

times of severe drought. However, improved fishing, storage and general management should help to minimise the effects of the next major regression. It has been suggested that in the past the effects of drought have been far more devastating than over-fishing and that commercial fish production could be increased markedly without causing a deleterious effect on the fish population. To this end a successful experimental trawling programme was carried out 1970-71 in the deeper waters of the southwestern part of the lake, which previously had not been fished.

Today fishing forms a major part of the local economy supplemented by subsistence farming. The floodplain is also important for rice production and stock keeping. Major problems facing the area now include rapid accumulation of silt as a consequence of increased agriculture on the floodplains and in the catchment. Since the lake is endorheic the silt is not carried away, causing the lake to become more shallow and turbid, leading to greater oxygen deprivation (Kalk 1979). Another problem, also associated with agricultural practices in the catchment, is the build-up of insecticides and herbicides, again exacerbated by the fact that the lake has no outflow.

8.2 WETLANDS OF ANGOLA

by R.H.MEPHAM

No definitive accounts of the wetlands of Angola appear to have been published and information for the sketchy account given has in the main, been gleaned by personal communication with ANGOP (London), Information Services of the Portuguese Embassy (London), Hunting Surveys Ltd., and personal knowledge of the area.

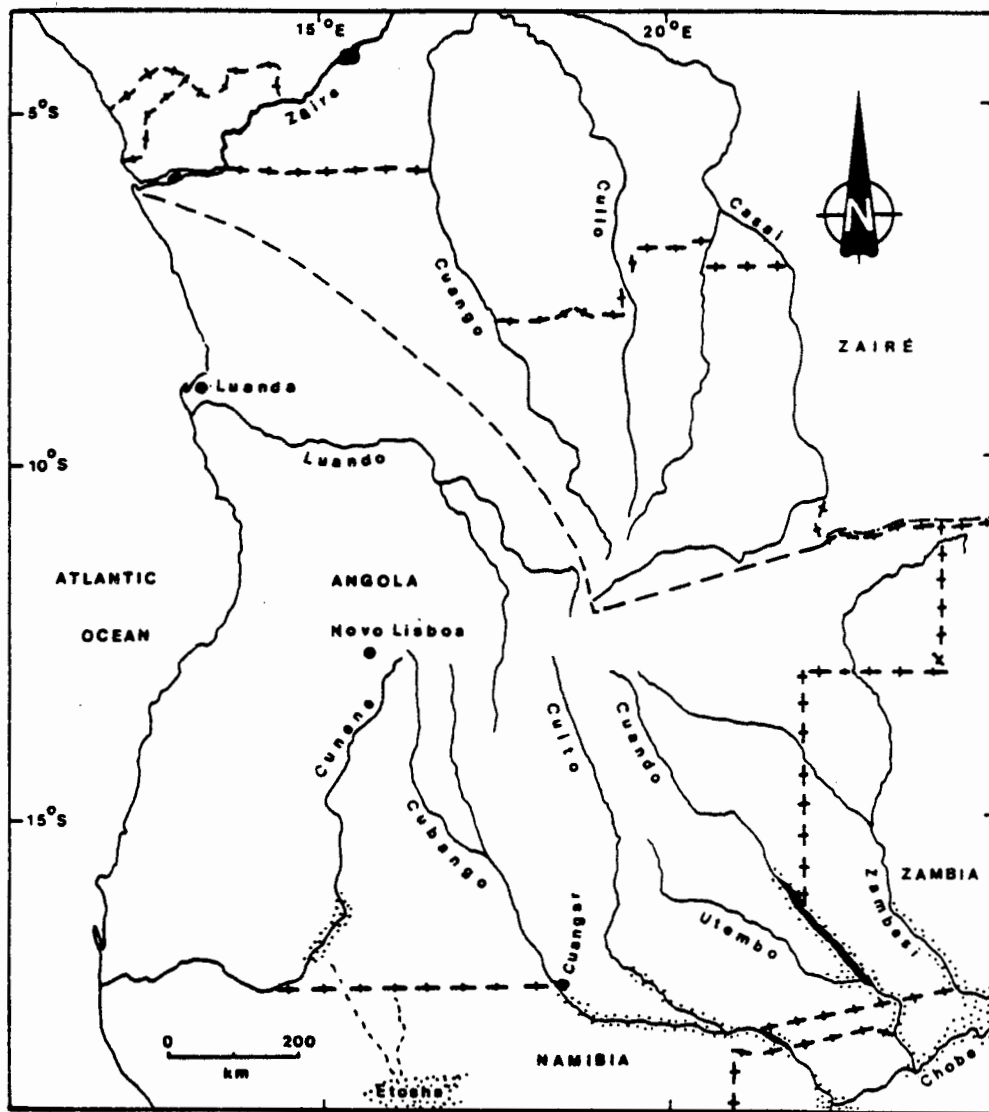
The principal wetlands are associated with the floodplains of rivers on the Central African Plateau in the southern and eastern parts of the country. These rivers rise in the Central Highlands and flow either west to the Atlantic Ocean or east to the Indian Ocean via the Zambesi. Other important wetlands occur on the Cuanza River which also rises on the plateau but flows to the Atlantic Ocean.

Perhaps the best known river is the Cunene (Kunene) which rises at about 1840 m asl near Novo Lisboa, at a latitude of 13°S, and in its upper course descends swiftly through hilly country to the Central African Plateau. Here, in parts of its middle course, it flows comparatively slowly across the western edge of the plateau, at an elevation close to 1100 m asl. In parts of this region, known as the Cunene Flats, it spills over the plain in most wet seasons following heavy rainfall in the headwater catchments. Here the plateau experiences hot summers with 950 mm rainfall, and warm dry winters. Rainfall over both the flats and the headwater catchment is very variable. On the flats the annual total may fall to 550 mm, but in the upper catchments it may reach 1808 mm. In the past the Cunene River flowed into a large pan on the flats, the existence of which is revealed by deep and extensive alluvial deposits. The fact that these deposits contain palaeolithic tools testifies to their recent age and suggests that this was once a centre of population. From this region the river used to flow southeastwards to Namibia before

discharging into Etosha Pan. However, during one great flood it overflowed the banks of the old Cunene Pan and found a new course to the sea, its waters being captured by another river. The old course leading to Etosha Pan is still quite clear but now contains only an ephemeral stream, while the lower course of the rejuvenated Cunene River falls steeply to the sea with many cataracts, and a waterfall 124 m high at Ruacana (Fig. 8.5). Peak flows at this place normally occur in April, but are occasionally as early as February. They invariably coincide with the inundation of the Cunene Flats upstream. A maximum wet season flow rate of $1069 \text{ m}^3 \text{ sec}^{-1}$ was measured at Ruacana in April 1965, but peak flows are usually in the range $350\text{--}450 \text{ m}^3 \text{ sec}^{-1}$. Some 50 km from its mouth ($17^\circ 16'S:11^\circ 50'E$) dunes of the Namibian desert form the south bank of the river and sand from them continuously slides into the river. When the river is in spate the sand is swept to the coast, but during the dry season the lower course is choked by sand banks. Water flow is minimal in the lower course at this time and the river discharges into a lagoon, its mouth having been deflected alongshore behind a sandy spit. By contrast, the opposite northern bank of the river is a rocky platform rising steeply from the water. This is an extremely arid area and average annual rainfall at the Cunene mouth (Fos do Kunene) is less than 20 mm a year. The Cunene River is dammed twice, at Matala and Ruacana, to provide hydroelectric power and water for irrigation purposes. The fish fauna of the river changes in passing upstream since fish are unable to ascend the waterfalls. The spectrum of species found on the plateau is similar to that found in the Cubango and other tributary streams of the upper Zambesi and Okovango systems.

The other major rivers of southern Angola, the Cubango (Okavango) and its tributary the Cuito, and the Cuando (Kwando) and its tributary the Utembo, rise in sponges on the eastern side of the high Lunda Divide in the Central Highlands. They flow out of the hills southwards to the Central African Plateau, and thence to the Caprivi Strip (Fig. 8.5) from where the waters of the Cuando reach the Zambesi, while those of the Cubango drain either into the Okavango swamp, or to the Zambesi. All these rivers inundate flood plains on the plateau after storms over their headwater catchments in the rainy season.

There are no important wetlands along the upper course of the Cubango, which is boulder strewn and full of rapids, although small Phragmites swamps occur on many of its tributaries, and much of the upper course carries a thin fringe of Phragmites as it flows through Brachystegia - Julbernardia woodland. Once it reaches the plateau, the fringe community becomes more complex and quite extensive on sandy patches, some of which measure several acres in extent. Plants such as Commelina microspatha, Ethulia conyzoides, Kosteletzkya buettneri, Mikania cordata, Pennisetum glaucocladum and Polygonum senegalense appear in the reed beds here. However, far more extensive patches of semi-permanent swampland border the river once it begins to meander below Cuangar, close to the Namibian border. Again stands of Phragmites mauritianus fringe the water but are interspersed with clumps of a bulrush, Typha domingensis. To landward of this vegetation there are numerous ponds, some of which are permanent and some which occasionally dry out. They contain water lilies (Nymphaea caerulea and Nymphaea lotus) and other floating species such as Aeschynomene fluitans, together with numerous submerged aquatics which have a luxuriant algal epiphyton. Around the margins, sedges (Cyperus distans and Scirpus muricinux) may be found together with a swamp fern, Cyclosorus interruptus, also tall grasses including Miscanthidium junceum



— + — international boundary which does not follow a river

••••• wetland

— — — boundary between region 7 and region 8

Fig. 8.5 Wetlands of Angola

and Pennisetum glaucocladum, and the commelinaceous Floscopa glomerata. There may be a thin fringe of Vetiveria nigritana on the landward side of the ponds, giving way to a low sward of Cynodon dactylon on flat land which is only occasionally and briefly flooded. Water levels in the permanent ponds vary by as much as 3.5 m in a year. Fish and frogs abound in these pools and are hunted by many birds. Juvenile fish are common in the reed beds all along the river during the wet seasons.

Riverine trees including Acacia nigrescens, Diospyros mespiliformis, Ficus burkei, Ficus sycomorus, Garcinia livingstonei, Hyphaene benguellensis, Kigelia pinnata, Phoenix reclinata, Sclerocarya caffra, Syzygium cordatum and Syzygium guineense become increasingly common below Cuangar and form sparse woodlands along the banks in suitable sites. Cyperus papyrus is reputedly common in swamps in the lower Cuito valley, and near the confluence with this tributary, papyrus also appears along the banks of the Cubango. From here, continuing downstream, Phragmites and papyrus alternately dominate the banks. Just over the border between Mucusso and Popa Falls in the Caprivi Strip, for a short distance, the Cubango River follows a highly braided course between innumerable islands with narrow flood plains on either bank. Both banks and islands support woodlands of the riverine species listed above, which are inundated by the seasonal floods, but never for any length of time as the flood crests seem to pass quickly. Behind the riparian woodlands the land rises in several grassy terraces, subject to occasional flooding, to reach dry savanna woodland in which Burkea africana and Combretum psidiodes predominate. Below Popa Falls a broad complex of floodplains extends on either side of the river as it approaches the Okavango Delta in Botswana. Before reaching the delta, however, the Cubango meets with the Linyanti (Chobe) River, and some of its water passes eastwards through the Chobe swamps to join the waters of the Cuando and eventually those of the Zambesi.

Like the Cubango, no important wetlands occur along the upper course of the Cuando River, which drains an area of 96 778 km², but for over 320 km as it approaches and then forms the border with Zambia, it has a vast intricately braided course, flowing in several major and hundreds of minor channels between myriad islands. When flood waters rise each year the whole of this area and the adjacent river terraces are inundated in a belt locally exceeding 15 km in width which has an estimated total area of some 3800 km². Rheophytic vegetation dominates this area, most island surfaces being covered with stunted trees, bushy thickets, perennial sedges and grasses, and many annual herbs. Across the border, in the Caprivi Strip, the Cuando becomes the Linyanti and its flood waters spill over the expanse of the Chobe or Linyanti Marshes, which cover a further 1500 km². Thereafter the flood passes down the Zambesi to the Indian Ocean.

The elevation of the floodplains on the Cubango and Cuando Rivers varies between about 1200 and 1000 m asl, and the mean annual rainfall over these regions ranges from about 510 mm in the west, where it is highly unreliable, to about 860 mm in the east. However, the upper catchments in the Central Highlands receive up to 2000 mm/yr.

The fish fauna of the rivers in the floodplain region is similar to that described for the Okavango (section 8.4). Antelopes are comparatively common in the area, and giraffes, zebras and elephants are still recorded. Crocodiles are common in some of the lower floodplains, but

become scarce with increasing elevation. Malaria is common in the lower floodplain areas, caused by the parasites, Plasmodium falciparum and Plasmodium malarise, both of which may be transmitted by either of the local vectors, Anopheles gambiae and Anopheles funestus. Other species of Anopheles have been recorded from the area but are not proven vectors of Plasmodium. Schistosoma and its snail vector are known in the floodplains, as is Glossinia morsitans, which transmits sleeping sickness.

A number of important wetlands occur between the lower courses of the Cubango and Cuando Rivers in an area 19°38'-22°56'E and 15°53'-17°22'S. In this region, the Luiana River, an affluent of the Cuando, drains 46 750 km² of flat land. The Luiana has a dozen headwater tributaries and almost all of these rise in swamps which together form a great crescent, oriented SW-NE. Downstream, these tributaries of the Luiana, and the Luiana itself, are lined by sections of floodplain and discontinuous strips of permanent reedswamp. In addition, much of the land surface between these tributary streams is covered by temporary marsh, or by clusters of little lakes which have permanent peripheral reedswamps. Lake Bezi Bezi (16°15'S/19°44'E) is an example.

Other important, but poorly described, wetlands occur north of the Cuando River close to the Zambian border. In a strip between Benda (15°40'S/21°37'N - a town on the Cuando River) and the Zairean border, no less than 18 major rivers flow eastwards from the Angolan Plateau to the Zambezi. A succession of lake clusters and their associated swamps lie on the plateaux between the rivers, while other swamps and floodplains lie along the river beds. Among the most extensive lake/swamp systems on the plateaux are the Chiume Lakes (15°08'S/21°27'E); the Minda Lakes (15°03'S/21°38'E) and the Malumbo Lakes (14°38'S/21°55'E). The most extensive valley swamps are on the Luena and Chefumage Rivers.

The Cuanza River drains a basin of 145 917 km² and rises to the east of Huambo. At first the river flows north, across the high plateau, with little accompanying wetland, but a series of swamps and floodplains appears south of the town of Cuanza (16°00'S/17°40'E), after the river dips below the 1000 m contour. Extensive swampy floodplains occur on the Cuanza and its principal tributary, the Luando, both above and below their confluence at Jimbe (10°19'S/16°39'E). Many lagoons and large tracts of permanent swamp, including swamp forest, occur in this area. Other lake/swamp systems occur farther upstream on the Luando and its affluent the Jombo in a comparatively humid region (10°22'-10°28'S/17°44'-17°54'E) where mean annual precipitation exceeds 1500 mm. A floodplain appears sporadically along the Cuanza all the way from Jimbe to the sea, but the largest seasonally flooded tracts are below Dondo (9°41'S/14°25'E) in the lowlands. Here the river meanders over a 160 km section and is flanked by lakes and lagoons. The river reaches the sea at Barra do Cuanza (9°20'S/13°10'E), where there is another large lagoon.

The valley of the Cuanza is more densely forested than the valleys of the rivers previously described, and in its middle reaches, dense riparian forests, patches of which are flooded seasonally, contain species such as Acacia nigrescens, Diospyros mespiliformis, Combretum spp., Garcinia livingstonei, Kigelia africana, Markhamia acuminata, Phoenix reclinata and Syzygium guineense, and there are vast expanses of herb swamp dominated by Cyperus papyrus, Phragmites mauritianus and Typha domingensis. These are broken by the open water of the lakes and lagoons

and by clumps of swamp forest along watercourses. Echinochloa pyramidalis, Oryza longistaminata and Vetiveria spp. are found on the floodplain sections. The mammalian fauna of these wetlands, including both resident species and regular visitors, comprises Atilax paludinosus, Cercopithecus ascanius, Colobus polykomos, Dasymys incomtus, Herpestes sanguineus, Hippopotamus amphibius, Kobus ellipsiprymnus, Kobus leche, Kobus vardoni, Leptailurus serval, Lutra maculicollis, Otomys angoniensis, Potamochoerus porcus, Redunca arundinum, Tragelaphus scriptus, Tragelaphus spekei and Thryonomys swinderianus. Numerous amphibians are present, together with a wide spectrum of snakes, Varanus exanthematicus and Crocodylus niloticus. There is a diverse fish fauna which includes many floodplain/swamp species such as Gymnarchus niloticus, Protopterus annectens and many clariids.

In northwestern and central Angola all rivers meander in their lowland valleys and where they cross the narrow coastal plain. All of them inundate small floodplains in these places, but the most extensive wetlands occur on the Zenza and Longa Rivers. Marshy and palm-fringed lagoons occur on the Zenza above its delta, and many reed-fringed lakes occur along the lower floodplain of the Longa.

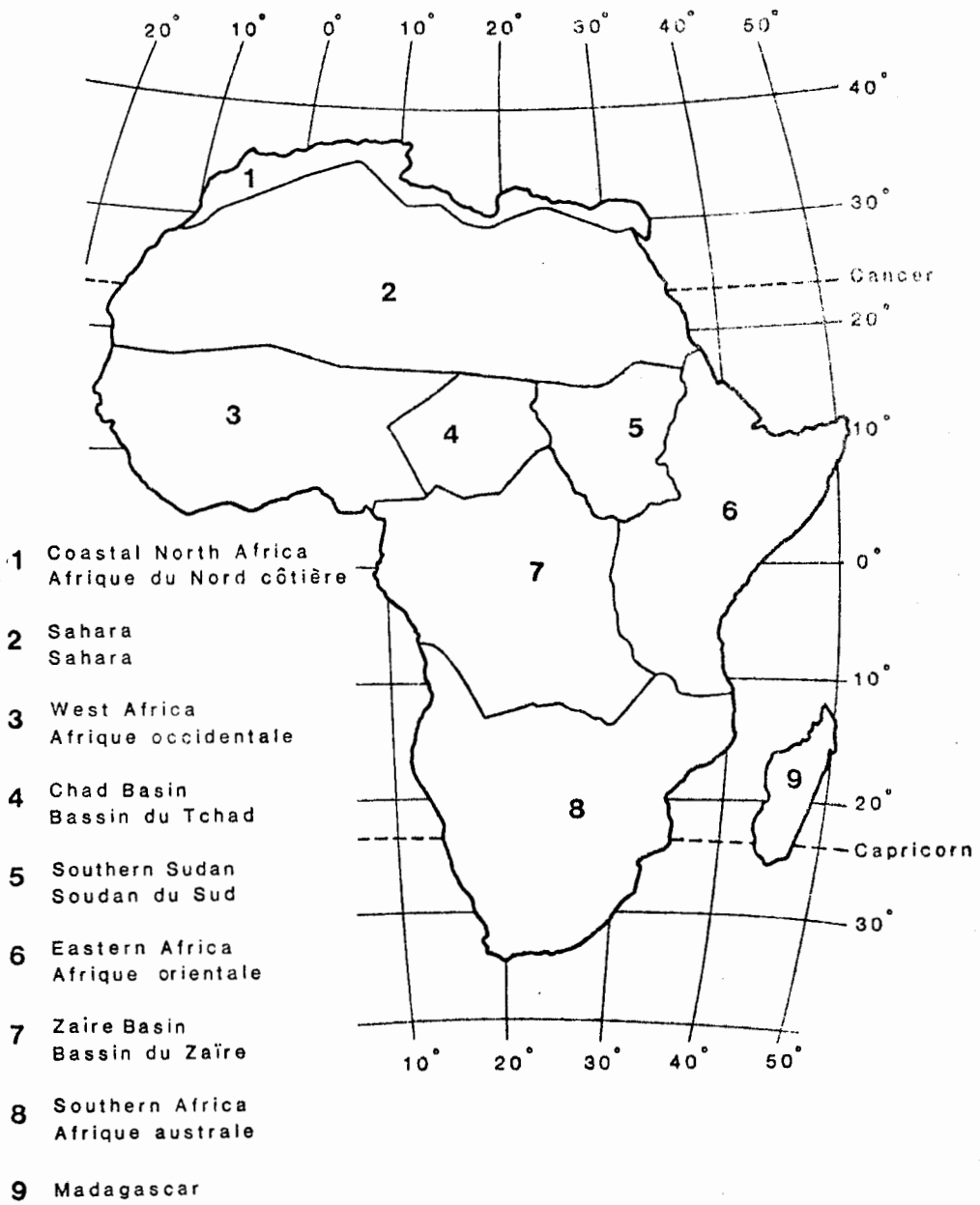
The rivers flowing northeast to the Cuango River in the extreme north of Angola, and the valleys of the rivers flowing north in Lunda Province, are deeply entrenched, wet, and densely forested. Mean annual precipitation in this region exceeds 1700 mm, and there is much more cloud cover than in the south. The rivers have narrow valleys and are comparatively swift flowing, and where they overflow their banks it is to inundate narrow strips of woodland. The riparian forests here are characterised by the presence of several species with Guinean-Congolan affinities which extend southwards from the Zaire Basin up these deep valleys. Common trees on the valley floors are Anthocleista vogelii, Aporrhiza nitida, Carapa procera, Mitragyna ciliata, Nauclea pobeguunii, Oxystigma bucholzii, Pandanus candelabrum, Parinari congensis, Phoenix reclinata, Raphia sp., Spondianthus preusii, Symphonia globulifera, Uapaca guineensis, Ventilago Africana, Voacanga thouarsii, Wildemaniodoixa laurentii and Xylopia rubescens. The fauna also shows affinities with that of the Zaire Basin. Further details are given by Mepham & Mepham, in the IUCN Directory of African Wetlands (in prep.).

8.3 SEASONAL AND SEMI-PERMANENT PANS

by R.H. & J.S.MEPHAM

In South Africa water is a very limited resource, and the conservation of relatively small water bodies is of prime importance. A comprehensive survey of all water resources in South Africa is given by Noble & Hemens (1978). In this account they classify water resources into the following groups.

1. River source sponges. Water-logged and spongy areas which are the head waters of many streams and rivers. A large number of these occur high in mountain ranges such as the Natal Drakensberg and the mountains of Lesoto and Transkei, and are easily damaged by erosion and overgrazing.



Regions of Africa treated in this Directory
Régions d'Afrique traitées dans le présent répertoire

DIRECTORY
REPERTOIRE



**African wetlands
and shallow water bodies**

**Zones humides
et lacs peu profonds
d'Afrique**

M. J. BURGIS
J. J. SYMOENS



Éditions de l'ORSTOM

INSTITUT FRANÇAIS DE RECHERCHE SCIENTIFIQUE POUR LE DÉVELOPPEMENT EN COOPÉRATION

**African wetlands
and shallow water bodies**

**Zones humides
et lacs peu profonds d'Afrique**

DIRECTORY
REPERTOIRE

Edited by / Publié par les soins de

M. J. BURGIS
J. J. SYMOENS

Éditions de l'ORSTOM

INSTITUT FRANÇAIS DE RECHERCHE SCIENTIFIQUE POUR LE DÉVELOPPEMENT EN COOPÉRATION

Collection **TRAVAUX et DOCUMENTS** n° 211

PARIS 1987

This work was completed with financial assistance of :
Ce travail a pu être réalisé grâce au support financier de :

Council for Scientific and Industrial Research (South Africa)
Fonds de la Recherche Fondamentale Collective (Belgique)
Ministère de l'Environnement (France)
Royal Society (Great Britain)
IUCN and WWF



Funds and facilities for the preparation of camera ready text were made available by IUCN and WWF

L'IUCN et le WWF ont procuré les fonds et les facilités pour la préparation des manuscrits définitifs

L'ORSTOM en a assuré la publication

La loi du 11 mars 1957 n'autorisant, aux termes des alinéas 2 et 3 de l'article 41, d'une part, que les « copies ou reproductions strictement réservées à l'usage privé du copiste et non destinées à une utilisation collective » et, d'autre part, que les analyses et les courtes citations dans un but d'exemple et d'illustration, « toute représentation ou reproduction intégrale, ou partielle, faite sans le consentement de l'auteur ou de ses ayants droit ou ayants cause, est illicite » (alinéa 1^{er} de l'article 40).

Cette représentation ou reproduction, par quelque procédé que ce soit, constituerait donc une contrefaçon sanctionnée par les articles 425 et suivants du Code Pénal.