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Author STORMANNS C

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AN INVENTORY AND ASSESSMENT OF THE CONSERVATION VALUE OF THE GREATER MKUZE WETLAND SYSTEM

Researcher

Mr Carl Stormanns
Institute of Natural Resources
University of Natal
PO BOX 375
Pietermaritzburg
3200

Leader

Professor CM Breen
Director : Institute of Natural Resources
University of Natal
PO BOX 375
Pietermaritzburg
3200

Collaborator

Mr PS Goodman
Natal Parks Board
Mkuze Game Reserve
PO MKUZE
3965

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ABSTRACT

The Greater Mkuze Wetland System comprises a complex mosaic of different wetland types ranging from seasonal wetlands to permanent wetlands and open water bodies. Land tenure of the wetland system is complex being divided amongst conservation authorities, private landowners, KwaZulu and the Department of Environment Affairs. Control is also vested with the military since parts of this area are used for manouevers and missile testing. An interest in assessing the conservation value of these wetlands has arisen because the Mkuze River, flowing through Mkuze Game Reserve and these wetlands, provides at least 56 % of the mean annual runoff into Lake St Lucia. The management of these wetlands and the existing conservation areas are therefore inextricably linked. Furthermore, the integrity of these wetlands is threatened by increasing human pressures, and therefore the wetlands in the conservation area are also threatened.

Currently available information was drawn together at a symposium during 1986, the proceedings of which are available as a report entitled 'Proceedings of the Greater Mkuze Swamp System Symposium and Workshop,' Investigational Report No 22. The wetland mosaic is characterized by 14 different plant communities which make up the hydrophilous grassland, marsh, swamp and forested wetland habitats. Associated with these habitats are at least 32 rare and endangered species. In addition to the geomorphological processes of subsistence, channel switching and sedimentation, the major determinants of community development include hydrological regime (flooding, water movement, water chemistry), and the nature of the substratum. The more important human influences affecting these wetlands include water abstraction and canalization. These activities have caused changes in the plant formations and therefore the functional values (sediment accretion and flood attenuation) of these wetlands have also been impaired.

Unfortunately, there is no explicit way of combining conservation value criteria to give an overall index, although usually this is done intuitively. Criteria used include biotic richness (671 species in the Mkuze System), rarity (32 species), human interference (localized), and potential value of the resource to man (high). It is therefore suggested that the Greater Mkuze Wetlands have a high conservation value.

INTRODUCTION

Conservation has traditionally been directed at the preservation of species, particularly those which are threatened, but this has changed during recent times with the developing awareness of the need for a holistic approach to conservation. The IUCN defines conservation as '...the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations, while maintaining its potential to meet the needs and aspirations of future generations.' This perspective has focused attention on the need to conserve the habitat in which species live, thereby implicitly recognizing the importance of interactions for the successful preservation of species.

Wetlands are habitats which support a characteristic flora and fauna which interact with both terrestrial and open water systems. Any assessment of conservation value must therefore take account of both species composition and interactions, including those with man. The aim of wetland conservation is to manage this resource wisely for the benefit and rational use by man.

The Mkuze Swamps are associated with the Mkuze River and Mbazwane Stream and lie between two existing conservation areas, namely Mkuze Game Reserve and Lake St Lucia. Situated on the seaward margin of the Zululand Coastal Plain, six small streams (including the Mbazwane Stream) flowing south between old dune ridges are dammed by the levees formed by the Mkuze River, adding further to the complexity of the system referred to as the 'Greater Mkuze Wetlands'.

Lake St Lucia, beyond the southern extremity of this wetland complex, is recognised as a unique system in South Africa providing unsurpassed fishing and bird watching. Because of its particular significance in South Africa it has been recognised as by the IUCN to be internationally significant and worthy of strong conservation protection.

The Mkuze River provides at least 56 % of the mean annual runoff into Lake St Lucia, and because all of this water passes through the swamp upstream of the lake, management of the lake and swamp are inextricably linked.

OBJECTIVES

The objectives of this study set out to :

1 synthesize existing information on the Mkuze Swamp and Delta System;

2 identify, classify and map the major biotic communities;

3 survey the physical characteristics of the system and identify the major determinants of community development;

4 assess the past and present extent of human use of the system, and the consequences thereof for the functions and values of the system;

5 assess the conservation value of the system;

6 inventorize plants and animals;

7 identify future research needs and make management recommendations.

METHODS

1 EXISTING INFORMATION

Available information on the Greater Mkuze Wetlands was drawn together at a symposium, compiled and published.

Ref. (Stormanns and Breen, 1986)

2 DESCRIPTION OF THE STUDY AREA

The description of the major physiographic features of these wetlands was based largely on published literature and work undertaken by Van Heerden (Personal communication). The approach adopted was to describe the geological and geomorphical origin and development of the system.

3 VEGETATION ANALYSIS

To identify and investigate the distribution of the major plant communities, available (1971) aerial photographs (1 : 20 000) and ortho-photos (1 : 10 000) were used to identify physiognomically distinctive vegetation formations. These were demarcated and used to select sampling sites during ground reconnaissance.

Two multivariate analytical techniques written in FORTRAN, as described by Hill (1979), were used for the analysis of the vegetation formation sample data. Two-Way Indicator Species Analysis (TWINSPAN) (Hill, 1979) was used to facilitate recognition of characteristic assemblages of plant species; this analysis could form the basis of a classification system of the wetland plant communities. The floristic and environmental relationships between the assemblages were inferred from both TWINSPAN and Detrended Correspondence Analysis (DECORANA) (Hill, 1979 a).

The distribution of the plant communities was mapped from the 1971 ortho-photos using the technique SPAM (Single Photo Aerial Mapping) as described by Barnes (1982).

4 HUMAN USE OF THE WETLAND SYSTEM

Information on the type and extent of human use of the wetland system was collected from the literature, from aerial photographs, and during ground reconnaissance in the area. Local people in the area were consulted in this regard. Following an understanding of the functioning of these wetlands, gained from the vegetation analysis, the consequences of human use for the functions and values of the system were assessed.

5 INVENTORIES

Inventories of flora and fauna have developed, to a large extent, as a consequence of other activities including collecting existing information, reconnaissance, and vegetation analysis.

6 THE ASSESSMENT OF CONSERVATION VALUE

The applicability of published methods for assessing conservation values were considered for wetlands. Criteria considered to be most important in assessing conservation value were used to facilitate the assessment of the conservation value of the Greater Mkuze Wetlands.

RESULTS

THE ORIGIN AND DEVELOPMENT OF THE MKUZE WETLAND SYSTEM

The Greater Mkuze Wetlands are situated on the seaward margin of the Zululand Coastal Plain, along the Mkuze River between Mkuze Game Reserve and Lake St Lucia. During the Cretaceous and Paleocene periods the sea reached the Lebombo Mountain Range and what is now the coastal plain was the sea bottom. As the sea retreated, complex Quaternary sediments representing a variety of depositional environments were superimposed on the underlying rocks, forming what has subsequently been reworked into the Zululand Coastal Plain.

During the Quaternary period sea levels fluctuated markedly and consequently both down cutting and flooding of river valleys would have occurred (van Heerden, 1986). The Mkuze Swamps are therefore thought to occupy a drowned river valley cut by the paleo-Mkuze River during the Pleistocene. Sedimentation and the subsequent superimposition of fluvial landforms onto the coastal plain has resulted in the present geomorphic form of these wetlands. Available evidence (van Heerden, 1986) indicates that the northern part of Lake St Lucia was cut off from the sea less than 2 000 years ago. Until then, the Mkuze River discharged into a lagoon with an opening to the sea. Indications therefore, are that until the disjunction of the lagoon complex (from the sea) the lower section of the Mkuze Swamps existed as a shallow arm of a larger lagoon complex.

The coastal plain of Zululand is overlain by partially consolidated sandy deposits of the Port Durnford beds (Maud, 1980) which were deposited after erosion of the underlying Tertiary sediments. Reworking of this surface during the late Pleistocene and recent times by wind-action has given rise to the extensive dune topography that characterizes most of Maputaland with its linear north-south tending dune ridges. It was the formation of these dunes that gave rise to the six small streams that flow into the Mkuze Swamps from the north where they intersect the east flowing Mkuze River. While most of the coastal plain is unconsolidated sand, the Mkuze River has superimposed on the coastal plain silty alluvium, associated with which is a system of floodplain pans and open water bodies.

The process whereby coastal floodplains are able to adjust their elevation following sedimentation, compaction, and dewatering, thereby maintaining features characteristic of a floodplain, is known as subsidence. In the Mkuze Wetlands if sediment deposition is followed by subsidence, water depth may increase. In other areas, depending on the degree of subsidence, differential sedimentation may lead to the switching of the river channel from one part of the floodplain to another.

The pans of the Mkuze River Floodplain formed in one of two ways. In the first instance, the drainage lines between the pleistocene dune ridges flooded as a consequence of being dammed by the levees of the Mkuze River, eg. Mozi and Yengweni Pans. This was made possible by the east flowing Mkuze River traversing the north-south orientated dune ridges and therefore these pans tend to be long linear features. In the second instance, other pans occupy topographic lows between the river levees and the high ground forming the edges of the floodplain. Depending on sedimentation and subsidence, pans may become shallower or deeper and as the river switches its course new pans may be created while others may be destroyed. Lastly, open water bodies may form from cut off meander streams.

The modern day physical regime

The Mkuze Wetlands have formed to the east of the Mkuze Game Reserve, where the Mkuze River attains grade on the Coastal Plain. The Mkuze River is characterized by mean annual flows varying between 211 - 326 $m^3 \times 10^6$ (Hutchison and Pitman, 1973) which seasonally overtop the levees and deposit alluvium on the adjacent floodplain. Whereas the Zululand Coastal Plain comprises geologically recent strata, the Mkuze River (headwaters) drains predominantly older Ecca shales and sandstones, and Dwyka tillite of the Karoo System. Consequently, by comparison to water draining from the coastal plain, the Mkuze River water is characteristically sediment laden and has a high electrical conductivity, ranging between 0.3 - 3.2 dS / m with a mean value of 1.5 dS / m .

Water does not only enter the Mkuze Wetlands from the Mkuze River but also from the six streams, referred to as the 'Manzibomvu' Streams, draining into the Mkuze Swamps from the north. These streams vary in character with the Mbazwane Stream in the east being the largest, contributing 5 - 8 % of the Mkuze River's mean annual flow (Hutchison and Pitman, 1973). Unlike the Mkuze River, these streams seldom flood, maintaining a more regular and persistent flow throughout the year. Draining the Pleistocene sands of the coastal plain, these waters are usually clear (sediment free) and have low electrical conductivity, ranging between 0.3 - 1.3 dS / m with a mean value of 0.6 dS / m .

Characteristically much of the Zululand Coastal Plain has a high water table and therefore these sand plains are believed to contain substantial groundwater reserves. Worthington (1978) concluded from his work in Zululand that despite the presence of heterogeneous substrata which affect drainage patterns, and perched water tables, groundwater flow appears to follow the general topography of the area. The eastern catchment of the Greater Mkuze Wetlands would therefore drain towards the east, although localized westward drainage off the old dune ridges into the wetlands may also occur. The amount of groundwater draining into the Manzibomvu Streams and Mkuze Wetlands therefore depends largely on the relationships between the drainage of the substratum, the depth of the water table, and the topography of the area. Estimates indicate that between 8-10 % (Hutchison, 1973 ; Kriel, 1966) of the hydrological input into these areas is derived from groundwater.

Substratum and hydrology are two factors which, to a large extent, determine the development of wetland plant formations. The substrata associated with the Greater Mkuze Wetland biota may be described as being either well drained aeolian sands, or clay rich alluvium with impeded drainage associated with the Mkuze River Floodplain. Hydrologically these wetlands are therefore complex being supplied by two distinctly different hydrological inputs which combined to form the Mkuze Swamps. Firstly, the Mkuze River has associated with it sediment laden seasonal floodwaters of low electrical conductivity. On the other hand, water is also derived from six streams entering the wetlands from the north and from groundwater. This input contributes proportionally less water, flooding comparable to the Mkuze River is uncommon, and water conductivity is generally Low. These two hydrological inputs join to form the Mkuze Swamps where water depth changes occur as a consequence of sedimentation and possibly also subsidence.

THE PLANT FORMATIONS AND THEIR DETERMINANTS

The aggregation of plants into communities reflects the degree of spatial and temporal discontinuity in the physical and chemical environment. By imposing limits on the distribution of organisms, the environment acts to compartmentalize the biota into units within which the organisms interact with the biotic and abiotic factors to modify the community, and amplify its properties. The community therefore reflects both the initial conditions of the environment and the extent to which these have been modified by the developing community including man (Breen, CM; Rogers, KH and Ashton, PJ (1988)).

From the 275 plant species recorded in association with the Greater Mkuze Wetlands and surrounding terrestrial areas, fourteen wetland plant communities have been identified, described and mapped (FIG 4). TWINSPAN (FIGURE 1) was used to facilitate the recognition of characteristic assemblages of plant species, and it is suggested that this could form the basis of a classification system. The first division of the TWINSPAN analysis identifies almost monospecific stands of Sporobolus virginicus from the northern parts of Lake St Lucia where they come under the influence of saline conditions. Hyphaene coriacea separates a second outlying community, occurring on the fringes of the wetlands where the water table is high. The remaining samples are polarized between these two outliers. The third division separates a group subsequently separated into three communities, the Cyperus natalensis, Scirpus nodosus and Cyperus corymbosus-Ischaemum arcuatum Communities. All of these communities occur between the dune ridges on sandy substrata where they are not under the influence of the inorganic sediment laden Mkuze River. Similarly, the fourth division separates two large groups of formations characteristic of the Mkuze River Floodplain (negative preferential species) and the Mkuze Swamps (positive preferential species) (FIG 1).

The floristic and environmental relationships between the plant formations are inferred from both TWINSPAN and DECORANA. The patterns of community sample separation in the DECORANA ordination closely parallels the separation generated by TWINSPAN. The three dimensional topographical plot (FIG 2) indicates clearly that there is a major discontinuity which separates the samples into groups. It is suggested that this discontinuity in sample ordination reflects an irregularity in the physical environment, namely the two distinctly different hydrological regimes prevalent in the Mkuze Wetlands.

This is supported in the two-dimensional DECORANA ordination (FIG 3) where the marsh communities are separated from the other communities associated with water derived from the Mkuze River or other streams. Because of the more continuous variation expressed in ordination, the separation of closely related samples tends to be less pronounced. For this reason, some of the sample groups are depicted as single sample groups rather than being identified separately.

Since the physical environment, to a large extent, determines the biota, it is possible to identify those physical conditions which are implicated in community development and those which separate communities (TABLE 1).

It is suggested that if conservation management is to be effective, account should be taken not only of the physical conditions which determine the wetland biota, but the determinants should be considered in context of wetland structure and part of physical processes. These physical processes were identified in the geomorphological study, where it was concluded that the major forces involved in the structuring and development of the Greater Mkuze Wetlands included dune formation, sea level fluctuations, flooding, subsidence, channel switching and sedimentation. Since these physical processes do affect the determinants of the plant communities (eg. subsidence affects water depth) at a geomorphological level, the physical processes are implicated as being determinants of community development.

Consequently, by knowing both the determinants of the biota and the physical processes with which they are associated, it is possible to predict biotic changes, for example those following human manipulation of the system. The plant communities of the Greater Mkuze Wetlands and the environmental conditions thought to be most important in determining their development are given in TABLE 1. Many of the determinants are interrelated and therefore, human manipulation of the physical environment may bring about biotic changes as a consequence of the effects of manipulation on the determinants. For example, water abstraction has the potential to influence water level fluctuations, water flow, the extent of flooding and the degree and duration of inundation, and consequently also the plant communities associated with these determinants are affected.

HUMAN USE OF THE WETLAND SYSTEM

In the past, wetlands have not been thought of as valuable conservation areas, and therefore they have been subjected to other forms of land use, particularly agriculture. Many agricultural practices such as canalization, drainage, water abstraction and indiscriminate burning, have either impaired the inherent functions and values of many wetlands, or have resulted in the complete loss of individual wetlands. Wetlands therefore, are affected by human events and natural processes which operate in both the short term and the long term, and which bring about changes of varying degree and duration. The Greater Mkuze Wetlands are no exception having been affected by several human influences.

1 Water abstraction, damming and canalization

Water abstraction, damming and canalization have been identified to have affected the normal flow regime of the Mkuze River, and consequently also those wetlands dependent on this water supply. In the past the Mkuze River has been impounded for irrigation. Although this is no longer the case, water abstraction for irrigation continues (Goodman, 1987). Hutchison and Pitman (1973) indicate that at that time approximately 15.7 % of the mean annual flow of the Mkuze River was being abstracted. With the increase in irrigation agriculture in the Lower Mkuze area subsequent to 1973, proportionately more water must be abstracted. In any event, abstraction is unlikely to greatly affect large floods but rather low and medium flows will be affected (Alexander, 1986) and consequently the frequency with which floodwaters overtop the river levees may be lower. Not only is the Mkuze River affected by abstraction but also the Mbazwane Stream. Estimates of groundwater abstraction by afforestation in the Mbazwane area indicate that between 8 - 10 % of the normal inflow into the Mkuze Wetlands is being lost (Lindley and Scott, 1987).

Canals affecting water flow in the Mkuze River include the well documented 'Van Niekerk' Canal (Alexander, 1986 ; Goodman, 1987) and the 'Tshanetshe' Canal (Loudon, 1986 ; Goodman, 1987). The reasons for the excavation of these canals include the provision of fresh water to Lake St Lucia and agricultural irrigation.
The consequences of water abstraction and the diversion of the Mkuze River along canals include the erosion and enlargement of these canals, and the subsequent drainage of wetland areas. The redirection of Mkuze River water along the canals accompanied by the erosion of these canals has resulted in the deposition of sediment downstream of the Mkuze 'Delta' region (Alexander, 1986) in the Ngwenya Flats area (Goodman, 1987). Drainage of wetland areas (notably Mpempe Pan and parts of the Ngwenya Flats) has also occurred as a result of canal construction (Goodman, 1987 ; Taylor, 1986). These alterations in the physical environment are evidenced by changes in the plant communities. Stands of Cyperus papyrus in the Mpempe Pan area are estimated, from 1971 aerial photographs, to have been reduced by at least 31 ha following drainage into the Van Niekerk Canal. This drainage of Mpempe Pan, associated with cattle grazing (Furness and Breen, 1980) in the area, has favoured the development of the Cyrodon dactylon Community which currently occupies approximately 154 ha in the Mpempe Pan area. Similarly, in the Ngwenya Flats area stands of Cyperus papyrus, approximately 94 ha in size, have been replaced by species which are tolerant of seasonal inundation rather than a permanence of the water. These species include Cyperus natalensis where the substratum is sandy and Echinocloa pyramidalis where the substratum is clay. Wetlands in the Umbumbu Pan area, to the north of the Mkuze River, are unaffected by drainage into canals owing to their isolation by the Mkuze River levees. Around Umbumbu Pan approximately 62 ha of Cyperus papyrus has been replaced by Echinoclon pyramidalis since 1971. Since Cyperus papyrus usually occurs as a floating mat, indications are that water levels have dropped in this area. Since these areas cannot drain directly into the canals, the reduction in water levels are attributed to a reduced frequency of flooding, owing to the canalization of the Mkuze River.

2 Riparian Forest Removal

Riparian forests not only attenuate floods but they also impart stability to the levees of the Mkuze River. Based on the 1971 aerial photographs and from ground reconnaissance, it is estimated that at least 33 % (48 ha) of the riparian forest of the Mkuze Wetlands has been removed. During 1981 a stand of 21 ha of riparian forest was removed from the south bank of the Mkuze River immediately downstream of the lower Mkuze Bridge for agricultural purposes (Goodman, 1987 ; London, 1986 ; Taylor, 1986). As a consequence, subsequent to 1981, floodwaters breached the aggrading Mkuze River levee and flowed across the floodplain into the Tshanetshe and Van Niekerk Canals. The reduced frequency with which floodwaters recharge floodplain pans (as described in the former section for Umbumbu Pan), have moved upstream and currently affect the Mkuze River Floodplain pans to the north of the river, notably Yengweni and Mdlanzi Pans. In addition, in areas further downstream several small stands of riparian forest totalling 27 ha have been removed by local inhabitants, since such levee areas are suitable for agriculture (Heeg and Breen, 1982).

3 Cultivation of Wetland Areas

Accompanying drainage caused by the Van Niekerk Canal, has been the extension of cultivation from the high-lying areas to other parts of the Mkuze River Floodplain, predominantly to the east of Mpempe Pan. It is estimated from reconnaissance and 1971 aerial photographs that a total of 472 ha of wetland are currently under cultivation, and that since the excavation of the Van Niekerk Canal 61 ha along its eastern side, originally occupied by Echinocloa pyramidalis, has been cultivated. Crops most commonly cultivated include maize, beans, cabbage, bananas and melons. It is predicted that in the event of the flooding of those cultivated floodplain areas, the reduced vegetation cover will result in an increased runoff from the floodplain accompanied by erosion of the unconsolidated substratum. These affects apply primarily to the cultivated areas along the Mkuze River and Van Niekerk Canal.

Cultivation off the floodplain areas has also occurred. During 1986 two sedge dominated marshes (Cyperus natalensis and Scirpus nodosus) west of Butterfly Pan in the Sodwana State Forest, were ploughed presumably for cultivation purposes. Although the total area affected is only approximately 4 ha, such marshes are thought to have a high breeding habitat value for rare bird species (Johnson, 1986).

4 Fire and Cattle

Apart from the use of fire as a means of removing vegetation in wetland areas that have dried out and therefore have become suitable for agriculture (as observed on the Mkuze River Floodplain east of Mpempe Pan) fire is also used as a means of stimulating grazing for cattle. These fires, ignited in dryland areas between the Lower Mkuze road and the Mbazwane Stream, either by local inhabitants who try to stimulate grazing in this area, or by the Department of Environment Affairs (Forestry) as a management practice, usually are uncontrolled and spread each year (1985, 1986 and 1987) into wetland areas. In this area therefore, it is the marshes which lie in depressions between dune ridges which are affected. These marshes are characterized by sedges (Cyperus natalensis, Scirpus nodosus and Cyperus corymbosus) although they commonly support stands of Ischaemum arcuatum, a hygrophilous grass, along their landward edge. The regrowth of this grass following burning is commonly grazed by cattle.

The long-term effects of fire in wetland areas are believed to reduce the productivity of wetland areas by reducing soil nutrients, and by causing desiccation through a lowering of the water table (Begg, 1986). In the Mkuze Wetlands, fire and grazing by cattle are thought to be partly responsible for a lowering of the water table around the outermost edges of the marsh communities. Both fire and cattle are therefore implicated as being involved in determining the development of the Cyperus corymbosus - Ischaemum arcuatum Community, in which the relative dominance of these species is seasonally variable (see Vegetation Analysis).

5 Harvesting of Wetland Species

Species are harvested in the Greater Mkuze Wetlands, as in other wetland systems, eg. Pongola River Floodplain (Heeg and Breen, 1982) for a variety of reasons by the local inhabitants of the area. Species harvested in the Mkuze Wetlands may be categorized into those harvested as building materials, those harvested for craftwork, and those harvested as food supplements (TABLE 2).

Species harvested as building materials include the reeds Phragmites australis and Phragmites mauritianus. Unlike the occasional harvesting of small patches (< 5 m x 5 m) of Phragmites australis in areas (Mpempe and Umbumbu Pan areas) along the western edge of the Mkuze Swamps particularly in the Ngwenya Flats area, and between Demazane Pan and Lake St Lucia, sites for the regular harvesting of reeds are well established. In this area, during 1985 - 1987, it was estimated that Phragmites australis was harvested within a total area of 20 ha (0.6 % of the community). Harvesting is largely restricted to these locations owing to difficulty of access in other areas. Phragmites mauritianus, occurring usually as a narrow band along flowing water courses, is harvested to a lesser extent compared to Phragmites australis. Harvesting was observed along the Van Niekerk Canal, in those areas between Mpempe Pan and Ngwenya Flats where accessibility was possible following drainage by the canal. Therefore there appears to be no regular harvesting of appreciable amounts of this species. Phragmites reedbeds contribute to flood attenuation and sediment accretion in the Mpempe Pan and Ngwenya Flats areas (Goodman, 1987) and therefore, the removal of appreciable amounts of Phragmites from areas draining into the Van Niekerk Canal is likely to increase the rate of drainage into the canal, accompanied by erosion of the sodium rich substratum. This would lead to the deposition of sediment to the south of Ngwenya Flats.

A variety of wetland species are harvested for craftwork purposes (TABLE 2) in the Mkuze Wetlands. Sedges are harvested in the streams (Cyperus immensus) draining into the Mkuze Wetlands from the north, and from the marshes between these streams. This area has, in the past, been under the control of the Department of Environment Affairs (Forestry) and therefore the extent of harvesting in the area has been limited. Harvest observations include the harvesting of Cyperus immensus culms from a stand approximately 40 m long by 10 m wide. Given a community size in excess of 52 ha in this area, these non-destructive harvests are considered unimportant. Similarly the harvesting of Cyperus textilis culms was recorded in the Mbazwane Stream swamp forest. Here, a stand of approximately 90 m x 70 m was harvested. The amount of Cyperus textilis occurring within the swamp forest is uncertain but again, culm harvesting of this species is not believed to hold serious consequences. The sedges which are harvested in the marshes, including Cyperus corymbosus, Cyperus natalensis and Scirpus nodosus, have their culms pulled rather than cut as was the case for the former species. Only tall culms, presumably the oldest, are pulled and therefore this technique of harvesting is unlikely to affect the entire plant. Furthermore, owing to the limited occurrence of this harvesting, serious consequences are unexpected.

The species harvested as food supplements include both plant and animal species (TABLE 2), the most extensive of which is the tapping of palms (Hyphaene coriacea and occasionally Hyphaene reclinata) for palm-wine. An extensive palm-wine tapping industry has been established within the Sodwana State Forest, in the high-lying areas immediately to the north of Umbumbu Pan. It is estimated that palms within an area of approximately 25 ha (or 1 % of the total area) representing some 797 plants, were being tapped during 1985 to 1987. Outside of formal conservation areas, the extent of Hyphaene utilization along the Zululand Coastal Plain is high (Pooley, 1980) and therefore the value of undisturbed stands of this community become increasingly more important to conservation organizations. The high degree of localized disturbance of this community within a conservation area therefore reflects the degree to which management efforts have been ineffective in the past. The harvesting of animals (TABLE 2) in the Sodwana State Forest by snaring similarly reflects the degree to which this activity is uncontrolled. Although estimates of the numbers of animals caught in the wetlands and surrounding terrestrial areas are unavailable, the intensity of snaring is believed to reflect the extent of this activity. During 1985 - 1986 the Department of Environment Affairs (Forestry) records indicate that approximately 30 wire snares per week were removed in the Sodwana State Forest. Species believed to have been caught do not include rare or endangered species, and therefore the consequences of this activity are likely to reduce only the abundances of those species caught. Fishing is also a common activity in the Umbumbu and Manyoni Pans, and in the Ngwanya Flats area. Species most commonly caught include Clarias garipinus and Oreochromis mocambicus (Taylor, 1986), however, the extent to which fish are caught using hand lines and gill nets remains unquantified. Owing to the localized occurrences of fishing in the Mkuze Wetlands because of difficulties of accessibility, the consequences of this activity are believed to be similar to those of snaring, namely a decrease in abundance of those species caught.

INVENTORIES

Inventories compiled by other contributors have been published by Stormanns and Breen (1986). These inventories (TABLES 3, 4, 5, 6, 7, 8) include :

Vegetation	275 species	(Vegetation Analysis)
Avifauna	231 species	(Johnson, 1986)
Herpetofauna	130 species	(Bourquin, 1986)
Fishes	14 species	(Batchelor, 1986)
Larger Mammals	11 species	(Personal Observation)
Molluscs	10 species	(Appleton, 1986)

A total therefore of 671 species have been recorded in association with these wetlands. Included within these at least 32 Red Data Book Species (Bourquin, 1986 and Johnson, 1987).

ASSESSING THE CONSERVATION VALUE OF THE GREATER MKUZE WETLANDS

The evaluation of the functions and values of wetlands is made complicated by the difficulty of comparing by some common denominator the ecological values of wetlands against socio-economic values. This is particularly the case for the Greater Mkuze Wetlands because of the conflict between private landowners' interests, and the objectives of conservation where the values of the system accrue to the public at large. Unfortunately, there is no explicit way of combining criteria to give an overall index of conservation value, though people responsible for assessing sites do this intuitively. This is largely due to the fact that some criteria are quantitative and some qualitative, and that not all are complementary. Margules and Usher (1981) suggest that criteria should be separated into two groups, those that are essentially scientific and those that are socio-economic or political. For quantification purposed, criteria that are not based on biological, ecological or biogeographic concepts should not be used in the primary assessment of conservation value, although these may play an essential role in a final decision on conserving a site.

Since a large amount (> 56 %) of the water reaching Lake St Lucia flows through the Greater Mkuze Wetlands, these wetlands not only have conservation values in their own right, but also, the functions and values of these wetlands are inextricably linked to the management of Lake St Lucia. Biological criteria most commonly used in assessing conservation values (Margules and Usher, 1981) which are applicable to the Mkuze Wetlands include :

1 Diversity

This relates to communities, habitats and species, and is interpreted to mean the total number of different entities.

Therefore ;

1.1 Plant Community Diversity = 14 (TABLE 9)
1.2 Habitat Diversity = 8 (TABLE 9)
1.3 Species Diversity = 671 (TABLE 9)

2 Proportion of the system within the proposed area

In the Mkuze Wetlands, this relates to each hydrological subsystem, including headwater, middle reach and lower reach, which make up the Greater Mkuze Wetland System.

2.1 Mkuze River = 50 % (lower reach and part of middle reach).

2.2 Six Manzibomvu Streams = 89 % (two headwaters outside of boundary).

2.3 Groundwater - largely unaffected.

3 Rarity

Rarity refers not only to rare communities and species but also to those habitats, communities and species which are poorly conserved. A list of ecosystem types (habitats), characterized by different plant communities, which are considered to be of conservation priority in South Africa are listed by Nobel and Hemens (1978). These include ; headwater streams, sedge marshes, sedge and reed swamps, swamp forest, and salt marsh, all of which are well represented in the Greater Mkuze Wetlands. In addition to these wetland types, floodplain is also well represented in these wetlands. Therefore, with regard to the wetland types which are attributed high conservation priority in South Africa, 100 % of these are well represented in the Greater Mkuze Wetlands System.

Secondly, in addition to these habitats, at least 32 Red Data Book Species are known to occur in the Greater Mkuze Wetlands (Bourquin, 1986 ; Johnson, 1986).

4 Naturalness

Naturalness implies the recognition of some natural condition. It is often used in a sense that implies freedom from human interference; '...but few, if any, communities are free from the influence of man. It is the extent of that influence that is critical' (Margules and Usher, 1981). The Greater Mkuze Wetlands have been affected by human involvement. The major categories of this involvement include :

(1) Water abstraction, damming and canalization,
(2) Cultivation,
(3) Fire and cattle,
(4) Harvesting of species.

It is suggested that the degree to which these influences have affected these wetlands should be subjectively assessed as follows :

(i) The degree to which each influence has affected each hydrological subsystem is assessed as being Low (scoring 1), Moderate (2) or High (3);

(ii) The extent of each influence is assessed as being Low (where only one of the three Mkuze Wetland hydrological subsystems is affected, Intermediate (where two subsystems are affected), and High (where all three subsystems are affected);

(iii) The two scores are multiplied so as to rank on a scale ranging from 1 - 3 (for low influence), 4 - 6 (moderate influence), and 7 - 9 (high influence).

Therefore:

- Abstraction, damming and canalization
  Degree = (3) x Extent = (3) = 9 (High)

- Cultivation
  Degree = (2) x Extent = (2) = 4 (Moderate)

- Fire and cattle
  Degree = (3) x Extent = (3) = 9 (High)

- Harvesting
  Degree = (1) x Extent = (3) = 3 (Low)

Overall Influence Scale :	0 - 12	(Low), if all scores were low
	13 - 24	(Moderate)
	25 - 36	(High), if all scores were high

Abstraction, damming and canalization	=	9	
Cultivation	=	4	
Fire and cattle	=	9	
Harvesting	=	3	
TOTAL	=	25	(High)

Cultivation, fires and cattle grazing, and harvesting in the Mkuze Wetlands are essentially management issues. Control of these could potentially reduce the overall human influence rating from high to low.

The fundamental values of the Greater Mkuze Wetlands to Lake St Lucia include ; (1) their functioning as a sediment trap, reducing the amount of sediment that reaches and is deposited in Lake St Lucia, and (2) because of the retardation and storage of water by the Greater Mkuze Wetlands, they control the release of water into Lake St Lucia, providing a gradual supply of fresh water over a longer time period than would be the case if water flowed directly into the Lake. Methods for evaluating the contribution of wetlands to 'Sediment Trapping' and 'Flood Storage' are provided by Adamus et al (1983). Although evaluations are based on the subjective estimates of several criteria, those criteria implicated in sediment trapping and flood storage include; wetland hydrological input exceeds output, dense vegetation indicating sediment (Phragmites, Echinocloa, Ficus sycomorus), wide wetland, sheet flow, and gently sloping gradients for sediment accretion. For flood storage, the wetlands must be high in the watershed, have a constricted outlet, be large, have a deep basin, have a high groundwater recharge potential, be densely vegetated, and have a gently sloping shoreline. The characteristics of the Greater Mkuze Wetlands fulfill nearly all of these criteria and therefore they are expected to be effective in accreting sediment and regulating the release of water into Lake St Lucia.

Because the Greater Mkuze Wetlands comprise a complex mosaic of eight different types of wetlands which are characterized by 14 plant communities (and 671 species), by comparison to other wetlands in South Africa (Noble and Hemens, 1978 ; Begg, 1986) the Mkuze Wetlands may be considered to have a high biotic diversity. Furthermore, about 65 - 70 % of the total area of these wetlands falls within existing conservation areas. With regard to rarity, all of the wetland types comprising this wetland complex are attributed high conservation priority by conservation organizations in South Africa. At least 32 Red Data Book Species are known to occur in the area, where the Greater Mkuze Wetlands provide largely unconserved habitats for these avifauna and herpetofauna. Although these wetlands have been subjected to human influence, a large proportion of this is management related, and surveys of the engineering options have been undertaken to alleviate the affects of canalization (Loudon, 1986). Finally, these wetlands do function as a sediment trap and provide a gradual release of fresh water to Lake St Lucia. From this, by comparison to other wetlands in South Africa, the Greater Mkuze Wetlands are attributed a high conservation value.

MANAGEMENT RECOMMENDATIONS

The main emphasis of management efforts in the Greater Mkuze Wetlands should be directed at those issues that adversely affect the high conservation value of these wetlands. Essentially, the control of human involvement in those parts of the Mkuze Wetlands within proclaimed conservation areas is a management issue. For example, a greater degree of control should be exercised over :

1 the uncontrolled burning of wetland areas, since the long term consequences of this may include reduced productivity of these wetlands, and species changes related to drying;

2 the grazing of cattle in wetland (particularly marsh) areas should be limited since this may cause wetland desiccation and species changes;

3 the harvesting of wetland and associated species should be controlled to fall within the desired (by management) limits of abundance;

4 cultivation of wetland areas within conservation areas should be prohibited;

5 where riparian forest has been removed for cultivation purposes, attempts should be made to stabilize the levees so as to prevent breaching during flooding. The re-establishment of riparian forest should be encouraged.

Canalization, damming, and water abstraction, which have had far greater effects on the integrity of these wetlands compared to the former influences, should be addressed. For the normal functioning of the system, the illegal damming of the Mkuze River, and uncontrolled water abstraction should be investigated. Furthermore, erosion, drainage, and the re-direction of water along canals should be considered as priority issues, since these effects and their rehabilitation have serious conservation and sociological implications. For conservation reasons, water should be redirected along former water courses so as to reduce wetland losses through drainage, desiccation, and erosion. However, the sociological implications of redirecting floodwaters along former water courses, are that cultivated wetland (floodplain) areas outside of formal conservation areas will be seasonally inundated. These areas were established for cultivation following construction of the 'Van Niekerk Canal' which directed floodwaters away from these areas and so causing desiccation and allowing accessibility.

Finally, a dryland management plan should be established which does not have deleterious effects on the wetland areas (eg. frequent burning). Accessibility roads should be planned away from wetland areas.

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APPENDIX

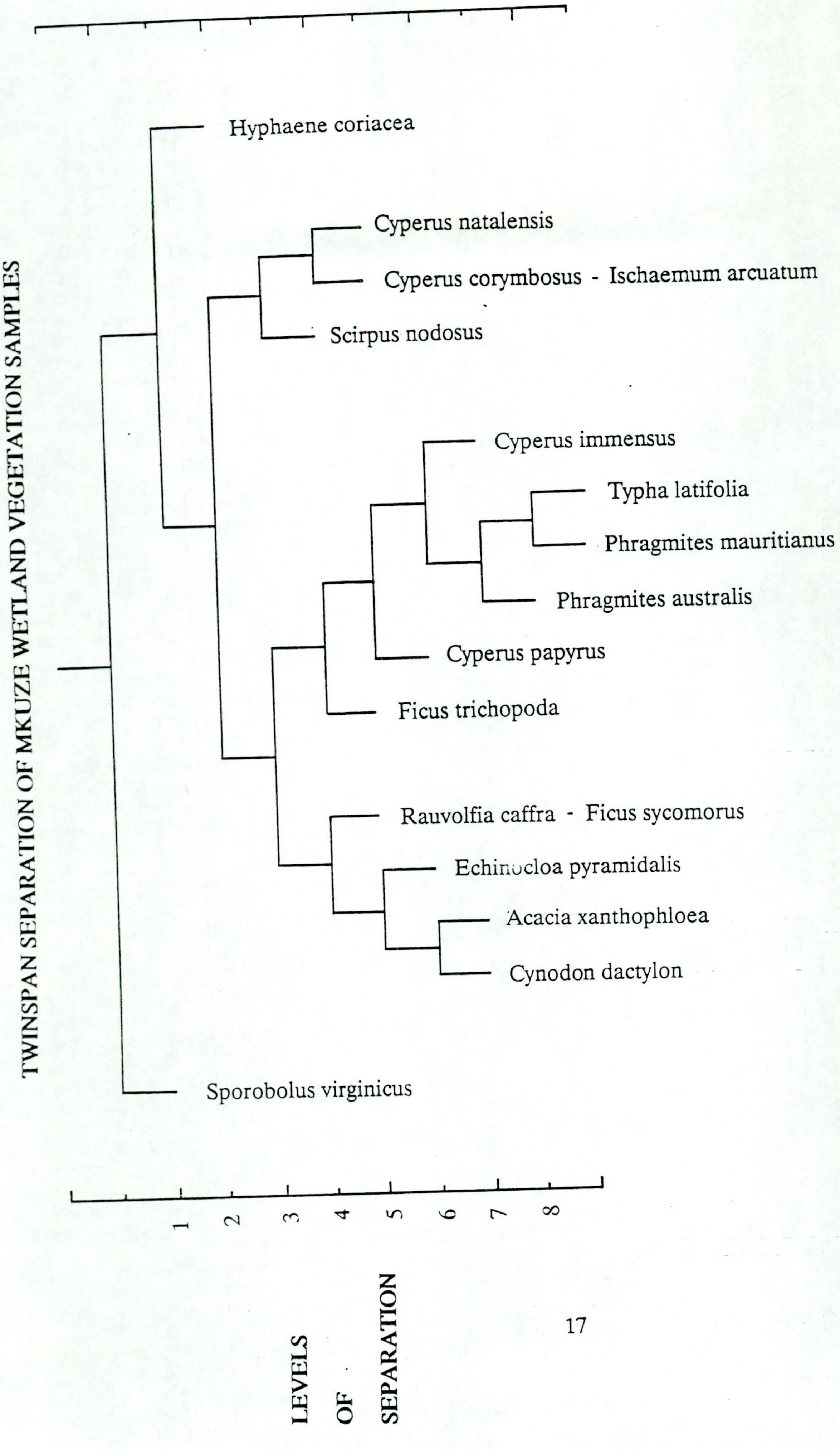


FIGURE 1

TWINSPAN separation of the Mkuze Wetland plant formations to eight levels. This is suggested as an initial classification of the wetland plant communities.

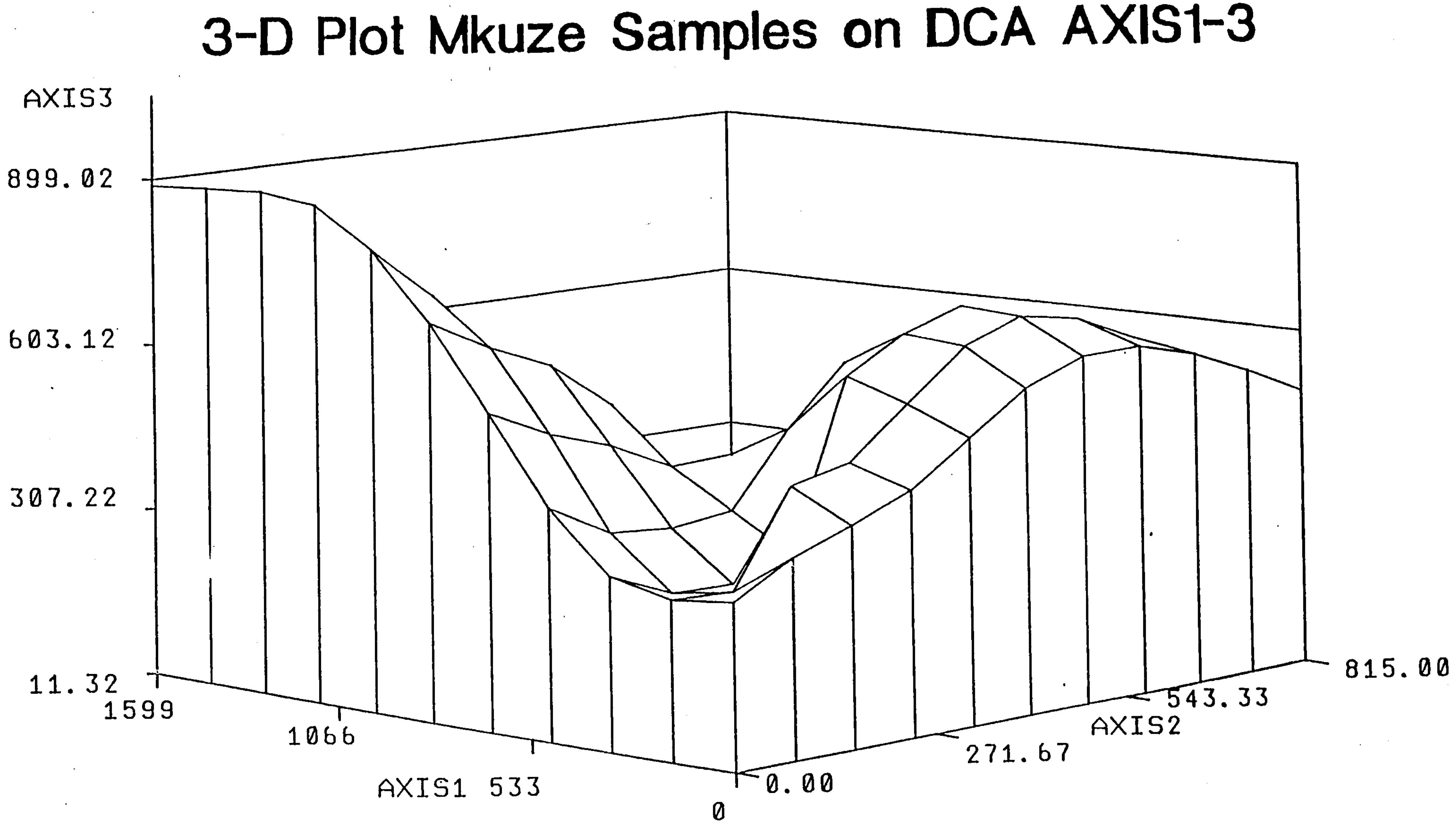


FIGURE 2

A three-dimensional topographical plot of the Mkuze Wetland plant formation samples. It is suggested that the irregularity in sample distribution along axis three reflects the association of particular samples with two different hydrological regimes.

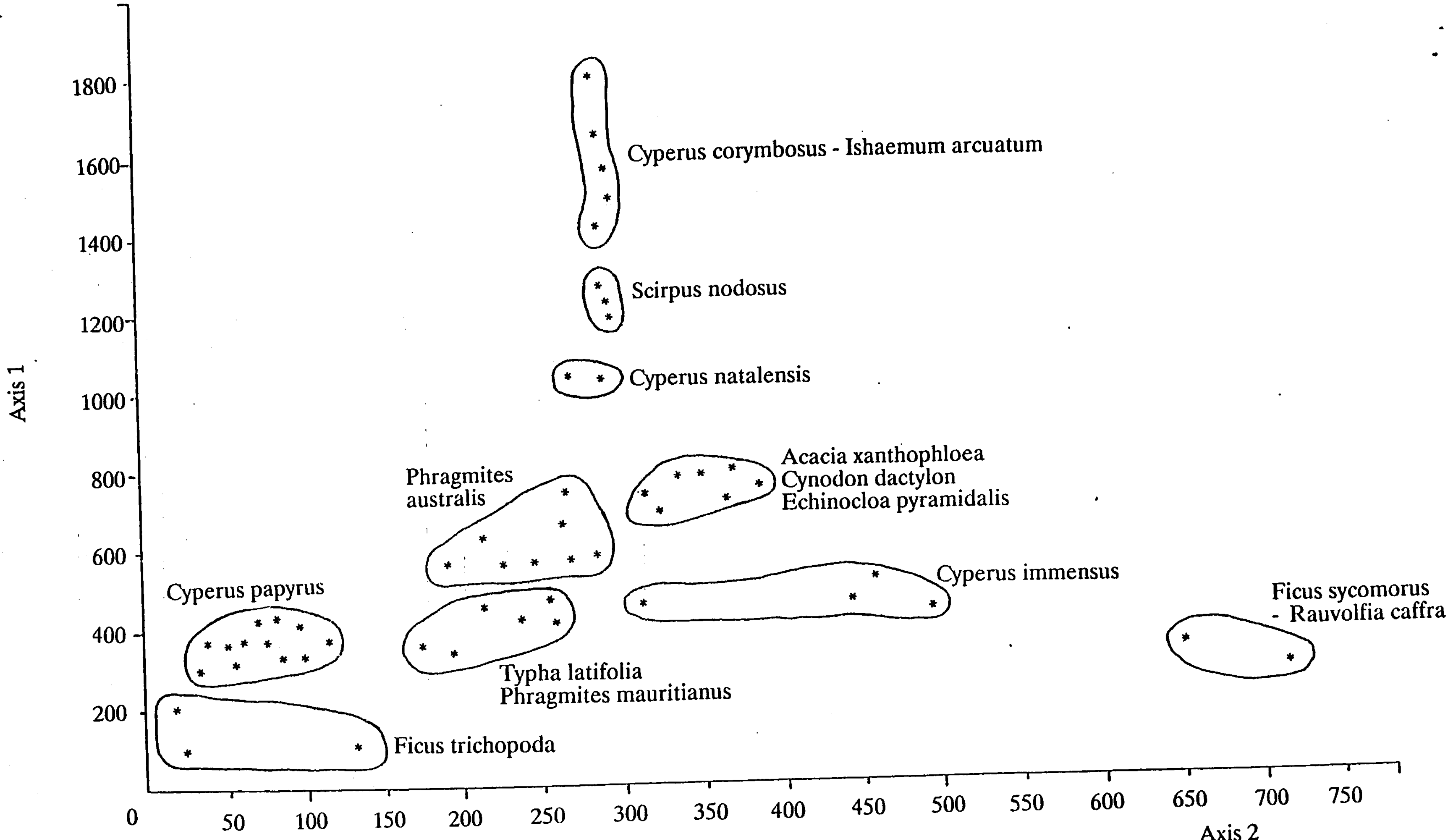
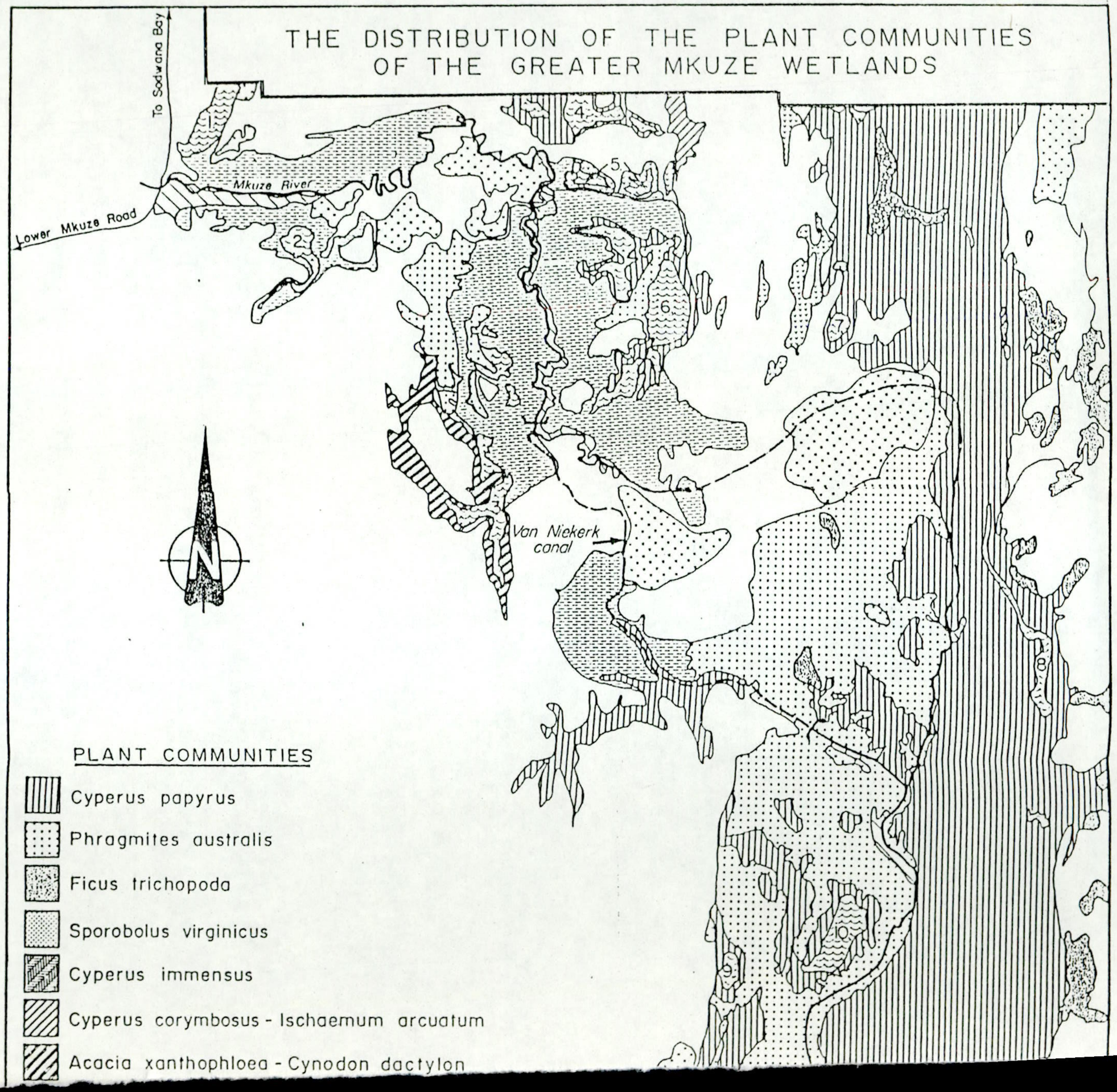


FIGURE 3

A two-dimensional scatter plot of the Mkuze Wetlands plant formation samples. This separation compares well with FIGURE 2. The samples occurring under the different hydrological regimes are identified as representing plant communities.

THE DISTRIBUTION OF THE PLANT COMMUNITIES OF THE GREATER MKUZE WETLANDS



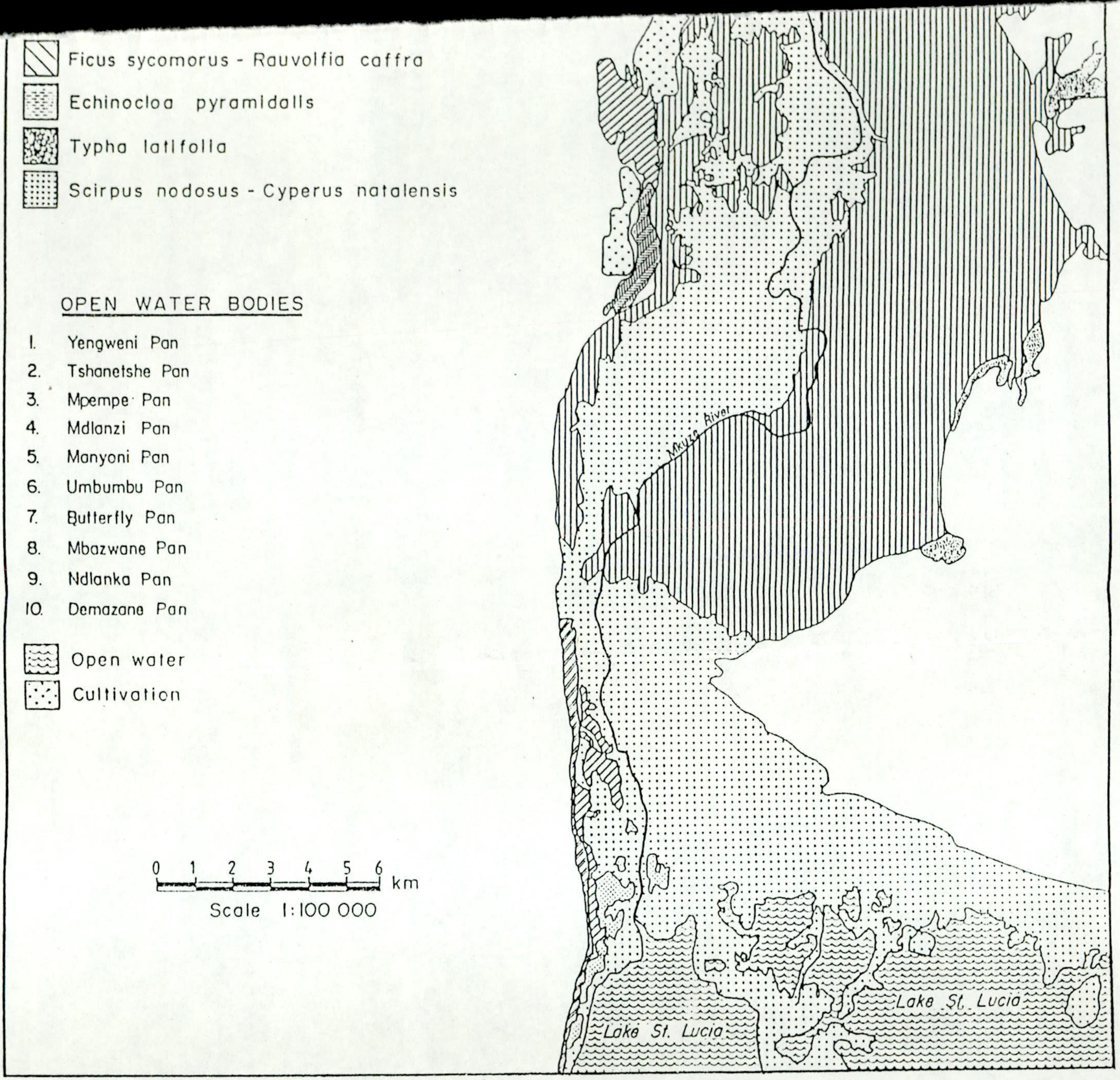


FIGURE 4,

The distribution of the plant community of the Greater Mkuze Wetlands, mapped from 1971 Ortho-photos (1 : 10 000) using SPAM (Barnes, 1982).

DETERMINANTS	S. virginicus	F. trichopoda	C. papyrus	P. australis	Typha-Phragmites	C. immensus	E. pyramidalis	C. dactylon	A. xanthophloea	F. sycomorus	C. natalensis	S. nodosus	C. corymbosus	H. coriacea
Water Level Fluctuations (Water Table)											☒	☒	☒	☒
Flowing Water		☒	☒		☒					☒				
Perennial Water		☒	☒	☒		☒				☒	☒			
Seasonal Inundation											☒	☒	☒	☒
Salinity	☒													
Low Water Conductivity		☒	☒			☒					☒	☒	☒	☒
High Water Conductivity	☒			☒	☒		☒	☒	☒	☒				
Disturbance								☒						
Clay Substrate	☒			☒	☒		☒	☒	☒					
Sand Substrate	☒	☒								☒	☒	☒	☒	☒
Flooding						☒	☒	☒	☒	☒				

TABLE 1

The plant community of the Greater Mkuze Wetlands and the environmental conditions thought to be most important in determining their development and separation.

Species Used		USE OF THE SPECIES				Subjective Estimates Of The Extent To Which The Resource Is Harvested
		Building materials	Craftwork	Beverage production	Food supplements	
Phragmites australis	Reeds	x				< 1 % of total
Phragmites mauritianus		x				
Cyperus textilis	Sedges	x	x			< 1 % of total
Cyperus immensus			x			< 1 % of total
Hyphaene coriacea	Palms		x	x		< 1 % of total
Phoenix reclinata			x	x		
Hippopotamus amphibius (Hippo)					x	LOW
Redunca arundinum (Common Reedbuck)					x	HIGH
Sylvicapra grimmia (Grey Duiker)					x	HIGH
Raphicerns campestris (Steenbok)					x	MODERATE
Potamochoerus porcus (Bushpig)					x	LOW
Pelomedusa subrufa subrufa (Pan Terrapin)					x	LOW
Clarias garipinus (Barbel)					x	LOW
Oreochromis mocambicus (Tilapia)					x	LOW

TABLE 2

Species known to be harvested in and around the Greater Mkuze Wetlands and their uses. Included are subjective estimates of the degree, in relation to total availability, of their use.

TABLE 3 INVENTORY - PLANTS

An inventory of the plants recorded in association with the Greater Mkuze Wetlands during 1985-1987

Acacia gerrardii Benth. var. gerrardii
Acacia schweinfurthii Brenan & Excell var. schweinfurthii
Achyranthes aspera L.
Ageratum houstornianum Mill.
Albizia adianthifolia (Schaumach.) W.F. Wight
Alternanthera sessilis (L.) DC.
Andropogon appendiculatus Nees
Andropogon sp.
Anthericum cooperi Bak.
Anthericum saundersiae Bak.
Antidesma venosum E. Mey ex Tul.
Apodytes dimidiata E. Mey. ex Arn.
Aristida junciformis Trin. & Rupr. subsp. junciformis
Asparagus falcatus L. var. falcatus
Asparagus sp.
Azima tetracantha Lam.
Bersama Lucens (Hochst.) Szyszyl.
Bidens sp.
Blighia unijugata Bak.
Brachylaena discolor DC.
Bridelia cathartica Bertol.f.
Bridelia micrantha (Hochst.) Baill
Bulbostylis contexta (nees) Bodard
Burchellia bubalina (L.f.) Sims
Canthium gueinzii Sond.
Canthium inerme (L.f.) Kuntze
Cardiospermum halicacabum L. var. halicacabum
Cassine aethiopica Thunb.
Cassipourea gummiflua Tul. var. verticillata (N.E.Br.) Lewis
Cassia mimosoides L.
Cassia plumosa (E.Mey) Vogel var. plumosa
Cassia sp.
Centella asiatica (L.) Urban
Ceratophyllum demersum L.
Cestrum laevigatum Schltr.
Setaria chevalieri Stapf ex Stapf & C.E. Hubb.
Chaetacme aristata Planch.
Chloris pycnothrix Trin.
Chloris sp.
Chrysanthemoides monilifera (L.) T. Norl.
Cissampelos sp.
Cladostemon kirkii (Oliv.) Pax & Gilg
Cladium mariscus (L.)
Clausena anisata (Willd.) Hook.f. ex Benth
Chloris gayana
Commiphora fischeri Engl.
Commiphora sp. cf. woodii Engl.
Commiphora woodi Engl.
Croton sp.
Cymbopogon validus Stapf ex Burtt Davy
Cynodon dactylon (L.) Pers.

Cyperus articulatus L.
Cyperus corymbosus Rottb.
Cyperus denudatus L.f. var. sphaerospermus (Schrad.) Kukenth.
Cyperus difformis L.
Cyperus fastigiatus Rottb.
Cyperus immensus C.B.Cl.
Cyperus latifolius Poir. var. angustifolius Krauss
Cyperus leptocladus Kunth
Cyperus natalensis Hochst
Cyperus papyrus L.
Cyperus prolifer Lam.
Cyperus sensilis Baijnath
Cyperus sp.
Cyperus textilis Thunb.
Cyperus tuibatus
Dalbergia obovata E. Mey.
Deinbollia oblongifolia (E.Mey.) Radlk
Desmodium dregeanum Benth
Desmodium sp.
Dichrostachys cinerea (L.) Wight & Arn.
Digitaria diversinervis (Neers) Stapf
Digitaria macroglossa Henr. var. prostrata (Stent) Henr.
Digitaria scalarum (Schweinf.) Chiov.
Dissotis canescens (E.Mey. ex Grah.) Hook.f.
Dracaena hookeriana K. Koch
Dryopteris prolifera (Retz.) C. Chr.
Dryopteris sp.
Echinochloa pyramidalis (Lam.) Hitchc. & Chase
Ekebergia capensis Sparrm.
Eleocharis limosa (Schrad.) Schult.
Entada sp.
Eragrostis lappula (Neers) var. lappula
Eragrostis pallens Hack
Eragrostis racemosa (Thunb.) Steud.
Eragrostis sp.
Eragrostis sp.
Erythroxylum delagoense Schinz
Ethulia conyzoides L.
Euclea sp. cf. natalensis A.DC.
Eugenia sp. cf. mossambicensis Engl.
Ficus trichopoda Bak.
Ficus natalensis Hochst.
Ficus sur Forssk.
Ficus sycomorus L.
Ficus verruculosa Warb.
Flagellaria guineensis Schumach
Fuirena sp.
Fuirena umbellata T. Anders
Garcinia livingstonei
Grewia occidentalis L.
Grewia sp.
Helichrysum kraussii Sch. Bip.
Helichrysum sp.
Hemarthria altissima (Poir.) Stapf & C.E. Hubb.
Hibiscus schnizii Comins.
Hypericum sp.

Hyphaene natalensis Kuntze
Imperata cylindrica (L.)
Indigofera sarmentosa L. f.
Indigofera schimperi Saub & Spach var. schimperi.
Inhambanella henriquesii (Engl. & Warb.) Dubard.
Ipomoea sp.
Ischaemum arcuatum (Nees) Stapf
Jasminum stenolobium Rolfe
Kigelia africana (Lam.) Benth.
Kraussia floribunda Harv.
Krauseola mosambicina (Moss) Pax & K. Hoffm.
Landolphia kirkii Dyer
Lemma minor L.
Leersia hexandra S.W.
Lippia sp.
Cyphia elata L.
Ludwigia stolonifera (Guil. & Perr.) Raven
Macrotyloma maranguense (Taub.) Verdc.
Mangifera indica L.
Manklkara discolor (Sond.) J.H. Hemsl.
Maytenus heterophylla compex (taxon B)
Melanthera scandens (Schumach. & Thonn.) Roberty subsp. dregei (DC) Wild.
Microcoelia exilis Lindl.
Mikania cordata (Burm.f.) B.L. Robinson
Mondia whitei (Hook.F.) Skeels
Musa sapientum
Myrica serrata Burm.f.
Nymphaea lotus L.
Oldenlandia cephalotes (Hochst) Kuntze
Oxygonum dreageanum Meisn. var. dreageanum
Ozoroa obovata (Oliv.) R.& A. Fernandes var. obovata
Pachystigma latifolium Sond
Panicum maximum Jacq.
Panicum sp.
Parinari czpensis Harv. subsp. capensis
Parinari caratellifolia Planch. ex Benth.
Paspalum vaginatum Swartz
Pavetta lanceolata Eckl.
Peddiea africana Harv.
Pentodon pentandrus (Schumach & Thonn) Vatke
Perotis patens Gand.
Phaseolus vulgaris
Phoenix reclinata Jacq.
Phragmites australis (Cav.) Trin. ex Steud.
Phymatodes scolopendria (Burm. f.) Ching.
Polygonum pulchrum Blume.
Polygonym senegalense Meisn. Forma albotomentosum R. Grah.
Pseudognaphalium luteo-album (L.) Hilliard & Burtt
Ptaeroxylon obliquum (Thunb.) Radlk.
Pycreus sp.
Rhoicissus tomentosa (Lam.) Wild & Drumm.
Rhynchelytrum repens (Willd.) C.E.Hubb.
Riccia sp.
Ricinus sp.
Rubus sp. cf. apetalus Poir
Sacciolepis curvata (L.) Chase

Sapium integerrimum (Hochst.) J. Leonard
Sarcostemma viminale (L.) R. Br.
Scabiosa columbaria L.
Scirpus Flutans L.
Scirpus littoralis Schrad.
Scirpus nodusus Rottb.
Scirpus sp.
Scirpus supinus L.
Scleria angusta Nees
Securinega virosa (Roxb. ex Willd.) Pax & K.Hoffm.
Sehima galpinii Stent
Senecio madagascariensis Poir.
Senecio polydon DC. var. polydon
Senecio sp. cf. S. lottoreus Thunb.
Sesbania sesban (L.) Merrill subsp. sesban var. nubica Chiov.
Sida dregei Burtt Davy
Smilax kraussiana Meisn.
Solanum sp. nov. (=C.J. Ward 3840)
Sporobolus africanus (Poir.) Robyns & Tournay
Stellaria media (L.) Vill
Stellaria sp.
Stenochlaena tenuifolia (Desv.) Moore
Strychnos madagascariensis Poir
Strychnos sp.
Strychnos spinosa Lam
Syzygium cordatum Hochst.
Syzygium guineense (Willd.) DC.
Tabernaemontana elegans Stapf
Tephrosia dregeana E. Meyer.
Themeda triandra Forssk.
Thunbergia dregeana Nees
Trema orientalis (L.) Blume
Trichilia emetica Vahl.
Tricalysia sonderana (Sond.) Burtt Davy
Tricalysia sonderiana Hiern
Typha latifolia L. subsp. capensis Rohrb.
Uvaria locida Benth. subsp. virens (N.E.Br.) Verdc.
Vangueria infausta Burch.
Veronia angulifolia DC.
Viscum rotundifolium L.f.
Voacanga thouarsii Roem. & Schult.
Wolffia sp.
Xylotheca kraussiana Hochst.
Rhus dentata Thunb.
Zea Mays L.

TABLE 4 : INVENTORY - BIRDS

An inventory of birds recorded in the Greater Mkuze Wetlands and surrounding areas.

Adapted from Johnson, 1986.

N - species recorded in the November 1985 survey
F - species added during the February 1986 survey
* - species dependent upon open grassland, vleis and pans

N *	Dabchick
*	White Pelican
*	Pinkbacked Pelican
F *	Whitebreasted Cormorant
N *	Reed Cormorant
N *	Darter
*	Grey Heron
N *	Blackheaded Heron
*	Goliath Heron
N *	Purple Heron
N *	Great White Egret
*	Little Egret
N *	Yellowbilled Egret
*	Black Egret
*	Cattle Egret
N *	Squacco Heron
N *	Rufousbellied Heron
N *	Hamerkop
N *	Woollynecked Stork
N *	Saddlebill Stork
*	Yellowbilled Stork
N *	Sacred Ibis
N *	Glossy Ibis
N *	Hadeda
*	African Spoonbill
*	Greater Flamingo
*	Lesser Flamingo
N *	Whitefaced Duck
N *	Whitebacked Duck
*	Fulvous Duck
*	Egyptian Goose
N *	Yellowbilled Duck
*	Cape Teal
*	Hottentot Teal
*	Redbilled Teal
*	Cape Shoveler
*	Southern Pochard
N *	Pygmy Goose
*	Knobbilled Duck
N *	Spurwinged Goose
N *	Secretarybird
N	Yellowbilled Kite
N	Blackshouldered Kite
	Cuckoo Hawk
N	Wahlberg's Eagle
	Lizard Buzzard
	Little Sparrowhawk
N	African Goshawk
N *	African Marsh Harrier
	Gymnogene
F *	Eastern Redfooted Kestrel
N *	Coqui Francolin
N *	Shelley's Francolin
N *	Common Quail
F	Crested Guineafowl
N *	Blackrumped Buttonquail
N *	Black Crake
*	Redchested Flufftail
*	Purple Gallinule
*	Moorhen
*	Redknobbed Coot
*	African Finfoot
N *	Stanley's Bustard
N *	Blackbellied Korhaan
N *	African Jacana
N *	Lesser Jacana
N *	Ringed Plover
*	Whitefronted Plover
*	Kittlitz's Plover
*	Threebanded Plover
N *	Blacksmith Plover
N *	Wattled Plover
*	Turnstone
*	Common Sandpiper
F *	Wood Sandpiper
*	Marsh Sandpiper
*	Greenshank
*	Curlew Sandpiper
*	Little Stint
*	Sanderling
F *	Ruff
F *	Ethiopian Snipe
*	Whimbrel
*	Avocet
*	Blackwinged Stilt
*	Water Dikkop
N *	Redwinged Pratincole
*	Greyheaded Gull
*	Caspian Tern
*	Swift Tern

	Martial Eagle
F	Crowned Eagle
N	Brown Snake Eagle
N	Blackbreasted Snake Eagle
N	Southern Banded Snake Eagle
F	Bateleur
N *	African Fish Eagle
N	Steppe Buzzard
	Cinnamon Dove
	Green Pigeon
N	Knysna Lourie
	Purplecrested Lourie
N	Redchested Cuckoo
	Emerald Cuckoo
N	Klaas's Cuckoo
N	Green Coucal
N *	Burchell's Coucal
F	European Nightjar
N *	Natal Nightjar
F *	Mozambique Nightjar
N	Speckled Mousebird
	Narina Trogon
N *	Pied Kingfisher
*	Giant Kingfisher
*	Halfcollared Kingfisher
*	Malachite Kingfisher
F	Pygmy Kingfisher
N	Brownhooded Kingfisher
N	Striped Kingfisher
F	European Bee-eater
F *	Bluecheeked Bee-eater
N	Little Bee-eater
F	European Roller
N	Trumpeter Hornbill
N	Crowned Hornbill
N	Blackcollared Barbet
	White-eared Barbet
N	Redfronted Tinker Barbet
N	Golden Rumped Tinker Barbet
N	Scalythroated Honeyguide
	Lesser Honeyguide
F	Goldentailed Woodpecker
	African Broadbill
N *	Rufousnaped Lark
N *	Flappet Lark
N	European Swallow
	Lesser Striped Swallow
F *	Greyrumped Swallow
F *	Sand Martin
*	Brownthroated Martin
F *	Banded Martin
N	Black Sawwing Swallow
	Black Cuckooshrike
	Grey Cuckooshrike
F	Forktailed Drongo
N	Squaretailed Drongo
*	Lesser Crested Tern
F *	Common Tern
N *	Whiskered Tern
F *	Whitewinged Tern
N	Redeyed Dove
F	Cape Turtle Dove
N	Greenspotted Dove
N	Tambourine Dove
N	Brown Robin
*	Cape Reed Warbler
*	Yellow Warbler
N *	African Sedge Warbler
	Barratt's Warbler
F	Willow Warbler
N	Yellowbreasted Apalis
N	Rudd's Apalis
F	Longbilled Crombec
N	Bleating Warbler
N *	Fantailed Cisticola
N *	Desert Cisticola
N *	Cloud Cisticola
N *	Palecrowned Cisticola
N	Rattling Cisticola
N *	Blackbacked Cisticola
N *	Croaking Cisticola
N	Neddicky
N *	Tawnyflanked Prinia
	Dusky Flycatcher
	Bluegrey Flycatcher
N	Chinspot Batis
	Woodwards' Batis
F	Wattle-eyed Flycatcher
	Bluemantled Flycatcher
F	Paradise Flycatcher
N *	Richard's Pipit
F *	Plainbacked Pipit
N *	Shorttailed Pipit
N *	Orangethroated Longclaw
N *	Yellowthroated Longclaw
N *	Pinkthroated Longclaw
*	Fiscal Shrike
F	Redbacked Shrike
N	Southern Boubou
N	Puffback
N	Blackcrowned Tchagra
N	Gorgeous Bush Shrike
N	Orangebreasted Bush Shrike
N	Olive Bush Shrike
F	Plumcoloured Starling
N	Blackbellied Starling
N	Purplebanded Sunbird
N	Grey Sunbird
N	Olive Sunbird
N	Scarletchested Sunbird
N	Collared Sunbird
	Yellow White-eye

N	Blackheaded Oriole
N	Pied Crow
N	Southern Black Tit
N	Blackeyed Bulbul
N	Terrestrial Bulbul
N	Sombre Bulbul
N	Yellowbilled Bulbul
N	Yellowspotted Nicator
*	Stonechat
	Chorister Robin
N	Natal Robin
	Cape Robin
	Starred Robin
N	Whitebrowed Robin
F *	Thickbilled Weaver
N	Forest Weaver
N	Spectacled Weaver
	Spottedbacked Weaver
N *	Yellow Weaver
*	Brownthroated Weaver
N *	Redshouldered Widow
	Green Twinspot
N	Bluebilled Firefinch
F *	Common Waxbill
	Grey Waxbill
N *	Quail Finch
N	Pintailed Whydah
N	Yelloweyed Canary

TABLE 5 : INVENTORY - HERPETOFAUNA

An inventory of the herpetofauna recorded and expected to occur in the Greater Mkuze Wetland area.

Adapted from Bourquin, 1986.

AMPHIBIA

Xenopus laevis
X. muelleri
Bufo gutturalis
B. garmani
B. carens
B. vertibralis
Breviceps adspersus
B. mossambicus
Phrynomerus bifasciatus
Pyxicephalus adspersus
Tomopterna natalensis
T. krugerensis
T. cryptotis
Rana angolensis
Strongylopus fasciatus
Ptychadena oxyrhynchus
P. anchietae
P. mascareniensis
P. porosissima
P. mossambica
P. taenioscelis
Phrynobatrachus natalensis
P. acridoides
P. mababiensis
Cacosternum boettgeri
Cacosternum nanum
Chiromantis xerampelina
Arthroleptix wahlbergi
A. stenodactylus
Hemisus guttatum
H. marmoratum
Leptopelis natalensis
L. mossambicus
Kassina maculata
K. senegalensis
Afrixalus avreus
A. fornasinii

Afrixalus delicatus
Hyperolius argus
H. tuberilinguis
H. pusillus
H. nasutus
H. pickersgilli
H. marmoratus

CHELONIDS

Pelomedusa subrufa
P. rhodesianus
P. castaneus
P. sinuatus

Geochelone pardalis
Kinixys belliana

CROCODILES

Crocodylus niloticus

LIZARDS

Homophilus wahlbergii
Afroedura pondolia
Hemidactylus mabouia
Lygodactylus capensis
Pachydactylus maculatus
P. capensis
Agama atricollis
Chamaeleo dilepis
Bradypodion setaroi
Scelotes brevipes
Scelotes inornatus
S. arenicola
S. bidigittatus
Mabuya homalocephala
M. striata
M. varia
M. capensis
Panaspis wahlbergii
Acontias plumbeus
Typhlosaurus aurantiacus
Gerrhosaurus flavigularis
Tetradactylus africanus
Ichnotropis squamulosa
I. capensis
Zygaspis violaceae
Monopeltis sphenorynchus
Varanus niloticus
V. exanthematicus
Chamaesaura macrolepsis
Cordylus tropidosternum

SNAKES

Typhlops fornasinii
T. schlegelii
Leptotyphlops conjuctus
L. scutifrons
Python sebae
Lycodonomorphus rufulus
Lamprophis aurora

L. fuliginosus
Lycophidion capense
L. semiannule
Mahelya nyassae
M. capensis
Natriciteres vareigata
Meizodon semiornatus
Philothamnus semivariegatus
P. hoplogaster
P. angolensis
P. natalensis
Prosymna ambigua
P. sundevallii
P. janii
Pseudaspis cana
Duberria lutrix
D. variegata
Dasypeltis scabra
D. inornata
D. medici
Telescopus semiannulatus
Crotaphopeltis hotamboeia
Dipsadoboa aulica
Dispholidus typus
Thelotornis capensis
Psammophis sibilans
P. phillipsii
Amblyodipsas concolor
A. microphtalma
A. polylepis
Xenocalamnus transvaalensis
Aparallactus capensis
Elapsoidea sundevallii
Naja haje
N. melanoleuca
N. mossambica
Dendroaspis angusticeps
Atractaspis bibronii
Causus rhombeatus
C. defilippii
Bibis arietans
B. gabonica

TABLE 6 : INVENTORY - FISH

Adapted from Batchelor (1986)

An inventory of the fish recorded and expected to occur in the Greater Mkuze Wetlands.

	Pongola	Mgobozeleni	Small swamps	Lake Sibaya	Kosi System	Mkuze River/Pans	Lake Bongazi (S)	Lake Bongazi (N)	Lake St. Lucia
Petrocephalus catostoma	x								
Marcusenius macrolepidotus	x			x					
Alestes imberi	x								
Alestes lateralis					x				x
Micralestes acutidens	x								
Hydrocynus vittatus	x								
Basbus afrohamiltoni	x								
B. annectens	x								
B. marequensis	x								
B. paludiuosus	x		x	x	x	x	x	x	x
B. natalensis						x			
B. radiatus	x								
B. toppini	x		x			x			
B. trimaculatus	x					x			x
B. viviparus	x		x	x		x	x	x	x
Opsaridium zambezeuse	x								
Mesobolo brevianalis	x					x			x
Labeo cylindrieus	x								
L. molybdinus	x			x					
L. rosae	x								
L. rubropunctatus	x								
Eutropius depressirostris	x								
Clarias gariepinus	x	x			x	x		x	x
C. ngamensis	x								
C. theodoral			x	x			x		
Chiloglanis paratus	x								
C. swierstrae	x								
Synodontis zambezensis	x								
Nothobranchius orthonotus	x								
Aplocheilicthys johnstonii			x	x	x				x
A. katangae		x	x	x	x			x	
A. myaposa				x	x				x
Ctenopoma multispinis			x	x		x	x		
Ctenopoma ctenotis							x		
	26	1	7	9	6	9	5	4	8

6.1 Current knowledge of the distribution of Primary freshwater fish in the Maputaland area.

	Pongola	Mgobozeleni	Small swamps	Lake Sibaya	Kosi System	Mkuze River/Pans	Lake Bongazi (S)	Lake Bongazi (N)	Lake St. Lucia
Pseudocrenilabrus philander	x	x	x	x	x	x	x	x	x
Oreochromis mosaambicus	x	x	x	x	x	x	x	x	x
Sarotherodon placidus		x							
Serranochromis meridianus		x							
Tilapia rendalli awierstae	x	x		x	x	x		x	
Tilapia sparrmanii	x	x	x	x	x	x	x	x	x
	4	6	3	4	4	4	3	4	3

6.2 Distribution of secondary freshwater fish in the Maputaland area.

	Pongola	Mgobozeleni	Small swamps	Lake Sibaya	Kosi System	Mkuze River/Pans	Lake Bongazi (S)	Lake Bongazi (N)	Lake St. Lucia
Carcharhinus l eucas	x								
Pristis microdon	x								
Megalops cyprinoides	x	x						x	
Gilchristella aestuarius				x					x
Anguilla bicolor bicolor	x	x							
A. mossambica	x	x							
A. marmorata	x								
A. nebulosa labiata	x	x							
Belonicthys fluviatalis	x								
Hepsetia breviceps				x	x				
Acanthopagrus berda	x				x				
Ambassis Commersoni									
Lutjanis argentimaculatus					x				
Mugil cephalus	x								
Myxus capensis		x							
Liza macrolepis		x							
Croila mossambica				x	x				
Glossogobius tenuiformis	x			x			x	x	x
Redigobius dewaali	x								x
Muginigobius durbanensis									x
Platygobius aeuofuscus	x			x					
Silhouetta sibaya				x					
Eleotris fusca					x				
Eleotris melanosoma		x							
Hypseleotris dayi						x			x
	13	7	-	6	5	1	2	2	4

6.3 Distribution of peripheral freshwater fish in Maputaland.

TABLE 7 : INVENTORY - MAMMALS

An inventory of the larger mammals recorded in the Greater Mkuze Wetlands and surrounding terrestrial areas (Stormanns, personal observation).

Common Reedbuck	Redunca arundinum
Steenbok	Raphicerus campestris
Grey duiker	Sylvicapra grimmia
Zebra	Equus burchelli
Bushpig	Potamochoerus porcus
Side-striped jackal	Canis adustus
Cape clawless otter	Aonyx capensis
Vervet monkey	Cercopithecus (aethiops) pygerythrus
Chacma baboon	Papio ursinus
Hippopotamus	Hippopotamus amphibius
Grand galago	Galago crassicandatus

TABLE 8 : INVENTORY - MOLLUSCS

An inventory on the Molluscs expected to occur in the Greater Mkuze Wetlands (Appleton, 1986).

Adapted from Appleton, 1986.

Gastropoda :

Melanoides tuberculata
Lymnaea natalensis
Biomphalaria pfeifferi
Gyraulus costulatus
Segmentorbis sp.
Bulinus cf natalensis
Bulinus globosus

Bivalves :

Aspatharia wahlbergi
Unio caffer
Corbicula africana

HABITAT		PLANT COMMUNITIES	
1	Palmveld	1	Hyphaene coriacea
2	Riparian forest	2	Ficus sycomorus - Rauvolfia caffra
3	Floodplain grassland	3	Echinocloa pyramidalis
4	Floodplain forest	4	Acacia xanthophloea - Cynodon dactylon
5	Sedge marsh	5.1	Cyperus corymbosus - Ischaemum arcuatum
		5.2	Scirpus nodosus
		5.3	Cyperus natalensis
6	Sedge and reed swamp	6.1	Cyperus papyrus
		6.2	Phragmites australis
		6.3	Phragmites mauritianus
		6.4	Typha latifolia
7	Forested swamp	7	Ficus trichopoda
8	Saline marsh	8	Sporobolus virginicus

TABLE 9

A list of the plant communities which create the habitats characteristic of the Greater Mkuze Wetlands.