

KOSI BAY NATURE RESERVE  
SOUTH AFRICA

Information sheet for the site designated to the  
List of Wetlands of International Importance  
in terms of the  
Convention on Wetlands of International Importance  
especially as Waterfowl Habitat

South African Wetlands Conservation Programme  
Document No 24/21/3/3/11 (1991)  
Department of Environmental Affairs and Tourism  
Private Bag X447  
PRETORIA 0001  
South Africa

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**KOSI BAY NATURE RESERVE:  
RAMSAR DATA**

- 1. COUNTRY** South Africa
- 2. DATE OF COMPILATION** Originally completed: Nov/Dec 1988  
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- 3. REFERENCE NUMBER** 1ZA011
- 4. COMPILER**
- |                            |                     |
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- 5. NAME OF WETLAND** **KOSI BAY NATURE RESERVE**
- 6. DATE OF RAMSAR DESIGNATION** 28 June 1991
- 7. GEOGRAPHICAL CO-ORDINATES** 26 52' S - 27 10' S, 32 42' E - 32 54' E  
Maps Number 1: 50 000 2632 DD and 2732 BB.
- 8. GENERAL LOCATION**

The system is orientated on an east north-east to south south-west axis.  
Bounded by Mozambique in the north and the Indian Ocean in east. The western border encapsulates the lakes of the Kosi System from a point on the Mozambique border  $\pm$  4 km from the Ocean. The border goes round much of the extant swamp forest around the system and in the south includes much of the catchment. In the north west the reserve boundary includes a narrow strip of land around the margins of the lakes.  
The Kosi system is some 470 km north east of Durban. The nearest town is Ingwavuma, situated 105 km from the estuary, although the village of KwaNgwanase is 13 km from the KwaZulu Department of Nature Conservation camp on the north western shores of Lake Nhlange.

There is a good tar road to within 13 km of the site but the road then deteriorates to gravel between KwaNgwanase and the campsite and the condition can be very poor following heavy rain.

**9. AREA (ha)** 10 981.63 ha  
*9.1 Boundary Integrity* No change

## **10. WETLAND TYPE**

A (Shallow marine waters)  
C (Coral reefs)  
E (Sand/shingle shores)  
F (Estuarine waters)  
G (Tidal mudflats, including intertidal flats and saltflats)  
H (Salt marshes)  
I (Mangrove/tidal forest)  
J (Coastal brackish/saline lagoons)  
K (Coastal fresh lagoons)  
L (Deltas)  
O (Freshwater lakes: permanent)  
P (Freshwater lakes: seasonal/intermittent)  
Q (Saline/brackish lakes/marches: permanent)  
R (Saline/brackish lakes/marches: seasonal/intermittent)  
Sp (Freshwater marches/pools: permanent)  
Ts (Freshwater marches/pools: seasonal/intermittent)

**11. ALTITUDE** Min: Sea level Max: 102 m

## **12. OVERVIEW OF SITE**

The area is generally made up of pale, sandy soil country which forms undulating grassland interspersed with lakes, pans, streams, marshes and swamps. The Kosi system offers a diverse habitat but one in which the overall nutrient status is low. Main vegetation types include: marches, sedges and aquatic communities; mangal communities; coastal dune forests; grassland/open woodland/palm communities; and algae.

The system is an estuary-linked lake system composed of four interconnected, roughly circular lakes (Makhawulani, Mpungwini, Nhlanga and Amanzimnyama), a broad channel leading to an estuary which opens to the Indian Ocean and three extensive areas of swamp. Principal habitats include swamp forest, Phragmites beds, mangrove forest (32 ha) and coastal grassland/open woodland/palm communities and algae. The lakes are separated from the ocean by a strip of forested sand dunes 600 - 2000 m in width. Numerous sandy mudbanks, emergent at low tide, occur in the lower part of the system.

## **13. PHYSICAL FEATURES**

### *13.1 Geology and geomorphology*

The Kosi system lies within the pale sandy soils of the Mozambique coastal plain which overlie Cretaceous beds. The coastal dunes are composed of both Holocene and Pleistocene sand deposits. West of the coastal dunes no rocks or stones are to be found, although on the coast; rock ledges, shelves and outcrops occur. One such rocky outcrop near the mouth forms a small reef within the estuary, upon which a very diverse fauna may be found.

The Kosi system illustrates the phenomenon of segmentation, a process which transforms the system into circular water bodies each separated by low beach barriers. The circularity of the lakes reflect the opposing wave energies generated by the prevailing winds. The system is made up of 4 lakes, plus a broad shallow channel leading to an estuary. There are no cut-off lakes behind the barrier dune system. The lakes are interlinked. The main lakes drain three large swamp areas through the Sihadhla, Naswamanzi and Sifazanene streams which are normally perennial flowing. This country is characterised by the prevalence of stagnant water and boggy ground due to a high water table.

### *13.2 Origins*

There are two principal rivers which enter the system:

- a) Sihadhla River which rises in the Mtombeni pans, is approximately 30 km long and, after receiving contributions from a network of twelve principal tributary systems, enters Lake aManzimnyama.
- b) Naswamanzi River which is approximately 15 km long, collects water from nine principal tributaries, and enters Lake Nhlange on its western shore.

### *13.3 Hydrology*

Very little information is recorded on the hydrology of the Kosi system. There is a fairly strong seasonal inflow of fresh water into the head of the estuary. In 1976 the Department of Water Affairs installed seven gauge plates and two water-level recorders. Records are maintained by staff members of the KwaZulu Department of nature Conservation stationed at Kosi.

### *13.4 Soil type and chemistry*

The bottom materials in the Kosi System are principally clean, white sands, particularly in the northernmost reaches where tidal influences are most marked. Sandy substrates are also characteristic even on steeply-shelving profiles and in the lake margins. The only silt is found in deeper waters, or as a thin layer overlying sand in certain shallow areas.

The sandy substrates of Kosi are characterised by a lack of fine particles, and are low in nutrient content. They contrast in these respects to the bottom materials of the deeper parts of the system where unconsolidated organic debris has collected. In these instances, the bottom materials are characterised by low dry weights and high volatile and nutrient values. They can be of considerable thickness and are black and hydrogen sulphide bearing. These materials originate in the marshes and swamps alongside the system and then naturally gravitate towards the deeper areas.

### *13.5 Water quality*

#### Thermal properties

Lake Nhlange is a warm lake which exhibits a complex pattern of stratification during summer. Several thermoclines develop during summer because of strong northerly or southerly winds. In the cool season Lake Nhlange tends to develop homothermal characteristics at 18,5o to 19oC. In lakes Mpungwini and Makhawulani temperature layering is evident, so that bottom temperatures may be significantly warmer than the surface waters. In the well-mixed, shallow, tidal portion of the system sea temperatures become more evident. Water temperatures in the channels do not fall below 20oC in winter and attain 30oC in summer. In the shallow margins summer temperatures of 39oC have been recorded.

#### Transparency

The Kosi system is renowned for its clear water, as illustrated by Secchi values of 4,2 - 7,0 m. In 1967, 1% of subsurface illumination was measured at 6 m in Lake Nhlange.

#### Salinity

A classical transition from sea water at the mouth to fresh water in Lake aManzimnyama (16 km distant) is evident. In the tidal basin salinities close to that of sea water may be encountered. These vary naturally with the tides, but it should be noted that on certain occasions at a low tide, salinities in this section of the system may drop to remarkably low levels.

The two lakes Makhawulani and Mpungwini both exhibit salinity layering. In Mpungwini a sharp, permanent halocline occurs at approximately 10 m, the bottom water being highly saline, with a high proportional ionic composition similar to that of sea water. The source of this deep salt layer is the sea and consequently these lakes are considered to be dominated by ectogenic meromixis.

Lake Nhlange is not similarly stratified, and is predominantly a freshwater lake, with a salinity range of 0.9 - 5.6o/oo. Here the water has an ionic composition different from the sea-water. In Lake Nhlange salinities fall, and yet the waters of Lake Nhlange are not considered simply as diluted sea water because the ion ratios between sea water and Nhlange water are markedly different. Lake Mpungwini is meromictic, but Lake Nhlange appears to be well mixed.

It has been suggested that the low salinities of Nhlange adversely affect the osmoregulation of many marine species of fish that would otherwise enter the lake.

#### Dissolved oxygen

Dissolved oxygen concentrations vary between 7.6 - 8.6 mg/l at the surface and 7.0 -7.7 mg/l at 10 m depth, but below this depth in Lake Mpungwini, the bottom waters become anoxic in winter and may contain hydrogen sulphide.

Other than the water in the hypolimnion of Lake Mpungwini, the waters of the Kosi system are well oxygenated. In Mpungwini oxygen falls to zero at 9 - 13 m depending on the season. This is due to abrupt temperature and salinity layering at this depth. Below the thermocline, the water may be hydrogen sulphide bearing. Such characteristics are regarded as a barrier to juvenile fish and other small organisms in their movements through the system, and consequently the shallows represent an important migration route. Very few fish are caught in depths > 6 m.

In Lake Nhlange, dissolved oxygen is found at all depths because the lake is not stratified and because circulation is effective throughout. It has been suggested that if the bottom materials in Lake Mpungwini become greatly disturbed, the whole lake could become temporarily anoxic.

#### Nutrient availability

In general terms nutrient levels are low and no abnormal nutrient additions occur which affect the system adversely. However, a substantial reservoir of nutrients lies on the bottom of the system in the form of organic detritus.

#### Nitrogen

In the Kosi system the recycling of nitrogen is assisted by the anaerobic reduction of organic nitrogen in the deep, organically rich areas of the system. Consequently the proportion of ammonia is substantial and some 50% higher than normal. Because of incorporation into biological materials and low volume interchange (through Mhtando channel), the total nitrogen concentration in Lake Nhlange is 50-100% higher than that in Lake Mpungwini-Makhawulani. An inexplicable phenomenon is the virtual absence of nitrate in Lake Nhlange.

#### Phosphorus

With nitrogen:phosphorus ratios of 50:1, the concentrations of phosphorus in the system are considered as limiting or inadequate.

#### Pollution

##### a) Heavy metals

In August 1976 low levels of heavy metals were encountered throughout the estuary.

##### b) Pesticide residues

One of the most serious problems in Kosi relates to the fact that DDT (DDE and TDE) is apparent in the sediments of Lake Mpungwini and Makhawulani, and present in fish tissues in relatively high levels. The malaria control spraying operations of the KwaZulu Department of Health are clearly responsible.

The spraying of tsetse fly in the area has long since ceased and the dipping of the large herds of native cattle around the Kosi system (in toxaphene) is also not considered to present any particular pollution threat to the system.

#### *13.6 Depth, fluctuations and permanence*

Maximum water depths, with mouth open, are 31 m in Lake Nhlange, 18 m in Lake Mpungwini, 8 m in Lake Makhawulani, but only 3 m in the estuary. Lake aManzimnyama at the southern extremity, farthest from the sea, is very shallow with a maximum depth of 2 m.

The deepest area of Lake Nhlange is 42 m deep. Due to the shallow nature of the tidal basin about 70% of its area becomes exposed at low tide.

The Kosi system sometimes experiences cyclones which can cause a considerable water level rise in a relatively short time. Drastic water level rises can lead to the death of plant communities, for example mangrove communities died after the cyclone Claude (1965) had caused increased lake levels.

The mouth of the estuary is open throughout the year and subjected to regular and strong tidal movements, although this opening is considered to be maintained with difficulty. However, this exchange with the sea is the lifeline on which the system depends. The mouth varies in size with every tide, particularly during spring tides. It is generally 20-50 m wide and 3 m deep. It can vary in width from 5-100 m.

#### *13.7 Tidal variations*

Tidal effects are occasionally noticeable in Nhlange during spring tides particularly in late winter (low water level periods). The levels in Kosi are lower at low neap tide than at low spring tide because the water which enters the estuary on the high spring tide does not have time to leave before the next high tide starts rising. Outflow towards the sea is greater during summer, and water movements during winter are due to tidal effects. In all cases outflow speeds exceed inflow speeds.

### *13.8 Catchment area*

The Kosi system lies on the coastal plain east of the Lebombo Mountains in the north-east extremity of the Ingwavuma district of Maputoland. The Kosi drainage system is ill-defined because of the pans, swamps and marshes which surround it. It is estimated to be approximately 500 km<sup>2</sup> in extent. A small portion of the catchment (ie that draining into Lake Zilonde) is in Mozambique.

There are two principal rivers which enter the system:

a) Sihadhla River which rises in the Mtombeni pans, is approximately 30 km long and, after receiving contributions from a network of twelve principal tributary systems, enters Lake aManzimnyama. This river drains about 13 000 ha of swampy land before entering the southernmost lake.

b) Nswamanzi River which is approximately 15 km long, collects water from nine principal tributaries, and enters Lake Nhlange on its western shore.

It has been suggested that only 5% of the total annual precipitation is borne by rivers/streams in the Kosi area, due to the high infiltration rate of water on the sandy coastal plain over which such rivers move. Small changes in drainage patterns could result in the isolation of Lake Nhlange because of its tenuous connection (the Mhtando channel) to the sea. Therefore reports of swamp drainage at the source of the Sihadhla River are viewed in a serious light.

### *13.9 Downstream area*

None

### *13.10 Climate*

The area has a warm to hot and humid subtropical climate:

Kosi Bay falls within a climatic region which is one of the most well-watered areas in South Africa.

The average yearly rainfall at Kosi Bay is 980 mm. Rain occurs mainly during summer from October to March and the highlight of the rain season is from February to March. Sometimes heavy showers fall in short periods with consequent floods which cause considerable damage. Although the rainfall is relatively reliable, droughts occur.

Cloudy weather during the summer months reduce the sunshine duration to approximately 45 % while the percentage in winter is approximately 70. The average daily maximum temperature extends from 28oC in January to 22oC in July but extremes can reach 43oC and 34oC respectively. Average daily minima are 19oC in January and 9oC in July while extremes can fall to 7oC and -1oC. Frost is virtually unknown, except occasionally in a few valleys in the interior.

The prevailing wind directions are north-east and south-west in almost equal proportions. The calm and clean winter weather makes this coast one of the most attractive holiday resorts in South Africa.

## **14. ECOLOGICAL FEATURES**

### *Swamp forest*

A characteristic feature of the swamp forest is the predominance of ferns as a ground cover, and conspicuous climbers such as *Stenoclaena ternifolia*.

### *Marshes, sedge and aquatic communities*

Amongst the marshes and sedges which surround the estuary or are marginal elements of the flora, *Phragmites australis*, *Cladium* sp and the fern *Achrostichum aureum* are dominant. Various semi-emergent plants, especially water-lilies (*Nymphaea* spp) are common along the edges of the system.

### *Mangal communities*

#### a) Mangrove association

The mangrove community of the Kosi system comprises five different species, two of which (*Ceriops tagal* and *Lumnitzera racemosa*) are at the southernmost limit of their distribution, which means that Kosi is the only place in SA where they grow. The Kosi mangrove community is stunted and unimpressive, largely as a result of the unsuitable substrate. It occupies some 32 ha.

#### b) *Barringtonia/Hibiscus* association

This association is of equal, if not more importance to the Kosi system and is very common on the water's edge and often interspersed among the mangroves. These trees fulfill much the same ecological role as the five species of mangroves, in terms of bank stabilisation, provision of habitat and the contribution of detritus. Near to the estuary, and growing under saline conditions, is the rare tropical shrub, *Caesalpinia bonduc*.

#### *Coastal dune forests*

Dominant species include *Euclea* spp, *Strelitzia* spp and *Mimusops* spp and, in places, the cycad *Encephalartos ferox* occurs. One of the major problems in the Kosi system area was the destruction of the coastal dune forest communities alongside the system, particularly on the eastern side of the estuary. This situation arose as a result of the "slash-and-burn" method of cultivation which is practised by the local peasant community. Since the proclamation in 1982 the severity of the destruction has decreased markedly.

#### *Grassland/Open woodland/Palm communities*

The undulating grasslands on the west of the Kosi system are made up principally of *Urelytrum* sp, among which are palm patches of *Phoenix reclinata* (date palm). Woodland vegetation predominantly comprises the umdoni (*Syzygium cordatum*), *Trichilia* sp, *Albizia* sp and *Dialium* sp.

#### *Algae*

The most common planktonic alga in the Kosi system is *Microcystis* sp, which is particularly noticeable in the uKhalwe inlet.

## **15. LAND TENURE**

The site is a Nature Reserve administered by the KwaZulu Department of Nature Conservation. The surrounding area is rural KwaZulu and consists of communally owned land falling under the Tembe Community (Tribal) Authority.

### *15.1 Legal status*

The area was proclaimed as a nature reserve in 1987.

## **16. CONSERVATION MEASURES TAKEN**

### *16.1 Management plans*

Current management practices are to allow sustainable yield utilisation of the natural resources. The area is managed by the KwaZulu Department of Nature Conservation and attempts are being made to refine management in the light of better data on the resources themselves.

A fairly large, well trained and armed, team of uniformed officers patrols the area to control illegal forest destruction, hunting and fishing.

Labour intensive schemes for the control of noxious weeds such as *Pereskia aculeata* are being carried out both to control the problem and to provide more employment to the local people.

Sustainable tourism is slowly being developed within the reserve with the active involvement of the surrounding rural communities.

A management plan is in its final draft and will be submitted as soon as it is available. Special aspects include the guaranteeing of traditional resource use and access to the area, promoting sustainable use of the available natural resources and the protection of fundamental ecological processes.

General management has succeeded in curbing the destruction of vegetation and controlling tourist developments. Many "unwise" aspects of resource use have been reduced while others have been monitored and in some cases promoted. Most resource use in the northern areas is monitored and results are beginning to suggest that overall resource use has increased since proclamation.

Management category

Category IV - Nature Reserve

## **17. CONSERVATION MEASURES PROPOSED**

The Kosi estuary has been rated foremost amongst Natal/KwaZulu's estuaries in terms of its conservation potential. It should thus be regarded as a system that should, without doubt, be very

carefully managed and developed. It is one of the last Natal/KwaZulu estuaries with a fairly silt free nature as the catchment of many others has been degraded.

Research needs: The most pressing area of research is related to the physical management of the system. Hydrological studies should enable workers to construct a physical model of the Kosi system. This should enable an assessment to be made of the effect that fish traps are having on sanding up in the tidal basin, whether disused fences should be removed and whether the channel between the traps should be made broader or narrower.

## **18. CURRENT LAND USE**

Current management practices are to allow sustainable yield utilisation of the natural resources. The area is now managed by the KwaZulu Department of Nature Conservation and attempts are being made to refine management in the light of better data on the resources themselves.

Efforts are being made to increase the tourist utilisation of the area in order to give more benefit to the local people. 25 % of the gross revenue of the reserve goes to the local community through the Community ( Tribal) Authority.

Labour intensive schemes for the control of noxious weeds such as *Pereskia aculeata* are being carried out both to control the problem and to provide more employment to the local people.

Subsistence agriculture - primarily of maize, millet and ground nuts in the dry areas and bananas, sugar cane and a crop called "madumbies" in the vleis and swamps. More and more the density of kraals is such that they (the homesteads) occupy much of the area, principally around the town of KwaNgwanase.

### *18.1 Resource utilization*

#### Consumptive utilization

Resources used include fish, crabs, shrimps, reeds, sedges, poles, branches, wild fruits, honey, palm wine, grazing, water and firewood.

The resources are utilized by both residents and recreational visitors.

The value of the resources harvested in 1994 was estimated at R 754 293.00 and this included, amongst others about 100 000 kg of fish. Resource utilization is controlled by a complex system including reserve regulations, permits local agreements and department policy.

#### Non-consumptive utilization

Factsheets on resource utilisation during 1994 in the Koasi Bay Nature Reserve (See Appendix 1).

## **19. DISTURBANCES AND THREATS INCLUDING CHANGES IN LAND USE AND MAJOR DEVELOPMENT PROJECTS**

### Slash-and-burn

Swamp forest destruction by the "slash-and-burn" method of cultivation which is practised by the local people.

This technique appears to be not only wasteful and destructive, but also unrewarding, because the sandy soils which the locals cultivate are unproductive. In places the destruction of the natural forests has come down to the water's edge, and on steep slopes this is leading to serious erosion. The cultivation of the swamps for crops like bananas often leads to the canalization and drying out of the swamps. This leads to the oxidisation of the peaty soils and the loss of the organic material. This not only renders the soil infertile it destroys its ability to hold water and stops the peat making process.

### Afforestation

Large areas of the catchment, outside the reserve, are being put under Eucalyptus plantations. Many of the wetland areas are threatened by this and thus the freshwater supply to the lakes system. Sustained decrease in the freshwater inflow could result in a progressive rise in salinity in the lakes and a concomitant change in the ecological processes there.

### Chemicals

The increasing use of fertilisers and chemicals in the catchment.

Eutrophication has not yet had a known serious impact as the local people use little fertiliser. Large areas of the catchment are under cultivation, however, and there are several schemes to encourage the local people to increase the use of fertilisers. Domestic sewerage has not been a problem but with

increasing human habitation in the catchment and several domestic water supply schemes this may soon change.

#### Population pressure

Increasing (human) population pressure.

This has the result of an ever increasing demand for new land for cultivation and house building.

#### Other

The scheme to make Kosi Bay into a harbour such as was done at Richards Bay.

The in-filling by sediment of the lakes of the system, due to swamp forest destruction and road and other development.

The changing (permanent) of the current salinity regime by changes to the profiles of the channels connecting the lakes and the ocean through boat traffic.

The encroachment of Phragmites reeds around the lakes and channels.

Noxious weeds - the principal one being *Pereskia aculeata* which grows and fruits well in the area.

#### DDT pollution

Gradual sanding up of the tidal basin. The fish traps used by the local community have often been perceived as contributing to the sanding-up of the tidal basin.

Bank erosion caused by the bow-waves from boats passing through the Mtando channel.

In the 19<sup>th</sup> century and again in 1981 plans were discussed to make Kosi Bay into a harbour such as was done at Richards Bay. This would have then given Swaziland better access to the ocean. These plans appear to have been shelved.

The dunes of the area are relatively rich in Titanium and other heavy metals and the mining of the dunes to retrieve these is always a possibility although there are currently no known plans.

#### 19.1 Present threats

In the 19<sup>th</sup> century and again in 1981 plans were discussed to make Kosi Bay into a harbour such as was done at Richards Bay. This would have then given Swaziland better access to the ocean. These plans appear to have been shelved.

The dunes of the area are relatively rich in Titanium and other heavy metals and the mining of the dunes to retrieve these is always a possibility although there are currently no known plans.

## 20. HYDROLOGICAL AND BIOPHYSICAL VALUES

## 21. SOCIAL AND CULTURAL VALUES

Zulu fishermen have used (and continue to use) the system since time immemorial. The lakes are extensively exploited by the local community for their fish resources mainly through a system of fish traps. Traditional spear fishing is also practised by the local community and they are also making increasing use of rod and line. Considerable numbers of recreational fishermen use the lakes. A legal gillnetting scheme was begun in 1992 and this allows the local community to use nets to catch fish in Nhlange lake on a controlled basis. Permits issued by the KDNC are distributed through committees of fishermen set up in neighbouring communities and this is an example of communities assisting the conservation authorities in the management of a resource within a reserve.

Some fruits of indigenous vegetation (such as the waterberry *Syzigium cordatum*) are collected and consumed by the local inhabitants. Alcoholic drinks are prepared from various "drinking crops", for example sugar cane and the date palm *Phoenix reclinata*. Raphia palm leaves are widely used, mainly in the construction of rafts, and in the building of houses.

The lakes and ocean are often used by local communities for religious and cultural activities.

Firewood is collected extensively from within the reserve for use outside.

## 22. NOTEWORTHY FAUNA

### a) Zooplankton

Marine forms of zooplankton occur in the tidal basin and these forms extend into Lake Mpungwini at salinities of 12 to 21 ppt. The zooplankton density is highest on the eastern shores of Lake Makhawulani, where the residence time of the water is thought to be maximal. The zooplankton is made up principally of the copepod *Pseudodiaptomus hessei*. Although over 50 taxa are present,

settled volumes are less than 1,0 ml/50 m haul throughout the system. This sparseness of zooplankton is to be expected in a nutrient poor system such as Kosi.

*b) Benthic fauna*

The mollusc *Musculus virgiliae* (a lamellibranch) is present in vast numbers. The benthic population is diverse (30 taxa) and numerically rich, but not in the anoxic bottom of Lake Mpungwini and Makhawulani. *Callianassa kraussi* is confined in distribution to Lake Mpungwini and Makhawulani and the southern section of the tidal basin. It is considered to be the major infaunal organism of the system, in spite of its confined distribution.

*c) Epifauna/Fauna from marginal vegetation*

The marginal vegetation in the Mthando channel and in the margins of Lake Nhlangwe supports several species of animals. Common species include *Musculus virgiliae*, detritus-feeding crustaceans (amphipods, isopods, tanaids) and the crab *Rhynchoplax bovis*.

*d) Prawns*

The Kosi system is well known for its paucity of penaeid prawns due to the silt-free and nutrient deficient condition of the Kosi lakes substrates and waters.

*e) Insect life*

A wide variety of insects inhabit the Kosi system, some of which are important elements of the benthos (eg *Clinotanypus* sp, *Chironomus* sp). Others, such as the weaver or tailor ant (*Oecophyllum smaragdina*) are common in the mangroves.

A particular species of butterfly, a skipper *Parnara micans*, is regarded as endemic to Kosi (Campbell 1969). *Charaxes protoclea azota* is a red data butterfly species. It is a marginal species which occurs only in Kosi Bay in South Africa and is distributed from South Africa to East Africa.

*f) Fish*

At Kosi the different physical characteristics of the lakes, the proximity of the estuary to the Agulhas current, tropical water temperatures and the absence of local silt-laden river systems result in a very diverse fish fauna. Kosi differs markedly from St Lucia in being a clear water system and a variety of marine piscivores (game fish), such as *Caranx ignobilis*, *C. sexfasciatus* (kingfishes), *Sphyrna jello* (barracuda) and *Scomberoides lysan* (queen fish) penetrate as far as Lake Nhlangwe. They feed mainly on the various grey mullet species, Gerreidae and *Rhabdosargus* spp. The clear water and sandy substrates of the shallower areas provide suitable conditions for at least five species of Gerreidae (pursemouths) and this family probably forms an important link in the food web at Kosi since they are abundant.

The Kosi estuary is important in facilitating the change-over in diet of juvenile grey mullet (Mugilidae). The absence of relatively high plankton densities at Kosi is in contrast to the situation at St Lucia and thus the pelagic food chains involving zooplankton-feeding fish, which are so important at St Lucia, are more or less absent at Kosi. Kosi also differs from most other southern African estuaries in having a rocky reef inside the mouth. Eighty percent of the species recorded in Kosi are found only on this reef. They represent an extension of a typical tropical Indo-Pacific reef fauna into the relatively quiet waters of an estuary and consist of, for example, surgeonfishes (Acanthuridae), damselfishes, butterflyfishes (Scorpaenidae) and wrasses (Labridae).

Freshwater species include:

*Barbus paludinosus*, *B. viviparus*, *Clarias gariepinus*, *Aplocheilichthys johnstonii*, *A. katangae*, *Pseudocrenilabrus philander*, *Sarotherodon mossambicus*, *Tilapia rendalli swierstrae*, *T. sparmanii*, *Kuhlia rupestris*, *Glossogobius giuris*, *Eleotris fusca*, *Eleotris melanosoma*, *Hypseleotris dayi*.

*g) Mammals*

The dominant mammal of the Kosi system is the hippopotamus (*Hippopotamus amphibius*) with a current population of around 60. Of the remaining 25 mammal species listed for the Kosi system, only the water mongoose (*Atilax paludinosus*), and clawless otter (*Aonyx capensis*) are estuary associated.

*h) Birds*

The prolific bird life of the Kosi system is essentially forest associated. From the list of 247 species for the system, only approximately 85 are water or estuary associated. Amongst the water/estuary

associated species some are rare, notably Flufftail (*Sarothrura* spp), Whitebacked Night Heron (*Gorsachius leuconotus*) and the Crab Plover (*Dromas ardeola*). Several bird species at Kosi are also at the most southerly limits of their distribution and are not encountered elsewhere in SA. Although the avifauna is diverse, largely as a result of the undisturbed condition of the marginal vegetation along the water's edge, no single species is outstanding in terms of its abundance. This is possibly another result of a diverse habitat but one in which the overall nutrient status is low.

### 23. NOTEWORTHY FLORA

A variety of plant communities exist with numerous rare species.

1) Coastal dune vegetation on the eastern margin of the system comprising plants, dune scrub and dune forest. Common species listed in Tinley's work (1976).

2) Mangroves - 5 species found in the system, namely *Rhizophora mucronata*, *Bruguiera gymnorrhiza*, *Avicennia marina*, *Lumnitzera racemosa* and *Ceriops tagal*, the only area in South Africa with 5 species of mangrove and the only place where *L. racemosa* and *C. tagal* are found in South Africa.

3) Aquatic vegetation includes submerged macrophytes (eg. *Ceratophyllum demersum* and *Potamogeton pectinatus*), semi-emergent plants such as *Nymphaea* spp. and *Polygonum* spp. and free-floating aquatics such as *Lemna* spp.

Hygrophilous grasslands and sedges are common in much of the lower-lying partially/periodically inundated areas; swamps and marshes occur where water is more permanent, with papyrus swamps being distinctive.

Extensive swamp forests occur in the area, this being the largest swamp forests in the country; due to the rarity of this forest type, this adds importance to the Kosi system. Common species include *Syzygium cordatum*, *Ficus trichopoda*, *Voacanga thouarsii* and *Rauvolfia caffra* as large trees, with *Rapanea melanophleas*, *Myrica serrata* and *Halleria lucida* as sub-canopy.

NOTE: A distinctive species is *Raphia australis* (a giant palm), Kosi being it's only natural habitat in the country and upon which the Palmnut vulture (a Red Data species) is dependant.

4) Dryland plant communities consist of open (secondary) grasslands, open and closed woodlands (recognized by *Syzygium cordatum*, *Sclerocarya birrea*, *Albizia adianthifolia*, *Trichilia emetica*, *Terminalia sericea* and *Apodytes dimidiata*) and coastal forest paths. Within the coastal forest patches, common species include *Dialium schlechteri*, *Mymenocardia ulmoides*, *Pteleopsis myrtifolia*, *Ficus* spp, *Strychnos* spp, *Mimusops caffra* and *Euphorbia* spp, *Drypetes natalensis*, and *Zanthoxylum capense*.

Red Data plant species in the system include: (after Hall, et al al 1980)

Vulnerable - *Diospyros rotundifolia*, *Encephalartos ferox*, *Lumnitzera racemosa*, *Raphia australis*,  
Rare - *Ancylanthus monteiroi*, *Bridelia cathartica cathartica*, *Ceriops tagal*, *Cordyla africana*, *Craibia zimmermannii*, *Dialium schlechteri*, *Entada pursaetha*, *Dracaena usambavensis*, *Morus mesozygia*, *Nymphaea lotus*, *Pseudobersama mossambicensis*, *Sophora inhambanensis*, *Suregada zanzibariensis*, *Tapura fischeri*,  
Uncertain - *Ficus tremula*

In addition to these, other notable plant species include *Tiliacora funifera*, *Scaevola sericea*, *Caesalpinia bonduc*, *Psilotum nudum*, *Mucuna gigantea*, *Inhambanella henriquesii*, *Platylepis glandulosa* and *Cheirostylis gymnochiloides*.

### 24. SCIENTIFIC RESEARCH AND FACILITIES

24.1 Projects in progress

24.2 Projects just completed

### 24.3 *New findings*

### 24.4 *Proposed projects*

## **25. CURRENT CONSERVATION EDUCATION**

The area has very great potential for conservation education. It affords the opportunity for people to observe both the relatively pristine and utilised "mini- ecosystems" in the system. Access to the area is now good and accommodation is available. The local people are generally friendly and co-operative and when approached properly will happily explain how they utilise the resources of the area. There are many examples of the wise use of natural resources by the local people and recreational visitors.

## **26. RECREATION AND TOURISM**

The area has special recreation potential and offers the possibility of walks through virtually undisturbed Coastal Dune forest and Swamp forest as well as open grassland and around the lakes. Fishing for optic-feeding game fish (marine) is probably the best in South Africa (except in the open ocean) as the system has a low turbidity. Main target species of sport anglers are the Kingfish (*Caranx spp*) Seapike (*Spyraena sp*) and Rock Salmon (*Lutianus argentimaculatus*).

There is also the opportunity to observe the local people involved in their artisanal fishery using the traditional fish traps and spears.

The atmosphere of the area is generally tranquil and the weather is conducive to pleasant camping throughout the year. The winters are generally dry and not too cold.

Bird watching in the bush and lakes is most rewarding although the species diversity is low relative to Ndumu Game Reserve.

## **27. MANAGEMENT AUTHORITY**

KwaZulu Department of Nature Conservation.

## **28. JURISDICTION**

KwaZulu Nature Conservation Act

Magisterial District: Ingwavuma

Divisional Council: KwaZulu Legislative Assembly

## **29. REFERENCES**

- BRUTON, M.N. & K.H. COOPER 1980. Studies on the Ecology of Maputaland. Grahamstown, Rhodes University.
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Internal reports for the KwaZulu Bureau of Natural Resources are also available from the Department of Economic Affairs if specific subjects are requested.

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### **30. REASONS FOR INCLUSION**

#### 1. Criteria for representative or unique wetlands

Kosi is undoubtedly the best "preserved" large estuary system in Natal. It is little degraded and supports a great diversity of fish and other aquatic fauna. The water is clear and deep relative to other Natal systems. It is still a "natural" system in that, unlike St Lucia, man has not yet significantly managed the system to what he sees as its best condition.

#### 2. General criteria based on plants or animals

There are many rare and threatened animals and plants in the area. There are 8 known "Red Data" fish of which most have their largest known populations in the Kosi System. Crocodiles breed there in small numbers and there are also several pairs of Palmnut Vultures. For details of species list and species of importance please refer to the relevant chapter of "Studies on Ecology of Maputland" by Bruton and Cooper (See page 20).

Kosi is a large, but relatively isolated, estuarine system. It is well over 100 km north or south to any other major estuarine system and this means that there is little transfer of truly estuarine animals between systems. If, on the other hand, Kosi ceased to function then it would be extremely difficult for estuarine species to move from north to south of Kosi. Kosi probably provides the only recruitment for several species of marine "spat" found along Natal coast (Bruton, 1980).

A distinctive plant species is *Raphia australis* (a giant palm), Kosi being its only natural habitat in the country and upon which the Palmnut vulture (*Gypohierax angolensis*), a Red Data species, is dependant for nesting and food.

#### *30.1 Conservation importance*

Kosi is undoubtedly the best "preserved" large estuary system in Natal/KwaZulu. It is little degraded and supports a great diversity of fish and other aquatic fauna. The water is clear and deep relative to other systems in the province. It is still a "natural" system in that unlike St Lucia man has not yet significantly managed the system to what he sees as its best condition.

There are many rare and threatened animals and plants in the area. there are 8 known "Red Data" fish of which most have their largest known population in the Kosi System. Crocodiles *Crocodylus niloticus* breed there in small numbers and there are also several pairs of Palmnut Vultures *Gypohierax angolensis*.

A variety of plant communities exist with numerous rare species. These communities are:

##### a) Coastal dune vegetation

b) Mangroves - The Kosi system is the only area in South Africa with 5 species of mangrove and the only place where *Lumnitzera racemosa* and *Ceriops tagal* are found in South Africa.

c) Aquatic vegetation - Extensive swamp forests occur in the area, this being the largest swamp forests in the country. A distinctive species is *Raphia australis* (a giant palm), Kosi being its only natural habitat in the country and upon which the Palmnut Vulture (a Red Data species) is dependant.

d) Dryland communities - various Red Data species are found in this community.

Kosi is a large, but relatively isolated, estuarine system. It is well over 100 km north and south before there is any other major estuarine system and this means that there is little transfer of truly estuarine animals between systems. If, on the other hand, Kosi ceased to function then it would be extremely difficult for estuarine species to move from north to south of Kosi. Kosi probably provides the only recruitment for several species of marine "spat" found along Natal coast.

### **31. OUTLINE MAP OF SITE**

## APPENDIX I

### FACTSHEET ON RESOURCE UTILISATION DURING 1994 IN THE KOSI BAY NATURE RESERVE

ROBERT KYLE

#### 1. INTRODUCTION

Resource monitoring is rarely an exact science in that, although numbers are used, absolute accuracy is not possible. Overall accuracy depend on the proportion of the off take monitored, supervision of staff, accuracy of recording and other factors which can often change at short notice. Estimates are, however, essential if an area and its resources are to be managed on a sustainable basis. To a degree as long as the monitoring method remains comparable from year to year then the values produced, although not absolute, can give an essential insight into the levels and trends of utilisation. It is often the trends and not actual values which are of importance.

In this report similar methods have been used from year to year and every effort has been make, within the financial constraints, to obtain the best information possible.

Data for 1987 are given as this was the first year of accurate total monitoring and also the last year before proclamation in the light of those collected prior to it. The impact of proclamation on the levels and types of utilisation can thus be described.

#### 2. METHODS:

In most cases a known proportion of each off take is monitored accurately and extrapolated to an estimate of the whole. Routine counts are also made, on a random basis, of the total numbers of people using resources in the north of the system and these are used to generate the "numbers of people counted daily".

Cash values are worked out as if all the material collected was sold locally. This is to some extent artificial as in artistic usage only a proportion is sold. The figures do, however, indicate the cash value of the resources.

For some reason there is a degree of resistance to almost any monitoring scheme. This factor distorts data, but nearly always results in underestimates. The data collection at Kosi focused on the northern areas of the system, due to financial realities, and this has also led to an underestimation of data. For these and other reasons the data supplied here must be viewed as conservative estimates.

#### 3. RESULTS:

Table 1. Mean numbers of people counted daily carrying out resources harvesting in the northern area. [See attached map.]

	1987	1990	1991	1992	1993	1994
Small crabs	17.5	17.52	19.88	19.91	9.82	6.10
Incema sedge	7.3	20.73	24.04	27.58	17.81	10.83
Reeds	4.0	4.08	5.12	8.25	4.27	3.69
Small fish	##	##	2.03	1.90	0.37	0.86
All women	28.8	42.33	51.07	57.64	32.27	21.48
Bait collection	5.0	8.71	7.15	9.75	10.16	6.49
Spearing	5.0	4.58	6.58	4.0	3.53	2.95
Fishing, small fish	9.25	50.17	44.96	32.92	32.67	19.80
Fishing, large fish						2.46
Spear/goggles	2.0	0	1.0	1.0	0.3	0.1
Jigging	2.0	0	0	0.5	0.1	0.1
All boys	23.25	63.73	59.69	48.17	46.76	31.90
Fishtraps	30	30	30	30	30	30
Legal netting					10	25
Total	82.05	136.06	140.76	135.81	119.03	108.38

Table 1a Mean numbers of people harvesting resources daily around NE Nhlange.  
(Not counted prior to 1993)

	1993	1994
Reeds	13.6	8.7
Sedges	6.4	8.7
Thatch	2.2	0
Fishing	0	0.9
Total	22.2	11.7

Table 2. Estimated numbers of fish caught legally in the Kosi bay Nature Reserve.

	1987	1990	1991	1992	1993	1994
Fishtraps	25 516	56 600	30 928	38 031	51 416	34 160
R&L Local (small)	68 613	247 213	266 350	322 140	271 757	142 083
R&L Local (big F.)	**	**	**	**	1 137	1 652
Rod & line Rec.	14 733	12 933	11 453	9 597	8 988	6 087
Spearfishing	3 620	4 425	12 681	8 367	6 332	4 608
Basket fish	##	##	723 046	616 519	120 058	279 054
Legal netting	0	0	0	4 797	10 559	27 925

Table 3. Estimated numbers of fish caught illegally in the Kosi Bay Nature Reserve.

Goggle & Spear	29 802	5 000	10 000	10 000	8 000	4 000
Jigging	16 614	3 000	2 000	2 000	2 000	500
Gill-netting ***	20 000	20 000	20 000	20 000	15 000	25 000

Table 4. Comparison of numbers of large fish and mass of all fish caught legally and illegally in the Kosi Bay Nature Reserve.

	1987	1990	1991	1992	1993	1994
Number legally	43 869	73 958	55 062	60 792	78 432	74 561
Number illegally***	66 416	28 000	32 000	32 000	25 000	24 500
Mass legally	57 388	77 934	71 306	76 390	86 355	60 541
Mass illegally***	31 689	14 000	16 000	16 000	12 500	12 250

\*\*\* These estimates are rough as nighttime monitoring of illegal activities is difficult.

Table 5. Numbers of invertebrates harvested in the Kosi Bay Nature Reserve.

Crabs by numbers	567 757	568 406	646 457	855 483	393 770	299 878
Crabs by mass (Kg)	11 356	11 369	12 929	17 110	7 875	5 997
Bait shrimp numbers	100 122	174 413	152 638	237 863	209 401	163 050
Bait shrimp mass	276	481	421	656	578	450

Other utilisation of renewable natural resources within the Kosi Bay Nature Reserve include;

1. "Muthi" collection by Inyangas.
2. Firewood collection.
3. Palm wine tapping.
4. House and trap building materials.
5. Honey from wild bee hives.
6. Grazing by several hundred cattle and goats.
7. Wild fruit collection.

8. The collection of whelks inside Kosi mouth.
9. The capture of small shoaling fish by hand and small net in the shallows.
10. Wild banana leaves (Ugede) for binding.
11. Dyes (roots and bark).
12. Raphia palm fronds for building.
13. Water for domestic animals and human needs.
- 14 Poles for building.
15. Prawn collection by children in Makawulani and Mpugwini.

Many of the above are harvested daily from within the reserve and then the materials are taken out through gates in the fence. More than twenty of these gates are unmanned and so accurate figures are not possible. During 1994 attempts were made to obtain data by sampling at some of these gates and then the results were extrapolated. Although absolute accuracy is not possible the results give an indication of the order of magnitude of the off takes in the areas monitored. These data are given in table 6.

Table 6. Estimates of the amount of resource utilisation through unmanned gates in the west of the reserve. [See attached map.] Units are the number of individual exits in 1994 associated with each activity.

Resource	Units
Firewood	13 744
Poles	528
Raphia palms	84
Wild bananas	50*
Commercial herbs	100*
Thatch	200*
Wild fruits	168
Dyes	24
"Muthis"	12
Honey	66
Palm wine	200*
Grazing	200 cattle, 200 goats*
Water for livestock	500 cattle, 300 goats*
Total	15 176 people exist in 1994

It must be stressed that the above are extrapolated estimates from sub sampling. They are thus underestimates of limited accuracy. The use is to give an indication of the relative importance of each use and as base line data for future as monitoring improves.

#### 4. FINANCIAL ESTIMATES:

Many of the resources harvested are sold locally or in KwaNgwanase while some harvesters are paid a daily rate to harvest resources. Clearly there is a financial aspect to each resource and available data on these are summarised in table 7 below.

Table 7. Estimates of the total cash value of resources harvested within the Kosi Bay Nature Reserve.

Resource	Est. of 1993 value	Est. of 1994 value
Fishtrap catches	308 496	222 040
Rod/line, big fish.	***	15 570
Rod/line, small fish	43 840	28 417
Speared fish	15 570	13 298
Legal gillnet catches	28 824	89 130
Small basket fish	10 005	15 200
Small crabs	49 221	37 485
Bait collection	12 775	14 213
Incema sedges	70 693	54 778

Building reeds	52 180	191 214
Firewood		72 948
Other resources	***	No useful estimate.
Total	R591 606	R754 293

## 5. BRIEF DISCUSSION:

It is clear from the data above that large amounts of a variety of renewable natural resources were harvested from the Kosi Bay Nature Reserve during 1994. The cash value is considerably up on that for 1993 but this is principally due to more comprehensive monitoring, and inflation, rather than a real increase in utilisation.

Many varied factors affect rates of utilisation and several of these act against each other. The overall slight decrease in the numbers of people using the northern areas daily is misleading as the principal factors affecting utilisation in 1993 worked in opposite ways. The recent and continuing drought depressed the economy both locally and nationally and this resulted in a greater dependency of natural resources. The other major factor was the remigration of thousand of people to Mozambique and this removed many of the resource users as, in the past, Mozambicans were unable to get work officially and often depended on resource harvesting for livelihood.

Firewood utilisation from within the reserve appeared to be at low levels in the past but recently it has become a major export from Maputaland as well as an important cash source. In many areas large trucks take the firewood as far away as Vryheid and the result is that the demand on the firewood resources of the region generally and the conserved areas specifically has increased markedly. The situation is being monitored but a decision needs to be made on the large scale commercial exploitation of firewood and other resources in conserved areas. Many resources such as building reeds, fish and the "muthi" plant *Impephu* are now harvested commercially within the reserve and taken out by vehicle. The cash values of resources given in this document are useful but must be viewed in context. It must be understood that they are against a background of rural poverty. Many of the resources give people with no other way of obtaining money a means of supporting themselves. Anyone in the area can obtain moderate amounts of fuel, building materials, food or money if they are prepared to work for it. The importance of this utilisation to the local people cannot be overstated and must not be seen in financial terms alone.

## 6. SOME INSIGHTS INTO OVERALL AND MONTHLY TRENDS IN FISH CATCHES:

Fishtrap data have been collected since 1981 and it is useful to compare the latest results with some earlier ones. Although there are differences the two most important groups, mullets and grunter, are still the same. Furthermore six of the seven most important species, accounting for over 90 % of the catch, have remained the same each year.

The most important obvious change in the lakes of the system over the last year was the increase of salinity from virtually 0 p.p.t. to over 3 p.p.t. This was caused principally by the drought but may well be exacerbated by the new eucalyptus plantations in the catchment. At present levels this alone has not killed any fish and the most obvious result is an increase in the abundance and size of sunnynose bream. If the trend continues the most important fish food in Nhlange lake, chironomid fly larvae, may well all but disappear from the lake.

The annual flathead mullet run of late summer was very poor in 1994. There was a good run of spotted grunter but the failure of the mullet run alone resulted in the relatively poor overall catches of the traps.

Pouter numbers seem to be at usual levels and this is being closely monitored as they are the primary target species of the legal gillnet project.

## 7. SUMMARY:

The number of "days spent harvesting resources" monitored with the northern areas of the Kosi Bay Nature Reserve increased from 29 948 in 1987 to 59 005 in 1994. The amount of food produced legally went from 57 388 Kg. in 1987 to 70 838 in 1994.

The total value of the resources of harvested legally by local residents was estimated at R754 293 in 1994, and this was collected by an average of 161.66 people daily. This indicates an average value of resources collected monthly by each local harvester at R388.83.

## **8. CONCLUDING REMARKS:**

In the figures gathered over the last two years there are indications that the marked increases in numbers of people harvesting resources within the reserve, evident in the early 1990's, has reversed. The expansion of the legal gillnetting project increased markedly the proportion of fish caught legally as it also eroded the illegal fish catch. The trends evident in the utilisation of resources in the reserve are promising, both in terms of benefitting local residents and becoming more in line with the wise use policy of the Department of Nature Conservation.

Another aspect from the gillnetting project is that the community netters themselves are becoming involved in the management of the fish resources through local Gillnetting Committees.

In terms of R/Hectare of the original Kosi Bay Nature Reserve proclamation the reserve thus yielded over 36.12 R/Ha. to the community during 1994. If the land alone is used the figure is 44.68 R/Ha. This compares favourably with many other possible land use options for the area.

Robert Kyle,  
Resources Research Officer