The dominant species included Musculus virgiliae and various detritus feeding crustaceans (amphipods, isopods and tanaids).

8. Fish

Blaber (1978) has listed 133 species of fish present in the Kosi system including 85 marine species found in association with the reef at the mouth, or which penetrate the tidal basin, 39 resident estuarine species which penetrate the system beyond the tidal basin, and 9 fresh water species. The Kosi system is considered as a prime fishing resort and the estuary appears to fulfil an important nursery function, as juvenile fish mature there before migrating back to the sea (Wallace et al. 1971; Heydorn 1972; Heydorn and Wallace 1973).

9. Other vertebrates

Reptiles: Crocodiles are not common in the Kosi System, and are restricted to the fresh water lakes Zilondo and Amanzimnyama. Three species of semi-aquatic snakes have been recorded by Bruton and Haacke (1975).

Birds: Birdlife is prolific in the Kosi area, although more are associated with the surrounding forests than the water. Tinley (1976) has listed 247 different species. No single species is outstanding in terms of its abundance, but several are at their southern most limit in Africa, and a few species are rated 'rare' in South Africa (including crab plovers, fishing owls, flufftails and white backed night herons).

Mammals: The hippopotamus population appears to have increased from 19 in 1958 (Tinley 1971) to 31 in 1980 (Begg 1980). They are found mainly in Lake Amanzimnyama.

## 8.7 THE PONGOLO RIVER FLOODPLAIN

by J.S. MEPHAM

The Pongolo Floodplain lies at the eastern foot of the Lebombo Mountain Range, on the Maputaland Coastal Plain of South Africa. It comprises a low lying area of approximately 1200 $km^2$ immediately adjoining the Pongolo River, and includes seasonally flooded land, marshes and floodplain pans which capture and retain floodwater when the river overflows its banks.

A comprehensive account of this region is given by Heeg and Breen (1982).

1. Geography and morphology

Location: 26°45'-27°30'S;32°20'-32°33'E. The floodplain of the Pongolo River is situated about 80 km inland from the Kosi Lake

System, on the Maputaland Coastal Plain, close to the border with Mocambique. See figures 8.15 and 8.17.

Altitude: 20–54 m asl (Ndumu to Mfongosi Pan).

| Area: | | | |
|---|---|---|---|
| | Length of floodplain | north to south | 60 km approx. |
| | Width of floodplain | east to west | 20 km approx. |
| | Total area | | 1200 $km^2$ approx. |

The Pongolo River: The Pongolo River rises in northern Natal, near Wakkerstroom, and flows eastwards, passing between the Lebombo and Ubombo Mountains, which comprise acid volcanic rocks. The river then turns north and flows parallel to the foot of the Lebombo Mountain Range across Cretaceous deposits of marine origin, to join the Usutu River which flows out to sea at the Bay of Maputo.

Landscapes: The floodplain lies to the W and E of the Pongolo River as it flows northwards. It is characterised by a number of seasonally flooded pans and marshes. The pans are sparsely fringed by grass and then by trees. The present course of the river is delineated by a number of low banks and levees, which have to be overtopped before the plain is flooded. A number of terraces bear testament to former levels of the river. The floodplain is surrounded by a flat area, the Makatini Flats.

## 2. Geology

The Pongolo River drains over sands of Tertiary and Recent origin which were laid down as described in section 8.6.

The soils of the floodplain originate from a number of sources; the weathering of the acid volcanic rocks of the Lebombo and Ubombo Ranges, the Cretaceous deposits at the foot of the mountains, the Tertiary and Recent windblown sands, and alluvium deposited by the river, which has come from further inland.

## 3. Climate

Records given are from the Makatini Agricultural Station, which lies just outside the floodplain area at 27°24'S and 32°11'E at an elevation of 71 m asl

Type code: BSwa (köppen)

Insolation: (hours of sunlight)

| | | |
|---|---|---|
| annual: | daily mean | 7.4 h |
| month of highest | August, daily mean | 8.2 h |
| months of lowest | Oct. Nov., daily mean | 6.6 h |

Wind:

| | | |
|---|---|---|
| annual | mean velocity | 8.0 $km.h^{-1}$ |
| month of highest velocity | September, mean | 10.0 $km.h^{-1}$ |
| month of lowest velocity | June, mean | 5.3 $km.h^{-1}$ |
| prevailing direction | August to December | N to NE |
| | January to July | S to SE |

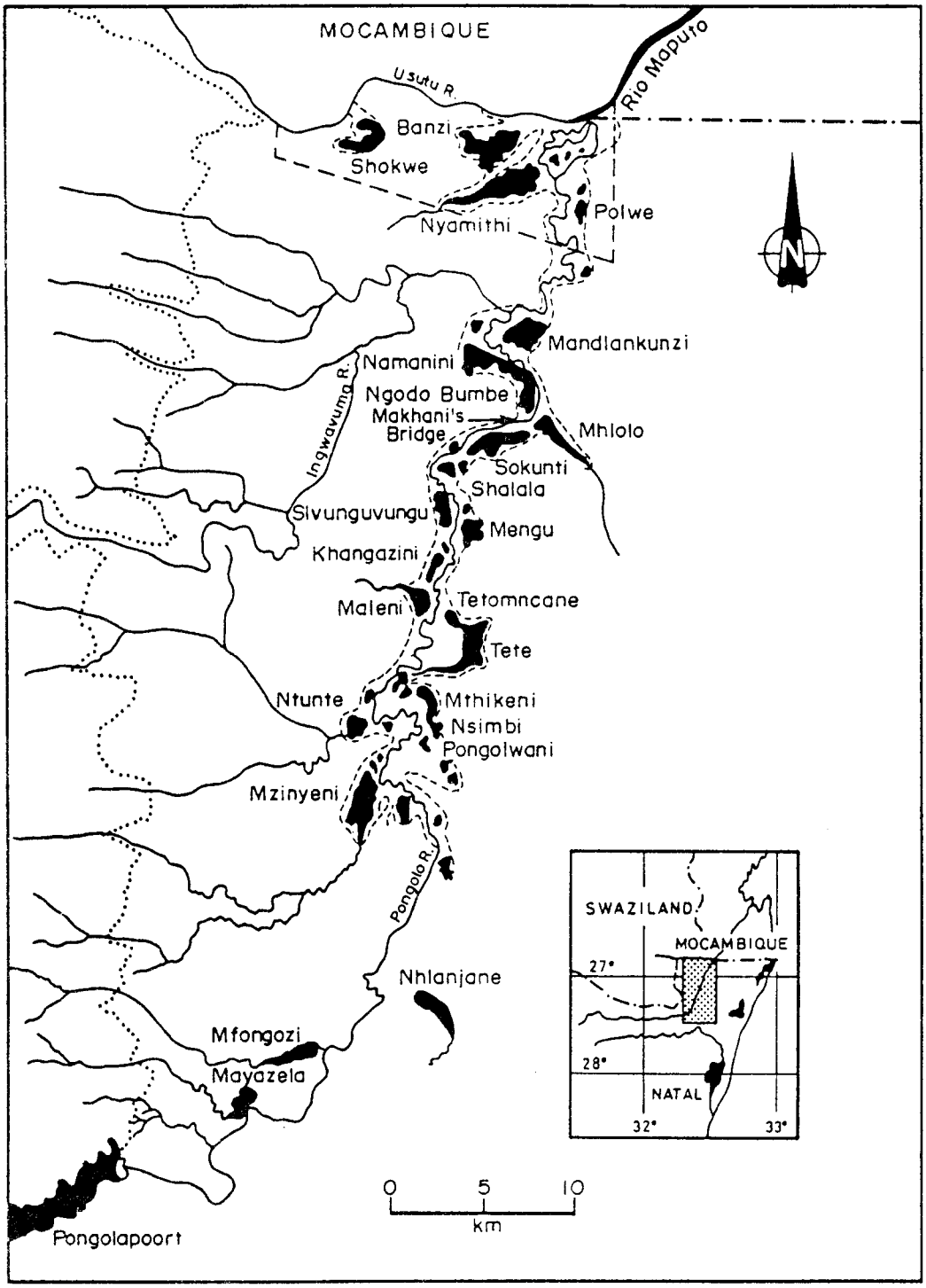



Fig. 8.17 Map of the Pongolo River Floodplain, showing major pans and the Pongolapoort Reservoir

| | | |
|---|---|---|
| **Rainfall:** | | |
| annual | mean | 572.6 mm |
| month of highest | February, mean | 105.6 mm |
| month of lowest | June, mean | 4.6 mm |
| **Relative Humidity:** | | |
| 08h00 | annual, mean | 78% |
| months of highest | May, June, July, mean | 86% |
| month of lowest | September, mean | 70% |
| 14h00 | annual, mean | 47% |
| months of highest | February, March, mean | 54% |
| months of lowest | July, August, mean | 39% |
| **Evaporation:** Class A Pan: | | |
| annual mean | 2 388.0 mm | |
| month of highest | January, monthly mean | 276.0 mm |
| month of lowest | June, monthly mean | 118.0 mm |
| **Air Temperature:** | | |
| annual | mean | 22.1°C |
| annual | mean maximum | 28.7°C |
| annual | mean minimum | 15.8°C |
| month of highest | Jan, mean maximum | 40.3°C |
| month of lowest | June, mean minimum, | 2.3°C |

## 4. Hydrography and hydrology

The area shows marked seasonal activity. In spring, (September, October) there is some rainfall in the catchment area and on the plain, but river flow rates are low and there are only a few occasions when those pans with the lowest levees receive water. On the floodplain the rate of evaporation exceeds the rate of precipitation at this time. Consequently pan water levels continue to fall, but water temperatures start to rise. In summer a marked increase in rainfall, particularly in the catchment area, results in major floods with a peak in February, when all the pans tend to fill. The floods may inundate as much as 10 000 hectares of floodplain, where part of the sediment load is deposited. In autumn (April), rainfall and floods are reduced, leaving the pans at their maximum retention levels, but with most of them losing connection with the river. In winter months there is little rainfall and lower temperatures prevail. Evaporation causes water levels in the pans to fall progressively. Water which seeps into some of the pans from the soil is unusually saline, which helps to raise the concentration of the salts, in the already brackish water even further. See figure 8.18.

Pongolo River Flow Volumes (recorded from Golela):

| | |
|---|---|
| annual, mean | 1082 x $10^6$ $m^3.y^{-1}$ |
| highest year, 1938/39 | 3295 x $10^6$ $m^3.y^{-1}$ |
| lowest year, 1930/31 | 309 x $10^6$ $m^3.y^{-1}$ |

About 70% of the total water flows between November and March, with

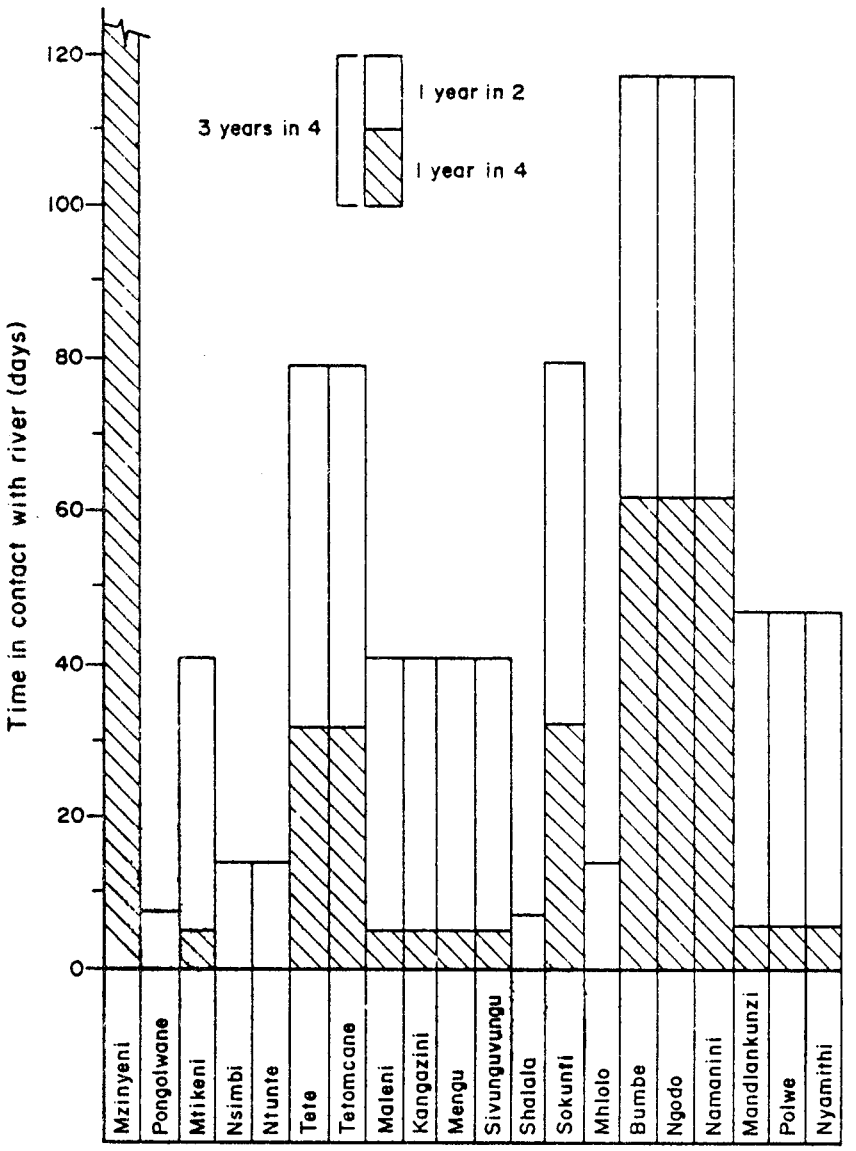



Fig. 8.18 Numbers of days per year during which different Pongolo River pans were in contact with the river.

the greatest volume (17.5%) flowing during February. Although the period from June to September generally shows the lowest volume flow, floods have been recorded during these months, as a consequence of cyclones and storms. The fourth highest flow ever recorded, 563 x $10^6$ $m^3.month^{-1}$, (a daily average of 1975 $m^3.sec^{-1}$) occurred in July 1963. Detailed records of river flow for the period 1929-72 are given in Heeg & Breen (1982).

Sediment Load: The sediment load is low and has been estimated at 2.1 x $10^6$ $m^3.y^{-1}$, approximately 0.15% of the total volume flow.

## 5. Physico-chemical characteristics of the water

Values for most parameters (e.g. temperature, pH, turbidity etc.) obviously vary markedly from pan to pan and from time to time. Some comparisons of dissolved solids have been made by Heeg and Breen (1982) which indicate the range between different seasons and between different pans.

Concentration ($mg.l^{-1}$) and composition of the dissolved solids in Pongolo River water during dry and rainy seasons:

| | Pongolapoort (in mountains) | | Makhani's Bridge (coastal plain) | |
|---|---|---|---|---|
| Season | dry | rainy | dry | rainy |
| total dissolved solids | 970 | 110 | 582 | 104 |
| sodium | 172 | 12 | 135 | 17 |
| calcium | 30 | 6 | 33 | 8 |
| magnesium | 30 | 7 | 33 | 7 |
| chloride | 185 | 9 | 165 | 17 |
| bicarbonate | 348 | 73 | 331 | 92 |
| sulphate | 11 | 17 | 33 | 9 |

Composition and concentration ($mg\ l^{-1}$) of the dissolved solids of floodplain pans prone to salinisation:

| | Nyamithi Pan inflow | Nyamithi Pan mid pan | Tete Pan | Mholo Pan |
|---|---|---|---|---|
| Total dissolved solids | 11 290 | 5630 | 3627 | 1933 |
| sodium | 2 645 | 1400 | 797 | 470 |
| calcium | 468 | 73 | 310 | 94 |
| magnesium | 761 | 290 | 181 | 80 |
| chloride | 6 110 | 2284 | 2094 | 760 |
| bicarbonate | 305 | 387 | 165 | 344 |
| sulphate | 1 153 | - | 163 | - |

## 6. Macrophytes

Five fairly distinct vegetational zones occur on the floodplain, largely determined by the soil types and the frequency of inundation:

(1) an Acacia xanthophloea - Dyschoriste depressa community, found in the driest areas near the edge of the floodplain;
(2) a Ficus sycomorus - Rauvolfia caffra community, found as riparian forests along the Pongolo and Usutu Rivers;
(3) 'lawns' of the grass Cynodon dactylon found in areas of frequent inundation and exposure, especially surrounding shallow pans;
(4) a Cyperus fastigiatus - Echinochloa pyramidalis zone, characterising the more marshy areas;
(5) a Phragmites australis and Phragmites mauritianus reed swamp occupying the wettest areas, with long standing water.

The floating leaved macrophytes Trapa bispinosa (water chestnut) and Nymphaea spp. are found as permanent occupants in the pans which have a relatively stable water level (e.g. Mhlolo). The submerged macrophytes Potamogeton crispus and Najas pectinata are found in those pans where a reasonable amount of water is retained over the dry season. These are the principal species which contribute to the primary production of the system.

## 7. Phytoplankton

The diatom Melosira granulosa and members of the Cyanophyta (blue-green algae) comprise much of the phytoplankton in all pans.

## 8. Invertebrates

Burrowers such as various fresh water mussels and oligochaetes are found together with the larvae of chironomids and caddis flies. There is an epifauna of snails, dragonfly nymphs and fresh water shrimps. Snails are important as intermediate hosts of bilharzia, especially Bulinus (Physopsis) globosus and Biomphalaria pfeifferi. Studies on invertebrate productivity have been carried out by Walley (1979) who studied the secondary productivity of the oligochaete Branchiura sowerbyi. He found that rates varied seasonally, giving mean annual ranges from 5.9 mg dry wt.$m^{-2}.y^{-1}$ for Mzinyeni Pan, to 21.1 mg.$m^{-2}.y^{-1}$ for Mhlolo Pan. This is equivalent to 92.97-330.13 J.$m^{-2}.y^{-1}$.

## 9. Fish

There is a very rich fish fauna with more than 50 species having been recorded. Many of these are exploited by the local population, including Tilapia spp., Oreochromis (= Sarotherodon) mossambicus, Labeo rubropunctatus, and Clarias spp. (barbel). In spite of the wide range of fishes occurring here, each species appears to occupy a different ecological niche, so that all food sources are utilised, and competition is kept to a minimum.

## 10. Other vertebrates

Reptiles: There are approximately 300 crocodiles (Crocodilus niloticus) living on the floodplain, most of which grow to an average length of 2.5 m. They are principally piscivorous, and remove an estimated 16 tonnes of fish per year from the system.

Birds: A great variety of bird life uses the plain, either for breeding or as a feeding habitat. Dendrocygnus viduata (white faced duck), Pelicanus onocrotalus (white pelican), Andrea goliath (goliath heron) and Phoenicopterus rufer (greater flamingo) are common in the region, while Anastomus lamelligerus (openbill stork) breeds here at the southern extremity of its range. It is a rare bird elsewhere in South Africa.

Mammals: In the past the Pongolo Floodplain harboured a wide variety of game animals, but these are now very much depleted. A few still remain in the Ndumu Game reserve to the northwest of the floodplain. Hippopotamus amphibius is the only large wild animal still to be found on the floodplain. An estimated 420 survive, most residing in the game reserve, but at any one time up to 50 may be found living outside it. Based on feeding studies by Field (1970) and assuming an assimilation efficiency of 35%, each hippopotamus contributes between 4.2 and 5.2 tonnes of detritus (fresh weight) to the pans annually, giving a total of between 1774 and 2184 tonnes for the system as whole. Domestic stock occur in considerable numbers on the floodplain, more than the environment can support satisfactorily.

## 11. Annual cycle of the system

Fig. 8.19 summarises the seasonal events of the Pongolo Floodplain ecosystem. In spring Potamogeton crispus is the most important primary producer, supplying food to snails and various other invertebrates, and to visiting water fowl. These birds eventually emigrate exporting some nutrients, but the remaining biota stays in the system. At this time the water levels are low and the Cynodon meadows are exposed and therefore part of the terrestrial community.

In summer, increasing temperatures and/or rising water levels probably trigger spawning in fish. Heavy rains lead to periodic flooding and an increase in the magnitude and duration of successive floods results in different pans becoming flooded at different times. The floodwaters become turbid and this reduces primary production by the aquatic vegetation. However, as the floods cover the Cynodon meadows, the submerged grass, together with other terrestrial plant flotsam, becomes an important food source for the development of the young fish.

During autumn river flow decreases, the floods subside and the water in the pans is held initially at their maximum retention levels. An abundant supply of invertebrates in the pans supports the surviving fish populations. The water becomes clearer and Potamogeton crispus starts to grow again from turions in the mud, while around the pan margins Cynodon dactylon regenerates from rhizomes, and provides energy for domestic stock during the dry winter.

In winter the climate becomes drier, the water levels fall and production of Cynodon dactylon decreases. The standing crop of Potamogeton crispus and its associated epiphyton builds up, and again becomes the major source of energy for the secondary producers.

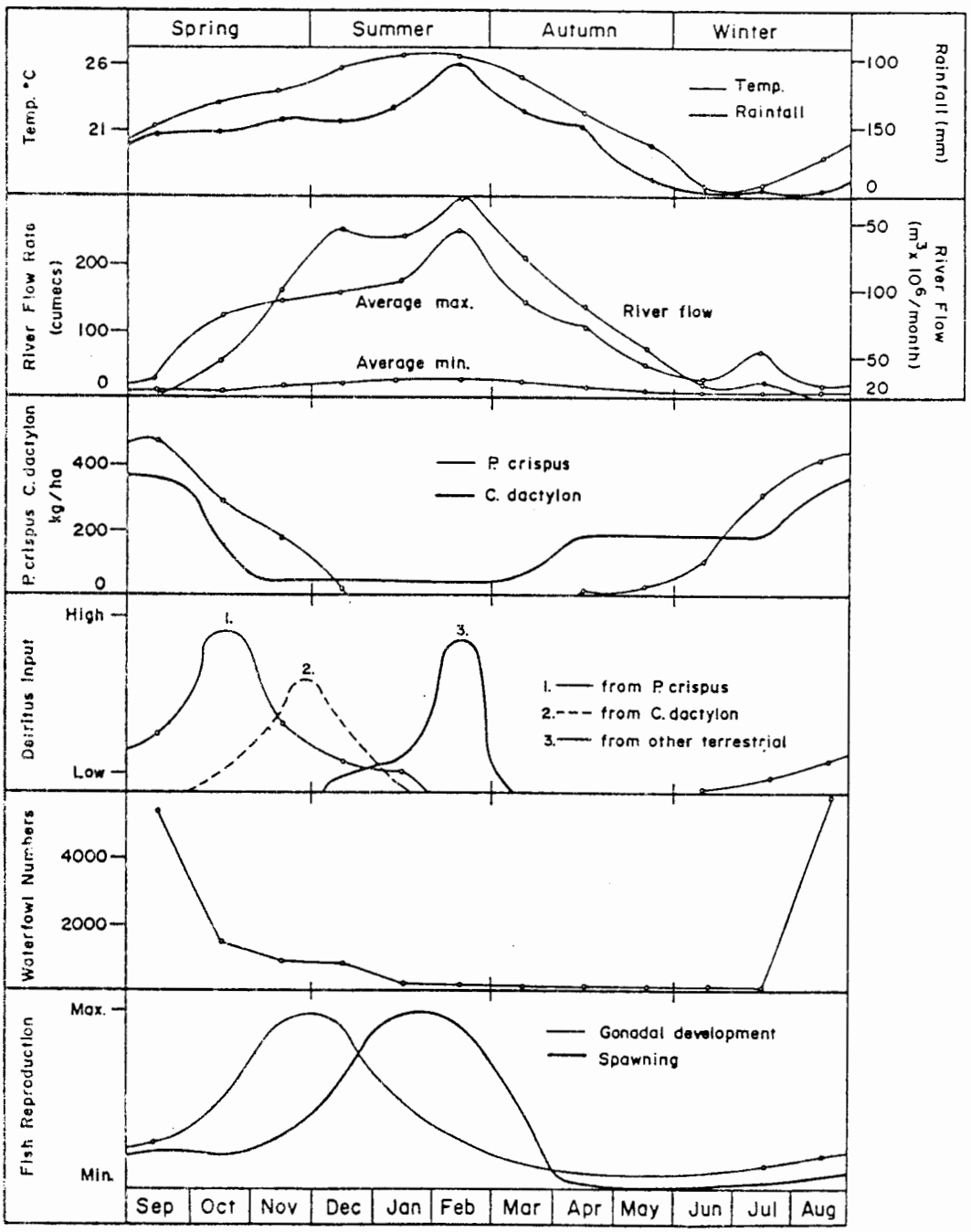



Fig. 8.19 Seasonal fluctuations in standing crop of various components in the Pongolo pans ecosystem.

**12. Human activity**

The people of the Makatini flats are descended from the Tembe-Thonga tribe, and have adopted Zulu nationality. The majority of them practise subsistence agriculture on the Makatini Flats, and come down to the floodplain to fish. Almost all their protein is derived from this fish, and they thus rely on the annual floods to maintain the pans in optimal condition for the growth of the fish. For a further descprition of these people see section 8.6.

Management: The completion of the Pongolopoort dam, higher up the river, in the Lebombo Mountains, has increased the agricultural potential of the area. However, manipulation of the water supply for irrigation programs could well have a deleterious effect on the floodplain. Pans may well dry out, or at least become so saline as to preclude survival of the life forms found there now. At the present time experimental releases of water from the dam are being carefully monitored, with a view to developing a sound policy of flood control.

## 8.8 LAKE SIBAYA

by J.S. MEPHAM

Lake Sibaya lies on the Maputaland Plain of northeastern South Africa as described in section 8.6. It is a fairly deep endorheic lake cut off from the Indian Ocean by high, forested sand dunes. It is poor in nutrients and consequently has low productivity. A comprehensive account is given by Allanson (1979).

**1. Geography and morphology** (Figs. 8.15 and 8.20)

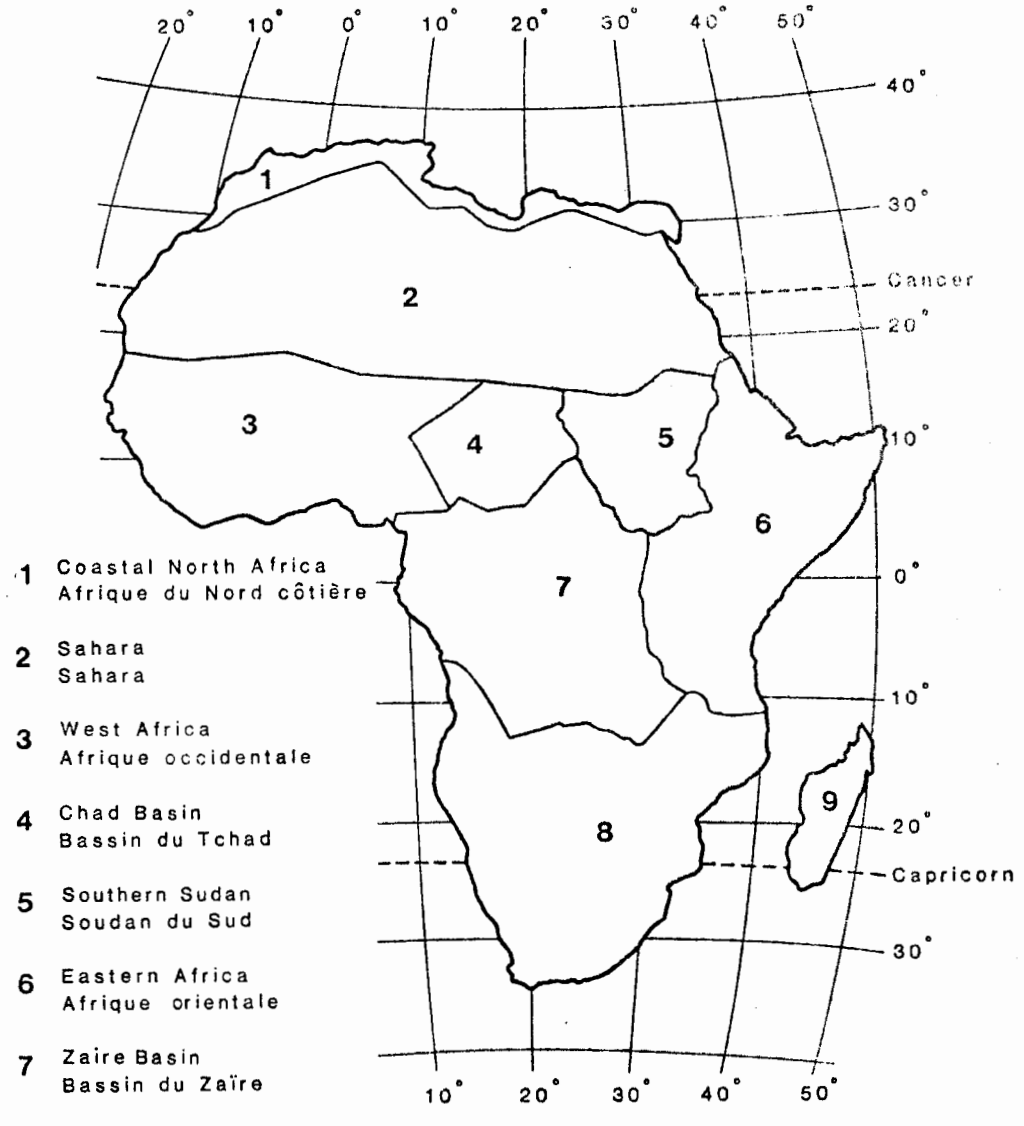
Location: 27°25'S; 32°40'E.

Altitude: The surface of the lake is about 21 m asl, and at the deepest part the floor is about 20 m below sea level.

Area: Area of lake: 65 $km^2$
Area of drainage basin: 530 $km^2$ approximately.

Landscapes: The eastern shores consist of high, densely forested dunes and in places the lake approaches to within 1 km of the sea. The other shores are predominantly covered by low thornveld.

Morphometry: The main basin of the lake is 8.5 km long and 6 km wide and occupies almost 60% of the total area of the system. It has the deepest water and opens into two smaller basins in the south, a large dendritic arm to the west and another one to the north. The SE basin is virtually separated from the rest by the formation of two major sand spits. The western arm of the lake occupies a narrow valley and deepens progressively from 5 m at the western end to 25 m where it joins the main basin. The valley continues for 2 km across the main basin before it enters a deep wide trough running NW to SE. Similarly the northern arm lies in a valley and is 28 m deep where it

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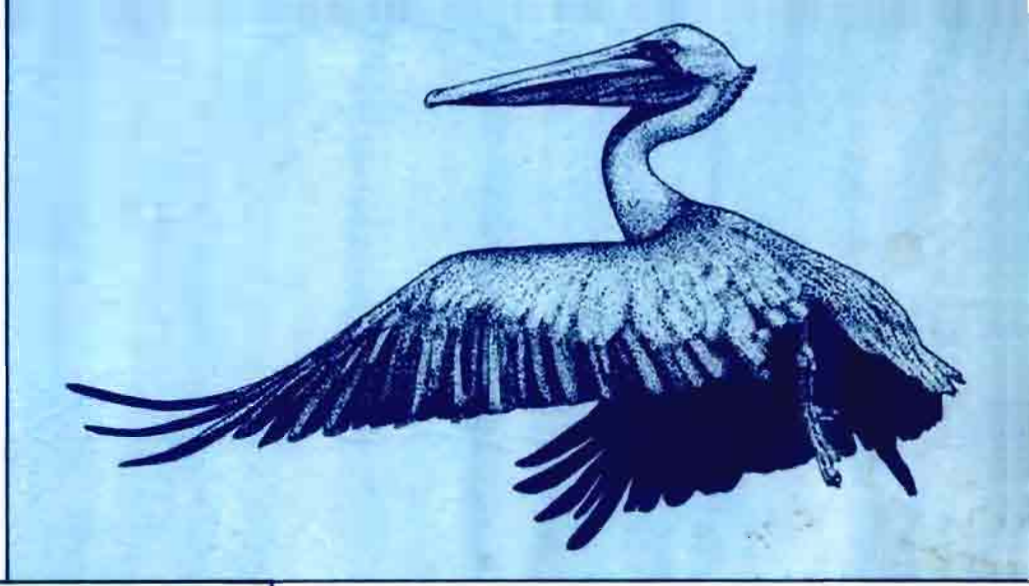

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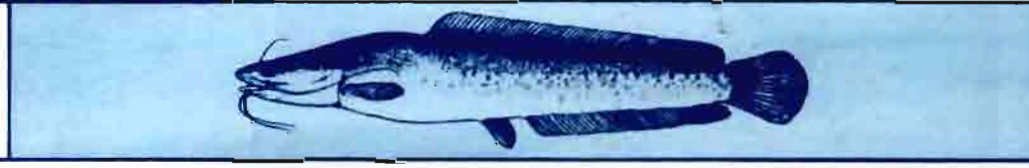

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