

# REGION 3

## WEST AFRICA

Benin	Liberia
Burkina Faso	Mali
Chad	Niger
Cote d'Ivoire	Nigeria
Gambia	Senegal
Ghana	Sierra Leone
Guinea	Togo
Guinea Bissau	

### Introduction

This region comprises the eleven maritime countries of West Africa, plus the land-locked states of Burkina Faso, Mali and Niger, thus encompassing the entire Niger drainage basin. Chad is included for reasons of geographical integrity. The region extends some 4510 km from east to west, from the eastern border of Chad (24°E) to Cape Vert in Senegal (17°31'W), and close to 2330 km from north to south from the northern border of Mali (25°N) to the southernmost point of the Niger Delta (4°17'N). It has a total area of 6 275 782 km<sup>2</sup> of which the three Sahelian countries, Chad, Mali and Niger comprise 59% (3 710 550 km<sup>2</sup>). In the west, 85% of the total land surface of Senegal, Gambia and Guinea Bissau, amounting to some 215 000 km<sup>2</sup>, lies below the 100 m contour, but most of the regional land surface is situated 200 -500 m asl. Only in Guinea and Nigeria in the south, and in Chad and Niger in the north, are there substantial areas above 500 m. In the south the so-called Guinean Dorsale comprises several long mountain ranges, some massifs, and high plateaux dissected by wide valleys. It stretches from the Fouta-Djallon buttresses in Guinea to the Man Heights in Cote d'Ivoire and is oriented NW-SE, about 250 km inland. The highest points in the dorsale are the Tingi Hills (1835 m) in the west and the Nimba Mountains (1752 m) in the east. Farther

east, a chain of mountains runs from south to north in Togo, reaching a maximum altitude of 986 m at Bauman Peak. In Nigeria, the Jos Plateau (1200 m) is surmounted by a number of high peaks, e.g. Shere Hill (1871 m) and Wadi Hill (1698 m), and along the border with Cameroon, mountains rise above 2000 m in several places, the highest being Chappal Wade (2419 m) and Vogel Peak (2042 m). In the far north, Mt. Greboun (20°00'N/8°37'E) rises to 2000 m in Niger, and in the Tibesti Mountains of Chad, Mt. Emi Koussi (18°52'N/18°33'E) rises to 3415 m and several other peaks exceed 3000 m.

The northern coast of Senegal is sandy, having evolved under the influence of prevailing swells from the NW and a southerly coastal drift. However, from Dakar (14°38'N/ 17°27'W) southeastwards to Monrovia (6°20'N/10°46'W) the coast is one of submergence with many drowned valleys and offshore islands. It is highly indented, but has a deltaic nature in parts of Guinea and Sierra Leone. From southern Guinea to Liberia, longshore drift is towards the NW, while east of Cape Palmas (4°25'N/7°50'W), on the Liberia/Cote d'Ivoire border, it is easterly towards the Niger Delta. Between Monrovia and Cape Palmas, and also in Ghana, the coast is rocky and of relatively high relief, but elsewhere along the Gulf of Guinea it is low lying and sandy. In these latter regions it is characterised by a series of large and comparatively deep lagoons, separated from the sea by dune covered barriers. The far eastern coastal sector is dominated by the delta of the Niger River, which, with an area of 36 260 km<sup>2</sup>, is the second largest delta in the world. Excluding offshore islands, and inlets with mouths less than 1 km wide, the coast of this region exceeds 5300 km in length.

Drainage in the region is dominated by a series of inland watersheds from which streams flow directly to the sea, or northwards to the Niger River. The Niger receives the great bulk of its water from right bank tributaries, since the lands situated north of the river are remarkably arid, while those to the south are mostly very wet. The Niger is one of the four major rivers of Africa, and rises just over 800 m asl at a point 9°07'N/10°41'E in the Fouta Djallon Highlands in Guinea, close to the border with Sierra Leone. It flows northeastwards into Mali where it breaks into a network of channels and lakes in the so called 'internal delta'. On leaving the delta at Tombouctou, it swings sharply southeastwards and flows through Niger to Nigeria and thence to the sea where it has built the largest delta in Africa covering 36 260 km<sup>2</sup>. However, in the early Pleistocene the Niger was a tributary of the Senegal River. It followed its upper course for a short distance into Mali, but then veered westwards into Senegal, depositing a great deal of alluvium in the low lying valleys of what is now the Baoulè system. Then, in the middle Pleistocene, arid conditions produced a barrier of sand dunes, the Erg Ouagadou, which diverted the river so that it discharged into a series of

endorheic lakes southwest of Tombouctou in Mali. Eventually, with the resumption of pluvial conditions, the lower Niger cut back and captured the waters of these lakes so that they drained, and the river now flows southeastwards from the point of capture to its delta at the coast. The present 'internal delta' has been built on the bed of the Pleistocene lakes. The history of the river thus explains the great similarity between the fish faunas of the Senegal and Niger Rivers.

A number of major tributary streams, notably the Tinkisso, Bala, Milo, Gbanhala, Baoule and Bagoé also rise in the humid Fouta Djallon Mountains and flow roughly northwards to the upper Niger, draining the northern parts of the countries lining the Guinea coast. The other major tributaries of the Niger enter along the lower course, below the 'internal delta'. The Sokoto (or Kebbi), Mariga/Kaduna and Gurara Rivers drain the Jos Plateau, while the Benue drains parts of Cameroon and the wet mountains along the Cameroon/ Nigeria border.

In the far west, the whole area of Senegal, Gambia and Guinea Bissau drains directly to the Atlantic Ocean. In the far east of the region, southern Chad, eastern Niger and northeastern Nigeria drain to Lake Chad. The Komadougou, Ngadda, Yedseram and El Beid Rivers come from Nigeria, but are extremely seasonal in their flows, and contribute only a small fraction of the total inflow to the lake, the great bulk of which comes from the Chari, which enters from Chad. With its tributaries this river drains humid highlands to the south, mostly out of the region in Cameroon and the The Central African Republic. The watercourses which enter Lake Chad from the desert regions of Niger and Chad are ephemeral, and their influence upon the hydrology of the lake is insignificant.

## **Climate**

The distribution of rainfall, and the patterns of temperature and humidity, are determined by the seasonal movements of high pressure zones. Two masses of air are in opposition over the region, a dry stable continental mass to the north, and a humid, less stable, oceanic mass to the south. These meet along an intertropical convergence zone, which lies along the parallel 8°N in January, but which pushes north to 22° in August. During the boreal winter, only the southern coastal zone receives rain, but as the front moves farther inland, rain extends over the interior. To the north of the intertropical front, trade and harmattan winds are accompanied by drought and intense heat and as the front never reaches the very north of the region in Mali, this area is true desert.

The north of the region encompasses part of the Sahara Desert and is extremely dry and hot, while the south is wet and less hot. Away from the

coast, mean temperatures always increase towards the north. On the coast the mean annual temperature is 24.3°C at Dakar with mean monthly maxima of 27.5°C in October (the warmest month), and 20.4°C in February (the coolest month). Corresponding figures for Conakry are 26.2°C; 27.5°C (April) and 24.6°C (August), while for Port Harcourt they are 25.9°C; 26.9°C (March) and 24.8°C (August).

Precipitation is greatest at the coast throughout the region, declining progressively in passing inland. Rainfall is 380 mm/yr on the coast at Saint Louis (16°01'N/16°30'W) at the mouth of the Senegal River, but it increases quickly in passing southwards along the coast, reaching 572 mm at Dakar, over 1000 mm at Banjul (13°28'N/16°39'W) at the mouth of the Gambia River, and 1547 mm at Ziguinchor (12°35'N/16°20'W) on the estuary of the Casamance River. A very wet pocket extends from near Bentimodia (10°32'N/14°28'W) in Guinea to Cape Palmas (4°25'N/7°50'W) in Liberia where the direction of the trade winds is perpendicular to the coast. Throughout this sector, in a belt extending up to 100 km inland, precipitation exceeds 3000 mm each year, and at the coast, from Conakry (9°31'N/13°43'W) to Greenville (5°01'N/9°03'W) it tends to exceed 4000 mm/yr, reaching 5200 mm at Cape Mount (16°44'N/11°25'W). In passing eastwards from here it declines to 2000 mm, but rises again to more than 2500 mm between Abidjan (5°19'N/4°01'W) and Takoradi (4°55'N/1°45'W). Thereafter it falls to a bare 800 mm on the coast near Accra (5°33'N/0°15'W), rising again to 1000 mm at Lome (6°10'N/1°21'E), and eventually to more than 3500 mm over the southern part of the Niger Delta. Northern Burkina Faso receives some 500 mm rain/yr, while northern Mali and Niger are the driest parts of the region, with mean annual falls of less than 20 mm, and since rainfall is so variable, some entirely rainless years. The 100 mm isohyet lies between 17-18°N across much of the region.

The seasonal distribution of rainfall is similar throughout the region (except for the coastal sector between Ghana and Nigeria) with one dry season in the northern winter and one wet season in the northern summer. The dry season decreases in severity from north to south. It is virtually continuous in the far north and nearly 10 months long in Saint Louis, decreasing to 8-9 months at Dakar, 7 months at Ziguinchor, 4-5 months at Conakry, 3 months at Lungi, while there is no dry season at Greenville. July and August are the wettest months throughout the region, except on the coast between 4°W and 4°E. Dakar, with a mean annual rainfall of 572 mm receives 90% of its precipitation during the 3 months July-September, with a mean monthly maximum of 275 mm in August. By contrast, Freetown (8°30'N/13°17'W), which has a mean annual rainfall of 3639 mm, receives 850 mm in both July and August, and only January and February are really dry. Both Freetown and Greenville have more than 180 rainy days/year. On the southern coast

from 4°W-4°E, rainfall has a bimodal pattern and there is a short dry season in August. However, towards the Niger Delta the SW monsoon again becomes important and effectively eliminates this minor dry season. Here, Port Harcourt (4°43'N/7°10'E) with a December-January dry season, has 170 rainy days/yr, and Calabar (4°56'N/ 8°22'E) on the Cross River, which has a less pronounced dry season, has more than 190 rainy days/yr.

It is convenient to recognise a southern, Guinean zone, in which the rainy season persists for 7-9 months and the dry season is mild, an inland Soudanian zone, with a 4-6 month wet season and a comparatively severe dry season, and a dry Sahelian zone in the north, the southern limit of which corresponds roughly with the 600 mm isohyet. This zone grades imperceptibly into the Sahara Desert.

### **Vegetation**

There are five principal vegetational zones, occupying broad belts, roughly oriented in parallel from east to west across the region, corresponding with these climatic zones. In the north, adjacent to the Sahara, a belt of Sahelian *Acacia tortilis* savanna and deciduous scrub woodland extends from Lake Chad to the coast of Senegal, encompassing the mouth of the Senegal River. Below this is a broad belt of Soudanian savanna woodland, which at the coast, reaches as far south as Dakar. The coastal lowlands along the Gulf of Guinea are covered by high rain forest in the wettest regions, but this grades into a mosaic of rain forest and secondary grassland where disturbance has been intense. This mosaic extends to the coast in the far west in Gambia, Guinea Bissau and Sierra Leone, and again in the central part of the region in Togo and Benin, in the so-called 'Dahomey Gap' which separates a western rain forest block from the eastern block. In Gambia, Togo and Benin, where the coasts are comparatively dry, receiving 1000-1500 mm rain/yr, the mosaic is different in specific composition from that in Guinea Bissau and Sierra Leone, and trends towards true savanna. Across the centre of the region, sandwiched between this mosaic and the Soudanian woodland belt, on the higher ground of the interior watershed, there is a broad belt of *Isobertinia* woodland. Montane vegetation occurs in the highest regions along the border with Cameroon, but hardly constitutes a major vegetational zone.

### **Wetlands**

Mangrove (tidal) forests occur on all coasts but are best developed on those of Gambia, Guinea Bissau, Sierra Leone and Nigeria, where they may reach 50 km in depth between the landward and seaward faces. Rivers are tidal for many kilometres in some countries, especially

Senegal and Gambia, and in these places mangroves occur 190 km up-river. On the Niger Delta the mangrove forest is backed by a belt of freshwater swamp forest occupying 1 760 000 ha and stretching 440 km across the delta with a maximum depth of 110 km. Most of this forest is flooded only during the rainy season, when the more seaward parts may be tidal, although inundated by freshwater. During the dry season most of the forest floor becomes dry, but there are pockets of permanent inundation. Extensive freshwater swamp forests also occur behind the mangroves in Guinea Bissau, Sierra Leone and Liberia, and to a lesser extent in Cote d'Ivoire. However, freshwater swamp forests are not exclusively associated with the mangroves, and strips of high swamp forest occur throughout the Guinean forest zone wherever rivers or streams meander through depressions. Some secondary grasslands in the coastal lowlands are also flooded seasonally, e.g. in the vicinity of Accra in Ghana. Swamp lands flank the coastal lagoons and there are numerous coastal lakes. In places, secondary herb swamps have developed where mangroves have been cleared from lagoon margins, e.g. on Lagos Lagoon. Galleries of forest extend inland, into the savanna zones, and parts of these are subject to seasonal flooding. Seasonal floodplains and permanent swamps occur on rivers in Senegal, northern Guinea, Burkina Faso and Mali, and again in the east on rivers entering Lake Chad. Other wetlands occur away from the rivers in the Soudanian zone. There are many clay based pans and ponds which carry standing water in most years. Firiki are large shallow depressions, almost plains, covered by impervious clay. During the wet season they are flooded and are covered by grasses which emerge above the surface of the water. The clays are black, and crack in the dry season, but lie on top of pervious sands. Such areas may be farmed. Fako or kabe, as they are called in Nigeria, are depressed clay pans from which the surface soil has been stripped. They retain water during the rains and support stunted bushes but virtually no grass. Semi-permanent pools known as tabki in Nigeria, occur throughout the Soudanian parts of the region. Individually they are small, but collectively they provide a large area of wetland in some countries.

Most of Lake Chad is situated within the region and there are several swampy lakes in southern and western Mali and northern Burkina Faso, and others in central and southern Chad. There are numerous impoundments, including Lakes Kainji and Volta, the latter providing the largest artificial water surface in Africa, covering 850 000 ha.

Some oases, with permanent pools and springs occur in the desert regions, in the gullies draining the high massifs, and there are numerous flat saline pans. In some of these the rise of subterranean water may wet the surface after heavy rain on distant catchments, and films of sparkling crystals may be left when the surfaces dry.

## Wetland Vegetation

**Tidal Swamps:** Over almost the entire region, mangrove vegetation is dominated by three species of *Rhizophora*. These grow on open sea coasts, where they are inundated by fully saline sea water, but also in the freshwater tidal zones of estuaries, deltas and lagoons. In the Guinean zone, the seaward mangrove comprises *Rhizophora racemosa*, which is size graded on rapidly prograding shores, the canopy increasing in height away from the sea. This species reaches 45 m in height in the Niger Delta and 40 m in Guinea Bissau. It may form monospecific zones more than 1 km wide. Behind this high frontal forest there is usually a lower zone of *Rhizophora harrisonii*, which to landward in drier areas, and upstream, gives way to yet lower (5-10 m) *Rhizophora mangle* scrub woodland. All three of these species occur in the Caribbean and on the Atlantic coasts of South America, but *having said this, there is some confusion as to the taxonomy of Rhizophora in West Africa.* Both Savory (1953) and Keay (1953) recognised three species in West Africa, but Rosevear (1947) held that there was only one. More recently, some authors have recorded only the first two of these species, e.g. Boye *et al.* (1975), and Breteler (1969) regarded *R. harrisonii* as a hybrid between *R. mangle* and *R. racemosa*. Certainly some populations of *R. harrisonii* exhibit very low fertility.

In the most landward sites the tidal forest comprises pure stands of *Avicennia africana*, or mixed stands of this species and *Laguncularia racemosa*. The driest, and least frequently inundated fringes may be occupied by *Conocarpus erecta*. These three species, and the three *Rhizophora* species, occur throughout the region. Both *Conocarpus erecta* and *Laguncularia racemosa* are also common in neotropical mangroves, but *Avicennia africana* is now regarded as distinct from the American species, *A. germinans* and *A. nitida*, to both of which the African material has at times been referred. Mudbanks along tidal creeks may be colonised by 'sea grasses', and then by *Crinum natans* when the banks first become emergent, while the aquatic grasses, *Anadelphia* spp., frequently precede mangroves on young alluvial banks in lagoons. Open lagoons are fringed by *Rhizophora* spp., often with *Acrostichum aureum* and *Hibiscus tiliaceus* in zones of shallow inundation, and *Paspalum distichum* (= *P. vaginatum*) in open glades. *Pandanus candelabrum*, *Phoenix reclinata* and *Paullinia pinnata* are common associates in brackish zones, and a *Pandanus-Phoenix-Rhizophora* association may grade into a pure *Raphia vinifera* swamp in the vicinity of river mouths. *Echinochloa stagnina* is locally abundant in openings in these swamps and also along channels in the brackish parts of tidal forests.

Closed lagoons which become highly saline in the dry season, or

which dry up periodically, are fringed by *Avicennia africana*, while their floors become covered by swards of *Phloxerus vermicularis* and *Sesuvium portulacastrum* when they are dry. *Scirpus littoralis*, *Fimbristylis obtusifolia* and *Sporobolus virginicus* are also common around these lagoons, on open sandy ground subject to infrequent shallow inundation.

Mangroves extend far upstream on many rivers in the region. In the drier countries, e.g. Senegal and Gambia, tidal rivers and creeks are bordered by low galleries of *Rhizophora mangle* (5-9 m high) or *R. racemosa*, with *Avicennia africana* dominant on the tidal flats behind. *Avicennia* is more important in Senegal than it is in the wetter, more equatorial countries. On the Senegal and Gambia Rivers, and on the Casamance estuary, the landward *Avicennia* flats are highly saline and give way to herbfields dominated by *Sesuvium portulacastrum* with, on the landward side, herbs such as *Eleocharis geniculata*, *E. mutata*, *Scirpus littoralis* and *Sporobolus virginicus*. Trees usually occur at the very limit of inundation, notably *Mitragyna inermis*, and locally *Avicennia africana* and *Conocarpus erecta*. Some of the flats are flooded only during the rainy season when river water backs up behind spring tides, and at these times annuals, e.g. *Heleocharis* spp., may bloom on the flats. Farther upstream on these western rivers, where tidal flooding is less important than freshwater flooding during the rains, the rivers are fringed by stands of *Cyperus* spp., *Phragmites mauritianus* and *Typha australis*.

By contrast, in the ever-wet zones of Guinea Bissau, Sierra Leone, Liberia and Nigeria, the riverine mangroves are tall and contain several species characteristic of the freshwater swamp forests into which they grade, e.g. *Anthocleista vogelii*, *Carapa procera*, *Chrysobalanus orbicularis*, *Crudia klainei*, *Cynometra mannii*, *Lophira procera*, *Manilkara obovata*, *Oxystigma mannii*, *Phoenix reclinata* (= *P. spinosa* of older authors) and *Raphia vinifera*. *Raphia palmipinus* and *Podococcus barteri* occur on the Cross River and in the eastern part of the Niger Delta. Epiphytes are common in the mangroves of the perhumid zones and include several orchids, e.g. *Bulbophyllum falcipetalum*, *Cyrtorchis aschersonii*, *Genyorchis pumila*, *Polystachya* sp. and *Tridactyle anthomaniaca*, the ferns *Nephrolepis biserrata*, *Phymatodes scolopendria* and *Platynerium stemaria* and the cactus, *Rhipsalis cassytha*. *Tapinanthus belvissi* is a common mangrove parasite. Epiphytes are uncommon in the mangroves of drier areas.

*Caesalpinia bonduc*, *Cynometra megalophylla*, *Dalbergia ecastaphyllum*, *Drepanocarpus lunatus*, *Hibiscus tiliaceus*, *Laguncularia racemosa* and *Ormocarpum verrucosum* occur on

shallowly flooded levees throughout the coastal parts of the region. Where the trees or bushes are well spaced, a dense herbaceous layer develops, in which *Acrostichum aureum*, *Eleocharis geniculata*, *Fimbristylis ferruginea*, *Paspalum distichum* and *Xyris anceps* are prominent.

Where *Avicennia africana*, *Hibiscus tiliaceus*, *Pandanus candelabrum*, *Phoenix reclinata* or *Rhizophora* spp. have been cleared from the margins of open lagoons, or are highly disturbed, a sedge-grass swamp tends to become established. In these situations *Cyperus articulatus* and *Paspalum distichum* are the most important pioneers, but *Iponwea cairica*, *Panicum maximum*, *Paullinia pinnata*, *Phragmites karka* and *Typha domingensis* become associates in fresh to lightly brackish water regions.

The freshwater zones of lagoons, and slow flowing waterways, support beds of *Ceratophyllum demersum*, *Najas marina*, *Potamogeton* spp., and *Utricularia* spp., with free floating species such as *Azolla* sp. and *Pistia stratiotes* and floating leaved species such as *Nymphaea lotus*. These are succeeded by grasses or papyrus and this often by *Pandanus candelabrum*. Depending upon conditions, this may give way to a *Raphia* swamp, or to a bushy *Alchornea cordifolia* zone, which appears to be the first stage of a freshwater swamp forest.

**Freshwater Swamp Forests:** Guinean freshwater swamp forests show some variation in floristic content across the region, and several species are common to both swamp and normal, dry ground, rain forests. Among this latter group are species which, in dry ground forest, are characteristic of secondary forest. However, the most common or widespread species in swamp forest are *Alstonia boonei*, *A. congensis*, *A. macrophylla*, *Anopyxis* sp., *Anthocleista nobilis*, *A. vogelii*, *Berlinia auriculata*, *Carapa procera*, *Irvingia smithii*, *Manilkara argentea*, *Mitragyna ciliata*, *M. stipulosa* (more common towards the interior), *Nauclea diderrichii*, *N. latifolia*, *N. pobguinii*, *Oxystigma mannii*, *Pandanus candelabrum*, *Phoenix reclinata* (essentially riparian), *Raphia hookeri*, *R. vinifera*, *Spondianthus preussii*, *Symphonia globulifera*, *Tarrietia utilis* (more common in the west), *Uapaca guineensis*, *U. heudelotii*, *U. paludosa*, *U. staudtii*, *Voacanga thouarsii* and *Xylopia staudtii*. *Gilbertiodendron dewevrei* occurs in southern Nigeria, and is present in the drier fringes of periodically inundated valley forests. Typically it forms mono-dominant stands. Pockets of permanent swamp forest are dominated by *Raphia* spp., or by *Sterculia ambacensis* and *Xylopia* spp. *Bequaertiodendron magalismontanum* is a component of riverside swamp forests in the central and western parts of the region and develops prominent knee roots, at least in Cote d'Ivoire. Understorey species include the shrub *Leea guineensis*, and the tall herbs *Cyrtosperma*

*senegalense* and *Marantochloa* spp. Species of *Ancistrophyllum*, *Calamus* and *Eremospatha* are common lianes in clearings in swamp forests, and also in *Raphia* swamps.

Trees which are common in dry ground secondary forest, but which also appear in swamp forests, especially in the Guineo-Soudanian transition region, include *Annona senegalensis*, *Ceiba pentandra*, *Diospyros mespiliformis*, *Ficus vogelii*, *Macaranga* sp., *Manilkara obovata* and *Musanga cecropioides*.

Seasonally inundated swamp forests occur along rivers in the Guineo-Soudanian transition zone and the Soudanian zone. Common species in this type of forest include *Berlinia grandiflora*, *Cola laurifolia*, *Cynometra vogelii*, *Diospyros elliotii*, *Mitragyna stipulosa*, *Parinari congensis*, *Phoenix reclinata*, *Pterocarpus santalinoides*, *Uapaca heudelotii* and *U. togoensis*, in addition to the secondary forest species listed above. This type of swamp forest is developed on numerous streams flowing north from the Fouta Djallon, e.g. the Tinkisso, Milo and Gbanhala Rivers in northern Guinea, and also on the upper Volta and Oti Rivers. In the far west, in Gambia and Senegal, the spectrum is slightly different. *Cola*, *Cynometra* and *Diospyros* are still common in swamp forest, but *Christiana africana*, *Croton scarciessii*, *Symmeria paniculata*, *Syzygium guineense* and *Ziziphus amphibia* are the commonest associates, often with groves of *Raphia sudanica*.

In the Soudanian zone proper, riparian forests, subject to varying degrees of inundation, contain *Acacia sieberana*, *Azelia africana*, *Ceiba pentandra*, *Detarium senegalense*, *Diospyros mespiliformis*, *Erythrophleum guineense*, *Ficus glumosa*, *F. sycomorus*, *Khaya senegalensis*, *Syzygium guineense*, *Tamarindus indica*, *Terminalia glaucescens* and *Vitex doniana*. On the Senegal/Mauritania border, in the southern Sahelian zone, *Acacia nilotica* forests occur on the floodplain of the Senegal River, which is otherwise locally dominated by *Vetiveria* grassland, and *Nauclea latifolia* and *Raphia sudanica* forms groves along the river in the riparian forest, which contains many of the above species. Here *Dalbergia saxatilis* and *Landolphia dulcis* are common scandent species.

Levee woodland, or levee scrub, along rivers in the northern Soudanian and southern Sahel zones is generally dominated by *Mitragyna inermis*, associated with species such as *Acacia nilotica*, *A. polyacantha*, *A. sieberana*, *Allophyllus africanus*, *Anogeissus leiocarpus*, *Antidesma venosum*, *Balanites aegyptiaca*, *Bauhinia rufescens*, *Borassus aethiopum*, *Celtis integrifolia*, *Crateva religiosa*, *Dalbergia melanoxylon*, *Diospyros mespiliformis*, *Ficus gnaphalocarpa*, *Morelia senegalensis*, *Parkia biglobosa*, *Phyllanthus muellerianus* and *Ziziphus mucronata*. In some

places, *Acacia nilotica* becomes dominant and may occur in almost mono-specific stands.

**Grasslands of Hydromorphic Soils:** Swampy grasslands occur on the coastal plains in the central and western parts of the region, e.g. on the Accra Plains in Ghana, and also in many places in the west of the region. These are dominated by *Vetiveria fulvibarbis*, together with *Andropogon canaliculatus*, *Brachiaria falcifera*, *Cassia mimosoides*, *Fimbristylis pilosa* and *Polygala arenaria*. Woody thickets occur on termite mounds in these grasslands and in these *Diospyros mespiliformis* is dominant, with *Capparis erythrocarpos*, *Elaeophorbia drupifera*, *Flacourtia indica*, *Grewia carpinifolia*, *Securinega virosa* and *Zanthoxylum zanthoxyloides* as common associates. *Sansevieria liberica* is often present in the field layer.

Floodplains of the Soudanian zone are dominated by tall grasses and occur in many wide river valleys, but often with widely spaced trees giving an 'orchard-like' appearance, although *Terminalia macroptera* often forms groves in depressions. The other arborescent species, which usually occur upon hummocks, include *Borassus aethiopum*, *Mitragyna inermis* and *Terminalia glaucescens*, while the most widespread grasses in these valleys are *Hyparrhenia cyanescens*, *Pennisetum polystachion* and *P. unisetum*. *Andropogon gayanus* and *Setaria sphacelata* cover great areas in the headwater areas of tributary streams.

Areas of waterlogged grassland occur on peat-filled depressions on high land in the Soudanian zone surrounded by *Isberlinia* woodlands. They are dominated by *Rhytachne rottboellioides* with an abundance of *Lycopodium affine* and several species of *Bulbine*, *Drosera*, *Utricularia* and *Xyris*.

The floodplains of the northern Soudanian and southern Sahelian zones are also dominated by grasses, e.g. those along the Niger in southern Mali and those draining to Lake Chad. In the zones of deepest and most prolonged inundation, where water depths may exceed 2 m, *Oryza barthii* is dominant, giving way to *Echinochloa pyramidalis* in the middle zones, with *Hyparrhenia rufa* and *Vetiveria nigriflora* on the margins. Other species seen on the margins during the rainy season are *Acroceras amplexans*, *Andropogon gayanus*, *Brachiaria deflexa*, *B. mutica*, *Chloris lamproparia*, *C. pilosa*, *Cyperus iria*, *C. longus*, *C. microlepis*, *C. pustulatus*, *C. tenuispica*, *Digitaria acuminatissima*, *D. marginata*, *Dinebra retroflexa*, *Echinochloa colona*, *E. obtusiflora*, *E. stagnina*, *Eleocharis atropurpurea*, *Eragrostis atrovirens*, *Hyparrhenia dissoluta*, *Ischaemum brachyatherum*, *Oryza breviligulata*, *Panicum anabaptismum*, *P. laetum*, *P. subalbidum*, *Paspalidium geminatum*, *Pennisetum ramosum*, *Pycreus albomarginatus*, *Scirpus ar-*

*ticulatus*, *S. praelongatus*, *Setaria anceps*, *Sorghum arundinaceum*, *S. bipennatum*, *Sporobolus nzarginatus*, *S. pyranzidalis*, *Thelepogon elegans* and *Urochloa lata*.

In the drainage channels, where water attains semi-permanent depths of a metre or more, and in the lakes and pools, one finds an ephemeral aquatic flora comprising such species as *Aeschynomene crassicaulis*, *Aponogeton subconjugatus*, *Burnatia enneandra*, *Centrostachys aquatica*, *Ceratopteris cornuta*, *Eichhornia crassipes* (among the most abundant), *Eriocaulon bifistulosum*, *Heteranthera callifolia*, *Ipomoea aquatica*, *Limnophyton obtusifolium*, *Lophocarpus guayanensis*, *Marsilea crenulata*, *Nymphaea lotus*, *N. rufescens* (among the most abundant), *Nymphoides indica*, *Ottelia ulvifolia*, *Scholleropsis lutea* (naturalised) and *Vossia cuspidata*. Among the rooted submerged species, *Ammania auriculata*, *Limnophila barteri*, *Rotala mexicana*, *R. tenella* and *R. welwitschii* are most common. Free-floating submerged species include *Chara zeylanica*, *Najas graminea*, *N. pectinata*, *Nitella acuminata*, and on the surface, *Utricularia benjaminiana*, *U. gibba* var. *exolata* and *U. inflexa* var. *stellaris*.

In the more superficially flooded areas, a mosaic vegetation develops in the rainy season, with patches of different composition, some containing only one gregarious species, others being heterogeneous. Representative species include *Acalypha crenata*, *Aeschynomene nilotica*, *A. uniflora*, *Alternanthera sessilis*, *Ammania auriculata*, *Aspilia helianthoides*, *Borreria radiata*, *Burnatia enneandra*, *Caperonia palustris*, *Cassia mimosoides*, *Celosia argentea*, *Cleome hirta*, *Commelina diffusa*, *C. erecta*, *Crinum pauciflorum*, *C. yuccaeflorum*, *Cucumis melo*, *Cyanotis cucullata*, *Dichondra repens*, *Evolvulus alsinoides*, *Glinus oppositifolius*, *Hibiscus articulatus*, *H. cannabinus*, *H. esculentus*, *H. panduriformis*, *Hygrophila auriculata*, *Ilysanthes parviflora*, *Luffa echinata*, *Melochia corchorifolia*, *Phyllanthus maderaspatensis*, *Sesbania leptocarpa*, *S. pachycarpa*, *S. sesban*, *Sonchus exauriculatus*, *Sphenoclea zeylanica*, *Stachytarpheta angustifolia*, *Thalia welwitschii*, *Withania somnifera* and *Zornia glochidiata*. *Acacia nilotica* and *A. seyal* are the only trees on the floodplain proper.

In the west, e.g. on the Gambia and Senegal Rivers, seasonally flooded grasslands may be covered by swards of *Andropogon gayanus*, *Echinochloa pyramidalis*, *Panicum anabaptistum*, *Paspalum orbiculare*, and *Vetiveria* spp., the distribution of species depending upon the depth and duration of inundation, and soil factors.

**Lakes & Ponds:** The southern shores of Lake Chad are fringed by great stands of *Cyperus papyrus* and *Phragmites mauritianus* with much *Vossia cuspidata* in the water, while on the northern shores these

species are replaced by *Phragmites australis* and *Typha latifolia* var. *australis*, and a similar type of vegetation occurs on other lakes and swamps in Chad. However, the absence of papyrus from the rest of the region is one of its more remarkable phytogeographical features. The lakes and swamps of Burkina Faso, Mali and Senegal are dominated by *Phragmites* and *Typha*, together with their typical, lower growing, grass and sedge associates.

Semi-permanent ponds in the Soudanian zone (tabki) are often fringed by a ring of lush grass and trees, the periphery remaining green throughout the dry season even when the ponds dry up. Among the trees present in this situation are *Acacia nilotica*, *A. polyacantha*, *A. sieberana*, *Anogeissus leiocarpus*, *Balanites aegyptiaca*, *Diospyros mespiliformis*, *Mitragyna inermis* and *Tamarindus indica*. *Echinochloa* spp., *Ipomoea aquatica*, *Oryza barthii* and *Vossia cuspidata* are often common in the ponds, as are *Ceratophyllum demersum*, *Nymphaea lotus*, *Pistia stratiotes*, *Potamogeton* spp. and *Utricularia* spp.

The pools and springs of oases may be fringed by *Phragmites mauritanus* and *Typha domingensis*, and there may occasionally be *Ficus* and *Tamarix* trees along the beds of oueds, and quite often *Hyphaene thebaica*. There have been plantings of *Phoenix dactylifera* at many oases.

### **Wetland Fauna**

Most of the savanna species are to be found on the great floodplains of the north of the region during the dry seasons, many moving onto the plain to graze the fresh grasses, closely followed by their predators. They are included in the following lists since they regularly exploit wetlands and are dependent upon them. In much the same way other species visit the closed swamp forests of the Guinean zone during the dry seasons.

**Fishes:** The fish fauna of the Niger Basin is well known, and is primarily Soudanian in character. Of the 112 species described by Daget (1954) in the upper and middle Niger, 66 are common to the Nile and 52 to the Gambia River, while 33 are common to all three rivers, including *Citharinus citharus*, *Hydrocynus forskalii*, *Lates niloticus* and *Oreochromis niloticus*. Some 20 species are apparently confined to the Niger Basin, among them *Gobiocichla wonderi* (middle Niger), *Microthrissa miri* (middle Niger, associated lakes and floodplain), and *Pellonula afziuli* (lower Niger). *Calamoichthys calabaricus* is an eel-like polypteran confined to the Niger Delta. The other rivers of the region have been less well studied, but all have many species in common with the Niger.

Widespread species which have all been collected from the Niger, and most of which have also been recorded from the Volta, Gambia and Senegal Rivers, include *Alestes baremose*, *A. dentex*, *A. leuciscus*, *A. macrolepidotus*, *A. nurse*, *Arius gigas* (on muddy bottoms), *Auchenoglanis occidentalis*, *Bagrus bayad*, *B. docmac*, *Barbus occidentalis*, *B. punctitaeniatus*, *B. stigmatopygus*, *Barilius niloticus*, *Channa obscura*, *Chrysichthys nigrodigitatus*, *Citharinus distichodoides*, *C. latus*, *Clarias anguillaris* (swamps), *C. lazera* (swamps), *C. submarginatus* (swamps), *Clarotes laticeps*, *Distichodus brevipinnis* (swamps), *D. engycephalus* (swamps), *D. rostratus* (swamps), *Eutropius niloticus*, *Gnathonemus adabii*, *G. petersii*, *G. tamandua*, *Gymnarchus niloticus* (swamps), *Hepsetus odoe*, *Heterobranchus bidorsalis*, *H. longifilis*, *Heteropisus bebe*, *Heterotis niloticus* (swamps), *Hydrocynus lineatus*, *H. vittatus*, *Ichthyborus besse*, *Labeo pseudocoubie*, *L. senegalensis*, *Malapterus electricus*, *Marcusenius ihuysi*, *M. psittacus*, *Mormyrops deliciosus*, *Monnyrus macrophthalmus*, *M. rume*, *Notobranchius walkeri* (floodplains/swamps), *Petrocephalus bane*, *Phago loricatus*, *Physalia pellucida*, *Polypterus ansorgei*, *P. endlicheri*, *P. senegalus*, *Protopterus annectens* (floodplains/swamps), *Schilbe mystics*, *Siluranodon auritus*, *Synbranchus afer*, *Synodontis batensoda* (stagnant pools), *S. clarias*, *S. eupterus*, *S. filamentosus*, *S. gobroni* (lower reaches of rivers), *S. nzembranceus*, *S. nigrita* (swamps), *S. ocellifer*, *S. sorex*, *Tetraodon fahaka*, *Tilapia aurea*, *T. galilaea* (sandy bottoms), *T. melanopleura* and *T. zillii* (reed beds).

Coastal lakes and lagoons often contain a mixture of estuarine fishes and fishes with more strictly lacustrine or riverine affinities, especially where the lagoons are periodically closed from the sea, yet fed by a river. Common species known to breed in coastal lagoons include *Acanthurus monroviae*, *Alestes macrolepidotus*, *Caranx carangus*, *Chrysichthys nigrodigitatus*, *Cynoglossus senegalensis*, *Dasyatis margarita*, *Distichodus rostratus*, *Elops lacerta*, *Ethmalosa fimbriata*, *Gerres melanopterus*, *Hemichromis fasciatus*, *Hepsetus odoe*, *Hydrocynus forskalii*, *Labeo senegalensis*, *Liza falcipinnis*, *Pellonula afezeliusi*, *Pristipoma jubelini*, *Psettus sebae*, *Sardinella eba*, *Tilapia nzelanopleura* and *T. zillii*.

A number of marine fish penetrate the rivers for considerable distances. For example *Pellonula vorax* occurs in the Niger Delta, in the mangroves, and migrates upriver to breed, and a flat fish (*Dagetichthys* sp.) and a stingray (*Potamotrygon garouensis*) have been recorded in the Benue River as far upstream as Cameroon. Daget (1954) distinguished between Guinean and Soudanian species, which live in forest and savanna waters respectively. Many fish exhibit seasonal migrations up and down river. *Alestes leuciscus* for example moves up to 400 km along the middle Niger each year (Daget, 1954), while others move up to 50 km

away from the rivers to the edges of floodplains to spawn. A good introduction to recent work on West African fishes is given by Lowe-McConnell (1975), while detailed accounts are provided by Daget (1954; 1957) for the Niger, Daget & Stauch (1963) for the Benue, Daget & Iltis (1965) for the Cote d'Ivoire, Johnels (1954) for the Gambia River and Durand (1970) for rivers entering Lake Chad.

**Amphibia:** Species more or less confined to the two Guinean rain forest blocks include *Bufo perreti*, *Phrynobatrachus alticola* and *Xenopus tropicalis*, while *Phrynobatrachus liberiensis* and *P. guineensis* are confined to the western block. *Hymebochirus merlini* is also confined to the western region but extends from the rain forest block into the coastal savanna zone of Senegal. *Rana galamensis* is a widespread savanna zone species, reaching the coast in the 'Dahomey Gap' but not extending far west of this, while *Phrynobatrachus francisci* occurs in the savanna zones throughout the region.

**Reptiles:** Reptiles found in the wetlands include *Crocodylus cataphractus*, *C. niloticus*, *Osteolaemus tetraspis* and *Varanus niloticus*. Among the snakes of forest streams and pools *Bothrophthalmus lineatus*, *Boulengerina annulata*, *Grayia smithii*, *Miodon acanthias*, *Naja melanoleuca*, *Natrix anoscopus*, *Pseudohaje nigra* and *Python sebae* are the most common. *Boulengerina* is also found in large lakes and impoundments. In the Soudanian zone, *Philothamnus* spp. occur in herbaceous swamps, rivers and pools, while *Psammophis sibilans* is common in wet, as well as dry, grasslands. *Atheris chloraechis*, *Boiga blandingii*, *Dasypeltis fasciata*, *Dendroaspis viridis*, *Thelotornis kirtlandii* and *Thrasops occidentalis* have been recorded in swamp forest trees, while *Dasypeltis scabra*, *Dispholidus typus*, *Philothamnus* sp. and *Thelotornis kirtlandii* have been recorded from riparian swamp forests in the savannas.

**Birds:** The avifauna of the mangrove areas is fairly constant throughout West Africa. Most species are piscivorous, or feed on insects, crabs or shellfish. Species which commonly nest in mangroves include *Ardea goliath*, *Ardea purpurea*, *Bubulcus ibis*, *Butorides striatus*, *Egretta garzetta*, *Hyphanturgus brachypterus*, *Melanophoyx ardesiaca*, *Platysteira cyanea*, *Ploceus cucullatus*, *Turtur afer* and *Uraeginthus bengalus*. Other species regularly seen in mangroves include *Acrocephalus scirpaceus*, *Alseonax aquaticus*, *Anhinga rufa*, *Anthreptes gabonica* (confined to mangroves), *A. longuemarie*, *Ardea cinerea*, *Ardeola ralloides*, *Calidris nzinuta*, *Casmerodius albus*, *Ceryle rudis*, *Chlorophoneus sulphureopectus*, *Cinnyris coccinogaster*, *Corythornis cristata*, *Dryoscopus gambensis*, *Gypohierax angolensis*, *Halcyon malimbicus*, *Haliaeetus vocifer*, *Himantopus himantopus*, *Hirundo rustica*, *Hypergerus atriceps*,

*Lanarius barbarus*, *Lophoceros nasutus*, *Macronyx croceus*, *Numenius phaeopus*, *Nunzida meleagris*, *Nycticorax leuconotus*, *N. nycticorax*, *Pandion haliaeetus*, *Phalacrocorax africanus*, *Phylloscopus collybita*, *P. trochilus*, *Pynonotus barbatus*, *Spermophaga haematina*, *Streptopelia semitorquata*, *Sylvia cantillans*, *Tringa nebularia* and *T. totanus*.

Other species widely distributed in West African coastal wetlands, including lagoons, lakes and estuaries, are *Anas acuta*, *A. clypeata*, *A. querquedula*, *Casmerodius albus*, *Dendrocygna bicolor*, *D. viduata*, *Egretta garzetta*, *Euplectes orix*, *Gelochidion nilotica*, *Hydroprogne caspia*, *Larus cirrocephalus*, *L. genei*, *Morus bassanus*, *Nycticorax nycticorax*, *Otis arabs*, *Pandion haliaeetus*, *Phaethon aethereus*, *Platalea leucorodia*, *Sterna albifrons*, *S. anaethetus*, *S. fuscata*, *Sula leucogaster* and *Thalasseus Maximus*.

Kingfishers occur in wetlands throughout the region. Those with the widest distribution occur right across the Soudanian zone and include *Ceryle rudis*, *Halcyon chelicuti* and *Halcyon senegalensis*. *Halcyon fuscopileus* and *Mioceyx lecontei* occur in both rain forest blocks, while *Halcyon badius badius* is confined to the eastern block and *Halcyon badius nigricans* to the western block. *Alcedo quadribrachys* and *Corythornis leucogaster* are found in the southern savanna zones and reach the coast in the 'Dahomey Gap'.

Common species on West African floodplains include *Alopochen aegyptiacus*, *Anas acuta*, *A. capensis*, *A. querquedula*, *Anhinga rufa*, *Ardea cinerea*, *A. goliath*, *A. melanocephala*, *A. purpurea*, *A. ralloides*, *Balearica pavonina*, *Bubulcus ibis*, *Butorides striatus*, *Calidris minuta*, *C. temminckii*, *C. testacea*, *Chlidonias hiaticula*, *C. hybrida*, *C. leucoptera*, *Ciconia ciconia*, *Dendrocygna viduata*, *Egretta garzetta*, *E. intermedia*, *Ephippiorhynchus senegalensis*, *Glareola nordmanni*, *G. pratincola*, *Hagedashia hagedash*, *Haliaeetus vocifer*, *Himantopus himantopus*, *Ixobrychus minutus*, *Larus cirrocephalus*, *Leptoptilos crumenifera*, *Limosa lapponica*, *L. limosa*, *Nettapus auritus*, *Pelecanus onocrotalus*, *Phalacrocorax africanus*, *P. carbo*, *Philomachus pugnax*, *Platalea alba*, *Plectropterus gambensis*, *Plegadis falcinellus*, *Sarkidiornis melanotos*, *Scotopelia peli*, *Threskiornis aethiopicus*, *Tringa glareola*, *T. erythropus* and *T. nebularia*.

**Mammals:** *Trichechus senegalensis* occurs in rivers and lakes throughout the region, extending several hundred kilometres inland. Large terrestrial mammals found in the swamp forests of the two rain forest blocks comprise *Cephalophus monticola*, *C. niger*, *C. ogilbyi*, *C. sylvicultor*, *Hyemoschus aquaticus*, *Loxodonta pumilio*, *Manis gigantea*

(extends into savannas), *M. tetradactyla*, *Potamochoerus porcus* and *Syncerus caffer nanus*. Others are confined to one or the other block, not crossing the 'Dahomey Gap'. Those restricted to the eastern rain forest block include *Cephalophus nigrifrons*, *Neotragus batesi* (E Niger Delta only), while those found only in the western block include *Cephalophus dorsalis*, *C. jentinki*, *Chloeropsis liberiensis*, *Neotragus pygmaeus*, *Tragelaphus euryceros* and *T scriptus*.

*Hippopotamus amphibius* is found in the savanna zones and the eastern rain forest block, but is replaced in the western forest block by *Chloeropsis liberiensis*. Other large mammals which visit wetlands throughout the savanna zones are *Cephalophus rufilatus* (S savanna zone), *Loxodonta africana*, *Lycaon pictus*, *Ourebia ourebi*, *Panthera leo* (floodplains), *Panthera pardus*, *Phacochoerus aethiopicus*, *Redunca redunca*, *Sylvicapra grinzmia* and *Syncerus caffer brachyceros*, while those with restricted distributions are *Damaliscus lunatus* (Lake Chad and floodplains of Sahel), *Hippotragus equinus* (gallery forest of central zone), *Kobus ellipsiprynzus* (W only), *K. kob* (W only), *Papio papio* (W savanna), *P. doguera* (E savanna), *Taurotragus derbianus* (W savanna), *Tragelaphus oryx* (between upper courses of Niger and Senegal Rivers), *T. spekei* (Lake Chad and W Senegal) and *Vulpes pallida* (floodplains of N). *Canis aureus* and *Hyaena hyaena* visit floodplains in the Sahel zone, while in the Soudanian zone they are replaced by *Canis adustus* and *Crocuta crocuta*. *Erythrocebus patas* occurs on the floodplains in the northern savanna and southern Sahel zones.

Arboreal species in swamp forests of the two rain forest blocks include *Anomalurus beecroftii*, *A. derbianus*, *A. peli*, *Cercocebus torquatus*, *Cercopithecus mona* (including mangroves), *C. nictitans*, *Colobus polykomos*, *Dendrohyrax arboreus*, *Epixerus ebii*, *Funisciurus pyrrhopus*, *Galago demidovii*, *Heliosciurus rufobrachium*, *Idiurus macrotis*, *Nandinia binotata*, *Paraxerus poensis* and *Protoxerus stangeri*. Those confined to the eastern block are *Cercopithecus cephus*, *C. lhoestii* (E Niger Delta only) while those confined to the western rain forest block are *Anomalurus pusillus*, *Cercopithecus petaurista*, *Colobus badius* (extends into Senegal), *C. verus*, *Heliosciurus gambianus* and *Poiana richardsoni*. *Cercopithecus aethiops* and *Galago senegalensis* are found throughout the savanna zones.

Small mammals found in wetlands throughout the region, although scarce in the Sahel zone, include *Aonyx capensis*, *Atilax paludinosus*, *Cricetomys ganzbianus*, *Genetta tigrina*, *Herpestes ichneumon*, *H. sanguineus*, *Lutra maculicollis*, *Thryonomys swinderianus* and *Viverra civetta*. *Crossarchus obscurus*, *Felis aurata* and *Malacomys longipes* live in the rain forest blocks while *Dasymys incomtus*, *Ichneurnia albicauda*, *Leptailurus serval* and *Mungos mungo* occur in the savanna zones. *Potamogale velox* was

believed to occur only in the extreme southeast of the region, on the Cross River, but has recently been reported from rivers in Guinea Bissau. Some of these species are uncommon in wetlands, but nevertheless merit mention because they do visit them and are known to eat frogs and freshwater crabs, e.g. *Crossarchus obscurus* and *Ichneumia albicauda*, while *Mungos mungo* often eats *Dasymys incomtus* and *Thryonomys swinderianus* which it takes in marginal wetlands. Several bats have been observed in and over high swamp forest, including *Glauconycteris superba*, *Hypsignathus monstrosus* and *Taphozous mauritanus*, while *Eidolon helvum*, *Epomophorus gambianus* and *Epomops franqueti* live in, or visit, wetlands of the savanna zones.