorocichla flaviventris</i>	C	Birds	Coastal n. EC & KZN
Spotted thrush	<i>Zoothera guttata</i>	Cl	Birds	Coastal EC & KZN
Chorister robin	<i>Cossypha dichroa</i>	Cl	Birds	LP, Mp, KZN, EC
Starred robin	<i>Pogonocichla stellata</i>	Cl	Birds	LP, Mp, KZN, EC
Brown robin	<i>Erythropygia signata</i>	Cl	Birds	e. Mp, coastal EC & KZN
Bearded robin	<i>Erythropygia quadrivirgata</i>	Cf	Birds	n. Zululand
Yellowthroated warbler	<i>Seicercus ruficapillus</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>	Cl	Birds	LP, Mp, KZN, EC, S.Cape
Blackbellied glossy starling	<i>Lamprotornis corruscus</i>	C	Birds	e. Mp, coastal EC & KZN
Olive sunbird	<i>Nectarinia olivacea</i>	C	Birds	EC, KZN
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Forest weaver	<i>Ploceus bicolor</i>	Cl	Birds	Coastal EC & KZN
Green twinspot	<i>Mandingoa nitidula</i>	Cl	Birds	LP, Mp, KZN, EC
Forest canary	<i>Serinus scotops</i>	Cl	Birds	LP, Mp, KZN, EC
Woodland mouse	<i>Grammomys dolichurus</i>		Mammals	LP, Mp, KZN, EC
Dark-footed forest shrew	<i>Myosorex cafer</i>		Mammals	LP, Mp, KZN, EC
Red squirrel	<i>Paraxerus palliatus</i>		Mammals	n. Zululand
Samango monkey	<i>Cercopithecus mitis</i>		Mammals	LP, KZN, EC
Plaintive rain frog	<i>Breviceps verrucosus</i>		Frogs	KZN, EC
Bush squeaker	<i>Arthroleptis wahlbergi</i>		Frogs	KZN, EC
Forest tree frog	<i>Leptopelis natalensis</i>		Frogs	KZN, EC
Clicking stream frog	<i>Strongylopus grayii</i>		Frogs	Widespread

Conservation & Management

Use & Value

Eastern Scarp Forests are “hotspots” of species richness and are extremely important in terms of biodiversity. They represent a transitional forest type between the Afrotemperate and Subtropical Coastal Forest types (Lawes 1990). Drawing species from both types, Eastern Scarp Forests are particularly species rich with many endemic species. As a consequence of their unique position and evolutionary history they have a very high scientific value. Many of these forests are relatively large (>500 ha) and in reasonable condition. Their socio-economic value is also high and they are harvested for timber and non-timber forest products. Consequently, their importance to rural livelihoods is significant for those communities living near these forests and as much as 40% of household income may be derived from forest products. These forests are subjected to medium to high harvesting intensity. Most tree species are single-stemmed and these forests are particularly valuable for poles. Because they contain many unusual and attractive plants (e.g., Bush Lily *Clivia miniata*) Eastern Scarp Forests also have a high horticultural, as well as bioprospecting, value.

Conservation Status

Eastern scarp forests are relatively well conserved and managed in KwaZulu-Natal (mainly by KwaZulu-Natal Wildlife). Although many of the larger forests in KwaZulu-Natal are protected, most of the approximately 70 smaller scarp forests between Durban and Umtamvuna are not protected. Estimates of the extent of this forest type range from 16 000 ha (Forest Biome Map) to 21 000 ha (NLC) with 51% and 66% conserved, respectively. About 1/3 of the conserved area is on State land.

Main Threats

- ⇒ Harvesting of wood and non-timber products (e.g. poles and laths) by local communities outside of protected areas. This could lead to successional collapse of tree communities and significant change to the forest structure.
- ⇒ Scarp forests are heavily harvested for muthi plants (particularly in the south) and represent a major source of supply for Durban's informal medicine market. Current use levels are mostly unsustainable and a threat to biodiversity.
- ⇒ Clearance for slash-and-burn type subsistence agriculture.
- ⇒ Land claims are likely to become a very real threat. If the forest is on state land a lease agreement may be entered into with adjacent communities.

Other Management Considerations

- ⇒ The conservation of Eastern Scarp Forests is paramount due to their high biodiversity and endemism.
- ⇒ The ecotourism potential of Eastern Scarp Forests is high as they are very species rich. The bird-watching market should be targeted (Turpie and Ryan 1998). Forests such as Ongoye contain regionally endemic bird species that are sought after by bird-watchers. This will require sensitive management due to the high level of risk to species and innovative strategies need to be considered, e.g. canopy walkway at Dhlinda. In addition, these forests are often located in areas of considerable scenic beauty and offer many opportunities for hiking and other outdoor pursuits e.g. Ongoye forest.
- ⇒ Some forests are sacred or of important cultural value and are still afforded some protection by traditional authorities (e.g. Ongoye, Gwaliweni).
- ⇒ Some Eastern Scarp Forests are quite inaccessible (gorges) which may give them some form of protection from exploitation.
- ⇒ Management may need to be sensitive to the different evolutionary origins of scarp forests in the north (Eastern Scarp Forests) and in the south (Pondoland Scarp Forests). Forests in the north carry many more tropical elements while those in the south show signs of Cape elements.
- ⇒ Although logging of Eastern Scarp Forests took place in the past, particularly in the south of its range, it was localised and selective. Only a few forests such as Ongoye were relatively heavily logged, and most north of the Tugela River were not affected.

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V2: Pondoland Scarp Forest

Synonyms

Tongaland-Pondoland Undifferentiated Forest p.p.	White (1983)
Pondoland Coastal Plateau Sourveld: Forest	Acocks (1988)
Ngoye Group Forests p.p.	MacDevette et al. (1989)
Pondoland Coast Forest	Cooper & Swart (1992)
Moist Subtropical Forest	Cawe (1996)
Coastal Forest p.p.	Low & Rebelo (1998)

Profile

Tall (15-25 m) species-rich forests found on Msikaba Formation sandstones of the coastal scarp ridge in north-eastern Transkei and southernmost KwaZulu-Natal. Structurally diverse with open substrata and poorly developed herb layer. Wooded steep slopes of gorges and many endemic species are characteristic features of this forest type.

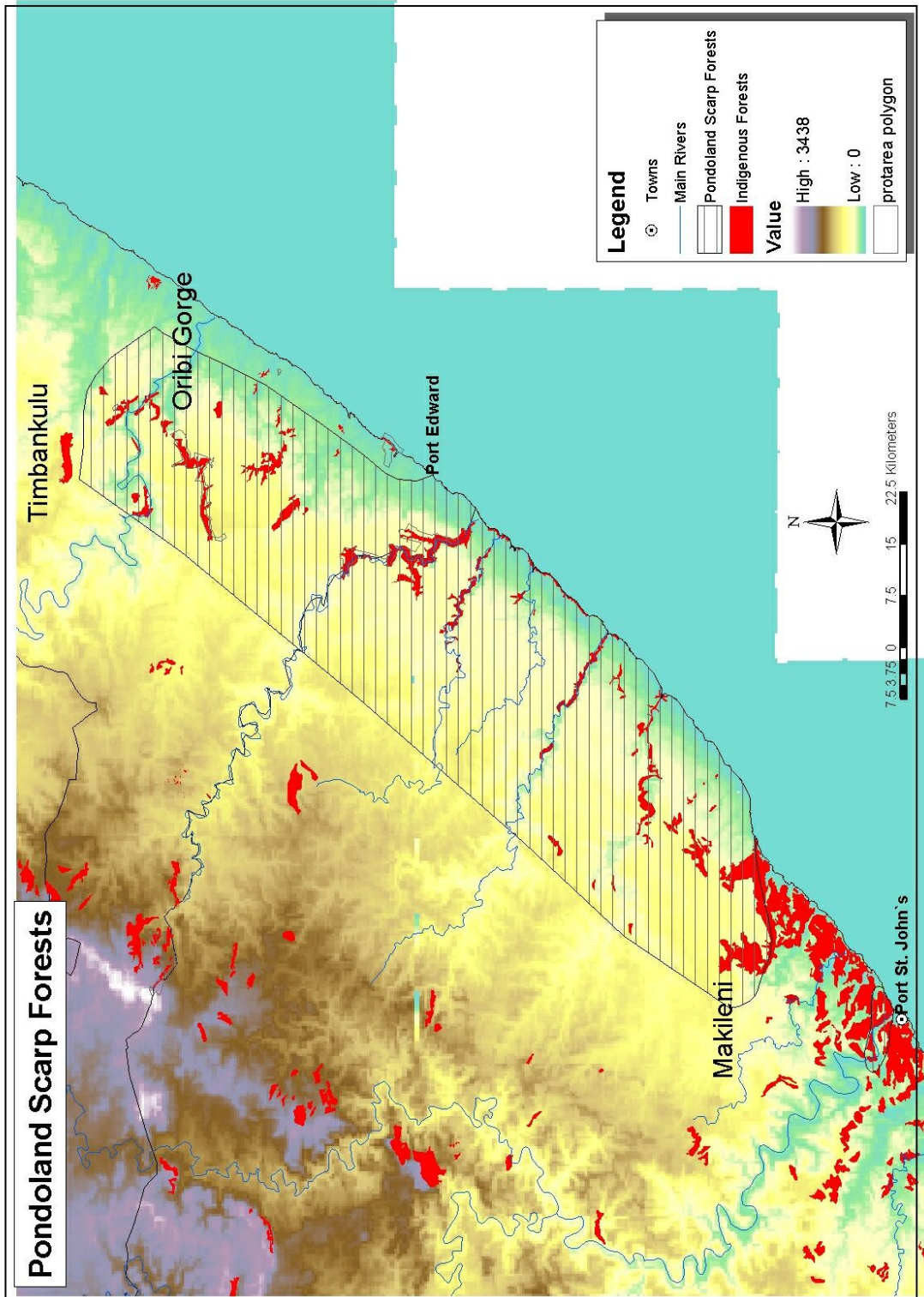
Distribution

Found on south-facing or east-facing slopes of the coastal scarp ridge, on sandstone outcrops (quartz arenites) of the region known as Pondoland in the north-eastern Transkei (Eastern Cape Province). From the complex of forests at and immediately north of Port St. Johns (incl. small region of Msikaba sandstones south of Egosso Interval (see Van Wyk, 1990)) reaching as far north as Oribi Gorge in southern KwaZulu-Natal. The region of occurrence of these forests is identical to the Pondoland centre of endemism defined by Van Wyk & Smith (2001).

Known Forests

Bulawu	Mount Thesiger Complex (Pembeni)
Egossa	Mpato
Endlini Yokozi	Mtambalala
Hili	Mt. Sullivan (Bovini)
Isituvi	Nkodolo
Isizilo	Nokabi
Ku-Hill	Noqekwana
Lopatana	Ntlopeni
Lotana	Ntsubane (incl. Frasers Gorge)
Lujazo	Pennington
Makileni	Poko
Mancu	Port St. Johns complex
Marudulu	Oribi Gorge
Mbaso	Sonkwe
Mbotyi	Umngampuzi
Mkambati	Umtamvuna Gorge
Mkolwana	Umzimpunzi

Map



Vegetation Structure & Texture

Stand Structure

Medium to high forest (15-20 m) comprising three distinct strata, with a well developed seedlings and sapling stratum and a poorly developed herb layer. Underneath the canopy the forest is relatively open and trees are mostly single stemmed. Medium- to coarse-grained forest indicating that it is gap or event driven. Although there is evidence for gap-size niche differentiation by tree species, gap regeneration is mostly random and by shade tolerant species, and only very large gaps (>140 m²) are colonized by light-demanding species (Obiri 2002). Forests are comprised of essentially random assemblages of typically shade tolerant species that are common in the canopy.

Ecology

Altitude & Geomorphology

Located on coastal hills (0 to 600 m altitude) close to the coast.

Climate

Range of this forest type is renown for strong north-easterly winds. Climate is less seasonal, cooler and not as moist as Eastern Scarp forests to the north.

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	660	8	24	18
Maximum	1200	12	28	20

Geology & Soil

Found on outcrops of the Msikaba Formation sandstones (quartz arenites). Although closely associated with the Natal Group sandstones this formation does not interfinger with the Natal Group, but is a younger formation than the underlying Natal Group. Current thinking is that the Msikaba Formation should be part of the Cape Supergroup (Mike Johnson, Geological Survey of South Africa, pers comm.). The locality of the forests probably has more to do with the suitability of the topography and the microclimate created by the topography than the underlying geology *per se*. Soils are generally nutrient poor, leached and shallow.

Disturbance

Medium to coarse-grained spatial scale of regeneration of woody plants indicates that this forest is gap or event driven (Everard et al. 1994), and most tree species require reasonably large areas of forest to replace themselves. The primary disturbance is windthrow caused by a combination of strong coastal winds and shallow soils. Fire is also implicated in some forests. Harvesting for pole-sized stems is also potentially affecting forest structure.

Biogeographical Affinities

I13 Transkei Coastal Forests.

see *Van Wyk & Smith (2001) and other papers by Van Wyk cited therein*

Dominant & Diagnostic Plant Species

Note: Species also occurs in named forest type.

L	S	D	Latin Name	Note
Tc	d		<i>Drypetes gerrardii</i>	
Tc	d		<i>Millettia grandis</i>	
Tc	d		<i>Millettia sutherlandii</i>	
Tc			<i>Dahlgrenodendron natalense</i>	
Tc			<i>Cryptocarya myrtifolia</i>	E. Scarp
Tc			<i>Harpephyllum caffrum</i>	
Tc			<i>Heywoodia lucens</i>	
Tc		C	<i>Maytenus oleosa</i>	Pondoland endemic
Tc			<i>Ochna arborea</i>	
Tc			<i>Olea woodiana</i>	E. Scarp, KZN Dune
Tc			<i>Olinia ventosa</i>	
Tc			<i>Ptaeroxylon obliquum</i>	
Tc			<i>Pterocelastrus tricuspidatus</i>	
Tcu			<i>Cassipourea gerrardii</i>	
Tcu			<i>Englerophytum natalense</i>	
Tu	d		<i>Oricia bachmannii</i>	
Tu	d		<i>Rinorea angustifolia</i>	E. Scarp
Tu	d		<i>Rothmannia globosa</i>	E. Scarp, KZN Dune
Tu		C	<i>Bersama swinnyi</i>	Pondoland endemic
Tu			<i>Brachylaena glabra</i>	Albany
Tu			<i>Buxus macowanii</i>	
Tu		C	<i>Catha abbottii</i>	Pondoland endemic
Tu		C	<i>Eugenia erythrophylla</i>	Pondoland endemic
Tu		C	<i>Eugenia umtamvunensis</i>	Pondoland endemic
Tu			<i>Drypetes arguta</i>	
Tu			<i>Eugenia natalitia</i>	E. Scarp, KZN Dune
Tu			<i>Eugenia zuluensis</i>	
Tu			<i>Ficus bizanae</i>	E. Scarp
Tu			<i>Loxostylis alata</i>	
Tu		C	<i>Manilkara nicholsonii</i>	Pondoland endemic
Tu			<i>Memecylon bachmannii</i>	
Tu			<i>Nectaropetalum capense</i>	
Tu			<i>Ochna natalitia</i>	
Tu			<i>Strychnos henningsii</i>	E. Scarp
Tu			<i>Strychnos mitis</i>	E. Scarp
Tcyc			<i>Encephalarctos natalensis</i>	
Tmon		D	<i>Aloe pluridens</i>	
Tp		C	<i>Jubaeopsis caffra</i>	Pondoland end. genus
ST	d		<i>Buxus natalensis</i>	
ST	d		<i>Memecylon natalense</i>	E. Scarp
ST		C	<i>Apodytes abbottii</i>	Pondoland endemic
ST			<i>Bachmannia woodii</i>	NScarp
ST		C	<i>Canthium vanwykii</i>	Pondoland endemic
ST			<i>Clausena anisata</i>	
ST			<i>Cola natalensis</i>	KZN Dune Forest
ST		C	<i>Colubrina nicholsonii</i>	Pondoland endemic
ST		C	<i>Grewia pondoensis</i>	Pondoland endemic
ST		C	<i>Gymnosporia bachmannii</i>	Pondoland endemic
ST		C	<i>Maytenus abbottii</i>	Pondoland endemic
ST			<i>Mitriostigma axillare</i>	
ST			<i>Pachystigma macrocalyx</i>	
ST			<i>Phyllanthus cedrellifolius</i>	KZN Dune Forest
ST		C	<i>Pseudosalacia streyi</i>	Pondoland end. genus
ST			<i>Pseudoscolopia polyantha</i>	E. Scarp
ST		C	<i>Rhinorea domatiosa</i>	Pondoland endemic
ST		C	<i>Rhynchocalyx lawsoniana</i>	Pondoland end. family
ST		C	<i>Syzygium pondoense</i>	Pondoland endemic
ST		C	<i>Tarchonanthus trilobus</i> var. <i>trilobus</i>	Pondoland endemic
ST			<i>Teclea natalensis</i>	
ST		C	<i>Tephrosia pondoensis</i>	Pondoland endemic

ST	C	<i>Tricalysia africana</i>	Pondoland endemic
ST	C	<i>Turraea streyi</i>	Pondoland endemic
S	C	<i>Bauhinia natalensis</i>	Pondoland endemic
S	C	<i>Eugenia simii</i>	Pondoland endemic
S	C	<i>Eugenia verdoorniae</i>	Pondoland endemic
S	C	<i>Indigofera braamtonyi</i>	Pondoland endemic
S		<i>Rhus pondoensis</i>	E. Scarp
SCw	C	<i>Rhus acocksii</i>	Pondoland endemic
SCw		<i>Cnestis polyphylla</i>	
SCw		<i>Monanthes caffra</i>	E. Scarp, KZN Dune
Cw	C	<i>Podranea ricasoliana</i>	Pondoland endemic
Cw	C	<i>Putterlickia retrospinosa</i>	Pondoland endemic
Cw		<i>Gerardanthus macrorrhizus</i>	E. Scarp
SGS	C	<i>Rhus rudatisii</i>	Pondoland endemic
Ssoft		<i>Piper capense</i>	
Ch	d	<i>Thunbergia alata</i>	
H	d	<i>Impatiens flanaganiae</i>	
H	C	<i>Helichrysum populifolium</i>	Pondoland endemic
H	C	<i>Plectranthus ernstii</i>	Pondoland endemic
H	C	<i>Plectranthus hilliardiae</i>	Pondoland endemic
H	C	<i>Plectranthus oertlandii</i>	Pondoland endemic
H	C	<i>Plectranthus oribiensis</i>	Pondoland endemic
H	C	<i>Plectranthus praetermissum</i>	Pondoland endemic
H	C	<i>Streptocarpus grandis</i>	Pondoland endemic
H	C	<i>Streptocarpus johannis</i>	Pondoland endemic
H	C	<i>Streptocarpus porphyrostachys</i>	Pondoland endemic
H		<i>Streptocarpus primulifolius</i> subsp. <i>formosus</i>	
H		<i>Streptocarpus trabeculatus</i>	
H		<i>Streptocarpus wendlandii</i>	
Hg		<i>Begonia dregei</i>	E. Scarp
Hg		<i>Begonia homogyna</i>	E. Scarp
Hg		<i>Clivia miniata</i>	
Hg		<i>Corymborkis corymbis</i>	
Hg		<i>Disa tripetaloides</i>	
Hg		<i>Gladiolus cruentus</i>	
Hg		<i>Gladiolus inandensis</i>	
Hg		<i>Haemanthus deformis</i>	
Eo		<i>Angraecum pusillum</i>	
Eo	C	<i>Rangeris muscicola</i>	Pondoland endemic?
Eo		<i>Tridactyle tridentata</i>	
Gsc		<i>Flagellaria guineense</i>	

Communities/Subunits

Ngoye Group Forests - Lower Scarp Forest Type (p.p.)	MacDevette et al. (1989)
Pondoland Coast Forest	Cooper & Swart (1992)
Moist Subtropical Forest	Cawe (1996)

Typical & Endemic Animals

Table. Forest dependent bird, mammal, frog and reptile species in the Pondoland Scarp Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, E – endemic, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>		Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>		Birds	Widespread
Buffspotted flufftail	<i>Sarothrura elegans</i>		Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>		Birds	Widespread
Tambourine dove	<i>Turtur tympanistria</i>		Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>		Birds	LP, Mp, KZN, EC, WC
Knysna lourie	<i>Tauraco corythaix</i>		Birds	EC, KZN, MP, NP
Emerald cuckoo	<i>Chrysococcyx cupreus</i>		Birds	LP, Mpu, KZN, EC
Green coucal	<i>Ceuthmochares aereus</i>		Birds	Coastal KZN & EC
Wood owl	<i>Strix woodfordii</i>		Birds	Widespread
Narina trogon	<i>Apaloderma narina</i>		Birds	LP, Mp, KZN, EC, S. Cape
Trumpeter hornbill	<i>Bycanistes bucinator</i>		Birds	LP, Mpu, KZN, EC
White-eared barbet	<i>Stactolaema leucotis</i>		Birds	Coastal Zululand
Goldenrumped tinker barbet	<i>Pogoniulus bilineatus</i>		Birds	e. Mp, coastal n. EC & KZN
Scalythroated honey guide	<i>Indicator variegatus</i>		Birds	e. Mp, coastal EC & KZN
Knysna woodpecker	<i>Campethera notata</i>		Birds	Coastal WC, EC & s.KZN
Olive woodpecker	<i>Mesopicos griseocephalus</i>		Birds	Widespread
African broadbill	<i>Smithornis capensis</i>		Birds	LP, coastal KZN
Grey cuckooshrike	<i>Coracina caesia</i>		Birds	Widespread
Squaretailed drongo	<i>Dicrurus ludwigii</i>		Birds	Mp, coastal EC & KZN
Bush blackcap	<i>Lioptilus nigricapillus</i>		Birds	LP, Mp, inland EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>		Birds	Mp, EC, KZN
Yellowbellied bulbul	<i>Chlorocichla flaviventris</i>		Birds	Coastal n. EC & KZN
Spotted thrush	<i>Zoothera guttata</i>		Birds	Coastal EC & KZN
Chorister robin	<i>Cossypha dichroa</i>		Birds	LP, Mp, KZN, EC
Starred robin	<i>Pogonocichla stellata</i>		Birds	LP, Mp, KZN, EC
Brown robin	<i>Erythropygia signata</i>		Birds	e. Mp, coastal EC & KZN
Yellowthroated warbler	<i>Seicercus ruficapillus</i>		Birds	LP, Mp, KZN, EC, S.Cape
Barthroated apalis	<i>Apalis thoracica</i>		Birds	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>		Birds	LP, Mp, KZN, EC, S.Cape
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>		Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>		Birds	LP, Mp, KZN, EC, S.Cape
Blackbellied glossy starling	<i>Lamprotornis corruscus</i>		Birds	e. Mp, coastal EC & KZN
Olive sunbird	<i>Nectarinia olivacea</i>		Birds	EC, KZN
Collared sunbird	<i>Anthreptes collaris</i>		Birds	EC, KZN
Forest weaver	<i>Ploceus bicolor</i>		Birds	Coastal EC & KZN
Green twinspot	<i>Mandingoa nitidula</i>		Birds	LP, Mp, KZN, EC
Forest canary	<i>Serinus scotops</i>		Birds	LP, Mp, KZN, EC
Woodland dormouse	<i>Graphiurus murinus</i>		Mammals	Widespread
Dark-footed forest shrew	<i>Myosorex cafer</i>		Mammals	LP, Mp, KZN, EC
Samango monkey	<i>Cercopithecus mitis</i>		Mammals	LP, KZN, EC
Natal ghost frog	<i>Heleophryne natalensis</i>		Frogs	LP, Mp, KZN, EC
Plaintive rain frog	<i>Breviceps verrucosus</i>		Frogs	KZN, EC
Kloof frog	<i>Natalobatrachus bonebergi</i>		Frogs	s. KZN, EC
Bush squeaker	<i>Arthroleptis wahlbergi</i>		Frogs	KZN, EC
Clicking stream frog	<i>Strongylopus grayii</i>		Frogs	Widespread
Giant legless skink	<i>Acontias plumbeus</i>		Reptiles	LP, e. Mp, n. KZN, East London
Green mamba	<i>Dendroaspis angusticeps</i>		Reptiles	Coastal KZN & EC

Conservation & Management

Use & Value

Pondoland Scarp forests are 'hotspots' of species richness and falls within the Pondoland centre of floral endemism (Van Wyk & Smith, 2001). They are extremely important in terms of their biodiversity. Their socio-economic value is also high and they are intensively harvested for timber (poles and laths), fuelwood and non-timber forest products (vines, medicinal plants esp. bark, bushmeat). Most species are single-stemmed and are valued particularly for poles.

Conservation Status

Pondoland Scarp Forest is generally less well conserved and managed than the Eastern Scarp Forest of KwaZulu-Natal and many large forests have already been destroyed. There is little management capacity in the Eastern Cape, although the new Pondoland Park initiative may improve the conservation status of these forests. Traditional authorities (TA) have been marginalized by the creation of TRCs since 1994 and community management of forests in the region is poor. The effect of the erosion of TA is particularly noticeable in this forest type and most Headman's forests have been over-exploited. PFM is urgently needed in this forest type.

The extent of this type is 17 000 ha (forest biome map) and 13 000 ha (NLC) with 37% and 53% conserved respectively.

Main Threats

- ⇒ Clearance for slash-and-burn type subsistence agriculture. Land claims are likely to become a very real threat. This will probably be a lease agreement of sorts.
- ⇒ Harvesting of wood and non-timber products (e.g., poles and laths) by local communities outside of protected areas (Obiri et al. in press). Scarp forests are heavily harvested for muthi plants (particularly in the south) and represent a major source of supply for Durban's informal medicine market. Current use levels are mostly unsustainable and a threat to biodiversity.
- ⇒ Pressure on forests for deadwood for fuel is high. The amount of deadwood removed from forests is very close to the amount produced (Obiri 2002). Very little deadwood is left to rot. Decomposition provides vital nutrients and minerals for soil formation and the maintenance of life. Suitable alternative sources of fuel are urgently needed.
- ⇒ Scarp forests are unusually susceptible to alien vegetation invasion.

Other Management Considerations

- ⇒ The conservation of scarp forests is paramount due to their high biodiversity and endemism.
- ⇒ The ecotourism potential of scarp forests is high as they are very species rich and located in very picturesque areas. This will require sensitive management due to the high level of risk to species and innovative strategies need to be considered.
- ⇒ Some scarp forests are quite inaccessible which may give them some form of protection from exploitation, although the establishment of illegal cottages and settlements near and in forests is fast becoming a real problem.
- ⇒ Many forests, particularly in the vicinity of Port St Johns are used by a criminal element as 'chop-shops' for stolen motor vehicles. Small areas are also cleared inside the forest to grow marijuana.
- ⇒ Management of these forests for traditional hunting opportunities presents a significant challenge.
- ⇒ Fire management is less of a problem in scarp than in other forest types.

Key References

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V3: Transkei coastal scarp forests

Synonyms

Transitional Coastal Forest	Acocks (1988)
Coastal Forest	Lubke & Strong (1988)
Transkei and Natal Coastal Forests p.p.	Phillipson & Russell (1988)
South Coast Forest	Cooper & Swart (1992)
Coastal Scarp Forest	Cooper & Swart (1992)
Medium Moist Subtropical Forest	Cawe (1996)
Dry Subtropical Forest	Cawe (1996)
Coastal Forest p.p.	Low & Rebelo (1996)

Profile

Transkei Scarp Forests comprise low-grown (up to 9 m) and middle-grown (15-25 m) species-rich forests. *Millettia grandis*, *M. sutherlandii*, *Buxus macowanii*, *B. natalensis* and locally *Umtiza listeriana* are typical constituents of canopy layer. The ground layer is only poorly developed. Two spatially separated subtypes can be recognized, such as Transkei Coastal Platform Forests, found scattered along the Southern Transkei coast between Mngazana in the north and East London in the south. More inland (up to 600-800 m of alt.), in scarp situations (e.g. on slopes of deeply-incised river valleys) are found Transkei Lower Scarp Forests.

Distribution

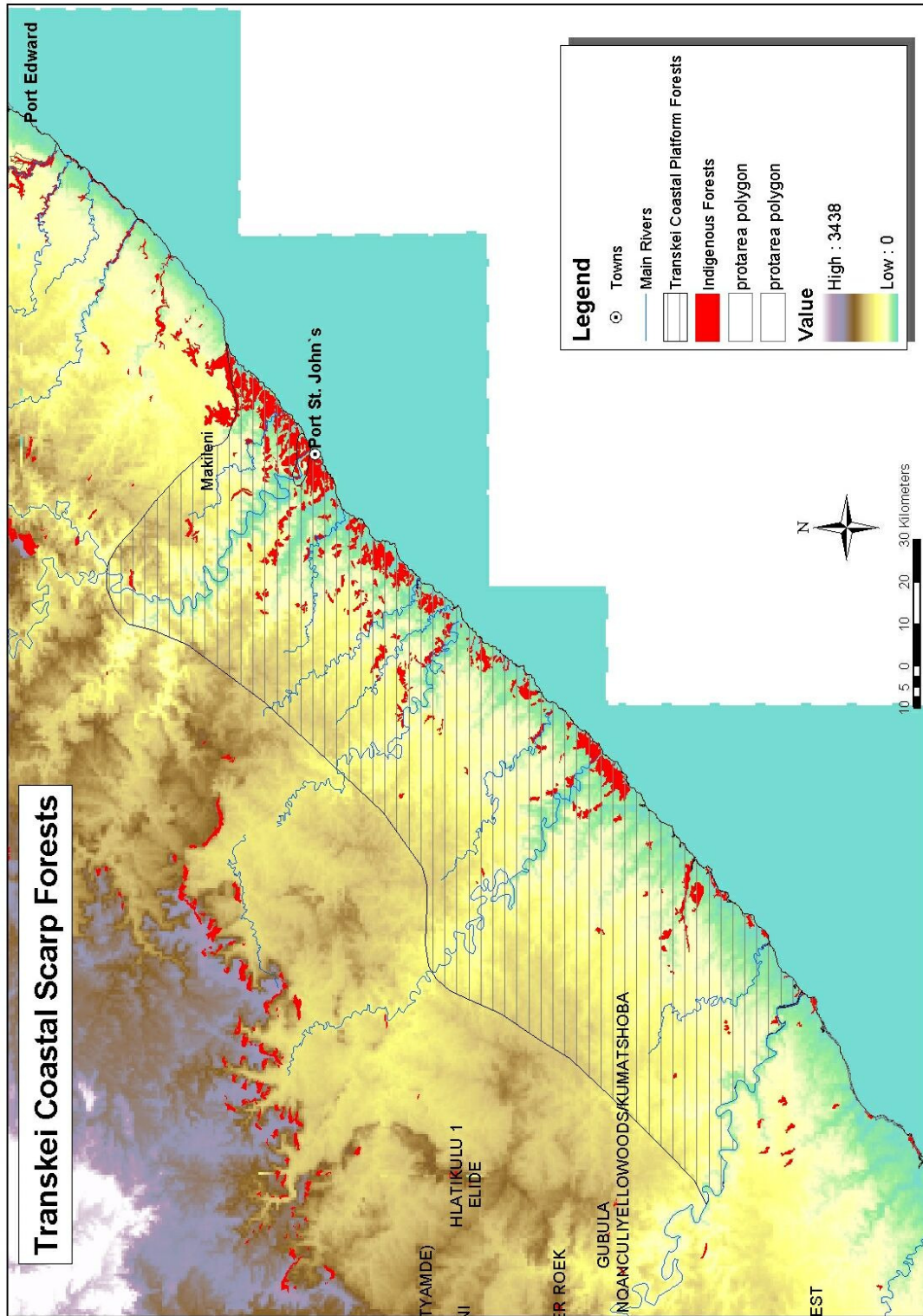
Transkei Coastal Scarp Forests occur as two spatially separated belts, representing two subtypes. Transkei Coastal Platform Forests are found scattered along the Southern Transkei coast between Mngazana (just south of Port St. Johns) in the north and East London in the south. Famous Transkei forest localities such as Hluleka, Dwesa and Manubi belong to this forest subtype. The southern most forest patch of this subtype is represented by Umtiza Forest (just west of East London). Transkei Lower Scarp Forests are situated in a belt more inland (up to 600-800 m of alt.), in scarp situations (e.g. on slopes of deeply-incised river valleys).

Known Forests

Transkei Lower Scarp Forests

Amanzamnyama	Swabeni
Beki	Engcobo Main Forest
Bele	Etwa
Bodlingwe	Etyeni-Etwa
Buffalo Nek	Goboti
Buswayo	Gomo
Camtsholo	Gora-Gulandoda
Cefane	Komgha
Ceka	Macibi
Dedelo	Izinja
Didwayo	Wilo
Dlani	Qiti
Duba	

Map



Transkei Coastal Platform Forests

Dweza	Mputikaka
Gulu	Nkwintyini
Gxwaleni	Nyanguba
Hluleka	Pagela
Lower Bulawu (S section)	Sipingelwini
Ludaka	Umtiza
Manubi	Upper Bulawu (N section)
Mpame	

Vegetation Structure & Texture**Stand Structure**

Medium to high forest (15-20 m) comprising three distinct strata, with a well developed seedlings and sapling stratum and a poorly developed herb layer. Underneath the canopy the forest is relatively open and trees are mostly single stemmed. Medium- to coarse-grained forest indicating that it is gap or event driven. Although there is evidence for gap-size niche differentiation by tree species, gap regeneration is mostly random and by shade tolerant species, and only very large gaps (>140 m²) are colonized by light-demanding species (Obiri 2002). Forests are comprised of essentially random assemblages of typically shade tolerant species that are common in the canopy.

Ecology**Altitude & Geomorphology**

The forest of this type are found on sloping coastal platforms as well as steep scarps in deep incised valleys at altitudes between 0 to 600-800 m.

Climate

Proximity to the coast helps moderate the climate.

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	630	7	25	17
Maximum	1200	11	27	20

Geology & Soil

Unlike Pondoland Scarp Forests (bordering on the Transkei Coastal Scarp Forests to the East), the geology supporting the coastal (and scarp) Southern Transkei coastal and inland low-scarp forest is relatively young. In case of the Umtiza Forest the underlying geology are Karoo sediments of Balfour Formation supporting relatively deem soils characterized by high porosity, silt and clay content (Geldenhuys 1993). The pH of these soils was found to be around 6.

Disturbance & Regeneration

Medium to coarse-grained spatial scale of regeneration of woody plants indicates that this forest is gap or event driven (Everard et al. 1994), and most tree species require reasonably large areas of forest to replace themselves. The primary disturbance is windthrow caused by a combination of strong coastal winds and shallow soils. Fire is also implicated in some forests. Harvesting for pole-sized stems is also potentially affecting forest structure.

In a classical study of forest regeneration under drought stress Geldenhuys (1993) found that in the Umtiza Forest the deciduous trees were better adapted to sudden (and prolonged) droughts than were the evergreen trees. Especially *Ptaeroxylon obliquum* was found to regenerate very well by coppicing. Drought effect was exacerbated by outbreak of a moth (*Palpita* sp., Pyraustidae, Lepidoptera) which caused heavy defoliation of *Buxus macowanii* (one of the most prominent trees in Umtiza) and other species.

Biogeographical Affinities

IV2 Transkei Mistbelt Forests

V2 Pondoland Scarp Forest

see Van Wyk & Smith (2001) and other papers by Van Wyk cited therein

Dominant & Diagnostic Plant Species

Note: Species also occurs in named forest type.

L	S	D	Latin Name	Note
Tce	d		<i>Millettia grandis</i>	
Tce	d		<i>Millettia sutherlandii</i>	
Tce			<i>Erythrina caffra</i>	
Tc	d		<i>Buxus macowanii</i>	
Tc	d		<i>Drypetes gerrardii</i>	
Tc	d		<i>Heywoodia lucens</i>	
Tc			<i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	
Tc			<i>Calodendrum capense</i>	
Tc			<i>Cassipourea gummiflua</i>	
Tc			<i>Celtis durandii</i>	
Tc			<i>Chionanthus peglerae</i>	
Tc			<i>Commiphora woodii</i>	
Tc			<i>Cryptocarya myrtifolia</i>	
Tc			<i>Curtisia dentata</i>	Afrotemperate
Tc			<i>Cussonia sphaerocephala</i>	
Tc			<i>Ekebergia capensis</i>	
Tc			<i>Harpephyllum caffrum</i>	
Tc			<i>Homalium dentatum</i>	
Tc			<i>Nuxia floribunda</i>	
Tc			<i>Olinia ventosa</i>	
Tc			<i>Podocarpus falcatus</i>	Afrotemperate
Tc			<i>Podocarpus latifolius</i>	Afrotemperate
Tc			<i>Ptaeroxylon obliquum</i>	
Tc			<i>Schotia latifolia</i>	
Tc			<i>Trichilia dregeana</i>	
Tcu			<i>Englerophytum natalense</i>	
Tcu			<i>Ochna arborea</i>	
Tcu			<i>Rhus chirindensis</i>	
Tcyc			<i>Encephalartos altensteinii</i>	Albany Thickets
Tcyc			<i>Encephalartos natalensis</i>	
Tcyc			<i>Encephalartos villosus</i>	
Tsuc			<i>Euphorbia grandidens</i>	
Tu	d		<i>Oricia bachmannii</i>	
Tu	d		<i>Rinorea angustifolia</i>	
Tu	d		<i>Rothmannia globosa</i>	
Tu			<i>Canthium inerme</i>	
Tu			<i>Chaetachme aristata</i>	
Tu			<i>Clerodendrum myricoides</i>	
Tu			<i>Commiphora harveyi</i>	
Tu			<i>Cryptocarya woodii</i>	
Tu			<i>Eugenia natalitia</i>	

Tu			<i>Gymnosporia peduncularis</i>	
Tu			<i>Halleria lucida</i>	Afrotemperate
Tu			<i>Kiggelaria africana</i>	Afrotemperate
Tu			<i>Mimusops obovata</i>	
Tu			<i>Nectaropetalum capense</i>	
Tu			<i>Ochna natalitia</i>	
Tu			<i>Olea capensis</i> subsp. <i>enervis</i>	
Tu			<i>Olea capensis</i> subsp. <i>macrocarpa</i>	
Tu			<i>Pterocelastrus tricuspidatus</i>	
Tu			<i>Rapanea melanophloeos</i>	Afrotemperate
Tu			<i>Rawsonia lucida</i>	
Tu			<i>Scolopia mundii</i>	Afrotemperate
Tu			<i>Scolopia zeyheri</i>	
Tu			<i>Strychnos henningsii</i>	
Tu			<i>Strychnos mitis</i>	
Tu			<i>Tricalysia lanceolata</i>	
Tu			<i>Trimeria grandifolia</i>	
Tu			<i>Vepris lanceolata</i>	
Tu			<i>Xymalos monospora</i>	Afrotemperate
Tu			<i>Zanthoxylum capense</i>	
Tu			<i>Zanthoxylum davyi</i>	
ST	d	C	<i>Umtiza listeriana</i>	endemic (Umtiza)
ST			<i>Allophylus dregeanus</i>	
ST			<i>Bauhinia bowkeri</i>	
ST			<i>Buxus natalensis</i>	
ST			<i>Canthium ciliatum</i>	
ST			<i>Canthium kuntzeanum</i>	
ST			<i>Cassipourea malosana</i>	
ST			<i>Englerodaphne subcordata</i>	
ST			<i>Eugenia zeyheri</i>	
ST			<i>Gymnosporia mossambicensis</i>	
ST			<i>Oxyanthus speciosus</i>	
ST			<i>Sclerochiton harveyanus</i>	
ST			<i>Strychnos usambarensis</i>	
ST			<i>Trichocadus crinitus</i>	Afrotemperate
ST			<i>Trichocladus ellipticus</i>	
ST			<i>Vangueria infausta</i>	
S			<i>Coddia rudis</i>	
S		C	<i>Metarungia galpinii</i>	endemic (Gulu Forest)
S			<i>Rhus carnosula</i>	
Ssoft		C	<i>Justicia bolusii</i>	endemic (Komgha Forest)
Ssoft		C	<i>Justicia petiolaris</i> subsp. <i>bowiei</i>	endemic
SCw			<i>Dalbergia obovata</i>	
SCw			<i>Scutia myrtina</i>	
Cw			<i>Capparis tomentosa</i>	
H		C	<i>Streptocarpus kentanensis</i>	endemic (Kentani)
M			<i>Fissidens wageri</i>	endemic to Scarp Forests
M			<i>Schotheimia ferruginea</i>	

Communities/Subunits

Typical & Endemic Animals

Table. Forest dependent bird, mammal, frog and reptile species in the Pondoland Scarp Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, E – endemic, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>		Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>		Birds	Widespread
Buffspotted flufftail	<i>Sarothrura elegans</i>		Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>		Birds	Widespread
Tambourine dove	<i>Turtur tympanistria</i>		Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>		Birds	LP, Mp, KZN, EC, WC
Knysna lourie	<i>Tauraco corythaix</i>		Birds	EC, KZN, MP, NP
Emerald cuckoo	<i>Chrysococcyx cupreus</i>		Birds	LP, Mpu, KZN, EC
Green coucal	<i>Ceuthmochares aereus</i>		Birds	Coastal KZN & EC
Wood owl	<i>Strix woodfordii</i>		Birds	Widespread
Narina trogon	<i>Apaloderma narina</i>		Birds	LP, Mp, KZN, EC, S. Cape
Trumpeter hornbill	<i>Bycanistes bucinator</i>		Birds	LP, Mpu, KZN, EC
White-eared barbet	<i>Stactolaema leucotis</i>		Birds	Coastal Zululand
Goldenrumped tinker barbet	<i>Pogoniulus bilineatus</i>		Birds	e. Mp, coastal n. EC & KZN
Scalythroated honey guide	<i>Indicator variegatus</i>		Birds	e. Mp, coastal EC & KZN
Knysna woodpecker	<i>Campethera notata</i>		Birds	Coastal WC, EC & s.KZN
Olive woodpecker	<i>Mesopicos griseocephalus</i>		Birds	Widespread
African broadbill	<i>Smithornis capensis</i>		Birds	LP, coastal KZN
Grey cuckooshrike	<i>Coracina caesia</i>		Birds	Widespread
Squaretailed drongo	<i>Dicrurus ludwigii</i>		Birds	Mp, coastal EC & KZN
Bush blackcap	<i>Lioptilus nigricapillus</i>		Birds	LP, Mp, inland EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>		Birds	Mp, EC, KZN
Yellowbellied bulbul	<i>Chlorocichla flaviventris</i>		Birds	Coastal n. EC & KZN
Spotted thrush	<i>Zoothera guttata</i>		Birds	Coastal EC & KZN
Chorister robin	<i>Cossypha dichroa</i>		Birds	LP, Mp, KZN, EC
Starred robin	<i>Pogonocichla stellata</i>		Birds	LP, Mp, KZN, EC
Brown robin	<i>Erythropygia signata</i>		Birds	e. Mp, coastal EC & KZN
Yellowthroated warbler	<i>Seicercus ruficapillus</i>		Birds	LP, Mp, KZN, EC, S.Cape
Barthroated apalis	<i>Apalis thoracica</i>		Birds	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>		Birds	LP, Mp, KZN, EC, S.Cape
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>		Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>		Birds	LP, Mp, KZN, EC, S.Cape
Blackbellied glossy starling	<i>Lamprotornis corruscus</i>		Birds	e. Mp, coastal EC & KZN
Olive sunbird	<i>Nectarinia olivacea</i>		Birds	EC, KZN
Collared sunbird	<i>Anthreptes collaris</i>		Birds	EC, KZN
Forest weaver	<i>Ploceus bicolor</i>		Birds	Coastal EC & KZN
Green twinspot	<i>Mandingoa nitidula</i>		Birds	LP, Mp, KZN, EC
Forest canary	<i>Serinus scotops</i>		Birds	LP, Mp, KZN, EC
Woodland dormouse	<i>Graphiurus murinus</i>		Mammals	Widespread
Dark-footed forest shrew	<i>Myosorex cafer</i>		Mammals	LP, Mp, KZN, EC
Samango monkey	<i>Cercopithecus mitis</i>		Mammals	LP, KZN, EC
Natal ghost frog	<i>Heleophryne natalensis</i>		Frogs	LP, Mp, KZN, EC
Plaintive rain frog	<i>Breviceps verrucosus</i>		Frogs	KZN, EC
Kloof frog	<i>Natalobatrachus bonebergi</i>		Frogs	s. KZN, EC
Bush squeaker	<i>Arthroleptis wahlbergi</i>		Frogs	KZN, EC
Clicking stream frog	<i>Strongylopus grayii</i>		Frogs	Widespread
Giant legless skink	<i>Acontias plumbeus</i>		Reptiles	LP, e. Mp, n. KZN, East London
Green mamba	<i>Dendroaspis angusticeps</i>		Reptiles	Coastal KZN & EC

Conservation & Management

Use & Value

They are extremely important in terms of their biodiversity. Their socio-economic value is also high and they are intensively harvested for timber (poles and laths), fuelwood and non-timber forest products (vines, medicinal plants esp. bark, bushmeat). Most species are single-stemmed and are valued particularly for poles.

Conservation Status

The Dwesa/Cwebe, Port St Johns, Mt Thesica forest reserve protect large blocks of this forest type. Many of the smaller patches are also declared state forest. There is little management capacity in the Eastern Cape, even within the protected forests. Traditional authorities (TA) have been marginalized by the creation of local municipalities since 1994 and community management of forests in the region is poor. The effect of the erosion of TA is particularly noticeable in this forest type and most Headman's forests have been over-exploited. PFM is urgently needed in this forest type.

The extent of this type is 31 000 ha (forest biome map) and 39 000 ha (NLC) with many of the larger patches declared forest reserves.

Main Threats

- ⇒ Clearance for slash-and-burn type subsistence agriculture. Land claims are likely to become a very real threat. This will probably be a lease agreement of sorts.
- ⇒ Harvesting of wood and non-timber products (e.g., poles and laths) by local communities outside of protected areas (Obiri et al. in press). Scarp forests are heavily harvested for muthi plants (particularly in the south) and represent a major source of supply for Durban's informal medicine market. Current use levels are mostly unsustainable and a threat to biodiversity.
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- ⇒ Scarp forests are unusually susceptible to alien vegetation invasion.

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- ⇒ Management of these forests for traditional hunting opportunities presents a significant challenge.
- ⇒ Fire management is less of a problem in scarp than in other forest types.

Key References

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V11: KwaZulu-Natal Coastal Forests

Synonyms

Coast Forest	Bews (1920)
Coast Lowlands Forest	Edwards (1967)
Undifferentiated Lowland Forest	Moll & White (1978)
Coast Forest	Ward (1980)
Tongaland-Pondoland Undifferentiated Forest p.p.	White (1983)
Coast Lowlands Forest	Cooper (1985)
Typical Coast-belt Forest	Acocks (1988)
Transkei and Natal Coastal Forests p.p.	Phillipson & Russell (1988)
Typical Coast Lowland Forest	Bartholomew (1989)
Mozambique Coastal Plain Forests	MacDevette et al. (1989)
Coastal Lowland Forest p.p.	Pooley (1993)
Coastal Forest p.p.	Low & Rebelo (1998)

Profile

Medium to tall, species rich forest closely associated with the flat to rolling topography of the coastal lowlands of KwaZulu-Natal in form of small-sized patches - remnants of formerly dominating vegetation type of the region. These forests occur in the immediate hinterland of coastal dunes or on free-draining deep sands of the Maputaland coastal plain. Many tropical species reach their southern distribution along the affected range. Typically dominating canopy and sub-canopy layers are found in trees such as *Albizia adianthifolia*, *Dyospyros inhacaensis*, *Drypetes arguta*, *D. natalensis*, *Englerophytum natalense*, *Protorhus longifolia*, *Teclea gerrardii* *Manilkara concolor*. Shrub layer and synusiae of climbers are well-developed, dense and rich in subtropical elements.

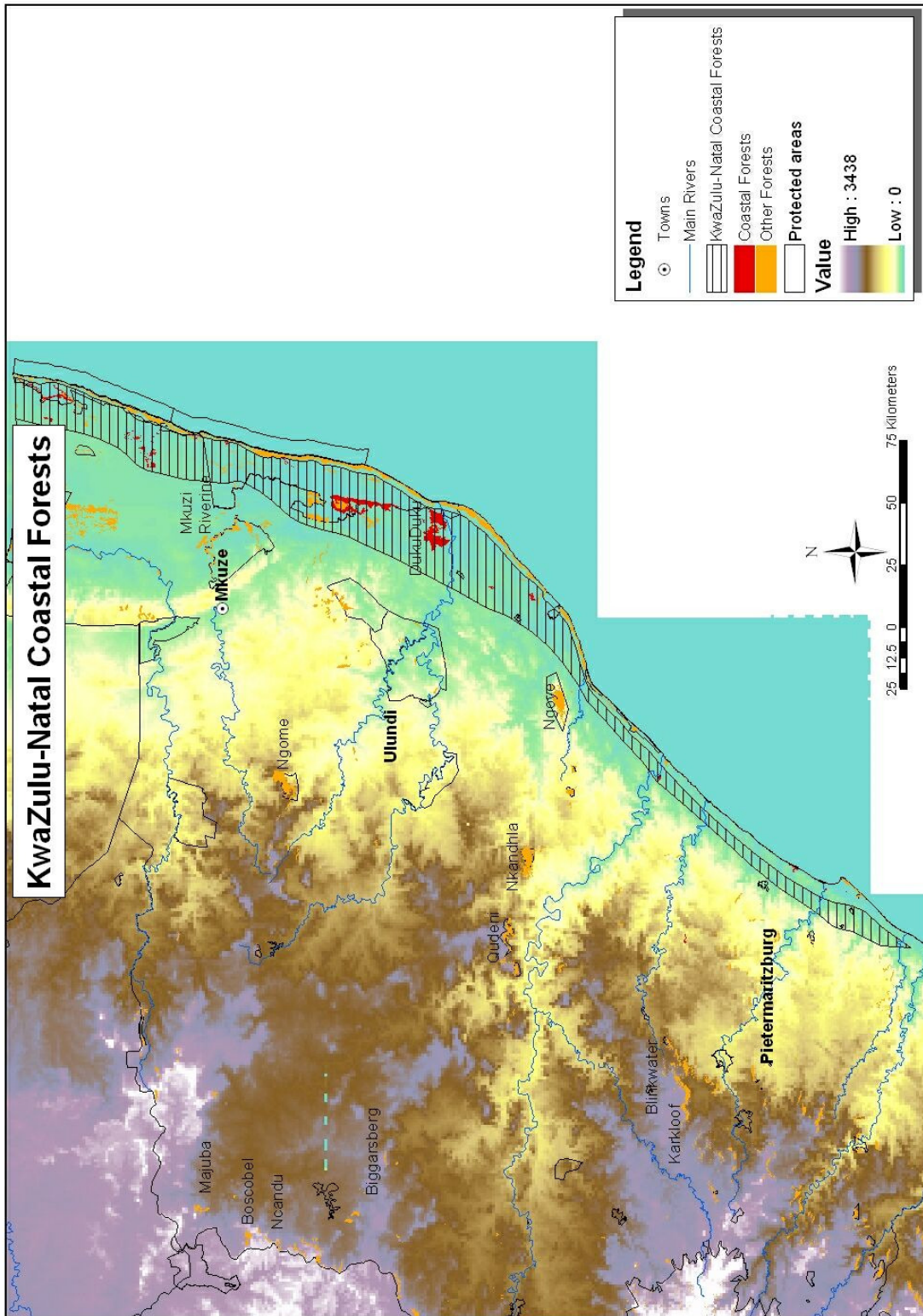
Distribution

KZN Coastal Forests occur in small patches (of which Dukuduku Forest is the largest one) on the rolling plains of the landward side of the dune cordon along the KwaZulu-Natal coast, from Southern Natal to beyond the Mozambique border. Represented by communities of stronger tropical nature they extend along the Indian Ocean seaboard as far as the coast of Tanzania. All the patches are imbedded within a narrow strip of so-called Indian Ocean Coastal Belt (extending 30 km inland in the north, but limited to 3-4 km from the coast in the south) and form the major vegetation element of the newly distinguished Coastal Subtropical Forest Biome (Mucina et al., in prep.).

Known Forests

Amangwe	Manguzi (Kosi Bay)
Amanzimwenya complex	Marriane Hill (Durban)
Ambleside Forest	Mpambanyoni complex
Burman Bush (Durban)	Mpisini N.R.
Dukuduku (greater part of)	Mtwalume River complex
Ellingham (Park Rynie)	North Park (Durban)
Enseleni N.R.	Palmiet N.R.
Happy Valley / Bluff (Durban)	Pigeon Valley (Durban)
Harold Johnstone N.R.	Riet Valley (Shakas Kraal)
Hawaan (Umhlanga)	Sibaya complex (Nyanene)
Henderson's Forest	Silverglen Forest (Durban)
Hlongweni (Tugela Mouth)	Sodwana State Forest (part of)
Ifafa River complex	The Valleys Forest
Inanda Game Park (Durban)	Tongaat Beach Forest
Kenneth Stainbank N.R. (Durban)	Trenance Farm
Mabhudu (Kosi Bay)	Umdoni Park (Pennington)

Map



Vegetation Structure & Texture

Stand Structure

KwaZulu-Natal Coastal Forests are medium to tall forests, with well-developed canopy, sub-canopy and shrub layers. In places these forests (in a stage of regeneration) have the appearance of "thickets" (Roberts 1993). Typically dominating canopy and sub-canopy layers are found in trees such as *Albizia adianthifolia*, *Dyospyros inhacaensis*, *Drypetes arguta*, *D. natalensis*, *Englerophytum natalense*, *Protorhus longifolia* and *Teclea gerrardii* *Manilkara concolor*. The shrub layer is well-developed, dense and rich in subtropical elements. Lianas and climbers are a common sight, emphasizing the tropical appearance of the forest structure. No distinct herb layer can be distinguished in these forests in the south, but might be well-developed in north and is usually dominated by *Isoglossa woodii*.

Diversity Patterns

Ecology

Altitude & Geomorphology

These are low-altitude forests occurring below a height of 100 m on the coastal plains or on slight slopes of the undulating landscape.

Geology & Soil

Sandy substrates, primarily recent sandy dystrophic soils of Mozambique coastal plain, Port Durnford red sands (which contain more clay) and occasional Cretaceous derived soils - siltstones.

Climate

Year round rainfall with summer maximum characteristic of coastal KwaZulu-Natal. Rainfall relatively low at 400-700 mm, conditions hot and humid. The warm coastal influence ensures that temperatures are never low, even in winter.

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	500	10	29	21
Maximum	1000	14	31	22

Disturbance

KwaZulu-Natal Coastal forests are coarse grain, event driven forests. Disturbance events include fire, large animals, cyclones and tornadoes. Iron-age farmers cleared much of the forest for agriculture. At present they are highly susceptible to alien plant invasion (*Chromolaena odorata* due to reliance on disturbance and subtropical coastal distribution which is conducive to rapid plant growth (Roberts ****)).

Biogeographical Affinities

Our floristic-sociological analyses suggest relations of the KwaZulu-Natal Coastal Forests to KwaZulu-Natal Dune Forests (especially in the Maputaland, to Licuati Sand Forests (transitional types have been identified in Maputaland: Lubbe 1996, Kirkwood & Midgley 1999) and in places to Lowveld Riverine Forests (due to immediate vicinity).

KZN Coastal Forests are geologically young ecosystems (limited to recent, Pleistocene sedimentary coastal plains) and do not have any exclusive endemic species. High number of pronouncedly tropical elements point strongly towards tropical origin of this forest type.

Communities/Subunits

* The classification of the plant communities indicated by asterisk is tentative.

<i>Cassipourea/Ekebergia</i> -gemeenskap	Venter (1972)
<i>Celtis africana</i> -gemeenskap	Venter (1972)
<i>Diospyros natalensis</i> -gemeenskap	Venter (1972)
<i>Manilkara discolor</i> -gemeenskap	Venter (1972)
* <i>Myrica serrata</i> -gemeenskap	Venter (1972)
<i>Ptaeroxylon obliquum</i> -gemeenskap	Venter (1972)
<i>Ziziphus mucronata</i> -gemeenskap	Venter (1972)
<i>Albizia adianthifolia</i> Woodland	Ward (1980)
Typical Coast Lowland Forest	Bartholomew (1989)
Transitional Forest	Bartholomew (1989)
Drainage Line/Coast Lowland Forest	Bartholomew (1989)
<i>Podocarpus-Celtis</i> Community	Gordon & Bartholomew (1989)
<i>Albizia-Ziziphus</i> Community	Gordon & Bartholomew (1989)
<i>Podocarpus-Ochna</i> Community	Gordon & Bartholomew (1989)
<i>Chaetacme-Zanthoxylum</i> Community	Gordon & Bartholomew (1989)
<i>Ekebergia-Celtis</i> Community	Gordon & Bartholomew (1989)
<i>Brachylaena-Maytenus</i> Community	Gordon & Bartholomew (1989)
<i>Cavacoa aurea</i> Association	MacDevette (1989)
<i>Diospyros natalensis</i> Association	MacDevette (1989)
<i>Drypetes natalensis</i> Association	MacDevette (1989)
<i>Celtis africana</i> Association	MacDevette (1989)
Mozambique Coastal Plain Forests - Northern Coastal Forests	MacDevette et al. (1989)
Mozambique Coastal Plain Forests - Southern Coastal Forests	MacDevette et al. (1989)
<i>Manilkara discolor-Tricalysia lanceolata</i> Short Thicket	Roberts (1993)
<i>Dovyalis rhamnoides-Hippobromus pauciflorus</i> Low Thicket	Roberts (1993)
<i>Protorhus longifolia-Psychotria capensis</i> Short Thicket	Roberts (1993)
<i>Hymenocardia</i> Thicket	Van Wyk et al. (1996)
<i>Hymenocardia</i> Forest	Van Wyk et al. (1996)
Northern peripheral Core Forest	Van Wyk et al. (1996)
Southern peripheral Core Forest	Van Wyk et al. (1996)
<i>Strychnos decussata</i> Central Core Forest	Van Wyk et al. (1996)
<i>Diospyros natalensis</i> Central Core Forest	Van Wyk et al. (1996)

Dominant & Diagnostic Plant Species

L	S	D	Latin Name	Note
Tce	d		<i>Albizia adianthifolia</i>	
Tc	d		<i>Celtis africana</i>	
Tc	d	C	<i>Diospyros inhacaensis</i>	
Tc	d		<i>Dovyalis longispina</i>	
Tc	d	C	<i>Drypetes natalensis</i>	
Tc	d		<i>Sideroxylon inerme</i>	
Tc	d		<i>Strychnos decussata</i>	
Tc	d		<i>Strychnos henningsii</i>	
Tc			<i>Balanites maughamii</i>	

Tc		<i>Chionanthus peglerae</i>	
Tc		<i>Chrysophyllum viridifolium</i>	
Tc		<i>Cussonia sphaerocephala</i>	
Tc		<i>Ekebergia capensis</i>	
Tc		<i>Erythrina caffra</i>	
Tc		<i>Eugenia woodii</i>	
Tc		<i>Ficus lutea</i>	
Tc		<i>Ficus natalensis</i>	
Tc	C	<i>Ficus polita</i> subsp. <i>polita</i>	
Tc		<i>Ficus sur</i>	
Tc		<i>Inhambanella henriquesii</i>	
Tc		<i>Macaranga capensis</i>	
Tc		<i>Manilkara discolor</i>	
Tc		<i>Margaritaria discoidea</i>	
Tc	A	<i>Melia azedarach</i>	
Tc		<i>Mimusops obovata</i>	
Tc	C	<i>Morus mesozygia</i>	
Tc		<i>Olea woodiana</i>	
Tc		<i>Podocarpus falcatus</i>	Afrotemperate
Tc		<i>Rothmannia globosa</i>	
Tc		<i>Schefflera umbellifera</i>	
Tc		<i>Strychnos gerrardii</i>	
Tc		<i>Tabernaemontana ventricosa</i>	
Tc	C	<i>Trichilia dregeana</i>	
Tc		<i>Trichilia emetica</i>	
Tcu	d	<i>Englerophytum natalense</i>	Eastern Scarp
Tcu		<i>Cassipourea gummiflua</i>	
Tu	d	<i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	
Tu	d	<i>Cavacoa aurea</i>	
Tu	d	<i>Diospyros natalensis</i>	
Tu	d	C <i>Drypetes reticulata</i>	
Tu	d	<i>Hymenocardia ulmoides</i>	
Tu	d	<i>Manilkara concolor</i>	
Tu	d	<i>Maytenus undata</i>	
Tu	d	<i>Protorhus longifolia</i>	
Tu	d	<i>Strychnos madagascariensis</i>	
Tu	d	C <i>Teclea gerrardii</i>	
Tu		<i>Baphia racemosa</i>	
Tu		<i>Bridelia micrantha</i>	
Tu		<i>Canthium inerme</i>	
Tu		<i>Celtis gomphophylla</i>	
Tu		<i>Cola natalensis</i>	
Tu		<i>Combretum kraussii</i>	
Tu		<i>Commiphora harveyi</i>	
Tu	C	<i>Craiba zimmermannii</i>	
Tu		<i>Croton sylvaticus</i>	
Tu		<i>Cryptocarya woodii</i>	
Tu		<i>Euclea natalensis</i>	
Tu		<i>Eugenia natalitia</i>	
Tu	C	<i>Ficus bubu</i>	
Tu		<i>Harpephyllum caffrum</i>	
Tu		<i>Maytenus peduncularis</i>	
Tu		<i>Mimusops caffra</i>	
Tu		<i>Peddiea africana</i>	
Tu		<i>Pleurostylia capensis</i>	
Tu		<i>Rhus chirindensis</i>	
Tu		<i>Sapium integerrimum</i>	
Tu		<i>Scolopia zeyheri</i>	
Tu		<i>Strychnos spinosa</i>	
Tu		<i>Syzygium cordatum</i>	
Tu		<i>Tapura fischeri</i>	
Tu		<i>Vangueria randii</i> subsp. <i>chartacea</i>	
Tu		<i>Zanthoxylum capense</i>	

ST			<i>Pavetta revoluta</i>	
ST	d		<i>Buxus natalensis</i>	Scarp Forests
ST	d		<i>Coffea racemosa</i>	Licuati Sand
ST	d		<i>Erythroxylum emarginatum</i>	
ST	d		<i>Gymnosporia nemorosa</i>	
ST	d		<i>Ziziphus mucronata</i>	
ST			<i>Acalypha glabrata</i>	
ST			<i>Allophylus natalensis</i>	
ST			<i>Antidesma venosum</i>	
ST		C	<i>Bauhinia tomentosa</i>	
ST			<i>Bersama lucens</i>	
ST			<i>Bridelia cathartica</i>	
ST			<i>Canthium ciliatum</i>	
ST			<i>Cassipourea malosana</i>	
ST			<i>Catunaregam spinosa</i>	
ST			<i>Chaetacme aristata</i>	
ST			<i>Clausena anisata</i>	
ST			<i>Clerodendrum glabrum</i>	
ST			<i>Cola greenwayi</i>	Licuati Sand
ST			<i>Combretum bracteosum</i>	
ST			<i>Combretum molle</i>	Savanna
ST			<i>Deinbollia oblongifolia</i>	
ST			<i>Diospyros villosa</i>	
ST			<i>Dovyalis rhamnoides</i>	
ST			<i>Drypetes arguta</i>	
ST			<i>Elaeodendron croceum</i>	
ST		C	<i>Ephippiocarpa orientalis</i>	
ST		C	<i>Erythrococca berberidea</i>	
ST			<i>Erythroxylum delagoense</i>	
ST			<i>Erythroxylum pictum</i>	
ST			<i>Euclea racemosa</i>	
ST			<i>Gardenia thunbergia</i>	
ST			<i>Hyperacanthus amoenus</i>	
ST			<i>Kraussia floribunda</i>	
ST			<i>Lagynias lasiantha</i>	
ST		C	<i>Lasiodiscus mildraedii</i>	
ST			<i>Maytenus procumbens</i>	
ST			<i>Mitriostigma axillare</i>	
ST			<i>Mystroxylum aethiopicum</i>	
ST			<i>Ochna natalitia</i>	
ST			<i>Oxyanthus pyriformis</i>	Eastern Scarp
ST		C	<i>Pancovia golungensis</i>	
ST			<i>Pavetta gerstneri</i>	
ST			<i>Pavetta natalensis</i>	
ST			<i>Plectroniella armata</i>	
ST			<i>Psychotria capensis</i>	Afrotemperate
ST			<i>Ptaeroxylon obliquum</i>	
ST			<i>Putterlickia verrucosa</i>	
ST			<i>Strychnos usambarensis</i>	
ST			<i>Suregada africana</i>	
ST			<i>Teclea natalensis</i>	
ST			<i>Trema orientalis</i>	
ST			<i>Tricalysia sonderiana</i>	
ST			<i>Trimeria grandifolia</i>	
ST			<i>Turraea floribunda</i>	
ST			<i>Turraea obtusifolia</i>	
ST			<i>Vangueria cyanescens</i>	
ST			<i>Xylothea kraussiana</i>	
S			<i>Carissa bispinosa</i>	
S			<i>Coddia rudis</i>	
S			<i>Cussonia arenicola</i>	
S			<i>Grewia occidentalis</i>	
SCw	d	A	<i>Chromolaena odorata</i>	

SCw		<i>Acridocarpus natalitius</i> var. <i>natalitius</i>
SCw		<i>Allocassine laurifolia</i>
SCw		<i>Artabotrys monteiroae</i>
SCw		<i>Asparagus falcatus</i>
SCw		<i>Landolphia kirkii</i>
SCw		<i>Monanthes affra</i>
SCw		<i>Uvaria affra</i>
Cw		<i>Mucuna gigantea</i>
Cw		<i>Quisqualis parviflora</i>
Cw		<i>Strophanthus gerrardii</i>
Ssoft	d	<i>Isoglossa woodii</i>
Ssoft		<i>Hypoestes aristata</i>
Hsc	d	<i>Commelina benghalensis</i>
G		<i>Cyperus albostrigatus</i>
G		<i>Oplismenus hirtellus</i>

Typical & Endemic Animals

Table. Forest dependent bird, mammal, frog and reptile species in the KwaZulu-Natal Coastal Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, E – endemic, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Crested guinea-fowl	<i>Guttera pucherani</i>	Cl	Birds	LP, e. Mp, KZN midl, n. KZN coast
Buff-spotted flufftail	<i>Sarothrura elegans</i>	C	Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Delegorgue's pigeon	<i>Columba delegorguei</i>	R	Birds	EC, KZN, e. Mp
Tambourine dove	<i>Turtur tympanistris</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Knysna lourie	<i>Tauraco corythax</i>	C	Birds	EC, KZN, MP, NP
Emerald cuckoo	<i>Chrysococcyx cupreus</i>	Cm	Birds	LP, Mpu, KZN, EC
Green coucal	<i>Ceuthmochares aereus</i>	Cf	Birds	Coastal KZN & EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Pel's fishing owl	<i>Scotopelia peli</i>	R	Birds	n. Zululand
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape
Trumpeter hornbill	<i>Bycanistes bucinator</i>	Cl	Birds	LP, Mpu, KZN, EC
White-eared barbet	<i>Stactolaema leucotis</i>	C	Birds	Coastal Zululand
Golden-rumped tinker barbet	<i>Pogoniulus bilineatus</i>	C	Birds	e. Mp, coastal n. EC & KZN
Scaly-throated honey guide	<i>Indicator variegatus</i>	Cf	Birds	e. Mp, coastal EC & KZN
Grey cuckoo-shrike	<i>Coracina caesia</i>	U	Birds	Widespread
Square-tailed drongo	<i>Dicrurus ludwigii</i>	C	Birds	Mp, coastal EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Yellow-streaked bulbul	<i>Phyllastrephus flavostriatus</i>	Cf	Birds	Ngoye forest north to e. Mp
Yellow-bellied bulbul	<i>Chlorocichla flaviventris</i>	C	Birds	Coastal n. EC & KZN
Spotted thrush	<i>Zoothera guttata</i>	Cl	Birds	Coastal EC & KZN
Chorister robin	<i>Cossypha dichroa</i>	Cl	Birds	LP, Mp, KZN, EC
Starred robin	<i>Pogonochlora stellata</i>	Cl	Birds	LP, Mp, KZN, EC
Brown robin	<i>Erythropygia signata</i>	Cl	Birds	e. Mp, coastal EC & KZN
Bearded robin	<i>Erythropygia quadrivirgata</i>	Cf	Birds	n. Zululand
Woodwards' batis	<i>Batis fratrum</i>	Cl	Birds	n. Zululand
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN

Common name	Scientific name	Status	Taxon	Distribution
Olive bush shrike	<i>Telophorus olivaceus</i>	Cl	Birds	LP, Mp, KZN, EC, S.Cape
Blackbellied glossy starling	<i>Lamprotornis corruscus</i>	C	Birds	e. Mp, coastal EC & KZN
Olive sunbird	<i>Nectarinia olivacea</i>	C	Birds	EC, KZN
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Forest weaver	<i>Ploceus bicolor</i>	Cl	Birds	Coastal EC & KZN
Green twinspot	<i>Mandingoa nitidula</i>	Cl	Birds	LP, Mp, KZN, EC
Forest canary	<i>Serinus scotops</i>	Cl	Birds	LP, Mp, KZN, EC
Blue duiker	<i>Philantomba monticola</i>		Mammals	KZN, EC
Red duiker	<i>Cephalophus natalensis</i>		Mammals	LP, n. Zululand
Mozambique woodland mouse	<i>Grammomys cometes</i>		Mammals	n. Zululand
Woodland mouse	<i>Grammomys dolichurus</i>		Mammals	LP, Mp, KZN, EC
Woodland dormouse	<i>Graphiurus murinus</i>		Mammals	Widespread
Dark-footed forest shrew	<i>Myosorex cafer</i>		Mammals	LP, Mp, KZN, EC
Red squirrel	<i>Paraxerus palliatus</i>		Mammals	n. Zululand
Samango monkey	<i>Cercopithecus mitis</i>		Mammals	LP, KZN, EC
Bush squeaker	<i>Arthroleptis wahlbergi</i>		Frogs	KZN, EC
Shovel-footed squeaker	<i>Arthroleptis stenodactylus</i>		Frogs	n. Zululand
Forest tree frog	<i>Leptopelis natalensis</i>		Frogs	KZN, EC
Giant legless skink	<i>Acontias plumbeus</i>	E	Reptiles	LP, e. Mp, n. KZN, East London
Natal purple-glossed snake	<i>Amblyodipsas concolor</i>	E, R	Reptiles	e. Mp, KZN
Gaboon adder	<i>Bitis gabonica</i>	R	Reptiles	n. Zululand
Green mamba	<i>Dendroaspis angusticeps</i>		Reptiles	Coastal KZN & EC
Forest cobra	<i>Naja melanoleuca</i>		Reptiles	Coastal KZN (north of Durban)
Mozambique shovel-snout	<i>Prosymna janii</i>	E	Reptiles	n. Zululand
Setaro's dwarf chamaeleon	<i>Bradypodion setaroi</i>	E	Reptiles	n. Zululand

Conservation & Management

Use & Value

KwaZulu-Natal Coastal Forest has a high biodiversity value relative to other forest types. There are only four endemic mammals in South Africa and one lives in these forests (the Zulu golden mole, *Amblystomus iris*). Rare plant species, such as *Morus mesozygia*, *Cavacoa aurea*, *Stangeria eriops*, also occur here. The fact that these forests are very species rich, coupled with their coarse grain, disturbance driven ecology, means that large tracts must be protected in order to conserve the full range of species. Forest communities relate to disturbance regimes or succession gradients and it is therefore imperative that landscape processes, such as fire, that maintain species diversity are also preserved. This forest type has a high socio-economic value for local communities, particularly in terms of medicinal plants and other forest products. It also has considerable ecosystem importance, especially with respect to river systems and the stabilisation of the sandy dune plain. Forest removal rapidly leads to sand blows and erosion due to infertile soils. A number of vital rivers run through these forests, e.g. those flanking Lake Sibaya.

Conservation Status

Relative to its original extent, KwaZulu-Natal Coastal Forest is poorly protected and the conservation capacity is moderate to non-existent in some remnants (e.g. Dukuduku). A number of remnant patches are protected within the metropolitan area of Durban. Forests that remain north of the Tugela River are good examples of the type and some are protected (Enseleni, Sodwana Bay, Manguzi, False Bay region). Others are under threat of slash and burn agriculture and illegal occupation. All are under threat of alien weed invasion (*Chromolaena odorata*). Its conservation status is high in that it requires active conservation intervention because so little is left and the forests have no resistance to invasion by people and plants.

The forest biome map gives 13 000 ha for this forest type, whilst the NLC gives over double at 26 000 ha. In both cases 70% is given as conserved.

Main Threats

- ⇒ Historically - commercial afforestation and sugarcane production, although nowadays forestry has a mainly positive effect, i.e., forest protection and expansion e.g. at Amangwe.
- ⇒ Subsistence agriculture, woodlots and sugarcane (small growers). People (especially sugar cane and subsistence farmers) have a higher impact on KwaZulu-Natal Coastal Forest than they do on the Dune Forest as the underlying soil is more arable. Also, these forests occur in areas of high human population density, e.g., Manguzi, Dukuduku.
- ⇒ Intensive harvesting of non-timber forest products as well as slash-and-burn agriculture, especially in the north around Amanzingwenya, Dukuduku and Manguzi. There is a very high demand on wood and even inappropriate species are being used. The pressure is increasing rapidly as population in the area increases.
- ⇒ The quinine tree (*Rauvolfia caffra*) and *Albizia adianthifolia* were previously common in these forests, but are now heavily stripped of bark and more rare. Other species used in the medicinal plant trade include *Balanites maughamii*, *Trichilia emetica*, *T. dregeana*, *Ekebergia capensis*, *Harpephyllum caffrum*, *Protorhus longifolia*, *Rapanea melanophloeos*, *Synaptolepis kirkii*.
- ⇒ *Dracaena alectrifomis* is used extensively for broom handles.
- ⇒ These forests are especially susceptible to alien plant invasion. Their dynamics require disturbance and alien weeds occupy this same niche, which leads to a halted succession. The nature of invading weeds does not allow overtopping of forest species in time.

Other Management Considerations

- ⇒ Land claim and land invasion – most of the area north of the Tugela River is under land claim.
- ⇒ Land use changes both past (afforestation and sugarcane plantation) and present (subsistence agriculture) are of considerable concern. Changes to woodlots, new cane plantings and maize cultivation.
- ⇒ Linking with local governance (metro councils and private estates) especially in the south, as many forests are on communal land
- ⇒ Stricter by-laws are required as well as control to manage land use change.
- ⇒ Some areas are not managed or controlled at all.
- ⇒ These forests occur in many small patches and one is to a large extent managing forests fragments.
- ⇒ Many forests are adjacent to or are bisected by access roads to the coast. This incorporates both the direct impact of the roads themselves and the indirect impact of increased numbers of people and associated illegal activities.
- ⇒ Daily high demand and harvesting of non-timber forest products.
- ⇒ Ecotourism (Enseleni N.R. especially is targeted)
- ⇒ Management must ensure that there is zonation and that this is strictly controlled.
- ⇒ Management of fire, grazing and alien plants and especially the synergy between fire and alien plants. For example, the infestation of *Chromolaena odorata* causes fire to enter forests.
- ⇒ The trade in Gabon vipers.

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VI2: KwaZulu-Natal Dune Forest

Synonyms

Psammophilous Bush	Bews (1920)
Coastal Dune Forest	Edwards (1967)
Dune Forest	Moll (1978)
Dune Forest	Moll & White (1978)
Dune Forest	Ward (1980)
Dune Forest	Cooper (1985)
Dune Forest	Weisser (1987)
Transkei and Natal Coastal Forests p.p.	Phillipson & Russell (1988)
Dune Forest	Cooper & Swart (1992)
Dune Forest	Weisser et al. (1992)
Dune Forest	MacDevette (1993)
Coastal Forest p.p.	Low & Rebelo (1996)

Profile

Shrubby thicket to tall forest occurring along the KwaZulu-Natal coastline on the primary dune cordon inland from salt spray zone. These forests show a distinct gradient of change from the beach to the landward side of the dunes. Characterised by sandy substrata, rolling dune field topography, strong winds and adjacent to ocean beaches. Multi-stemming common and herb layer dominated by *Isoglossa woodii*. Species rich forests with many tropical and subtropical species reaching their southern distribution limits along north-south gradient.

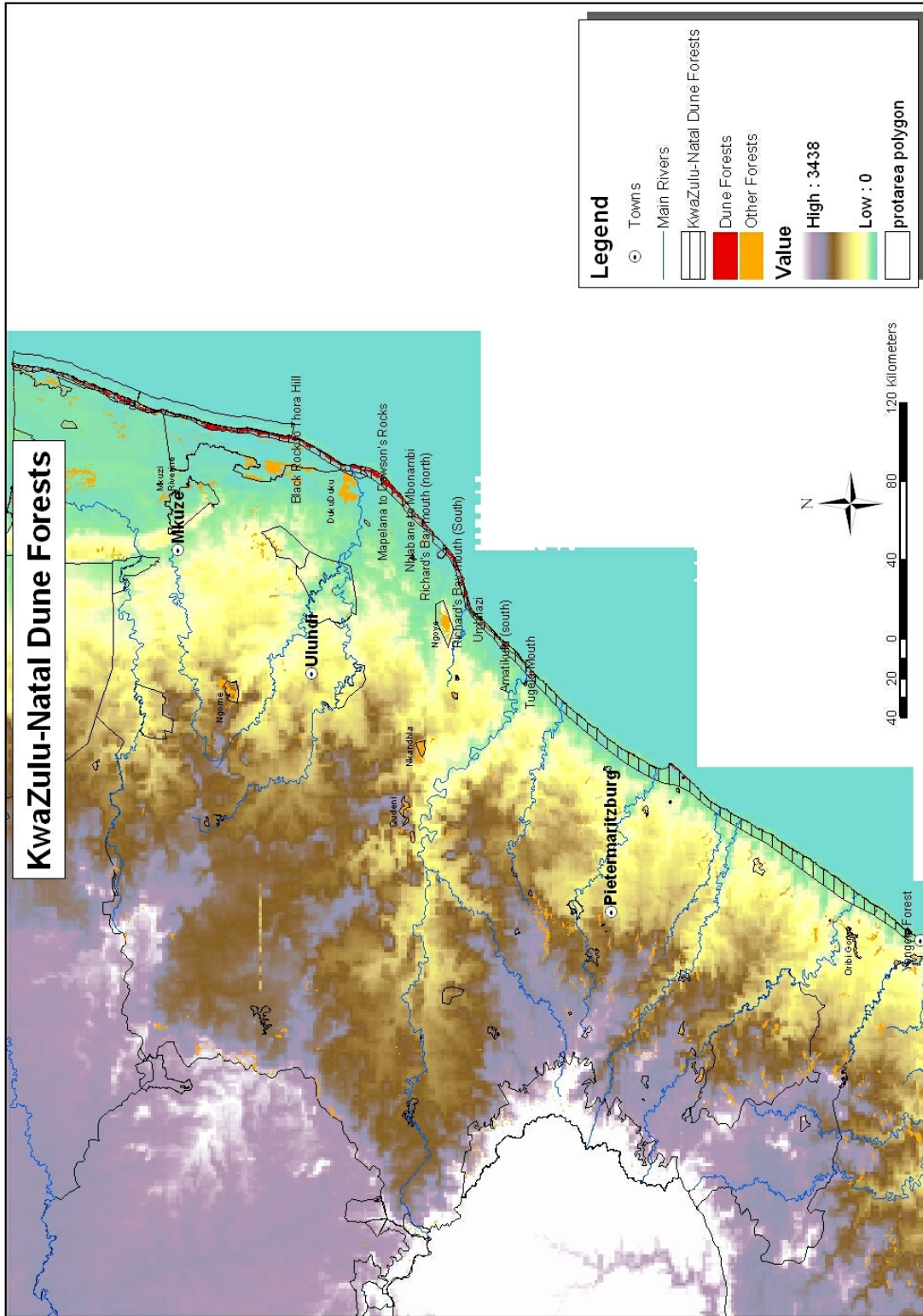
Distribution

Coastal dune cordon of KwaZulu-Natal from Port Edward northward to Maputaland and into Mozambique. Almost continuous from Amatikulu north to Mozambique border but patchy toward southern limits of distribution. Highly fragmented on KwaZulu-Natal south coast due to coastal resort development (Breen 1971, MacDevette et al. 1989a, b, 1993, MacDevette & Gordon 1989, MacDevette & MacDevette 1989, MacDevette et al. 1989, Mol 1972, 1978, Lubbe 1996, Mol & White 1978, Tinley 1985, Van Wyk et al. 1996, Venter 1972, 1976, von Maltitz et al. 1996, Weisser 1978, 1980, 1987, Weisser et al. 1992, Weisser & Cooper 1993, Ward 1980, White 1983).

Known Forests

Amatikulu,	Port Edward.
Black Rock	Port Zimbali
Cape St. Lucia	Reunion,
Cape Vidal	Richard's Bay Sanctuary
Dawson's Rock	Salmon Bay/Jex Estate
Hlogwene (part)	Siyai/Twinstreams
Kosi Bay	Sodwana Bay
Lake Sibaya,	Southbroom
Mapelana North	St Mary's Hill
Mapelana South	Trafalgar
Mbonambi Beach	Treasure Beach
Mdlangu	Umdloti
Mdlotane	Umhlanga
North Bhangazi	Umlalazi
Perrier's Rocks	Unophonjwana
Peter Pan Bay	Zinkwazi (north & south)
Port Durnford	

Map



Vegetation Structure & Texture

Stand Structure

Two main gradients are found in the dune area, a gradient from the coast inwards and a gradient from mature to secondary stands. High forest communities of mature stands are dominated by *Sideroxylon inerme* and are about 16m in height. By contrast coastal thicket is dominated by *Euclea schimperi* and *Eugenia capensis* and is only a few meters tall. Multitemmed trees are the norm. A dense and often thorny undercanopy makes penetration into this forest type difficult. Lianas and climbers are common and *Isoglossa woodii* may dominate in the herb layer. Secondary succession stands are dominated by *Apodytes dimidiata* or *Acacia Karroo*. Where *Acacia Karroo* occurs it often forms near mono-specific stands with a distinctly open understory (in comparison to other stand structures). *Acacia karroo* is more common south of St Lucia than to the North. For dune communities are low and dominated by salt spray tolerant species such as *Mimusops caffra*, *Strychnos gerrardii*, *Drypetes natalensis*, *Dovyalis longispina* and *Ziziphus mucronata*.

Ecology

Altitude & Geomorphology

These forests are restricted to the sandy coastal dunes, most of which are geologically young, about 10 000 years. Altitudinally these forests occur below 100 m AMSL and extend to the beach where spray tolerant species predominate.

Geology & Soil

A wide series of deposits were laid down during a general decline of sea levels across the coastal plain due to glacioeustasy and tectonic process. The underlying deposits of the coastal dunes are siltstone of Cretaceous age, and shelly limestones and calcarenites of Late Tertiary age. A series of dune cordons were one of the deposits left across the coastal plain, declining in age from west to east. (Hobday 1979). During the last glacial period, approximately 18 000 years ago, the sea level descended by approximately 100 m below present and the present dunes were formed from on the exposed sand plain (Tinley 1985). Soils are deep and sandy. Clays and nutrients are higher in the A horizon than in the B horizon and the development of water repellent soils is a significant factor in dune system ecology.

Climate

Subtropical climate in Maputaland, year round rainfall regime with summer maximum, \pm 850–1200 mm/annum. To the south, warm temperate climate with summer rainfall of \pm 1000 mm.

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	660	12	28	21
Maximum	1100	14	30	22

Disturbance

Natural disturbances include dramatic storms during summer. These forests are event driven, disturbance includes fire, wind, subtropical storms and slumping of unstable dune sand substrate. The high degree of salt spray and strong winds help to shape the structure and species composition of the dune forest. Potential recruitment bottlenecks and arrested succession caused by dominant herb layer (esp. *Isoglossa woodii*). Slash and burn agriculture has played an important role in the current community structures, and more recently dune mining is a major man induced disturbance to this vegetation type.

Biogeographical Affinities

Kwa-Zulu Natal coastal forests VI1

Communities/Subunits

Subunits:

Psammophilous Bush	Bews (1920)
Dune Forest with <i>Phymatodes scolopendria</i>	Moll (1972)
<i>Mimusops caffra</i> -gemeenskap	Venter (1972)
<i>Mimusops/Apodytes</i> -gemeenskap	Venter (1972)
* <i>Strelitzia nicolai</i> -gemeenskap	Venter (1972)
<i>Acacia karroo</i> Woodland	Weisser (1978)
Coastal Dune High Forest	Weisser (1978)
Coastal Dune Medium Forest	Weisser (1978)
Secondary Dune Forest	Weisser (1978)
<i>Mimusops caffra</i> Transitional Forest	Ward (1980)
Climax Dune Forest	Weisser (1987)
Low Forest	Weisser (1987)
Primary <i>Acacia karroo</i> Woodland	Weisser (1987)
Secondary <i>Acacia karroo</i> Woodland	Weisser (1987)
Secondary Dune Forest	Weisser (1987)
<i>Trema orientalis</i> Woodland	Weisser (1987)
<i>Mimusops caffra</i> Association	MacDevette (1989)
<i>Acacia karroo</i> Woodland	Weisser et al. (1992)
Dune Forest	Weisser et al. (1992)
Low Forest	Weisser et al. (1992)
<i>Trema orientalis</i> Woodland	Weisser et al. (1992)
<i>Acacia karroo</i> Woodland	MacDevette (1993)
Dune Forest	MacDevette (1993)
Dune Scrub-forest	MacDevette (1993)
<i>Pavetta gerstneri</i> - <i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	
Coastal Dune Forest	Lubbe (1996)
<i>Croton gratissimus</i> var. <i>gratissimus-Isoglossa woodii</i>	
Coastal Dune Forest	Lubbe (1996)

Dominant & Diagnostic Plant Species

L	S	D	Latin Name	Note
Tce	d		<i>Mimusops caffra</i>	
Tc	d		<i>Acacia karroo</i> " <i>kosibaaiensis</i> "	
Tc	d	C	<i>Dovyalis longispina</i>	
Tc	d	C	<i>Psydrax obovata</i> subsp. <i>obovata</i>	
Tc			<i>Celtis africana</i>	
Tc			<i>Chionanthus peglerae</i>	
Tc			<i>Cussonia sphaerocephala</i>	
Tc			<i>Drypetes natalensis</i>	
Tc			<i>Ekebergia capensis</i>	
Tc			<i>Erythrina lysistemon</i>	
Tc			<i>Mimusops obovata</i>	
Tc			<i>Morus mesozygia</i>	
Tc			<i>Olea woodiana</i>	
Tc			<i>Protorhus longifolia</i>	
Tc			<i>Trichilia emetica</i>	
Tc			<i>Vepris lanceolata</i>	
Tu	d		<i>Allophylus natalensis</i>	

Tu	d		<i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	
Tu			<i>Albizia adianthifolia</i>	
Tu			<i>Canthium inerme</i>	
Tu	A		<i>Cestrum laevigatum</i>	
Tu			<i>Chaetachme aristata</i>	
Tu			<i>Commiphora harveyi</i>	
Tu			<i>Cordia caffra</i>	
Tu			<i>Diospyros natalensis</i>	
Tu			<i>Diospyros rotundifolia</i>	
Tu			<i>Euclea natalensis</i>	Dune Thicket
Tu			<i>Eugenia natalitia</i>	
Tu			<i>Ficus burtt-davyi</i>	
Tu			<i>Garcinia livingstonei</i>	
Tu			<i>Hymenocardia ulmoides</i>	
Tu	A		<i>Psidium guajava</i>	
Tu			<i>Robsonodendron eucleiforme</i>	
Tu			<i>Rothmannia globosa</i>	
Tu			<i>Scolopia zeyheri</i>	
Tu			<i>Sideroxylon inerme</i> subsp. <i>inerme</i>	
Tu			<i>Syzygium cordatum</i>	
Tu			<i>Tarchonanthus camphoratus</i>	
Tu			<i>Teclea gerrardii</i>	
Tu			<i>Trema orientalis</i>	
Tu			<i>Zanthoxylum capense</i>	
Tcyc			<i>Encephalarctos ferox</i>	Maputaland endemic
ST	d	C	<i>Brachylaena discolor</i> var. <i>discolor</i>	
ST	d		<i>Eugenia capensis</i>	
ST	d		<i>Kraussia floribunda</i>	
ST	d		<i>Peddiaea africana</i>	
ST	d	C	<i>Rhus nebulosa</i>	
ST		C	<i>Acokanthera oblongifolia</i>	Dune Thicket
ST			<i>Annona senegalensis</i>	
ST			<i>Baphia racemosa</i>	
ST			<i>Bersama lucens</i>	
ST			<i>Bridelia cathartica</i>	
ST			<i>Canthium ciliatum</i>	
ST			<i>Catunaregam spinosa</i>	Savanna
ST			<i>Clausena anisata</i>	
ST			<i>Clerodendrum glabrum</i>	
ST			<i>Commiphora neglecta</i>	
ST			<i>Deinbollia oblongifolia</i>	
ST			<i>Dovyalis rhamnoides</i>	
ST			<i>Erythrococca berberidea</i>	
ST			<i>Erythroxylum emarginatum</i>	
ST			<i>Gymnosporia nemorosa</i>	
ST			<i>Gymnosporia senegalensis</i>	
ST			<i>Hippobromus pauciflorus</i>	
ST			<i>Lagynias lasiantha</i>	
ST			<i>Maytenus procumbens</i>	
ST			<i>Ochna natalitia</i>	
ST			<i>Ozoroa obovata</i>	
ST			<i>Pavetta revoluta</i>	
ST			<i>Plectroniella armata</i>	
ST			<i>Psychotria capensis</i>	
ST			<i>Putterlickia verrucosa</i>	
ST			<i>Strychnos madagascariensis</i>	
ST			<i>Strychnos spinosa</i>	
ST			<i>Tarenna littoralis</i>	
ST			<i>Teclea natalensis</i>	
ST			<i>Thespesia acutiloba</i>	
ST			<i>Tricalysia sonderiana</i>	
ST			<i>Turraea floribunda</i>	
ST			<i>Xylothea kraussiana</i>	

ST			<i>Ziziphus mucronata</i>	
S	d		<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>	Dune Thicket
S			<i>Carissa bispinosa</i> subsp. <i>bispinosa</i>	
S			<i>Carissa macrocarpa</i>	Dune Thicket
S		C	<i>Cussonia arenicola</i>	
S			<i>Grewia occidentalis</i>	
Smon	d		<i>Dracaena alectriformis</i>	Dune Thicket
Smon			<i>Aloe thraskii</i>	Dune Thicket
SCw	d	C	<i>Acacia kraussiana</i>	
SCw			<i>Dalbergia obovata</i>	
SCw			<i>Grewia caffra</i>	
SCw			<i>Monanthes caffra</i>	
SCw			<i>Pisonia aculeata</i>	
SCw			<i>Rhus natalensis</i>	
SCw			<i>Scutia myrtina</i>	
SCw			<i>Tecoma capensis</i>	
SCw			<i>Uvaria caffra</i>	
Cw	d		<i>Asparagus falcatus</i>	
Cw	d		<i>Rhoicissus tomentosa</i>	
Cw			<i>Adenia gummifera</i>	
Cw			<i>Asparagus setaceus</i>	
Cw			<i>Cynanchum ellipticum</i>	
Cw			<i>Heliophila scandens</i>	
Cw			<i>Pyrenacantha scandens</i>	
Cw			<i>Rhoicissus digitata</i>	
Cw			<i>Rhoicissus rhomboidea</i>	
Cw			<i>Secamone alpini</i>	
Cw			<i>Secamone filiformis</i>	
Cw			<i>Smilax anceps</i>	
Cwsuc			<i>Cyphostemma cirrhosum</i>	
Cwsuc			<i>Vanilla roscheri</i>	
Ssoft	d		<i>Isoglossa woodii</i>	
Ssoft			<i>Abutilon sonneratianum</i>	
Ssoft			<i>Dicliptera heterostegia</i>	
Ssoft		A	<i>Rivina humilis</i>	
Ssp			<i>Colpoon compressum</i>	Dune Thicket
Hban	d	D	<i>Strelitzia nicolai</i>	Dune Thicket
Hcr			<i>Commelina erecta</i>	
Hf	d		<i>Microsorium scolopendrium</i>	
Hf			<i>Asplenium prionitis</i>	
Hg			<i>Botanea lamprophylla</i>	
Hg			<i>Chlorophytum modestum</i>	
Hg			<i>Crocsmia aurea</i>	
Hg			<i>Cyrtorchis arcuata</i>	
Hg			<i>Drimiopsis maculata</i>	
Hg			<i>Freesia laxa</i>	
Hg			<i>Haemanthus albomaculatus</i>	
Hg			<i>Scadoxus membranaceus</i>	
Hg			<i>Scadoxus puniceus</i>	
Hsc			<i>Barleria repens</i>	
Hsc/Ch			<i>Pupalia lappacea</i>	
Ch			<i>Coccinea palmata</i>	
Ch			<i>Cynanchum ellipticum</i>	
Ch			<i>Gloriosa superba</i>	
Ch			<i>Rubia cordifolia</i>	
Ch			<i>Tragia glabrata</i>	
H/Ch			<i>Thunbergia dregeana</i>	
Hsap			<i>Didymoplexis verrucosa</i>	
H	d		<i>Asystasia gangetica</i>	
H	d		<i>Laportea peduncularis</i>	
H			<i>Achyranthes aspera</i>	
H			<i>Aneilema schlechteri</i>	
H			<i>Laportea grossa</i>	

H		<i>Laportea peduncularis</i>
H		<i>Plectranthus ambiguus</i>
G	d	<i>Cyperus albostriatus</i>
G		<i>Dactyloctenium australe</i>
G		<i>Dactyloctenium geminatum</i>
G		<i>Panicum chusqueoides</i>
G		<i>Panicum maximum</i>
Gcr		<i>Oplismenus hirtellus</i>

Typical & Endemic Animals

Table. Forest dependent bird, mammal, frog and reptile species in the KwaZulu-Natal Dune Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, E – endemic, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Buffspotted flufftail	<i>Sarothrura elegans</i>	C	Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Tambourine dove	<i>Turtur tympanistria</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Knysna lourie	<i>Tauraco corythaix</i>	C	Birds	EC, KZN, MP, NP
Emerald cuckoo	<i>Chrysococcyx cupreus</i>	Cm	Birds	LP, Mpu, KZN, EC
Green coucal	<i>Ceuthmochares aereus</i>	Cf	Birds	Coastal KZN & EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape
Trumpeter hornbill	<i>Bycanistes bucinator</i>	Cl	Birds	LP, Mpu, KZN, EC
White-eared barbet	<i>Stactolaema leucotis</i>	C	Birds	Coastal Zululand
Goldenrumped tinker barbet	<i>Pogoniulus bilineatus</i>	C	Birds	e. Mp, coastal n. EC & KZN
Scalythroated honey guide	<i>Indicator variegatus</i>	Cf	Birds	e. Mp, coastal EC & KZN
Olive woodpecker	<i>Mesopicos griseocephalus</i>	Cf	Birds	Widespread
Grey cuckooshrike	<i>Coracina caesia</i>	U	Birds	Widespread
Squaretailed drongo	<i>Dicrurus ludwigii</i>	C	Birds	Mp, coastal EC & KZN
Bush blackcap	<i>Lioptilus nigricapillus</i>	U	Birds	LP, Mp, inland EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Yellowbellied bulbul	<i>Chlorocichla flaviventris</i>	C	Birds	Coastal n. EC & KZN
Spotted thrush	<i>Zoothera guttata</i>	Cl	Birds	Coastal EC & KZN
Chorister robin	<i>Cossypha dichroa</i>	Cl	Birds	LP, Mp, KZN, EC
Starred robin	<i>Pogonocichla stellata</i>	Cl	Birds	LP, Mp, KZN, EC
Brown robin	<i>Erythropgyia signata</i>	Cl	Birds	e. Mp, coastal EC & KZN
Yellowthroated warbler	<i>Seicercus ruficapillus</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Barthroated apalis	<i>Apalis thoracica</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>	Cl	Birds	LP, Mp, KZN, EC, S.Cape
Blackbellied glossy starling	<i>Lamprotornis corruscus</i>	C	Birds	e. Mp, coastal EC & KZN
Olive sunbird	<i>Nectarinia olivacea</i>	C	Birds	EC, KZN
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Forest weaver	<i>Ploceus bicolor</i>	Cl	Birds	Coastal EC & KZN

Common name	Scientific name	Status	Taxon	Distribution
Green twinspot	<i>Mandingoa nitidula</i>	CI	Birds	LP, Mp, KZN, EC
Forest canary	<i>Serinus scotops</i>	CI	Birds	LP, Mp, KZN, EC
Woodland mouse	<i>Grammomys dolichurus</i>		Mammals	LP, Mp, KZN, EC
Woodland dormouse	<i>Graphiurus murinus</i>		Mammals	Widespread
Dark-footed forest shrew	<i>Myosorex cafer</i>		Mammals	LP, Mp, KZN, EC
Blue duiker	<i>Philantomba monticola</i>		Mammals	Coastal KZN & EC
Red duiker	<i>Cephalophus natalensis</i>		Mammals	LP, n. Zululand
Samango monkey	<i>Cercopithecus mitis</i>		Mammals	LP, KZN, EC
Natal ghost frog	<i>Heleophryne natalensis</i>		Frogs	LP, Mp, KZN, EC
Plaintive rain frog	<i>Breviceps verrucosus</i>		Frogs	KZN, EC
Kloof frog	<i>Natalobatrachus bonebergi</i>		Frogs	s. KZN, EC
Bush squeaker	<i>Arthroleptis wahlbergi</i>		Frogs	KZN, EC
Forest tree frog	<i>Leptopelis natalensis</i>		Frogs	KZN, EC
Clicking stream frog	<i>Strongylopus grayii</i>		Frogs	Widespread
Giant legless skink	<i>Acontias plumbeus</i>	E	Reptiles	LP, e. Mp, n. KZN, East London
Smith's dwarf burrowing skink	<i>Scelotes inornatus</i>	E	Reptiles	n. Zululand
Natal purple-glossed snake	<i>Amblyodipsas concolor</i>	E, R	Reptiles	e. Mp, KZN
Green mamba	<i>Dendroaspis angusticeps</i>		Reptiles	Coastal KZN & EC
Forest cobra	<i>Naja melanoleuca</i>		Reptiles	Coastal KZN (north of Durban)

Conservation & Management

Use & Value

Socio-economic value moderate to high especially considering recreation opportunities. Recreational use in coastal resort areas, e.g., Mlalazi, Mapelane and Cape Vidal. is high to moderate. Biodiversity value is moderate to high in that this forest type is species rich and contains many rare species, e.g. *Morus*, *Inhambanella*, *Blighia*, *Coffea*. Ecosystem value is relatively high in terms of dune stabilization. It also acts as a coastal migration corridor for species such as the Pygmy Kingfisher and Spotted Forest Thrush.

Conservation Status

The coastal dune is moderately well protected compared to the coastal plain. The entire dune cordon from Mozambique to the south of Cape St Lucia is protected within the Greater St Lucia Wetland Park. However capacity for management and protection needs improving. Management capacity is being eroded in Maputaland with increased slash and burn, and illegal development in the coastal reserve. Community antagonism towards forest conservation needs to be defused. An understanding of the ecological processes underlying dune forest is necessary for management. KwaZulu-Natal dune forest is a more resilient type of forest than the rest of the coastal plain forest and other forest types.

The forest biome map gives 14 000 ha of this forest type with 88% conserved. The NLC gives almost twice the area at 25 000 ha with 78% conserved.

Main Threats

- ⇒ Strip/sand mining
- ⇒ Forest clearing for slash and burn agriculture in Maputaland
- ⇒ Harvesting of timber, non-timber forest products, firewood and medicinal plants. Limited impact in the North with increasing use southward.
- ⇒ Alien plant invasions, e.g. Amatigulu
- ⇒ Demand for fire wood
- ⇒ Servitudes – open access and peripheral activities associated with uncontrolled access
- ⇒ Coastal development, holiday resorts leading to forest fragmentation and alien weed invasion.
- ⇒ Servitudes, i.e. open access and peripheral activities associated with uncontrolled access
- ⇒ Unstable sandy substrata may be threatened by a global sea level rise undercutting dunes.

Other Management Considerations

- ⇒ Dune forest receives less use than coastal plains, possibly due to deeper sandy soils.
- ⇒ Look at the context as to what is required for good management.
- ⇒ Need to prevent salt spray from entering the understory.
- ⇒ Ecotourism, coastal access and servitudes, hiking trails.

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VII1: Eastern Cape Dune Forests

Synonyms

Coast Dune Bush	Comins (1962)
Coastal Forest	Lubke & Strong (1988)
Coastal Forest	Lubke & de Villiers (1991)
Mature Dune Forest	Burns & Raal (1993)

Profile

Subtropical low-stature, dense-canopy forest on old stabilized coastal dune cordons fringing the Eastern Cape coast, usually dominated by *Mimusops caffra*, *Sideroxylon inerme* and *Dovyalis rotundifolia*.

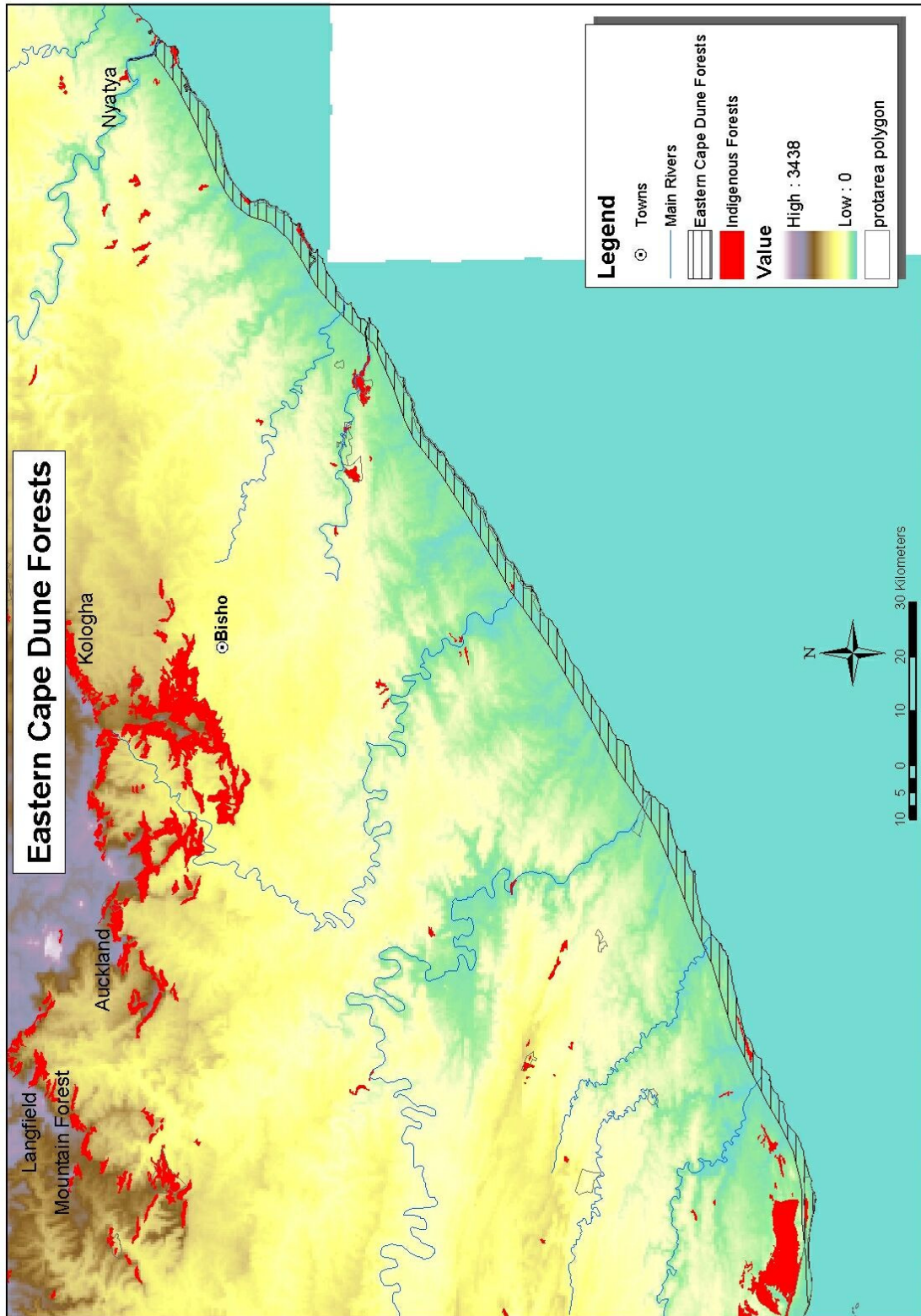
Distribution

Endemic to the Eastern Cape province, these dune forests are found in small pockets as far north as the Transkei Wild Coast (Nxaxo) and as far south as Woody Cape (S of Alexandria), where this forest type abuts the Alexandria Forest (latter classified as Albany Coastal Forest). The highest density of patches of Eastern Cape Dune Forest occurs between the Kei River mouth and Mcantzi River mouth (see the map in Burns 1986). For further distribution data consult Tinley (1985: 120, 136) and Avis (1995).

Known Forests

Beacon Bay	Kobonqaba
Bosbokstrand	Kwelera
Cape Henderson	Kwexura
Citsa	Morgan Bay
Eastern Beach (East London)	Nxaxo
Gudu	Queensberry
Kenton-on-Sea	Willowvale Coastal
Kidd's Beach	Woody Cape (bordering on Alexandria Forest)

Map



Vegetation Structure & Texture

Stand Structure

Canopy height varies from 8 - 15 m, and decreases along east-west gradient, reaching approximately 5 metres in localities such as Kenton-on-Sea (Joan Muirhead N.R.; Lubke & de Villiers 1991) and Woody Cape N.R. (L. Mucina & D.B. Hoare unpubl.). Common canopy species include *Mimusops caffra*, *Sideroxylon inerme*, *Dovyalis rotundifolia*, *Allophylus natalensis*, *Cassine aethiopica*, *Euclea natalensis* and *E. racemosa*. In dune valley forests (see Burns 1986) *Erythrina caffra*, *Diospyros natalensis*, *Harpephyllum caffrum*, *Schotia latifolia*, *Teclea natalensis*, *Zanthoxylum capense* and yellowwoods (*Podocarpus falcatus* and *P. latifolius*) may occur as canopy constituents.

The height of the sub-canopy spans 2.5 – 7 m but it is often difficult to distinguish the canopy and sub-canopy strata apart. Species such as *Acokanthera oblongifolia*, *Cassine papillosa*, *Deinbollia oblongifolia*, *Dracaena alectrifolmis*, *Psychotria capensis* are dominant in the sub-canopy stratum (Burns 1986).

The woody herb *Isoglossa woodii* (Acanthaceae) can be locally common and dense in the herb layer, reaching heights of 1.5 m. *Hypoestes aristata* and some *Panicum* species are also typical of the herb layer.

Diversity Patterns

The species diversity of the canopy stratum is relatively low with only eleven species recorded in a sample [how big – e.g., ten 0.1 ha plots] by Burns (1986). The number of tree and shrub species in Eastern Cape dune forests is characteristically lower than in similar dune forests of KwaZulu-Natal (Burns & Raal 1993). This trend is commensurate with a north-south (and east-west) gradient of floristic impoverishment also found in other forests groups (Geldenhuys 1992, Midgley et al. 1997).

Ecology

Altitude & Geomorphology

A narrow cordon of coastal dunes along much of the shoreline adjacent to the predominantly sandy and mixed sandy and rocky beaches, intersected at intervals by a number of river mouths, is typical of the Eastern Cape Dune Forest landscape. The most prominent feature of the system is the large landward barrier dune that is aligned more or less parallel to the coastline, of the type which is referred to as a precipitation ridge (Burns 1986). The barrier dune is fixed by vegetation in various stages of succession, including the thicket and forest communities. The forests occur typically in landward and sheltered positions and are best developed in inter-dune valleys. The windward slopes of the dunes are covered by floristically similar vegetation called "dune thicket" that is typical of low-stature - pruned by steady on-shore winds and salt spray carried inland by the winds.

The Eastern Cape Dune Forests are found at altitudes from 5 - 70 m a.s.l., reflecting the height of the dunes - the tallest dunes in the region are those at Eastern Beach near East London and reach 70 m.

Geology & Soil

Eastern Cape Dune Forests are established on aeolian dunes of Late Tertiary age, some 20 Myrs ago (Rust 1988, Burns & Raal 1993). The dunes are resting on aeolinite and other sedimentary rocks of fluvial origin. The occurrence of reddish-brown sands in some of the older fixed dunes have been associated with weathered dolerite (Burns 1986).

Most of the dune soils (arenosols) found under these forests are classified as Fernwood form (Macvicar et al. 1977). Duplex soils (Oakleaf form) have developed in some of the older dune valleys. These dune sands are calcareous (60-95 % quartz, with the balance consisting of calcite, derived from shell material).

Pedogenesis on the dunes is linked to vegetation succession processes. The soil-formation processes are initiated once they have been partially fixed by vegetation. Deep rooted woody species are capable of

recycling part of the lower profile accumulation of nutrients and return this through litter fall to the humic surface (Burns 1986).

Climate

Schulze (1965) describes the climate as temperate to warm and humid with a summer rainy season. Heydoorn & Tinley (1980) describe the climate as subtropical, with a bimodal summer rainfall pattern.

In summer, strong winds are from the ENE. In winter the pattern is reversed with winds from the W and WSW with a frequency of 37.8% (Burns 1986). The month of August through October are the windiest while the calmest period is from January to March.

Seaward slopes have a more moderate climate than landward slopes due to their aspect and proximity to the ameliorating effect of the sea. Landward slopes are both hotter during the day and colder at night. Within the dune communities it is suggested that temperature contributes indirectly towards the establishment of the floristic gradients on the dune profiles (references).

Disturbance

Dune forests are sensitive to many forms of disturbance, but appear to be reasonably well adapted to fire. Recovery is slow, however, mainly due to low nutrient levels (such as phosphorus) in the dune substrate (Tinley 1985, Burns 1986, Burns & Raal 1993).

Secondary succession after fire produces communities resembling those of the original forest. Repeated fires could result in forest recession and nutrient deficiency in the soil resulting in leaching and low recovery potential (Burns 1986)

Biogeographic Affinities

Eastern Cape Dune Forests show floristic similarities to KwaZulu-Natal Dune Forests with the occurrence of *Sideroxylon inerme*, *Mimusops caffra* and *Dovyalis rotundifolia* (here reaching the western limit of their distribution) as canopy dominants. The central functional and structural position of *Sideroxylon inerme* links this forest type to Western Cape Milkwood Forests. A number of species of subtropical provenance (see below for a list) reach their western limit of distribution in Eastern Cape Dune Forests.

Burns & Raal (1993) ascribe the occurrence of yellowwoods and other Afrotropical elements in this type of forest to a riverine migration link connecting the coast and mountains.

Communities/Subunits

Cassine aethiopica-Apodytes dimidiata Landward Community	Burns (1986)
Diospyros natalensis-Sideroxylon inerme Valley Community	Burns (1986)
Mimusops caffra-Maytenus heterophylla Landward Forest Community	Burns (1986)
Mimusops caffra-Schotia afra Landward Community	Burns (1986)
Sideroxylon inerme-Diospyros natalensis Valley Forest	Burns (1986)
Sideroxylon inerme-Mimusops caffra Landward Community	Burns (1986)
Sideroxylon inerme-Schotia latifolia Valley Forest	Burns (1986)

Dominant & Diagnostic Plant Species

L	S	D	Latin Name	Note
Tc	d		<i>Dovyalis rotundifolia</i>	W limit
Tc	d		<i>Mimusops caffra</i>	W limit
Tc	d		<i>Sideroxylon inerme</i> subsp. <i>inerme</i>	
Tc			<i>Erythrina caffra</i>	
Tc			<i>Euclea racemosa</i>	

Tc		<i>Schotia latifolia</i>	
Tcu	d	<i>Allophylus natalensis</i>	
Tcu	d	<i>Diospyros natalensis</i>	
Tcu		<i>Chionanthus foveolatus</i> subsp. <i>foveolatus</i>	
Tcu		<i>Cussonia spicata</i>	
Tcu		<i>Podocarpus falcatus</i>	Afrotemperate element
Tcu		<i>Podocarpus latifolius</i>	Afrotemperate element
Tcu		<i>Pterocelastrus tricuspidatus</i>	
Tcu		<i>Zanthoxylum capense</i>	Afrotemperate element
Tu	d	<i>Cassine aethiopica</i>	
Tu	d	<i>Euclea natalensis</i>	
Tu		<i>Chionanthus peglerae</i>	
Tu		<i>Cordia caffra</i>	
Tu		<i>Elaeodendron croceum</i>	
Tu		<i>Harphephyllum caffrum</i>	
Tu		<i>Olea capensis</i> subsp. <i>macrocarpa</i>	
Tu		<i>Protorhus longifolia</i>	W limit
Tmon		<i>Strelitzia nicolai</i>	W limit
Tp		<i>Phoenix reclinata</i>	W limit
TuSt		<i>Ficus burtt-davyi</i>	
ST	d	<i>Acokanthera oblongifolia</i>	
ST	d	<i>Brachylaena discolor</i> var. <i>discolor</i>	
ST	d	<i>Deinbollia oblongifolia</i>	
ST	d	<i>Gymnosporia buxifolia</i>	
ST		<i>Chaetacme aristata</i>	W limit
ST		<i>Dovyalis lucida</i>	W limit
ST		<i>Dovyalis rhamnoides</i>	
ST		<i>Eugenia capensis</i>	
ST		<i>Gymnosporia procumbens</i>	
ST		<i>Maerua caffra</i>	
ST		<i>Psychotria capensis</i>	Afrotemperate element
ST		<i>Psydrax obovata</i> subsp. <i>obovata</i>	
ST		<i>Rhus natalensis</i>	
ST		<i>Scolopia zeyheri</i>	
ST		<i>Tarchonanthus camphoratus</i>	
ST		<i>Teclea natalensis</i>	W limit
ST		<i>Turraea obtusifolia</i>	W limit
S		<i>Carissa bispinosa</i> subsp. <i>bispinosa</i>	
S		<i>Rhus glauca</i>	
Smon		<i>Dracaena alectrififormis</i>	W limit
SCw		<i>Behnia reticulata</i>	
SCw		<i>Capparis sepiaria</i>	
Cw		<i>Dioscorea mundii</i>	
Ssoft	d	<i>Isoglossa woodii</i>	
Ssoft		<i>Hypoestes aristata</i>	
Hsc		<i>Asparagus africanus</i>	
Hsc		<i>Pupalia lappacea</i>	
G		<i>Panicum aequinerve</i>	
G		<i>Panicum deustum</i>	

Typical & Endemic Animal Species

Table. Forest dependent bird, mammal, frog and reptile species in the Eastern Cape Dune Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Buffspotted flufftail	<i>Sarothrura elegans</i>	C	Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Tambourine dove	<i>Turtur tympanistria</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Knysna lourie	<i>Tauraco corythaix</i>	C	Birds	EC, KZN, MP, NP
Emerald cuckoo	<i>Chrysococcyx cupreus</i>	Cm	Birds	LP, Mpu, KZN, EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape
Trumpeter hornbill	<i>Bycanistes bucinator</i>	Cl	Birds	LP, Mpu, KZN, EC
Scalythroated honey guide	<i>Indicator variegatus</i>	Cf	Birds	e. Mp, coastal EC & KZN
Knysna woodpecker	<i>Campethera notata</i>	U	Birds	Coastal WC, EC & s.KZN
Olive woodpecker	<i>Mesopicos griseocephalus</i>	Cf	Birds	Widespread
Grey cuckooshrike	<i>Coracina caesia</i>	U	Birds	Widespread
Squaretailed drongo	<i>Dicrurus ludwiggii</i>	C	Birds	Mp, coastal EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Yellowstreaked bulbul	<i>Phyllastrephus flavostriatus</i>	Cf	Birds	Ngoye forest north to e.Mp
Spotted thrush	<i>Zoothera guttata</i>	Cl	Birds	Coastal EC & KZN
Chorister robin	<i>Cossypha dichroa</i>	Cl	Birds	LP, Mp, KZN, EC
Starred robin	<i>Pogonocichla stellata</i>	Cl	Birds	LP, Mp, KZN, EC
Brown robin	<i>Erythropygia signata</i>	Cl	Birds	e. Mp, coastal EC & KZN
Knysna warbler	<i>Bradypterus sylvaticus</i>	R	Birds	Coastal WC, EC & s. KZN
Yellowthroated warbler	<i>Seicercus ruficapillus</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Barthroated apalis	<i>Apalis thoracica</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>	Cl	Birds	LP, Mp, KZN, EC, S.Cape
Blackbellied glossy starling	<i>Lamprotornis corruscus</i>	C	Birds	e. Mp, coastal EC & KZN
Olive sunbird	<i>Nectarinia olivacea</i>	C	Birds	EC, KZN
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Forest weaver	<i>Ploceus bicolor</i>	Cl	Birds	Coastal EC & KZN
Green twinspot	<i>Mandingoa nitidula</i>	Cl	Birds	LP, Mp, KZN, EC
Forest canary	<i>Serinus scotops</i>	Cl	Birds	LP, Mp, KZN, EC
Dark-footed forest shrew	<i>Myosorex cafer</i>		Mammals	LP, Mp, KZN, EC
Samango monkey	<i>Cercopithecus mitis</i>		Mammals	LP, KZN, EC
Giant golden mole	<i>Chrysopalax trevelyani</i>		Mammals	EC
Blue duiker	<i>Philantomba monticola</i>		Mammals	EC, KZN
Plaintive rain frog	<i>Breviceps verrucosus</i>		Frogs	KZN, EC
Bush squeaker	<i>Arthroleptis wahlbergi</i>		Frogs	KZN, EC
Clicking stream frog	<i>Strongylopus grayii</i>		Frogs	Widespread

Conservation & Management

Use & Value

Use of this forest type has not been great (Burns 1986), although its unique position along the coast offers considerable recreational and tourism potential.

The major value of these forests lies in their stabilisation function of coastal dunes.

Conservation Status

Because the frontal dune cordons along the Eastern Cape coast fall largely on state-owned land, they are relatively well-preserved by Eastern Cape Nature Conservation authorities. A number of nature reserves protect patches of this forest type (Cape Henderson N.R., Gudu N.R., Joan Muirhead N.R., Kwelera N.R., Woody Cape N.R.).

Main Threats

- ⇒ Coastal recreational development: This is currently the major threat to this forest type;
- ⇒ Coastal (dune) mining of valuable heavy minerals (metals): Mining by Cape Morgan Titanium Mines (Pty) Limited between 1969 and 1972 resulted in disturbance of 35 ha of forest due to damage from secondary causes (accidental fire);
- ⇒ Accidental fires: Although the regeneration of this type of forest after fire is good, fires might pose a threat to the structure of the forest and to recruitment of some vulnerable species; soil development might be hindered after fires as well (see above);
- ⇒ Encroachment of alien woody species such as *Sesbania punicea*, *Pereskia aculeata*, *Acacia cyclops*, *Casuarina equisetifolia*, *Ricinus communis*, *Psidium guava*, *Lantana camara*, *Cestrum laevigatum* and herbaceous *Cirsium vulgare* (in disturbed habitats); *Acacia cyclops* is one of the major eradication targets on dunes by the Working for Water programme.

Other Management Considerations

- ⇒ Drift sand stabilization (see Burns 1986, Avis 1995);
- ⇒ Off-road driving: Despite the general ban of road vehicles from beaches (effective from January 1, 2002) this is still an issue of concern

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VII2: Albany Coastal Forests

Synonyms

Alexandria Forest	Acocks (1988)
Alexandria Forest	Phillipson & Russell (1988)
Coastal Forest p.p.	Low & Rebelo (1998)
Warm Temperate Forest Sub-Formation	Martin & Noel (1960)
Low Forest and Bush	Dyer (1937)

Profile

Dense, short-statured forest, with canopy height varying from approximately 5 to 15 m on deep sands overlaying the Nanaga and Alexandria Formations in the Port Elizabeth region (Maitland River to Kei River mouths). The presence of canopy emergents *Erythrina cafra* and *Podocarpus falcatus* and the abundance of lianas, spinescent shrubs such as *Scutia myrtina* and *Capparis sepiaria*, and of herbs (notably of the family Acanthaceae and *Solanum geniculatum*) are also characteristic. The undergrowth can form an impenetrable mass of vegetation, especially where the canopy is less than 5 m high. The forest is mostly surrounded by pasture, almost all of which is transformed Albany Forests.

Distribution

The main forest stretched from Maitlands River mouth (east of Port Elizabeth) in the west to the regions near Kei River mouth in the east. The massive dune fields on the coast, and a band of dune forest between the dunes and the Alexandria Forest, ensures that this forest is always a few km from the coastline. The forest thus forms a narrow band about 50 km long and about 6 km wide, but mostly thinner than this, just inland of the coastal dunes. This forest also used to occur on the hills in and around Bathurst. It occurs from sea level to an altitude of 900 m, though most is at low altitude. In the deep river valleys of the Bushmans, Kariega and Kowie Rivers, on the south slopes where the soil is deeper, or on alluvial soils in the valley bottom, small patches of forest are embedded in the surrounding thicket vegetation.

Known Forests

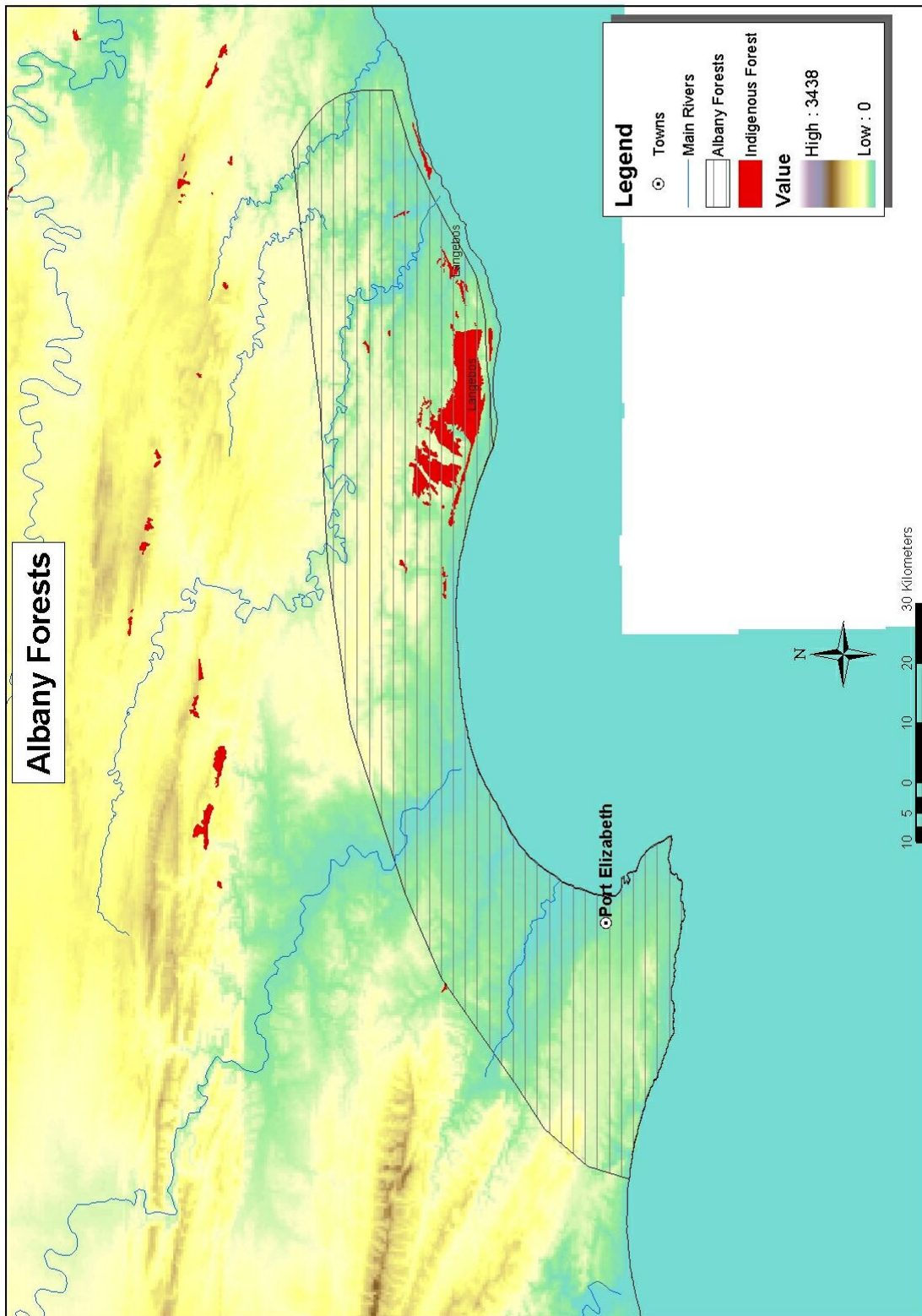
Coastal Subtype

Alexandria Forest
Island Forest
Maitlands River mouth

Inland Subtype

Blaauwkrans Gorge
Bushmans River valley (complex)
Fernkloof (by Grahamstown)
Groendael (by Uitenhage)
Kariega River valley (complex)
Peddlar's Bush (by Grahamstown)
Thomas Baines Nat. Res. (complex)
Waters Meeting Nat. Res. (complex)
Welcome Wood
Zuurberg (complex)

Map



Structure & Texture

Stand Structure

Primarily a short (10 m canopy) dense forest, but in some places in the wetter valley floors it can reach 15-20 m tall. On shallower soils on the drier hilltops and towards the coast the canopy is only 5 m tall. Canopy emergents may reach 30 m in the best-developed forest, which usually occurs in the valley bottoms where sandy soils are deeper and water supplies perennial. Inland, the undergrowth can be dense and impenetrable, while in more seaward forests there is little or no undergrowth. Where it is best developed there are three strata, a tangled understorey of creepers, shrubs (often spinescent), and herbs, a canopy of trees and canopy emergents. The high abundance of lianas in Alexandria Forest is a result of the low stature of the forest, which provides more entry points for lianas into their host canopy trees.

Life Forms

Most of the species are evergreen, but semi-deciduous or facultative deciduous trees are also common (e.g. *Celtis africana*, *Vepris undulata*, *Erythrina cafra*). Ferns, hygrophytes and epiphytes are scarce, while lianas and spinescent shrubs are more common than in many other forest types. Many species are 'pioneer type \hat{O} species' and are often also associated with thicket vegetation. The canopy emergents in Alexandria Forest are classic examples of this and probably regenerate best on the outskirts of the forest, rather than under the canopy.

Ecology

Altitude & Geomorphology

Coastal areas with higher rainfall than surrounding areas, on rolling hills of the Nanaga and Alexandria Formations. Embedded within the Albany Thicket Biome. The altitude of the Alexandria Forest ranges from 100 to 350 m above sea level.

Geology & Soils

Alexandria abuts on huge dune fields but occurs mostly on Nanaga and Alexandria Formations, which provide a nutrient rich, deep and well-drained sandy soil. Dune sand overtops this geology in some places, providing a deeper, well-drained, sandy soil overlying the limestone base. Where the Alexandria Formation is exposed, the soils may be shallower and richer in calcium, and a more stunted forest may be found. It is possible that the valley bottoms provide a permanent water supply in the form of underground water, but the deep sandy soils that are derived from the near by dunes ensure that drainage is good and anoxic conditions never come close to the surface.

Climate

The maritime influence on climate is important, the rainfall is non-seasonal, and heavy rain can occur at any time of the year, ranging from 700 to 900 mm year⁻¹. The climate is essentially sub-tropical, but is tempered by the coastal influence.

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	440	8	26	17
Maximum	800	9	27	18

Disturbance

While the Alexandria Forest was apparently fire protected, its outer limits graded into savanna or grassland and it is probable that herbivores moved in and out of the forest to escape the fires in the surrounding habitat. Along with increased herbivore pressure during drier periods when game would have converged

around the forest, this may have reduced fuel loads on the outskirts of the forest, thereby keeping fire intensities down and reducing the chance of fire penetrating and burning the forest. Browsing of the abundant spinescent bushy species may also have formed a skirt of fire resistant thicket clumps in a mosaic with grassy fynbos, grassland or savanna vegetation. Gaps created from old and dying trees is thus important for forest regeneration in Alexandria. Disturbance from herbivores ranging from Bush Pig to Elephants (now extinct), would also have been important for opening up the dense undergrowth to allow certain species to regenerate in the gaps.

Biogeographic Affinities

Transkei Coastal Scarp Forest (II3) and Eastern Cape Dune Forest (III3). Also some similarity with the Southern Cape Afrotemperate Forest (I8) and the Amatole Mistbelt Forest (I6). It borders on Eastern Cape Dune Forest at its coastal extremities (for instance on Woody Cape).

Dominant & Diagnostic Plant Species

Note: Endemics exclusive to this forest type are indicated by *. Species also occurs in named forest types.

L	S	D	Latin Name	Note
Tc	d		<i>Celtis africana</i>	
Tc	d		<i>Erythrina caffra</i>	
Tc	d		<i>Nuxia congesta</i>	
Tc	d		<i>Podocarpus falcatus</i>	
Tc	d		<i>Rhus chirindensis</i>	
Tc	d		<i>Sideroxylon inerme</i>	
Tc	d		<i>Vepris lanceolata</i>	
Tc			<i>Calodendrum capense</i>	
Tc			<i>Podocarpus latifolius</i>	
Tcu		D	<i>Aloe speciosa</i>	
Tcyc		D	<i>Encephalartos altensteinii</i>	endemic to E. Cape
Tcyc		C	<i>Encephalartos latifrons</i>	endemic to Alexandria Forest*
Te			<i>Cussonia spicata</i>	W limit (Groendael)
Tsuc		D	<i>Euphorbia grandidens</i>	
Tsuc		D	<i>Euphorbia triangularis</i>	
Tu	d		<i>Maytenus undata</i>	
Tu	d		<i>Schotia latifolia</i>	
Tu			<i>Brachylaena glabra</i>	Pondoland Scarp
Tu			<i>Buxus macowanii</i>	
Tu		C	<i>Atalaya capensis</i>	endemic to E. Cape*
Tu			<i>Ptaeroxylon obliquum</i>	W limit (Groendael)
Tu			<i>Zanthoxylum capense</i>	
ST			<i>Brachylaena ilicifolia</i>	Eastern Scarp
ST		C	<i>Smelophyllum capense</i>	endemic to E. Cape*
ST		C	<i>Sterculia rogersii</i>	endemic to E. Cape*
ST	d		<i>Gymnosporia buxifolia</i>	
ST			<i>Dovyalis rhamnoides</i>	
ST			<i>Eugenia capensis</i>	
ST			<i>Eugenia zeyheri</i>	
S	d		<i>Hyperacanthus amoenus</i>	W limit
S	d		<i>Trichocladus ellipticus</i>	
S			<i>Carissa bispinosa</i>	
S		D	<i>Azima tetracantha</i>	
S		D	<i>Cordia caffra</i>	
S		D	<i>Nylandtia spinosa</i>	
S		D	<i>Phyllanthus heterophyllus</i>	
S		D	<i>Plumbago auriculata</i>	
S			<i>Gardenia thunbergia</i>	
S	d		<i>Strychnos decussata</i>	

SCw		D	<i>Tecomaria capensis</i>
SCw			<i>Scutia myrtina</i>
Smon	d		<i>Dracaena alectrifomis</i>
Ssoft	d	C	<i>Euphorbia kraussiana</i>
Ssuc		D	<i>Aloe ciliata</i>
Ssuc		D	<i>Cotyledon velutina</i>
Ssuc		D	<i>Crassula nemorosa</i>
Cw	d		<i>Behnia reclinata</i>
Cw	d		<i>Rhoicissus tomentosa</i>
Cw			<i>Asparagus asparagoides</i>
Cw			<i>Capparis sepiaria</i>
Cw			<i>Rhoicissus digitata</i>
Cw			<i>Secamone alpini</i>
TuSt	d		<i>Ficus thonningii</i>
G	d		<i>Cyperus albostratus</i>
G	d		<i>Ehrharta erecta</i>
Gcr	d		<i>Oplismenus hirtellus</i>
H	d		<i>Laportea grossa</i>
H			<i>Galopina circaeoides</i>
H			<i>Justicia petiolaris</i>
H			<i>Streptocarpus rexii</i>
Hcr	d		<i>Achyranthes aspera</i>
Hf			<i>Rumohra adiantifolia</i>
Hg	d	D	<i>Sansevieria hyacinthoides</i>
Hg		D	<i>Chlorophytum comosum</i>
Hg			<i>Dietes iridioides</i>
Hg			<i>Haemanthus albiflos</i>
Hg			<i>Scadoxus puniceus</i>
H/Eh			<i>Peperomia tetraphylla</i>
Eo			<i>Angraecum pusillum</i>

Typical & Endemic Animals

Table. Forest dependent bird, mammal, frog and reptile species in the Albany Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC to Knysna
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Tambourine dove	<i>Turtur tympanistris</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Knysna lourie	<i>Tauraco corythaix</i>	C	Birds	EC, KZN, MP, NP
Emerald cuckoo	<i>Chrysococcyx cupreus</i>	Cm	Birds	LP, Mpu, KZN, EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape
Trumpeter hornbill	<i>Bycanistes bucinator</i>	Cl	Birds	LP, Mpu, KZN, EC
Scalythroated honey guide	<i>Indicator variegatus</i>	Cf	Birds	e. Mp, coastal EC & KZN
Knysna woodpecker	<i>Campethera notata</i>	U	Birds	Coastal WC, EC & s.KZN
Olive woodpecker	<i>Mesopicos griseocephalus</i>	Cf	Birds	Widespread
Grey cuckooshrike	<i>Coracina caesia</i>	U	Birds	Widespread
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Chorister robin	<i>Cossypha dichroa</i>	Cl	Birds	LP, Mp, KZN, EC

Common name	Scientific name	Status	Taxon	Distribution
Starred robin	<i>Pogonocichla stellata</i>	CI	Birds	LP, Mp, KZN, EC
Brown robin	<i>Erythropygia signata</i>	CI	Birds	e. Mp, coastal EC & KZN
Knysna warbler	<i>Bradypterus sylvaticus</i>	R	Birds	Coastal WC, EC & s. KZN
Yellowthroated warbler	<i>Seicercus ruficapillus</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Barthroated apalis	<i>Apalis thoracica</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Cape batis	<i>Batis capensis</i>	C	Birds	LP, Mp, KZN, EC, S.Cape
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>	CI	Birds	LP, Mp, KZN, EC, S.Cape
Blackbellied glossy starling	<i>Lamprotornis corruscus</i>	C	Birds	e. Mp, coastal EC & KZN
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Forest weaver	<i>Ploceus bicolor</i>	CI	Birds	Coastal EC & KZN
Forest canary	<i>Serinus scotops</i>	CI	Birds	LP, Mp, KZN, EC
Plaintive rain frog	<i>Breviceps verrucosus</i>		Frogs	KZN, EC
Clicking stream frog	<i>Strongylopus grayii</i>		Frogs	Widespread
Samango monkey	<i>Cercopithecus mitis</i>		Mammal	LP, KZN, EC
Blue duiker	<i>Philantomba monticola</i>		Mammal	KZN, EC

Conservation & Management

Use & Value

Biodiversity and ecosystem value is high. Socio-economic importance is also high. Most of the forest resources on private land have already been used up and converted into pastures for grazing.

Conservation Status

The largest patch of the Albany Forests is protected in the Alexandria Conservation Area. Small patches are Waters Meeting, Thomas Baines, and Peddlar's Bush. The rest of the area is largely unprotected. It is estimated that there is about 11 000 ha of Albany forest, but this is possibly an under-estimate since some large patches are missing from the map. The amount protected ranges from 13% to 17% for the NLC and forest biome maps respectively and non of this is on DWAF land.

Main Threats

- ⇒ Outside protected areas it is threatened by cattle ranching, wild fires and fuelwood collection
- ⇒ Inside protected areas it is threatened by wild fires and absence of adequate herbivore disturbance for forest regeneration.

Other Management Considerations

- ⇒ Uncontrolled fires are more of a threat to this forest type now than previously because of the changing land use on the forest margins. Cattle pastures have effectively reduced the chance of fires penetrating into the forest, if these lands are restored by conservation efforts, the chance of wild fires will increase.

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VII3: Western Cape Milkwood Forests

Synonyms

Coastal Forest

Knight (1989)

Profile

Small patches of forest in sheltered localities along or near the coast between Mossel Bay (or Knysna) and the Cape Peninsula, mainly on Aeolian sand. The forests are generally species-poor, and often dominated by one or a few canopy tree species.

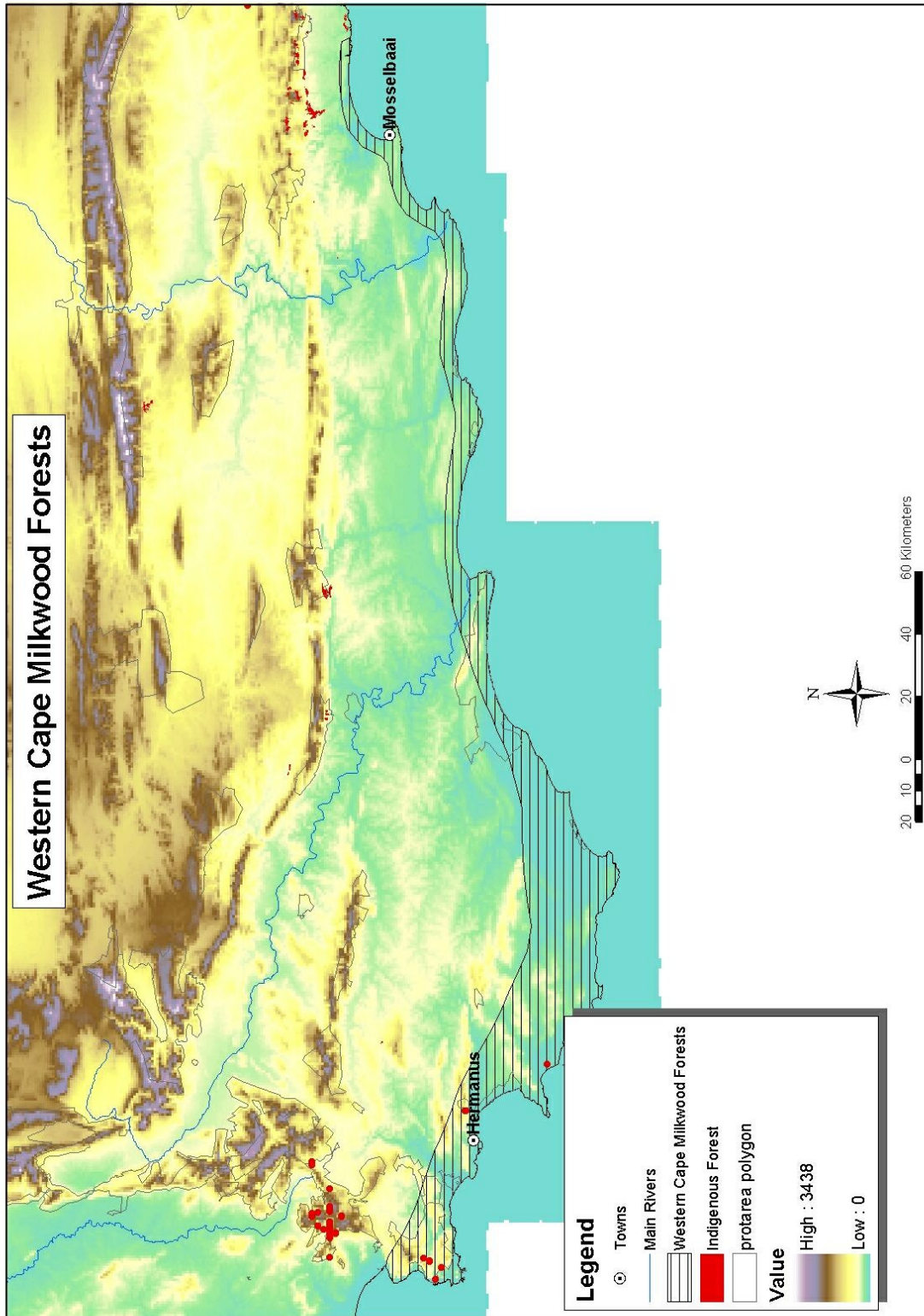
Distribution

Western Cape Province, near the coast from the Groenvlei forest (Goukamma Nature Reserve), the Standford-Hermanus area, to parts on the eastern and western side of the Cape Peninsula.

Known Forests

Betty's Bay
 Botes
 Danger Point
 Dawidskraal
 De Hoop
 Duiwhok
 Goukamma (Sedgefield)
 Groenvlei (Sedgefield)
 Groot Hagelkraal
 Grootbos (stanford)
 Grotto (Hermanus)
 Harmony
 Keurbooms
 Kloof (Bredasdorp)
 Noordhoek (Cape Town)
 Poort (Bredasdorp)
 Puntje
 Stilbaai
 Voeklip
 Wildevoelvrei

Map



Vegetation Structure & Texture

Stand Structure

Generally low forest with trees with large stems and widely spreading crowns. The stands are often dominated by *Sideroxylon inerme*, and/or *Celtis africana* and/or *Apodytes dimidiata*. The understorey is either open or a shrub layer with diverse species, including soft shrubs of the *Acanthaceae*.

Diversity Patterns

Floristically impoverished but have dominant subtropical elements.

Ecology

Altitude & Geomorphology

A low altitude forest type.

Geology & Soils

Limestone and Aeolian sand substrate

Their distribution is related to the ability to tolerate Aeolian sand with high sodium content and strong winds from the sea.

Climate

This forest occurs in a winter rainfall region. Temperature is moderated by the coastal influence. A lack of distribution data prevents the creation of a temperature profile.

Disturbance

The Western Cape Coastal forests have largely been destroyed by coastal developments because the wide spreading crowns provide shelter for camping and picnic near the coast.

Biogeographic Affinities

Marginally related to the forests of Alexandria and The Island

Dominant & Diagnostic Plant Species

L	S	D	Latin Name	Note
Tc	d		<i>Celtis africana</i>	
Tc	d		<i>Sideroxylon inerme</i>	
Tc			<i>Olinia ventosa</i>	
Tu	d		<i>Euclea racemosa</i>	
Tu			<i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	
Tu			<i>Canthium mundianum</i>	
Tu			<i>Kiggelaria africana</i>	
Tu			<i>Olea capensis</i> subsp. <i>capensis</i>	
Tu			<i>Olea europaea</i> subsp. <i>africana</i>	
ST			<i>Chionanthus foveolatus</i> subsp. <i>foveolatus</i>	

ST			<i>Myrsine africana</i>	
ST			<i>Tarchonanthus camphoratus</i>	
S	d		<i>Carissa bispinosa</i>	
S			<i>Gymnosporia buxifolia</i>	
S		D	<i>Metalasia muricata</i>	
S		D	<i>Rhus lucida</i> var. <i>lucida</i>	
SCw			<i>Cassine tetragona</i>	
SCw		D	<i>Cissampelos capensis</i>	
SCw			<i>Solanum africanum</i>	
Cw			<i>Asparagus aethiopicus</i>	
Cw			<i>Cynanchum obtusifolium</i>	
Ch		D	<i>Cysticapnos cracca</i>	endemic to Capensis
Ch			<i>Kedrostis nana</i>	
H	d	D	<i>Droguetia iners</i> subsp. <i>burchellii</i>	
H		D	<i>Nemesia affinis</i>	
Hg	d	D	<i>Oxalis pes-caprae</i>	
Hg		D	<i>Malasphaerula ramosa</i>	
Hg		D	<i>Zantedeschia aethiopica</i>	
G			<i>Ehrharta erecta</i>	

Typical & Endemic Animals

No data available

Conservation & Management

Use & Value

Low species richness, but important for the shelter it provides for lodge and campsite developments

Conservation Status

There is insufficient distribution data to calculate area or conservation status.

Main Threats

⇒ Coastal urban and resort development

Other Management Considerations

⇒ Special requirements are needed for development in or near these forests.

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A1: Lowveld Riverine Forests

Synonyms

Deciduous Orthophyll Tall Savanna	de Moor et al. (1977)
Fringing Forest	Moll & White (1978)
Riverine Forest	Cooper (1985)
Riverine Forest	MacDevette et al. (1989)

Profile

The Lowveld Riverine Forests are tall, gallery forests fringing stretches of major rivers of the low altitude subtropical areas of the Savanna Biome. They occur on nutrient-laden sediments brought by summer floods. *Ficus sycomorus*, *Diospyros mespiliformis*, *Breonadia salicina*, *Faidherbia albida* and *Kigelia africana* are characteristic tree dominants of these gallery forests. The river valleys of the lower slopes of the Mpumalanga and Northeastern Escarpment and facing Lowveld also support riparian forests (interpreted here as a subtype of the Lowveld Riverine Forest). *Syzygium cordatum* and *Anthocleista grandiflora* are important tree elements in such forests.

Distribution

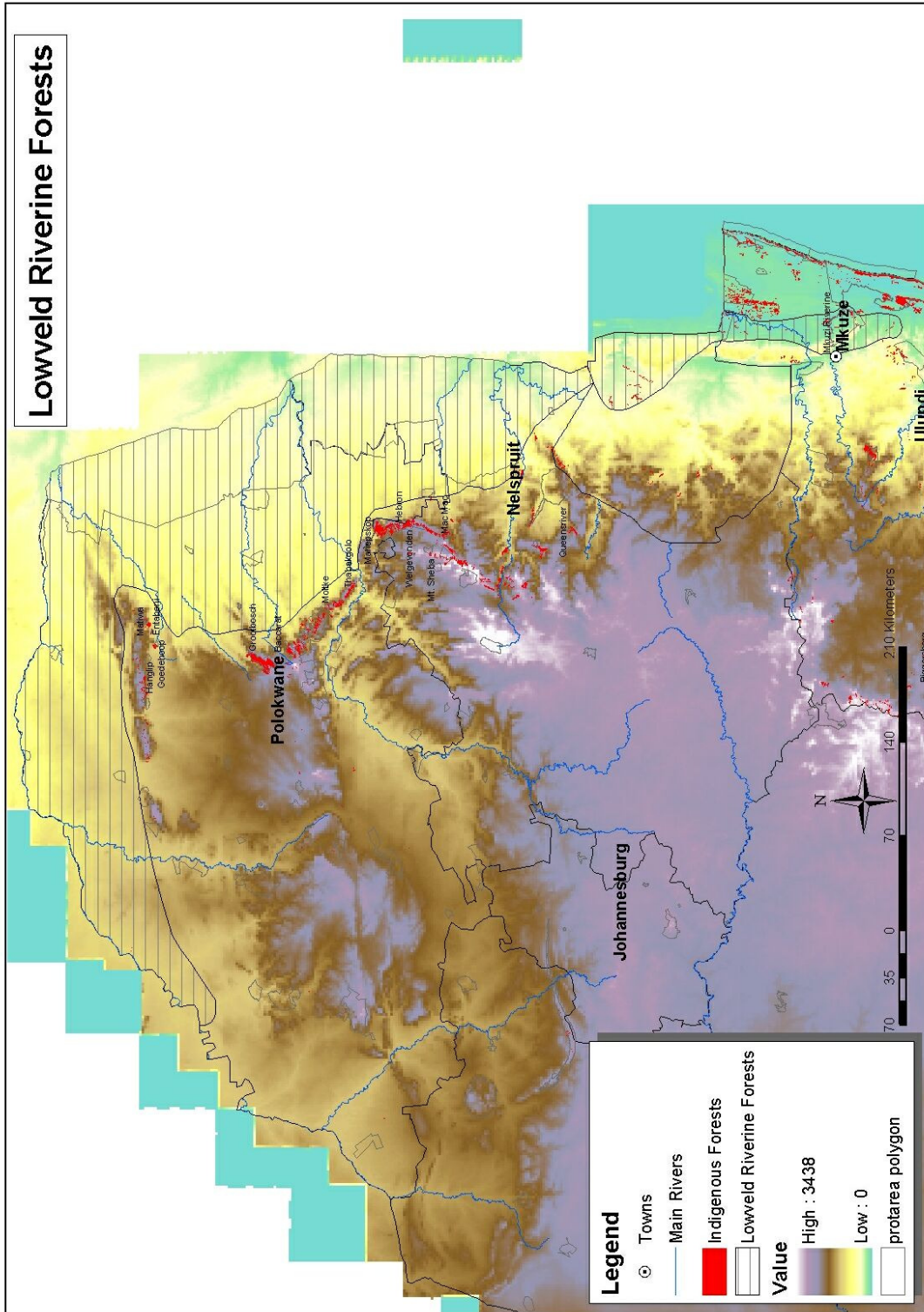
This typically hydro-pedologic azonal forest occurs imbedded within the Lowveld areas of the Savanna Biome, where it is found on alluvia of rivers (from the Limpopo River in the north to the Amatigulu River in Zululand in the south). The largest and best-developed patches are found in Maputaland (De Moor et al. 1977, Moll 1978, Moll & White 1978, Furness & Breen 1980) and in the Mpumalanga and Limpopo Lowveld (Van der Schiff 1957, Van Rooyen et al. 1981, Gertenbach 1983, Bredenkamp 1987, Bredenkamp & Deutschländer 1995). Impoverished, albeit floristically interesting, riparian forests still classified within this Forest Type occur on low slopes and at the foot of the Northern Escarpment bordering the Lowveld in Mpumalanga and Limpopo Province (Scheepers 1978, Deall et al. 1989). Lowveld Riverine Forests are also present in neighbouring Swaziland (Gertenbach & Potgieter 1978).

At low altitudes, in close proximity to river mouths, some rivers discharging into the Indian Ocean between Durban and Port Edward carry riparian forests, usually those dominated by *Syzygium cordatum*. Due to lack of data these forests cannot be classified satisfactorily at this stage. However, ecological and floristic features are present (L. Mucina, unpubl.) which places them in our classification system as similar to the Lowveld Riverine Forests..

Known Forests

Amatigulu Nature Reserve (Zululand)	Mkhuze River (Fig Forest)
Crocodile River (Kruger N.P. and outside the Park)	Olifants River (Kruger N.P.)
Hlane Wildlife Sanctuary (Swaziland)	Pongolo River
Hluhluwe River	Sabie River (Kruger N.P.)
Ingwavuma River Gorge (Maputaland)	Shindwedzi (Kruger N.P.)
Letaba (Kruger N.P.)	Timbavati (Kruger N.P.)
Limpopo River	Umfoloji River
Luvubu River (N Kruger N.P.)	Usutu River (Maputaland)
Manyeleti Game Reserve	Westfalia Estates (Limpopo Prov.)

Map



Vegetation Structure & Texture

Stand Structure

The Lowveld Riverine Forests are usually tall (up to 20 m), almost closed forests forming narrow belts along water courses. They are also called gallery forest. *Ficus sycomorus* (with huge, well-butressed individuals), *Diospyros mespiliformis*, *Breonadia salicina*, *Faidherbia albida*, and *Kigelia africana* are characteristic tree dominants of this forest. The woody undergrowth is often well developed and in places dense understorey thickets can be formed, up to 3 m tall (Van Rooyen et al. 1981).

Diversity Patterns

There are no published data specifically devoted to species richness and species turnover patterns in these forests.

Ecology

Altitude & Geomorphology

The Typical Lowveld Riverine Forests (a subtype of Lowveld Riverine Forests) occur in narrow alluvia and sometimes on steep banks of rivers at altitudes spanning 200-400 m (e.g. Van Rooyen et al. 1981: 197-215 m). An altitudinal belt between 400-800 m, directly adjacent to the Lowveld, supports another subtype - the Northern Escarpment Riverine Forests (Scheppers 1978, Schmidt et al. 2002, M. Lotter pers. comm.).

Geology, Soil & Hydrology

In northern Kruger N.P. a *Ficus sycomorus* dominated riverine community occurs on alluvial fine-textured, dark (red-brown to brown-black) sandy-loamy to clayey soils, more than 1 m deep, having weakly blocky structure on the surface. The pH of the soils was measured between 7.2-7.6 (hence neutral) with only moderate concentration of soluble salts (Van Rooyen 1978, Van Rooyen et al. 1981).

Bredenkamp (1987) and Bredenkamp & Deutschländer (1995) studied these forests on granitic soils in the Manyeleti Game Reserve and found the Lowveld Riparian Forests (dominated by *Diospyros mespiliformis* and *Acacia robusta*) to grow either on soils of Escourt and Arcadia forms, having high content of sodium, magnesium and calcium (alliance of *Eucleo natalensis-Diospyrion mespiliformis*), or on soils of Dundee form – of apedal consistency and high eluviation - hence low base status (the *Mayteno-Diospyrion mespiliformis*).

Gertenbach & Potgieter (1978) observed that in Swaziland the riverine vegetation on basaltic and shale substrates shows differences – being more open on basaltic soils.

Generally heavy, clay alluvial soils, subjected to periodic flooding and waterlogging, hence the constituent plants of these forest have to cope with temporary anoxia. Soils may also dry out at times, which results in mechanical stress (shrinking/swelling action of clay) on roots.

The Sabie River (Kruger National Park) was the subject of a number of studies devoted to questions the role of environmental (soil, hydrology) gradients and geomorphic patch hierarchies in structuring the riparian (incl. forest) vegetation (Van Coller 1993, Van Coller et al. 1997, 2000).

Disturbance

The Lowveld Riverine Forests are a disturbance driven system, undergoing periodic flooding and occasional catastrophic flood surges associated with monsoonal rains hitting the Lowveld. In 1984 Cyclone Demoina devastated many patches of tall-grown riparian fig forest, especially in Zululand. Species favouring disturbed habitats (also outside the habitats of riverine forests) are typical of the herbaceous layer in these forests, which is attributable to floods and silt deposition (a combination of destruction and renewal) (Van der Schiff 1957). In places pressure of river-bank dwelling grazers (hippo) and herds of antelopes coming down to the river may impact this forest type.

Biogeographic Affinities

The floristically and ecologically most similar Forest Type is the Swamp Forest. These two hygrophilous forests share a number of species tolerating anaerobic or poorly oxygenated waterlogged soils (for examples see the List of Species below). A number of bushveld elements (especially those typical of heavy soils) are typically found in these forests since they all are imbedded within Savanna Biome.

This forest type occurs well beyond the borders of the Republic in all northern neighbouring countries. Further north, towards the Tropics, it is replaced by luxurious, species-rich Congolian gallery forests.

Communities/Subunits

M. Lötter (in litt.) suggested that riparian forests can be subdivided by 600 m isohypse into “High-lying Riverine Forests” and “Low-lying Riverine Forests” in Mpumalanga (both sub-types having clear subtropical character). Here we adopt this subdivision on preliminary basis and coin names A1a: Northern Escarpment Riverine Forests for the high-altitude ones) and A1b: Typical Lowveld Riparian Forests for the low-altitude ones. *Anthocleista grandiflora*, *Breonadia salicina*, *Rauvolfia caffra*, *Ficus sur*, *Bridelia micrantha*, *Heteropyxis canescens*, *Morella serrata*, *Rhus gerrardii* and *Syzygium cordatum* are typical of the Sub-Escarpment forests, while *Ficus sycomorus*, *Acacia xanthophloea*, *Croton megalobotrys*, *Phyllanthus reticulatus*, *Combretum microphyllum*, *Bridelia cathartica*, *Phoenix reclinata*, *Trichilia emetica* and *Diospyros mespiliformis* are characteristic of the Typical Lowveld Riparian Forests (M. Lötter, in litt.). It appears that this system can be applied also to Limpopo Province and that some of the forests described by Scheepers (1978) from the lower slopes of the Northern Escarpment (Westphalia Estate) belong to the Sub-Escarpment Riverine Forests as well.

A1a: Northern Escarpment Riverine Forests

<i>Syzygium cordatum</i> Gallery Forest	Scheepers (1978)
<i>Syzygium gerrardii</i> -Other Species Riverine Forest	Scheepers (1978)
<i>Schoenoplectus corymbosus</i> - <i>Syzygium cordatum</i> Tall (Riparian) Forest	Deall et al. (1989)

A1b: Typical Lowveld Riparian Forests

Deciduous Orthophyll Tall Savanna	Moor et al. (1977)
<i>Ficus sycomorus</i> - <i>Rauvolfia caffra</i> Community	Furness & Breen (1980)
<i>Acacia albida</i> - <i>Ficus sycomorus</i> Riverine Forest	Van Rooyen et al. (1981)
<i>Acacia albida</i> - <i>Ficus sycomorus</i> Riverine Forest	Gertenbach (1983)
<i>Ficus sycomorus</i> - <i>Schotia brachypetala</i> Riverine Forest	Whateley & Porter (1983)
<i>Spirostachys africana</i> - <i>Euclea schimperi</i> Riverine Forest	Whateley & Porter (1983)
<i>Spirostachys africana</i> - <i>Diospyros mespiliformis</i> Bush	Bredenkamp (1987)
<i>Schotia brachypetalae</i> - <i>Diospyretum mespiliformis</i>	Bredenkamp & Deutschländer (1995)
<i>Spirostachyo africanae</i> - <i>Phoenixetum reclinatae</i>	Bredenkamp & Deutschländer (1995)
<i>Albizia harveyi</i> - <i>Diospyretum mespiliformis</i>	Bredenkamp & Deutschländer (1995)

Dominant & Diagnostic Plant Species

Note: Species also occurs in named forest type or biome.

L	S	D	Latin Name	Note
Tc	d	C	<i>Ficus sycomorus</i>	
Tc	d	C	<i>Diospyros mespiliformis</i>	
Tc	d	C	<i>Breonadia salicina</i>	
Tc	d		<i>Faidherbia albida</i>	
Tc	d	C	<i>Kigelia africana</i>	Savanna
Tc	d		<i>Rauvolfia caffra</i>	Swamp Forest
Tc	d		<i>Schotia brachypetala</i>	Savanna
Tc	d		<i>Spirostachys africana</i>	Savanna
Tc	d		<i>Syzygium cordatum</i>	
Tc			<i>Anthocleista grandiflora</i>	
Tc			<i>Bridelia micrantha</i>	Swamp Forest
Tc			<i>Ekebergia capensis</i>	
Tc			<i>Xanthocercis zambesiaca</i>	
Tpc			<i>Phoenix reclinata</i>	Swamp Forest
Tpc			<i>Hyphaene coriacea</i>	
Tpc		C	<i>Hyphaene petersiana</i>	Limpopo valley
Tu	d		<i>Acacia robusta</i> subsp. <i>clavigera</i>	
Tu	d		<i>Lannea schweinfurthii</i>	
Tu			<i>Acacia burkei</i>	Savanna
Tu			<i>Berchemia discolor</i>	Savanna
Tu			<i>Blighia unijugata</i>	
Tu			<i>Combretum imberbe</i>	Savanna
Tu		C	<i>Heteropyxis canescens</i>	
Tu			<i>Lonchocarpus capassa</i>	Savanna
Tu			<i>Manilkara mochisia</i>	Savanna
Tu			<i>Nuxia oppositifolia</i>	Savanna
Tu			<i>Sapium ellipticum</i>	
Tu			<i>Syzygium guineense</i>	Savanna
Tu			<i>Trichilia emetica</i>	Coastal Forest
Tu			<i>Vernonia myriantha</i>	
TuSt	d		<i>Ficus thonningii</i>	
TuSt			<i>Ficus sur</i>	
ST	d		<i>Ficus capreifolia</i>	
ST	d		<i>Gymnosporia senegalensis</i>	
ST			<i>Albizia harveyi</i>	
ST			<i>Balanites pedicellaris</i>	
ST			<i>Carissa edulis</i>	
ST			<i>Combretum erythrophyllum</i>	
ST			<i>Combretum hereroense</i>	Savanna
ST		C	<i>Croton madendensis</i>	Limpopo valley
ST		C	<i>Croton megalobotrys</i>	
ST			<i>Dalbergia melanoxylon</i>	
ST			<i>Deinbollia oblongifolia</i>	
ST		C	<i>Dombeya kirkii</i>	
ST			<i>Dombeya rotundifolia</i>	
ST			<i>Elaeodendron transvaalense</i>	
ST			<i>Euclea divinorum</i>	Savanna
ST			<i>Flueggea virosa</i>	
ST			<i>Gardenia volkensii</i>	Savanna
ST			<i>Morella serrata</i>	
ST			<i>Mystroxydon aethiopicum</i>	
ST		C	<i>Oncoba spinosa</i>	
ST			<i>Phyllanthus reticulatus</i>	
ST			<i>Rhus gueinzii</i>	Savanna
ST			<i>Salvadora australis</i>	
ST			<i>Salvadora persica</i>	
ST			<i>Thespesia acutiloba</i>	
ST		C	<i>Vernonia colorata</i>	
ST			<i>Vernonia amygdalina</i>	

ST			<i>Ziziphus mucronata</i> subsp. <i>mucronata</i>	
S	d		<i>Grewia flavescens</i>	Savanna
S			<i>Abutilon angulatum</i>	
S			<i>Anisotes formosissimus</i>	
S			<i>Hibiscus calyphyllus</i>	
S			<i>Rhus gerrardii</i>	
S			<i>Rhus pyroides</i>	
SCw	d	C	<i>Acacia schweinfurthii</i> var. <i>schweinfurthii</i>	
SCw			<i>Adenopodia spicata</i>	
SCw			<i>Jasminum fluminense</i>	
Cw			<i>Secamone parvifolia</i>	
Cw		C	<i>Combretum microphyllum</i>	
Ssoft			<i>Hypoestes aristata</i>	
Ssoft			<i>Barleria elegans</i>	
Ssoft			<i>Justicia protracta</i>	
H	d		<i>Achyranthes aspera</i>	
H			<i>Ruellia patula</i>	
Hcr			<i>Aspilia mossambicensis</i>	
Hcr			<i>Commelina erecta</i>	
Hg			<i>Crinum moorei</i>	
Gt	d		<i>Phragmites mauritianus</i>	
G	d		<i>Digitaria eriantha</i>	
G	d		<i>Panicum maximum</i>	
G			<i>Cyperus fastigiatus</i>	
G			<i>Echinochloa holubii</i>	
G			<i>Echinochloa pyramidalis</i>	
G			<i>Panicum coloratum</i>	
G			<i>Setaria incrassata</i>	
G			<i>Setaria sphacelata</i>	

Typical & Endemic Animal Species

Table. Forest dependent bird, mammal, frog and reptile species in the Subtropical Riparian Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, E – endemic, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Crested guineafowl	<i>Guttera pucherani</i>	Cl	Birds	LP, e. Mp, KZN midlands, n. KZN
Buffspotted flufftail	<i>Sarothrura elegans</i>	C	Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Tambourine dove	<i>Turtur tympanistria</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Knysna lourie	<i>Tauraco corythaix</i>	C	Birds	EC, KZN, MP, NP
Emerald cuckoo	<i>Chrysococcyx cupreus</i>	Cm	Birds	LP, Mpu, KZN, EC
Green coucal	<i>Ceuthmochares aereus</i>	Cf	Birds	Coastal KZN & EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Pel's fishing owl	<i>Scotopelia peli</i>	R	Birds	n. Zululand
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape
Trumpeter hornbill	<i>Bycanistes bucinator</i>	Cl	Birds	LP, Mpu, KZN, EC
White-eared barbet	<i>Stactolaema leucotis</i>	C	Birds	Coastal Zululand
Goldenrumped tinker barbet	<i>Pogoniulus bilineatus</i>	C	Birds	e. Mp, coastal n. EC & KZN
Scalythroated honey guide	<i>Indicator variegates</i>	Cf	Birds	e. Mp, coastal EC & KZN

Common name	Scientific name	Status	Taxon	Distribution
African broadbill	<i>Smithornis capensis</i>	CI	Birds	LP, coastal KZN
Grey cuckooshrike	<i>Coracina caesia</i>	U	Birds	Widespread
Squaretailed drongo	<i>Dicrurus ludwigii</i>	C	Birds	Mp, coastal EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Yellowbellied bulbul	<i>Chlorocichla flaviventris</i>	C	Birds	Coastal n. EC & KZN
Starred robin	<i>Pogonocichla stellata</i>	CI	Birds	LP, Mp, KZN, EC
Bearded robin	<i>Erythropygia quadrivirgata</i>	Cf	Birds	n. Zululand
Woodwards' batis	<i>Batis fratrum</i>	CI	Birds	n. Zululand
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>	CI	Birds	LP, Mp, KZN, EC, S.Cape
Olive sunbird	<i>Nectarinia olivacea</i>	C	Birds	EC, KZN
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Forest weaver	<i>Ploceus bicolor</i>	CI	Birds	Coastal EC & KZN
Green twinspot	<i>Mandingoa nitidula</i>	CI	Birds	LP, Mp, KZN, EC
Four-toed elephant shrew	<i>Petrodromus tetradactylus</i>		Mammals	n. Zululand
Natal purple-glossed snake	<i>Amblyodipsas concolor</i>	E, R	Reptiles	e. Mp, KZN

Conservation & Management

Use & Value

Subtropical riverine forest is a unique habitat and has high biodiversity value. These forests provide an important food source (browse and fig trees) and serves as a heat avoidance microhabitat for savanna dwelling animals and shelter for riverine animals. Its socio-economic value is moderate because it occurs on flood plains, although the alluvial soils may be sought after for agriculture. An important ecosystem function is provided by the root system, which helps to bind soil promoting stream bank stabilisation and preventing erosion.

Conservation Status

Much of the Lowveld Riparian Forests have been destroyed by conversion into agriculture and sugar cane production (e.g. along the Umfolozi and Pongola rivers, at Umhlatuzi and at the KwaZulu-Natal coast). Most of the extant forests occur outside nature reserves - in farmlands and rural areas, where they appear to be very vulnerable to heavy exploitation. There are, however, some cultural taboos among the Zulu and Tonga peoples concerning the harvesting of riverine trees such as the Fever Tree (*Acacia xanthophloea*). Where it occurs in reserves (such as Mkhuze and Ndumu), its habitat is not the primary conservation target, but it is still protected by default under a protectionist paradigm. Management capacity varies - in State Forest areas it is at reasonable level and in the Kruger National Park it is fine.

Main Threats

- ⇒ Mismanagement of upstream, catchment areas, including the building of dams and water extraction for agriculture and mining;
- ⇒ Although fairly fire tolerant it is also vulnerable to mismanagement of the surrounding savanna habitats;
- ⇒ It is prone to weed and alien plant infestation;
- ⇒ Exploitation for timber and non-timber forest products outside reserves (e.g. bark of *Acacia xanthophloea*), harvesting of grasses.

Other Management Considerations

- ⇒ This is a disturbance driven system prone to regular flooding;
- ⇒ Mega-herbivore damage from animals inhabiting surrounding savanna (e.g. elephant);
- ⇒ Ecotourism is an important consideration, e.g. Blyderiver below the dam, Klaserie/Hoedspruit forests, Luvubu, Limpopo. Patches of riverine forest are often a feature or attraction of primarily savanna reserves and lodges are often placed along the river in these forest patches.

- ⇒ There is no commercial timber extraction from riverine forests but some timber theft may occur, e.g. *Breonadia salicina* (Mingerhout or Transvaal Teak) and *Anthocleista grandiflora* (Forest Fever Tree).
- ⇒ Formal and informal agriculture, e.g. cattle grazing at Mkhuze;
- ⇒ Collection of eagle eggs and chicks, e.g. in Mpumalanga;
- ⇒ Since these forests are located in a transitional zone, it may be affected by the management of surrounding areas, especially agriculture and consideration of riparian buffer zones is needed (Agriculture Resources Act & New Water Act).
- ⇒ Since it occurs in relatively small, linear patches, management should take into consideration the effects of, for example, patch size, edge effects, connectivity and fragmentation.

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A2: Swamp Forests

Synonyms

Swamp Forest	Edwards (1967)
Swamp Forest	Moll (1978)
Swamp Forest	Moll & White (1978)
Swamp Forest	Weisser (1978, 1987)
Hygrophilous Forest	Weisser (1978, 1987)
Tongaland-Pondoland Swamp Forest	White (1983)
Swamp Forest	Cooper (1985)
Swamp Forest	MacDevette et al. (1989)
Swamp Forest	Cooper & Swart (1992)
Hydrophilous Forest	Weisser et al. (1992)

Profile

Swamp Forests of South Africa are usually 12-15 m tall and comprise two main strata - canopy tree stratum and the shrub layer. The dominant trees are *Ficus trichopoda*, *Barringtonia racemosa*, *Cassipourea gummiflua*, *Syzygium cordatum*, *Phoenix reclinata* and *Raphia australis*. The trees and herbaceous plants have strong tropical affinities. Swamp Forests are supported by sandy, waterlogged soils in habitats close to still, or very slow flowing, fresh water bodies. There is a characteristic build up of organic decaying material. Specialized breathing and mechanical supports, such as stilt roots, underground suckers, lenticels, and microphores occur in some dominant species in these forests. Presence of ferns, epiphytes and creepers in the understorey is another striking feature of this forest type. Low-stature thickets and forests dominated by *Hibiscus tiliaceus* (in freshwater situations) are also classified within this Forest Type.

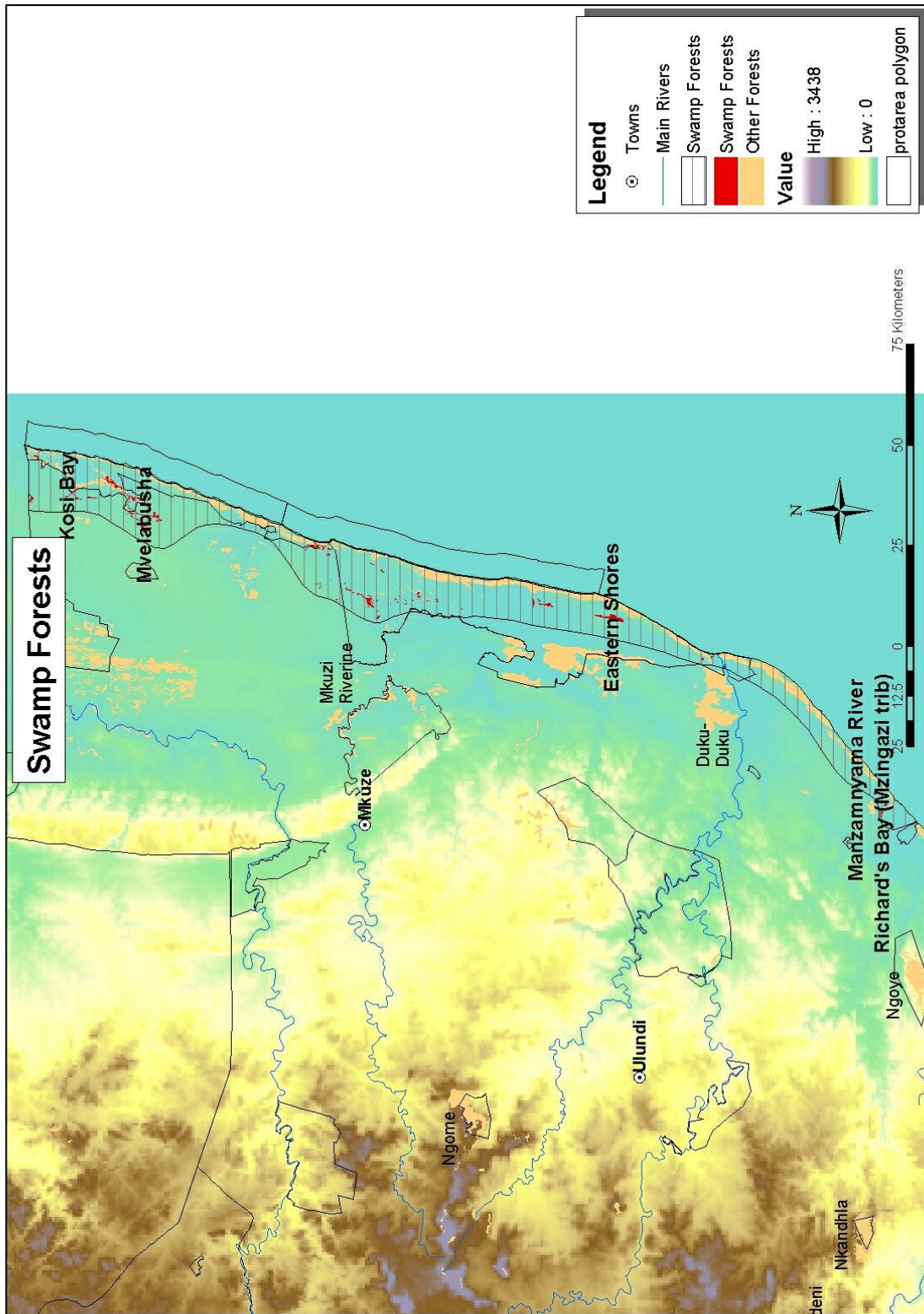
Distribution

Pockets and narrow ribbons of Swamp Forests extend in a narrow belt along the Indian Ocean coastal seaboard from within Mozambique, through Maputaland to as far south as Port Grosvenor - Msikaba River in Pondoland (Bews 1920, Moll 1972, Venter 1972, 1979, Moll & White 1978, Ward 1980, Weisser & Ward 1982, Weisser 1978, 1987, Weisser et al. 1992, Wessels 1991a,b,c, Lubbe 1997). Their distribution is curtailed more in the south than that of Mangrove Forests, suggesting they are more climatically susceptible than mangroves.

Known forests

Amanzimwenya	Msunduze River area
Amanzimyana (Kosi Bay lagoon)	Mtunzini
Amatikulu Nature Reserve	Mzingazi Lake (E of Richard's Bay)
Bhangazi (south and north) Lakes	Nklabane Lake
Dukuduku State Forest	Nyalazi
Durban Bay	Port Grosvenor (just south of Msikaba River)
Isipingo	Richard's Bay Harbour (destroyed)
KwaNgwanase	Samango Swamp (Sodwana Bay)
Maphelana	Sihadla River system
Maphelane	Sokulu (St. Lucia area)
Mdloti	Umfoloji Swamps
Mfabeni (Eastern Shores State Forests)	Umhlanga
Mgobezeleni	Umkambati
Mhlatuze	Umlalazi
Mpoza	Umtamvuna

Map



Vegetation Structure & Texture

Stand Structure

Canopy of Swamp Forests is approx. 12-15 m high, comprising two main strata - canopy and shrub layers. Major tree dominants include *Ficus trichopoda*, *Barringtonia racemosa*, *Syzygium cordatum* and *Raphia australis*. The herb layer is poorly developed, however epiphytic ferns and mosses are a common sight in these forests. Climbers and vines are diverse and abundant.

Many dominating species are relatively mobile, fast-growing and with active dispersal and several clonal mechanisms assuring their persistence in the habitat. Interesting is the presence of at least five species of *Ficus* and two palm species (one of which is endemic; *Genus species*) in these forests.

Swamp forest occurs in relatively small, highly fragmented and isolated patches (< 5 ha). West of Lake St. Lucia swamp forest is found along narrow drainage lines 20-100 m wide, although it may reach up to 1 km wide adjacent to the Mfabeni swamps east of the lake.

Diversity Patterns

The extreme and very specialized habitat conditions of Swamp Forest do not support a high number of species. In addition, this tropical forest type reaches its southernmost distribution limits in South Africa and is naturally depauperate. Few dominant canopy tree species reflects the low species diversity of this forest type.

Ecology

Altitude & Geomorphology

Swamp Forest is a lowland forest type – found on low-lying coastal plains. The typical habitats are shallow waterlogged depressions or on slightly sloping banks of lakes and along slow flowing river systems.

Geology, Soil & Hydrology

Swamp Forests occur on very fine sandy and muddy, waterlogged soil, with a high organic humus content, a peat-like layer and anoxic conditions. The St. Lucia swamp forests are found on sand, sandy loam or loamy sand with a moderate to high organic matter content (7-17 %). The soil is acidic, pH range is 2.5 to 6 (mean 3 to 4.5) and calcium and magnesium concentrations can be high. Water is acidic to alkaline and mineral-rich with high calcium, magnesium, and conductivity values (Wessels 1991a,b,c).

Impeded drainage and poor aeration characterise the soil forms such as, Sterkspruit, Valsrivier and Katspruit in the Nyalazi area (Jacobs et al. 1989). Fernwood and Champagne forms dominate pans and depressions in the Eastern Shores State Forest in the St. Lucia area (Schafer & Van Wyk 1988). Water tables fluctuate between 600 mm below the surface to the surface (Wessels 1991b).

Climate

Swamp Forests experience subtropical winters and tropical summers. Precipitation patterns suggest that this belt can have rains all year round, but mainly in summer.

	Rainfall (mm)	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	400	12	28	21
Maximum	700	14	30	22

Disturbance & Regeneration

Swamp forests experience very little natural disturbance. Fire occurs only rarely in these forests. An example from Port Durnford shows that the swamp forests regenerated to approximately 6 m high within 5-6 years following a fire. Human disturbance is of serious concern. Swamps forests have not been traditionally targeted for agriculture in Africa because of the obvious problems of dealing with muddy-soil and flooding. However, in some rural localities, particularly those with high human population densities (such as KwaNgwanase, Maputaland), some of these forests within the settlement borders have been cleared and drained for agriculture. Weisser & Ward (1982) documented the demise of swamp forests at Richards Bay after the opening of a new mouth (by extending the local harbour), which resulted in increased tidal range and salinity.

Biogeographic Affinities

Swamp Forest is clearly an azonal vegetation type with loose ecological (and floristic) relationships to Lowveld Riverine Forest (through occurrence of *Bridelia*, *Adenopodia*, *Phoenix*) and to the local neighbouring terrestrial coastal forests of KwaZulu-Natal (KZN Coastal Forests and KZN Dune Forests).

Presence and structural importance of genera such as *Ficus*, *Raphia*, *Tarenna*, *Urera*, *Voacanga*, and several ferns and orchids, suggests strong links with tropical Guineo-Congolian forests that harbour many different types of paleotropical swamp forests.

The enigmatic presence of Afrotropical elements in these forests (*Podocarpus*, *Rapanea*, *Burchellia*, *Halleria*, *Ilex*, *Psychotria*) still requires explanation.

Communities/Subunits

<i>Barringtonia</i> consocias	Bews (1920)
<i>Barringtonia-Hibiscus</i> associas	Bews (1920)
Waterboom Associas	Bews (1920)
<i>Phoenix/Hibiscus</i> -gemeenskap	Venter (1972)
<i>Barringtonia racemosa</i> -gemeenskap	Venter (1972)
<i>Cassipourea gummiflua</i> -gemmaenskap	Venter (1972)
Swamp Forest	Weisser (1978)
<i>Ficus sycomorus</i> Forest Complex	Weisser (1978)
Hydrophilous Forest	Weisser (1978)
<i>Hibiscus tiliaceus</i> Community	Ward (1980)
<i>Bridelia-Syzygium-Ficus capensis</i> Mixed Semi-hydrophilous Woodland	Ward (1980)
<i>Phoenix/Hibiscus</i> Swamp Community	Weisser & Ward (1982)
<i>Barringtonia racemosa</i> Swamp Community	Weisser & Ward (1982)
<i>Phoenix/Hibiscus</i> Swamp	Weisser (1987)
<i>Barringtonia racemosa</i> Swamp	Weisser (1987)
<i>Hibiscus tiliaceus</i> Thicket	Weisser (1987)
Swamp Forest	Weisser (1987)
Hydrophilous Forest	Weisser (1987)
<i>Phoenix reclinata-Microsorium punctatum</i> Community	Wessels (1991)
<i>Barringtonia racemosa-Nephrolepis biserrata</i> Community	Wessels (1991)
<i>Nephrolepis biserrata-Ficus trichopoda</i> Swamp Forest	Lubbe (1997)

Dominant & Diagnostic Plant Species

L	S	D	Latin Name	Note
Tcp	d	C	<i>Raphia australis</i>	Maputaland endemic
Tcp	d		<i>Phoenix reclinata</i>	Lowveld Riverine Forest
Tc	d		<i>Bridelia micrantha</i>	Lowveld Riverine Forest
Tc	d		<i>Cassipourea gummiflua</i>	Coastal Forests
Tc	d	C	<i>Ficus trichopoda</i>	
Tc	d		<i>Myrica serrata</i>	
Tc	d		<i>Rauvolfia caffra</i>	
Tc	d		<i>Schefflera umbellifera</i>	
Tc	d	C	<i>Voacanga thouarsii</i>	
Tc			<i>Cussonia sphaerocephala</i>	
Tc		C	<i>Ficus lutea</i>	
Tc			<i>Trichilia dregeana</i>	
Tu	d	C	<i>Barringtonia racemosa</i>	absolute southern limit
Tu	d		<i>Syzygium cordatum</i>	
Tu			<i>Halleria lucida</i>	Afrotemperate element
Tu			<i>Ilex mitis</i>	Afrotemperate element
Tu		C	<i>Scolopia stolzii</i>	absolute southern limit
Tu			<i>Macaranga capensis</i>	Scarp Forests
Tu			<i>Mimusops obovata</i>	Coastal Forests
Tu			<i>Podocarpus falcatus</i>	Afrotemperate element
Tu			<i>Rapanea melanophloeos</i>	Afrotemperate element
TuSt			<i>Ficus natalensis</i>	
TuSt			<i>Ficus sur</i>	
Tmon		C	<i>Dracaena mannii</i>	absolute southern limit
ST	d		<i>Allophyllus dregeanus</i>	
ST	d		<i>Hibiscus tiliaceus</i>	Mangrove
ST	d		<i>Psychotria capensis</i>	Afrotemperate element
ST	d		<i>Sapium ellipticum</i>	
ST	d		<i>Tarenna pavettoides</i> subsp. <i>pavettoides</i>	Scarp Forests
ST			<i>Bersama lucens</i>	
ST		C	<i>Ficus verruculosa</i>	
ST			<i>Kraussia floribunda</i>	Coastal Forests
ST			<i>Rhus nebulosa</i>	
S	d		<i>Burchellia bubalina</i>	Afrotemperate element
SCw	d		<i>Adenopodia spicata</i>	Lowveld Riverine forest
SCw			<i>Keetia guenzii</i>	
Cw			<i>Asparagus falcatus</i>	
Cw			<i>Dioscorea cotinifolia</i>	
Cw			<i>Entada rheedi</i>	
Cw			<i>Rhoicissus rhomboidea</i>	
Cw			<i>Rhoicissus tomentosa</i>	
Cw			<i>Smilax kraussiana</i>	
Cw			<i>Tacazzea apiculata</i>	
Cw			<i>Ureca trinervis</i>	
Ch			<i>Flagellaria guineensis</i>	
Ch	d		<i>Ipomoea congesta</i>	
Ch			<i>Mikania natalensis</i>	
Ha			<i>Crassocephalum crepidioides</i>	
Hcr			<i>Coleotrype natalensis</i>	
Hf	d		<i>Microsorium punctatum</i>	
Hf	d		<i>Nephrolepis biserrata</i>	
Hf	d		<i>Stenochlaena tenuifolia</i>	
Hf			<i>Cyclosorus interruptus</i>	
Hf			<i>Lindsaea ensifolia</i>	
Hf			<i>Lygodium microphyllum</i>	
Hfe			<i>Psilotum nudum</i>	

Hf		<i>Thelypteris dentata</i>
Hg	d	<i>Eulophia horsfallii</i>
Hg		<i>Cyrtorchis arcuata</i>
Hg		<i>Drimiopsis maculata</i>
Hsc		<i>Aneilema aequinoctiale</i>
Gt	d	<i>Scleria angusta</i>

Typical & Endemic Animals

Table. Forest dependent bird, mammal, frog and reptile species in the Swamp Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, E – endemic, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Tambourine dove	<i>Turtur tympanistria</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Knysna lourie	<i>Tauraco corythaix</i>	C	Birds	EC, KZN, MP, NP
Green coucal	<i>Ceuthmochares aereus</i>	Cf	Birds	Coastal KZN & EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Pel's fishing owl	<i>Scotopelia peli</i>	R	Birds	n. Zululand
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape
Trumpeter hornbill	<i>Bycanistes bucinator</i>	Cl	Birds	LP, Mpu, KZN, EC
White-eared barbet	<i>Stactolaema leucotis</i>	C	Birds	Coastal Zululand
Goldenrumped tinker barbet	<i>Pogoniulus bilineatus</i>	C	Birds	e. Mp, coastal n. EC & KZN
Scalythroated honey guide	<i>Indicator variegatus</i>	Cf	Birds	e. Mp, coastal EC & KZN
African broadbill	<i>Smithornis capensis</i>	Cl	Birds	LP, coastal KZN
Squaretailed drongo	<i>Dicrurus ludwigii</i>	C	Birds	Mp, coastal EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Yellowbellied bulbul	<i>Chlorocichla flaviventris</i>	C	Birds	Coastal n. EC & KZN
Starred robin	<i>Pogonocichla stellata</i>	Cl	Birds	LP, Mp, KZN, EC
Brown robin	<i>Erythropygia signata</i>	Cl	Birds	e. Mp, coastal EC & KZN
Bearded robin	<i>Erythropygia quadrivirgata</i>	Cf	Birds	n. Zululand
Woodwards' batis	<i>Batis fratrum</i>	Cl	Birds	n. Zululand
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>	Cl	Birds	LP, Mp, KZN, EC, S.Cape
Blackbellied glossy starling	<i>Lamprotornis corruscus</i>	C	Birds	e. Mp, coastal EC & KZN
Olive sunbird	<i>Nectarinia olivacea</i>	C	Birds	EC, KZN
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Forest weaver	<i>Ploceus bicolor</i>	Cl	Birds	Coastal EC & KZN
Green twinspot	<i>Mandingoa nitidula</i>	Cl	Birds	LP, Mp, KZN, EC
Woodland mouse	<i>Grammomys dolichurus</i>		Mammals	LP, Mp, KZN, EC
Bush squeaker	<i>Arthroleptis wahlbergi</i>		Frogs	KZN, EC
Shovel-footed squeaker	<i>Arthroleptis stenodactylus</i>		Frogs	n. Zululand
Giant legless skink	<i>Acontias plumbeus</i>	E	Reptiles	LP, e. Mp, n. KZN, East London
Gaboon adder	<i>Bitis gabonica</i>	R	Reptiles	n. Zululand
Green mamber	<i>Dendroaspis angusticeps</i>		Reptiles	Coastal KZN & EC
Forest cobra	<i>Naja melanoleuca</i>		Reptiles	Coastal KZN (north of Durban)
Mozambique shovel-snout	<i>Prosymna jani</i>	E	Reptiles	n. Zululand

Conservation & Management

Use & Value

Although relatively species poor, swamp forest has a high biodiversity value in terms of providing a unique habitat supporting a number of phytogeographically interesting species (figs, ferns, orchids, palms). Although it may have a relatively low socio-economic value, the build up of organic material in the soil makes this forest type vulnerable to clearing for subsistence agriculture. Its ecosystem value is high in terms of water retention and purification, and sediment filtering. The removal of swamp forests in the past has been an important contributing factor in the silting of coastal rivers and estuaries in the area. Due to the azonal nature of swamp forest it also has potential value in terms of interchange with surrounding habitats and dispersal.

Conservation Status

Swamp forest occurs in relatively small, isolated patches. Swamp forest is largely imbedded in other forests and as such it is difficult to estimate their conservation status. Many areas (e.g., Mfabeni, Sihadla, Umlalazi, Dukuduku, Maphelana) are protected by KwaZulu-Natal Wildlife, but usually as part of a bigger conservation area and are managed primarily under a protectionist paradigm. However, much swamp forest occurs in communal areas and is not protected. The capacity of management depends on the area, varying from relatively good to relatively poor. Where it occurs within KZNW areas, from a national perspective, it receives good management. However, there is some debate as to whether the management authorities in some areas have sufficient capacity. This is a major issue for example at Kosi Bay. Cooper (1985) has called for the complete protection of this forest type because of its rarity.

Main Threats

- ⇒ In communal areas swamp forest is highly threatened from clearing for subsistence and small-scale agriculture.
- ⇒ Considerable areas have been lost to sugar cane in the past, and many remaining swamp forests occur in areas of high timber and sugar cane production. Some may be threatened by forestry invasion, although forestry generally provides protection from fires and may lead to the expansion of swamp forests along drainage lines.
- ⇒ Regional development and increased access;
- ⇒ Altering of the water table or hydrological regime;
- ⇒ Alien weed invasion;
- ⇒ While relatively resistant to fire, long, slow-burning, peat-type fires (which can wipe out the seed source) are a potential threat;
- ⇒ A serious potential threat is global climate change - leading to extremes in climate (e.g., increased El Niño events), changing water regimes, possible drought and increased likelihood of peat fires; and
- ⇒ There is some debate as to whether swamp forest species have a response mechanism for coping with drought. Although some species have the ability to 'forage' for water and may survive short-term periods of low water availability, swamp forest is primarily water dependent and is likely to be susceptible to long-term drought, accompanied by a drying up of the soil and increased incidence of fire.

Other Management Considerations

- ⇒ Ecotourism - although swamp forests tend not to be the primary focus of ecotourism in the area, where it does occur in swamp forest it may need active management, e.g. by building a boardwalk such as raphia palm walk at Mtunzini;
- ⇒ Catchment management - particularly drainage and other activities that lower the water table or alter the hydrological regime;
- ⇒ The harvesting of timber and non-timber forest products is not an active concern of management in these forests, although the gathering of poles, laths, honey and perhaps bulbs may be site-specific concerns;
- ⇒ Control of mosquito breeding and malaria.

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A3: Mangrove Forest

Steinke, T.D. & Mucina, L.

Synonyms

Mangrove Swamp	Weisser (1978, 1987)
Mangrove Forests	MacDevette et al. (1989)
Mangrove Communities	Cooper & Swart (1992)

Profile

Mangroves are low-grown forest or tall shrubbery growing in the tidal, saline wetlands in bays and estuaries along the coast of the Indian Ocean spanning Kosi Bay (KwaZulu-Natal) to Nahoon estuary (near East London, Eastern Cape Prov.). Mangroves are extremely species poor and only 7 species qualify as typical mangrove elements (*Acrostichum aureum*, *Avicennia marina*, *Bruguiera gymnorrhiza*, *Ceriops tagal*, *Lumnitzera racemosa*, *Rhizophora mucronata* and *Xylotheca granatum*). Characteristic animals include mudskippers, fiddler crabs and mangrove snails.

General accounts on the distribution and ecology of mangrove species and mangrove vegetation in South Africa are found in Bayer (1953), Moll & Werger (1978) and Steinke (1995, 1999).

Distribution

Mangroves are a common sight on the shallow coasts of the World's tropics and subtropics (Chapman 1970, 1975, 1977). According to Moll & Werger (1978) the South African mangroves are part of the "East Coast Mangroves" occurring along the eastern African seaboard of the Indian Ocean. In South Africa they reach their southernmost occurrence and extend from the Kosi Bay lagoon system (26° S lat.) in the north to the Nahoon River (33° S lat.) in the south (Ward & Steinke 1982). The original stand near the mouth of the Nahoon River arose from material transplanted from Durban Bay, although several estuaries to the north of East London (e.g. Kwelera, Kei) have natural populations. In the Kosi system seven mangroves are present: *Avicennia marina*, *Bruguiera gymnorhiza*, *Rhizophora mucronata*, *Acrostichum aureum*, *Ceriops tagal*, *Lumnitzera racemosa* and *Xylocarpus granatum*. The last three do not occur naturally further south. *Avicennia marina* is common throughout the distribution range, but *B. gymnorhiza* is sparse south of the Umbashe River and its natural distribution ends at Wavecrest (Nxaxo-Ngqusi Rivers). *R. mucronata*, which is common as far south as the Umtata River, reaches its southern limit at the Bulungula River. *A. aureum*, the mangrove fern, extends into Pondoland. In addition to their geographical spread, mangroves are distributed according to at least two other gradients: their location within an estuary, and their position along the intertidal profile. For example, *A. marina* may occur from the mouth to the upper reaches, and from the water's edge to parts of the swamp inundated only infrequently at very high tides; while *R. mucronata* has a more restricted distribution. Generally, mangroves are restricted to a relatively short distance from the mouth of the estuary, although in some of the larger systems (e.g. St Lucia) they may extend several kilometres upstream.

Phytosociological data on the mangrove vegetation were published by Weisser & Ward (1982), Ward et al. (1986), Weisser (1987), Roberts (1993) and Lubbe (1997).

Known Forests

Estuaries ordered from North to South:

Kosi Bay
 Mgobozeleni
 St Lucia
 Mfolozi
 Richards Bay
 Umlalazi
 Umgeni
 Sipingo
 Ilovu
 Umkomazi
 Umahlongwa
 Umtamvuna
 Umzamba
 Umnyameni
 Umtentu
 Umzintlava
 Umntafufu
 Umzimvubu
 Umngazana
 Umtakatye
 Umdumbi
 Umtata
 Bulungula
 Xora
 Umbashe
 Nqabara-Nqabarana
 Nxaxo-Ngqusi
 Kobonqaba
 Nahoon

Vegetation Structure & Texture

Stand Structure

Because South Africa has few mangrove species, zonation patterns are not as complex and clearly defined as they are in tropical mangroves. In some of the southern estuaries *A. marina* is the only mangrove present. Generally, where more species are represented, *A. marina* tends to occur on the seaward as well as the landward edge with *B. gymnorhiza* more common between these two ranges. At Umgazana and at Kosi, *R. mucronata* occurs at the edges of channels that infringe on deeper water. In the latter system, where all species of mangroves are present, *C. tagal* usually is present with *B. gymnorhiza* inland of an *A. marina* fringe along the water's edge, while *L. racemosa* is most common at the landward margin of the swamps. Although local variations do occur, trees in the northern stands are larger (10-15 m), with a decrease in size towards the southern limits of the mangroves. In the southern estuaries *A. marina*, at the upper estuarine limits, may be reduced to a narrow fringe of low-growing trees (1-2 m high). Biomass studies in Umgeni estuary revealed that in a stand dominated by *B. gymnorhiza* (6 m) mean above-ground living biomass was calculated at 94.5 ± 7.8 t dry matter ha^{-1} , while dead wood contributed a mean mass of 7.6 ± 0.9 t dry matter ha^{-1} . Algae may be present as epiphytes on the above-ground parts of mangroves, or as mats of cyanobacteria on the mud substratum either in the mangroves or in the adjacent salt marshes (see dominant and diagnostic species).

Diversity Patterns

Due to extreme ecological conditions resulting from a combination of stress (high salinity, anoxia) and disturbance (repeated flooding), as well as due to the extreme southernmost distribution of this tropical vegetation, the mangroves in South Africa are species poor: only 7 typical mangrove species – a fraction of species richness found in tropical regions, such as Indo-Malaysia (Watson 1928, Mepham 1983). Usually one or two species dominate the stands.

Ecology

Altitude & Geomorphology

Mangroves occur between mean sea level and mean high water spring tide level, on tidal flats.

Geology, Soil & Hydrology

Mangrove soils are poorly drained, saline, anoxic, fine-grained and rich in organic matter (Lear & Turner 1977). The high organic content originates largely from plant debris, much of which is produced by the mangroves themselves. This debris is decomposed by micro-organisms such as bacteria and fungi. In addition to organic matter, the primary constituents of the soils are variable and range from fine sediments (silt and clay), or sand-sized particles, to relatively coarse material such as rock fragments and coral and shell debris (Naidoo 1980). These soils form by accretion of river-borne sediments to which is added material brought in from the sea with the rising tide. Usually mangrove soils are poorly-consolidated clayey mud and the high proportions of fine sediments result in poor drainage. The soils are waterlogged at high tide and tend to remain so even when the tide is low because of the poor drainage. Consequently, mangrove sediments are typically anaerobic or anoxic with oxygen present only in the surface layer. In these anaerobic conditions below the surface, sulphate-reducing bacteria produce hydrogen sulphide by reduction of organic sulphate from debris and reduction of sulphate in the estuarine waters. This gas gives mangrove soils their pungent odour and also reduces ferric iron compounds in the soil to a variety of hydrated ferrous sulphides that give the soils their characteristic dark colour.

At high tides the roots and lower stems of trees may be submersed by saline waters, while at low tides they may be exposed for several hours.

Ecological Adaptations

Mangrove species possess a number of interesting ecological adaptations such as breathing structures (lenticels) on exposed roots and/or trunk, aerial roots (e.g. *A. marina*), pneumatophores or pencil roots, knee roots (e.g., *B. gymnorhiza*) and prop roots (*R. mucronata*). Other adaptations include trunk buttresses that

provide support for the above-ground mass of the tree, vivipary (seeds that germinate while still attached to the parent), and propagules that are buoyant for at least a short dispersal phase.

Climate

Mangroves are found throughout tropical regions of the world and extend into subtropical regions (Chapman 1970, 1977). Along the coastline of eastern South Africa mangroves extend south to East London where the monthly mean air temperatures are 21.5° C and 15.6° C for January and July, respectively. The coastline supporting mangroves experiences little or no frost. Annual rainfall along this part of the coastline generally exceeds 800 mm.

Disturbance

Magroves experience little natural disturbance except for the tidal flux. Occasional major disturbance events include flood surges (e.g., at Umtata and Umgeni Rivers) and cyclones (e.g., St Lucia and Kosi Bay; Steinke & Ward 1989). In Kosi Bay lagoon, mortality of mangroves was caused by high water levels following a cyclone (Ward et al. 1986).

Biogeographic Affinities

Mangrove Forest is the most distinct Forest Type found in South Africa from an ecological point of view and its virtual lack of floristic links to other Types. Only the marginal occurrence of some species such as *Hibiscus tiliaceus* or *Juncus kraussii* links this vegetation to Swamp Forests or spatially close salt marshes, respectively. The South African mangroves are an impoverished version of the tropical mangrove forests.

Communities/Subunits

Although most estuaries have 1–3 mangrove species, the communities found in the Kosi Bay lagoon system could be considered a special subtype on the basis of number of mangrove species (six arboreal species and the mangrove fern). Three of the arboreal species occur naturally no further south.

<i>Avicennia marina</i> -gemeenskap	Venter (1972)
<i>Bruguiera gymnorrhiza</i> -gemeenskap	Venter (1972)
<i>Bruguiera gymnorrhiza</i> Consocieties	Ward (1980)
<i>Bruguiera gymnorrhiza</i> Community	Ward (1980)
<i>Avicennia-Bruguiera</i> Woodland	Ward (1980)
<i>Avicennia</i> Woodland	Ward (1980)
<i>Avicennia-Bruguiera</i> Associates	Ward (1980)
<i>Rhizophora</i> Associates	Ward (1980)
<i>Rhizophora</i> Swamp Associates	Ward (1980)
<i>Avicennia marina-Bruguiera gymnorrhiza</i> Mangrove Short Forest	Roberts (1993)

Dominant & Diagnostic Plant Species

L	S	D	Latin Name	Note
Tc	d	C	<i>Avicennia marina</i>	S limit on E African coast
Tcu	d	C	<i>Bruguiera gymnorrhiza</i>	S limit on E African coast
Tu		C	<i>Rhizophora mucronata</i>	S limit on E African coast
Tu		C	<i>Lumnitzera racemosa</i>	S limit on E African coast
Tu		C	<i>Ceriops tagal</i>	S limit on E African coast
Tu		C	<i>Xylothea granatum</i>	S limit on E African coast
Hf		C	<i>Acrostichum aureum</i>	S limit on E African coast
ST			<i>Hibiscus tiliaceus</i>	on edges
G			<i>Juncus kraussii</i>	on edges

Epiphytic cyanobacteria and algae – approx. 48 species of Cyanophyceae, Rhodophyceae, Chlorophyceae and Phaeophyceae have been isolated as epiphytes on the above-ground parts of mangroves, mainly *A. marina*. Marine angiosperms (*Zostera capensis* and *Halophila ovalis*) may be found in shallow coastal waters in the estuaries with mangroves

Typical & Endemic Animals

Table. Forest dependent bird, mammal, frog and reptile species in the Mangrove Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, E – endemic, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Crested guineafowl	<i>Guttera pucherani</i>	Cl	Birds	LP, e. Mp, KZN midlands, n. KZN
Buffspotted flufftail	<i>Sarothrura elegans</i>	C	Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Tambourine dove	<i>Turtur tympanistria</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Knysna lourie	<i>Tauraco corythaix</i>	C	Birds	EC, KZN, MP, NP
Green coucal	<i>Ceuthmochares aereus</i>	Cf	Birds	Coastal KZN & EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Pel's fishing owl	<i>Scotopelia peli</i>	R	Birds	n. Zululand
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape
Trumpeter hornbill	<i>Bycanistes bucinator</i>	Cl	Birds	LP, Mpu, KZN, EC
White-eared barbet	<i>Stactolaema leucotis</i>	C	Birds	Coastal Zululand
Goldenrumped tinker barbet	<i>Pogoniulus bilineatus</i>	C	Birds	e. Mp, coastal n. EC & KZN
Scalythroated honey guide	<i>Indicator variegatus</i>	Cf	Birds	e. Mp, coastal EC & KZN
African broadbill	<i>Smithornis capensis</i>	Cl	Birds	LP, coastal KZN
Grey cuckooshrike	<i>Coracina caesia</i>	U	Birds	Widespread
Squaretailed drongo	<i>Dicrurus ludwigii</i>	C	Birds	Mp, coastal EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Yellowstreaked bulbul	<i>Phyllastrephus flavostriatus</i>	Cf	Birds	Ngoye forest north to e.Mp
Yellowbellied bulbul	<i>Chlorocichla flaviventris</i>	C	Birds	Coastal n. EC & KZN
Starred robin	<i>Pogonocichla stellata</i>	Cl	Birds	LP, Mp, KZN, EC
Brown robin	<i>Erythropygia signata</i>	Cl	Birds	e. Mp, coastal EC & KZN
Woodwards' batis	<i>Batis fratrum</i>	Cl	Birds	n. Zululand
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>	Cl	Birds	LP, Mp, KZN, EC, S.Cape
Blackbellied glossy starling	<i>Lamprotornis corruscus</i>	C	Birds	e. Mp, coastal EC & KZN
Olive sunbird	<i>Nectarinia olivacea</i>	C	Birds	EC, KZN
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Forest weaver	<i>Ploceus bicolor</i>	Cl	Birds	Coastal EC & KZN
Green twinspot	<i>Mandingoa nitidula</i>	Cl	Birds	LP, Mp, KZN, EC
Red duiker	<i>Cephalophus natalensis</i>		Mammals	LP, n. Zululand
Woodland mouse	<i>Grammomys dolichurus</i>		Mammals	LP, Mp, KZN, EC
Woodland dormouse	<i>Graphiurus murinus</i>		Mammals	Widespread
Red squirrel	<i>Paraxerus palliatus</i>		Mammals	n. Zululand
Four-toed elephant shrew	<i>Petrodromus tetradactylus</i>		Mammals	n. Zululand
Shovel-footed squeaker	<i>Arthroleptis stenodactylus</i>		Frogs	n. Zululand
Giant legless skink	<i>Acontias plumbeus</i>	E	Reptiles	LP, e. Mp, n. KZN, East London
Gaboon adder	<i>Bitis gabonica</i>	R	Reptiles	n. Zululand
Green mamba	<i>Dendroaspis angusticeps</i>		Reptiles	Coastal KZN & EC
Forest cobra	<i>Naja melanoleuca</i>		Reptiles	Coastal KZN (north of Durban)
Mozambique shovel-snout	<i>Prosymna janii</i>	E	Reptiles	n. Zululand

Conservation & Management

Use & Value

A high biodiversity value. Although South African mangrove forests do not comprise many tree species, there is a high diversity among associated plants and animals with which mangroves form a complex interaction. For example, over 60 species of marine fungi are associated with mangrove litter breakdown. Ecosystem value is also high. Mangroves provide a source of reduced carbon in the form of leaves, wood and other litter that falls from the trees and contributes to detritus-based food chains in estuaries. Studies have shown that mangroves make a significant contribution of litter towards our estuaries and that leaf material makes up approx. 60 % of this litter. It is generally recognized that estuaries are an important breeding and feeding ground for marine species. Mangrove detritus provides nutrients for zooplankton, including crustaceans and fish larvae, while the mangrove environment provides food, shelter and breeding sites for numerous species of fish, many of which are commercially important. Mangroves lining waterways also form a river/land barrier which protects the shoreline from erosion. Socio-economic value is increasing and a number of estuaries mangroves are chopped and used as a source of timber for poles and construction, and for the making of kraals and fish traps. Associated plants, e.g. *Juncus kraussii*, may be harvested by local people for use in traditional crafts. Mangrove swamps near cities have been used extensively for educational purposes.

Conservation Status

Along the KwaZulu-Natal coast many estuaries have become degraded through unfavourable agricultural practices. However, estuaries, and thus mangrove forests, in the former Zululand are receiving protection. While there are indications that the estuaries in the Eastern Cape are being subjected to increased pressures, the estuaries and their mangroves generally remain in reasonably good condition. One problem affecting the management of our coastal resources has been the conflict of responsibilities for these resources among government and other agencies. In addition, because many mangrove forests occur in small, often isolated, estuarine pockets, it has proved difficult to control and manage these areas effectively. Clearly, these obstacles must be removed in the interests of conserving our estuaries.

Main Threats

- ⇒ In recent years significant reductions in mangrove forests have been caused by (1) harbour development at Richards Bay and Durban; (2) poorly-planned bridge construction at Sodwana and Beachwood; and (3) clearing a large area of mangroves during land development operations at Sipingo.
- ⇒ Chopping of mangroves at Kosi for construction of fish traps and at several Transkeian estuaries for kraal and other construction;
- ⇒ Livestock browsing on mangroves (animals obtain salt from the leaves, esp. *A. marina*);
- ⇒ Cultivation, which makes inroads into the mangroves;
- ⇒ Mass removal of crabs of all species in the Kosi system has resulted in the destruction of many pioneer trees. The removal of so many animals has had serious consequences for the mangrove environment by removing an important part of the food web.
- ⇒ Collection of bait for fishing;
- ⇒ Dumping of refuse;
- ⇒ The removal of the giant mud crab (*Scylla serrata*) for food;
- ⇒ Unwise agricultural practices in catchment areas, e.g. incorrect veld management, cultivation of steep areas, and a lack of contour furrows cause degradation and affect estuaries adversely.

Other Management Considerations

Expansion of coastal resorts and new developments must be planned correctly to cause minimal damage to the estuarine environment. Future developments must be planned to fit in with the natural surroundings and to detract as little as possible from the aesthetic appeal. Structures such as bridges can cause considerable damage unless constructed in such a way as to allow tidal flow to be maintained.

More research is needed into the biology, sustainable use and management of mangroves, including their interaction with other coastal systems in order to limit, with confidence, the utilization of mangroves and their associated fauna and flora at levels to ensure sustainable yields.

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A4: Licuati Sand Forests

L. Mucina, W. Matthews & M. Lawes

Synonyms

Licuati Forest	Myre (1964)
Sand Forest	Moll (1978)
Sand Forest	Cooper (1985)
Sand Forest	Low & Rebelo (1998)

Profile

Licuati Sand Forests are endemic to Maputaland.. These forests are generally low-grown, forming a closed canopy of *Cleistanthus schlechteri*, *Dialium schlechteri* and *Hymenocardia ulmoides*. Magnificent flat-crown *Newtonia hildebrandtii* overtops the canopy as emergent. *Croton pseudopulchellus*, *Pteleopsis myrtifolia*, *Drypetes arguta*, *Uvaria lucida* and *Cola greenwayi* are the most common shrubs in the understorey while *Eragrostis moggii* is the most abundant grass in the ground layer. Epiphytic orchids are common.

These forests occur on ancient sand dunes of the Maputaland coastal plain, and have a relic character showing clear links to tropical forest flora. The patches of Licuati Sand Forests are characterised by very sharp boundaries towards the surroundings vegetation (generally sandy bushveld) and a distinct surrounding 'mantle' of thicket-like vegetation. In most cases the forests are delimited by narrow zones of sparse grass-vegetated or bare-sand areas directly adjacent to the sand forest, and these in turn are surrounded by open woodland communities.

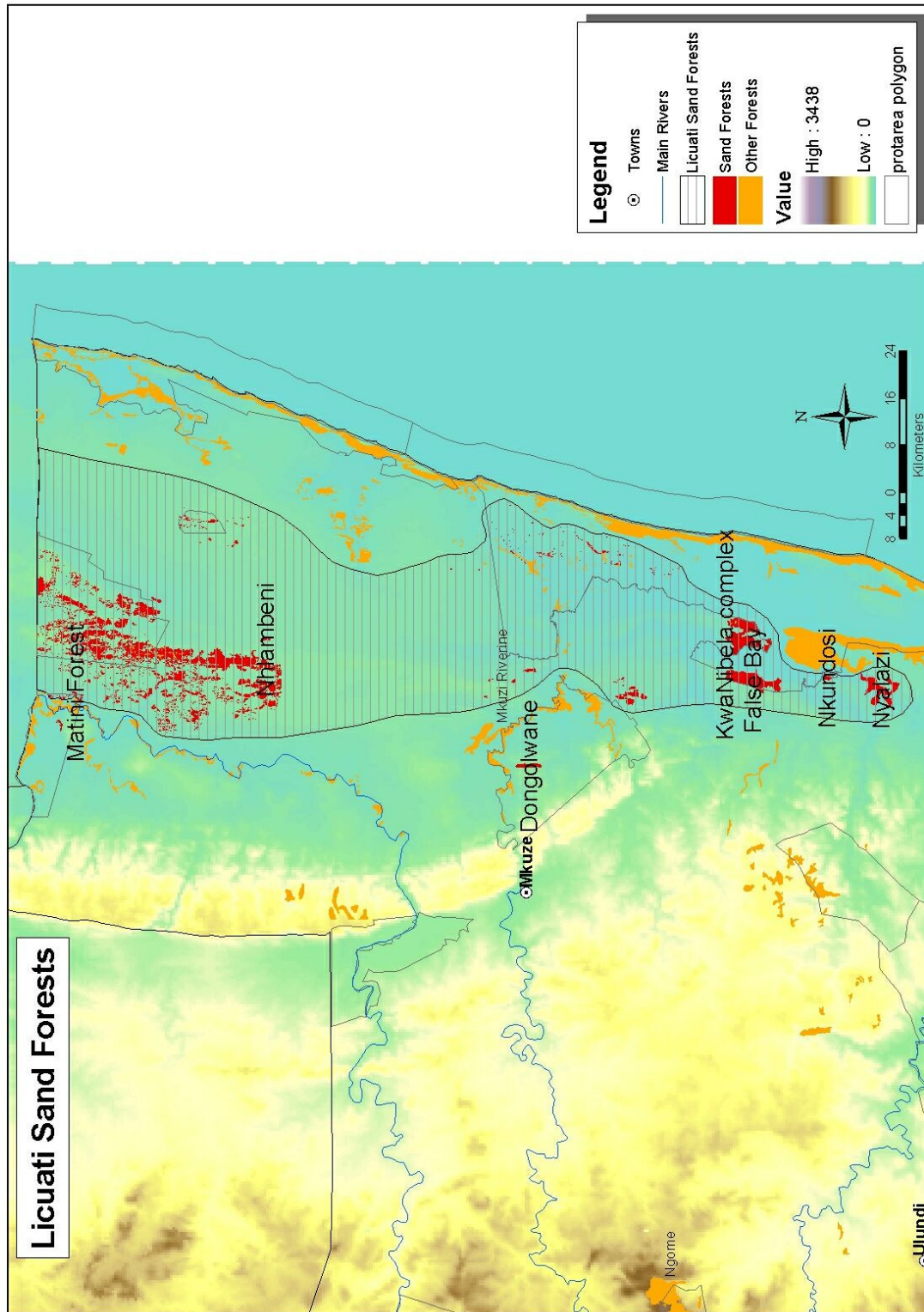
Distribution

This unique forest is endemic to Maputaland (shared by South Africa and Mozambique). It occurs in patches from False Bay in the south to areas S of Maputo in Mozambique (Myre 1964, de Moor et al. 1977, Moll 1978, Moll & White 1978, Matthews et al. 1991, 2001, Everard et al. 1995, Lubbe 1997, Kirkwood & Midgley 1999, Goodman 1990, Siebert et al. 2002). The biggest patch of this forest is found in southern Mozambique (north of Tembe Elephant Park) - 25 km long and 8 km wide (Siebert et al. 2002).

Known Forests

False Bay (KwaNibela)
 Mahlongwana
 Mkhuze Game Reserve
 Ndumo Game Reserve
 Nkundusi
 Phinda Resource Reserve
 Shengwana
 Sileza Nature Reserve
 Sodwana Bay
 Tembe Elephant Park

Map



Vegetation Structure & Texture

Stand Structure

Licuati Sand Forests are generally low-grown with tree statur dominated by *Drypetes arguta*, *Cleistanthus schlechteri*, *Dialium schlechteri* and *Hymenocardia ulmoides* (usually overtopped by emergent *Newtonia hildebrandtii* or *Balanites maughamii*). The shrub undergrowth is rich, consisting of oscar of the tree dominants, and numerous shrubs such as *Uvaria lucida*, *Pteleopsis myrtifolia*, *Cola greenwayi* and *Croton pseudopulchellus*. The ground layer is poorly developed, usually dominated by *Eragrostis moggii*. Epiphyte orchids are common.

A distinct 'mantle' of low-grown thicket (shrubby) vegetation dominated characteristically by *Croton steenkampianus* surrounds the patches of sand forest. In most cases, the forests and the mantle are delimited by narrow zones of sparsely vegetated to bare sand areas directly adjacent to the sand forest which are in turn surrounded by grassland or open woodland communities. The belts of vegetation yielding low fuel load can possibly provide protection against fire. Once inside the forest proper, however, ample penetration of sunlight. Semi-deciduous trees occur here although they are not the dominant species. There is a low rate of seedling regeneration and few saplings, indicating that this is a relict forest type with poor recovery potential. Multi-stemming, however, is high.

Diversity Patterns

Although relatively species poor within individual forest patches, over the entire range, from north to south and east to west, Licuati Sand Forest can be considered species rich.

Ecology

Altitude & Geomorphology

This forest type occurs at altitudes between 60 and 100 m above sea level on linear (approx. north-south stretched) ancient dunes, both on ridges as well as in inter-dune depressions.

Geology & Soils

The Licuati Sand Forests are found on deep, grey sands of ancient dune formations (approximately 5-3 million years old and younger, 125 000 yr. A thin, surface layer of a slowly decaying mulch of leaves covers the nutrient poor soil. Allelopathy (substances leached from decaying leaves) is assumed to control the occurrence of barely vegetated zones surrounding the sand forest patches (Van Wyk & Smith 2001, Matthew et al. submitted).

Climate

Approximately 30-70 km from the coast, these sand forests experience a sub-tropical but seasonal climate with less rain than on coastal dunes.

	Rainfall	Coldest temperature coldest month	Hottest temperature hottest month	Mean temperature
Minimum	300	10	30	22
Maximum	500	12	32	22

Disturbance

Sand forests experience little natural disturbance as the density of grazers and browsers is generally much lower than in the surrounding sandy Bushveld. However, when the forest edge is opened by browsing elephant (which is increasingly happening in Tembe Elephant Park) the structure of the sand forest suffer, and fire can penetrate through the open edges. The regeneration potential of this forest is very poor.

Biogeographic Affinities

The Licuati Sand Forest shows clear tropical affinity since a number of genera and families have their centre of diversification in the tropics. Remarkably high local endemism (Van Wyk & Smith 2001) is one of the major features of this enigmatic relictual forest type.

Transitional types were recognised, linking the Licuati Sand Forests to the Northern KwaZulu-Natal Coastal Forests (see Lubbe 1997, Matthews et al. 1991, Kirkwood & Midgley 1999). Many species are shared between the Sand forest and the surrounding sandy bushveld.

Communities/Subunits

Various authors suggest conflicting classifications of the Licuati Sand Forests into subtypes or communities. It appears, however, that geographic variability (east-west and north-south) gradients, reflecting to an extent also level of forest fragmentation may play the major role in the differentiation of this Forest Type. The final word is pending re-analysis of the complete data set.

<i>Artabotrys monteiroae</i> - <i>Hymenocardia ulmoides</i> Inland Forest	Lubbe (1997)
<i>Catunaregam spinosa</i> subsp. <i>spinosa</i> - <i>Tabernaemontana elegans</i> Inland Forest	Lubbe (1997)
Eastern Sand Forests	MacDevette et al. (1989)
Western Sand Forests	MacDevette et al. (1989)
Western Sand Forest	Kirkwood & Midgley (1999)
Eastern Sand Forest	Kirkwood & Midgley (1999)
<i>Artabotrys monteiroae</i> - <i>Dialium schlechteri</i> Forest	Matthews et al. (1999)
<i>Cola greenwayi</i> - <i>Balanites maughamii</i> Tall Sand Forest	Matthews et al. (2001)
<i>Psydrax fragrantissima</i> - <i>Hyperacanthus microphyllus</i> Short Sand Forest	Matthews et al. (2001)

Dominant & Diagnostic Plant Species

Note: Nomenclature of plants designated by § follow Matthews et al. (2001). The term "Maputaland endemic" (incl. sub-endemics or near-endemics) implies the region of Maputaland Centre of Endemism as defined by (Van Wyk & Smith 2001). Maputaland endemics confined to the Licuati Sand Forests are indicated by *.

L	S	D	Latin Name	Note
Te	d		<i>Balanites maughamii</i>	Savanna
Te	d	C	<i>Newtonia hildebrandtii</i> var. <i>hildebrandtii</i>	
Tc	d	C	<i>Cleistanthus schlechteri</i>	
Tc	d		<i>Dialium schlechteri</i>	
Tc			<i>Azelia quanzensis</i>	Savanna
Tc			<i>Albizia forbesii</i>	
Tc		C	<i>Erythrophloeum lasianthum</i>	Maputaland endemic*
Tc			<i>Euphorbia grandidens</i>	
Tc			<i>Manilkara discolor</i>	
Tcu	d	C	<i>Hymenocardia ulmoides</i>	KZN Dune
Tcu			<i>Ptaeroxylon obliquum</i>	
Tu	d		<i>Brachylaena huillensis</i>	Savanna
Tu			<i>Boscia foetida</i> subsp. <i>rehmanniana</i>	

Tu			<i>Cladostemon kirkii</i>	Savanna
Tu			<i>Cordyla africana</i>	
Tu			<i>Haplocoelum gallense</i>	Maputaland endemic
Tu			<i>Pseudobersama mossambicensis</i>	KZN Dune
Tu			<i>Rothmannia fischeri</i>	Savanna, KZN Dune
Tu			<i>Tapura fischeri</i>	
Tu			<i>Zanthoxylum lepreurii</i>	
TuSt			<i>Ficus tremula</i>	
Tcyc			<i>Encephalartos ferox</i>	Maputaland endemic
ST	d	C	<i>Cola greenwayi</i> var. <i>greenwayi</i>	Northern Afrotemperate
ST	d	C	<i>Drypetes arguta</i>	
ST	d		<i>Psydrax locupes</i>	
ST	d	C	<i>Pteleopsis myrtifolia</i>	
ST	d	C	<i>Toddaliopsis bremekampii</i>	
ST	d	C	<i>Wrightia natalensis</i>	Maputaland endemic*
ST			<i>Bridelia cathartica</i>	
ST			<i>Canthium setiflorum</i> subsp. <i>setiflorum</i> §	Maputaland endemic
ST		C	<i>Cassiopurea mossambicensis</i>	Maputaland endemic*
ST			<i>Coffea racemosa</i>	KZN Dune
ST		C	<i>Combretum mkuzense</i>	Maputaland endemic*
ST			<i>Commiphora zanzibarica</i>	KZN Dune
ST			<i>Drypetes natalensis</i>	
ST			<i>Grewia microthyrsa</i>	Maputaland endemic
ST		C	<i>Hyperacanthus microphyllus</i>	Maputaland endemic*
ST		C	<i>Lagynias lasiantha</i>	Maputaland endemic*
ST		C	<i>Lagynias monteroi</i> §	Maputaland endemic
ST		C	<i>Memecylon sousae</i>	Maputaland endemic*
ST			<i>Monodora junodii</i>	
ST		C	<i>Ochna barbosa</i>	Maputaland endemic*
ST		C	<i>Oxyanthus latifolius</i>	Maputaland endemic*
ST			<i>Pavetta catophylla</i>	
ST		C	<i>Pavetta gerstnerii</i>	Maputaland endemic*
ST			<i>Plectroniella armata</i>	
ST		C	<i>Psydrax fragrantissima</i>	Maputaland endemic*
ST			<i>Suregada zanzibariensis</i>	
ST			<i>Synedrium cupulare</i>	
ST			<i>Tarenna junodii</i>	Maputaland endemic
ST			<i>Tarrena littoralis</i>	
ST			<i>Tricalysia delagoensis</i>	Maputaland endemic
ST			<i>Vitex amboniensis</i>	Savanna
S	d	C	<i>Croton steenkampianus</i>	Maputaland endemic*
S	d		<i>Croton pseudopulchellus</i>	
S			<i>Carissa tetramera</i>	Savanna
S		C	<i>Combretum celastroides</i> subsp. <i>orientale</i>	Maputaland endemic*
S			<i>Leptactinia delagoensis</i> subsp. <i>delagoensis</i>	
S		C	<i>Phyllanthus</i> sp. <i>nova</i>	Maputaland endemic*
S			<i>Salacia leptoclada</i>	
S		C	<i>Sclerochiton apiculatus</i>	Maputaland endemic*
S		C	<i>Tricalysia junodii</i> var. <i>junodii</i>	Maputaland endemic*
SCw			<i>Acacia kraussiana</i>	
SCw			<i>Hippocratea delagoensis</i>	Maputaland endemic
Cw	d		<i>Secamone delagoensis</i>	Maputaland endemic
Cw		C	<i>Strophanthus gerrardii</i>	Maputaland endemic*
Cw		C	<i>Strophanthus luteolus</i>	Maputaland endemic*
H			<i>Cleome bororensis</i>	Maputaland endemic
Hg		C	<i>Aneilema arenicola</i>	Maputaland endemic*
Ho		C	<i>Bonatea lamprophylla</i>	Maputaland endemic*
Hsc		C	<i>Barleria prionitis</i> subsp. <i>delagoensis</i> §	Maputaland endemic*
Hsuc		C	<i>Crassula maputensis</i>	Maputaland endemic*
Eo	d		<i>Microcoelia exilis</i>	
G	d		<i>Eragrostis moggi</i> var. <i>moggi</i>	Maputaland endemic
G			<i>Leptochloa uniflora</i>	
G			<i>Panicum deustum</i>	

G	<i>Panicum laticomum</i>	
Gcr	<i>Brachychloa fragilis</i>	Maputaland endemic
Gcr	<i>Brachychloa schiemaniana</i>	Maputaland endemic

Typical & Endemic Animals

Table. Forest dependent bird, mammal, frog and reptile species in the Licuati Sand Forests. LP – Limpopo Province, Mp – Mpumalanga, KZN – KwaZulu-Natal, EC – Eastern Cape, WC – Western Cape. S. Cape refers to the region from George to Tsitsikamma. Cm – common intra-African migrant, C – common resident, Cf – fairly common resident, Cl – locally common resident, E – endemic, R – rare, U – uncommon resident. Status and distribution from Maclean (1993), Branch (1988), Smithers (1983), Carruthers (2001).

Common name	Scientific name	Status	Taxon	Distribution
Crowned eagle	<i>Stephanoaetus coronatus</i>	C	Birds	LP, e. Mp, KZN, coastal EC
African goshawk	<i>Accipiter tachiro</i>	C	Birds	Widespread
Crested guineafool	<i>Guttera pucherani</i>	Cl	Birds	LP, e. Mp, KZN midlands, n. KZN
Buffspotted flufftail	<i>Sarothrura elegans</i>	C	Birds	WC, coastal & inland KZN & EC
Rameron pigeon	<i>Columba arquatrix</i>	Cl	Birds	Widespread
Tambourine dove	<i>Turtur tympanistria</i>	C	Birds	LP, Mpu, KZN, EC
Cinnamon dove	<i>Aplopelia larvata</i>	C	Birds	LP, Mp, KZN, EC, WC
Knysna lourie	<i>Tauraco corythaix</i>	C	Birds	EC, KZN, MP, NP
Emerald cuckoo	<i>Chrysococcyx cupreus</i>	Cm	Birds	LP, Mpu, KZN, EC
Green coucal	<i>Ceuthmochares aereus</i>	Cf	Birds	Coastal KZN & EC
Wood owl	<i>Strix woodfordii</i>	Cf	Birds	Widespread
Pel's fishing owl	<i>Scotopelia peli</i>	R	Birds	n. Zululand
Narina trogon	<i>Apaloderma narina</i>	Cf	Birds	LP, Mp, KZN, EC, S. Cape
Trumpeter hornbill	<i>Bycanistes bucinator</i>	Cl	Birds	LP, Mpu, KZN, EC
White-eared barbet	<i>Stactolaema leucotis</i>	C	Birds	Coastal Zululand
Goldenrumped tinker barbet	<i>Pogoniulus bilineatus</i>	C	Birds	e. Mp, coastal n. EC & KZN
Scalythroated honey guide	<i>Indicator variegatus</i>	Cf	Birds	e. Mp, coastal EC & KZN
African broadbill	<i>Smithornis capensis</i>	Cl	Birds	LP, coastal KZN
Grey cuckooshrike	<i>Coracina caesia</i>	U	Birds	Widespread
Squaretailed drongo	<i>Dicrurus ludwigii</i>	C	Birds	Mp, coastal EC & KZN
Terrestrial bulbul	<i>Phyllastrephus terrestris</i>	Cf	Birds	Mp, EC, KZN
Yellowbellied bulbul	<i>Chlorocichla flaviventris</i>	C	Birds	Coastal n. EC & KZN
Starred robin	<i>Pogonocichla stellata</i>	Cl	Birds	LP, Mp, KZN, EC
Bearded robin	<i>Erythropygia quadrivirgata</i>	Cf	Birds	n. Zululand
Woodwards' batis	<i>Batis fratrum</i>	Cl	Birds	n. Zululand
Bluemantled flycatcher	<i>Trochocercus cyanomelas</i>	U	Birds	e. Mp, coastal WC, EC & KZN
Olive bush shrike	<i>Telophorus olivaceus</i>	Cl	Birds	LP, Mp, KZN, EC, S.Cape
Olive sunbird	<i>Nectarinia olivacea</i>	C	Birds	EC, KZN
Collared sunbird	<i>Anthreptes collaris</i>	C	Birds	EC, KZN
Forest weaver	<i>Ploceus bicolor</i>	Cl	Birds	Coastal EC & KZN
Green twin-spot	<i>Mandingoa nitidula</i>	Cl	Birds	LP, Mp, KZN, EC
Four-toed elephant shrew	<i>Petrodromus tetradactylus</i>		Mammals	n. Zululand
Natal purple-glossed snake	<i>Amblyodipsas concolor</i>	E, R	Reptiles	e. Mp, KZN

Conservation & Management

Use & Value

Sand forest has a very high biodiversity value because it is a specialised, relict forest type supporting many neo-endemic species. It also has a high socio-economic value and extensive use outside conservation areas.

Conservation Status

Much of this forest type has already been lost. Portions of sand forest in the Hluhluwe area, for example, have been cleared for pineapple agriculture. Although the complex of sand forests is still relatively extensive, individual forests are small and linear. Generally, sand forest is not well protected although some is conserved at Ndumu Game Reserve, Tembe Elephant Park, Sileza Nature Reserve, False Bay, Mkhuze Game Reserve and Phinda Resource Reserve. Where it occurs in conservation areas it is managed under protectionist paradigm. Generally there is very little capacity to manage sand forest and the use of this forest type is largely out of control. However, the King of Tsonga (Inkosi Tembe) now wants to enlarge protected areas to help preserve this forest type.

The NLC map estimates 6 000 ha of this forest type with 46% conserved, the forest biome map gives 4 000 ha with 65% conserved. None is on land managed by DWAF.

Main Threats

- ⇒ Clearing for subsistence agriculture and grazing;
- ⇒ Harvesting of timber forest products, including poles, laths and firewood, especially *Newtonia hildebrandtii*; harvesting of *Cleistanthus schlechteri* used in the woodcraft industry and in Mozambique used for making charcoal.

Other Management Considerations

- ⇒ Management of the bushveld surrounding sand forest, particularly the management of fire and burning regimes;
- ⇒ Ranges of sand forest should be conserved encompassing the north to south and east to west variations;
- ⇒ The impact of elephants e.g. at Tembe Elephant Reserve (when browsing pressure becomes too high the surrounding, protective thicket mantle may be destroyed and the forest exposed to severe damage); other browsers may also impact severely on sand forest (e.g. at False Bay);
- ⇒ Given its low recovery potential, sand forest is very sensitive to disturbance, especially elephant damage and fire;
- ⇒ Ecotourism (e.g. Sileza Nature Reserve) and road access.

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