

Birds: Cyrus et al. (1980) recorded 279 bird species in the area and Bruton (1979) maintains that 62 of these are closely associated with the lake in one or more ways. From 1970 to 1976 the most numerous species were white breasted cormorants and reed cormorants, which consume gobies and small cichlids. Other fish eaters include pied, giant and malachite kingfishers, fish eagles, various large herons, darters and grey headed gulls. African jacanas, black crakes, purple gallinules, moorhens and little bitterns are found in the sheltered bays. Sandy beaches are inhabited by white fronted sand plovers which breed at Lake Sibaya. The commonest waders include black winged stilts, avocets, greenshanks, and the purple, great white and goliath herons (Bruton 1980).

Mammals: Only six mammal species are consistently associated with Lake Sibaya: Ichneumia albicauda (white tailed mongoose), Atilax paludinosus (water mongoose), Hippopotamus amphibius, Redunca arundinum (reedbuck), Otomys irroratus (vlei otomys) and Dasymys incomptus (African marsh rat). In 1973 Bruton estimated that there were 95 hippopotamuses in the area, which probably play an important rôle in the transfer of nutrients from land to water and in the stirring up of sediments by their trampling.

11. Human activities and management

This is largely dealt with in section 8.6. The lake supplies fish to the local inhabitants throughout the year, but most fish are taken in the summer, when large numbers of breeding Oreochromis mossambicus and Clarias gariepinus are speared and netted.

8.9 THE SAINT LUCIA LAKE SYSTEM

by J.S. MEPHAM

The St Lucia System lies on the Maputaland Plain on the north eastern coast of South Africa. It consists of an estuarine lake system which drains via a narrow outlet, 'The Narrows', to the Indian Ocean. The system is subject to extreme climatic variations, and as a result the lake experiences dramatic changes in salinity, in some parts from 0-120‰. This propensity for internal change makes it difficult to derive meaningful generalisations about the system, and even its status oscillates between lake, lagoon and estuary.

1. Geography and morphology

Location: The St Lucia Lake System (Fig.s 8.15 and 8.21) is situated on the Maputaland coastal plain with the Lebombo Mountains lying to the NW and the Indian Ocean to the east, between 27°52'-28°24'S: and 32°21'-32°34'E. This excludes the extensive Mkuzi Swamps, which lie to the north of, and drain into the lake. Although these swamps are an integral part of the St. Lucia System virtually no research has been carried out on them.

Altitude: The system is at sea level with the floor of the lake between 1.0 and 2.5 m below sea level. Water levels in the lake have varied from 0.6 m below sea level to 1.06 m asl (1951-1956), and in 1984, after Cyclone Demoina, rose to 3 m asl

Area: This varies with the seasons; in a wet year the system may expand to 417 km², but in a dry year it may be reduced to as little as 225 km². The average size is approximately 350 km².

Landscapes: The St Lucia System is situated on the coastal plain as described in section 8.6.

Morphometry: The system describes an H-shape, with the long axis lying parallel to the coast in a N-S direction.

Axial Length: 61-66 km, comprising a 21 km long channel, The Narrows, and a 40-45 km long lake to the north of it. The length of the shoreline varies between 300 and 400 km reflecting seasonal variations in the size of the lake.

Maximum Width: This is 22 km, but the average width of the lakes is 3-8 km, and The Narrows varies between 100 and 400 m across. The mouth of the estuary is generally less than 100 m wide.

Volume: Estimates vary between 295 and 322 x 10⁶ m³ (Hutchison 1976; Blok 1976)

Mean Depth: Less than one metre in the lake but up to 3 m in The Narrows, during normal conditions. However after Cyclone Demoina, in 1984, the level at the mouth rose to 16 m.

Tidal Range: Tidal influence occurs only within The Narrows, and true tidal mixing is found only south of the bridge, close to the mouth. One kilometre from the sea a tidal range of 1.5 m may be experienced at spring tide.

Habitats: A variety of habitats are found in the St Lucia System including islands, mudflats, aquatic vegetation, reed swamps, open grasslands, fresh water swamp forest, tidal swamp forest, coastal dunes, riverine communities, freshwater pans and beaches.

2. Geology

The St Lucia System is situated on the Maputaland coastal plain. For a fuller account of this region see section 8.6. The western side of the lake comprises a Pleistocene barrier dune complex while to the east the land is at first marshy but is finally separated from the sea by sand dunes which reach 188 m asl. The entire system, excluding False Bay in the west, is underlain by sand and gravel, while False Bay and the two peninsulas (see Fig. 8.21) are composed of Cretaceous sandstones, shales and limestones. Bedrock depths range from 8 m in Catalina Bay to 32 m in Hell's Gates (Van Heerden 1976).

Substrates: Soft muds extend to depths of 10-30 m below the floor of the system and it has been estimated that there are 3 115 x

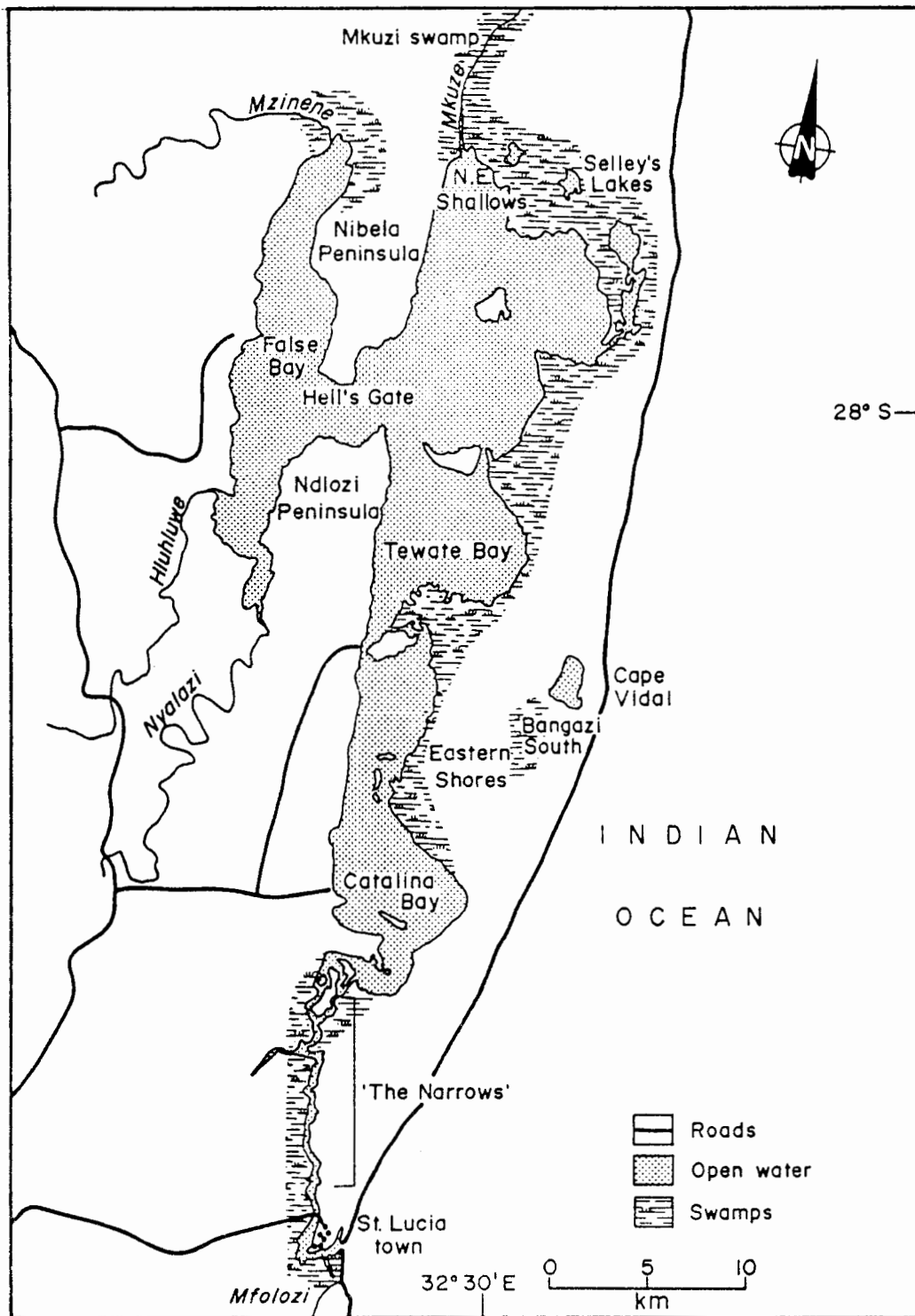


Fig. 8.21 Map of the St Lucia Lake System

10^6 m^3 of mud. Most reports attribute these sediments to fluvial origin but Cholnoky (1968) maintains that they are of marine origin. Probably some proportion of them has been derived from marine sedimentation when patterns of tidal activity were different in the past, but the bulk would appear to be river borne.

The Sandbar: Since the sixteenth century the mouth of the estuary has become closed periodically by the formation of sandbars. Sandspits develop in a N-S direction, and closure of the mouth may occur as a result of strong drifting at times when discharge from the lake is minimal, or occasionally as a consequence of cyclonic storms. The estuary was last closed in 1956 after artificial drainage of the Mfolozi swamps to the south, caused massive incursions of silt to the system. The mouth is now kept open by dredging operations.

Siltation: Current annual silt accumulation has been estimated at $0.98-2.0 \times 10^6 \text{ m}^3$ per year, which is thought to be two to three times greater than the mean rate over the last 5000 years, and to be due to the accelerating rate of erosion in the hinterland. However, it is clearly subject to large scale variations. Cyclonic storms, such as occurred in 1984, may cause the deposition of more silt in a few days than would normally occur in a decade. These violent storms are known to occur several times a century.

3. Climate

There is a seasonal pattern of hot wet summers, from October to April, and warm dry winters, from May to September (see Fig. 8.2 Cape St. Lucia).

Type Code: BSw₅a (Köppen)

Air Temperature:

annual mean	21.3°C
hottest month: February, mean min. and max.	19.2; 30.3°C
coolest month: July, mean min. and max.	10.3; 23.5°C

Wind:

strength	5-25 km.h ⁻¹ , gusting to 166 km.h ⁻¹
seasonality	low in winter, higher in summer
prevailing directions	from NE and SW, parallel to the long axis of the lake.

Rainfall:

annual total	mean	890 mm
range	from mouth to NW	1200-625 mm.y ⁻¹
month of highest	March, mean	131 mm
month of lowest	August, mean	32 mm
year of highest	1925	2057 mm
year of lowest	1926	530 mm
distribution	approximately equivalent on lake and in the drainage basin.	

Evaporation:

estimated mean total from whole catchment $397 \times 10^6 \text{ m}^3 \cdot \text{y}^{-1}$
 estimated mean total from whole lake surface $1\,380 \text{ m}^3 \cdot \text{y}^{-1}$

4. Hydrography and hydrology

The St Lucia System is fed by a number of rivers. The Nyalazi, Hluhluwe, and Mzinene Rivers enter False Bay, and the Mkuze River, which drains the Mkuze Swamps to the north, enters the northern part of the easterly arm. There is an appreciable but seasonal influx of ground water on most shores. The whole system drains south through The Narrows to the Indian Ocean.

Water is lost mainly by evaporation, but some is lost, especially at times of flood, through the estuary to the sea. Reduced fresh water influxes are compensated for by entry of sea water, which averages $70 \times 10^6 \text{ m}^3 \cdot \text{y}^{-1}$. The lake tends to experience alternating periods of very low and very high salinity in response to alternating weather patterns of drought and flood. Changes in water level are less dramatic, and probably less important to the system, than are changes in salinity.

Depending on lake level, sea water has been known to flood into the estuary at a rate of $7 \text{ m}^3 \cdot \text{sec}^{-1}$. Current patterns within the lake have not been established. Seiches of 0.3 to 0.43 metres are experienced, which are caused by wind.

Water Balance for the St Lucia System (estimated averages):

input	$10^6 \text{ m}^3 \cdot \text{y}^{-1}$	output	$10^6 \text{ m}^3 \cdot \text{y}^{-1}$
river inflow	300	net outflow to sea	170
direct rainfall	270	evaporation	400
total input	570	total output	570

In the past, south of St Lucia, the Mfolozi River flowed into the St Lucia estuary, but when the Mfolozi Swamps were drained for sugar cane production, so much sediment was deposited in the estuary that in 1952 a new mouth was created for the Mfolozi River separate from the St. Lucia system. The present policy is to maintain separate mouths, but a 'Link Canal' has been constructed from the Mfolozi River to the First Narrows, so that water may be channelled from the Mfolozi into Lake St Lucia during times of hyper-salinity.

5. Physico-chemical characteristics of the water

	Minimum	Maximum
Temperature: (°C)	17 (June/July)	29 (Dec/Jan)
Transparency: (m)	0.076-0.5 (summer)	0.15-1.37 (winter)
Conductivity: (10 ⁻⁶ S.cm ⁻¹)	1000 (mean)	
Salinity: ‰	0	120
Nitrogen: (10 ⁻⁶ .g l ⁻¹)	54	200
Phosphorus: (10 ⁻⁶ .g l ⁻¹) (as orthophosphate)	9	14

Principal Ions: The following cations are found, in descending order of concentration levels: Na, Mg, Ca, K. The concentration of Cl is higher than both SO₄ and Na.

Salinity: When the mouth is open, the estuary maintains a constant, fairly low salinity due to the effect of the incoming sea water, but a 'wedge' of seawater may penetrate a considerable way up The Narrows. Extreme levels of salinity due to evaporation are experienced in the northern most parts of the lake. Here they may vary from 0-120‰, the highest levels having been recorded at Hell's Gates, Selley's Lakes and the Mkuze mouth, during times of drought. The lakes in the south of the system never become as saline as those in the north and during such times they act as a refuge for living organisms, which are then redistributed when the unfavourable conditions have passed.

6. Macrophytes

Submerged macrophytes: Extensive beds of Potamogeton pectinatus are found in the northern regions of the system. These are replaced by Ruppia spiralis further south and by Zostera capensis nearer the sea. Enteromorpha spp. are the most conspicuous of the filamentous algae. They grow in the shallows when the lake is receding, or epiphytically on the upper surfaces of submerged vegetation.

Floating Macrophytes: Eichhornia sp. has been reported (Begg 1978), but it is not considered important or out of control.

Emergent macrophytes: Much of the lake shoreline is bordered by beds of the reed Phragmites australis, with the greatest area occurring in the Mkuzi Swamp, which unfortunately has not been well studied. These swamps trap silt and floating debris thereby adding large quantities of decaying organic matter to the system and providing spongy, fresh water reserves. They flourish best during periods of low salinity and regress during periods of high salinity. The Mkuzi Swamps are protected by a natural bar which prevents the incursion of saline water. Elsewhere in low-lying badly drained areas, there are marshes dominated by various sedges, principally Scirpus spp., together with Juncus maritimus, and grasses such as Sporobolus virginicus and Paspalum sp.

Swamp forests: Mixed fresh water associations comprising Barringtonia racemosa, Ficus tricopoda, Garcinia livingstonei,

Phoenix reclinata, Syzygium cordatum, Syzygium guineense and Voacanga thouarsii are found on the Eastern Shores of the lake. In The Narrows, where hypersalinity is not experienced, there is a small area of tidal forest dominated by young Avicennia marina with a few trees of Bruguiera gymnorrhiza. Dredging operations, and in particular the dumping of dredge spill at the waterside, have greatly reduced the area covered by mangroves in recent years.

7. Phytoplankton

Most of the phytoplankton volume comprises autochthonous species of marine origin. There is a decrease in variety towards the most changeable northern areas (Johnson 1976). At times of concurrent high salinity, high temperatures and calm weather, outbreaks of 'red water' caused by the alga Noctiluca scintillans have occurred.

8. Invertebrates

129 species of invertebrates have been recorded from the St. Lucia System (Day 1954; and Millard 1954).

Zooplankton: Grindley (1976) has demonstrated that the majority of zooplankton found are typically estuarine species, many of which have a high salinity tolerance although few can survive above 80‰. Those showing high salinity tolerance include Pseudodiaptomus charteri, Acartia natalensis, Halicyclops sp., Mesopodopsis africana and Grandidierella bonieri.

Benthic fauna: A comprehensive study of benthos is given by Bolt (1975) and Blaber *et al.* (1983). The most abundant benthic species is a small gastropod Assimineia sp., which is eaten by a variety of animals. Most benthic organisms in the system can tolerate salinities of up to 55‰ and when this has been exceeded recolonisation is effected by planktonic larvae brought into the lake by wind induced water movements.

Insects: There has been little work on the insects of this area, but chironomids are common, and these provide an important food item for fish, young crocodiles and birds.

Prawns: The St Lucia System is important as a nursery for penaeid prawns and according to Champion (1976) is the largest reserve in the Republic of South Africa. The dominant species is Penaeus indicus, although during periods of low salinity Forbes (in a personal communication to Begg 1978) found that Macrobrachium equidens became dominant. The prawns are eaten by fish such as kob (Argyrosomus sp.), springer (Elops sp.), and kingfish (Caranx sp.) and they also support a bait fishery.

9. Fish

Eighty-two species of fish have been recorded from the St Lucia System since 1964 (Day 1954; Van der Elst 1976; and Whitfield 1977).

The shallow marginal areas act as nurseries for young larval fish and many adult fish come into the estuary to feed. The most commonly caught species include Pomadasys commersonni (spotted grunter), Argyrosomus hololepidotus (kob), Acanthopagrus berda (perch), Rhabdosargus sarba (stumpnose) and Mugil cephalus (mullet). Various species of shark are common in the vicinity of the mouth of the estuary. Carcharinus leucas (Zambezi shark) and Pristis pectinatus (sawfish) penetrate the whole system. Gravid females of Carcharinus leucas frequently give birth to their young in the system (Bass 1976).

The high salinity phase of the lake in 1970-71 did not appear to affect the biology of the mullet or springer Elops machnata adversely. Tilapia, Oreochromis (= Sarotherodon) mosambicus were found to breed in hypersaline water of 116‰. Many of the fish show wide salinity tolerances. Ten species have upper tolerance limits of 65-70‰, and 32 species have lower tolerance limits of 1-3‰ (Whitfield 1977).

10. Other vertebrates

Reptiles: It has been estimated from an aerial census that St Lucia has a population of approximately 500 crocodiles (Crocodylus niloticus). Crocodile breeding places are protected, and crocodiles show marked movement patterns from summer breeding places to winter basking grounds. Many are found in the Mkuzi swamp.

Birds: There are about 340 species of birds associated with the St Lucia System. Ninety of these predominate on islands, mudflats and in reedswamps. Migrant waders are common in summer, with pelicans and Caspian terns more common in winter. The system is renowned for its pelicans and flamingoes. St Lucia is a recognised breeding ground for about twenty aquatic bird species such as open-billed stork, wood stork and pink backed pelican, and it is the only breeding place in South Africa for the white pelican. During high salinity phases most of the birds migrate away from St. Lucia and cease breeding (Whitfield 1977).

Mammals: Aerial counts of Hippopotamus have shown that the number has increased over the last twenty years to about 600 (Taylor 1976). They are found mainly along the eastern shores where they are said to play an important rôle in carving channels through the swamps, modifying the drainage lines and releasing large quantities of plant detritus into the lake in their faeces. The Eastern Shores are recognised as a game reserve in which antelopes such as reedbeek, nyala, impala and suni are common. Buffaloes and black rhinoceroses have been introduced recently.

11. Human activities and management

This is largely dealt with in section 8.6.

Exploitation: The St. Lucia area has been exploited for tourism under the auspices of the Natal Parks Board, which has designated special areas for recreation, accommodation and conservation.

The St. Lucia Game Reserve occupies an area of 36 826 hectares. It comprises the water area and islands of Lake St. Lucia and a strip of land approximately 0.8 km wide around most of the shoreline. The northeastern sector is set aside as a wilderness area, but the remainder is available for boating and recreational activities. A substantial segment of the lake area has restricted access due to military control and the use of the area for missile testing purposes.

St. Lucia Park, an area of 12 545 hectares, has some camping facilities, but a portion of the park is maintained as a conservation area.

False Bay Park on Lake St. Lucia, has an area of 2 247 hectares which is set aside for recreation, has camping facilities and provides angling, boating and game viewing.

Note on the Mkuzi Swamp

The Mkuzi Swamp is an integral part of the St. Lucia System, but it seems that very little research has been carried out in that area. It is a northern extension of St. Lucia Lake which has become shallow enough to support rooted and floating vegetation including stands of papyrus species. A natural bar at the southern end of the swamp inhibits the intrusion of saline water. There are four stretches of open water in the swamp: Ndlaka, Demezane, Mbazwan and Butterfly. Where the river enters the swamp there is a delta which contains four open lakes: Mpempe, Ntshangwe, Mdlanzi and Tshanetsha, forming an ecosystem hydrologically separated from the main Mkuzi swamp by two dry, narrow and steep sections at the toe of the delta.

A channel was once excavated from the Mkuze River near Mpempe Pan to a point near Demezane Pan in an attempt to introduce more fresh water to Lake St. Lucia. This channel has now closed and no attempts are planned to re-open it as the probable deleterious effect on the Mkuze swamps would seem to outweigh any advantage that might be gained by reducing the salinity of the northern end of Lake St. Lucia (Alexander 1976).

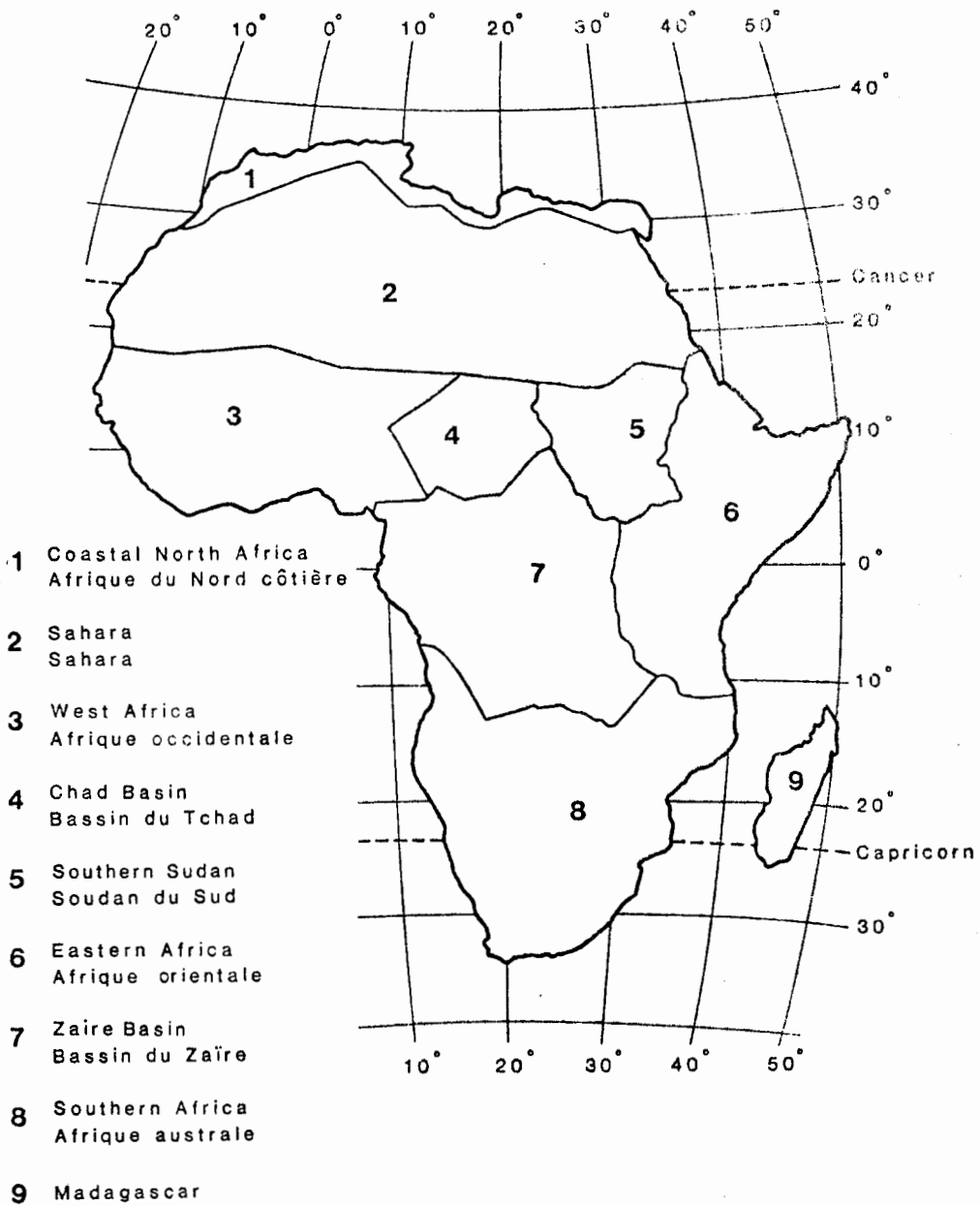
8.10 THE WILDERNESS LAKES

by J.S. MEPHAM

The Wilderness Lakes comprise a number of small estuarine lakes and lagoons located on the southern coast of Cape Province in the Republic of South Africa. They lie parallel to the coast between the Outeniqua Mountains to the north and coastal sand hills to the south. The lakes are fed by a number of rivers, most of which periodically breach the dunes to drain into the Indian Ocean. These old consolidated dunes protect the system from the prevailing southerly on-shore winds.

The systems dealt with here are:

- 8.9.a. The Touw River Floodplain (including Rondevlei, Langvlei, Eilandvlei and the Wilderness Lagoon),
- 8.9.b. Swartvlei,
- 8.9.c. Groenvlei.



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DIRECTORY
REPERTOIRE



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**Zones humides
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d'Afrique**

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