

## 4.5 GABON

### Introduction

Gabon has an area of 267 665 km<sup>2</sup>, a population of 1 292 000 and a population density of 4.8 persons/km<sup>2</sup>. It is bounded by Equatorial Guinea and Cameroon in the north, by Congo in the east and south, and by the Atlantic Ocean in the west. The northern, eastern and western borders are in hills at elevations of 500 -700 m asl, and by far the greatest part of the country drains towards the centre, into the Ogooud River and thence to the Atlantic Ocean. However, in the extreme northwest, the Nye and Ntem Rivers flow into Cameroon and the Woleu River flows into Equatorial Guinea. All the way down the coast little streams, draining the coastal hills, flow directly to the sea across the coastal plain. In the southeast the Nyanga River rises in the Moukande Mountains and flows south into Congo, then in an arc back into Gabon, where it enters a deep trough running SE-NW between the highlands of the Massif du Chaillu and the Koungou Mountains. This latter range it breaches, in a narrow valley, to reach the sea. The highest point in the country is Mt. Iboundji (1°06'S/11°48'E), 1575 m asl in the Moukandó Mountains, and only in the immediate vicinity of this peak does land rise above the 1000 m contour.

Gabon straddles the equator between latitudes 2°17'N and 3°57'S, but the coastline extends only from 1°00'N to 3°57'S. Although this is a straight line distance of 545 km, the coastline is highly indented and exceeds 1460 km in length. The short northern strip of coast is 'set back' and sheltered, but from Cape Lopez (0°37'S/8°45'E) southwards, coastal form is dictated by a powerful northward longshore drift. Most of the central and southern coast is sandy and of low relief, and river mouths have been deflected northwards behind long sandspits, each of which subtends a large lagoon, the principal ones, from north to south, being N'Komi, Igtiela, Ndogo and M'Banio.

### Climate

Mean annual precipitation at the coast decreases from north to south. It is over 3500 mm at Cocobeach on the northern border, 2645 mm at Libreville, 1768 mm at Mayumba and about 1650 mm at the southern border. In the far north rainfall is almost aseasonal, but in the south most of the rain falls during the 8 months from October to May. Here the June-September period is almost rainless and insolation is correspondingly higher. Rainfall decreases and then increases again, in passing inland. The high borderlands in the north receive mean annual falls in excess of 1700 mm, but this increases to 2000 mm on the eastern border and to more than 2200 mm in a wet pocket in the southeast around Franceville (1°40'S/13°31'E). However, rainfall is still seasonal, July is the driest month, and the town of Franceville, which is situated in a valley, receives only 1890 mm/yr.

The mean annual temperature is close to 26°C along the coast, but with little monthly fluctuation in the north and increasing seasonal variation towards the south. At Mayumba (3°23'S/10°38'E) for example, where the climate is distinctly seasonal, the warmest

month is March, with a mean maximum temperature of 30°C, a mean minimum temperature of 23°C, and a mean monthly temperature of 27°C. By contrast, in July, the coolest month, the corresponding figures are 26, 18.5 and 22°C.

## **Wetlands**

Because of the longshore drift river mouths are deflected northwards behind sandy spits, and tidal forests are well developed below the 'elbows' where the rivers turn north. From these sites of northward deflection low lying areas extend southeastwards, down the coast, immediately to landward of the beach. Mangroves are more extensive on the south banks of rivers than on the north banks. The flow of water in the Ogooue River is so great that a mass of fresh water backs up behind the tide, and fresh water tidal areas occur upstream, which are forested by a community distinct from that which occupies the saline areas downstream. Tidal (mangrove) forests occur in all estuaries, bays and lagoons along the coast. An IUCN report (Saenger *et al.*, 1983) suggests that there are 250 000 ha of 'mangrove' forest on the coast, but this could well be an underestimate, and refers only to forests dominated by *Rhizophora* and *Avicennia*. The total area of tidal forest, in its broadest sense, is probably in excess of 350 000 ha. Numerous shallow lakes, fringed by extensive swamps, occur on the coastal plain, and there are other deeper lakes at the lower ends of valleys where the Ogooue traverses the coast range. A large area of swamp forest, still in pristine condition, is situated in the headwater basins of the Ivindo and Djoua Rivers, and swamps accompany the Ogooue River for almost its entire course. The valleys of the Nyanga and Ngounie Rivers are also swampy.

## **Wetland Flora**

All the typical West African tidal forest species have been collected on the Gabonese coast, with two species of *Rhizophora* (*R. harrisonii* and *R. racemosa*) and *Avicennia africana* dominating the more seaward areas, and *Acrostichum aureum*, *Caesalpinia bonduc*, *Conocarpus erecta*, *Dalbergia ecastaphyllum*, *Dodonaea viscosa*, *Drepanocarpus lunatus*, *Heteropterys leona*, *Laguncularia racemosa*, *Ormocarpum verrucosum*, *Rhopalopilina inarquesii* and *Ternstroemia africana* in less frequently inundated zones, and in the dry fringes.

Sea grasses occur on the mudflats prior to their colonisation by *Rhizophora racemosa* which is almost always the seaward pioneer. Stands on rapidly prograding shores are usually size-graded, with the forest canopy ascending smoothly away from the sea until a zone of mature *Rhizophora* forest is reached, where the canopy may be more than 30 m high. This high mangrove forest occupies belts up to 700 m wide in the Bay of Cape Lopez. *Nypa fruticans* was introduced to West Africa at the turn of the century, and became established in Cameroon and has been reported from Gabon. Another Indo-Pacific strand species, that occurs naturally in mangroves in Madagascar, *Calophyllum inophyllum*, has also become naturalised in West Africa and is reputedly present in Gabon.

*Hibiscus tiliaceus* often appears on sandy banks along rivers, in brackish sites, where it

forms dense groves, sometimes with *Avicennia africana* as an associate. *Afrosersalisia afzelii*, *Aucoumea klaineana*, *Leconitedoxa nogo*, *Manilkara lacera*, *Sideroxylon mayumbense* and *Synsepalum congolense* are common on lagoon margins and often occur in the fringes of mangroves. Both *Avicennia africana* and *Rhizophora harrisonii* extend into fresh water tidal swamps. There is virtually no understorey in the mangrove forests, but *Acrostichum aureum* occurs in clearings in the upper tidal reaches, and may fill them with dense vegetation up to 2 m high. *Schizolegnia ensifolia* is another terrestrial fern found in the less deeply flooded parts of mangrove swamps, and *Nephrolepis biserrata* and *Platynerium stemaria* are common epiphytes. The lagoon grasses, *Anadelphia* spp., also occur in the fringes of mangroves in the brackish areas of deltas, estuaries and lagoons. *Chrysobalanus* sp., *Cynometra mannii*, *Crudia klainei*, *Manilkara obovata*, *Phoenix reclinata* and *Oxystigma mannii* occur on levees and in the wet fringes of tidal swamps, in transitions to non-tidal swamp forest. In transitions to palm swamps, *Rhizophora harrisonii* occurs with *Pandanus candelabrum*, *Phoenix reclinata* and *Raphia hookeri*. These swamps grade, upstream and inland, into pure *Raphia* palm swamps, which are often rendered impenetrable by the prolific development of lianoid palms belonging to *Ancistrophyllum*, *Calamus* and *Eremospatha*. Palm swamps, or 'raphiales' as they are known, frequently grade into fresh water swamp forest.

The flora of permanently and seasonally inundated forests, including gallery forests, is rich, and is very variable from place to place. The commonest species include *Albiziazygia*, *Alstonia boonei*, *A. congensis*, *Anopyxis klaineana*, *Anthocleista liebrechtsiana*, *A. nobilis*, *Anthonotha pynaertii*, *Anubias affinis*, *Aucoumea klaineana*, *Baikaea insignis*, *Berlinia bruneelii*, *B. grandiflora*, *B. sapinii*, *Berberia laurentii*, *Brazzea congoensis*, *Bridelia nzacrantha*, *B. ripicola*, *Ceiba thonningii*, *Chrysobalanus atocorensis*, *Coelocaryon botryoides*, *Coffea congensis*, *Cola attiensis*, *C. lepidota*, *Crotonogyne giorgii*, *C. poggei*, *Dacryodes edulis*, *Dialium pachyphyllum*, *Dichaetanthera africana*, *D. strigosa*, *Dichostemma glaucescens*, *Elaeis guineensis*, *Eiztandrophragma palustre*, *Eriocoelunz microspermum*, *Ficus mucosa*, *Gambeya africana*, *G. subnuda*, *Garcinia smeathmannii*, *Gilbertiodendron dewevrei*, *Gluema ivorensis*, *Guibourtia demeusii*, *Hymenocardia heudelotii*, *Irvingia grandiflora*, *smithii*, *Lanea welwitschii*, *Lasiodiscus nzarzoratus*, *L. mannii*, *Mallotus oppositifolius*, *Mimusops warneckei*, *Mitragyna ciliata*, *M. stipulosa*, *Monopetalanthus pteridophyllus*, *Nauclea diderrichii*, *N. pobegui nii*, *Octolobus heteromus*, *Oubanguia africana*, *Paramacrolobium coeruleum*, *Parinari congensis*, *P. glabra*, *Pseudospondias microcarpa*, *Pycnanthus marchalianus*, *Raphia hookeri*, *R. laurentii*, *R. sese*, *Ricinodendron palustre*, *Sersalia palustre*, *Spondiathus preussii*, *Sterculia ambacensis*, *S. bequaertii*, *Symphonia globulifera*, *Synsepalunz dulcificum*, *Syzygiunz gillettii*, *S. guineense*, *Treculia africana*, *Trichelia retusa*, *Uapaca guineensis*, *U. heudelotii*, *Uvaria laurentii*, *Uvarioidendron mayumbense*, *Wildemaniodoxa laurentii*, *Ventilago africana*, *Voacanga thouarsii*, *Xylophia aethiopica*, *X. rubescens* and *X. staudtii*. Buttresses, loop roots, stilt roots and erect pneumatophores are common in the swamp forests, and undergrowth is scant except in clearings and along watercourses. *Cyrtosperma senegalense* and *Marantochloa* spp. are common in these situations, as are several terrestrial ferns, among them *Adiantum vogellii*, *Asplenium diplazisorum* (raphiales), *A. variabile*, *Bolbitis auriculata*, *Diplazium proliferum* (raphiales), *Lonchitis currori*,

*Lygodium microphyllum*, *Nephrolepis biserrata*, *Pteris mildbraedii* (raphiales), *P. marginata* and *Tectaria angelicifolia* (raphiales). *Leea guineensis* forms straggling woody thickets, supported by prop roots, in open spaces, and *Bequaertiodendron magalisnzontanum* occurs as an occasional small tree which develops knee roots in streamside situations under a broken canopy (it also grows on the Drakensberg Mountains in Swaziland and South Africa).

Lianes, including *Artabotrys* spp., *Ancistrophyllum secundiflorum*, *Donella welwitschii*, *Eremospatha haullevilleana* and *Landolphia* spp., are locally abundant, and the well developed epiflora is dominated by ferns and orchids. Common species include *Lomariopsis palustris*, *Platycerium angolense*, *P. stemaria*, *Nephrolepis biserrata*, *Selaginella* spp. and *Trichomanes erosum*.

Forest pools may be covered by *Azolla africana*, *Lemna paucicosta*, *Pistia stratiotes* and *Salvinia nymphellula*, but these species also occur in backwaters of the Ogooue and other rivers. *Ceratopteris cornuta* and *Impatiens irvingii* grow in the water around the banks of ponds, lakes and slow flowing rivers, with *Impatiens gossweileri*, *hians*, *niamniamensis* and *Lycopodiunt cernuunz* at higher drier levels. *Cyathea manniana* occurs in swampy depressions and may be found around forest pools and along streams. *Nymphaea* spp. are dominant on quiet waters open to the sunlight, and in these situations *Ceratophyllum demersum* and species of *Najas* and *Potamogeton* form dense submerged beds.

*Cyathea camerooniana* lines watercourses in the highlands, and *Cyperus papyrus* dominates some swamps in the upper valleys of streams and also occurs on the coastal plain, with lower growing associates such as *Cyclosorus striatus* and *Vossia cuspidata*. In the south, there are areas of short marshy littoral steppes dominated by *Loudetia simplex* with *Bulbostylis laniceps* and *Rhytachne rottboellioides*.

## **Wetland Fauna**

**Fishes:** The fish faunas of the majority of the rivers have not been reported in detail, but that of the Ogooue is known to include species with either West African or Zaire Basin affinities. *Gymnarchus niloticus* and *Protopterus annectens* occur in seasonally flooded areas, and species of *Alestes*, *Auchenoglanis*, *Bagrus*, *Barbus*, *Channa*, *Chrysichthys*, *Citharinus*, *Clarias*, *Distichodus*, *Eutropius*, *Gnathonemus*, *Hentichromis*, *Hepsetus*, *Heterobranchus*, *Hydrocynus*, *Labeo*, *Marcusenius*, *Mormyrus*, *Mormyrops*, *Polypterus*, *Schilbe*, *Synodontis*, *Tetraodon* and *Tilapia* occur in the lakes and rivers. The fishes of the Ivindo Basin have been described by Gery (1965).

**Reptiles:** *Crocodylus cataphractus*, *C. niloticus* and *Varanus niloticus* occur in the upstream swamps throughout coastal Gabon, together with species of *Pelomedusa* and *Pelusios*. The African dwarf crocodile, *Osteolaemus tetraspis* also occurs locally, e.g. in the coastal swamps around Ndogo Lagoon. Among the snakes *Boulengerina annulata*, *Naja melanoleuca*, *Natriciteres olivacea*, *Philothamnus irregularis* and *Python sebae* are widespread aquatic or semi-aquatic species, while *Psanzmophis sibilans* inhabits

herb swamps and wet grasslands, and *Dasyeltis fasciata*, *Dendroaspis jamesonii*, *Philothamnus semivariatus*, *Thelotornis kirtlandii* and *Thrasops occidentalis* (N only) are arboreal in swamp and flooded gallery forests.

**Birds:** The avifauna includes several species which prey upon squirrels and monkeys, e.g. *Hieraaetus spilogaster*, *Stephanoaetus coronatus* and *Urotriorchis macrourus*, also numerous piscivorous species such as *Ceryle rudis*, *Haliaeetus vocifer*, *Larus fuscus*, *Megaceryle maxima*, *Pandion haliaetus*, *Pelecanus onocrotalus*, *Rynchops flavirostris* and *Scotopelia peli*. There are also ducks, geese, herons, ibises, storks, egrets and bitterns. Other species, including several weavers, are abundant in the palm, pandan and papyrus swamps.

**Mammals:** Small mammals found in the wetlands include *Aonyx capensis* (including mangroves), *A. congica*, *Atherurus africanus* (gallery forests), *Atilax paludinosus*, *Dasyms bentleyi* (herb swamps), *Genetta tigrina* (palm and papyrus), *Herpestes ichneumon*, *H. naso* (temporarily inundated forests), *H. sanguineus* (gallery forest), *Lutra maculicollis*, *Otomys* cf. *angoniensis*, *Potamogale velox*, *Thryonomys gregorianus*, *T. swinderianus* (herb swamps) and *Viverra civetta* (gallery forests). Larger mammals resident in the wetlands, or which visit them regularly include *Cephalophus callipygus*, *C. dorsalis*, *C. leucogaster*, *C. monticola*, *C. nigrifrons*, *C. sylvicultor*, *Felis aurata*, *Hippopotamus amphibius*, *Hyemoschus aquaticus*, *Loxodonta africana cyclotis*, *Manis gigantea* (N only), *Manis tetradactyla*, *Panthera pardus*, *Phacochoerus aethiopicus*, *Potamochoerus porcus*, *Syncerus caffer nanus*, *Tragelaphus scriptus*, *T. spekei* and *Trichechus senegalensis* (mangrove estuaries and large rivers). *Kobus ellipsiprymnus* is reported by some authorities and both *Gorilla gorilla* and *Pan troglodytes* are thought to visit temporarily flooded forests.

Arboreal mammals comprise *Anomalurus beecroftii*, *A. derbianus*, *A. pusillus*, *Cercocebus albigena albigena*, *Cercopithecus cephus cephus*, *C. neglectus* (E only), *Colobus polykomos satanas*, *Dendrohyrax arboreus* (gallery forests), *Epixerus ebii*, *Funisciurus lemniscatus*, *F. pyrrhopus* (including mangroves), *Galago demidovii*, *Heliosciurus rufobrachium*, *Idiurus macrotis*, *Miopithecus talapoin* (including mangroves), *Myosciurus pumilio*, *Nandinia binotata* (gallery forests), *Paraxerus poensis*, *Poinana richardsoni*, *Protoxerus stangeri* and *Zenkerella insignis*.

### List of Wetlands Described

1. Wetlands of the Coastal Plain
2. Wetlands of the Ivindo River Headwater Basin
3. Wetlands of the Upper Ogooue Valley
4. Wetlands of the Ngounie River

### 1. Wetlands of the Coastal Plain

**Country:** Gabon

**Coordinates:** 1°00'-3°57'S/9°15'-11°19'E

**Area:** 2 975 000 ha (650 000 ha wetland)

**Altitude:** 0-100 m asl

**Nearest Towns:** Libreville; Mayumba (both on Plain)

**General:** At the coast, the Mitemboni River marks the northern boundary and a few kilometres from its mouth it is joined on the Gabonese bank by a short tributary, the Noya, which meanders for some 40 km across a flat coastal plain. Tidal swamps exist at the Mitemboni River mouth, and upstream and along the Noya River for many kilometres, covering some 3 000 ha, but from Pointe Bini, just to the south, the coast is at first sandy and runs due south for 31 km to the Bay of Monda. Low hills run parallel to the coast with a watershed 22 km inland, reaching a maximum altitude of 210 m asl. Many small streams flow down from these hills, across the narrow coastal plain which is mostly coral by evergreen rain forest. The short stream drains in a clam pattern of channels at the coast between latitudes 0°48'-0°35'N, where there is a tidal swamp some 1.5 km wide and 22 km long. At its northern end the swamp extends inland behind the sandy coastal dunes, and here the mangrove forest has a transition to dune forest on the seaward side and grades into swampy rain forest on the landward side.

Farther south, mangrove forests occupy all the shores of the Bay of Monda (0°38'N/9°33'E) in a wide belt which extends inland for 18-22 km up the estuaries of the Ayondo River, and several other streams which enter the head of the bay. Altogether there are close to 17 400 ha of tidal swamp in the bay. The city of Libreville (0°24'N/9°27'E) is situated on the seaward side of the sandspit that forms the outer arm of Monda Bay, facing southwest towards Pt. Pongara across the mouth of the Gabon Estuary. Several streams enter this broad estuary and mangrove forests fringe its entire shoreline. On the northern side they form a belt 1-2 km wide and over 44 km long, but they stretch for almost 90 km along the concave southern shore, reaching inland for up to 21 km in huge blocks in those areas watered by tributary streams. There are approximately 45 200 ha of tidal forest here, backed on the southern side by rain forest or fresh water swamp forest, and again the mangrove canopy exceeds 30 m in height.

The rather rugged and indented coast, with a densely forested hinterland, continues south from Pt. Pongara to the Bay of Cape Lopez (Nazare) at latitude 0°37'S. Small indentations support minor mangrove stands, and the coast is backed by dense littoral forest grading into swamp forest or wet savanna inland. The Bay of Cape Lopez is protected on its seaward, western, side by the sandspit of Cape Lopez, and is filled with mangroves on vast alluvial mudbanks produced at the mouths of some distributaries of the Ogooue River. This tidal forest forms a continuous block 22 km wide and 28 km deep between the sea and the land, broken only by the courses of distributary streams. The bay contains over 61 600 ha of tidal forest.

On the landward, eastern, shore of the bay, the coastal plain is dotted with little lakes, many receiving inputs from one or more streams, but having no canalised outflow in most cases, while others are arranged in chains along indistinct drainage lines. In this region, densely forested coastal hills, which reach 245 m in height, approach to within 12 km of the coast. They drain to the sea via these little lakes through everchanging watercourses in the sandy substratum. The lakes are enclosed by permanent swamplands, and in the hills behind, at altitudes up to 200 m,

there are other small endorheic crater lakes, the largest measuring 2x1.5 km.

The main course of the Ogooue River passes south of the Bay of Cape Lopez to another part of its delta on the coast. Here it discharges through its main channel and several tributaries, reaching the sea behind a sandy barrier island. Alluvium from the river is swept northwards up the coast, contributing to the spit of Cape Lopez. To the south, fresh spits are continuously extending northwards from below the delta, slowly growing across its face before detaching from the mainland at their bases and becoming barrier islands. These continue to move north. Eventually they join or are dispersed along earlier northward spits if they catch them. The present barrier island is some 4 km wide and 55 km long with a N-S channel 7 km wide between it and the delta face. On the south bank of the principal mouth of the Ogooue a block of tidal forest covers 14 000 ha, backed by a block of palm and *Pandanus* swamp of equivalent area, while upstream, on both banks, there are large areas that are regularly inundated by a combination of tides and fresh water floods. In total, swamplands occupy 109 400 ha, some 55% of which are forested, while 45 % support herbaceous cover, with local, but very small, areas of bare mudflat.

On either side of the Ogooue River, backing the floodplain, there is a series of lakes. These abut a line of low hills, rising to 80 m asl, which the Ogooue traverses in a valley about 30 km wide. The lakes on the northern side extend far up tributary valleys into the hills so that they have the highly indented shapes so characteristic of flooded valleys. Along this bank of the Ogooue most of the lakes have direct connection with the river. They are, in passing upstream, Lakes Iwande, Ingoyo, Gome, Loge, Ntchonie, Igouloue, Akombie, Nkomie and Ogonobie. Lake Gome is nearly 17 km long with a mean width of 2 km. On the south bank the river drains Lakes Ogonie, Auanga and Onangue, the latter being the largest group with a maximum width of 25 km and a length of 30 km. Swamps occur in patches around the shores of the north bank lakes and may continue up valleys into the hills in tracts several kilometres wide and up to 17 km long. These valley swamps reach elevations of 45 m asl. There is however, far more swampy land around the lakes on the south bank and this supports palm-pandan swamps and swamp forest. The Ogooue flows in multiple channels between the delta and its confluence with the Ngounie River at Lambarene (0°42'S/10°16'E) some 150 km inland. A broad floodplain accompanies it throughout this stretch and much of the land between the river channels, which in places are 18 km apart, is subject to periodic inundation.

The Ogooue Delta extends over a whole degree of latitude between 0°38'S at Pt. Fetiche in the Bay of Cape Lopez, to 1°37'S where the southernmost distributary discharges near the mouth of N'Komi (Fenian Vaz) Lagoon, the next most southerly lagoon. The lagoon covers an area of 31 500 ha and has large areas of forested tidal swamp on its periphery. The swamps are best developed at the head of the lagoon where the River Rembo N'Komi enters and a large tidal area extends back upstream for some 20 km. 10 000 ha of tidal swamp and forest occur in this region.

From N'Komi Lagoon to 'piela (N'Gove) Lagoon the beaches are low, sandy and backed by littoral forest festooned with climbers. Igtiela Lagoon is again fringed by mangrove forests which are in their turn backed by areas of freshwater swampland. Just south of Igtiela Lagoon is the small stranded and very swampy Gamba Lagoon. From this place swamps extend SE along the

course of the N'Gove River, a coastal stream, which rises inland of Petit Loango (2°15 'S/9°40'E), a small village on the coast. This little riverine swamp covers 16 000 ha, and stretches 20 km along the stream, almost parallel to the coast.

Farther south, the large island studded Ndogo (N'Dogau) Lagoon opens from the coast with a channel which branches northwards to the smaller Sounga Lagoon. Ndogo Lagoon has an open water area in excess of 50 000 ha and measures 42 km in length with a mean width of 12 km, excluding the entrance channel which is 1 km wide and 14 km long. The lagoon margin is highly indented and together with the islands is very largely fringed by mangrove forests. These are best developed at the northern and southern ends of the lagoon and along the eastern, landward, shore. Mangroves also fringe much of Sounga Lagoon.

A sandy coast reaches south from Ndogo Lagoon, with parallel sandy ridges separating swampy swales. Numerous small lagoons open to the coast in this sector, and most are continuously fringed by mangrove forests, grading into fresh water swamps at their heads where little streams flow in. Inland, moist savanna woodlands occupy the parallel ridges. Still further inland, 19 km from the coast, is Lake Mandje (Cachimba), a rectangular expanse of water 12x6 km (2°50'S/10°22'E). The lake is almost completely surrounded by 17 400 ha of permanent swamps, except along parts of the western shore. The swamps reach south to the Nyanga River, with which the lake appears to have no permanent open connection, but into which it drains in diffuse fashion.

Hills rise 14 km east of Lake Man\* (36 km from the coast) and are drained by the Nyanga River which rises in the Massif de Chaillu in Congo. This river has 11 sets of rapids. The first is just 26 km from the sea in a straight line, but extends 62 km upstream. In its lower reaches the river meanders and is flanked by broad swamps grading from fresh water tidal to salt water tidal in passing downstream. The largest swamp covering 39 780 ha, is continuous along the south bank for 14 km near the river mouth, and reaches 36 km in depth. Numerous small streams flow into the swamp from hills which rise abruptly to 160 m asl along its eastern flank, and there are several small islands of dry land in it, which support dense littoral forest.

In proceeding farther south, the Koungou Mountains attain heights of over 600 m asl, and approach to within 11 km of the long sandy coast. In this southernmost section of the Gabonese coast, Lagoon M'Banio, extends SE for 80 km from the town of Mayumba (3°26'S/10°38'E), situated near the end of the long spit which separates the lagoon from the sea. The mountains and hinterland are densely forested, while the coastal strip supports swamps, moist savannas and large patches of high forest. Many small streams run down from the mountains, reaching the sea to the north of M'Banio Lagoon, e.g. the Bourne Bourne Rivulet, but most enter the lagoon along its eastern shore, e.g. the Louzibi, Djaungou and N'Douma Rivers. These streams all support tidal forest at their mouths and swamp forest upstream. The head of M'Banio Lagoon is situated 16 km inland and is completely fringed by tall swamp forests which are traversed by a road from an inland timber collection point to an export point on the lagoon.

**Human Impact & Utilisation:** Major centres of population, e.g. Libreville, Port Gentil and Mayumba, are situated on the coastal sandspits, away from the swampy mosquito infested coastal lowlands. Timber has traditionally been the basis of the national

economy, and has been brought from interior collection sites to jetties constructed on the landward sides of all the major lagoons, from where it is taken to Libreville or Port Gentil for export overseas. The principal species exploited have been *Aucoumea klaineana* (a tree of swampy depressions), *Chlorophora excelsa* and *Terininalia superba*. Oil exploration is proceeding along the coast, both in the coastal strip and offshore, and a pipeline reaches 100 km north from the present centre of extraction to Port Gentil. The indigenous population of the Coastal Plain is sparse and there are no metalled roads, only forestry roads. The main road linking Libreville with Pointe Noire in Congo runs through the Ngounie Valley well inland, and the only road leaving this for the coast goes to Mayumba. All traffic to Port Gentil is by sea. The many lakes along the Ogooue River, and the rivers themselves, are fished quite intensively.

**Conservation Status:** Two major coastal areas are protected. An area midway between Libreville and Port Gentil comprises the National Park of Wonga Wongue (55 000 ha) and an associated hunting reserve (330 000 ha). Farther south, 100 000 ha in the Moukalaba Faunal Reserve is intended for total protection, but is at present, still subject to some residual forestry leases. It is contiguous with the Petit Loango Faunal Reserve of 80 000 ha, and together these areas may be combined as the Petit Loango National Park, which will then extend from the head of 'piela Lagoon to the mouth of Ndogo Lagoon. All these protected areas have extensive open sea frontages and all extend inland over the flat or gently undulating coastal plain. All include areas of coastal wetland, including lakes, herb, palm and tree swamps, although no large mangrove area is included. It is not yet clear whether any lagoon shore will be included.

## 2. Wetlands of the Ivindo River Headwater Basin

**Country:** Gabon

**Coordinates:** 0°00' -2°00' N/12°00' -14°16' E

**Area:** 3 630 000 ha (c. 432 000 ha wetland, i.e. 12% landsurface)

**Altitude:** 200-650 m asl

**Nearest Towns:** Makokou (in basin); Libreville (350 km W)

**General:** In the highest part of the basin, the Nina (Ayina) River meanders along the border with Cameroon, flowing due east and descending from 557 to 543 m asl, largely in one rapids section. An extensive block of swamp forest occurs along the river, centred at 2°15'N/13°05'E. At 13°17'E the river swings southwards, forming the border with Congo, and from this point a floodplain extends along its entire length, reaching an average width of 2 km in Gabon before the river traverses a narrower valley between Misseke Mountain in Congo and the Kokamegue Mountains in Gabon. Immediately south of this point, at an altitude of 495 m asl, the river is known as the Ivindo. At an altitude of 492 m asl (1°45'N), the river flows through a series of channels and the floodplain broadens to 5 km on either bank. Permanent swamps and forested floodplains occur along the tributaries, e.g. the Bêmvoula River which joins the Ivindo at 1°35'N. All these periodically flooded plains are covered by dense undisturbed swamp forest, with isolated depressions containing permanently flooded forest.

The principal headwater tributary, the Djoua River, flowing westwards along the Congolese border, descends the Eyoya Rapids and joins the Ivindo at an altitude of 473 m

asl, just above the town of Mvadi (1°11'N/13°11'E). Above the rapids a seasonally flooded area follows the Djoua for 120 km to the east. At first the flood extends 5-10 km into Gabon, but between longitudes 13°30'-14°00'E it spreads 30 km southwards away from the Djoua River, contracting again upstream. There are at least 210 000 ha of swamp forest on the Djoua River in Gabon.

A floodplain follows the Ivindo 75 km southwestwards from Mvadi to its confluence with the Djadid (Zadiè) River, where it merges with the Djadie Floodplain. This latter floodplain extends upstream from the confluence and is well developed north of latitude 1°N. It extends for 175 km upstream, in a strip 2-5 km wide, reaching an altitude of 521 m asl near the head of the valley. The town of Mekambo (1°03'N/13°49'E) is surrounded by wetlands and there are some 55 000 ha of swamp forest along this river. All the other tributaries, e.g. the Nouma and Sing Rivers, also have narrow floodplains.

From the Ivindo/Djadic confluence to the meeting of the Ivindo and Ogooue Rivers, 135 km SW, the Ivindo is mostly slow flowing and again has a floodplain, although this is often only a few kilometres wide. The total wetland area in the basin, including permanent and temporarily inundated forests, and areas of *Raphia* and papyrus along some rivers, probably exceeds 400 000 ha.

**Human Impact & Utilisation:** The upper part of the basin is very sparsely inhabited. There are no roads and the forests are virtually undisturbed. However, in the lower basin seasonal roads link the town of Makokou with several other centres, and the forests have been exploited for timber locally.

**Conservation Status:** A small area, c. 15 000 ha, on the banks of the lower Ivindo River, centred on 0°31'N/12°48'E, 15 km from the town of Makokou, is protected in the Ipassa-Makokou Strict Nature Reserve. A large part of the area is situated on riverine alluvium and is densely forested. No less than 2000 plant species have been collected from the Reserve and its resident animals include the drill, *Mandrillus sphinx*. All the valleys of the basin are densely forested and little disturbed, while the upper ones, e.g. that of the Djoua River, are in pristine condition, but are unprotected.

### **3. Wetlands of the Upper Ogooue Valley**

**Country:** Gabon

**Coordinates:** 0°00'-2°00'S/12°00'-14°00' E

**Area:** 2 986 875 ha (between 200-500 m asl)

**Altitude:** 200-500 m asl

**Nearest Towns:** Franceville (in head of valley); Libreville (350 km ESE)

**General:** The Ogooue River rises in Congo and flows into Gabon over a wide flat valley floor over 500 m asl, descending at the waterfall of Poubara (1°45'S/13°33'E) into a broad upper valley at about 470 m asl. From here the river flows northwestwards for 600 km, to a point just south of the equator. Here it swings west, descends below the 200 m contour, receives the Dilo and Ivindo Rivers, and passes over a series of six waterfalls and rapids

in an 80 km section before reaching the coastal plain. A forested floodplain with large pockets of permanent swamp accompanies the river throughout most of the upper valley.

Immediately below the Poubara Falls, the valley broadens and in a roughly rectangular area ( $1^{\circ}07' - 1^{\circ}44' \text{S} / 13^{\circ}15' - 13^{\circ}38' \text{E}$ ), covered by 20 anastomosing rivers, the Ogooue receives 10 tributaries. The most important of these are, from south to north, the Mpsa, Lebombi, Lekedi, Lèkati and Lèkoni Rivers. The floor of this valley is flooded periodically between the many watercourses, creating a semi-continuous wetland area covering 144 000 ha. North of the confluence with the Lèkoni River, the Ogooue enters a much narrower valley, into which the Sthe River descends over a series of 6 falls, and where the current is much swifter, and the accompanying floodplain much narrower. However, the valley widens again close to the parallel  $1^{\circ}\text{S}$ , and from here to  $0^{\circ}05'\text{S}$ , where it turns west, the river flows in a wide bed over a broad floodplain. To the west, a major tributary, the Lobo River, flows in parallel for much of this distance, and permanent swamps and floodplain extend in places across all the intervening land. The two rivers approach to within 5 km of each other and then diverge around some elevated land before reaching a confluence at a point  $0^{\circ}19'\text{S} / 12^{\circ}20'\text{E}$ . In this latter part of the valley wetlands cover a total of some 162 000 ha. The entire upper valley floor is forested.

**Human Impact & Utilisation:** The Ogooue Valley is the main communication route between Libreville and the interior of Gabon. It carries a main road and railway line, both of which terminate at Franceville, and several towns have developed along the railway. Another railway connects the head of the valley at Franceville, to Pointe Noire and Brazzaville in Congo. The forests of the valley have been intensively exploited, the timber being taken to Libreville and Congo by road and rail. The valley is thus comparatively densely populated and the rivers and swamps are fished heavily.

**Conservation Status:** The Lope-Okanda Reserves straddle the Ogooue River towards the lower northern end of the valley. The river separates the two sections, but it is intended to redesignate both as one National Park. The total protected area amounts to about 500 000 ha, and includes the river bed and a substantial area of floodplain and swamp. At present the protected area comprises a conservation park, a faunal reserve and a hunting reserve. Precise details of the boundaries are not available.

#### **4. Wetlands of the Ngounie River**

**Country:** Gabon

**Coordinates:**  $0^{\circ}42' - 2^{\circ}14'\text{S} / 10^{\circ}16' - 11^{\circ}31'\text{E}$

**Area:** 450 000 ha (lower valley floor); c. 250 000 ha wetland

**Altitude:** 30-100 m asl

**Nearest Towns:** Lambarene (on river); Libreville (150 km NE)

**General:** The Ngounie River rises on the southern slopes of the Birougoo Mountains at a point  $2^{\circ}04'\text{S} / 12^{\circ}12'\text{E}$ , and flows south and then west for 60 km, over which distance it forms the border with Congo. At its confluence with the Polo River it turns northwest, leaving Congo, and after descending 3 waterfalls develops a floodplain in its 220 km long

valley between the parallel ranges of the Moukande Mountains and the Massif du Chaillu. The Ngounie is a lowland stream almost throughout. It descends below the 100 m contour at the head of its valley, and meanders for 400 km over the valley floor before joining the Ogooue just above Lambarene (0°42'S/10°16'E), still 150 km from the sea. The floodplain is best developed in two sections; from Lèbamba (2°14'S/11°31'E) to Mouila (1°51'S/11°01'E), and from just above Fougamou (1°17'S/10°35'E) to the Ogooue at Lambarene. Estimates of the total area of flooded land in the valley vary between 150000 - 300000 ha, but 150 000 ha appears to be a very conservative figure.

**Human Impact & Utilisation:** A main road connecting Libreville and Lambarene with Pointe Noire and Brazzaville runs through the valley and there are a number of small centres of population on the road throughout the length of the valley. The area has been exploited for its timber, which is shipped from Libreville or Pointe Noire. The valley is densely forested, although there is much secondary forest. The swamp forests have been little exploited compared with unflooded forests and the land which is regularly flooded has not yet been cleared for agriculture on any scale.

**Conservation Status:** Unprotected.