The vegetation ecology of Mfabeni peat swamp, St Lucia, KwaZulu-Natal

by

Catharina Elizabeth Venter

Submitted in partial fulfillment of the requirements for the degree

Magister Scientia

in the Faculty of Natural & Agricultural Science

University of Pretoria

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Supervisor: Prof. Dr. G.J. Bredenkamp

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Abstract

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A vegetation survey, on the plant community level of organization, was conducted on the Mfabeni swamp on the eastern shores of Lake St Lucia. The survey included both the sedge/grass swamp and the swamp forest. Mfabeni swamp is a peatland with peat up to 10 m in depth. Except for limited studies in Lesotho and KwaZulu-Natal, this is a first vegetation survey on the plant community level of peatland vegetation in southern Africa. Total floristic composition and habitat information were recorded in 214 sample plots, fully referenced by GPS for GIS mapping. The data were captured in the TURBOVEG data base for vegetation data, classified using the TWINSPAN numerical classification algorithm and phytosociological tables were compiled using the MEGATAB computerized table management program. Fourteen plant communities were identified, characterized by diagnostic and dominant species, described, and the localities noted by GIS. The data were also processed by the PCOrd numerical ordination program and the axes of the resulting ordination diagrams were related to environmental conditions. This gave an indication of the environmental factors controlling the existence and distribution patterns of the different plant communities. An ordination was run on the habitat data collected to further illustrate the relationship between the plant communities and environmental variables. It seems that water depth, seasonality of the water depth and certain water chemical properties, such as pH conductivity and dissolved oxygen content of the water play an important role in determining floristic composition and therefore plant community type in the Mfabeni swamp.

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Chapter 1
Introduction

1.1 Background

The Mfabeni Swamp is situated within the Greater St Lucia Wetlands Park. This Park is South Africa's first Natural World Heritage Site. It was declared a World Heritage Site on 1 December 1999 by the UNESCO Protocol (KwaZulu-Natal Wildlife nd).

The Park is situated along the north-eastern coast of KwaZulu-Natal and it stretches from south of the St Lucia town, northwards to the Mozambique border. The Park is the third largest conservation area in South Africa, covering 328 000 ha and including 280 km of coastline. Lake St Lucia is a 85 km long estuarine lake which has an average depth of 1 m (KwaZulu-Natal Wildlife nd).

A World Heritage Site is considered to be important due to its cultural and/or natural significance. The Greater St Lucia Wetlands Park may be regarded as a site of international natural importance. A natural site should have either of the following qualities: "outstanding examples of major stages in the earth's evolutionary history", it should represent "significant ongoing geological processes, biological evolution, and man's interaction with his natural environment", have "superlative natural phenomena, formations or features", or have "the most important and significant natural habitats where threatened species of animals or plants of outstanding value still survive" (International Committee for the Protection of the World Cultural and Natural Heritage 1988). There is an obligation to promote and to protect World Heritage Sites. This may be seen as conflicting, since promoting a site may be detrimental to its natural features, due to increased impacts caused by visitors. It is therefore important to maintain a balance between promoting and protecting the site. A site should not be promoted to such an extent that the site degrades due to peoples' actions and the impacts of visitors resulting in not meeting the conservation criteria for a

World Heritage Site any more. The member countries should promote the role of the natural heritage in the community and the protection of the site should be integrated into the planning program (Drost 1996).

Mfabeni swamp is a peatland situated on the Eastern Shores of the St Lucia Lake, near Cape Vidal, in the Greater St Lucia Wetland Park. It is located between the lake and the tall, coastal dunes (Fig 1.1). The peatland is situated in the Hlabisa district, in the minor area Bhangazi (Baartman 1997) and is located at 24º09'44"S, 32º31'64"E, at an altitude of 20 m.

Wetlands are very important in nature, because they constitute an unique habitat for certain aquatic plant and animal species, especially large numbers of waterfowl. Wetlands lessen the devastating effects of floods and are responsible for clearer and healthier surface water. They act as a filter for sediment and other impurities and absorb a lot of water that may be released over time. Not many plant species grow in wetlands, but the species that do occur there are often unique (Hey & Philippi 1999).

According to Joosten & Clarke (2002) the functions and values of peatland differ according to the different definitions of the word function and values. The values can be divided into three different approaches: idealistic, naturalistic and preference. Each of these approaches would give a different set of values for peatlands and the influences of the different approaches are discussed. The functions of a peatland are divided into five types: production functions, carrier functions, regulation functions, information functions and transformation and option functions. The production functions include functions where the peat is extracted and used for agriculture, horticulture, as a filter, for peat textiles and as bedding. Drinking water, the use of plants growing on the peatland, the use of wild animals the uses of the peatland for agriculture are also included in the production functions. Carrier functions include the use of the site for water reservoirs, as fishponds, as an area for urban and industrial development and for

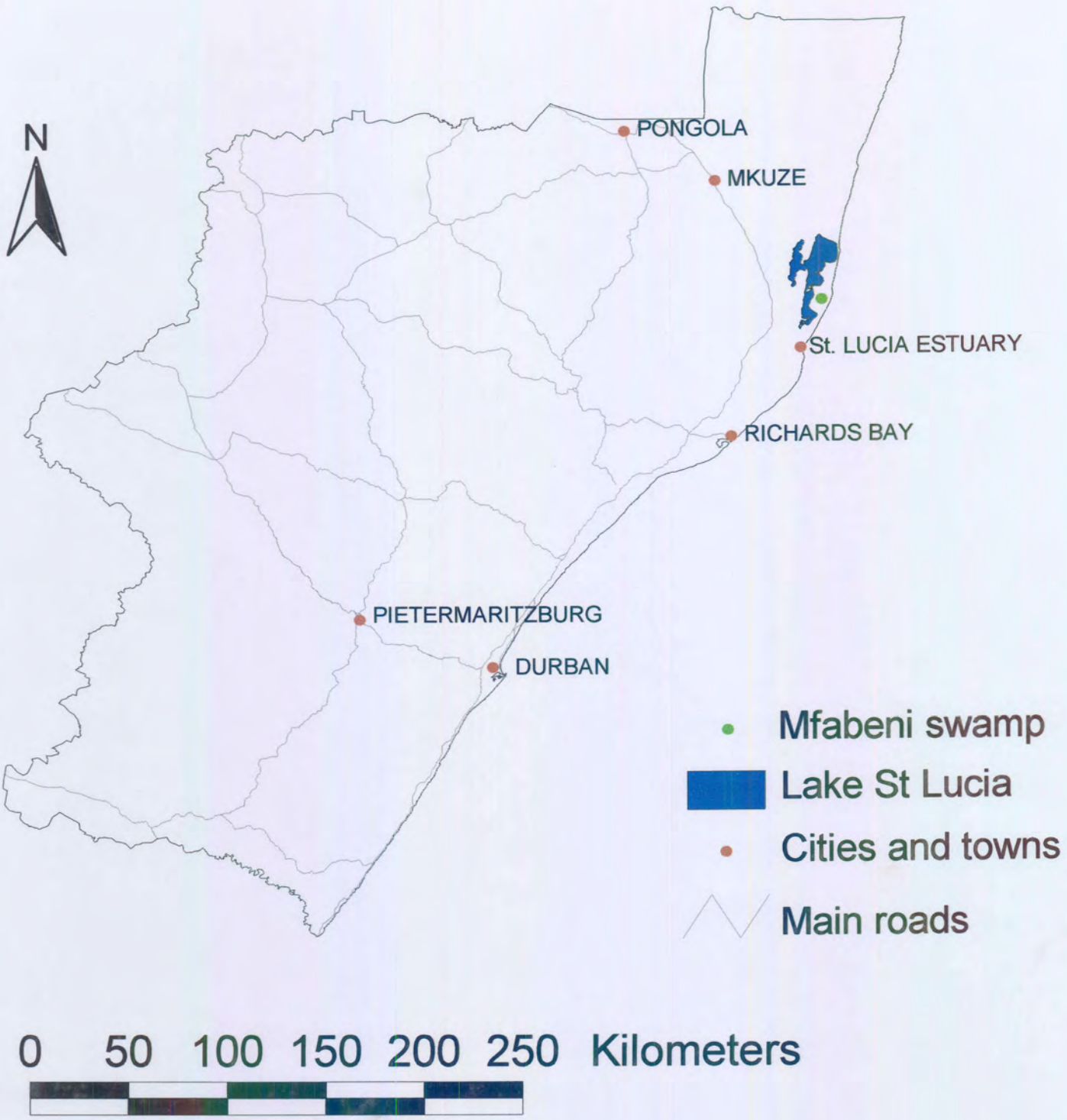

Fig 1.1 Locality map of Mfabeni swamp.

use in military exercises and defense. The regulation functions include the regulation of global climate, regional and local climates, catchment hydrology, catchment hydrochemistry and soil conditions. The information functions include functions such as social-amenity and history, recreation and aesthetics. The different functions and usages are discussed in detail in Joosten & Clarke (2002).

Peatlands are a special kind of wetland with a substrate of peat and they therefore constitute an important natural resource. The peat is acidic and is formed by anaerobic processes from the roots and leaves of sedges, *Phragmites* and *Typha* and other plant species, including woody species. In the Northern Hemisphere, under cold climatic conditions, peat is often formed by *Sphagnum* moss. Peat formed by *Sphagnum* is not common in South Africa, though *Sphagnum* does occur in certain plant communities in the Mfabeni swamp. To be classified as peat a substrate needs to have at least 30% carbon and a wetland can only be classified as a peatland if it has peat at least 30 cm deep (Backéus 1988). Peatlands are not only a source of water but also act as a carbon sink. Peatlands in South Africa are mostly used for grazing by livestock, though the peat may be mined to be used for horticulture. Certain wetland plants are also used as building material, mostly *Typha* and *Phragmites*, or for woven products such as baskets and mats, mostly Cyperaceae or *Juncus* as well as grasses and *Typha*. Peat is often mined for use as a growth medium in the mushroom industry. Peat is not used as a fuel in South Africa, which may be because of the preference for wood or lack of knowledge of this use. Peatlands are an important source of clean water, because it filters the water and the clean water is available to people who do not have access to water services.

It is important to protect peatlands from overexploitation, such as overgrazing, mining and cultivation, since this is such a rare commodity in South Africa (Grundling *et al* 1998, Grundling & Thamm 1995).

The occurrence of plant species in a certain area is controlled and influenced by environmental factors (Kent & Coker 1995). Species that are tolerant of a similar set of environmental conditions and are intolerant of another set of conditions would therefore be restricted to specific habitats and would not occur with species that favour other sets of conditions. The plant species that do occur together in an area form a plant community. The plant community represents an unique interaction of a specific plant species composition and an unique set of environmental variables, to form an ecosystem, which also forms a specific habitat for animal species (Bredenkamp & Brown 2001). It is therefore important to understand that a plant community is not only an indication of the plant species that occur in an area, but also of the environmental factors and the vertebrate and invertebrate faunal species. Plant communities can therefore be used as the fundamental units for the planning of Nature Reserves (Bredenkamp & Brown 2001).

In South Africa almost no vegetation surveys on the plant community level of organization, have been done on peatlands, though several reports have been published on wetland vegetation in general. Some studies have been done on peatland plant communities from the high altitudes in Lesotho (Backéus 1988, Van Zinderen Bakker & Werger 1974), but these temperate vegetation types are vastly different from the subtropical vegetation in the Greater St Lucia Wetlands Park. The only classification of swamp vegetation in this area was done for Mkuze swamp (Schoultz 2000), so there exists very limited information on the classification of peatland vegetation into plant communities to which the vegetation of Mfabeni can be compared. This study was therefore initiated to fill the gap in our knowledge on peatland vegetation on the community level of organization in South Africa in general, and in KwaZulu-Natal in particular.

1.2 Objectives

The aim of this study was to identify the plant communities present in the Mfabeni swamp, and where possible, to interpret them according to the particular

environmental conditions. This project forms part of the Impesa initiative, which is an initiative for the Identification and Mapping of Peatlands in southern Africa (Sliva 2002). The goals of Impesa are to make an inventory of the peatlands, to identify the key peatland areas in southern Africa and to develop and promote a network of research and management initiatives.

1.3 Rationale

Problem identification

Almost no studies have been done on the vegetation of peatlands in South Africa.

It is important to have an inventory of the plant communities with their specific plant species compositions, occurring in a World Heritage Site. This provides data on the biodiversity and habitat diversity of the site, and is also an inventory of the plant species and plant communities present, since this may have an influence on the management of the swamp.

Attempts to solve the problem

The existence and distribution of these communities should be explained by relating them to environmental conditions, as this will provide the inventory of the ecosystems present on the site. A vegetation survey and a plant community classification should therefore provide the information needed for inventory and management purposes.

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Chapter 2

Vegetation studies on peatlands in South Africa and Lesotho

In southern Africa there are very few phytosociological studies on the plant communities occurring on peat. However some species lists of plants occurring on peatlands have been compiled. These lists are mostly in unpublished reports and Environmental Impact Assessment reports of several sites in southern Africa. There are also incomplete plant species lists in published articles (Killick 1978, Jacot-Guillarmod 1962, Jacot-Guillarmod 1963, Van Zinderen Bakker 1981, Backéus & Grab 1995, Schwabe 1995). This is because the articles were mostly about other characteristics of the peatland and the vegetation cover is only mentioned briefly. In some articles or reports only the plants with specific uses, such as *Phragmites* and some of the sedges, which occur in the peatland are mentioned.

There is some confusion as to the different terminologies used in the description of peatlands. According to Backéus (1988) a mire is any peatforming wetland. The word "mire" is commonly used, but not always with the same definition. A mire can be either a bog or a fen. A bog is a peatland that receives water only by rain and is completely cut off from any other water source including groundwater. Another definition for a bog is for semi-aquatic vegetation occurring on acidic peat (Backéus 1988). Van Zinderen Bakker & Werger (1974) based their description of the bog vegetation in Lesotho on this definition. The first definition is widely preferred and according to this definition there are no bogs in Lesotho (Grundling & Marneweck 2003). A fen can be defined as vegetation on peat or, preferably, a peatland that has a source of water other than only rainwater. Peatlands in southern Africa are therefore considered to be fens (Backéus 1988). Some of the peatlands in southern Africa have also been named differently, including "swamp" and "vlei", though they may also be without peat. The terminology used is therefore often confusing.

2.1 Peatlands in South Africa

One of the few phytosociological studies done on peat was by Schoultz (2000). The vegetation of the eastern portion of the Mkuze wetland was sampled and the plant communities described. The Mkuze swamp forms part of the Greater Mkuze Wetland System on the Zululand Coastal Plain and is located north of Lake St Lucia. Nine communities that can be classified into three broad groups were described. The three groups are swamp forest, emergent herbaceous swamp/marsh and grassland floodplain communities. It was found that the duration and depth of flooding is an important environmental factor controlling the occurrence of the different plant communities. Fire and protection from the wind by high sand dunes also play a role in determining the occurrence of swamp forest or herbaceous swamp/marsh. The size of the sample plots was 100 m^2 for the forested areas and 25 m^2 for the swamp and grassland areas (Schoultz 2000).

In a recent study the pioneer vegetation on a rehabilitated peatland in the Rietvlei Nature Reserve was determined (Venter *et al.* 2003). The Rietvlei Nature Reserve is located just south of Pretoria in Gauteng. A baseline vegetation survey was done and a monitoring survey the following year. Three communities, each with two sub-communities, were found during the baseline study. A pioneer community dominated by weeds, a close-to-climax community dominated by *Phragmites* on deep peat and a close-to-climax community dominated by *Cyperus* and *Typha* occurring on a clay soil, exposed during peat mining operations in the past, were identified. The data for the two years, the baseline survey and the monitoring survey, were combined in a database and an ordination was done. It seems that succession is taking place and the pioneer community is moving towards the close-to-climax community dominated by *Phragmites* (Venter *et al.* 2003).

In a proposal to rehabilitate a railway servitude containing a peat wetland in the Colbyn valley wetland in Pretoria, a list of plant species found on this peatland is given. The peat as well as the hydrological regime of the peatland is described. The wetland is classified into 5 different zones. These zones are the riparian zone and floodplain, mixed sedge/grass meadow zone, tall emergent peatland zone, tall emergent (clay based) zone and the mixed damp grass/sedge zone. The functional values as well as the current status of the wetland were also investigated. The aim of the rehabilitation was to combat erosion by placing gabions in the erosion channels. This should also strengthen the railway line since the erosion is damaging the foundations of the railway (Grundling & Marneweck 2000).

In a study on the peat resources of KwaZulu-Natal 12 peatlands were investigated (Grundling *et al.* 1998). Some of these wetlands were disturbed or utilized and the type and degree of disturbance were noted in the report. The peatlands were mainly utilized for cultivation of bananas or other vegetables, harvesting of the peatland plants and as a source of clean water. Three different categories were identified: Swamp forest, reed/papyrus/bulrush and grass/sedge swamp. All of these peatlands could be fitted into one of these three general categories. The main species that contributed to peat formation are *Cyperus papyrus, Phragmites australis,* a combination of sedge species and the tree *Syzygium cordatum.* It is noted that the utilization of peatlands for harvesting and the production of vegetables may be unsustainable (Grundling *et al.* 1998), and a new project was initiated to investigate this problem (Grobler pers. com.)[1].

In a recent study of the peatlands in KwaZulu-Natal a section of the report is devoted to the flora of 5 sites. Two of the sites are at Mhlanga near Port Durnford and the others are located at Amatikhulu, Trafalgar Lot and Mpenjati respectively. The flora of each site is described in general and a plant species list

[1] Retief Grobler. Botany Department, University of Pretoria.

is given. The disturbance and threats of these peatlands are also noted (Grundling *et al.* 2000).

In various scoping reports or Environmental Impact Assessment reports some indication is given on the plant species present. For example, in a scoping report investigating the expansion of the Vindex peat mining operations at Rietfontein some plant species occurring in the peatland were noted. A short description of the peat resource and the wetland is given. Rietfontein is located near Bapsfontein in the Bronkhorstspruit District of Gauteng, at approximately 26°03' 05" S and 28°30'30' 'E. The classification of the wetland, its hydrological regime and the different habitat types and water quality, its functional values and the current status of the wetland were also mentioned (Marneweck 2000).

A list of plant species occurring on peatlands in South Africa is given in Table 2.1 (Appendix A).

2.2 Peatlands in Lesotho

Results of some phytosociological studies were published on the vegetation occurring on the peatlands in Lesotho. Van Zinderen Bakker and Werger (1974) sampled three alpine "bogs" 30 km north-west of Mokhotlong at an altitude of 3200 m. Twenty-eight plots were placed in these peatlands. The size of the plots was 25-100 dm². This size and the placement of the plots were chosen to avoid obvious heterogeneity in the vegetation and surface of the "bogs". Some bigger sample plots were also placed in the surrounding vegetation for comparison with the "bog" vegetation. A species list was compiled for every plot and the cover-abundance and sociability values recorded for every species. Three associations were identified on the peatlands, referred to as bogs, of Lesotho. These peatlands should rather be called fen according to the more general definition of bogs and fens (Backéus 1988). The first of these associations is the *Crassuletum natantis.* Under the alliance *Scirpo-Limosellion longiflora* the following associations were classified: *Ranunculetum meyeri* with the two subassociations

aponogetonetosum and *haplocarphetosum* and *Senecionetum cryptolanati* with the sub-associations *inops* and *merxmuelleretosum.* These associations were linked to variation in the depth of the water table. Disturbance and the possible formation of these peatlands are also mentioned in the text.

Backéus (1988) did a phytosociological study on the mire vegetation in the Thaba-Putsoa Range in Lesotho. Sample plots of 0.5m × 0.5m, 1m × 1m or 1.5m × 1.5m were used depending on the vegetation structure. The survey was done on low-altitude wetlands (ca 2200 m a.s.l), middle-altitude wetlands (at 2500 – 2600 m a.s.l) and two high-altitude mires (ca 3200 m a.s.l). Twelve communities were found with eight sub-communities: four in community 6, two in community 7 and two in community 9. The communities with *Merxmuellera macowanii* gave a peculiar character to the vegetation that was visible from far away. This is due to its big tussocks. Trampling and grazing on and around the wetlands can change their hydrological conditions and cause erosion. No hummocks and hollows were formed in the communities and this may be a result of a absence of hummock-forming species in the area and no frost heaving are taking place on these mires as in other areas of Lesotho. The wettest areas have open vegetation and comparable to "mud-bottoms". The ordination shows a moisture gradient in a semi-circle around 6a and 6b (*Merxmuellera macowanii* community). This is due to the presence of *Merxmuellera macowanii.* An ordination without these species it was found that the moisture gradient is straighter (Backéus 1988).

Two studies were conducted by Marneweck & Grundling (1999, 2000) in Lesotho. The first study investigated wetlands in the catchment areas of the Bokong, Maliba-Matšo and Motete, as well as rivers in the Leribe, Mokholong and Butha-Buthe districts. The second study overlapped with the above study areas, but different wetlands were investigated. These wetlands occurred in the upper catchments of the Maliba-Matšo, Motete, Motsoku & Khubela rivers in the Mokhotlong and Butha-Buthe districts. A total of 28 wetlands were sampled. The study was a baseline assessment of the current status of the wetland to

determine the current and potential threats to long-term conservation. The wetlands in this area play an important role in regulating the quality and quantity of water flowing to the Katse Dam. Many of these wetlands have been degraded by anthropogenic impacts that cause desiccation and erosion. They are degraded due to the disturbance of the new main roads in the area as well as livestock trampling and overgrazing. The wetlands are also important because they contribute to the biodiversity of the Maluti Mountain landscape and this type of wetlands is unique in southern Africa. They are therefore valuable both in terms of hydrology and biology. Rehabilitation of the wetlands was suggested as well as mitigatory measures for the road (Marneweck & Grundling 1999, 2000).

Killick (1978) made a few brief notes on the vegetation in Lesotho. Two "bog" communities were studied and some of the plant species are mentioned.

Jacot-Guillarmod studied the Larg and Tipperary "bogs" in Lesotho in 1962 and 1963 respectively. The functions and the vegetation of the "bogs" were noted as well as the impacts and disturbance of the "bogs". The main disturbances were grazing, diamond mining and prospecting, and the disturbance from the roads. The conservation needs of the peatlands were noted. These studies only included two types of peatlands and these peatlands differed from other types of peatlands that occur in Lesotho. Species characteristic of each part of the bog was named.

Wetlands in the areas of the Jorotane, Bokong and Senqunyane Rivers in the Likalaneng region of Lesotho were studied as part of the flora section of the EIA report for the Lesotho Highlands Water Project (Marneweck 1996). The potential impact of Phase 1B on the wetlands of the region was assessed and the conservation and functional importance of the wetlands were determined. A total of 24 wetlands were sampled and 74 species were found. The wetlands could be classified into 9 types: Footslope fen, Valleyhead fen, Midslope fen, Oxbow, Drainage line, Sheetrock depression, Marsh, Spring and Seep. A description is

given of each type of wetland, along with the disturbance (degradation), conservation and threats to each type. The threats include trampling, erosion and drainage of the wetlands. The plant communities in the wetlands were noted along with the dominant species. The habitat of each type was described as well as its terrain location, such as slope. The functions of the wetlands include groundwater storage, recharge and discharge, flood flow attenuation, wetland soil stabilization, sediment and toxin retention, nutrient removal and transformation and organic matter production and export. Each of these functions is discussed. Recommendations for the management of these wetlands are given with regard to the impacts on the wetlands, the degradation and the conservation value of each type. The only wetland that was not degraded was the spring. This is probably a result of the medicinal value the local people place on the spring. (Marneweck 1996).

A list of Lesotho peatland species is given in Table 2.2 (Appendix A).

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Chapter 3
Study area

3.1 Location

Mfabeni swamp is a peatland situated on the eastern shore of the St Lucia Lake, near Cape Vidal, in the Greater St Lucia Wetland Park. It is located between the lake and the tall, coastal dunes (Fig 1.1). The peatland is situated in the Hlabisa district, in the minor area Bhangazi (Baartman 1997) and is located at 24º09'44"S, 32º31'64"E, at an altitude of 20 m. The Park is situated along the north-eastern coast of KwaZulu-Natal and it stretches from south of the St Lucia town, northwards to the Mozambique border.

3.2 Climate

The swamp forms a peatland, which is located in a subtropical climate. Approximately 60% of the rainfall occurs in summer (Grundling 1997). The average monthly temperature is given in Fig 3.1 and the average monthly rainfall is given in Fig 3.2. An average of 1424 mm of rainfall per year was recorded over a 29 year period. The average maximum humidity is normally between 96 and 98% and the average minimum humidity range between 30 and 59%. Hail is a very rare occurrence, but fog and thunderstorms are more numerous (South African Weather Bureau 1990).

3.3 Geomorphology

Mfabeni swamp occurs on a paleochannel that incised into grey clay that is probably of Cretaceous age. The underlying clay assists the accumulation of peat due to its impermeability. The paleochannel runs parallel with the sand ridges of Holocene age, Sibayi Formation and the incision of the channel could be of earlier Pleistocene age (Grundling 1997, Grundling *et al.* 2000). Mfabeni does not have the underlying dune topography of KwaMbonambi Formation that occur commonly underneath peatlands in Maputaland (Grundling *et al.* 2000).

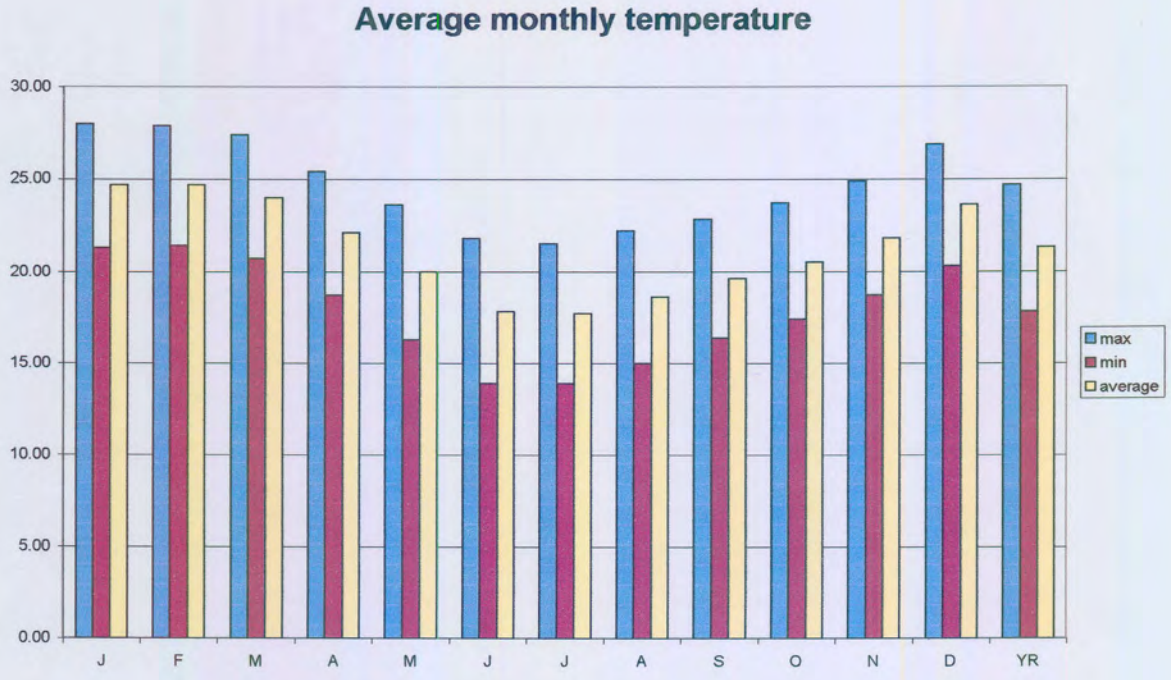

Fig 3.1. The average monthly temperature of St Lucia, as well as the yearly average, over a 29 year period (South African Weather Bureau 1990).

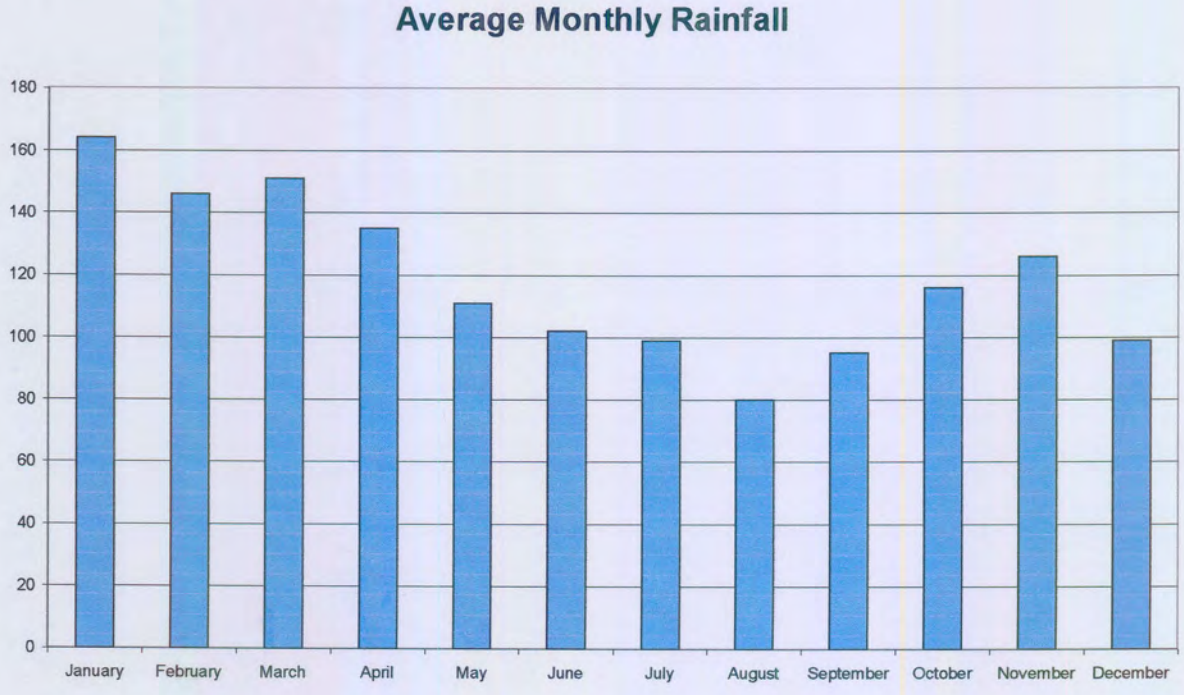

Fig 3.2. The average monthly rainfall of St Lucia over a 29 year period (South African Weather Bureau 1990).

3.4 Hydrology

The doming of the peatland is caused by the capillary action and water holding capacity of the peat. Due to this doming the surface water drains to the eastern and western sides of the peatland. The water is channelled on the edges of the peatland and the doming causes the water on the eastern side of the swamp to flow northwards into Lake Bhangazi. On the western side of the swamp the water flows in the Nkazana stream to Lake St Lucia at Catalina Bay in the south (Grundling 1997). Different vegetation types occur along the streams and central dome area.

3.5 Peat stratigraphy

The peatland has both a main basin and a sub-basin. The shallower, smaller sub-basin is located in the north-eastern part of the peatland. The peat depth in the main basin is about 10.8 m and 2.5 m in the sub-basin. The main basin has steep sides in the east and west, declining by approximately 10 m in 150 m. Grundling (1997) gives a detailed description of the peat stratigraphy of Mfabeni. The peatland has a very consistent layering across the length, width and depth of the peatland. The different layers are described in terms of the inorganic content and fibrous nature of peat. In the length profile seven distinct layers are recognised. A sandy peat layer of about 1 m deep starts at 3.95 m and is an indicator of higher energy flow at the time it was formed. The age is about 11 000 years BP, at the Holocene-Pleistocene boundary. Sand lenses in the central part of the peatland show fluctuating energy levels and environments during the late Pleistocene. In some cases the sand layers are linked to certain peat layers and this indicate changing conditions and climatic cycles. Ash layers in the profiles indicate that the peat dried out and therefore that the climate has been drier, and the vegetation burned. It seems that the northern part of the peatland was affected most by these changes in the environment. The ash layers are present in the western portion of the swamp in both the Pleistocene and Holocene age layers. The carbon dating close to the bottom shows a reversal of ages and this is probably due to a reworking of the peat. This reversal can be associated with

higher energy flows as indicated by the sand lenses at 7.5 - 8.5 m depth. The different peat layers are indicative of different environmental conditions and plant species composition. A layer with wood nodules and bog iron indicates that the whole swamp was covered by swamp forest approximately 2 500 years BP. This forest has since declined to the western part of the swamp, where it still occurs today. This is probably due to changes in the environmental conditions such as hydrology (Grundling 1997).

3.6 Origin

The following description is based on an account of Taylor (1991). Lake St Lucia formed in two distinct stages. The first stage was during the Cretaceous Era (about 140 mil years ago). At this stage the Western Shores was a marine environment as illustrated by the fossil deposits in this area. The lake, Eastern shores and the Mkuze swamps just north of the lake has more recent origins. The lake in its present form resulted from the changing sea levels associated with the various ice ages and the different wet and dry periods of the past two million years. At some stage the sea level dropped by about 150 m and the Western Shores were exposed and formed part of the coastline. The rivers in the areas cut deep valleys due to this drop, and when the sea level rose again the valleys were flooded. A large bay formed which is now False Bay. About 125 000 years ago the sea level rose to two meters higher than the present sea level and False Bay was a tropical marine habitat. At about 80 000 years ago the sea level was relatively stable and shell debris accumulated on the beaches and the sand fused together into sandstone. The sandstone is the same rock that occurs in the present-day surf zone and forms the offshore reefs. The rock was a trap for sand carried in the currents and the deposited sand formed a barrier on which the coastal dunes grew. The barrier enclosed a lagoon and the lagoon became Lake St Lucia. Two of the lake rivers created a way through the barrier to the sea: the Umfolozi, near the existing mouth and the Mkuze, north of the lake. This occurred about 25 000 years ago. Wind-blown sand and river sediments have since build up the dues and the lake has become shallower. The northern parts

of the lake have silted up to become the Mkuze swamps and the river has been diverted into a lower portion of the lake. The mouth of the river closed and the only evidence of the mouth is the sub-marine canyon off Leven Point (Taylor 1991).

3.7 Palaeopalynology

The following description is based on an account of Grundling *et al.* (1998). In a pollen analysis on the Mfabeni peatland more than a hundred samples were taken to a depth of 10 m, prepared and analysed. A description of the pollen in the different layers is given (Grundling *et al.* 1998). It is concluded that the site was exposed to the sea about 43 000 years ago, due to the absence of pollen and the presence of foraminifers in the bottom part of the profile. From 43 000 to 41 000 BP the dryland vegetation established in the area and was a hydromorphous forest composed of *Podocarpus*, *Celtis* and other forest trees. *Typha* pollen was found as part of the aquatic community and this indicates freshwater conditions in the swamp. In the part of the peat profile representing 41 000 to 33 000 years BP the peat has been reworked and the pollen data are therefore not very reliable. The pollen data does however show that the hydromorphous forest still existed. The vegetation changed significantly, after 33 000 years BP, to a grassland with herbs and bulbs. The floristic composition are indicative of a cool, dry climate and it suggested a lowering of the Ericaceous belt during the Late Pleistocene. Between 20 800 and 11 570 years ago the aquatic pollen increased and this suggest that a higher water table was present in the mire. From 11 570 and 5 000 years BP the hydromorphous forest expanded in the area and began emigrating from the area. Approximately 2 450 years ago the forest decreased and hydrophilous grasses and sedges increased. The swamp forest appeared around 600 years ago and is composed of species such as *Syzygium, Ficus* and *Myrica* (Grundling *et al.* 1998).

According to the palaeopalynology the peatland formed approximately 45 000 years ago and was exposed to the sea till 43 000 years ago. According to the

fossilbeds and theories about the formation of St Lucia the barrier that became the eastern shores formed a bit later. The river mouths formed around 25 000 years BP. Although the two sets of dates are compatible, they do raise some questions as to the precise dates and the correct theories. Both sets of dates can be correct, but both theories should be combined to give a more precise picture of how the Eastern Shores formed.

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Chapter 4
Methods

4.1 Sampling

Major ecosystems, probably representing groups of associated plant communities, were identified and stratified on digital aerial photographs (Fig 4.1). A total of 7 of these major ecosystems were identified. Sample plots were placed randomly within each of these major ecosystems. The sample plots were placed in areas where the vegetation was relatively homogeneous and where it differed visibly from the vegetation of other, adjacent areas. Often differences in vegetation may occur over a very small area and this variation cannot be observed on the aerial photographs. Patches with different vegetation were therefore selected in the field and sampled.

A total of 201 plots were sampled in the peatland east of the swamp forest, 10 plots in the swamp forest and three plots in the peatland west of the swamp forest. The locations of the relevés are indicated in Figure 4.2.

Different sample plot sizes have been used in South Africa and Lesotho for vegetation studies on peatlands. Schoultz (2000) used sample plots of 100 m^2 in forested areas and 25 m^2 in swamp and grassland areas in a study of the Mkuze Wetland System. Venter *et al.* (2003) used 4 m x 4 m plots in a disturbed peatland at Rietvlei Nature Reserve near Pretoria and sample plots of 0.5 m x 0.5 m to 1 m x 1 m were used in a study on the "bog" vegetation in Lesotho by Van Zinderen Bakker and Werger (1974). Bakéus (1988) used plots of 0.5 m x 0.5 m, 1 m x1 m or 1.5 m x 1.5 m depending on vegetation structure in a study on the peatlands in Lesotho in 1988.

In this study the sample plot sizes were 1 m × 1 m for the peatland vegetation. This plot size was selected, because most of the species of a particular plant community do occur in this size plot. Larger plot sizes would often include

species of other communities and would result in mixed relevés and therefore give an inaccurate representation of the floristic composition of the community, and also cause problems with the numerical classification. A plot size of approximately 10 m x 10 m was used to sample the swamp forest.

The position of each sample plot was determined by GPS, except in the swamp forest where the tree canopy screened the signal from the satellites.

A relevé was compiled in each sample plot. All the plant species present in the sample plots and their Braun-Blanquet cover abundance values were noted (Werger 1974, Westhoff & Van der Maarel 1978), as well as the (current) depth of the water on the site. Plant species were identified by using field identification guides. Herbarium specimens were made of plant species that could not be identified and these specimens were identified at the herbarium of Ezemvalo KwaZulu-Natal Wildlife at St Lucia, the Schweickerdt herbarium at the University of Pretoria and the National herbarium of the National Botanical Institute in Pretoria.

During the last fieldwork session (after the plant communities have been identified by classification (TWINSPAN and Braun-Blanquet) methodology) environmental variables were measured in the different, identified, plant communities of the swamp. The pH, conductivity, dissolved oxygen and water depth was measured, using appropriate field instruments, in different parts of the swamp and the specific plant community at each of these sites was recorded. The sub-communities were not noted since they are difficult to identify in the field. The locations of the water sample points are indicated in Figure 4.2.

Fig 4.1. Aerial photograph of Mfabeni swamp.

Fig 4.2. Location of vegetation and water sample plots in Mfabeni peatland.

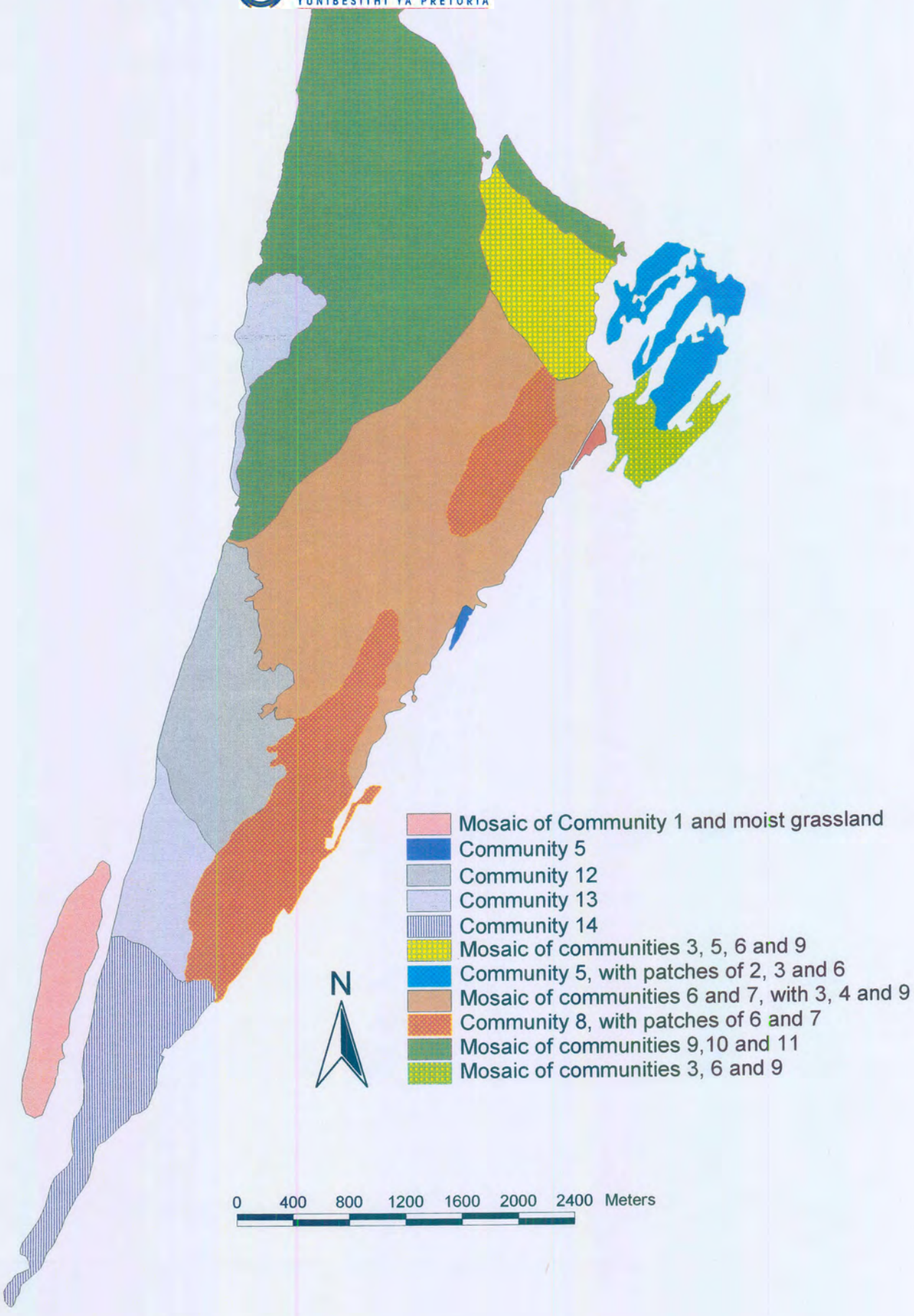

Fig 4.2. Location of vegetation and water sample plots in Mfabeni peatland.

4.2 Data analysis

The floristic data from each sample plot were captured into the vegetation database Turboveg for Windows (Hennekens 1996a, Hennekens & Schaminee 2001). This entire database was exported as a Cornell Condensed species file into a working directory in MEGATAB (Hennekens 1996b).

A Twinspan classification (Hill 1979b), incorporated in MEGATAB, was used to obtain a first approximation of the plant communities occurring in the area. This classification was used to compile a table using the Braun-Blanquet method (Werger 1974, Westhoff & Van der Maarel 1978) in the data editor program MEGATAB (Hennekens 1996b). The final phytosociological table indicates the different identified plant communities, as well as the floristic variation within each community and the relationships between communities. A dendrogram was drawn to illustrate the hierarchical levels of this classification. Based on the major divisions in the hierarchical classification, the table was divided into five parts. The data in each of the parts were classified separately, using TURBOVEG (Hennekens 1996a), TWINSPAN (Hill 1979b) and MEGATAB (Hennekens 1996b), to clearly indicate the different communities and the differences between the sub-communities within the communities. The communities with their sub-communities and variants were then described, according to their diagnostic species, dominant species and associated species. To indicate the relationships between the communities presented in different phytosociological tables, an appropriate synoptic table was compiled using MEGATAB (Hennekens 1996b).

The different sample plots and the plots where the environmental variables were measured, were mapped on the aerial photographs using the GIS program ArcView.

A DECORANA ordination (Hill 1979a) was done on the data set, using the ordination program PCOrd (McCune & Mefford 1999), to illustrate the probable gradients between the communities. Since the sample plots were not the same

for the vegetation data and the environmental data, the environmental data could not be overlaid on this ordination. The indicator values (Dufrene & Legendre 1997) of the species in the different communities were tested using PCOrd and a Monte Carlo Test of significance was done on this data. The species with significant values in the Monte Carlo test and high values in the indicator tests are those species that are indicators of the different communities. These species are often the diagnostic and the dominant species in a community.

The habitat data were captured into PCOrd and analysed by applying Reciprocal Averaging (RA), (Hill 1973) and Principal Components Analysis (PCA) (Orlóci 1966). Since an ordination cannot be run on negative values the data of dissolved oxygen values were normalised by adding a value of 20 to all values. The three different types of PCA were used: centered (variance/covariance), non-centered and correlation. By using PCOrd, the different identified plant communities were overlain over the ordination graphs to determine the environmental gradients.

Major plant communities (Chapter 5) were described in terms of distribution, broad habitat, diagnostic species, species with significant indicator value and dominant species.

A detailed classification with sub-communities is presented in Chapter 6. Here a more detailed quantitative description of habitat factors are given, and analysis of the sub-communities included.

Plant community names are based on diagnostic and/or dominant species, while the structural component of the name is based on and adapted from the classification of Edwards (1983). No attempt was made to formalize plant community names according to the International Code for Syntaxonomic Nomenclature, due to the limited knowledge on peatland vegetation, on the community level, in southern Africa.

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Chapter 5

Results: Major plant communities on the Mfabeni swamp

In this chapter the major plant communities are identified and described. A detailed analysis of each major community, with the proposed subdivision into sub-communities, is given in Chapter 6.

5.1 Classification

As mentioned in the methods the data were classified using TWINSPAN to produce a first approximation of the plant communities. The results are presented in a dendrogram (Figure 5.1). The default TWINSPAN analysis was not sufficient for two of the groups to make divisions between all the plant communities and another TWINSPAN was done on these groups. A total of 28 groups resulted and these groups represent 14 communities. The first division of TWINSPAN was between the swamp forest and the rest of the swamp. As can be expected, the tree-dominated swamp forest is not only structurally, but also floristically quite different from the sedge-dominated swamp.

Swamp forest

Further division of the relevés representing the swamp forest resulted in splitting of the *Barringtonia racemosa*-dominated forest, which occurs along flowing streams, from the rest of the forest. In the following division the drier *Syzygium cordatum*-dominated and the wetter *Ficus trichopoda*-dominated vegetation were distinguished.

Sedge-dominated swamp

The second division (within the sedge-dominated swamp) was between the unique *Restio zuluensis* community on the western side of the swamp forest and the rest of the sedge-dominated swamp. The next division in the swamp was between the communities 9 (*Cladium mariscus*-dominated), 10 (*Cyperus prolifer-*

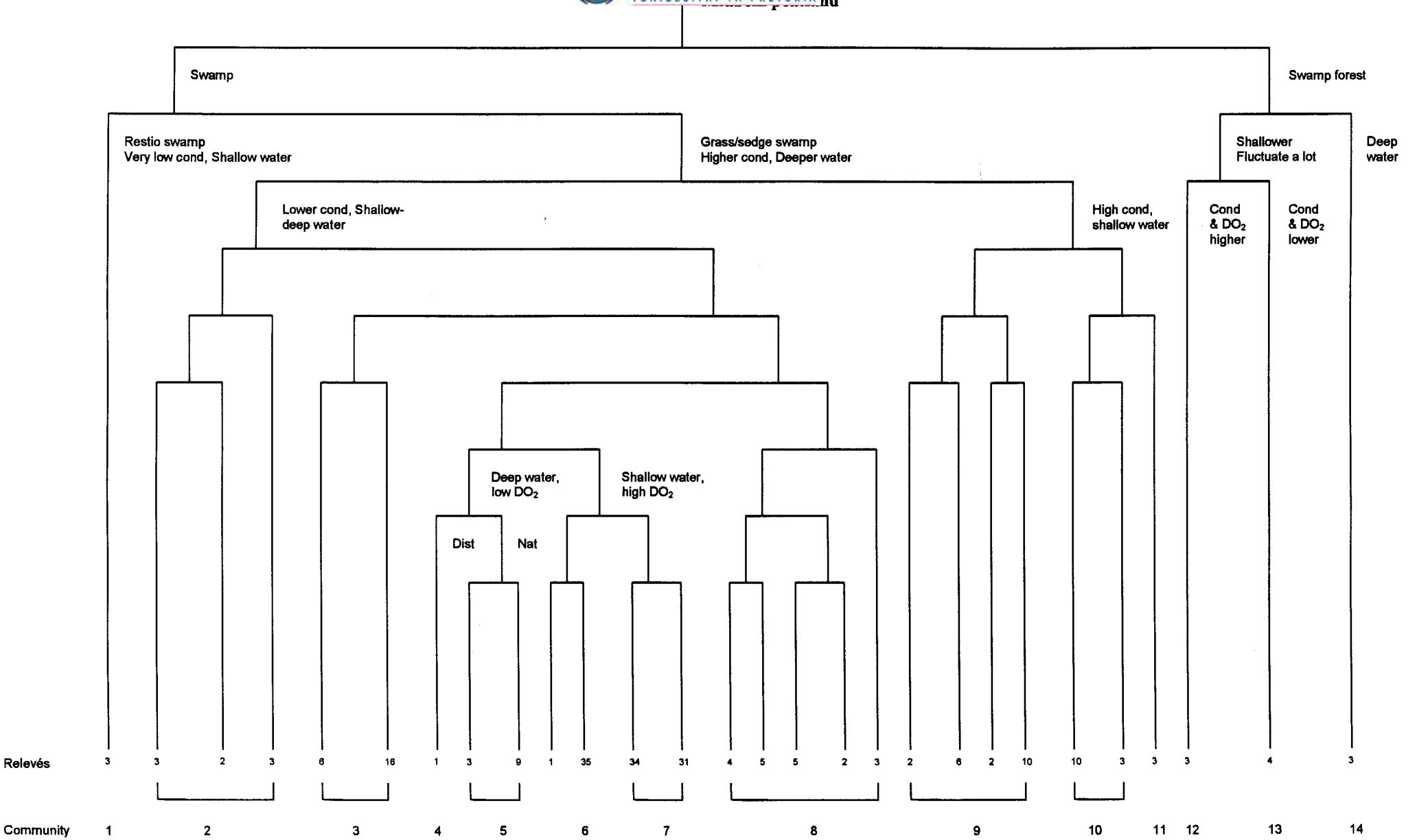

Fig 5.1. Dendrogram illustrating the hierarchical classification of the communities on Mfabeni swamp. Dist=Disturbed, Nat=Natural.

dominated) and 11 (*Cyperus fastigiatus*-dominated) and the rest of the swamp, occurring in more stagnant conditions.

The divisions of TWINSPAN mostly do not correlate well with the measured environmental variables. When there is a correlation at these levels, it is mostly a weak correlation with water depth, although conductivity and dissolved oxygen also have a small influence.

Communities 10 (*Cyperus prolifer*-dominated) and 11 (*Cyperus fastigiatus*-dominated), however, seem to be correlated with flowing water, where-as this is not so obvious in Community 9 (*Cladium mariscus*-dominated).

In the other group (Communities 2-8) (see Fig 5.1) that occurs in more stagnant water, Community 2 (*Scleria poiformis*-dominated) is separated from the rest of the communities. Hereafter Community 3 (*Rhynchospora holoschoenoides*-dominated) which occurs in shallow water that fluctuates a lot, is separated. In the next division Community 8 where *Sphagnum truncatum* is dominant, is separated from Communities 4-7. These communities are fairly similar, though are distinguished by dominance of different species. Communities 4 and 5 (respectively dominated by *Typha capensis* and *Eleocharis dulcis*) occur in stagnant, though somewhat deeper water, with the *Typha capensis* associated with deep, stagnant Hippopotamus pools and disturbed areas. Communities 6 and 7 (respectively dominated by *Rhynchospora corymbosus* and *Fimbristylis bivalvis*) are closely related as they are widespread over the entire swamp area in shallow, stagnant water.

Refinement of the TWINSPAN result

The result of the TWINSPAN was further refined using MEGATAB to do a manual editing of the table by applying Braun-Blanquet procedures. The only refinement needed was to move relevé 17 from a single relevé group to a group representing sub-community 7.2. MEGATAB facilitated the compilation of a

synoptic table (Table 5.1) which summarises the final classification, and provides the diagnostic species for each major community, as well as the distribution of the species in the communities identified.

The major communities recognised, are the following:

1. *Restio zuluensis – Andropogon appendiculatus* closed low sedge and grass peatland
2. *Scleria poiformis* closed tall sedge peatland
3. *Rhynchospora holoschoenoides* open to closed short sedge peatland
4. *Typha capensis – Ludwigia octovalvis* closed high peatland
5. *Eleocharis dulcis* closed tall sedge peatland
6. *Rhynchospora corymbosa* closed low sedge peatland
7. *Fimbristylis bivalvis* open to closed short sedge peatland
8. *Sphagnum truncatum – Xyris natalensis* closed short moss peatland
9. *Cladium mariscus* closed high sedge peatland
10. *Cyperus prolifer* closed short sedge peatland
11. *Cyperus fastigiatus* closed tall sedge peatland
12. *Syzygium cordatum –Stenoclaena tenuifolia* swamp forest
13. *Ficus trichopoda –Nephrolepis biserrata* swamp forest
14. *Barringtonia racemosa – Bridelia micrantha* swamp forest

The results for the indicator values test in PCOrd are presented in Table 5.2. The results of the Monte Carlo test of significance are presented in Table 5.3. The relative abundance and relative frequency are presented in Tables 5.4. and 5.5 respectively (Appendix B).

The results of the indicator values give the percentage of perfect indication of a species in the group. This value is based on the combined values of the relative abundance and relative frequency presented in tables 5.4. and 5.5 (Appendix B). The Monte Carlo test of significance gives an indication of the significance of the

Table 5.1: Syntable of the communities occuring in the Mfabeni swamp.

Community	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Number of relevés	3	8	22	2	12	35	66	20	20	13	3	3	4	3
Species group A														
Restio zuluensis	100	.	.	.	.	.	.	.	.	.	.	.	.	.
Andropogon appendiculatus	100	.	.	.	.	.	.	.	.	.	.	.	.	.
Neurotheca schlechteri	67	.	.	.	.	.	.	.	.	.	.	.	.	.
Trichopteryx dregeana	67	.	.	.	.	.	.	5	.	.	.	.	.	.
Selaginella species	33	.	.	.	.	.	.	.	.	.	.	.	.	.
Thesium natalense	33	.	.	.	.	.	.	.	.	.	.	.	.	.
Dierama species	33	.	.	.	.	.	.	.	.	.	.	.	.	.
Oldenlandia rosulata	33	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentified Poaceae 4	33	.	.	.	.	.	.	.	.	.	.	.	.	.
Vernonia oligocephala	33	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group B														
Scleria poiformis	.	100	.	.	.	.	.	.	.	.	.	.	.	.
cf Dactylotenium species	.	25	.	.	.	.	.	.	.	.	.	.	.	.
Hemarthria altissima	.	13	.	.	.	.	.	.	.	.	.	.	.	.
Species group C														
Rhynchospora holoschoenoides	.	.	100	.	.	6	8	15	.	.	.	.	.	.
Juncus kraussii	.	.	5	.	.	.	.	.	.	.	.	.	.	.
Species group D														
Typha capensis	.	.	.	100	.	.	.	.	.	.	.	.	.	.
Polygonum species	.	.	.	50	.	.	.	.	.	.	.	.	.	.
Unidentified Poaceae 1	.	.	.	50	.	.	.	.	.	.	.	.	.	.
Pycreus polystachyos	.	.	.	50	.	6	6	.	.	.	.	.	.	.
Species group E														
Eleocharis dulcis	.	63	9	50	100	29	15	.	25	.	33	.	.	.
Nymphaea nouchali	.	.	.	.	42	.	2	.	.	.	.	.	.	.
Utricularia species	.	.	.	.	42	.	.	5	.	.	.	.	.	.
Species group F														
Rhynchospora corymbosa	.	13	14	.	.	97	42	30	5	8	.	.	.	.
Species group G														
Fimbristylis bivalvis	.	.	36	.	.	31	80	40	.	.	.	.	.	.
Pycreus nitidus	.	.	.	.	.	.	5	.	.	.	.	.	.	.
Unidentified Poaceae 2	.	.	.	.	.	.	3	.	.	.	.	.	.	.
Species group H														
Sphagnum truncatum	.	.	.	.	.	.	2	100	5	.	.	67	.	.
Xyris natalensis	100	.	.	.	.	.	2	75	.	.	.	.	.	.
Rhynchospora brownii	.	.	.	.	.	3	3	45	.	.	.	.	.	.
cf Pentodon species	.	.	.	.	.	.	2	35	.	.	.	.	.	.
Andropogon huillensis	.	.	.	.	.	3	.	30	.	.	.	.	.	.
Unidentified species 1	.	.	.	.	.	.	.	15	.	.	.	.	.	.
Hypericum species	.	.	.	.	.	.	.	15	.	.	.	.	.	.
cf Laurembergia repens	.	.	.	.	.	.	2	10	.	.	.	.	.	.
Xyris anceps	.	.	.	.	.	.	.	10	.	.	.	.	.	.
Disa woodii	.	.	.	.	.	.	.	10	.	.	.	.	.	.
Nymphoides thunbergiana	.	.	.	.	.	.	.	5	.	.	.	.	.	.
Drosera madagascariensis	.	.	.	.	.	.	.	5	.	.	.	.	.	.
Species group I														
Utricularia prehensilis	.	.	.	.	.	.	3	5	.	.	.	.	.	.
Eulophia angolensis	.	.	.	.	.	.	9	5	.	.	.	.	.	.
Species group J														
Cladium mariscus	.	.	5	.	.	.	3	5	100	54	33	.	.	.
Ficus verruculosa	.	.	.	.	.	.	.	.	10	.	.	.	.	.
Zantedeschia species	.	.	.	.	.	.	.	.	5	.	.	.	.	.
Species group K														
Cuscuta campestris	.	.	5	.	.	29	27	35	20	.	.	.	.	.
Ischaemum species	.	.	5	.	.	3	8	15	5	.	.	.	.	.
Fuirena cf hirsuta	.	.	27	.	25	37	11	.	10	.	.	.	.	.

Species group L																	
Ischaemum fasciculata	33	13	9	.	.	6	6	.	5	.	.	.	.	.			
Species group M																	
Thelypteris interrupta	.	.	.	50	.	.	2	.	45	69	33	100	50	67			
Cyperus prolifer	.	.	.	.	.	.	2	.	15	100	67	100	.	.			
Senecio deltiodes	.	.	.	50	.	.	.	.	5	46	.	.	.	33			
Unidentified Poaceae 3	.	.	.	.	.	.	.	.	.	39	.	.	.	.			
Species group N																	
Pycreus nitidus	.	13	77	.	50	77	58	55	10	23	.	.	.	.			
Schoenoplectus brachyceras	.	50	5	.	58	49	56	30	15	31	.	.	.	.			
Panicum brevifolium	.	.	51	50	.	63	39	65	45	15	.	.	.	.			
Panicum parvifolium	67	.	.	.	.	.	.	30	.	.	.	.	.	.			
Leersia hexandra	.	25	14	50	67	69	74	30	25	77	.	.	.	.			
Species group O																	
Cyperus fastigiatus	.	.	.	50	17	.	.	.	.	31	100	.	.	.			
Species group P																	
Cynodon dactylon	.	13	5	.	33	43	79	50	30	.	33	.	.	.			
Ludwigia octovalvis	.	.	.	50	.	.	2	.	.	.	33	.	.	.			
Phragmites australis	.	.	18	.	8	14	44	5	35	46	33	.	.	.			
Persicaria serrulata	.	13	.	100	.	.	.	.	40	.	100	.	.	.			
Species group Q																	
Syzygium cordatum	.	.	.	.	.	.	.	.	.	.	.	100	25	100			
Rapanea melanophloeos	.	.	.	.	.	.	.	.	.	.	.	33	.	.			
Dichrostachys cinerea	.	.	.	.	.	.	.	.	.	.	.	33	.	.			
Erianthemum dregei	.	.	.	.	.	.	.	.	.	.	.	33	.	.			
Species group R																	
Nephrolepis biserrata	.	.	.	.	.	.	.	.	.	.	.	33	100	33			
Ficus trichopoda	.	.	.	.	.	.	.	.	.	.	.	.	100	33			
Thamnocalamus tessellata	.	.	.	.	.	.	.	.	.	.	.	.	100	100			
Eugenia species	.	.	.	.	.	.	.	.	.	.	.	.	50	.			
Senecio deltoideus	.	.	.	.	.	.	.	.	.	.	.	.	50	.			
Trema orientalis	.	.	.	.	.	.	.	.	.	.	.	.	50	.			
Rhus species	.	.	.	.	.	.	.	.	.	.	.	.	25	.			
Cyperus species	.	.	.	.	.	.	.	.	.	.	.	.	25	.			
Cassipourea gummiflua	.	.	.	.	.	.	.	.	.	.	.	.	25	.			
Cussonia spicata	.	.	.	.	.	.	.	.	.	.	.	.	25	.			
Schefflera umbellifera	.	.	.	.	.	.	.	.	.	.	.	.	25	.			
Unidentified species 2	.	.	.	.	.	.	.	.	.	.	.	.	25	.			
Unidentified species 3	.	.	.	.	.	.	.	.	.	.	.	.	25	.			
Macaranga capensis	.	.	.	.	.	.	.	.	.	.	.	.	25	.			
Species group S																	
Englerophytum natalense	.	.	.	.	.	.	.	.	.	.	.	67	50	.			
Voacanga thouarsii	.	.	.	.	.	.	.	.	.	.	.	33	75	.			
Morella serrata	.	.	.	.	.	.	.	.	.	.	.	100	25	.			
Species group T																	
Bridelia micrantha	.	.	.	.	.	.	.	.	.	.	.	.	25	100			
Rhoicissus species	.	.	.	.	.	.	.	.	.	.	.	.	25	100			
Barringtonia racemosa	.	.	.	.	.	.	.	.	.	.	.	.	.	100			
Antidesma venosum	.	.	.	.	.	.	.	.	.	.	.	.	.	67			
Setaria megaphylla	.	.	.	.	.	.	.	.	.	.	.	.	.	67			
Phoenix reclinata	.	.	.	.	.	.	.	.	.	.	.	.	.	67			
Ficus natalensis	.	.	.	.	.	.	.	.	.	.	.	.	.	67			
Ekebergia pterophylla	.	.	.	.	.	.	.	.	.	.	.	.	.	67			
Rothmannia fischeri	.	.	.	.	.	.	.	.	.	.	.	.	.	67			
Canavalia bonariensis	.	.	.	.	.	.	.	.	.	.	.	.	.	33			
Dalbergia armata	.	.	.	.	.	.	.	.	.	.	.	.	.	33			
Lygodium microphyllum	.	.	.	.	.	.	.	.	.	.	.	.	.	33			
Oplismenus hirtellus	.	.	.	.	.	.	.	.	.	.	.	.	.	33			
Tarenna pavettoides	.	.	.	.	.	.	.	.	.	.	.	.	.	33			
Ficus sur	.	.	.	.	.	.	.	.	.	.	.	.	.	33			
Ficus burtt-davyi	.	.	.	.	.	.	.	.	.	.	.	.	.	33			
Chlorophytum species	.	.	.	.	.	.	.	.	.	.	.	.	.	33			

Species group U			
Ipomoea mauritiana	75	67	
Secamone species	75	67	
Polypodium species	25	33	
Allophylus dregeanus	25	33	
Psychotria capensis	50	100	
Trimeria grandifolia	25	67	
Rauvolfia caffra	25	33	
Species group V			
Stenocleana species	100	100	100
Smilax anceps	67	75	33
Kraussia floribunda	100	25	67
cf Behnia species	33		33
Tabernaemontana elegans	33		33

Table 5.2. The indicator values of each species in the communities as calculated in PCOrd.

INDICATOR VALUES				Group													
Sequence:				1	2	3	4	5	6	7	8	9	10	11	12	13	14
Identifier:				7	6	9	4	3	5	8	10	11	2	13	14	1	12
Number of items:				66	35	20	2	22	12	20	13	3	8	4	3	3	3
Column	*Avg*	*Max*	*MaxGrp*														
1 CUSCCAM0	*2*	*12*	*7*	12	4	1	0	0	0	12	0	0	0	0	0	0	0
2 CYNODAC0	*4*	*37*	*7*	**37**	8	3	0	0	1	4	0	1	1	0	0	0	0
3 ELEODUL0	*6*	*71*	*5*	0	2	0	4	0	**71**	0	0	2	3	0	0	0	0
4 FUIRHIR0	*2*	*16*	*6*	1	16	0	0	11	2	0	0	0	0	0	0	0	0
5 PYCRPOL0	*3*	*42*	*4*	0	0	0	**42**	0	0	0	0	0	0	0	0	0	0
6 SCHUBRA0	*4*	*24*	*5*	21	4	0	0	0	24	1	1	0	2	0	0	0	0
7 UROH/SP0	*3*	*13*	*8*	10	7	3	2	10	0	13	2	0	0	0	0	0	0
8 FESTCOS0	*4*	*20*	*7*	20	9	1	8	0	7	1	14	0	2	0	0	0	0
9 RHYOCOR0	*7*	*89*	*6*	2	**89**	0	0	0	0	0	0	0	0	0	0	0	0
10 CLAIMAR0	*6*	*78*	*9*	0	0	**78**	0	0	0	0	8	2	0	0	0	0	0
11 FIMBBIV0	*5*	*60*	*7*	**60**	1	0	0	2	0	8	0	0	0	0	0	0	0
12 NYMPNOU0	*3*	*42*	*5*	0	0	0	0	0	**42**	0	0	0	0	0	0	0	0
13 PYCRNIT0	*4*	*22*	*6*	11	22	0	0	11	10	8	1	0	0	0	0	0	0
14 LUDWOCT0	*3*	*46*	*4*	0	0	0	**46**	0	0	0	0	2	0	0	0	0	0
15 PERCSER0	*6*	*61*	*4*	0	0	4	**61**	0	0	0	0	25	0	0	0	0	0
16 TYPHCAP0	*7*	*100*	*4*	0	0	0	**100**	0	0	0	0	0	0	0	0	0	0
17 PHRGAUS0	*3*	*10*	*7*	10	1	9	0	1	0	0	10	4	0	0	0	0	0
18 RHYOHOL0	*7*	*99*	*3*	0	0	0	0	**99**	0	0	0	0	0	0	0	0	0
19 ISCH/SP0	*1*	*3*	*7*	3	0	1	0	1	0	2	0	0	0	0	0	0	0
20 UNIDPOA2	*0*	*3*	*7*	3	0	0	0	0	0	0	0	0	0	0	0	0	0
21 EULOANG0	*1*	*6*	*7*	6	0	0	0	0	0	2	0	0	0	0	0	0	0
22 PANIBRE0	*0*	*5*	*3*	0	0	0	0	5	0	0	0	0	0	0	0	0	0
23 RHYOBRO0	*3*	*41*	*8*	0	0	0	0	0	0	**41**	0	0	0	0	0	0	0
24 JUNCKRA0	*0*	*5*	*3*	0	0	0	0	5	0	0	0	0	0	0	0	0	0
25 UTRI/SP0	*3*	*40*	*5*	0	0	0	0	0	**40**	0	0	0	0	0	0	0	0
26 SPHGTRU0	*7*	*88*	*8*	0	0	0	0	0	0	**88**	0	0	0	0	0	0	4
27 XYRINAT0	*6*	*65*	*8*	0	0	0	0	0	0	**65**	0	0	0	0	0	13	0
28 DROEMAD0	*0*	*5*	*8*	0	0	0	0	0	0	5	0	0	0	0	0	0	0
29 PENO/SP0	*2*	*33*	*8*	0	0	0	0	0	0	**33**	0	0	0	0	0	0	0
30 PANIPAR0	*3*	*31*	*1*	0	0	0	0	0	0	16	0	0	0	0	0	**31**	0
31 HYPI/SP0	*1*	*15*	*8*	0	0	0	0	0	0	15	0	0	0	0	0	0	0
32 TRIPDRE0	*4*	*56*	*1*	0	0	0	0	0	0	1	0	0	0	0	0	**56**	0
33 THEYINT0	*4*	*17*	*10*	0	0	5	14	0	0	0	17	2	0	3	6	0	16
34 FICUVER0	*0*	*5*	*9*	0	0	5	0	0	0	0	0	0	0	0	0	0	0
35 ISCHFAS0	*1*	*6*	*1*	2	0	0	0	2	0	0	0	0	1	0	0	6	0
36 UTRIPRE0	*0*	*2*	*7*	2	0	0	0	0	0	1	0	0	0	0	0	0	0
37 ANDPHUI0	*2*	*29*	*8*	0	0	0	0	0	0	**29**	0	0	0	0	0	0	0
38 DISAWOO0	*1*	*10*	*8*	0	0	0	0	0	0	10	0	0	0	0	0	0	0
39 NYMHTHU0	*0*	*5*	*8*	0	0	0	0	0	0	5	0	0	0	0	0	0	0
40 UNIDSPE1	*1*	*15*	*8*	0	0	0	0	0	0	15	0	0	0	0	0	0	0
41 LAURREP0	*1*	*10*	*8*	0	0	0	0	0	0	10	0	0	0	0	0	0	0
42 XYRIANC0	*1*	*10*	*8*	0	0	0	0	0	0	10	0	0	0	0	0	0	0
43 CYPEPRL0	*7*	*85*	*10*	0	0	0	0	0	0	0	**85**	4	0	0	0	0	7
44 ZANT/SP0	*0*	*5*	*9*	0	0	5	0	0	0	0	0	0	0	0	0	0	0
45 CYPEFAS0	*7*	*93*	*11*	0	0	0	1	0	0	0	1	**93**	0	0	0	0	0
46 LEERHEX0	*2*	*20*	*5*	0	0	0	0	0	20	0	4	0	6	0	0	0	0
47 SCLRPOI0	*7*	*100*	*2*	0	0	0	0	0	0	0	0	0	**100**	0	0	0	0
48 UNIDPOA3	*3*	*38*	*10*	0	0	0	0	0	0	0	38	0	0	0	0	0	0
49 SENCDEL0	*3*	*26*	*4*	0	0	0	26	0	0	0	21	0	0	0	0	0	0
50 FICU/SP0	*0*	*5*	*9*	0	0	5	0	0	0	0	0	0	0	0	0	0	0
51 BLECTAB0	*7*	*97*	*13*	0	0	0	0	0	0	0	0	0	0	**97**	0	0	0
52 ENGONAT0	*4*	*34*	*12*	0	0	0	0	0	0	0	0	0	0	24	0	0	34
53 EUGE/SP0	*4*	*50*	*13*	0	0	0	0	0	0	0	0	0	0	**50**	0	0	0
54 FICUTRI0	*7*	*99*	*13*	0	0	0	0	0	0	0	0	0	0	**99**	0	0	0

55	IPOMMAU0	5	43	13	0	0	0	0	0	0	0	0	0	0	**43**	29	0	0
56	LYGO/SP0	7	52	12	0	0	0	0	0	0	0	0	0	0	27	21	0	**52**
57	SENEDEL0	4	50	13	0	0	0	0	0	0	0	0	0	0	**50**	0	0	0
58	SMILANC0	5	35	13	0	0	0	0	0	0	0	0	0	0	35	6	0	24
59	THAOTES0	7	89	13	0	0	0	0	0	0	0	0	0	0	**89**	11	0	0
60	TREMORI0	4	50	13	0	0	0	0	0	0	0	0	0	0	**50**	0	0	0
61	VOACTHO0	5	54	13	0	0	0	0	0	0	0	0	0	0	**54**	0	0	9
62	RHUS/SP0	2	25	13	0	0	0	0	0	0	0	0	0	0	25	0	0	0
63	SECM/SP0	5	40	13	0	0	0	0	0	0	0	0	0	0	**40**	31	0	0
64	CYPE/SP0	2	25	13	0	0	0	0	0	0	0	0	0	0	25	0	0	0
65	POLD/SP0	2	19	14	0	0	0	0	0	0	0	0	0	0	11	19	0	0
66	ALLPDRE0	2	19	14	0	0	0	0	0	0	0	0	0	0	11	19	0	0
67	CASPGUM0	2	25	13	0	0	0	0	0	0	0	0	0	0	25	0	0	0
68	CUSSSPI0	2	25	13	0	0	0	0	0	0	0	0	0	0	25	0	0	0
69	KRASFLO0	6	52	12	0	0	0	0	0	0	0	0	0	0	3	23	0	**52**
70	PSYCCAP0	6	70	14	0	0	0	0	0	0	0	0	0	0	15	**70**	0	0
71	SCHEUMB0	2	25	13	0	0	0	0	0	0	0	0	0	0	25	0	0	0
72	TRI]GRA0	4	43	14	0	0	0	0	0	0	0	0	0	0	9	**43**	0	0
73	ANTDVEN0	5	67	14	0	0	0	0	0	0	0	0	0	0	0	**67**	0	0
74	BARRRAC0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	**100**	0	0
75	BEHN/SP0	2	17	14	0	0	0	0	0	0	0	0	0	0	0	17	0	17
76	BRIDMIC0	6	82	14	0	0	0	0	0	0	0	0	0	0	4	**82**	0	0
77	CANABON0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
78	DALBARM0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
79	EKEBPTE0	5	67	14	0	0	0	0	0	0	0	0	0	0	0	**67**	0	0
80	FICUNAT0	5	67	14	0	0	0	0	0	0	0	0	0	0	0	**67**	0	0
81	LYGOMIC0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
82	OPLIHIR0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
83	PHOEREC0	5	67	14	0	0	0	0	0	0	0	0	0	0	0	**67**	0	0
84	RHOC/SP0	6	80	14	0	0	0	0	0	0	0	0	0	0	5	**80**	0	0
85	SETAMEG0	5	67	14	0	0	0	0	0	0	0	0	0	0	0	**67**	0	0
86	SYZYCOR0	7	95	12	0	0	0	0	0	0	0	0	0	0	1	3	0	**95**
87	TABEELE0	2	17	14	0	0	0	0	0	0	0	0	0	0	0	17	0	17
88	TAREPAV0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
89	SENEDEL0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
90	ROTMFIS0	5	67	14	0	0	0	0	0	0	0	0	0	0	0	**67**	0	0
91	FICUBUR0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
92	FICUSUR0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
93	RAUVCAF0	2	19	14	0	0	0	0	0	0	0	0	0	0	11	19	0	0
94	CHLR/SP0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
95	UNIDSPE3	2	25	13	0	0	0	0	0	0	0	0	0	0	25	0	0	0
96	MACRCAP0	2	25	13	0	0	0	0	0	0	0	0	0	0	25	0	0	0
97	MYRISER0	6	80	12	0	0	0	0	0	0	0	0	0	0	5	0	0	**80**
98	ANDPAPP0	7	100	1	0	0	0	0	0	0	0	0	0	0	0	0	**100**	0
99	NESA/SP0	5	67	1	0	0	0	0	0	0	0	0	0	0	0	0	**67**	0
100	RESTZUL0	7	100	1	0	0	0	0	0	0	0	0	0	0	0	0	**100**	0
101	SELA/SP0	2	33	1	0	0	0	0	0	0	0	0	0	0	0	0	33	0
102	THESNAT0	2	33	1	0	0	0	0	0	0	0	0	0	0	0	0	33	0
103	DIER/SP0	2	33	1	0	0	0	0	0	0	0	0	0	0	0	0	33	0
104	OLDNROS0	2	33	1	0	0	0	0	0	0	0	0	0	0	0	0	33	0
105	UNIDPOA4	2	33	1	0	0	0	0	0	0	0	0	0	0	0	0	33	0
106	VEROOLI0	2	33	1	0	0	0	0	0	0	0	0	0	0	0	0	33	0
107	RAPAMEL0	2	33	12	0	0	0	0	0	0	0	0	0	0	0	0	0	33
108	DICSCIN0	2	33	12	0	0	0	0	0	0	0	0	0	0	0	0	0	33
109	ERIADRE0	2	33	12	0	0	0	0	0	0	0	0	0	0	0	0	0	33
110	LACS/SP0	2	25	2	0	0	0	0	0	0	0	0	0	25	0	0	0	0
111	HEMAALT0	1	13	2	0	0	0	0	0	0	0	0	0	13	0	0	0	0
112	UNIDPOA1	4	50	4	0	0	0	**50**	0	0	0	0	0	0	0	0	0	0
113	POLO/SP0	4	50	4	0	0	0	**50**	0	0	0	0	0	0	0	0	0	0
Average		3	41		2	1	1	4	1	2	3	2	1	1	8	11	5	4

Table 5.3. Results of the Monte Carlo test of significance for the indicator values

MONTE CARLO test of significance
500 permutations
Random number seed: 1944

Colum	Indicator groups Value (IV)	Mean	S.Dev	p *
1 CUSCCAM0	12.1	13.9	8.63	0.454
2 CYNODAC0	37.3	14.6	7.05	**0.014**
3 ELEODUL0	71.3	14.4	8.96	**0.002**
4 FUIRHIR0	15.7	13.4	10.43	0.26
5 PYCRPOL0	42.5	11.8	10.01	**0.012**
6 SCHUBRA0	23.7	16.5	9.12	0.178
7 UROH/SP0	13.3	15.5	8.26	0.516
8 FESTCOS0	19.7	16.3	7.42	0.252
9 RHYOCOR0	88.5	14.6	7.08	**0.002**
10 CLAIMAR0	77.8	12.8	8.3	**0.002**
11 FIMBBIV0	59.6	14.2	6.79	**0.002**
12 NYMPNOU0	41.6	10.3	11.29	**0.032**
13 PYCRNIT0	21.6	14.8	7.24	0.16
14 LUDWOCT0	46.5	8.1	8.99	**0.012**
15 PERCSER0	61.3	12	8.48	**0.002**
16 TYPHCAP0	100	8.5	9.73	**0.002**
17 PHRGAUS0	10.4	12.3	6.75	0.488
18 RHYOHOL0	99.2	13	7.76	**0.002**
19 ISCH/SP0	3.1	10.8	9.01	0.942
20 UNIDPOA2	3	8.1	9.41	0.836
21 EULOANG0	6	11.6	9.74	0.586
22 PANIBRE0	4.5	6.4	8.25	0.52
23 RHYOBRO0	40.7	12.5	9.03	**0.018**
24 JUNCKRA0	4.5	7.6	9.94	0.56
25 UTRI/SP0	40.2	10.3	10.3	**0.024**
26 SPHGTRU0	87.8	12.7	7.81	**0.002**
27 XYRINAT0	64.7	13.4	9.52	**0.004**
28 DROEMAD0	5	7.1	9.75	0.45
29 PENO/SP0	32.6	12.2	9.86	**0.046**
30 PANIPAR0	30.8	11.7	8.88	**0.042**
31 HYPI/SP0	15	9.8	9.95	0.246
32 TRIPDRE0	55.6	9.6	10.11	**0.006**
33 THEYINT0	17.3	12	7.28	0.188
34 FICUVER0	5	6.6	9.01	0.432
35 ISCHFAS0	6	11.3	9.71	0.61
36 UTRIPRE0	2.3	8.7	9.09	0.856
37 ANDPHUI0	29.3	10.9	9.58	**0.052**
38 DISAWOO0	10	8.3	9.93	0.208
39 NYMHTHU0	5	6.9	9.39	0.446
40 UNIDSPE1	15	9.1	10.09	0.21
41 LAURREP0	9.9	7.9	8.72	0.22
42 XYRIANC0	10	7.7	8.89	0.194
43 CYPEPRL0	85.3	13.1	8.68	**0.002**
44 ZANT/SP0	5	6.3	8.39	0.424
45 CYPEFAS0	93.3	11.3	9.37	**0.002**
46 LEERHEX0	19.7	12.2	8.99	0.158
47 SCLRPOI0	100	11.2	8.85	**0.002**
48 UNIDPOA3	38.5	10.8	10.26	0.028
49 SENCDEL0	25.8	11.8	9.04	0.09
50 FICU/SP0	5	6.5	8.86	0.426
51 BLECTAB0	97.2	10.1	9.64	**0.002**
52 ENGONAT0	34.4	10.4	10.48	0.044
53 EUGE/SP0	50	8.7	10.39	**0.002**

54	FICUTRI0	98.5	10.1	10.56	**0.002**
55	IPOMMAU0	42.6	10.3	9.58	**0.012**
56	LYGO/SP0	52	11.5	8.91	**0.004**
57	SENEDEL0	50	8	9.47	**0.006**
58	SMILANC0	35	11.5	9.68	**0.032**
59	THAOTES0	89.1	10.5	9.79	**0.002**
60	TREMORI0	50	8.7	10.37	**0.002**
61	VOACTHO0	54.3	10.3	10.05	**0.004**
62	RHUS/SP0	25	6.2	8.26	0.074
63	SECM/SP0	39.7	10.9	9.92	**0.01**
64	CYPE/SP0	25	6.7	9.36	0.09
65	POLD/SP0	19	9.1	10.45	0.178
66	ALLPDRE0	19	8.2	8.97	0.152
67	CASPGUM0	25	6.1	7.65	0.08
68	CUSSSPI0	25	6.1	7.65	0.08
69	KRASFLO0	52.2	11.3	9.47	**0.006**
70	PSYCCAP0	70	10.6	9.33	**0.002**
71	SCHEUMB0	25	6.1	7.65	0.08
72	TRI]GRA0	42.7	9	9.02	**0.004**
73	ANTDVEN0	66.7	8.8	10.34	**0.004**
74	BARRRAC0	100	9.9	10.52	**0.002**
75	BEHN/SP0	16.7	8.9	10.39	0.17
76	BRIDMIC0	82.4	10.6	10.3	**0.002**
77	CANABON0	33.3	6.8	9.35	0.078
78	DALBARM0	33.3	6.8	9.35	0.078
79	EKEBPTE0	66.7	8.8	10.34	**0.004**
80	FICUNAT0	66.7	8.8	10.33	**0.004**
81	LYGOMIC0	33.3	6.8	9.35	0.078
82	OPLIHIR0	33.3	6.8	9.35	0.078
83	PHOEREC0	66.7	8.8	10.12	**0.002**
84	RHOC/SP0	80	10.6	10.34	**0.002**
85	SETAMEG0	66.7	8.8	10.34	**0.004**
86	SYZYCOR0	94.9	11.2	11.32	**0.002**
87	TABEELE0	16.7	9.3	10.63	0.184
88	TAREPAV0	33.3	6.8	9.35	0.078
89	SENEDEL0	33.3	6.8	9.35	0.078
90	ROTMFIS0	66.7	8.5	9.71	**0.004**
91	FICUBUR0	33.3	6.2	8.41	0.064
92	FICUSUR0	33.3	6.2	8.41	0.064
93	RAUVCAF0	19	8.4	9.66	0.158
94	CHLR/SP0	33.3	6.2	8.41	0.064
95	UNIDSPE3	25	6.5	8.66	0.086
96	MACRCAP0	25	6.5	8.66	0.086
97	MYRISER0	80	11.1	10.93	**0.002**
98	ANDPAPP0	100	11	11.7	**0.002**
99	NESA/SP0	66.7	9.8	11.34	**0.002**
100	RESTZUL0	100	11	11.7	**0.002**
101	SELA/SP0	33.3	7	9.66	0.082
102	THESNAT0	33.3	6.7	8.71	0.066
103	DIER/SP0	33.3	7.3	10.03	0.09
104	OLDNROS0	33.3	7.3	10.03	0.09
105	UNIDPOA4	33.3	7.3	10.03	0.09
106	VEROOLI0	33.3	7.3	10.03	0.09
107	RAPAMEL0	33.3	6.5	8.74	0.066
108	DICSCIN0	33.3	6.5	8.92	0.074
109	ERIADRE0	33.3	6.5	9.21	0.07
110	LACS/SP0	25	7.6	8.92	0.098
111	HEMAALT0	12.5	6.1	8.12	0.11
112	UNIDPOA1	50	6.9	9.07	**0.014**
113	POLO/SP0	50	6.9	9.07	**0.014**

indicator values in the group where the indicator values is highest. As in all statistical significance tests a p-value of 0.05 is considered as significant. A p-value of 0.01 is very significant and a p-value of 0.001 is highly significant.

The species with high appropriate significance values are highlighted in Table 5.3 and the corresponding species are highlighted in Table 5.2. The species that are indicator species for the various communities are listed below.

5.2 Description of the plant communities

In the description of the plant communities, species groups refer to Table 5.1.

1. *Restio zuluensis – Andropogon appendiculatus* closed low sedge and grass peatland (Fig 5.4)

The unique community is represented by three relevés and is located within the grassland that is situated to the west of the swamp forest (Fig 5.2, Fig 5.3), on shallow, moist peat. It occurs in patches, mostly situated in bottomland situations, forming a mosaic with the more extensive moist grassland on upland sites on the western side of the swamp forest. This peatland community is normally not found inside the boundaries of the Mfabeni swamp peatland.

This community is characterized by species group A. The dominant species are *Restio zuluensis, Andropogon appendiculatus* and *Trichopteryx dregeana*.

The species with significant indicator values are (Table 5.2): *Panicum parvifolium, Trichopteryx dregeana, Andropogon appendiculatus, Neurotheca schlechteri* and *Restio zuluensis.*

2. *Scleria poiformis* closed tall sedge peatland (Fig 5.5)

This sedge dominated plant community is located in the northern to north-eastern parts of the swamp (Fig 5.2, Fig 5.3). It is represented by eight relevés. This

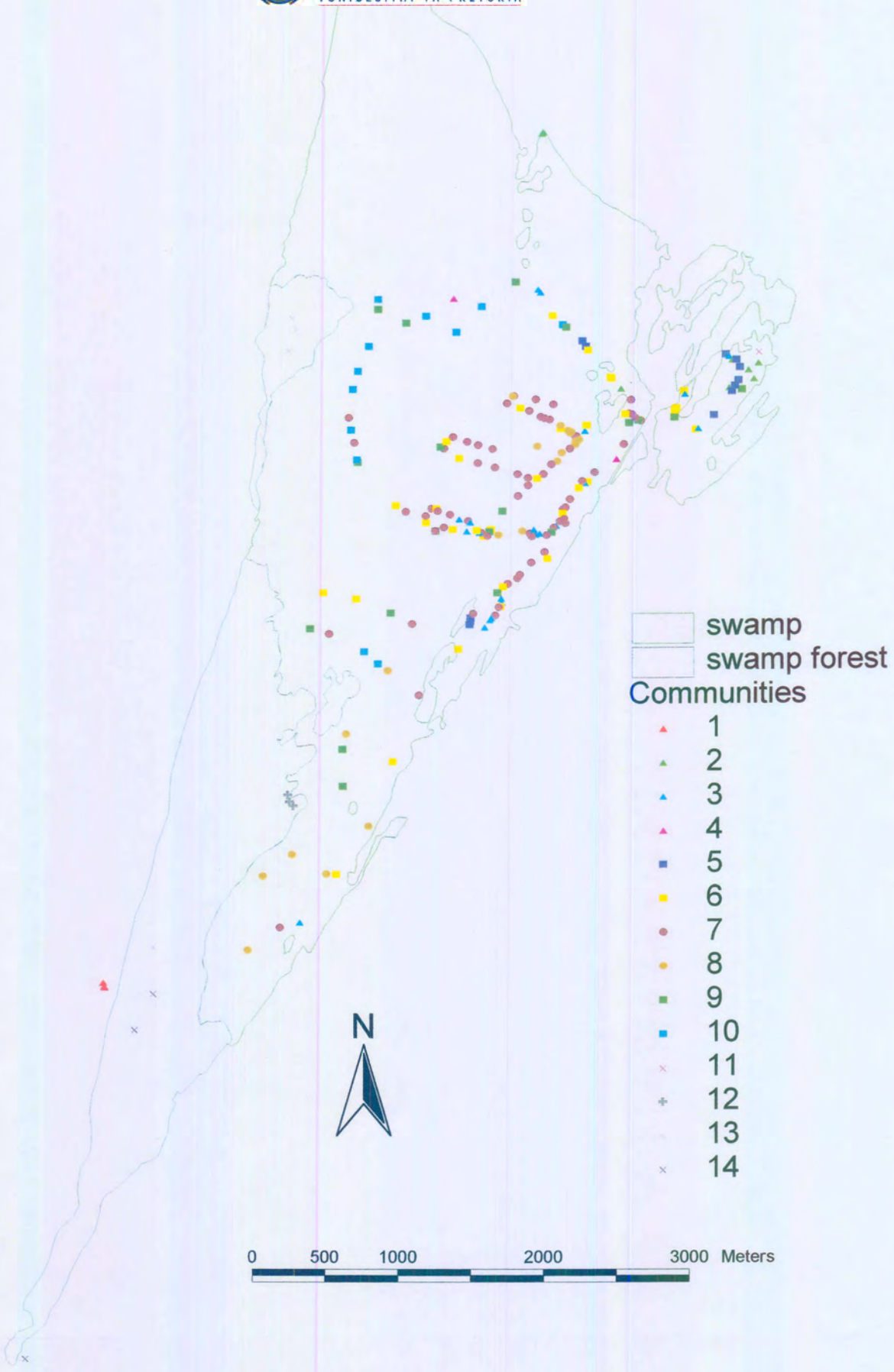

Fig 5.2. Location of plant relevés, showing the community present at each relevé.

Fig 5.4. The moist grassland that form a mosaic with community 1 (*Restio zuluensis* – *Andropogon appendiculatus* closed low sedge and grass peatland), which occurs closer to the swamp forest in the depressions.

Fig 5.5. Community 5 (*Eleocharis dulcis* closed tall sedge peatland) can be seen in the foreground and Community 2 (*Scleria poiformis* closed tall sedge peatland) is right behind it.

vegetation occurs in shallow water that may fluctuate to a water depth of up to 50 cm.

This plant community is characterized by species group B. The dominant plant species is *Scleria poiformis*, a 2 m tall sedge growing in dense stands. *Scleria poiformis* usually occurs in shallow lakes and pans along the coastal plain of northern KwaZulu-Natal as well as in some other countries (Pooley 1998) and these plants often occur in almost pure stands (Gordon-Gray 1995).

The species with a significant indicator value is (Table 5.2): *Scleria poiformis*.

3. *Rhynchospora holoschoenoides* open to closed short sedge peatland (Fig 5.6)

This community occurs along the eastern edge of the swamp and also close to islands that are situated in the eastern portion of the swamp (Fig 5.2, Fig 5.3). This community is represented by 22 relevés.

This sedge community occurs in patches with very shallow water, although some stands were found in somewhat deeper water (20 cm) during the second session of fieldwork, when there was generally more water in the swamp. In these areas a great fluctuation in the water table is experienced and during a particular time period, different stands of this community may occur in different depths of water.

This community is characterized by species group C. The community is totally dominated by *Rhynchospora holoschoenoides*. *Rhynchospora holoschoenoides* is a perennial sedge mostly found in wet or very moist conditions, usually on sand and/or where there is an impediment on drainage (Gordon-Gray 1995).

The species with a significant indicator value is (Table 5.2): *Rhynchospora holoschoenoides*.

Fig 5.6. Community 3, *Rhynchospora holoschoenoides* open to closed short sedge peatland.

Fig 5.7. Community 4, *Typha capensis-Ludwigia octovalvis* closed high peatland.

4. *Typha capensis – Ludwigia octovalvis* closed high peatland (Fig 5.7)
This tall-growing *Typha* community occurs locally within the swamp in deep water, especially where deep pools were created by Hippopotamus (Fig 5.2, Fig 5.3). This community also occurs on disturbed sites next to the closed, old road that transected a portion of the peatland. Here the community is located on exposed soil, not peat. Generally *Typha* seems to prefer somewhat more nutrient-rich substrates. Only two relevés were compiled in this plant community.

The community is characterized by species group D and shares many species with other communities. The dominant species are *Typha capensis* and *Ludwigia octovalvis*. *Persicaria serrulata* and *Pycreus polystachyos* are also prominent.

The species with significant indicator values are (Table 5.2): *Pycreus polystachyos, Ludwigia octovalvis, Persicaria serrulata, Typha capensis,* Unidentified Poaceae1, *Polygonum* species.

5. *Eleocharis dulcis* closed tall sedge peatland (Fig 5.8)
This tall sedge community is mainly restricted to the deep water that occurs in the north-eastern and northern parts of the swamp (Fig 5.2, Fig 5.3). Twelve relevés represent this community.

The habitat of this community is deep water (20cm - 1m) and although the water depth may fluctuate somewhat in some parts of the community, it is mostly deep and stable.

The community is characterized by species group E. The sedge *Eleocharis dulcis* is the dominant species, though the sedge *Schoenoplectus brachyceras,* the grass *Leersia hexandra* and the water lily *Nymphaea nouchali* are often prominent in this community. *Eleocharis dulcis* is a stoloniferous perennial sedge that occurs in permanent, fresh water of vleis and pans (Gordon-Gray 1995). *Nymphaea nouchali* is an aquatic macrophyte occurring in rivers, pools and lakes

Fig 5.8. Community 5, *Eleocharis dulcis* closed tall sedge peatland.

Fig 5.9. Community 6, *Rhynchospora corymbosa* closed low sedge peatland.

(Pooley 1998) and is therefore associated with the areas of deeper water in the swamp.

The species with significant indicator values are (Table 5.2): *Eleocharis dulcis, Nymphaea nouchali, Utricularia* species.

6. *Rhynchospora corymbosa* closed low sedge peatland (Fig 5.9)
This sedge community is widespread and occurs in the north-eastern as well as in the south-eastern and central parts of the peatland (Fig 5.2, Fig 5.3). A total of 35 relevés were compiled in this community.

Although the water depth where this community is found may be variable, it is mostly quite shallow (10cm) and the depth does not fluctuate much.

The community is characterized by species group F. The dominant species is the sedge *Rhynchospora corymbosa* which is a perennial sedge occurring in lowland coastal swamp areas, up to 1000 m altitude (Pooley 1998, Gordon-Gray 1995).

The species with a significant indicator value is (Table 5.2): *Rhynchospora corymbosa.*

7. *Fimbristylis bivalvis* open to closed short sedge peatland (Fig 5.10)
This sedge community is widespread and it occurs mostly in the north-eastern to central northern parts of the peatland, with some isolated patches occurring in the central-eastern to south-eastern parts (Fig 5.2, Fig 5.3). This community is represented by 66 relevés.

The water depth is also variable, but is mostly of medium depth (17 cm) and is relatively stable, without much fluctuation.

Fig 5.10. Community 7, *Fimbristylis bivalvis* open to closed short sedge peatland.

Fig 5.11. *Sphagnum truncatum* is a dominant species in community 8.

Species group G characterizes the community and the sedge *Fimbristylis bivalvis* is the dominant species. The grass *Leersia hexandra,* the sedge *Pycreus nitidus* and the reed *Phragmites australis* are further important species in this community.

The species with significant indicator values are (Table 5.2): *Cynodon dactylon* and *Fimbristylus bivalvis.*

8. *Sphagnum truncatum – Xyris natalensis* closed short moss peatland (Fig 5.11, Fig 5.12)
This *Sphagnum* community occurs extensively in the southern and central-northern parts of the peatland (Fig 5.2, Fig 5.3). This community is represented by 20 relevés.

Where this community occurs, the water is shallow and the water depth is constant without much fluctuation.

Species group H is characteristic for this community. The peat moss *Sphagnum truncatum* and *Xyris natalensis* are dominant species, while the sedge *Rhynchospora brownii*, the herb cf *Pentodon* species, the forb cf *Laurembergia repens* and the grass *Andropogon huillensis* are conspicuously present in this community.

Although very prominent in the Northern Hemisphere mires, *Sphagnum* moss communities are rare in Southern Africa, and this community is considered as rare and unique in South Africa.

The species with significant indicator values are (Table 5.2): *Rhynchospora brownii, Sphagnum truncatum, Xyris natalensis, cf Pentodon* species, *Andropogon huillensis.*

Fig 5.12. Community 8, *Sphagnum truncatum-Xyris natalensis* closed short moss peatland.

Fig 5.13. Community 9, *Cladium mariscus* closed high sedge peatland.

9. *Cladium mariscus* closed high sedge peatland (Fig 5.13)

This community occurs in dense stands in the north-western and central-western parts and also in patches in the north-eastern and southern portions of the swamp. These stands cover a considerable portion of the swamp (Fig 5.2, Fig 5.3). The water depth of this community is relatively stable and shallow (6 cm). This community is represented by 20 relevés.

The community is characterized by species group J. The tall-growing sedge *Cladium mariscus* is the dominant species and the forb *Persicaria serrulata*, the fern *Thelypteris interrupta* and the grass *Panicum brevifolium* are also prominent. *Cladium mariscus* normally occurs in dense stands on the margins of swamps and near streams (Pooley 1998).

The species with a significant indicator value is (Table 5.2): *Cladium mariscus*.

10. *Cyperus prolifer* closed short sedge peatland (Fig 5.14)

This community occurs in the north-western to northern parts of the swamp, often adjacent to and merging into the swamp forest (Fig 5.2, Fig 5.3). The water depth is variable. There were 13 relevés compiled in this community.

Species group K is characteristic and the community is dominated by the sedge *Cyperus prolifer*. The fern *Thelypteris interrupta* and forb *Senecio deltoides* are also prominent in this community. *Cyperus prolifer* often occurs in well aerated water of marshes and streams along the coast from NE Cape, along the east coast of Africa, as well as on some islands (Pooley 1998) It is intolerant of stagnant conditions and shading, which will result in failure to produce perfect spikelets (Gordon-Gray 1995). This would explain why the community occurs closer to the drainage lines, where water is flowing and therefore may have more oxygen.

The species with a significant indicator value is (Table 5.2): *Cyperus prolifer*.

Fig 5.14. Community 10, *Cyperus prolifer* closed short sedge peatland.

Fig 5.15. Community 11, *Cyperus fastigiatus* closed tall sedge peatland.

11. *Cyperus fastigiatus* closed tall sedge peatland (Fig 5.15)
This community is restricted to the northern portions of the swamp, mostly in the deeper water channels that drain through the northern edges of the swamp (Fig 5.2, Fig 5.3).

The water depth is medium to deep (15 - 30cm). Three relevés represent this community.

The community is characterized by species group L. The dominant species is *Cyperus fastigiatus* and the forbs *Ludvigia octovalvis* and *Persicaria serrulata* and reed *Phragmites australis* are also present.

The species with a significant indicator value is (Table 5.2): *Cyperus fastigiatus*.

12. *Syzygium cordatum – Stenochleana tenuifolia* swamp forest (Fig 5.16)
This swamp forest occurs in the middle portion of the swamp forest along the western part of the peatland (Fig 5.2, Fig 5.3). Three relevés were compiled in this community.

The community occurs on peat with shallow water (4 cm) and the water table may fluctuate resulting in wetter and drier patches within the forest.

Species group P characerizes the community and the tall forest tree *Syzygium cordatum* and the climbing fern *Stenochleana tenuifolia* are dominant.

The species with significant indicator values are (Table 5.2): *Stenocleana* species, *Kraussia floribunda, Syzygium cordatum* and *Myrica serrata.*

13. *Ficus trichopoda – Nephrolepis biserrata* swamp forest (Fig 5.17)
This community occurs in the northern and southern parts of the swamp forest (Fig 5.2, Fig 5.3). This community is represented by four relevés.

Fig 5.16. Community 12 (*Syzygium cordatum –Stenoclaena tenuifolia* swamp forest) can be seen in the background.

Fig 5.17. Community 13, *Ficus trichopoda-Nephrolepis biserrata* swamp forest.

The water depth within this community is about 7 cm, but it may fluctuate, causing shallower and deeper water in the peat.

Species group Q characterizes the community. *Ficus trichopoda* is the dominant tree with the small trees or shrubs *Voacanga thoursii, Trema orientalis* and *Eugenia* species also important in the woody strata. The fern *Nephrolepis biserrata* or the sedge *Scleria angusta* are dominant in the herbaceous layer.

The species with significant indicator values are (Table 5.2): *Nephrolepis biserrata, Eugenia* species, *Ficus trichopoda, Ipomoea mauritiana, Scleria angusta, Trema orientalis and Voacanga thouarsii.*

14. *Barringtonia racemosa – Bridelia micrantha* swamp forest (Fig 5.18)
This forest community occurs in the southern portion of the swamp forest, along the stream (Fig 5.2, Fig 5.3). This forest is less dense than the other two forest communities. This community is represented by 3 relevés.

The water table of this community is of medium depth and seems to be relatively stable, although it may fluctuate a bit.

This community is characterized by species group S and the dominant species are the trees *Barringtonia racemosa* and *Bridelia micrantha* and the liana *Rhoicissus* species. The grass *Setaria megaphylla,* the palm tree *Phoenix reclinata* and the shrub *Antidesma venosum* are also conspicuous. The understory of this community is much more open than that of the other two swamp forest communities.

The species with significant indicator values are (Table 5.2): *Psychotria capensis, Antidesma venosum, Barringtonia racemosa, Bridelia micrantha, Ekebergia*

pterophylla, Ficus natalensis, Phoenix reclinata, Rhoicissus species, *Setaria megaphylla* and *Rothmannia fischeri.*

Fig 5.18. Edge of community 14, *Barringtonia racemosa-Bridelia micrantha* swamp forest.

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Chapter 6

Results: Description of the plant communities of the Mfabeni swamp

The major plant communities were identified in Chapter 5. A detailed analysis and description of each major community, with the proposed subdivision into sub-communities, are given in this chapter.

6.1 Classification

The results obtained by TWINSPAN refined by Braun-Blanquet procedures by using the editor in MEGATAB are presented in the dendrogram (Figure 5.1). This dendrogram gives, in addition to the major plant communities (Chapter 5) a proposed subdivision into sub-communities and variants. However, by using the results of the refined TWINSPAN, the resulting large phytosociological table (214 relevés) was divided into five separate tables, in order to give a more accurate and easily representable analysis of the major communities. Division of the large table was based on the hierarchical classification. The practical representation of large tables in the thesis is difficult therefore division was needed. Communities 1-5 are given in Table 6.1, Communities 6 & 7 in Table 6.2, Community 8 in Table 6.3, Communities 9-11 in Table 6.4 and Communities 12-14 in Table 6.5.

The detailed classification of the vegetation of the Mfabeni swamp is as follows:

1. *Restio zuluensis – Andropogon appendiculatus* closed low sedge and grass peatland
2. *Scleria poiformis* closed tall sedge peatland
   - 2.1. *Scleria poiformis* typical subcommunity
   - 2.2. *Scleria poiformis – Dactylotenium* species sub-community
   - 2.3. *Scleria poiformis – Leersia hexandra* sub-community
3. *Rhynchospora holoschoenoides* open to closed short sedge peatland
   - 3.1. *Rhynchospora holoschoenoides – Panicum brevifolium* sub-community
   - 3.2. *Rhynchospora holoschoenoides – Pycreus nitidus* sub-community
4. *Typha capensis – Ludwigia octovalvis* closed high peatland

5. *Eleocharis dulcis* closed tall sedge peatland
   5.1. *Nymphaea nouchali – Utricularia* species sub-community
   5.2. *Eleocharis dulcis – Schoenoplectus brachyceras* sub-community
6. *Rhynchospora corymbosa* closed low sedge peatland
7. *Fimbristylis bivalvis* open to closed short sedge peatland
   7.1. *Fimbristylis bivalvis – Schoenoplectus brachyceras* sub-community
   7.2. *Fimbristylis bivalvis* typical sub-community
8. *Sphagnum truncatum – Xyris natalensis* closed short moss peatland
   8.1. *Sphagnum truncatum – Xyris natalensis* sub-community
      8.1.1. *Andropogon huillensis* variant
      8.1.2. *Fimbristylis bivalvis* variant
      8.1.3. *Xyris natalensis* variant
      8.1.4. *Eulophia angolensis* variant
   8.2. *Sphagnum truncatum – Laurembergia repens* sub-community
9. *Cladium mariscus* closed high sedge peatland
   9.1. *Cladium mariscus – Cynodon dactylon* sub-community
      9.1.1. *Ischaemum* species variant
      9.1.2. *Eleocharis dulcis* variant
   9.2. *Cladium mariscus – Sphagnum truncatum* sub-community
   9.3. *Cladium mariscus – Thelypteris interrupta* sub-community
10. *Cyperus prolifer* closed short sedge peatland
   10.1. *Cyperus prolifer – Leersia hexandra* sub-community
   10.2. *Cyperus prolifer – Pycreus nitidus* sub-community
11. *Cyperus fastigiatus* closed tall sedge peatland
12. *Syzygium cordatum –Stenoclaena tenuifolia* swamp forest
13. *Ficus trichopoda –Nephrolepis biserrata* swamp forest
14. *Barringtonia racemosa – Bridelia micrantha* swamp forest

6.2 Description of the plant communities

1. *Restio zuluensis – Andropogon appendiculatus* closed low sedge and grass peatland

The community is located within the grassland that is situated to the west of the swamp forest on shallow, moist peat. It occurs in patches, mostly situated in bottomland situations, forming a mosaic with the more extensive moist grassland on upland sites on the western side of the swamp forest. This peatland community is normally not considered to be inside the boundaries of the Mfabeni swamp peatland.

The community has a fluctuating water table. The substrate is relatively dry with very little surface water, though the peat is moist to wet.

The conductivity is relatively low (131µS), with a pH of around 5.75. The dissolved oxygen in the water is between medium and low (-6.33%) compared to the oxygen content of the rest of the swamp.

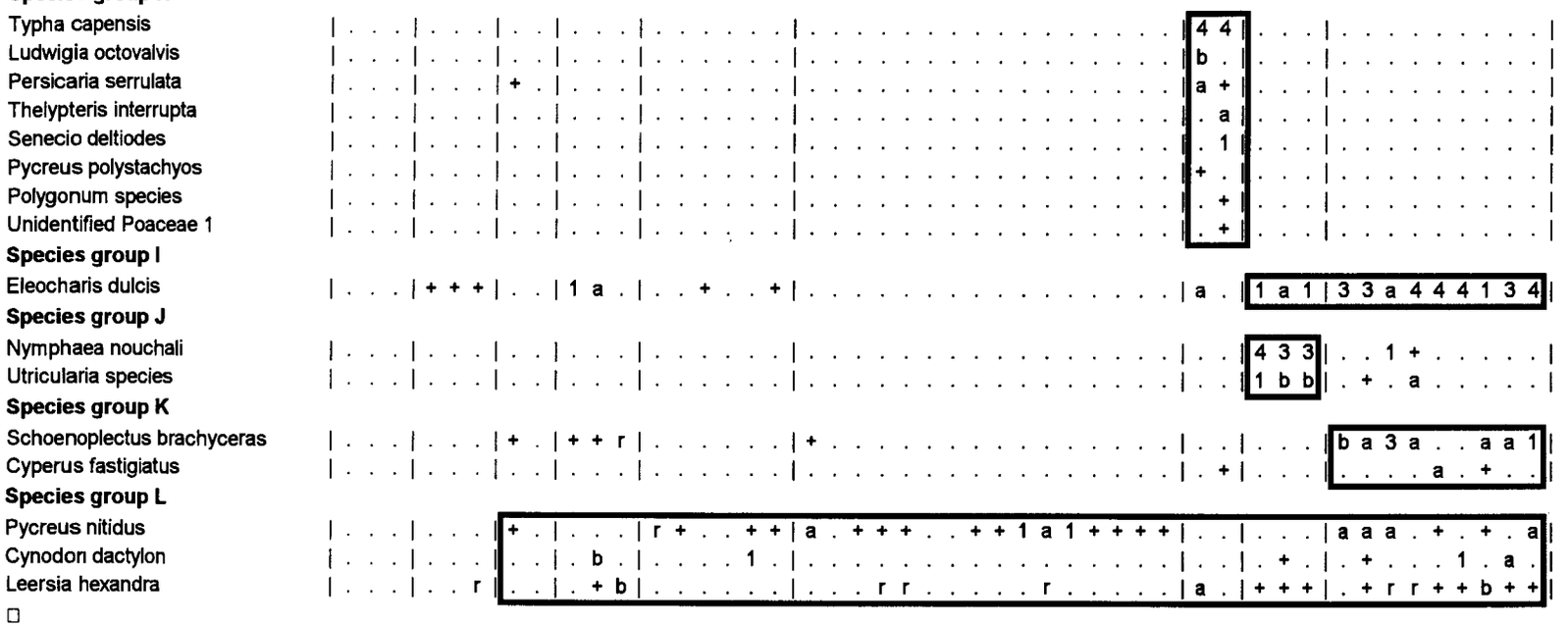
This community is characterized by species group A. The most prominent diagnostic species are *Restio zuluensis, Andropogon appendiculatus, Xyris natalensis, Dierama* species, *Trichopteryx dregeana,* and *Neurotheca schlechteri* species (Table 6.1). *Restio zuluensis* is also the dominant species in the community.

Only three relevés represent this community. An average of 7 species per relevé and a total 13 species were noted in this community.

This is an interesting community, dominated by a member of the Restionaceae, a plant family that is normally associated with the Cape Floral Kingdom.

Table 6.1: Table of some of the plant communities in the Mfabeni swamp.

Community	1			2							3																						4		5											
				2.1			2.2		2.3			3.1						3.2																	5.1			5.2								
Relevé nr.	205	206	207	154	155	157	212	213	150	153	185	44	45	149	176	188	193	13	23	27	28	39	40	46	52	71	75	77	88	90	126	143	175	10	214	195	196	197	47	48	49	148	151	152	180	181	194
Species group A																																															
Restio zuluensis	5	5	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Andropogon appendiculatus	a	a	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Xyris natalensis	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dierama species	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trichopteryx dregeana	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Selaginella species	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Neurotheca schlechteri	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Panicum parvifolium	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thesium natalense	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oldenlandia rosulata	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unidentified Poaceae 4	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vernonia oligocephala	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group B																																															
Scleria poiformis	.	.	.	4	4	5	5	5	b	4	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group C																																															
cf Dactylotenium species	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hemarthria altissima	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group D																																															
Rhynchospora corymbosa	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group E																																															
Rhynchospora holoschoenoides	.	.	.	.	.	.	.	.	.	.	.	4	b	4	4	1	4	4	4	4	4	4	4	3	4	3	3	4	4	4	3	b	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fimbristylis bivalvis	.	.	.	.	.	.	.	.	.	.	.	+	.	r	+	.	.	.	.	+	+	.	.	+	.	.	.	.	b	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group F																																															
Panicum brevifolium	.	.	.	.	.	.	.	.	.	.	.	b	a	a	a	b	a	.	.	.	.	.	1	+	.	.	.	+	+	r	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.
Fuirena cf hirsuta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	1	.	.	.	.	r	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	.	+	.	.	+	.	.
cf Ischaemum species	.	.	.	.	.	.	.	.	.	.	.	.	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus kraussii	.	.	.	.	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladium mariscus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group G																																															
Phragmites australis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	r	.	.	+	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Ischaemum fasciculatum	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cuscuta campestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.


Species group H
Typha capensis
Ludwigia octovalvis
Persicaria serrulata
Thelypteris interrupta
Senecio deltiodes
Pycreus polystachyos
Polygonum species
Unidentified Poaceae 1
Species group I
Eleocharis dulcis
Species group J
Nymphaea nouchali
Utricularia species
Species group K
Schoenoplectus brachyceras
Cyperus fastigiatus
Species group L
Pycreus nitidus
Cynodon dactylon
Leersia hexandra

2. *Scleria poiformis* closed tall sedge peatland

This sedge dominated plant community is located in the northern to north-eastern parts of the swamp.

This vegetation occurs in shallow water that may fluctuate to a water depth of up to 500 mm. The water mostly has a relatively high pH (5.77 - 5.8) although it may in exceptional cases be as low as pH 5.6. The conductivity of the water is mostly low (251 µS), as is the dissolved oxygen content (-5.67%).

This plant community is characterized by species group B. The only diagnostic and also totally dominant plant species is *Scleria poiformis* (Table 6.1), a 2 m tall sedge growing in dense stands. *Scleria poiformis* usually occurs in shallow lakes and pans along the coastal plain of northern KwaZulu-Natal as well as in some other countries (Pooley 1998) and these plants often occur in almost pure stands (Gordon-Gray 1995).

The sedges *Eleocharis dulcis* and *Schoenoplectus brachyceras* are present in some of the plots within the *Scleria poiformis* closed tall sedge peatland.

The following sub-communities are recognized:
2.1. *Scleria poiformis* typical sub-community
2.2. *Scleria poiformis* – *Dactylotenium* species sub-community
2.3. *Scleria poiformis* – *Leersia hexandra* sub-community

2.1 *Scleria poiformis* typical sub-community

This sub-community represents the typical *Scleria poiformis* vegetation, where the habitat is drier than sub-community 2.3, but wetter than 2.2 with the water from the surface of the soil to 10 mm deep.

This sub-community is characterized by the presence of species group B, but the absence of species groups C and D (Table 6.1). *Scleria poiformis* is the dominant

species and *Eleocharis dulcis* is also important in this sub-community. Very few other species may be present as single individuals with low cover abundance values.

There are only 3 species in this sub-community. Three relevés with an average of 2 species per relevé represent the sub-community.

2.2. *Scleria poiformis – Dactylotenium* species sub-community

The *Scleria poiformis*-dominated vegetation in the northern part of the swamp is somewhat drier and the water table is level with the peat, with no free-standing water. This vegetation represents the *Scleria poiformis-Dactylotenium* species sub-community.

Species group C is diagnostic with *cf Dactylotenium* species and *Hemarthria altissima* as the diagnostic species (Table 6.1), indicating less waterlogged conditions. A total of 7 species were recorded from 2 relevés, with an average of 5 species per relevé, indicating that this sub-community, with its slightly more favourable habitat conditions is richer in species than the typical sub-community.

2.3. *Scleria poiformis – Leersia hexandra* sub-community

This is the wetter of the sub-communities within the *Scleria poiformis*-dominated vegetation, with a water depth of between 10 mm and 100 mm.

The sub-community is characterized by species group D, with *Rhynchospora corymbosa* the only diagnostic species (Table 6.1). *Scleria poiformis* is still the dominant species, but the hygrophilous sedges *Eleocharis dulcis* and *Schoenoplectus brachyceras,* and grass *Leersia hexandra*, are also present. *Leersia hexandra* is a perennial grass growing in or near permanent water (Van Oudtshoorn 1999).

The sub-community is represented by 3 relevés with an average of 4 species per relevé. There is a total of 7 species in this sub-community.

3. *Rhynchospora holoschoenoides* open to closed short sedge peatland

This community occurs along the eastern edge of the swamp and also close to islands that are situated in the eastern portion of the swamp.

This sedge community occurs in patches with very shallow water, although some stands were found in somewhat deeper water (200 mm) during the second session of fieldwork, when there was generally more water in the swamp. In these areas a great fluctuation in the water table is experienced and during a particular time period, different stands of this community may occur in different depths of water.

The conductivity of the water is quite variable between the different stands of the community. The dissolved oxygen in the water tends to be relatively high (4.17%) and the pH is between medium and high (mostly between 5.73 and 5.83).

This community is characterized by species group E. The community is totally dominated by the diagnostic sedge *Rhynchospora holoschoenoides*, while *Fimbristylis bivalvis* is also diagnostic (Table 6.1). *Rhynchospora holoschoenoides* is a perennial sedge found in wet or very moist conditions, usually on sand and/or where there is an impediment on drainage (Gordon-Gray 1995).

This community is represented by 22 relevés and a total of 17 species was recorded. An average of 4 species was found per relevé.

This community can be divided into two sub-communities. (Table 6.1)

3.1. *Rhynchospora holoschoenoides – Panicum brevifolium* sub-community

3.2. *Rhynchospora holoschoenoides – Pycreus nitidus* sub-community

3.1. *Rhynchospora holoschoenoides – Panicum brevifolium* sub-community

This sub-community is the drier of the two with the water only at the surface. Species group F characterizes this sub-community with *Panicum brevifolium* and *Fuirena cf hirsuta* the most prominent diagnostic species (Table 6.1). The vegetation is totally dominated by *Rhynchospora holoschoenoides* *Rhynchospora holoschoenoides* is sparsely tufted, perennial plants that usually occur on sand in very moist to wet conditions. It is common on areas with an impediment to drainage and although the aerial parts die when conditions become too stagnant the rhizomes survive (Gordon-Gray 1995).

Eleocharis dulcis and *Juncus kraussii* are also prominent in this sub-community. *Juncus kraussii* is a large perennial occurring in brackish marshes (Pooley 1998). *Eleocharis dulcis* is a tufted, emergent perennial growing in permanent fresh water of pans and vleis (Gordon-Gray 1995). It is an indicator of wetter conditions.

A total of 10 species were recorded from 6 relevés that represent this sub-community, with an average of 5 species per relevé.

3.2. *Rhynchospora holoschoenoides – Pycreus nitidus* sub-community

The habitat where this sub-community occurs is the wetter than that of the other sub-community. The water depth is mostly up to 20 mm, but may even be deeper at certain localities.

The sub-community is characterized by species group G, with *Phragmites australis* and *Ischaemum fasciculatum*, although they are sparsely distributed amongst the most important diagnostic species (Table 6.1). The dominant species are *Rhynchospora holoschoenoides, and Pycreus nitidus. Pycreus nitidus* is a perennial on the margin of estuaries, streams and swamps. The

species may form mats of floating vegetation on water and occurs from tropical Africa to the eastern Cape (Pooley 1998).

This sub-community has an average of 4 species per relevé and a total of 11 species were recorded from 16 relevés.

4. *Typha capensis – Ludwigia octovalvis* closed high peatland

This tall-growing *Typha* community occurs locally within the swamp in deep water, especially where deep pools were created by Hippopotamus. This community also occurs on disturbed sites next to the closed, old road that transected a portion of the peatland. Here the community is located on exposed soil, not peat. Generally *Typha* seems to prefer somewhat more nutrient-rich substrates.

The community has a pH of 5.75 and the conductivity is medium (368 µS). The dissolved oxygen in the water is low (-9%). The water table is deep and very variable in time and across different sites.

The community is characterized by species group H and shares many species with other communities. The diagnostic species are the dominant *Typha capensis*, *Ludwigia octovalvis*, *Persicaria serrulata* and *Pycreus polystachyos* (Table 6.1). Other prominent species are *Eleocharis dulcis* and *Leersia hexandra*.

Only two relevés were placed in this community and a total of 12 species, with an average of 7 species per relevé were found in the community.

5. *Eleocharis dulcis* closed tall sedge peatland

This tall sedge community is mainly restricted to the deep water that occurs in the north-eastern and northern parts of the swamp.

The habitat of this community is deep water (200 mm – 1000 mm) and although the water depth may fluctuate somewhat in some parts of the community, it is mostly deep and stable. The pH of the water is between medium and high (5.77) and the dissolved oxygen content is mostly between medium and low (-6.8%), while the conductivity of the water is 248 µS on average, but this may vary considerably between different stands of this community.

The community is characterized by species group I. The sedge *Eleocharis dulcis* is the only diagnostic species, also being very prominent (Table 6.1). The sedge *Pycreus nitidus,* and the grasses *Leersia hexandra* and *Cynodon dactylon* are often prominent in this community. *Eleocharis dulcis* is a stoloniferous perennial sedge that occurs in permanent, fresh water of vleis and pans (Gordon-Gray 1995).

An average of 5 species was recorded per relevé. A total of 11 species were recorded from the 12 relevés representing the community.

This community can be divided into two sub-communities. (Table 6.1)
5.1. *Nymphaea nouchali – Utricularia* species sub-community
5.2. *Eleocharis dulcis – Schoenoplectus brachyceras* sub-community

5.1. *Nymphaea nouchali – Utricularia* species sub-community

This sub-community occurs in the deep (250 mm – 500 mm), more open water, in the north-eastern portion of the swamp. This sub-community occurs in the more open areas in a mosaic with sub-community 5.2.

The sub-community is characterized by species group J with *Nymphaea nouchali* and *Utricularia* species as diagnostic (Table 6.1). *Eleocharis dulcis* is also important in this sub-community. *Nymphaea nouchali* is an aquatic macrophyte occurring in rivers, pools and lakes (Pooley 1998) and is therefore associated

with the areas of deeper water in the swamp. The genus *Utricularia* occurs in water or in damp places, with traps to capture insects (Pooley 1998).

There are 7 species and 3 relevés in this sub-community, with an average of 5 species per relevé.

5.2. *Eleocharis dulcis* – *Schoenoplectus brachyceras* sub-community

This sub-community occurs in deep water, 40 mm – 500 mm, in the northern and north-eastern portion of the swamp.

Eleocharis dulcis has a very high cover abundance value and are therefore the dominant species. *Eleocharis dulcis* is a robust, stoloniferous perennial that occurs in permanent fresh water. It is a tufted emergent that is uncommon in Natal (Gordon-Gray 1995). Species group K characterises this sub-community with *Leersia hexandra, Schoenoplectus brachyceras* and *Cyperus fastigiatus* the diagnostic species (Table 6.1) *Leersia hexandra* grows in or near permanent water and can form dense stands in wet soil or shallow water (Van Oudtshoorn 1999).

Nine relevés represent this sub-community, with an average of 5 species per relevé and a total of 10 species.

6. *Rhynchospora corymbosa* closed low sedge peatland

This sedge community is widespread and occurs in the north-eastern as well as in the south-eastern and central parts of the peatland.

Although the water depth where this community is found may be variable, it is mostly quite shallow (100 mm) and the depth does not fluctuate much. The pH is medium to low (5.55 - 5.7) and the dissolved oxygen content is mostly between

medium and high (235 μS). The conductivity of the water varies from medium to high.

The community is characterized by species group A with *Rhynchospora corymbosa* and *Fuirena cf hirsuta* the diagnostic species (Table 6.2). The dominant species is the sedge *Rhynchospora corymbosa*. *Rhynchospora corymbosa* is a perennial sedge occurring in lowland coastal swamp areas, up to 1000 m altitude (Pooley 1998, Gordon-Gray 1995). Other species that occur in lower abundance include the sedges *Schoenoplectus brachyceras, Fimbristylis bivalvis, Pycreus nitidus, Rhynchospora holoschoenoides, Eleocharis dulcis, Pycreus polystachyos,* the grasses *Panicum brevifolium, Cynodon dactylon, Leersia hexandra*, *Phragmites australis* and the parasitic *Cuscuta campestris* which all occur in many of the other peatland communities.

This community is closely related to community 7, the *Fimbristylis bivalvis* open to closed short sedge peatland, with which it shares many species. These two communities differ only in their dominant species and the habitat of Community 7 is slightly wetter than that of Community 6.

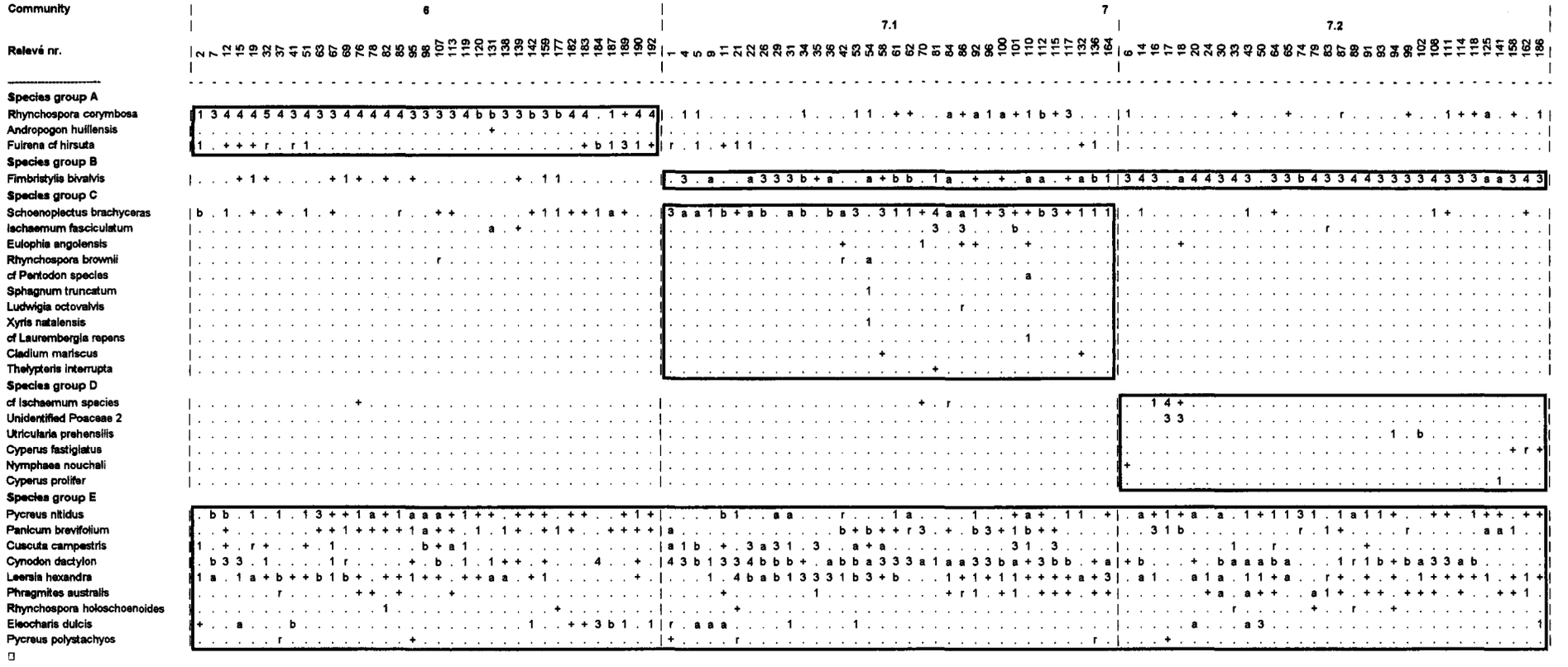
The community has an average of 6 species per relevé. A total of 17 species were recorded from the 35 relevés that represent this community.

7. *Fimbristylis bivalvis* open to closed short sedge peatland

This sedge community is widespread and it occurs mostly in the north-eastern to central northern parts of the peatland, with some isolated patches occurring in the central-eastern to south-eastern parts.

The pH of the water is very variable. The water depth is also variable, but is mostly medium-deep (170 mm) and is relatively stable, without much fluctuation. The conductivity of the water is medium to high (261 μS) as well as the dissolved oxygen content (6%).

Table 6.2: Table of communities 6 and 7 of the Mfabeni swamp



Species group B characterizes the community and the sedge *Fimbristylis bivalvis* is the only diagnostic species and it is also dominant (Table 6.2).

Other species present are sedges *Schoenoplectus brachyceras, Fimbristylis bivalvis, Pycreus nitidus, Rhynchospora holoschoenoides, Eleocharis dulcis, Pycreus polystachyos,* the grasses *Panicum brevifolium, Cynodon dactylon, Leersia hexandra*, and *Phragmites australis* and the parasitic *Cuscuta campestris* which all occur in many of the other peatland communities.

This community is closely associated with community 6, the *Rhynchospora corymbosa* closed low sedge peatland, and the two communities often form a mosaic distribution pattern in the same area.

From 66 relevés a total of 29 species, and an average of 6 species per relevé were recorded.

This community can be divided into two sub-communities. (Table 6.2)
7.1. *Fimbristylis bivalvis – Schoenoplectus brachyceras* sub-community
7.2. *Fimbristylis bivalvis* typical sub-community

7.1. *Fimbristylis bivalvis – Schoenoplectus brachyceras* sub-community

The sub-community is characterized by species group C with *Schoenoplectis brachyceras* as the most important diagnostic species. The other diagnostic species listed under species group C are sparsely distributed. (Table 6.2).

Fimbristylis bivalvis, Schoenoplectis brachyceras and *Rhynchospora corymbosa* are dominant and also prominent.

Other species present are sedges *Schoenoplectus brachyceras, Fimbristylis bivalvis, Pycreus nitidus, Rhynchospora holoschoenoides, Eleocharis dulcis, Pycreus polystachyos,* the grasses *Panicum brevifolium, Cynodon dactylon,*

Leersia hexandra, and *Phragmites australis* and the parasitic *Cuscuta campestris* which all occur in many of the other peatland communities.

This sub-community is related to community 6 through the presence of *Schoenoplectus brachyceras*.

The sub-community has a total of 24 species and is represented by 34 relevés. An average of 7 species per relevé was recorded.

7.2. *Fimbristylis bivalvis* typical sub-community

This sub-community is characterized by species group D, though the diagnostic species are sparsely distributed. The dominant species are the sedges *Fimbristylis bivalvis, Pycreus nitidus* and the grass *Cynodon dactylon*.

An average of 5 species per relevé was found in this sub-community and a total of 20 species recorded from 32 relevés. This community has fewer species than sub-community 7.1. and a lower average number of species per relevé.

8. *Sphagnum truncatum – Xyris natalensis* closed short moss peatland

The *Sphagnum truncatum - Xyris natalensis* community occurs extensively in the southern and central-northern parts of the peatland.

Where this community occurs, the water is shallow (5-20 mm) and the water depth is constant without much fluctuation. The conductivity of the water (283 μS), as well as the dissolved oxygen content (6%), are medium to high while the pH is medium to low (5.63).

Species group A is characteristic for this community (Table 6.3). The peat moss *Sphagnum truncatum* is the only diagnostic species and is, together with *Xyris natalensis*, the dominant species. Other prominent species is parts of this community are *Cuscuta campestris, Panicum parvifolium, Pycreus nitidus,*

Table 6.3: Table of community 8 of the Mfabeni swamp

Community	8																								
	8.1																				8.2				
	8.1.1				8.1.2					8.1.3							8.1.								
Relevé nr.	122	123	127	130	57	73	121	124	133	55	56	72	103	104	116		59	60		105	106	109			
Species group A																									
Sphagnum truncatum	3	3	5	5	4	b	4	4	3	4	a	4	5	4	3		a	4		b	3	3			
Species group B																									
Xyris natalensis	b	1	a	a	a	.	1	a	.	3	b	b	3	4	b		+	.		.	.	+			
Species group C																									
Andropogon huillensis	b	b	a	.	.	.	.	+	.	.	.	.	.	+	.		.	.		.	r	.			
Species group D																									
Leersia hexandra	.	.	.	.	1	r	+	+	a	.	1	.	.	.	.		.	.		.	.	.			
Cladium mariscus	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.		.	.		.	.	.			
Phragmites australis	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.		.	.		.	.	.			
Species group E																									
cf Pentodon species	.	.	.	.	+	.	.	.	.	.	b	.	+	1	1		.	.		1	.	+			
cf Ischaemum species	.	.	.	.	.	.	.	.	.	.	.	+	+	.	1		.	.		.	.	.			
Drosera madagascariensis	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.		.	.		.	.	.			
Species group F																									
Trichopteryx dregeana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		a	.		.	.	.			
cf Hypericum species	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.		1	.		+	.	.			
Eulophia angolensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	+		.	.	.			
Species group G																									
Cuscuta campestris	.	.	.	.	1	.	.	.	.	a	a	a	a	.	.		a	b		.	.	.			
Panicum parvifolium	.	.	.	.	.	.	.	.	.	.	.	a	+	a	1		+	a		.	.	.			
Species group H																									
Rhynchospora corymbosa	.	.	.	.	1	.	+	1	.	+	.	.	.	.	.		1	1		.	.	.			
Species group I																									
Pycreus nitidus	.	.	+	a	1	1	1	+	1	.	+	+	.	.	.		a	a		.	.	.			
Schoenoplectus brachyceras	.	+	+	.	.	.	.	.	+	1	.	.	.	.	+		+	.		.	.	.			
Panicum brevifolium	+	+	+	+	.	+	+	+	.	.	.	+	a	a	a		b	1		.	.	.			
Cynodon dactylon	+	+	.	.	1	.	+	.	.	a	1	+	.	a	.		.	b		.	.	+			
Species group J																									
Nymphoides thunbergiana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.		4	.	.			
Disa woodii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.		+	r	.			
Unidentified species 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.		1	+	a			
cf Laurembergia repens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.		.	a	4			
Xyris anceps	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.		.	+	+			
Utricularia species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.		.	.	1			
Utricularia prehensilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.		.	.	+			
Species group K																									
Fimbristylis bivalvis	.	.	1	+	a	4	1	.	.	.	.	.	.	.	+		.	3		+	.	.			
Rhynchospora brownii	.	.	.	.	+	.	.	.	.	a	+	.	.	+	1		a	+		+	.	+			
Rhynchospora holoschoenoides	.	.	.	.	.	.	.	+	.	.	.	r	.	.	.		.	.		.	.	r			

Schoenoplectus brachyceras, Panicum brevifolium, Cynodon dactylon, Fimbristylis bivalvis and *Rhynchospora brownii.*

There are 20 relevés representing this community and 29 species were recorded from these relevés. An average of 8 species was recorded per relevé.

This community can be divided into two sub-communities and the one sub-community can be further subdivided into four variants. (Table 6.3). The classification is as follows:

8.1. *Sphagnum truncatum – Xyris natalensis* sub-community
8.1.1. *Andropogon huillensis* variant
8.1.2. *Fimbristylis bivalvis* variant
8.1.3. *Xyris natalensis* variant
8.1.4. *Eulophia angolensis* variant
8.2. *Sphagnum truncatum – Laurembergia repens* sub-community

8.1. *Sphagnum truncatum – Xyris natalensis* sub-community

This sub-community is widespread in the central-northern and southern portion of the swamp.

Species group B (Table 6.3) characterizes this sub-community and it is dominated by *Sphagnum truncatum* and the diagnostic *Xyris natalensis*. *Pycreus nitidus, Schoenoplectus brachyceras, Panicum brevifolium, Cynodon dactylon* and *Fimbristylis bivalvis* are also conspicuous in this sub-community.

A total of 22 species with an average of 8 species per relevé were found in the 17 relevés that represent this sub-community.

8.1.1. *Andropogon huillensis* variant

The area where this variant occurs burned prior to the period in which sampling was done. This variant has a water level between 10 mm and 20 mm and is

considered to be quite dry, being the drier of the variants that burned. It is as wet as variant 8.1.4 (*Sphagnum truncatum - Eulophia angolensis* variant), which did not burn, but wetter than variant 8.1.3 (*Xyris natalensis* variant).

The variant (*Andropogon huillensis* variant) is characterized by species group C with *Andropogon huilensis* the only diagnostic species (Table 6.3). *Andropogon huilensis*, *Xyris natalensis* and *Sphagnum truncatum* are dominant. As in the sub-community (*Sphagnum truncatum – Xyris natalensis* sub-community) *Schoenplectus brachyceras, Panicum brevifolium, Cynodon dactylon, Fimbristylis bivalvis* and *Pycreus nitidus* are also prominent in this variant.

Andropogon huillensis occurs in wet places such as riverbanks, vleis and drainage channels in road reserves. It can also occur in the veld in areas with high rainfall and favors wet sandy soil (Van Oudtshoorn 1999).

The variant has a total of 8 species and is represented by 4 relevés, with an average of 6 species per relevé.

8.1.2. *Fimbristylis bivalvis* variant

This variant is the wettest of all the identified *Sphagnum truncatum* peatland communities, with a water level between 5 and 150 mm. Some of the relevés were compiled in areas that burned just prior to the sampling, though some areas did not burn. It seems that the burning did not influence the classification greatly, as all these relevés were indeed classified into a single variant.

This variant is characterized by species group D (Table 6.3), with *Leersia hexandra* the most prominent diagnostic species. The dominant species are *Pycreus nitidus, Sphagnum truncatum*, and *Fimbristylis bivalvis*.

A total of 16 species, with an average of 7 species per relevé were found in the 5 relevés that represent this variant.

8.1.3. *Xyris natalensis* variant

This variant is the driest of all the *Sphagnum truncatum* peatland communities identified, with a water depth of 5 -15 mm.

The variant is characterized by species group E with cf *Pentodon* species and *cf Ischaemum* species the most prominent diagnostic species (Table 6.3) The dominant species are *Xyris natalensis, Spagnum truncatum*, *Cuscuta campestris, Panicum parvifolium, Panicum brevifolium, Cynodon dactylon* and *Rhynchospora brownii. Cuscuta campestris* is a cosmopolitan parasitic weed from South America (Pooley 1998).

A total of 18 species and an average of 8 species per relevé were found in the 6 relevés of this variant.

8.1.4. *Eulophia angolensis* variant

This variant is relatively wet, but drier than 8.1.2. (*Fimbristylis bivalvis* variant) and has a water depth of between 10 mm and 40 mm.

Species group F characterizes the variant with *Trichopteryx dregeana, Hypericum* species and *Eulophia angolensis* as diagnostic species (Table 6.3). It also differs from the other variants in this sub-community due to the absence of *Xyris natalensis.* Prominent species in this variant are *Sphagnum truncatum, Cuscuta campestris, Panicum parvifolium, Rhynchospora corymbosa, Pycreus nitidus* and *Panicum brevifolium*.

There is an average of 11 species per relevé and a total 14 species were recorded from 2 relevés in this variant.

8.2. *Sphagnum truncatum – Laurembergia repens* sub-community

This sub-community occurs in small patches in the swamp. It has very short, open vegetation and the peat is less stable, with wet peat. The water depth varies from 20 mm to 100 mm.

The sub-community is characterized by species group J with Unidentified species 1, cf *Laurembergia repens, Xyris anceps, Disa woodii, Urticularia prehensilis* and *Nymphoides thunbergiana* as the diagnostic species (Table 6.3). The sub-community is dominated by *Sphagnum truncatum*. *Nymphoides thunbergiana* is an aquatic perennial herb in rivers and pools up to 1600 m altitude (Pooley 1998). *Utricularia prehensilis* is a terrestrial herb occurring in seasonally flooded and marshy areas from the coast to 2000 m altitude (Pooley 1998). *Utricularia* species are perennial herbs in damp places or submerged in the water (Pooley 1998).

This community is represented by 3 relevés and has 16 species with an average of 8 species per relevé.

9. *Cladium mariscus* closed high sedge peatland

This community occurs in extensive, dense stands in the north-western and central-western parts and also in patches in the north-eastern and southern portions of the swamp.

The water depth of this community is relatively stable and shallow (60 mm). The conductivity of the water is mostly medium (312 μS), but higher (416 μS) in a few places. The dissolved oxygen content is mostly medium (1.2%) and the pH of the water is low to medium (5.7).

The community is characterized by species group A, with *Cladium mariscus* the only diagnostic species (Table 6.4). The tall-growing sedge *Cladium mariscus* is

Table 6.4: Table of communities 9, 10 and 11 on the Mfabeni swamp

Community	9																				10													11		
	9.1								9.2		9.3										10.1										10.2					
	9.1.		9.1.2																																	
Relevé nr.	66	68	3	8	25	38	156	191	128	129	80	97	137	140	146	160	168	170	174	179	161	163	165	166	167	169	171	172	173	178	134	135	144	145	147	211
Species group A																																				
Cladium mariscus	5	4	5	4	5	5	4	5	b	3	5	5	3	3	3	4	4	4	3	3	1	.	.	4	1	.	3	3	+	+	.	.	.	b	.	.
Species group B																																				
cf Ischaemum species	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group C																																				
Eleocharis dulcis	.	.	1	1	.	1	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a
Species group D																																				
Cynodon dactylon	a	b	b	a	a	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Cuscuta campestris	1	+	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group E																																				
Sphagnum truncatum	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group F																																				
Ficus verruculosa	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zantedeschia species	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fuirena cf hirsuta	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ischaemum fasciculatum	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group G																																				
Cyperus prolifer	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	3	b	a	1	4	3	a	1	4	1	3	b	b	1	1	.
Species group H																																				
Leersia hexandra	.	a	.	.	.	.	.	+	.	.	.	.	.	.	r	+	.	.	+	.	1	+	a	+	a	.	+	a	a	b	.	.	+	.	.	.
Unidentified Poaceae 3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	+	.	+	+	1	.	.	.	.	.	.	.	.	.	.
Senecio deltoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	.	r	+	r	a	.	.	+	.	.	.	.	.	.	.
Species group I																																				
Thelypteris interrupta	.	1	.	.	.	.	.	.	.	.	+	+	1	.	.	1	a	a	1	+	+	+	1	a	a	a	a	.	a	.	r	.	.	.	.	+
Species group J																																				
Pycreus nitidus	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	.	.	.
Schoenoplectus brachyceras	.	.	.	.	.	.	.	.	r	.	1	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.
Panicum brevifolium	+	1	.	r	.	.	.	.	1	+	+	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	b	.	+	.	.	.
Species group K																																				
Cyperus fastigiatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	.	.	.	a	.	.	.	1	.	.	+	3	b	5
Ludwigia octovalvis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Species group L																																				
Phragmites australis	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	a	.	+	.	a	.	+	+	.	+	1	1	+	.	.	.	.	.	+	.	.
Persicaria serrulata	.	1	.	.	.	.	+	.	.	.	.	.	+	+	+	.	1	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+
Rhynchospora corymbosa	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.

□

also the dominant species and the forb *Persicaria serrulata*, the fern *Thelypteris interrupta* the reed *Phagmites australis* and the grasses *Panicum brevifolium* and *Cynodon dactylon* are also locally prominent. *Cladium mariscus* normally occurs in dense stands on the margins of swamps and near streams (Pooley 1998).

This community often occurs interspersed with Community 10, the *Cyperus prolifer* closed short sedge peatland, in a mosaic distribution pattern.

A total of 21 species were recorded from 20 relevés with an average of 5 species per relevé.

This community can be divided into three sub-communities and one of these can be further divided into two variants. (Table 5)
9.1. *Cladium mariscus – Cynodon dactylon* sub-community
9.1.1. *Ischaemum* species variant
9.1.2. *Eleocharis dulcis* variant
9.2. *Cladium mariscus – Sphagnum truncatum* sub-community
9.3. *Cladium mariscus – Thelypteris interrupta* sub-community

9.1. *Cladium mariscus – Cynodon dactylon* sub-community
This sub-community occurs mostly in the north-eastern part of the swamp.

The Sub-community is characterized by species group D *Cynodon dactylon* and *Cuscuta campestris* the diagnostic species. The dominant species are *Cladium mariscus* and *Cynodon dactylon* while single individuals of the reed *Phragmites australis* also occur in this sub-community. *Cladium mariscus* can usually be found in stands on the margin of swamps and close to streams in the northern areas of Natal (Pooley 1998).

A total of 12 species and an average of 5 species per relevé were recorded from 8 relevés.

9.1.1. *Ischaemum* species variant

The habitat of this variant is drier than variant 9.1.2. (*Eleocharis dulcis* variant) with the water level at the surface of the peat.

Species group B characterizes this variant, with cf *Ischaemum* species the only diagnostic species (Table 6.4). The vegetation is dominated by *Cladium mariscus, Cynodon dactylon* and *Ischaemum* species.

A total of 8 species, with an average of 6 species per relevé were recorded from the 2 relevés that represent this variant.

9.1.2. *Eleocharis dulcis* variant

The habitat of this variant is relatively wet and has a water depth between the surface and 200 mm.

This variant is characterized by species group C, with *Eleocharis dulcis* the only diagnostic species (Table 6.4). The dominant species are *Cladium mariscus, Cynodon dactylon, Phragmites australis* and *Eleocharis dulcis. Eleocharis dulcis* is a robust emergent perennial occurring in tufts in the permanent fresh water of vleis and pans (Gordon-Gray 1995).

A total of 10 species and an average of 5 species per relevé were recorded from 6 relevés in this variant.

9.2. *Cladium mariscus* – *Sphagnum truncatum* sub-community

The habitat of this sub-community is relatively wet with a water depth of 50 mm to 150 mm. This sub-community was sampled shortly after it burned, though it was possible to identify the species present (or have specimens identified by the National Herbarium, National Botanical Institute, Pretoria).

This sub-community is characterized by species group E, with *Sphagnum truncatum* the only diagnostic species. The dominant species are *Cladium mariscus* and *Sphagnum truncatum* and *Pycreus nitidus* and *Panicum brevifolium* are also prominent.

In this 2 relevés sampled in this sub-community a total of 5 species and an average of 4 species per relevé were recorded.

9.3. *Cladium mariscus – Thelypteris interrupta* sub-community

This sub-community is relatively dry with water depth mostly at the surface of the peat. Some of the relevés were sampled after the vegetation was burned, but some relevés were sampled during the previous fieldwork season before the area was burned.

The sub-community is characterized by species group F, though the diagnostic species are poorly represented. The absence of species groups B-E may however also be regarded as being diagnostic (Table 6.4). The dominant species in this sub-community is *Cladium mariscus*, but *Thelypteris interrupta, Persicaria serrulata* and *Phragmites australis* is also prominently present.

A total of 14 species with an average of 5 species per relevé were recorded from the 10 relevés that represent this sub-community.

10. *Cyperus prolifer* closed short sedge peatland

This community occurs in the north-western to northern parts of the swamp, often adjacent to and merging into the swamp forest (Communities 12 and 13, the *Syzygium cordatum – Stenochlaena tenuifolia* swamp forest and the *Ficus trichopoda – Nephrolepis biserrata* swamp forest).

The water depth is variable (-30 mm to 300 mm) and the dissolved oxygen content of the water also varies considerably (-7% to 7%). The conductivity of the water is medium, with an average of 131 μS and the pH is mostly medium (5.78).

Species group G is characteristic and diagnostic and dominant species is the sedge *Cyperus prolifer* (Table 6.4). The fern *Thelypteris interrupta*, the grass *Leersia hexandra*, the reed *Phragmites australis* and the sedge *Cladium mariscus* may be prominent locally, as is the forb *Senecio deltoides*. *Cyperus prolifer* often occurs in well aerated water of marshes and streams along the coast from NE Cape, along the east coast of Africa, as well as on some islands (Pooley 1998) It is intolerant of stagnant conditions and shading, which will result in failure to produce perfect spikelets (Gordon-Gray 1995). This would explain why the community occurs closer to the drainage lines, where water is flowing and therefore may, at least periodically, have a higher dissolved oxygen content.

Community 10 is floristically related to community 9.3 through species group I (Table 6.4)

A total of 13 species with an average of 6 species per relevé recorded from 13 relevés.

This community can be divided into two sub-communities:
10.1. *Cyperus prolifer – Leersia hexandra* sub-community
10.2. *Cyperus prolifer – Pycreus nitidus* sub-community

10.1. *Cyperus prolifer – Leersia hexandra* sub-community

This sub-community occurs mainly in the north-western portion of the swamp.

Species group H characterizes this sub-community, with *Senecio deltoides* and *Leersia hexandra* as diagnostic species (Table 6.4). *Cyperus prolifer, Cladium*

mariscus, Leersia hexandra and *Thelypteris interrupta* are the most dominant species.

A total of 11 species and an average of 6 species per relevé were recorded from the 10 relevés that represent the sub-community.

10.2. *Cyperus prolifer – Pycreus nitidus* sub-community

This sub-community occurs in the central and north-western parts of the swamp and is characterized by species group J, with *Pycreus nitidus, Schoenoplectus brachyseras* and *Panicum brevifolium* as diagnostic species (Table 6.4). *Cyperus prolifer* is dominant and *Pycreus nitidus* and *Panicum brevifolium* are also conspicuous. *Pycreus nitidus* is a perennial occurring on the margin of swamps and streams and may form floating mats on water (Pooley 1998).

A total of 7 species and an average of 5 species per relevé and were found in the 3 relevés representing this sub-community.

11. *Cyperus fastigiatus* closed tall sedge peatland

This community is restricted to the northern portions of the swamp, mostly in the deeper water channels that drain through the northern edges of the swamp.

The water depth is medium to deep (150 – 300 mm) and the conductivity of the water is low (263 μS). The pH is relatively high (5.76 - 5.88), with low (-10%) dissolved oxygen in the water.

The community is characterized by species group K, with *Cyperus fastigiatus* and *Ludwigia octovalvis* the diagnostic species (Table 6.4). The dominant species are *Cyperus fastigiatus* and the forbs *Ludwigia octovalvis* and *Persicaria serrulata* while the reed *Phragmites australis* is also present.

A total of 9 species were found in this community, with an average of 5 species per relevé. It is represented by 3 relevés.

***12. Syzygium cordatum – Stenochleana tenuifolia* swamp forest**

This swamp forest occurs in the central portion of the swamp forest along the western part of the peatland.

The community occurs on peat with shallow water (40 mm) and the water table may fluctuate resulting in wetter and drier patches within the forest. The pH of the water in this community is between medium and low (5.63) and the dissolved oxygen content is medium (1%). The conductivity of the water varies.

Species group A characterizes the community and the tall forest tree *Syzygium cordatum* and the moss *Sphagnum truncatum* and the sedge *Cyperus prolifer* are diagnostic (Table 6.5). *Syzygium cordatum* and the climbing fern *Stenochleana tenuifolia* are by far the most dominant species in this forest community.

Other species noted include:
Trees and shrubs (Table 6.5)
Rapanea melanophloeos
Dichrostachys cinerea
Englerophytum natalense
Voacanga thouarsii
Myrica serrata
Kraussia floribunda
Tabernaemontana elegans

Forbs
Erianthemum dregei
Smilax anceps
Thelypteris interrupta

Table 6.5: Table of the swamp forest communities of Mfabeni swamp

Community	12			13				14		
Relevé nr.	208	209	210	198	199	200	204	201	202	203
Species group A										
Syzygium cordatum	5	4	4	.	.	.	a	+	+	+
Sphagnum truncatum	1	.	a	.	.	.	.	.	.	.
Cyperus prolifer	+	+	+	.	.	.	.	.	.	.
Rapanea melanophloeos	+	.	.	.	.	.	.	.	.	.
Dichrostachys cinerea	.	+	.	.	.	.	.	.	.	.
Erianthemum dregei	.	.	+	.	.	.	.	.	.	.
Species group B										
Ficus trichopoda	.	.	.	4	4	1	3	.	+	.
Nephrolepis biserrata	.	+	.	a	3	4	4	.	.	+
Scleria angusta	.	.	.	b	b	+	3	+	1	+
Trema orientalis	.	.	.	1	1	.	.	.	.	.
Cassipourea gummiflua	.	.	.	.	.	a	.	.	.	.
Eugenia species	.	.	.	+	1	.	.	.	.	.
Senecio deltoideus	.	.	.	+	.	+	.	.	.	.
Cussonia spicata	.	.	.	.	.	1	.	.	.	.
Rhus species	.	.	.	+	.	.	.	.	.	.
Schefflera umbellifera	.	.	.	.	.	+	.	.	.	.
Unidentified species 3	.	.	.	.	.	.	+	.	.	.
Unidentified species 2	.	.	.	.	.	.	+	.	.	.
Cyperus species	.	.	.	.	r	.	.	.	.	.
Species group C										
Englerophytum natalense	+	+	.	+	1	.	.	.	.	.
Voacanga thouarsii	+	.	.	+	1	.	+	.	.	.
Myrica serrata	+	+	+	.	.	.	+	.	.	.
Species group D										
Barringtonia racemosa	.	.	.	.	.	.	.	5	4	5
Bridelia micrantha	.	.	.	.	.	.	+	+	+	1
Rhoicissus species	.	.	.	.	.	.	+	+	+	+
Phoenix reclinata	.	.	.	.	.	.	.	1	+	.
Ficus natalensis	.	.	.	.	.	.	.	1	.	+
Antidesma venosum	.	.	.	.	.	.	.	+	.	+
Ekebergia pterophylla	.	.	.	.	.	.	.	+	.	+
Setaria megaphylla	.	.	.	.	.	.	.	+	.	+
Rothmannia fischeri	.	.	.	.	.	.	.	.	+	+
Canavalia bonariensis	.	.	.	.	.	.	.	+	.	.
Lygodium microphyllum	.	.	.	.	.	.	.	+	.	.
Oplismenus hirtellus	.	.	.	.	.	.	.	+	.	.
Dalbergia armata	.	.	.	.	.	.	.	+	.	.
Tarenna pavettoides	.	.	.	.	.	.	.	+	.	.
Senecio species	.	.	.	.	.	.	.	+	.	.
Ficus sur	.	.	.	.	.	.	.	.	.	+
Ficus burtt-davyi	.	.	.	.	.	.	.	.	.	+
Chlorophytum species	.	.	.	.	.	.	.	.	.	+
Species group E										
Ipomoea mauritiana	.	.	.	1	.	+	+	+	.	+
Secamone species	.	.	.	+	+	.	+	.	+	+
Polypodium species	.	.	.	.	+	.	.	.	+	.
Allophylus dregeanus	.	.	.	.	.	+	.	.	.	+
Psychotria capensis	.	.	.	.	.	+	+	+	+	1
Trimeria grandifolia	.	.	.	.	.	1	.	.	+	+
Rauvolfia caffra	.	.	.	.	.	.	+	.	.	+
Species group F										
Stenocleana species	a	3	a	a	1	a	b	+	b	+
Smilax anceps	+	+	.	+	1	.	+	+	.	.
Thelypteris interrupta	1	+	+	.	+	.	+	+	.	+
Kraussia floribunda	+	+	+	.	.	+	.	.	+	+
Behnia species	+	.	.	.	.	.	.	+	.	.
Tabernaemontana elegans	.	+	.	.	.	.	.	+	.	.

□

The community shares species group C with community 13, the *Ficus trichopoda – Nephrolepis biserrata* swamp forest. Species group F contains the general species of the swamp forest.

The community has an average of 10 species per relevé and a total of 16 species were recorded from 3 relevés.

***13. Ficus trichopoda – Nephrolepis biserrata* swamp forest**

This community occurs in the northern and southern parts of the swamp forest.

The water depth within this community is about 70 mm, but it may fluctuate, causing shallower and deeper water in the peat. Deep pools filled with water are found in this area. The conductivity (225 μS) and dissolved oxygen content of the water (-11.5%) are both low but the pH is relatively high (5.84).

Species group B characterizes the community with *Ficus trichopoda, Trema orientalis* and *Cassipouria gummiflua* the most prominent diagnostic woody species (Table 6.5). *Ficus trichopoda* is by far the most dominant tree with the small trees or shrubs *Voacanga thouarsii, Trema orientalis* and *Eugenia* species also important in the woody strata.

Other species noted include:

Trees and shrubs

Cussonia spicata

Englerophytum natalense

Voacanga thouarsii

Myrica serrata

Allophylus dregeanus

Forbs

Senecio deltoides

Cyperus species
Ipomoea maurítiana

The fern *Nephrolepis biserrata* or the sedge *Scleria angusta* are dominant in the herbaceous layer.

Species group E contains species that indicate a floristic relationship with community 14, the *Barringtonia racemosa – Bridelia micrantha* swamp forest.

A total of 30 species, with an average of 15 species per relevé, were found in this community, represented by 4 relevés.

***14. Barringtonia racemosa – Bridelia micrantha* swamp forest**

This forest community occurs in the southern portion of the swamp forest, along the drainage line. This forest is less dense than the other two forest communities.

The water depth of this community is medium (200 mm) and seems to be relatively stable, although it may fluctuate a bit. The pH of the water is between medium and high (5.76) and the conductivity and the dissolved oxygen content of the water are both medium to low (274µS and 0% respectively).

The understory of this community is much more open than that of the other two swamp forest communities.

This community is characterized by species group D and the diagnostic species are the trees *Barringtonia racemosa* and *Bridelia micrantha* and the liana *Rhoicissus* species. The grass *Setaria megaphylla,* the palm tree *Phoenix reclinata* and the shrub *Antidesma venosum* are also conspicuous diagnostic species (Table 6.4).

Other prominent trees and shubs:

Ficus natalensis
Ekebergia pterophylla
Rothmannia fischeri
Psychotria capensis

Grasses
Oplismenus hirtellus

Forbs
Ipomoea mauritiana
Senecio species

This community is represented by 3 relevés with a total of 35 species and an average of 20 species per relevé.

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Chapter 7
Results: Ordination and Habitat Interpretation

7.1 Floristic ordination

The floristic data were subjected to DECORANA ordination and the results of this ordination are displayed in Figures 7.1, 7.2 and 7.3.

The ordination which included all 214 relevés (Fig 7.1) clearly separated the *Restio zuluensis – Andropogon appendiculatus* closed low sedge and grass peatland community (Community 1), the 10 communities representing the swamp (Communities 2-11) and the three communities representing the swamp forest (Communities 12-14). The Eigenvalues for axis 1, 2 and 3 were 0.979, 0.810 and 0.790 respectively. The particular plant species compositions of the different plant communities, resulted in the relevés representing Community 1 being placed to the far left in the ordination diagram, the relevés representing the forest communities to the far right, and the 10 communities representing the swamp communities were concentrated in the centre of the diagram (Fig 7.1). Although the (10) different swamp communities were largely restricted to specific areas in the ordination diagram, the clustering in the centre of the diagram hampered interpretation of floristic relationships, and also relationships with environmental factors. Due to the strong discontinuity shown in the ordination diagram, between the *Restio zuluensis – Andropogon appendiculatus* closed low sedge and grass peatland, the swamp communities and the forest communities, indicating that these communities are floristically quite different, it was decided to do the ordinations of the swamp and swamp forest separately (Fig 7.2 and 7.3 respectively). Since the *Restio zuluensis – Andropogon appendiculatus* closed low sedge and grass peatland community, represented by only 3 relevés, is clearly different and not related to the rest of the swamp communities it was removed from the swamp ordination and placed in an ordination together with the swamp forest.

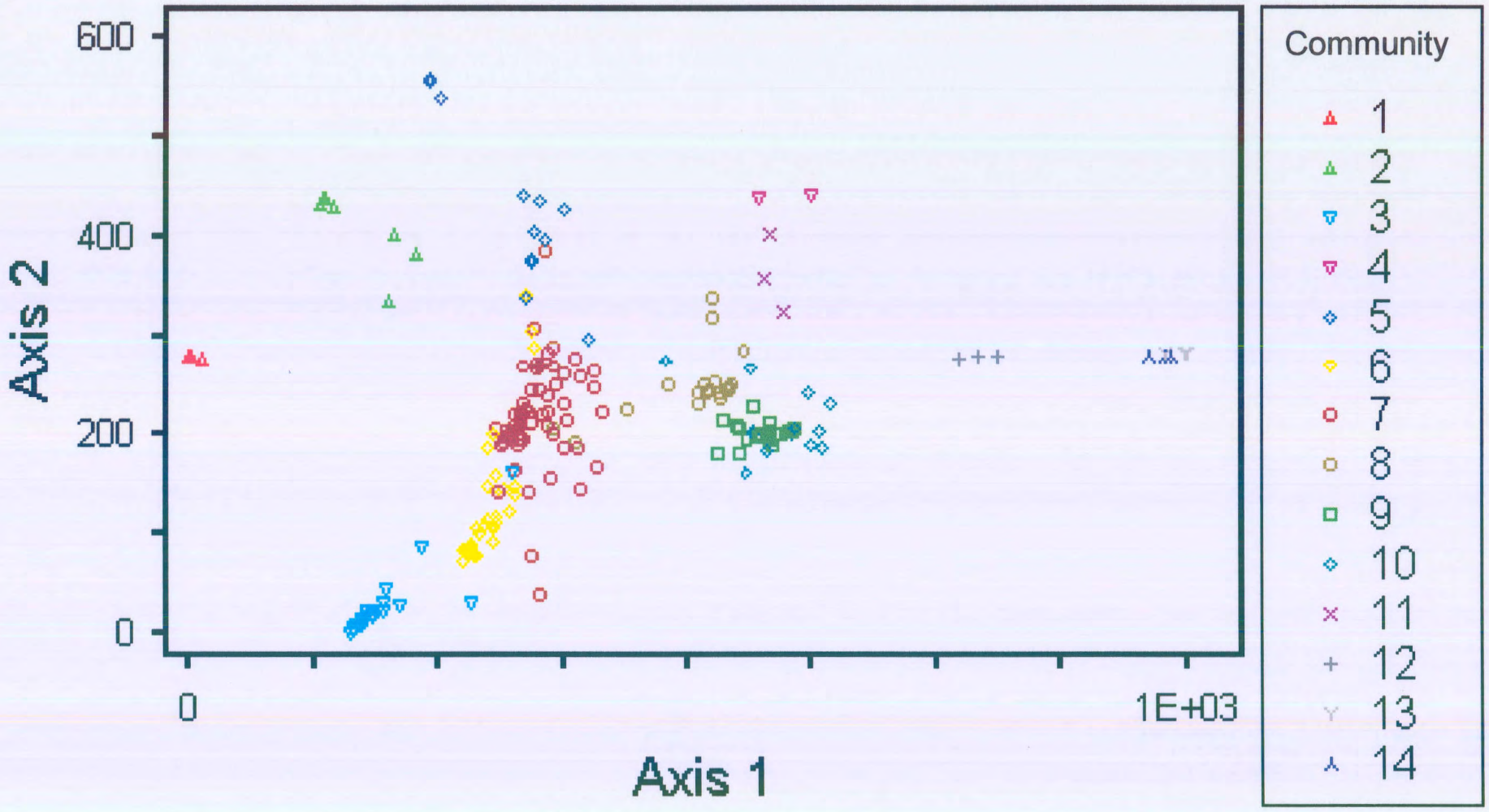

Fig 7.1. DECORANA ordination of the Mfabeni swamp, with the communities overlaid.

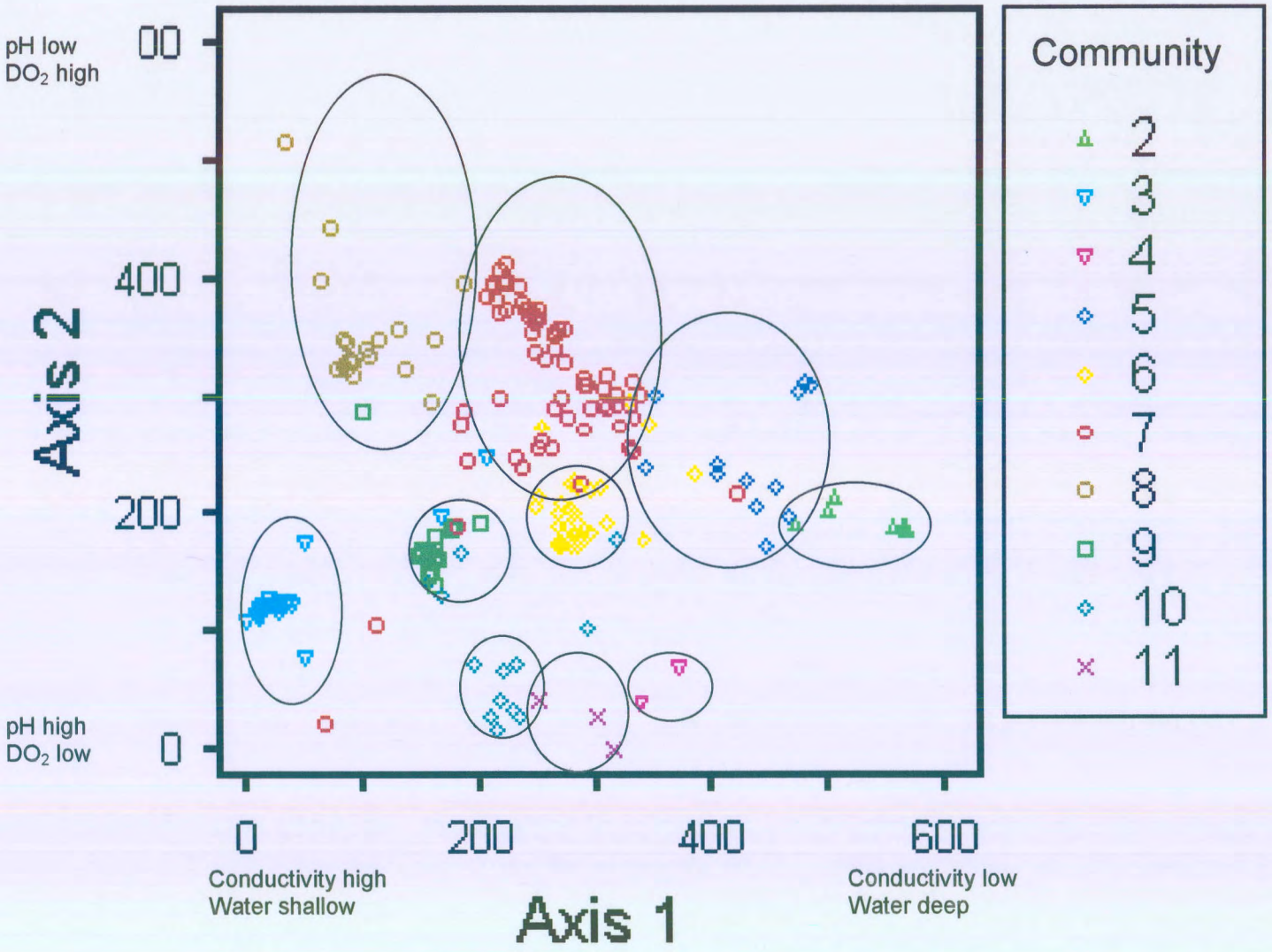

Fig 7.2. DECORANA ordination of the grass/sedge communities of the Mfabeni swamp.

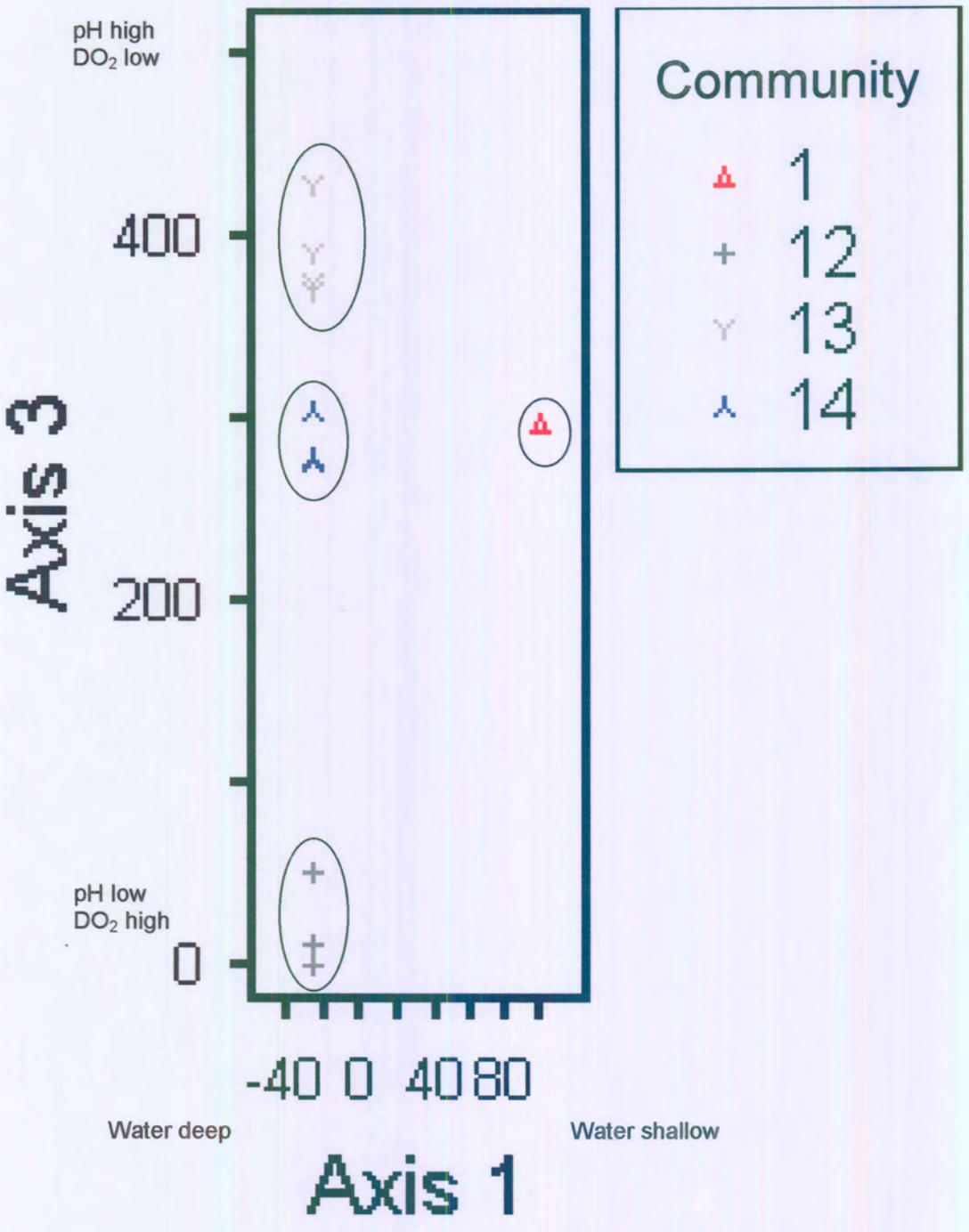

Fig 7.3. DECORANA ordination of the swampforest and *Restio* swamp.

Swamp ordination

Although habitat data were not collected at the sample sites, but habitat data were later collected within the identified plant communities, the average values of these habitat variables could be used to interpret the floristic gradients obtained through DECORANA. A summary of these average values per community is given in Table 7.1.

The relevés representing the swamp communities were more scattered in the resulting ordination diagram (Fig 7.2) with an easier interpretation of the floristic relationships among these 10 communities. The respective Eigenvalues for axis 1, 2 and 3 were 0.900, 0.734 and 0.668. From this diagram is clear that the relevés of each community are more or less restricted to particular zones in the diagram. On the right in the diagram is Community 2, sequentially, followed by Communities 5, 6, 7 and 8 towards the left, top corner of the diagram.

Although not statistically significant, these gradients in plant communities tend to follow gradients in environmental variables. Although there are exceptions, the communities of shallow water with a high conductivity are situated to the left in the diagram, and deep water with low conductivity to the right. Furthermore, communities in water with a relatively high pH and low oxygen content tend to be situated at the bottom of the diagram while those with low pH and high oxygen content in the water tend to be located at the top of the diagram.

Gradients in plant communities therefore tend to follow gradients in water depth and in conductivity of the water, from deep water with low conductivity values in Community 2, through to shallow water with high conductivity values and a high oxygen content of the water in Community 8. Likewise, a gradient in communities can be observed from Community 2, associated with deep water with low conductivity on the right in the diagram, via Communities 5 and 6, to Communities 9 and 3, mostly associated with shallow water with higher conductivity, but higher oxygen content of the water. Communities 4, 10 and 11,

Table 7.1 Average normalised values for pH, dissolved oxygen content, conductivity and water depth for the swamp communities of the Mfabeni Swamp.

Community	pH	DO_2	Conductivity	Water depth
2	73.9	34.9	41.	11.7
3	74.1	89.2	37.	14.8
4	74.3	16.5	61.	100.0
5	74.6	28.7	41.	34.0
6	73.1	86.9	38.	10.5
7	100.0	99.3	43.	17.2
8	72.7	100.0	47.	4.7
9	73.6	72.8	51.	6.2
10	74.3	73.3	55.	5.9
11	75.3	11.0	43.	21.7

Table 7.2. Average normalised values for pH, dissolved oxygen content, conductivity and water depth for the swamp communities of the Mfabeni swamp.

Community	pH	DO_2	Conductivity	Water depth
1	74.7	31.3	21.	1.7
12	72.7	71.7	10	4
13	75.5	2.8	37.	7
14	74.4	66.2	45.	20

located at the bottom of the diagram, seem to be associated with medium conductivity values, though with a high pH and low oxygen content of the water.

The results of the ordination also complement the classification. Not only are the relevés of the various plant communities to a large extent grouped, thereby confirming the result of the classification, but the floristic relationships between specific communities are also confirmed.

Swamp forest ordination

The swamp forest is clearly different from the *Restio zuluensis – Andropogon appendiculatus* closed low sedge and grass peatland (Community 1). The Eigenvalues for axis 1, 2 and 3 were 0.999, 0.791 and 0.589 respectively. The environmental variable, from the variables mentioned (Table 7.2), correlating with this disjunction seems to be water depth. The water depth of Community 1 is shallower than that of the swamp forest, as can be seen in Table 7.2. Axis 3 of the ordination illustrates a gradient from low pH and high dissolved oxygen content to high pH and low dissolved oxygen content. The pH gradient between the different communities is relatively strong and the dissolved oxygen gradient is weak.

7.2 Ordination of habitat data

The habitat data from 80 sample plots representative of the different major plant communities identified (Chapter 5) were subjected to various ordination options within the PCOrd program package. The aim of these ordinations was to establish the possible relationships between plant community and environmental variables. The four most important variables measured at the sample plots were water depth, pH, dissolved oxygen content and conductivity of the water.

Water depth

In the case of water depth a RA ordination of the plots gave the best correlation with the distribution of the plant communities (Fig 7.4). The distribution of the 80

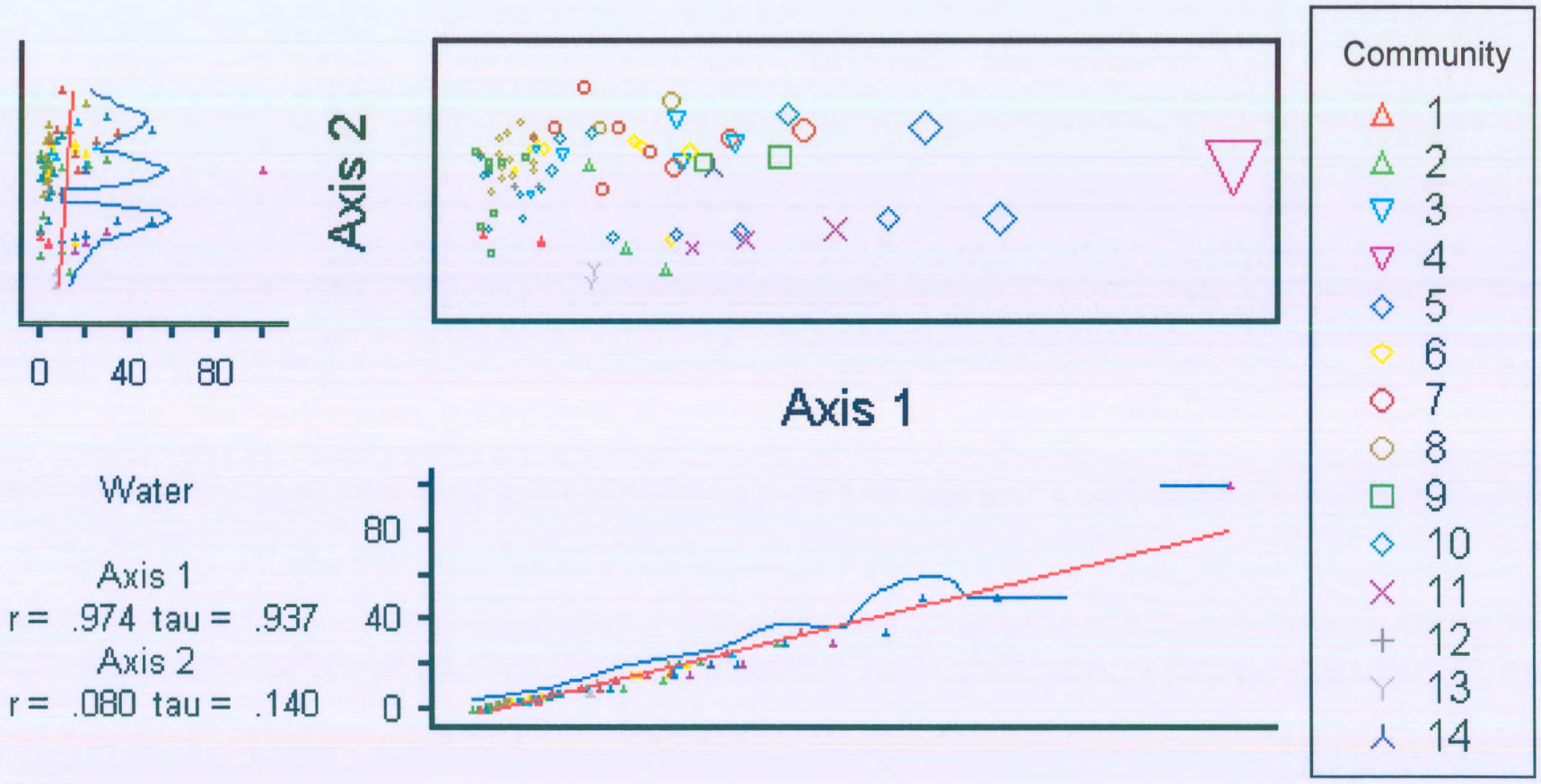

Fig 7.4. RA ordination diagram of the environmental data illustrating the water gradient.

plots along axes 1 and 2 is shown in Fig 7.4. Axis 1 gave a significant correlation with water depth (r = 0.974). It is clear that Communities 4, 5 and 11 are associated with deeper water, where-as Communities 1, 8, 9 and 10 occur in shallow water. These results confirm the tendencies found in the floristic ordination.

Dissolved Oxygen content

A RA ordination gave the best correlation (r = 0.942) between dissolved oxygen content and the distribution of plant communities on the second axis of ordination (Fig 7.5). Communities 3, 7 and 8 occur in water with high dissolved oxygen values and Communities 1, 5, 11 and 13 are associated with water with low dissolved oxygen content. This result has some similarity with the results obtained from the floristic ordination.

Conductivity

In the case of conductivity of the water a non-centered PCA ordination resulted in a high negative correlation (r = -0.934) with the distribution of plant communities along axis 1 of the ordination (Fig 7.6). The communities with the highest conductivity values in the water are Communities 7, 8 and 9 and with lower conductivity are Communities 1, 2, 5, 11 and 13. These results confirm the results of the floristic ordination.

pH

The results of a non-centered PCA on the pH values of the water are given in Figure 7.7. The distribution of plant communities along axis 1 of the ordination is significantly correlated (r = 0.855) with the pH values. Communities occurring in water with higher pH values are Communities 1, 5, 11 and 13 and the communities with a correlation with lower pH are Communities 7 and 8. These results confirm the results of the floristic ordination to a great extend.

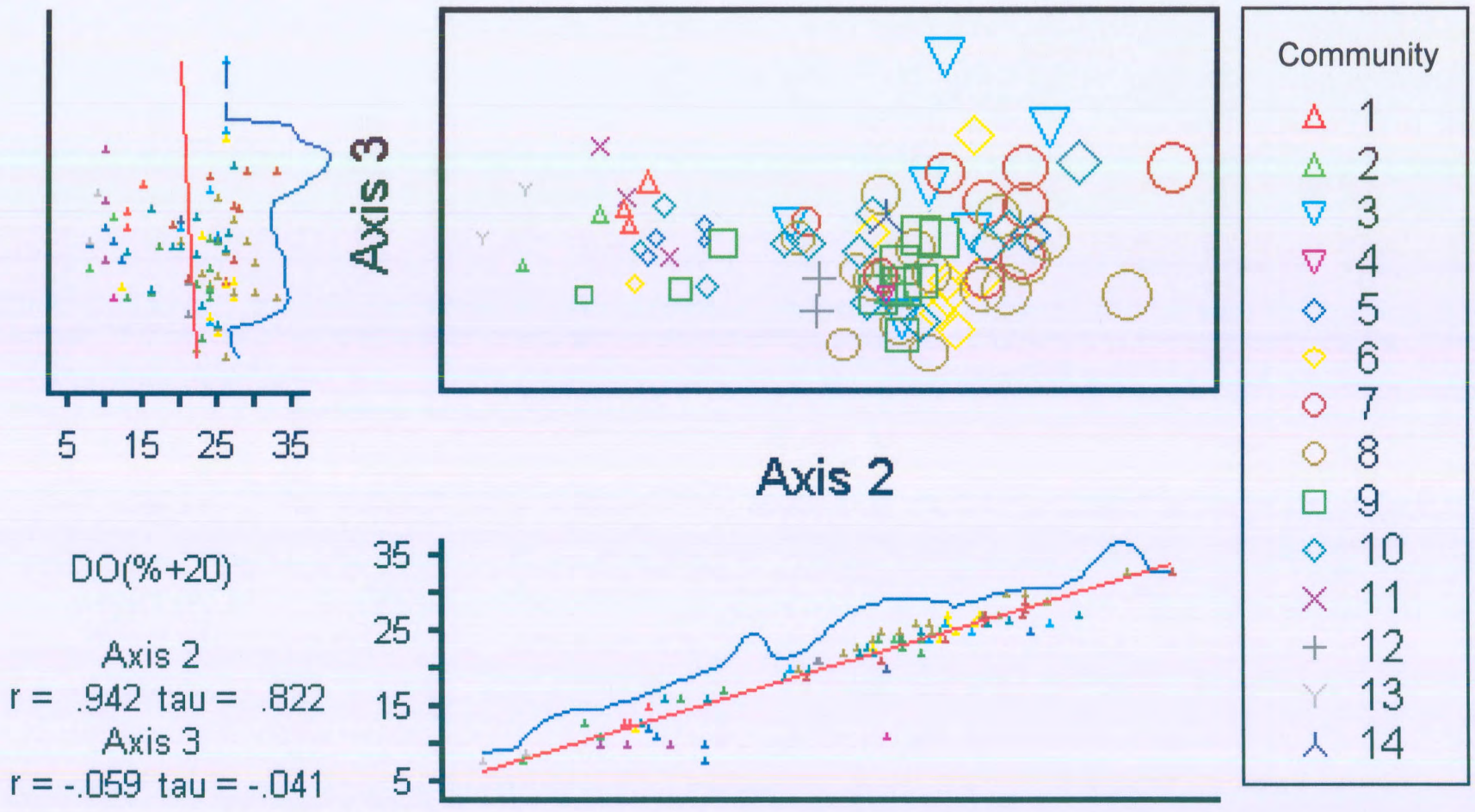

Fig 7.5. RA ordination graph of environmental data, illustrating the dissolved oxygen gradient.

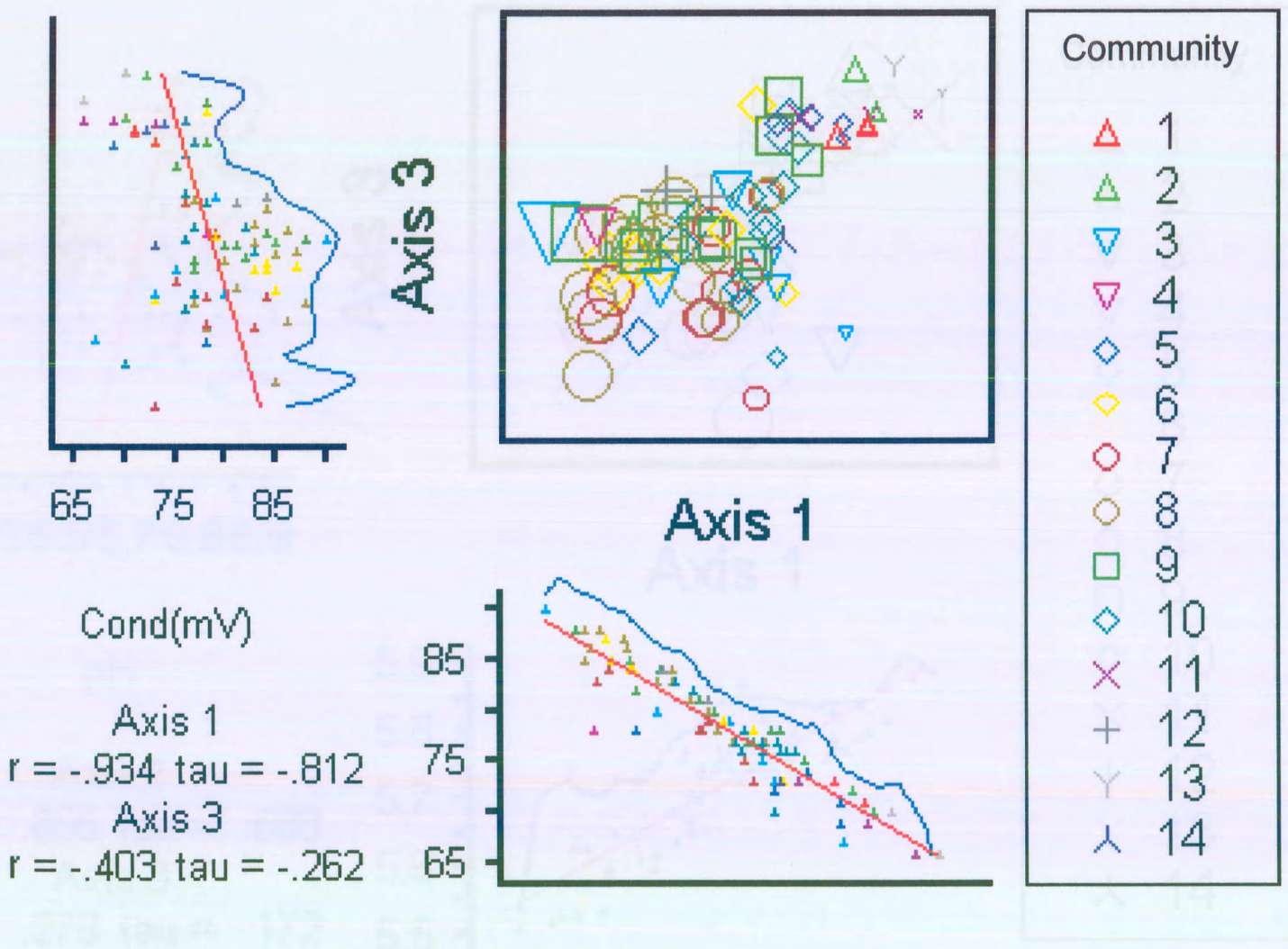

Fig 7.6. Non-centered PCA ordination of environmental data illustrating the conductivity gradient.

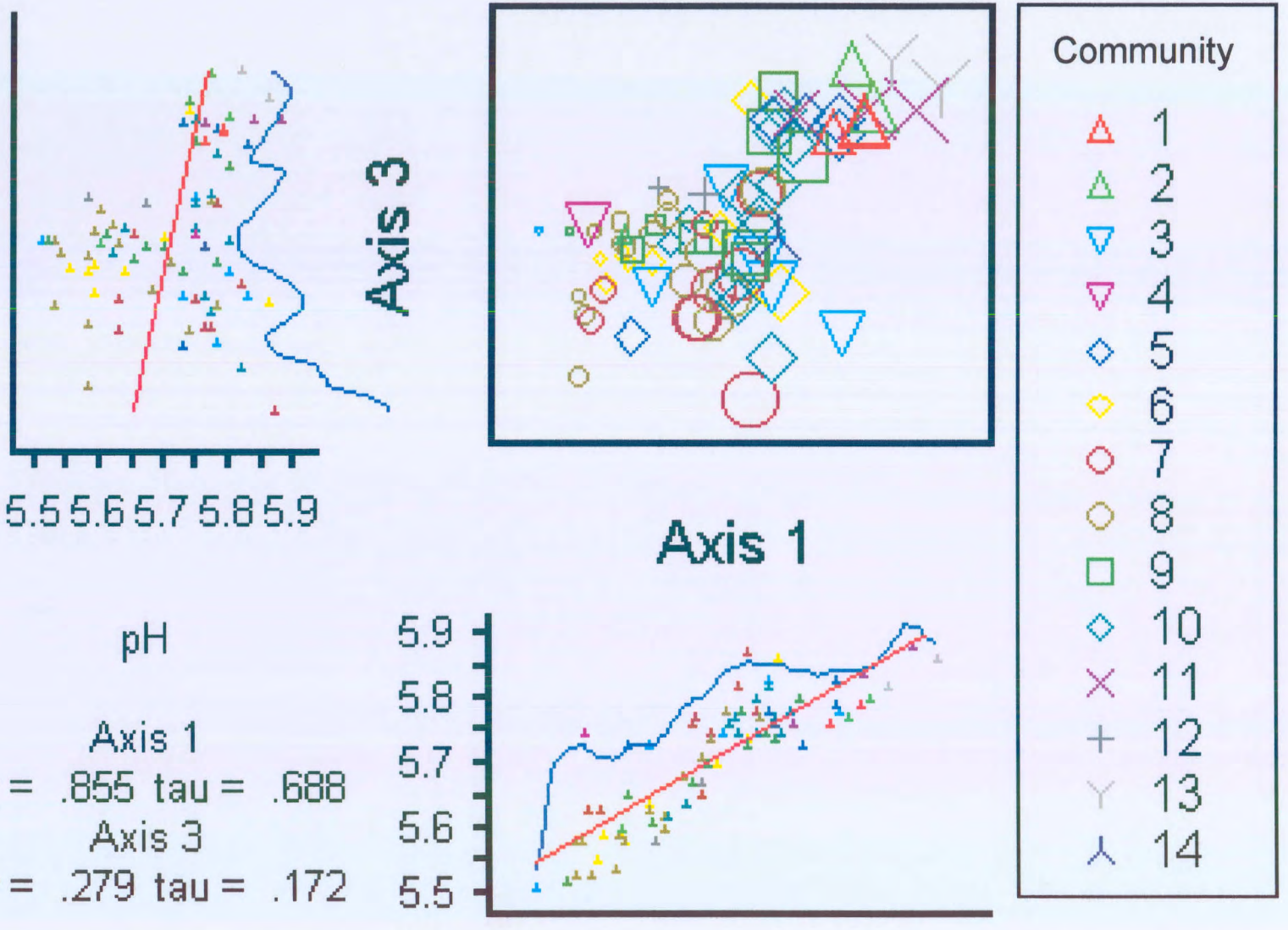

Fig 7.7. Non-centered PCA ordination of environmental data illustrating the pH gradient.

Chapter 8
Discussion and conclusion

Most of the swamp communities, or at least sub-communities, are described for the first time. This is due to the lack of floristic and plant community studies on peatlands. Some communities with similar dominant species were described by Schoultz (2000) from the Mkuze swamps. The similar communities include *Ficus trichopoda/Scleria angusta* Swamp Forest Community, *Typha capensis/Pycreus mundii/Leersia hexandra* Marsh Community and *Phragmites australis/Cladium mariscus/Ficus verruculosa* Swamp Community. Although the communities have similar dominant species as communities 13, 4 and 9 respectively it seems that these communities differ considerably, as far as total floristic composition is concerned, from those found in Mfabeni swamp. In the Mfabeni swamp *Cladium mariscus* form dense stand of almost homogenous vegetation, whereas in Mkuze their cover abundance values are much less. This may, however, be an artifact caused by differences in plot sizes used in Mkuze and Mfabeni. Schoultz (2000) used much larger plots (100 m^2) where-as the plot size in the Mfabeni study was 1 m^2. The plot sizes used in a swamp have a great influence on the communities identified in the area. Some of the patches of a community in Mfabeni were little bigger than the plot size used. The plot sizes used in peatlands in southern Africa vary from 0.25m^2 to 100m^2, but the most often used is the smaller plot sizes. Since there are few plant species in most wetland communities the small plot sizes are adequate and prevent overlap into other communities. The small sample plots can only be used in peatland that are sedge or grass dominated, swamp forests need bigger sample plots.

In a study on the ecology and conservation of swamp forests by Wessels (1997) similar swamp forest communities were identified and described. The same three main forest communities found by Wessels (1997) were identified in this study and the species compositions recorded in forest communities by the two studies are quite similar. However, Wessels (1997) recorded some species in the forest

communities that were not recorded at Mfabeni during the present study. The study of Wessels (1997) was done over a larger study area and this may account for the slight differences in total species composition, though the dominant species are similar (Wessels 1997). Furthermore, in the present study at Mfabeni only 10 relevés were compiled in the forest communities, as the study concentrated on the sedge swamp. This small number of relevés also contributes to the smaller number of species recorded at Mfabeni. In spite of these (smaller) floristic differences, the floristic dataset from the swamp forest at Mfabeni is considered as representative of these forests.

Schoultz (2000) found that the distribution of the three swamp forest communities in Mkuze might be a result of fire and a topographic influence. The swamp forest is protected from berg wind conditions by a steep, high dune and this protection also protects the swamp forest from fire. The parts of the swamp forest that do not have protection in this way are disturbed or form part of the precursor swamp forest community, the mature swamp forests are restricted to this protected areas (Schoultz 2000).

According to Wessels (1997) the occurrence and composition of swamp forest are influenced by selected environmental factors. The main factor is the hydroperiod. If the hydroperiod is too severe, as with prolonged waterlogged conditions or great fluctuations in water depth, it prevents the succession of swamp forest, while increasing moderation allows different plant species to colonize the habitat. The dominant species are however persistent and are not easily replaced by other colonists. Frequent fires also play a role, since it will prevent the development of swamp forest, but when the swamp forest is established, fire has little influence. The fire does not damage the swamp forest since it cannot penetrate deep into the forest, but fire can prevent the expansion of the swamp forest into adjacent grassland or sedge swamp. The seed dispersal may also play a role in the presence of the dominant species. *Ficus trichopoda* has small seeds and are easily distributed by birds, *Syzygium cordatum* is also

distributed by birds, but since the seeds are larger the birds are normally larger forest birds. *Barringtonia racemosa* is the poorest disperser and is dispersed by water. Although all three dominant forest tree species are tolerant of extreme hydroperiods the most tolerant (to anoxic conditions) is *Syzygium cordatum* (Wessels 1997).

Taylor (pers. comm.)[1] has a hypothesis that the swamp forest occurs where there is significant groundwater seepage. At this stage this is only speculation and it will be interesting to look further into this theory. Examples of such forest sites are along the western margin of the Mfabeni swamp. It is possible that there is less groundwater along the eastern margin, and that this water is also more dispersed, and no forests occur here. The western margin is located along a drainage line and it is possible that there is therefore also groundwater seepage. Swamp forest occurs in and along the seepage lines along the shoreline of the Brodies crossing site (directly west of Mission Rocks), along the shoreline of Dead Tree Bay, as well as several other places. What the actual determinant is, is still unknown. It may be the sustained wetness, even during extreme droughts. It could also be the flowing water in the drainage lines.

The different vegetation ordination graphs illustrate the relationships between the various communities. The floristic ordination (Fig. 7.1) illustrates the difference between the swamp forest, *Restio* dominated community and the rest of the (sedge) swamp communities. Fig 7.2. illustrate a DECORANA ordination on the swamp data only, with the communities overlaid over the scatter diagram. The communities are grouped into different groups indicating the existence of definite plant communities, but sometimes communities tend to overlap indicating gradients between communities. Some correlations of community distribution with environmental variables are illustrated in the Fig 7.2 and Fig. 7.3.

[1] R Taylor, Ezemvelo KwaZulu-Natal Wildlife Services, Pietermaritzburg.

In the habitat ordinations the influence of certain habitat variables on the communities distribution is illustrated. The environmental variable that seems to have the strongest influence on plant species and plant community distribution is water depth and fluctuation in water depth. Some communities with different dominant species, though similar subordinate species, such as Communities 6 and 7, occur where different environmental conditions prevail. In this case the difference is in the water depth, Community 6 occurs in slightly shallower water than Community 7. All the communities have different sets of environmental conditions, but whether these conditions are responsible for the occurrence of the plant community or vice versa are still not sure.

Plant communities are able to cause changes in the habitat and it seems likely that this may be the case with at least some of these peatland communities. These communities are likely to be able to change the pH, conductivity and dissolved oxygen content of the water. It is even possible for some of the communities to change the water depth to a small extent. The *Cladium mariscus* closed high sedge peatland (Community 9) almost always occurs in shallow water, even when the entire *Cladium mariscus* patch is surrounded by deeper water. The *Sphagnum truncatum – Xyris natalensis* closed short moss peatland (community 8) also occurs in shallow water, since the moss can not grow in permanently inundated conditions. The water level in this community is also much more stable and does not fluctuate as much as is the case in some of the other communities. Another example of the influence of water depth is the *Eleocharis dulcis* closed tall sedge peatland (community 5), which occurs in deep water and prefers very wet conditions. *Eleocharis dulcis* can occur in other communities as well, but with much lower cover abundance and the plants are also smaller. This occurrence of *Eleocharis dulcis* only seems to happen when the swamp is wetter and the habitat is therefore more suitable to the species.

A few problems were experience with the identification of the species, since a lot of the plants were not flowering at the time of the fieldwork. Another problem was

that the swamp burned down two weeks prior to the second fieldwork session and the plants were very small. A great problem is that there are few collections of wetland plants in herbariums and very little inventories of the taxons occurring in peatlands. It is important to carry out a proper inventory of all the plants occurring in the swamp over a longer period, to compile species lists and a permanent record, such as in a herbarium, especially since the swamp is located in a conservation area and World Heritage Site.

This study gives an inventory of the swamp communities and tries to explain the distribution of the communities. A large amount of swamp communities are conserved in this area and the communities have experienced very little disturbance in the past. This study contributed a great deal to not only the knowledge of the swamp, but also the knowledge of peatland vegetation in South Africa. The study forms a basis for the understanding and ultimately the responsible management of the peatland.

The study has shown that the first two hypotheses are correct, in other words, different plant communities, with different species composition, do exist in the study area. Some evidence was also found to support the third hypothesis that environmental factors influence the distribution of plant communities. The extent of this influence is unclear.

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Appendix A

Table 2.1. Specieslist of South African peatlands

	1 Venter 2003	2 Grundling & Marneweck 2000	3 Marneweck 2000	4	5	6	7	8 Grundling *et al.* 2000	9	10	11	12	13	14	15	16	17	18	19	20 Grundling *et al.* 1998	21 Grewer 1997
Abildgaardia hygrophil																					x
Abrus precat s. africa										x				x					x		
Acacia species																					
Acalypha segetalis																					x
Achyranthes species													x								
Adenia gummifera						x															
Aeschynomene micrantha																					x
Agathi bojeri s. bojer																					x
Agathisanthemum bojeri																					x
Ageratum houstonianum				x																	
Agrostis eriantha			x																		
Agrostis lachnantha	x																				
Albizia adianthifolia						x		x		x	x								x		x
Alectr sessil v. sessi												x			x	x	x				
Alisma plantago-aqu	x																				
Allophylus dregeanus																					x
Allophylus natalensis						x															
Alloteropsis semialata																					x
Aloe myriacantha																					x
Amaranthus deflexus																					
Amaranthus hybridus	x																				
Amaranthus viridis																					
Andropogon appendicula																					x
Andropogon eucomus																x	x		x	x	
Andropogon festuciform																					x
Andropogon gayanus																					x
Andropogon schirensis																					x
Antidesma venosum				x							x							x			x
Apodyt dimidi s. dimid				x							x							x			
Apodytes dimidiata																					x
Aristea gerrardii																					x
Aristida congesta																					
Aristida diffusa																					
Aristida junciformis			x																		
Arundinella nepalensis		x	x																		
Askidiosperm albo-aris	x																				
Aspalathus species																	x				
Asparagus densiflorus				x	x																
Asparagus falcatus						x		x													
Asparagus setaceus																			x		
Asparagus species																					
Asystasia gangetica						x	x	x			x										
Barringtonia racemosa						x	x	x			x			x				x			x
Berkheya radula	x	x	x																		
Berkheya species																					
Bidens bipinnata			x																		
Bidens pilosa	x	x					x			x											
Blumea species										x			x			x					
Bothriochloa insculpta			x																		
Brachylaena discolor				x	x																
Brachylaena elliptica					x																

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Bridelia micrantha	.	.	.	x	x	x	x	x	.	.	.	.	.	x	.	.	.	x	.	.	x
Bulbostylis burchellii	.	.	.	.	.	x	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.
Bulbostylis contexta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Burchellia bubalina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Canavalia rosea	.	.	.	.	.	.	x	.	.	.	.	.	.	x	.	.	.	x	.	.	.
Canthium inerme	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Canthium spinosum	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cappar fascic v. zeyhe	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	x	.	.
Capsicum species	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex cognat v. cognat	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.
Carex species	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cariss bispin s. zambe	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Cassip gummif v. verti	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cassipourea gummiflua	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Cassytha filiformis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Celtis africana	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Centella asiatica	.	.	.	x	.	x	.	.	x	x	x	x	.	x	x	.	x	.	x	x	x
Cestrum laevigatum	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chaetacanthu burchelli	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Chamaecrista mimosoide	.	.	.	.	.	.	.	.	.	x	.	.	x	.	.	x	x	.	.	.	x
Cheila multif s. lacer	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cheilanthes viridis	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.
Chenopodium album	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chloris virgata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chromolaena odorata	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chrysanthemo monilifer	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cirsium vulgare	x	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cissampelos hirta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Cissampelos torulosa	.	.	.	.	.	x	.	.	.	.	x	.	.	.	.	.	.	.	x	.	.
Cladiu marisc s. jamai	.	.	.	.	.	x	.	.	x	.	.	x	.	x	x	.	x	.	x	x	.
Cladium mariscus	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Clerodendrum glabrum	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Combretum erythrophyll	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Combretum species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Commel diffus s. diffu	.	.	.	.	.	.	.	.	.	x	x	.	x	x	.	.	.	x	x	.	.
Commelina africana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Commelina erecta	.	.	.	x	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Commelina species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Conyza albida	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Conyza bonariensis	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Conyza chilensis	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
Conyza podocephala	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Conyza species	.	.	.	.	.	.	x	.	.	.	x	.	.	.	x	x	.	.	x	.	.
Cosmos bipinnatus	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crocosmia aurea	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cuscuta campestris	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	x	x	x	.	.
Cussonia species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Cussonia sphaerocepha	.	.	.	.	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyathea dregei	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cycnium tubulosum	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cymbopogon excavatus	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cymbopogon species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cymbopogon validus	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Cynodon dactylon	x	x	x	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	x	.
Cynodon nlemfuensis	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyperus denudatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Cyperus dives	.	.	.	.	.	x	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
Cyperus eragrostis	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyperus esculentus	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyperus fastigiatus	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Cyperus natalensis	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	x

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Cyperus papyrus	.	.	.	.	.	.	.	.	.	.	.	.	x	.	x	x	.	.	.	.	.
Cyperus prolifer	.	.	.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cyperus pulcher	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyperus sensilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	x	.
Cyperus species	x	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyperus sphaerospermus	.	.	.	.	.	x	.	.	.	.	.	x	x	.	.	.	.	.	.	.	.
Cyrtanthus mackenii	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyrtorchis arcuata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Dactylocteni aegyptium	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dactylocteni geminatum	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dalbergia obovata	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
Datura stramonium	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Denekia capensis	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Desmodium dregeanum	.	.	.	.	.	.	.	.	.	x	x	.	.	.	.	.	x	.	.	x	x
Desmodium setigerum	.	.	.	x	x	x	.	.	.	.	x	.	.	x	.	.	.	x	.	.	x
Dichrostachys cinerea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Dierama igneum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Digitaria didactyla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Digitaria eriantha	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Digitaria sanguinalis	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Digitaria species	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Diheteropogo amplecten	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Diheteropogo filifoliu	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Dioscorea rupicola	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dioscorea sylvatica	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Diospyros lycioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Dissotis canescens	.	.	.	x	x	x	x	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Dracaena aletriformis	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Drosera natalensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Eleocharis dulcis	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.
Elephantorrh elephanti	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Eleusi coraca s. afric	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elionurus muticus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Epilobium hirsutum	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis curvula	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis gummiflua	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis inamoena	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	x	x	.
Eragrostis plana	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Erianthemum dregei	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Erioca dregei v. sonde	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Eriosema cordatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Eriosema parviflorum	.	.	.	.	.	.	.	.	.	.	x	.	x	.	x	x	x	.	.	.	.
Eriosema salignum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Eriosema species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Erythrina lysistemon	.	.	.	x	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.
Eucalyptus species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eugenia albanensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Eugenia erythrophylla	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eulophia species	.	.	.	.	.	.	.	.	.	.	.	x	.	.	x	.	.	.	.	x	.
Ficus lutea	.	.	.	x	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
Ficus natale s. natale	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Ficus sur	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	x	.	.	x
Ficus trichopoda	.	.	.	.	.	x	.	.	.	x	x	x	.	x	x	x	x	x	x	.	x
Ficus verruculosa	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	x	.	x	.	x
Fimbristylis complanat	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	x
Fimbristylis ferrugine	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Fimbristylis longiculm	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	x	.	.	.	.
Fimbristylis microcary	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Fimbristylis species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	x	.
Fuirena hirsuta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Fuirena obcordata	.	.	.	.	.	x	.	.	.	.	.	x	.	.	x	x	x	.	.	x	.
Fuirena pachyrrhiza	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Fuirena species	.	x	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fuirena umbellata	.	.	.	.	.	x	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.
Gerbera ambigua	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Gerbera species	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.
Gnidia kraussiana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Gomphocarpus fruticosu	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gomphocarpus physocarp	.	.	.	.	.	.	.	.	x	.	.	x	.	.	x	x	x	.	.	x	.
Gomphrena celosioides	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Grewia flaves v. flave	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Gunnera perpensa	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Halleria lucida	.	.	.	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	x	.	x
Haplocarpha lyrata	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Haplocarpha scaposa	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Harpephyllum caffrum	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helichrysum decorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.
Helichrysum natalitium	.	.	.	.	x	.	.	.	.	.	.	x	.	.	.	x	.	.	.	x	.
Helichrysum species	x	x	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hemarthria altissima	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Heteropogon species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Hewittia malabarica	.	.	.	.	.	.	x	.	.	.	x	.	.	.	.	.	.	x	.	.	.
Hewittia species	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
Hibiscus calyphyllus	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hibiscus species	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
Hibiscus surattensis	.	.	.	.	.	.	x	.	.	.	.	.	.	.	x	x	.	.	.	.	.
Hibiscus tiliaceus	.	.	.	.	.	x	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.
Hibiscus trionum	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hydrocotyle bonariensi	.	.	.	x	.	x	x	.	x	.	.	.	.	x	x	.	.	x	.	x	.
Hyparrhenia hirta	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hyparrhenia tamba	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypericum lalandii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.
Hyphaene coriacea	.	.	.	x	x	.	.	.	.	.	.	.	.	x	.	.	.	.	x	.	.
Hypochaeris radicata	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Imperata cylindrica	.	x	x	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	x
Ipomoea batatas	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
Ipomoea cairica	.	.	.	.	.	x	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.
Ipomoea mauritiana	.	.	.	x	.	x	.	.	.	x	x	.	.	x	.	.	.	x	.	.	.
Ipomoea species	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	x	x	.	.
Ischaemum fasciculatum	.	.	.	.	x	.	.	.	.	x	.	.	x	.	x	.	.	x	.	.	x
Juncus exsertus	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus kraussii	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	x
Juncus oxycarpus	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus species	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Keetia gueinzii	.	.	.	.	.	x	.	.	.	.	x	.	.	.	.	.	.	.	.	.	x
Kniphofia drepanophyll	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kniphofia species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kraussia floribunda	.	.	.	.	.	.	.	x	.	.	.	.	.	x	.	.	.	.	.	.	.
Kyllinga erecta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Kyllinga species	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lantana camara	.	x	.	x	x	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lantana rugosa	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Leersia hexandra	.	x	x	x	x	x	.	x	x	x	x	.	.	x	.	x	x	.	x	x	x
Lobeli flacci s. mossi	.	.	.	.	.	.	.	.	x	.	.	x	.	.	.	x	x	x	x	x	.
Lobelia erinus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Lobelia flaccida	.	.	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lobelia galpinii	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lobelia pinifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Lycopersicon species	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lycopodiella cernua	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lygodium microphyllum	.	.	.	.	.	x	.	.	.	.	x	.	.	.	.	.	.	x	.	.	.
Macaranga capensis	.	.	.	x	x	x	.	x	.	x	x	.	.	.	.	.	.	x	.	.	x
Maesa lanceolata	.	.	.	x	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mangifera indica	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.

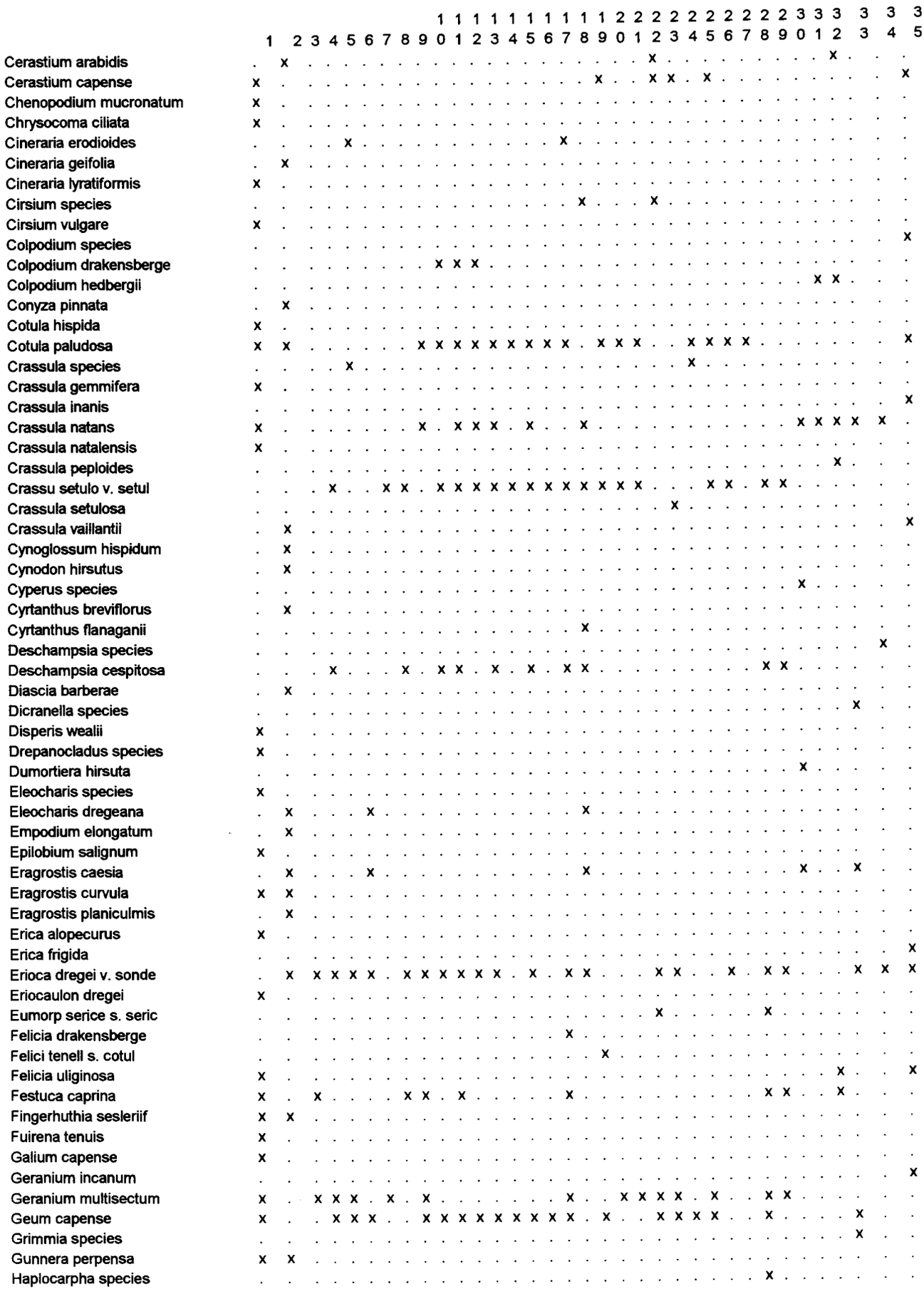
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Manihot esculenta	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
Mariscus solidus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.
Mariscus species	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melanthera scandens	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Melia azedarach	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melinis repens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mentha aquatica	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Microsorium punctatum	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	x	.	.	.
Mikania natalensis	.	.	.	x	x	x	.	.	.	.	.	x	.	.	x	x	.	.	.	x	.
Mimusops obovata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Miscanthus junceus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Monocymbium ceresiifor	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Monopsis decipiens	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Morella serrata	.	.	.	.	x	.	.	.	x	.	x	.	.	x	x	x	.	x	.	x	x
Mukia maderaspatana	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Nephrolepis biserrata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Nesaea species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Nesaea tolypobotrys	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.
Nymphaea nouchali	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oenothera rosea	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Olea europa s. africa	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxalis corniculata	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxalis obliquifolia	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxygon dregea s. drege	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Panicum aequinerve	.	.	.	.	.	x	.	.	.	.	.	.	.	x	.	x	x	x	x	x	.
Panicum deustum	.	.	.	x	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.
Panicum dregeanum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Panicum hymeniochilum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	x
Panicum maximum	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Panicum schinzii	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Panicum species	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Panicum volutans	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Parinari capensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Paspalum dilatatum	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Paspalum distichum	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Paspalum scrobiculatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Paspalum species	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Paspalum urvillei	.	.	.	.	.	.	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.
Passiflora subpeltata	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Pavetta natalensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Peddiea africana	.	.	.	.	.	.	.	x	.	.	.	.	.	x	.	.	.	x	x	.	x
Pelargonium luridum	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pennisetum clandestinu	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pentod pentan v. minor	.	.	.	.	.	.	.	.	.	.	.	x	x	.	.	.	.	.	x	x	.
Persicaria lapathifoli	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Persicaria species	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Petopentia natalensis	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phoenix reclinata	.	.	.	x	x	.	.	x	.	.	x	.	.	.	.	.	.	x	.	.	x
Phragmites australis	x	x	x	x	x	.	x	x	x	x	.	x	.	x	x	x	x	.	.	.	.
Phyla nodifl v. nodifl	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Phymatosoru scolopendr	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.
Physalis angulata	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phytolacca octandra	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pinus elliottii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Pityro calome v. aureo	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plantago lanceolata	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plectranthus ciliatus	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygonum lapathifoliu	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygonum plebeium	.	.	.	.	.	.	.	.	x	.	x	x	x	.	x	x	.	x	x	x	.
Populus x canescens	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potamogeton pectinatus	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Protorhus longifolia	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Pseudognapha luteo-alb	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Pseudognapha species	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pseudognapha undulatum	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Psilotum nudum	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.
Psychotria capensis	.	.	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Psydrax obovata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Pycreus mundii	.	.	.	.	.	.	.	.	.	.	.	x	x	.	x	x	x	.	.	.	.
Pycreus nitidus	.	.	.	.	.	.	.	.	.	x	.	.	.	.	x	.	.	.	x	x	.
Pycreus polystachyos	.	.	.	.	.	x	x	.	.	x	x	.	x	.	.	.	x	.	.	x	.
Pycreus species	.	x	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pyracantha angustifoli	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus multifidus	x	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus species	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rapanea melanophloeos	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Raphionacme elata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Rauvolfia caffra	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	x	.	.	.
Restio distichus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Rhoicissus rhomboidea	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhus leptodictya	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhus natalensis	.	.	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhus nebulosa	.	.	.	x	.	.	.	.	.	x	x	.	.	x	.	.	.	x	.	.	.
Rhus pyroides	.	.	.	.	.	x	.	.	.	.	x	.	.	x	.	.	.	.	.	.	.
Rhus species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhynchosia totta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Rhynchospora corymbosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	x
Rhynchospora holoschoe	.	.	.	.	.	x	.	.	.	.	.	x	.	.	.	.	x	.	.	.	x
Rhytachne rottboellioi	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Richardia brasiliensis	.	.	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Ricinus communis	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Romulea species	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rorippa humifusa	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubus rigidus	.	.	.	.	.	.	.	.	x	.	.	.	.	.	x	.	.	.	.	.	.
Rumex crispus	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rumex lanceolatus	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix babylonica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix species	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Samolus valerandi	x	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Sapium ellipticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Schefflera umbellifera	.	.	.	.	x	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
Schinus terebinthifo	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Schizachyriu jeffreysi	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Schizoglossum hamatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Schoenoplect corymbosu	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Schoenoplect tabernaem	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scilla nervosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Scirpus species	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scleria angusta	.	.	.	.	x	x	.	.	.	.	x	x	.	x	.	.	.	x	.	.	.
Scleria melanomphala	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Scleria poiformis	.	.	.	.	.	x	x	.	.	.	.	x	.	x	.	x	.	x	x	.	.
Scleria sobolifer	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	x	.	.	.	x
Sebaea leiostyla	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sebaea sedoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Senecio adnatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Senecio species	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senna pendula	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Setari sphace v. seric	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Setaria pumila	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Setaria species	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Setaria sphacelata	.	x	x	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Setaria verticillata	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sisymbrium thellungii	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Smilax anceps	.	.	.	x	x	x	x	x	.	x	x	.	.	x	x	.	x	x	x	.	x

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Solanum incanum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solanum mauritianum	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solanum nigrum	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solanum sisymbrifolium	x	.	.	.	.	x	.	.	.	x	.	.	.	.	.	.	.	.	x	.	.
Solanum species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Sorghastrum stipoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Spermacoce natalensis	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	x	x	.	x	x	.
Sporobolus africanus	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
Sporobolus centrifugus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Stenochlaena tenuifoli	.	.	.	x	x	x	.	x	.	x	x	.	.	x	.	.	.	x	.	.	.
Strelitzia nicolai	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Strychnos spinosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Stylosanthes fruticosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Syzygium cordatum	.	.	.	x	x	x	x	x	.	x	x	.	.	x	.	.	x	x	x	x	x
Syzygium guineense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Tabernaemont elegans	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
Tabernaemont ventricos	.	.	.	x	.	x	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.
Tacazzea apiculata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.
Tagetes minuta	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Taraxacum officinale	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tarenn pavett s. pavet	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
Tarenna pavettoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Tephrosia multijuga	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Tephrosia species	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tetraria cuspidata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Thelypteris interrupta	.	.	.	x	x	x	x	x	.	x	x	x	x	x	.	x	x	x	x	x	.
Themeda triandra	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Thesium junceum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Thunbergia atriplicifo	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Tithonia rotundifolia	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Torenia thouarsii	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.
Trachypogon spicatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Trema orientalis	.	.	.	.	.	.	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.
Tricalysia sonderiana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Trichopteryx dregeana	.	.	.	.	x	.	.	.	.	.	.	.	.	.	x	.	x	.	.	.	x
Trifolium africanum	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trifolium pratense	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tristachya leucothrix	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Typha capensis	x	x	x	x	x	x	.	.	x	.	x	.	x	x	.	x	.	x	.	.	.
Urelytrum agropyroides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Urochloa panicoides	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Verbena bonariensis	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Verbena brasiliensis	x	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Verbena officinalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vernonia oligocephala	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Vernonia species	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Veronica anagallis-aq	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Voacanga thouarsii	.	.	.	x	x	x	.	x	.	x	x	.	.	x	.	.	.	x	.	.	x
Wahlen abyssi s. abyss	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Xanthium spinosum	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Xanthium strumarium	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Xyris anceps	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	x	x	x	.	x	.
Xyris capensis	.	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Xyris natalensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Xysmalobium undulatum	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zantedeschia aethiopic	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zinnia peruviana	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zornia capensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x

Table 2.2. Specieslist of Lesotho peatlands

	Backéus 1998	Marneweck 1998	Marneweck & Grundling 1999															Marneweck & Grundling 2000													Van Zinderen Bakker & Werger 197		Jacot-Guillarmod 1962	Jacot-Guillarmod 1963	Killick1978
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Agrostis species	.	.	x	.	x	.	.	.	.	x	x	x	x	.	x	x	x	x	.	.	.	.	x	.	x	.	x	x	x	x	.	.	.	.	.
Agrost bergia v. laevi	.	.	.	.	x	.	.	x	x	x	x	x	x	x	x	x	x	.	x	.	.	.	x	x	.	.	x	x	x	.	.	.	.	.	.
Agrostis bergiana	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agrost lachna v. lachn	.	x	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agrostis lachnantha	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agrostis subulifolia	x	.	.	.	.	.	.	x	.	x	.	.	.	.	x	.	x	.	x	.	.	.	x	.	.	x	.	.	.	.	.	.	.	.	x
Alchemilla woodii	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alepidea species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.
Alepidea pilifera	.	.	x	x	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alepidea pusilla	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Anagallis huttonii	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	x	.
Androc melant v. subul	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Andropogon appendicula	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anthoxanthum ecklonii	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aponog junceu s. junce	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Aponogeton junceus	x	.	.	x	x	.	.	x	x	x	x	x	x	.	x	x	x	x	.	.	.	.	.	x	.	x	.	x	x	.	.	x	.	.	x
Arctotheca calendula	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arctotis arctotoides	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arctotis microcephala	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	x
Aristida species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Aster species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Aster erucifolius	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Athrixia fontana	.	.	x	.	x	.	.	x	x	x	x	x	x	x	x	x	x	x	x	.	.	.	x	x	x	x	x	x	x	x	.	x	x	.	x
Bartramia hampeana	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Barbula species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Berkheya multijuga	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berula erecta	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachythecium species	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Braunia secunda	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Bromus catharticus	x	x	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	x	.	.	.	x	.	.	.	.	.	.
Bryum alpinum	x	.	x	x	x	.	.	x	x	x	x	x	x	.	.	x	x	x	x	x	x	x	.	x	x	.	x	x	x	x	.	.	.	.	.
Bryum andicola	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum argenteum	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	x	.	.	.
Bryum pseudotriquetrum	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Bulbostylis humilis	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Campylopus atroluteus	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	x	.	.	.	x	.	.
Carex acutiformis	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex austro-africana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.
Carex cognat v. draken	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex cognata	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex glomerabilis	x	x	.	.	x	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex monotropa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	x	.	x
Carex subinflata	x	.	.	.	x	.	x	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ceratodon purpureus	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cerastium species	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
Cerastium arabidis
Cerastium capense
Chenopodium mucronatum
Chrysocoma ciliata
Cineraria erodioides
Cineraria geifolia
Cineraria lyratiformis
Cirsium species
Cirsium vulgare
Colpodium species
Colpodium drakensberge
Colpodium hedbergii
Conyza pinnata
Cotula hispida
Cotula paludosa
Crassula species
Crassula gemmifera
Crassula inanis
Crassula natans
Crassula natalensis
Crassula peploides
Crassu setulo v. setul
Crassula setulosa
Crassula vaillantii
Cynoglossum hispidum
Cynodon hirsutus
Cyperus species
Cyrtanthus breviflorus
Cyrtanthus flanaganii
Deschampsia species
Deschampsia cespitosa
Diascia barberae
Dicranella species
Disperis wealii
Drepanocladus species
Dumortiera hirsuta
Eleocharis species
Eleocharis dregeana
Empodium elongatum
Epilobium salignum
Eragrostis caesia
Eragrostis curvula
Eragrostis planiculmis
Erica alopecurus
Erica frigida
Erioca dregei v. sonde
Eriocaulon dregei
Eumorp serice s. seric
Felicia drakensberge
Felici tenell s. cotul
Felicia uliginosa
Festuca caprina
Fingerhuthia sesleriif
Fuirena tenuis
Galium capense
Geranium incanum
Geranium multisectum
Geum capense
Grimmia species
Gunnera perpensa
Haplocarpha species

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Haplocarpha nervosa	x	x	x	x	x	.	.	x	.	x	x	x	x	.	x	x	x	x	.	x	x	x	x	x	.	x	x	x	x	x	.	x	x	.	x
Haplocarpha scaposa	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helichrysum species	.	.	.	.	x	.	.	.	x	.	x	x	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.
Helichrysum bellum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.
Helich cymosu s. calvu	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helichrysum cymosum	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helichrysum flanaganii	.	x	.	x	x	.	x	x	x	.	.	.	.	.	.	.	.	.	.	x	x	x	.	x	.	.	.	.	.	.	x	x	.	x	.
Helichrysum lineatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helichrysum melanacme	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helichrysum odoratissi	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helichrysum subfalcatu	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Helichrysum subglomera	x	.	.	x	.	.	.	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Helichrysum trilineatu	x	.	.	.	.	.	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.
Helichrysum witbergens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.
Hesperantha baurii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.
Hesperantha candida	.	.	.	x	.	.	.	x	x	.	.	.	x	.	x	.	x	.	.	.	.	.	x	.	.	.	x	x	.	.	.	.	.	.	.
Hordeum capense	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Inulanthera thodei	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Isolepis angelica	x	x	x	x	x	.	.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	.	.	.	.	.	.
Isolepis cernua	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Isolepis costata	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Isolepis fluitans	x	x	x	x	x	x	.	x	x	x	x	x	x	.	x	.	x	x	.	.	.	.	.	.	.	.	.	.	.	x	.	x	x	.	.
Isolepis setacea	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Juncus species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	x	.	.
Juncus dregeanus	x	.	x	x	x	.	.	.	x	x	x	x	x	.	x	x	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Juncus exsert s. lesut	.	.	.	x	x	.	.	.	x	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus effusus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus exsertus	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus inflexus	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus mollifolius	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus oxycarpus	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kniphofia species	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	x	.	.	.	.	.	.	.	.
Kniphofia caulescens	x	x	x	x	x	x	x	x	x	.	.	.	.	.	.	.	x	x	.	.	.	x	.	.	x	.	x	x	x	x	.	.	x	x	x
Koeleria capensis	x	x	.	x	.	.	.	.	x	x	x	.	x	x	x	x	.	.	x	.	.	.	x	x	x	x	x	x	x	.	.	x	.	.	.
Kyllinga erecta	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kyllinga pauciflora	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kyllinga pulchella	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Lagarosiphon muscoides	x	.	.	.	.	.	.	.	.	.	x	x	x	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	x	x	.	x
Ledebouria cooperi	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lepidium transvaalense	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Limeum africanum	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Limosella species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Limosella australis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Limosella grandiflora	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	x	.	x
Limosella inflata	x	x	.	.	.	.	.	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Limosella longiflora	x	.	.	x	x	.	.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	.	x	x	x	.	x	x	.	.	x
Limosella maior	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Limosella vesiculosa	x	x	x	x	x	.	x	x	x	x	.	x	x	.	x	.	x	x	.	x	x	x	.	x	x	.	.	.	.	x	.	.	.	.	.
Lobelia species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.
Lobelia flaccida	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lobelia galpinii	x	x	.	.	.	.	.	.	x	x	x	x	x	.	x	x	.	.	x	x	x	.	x	x	x	x	x	x	x	.	.	.	x	x	.	x
Lobelia laxa	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Luzula africana	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mariscus congestus	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mariscus squarrosus	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mentha aquatica	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mentha longifolia	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merxmuellera disticha	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	x	x	.	.	.	.	.	x	.	.	x	x	.	.
Merxmuellera drakensbe	.	.	.	x	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	x	.	.	x	x	x	.	.	x	.	.
Merxmuellera macowanii	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Merxmuellera stricta	.	.	x	x	.	.	.	x	x	.	x	x	x	x	x	x	x	.	.	.	.	x	.	x	x	.	.	x	x	.	.	.	.	.	.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Moraea alticola	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Moraea huttonii	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myosotis species	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myosotis sylvatica	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Nemesia species	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nidorella auriculata	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ornithogalum graminifo	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ornithogalum paludosum	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Ornithogalum sephtonii	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxalis depressa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Oxalis obliquifolia	x	x	.	x	.	x	x	.	.	.	.	.	.	.	.	.	x	.	.	.	.	x	.	.	x	.	.	x	x	x	.	.	.	.	.
Oxalis smithiana	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Panicum species	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Papaver aculeatum	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Passerina montana	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pentaschistis species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Pentaschistis galpinii	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pennisetum sphacelatum	.	x	.	.	.	.	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pennisetum thunbergii	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pentzia cooperi	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.
Persica senegal f. alb	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Philonotis falcata	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phragmites australis	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa annua	.	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	x	.	.	.	x	.	.	.	.	.
Poa binata	x	x	.	x	x	.	.	.	.	x	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.
Pohlia species	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polytrichum species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.
Polytrichast formosum	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potamogeton thunbergii	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pseudognapha luteo-alb	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pseudognapha undulatum	x	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pycreus betschuanus	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pycreus oakfortensis	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus meyeri	x	x	.	x	x	.	.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	.	x	x	x	x
Ranunculus multifidus	x	x	.	x	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	x
Rhodohypoxis species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	x	.
Rhodohypoxis deflexa	x	x	.	x	x	.	.	x	x	x	x	x	x	.	x	x	x	x	x	x	x	.	.	x	x	x	x	x	x	.	.	.	.	.	.
Rhodohypoxis milloides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Rhodohypoxis rubella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	x
Riccardia compacta	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Riccardia stephanii	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rorippa humifusa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rumex acetosella	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rumex crispus	.	x	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.
Rumex steudelii	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scabiosa columbaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Schoenoxiphi filiforme	x	.	.	x	x	.	.	x	.	.	.	.	.	.	.	.	.	.	x	.	.	x	x	x	.	x	x	x	x	.	.	.	.	.	x
Schoenoxiphi sparteum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Scirpus species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	x	.
Isolepis diabolica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Scirpus ficinioides	.	x	.	x	x	x	x	.	x	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.
Sebaea leiostyla	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sebaea marlothii	.	.	.	.	.	.	.	.	.	x	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	x	.	x	x	.	.
Sebaea natalensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	x	x	.	.	.	.	.
Selago galpinii	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio species	.	.	.	x	.	.	.	x	.	.	x	.	x	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio asperulus	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio cryptolanatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	x
Senecio cristimontanus	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio exuberans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.
Senecio harveianus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Senecio hypochoerideus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio inaequidens	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio macrocephalus	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Seneci polyod v. subgl	.	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.
Senecio polyodon	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	x	.	.	.	.	.	.	.
Senecio seminiveus	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio serrulatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.
Solanum americanum	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Taraxacum species	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Taraxacum brachyglossu	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.
Themeda triandra	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thesium nigrum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.
Tortella species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Trifol burche s. burch	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	x	x	.	.	.	.	x	.	.	.	.	.	.	.	.	.
Trifolium burchellianu	x	x	.	.	x	.	.	.	x	x	x	x	x	x	x	x	x	.	x	.	.	.	.	.	.	.	.	.	.	.	x	x	.	.	x
Utricularia species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	x	.	.	.	x	.	.	.
Utricularia arenaria	.	.	.	.	x	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Utricularia australis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.
Utricularia livida	x	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.
Veronica anagallis-aq	x	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wahlenbergia krebsii	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wahlenbergia undulata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wurmbea species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x	.	.	.
Wurmbea elatior	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Xyris capensis	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

□

Appendix B

Table 5.4. The results of the indicator values test in PCOrd illustating relative abundance of species in the communities

RELATIVE ABUNDANCE				Group														
Sequence:					1	2	3	4	5	6	7	8	9	10	11	12	13	14
Identifier:					7	6	9	4	3	5	8	10	11	2	13	14	1	12
Number of items:					66	35	20	2	22	12	20	13	3	8	4	3	3	3
Column	*Avg*	*Max*	*MaxGrp*															
1 CUSCCAM0	7	44	7		44	14	6	0	2	0	34	0	0	0	0	0	0	0
2 CYNODAC0	7	47	7		47	19	10	0	0	4	8	0	3	7	0	0	0	0
3 ELEODUL0	7	71	5		3	6	1	8	0	71	0	0	6	4	0	0	0	0
4 FUIRHIR0	7	42	6		5	42	3	0	41	9	0	0	0	0	0	0	0	0
5 PYCRPOL0	7	85	4		8	7	0	85	0	0	0	0	0	0	0	0	0	0
6 SCHUBRA0	7	41	5		37	9	1	0	0	41	3	3	0	5	0	0	0	0
7 UROH/SP0	7	26	7		26	11	6	3	23	0	20	10	0	0	0	0	0	0
8 FESTCOS0	7	27	7		27	14	3	15	1	10	4	18	0	10	0	0	0	0
9 RHYOCOR0	7	91	6		4	91	0	0	1	0	2	0	0	2	0	0	0	0
10 CLAIMAR0	7	78	9		0	0	78	0	0	0	0	15	7	0	0	0	0	0
11 FIMBBIV0	7	74	7		74	2	0	0	4	0	19	0	0	0	0	0	0	0
12 NYMPNOU0	7	100	5		0	0	0	0	0	100	0	0	0	0	0	0	0	0
13 PYCRNIT0	7	28	6		18	28	2	0	14	19	14	3	0	2	0	0	0	0
14 LUDWOCT0	7	93	4		0	0	0	93	0	0	0	0	7	0	0	0	0	0
15 PERCSER0	7	61	4		0	0	11	61	0	0	0	0	25	3	0	0	0	0
16 TYPHCAP0	7	100	4		0	0	0	100	0	0	0	0	0	0	0	0	0	0
17 PHRGAUS0	7	26	9		24	5	26	0	6	3	2	21	13	0	0	0	0	0
18 RHYOHOL0	7	99	3		0	0	0	0	99	0	0	0	0	0	0	0	0	0
19 ISCH/SP0	7	41	7		41	2	14	0	29	0	13	0	0	0	0	0	0	0
20 UNIDPOA2	7	100	7		100	0	0	0	0	0	0	0	0	0	0	0	0	0
21 EULOANG0	7	66	7		66	0	0	0	0	0	34	0	0	0	0	0	0	0
22 PANIBRE0	7	100	3		0	0	0	0	100	0	0	0	0	0	0	0	0	0
23 RHYOBRO0	7	90	8		8	2	0	0	0	0	90	0	0	0	0	0	0	0
24 JUNCKRA0	7	100	3		0	0	0	0	100	0	0	0	0	0	0	0	0	0
25 UTRI/SP0	7	96	5		0	0	0	0	0	96	4	0	0	0	0	0	0	0
26 SPHGTRU0	7	88	8		0	0	6	0	0	0	88	0	0	0	0	0	0	6
27 XYRINAT0	7	86	8		0	0	0	0	0	0	86	0	0	0	0	0	13	0
28 DROEMAD0	7	100	8		0	0	0	0	0	0	100	0	0	0	0	0	0	0
29 PENO/SP0	7	93	8		7	0	0	0	0	0	93	0	0	0	0	0	0	0
30 PANIPAR0	7	54	8		0	0	0	0	0	0	54	0	0	0	0	0	46	0
31 HYPI/SP0	7	100	8		0	0	0	0	0	0	100	0	0	0	0	0	0	0
32 TRIPDRE0	7	83	1		0	0	0	0	0	0	17	0	0	0	0	0	83	0
33 THEYINT0	7	27	4		0	0	12	27	0	0	0	25	5	0	7	9	0	16
34 FICUVER0	7	100	9		0	0	100	0	0	0	0	0	0	0	0	0	0	0
35 ISCHFAS0	7	39	7		39	8	3	0	26	0	0	0	0	7	0	0	18	0
36 UTRIPRE0	7	76	7		76	0	0	0	0	0	24	0	0	0	0	0	0	0
37 ANDPHUI0	7	98	8		0	2	0	0	0	0	98	0	0	0	0	0	0	0
38 DISAWOO0	7	100	8		0	0	0	0	0	0	100	0	0	0	0	0	0	0
39 NYMHTHU0	7	100	8		0	0	0	0	0	0	100	0	0	0	0	0	0	0
40 UNIDSPE1	7	100	8		0	0	0	0	0	0	100	0	0	0	0	0	0	0
41 LAURREP0	7	99	8		1	0	0	0	0	0	99	0	0	0	0	0	0	0
42 XYRIANC0	7	100	8		0	0	0	0	0	0	100	0	0	0	0	0	0	0
43 CYPEPRL0	7	85	10		0	0	1	0	0	0	0	85	7	0	0	0	0	7
44 ZANT/SP0	7	100	9		0	0	100	0	0	0	0	0	0	0	0	0	0	0
45 CYPEFAS0	7	93	11		0	0	0	2	0	2	0	3	93	0	0	0	0	0
46 LEERHEX0	7	47	5		0	0	0	0	0	47	0	29	0	24	0	0	0	0
47 SCLRPOI0	7	100	2		0	0	0	0	0	0	0	0	0	100	0	0	0	0
48 UNIDPOA3	7	100	10		0	0	0	0	0	0	0	100	0	0	0	0	0	0
49 SENCDEL0	7	52	4		0	0	3	52	0	0	0	45	0	0	0	0	0	0
50 FICU/SP0	7	100	9		0	0	100	0	0	0	0	0	0	0	0	0	0	0
51 BLECTAB0	7	97	13		0	0	0	0	0	0	0	0	0	0	97	1	0	1
52 ENGONAT0	7	52	12		0	0	0	0	0	0	0	0	0	0	48	0	0	52
53 EUGE/SP0	7	100	13		0	0	0	0	0	0	0	0	0	0	100	0	0	0
54 FICUTRI0	7	99	13		0	0	0	0	0	0	0	0	0	0	99	1	0	0

55	IPOMMAU0	7	57	13	0	0	0	0	0	0	0	0	0	0	57	43	0	0
56	LYGO/SP0	7	52	12	0	0	0	0	0	0	0	0	0	0	27	21	0	52
57	SENEDEL0	7	100	13	0	0	0	0	0	0	0	0	0	0	100	0	0	0
58	SMILANC0	7	47	13	0	0	0	0	0	0	0	0	0	0	47	18	0	36
59	THAOTES0	7	89	13	0	0	0	0	0	0	0	0	0	0	89	11	0	0
60	TREMORI0	7	100	13	0	0	0	0	0	0	0	0	0	0	100	0	0	0
61	VOACTHO0	7	72	13	0	0	0	0	0	0	0	0	0	0	72	0	0	28
62	RHUS/SP0	7	100	13	0	0	0	0	0	0	0	0	0	0	100	0	0	0
63	SECM/SP0	7	53	13	0	0	0	0	0	0	0	0	0	0	53	47	0	0
64	CYPE/SP0	7	100	13	0	0	0	0	0	0	0	0	0	0	100	0	0	0
65	POLD/SP0	7	57	14	0	0	0	0	0	0	0	0	0	0	43	57	0	0
66	ALLPDRE0	7	57	14	0	0	0	0	0	0	0	0	0	0	43	57	0	0
67	CASPGUM0	7	100	13	0	0	0	0	0	0	0	0	0	0	100	0	0	0
68	CUSSSPI0	7	100	13	0	0	0	0	0	0	0	0	0	0	100	0	0	0
69	KRASFLO0	7	52	12	0	0	0	0	0	0	0	0	0	0	13	35	0	52
70	PSYCCAP0	7	70	14	0	0	0	0	0	0	0	0	0	0	30	70	0	0
71	SCHEUMB0	7	100	13	0	0	0	0	0	0	0	0	0	0	100	0	0	0
72	TRIJGRA0	7	64	14	0	0	0	0	0	0	0	0	0	0	36	64	0	0
73	ANTDVEN0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
74	BARRRAC0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
75	BEHN/SP0	7	50	14	0	0	0	0	0	0	0	0	0	0	0	50	0	50
76	BRIDMIC0	7	82	14	0	0	0	0	0	0	0	0	0	0	18	82	0	0
77	CANABON0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
78	DALBARM0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
79	EKEBPTE0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
80	FICUNAT0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
81	LYGOMIC0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
82	OPLIHIR0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
83	PHOEREC0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
84	RHOC/SP0	7	80	14	0	0	0	0	0	0	0	0	0	0	20	80	0	0
85	SETAMEG0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
86	SYZYCOR0	7	95	12	0	0	0	0	0	0	0	0	0	0	3	3	0	95
87	TABEELE0	7	50	14	0	0	0	0	0	0	0	0	0	0	0	50	0	50
88	TAREPAV0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
89	SENEDEL0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
90	ROTMFIS0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
91	FICUBUR0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
92	FICUSUR0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
93	RAUVCAF0	7	57	14	0	0	0	0	0	0	0	0	0	0	43	57	0	0
94	CHLR/SP0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
95	UNIDSPE3	7	100	13	0	0	0	0	0	0	0	0	0	0	100	0	0	0
96	MACRCAP0	7	100	13	0	0	0	0	0	0	0	0	0	0	100	0	0	0
97	MYRISER0	7	80	12	0	0	0	0	0	0	0	0	0	0	20	0	0	80
98	ANDPAPP0	7	100	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
99	NESA/SP0	7	100	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
100	RESTZUL0	7	100	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
101	SELA/SP0	7	100	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
102	THESNAT0	7	100	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
103	DIER/SP0	7	100	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
104	OLDNROS0	7	100	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
105	UNIDPOA4	7	100	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
106	VEROOLI0	7	100	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
107	RAPAMEL0	7	100	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
108	DICSCIN0	7	100	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
109	ERIADRE0	7	100	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
110	LACS/SP0	7	100	2	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0
111	HEMAALT0	7	100	2	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0
112	UNIDPOA1	7	100	4	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
113	POLO/SP0	7	100	4	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
Average		7	84		6	2	4	6	4	4	12	3	1	3	16	21	9	7

Table 5.5. The results of the indicator value tests in PCOrd illustrating the relative frequency of the species in each of the communities.

RELATIVE FREQUENCY				Group												
Sequence:				1	2	3	4	5	6	7	8	9	10	11	12	13	14
Identifier:				7	6	9	4	3	5	8	10	11	2	13	14	1	12
Number of items:				66	35	20	2	22	12	20	13	3	8	4	3	3	3
Column	*Avg*	*Max*	*MaxGrp*														
1 CUSCCAM0	*8*	*35*	*8*	27	29	20	0	5	0	35	0	0	0	0	0	0	0
2 CYNODAC0	*20*	*79*	*7*	79	43	30	0	5	33	50	0	33	13	0	0	0	0
3 ELEODUL0	*23*	*100*	*5*	15	29	25	50	9	100	0	0	33	63	0	0	0	0
4 FUIRHIR0	*8*	*37*	*6*	11	37	10	0	27	25	0	0	0	0	0	0	0	0
5 PYCRPOL0	*4*	*50*	*4*	6	6	0	50	0	0	0	0	0	0	0	0	0	0
6 SCHUBRA0	*21*	*58*	*5*	56	49	15	0	5	58	30	31	0	50	0	0	0	0
7 UROH/SP0	*23*	*65*	*8*	39	63	45	50	45	0	65	15	0	0	0	0	0	0
8 FESTCOS0	*31*	*77*	*10*	74	69	25	50	14	67	30	77	0	25	0	0	0	0
9 RHYOCOR0	*15*	*97*	*6*	42	97	5	0	14	0	30	8	0	13	0	0	0	0
10 CLAIMAR0	*14*	*100*	*9*	3	0	100	0	5	0	5	54	33	0	0	0	0	0
11 FIMBBIV0	*13*	*80*	*7*	80	31	0	0	36	0	40	0	0	0	0	0	0	0
12 NYMPNOU0	*3*	*42*	*5*	2	0	0	0	0	42	0	0	0	0	0	0	0	0
13 PYCRNIT0	*26*	*77*	*3*	59	77	10	0	77	50	55	23	0	13	0	0	0	0
14 LUDWOCT0	*6*	*50*	*4*	2	0	0	50	0	0	0	0	33	0	0	0	0	0
15 PERCSER0	*18*	*100*	*4*	0	0	40	100	0	0	0	0	100	13	0	0	0	0
16 TYPHCAP0	*7*	*100*	*4*	0	0	0	100	0	0	0	0	0	0	0	0	0	0
17 PHRGAUS0	*15*	*46*	*10*	44	14	35	0	18	8	5	46	33	0	0	0	0	0
18 RHYOHOL0	*9*	*100*	*3*	8	6	0	0	100	0	15	0	0	0	0	0	0	0
19 ISCH/SP0	*2*	*15*	*8*	8	3	5	0	5	0	15	0	0	0	0	0	0	0
20 UNIDPOA2	*0*	*3*	*7*	3	0	0	0	0	0	0	0	0	0	0	0	0	0
21 EULOANG0	*1*	*9*	*7*	9	0	0	0	0	0	5	0	0	0	0	0	0	0
22 PANIBRE0	*0*	*5*	*3*	0	0	0	0	5	0	0	0	0	0	0	0	0	0
23 RHYOBRO0	*4*	*45*	*8*	3	3	0	0	0	0	45	0	0	0	0	0	0	0
24 JUNCKRA0	*0*	*5*	*3*	0	0	0	0	5	0	0	0	0	0	0	0	0	0
25 UTRI/SP0	*3*	*42*	*5*	0	0	0	0	0	42	5	0	0	0	0	0	0	0
26 SPHGTRU0	*12*	*100*	*8*	2	0	5	0	0	0	100	0	0	0	0	0	0	67
27 XYRINAT0	*13*	*100*	*1*	2	0	0	0	0	0	75	0	0	0	0	0	1	0
28 DROEMAD0	*0*	*5*	*8*	0	0	0	0	0	0	5	0	0	0	0	0	0	0
29 PENO/SP0	*3*	*35*	*8*	2	0	0	0	0	0	35	0	0	0	0	0	0	0
30 PANIPAR0	*7*	*67*	*1*	0	0	0	0	0	0	30	0	0	0	0	0	67	0
31 HYPI/SP0	*1*	*15*	*8*	0	0	0	0	0	0	15	0	0	0	0	0	0	0
32 TRIPDRE0	*5*	*67*	*1*	0	0	0	0	0	0	5	0	0	0	0	0	67	0
33 THEYINT0	*30*	*100*	*12*	2	0	45	50	0	0	0	69	33	0	50	67	0	100
34 FICUVER0	*0*	*5*	*9*	0	0	5	0	0	0	0	0	0	0	0	0	0	0
35 ISCHFAS0	*5*	*33*	*1*	6	6	5	0	9	0	0	0	0	13	0	0	33	0
36 UTRIPRE0	*1*	*5*	*8*	3	0	0	0	0	0	5	0	0	0	0	0	0	0
37 ANDPHUI0	*2*	*30*	*8*	0	3	0	0	0	0	30	0	0	0	0	0	0	0
38 DISAWOO0	*1*	*10*	*8*	0	0	0	0	0	0	10	0	0	0	0	0	0	0
39 NYMHTHU0	*0*	*5*	*8*	0	0	0	0	0	0	5	0	0	0	0	0	0	0
40 UNIDSPE1	*1*	*15*	*8*	0	0	0	0	0	0	15	0	0	0	0	0	0	0
41 LAURREP0	*1*	*10*	*8*	2	0	0	0	0	0	10	0	0	0	0	0	0	0
42 XYRIANC0	*1*	*10*	*8*	0	0	0	0	0	0	10	0	0	0	0	0	0	0
43 CYPEPRL0	*20*	*100*	*10*	2	0	15	0	0	0	0	100	67	0	0	0	0	100
44 ZANT/SP0	*0*	*5*	*9*	0	0	5	0	0	0	0	0	0	0	0	0	0	0
45 CYPEFAS0	*14*	*100*	*11*	0	0	0	50	0	17	0	31	100	0	0	0	0	0
46 LEERHEX0	*6*	*42*	*5*	0	0	0	0	0	42	0	15	0	25	0	0	0	0
47 SCLRPOI0	*7*	*100*	*2*	0	0	0	0	0	0	0	0	0	100	0	0	0	0
48 UNIDPOA3	*3*	*38*	*10*	0	0	0	0	0	0	0	38	0	0	0	0	0	0
49 SENCDEL0	*7*	*50*	*4*	0	0	5	50	0	0	0	46	0	0	0	0	0	0
50 FICU/SP0	*0*	*5*	*9*	0	0	5	0	0	0	0	0	0	0	0	0	0	0
51 BLECTAB0	*12*	*100*	*13*	0	0	0	0	0	0	0	0	0	0	100	33	0	33
52 ENGONAT0	*8*	*67*	*12*	0	0	0	0	0	0	0	0	0	0	50	0	0	67
53 EUGE/SP0	*4*	*50*	*13*	0	0	0	0	0	0	0	0	0	0	50	0	0	0
54 FICUTRI0	*10*	*100*	*13*	0	0	0	0	0	0	0	0	0	0	100	33	0	0

55	IPOMMAU0	10	75	13	0	0	0	0	0	0	0	0	0	0	75	67	0	0
56	LYGO/SP0	21	100	13	0	0	0	0	0	0	0	0	0	0	100	100	0	100
57	SENEDEL0	4	50	13	0	0	0	0	0	0	0	0	0	0	50	0	0	0
58	SMILANC0	13	75	13	0	0	0	0	0	0	0	0	0	0	75	33	0	67
59	THAOTES0	14	100	13	0	0	0	0	0	0	0	0	0	0	100	100	0	0
60	TREMORI0	4	50	13	0	0	0	0	0	0	0	0	0	0	50	0	0	0
61	VOACTHO0	8	75	13	0	0	0	0	0	0	0	0	0	0	75	0	0	33
62	RHUS/SP0	2	25	13	0	0	0	0	0	0	0	0	0	0	25	0	0	0
63	SECM/SP0	10	75	13	0	0	0	0	0	0	0	0	0	0	75	67	0	0
64	CYPE/SP0	2	25	13	0	0	0	0	0	0	0	0	0	0	25	0	0	0
65	POLD/SP0	4	33	14	0	0	0	0	0	0	0	0	0	0	25	33	0	0
66	ALLPDRE0	4	33	14	0	0	0	0	0	0	0	0	0	0	25	33	0	0
67	CASPGUM0	2	25	13	0	0	0	0	0	0	0	0	0	0	25	0	0	0
68	CUSSSPI0	2	25	13	0	0	0	0	0	0	0	0	0	0	25	0	0	0
69	KRASFLO0	14	100	12	0	0	0	0	0	0	0	0	0	0	25	67	0	100
70	PSYCCAP0	11	100	14	0	0	0	0	0	0	0	0	0	0	50	100	0	0
71	SCHEUMB0	2	25	13	0	0	0	0	0	0	0	0	0	0	25	0	0	0
72	TRI]GRA0	7	67	14	0	0	0	0	0	0	0	0	0	0	25	67	0	0
73	ANTDVEN0	5	67	14	0	0	0	0	0	0	0	0	0	0	0	67	0	0
74	BARRRAC0	7	100	14	0	0	0	0	0	0	0	0	0	0	0	100	0	0
75	BEHN/SP0	5	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	33
76	BRIDMIC0	9	100	14	0	0	0	0	0	0	0	0	0	0	25	100	0	0
77	CANABON0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
78	DALBARM0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
79	EKEBPTE0	5	67	14	0	0	0	0	0	0	0	0	0	0	0	67	0	0
80	FICUNAT0	5	67	14	0	0	0	0	0	0	0	0	0	0	0	67	0	0
81	LYGOMIC0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
82	OPLIHIR0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
83	PHOEREC0	5	67	14	0	0	0	0	0	0	0	0	0	0	0	67	0	0
84	RHOC/SP0	9	100	14	0	0	0	0	0	0	0	0	0	0	25	100	0	0
85	SETAMEG0	5	67	14	0	0	0	0	0	0	0	0	0	0	0	67	0	0
86	SYZYCOR0	16	100	14	0	0	0	0	0	0	0	0	0	0	25	100	0	100
87	TABEELE0	5	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	33
88	TAREPAV0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
89	SENEDEL0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
90	ROTMFIS0	5	67	14	0	0	0	0	0	0	0	0	0	0	0	67	0	0
91	FICUBUR0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
92	FICUSUR0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
93	RAUVCAF0	4	33	14	0	0	0	0	0	0	0	0	0	0	25	33	0	0
94	CHLR/SP0	2	33	14	0	0	0	0	0	0	0	0	0	0	0	33	0	0
95	UNIDSPE3	2	25	13	0	0	0	0	0	0	0	0	0	0	25	0	0	0
96	MACRCAP0	2	25	13	0	0	0	0	0	0	0	0	0	0	25	0	0	0
97	MYRISER0	9	100	12	0	0	0	0	0	0	0	0	0	0	25	0	0	100
98	ANDPAPP0	7	100	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
99	NESA/SP0	5	67	1	0	0	0	0	0	0	0	0	0	0	0	0	67	0
100	RESTZUL0	7	100	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
101	SELA/SP0	2	33	1	0	0	0	0	0	0	0	0	0	0	0	0	33	0
102	THESNAT0	2	33	1	0	0	0	0	0	0	0	0	0	0	0	0	33	0
103	DIER/SP0	2	33	1	0	0	0	0	0	0	0	0	0	0	0	0	33	0
104	OLDNROS0	2	33	1	0	0	0	0	0	0	0	0	0	0	0	0	33	0
105	UNIDPOA4	2	33	1	0	0	0	0	0	0	0	0	0	0	0	0	33	0
106	VEROOLI0	2	33	1	0	0	0	0	0	0	0	0	0	0	0	0	33	0
107	RAPAMEL0	2	33	12	0	0	0	0	0	0	0	0	0	0	0	0	0	33
108	DICSCIN0	2	33	12	0	0	0	0	0	0	0	0	0	0	0	0	0	33
109	ERIADRE0	2	33	12	0	0	0	0	0	0	0	0	0	0	0	0	0	33
110	LACS/SP0	2	25	2	0	0	0	0	0	0	0	0	0	25	0	0	0	0
111	HEMAALT0	1	13	2	0	0	0	0	0	0	0	0	0	13	0	0	0	0
112	UNIDPOA1	4	50	4	0	0	0	50	0	0	0	0	0	0	0	0	0	0
113	POLO/SP0	4	50	4	0	0	0	50	0	0	0	0	0	0	0	0	0	0
Average		7	52		5	5	4	6	3	4	7	5	4	3	12	18	6	9