12. Monte Alén-Monts de Cristal Landscape

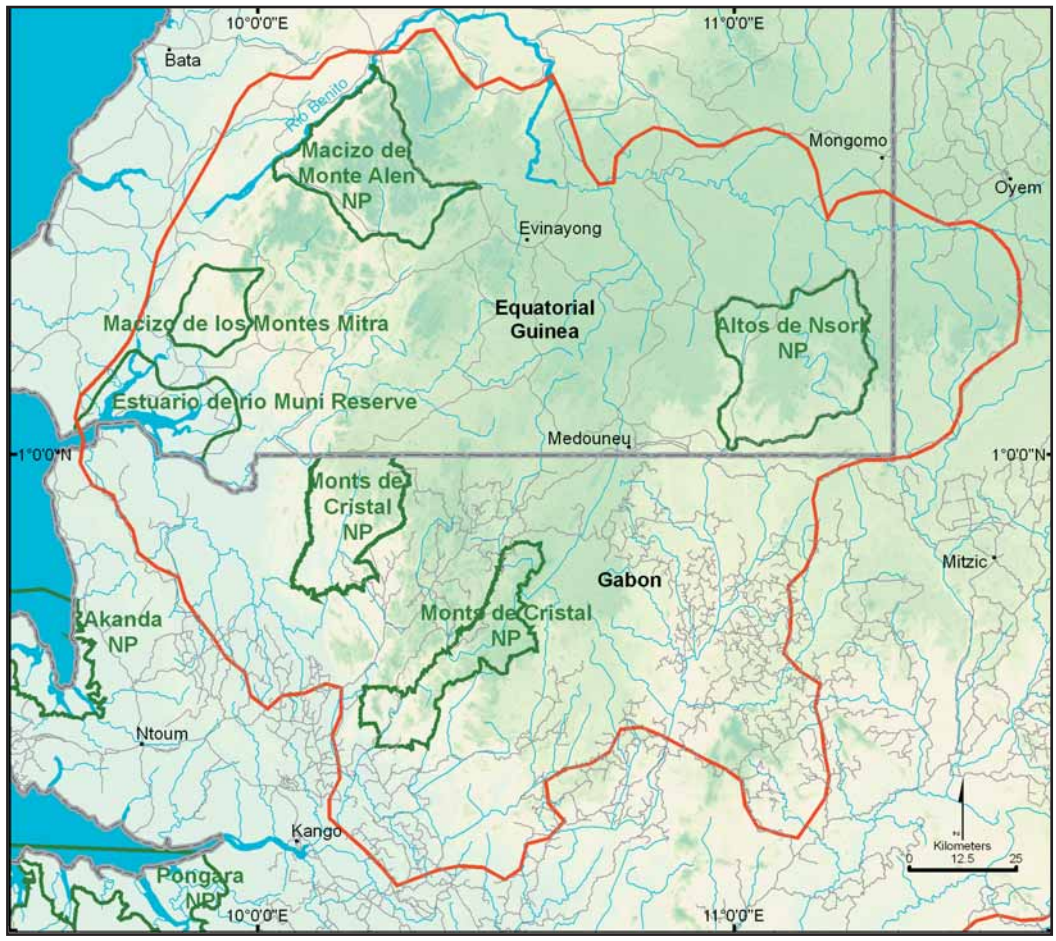


Figure 12.1. Map of Monte Alén-Monts de Cristal Landscape (Sources: CARPE, JRC, SRTM, WCS-Gabon).

The Landscape in brief

Coordinates: 1°53'35"N – 0°5'38"N; 9°37'2"E – 11°36'3"E
Area: 26,747 km²
Elevation: 300-1,250 m
Terrestrial ecoregion: Atlantic Congolese forests ecoregion
Aquatic ecoregions: Central West equatorial coastal ecoregion
Southwest equatorial coastal ecoregion
Protected areas:
Monte Alén National Park, 200,000 ha, 1988/2000, Equatorial Guinea
Altos de Nsork National Park, 40,000 ha, 2000, Equatorial Guinea
Monts de Cristal National Park, 120,000 ha, 2002, Gabon
Rio Muni Estuary Reserve, 70,000 ha, 2000, Equatorial Guinea
Piedra Nzas Natural Monument, 19,000 ha, 2000, Equatorial Guinea

Location and area

The Monte Alén-Monts de Cristal Landscape covers the south and southeast of Equatorial Guinea and the northwest of Gabon (Figure 12.1). It has an area of approximately 26,747 km², of which about half is located in Equatorial Guinea and half in Gabon. In Equatorial Guinea, it includes the Monte Alén and Altos de Nsork national parks, as well as the Rio Muni Estuary Reserve and the Piedra Nzas Natural Monument. In Gabon, it comprises the two sections of Monts de Cristal National Park.

Physical environment

Relief and altitude

The Landscape occupies a rugged area of plateaus and mountain chains mainly situated at an altitude of 300 m to 650 m to the northeast of the coastal sedimentary basin of Gabon (Figure 12.2). In Equatorial Guinea, the highest peak is formed by Monte Mitra, which rises to 1,250 m and is

the culminating point of the Niefang chain which runs from the southwest to the northeast. Monte Alén is slightly lower. To the east of this chain is a peneplain with a smoother relief at an average altitude of 650 m and with a landscape studded with granite inselbergs such as that of Piedra Nzas (700 m). In Gabon, the relief forms alignments running from the northeast to the southwest. The highest point is Mont Mbilan (800 m).

Geology and soils

The vast majority of rocks in the Landscape are Archean. In Gabon, the 3.2 billion years old non-differentiated gneisses are dominant, but there are also formations of amphibolites, aged 2.9-3.2 billion years, and ultramafic intrusions, 2.7-2.8 billion years old. In Equatorial Guinea and the Medouneu region, the dominant rocks are calco-alkaline granite aged 2.9 billion years.

Hydrology

In Equatorial Guinea, the Landscape is drained by the Mitemele, Laña and Wele rivers, which run to the estuaries of Rio Muni and Rio Mbini, two very important features of the coastal marine ecosystems in the Gulf of Guinea. These estuaries contain the coral reefs of the islands of Corisco and Elobey. The south of the Landscape includes humid areas that form the heads of the Komo River, which empties into the Gabon Estuary. In Gabon, the Landscape is drained by four watercourses that flow towards the southeast. The Mbé and the Komo form part of the basin of the Gabon Estuary. The Adouré and the Noya turn west and then northwest before ending in the Muni Estuary.

Climate

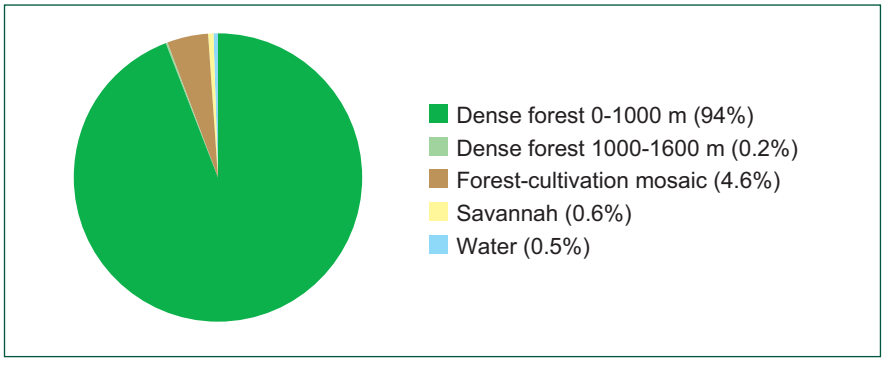
Across the Landscape, annual rainfall varies between 2,000 mm in the east to 2,800 mm in the west. There is a dry season of three months that runs from July to September, but its effects are considerably attenuated by the fact that a good part of the Landscape is then shrouded in low clouds. Not only does the whole region have high rainfall, but the humid winds from the Atlantic and the clouds that drift into the western flank of the mountains maintain a high level of humidity, especially in the dry season when the clouds are very low. These special conditions existed during the glacial eras. They were perhaps even more marked at that time due to the fact that the surface temperatures in the Gulf of Guinea were lower and stratiform clouds were more frequent. The mountains in this Landscape have thus been able to maintain large forest formations and represent a forest refuge.

Figure 12.2. Mountains in the Tchimbélé region.

Vegetation

The dominant vegetation is terra firma forest (Figure 12.3) of which 15-18%, in Gabon at least, has been modified by agriculture. Near the estuaries of the Rio Muni and the Komo, there are stretches of swamp forest (<1%) and an abandoned plantation of 500 ha of okoume can be found just to the south of the Seni section of the Monts de Cristal National Park. These forests are a part of the Atlantic coast forests and the caesalpiniaceous forests, which form more or less parallel chains along the coast of the Gulf of Guinea. The domi-

Figure 12.3. Main vegetation types (Source: JRC).



nant tree families are Burseraceae, Euphorbiaceae and Leguminosae-Caesalpinioideae. Above 650 m, the forest formations show submontane influences and, on high peaks or slopes exposed to the clouds of the Atlantic, there are cloud forests recognizable by their abundant epiphytes. The inselbergs also have a very particular vegetation, with meadows of *Afrotrilepis pilosa* and thickets very rich in epiphytes.

As part of an ancient Pleistocene refuge, the forests have maintained a very high level of species richness and numerous endemic species. The flora includes over 3,000 species of which a hundred or so are endemic to the Atlantic coastal region of Lower Guinea. The montane species found in Equatorial Guinea include *Podocarpus spp*. On the inselbergs, *Elaeophorbia grandifolia* and *Polyscias aequatoguineensis* have been found. In the Gabonese section, there are some species with a very limited distribution, particularly *Bikinia durandii*, a Caesalpinioideae, and *Marquesia excelsa*, the only Dipterocarpaceae in Africa, which is endemic to Gabon.

Recent studies suggest that the forests of the Monts de Cristal constitute the richest forest formations in Central Africa, from the point of view of both alpha and beta diversity, and the second richest in the world following a site in Ecuador[1]. In addition, the 'hot spots' are not the same for different groups or families of plants. Among the families that are exceptionally well represented are Acanthaceae, Melastomataceae, Balsaminaceae, Orchidaceae (Figure 12.4) and Begoniaceae (Figure 12.5). The forests of Monte Mitra are also exceptionally rich with an average of 107 plant species with a stem of over 1cm in diameter, per hectare.

Fauna

Mammals

The forests in the Landscape contain most of the mammals typically found in the forests of western Central Africa, notably the forest elephant *Loxodonta africana cyclotis*, the buffalo *Syncerus caffer*, the giant pangolin *Manis gigantea*, the water chevrotain *Hyemoschus aquaticus*, six species of duiker, de gorilla *Gorilla gorilla*, the chimpanzee *Pan troglodytes*, the mandrill *Mandrillus sphinx*, the black colobus *Colobus satanas*, the Ogooué talapoin monkey *Miopithecus ogoouensis*, the leopard *Panthera pardus* and the golden cat *Felis aurata*. The aardvark *Orycteropus afer* has also been reported. In the lower parts of Equatorial Guinea, the white-collared mangabey *Cercocebus torquatus* and the hippopotamus *Hippopotamus amphibious* have been found. It is important to mention that on the fringe of the Landscape – but still within the same forest block – manatees (*Trichechus senegalensis*) live in the Komo and Abanga rivers (comm. ENEF-WWF).

Birds

There is no comprehensive list of birds for the Landscape, but 267 species have been recorded in Monte Alén National Park and 340 in the Monts de Cristal region. Among the species endemic to Lower Guinea are the Cameroonian picatharte *Picathartes oreas*, Verreaux's Batis *Batis minima*, the forest swallow *Hirundo fuliginosa* and Rachel's malimbe *Malimbus racheliae*. In the Equatorial Guinea section, three montane species have been found that have not yet been observed in the Gabonese section: the pink-footed puffback *Dryoscopus angolensis*, the grey cuckooshrike *Coracina caesia* and the black-capped woodland warbler *Phylloscopus herberti* (Fishpool & Evans, 2001).

Herpetofauna

The reptiles are still poorly known, but their fauna appears rich and representative of the forests of the region. It includes the forest crocodile *Osteolaemus tetraspis*, the false gavial *Crocodylus cataphractus*, the forest tortoise *Kinixys erosa*, the ornate monitor *Varanus ornatus* and the African python *Python sebae*. In the Gabonese section, 48 species have been counted so far, but the total number of species is probably around 65 (Pauwels, pers. comm.).

As concerns amphibians in Gabon, species have been found that are associated with forest waterfalls; several of these species were only known from western Cameroon and one is a new species for science. In the Equatorial Guinea section, three threatened species have been found: *Bufo superciliaris*, the largest toad in Africa, *Conraua goliath*, the largest frog in the world, and *Trichobatrachus robustus*, a hairy frog.

Invertebrates

The invertebrate fauna is very poorly known, but preliminary prospecting in Gabon has revealed butterfly species that were considered endemic to western Cameroon, particularly *Cymothoe haimodi* and species with localized distributions, like *Euphaedra limbourgi*, *E. brevis*, *E. dargei*, *E. dargeana*, *E. adolfifrederickii*, *Euriphene minkoi*,

[1] On five sample plots of 1 ha, an average of 97 woody species with a diameter of over 10 cm were recorded; the richest sites in Cameroon have between 73 and 93 woody species (Thomas, 2004).

Euryphura euthalioides and *Euryphura nobilis* (G. Vande weghe, in prep.).

Humans in the Landscape

Density and distribution

The average population density is 16-18 inhabitants/km² in Equatorial Guinea and 0.6 inhabitants/km² in Gabon. In Gabon, the populations are concentrated along the Medouneu road and in the departmental capital where some 3,000 inhabitants reside. Cocobeach and Kango are situated just outside the Landscape and Libreville is less than 100 km away. These population centers are major destinations for bushmeat from the west and south of the Landscape. In Equatorial Guinea, the recent development of petroleum extraction has instigated large-scale migration to the towns of Bata and Malabo, as well as Evinayong (10,000 inhabitants), which is situated within the Landscape. Despite the significant urbanization of populations, immigrants to urban areas maintain contact with the rural areas and there are still important economic, family and cultural links between new urban populations and rural populations. In some remote areas, whole villages have been abandoned and fields recolonized by the forest.

Ethnic groups

The dominant ethnic group in the mountain areas of the Landscape is the Fang group. Ndowe live in the coastal basin in Equatorial Guinea and small populations of Beyele Pygmies remain in the Altos de Nsork region.

Activities

In both Gabon and Equatorial Guinea, human populations depend on subsistence agriculture and hunting. Cultivation is itinerant and is usually established in old secondary forests or abandoned coffee plantations. Any surplus of agricultural products is sold along the roadsides or, less frequently, transported to towns. In the Gabonese section of the Landscape, there are 40-50 professional hunters, ten of whom are elephant hunters. In Medouneu, 400-500 people are employed by the government. In the periphery of the Landscape, commercial hunting for bushmeat is a very important activity along the Ndjolé-Lalara road (recently tarred).

Land use

Forest concessions cover 65% of the Landscape, protected areas 18% (27% in Equatorial Guinea), and crops 3% (Figure 12.6). In Gabon, two hydroelectric dams have been constructed in the Mbé Valley to supply Libreville, the capital of the country.

Logging

In Gabon, most of the Landscape is covered by forest concessions and 'family felling rights'. Logging began in the 1970s and old maps show a dense network of logging roads, most of which are no longer useable because they have been overtaken by the forest and the bridges have collapsed. At present, logging takes place in the south and east of the Mbé sector. Very recently, it has also begun in the northeast. However, the most intense logging used to be in the west of this sector, but it stopped in 2004 because it was no longer profitable. Logging continues in the lower regions in the south of the Seni sector. The concessions are worked by French, Asian and Franco-Gabonese companies (NBG, TLP, Afrique Verte, SGG, SEEF, Rougier, BSG).

In Equatorial Guinea, timber was the main source of foreign exchange before oil was discovered in 1995. The volume harvested rose from 50,000 m³ in 1980 to 790,000 m³ in 1999, although maximum sustainable production had been officially estimated at 400,000 m³ and legal small-scale production was set at 450,000 m³. The main species harvested was okoume and 85% of production was exported as logs to Asia. With oil revenue, the pressure on the forest eased, but unregulated and unsupervised logging continues. Companies are taxed on the basis of the logs arriving at the port of export; consequently, companies have no interest in reducing the impact of their logging and the government is deprived of revenue that could finance monitoring. Most of the Landscape outside of the protected areas is divided up into concessions, but many are inactive. Recently, the President of the Republic ordered the creation of a permanent national forest domain of 500,000-600,000 ha where logging would be supervised. This measure could ensure the interconnectivity of the protected areas.

Figure 12.4. Among the Orchidaceae, the genus Polystachya is particularly well diversified.

Figure 12.5. Among the Begoniaceae are many land plants as well as epiphytes.

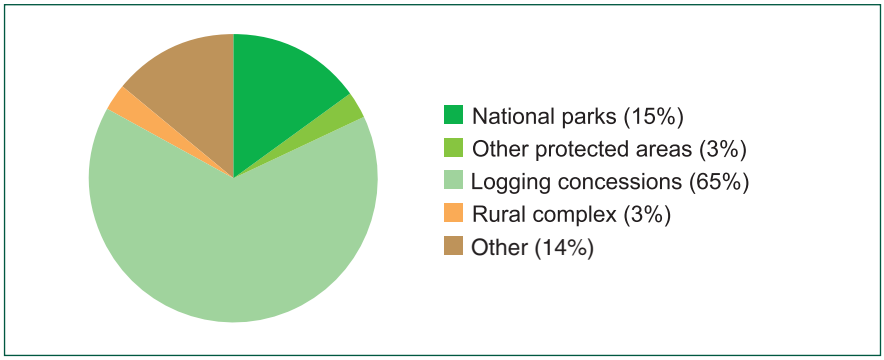


Figure 12.6. Main land use types.

Reasons for the identification of the Landscape

(1) This Landscape was chosen for its extraordinary biodiversity, linked to the climatic conditions, and because it contains an ancient Pleistocene refuge.

(2) The Equatorial Guinea section was considered important for bird conservation (Fishpool & Evans, 2001).

(3) The human population density is relatively low, especially in Gabon.

(4) The forests are still fairly well conserved.

Conservation

History

In Equatorial Guinea, Monte Alén National Park was created in 1988 and benefited from the support of the ECOFAC program which began in 1992. In 1997, a forest law was passed providing for the creation of a vast network of protected areas. In March 2000, following the Yaoundé Declaration and the CUREF program proposals, 13 protected areas were created, four of them in the Landscape: Monte Alén National Park, Altos de Nsork National Park, Piedra Nzas National Monument and Rio Muni Nature Reserve. The CUREF program ended in 2002 and its activities were handed over to the *Instituto de Desarrollo Forestal* (INDEFOR), created to manage the country's forests and protected areas. The ECOFAC program was suspended in 2004 and is set to resume in 2007. Very recently, following a COMIFAC meeting, the national forest domain was created and a good part of it lies within the Landscape. The aim of the forest domain is to 'let the forests rest' after a recent phase of intense logging. However, the creation of this forest domain has not yet been approved by Parliament.

In Gabon, the value of the region was recognized by conservation botanists well before it was added to the list of priority conservation sites by the IUCN in 1990. The creation of Monts de Cristal National Park in 2002 was a result of this recognition. It is composed of two blocks of 600 km² (Seni sector and Mbé sector) that cover 10% of the surface area of the Landscape in Gabon.

Players

In Gabon:

- CNPN, MEFEPPN, WCS and WWF are the principal conservation players.
- The Smithsonian Institution, the Missouri Botanical Garden, the University of Wageningen and the national herbarium (CENAREST) are engaged in research.
- The Gabonese Water and Energy Company (SEEG) runs the hydroelectric dams.
- The main industrial logging companies are: NBG, TLP, Afrique Verte, SGG, SEEF, Rougier, and BSG.

In Equatorial Guinea:

- INDEFOR, the University of Acalá, the Missouri Botanical Garden, Imperial College, the University of Wageningen, Boston College and the Smithsonian Institution are involved in research.

Direct threats

(1) Hunting and bushmeat trade

In both Equatorial Guinea and Gabon, hunting for bushmeat represents the main threat to biodiversity. In Equatorial Guinea, the consumption of bushmeat has risen considerably in the last few years. This increase is the result of an increase in the purchasing power of the urban populations following the development of oil extraction. Regulations are not observed and even protected animals are openly sold in the markets.

(2) Ivory trade

In Gabon, elephant hunters continue to operate, but they are as equally concerned with elephant meat as ivory. As in many other regions of Central Africa, they are supported by local elites.

(3) Industrial logging

In Equatorial Guinea, despite a recent slowdown, logging continues to be unsustainable and there is ongoing degradation. In Gabon, there is pressure to restart logging in the buffer zones of national parks due to the fact that laws and

regulations on the management of these areas do not yet exist. However, small companies operating in the Landscape, with the exception of SEEF, are not in a position to practice reduced-impact sustainable management. Chinese and Malaysian companies, in particular, operate in a destructive manner[2]. Unlike other companies, they harvest timber of lower value and leave behind highly impoverished forests. In general, industrial logging causes much more damage in mountainous areas than on flat ground. Submontane forests and cloud forests are more sensitive to any opening-up of their canopy; the penetration of light into the undergrowth transforms the microclimate, which may become unsuitable for very sensitive plants, such as begonias.

(4) Small-scale mining

In a few places in the Gabonese part of the Landscape there are gold panners who disturb streams, aggravate erosion, intensify sedimentation and spend a lot of time hunting.

(5) Industrial mining

It is also possible that in the southern part of the Landscape platinum mining may start over a strip of 85 km, of which 75 km are in the Mbé sector of Monts de Cristal National Park or in the 5 km buffer zone. Initial prospecting has already been carried out and more advanced prospecting will take place over the next few years to determine the economic feasibility of this mining activity. If the results are positive, partial declassification of the national park could be forseen, with compensatory classification of other forests with the same area. In this scenario, the richest forests of Central Africa would be 'replaced' by poorer forests. Logging could also have adverse effects on the hydrological system in the region and could impact hydroelectric supplies of electricity to Libreville by affecting the operation of turbines and increasing erosion and sedimentation in dams.

Indirect threats

(1) Weak institutions

In Equatorial Guinea, INDEFOR has little influence within the government, including within its own Ministry, and does not have the financial means to carry out its tasks. Consequently, the concessions are not monitored, the guards responsible for supervising the protected areas are ineffective and laws are ignored because of a lack of professionally qualified personnel. The few existing personnel have little training, remain isolated and are poorly paid.

(2) Ad hoc development

In Equatorial Guinea, the government has started repairing and extending the road system, while logging companies are constructing their own roads. The number of vehicles has risen substantially. These activities enormously increase accessibility to the forests and facilitate poaching.

State of the vegetation

There is little concrete data suitable for evaluating and quantifing the impacts of human activities on forests. However, in general, the forests are a mosaic of degraded and intact formations, where intact formations are protected by their inaccessibility. The national parks of Monte Alén, Altos de Nsork and Monts de Cristal still have considerable expanses of primary forests. In Equatorial Guinea, the composition of the forests in the coastal basin has been modified by the excessive logging of okoume, but these changes are not irreversible and these forests can still recover a good portion of their biodiversity. The forests in the interior of the country have been minimally logged and those in Altos de Nsork National Park are intact.

State of the fauna

No species in the Landscape has been eliminated locally, but population densities are very low, especially in Gabon. Recent inventories show that the northern block of Monts de Cristal National Park is particularly 'empty' of large fauna[3]. The Mbé sector of Monts de Cristal National Park is nevertheless part of a large area of forest stretching as far as Ndjolé, Mitzic and Medouneu. The interior of the Abanga forests (15,000 km^2) contains high densities of large mammals and most notably elephants (SEEF, CFAD Haut-Abanga de Rougier). The elephants move between the forests of the Tridom and the forests of Abanga.

[2] These companies often work on very steep slopes where they carve out roads and cause serious erosion.

[3] Inventories to be completed later with a report in preparation.

Financing of conservation

In Equatorial Guinea and Gabon, only one protected area is certain of financing in the short term (<2 years).

Environmental education and capacity building

In Gabon, WCS runs an environmental program in villages on the periphery of Lopé National Park that includes actions targeted at schoolchildren and informal meetings for adults. An apiculture project and a vegetable garden for children have been launched to promote the sustainable management of natural resources on communal land.

Management and governance in the field of renewable natural resources

(1) At the Landscape level

In Equatorial Guinea, the CUREF project (European Commission) has developed a land pre-classification map covering an area of about 20,000 km^2, which has yet to be validated by the government.

(2) In protected areas

Throughout the Landscape, with the exception of Monte Alén National Park, management of protected areas is still in its early stages. In Gabon, Monts de Cristal National Park is managed by CNPN with the support of WCS. All the protected areas have legally defined limits.

(3) In the extractive zones

In Gabon, the forests outside the village sectors are the responsibility of the Ministry of the Forest Economy. In the eastern and southern part of the Abanga forests, WWF is working in collaboration with the Ministry of Forest Economy and with loggers to improve the management of fauna in this forest network; a cooperative agreement is being prepared between the Ministry, Rougier Gabon and WWF. This agreement centers on the conservation of fauna in the Rougier CFAD of 'Haut-Abanga' (288,626 ha). Socioeconomic surveys have been carried out along the Medouneu-Sam, Lalara-Ndjolé and Ndjolé-Bifoun-Oyan axis. A network of old forest tracks in the Oyan-Bifoun-Ndjolé area provides access to poachers.

(4) In rural areas

No actions have been initiated.

Monitoring of natural resources

In Gabon, basic demographic, socioeconomic, resource use, human pressure, and biological data were collected in 2004 and 2005. These efforts involved national and international institutions and covered almost the entire Landscape. An exhaustive report is being drawn up to support management and local and regional monitoring activities. These surveys were an initial reconnaissance exercise to assess the prevailing conditions and in no case constitute exhaustive inventories. A more comprehensive monitoring program will be proposed on the basis of the data obtained and will be used to measure changes over the course of time. Unfortunately, such monitoring is expensive and budgetary constraints make it impossible in the near future.

To monitor forest dynamics, five one hectare plots were identified and all woody species with a diameter of over 1 cm or 10 cm were recorded. This work was made possible through collaboration between the national herbarium of Gabon, the Smithsonian Institution and the Missouri Botanical Garden (Thomas, 2004).

In Equatorial Guinea, capacities are being developed through a promising collaboration between INDEFOR, IUBioma (the national biodiversity institute), the University of Acalá, the Missouri Botanical Garden, Imperial College and Conservation International. IUBioma and INDEFOR are developing a national research and monitoring plan which will include the Landscape.

13. Gamba-Mayumba-Conkouati Landscape

Figure 13.1. Map of Gamba-Mayumba-Conkouati Landscape (Sources: CARPE, JRC, SRTM, WCS-Gabon).

Location and area

The Gamba-Mayumba-Conkouati Landscape is transnational and centered on the Loango, Moukalaba-Doudou and Mayumba national parks in Gabon, and Conkouati-Douli National Park in the Republic of Congo (Figure 13.1). Lying between the national parks in Gabon is a set of hunting areas - Ngové-Ndogo, Moukalaba, Sette Cama and Iguéla - plus the Ouanga Plain Wildlife Reserve. The Landscape extends over a total area of 34,258 km², of which approximately 75% lies in Gabon and 25% lies in the Republic of Congo, and stretches along the southwestern coast of Gabon and the western coast of the Republic of Congo. Mayumba and Conkouati-Douli national parks extend back 15 km and 22 km from the beach respectively, covering an area of 80,000 hectares in Gabon and 120,000 hectares in the Republic of Congo.

The Landscape in brief

Coordinates: 1°36'26"S – 4°26'26"S; 9°15'48"E – 12°24'28"E
Area: 34,258 km²
Elevation: 0-840 m
Land ecoregions:
Congolese Atlantic forests ecoregion
Southwestern forest-savannah mosaic ecoregion
Aquatic ecoregion:
Southernmost western equatorial coastal ecoregion
Protected areas:
Loango National Park *, 153,581 hectares, 2002, Gabon
Moukalaba-Doudou National Park *, 502,805 hectares, 2002, Gabon
Mayumba National Park, 80,000 hectares, 2002, Gabon
Conkouati-Douli National Park, 505,000 hectares, 1980/1999, Republic of Congo
Ngové-Ndogo Hunting Area*, 1956, Gabon
Moukalaba Hunting Area *, 20,000 hectares, 1962, Gabon
Iguéla Hunting Area *, 1962, Gabon
Ouanga Plain Wildlife Reserve *, 1962, Gabon
(*) protected areas located in the Gamba Protected Areas Complex

Figure 13.2. Along the coast of Loango National Park are several small cliffs, rich in cretaceous fossils.

Physical environment

Relief and altitude

The relief is quite varied, consisting of beaches and low dunes stretching along the Atlantic Ocean, coastal plains and low undulating plateaus of the coastal sedimentary basin, and the Monts Doudou Mountain Range in Moukalaba-Doudou National Park, which rises to over 800 meters and is a flank of the Mayombe Range. The Monts Kouboula Mountain Range in the Republic of Congo rises to over 800 meters. Mayumba National Park in Gabon and the nearby Conkouati-Douli National Park in the Republic of Congo each include a 60 km long, narrow strip of beaches and lowland areas between the ocean and lagoons. The terrain is flat, but near the Congolese border it gives way to low rising hills behind the beach, intersected by small lagoons and mangroves. The marine sections have a depth of 50 meters at their deepest, and the sea bottoms are sandy with scattered low-lying rocky outcrops (dolerites and gabbros) visible on the coastline.

Figure 13.3. The flood plains of the Ngové River in Loango National Park.

Geology and soils

The Landscape comprises three geological entities. Most of it belongs to the coastal sedimentary basin, which narrows from 80-100 km wide in the north to only 10-20 km wide south of Mayumba. This basin is formed of sedimentary rocks from the Cretaceous-Tertiary period, resulting in heavily leached and poor sandy to sandy-clay soil. The entire coastline of older layers is covered by cirque series sand sheets of the Pliocene epoch. On the coast, in particular at Milango Point in Loango National Park, marine erosion has exposed rocks rich in marine fossils (fish, ammonites) dating from the second half of the Cretaceous period (Figure 13.2). Monts Doudou Mountain Range is composed of granite and compound gneisses of the lower Proterozoic, 2.2-2.5 billion years old, which result in ferruginous soils. Nyanga-Moukalaba Basin chiefly consists of 500-700 million year old Upper Proterozoic calcareous or dolomitic sedimentary rocks. The Landscape's present relief comes from the coastal basin land emergence caused by the uplift of the western margin of Central Africa during the Tertiary period.

Hydrology

The water system consists of the Nyanga River, the Ndogo, Ngové and Banio lagoons in Gabon, the Ngongo, the Conkouati Lagoon and the Noumbi River in the Republic of Congo. The Nyanga is Gabon's second largest river in terms of flow and drains a 22,500 km² basin, of which 80% is located in the country. The Banio Lagoon divides Mayumba National Park from the hinterland. It is over 70 km long and runs parallel to the coast. The three large lagoons are supplied by rivers that drain the coastal basin and have a permanent outlet. Some of these rivers are surrounded by vast flood plains (Figure 13.3). In the Republic of Congo, the Ngongo River supplies the Tchibinda, Tchivoka, Tchimpa and Manzimanouvou lakes, all of which supply significant volumes of fresh water to the Conkouati Lagoon, creating highly fluctuating levels of salinity. The Noumbi is the third largest river of the Republic of Congo after the Congo and Kouilou rivers. The coastline

is dotted with countless small lagoons that discharge into the sea during the rainy season. In the dry season, their outlet is blocked by a sand bar. Paradoxically, the level of these lagoons is highest towards the end of the dry season[1].

Climate

Annual rainfall averages from approximately 1,800 mm in the north of the Landscape to under 1,500 mm in the Moukalaba and Nyanga valleys. The dry season extends from June to September, but January-February represents a period of lower rainfall. During the dry season, low stratiform clouds, driven by the Atlantic winds, reduce solar radiation and lower the temperature by an average of 3°C, causing a sharp decrease in evaporation.

Vegetation

The Gamba-Mayumba-Conkouati Landscape is probably the most diverse of all Landscapes in Central Africa (Figure 13.4). The coastline vegetation consists of a succession of stands composed of sand-binding vegetation such as *Ipomea pescaprae*, coastal pastures of grasses and sedge, coastal thickets of *Dalberghia ecastaphyllum, Hibiscus tiliaceus, Phoenix reclinata* and *Hyphaene guineensis*[2] and the coastal sclerophyllous forest containing *Chrysobalanus, Manilkara* and *Fegimanra* (Figure 13.5). Further inland, there is a spreading mosaic of forest stands composed of pioneer forests, containing *Aucoumea klaineana* and *Sacoglottis gabonensis* of different ages, and mature stands, which are more diversified in *Aucoumea, Desbordesia glaucescens, Dacryodes buettneri, Tetraberlinia moreliana, Monopetalanthus pellegrini, Tessmannia africana, Odyendyea gabonensis, Lophira alata, Klainedoxa gabonensis* and *Librevillea klainei*. In addition, the Moukalaba Basin contains *Dialium pachyphyllum, Toubaouate brevipaniculata, Autranella congolensis* and *Dacryodes heterotricha.* Monts Doudou Mountain Range is clad in dense forests, which above 650 meters show submontane affinities. Cloud forests are found on the highest summits and peaks exposed to Atlantic winds. In the lower regions, terra firma forests are interspersed with raffia palm-groves and vast expanses of swamp or floodplain forests of *Alstonia congensis, Anthocleista vogelii, Anthostema aubryanum, Hallea ciliata, Syzygium sp., Xylopia sp., Lecomtedoxa biraudii* and *Gilbertiodendron unijugum*.

The forests are also interspersed with open, permanent or semi-permanent marshes, in particular papyrus swamps, and grass savannahs. In the coastal basin, the latter belong to three specific types: periodically flooded savannahs in the lowest-lying lagoon areas, steppe savannahs on white sand, and savannahs with denser herbaceous cover on sandy clay soil. In several spots, especially in Loango National Park, steppe savannahs are being colonized by thickets of *Chrysobalanus*. In the Nyanga and Moukalaba valleys, the savannahs consist of tall grasses and include a shrub stratum with *Nauclea latifolia, Bridelia ferruginea* and *Crossopteryx febrifuga*.

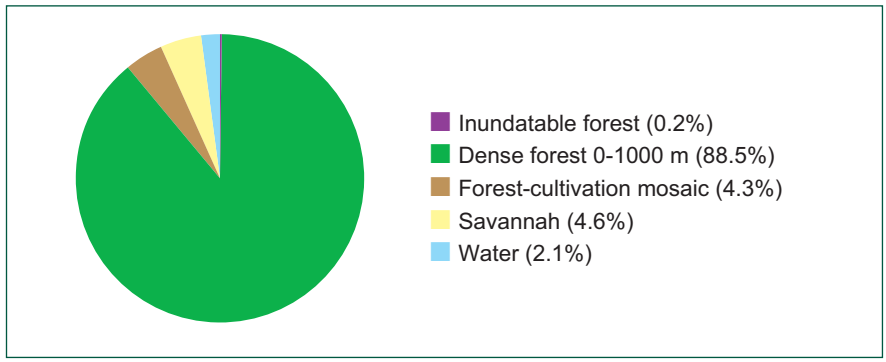


Figure 13.4. Main vegetation types (Source: JRC).

The low, periodically flooded savannahs are dotted by semi-permanent ponds with *Nymphaea* and *Utricularia*. The lagoon mouths are home to mangroves with *Rhizophora* and *Avicennia*, as well as relatively brackish floodplain grasslands.

The region's flora was little-known, but specimen collected over the past ten years by the University of Wageningen, the Missouri Botanical Garden, CENAREST and the national herbarium have considerably expanded the knowledge base[3]. A study of the orchid family revealed the presence of 73 species[4]. In the Monts Doudou Mountain Range, 991 species have been collected from 2,459 herbarium samples, including 5 endemic species and 9 restricted-range species[5]. Overall, 11% of species appear to be endemic to the biogeographic area, and the richest areas are situated at the medium and high altitudes. These findings support the theory that Monts Doudou Mountain Range was a forest refuge in the Pleistocene era. In the Republic of Congo, over 2,500 plant species have been recorded in Conkouati-Douli National Park and its surrounding environments.

Fauna

Mammals

At least 89 species of mammals inhabit the Landscape. Significant species include the forest elephant *Loxodonta africana cyclotis* (Figure 13.6), the buffalo *Syncerus caffer*, the hippopotamus *Hippopotamus amphibius*, the lowland gorilla *Gorilla gorilla*, the chimpanzee *Pan troglodytes*, the

[1] These small lagoons are particularly important for populations of Nile crocodiles *Crocodylus niloticus*.

[2] The shrub *Tabernanthe iboga*, of the dogbane family, widely used in Gabon in certain traditional rites for its hallucinogenic properties, is extremely abundant in these coastal thickets, which probably represent its original environment.

[3] At least 30 new plant species of the *Commitheca, Begonia* and *Impatiens* genera have been discovered, as well as a giant tree, *Xanthoceris rabiensis*, in the Rabi region (Hallé & Louis, 1989). More recently, detailed studies of 75 plots throughout the Gamba Complex have yielded information on 7,305 plants (Campell *et al.*, 2006).

[4] Including 20 terrestrial and 53 epiphytic species; 3 species are new to science and still require description (Stevart & Droissart).

[5] The species endemic to the Monts Doudou Mountain Range or southwestern Gabon are: *Adhatoda le-testui* (Acanthaceae), *Anthonota trunciflora, Cynometra nyangensis* and *Isomacrolobium conchyliophorum* (Caesalpinioidea), *Begonia dewildei* and *B. gabonensis* (Begoniaceae), *Calpocalyx brevifolius* (Mimosaceae), *Commitheca letestuana* and *Tarenna jolinonii* (Rubiaceae), *Trichoscypha gambana* (Anacardiaceae), *Costus nudicaulis* (Costaceae), *Dichapetalum sp. nov.* (Dichapetalaceae), *Impatiens floretii* (Balsaminaceae) and *Trichostephanus gabonensis* (Flacourtiaceae).

Figure 13.5. Coastal thickets with Fegimanra africana.

black colobus monkey *Colobus satanas* and the collared mangabey *Cercocebus torquatus* (Figure 13.7), the Ogooué talapoin monkey *Miopithecus ogoouensis*, the mandrill *Mandrillus sphinx*, seven species of duikers, including the white-legged Ogilby's duiker *Cephalophus ogilbyi crusalbum*, and the defassa waterbuck *Cobus ellipsiprymnus*, the most important waterbuck in Gabon and probably the only one in the Republic of Congo. In April 2000, four species of bush babies (*Galago sp.*[6]*, Euoticus elegantulus, Galagoides thomasi* and *Galagoides demidoff*) as well as Bosman's potto *Perodicticus potto* (Bearder, 2000) were identified around Gamba. The side-striped jackal *Canis adustus* is found in all savannahs, while the manatee *Trichechus senegalensis*[7] inhabits the lagoons and some rivers of both Gabon and the Republic of Congo.

Little research has been done on marine mammals, but a total of 17 species of cetaceans have been observed (Box 13.1) and 10 other species may be present, based on their known distribution (Findlay *et al.*, 2004). Most common are the humpback whale *Megaptera novaeangliae*, the common or saddle-backed dolphin *Delphinus delphis*, the bottlenose dolphin *Tursiops truncatus* and the Atlantic hump-backed dolphin *Souza teuszii*. The latter is a rare species, but it has been observed in great numbers in the southern part of Mayumba National Park. The Cape fur seal *Arctocephalus pusillus* has also been found on the beach (Thibault 1999a, Thibault, 1999b).

Twelve species of *Muridae* and 9 species of *Soricidae* have been collected in the Monts Doudou Mountain Range (Nicolas *et al.*, 2004). None of these represent mountain species.

Birds

In terms of bird life, Sargeant (1993) has inventoried 380 species in the Gamba region. The most recent inventory of bird life inhabiting the Gamba Protected Areas Complex lists nearly 500 species (Christy, pers. comm.). Christy and Goodman (2004) noted 230 species, including 161 typically forest species in the Monts Doudou Mountain Range, which is also home to little-known birds such as the African green ibis *Bostrychia olivacea*, the Bates' swift *Apus batesi*, the Angola pitta *Pitta angolensis*, the forest swallow *Hirundo fuliginosa* and notably the grey-necked rockfowl *Picathartes oreas*[8]. Two hundred bird species have been inventoried in Loango National Park. They include the loango slender-billed weaver *Ploceus subpersonatus*, a known coastal species ranging from Gabon to Angola. No inventory has been done in the Mayumba region, but it appears to be a major stopover site for Palearctic terns (*Sterna hirundo, S. paradisea* and *S. sandvicensis*) and the Damara tern *S. balaenarum*, an endangered species from southern Africa. Steppe savannahs in both the Republic of Congo and Gabon are nesting sites for the African river martin *Pseudochelidon eurys-*

[6] A new, previously unrecognized species closely related to *Galago alleni* and *G. gabonensis*. The latter is found only in northern Gabon and southern Cameroon. All three were undifferentiated until recently and taxonomised as *G. alleni* generally.

[7] This manatee population is the only one in the Republic of Congo.

[8] The discovery of *Picathartes oreas* at 600 meters of altitude in the Monts Doudou Mountain Range considerably extended the south-westward distribution of this species.

Figure 13.6. Elephants in coastal vegetation.

Figure 13.7. The collared mangabey Cercocebus torquatus.

tomima and the rosy bee-eater *Merops malimbicus*. The *Hyphaene* coastal thickets are home to the rufous-tailed palmthrush *Cichladusa ruficauda*. Thickets in both the Republic of Congo and Gabon are inhabited by a Zambezian species, the black-backed barbet *Lybius minor*, while the wet coastal plains are also home to the saddle-billed stork *Ephippiorhynchus senegalensis*.

Herpetofauna

A total of 86 reptile species are known in the Gamba Complex: 11 chelonians[9], 3 crocodilians, 2 amphisbaenians, 22 lacertilians (Figure 13.8) and 48 ophidians including 30 Colubridae (Pauwels *et al.*, 2006). Seven species are on the IUCN Red List: the four sea turtles (*Chelonia mydas, Erethmochelys imbricata, Lepidochelys olivacea* and *Dermochelys coriacea*), the turtle *Kinixys erosa*, and the crocodiles *Crocodylus cataphractus* and *Osteolaemus tetraspis*. The Nile crocodile *Crocodylus niloticus* is plentiful in lagoons and at sea. This important population is probably the last in Gabon.

Fifty-four species of amphibians have been found in the Monts Doudou Mountain Range - a relatively high abundance of species for an African site. They include 6 species new to Gabon; the *Hemisus* and *Kassina* genera were also previously unrecorded at this site (Burger *et al.*, 2004). Sixty-six species of amphibians have been found in the Gamba Complex as a whole (Burger *et al.*, 2006).

Ichthyofauna

Sixty-seven fish species have been found in the Rabi region (Mamoneke *et al.*, 2006), while in the Ndogo Lagoon more than 68 fish species belonging to 34 families have been inventoried (WWF, 1998). A rapid census of the Conkouati Lagoon in the Republic of Congo identified 55 species belonging to 31 families (Mamonekene, 2005). Industrial fishing, in practice since 1989, may have impacted these findings. In January and February 1989, a Norwegian team sampled a total of 354 marine species along the Gabonese coast between Pointe-Noire and Port-Gentil (Bianchi, 1992). An inventory is being done in Mayumba. Panga Bay, opposite the town of Mayumba, appears to be a major shark nursery and could be a significant feeding area for the manta ray *Manta birostris*.

Box 13.1: Marine mammals

Seventeen species of marine mammals have been recorded in Gabonese waters and ten other species are known to inhabit the Gulf of Guinea ecosystem or are expected to be found in the region based on their world distribution. This list includes seven species of large cetaceans (baleen or toothed whales). The whales are present in the area during the Antarctic winter and include populations that migrate between their warm or tropical water winter breeding quarters and their Antarctic or sub-Antarctic summer feeding quarters. Humpback whales are present from June to October, and the entire continental shelf area (up to a depth of 200 m) is critically important to the calving, nursing and mating of this species. There is little information on the distribution and abundance of other Cetacea in Gabonese waters, but Gabon's entire inshore area, near the beaches, is critically important for the Atlantic hump-backed dolphin (Findlay *et al.*, 2004).

Baleen whales
Humpback whale *Megaptera novaeangliae*
Blue whale *Balaenoptera musculus*
Fin whale *Balaenoptera physalis*
Sei whale *Balaenoptera borealis*
Bryde's whale *Balaenoptera edeni*
Southern Right Whale *Eubalaena australis*

Toothed whales
Sperm whale *Physeter macrocephalus*
Killer whale *Orcinus orca*
False killer whale *Pseudorca crassidens*
Melon-headed whale *Peponocephala electra*
Short-finned pilot whale *Globicephala macrorynchus*
Risso's dolphin *Grampus griseus*
Rough-toothed dolphin *Steno bredanensis*
Bottlenose dolphin *Tursiops truncatus*
Long-beaked common dolphin *Delphinus capensis*
Common dolphin *Delphinus delphis*
Atlantic hump-backed dolphin *Sousa teuszii*

Invertebrates

Data on invertebrates have been collected in the Monts Doudou Mountain Range for three groups of hymenoptera: ants, ichneumons and chaclid wasps, a group of small wasps that breed in figs, the fruit of *Ficus*[10]. The Smithsonian Institution's work has recorded over 1,500 morpho-species in Loango National Park.

[9] Monitoring of 5.75 km of beach during the 2002-2003 egg-laying season found 607 traces of leatherback turtles with clutches and 71 traces of olive Ridley turtles, but no trace of the other two species which had previously been found (Billes *et al.*, 2006).

[10] For the Formicidae (ants), 310 species belonging to 56 genera were found - the greatest number of species ever found in Africa (Fisher, 2005). Thirty species of Chalcidoidea (chaclid wasps) were found, 28 of them new for Gabon (van Noort, 2004b). Among the Ichneumonidae (ichneumons), 112 species were found; only 28 species had been recorded previously in Gabon (van Noort, 2004a).

Figure 13.8. The chameleon Chamaeleo dilepis.

Humans in the Landscape

Southern Gabon has essentially been populated over the past 300 years by Bantu populations from the south. These migrations are due in part to the upheavals created by contact with Europeans[11], but also because of the increase in certain populations in the interior of the continent.

Density and distribution

The estimated population in the Gabonese section of the Landscape is 15,000, with an average density of 0.5 inhabitants/km². These populations are grouped into three population centers with little communication between them: the Iguéla sector in the northwest; the Mourindi sector in the east; and the Ndogo Lagoon region, with Gamba and Mayonami, in the center. The Gamba Protected Areas Complex has a population of 9,500 people distributed between forty-odd villages. The largest of these is the town is Gamba, with a population of 7,500. Gamba developed around the Shell Gabon facility and its population includes both Gabonese and foreigners. Rural population density (2,300 inhabitants) is 0.2 inhabitants/km². The over-55 age group accounts for 29% of the population; fewer than 30% belong to the under-15 age group and the over-15 population is 59% female. These statistics reflect rural migration towards development centers, which has left several villages abandoned since the 1960s. The Landscape's second-largest town is Mayumba with 2,980 inhabitants.

The Congolese portion of the Landscape has a low population density - approximately 5,900 people are distributed between 25 villages in and around the national park. The total population size and distribution changes as industrial forest exploitation companies come and go. Between 1964 and 1984, the rural population of Kouilou (including Conkouati) was halved and, in 1990, the estimated density was 2.8 inhabitants/km². The population living in the vicinity of the national park in 1996 was half of that of 2005 (Paris, 1996; WCS, 2005). Migration towards Pointe-Noire has slackened in the last decade.

Within 40 km of the Landscape's borders there are four towns (Pointe-Noire, Dolisie, Loudima and Makabana) whose populations benefit from the Landscape's resources. Pointe-Noire, the economic capital of the Republic of Congo, has a population of close to a million inhabitants and is linked to Brazzaville by the railway, several daily flights and a road unfit for traffic. Railways and aircraft are key means for transporting bushmeat away from the Landscape for sale in Brazzaville.

Ethnic groups

In Gabon, the ethnic groups of the coastal basin, from Rembo Ndogo to the Atlantic Ocean, are the Vili, Lumbu and Ngové. Those of the Moukalaba and Nyanga river basins are the Punu, Varama and Vungu. These ethnic groups belong to the Punu-Eshira group and originate in the Congo (Raponda-Walker & Sillans, 1995). At present, the Ngové mainly speak Nkomi, which is a Myene language. The ethnic groups form autonomous subdivisions - clans - that occupy a common territory and abide by the same traditions and taboos. Clan affiliation is established through matrilineal descent. The clan concept and its associated traditions are disappearing through acculturation, which is particularly marked in the Ndogo Lagoon region because of the town of Gamba.

The dominant ethnic groups in the Republic of Congo are the Vili and Lumbu. The Vili are coastal people who have been settled in the Conkouati region since the 13th century. The Lumbu are forest people from the Mayombe Mountains who moved into the Conkouati region within the past 100 years. Together with other ethnic groups, they were imported to construct the Pointe-Noire-Brazzaville railway, and more recently for industrial logging (Hecketsweiler & Mokoko Ikonga, 1991).

Social organization

Administratively, the Gabonese portion of the Landscape straddles three provinces: Ogooué-Maritime, Ngounié, and Nyanga. Each province is administered by a governor. Departments are run by a prefect and a departmental council. The prefect, assigned by the Interior Ministry and supervised by the provincial governor, is in charge of departmental administrative services. The prefect also oversees the budgets of the different central government agencies, the departmental council and the local town hall. The departmental council, composed of a leader, deputy leaders and councilors, is involved in infrastructure development, improving living conditions and forwarding local people's complaints to higher authorities. At the departmental level, deputies represent the population at the National Assembly. Each department is divided into cantons. The hierarchical organization of the local authority structure into canton, settlement and village leaders, a legacy of the co-

[11] The first exchanges between the Vili Kingdom of Loango and the Portuguese and Dutch date back to at least 1570. Trade originally centered around copper, ivory, raffia and redwood and then, as of the 17th century, slaves. The slave trade expanded rapidly under the English and then the French who founded the first European establishments. After the Congress of Vienna and the abolition of slave trafficking south of the equator (1836), trade declined despite persistent illegal trafficking. After 1883, European exploitation changed from a barter-based system to a colonial model of concessions. The establishment of French Equatorial Africa in 1910 led to a surge in economic activity and the development of forest exploitation (Blaney, 1998).

lonial period, is the framework within which the traditional forms of authority derived from customary law are exercised.

Activities

(1) Agriculture

As in the rest of Gabon, there is little tradition of agriculture in the Gabonese portion of the Landscape[12] (Figure 13.9). Farming is a predominantly female occupation. The women see to land clearing (June-July), sowing (September-November), weeding (December-February) and the selling of produce. Men take part in tree felling in the dry season. The main crops are cassava, plantains, corn, 'old' coco-yams (dasheen) and sugar cane. The per capita annual area under crop gives an indication of farming intensity: the Etimboué department has the highest value with 2,090 m²/person/year while elsewhere it ranges from 687 to 1,445 m²/person/year.

In rural areas, farming is primarily a subsistence activity. In Gamba, where 56% of urban families engage in agriculture (Blaney *et al.*, 1998), most production is sold to provide women with 'pin money' to supplement the head of household's income. Production from local agriculture still remains marginal in Gamba's overall supply. A relatively affluent, significant share of the population buys imported goods. In the surrounding Gamba region, agriculture is mainly reserved for indigenous ethnic groups; customary law restricts land tenure opportunities for immigrants, who form the bulk of Gamba's population. Landscape-wide, the pressure on natural environments by agriculture is minimal and is confined to populated areas.

Plantations are regularly devastated by elephants, which abound in the Gamba area. This is a problem throughout the Gamba Complex, and is the source of extreme discontent. The forest management agency, assisted by WWF, is supporting the installation of protection systems in the form of rope fences, to which empty drink cans filled with pebbles are attached in order to create noise.

(2) Fishing

Fishing is concentrated on the lagoons, lakes and main rivers, and is the main source of animal protein for lagoon and sea-side villages, as well as the towns of Gamba and Mayumba.

Recent studies have been done on fishing in the Ndogo Lagoon (Pinkston, 1997; Blaney *et al.*, 1998, Nteme Mba, 2001 and 2005). The gill net is the most common method used (85% of fishermen), followed by seine nets (10%) and lines (3%). Apart from pot and barrier fishing in the dry season, both done by women, fishing is a male occupation carried out in paddled or powered dugout canoes. Approximately 40% of the lagoon fishermen are based in Gamba. The most common catches are 'tilapias' or carp, mullet, sea catfish, horse mackerels and sea-bream. April to September is the peak fishing season, but total catches do not satisfy local demand. With a total of 125 fishermen working the lagoon and Basse-Nyanga, the Gamba Complex's fishery resources are arguably under exploited. The traditional fishing business would therefore stand improvement. For this reason, the fishery management agency and WWF are helping fishing communities through capacity-building for the Ndougou department fishermen's association (APDN). A regular supply of fish to the towns could help cut the trade in poached bushmeat.

Fishing and the fish trade are the main activities in the town of Mayumba and the area around Mayumba National Park. In the villages surrounding the park, 90% of the population believes that fishing is 'very important' or 'essential'. Fresh water lagoon fishing is restricted to native Gabonese and prohibited to foreigners. Sea fishing is carried out only by West Africans, especially Beninese, who live in Mayumba. Overall, the resources are not being over-fished, and commercial trawlers pose a bigger threat.

(3) Game hunting and trade

Hunting is very widespread and goes well beyond the bounds of what is customarily allowed[13]. There is a profitable trade in game, with major flows to big town and city markets. Urban markets are supplied by well-equipped professional hunters taking advantage of the access routes opened up by the mining and oil companies. Since Waters and Forests (General Principles) Act No. 1/82 of 22 July 1982, this sector of activity, despite being given 'official status', has become illegal and equated to poaching. The Gabonese section of the

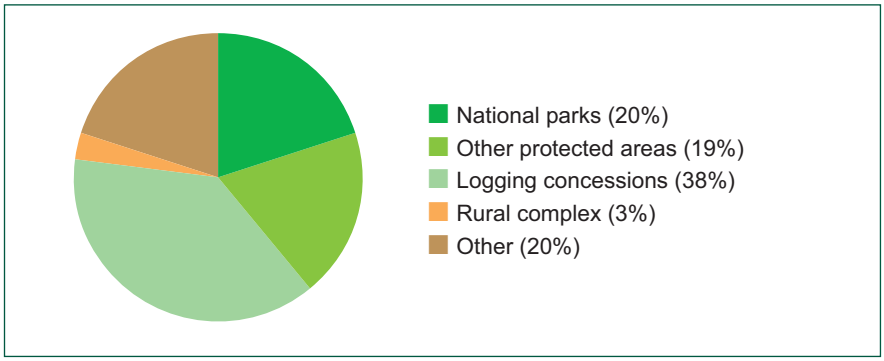


Figure 13.9. Land use types.

[12] Pre-colonization, hunting and gathering were the main means of subsistence. An agricultural development policy notwithstanding, only 10% of the population engage in farming. Twenty-five percent of the population's needs are met by food imports. The growth of a mining-based economy has been a major factor in the decline of Gabonese agriculture. Between 1961 and 1975, Gabon's 'area under crop' shrank by 32% while the number of farming households aged 50 and over rose from 30 to 52%. The appeal of urban jobs prompted a youth exodus to the towns, leaving the oldest family members to work the land.

[13] Hunting is a very deep rooted tradition in Gabon. Country wide, it is the main source of animal protein, ahead of fishing and livestock production, which contributes only 5% of total requirements. So great is the sociocultural value of game to both rural and urban populations that no alternative solution has so far succeeded in limiting hunting and the associated game trade (Pfeffer, 1996). People are willing to pay premium prices to satisfy their food preferences, despite how hard it is to make a living.

Landscape is no exception to the rule. Some areas accessible via the old and new forest and oil roads in the Gamba Complex are a source of supply for the meat trade to Omboué, Port-Gentil, Mandji, Lambaréné and Libreville. Despite the presence of three teams of Ministry of Water and Forests wildlife rangers, quotas are being exceeded, protected species are being slaughtered and the hunting season periods are being breached. Spot checks on the Gamba, Tchibanga and Omboué markets over the past ten years clearly demonstrate the role that the Gamba Complex plays as a wildlife reserve for local hunters. The most populous species are duikers, water chevrotain, bushpigs, brush-tailed porcupines, crocodiles and mangabeys.

There are no villages or permanent encampments within Mayumba National Park boundaries, but they abound in the buffer zone. Three small encampments and two fishing villages located near the park's boundaries are used as bases for poaching. The villagers traditionally used the coastal margin to collect salt and turtle eggs. Salt collection is no longer economically viable, but there is fierce opposition to the ban on collecting turtle eggs. This ban and the crackdown on poaching are the main points of contention between the national park authorities and the villagers.

In the Republic of Congo, the Vili are traditionally fishermen, whereas the Loumbou are hunter-gatherers. Farming, fishing and hunting, along with public administration, are the main economic activities, and most of the population still depends on locally obtained naturally occurring resources. Shifting cultivation (cassava, bananas and corn) is practiced by women; fishing and hunting are carried out by men. Hunting is less important than fishing. Minor activities include the collection of firewood, marantaceae leaves for cassava preparation, mushrooms and other forest produce[14].

(4) Gold panning

This is a rapidly expanding activity in the Republic of Congo: in 1996, it employed 40 people; in 2005, about 1,000, over 99% of whom are illegal immigrants from DRC. In this same area, the economic value of conservation is not negligible: the park employs 45 people full-time, and 20 for at least 7 months of the year for the monitoring and protection of sea turtles.

Development and public services

The exploitation of oil has provided a considerable development stimulus to the Gabonese section of the Landscape, particularly in the Gamba region. The situation is very different in the Congolese section of the Landscape. Public service provisioning is lacking: there are only 5 health clinics, 15 primary schools and 2 secondary schools. Families who can afford it, send their children to Pointe-Noire or Brazzaville, but many children do not attend school because their parents cannot afford it. The regional capital, Nzambi, has a police station and national security station, but the police have no working radio, equipment or facilities. Nzambi is separated from the town of Pointe-Noire by the Noumbi River and the Conkouati Lagoon, which can be crossed only by dilapidated ferries. For a civil servant to be posted to Nzambi is equivalent to a punishment. As a result, Conkouati often inherits 'disgraced' civil servants to represent the 'security' authorities.

Eighty percent of the water supply to villages in the Gabonese section of the Landscape comes from upwellings: streams and rivers. Very few villages have a well or power generating units. Health care services barely meet villages' needs: only 14.3% of localities in the Gamba Complex have a public health clinic staffed by qualified personnel[15]. Patients are often transported to one of Gamba's three medical facilities: a hospital and two private clinics. Villages with a school (40% of villages in the Gamba Complex) manage to support a population of children aged 6-14, and therefore retain families. Villages without a school do not.

The town of Gamba (meaning 'fog' in the Vili language and named after the lagoon on whose shores it lies) did not grow out of any indigenous settlement in the Landscape. In the 1960s, no one lived where Gamba now stands. The city was built from scratch by Shell Gabon when the first wells of the Gamba-Ivinga deposit came on line in 1963. Shell's employees were settled in Gamba with their families. Oil production and its accompanying economic development attracted a sizeable population. The town grew very rapidly from 1965 to 1974, despite its isolated position in the middle of inhospitable wetlands. General supply stores were created in 1966, and a primary school in 1969. By 1977, Gamba had a hospital, a cultural center, an outpost of Gabon's power and water company (SEEG), a police station, airport and post office. The secondary school was opened in 1983. Having become the departmental capital in 1966, Gamba was briefly (1970-74) assigned the status of an autonomous district by a government decision that curtailed the conflicts of interests between the Ogooué-Maritime and Nyanga provinces, which were trying to claim the 'oil

[14] A family living in the area around the national park earns an average annual income of approximately 800,000 CFA francs from fishing and 200,000 CFA francs from agriculture. The total value of catch/produce harvested in the immediate periphery of the park is estimated at 250 million CFA francs per year.

[15] Although it must be said that the localities are so small and scattered that it would be hard to deliver educational and health care services to them all.

city' as part of their territory. Gamba now has 3 health centers and 6 schools (4 primary and 2 secondary). Ndougou department, which includes Gamba and 13 villages distributed between three cantons, has 14 schools, 16 health centers and 13 communal TV/radio viewing and listening centers. The coming on line of Rabi in 1986 brought a new influx of labor, but the trend is now reversing as Shell Gabon gradually pulls out and the first big layoffs are made.

In the Gabonese section of the Landscape, telephone access is restricted to the urban centers of Gamba, Mayumba and Tchibanga, which have unreliable landline networks, but also mobile phone operators (Celtel and Libertis). Gamba and Tchibanga also have a cybercafe.

The main highways in the Gabonese section of the Landscape are laterite roads, sporadically maintained by the provincial public works department. Only the three towns have tarmac roads, maintained by the town councils. There is no road link between the Congolese and Gabonese parts of the Landscape. The town of Gamba is also very cut off from the outside world and only accessible by a sandy track, seasonally flooded over approximately 80 km and crossed by 2 ferries. The only way to the town of Mayumba is across the Banio Lagoon on the ferry operated by the public works department.

Logging

Four logging companies currently operate in the Gabonese section of the Gamba-Conkouati Landscape. In order of size, they are: *Compagnie des bois du Gabon* (CBG), Idriss Plantation Holdings Gabon (IPHG), *Société d'exploitation et d'aménagement forestier* (SEAF) and *Transformation et exploitation forestière* (TEF). Only CBG has two publicly approved forest working concessions (CFAD): one for 350,000 hectares in the north of the Landscape and one for 190,000 hectares close to Mayumba. The other forest companies operate under family felling operations or temporary operating licenses.

CBG's Mandji CFAD is in the northeastern tip of the Gamba Complex, north of Moukalaba-Doudou National Park. The company's management plan was approved by the forestry economy ministry in December 2004 and put into operation in January 2005. Despite its efforts, the company is finding it hard to implement the wildlife component of the management plan. Due to these difficulties, it began discussions with WWF (Gamba Project) in early 2005. These discussions resulted in WWF being given support by the French Global Environment Facility (FFEM) under the CAWHFI program to provide technical support to the administration and CBG in implementing the wildlife management plan. The plan is that WWF will interface between the ministry for the forestry economy, the national park management authorities, the operating company and local communities.

In the Republic of Congo, the Landscape includes 4 large concessions (UFA): Pointe-Noire, Niari-Kimongo, Kayes and Kibango. At least 8 companies have operated in the Landscape since 1980, including in what is currently the national park. These areas were working concessions up until the war in 1997. Insecurity and the collapse of transport systems subsequently brought exploitation to a halt. In 1999, after the national park was created, the Asian company *My Fai Tai* started up operations in the Landscape and the national park. Despite national park status, this logging is still going on today over an area of 916,000 hectares. It has had serious consequences for the Landscape: it has changed the human population distribution, population processes, socioeconomic factors, and the composition and structure of forests; it has also left roads and skid trails everywhere. The impact on the national park is dramatic.

Oil extraction

Oil deposits in Gabon have been known since 1928, but they were not exploited prior to 1957. The oil industry developed rapidly in the 1960s and 1970s following the discovery of extensive reserves in the Sette Cama hunting reserve and offshore from Port-Gentil. Shell commenced explorations in the Gamba Complex in 1960 in the guise of *Compagnie Shell de recherches et d'exploitation du Gabon* (COSREG). In August 1963, COSREG found oil near Gamba, then in Ivinga. The Gamba-Ivinga oilfield was producing 50,000 barrels per day in the 1970s, but this fell to 7,000 barrels per day in 2001. As early as 1985, known Gabonese reserves had decreased, and production had fallen to 150,000 barrels per day. The effects of this decrease were compounded by falling oil prices. The discovery of the Rabi deposits in 1985 was providential, therefore, increasing production by 77%. Rabi was the biggest onshore oil field in sub-Saharan Africa, and came fully on line in 1987, achieving an output of 240,000 barrels per day in 1997 (60% of Gabonese production). In 2003, Shell Gabon's total output was 69,000 barrels per day.

Other onshore exploitations in the Gamba

Complex include Atora (Total Gabon), in production since 2001 (15,000 barrels per day), Echira, Moukouti and Niango (Perenco). The Bendé gas reserves (Shell) power Shell and the Gamba power company's (SEEG) turbines. Current exploration licenses in the Complex include those of Lotus (Sinopec), Eketamba (Transworld) and Nziembou-Dhighe (Perenco). Other companies present are operating individually or in joint ventures. They include Amerada Hess, Broken Hill Petroleum, Devon Energy, Energy Africa, Eni, Marathon, PanAfrican Energy, Petrofields, Petronas, Pioneer Natural Resources, Sasol Petroleum International, Vaalco and Vanco. The crude oil is shipped to the Gamba and Cap Lopez terminals.

Tourism

Despite its potentials, Gabon had remained virtually unknown as a tourist destination; however, recent years have seen the emergence of ecotourism schemes, especially around Petit Loango Reserve, now Loango National Park. Four lodges or tourist camps are now operational. The Iguéla area has Loango Lodge, operated by *Société de conservation et de développement* (SCD), with satellite camps at Akaka, Tassi, Pointe Sainte-Catherine and Petit Loango, as well as Ngavilo Lodge. SCD operates under the guise of Operation Loango and supports research through WCS, Apenheul and the Max Planck Institute. In Sette Cama, Africa Tours Operators (ATO) runs the Camp Missala Lodge and Sette Cama Safaris. The Ndougou departmental council runs a holiday lodge at Sette Cama in association with the village and technical and financial support from the European Union's Protected Areas Development Program (PSVAP). Shell Gabon runs a small private lodge at the southern end of the national park. A guide service and tourist reception center have been set up at the southern tip of the park with PSVAP support, and contracted out to the local NGO, Ibonga.

Tourist activities in the Loango National Park currently include sport fishing and photographic safaris from the four lodges established in the north and south of the park. The provision of tourist facilities and products make Loango National Park one of the primary destinations in Gabon and the whole of forested Central Africa.

Reasons for the identification of the Landscape

(1) The Gamba region was identified as critical to conservation in Central Africa as long ago as 1990 (Wilks, 1990), partly for its unrivalled diversity.
(2) The Gamba Complex has been identified as an important birdlife conservation area (Fishpool & Evans, 2001).
(3) The Monts Doudou Mountain Range is a Pleistocene era forest refuge whose protection was called for in 1990 by the IUCN (Wilks, 1990), because of its tremendous botanical significance[16] and the recent discovery of the white-legged Ogilby's duiker *Cephalophus ogilbyi crusalbum*[17].
(4) Unlike other lagoon systems in the Gulf of Guinea, the Gamba-Mayumba-Conkouati Landscape lagoons lie in an area of very low human population density, which helps preserves the integrity of their ecosystems. The large lagoons, as well as the countless small lagoons, are critically important to the development of commercially significant fish populations; not only in the lagoon waters, but also the contiguous inshore waters.
(5) The Landscape is important for its near-intact large mammal populations.
(6) Mayumba National Park is contiguous with Conkouati National Park in the Republic of Congo and both make up a transnational zone of 120 km of protected beaches comprising one of the world's two most important leatherback turtle egg-laying sites.

Conservation

History

Gabon's 250,000 hectare Ngové-Ndogo Hunting Area, and its 50,000 hectare Petit Loango National Park were created in 1956. The 700,000 hectare Sette Cama Wildlife Utilization Area was classified in 1962. The Ngové-Ndogo Hunting Area remained unchanged, but the Petit Loango National Park became the Iguéla-Petit Loango Wildlife Reserve and its area increased to 80,000 hectares. Three new entities - the 20,000 hectare Ouanga Plain Wildlife Reserve, the 200,000 hectare Sette Cama Hunting Area, and the 150,000 hectare Iguéla Hunting Area - were also added to the Sette Cama area. In 1966, the Iguéla-Petit Loango Wildlife Reserve became the Petit Loango Wildlife Reserve with a reduced area of 50,000 hectares, and the Iguéla Hunting Reserve was in-

[16] Two endemic species of begonias - *Begonia dewildei* and *B. floretii* - had been just found there.

[17] This form endemic to Gabon was discovered only in 1978, and at the time so little was known of its distribution that the Monts Doudou mountain range was thought to be essential to its conservation (Christy *et al.*, 2003).

creased to 180,000 hectares. In 1971, the areas remained unchanged, but the complex was split into three sectors: Iguéla, Sette Cama and Ouanga. The Moukalaba-Dougoua Wildlife Utilization Area was created in 1962 out of the Moukalaba-Dougoua Wildlife Reserve (80,000 hectares) and the Moukalaba Hunting Area (20,000 hectares). The 332,000 hectare Monts Doudou Mountain Range Wildlife Utilization Area was classified in 1998. The contiguous collection of protected areas has become know as the Gamba Protected Areas Complex, in which WWF has became the partner of the Ministry for Water and Forests. Loango, Moukalaba-Doudou and Mayumba national parks were the last to be created, in August 2002.

In the Republic of Congo, Conkouati Reserve was created in 1980 over a land area of 300,000 hectares. For a decade, it was under the sole management of the Ministry for Water and Forests and suffered from a lack of human and financial resources. In 1989, much of it was given over to industrial logging, reducing the reserve to 144,000 hectares. In 1994, the Republic of Congo secured GEF/PROGECAP funding to support a number of conservation-related activities in the reserve, while the IUCN was commissioned to provide technical assistance to the Congolese government. At the end of the GEF/PROGECAP program in the late 1990s, WCS became the MEFE's partner in the Landscape. In 1999, the wildlife reserve became the 505,000 hectare Conkouati-Douli National Park (approximately 25% of it marine) by Executive Order No. 99-136bis.

Players

In Gabon:

- Natural resource management is the responsibility of the MEFEPPN, acting through the provincial water, forests and fisheries inspectorates in Tchibanga, the water and forest cantons in Mayumba, Ndindi and Mandji, the fisheries brigades in Mayumba and Gamba, and the wildlife brigades in Mourindi, Sette Cama and Iguéla.
- Protected areas are managed by the CNPN and the MEFEPPN's wildlife and hunting department.
- WWF (since 1989) and WCS (since 2002) are the main international NGOs supporting conservation.
- CI, ASF, the *Association des pêcheurs du département de Ndougou* (APDN), the *Comité de réflexion pour l'après-pétrole* (CRAP), Ibonga-ACPE (Association for Environmental Knowledge and Protection), Nyanga-Tours and various European Union-funded programs (Cybertracker Monitoring Program, the '*Espèces Phares*' critical species program, the Kudu and Protomac programs) provide more case-specific support or are concentrating their work on particular aspects of management.
- The oil companies Shell Gabon and Total Gabon operate in the protected areas between Loango and Moukalaba-Doudou national parks to recognized environmental standards. Shell Gabon also supports the work done by the Smithsonian Institution and the Ndougou Department of Sustainable Development Support Program (PADDN). The PADDN program is also supported by the Shell Foundation and run by a steering committee that includes the National Employment Office (ONE), Omar Bongo University (UOB), the Expansion and Development Fund for Small and Medium-sized Enterprises (FODEX), the local authorities, Shell and WWF.
- The National Scientific and Technological Research Center (CENAREST), the national herbarium, the University of Wageningen, the University of Kyoto, the Smithsonian Institution and the Max Planck Institute are conducting research.
- Operation Loango (SCD) is working to develop tourism in the northern part of Loango National Park.
- The European Commission's Protected Areas Development Program (PSVAP) is active in the Gamba Complex.

In the Republic of Congo:

- The Ministry for Forestry Economics and the Environment (MEFE), formerly MEF, has had field operations in place since the Conkouati Wildlife Reserve was created in May 1980. There have been a conservation officer and assistant conservation officer since 2000.
- The NGO *Habitat Environnement et Liberté des Primates* (HELP) secured Ministry for Forestry Economics (MEF) authorization to establish a chimpanzee sanctuary on four islands in the Conkouati Wildlife Reserve in 1991.
- In 2000, WCS signed a draft agreement for management of the Conkouati-Douli National Park in partnership with the MEFE.

Direct threats

(1) Hunting

Illegal hunting is the main threat in both Gabon and the Republic of Congo.

(2) Logging

Non-sustainable logging is prevalent throughout the Landscape in Gabon, and even 'accidentally' overspills into the Gamba Complex. Instances of unlawful transnational logging have been recorded. Illegal logging is found in the very heart of the national park in the Republic of Congo.

(3) Industrial fishing

Illegal industrial fishing practiced by national and foreign trawlers is a major threat to marine biodiversity. Neither the Gabonese nor Congolese governments have the policing and enforcement resources to counter this threat. Trawlers regularly ply the no-fishing zone within 6 nautical miles of the beach. In the Republic of Congo, trawlers have even dynamited rock clusters, endangering the survival of local communities who largely depend on fishing for their subsistence, threatening resource sustainability, destroying bottom-dwelling communities and posing a serious threat to sea turtles from capture in nets. Indirectly, the decrease in fish supplies to local markets may increase pressure on land resources, in particular through an increase in hunting.

(4) Traditional fishing

Illicit lagoon fishing, practiced mainly by foreign fishermen, is a serious threat to lagoon ecosystems, as traditional methods have been replaced by new and potentially less sustainable techniques[18] introduced by fishermen from West Africa, who are established and fishing illegally in the region, often under the protection of local political authorities. The main danger comes from the widespread use of nets in lagoons, especially banned monofilament nets, and the blocking of tidal waterways preventing any exchange of fish between ecosystem components.

(5) Sport fishing

In areas where codes of practice are not followed, this may also represent a threat: the regular catching of very large mature fish is not sustainable and threatens populations with regards to both population dynamics and genetics.

(6) Oil exploration

On and offshore oil exploration, including in the protected areas, constitutes a significant threat:

- Wells, roads and pipelines cover dozens of square kilometers, generate access and fragment habitats.
- Waste and/or accidental spillages are polluting. There are many offshore oil rigs, drowned springs and pipelines lying very close to the Landscape limits. So far, accidental pollution has not caused massive damage, but the threat of a major oil slick cannot be ruled out.
- The long term effects of low-level but constant petroleum hydrocarbon pollution are not yet known, but could be more significant than assumed.
- Human populations have been introduced into previously uninhabited habitats.
- Seismic studies have a negative impact on the whale population, especially on humpback whales during the breeding season.
- The declining output from old production licenses means that oil permits worked by large international companies with recognized environmental standards are transferred to small opportunistic operators. This threatens the medium and long term quality of environmental management systems.
- The decline in the oil business could also prompt many unemployed workers to join in the exploitation of wild resources, especially through hunting, as evidenced since the late 1980s[19]. It is therefore important to involve the oil companies in the planning and zoning of protected areas as part of their withdrawal strategy.

One deeply disturbing fact is that Loango National Park is included in the 'Lotus' exploration license - previously 'LT 2000' - recently sold to the Chinese oil company Sinopec. Likewise, the western part of Moukalaba-Doudou National Park straddles an exploration license.

It must, however, be acknowledged that Shell Gabon and Total Gabon have done much to support natural resource management and limit their environmental impact. Shell Gabon is not only ISO-14001 certified, but is developing its biodiversity action plan with scientific support from the Smithsonian Institution. In preparation for the post-oil era in the Gamba Complex, Shell Gabon and the Shell Foundation have also initiated the 'After Oil Development Support Program for the Ndougou Department' aimed at framing a development approach up to 2015 through a

[18] Non-sustainable practises also include the capture of large numbers of immature sharks.

[19] Commercial hunting began in the Loango National Park area in the late 1980s when the oil companies started to shed jobs. Hunters then came from Port-Gentil.

participatory process including local leaders and other players. At the same time, they are supporting small enterprise development.

(7) Sea turtle egg collection

This 'traditional' activity is not sustainable and is threatening these already vulnerable populations (Box 13.2).

(8) Mining activities

Gold panning destroys freshwater aquatic ecosystems and diminishes water quality. But over 1,000 gold panners are operating within the boundaries of Conkouati-Douli National Park. The Milingui zone iron deposit, towards the southern part of Moukalaba-Doudou National Park, could be worked in the future.

(9) Pollution

The beaches of southwest Gabon are badly polluted by waste from the Republic of Congo, DRC and Angola. Many lost logs wash up along the shores and represent a danger to sea turtles (Figure 13.10).

Indirect threats

(1) Lack of managerial know-how

The lack of an efficient management system, and a shortage of human, technical and financial resources, is a constant threat. In Gabon, the Gamba Complex is currently managed by the MEFEPPN, but the CNPN, created by presidential order in 2002, has general oversight of the development of the national parks network. In the Gamba Complex, two park wardens have been appointed for Loango National Park and Moukalaba-Doudou National Park, but the MEFEPPN seriously lacks the human, financial and technical resources to deal with inadequate, poorly-maintained facilities and equipment. Roles and responsibilities must be clarified, especially in the protected area located between the two national parks, which is what prompted WWF to initiate a study in December 2003 to come up with a new zoning and management methods for the Gamba Complex (Blom & Geerling, 2004). Park staff must be appointed, trained and equipped. Buffer zone management must also be clarified. A similar situation exists in the Republic of Congo.

(2) Lack of transboundary coordination

The lack of protected status for areas abutting Conkouati-Douli National Park in Gabon poses an indirect threat to the integrity of the national park in the Republic of Congo. Expelling gold panners, illegal hunters and fishermen from Conkouati-Douli National Park has only moved the problem elsewhere. Some of those expelled have relocated close to Mayumba National Park and its buffer zone. A Landscape technical management committee was set up in 2005 to step up transnational collaboration. Two transnational meetings have been held so far between the wardens of the four national parks in the Landscape with representatives of the Gabon MEFEPPN, WCS and WWF to map out strategies for working together on coast surveillance, industrial fishing, oil pollution monitoring, sea turtle monitoring and the exchange of information on other illegal transnational activities like poaching and logging.

State of the vegetation

In Gabon, most of the Gamba Complex forests have been logged at least once in recent decades. This activity has left disused access tracks, facilities, deserted villages and stumps *in situ*. But logging has had limited impacts on forest ecosystems, due to the selective logging method which focused only on a few commercially valuable species, chiefly okoume. Logging notwithstanding, the forests are still in good condition and vast tracts of primeval forests remain. Illegal logging has caused serious damage to the national park in the Republic of Congo.

State of the fauna

Gabon's terrestrial wildlife is abundant and no species is in immediate danger. There are concerns about the manatee, however, which despite being legally protected is still being poached. The Banio and Ndogo lagoon aquatic resources are currently being assessed by the MEFEPPN, WCS and WWF. There is evidence that the Banio Lagoon is suffering from overfishing; the Ndogo Lagoon seems less endangered. As regards saltwater fishing, local fishermen complain of a sharp drop in catches, for which they blame industrial trawlers near or in their fishing areas. Targeted studies are essential to assess stocks of particular species, such as sharks. Controlling industrial fishing in the Mayumba and Iguéla zones, and in the future in Sette Cama and Nyanga, could substantially ease the pressure on fishery resources, but control of traditional fishing is also essential.

Recent estimates by WCS and MEFE in the Republic of Congo show a sharp decline in large mammal populations in the *My Fai Tai* concession.

Box 13.2: Sea turtle conservation

The conservation of sea turtles is the top priority in the Mayumba portion of the Landscape. The Pacific leatherback turtle population has declined by 90% over the past 20 years as a result of fishing, damage to beaches and egg collection. Atlantic turtles are now exposed to the same threats, but their populations remain relatively strong. This means it is essential to protect all egg-laying beaches, especially those in the Mayumba region where nest density is among the world's highest. Research is also starting to identify offshore sites that are important for successful conservation.

Figure 13.10. The lost logs on the beaches of the Gamba Complex of Protected Areas are a permanent threat to the marine turtles.

Management and governance in the field of renewable natural resources

(1) At the Landscape level

In 1995, WWF produced a first framework plan for the Gamba Complex, which was updated in 2001 and 2002. To catalyze this coordinated management strategy, the WWF Gamba project drew up and distributed a working paper to a number of key players at the end of April 2003. This document sets out a draft strategic management framework with proposals on key strategies and the different players' roles and responsibilities, on the basis of a comprehensive SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis. One of the most pressing needs is to review the status of the Complex's different protected areas, other than the two national parks. These include hunting areas and wildlife reserves that overlay oil exploration and extraction licenses, village territories and community farming, hunting and fishing lands, as well as the town of Gamba. As a result of consultations initiated by WWF in December 2003, recommendations on zoning, protected area management methods and future management structures were written and produced in April 2004 (Blom & Geerling, 2004).

In Iguéla and Mayumba, permanent monitoring camps have been set up along the coast to feed back information on illegal fishing activities, especially by industrial trawlers. An information system generates reports on illegal fishing and can launch boat operations using small crafts stationed in Iguéla and Mayumba to control or prevent contraventions. These measures will be strengthened by creating posts between the Landscape's northern and southern points[20]. National park staff work closely with MEFEPPN personnel, which strengthens mutual collaboration and support. The fisheries department lacks the technical and budgetary resources to police the fishing zones, but a partnership with the national parks and NGOs could help resolve this shortcoming.

Oil extraction is still taking place in the coastal waters of the national park in the Republic of Congo, even though prohibited by law. In 2005, new seismic prospecting took place unbeknown to the national park authorities[21].

(2) In the national parks

In Gabon,

- CNPN has appointed four conservation officers, assigned to Mayumba, Tchibanga, Gamba/Sette Cama and Omboué/Iguéla. Total staff assigned to management and monitoring of protected areas is 0.76/1000 km² (Annex 1).
- Bases for developing management plans have been worked out for the national parks, and a first management plan has been developed for Loango National Park. It will be finalized in 2006.
- Substantial support is expected under a GEF program run by the World Bank and approved in May 2005[22].
- Delimitation in Loango and Moukalaba-Doudou national parks is almost completed.
- Wildlife brigades have been set up in Iguéla and Sette Cama for Loango National Park and in Mourindi for Moukalaba-Doudou National Park. Surveillance stations have been built at Panga and Digoudou on the edges of Moukalaba-Doudou National Park.
- A total of 9 sworn agents, including the 3 park wardens supported by forty rangers and ecoguides paid for by government or NGOs and tourism operators, are responsible for running the Complex.
- In Loango National Park, cleaning up the waste littering beaches boosted the coastline's attractiveness and enabled a database of all the waste collected to be compiled, as the basis for an international waste pollution campaign.
- In the Mayumba region, NGOs and conservation officers are working to persuade MEFEPPN personnel to enforce forestry laws in the Landscape.

[20] These actions are vital to preserve fish stocks in Gabon and are in the immediate interest of the country's human populations who consume large quantities of fish as their main source of protein; agriculture and livestock production are under developed.

[21] The company that carried out the explorations paid fishermen not to fish for a month.

[22] This US $10 million, 5-year program will swing into action only after Gabon has passed a new law on the national parks, and once the national parks agency - an MEFEPPN-supervised semi-public agency for the management of the national parks - takes shape.

In the Republic of Congo:

- Conkouati-Douli National Park has minimal facilities, which were substantially upgraded in 2005[23]. The plan for 2006-2007 is to build visitor and researcher accommodations.
- When the national park was created in 1999, it was divided into ten areas with five different protected statuses: two fully-protected zones, two partially protected zones (former forest exploitations), two multiple use zones (ongoing forest exploitations), three sustainable development zones and a marine zone known as the 'marine extension'. These zones were ill-defined both geographically and in terms of authorized activities, and the legal bases of management remain unclear. The illegal presence of an industrial logging company in a fully-protected zone in the middle of the national park prevents any effective management. To address this zoning issue, WCS in partnership with the Conkouati park warden and assistant warden, developed clear rules and regulations, and a new development plan that divides the park into two zones with clearly-defined natural boundaries: (1) a fully-protected land and marine zone in which no human settlement is permitted; (2) a sustainable development zone in which the sustainable, controlled exploitation of natural resources by park residents will be permitted.
- Despite these problems, the MEFE warden, helped by 22 rangers, tries to enforce the laws. In 2005, a checkpoint was set up in Yanika to stem the bushmeat flow to Pointe-Noire. This checkpoint proved highly effective[24], and a second checkpoint has been set up at Youbi on the Gabon road[25]. Within the park boundaries, anti-poaching patrols concentrated on clearing the park of traps[26].
- In 2004, WCS submitted a report to the government on the impact of industrial logging in Conkouati-Douli National Park and called for it to be banned from the park, but it still continues at the time of this writing[27].

(3) In extraction zones

A sport fishing company has set up in the Mayumba National Park buffer zone in Gabon, which might also in the near future consider starting up legal sport hunting for elephants and other large mammals. Efforts are being made to see that any such activity stays within strict quotas and that operating and monitoring procedures are established and complied with.

The forests situated outside the national park in the Republic of Congo are all included in concessions, but there is no policing of wildlife management or even logging activities.

(4) In rural areas

- Mayumba National Park personnel and local fishermen are jointly studying sustainable saltwater and freshwater fishing. It is a highly participatory process using the PARFISH methodology developed by the United Kingdom's Department for International Development. The first meetings have been held and an initial period of basic data collection has been completed to draw up a long term follow-up program. The outcomes will be used to guide fishermen towards the adoption of the sustainable management measures suggested by the project.
- A study is also taking place on sustainable oyster fishing at Mayumba. The idea is to form a co-operative and find lucrative markets for the exploitation of a quality product, to avoid over-fishing and enable stock control.

Monitoring renewable natural resources and their management

A wide range of environmentally and socio-economically related activities are taking place. A large body of information is starting to materialize, but there is no harmonized Landscape-wide database as yet.

(1) Fisheries monitoring

Traditional fishing is a major economic activity for many villages, including Gamba and Mayumba, but the ecosystem's productive capacity is unknown and is certainly affected by industrial fishing. Therefore, fishermen must be given supportive guidance, their rights or obligations must be clearly defined, no-fishing zones must be delimited and catch monitoring introduced. Fisheries monitoring is also being set up in Mayumba, and the government department responsible for fisheries has shown a keen interest in the program. Should the early results be conclusive, the PARFISH method could be given official status across all Gabonese fisheries.

Inshore waters surveillance equipment and methods are being tested out in Iguéla and Mayumba. It is hoped that the surveillance network will be extended by NGOs and national parks managers, including Conkouati-Douli National Park in the Republic of Congo, as well as the MEFEPPN's fisheries department. A new project supporting the fisheries sector and backed by the African Development Bank (ADB) is in

[23] These facilities include headquarters with 3 houses, 2 offices, a volunteer house, 2 stores, a generator room, a small port, a small boathouse, a sea-going boat, a garage and a workshop.

[24] 129 animals were confiscated in the first week of January, compared to just 8 in December 2005.

[25] 497 animals were confiscated from bushmeat traffickers in its first week of operation.

[26] More than 20,000 neck snares were removed and destroyed between January and December 2005.

[27] The company was fined 11 million CFA francs (US $20 000) in 2005 for operating in the middle of the park's fully-protected zone. This is a paltry sum relative to the damage done.

its development period in Gabon, as part of the Forests and Environment Sector Program (PSFE). Building the institutional capacity for inshore waters surveillance through setting up forward surveillance bases and bringing high speed motorboats into service is planned for the Landscape's coastal zones. In Loango National Park, an ocean-going vessel - the Gemini - is already in service to support surveillance of illegally operating trawlers.

(2) Monitoring oil extraction

Standards and the practical implementation of standards have been considerably strengthened over the past two decades, albeit to different extents between the different companies. The standards applied by oil companies and their suppliers are mainly dictated by their sensitivity to international public attention, which is in turn determined by the company's size, the scale of its international presence, and the culture of its headquarter's country. In the case of large companies like Shell and Total, natural and human environmental aspects are addressed by health, safety and environmental management plans. Shell Gabon is ISO 14001 certified. But these procedures were not introduced when oil operations first came on line 40 years ago and they continue to be a work in progress. Where the Gamba area is concerned, the legacy of past practices is still visible as 'black spots'. A program has been implemented to deal with them.

In Mayumba, a coastal oil pollution monitoring system was initiated by WCS and is in the process of being given official status. Procedures have been developed to standardize surveillance and reporting for monthly or spot checks along beaches. Past oil slicks have received little attention and many surely went unnoticed. This failing has probably held back the development and introduction of a binding code for offshore oil exploitation similar to that in Europe or the United States. Therefore, standardized monitoring of beaches will not only enable rapid responses to major pollution incidents, but it will also force some companies to change their strategies for security/safety and reducing environmental impacts.

(3) Sea turtle monitoring

The study of sea turtles, commenced six years ago in Mayumba by ASF, *Gabon Environnement*, ECOFAC/Protomac and WCS, is ongoing. A research program has been conducted on the Gamba beaches by Ibonga, ENEF, Biotopic, the University of Glasgow, Protomac/Kudu and WWF since 2002. Turtles in the north of Loango National Park have been monitored since 2003 by a team of Gabonese researchers from WCS. Two specialized aquatic ecology researchers are monitoring sea turtles in the Republic of Congo, aided by 20 temporary assistants.

The activities carried out by all these partners include using transmitters for the satellite tracking of females' movements during and after the egg-laying period, studies on turtle population genetics, studies on turtle health and monitoring breeding success. Standardized counts at seven points in the Landscape in both Gabon and the Republic of Congo are added to national and regional databases, and the exchange of data on tagged turtles gives a better understanding of their migration patterns.

Proposed new activities include a project to put NGO observers on selected trawlers to collect data on accidental turtle captures and a future workshop on trawlers' use of Turtle Excluder Devices (TED), to reduce accidental captures. Finally, regular boat-borne operations in the Mayumba region will be carried out to study turtle migrations, egg-laying sites and offshore abundance.

(4) Great ape monitoring

The first great ape studies were done in Loango National Park by the University of Kyoto in 1995. In 2004 and 2005, the Max Planck Institute in collaboration with WWF conducted a study of chimpanzee and gorilla densities and spatial distributions in Moukalaba-Doudou National Park. The data are currently being analyzed by the Max Planck Institute. In Loango National Park, another team from the Max Planck Institute has been studying gorillas since 2005 in order to habituate them to tourism. In Doussala, in the east of Moukalaba-Doudou National Park, the University of Kyoto has been running a gorilla habituation program since 2001.

(5) Elephant monitoring

Satellite tracking of elephants in the Gamba Complex is being done by WCS, SCD and SI. The data are available on the CARPE website (CARPE Mapper). The plans are to fit three more collars in August 2006 in the Akaka swamplands on the edge of Loango National Park. Plans are being developed to study the use of the environment by forest elephants in Loango National Park and to set up a tracking program based on individual identification.

(6) Cetacean monitoring

The WCS Cetacean Research and Conservation Group has been studying the migrating population of humpback whales off the Landscape's coast since 1999. In collaboration with Operation Loango, in Iguéla, briefly in Gamba and more recently in Mayumba, the research efforts have been focused on studying the size and structure of the population that visit Gabonese waters from June to October. Methods used include systematically photographing fin and tail details for individual identification and skin sampling for genetic studies. Toxicological analyses have also been done to assess petroleum hydrocarbon levels in whales. In 2005, research out of Mayumba was able to individually identify 245 whales in 105 groups in 28 boat days. Other species identified on these outings were the common or saddle-backed dolphin, the bottlenose dolphin, the Atlantic hump-backed dolphin, the killer whale, the leatherback turtle and the olive Ridley sea-turtle, with occasional sightings of hawksbill turtles and green turtles. In 2006, research will be done out of three sites - Iguéla, Mayumba and Conkouati - which should yield vital information for whale conservation worldwide. New initiatives also include a study of the hump-backed dolphin, a rare and elusive species about which little is known. The findings of research on humpback whales have been submitted to the International Whaling Commission.

(7) Research on crocodiles

Research into the breeding and egg-laying of the African Dwarf Crocodile *Osteolaemus tetraspis* has been ongoing since 2004. In 2005, nine crocodiles were fitted with telemetric transmitter units to determine their territory.

(8) Botanical monitoring

Botanical research has been done in the Gamba Complex, particularly in the Monts Doudou Mountain Range area, for twenty-odd years by the Gabonese national herbarium, the Meise Botanical Garden (Belgium), the *Institut de Recherche en Ecologie Tropicale* (IRET - Tropical Ecology Research Institute), the Universities of Wageningen and Gembloux, and the NGOs Nature + and WWF. In early 2003, botanists from Gabon's national herbarium working in close collaboration with the Missouri Botanical Garden, the Royal Botanical Gardens in Edinburgh and WCS, took a botanical inventory of Loango National Park. Over 500 species have been identified to date. More in depth historical research into the park's vegetation began in 2005, focused on the diversity, abundance and distribution of plants of the *Chrysobalanus* genus.

(9) Monitoring large mammals and human presence

The first inventories of large mammals in the Gamba Complex were done by WCS and WWF in 1997 and 1998 (Thibault *et al.*, 2001). In 2004, an expert from the Max Planck Institute (MPI) helped the CNPN, MEFEPPN and WWF Gamba teams develop an environmental monitoring procedure based on an innovative combination of point and line transects. The procedure was tested in 2005. With support from an MPI expert, attempts are now being made to harmonize the monitoring approaches between WWF and WCS. Joint monitoring of Loango National Park is planned to start in 2006. Vital information on the socioeconomic dynamics of villages in the Gamba Complex area has been provided by studies done by WWF since 1998.

In the Republic of Congo, environmental research done to collect source data includes a study on vegetation and large mammal inventories. Using 2004 data, a new method was designed by WCS statisticians and successfully applied in November 2005 to yield excellent source data on large and small mammals. The elephant population was estimated at 0.2/km² or 772 (±189) elephants for the entire park. The data also enabled mapping on the distribution of human impact, and the following species: elephant, gorilla, chimpanzee, buffalo, sitatunga, bushbuck, bushpig, blue duiker, red duiker, and brush-tailed porcupine. Socioeconomic studies were completed in May 2005. They include censuses in the villages around the park, the collection of demographic data, the collection of employment status data, and gender-specific socioeconomic studies. Thus far, data has been obtained from more than 5,900 people. The monitoring personnel consists of: 2 researchers specializing in aquatic environments, 2 in socioeconomics and 2 in ecology.

14. Lopé-Chaillu-Louesse Landscape

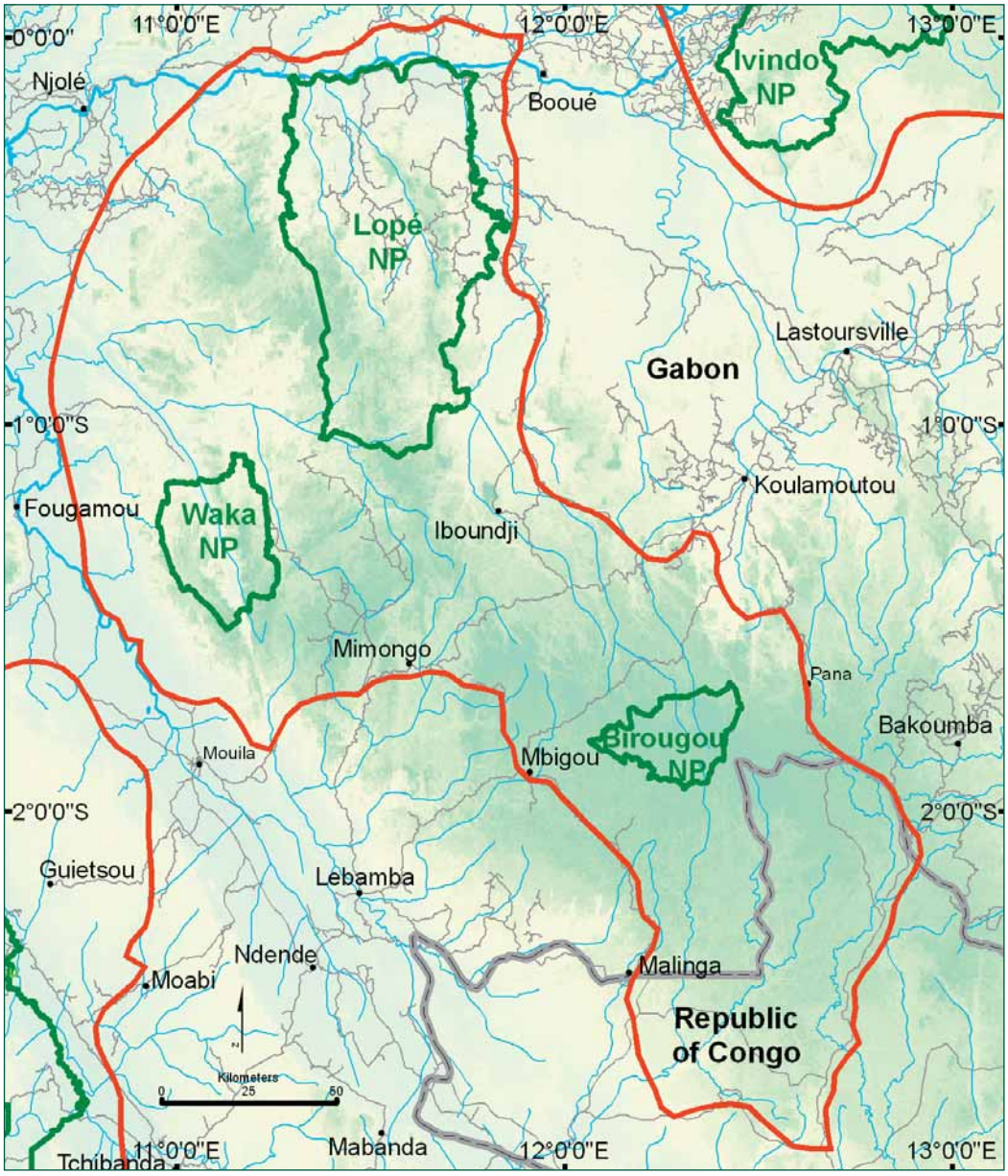


Figure 14.1. Map of Lopé-Chaillu-Louesse Landscape (Sources: CARPE, JRC, SRTM, WCS-Gabon).

Location and area

The Lopé-Chaillu–Louesse Landscape covers 35,000 km² and extends over 275 km from north to south, from the center of Gabon to 50 km inside the Republic of Congo (Figure 14.1). It centers on the Chaillu Massif, a mountainous region that is assumed to have sheltered one of the forest refuges of the Pleistocene[1], explaining the presence of numerous endemic species. The Gabonese section of the Landscape includes Lopé, Waka and Birougou national parks.

The landscape in brief

Location: 0°2'52"N – 2°52'16"S; 10°40'25"E – 12°55'8"E
Area: 35,000 km²
Elevation: 100-1,000 m
Land ecoregions: Congolese forests ecoregion in the northwest
Atlantic Congolese forests ecoregion
Congolese forest-savannah mosaic ecoregion in the southwest
Aquatic ecoregion: Southwest equatorial coastal ecoregion
Protected areas: Lopé National Park, 497,000 ha, 1946/2002, Gabon
Waka National Park, 107,000 ha, 2002, Gabon
Birougou National Park, 69,000 ha, 2002, Gabon

[1] During the last glaciation of the Pleistocene the foothills of the Chaillu Massif seem to have been covered with savannahs and, contrary to the case in the Monts de Cristal, it is not certain that the highest areas were covered with dense continuous forests. Some people think that they were covered with a mosaic of plant environments and forest formations. Recent studies suggest, moreover, that even the forest galleries of Lopé National Park functioned as a refuge during the last glaciation for several species of Caesalpinioideae with very low colonization ability (Leal, 2004)

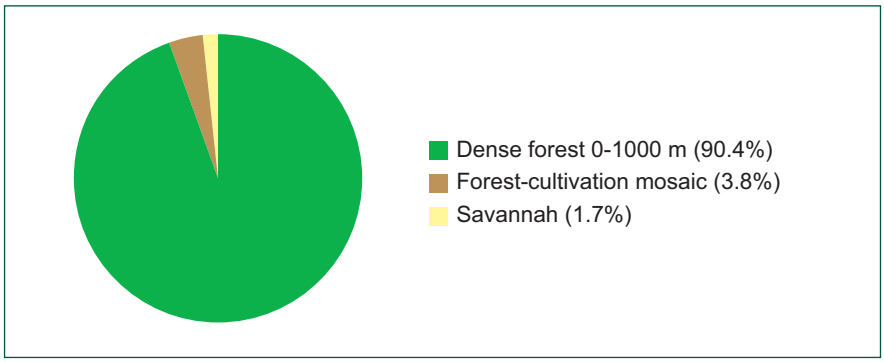


Figure 14.2. Main vegetation types (Source: JRC).

Figure 14.3. The forest-savannah mosaic in northen Lopé National Park.

Physical environment

Relief and altitude

The majority of the Landscape is made up of hills and mountains with a rather steep relief of between 100 m altitude at the Ogooué and 1,020 m at the summit of Mount Milondo (Figure 14.1). Nearly half the area of the Landscape is located above 600 m in altitude. With the Monts de Cristal in the north, the Chaillu Massif forms the 'backbone' of Gabon. In contrast to the Monts de Cristal, which are located only 100-120 km from the ocean, the Chaillu Massif is 300 km or more from the coast and is separated from the ocean by two intermediate ranges, the Doudou and Mayombe Mountain Range and the Ikoundou Range. These mountain ranges accumulate the clouds from the Atlantic and attenuate their effects.

Geology and soils

The Landscape is characterized by a complex geological structure. The major part of the northern half of the Landscape, including Lopé and Waka national parks, rests on the volcano-sedimentary and cristallophyllian rocks of the Ogooué system, dating from the Later Proterozoic and aged 2 to 2.5 billion years. A narrow eastern band, along the Offoué River, rests on the volcano-sedimentary rocks of the Booué Basin, a subset of the Francevillien, also dating from the Later Proterozoic and 2-2.1 billion years old. The two systems are separated by archean rocks, 3.2 billion years old, which form a north-south band with a maximum width of twenty kilometers connecting the archean formations of the north and south of Gabon[2]. In its northern part, at the height of the Lopé savannahs, the Landscape is characterized by the presence of isolated rocks made up of ultramafic formations of unknown age. The southern half of the Landscape, including the Chaillu Massif, chiefly rests on old undifferentiated archean gneiss that is 3.2 billion years old, interspersed with strands of granites and of calco-alkaline or alkaline granitoids that are 2.6 to 2.9 billion years old.

Hydrology

The Chaillu Massif and the north of the Landscape include the sources of the Lolo, Offoué, Ikoy and Ngounié, all rivers that belong to the Ogooué Basin. The south, between Mouila and Mimongo, belongs to the basin of the Nyanga and the Congolese section drains toward the Niari.

Climate

The annual average rainfall varies from 1,400-1,500 mm in the Lopé savannahs to 2,000-2,400 mm on the Chaillu Massif. The dry season lasts three months (June, July and August); the rainy season extends from September to May but it is interspersed with a season of less rainfall in January and February, which is extremely variable from one year to the next.

Vegetation

The Landscape includes three main zones (Figure 14.2):

- the area of savannahs of the middle Ogooué, interspersed with forest galleries (Figure 14.3)
- the mature forest area of the Chaillu Massif (Figure 14.4)
- the area of pioneer forests of okoume *Aucoumea klaineana* and the Marantaceae forests of the Lopé that extends over a distance of 50 km to the south of the Ogooué (Figure 14.5)

[2] The savannah area north of Lopé National Park rests on this archean 'tongue', while the Brazza Mountain Range belongs to the cristallophyllian system of the Ogooué.

Figure 14.4. Mature forests in Waka National Park, centered on the Ikobé River.

Figure 14.5. Marantaceae forest in Lopé National Park.

The majority of the information known about the vegetation comes from Lopé National Park (White & Abernethy, 1996) and its immediate environs, where more than 1,500 species belonging to 710 genera and 120 families have already been identified. With 52 genera and 138 species, the Rubiaceae represent the most diversified family. Other important families are the legumes, with the Caesalpinioideae and the Papilionoideae, the Poaceae and the Euphorbiaceae. Ferns are also very well represented. Several species are endemic to the Landscape: notably the trees *Dialium Lopénse* (Caesalpinioïdeae) and *Cola lizae* (Sterculiaceae), the Zingiberaceae *Aframomum sericeum* and several species of Begoniaceae.

Studies carried out in the northern part of the park have shown a complex mosaic of plant communities: 17 habitats in the forest and 6 in the savannah (White, 1992). The diversity of these habitats plays an important role in maintaining a large biomass and animal diversity because it offers an enormous choice of nutritive resources with varied phenologic and temporal patterns. This vegetal mosaic reflects the very dynamic history of the Lopé region with a transition from open herbaceous formations, frequently burned, through various colonizing forest formations, dominated by the pioneer species *Aucoumea klaineana* and *Lophira alata*, toward mature old-growth forests with a closed canopy and a great diversity of tree species. In certain low areas of the Landscape, *Sacoglottis gabonensis* makes up monodominant formations, which are frequented by a large number of elephants during fructification[3]. On the other hand, the majority of the Landscape has probably been influenced for centuries by moving islands of itinerant cultures that have locally rejuvenated the forest formations.

Fauna

Mammals

The mammalian fauna includes nine species of diurnal primates and six species of nocturnal primates, including four species that are among the most endangered on the continent: the western lowland gorilla *Gorilla gorilla*, the chimpanzee *Pan troglodytes*, the black colobus *Colobus satanas* and the sun-tailed guenon *Cercopithecus solatus*, a species that is nearly endemic to the Landscape[4]. Ungulates are represented by thirteen species, including *Cephalophus ogilbyi crusalbum*, a form endemic to Gabon. There are a dozen carnivore species, the largest one being the leopard, which achieves very high densities in the northern part of Lopé National Park. In the north of the Landscape, the very large mammalian biomass (White, 1994) is dominated by the elephant, although other species are also represented by large populations, notably the gorilla, the chimpanzee, the *Syncerus caffer* buffalo, the bushpig *Potamochoerus porcus* and several species of primates, especially the mandrill *Mandrillus sphinx*[5]. Toward the south the mammalian biomass decreases, probably in relation to the low productivity of the dense forests in the mountainous terrain. In all, the Landscape con-

[3] It has been estimated that all the elephants in a radius of 50 km are concentrated in these *Sacoglottis* forests (White, 1994).

[4] This monkey was described in 1986 after being 'discovered' in 1984 in the forest of Abeilles, located just to the east of the Offoué. Subsequently, it was also found in Lopé National Park, to the west of the Offoué, and more recently around the sources of the Offoué in Birougou National Park.

[5] The Landscape is at the center of the distribution of the mandrill which inhabits Lopé National Park in troops averaging 650. In the savannahs to the north, gatherings of more than 1,000 individuals have even been observed (Abernethy *et al.,* 2002).

tains 23 species that are considered endangered according to IUCN criteria (Annex C).

Birds

The avian fauna of the Landscape includes more than 400 species, 193 of them species typical of the Guinean-Congolese forests. Seventy-one species are residents of the savannah, in the forest galleries and copses in the north of the Landscape, which underlines the fact that the importance of these habitats is not limited to mammals. The forest avian fauna includes six species endemic to the forests of Lower Guinea: the grey-necked rockfowl *Picathartes oreas* and the forest swallow *Hirundo fuliginosa,* which depend on the rocks in the forest, the lesser bristlebill *Bleda notata*, the grey-headed puffback *Batis minima*, the black-necked wattle-eye *Dyaphorophyia chalybea* and the Dja River scrub warbler *Bradypterus grandis*, a marsh species of Cyperaceae. In the forests around Birougou National Park, the pink-footed puffback *Dryoscopus angolensis*, a submontane or montane species, which has not been found elsewhere in Gabon, can be found (Christy, pers. comm.). This species had previously been observed in the Congolese part of the Landscape, along with another montane species, Crossley's ground thrush *Zoothera crossleyi* (Dowsett-Lemaire & Dowsett, 1991).

Herpetofauna

The reptiles and amphibians of the Landscape are not well known, but preliminary observations made in 2001 indicate a rich herpetofauna[6]: in 1995, *Leptodactylodon blanci*, a fast mountain stream frog, was described in the Lopé reserve; in 2001, the gecko *Hemidactylus kamdemtohami*, the burrowing snake *Letheobia pauwelsi* and the waterfall frog *Werneria iboundji* were described in Mount Iboundji, while the water snake *Hydraethiops laevis*, known only in Cameroon, has been found in the Chaillu Massif (Pauwels, pers. comm.).

Ichthyofauna

The majority of the Landscape is within the Ogooué Basin, which forms part of the southwest equatorial coastal ecoregion and houses more than 230 species of fish, 25% of which are endemic to the ecoregion. The Mormyridae and the Aplocheilidae are particularly diversified. The basins of the Nyanga and Niari form a transition with the basin of the Congo River, but the Chaillu Massif has never really been investigated, and it is expected that numerous other small endemic species will be found in the mountain streams (Kamdem Toham *et al.,* 2003; Thieme *et al.,* 2005).

Invertebrates

The invertebrates are almost totally unknown, but a study of the social Hymenoptera of Gabon showed that the Chaillu Massif could be the region richest in species (Polly, pers. comm.). A preliminary inventory of the diurnal butterflies in the Lopé park (G. Vande weghe, in prep.) has so far revealed the existence of only 200 species, but these include two *Nymphalidae* with limited distributions (*Euphaedra dargei* and *Bebearia oremansi*) and one species new to science (*Bebearia Lopéensis*). A casual collection of Geometridae in 2000 led to the description of six new species in the *Zamarada* genus (Pierre-Baltus & Pierre, 2000).

Humans in the Landscape

Archaeology

The savannahs of the middle Ogooué have been inhabited for at least 400,000 years and archaeological excavations have revealed a nearly continuous set of artifacts going back 100,000 years and covering the entire Paleolithic, the Neolithic and the Iron Age (Oslisly, 1994, 1998, and 2001). However, between 1400 and 700 BP, the region was depopulated[7]. Around 700 BP, the valley of the middle Ogooué was repopulated by new populations, most probably coming from the northeast, whose descendants today are the Okandé. Following the introduction of American plants and the development of the slave trade and a barter economy in the 17th century, the populations gradually moved their villages closer to the Ogooué, which had become an important trade route. More recently, they have moved closer to the Trans-Gabon Railroad.

Density and distribution

According to CARPE data, the average density of the populations in 1990 in the Landscape was 2.8 inhabitants/km². This Landscape therefore has the second lowest population density among the Landscapes. Its populations are concentrated along the roads and the navigable watercourses. In the north, they are concentrated along the Ogooué and the railway line. In the south, they

[6] During a short investigation of Mount Iboundji, at least three new species were found, which underlines the biological importance of the submontane habitats in the south of the Landscape (Pauwels, pers. comm.).

[7] Radiocarbon dating shows an absence of human activity in a large part of Gabon and the Republic of Congo during this era (Oslisly, 1998 and 2001) The reasons are unknown.

are concentrated along the roads and certain pedestrian paths that cross the Landscape (above all the Mouila-Koulamoutou road, the Ndendé-Mbigou-Koulamoutou road and the Iboundji area). Between the two areas there is an enormous region with few inhabitants, where Waka National Park and the southern part of Lopé National Park extend. Koulamoutou, Mimongo and Mouila are the principal population centers in the south of Gabon, but they are located either just outside the Landscape or on its borders. All are major markets for bushmeat, as is Libreville, which is located at the end of the railway line. In the Republlic of Congo, Mossendjo is located on the southern edge of the Landscape and Moyoko is the only other major population center located on the Franceville-Mossendjo road, the most important trade route between the two countries.

Ethnic groups

The Landscape is occupied by eight Bantu groups. The Okandé and the Tsogo group, comprised of the Simba, Povi and Apindji, are more or less related[8]. In addition one finds Makina, Akélé, Mbahouin, Saké and Massango. In certain areas, groups of Bongo Pygmies remain, some of whom maintain a traditional hunter-gatherer lifestyle[9].

Activities

The primary traditional activities are subsistence agriculture, usually slash and burn, and hunting, but logging has become the most important activity over the last few decades. The construction of the Trans-Gabon Railroad in the 1970s triggered socio-economic development in the extreme north of the Landscape, with the creation of massive numbers of jobs and the construction of logistical base camps that later became the principal infrastructure of new and existing villages. This process was accompanied by the immigration of significant numbers of railroad workers, shopkeepers and hunters. With the end of work related to the railroads in the 1980s, the majority of these people lost their jobs. The more highly skilled left; the others remained in place without income or were hired by the logging industry. The establishment of the ECOFAC program in 1992 offered new employment opportunities[10], but the interruption in the financing of this program once again increased unemployment. At present, the principal means of employment are logging, hunting and administrative tasks.

In the southern part of the Landscape, in Gabon and the Republic of Congo, the main activities remain agriculture, hunting and logging. The city of Mossendjo still houses the MEFE forestry school, but due to a lack of financing over the past fifteen years it hardly operates. The road that crosses the Landscape to the Republic of Congo can be traveled by 4x4 vehicles and serves as a commercial route to take agricultural products and bushmeat to the urbanized centers in the southern part of the country.

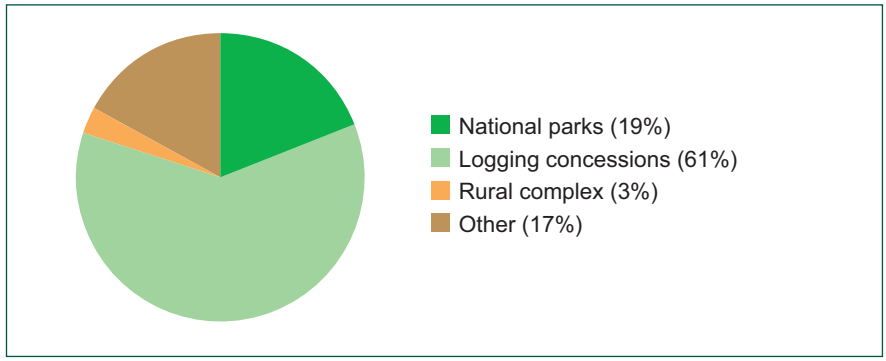


Figure 14.6. Land use types.

Land use

Around 61% of the area of the Landscape is occupied by logging concessions (Figure 14.6). The protected areas cover 666,300 ha, making up 19% of the Landscape.

Logging

In the Republic of Congo, a single concession, the UFA of Mossendjo, covers 1,170,000 ha and the entire Congolese part of the Landscape. It does not appear to be allocated at present. In Gabon, in 2004, the Landscape included 107 logging permits covering a total area of 1,934,888 ha. The average size of the permits was 18,000 ha. This difference necessitates very different approaches, both to the management of logging operations and to relations between operators and forest conservationists. In the Republic of Congo, conservationists have just one potential partner. In Gabon, they are confronted with a plethora of companies. These companies have different levels of skill, different levels of available financing, different length permits, and different objectives and interests as concerns the sustainability of the operations.

The relations between Leroy-Gabon and the Lopé reserve were extremely antagonistic up until 1997 after a very controversial FSC certification was withdrawn from the company at the beginning of the 1990s. Afterwards serious progress was made concerning sustainable operations. In 2001, Leroy-Gabon set up a protocol for manag-

[8] This group could be considered endemic to Gabon and the Chaillu Massif represents its 'homeland'. It is very important culturally because of the fact that it seems to have taken up many elements of the culture of the Pygmies and because it has strongly influenced other ethnic groups in the country, many of which have adopted elements of the Tsogo culture (among others the Bwiti ritual).

[9] All the Pygmies of the Chaillu Massif have base villages, usually in the region of Etéké-Massima, but they go away for long stays (up to six months) in the forest triangle: Sindara-Mimongo-South Lopé.

[10] The program made a point of recruiting workers from the villages located around the national park, but the number never exceeded 50.

ing the fauna in its concession that limited hunting in the concession, the transport of hunters, the use of firearms and the trade in bushmeat. Unfortunately, the company seems to have given up its sustainable management program and lost its certification in March 2005. Later in the year the administration withdrew its approval of the management plan. One of the weaknesses for this company in terms of long term planning is the fact that it has changed ownership several times.

The company SBL[11], which operates between Lastoursville and Koulamoutou in the south of the Landscape, has terminated its management inventory, and its management plan, approved by the administration, is in the process of implementation. This company was selected by the Tropical Forestry Foundation (TFF) for the organization of a training program in reduced-impact logging (RIL) in which Form-International and WCS participated. The company SEEF also initiated the development of a management plan, but the company IFL, a company associated with SBL, which operates in the southwest of Waka National Park, has not yet initiated its management plan. The companies EGG, CFA and BSG—the latter operates in the BOFIGA concession which adjoins Lopé National Park—have also adopted a wait-and-see attitude insofar as development is concerned. However, Gabonese law stipulates that as of December 31, 2005 all companies will have to have implemented sustainable management. These companies are therefore in breach of the law and their operations have become illegal. They are probably counting on the 'flexibility' of the government.

The Malaysian company Rimbunan Hijau, the largest logging company in the world, operates to the southwest of Lopé National Park. It was established in Gabon after conducting aerial explorations and market studies. It was initially established in Lambaréné under the name of Bordamur, which has currently become the second largest forestry company in Gabon after Rougier. For the drafting of its management plan, Bordamur is working with the Sylvafrica office, whose principal shareholder is the French *Office national des forêts* (ONF).

All the companies cited have foreign roots and it is very difficult to generalize, since each company is a separate case with very different approaches and objectives.

Reasons for the identification of the Landscape

(1) The Chaillu Massif forms the heart of a biogeographical subregion of Lower Guinea, has many endemic species and is considered one of the priority areas for conservation (WWF, 2006).
(2) The pioneer forests of the north of the Landscape provide a habitat for densities of large mammals that are among the highest in tropical forests.
(3) The Landscape includes three national parks (Lopé, Waka, Birougou) in Gabon.
(4) Lopé National Park is an important site for the conservation of birds (Fishpool & Evans, 2001).
(5) Outside of the protected areas there are very rich sites, such as Mount Iboundji, which provides habitat for endemic species of reptiles and amphibians.
(6) In its northern part, the Landscape harbors an intact transition between open savannah and dense mature forest, making it possible to study the dynamics of this transition, which has played a fundamental role in the phenomena of speciation.
(7) The Landscape houses the oldest vestiges of human occupation in western Central Africa[12] and a set of engravings on rock that is unique in Central Africa, making it possible to follow in detail the interactions between human beings and their environment over the course of the last 50,000 years.
(8) There are significant opportunities for conservation:
   a. Huge areas of the Landscape are very sparsely populated with humans and free of access routes.
   b. Lopé National Park has been protected for a long time and Waka and Birougou national parks are well accepted by the surrounding populations.
   c. The region of Lopé National Park is well known, especially through the existence of a research station on gorillas and chimpanzees.
   d. Lopé National Park has benefited from support for more than fourteen years through the ECOFAC program (EU) first and later on WCS.
(9) The opportunities for developing tourism are significant and tourist accommodation infrastructures already exist in Lopé and in Mikongo in Lopé National Park.

[11] This French company was established in Gabon in the 1980s after the prospects for industrial exploitation of forests in Côte d'Ivoire were sharply reduced.

[12] At Elarmekora, in the savannahs of the middle Ogooué, located on the border of the Landscape, worked stones dating from at least 400,000 years ago have been found. These stones are associated with the presence of a population of primitive *Homo sapiens*.

(10) In the Congolese section of the Landscape there are opportunities for creating a protected area — in the process of being examined by MEFE and WCS — but the animal population densities are very low; the renovation of the forestry school of Mossendjo could, however, revitalize an indispensable Congolese institution and offer combined training in forestry management and fauna management. The Landscape could serve as a site for field training.

(11) The majority of the Gabonese section of the Landscape has been only slightly logged and there are still major opportunities for implementing sustainable logging.

Conservation

History

Pursuant to a decree of 1944 governing hunting in French Equatorial Africa, in 1946 the partial hunting reserve of Lopé-Okanda, Okanda National Park and the complete nature reserve of Offoué were created. The borders of these protected areas were determined provisionally and definitive borders were never published (Christy *et al.*, 2003). In 1960, all the protected areas were transformed into areas for the rational exploitation of fauna and a decree of 1962 classified an area of rational exploitation of fauna in Offoué amounting to 500,000 ha, including the fauna reserve of Lopé-Okanda (350,000 ha) and the hunting domain of Lopé-Okanda (150,000 ha). A decree of April 1971 defined the sectors of tourist exploitation of fauna and introduced the name of 'Lopé-Okanda'. In 1982, a brigade for regulating fauna was set up in Lopé. A decree of 1996 divided the whole into a 'central core' of 167,018 ha classified as an integral reserve and a 'peripheral zone' of 369,000 ha where economic activities, especially hunting, could be organized by decree and where logging retained its rights. This decree had the objective of regulating the logging concessions granted starting in 1971 in the form of lots in the catchment area of the railroad (Christy *et al.,* 2003). A decree of November 1996 increased the central core to 240,000 ha. Finally, in 2002, the national park was created. Currently under discussion are the creation of a Mount Iboundji sanctuary and the creation of protection series in several logging concessions, like the reserve of Mount Mimongo set up by SBL.

Players

In Gabon:

- Conservation is managed by two governmental institutions: CNPN and MEFEPPN, responsible outside the protected areas[13].
- The ECOFAC program, financed by the European Commission, has developed conservation activities, including development of ecotourism with support for the hotel of Lopé, training of ecoguides, maintenance of infrastructure and connections with forestry companies. ECOFAC has also played an important part in the technical and administrative development of the national park, but is currently experiencing a break in financing while waiting for the start-up of their fourth stage 2006-2009. This interruption in financing has occurred in the past and has a very negative effect on the continuity of the program and the pursuit of conservation activities.
- Before the financing obtained within the framework of the CBFP, WCS was active at the level of the Landscape in the area of conservation-oriented research within the framework of the SEGC station. It set up basic research and applied research programs focused on large primates, in collaboration with CIRMF (*Centre International de Recherche Médicale de Franceville*). The scientific publications resulting from these research studies are among the most important in the area of forest ecology in Africa. Although these publications have contributed greatly to decision-making concerning conservation, WCS was not involved in the management of the protected area. WCS was, however, behind the creation of Waka and Birougou national parks.
- Since obtaining CBFP funds, WCS has played a more and more important role in the management of the Landscape and it is currently recognized as a partner of CNPN in the management of Waka and Birougou national parks. Its primary achievements are the delimitation of the three protected areas (nearly complete), the organization of meetings with the operators in the Landscape that have resulted in the drawing up of land use plans, ecological and socio-economic surveys, environmental education and setting up efforts to combat poaching throughout the Landscape.

In the Republic of Congo:

- The Landscape is managed by MEFE.

[13] During a recent ministerial reshuffling, the management of national parks was placed under the responsibility of the Ministry of Forest Economy, but the creation of a semi-public institution is under way.

Figure 14.7. The leopard orchid Anselia africana *is widespread but not common.*

Direct threats

(1) Logging

A large part of the Landscape is covered by logging concessions. The high rainfall and the irregular terrain make logging difficult and cause significant erosion with sedimentation of the rivers and disruption of the aquatic ecosystems. Logging also opens up the canopy, increases the amount of sunshine on the underbrush and affects plants that require shade and constant humidity, such as the Begoniaceae, Balsaminaceae (Figure 14.7) and Orchidaceae, many species of which are not found elsewhere. On the other hand, logging involves the harvesting of species whose fruit are used by the local populations, in particular the moabi *Baillonella toxisperma*[14], the ozigo *Dacryodes buettneri*, the amvut *Trichoscypha acuminata* and *T. abut*, as well as wild mango trees *Irvingia sp*.

Indirectly, logging opens up the forests to hunters. In the Bordamur concession, a primary logging road is under construction. It will pass less than 1 km from Waka National Park and will climb back toward the north parallel to Lopé National Park at a distance of 10-20 km from the edge of the park. It will bring Waka National Park directly in contact with the Ndjolé market. It will break the connection between the two national parks, end the isolation of the whole region, which is currently difficult to access, and require major support at the management level.

(2) Hunting for bushmeat

This represents a major threat throughout the Landscape and is facilitated by the proximity of markets such as those at Mouila and Koulamoutou, the construction of forest paths and the presence of the railroad. Large mammals with a slow reproductive process are being hunted in a non-sustainable way and are becoming more and more rare near roads and residences. Hunting for ivory remains a problem and laws are not being applied. WCS's research studies have shown that hunters outside the concessions, more than those based in the villages, represent the major danger for the fauna. Therefore it is important to limit hunting in the concessions. Unfortunately, there is no consensus, even among conservation circles, on what must be given priority in the absence of data on the carrying capacity in the forest and the actual impact of hunting around base camps and felling sites. Many local communities in and around the Landscape still depend on forest resources, particularly bushmeat. In contrast to the more mobile commercial hunters, the villagers concentrate on areas close to home. This could lead to overhunting, but it also has the effect that villagers feel more concerned with the sustainability of their hunting. WCS's approach in the area of the management of renewable natural resources consists of applying advanced and participatory studies of the use of these resources, in particular hunting and agriculture.

(3) Epidemic diseases

The Landscape is at the edge of the region that has been affected by epidemics of Ebola during the last few decades. In 1997, this disease was found in a dead chimpanzee near the Lopé research station, but it did not spread as it did in the Minkébé region. Nonetheless it remains a potential major threat, as much for the great apes as for humans. It will continue to be monitored by the WCS Field Veterinary Program in collaboration with CIRMF.

(4) Invasive species

The savannahs of Lopé National park have been invaded by *Lantana camara*, a shrubby Verbenaceae originating in America, and the forests have been invaded locally by the ant *Wassmannia auropunctata*, also of American origin, which has a disastrous impact on the entomofauna[15].

(5) Brush fires

In the savannahs of Lopé National Park, brush fires are frequent locally. They degrade the plant cover and reduce its nutritive capacity.

(6) Extraction of non-timber forest products

Many NTFPs are collected by the local populations, but in the majority of cases this use does

[14] This tree, which is nearly endemic to Lower Guinea, has a very late maturation (not before 70-100 years), but produces fruits which are highly appreciated by the local populations for the oil that can be extracted.

[15] This ant was introduced as a tool for biological control, but has now escaped and is out of control. Its colonies include satellite colonies that can replace the principal colonies in the event of destruction.

not endanger the species involved. The collection of 'bitter kola' *Garcinia kola* nonetheless has the effect of making this species rare[16].

(7) Agriculture

The development of a nearly continuous strip of crops along the roads has intensified not only deforestation, but also fragmentation of the forests. Secondly, agriculture increases erosion and the disruption of aquatic ecosystems.

(8) Traditional mining activities

Panning for gold is practiced in the Etéké region between Waka and Lopé national parks. This causes serious disruption of aquatic ecosystems and a local increase in hunting pressure for bushmeat and ivory. Other mineral resources exist in the Landscape and could be worked in the future.

Indirect threats

(1) Weakness of institutional capacity

CNPN was created in 2002 to manage national parks, but it possesses neither the technical nor financial resources necessary. In addition, there is a rivalry or lack of understanding between CNPN and MEFEPPN.

(2) Weak interministerial coordination

Between the Ministry with authority over the mines and the Ministry in charge of the environment and conservation there is little coordination and antagonistic actions are frequent.

(3) Economic slowdown

The decrease in oil reserves is increasing the pressure on forest ecosystems.

State of the vegetation

In general, the forests are still in good condition and even though certain areas are made up of a mosaic of primary formations and secondary formations of different ages, enormous areas that are scarcely disturbed still remain. The savannahs of Lopé could be locally degraded by overly frequent fires.

State of the fauna

The Landscape still has significant populations of large mammals, but the majority of large-sized species with slow reproduction rates have become rare or very rare in the proximity of villages and roads. The population of elephants is suffering from ivory hunting and chimpanzees are suffering from the opening up of the forests by industrial logging. The invertebrate fauna are seriously disturbed locally by the presence of the ant *Wassmannia*.

Increasing capacity

The training center in Lopé, financed by WCS, offers an excellent basis for training agents and local, national and international researchers in scientific field methods, including monitoring. This center was chosen by the MIKE program for the organization of a workshop on analyzing data from regional inventories of elephants, large apes and human impacts in a number of selected sites throughout the Congo Basin. More than twelve agents participated in this workshop, representing all the countries of the Congo Basin, with the exception of Equatorial Guinea.

Courses for governmental and non-governmental researchers are organized periodically. In 2004 and 2005, a course of 8-10 weeks was organized by WCS, entitled: '*Méthodes de conservation pour les inventaires et le suivi de la faune*'[17]. In 2003, the Lopé center was also chosen as a training base for the People and Parks Program, financed by NDF, which consisted of evaluating the impact of national parks on human wellbeing and the living standards of the populations. In 2005, a conceptual modeling course was organized for the commissioners of Birougou, Waka, Lopé and Batéké national parks, as well as seven agents of the Gabonese administration. The training center was used again for the organization of numerous short-duration courses in subjects, including: telemetry applied to fauna, methods of socio-economic surveys, the use of computers and GIS. Recently a course in ArcGIS was given in cooperation with the University of Maryland and OSFAC. The Lopé training center therefore has impacts considerably beyond the scope of the Landscape.

[16] To collect its bark, this tree is felled and even its roots are often used.

[17] In 2004, ten Gabonese students were trained, including three officials from the Ministry, a Cameroonian and two Europeans. In 2005, four Gabonese, a Nigerian and four Cameroonians were trained. One of the students trained in 2004 participated as a trainer in 2005.

Management and governance in the field of renewable natural resources

(1) At the scale of the Landscape

Financing was recently granted by USFWS to set up a mobile unit for fighting poaching based in Libreville. In cooperation with WCS, this team has started to carry out patrols throughout the Gabonese section of the Landscape.

(2) In the national parks

The prospects for developing ecotourism are being evaluated as an alternative for the economic development of natural resources. This program is well advanced in and around Lopé National Park and efforts have been undertaken by WCS and CNPN so that a larger share of the profits go to the local populations. Waka and Birougou national parks, because of their isolation, do not constitute immediate destinations for ecotourism, but potentially interesting sites continue to be catalogued.

The MEFEPPN brigade based in Lopé has been involved for a great many years in the battle against poaching. Unfortunately, with the interruption of the ECOFAC program, the brigade has lost the major part of its financial resources and very few patrols could be organized in the course of 2005. WCS has contributed funds and equipment, but a conflict between the Ministry and CNPN created an obstacle to their use. These problems will have to be resolved in the near future.

(3) In the logging areas

In Gabon, negotiations are under way between WCS and several logging companies with a view to implementing a reduced-impact logging (RIL) area in the Landscape and management of the fauna in the concessions. Discussions are under way to limit hunting by the workforces of the companies. The logging companies are also being encouraged by the Gabonese government to put 5% of the area of the concessions into a 'protection category'. WCS has offered its cooperation for the identification of these categories.

(4) In the rural areas

A process is under way to define the needs of units for the community management of natural resources. It includes participatory mapping of the areas used by the villages: the agricultural areas, the hunting areas and the traditionally defined and accepted areas in the north of the Landscape[18]. Participatory maps have been produced for each village on the periphery of Waka and Birougou national parks, and the formalization of community lands is under way. As a general rule, teams of social scientists work with the local communities to define their lands, as well as identify sources of conflict and ways to attenuate them.

Monitoring renewable natural resources and their management

Ecological monitoring

In the Gabonese section of the Landscape, Lopé National Park has been selected as a MIKE site and a permanent MIKE agent is responsible for law enforcement monitoring in the national park and its environs. In 2005, inventories were designed and implemented in the three national parks; some are still being completed. In Lopé National Park these inventories include linear transects to estimate the densities of elephant dung and of great apes' nests. Financial limitations have reduced the Waka and Birougou inventories to simple reconnaissance missions.

In the Congolese section, basic inventories have been completed by WCS, by the *Centre d'inventaires et d'aménagement des ressources forestières et fauniques* (CNIAF) and by MEFE teams. Follow-up inventories are planned for the first half of 2006. In parallel, botanical inventories have been performed by the *Institut de développement rural de Marien Ngouabi* of the University of Brazzaville. These inventories have revealed the presence of 299 plant species, five of which could be endemic to the Landscape. WCS and CNIAF have expanded their inventories between the Landscape into the fauna reserve of Mount Fouari, the fauna reserve of Nyanga-Nord, the hunting domain of Mount Mavoumbou and the hunting domain of Nyanga-Sud. In all, 19 species of large mammals have been found.

[18] In total, seven village use areas have been proposed in Lopé National Park, covering an overall area of 7,727 ha.

15. Dja-Odzala-Minkébé (Tridom) Landscape

Figure 15.1. Map of Dja-Odzala-Minkébé (Tridom) Landscape (Sources: Atlas of Cameroon, GFW/WRI, CARPE, JRC, SRTM, WCS-Congo, WCS-Gabon, WWF-Jengi).

Location and area

The Tridom Landscape extends over the Republic of Congo, Gabon and Cameroon (Figure 15.1). It includes seven protected areas and covers a surface area of 141,000 km², with 35,968 km² (24%) encompassed by protected areas.

Physical environment

Relief and altitude

The entire Landscape lies on a plateau at an altitude of between 300 and 1,000 m. In many places, especially in the regions of Minkébé in Gabon and the Dja in Cameroon, the plateau is punctuated with inselbergs (Figure 15.2). Along the Gabonese-Congolese border the Landscape is

The Landscape in brief

Coordinates: 3°29'53"N – 0°26'28"N; 11°51'54"E – 15°57'21"E
Area: 141,000 km²
Elevation: 300-1,000 m
Terrestrial ecoregion: Ecoregion of the northwest Congolese forests
Aquatic ecoregions: Southwest equatorial coastal ecoregion
Sangha ecoregion (Thieme *et al.*, 2005)
Protected areas:
Odzala-Koukoua National Park, 1,250,000 ha, 1935/1999, Republic of Congo
Minkébé National Park, 756,700 ha, 1997/2002, Gabon
Ivindo National Park, 300,274 ha, 1971/2002, Gabon
Mwagna National Park, 116,500 ha, 2002, Gabon
Boumba-Bek National Park, 309,300 ha, 2005, Cameroon
Nki National Park, 238,300 ha, 2005, Cameroon
Dja Fauna Reserve, 526,000 ha, 1950, Cameroon

Figure 15.2. An inselberg of the Minkébé region.

Figure 15.3. The Djidji waterfalls.

also cut from north to south by a steep vertical escarpment that is 75 km long and represents a total drop of 100 m.

Geology and soils

The major part of the Landscape rests on Archaean rocks 3.2 billion years old, with the exception of Mount Bélinga and Mount Minkébé in Gabon, which are part of a ring of greenstone rock ferriferous fissures (itabirites, metabasalts, amphibolites) that are 2.8 to 3.2 billion years old. The basin of the Djoua includes enormous expanses of quaternary alluviums. In the north, the Congolese section includes Archaean plateaus that descend toward the south and the east. The alluvial basin of the Mambili represents an extension of the sedimentary basin of the central Congo Basin and consists of alluvial soils of the Quaternary age. In the far south, this section of the Landscape includes the last extensions of the Batéké plateau.

Hydrology

The Gabonese section of the Tridom is drained by the Ivindo, the main tributary of the Ogooué; the Ivindo is separated from the Ogooué by a succession of falls and rapids that form a biogeographical barrier (Figure 15.3). The Minvoul region is drained by the Ntem. The central and southern parts of Ivindo National Park are drained by the Djidji and the Langoué, two minor tributaries of the Ogooué. The Cameroonian section is drained by the Ntem and more significantly the Dja and the Boumba, tributaries of the Congo River. The Congolese section is drained by the Mambili and pertains entirely to the basin of the Congo River. In the high streams of the Ivindo and the Ntem the waters are 'black'; within the drainage of the Mambili they are heavily loaded with alluviums.

Climate

The annual rainfall is between 1,600 and 2,000 mm. Since the Tridom Landscape is located very close to the Equator, the climate is bimodal. There are two seasons with less rainfall, around January and July, and two rainy seasons, around October and April-May. There are four to five 'dry' months. In the north of the Landscape the driest period occurs around January-February; in the south around July-August.

Vegetation

The majority of the Landscape is covered with forests (Figure 15.4). Among the terra firma forests, there are: dense mixed semi-caducifoliated forests rich in Meliaceae[1], Ulmaceae and Sterculiaceae (in particular *Triplochiton scleroxylon*) with an abundance of *Terminalia superba* and *Lophira alata*; forests scattered with Marantaceae[2]; forests with a monodominance of *Gilbertiodendron dewevrei*; and young and old secondary forests with *Musanga*. Flooded or floodplain forests are represented by vast expanses of riparian forests of *Uapaca heudelotii,* swamp forests of *Hallea sp*., palm groves of *Phoenix reclinata* (along the Mambili) and raffia palm groves. These

[1] The common species are *Entandrophragma utile* (sipo), *E. cylindricum* (sapele), *E. angolense* (tiama) and *E. candollei* (kosipo). They make up 90% of the exports of sawn timber from northern Congo. This explains the logging companies' interest in this region.

[2] Studies carried out in Odzala-Koukoua National Park show that these Marantaceae forests have a tendency to spread to the detriment of dense forests (Brugière et al., 2000).

Figure 15.5. The Langoué bai in Ivindo National Park.

Figure 15.6. A rocky clearing in the south of Ivindo National Park.

forest formations contain a gradient of influences: Atlantic in the west and Congolese in the east. They are punctuated with marshy clearings (or 'bais') with Cyperaceae. These clearings only cover a small area, but they are very important for the fauna (Figure 15.5). Certain clearings are rich in mineral salts and merit the name 'salt marshes'[3].

The inselbergs and rocky outcrops of Gabon and Cameroon are covered with grassy prairies of *Afrotrilepis pilosa* (Figure 15.6) and a variety of woody thickets that shelter a succession of very specialized plants, in particular numerous orchids and cactus-shaped Euphorbiaceae (*Elaeophorbia grandifolia*, *Euphorbia letestui*). Savannahs found in the southern Congolese portion of the Landscape represent the northern extremity of

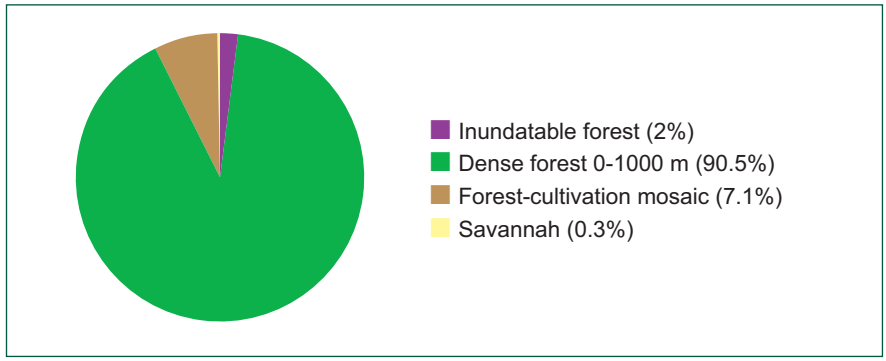


Figure 15.4. The main vegetation types (Source: JRC).

the savannahs of the Batéké plateau. Fields and fallow land are located around the villages of this area. Because of itinerant slash-and burn farming, significant proportions are gradually becoming occupied by secondary species and an invasive Asteraceae, *Chromolaena odorata*.

Fauna

Mammals

The Tridom is rich in large mammals, in particular the elephant *Loxodonta africana* (Figure 15.7), the western lowland gorilla *Gorilla gorilla*, the chimpanzee *Pan troglodytes*, the buffalo *Syncerus caffer*, the forest hog *Hylochoerus meinertzhageni*, the bush pig *Potamochoerus porcus*, the bongo antelope *Tragelaphus eurycerос*, the aardvark *Orycteropus afer*, the giant pangolin *Manis gigantea* and the spotted hyena *Crocuta crocuta* (only in Odzala National Park). Among the primates, there are the agile mangabey *Cercocebus agilis*, the black and white colobus monkey *Colobus guereza*, the De Brazza's monkey *Cercopithecus neglectus* and the mandrill, whose distribution in Minkébé-southern Dja is limited by the Dja River, the Ivindo and the Katangoua. The Landscape is home to the largest population of forest elephants in Central Africa[4] and these animals, a keystone species, play a major ecological role. The buffalo population in the forests of eastern Odzala is one the largest surviving populations of buffalo in the Congo Basin. The prevalence of large concentrations of large mammals in the Tridom Landscape is related to the fact that a major portion of the Tridom is located outside of areas used by professional bushmeat hunters, far from roads and navigable rivers. A few lions may still survive on the savannahs of Odzala. However, in places like Minkébé, Mwagna, Lossi and Odzala, the great apes have fallen victim to the Ebola virus. It is estimated that almost 98% of the great apes living in the intact heart of Minkébé National Park have disappeared in this way.

[3] Certain clearings, like that of Lango near Mboko, were traditionally worked for their salt.

[4] Inventories carried out in Minkébé, within the framework of the MIKE program, revealed a population density of three elephants per km² in an area of 10,000 km² (a third of the Minkébé forest). These findings indicate the presence of 30,000 elephants.

Figure 15.7. An elephant in a swamp along the upper Ivindo River.

Birds

The avian fauna includes 350 species found in the Dja region, 444 species found in the Odzala region and more than 400 species found in the region of the lower Ivindo[5]. Among the species with restricted distributions are the grey-necked rockfowl *Picathartes oreas* and the forest swallow *Hirundo fuliginosa*, which are associated with the presence of rocks or caverns, and a variety of other species including Zenker's honeyguide *Melignomon zenkeri*, Gosling's apalis *Apalis goslingi*, the black-eared ground-thrush *Zoothera camaronensis*, the grey ground-thrush *Zoothera princei*, the eastern wattled cuckoo-shrike *Lobotos oriolinus*, Verreaux's batis *Batis minima*, Bates's weaver *Ploceus batesi*, the yellow-capped weaver *Ploceus dorsomaculatus* and Rachel's malimbe *Malimbus racheliae* (Christy, pers. comm.). Among the vulnerable species are the black-casqued hornbill *Ceratogymna atrata*, *Bycanistes sp*. and certain large birds of prey like the crowned-hawk eagle *Stephanoaetus coronatus*. The grey parrot *Psittacus erithacus* is abundant, and roosts of more than 5,000 grey parrots have been observed recently in Ivindo National Park.

Herpetofauna

There are no exhaustive lists of reptiles and amphibians found in the Tridom Landscape, but the majority of species with a wide distribution and typical of the forests of Central Africa are present. Locally the slender-snouted crocodile *Crocodylus cataphractus* is abundant (Odzala, Ivindo). The Nile crocodile *Crocodylus niloticus* is very rare on the Dja, the Boumba and perhaps the Mambili.

Figure 15.8. A butterfly of the genus Euphaedra, typical in the understory of dense forest.

Invertebrates

Of the invertebrates, only the butterflies have been studied in this region: 346 species have been found in Odzala National Park and 647 in the park and its periphery (Dowsett, 1997); 440 species have been found in Ivindo National Park, not counting the Hesperidae (G. Vande weghe, *in prep*.). For the entire Landscape, 25 species are believed to be endemic, among them 17 species of Lycaenidae[6]. In Ivindo National Park, the diversity of species in the undergrowth (Figure 15.8) is unique in Central Africa[7] and a new species was just described in 2005: *Bebearia ivindoensis*. The inselbergs of Cameroon and the rocky outcrops of the Langoué clearing are inhabited by *Acraea rupicola,* a species endemic to these environments. The floating aquatic plant habitats of the Ivindo River accommodate *Acraea encoda*, a species that has not been found anywhere else other than on the Sangha River.

Humans in the Landscape

Density and distribution

The average human population density is on the order of 1-2 inhabitants/km² in the majority of the Landscape, but it reaches 3-4 inhabitants/km² in the region of Djoum and Somalomo in Cameroon. Vast expanses, especially in the regions of the Landscape covering portions of Gabon and the Republic of Congo, are totally uninhabited. The majority of human populations are grouped together in villages located along roads and in nine larger towns (Table 15.1).

[5] In terms of ornithology, the Ipassa Reserve in the north of Ivindo National Park is the most well studied forest area in Central Africa because of the presence of the IRET research station, which has been there since the 1960s.

[6] Among these species are 12 species of the sub-family Lipteninae which are particularly fond of Marantaceae forests.

[7] In the old forests of Caesalpinioideae, 41 of the 200 species of the genus *Euphaedra* found in the Guinea-Congolese region have been recorded, one of which, *E. abri,* is not known from any national parks other than Ivindo (G. Vande weghe, 2006).

Ethnic groups

The main ethnic groups are the Fang, Badjoué, Bulu, Kwélé, Kota, Nzime, Ndjem, Mboko, Bonguili and Sangha-Sangha. In addition to these groups who are mostly farmers, groups of BaAka and Bakola Pygmies also live within the Tridom Landscape.

Activities

(1) Agriculture

The rural economy is based on slash-and-burn (shifting) agriculture, cacao and/or coffee crops, supplemented with simple gathering. The predominant forms of agriculture cover only very small areas and, in part because of the physical effort required to clear primary forests, are generally carried out at the expense of the secondary forests. Their impact on the primary forests, therefore, is minimal. Locally there are industrial plantations, including palm oil plantations to the southwest of Ouesso and rubber plantations in the region of Mitzic. In Cameroon, there is a strong trend toward agro-industry, principally in the southwest area of the Dja Reserve, involving crops such as pineapple and rubber. According to Ngo Nlend (2002), these crops currently occupy a surface area on the order of 7,000 ha for the industrial production of pineapples and 15,000 ha of rubber trees (primarily in the southwest).

(2) Logging

In Cameroon, logging is becoming an increasingly important part of the village economy, especially as 40% of the taxes on logging are transferred to the communities. Community forestry is also becoming important in Cameroon. In Gabon, there has been an increase in the practice of 'family felling' affecting bands of trees located within 5 km on either side of the roads. No community forests have been designated in these areas of Gabon as of yet. This type of logging represents a new source of quick income for rural populations who sub-contract the logging to medium-sized companies.

(3) Hunting

Hunting supplies a variety of proteins to humans occupying the villages and small towns. It also represents a source of income for many unemployed people and does not demand a great deal of investment or technical expertise. Hunting produces a very quick yield, in contrast to cacao plantations, which require a year's wait before obtaining a yield and which present a greater economic risk. The trade in meat is primarily in the hands of women—the '*buyam-sellam women*'. The Baaka and Bakola hunter-gatherers are much less involved in agriculture and therefore depend significantly on the immediate resources of the forest or on temporary work they perform for the Bantus. The Baaka are also often engaged as elephant hunters for Bantu bosses.

Table 15.1. The principal towns and cities of the Landscape.

Country	Town or city	Number of inhabitants
Cameroon	Yokadouma	15,000
	Lomié	4,000
	Djoum	3,000
Gabon	Makokou	12,000
	Oyem	23,000
Republic of Congo	Ouesso	18,000
	Sembe	3,000
	Souanke	5,500
	Mbomo	5,000

(4) Mining activities

Panning for gold affects several rivers in the basin of the Upper Ivindo in Gabon (Figure 15.8) and in the Republic of Congo.

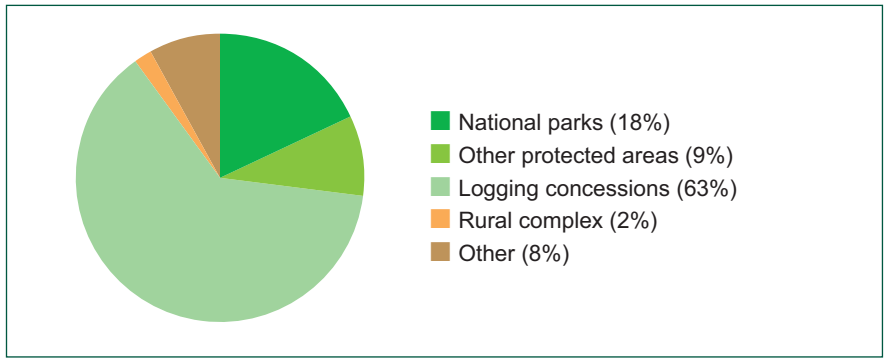
(5) Trade

This is in the hands of the West African traders who are found in all areas of human occupancy, including the most remote mining camps.

Land use

Around 24 % of the Landscape is occupied by protected areas and 50% by logging concessions (Figure 15.9). There are still vast expanses of intact forests that have not been designated to concessions or protection (Table 15.2).

Figure 15.9. The main landuse types.



Logging

The expansion of industrial logging has been rapid in the Tridom Landscape. Ten years ago, only a small fraction of the Landscape had been allocated. Currently nearly 50% of the area has been allocated. The majority of allocation has been done without planning, with the exception of in the south of Cameroon. The areas of the Tridom located between the existing protected areas offer some of the few opportunities in Central Africa to create new protected areas that have not been exploited and could function as a corridor linking the existing protected areas. Only careful land use planning can achieve this objective. Among the concessions allocated, several have approved management plans (in particular Rougier in Gabon, IFO-Danzer in the Republic of Congo, Decolvenaere, TTS-SCFS, Pallisco in Cameroon) and are involved in the certification process. Cooperation between governmental agencies, NGOs and logging companies is being strengthened, specifically as pertains to the sustainable management of fauna.

Table 15.2. 'Non-status' Forests.

Country	Site	Area	Comments
Cameroon	Forest of Ngoïla-Mintom	830,000 ha	Allocations to logging companies were suspended by the Cameroonian government pending the results of surveys looking at creating a conservation area. These forests have been proposed as a cross-border corridor between the protected areas of the Dja, Nki and Minkébé.
Gabon	Forest of the Ayina	250,000 ha	Has not yet been allocated because of the poor timber quality. The forest is marshy and difficult to access. It could form part of the cross-border corridor linking the Minkébé forest with a new protected area in Cameroon (Mengame).
	Forests of the Djoua and the Zadié	200,000 ha	The flooded or floodplain forests have not been allocated because they cannot be logged; they could form part of a corridor for conservation between Odzala and the forests of the Djoua and the Ivindo in the Congo. These forests were identified as providing significant habitat for large primates in May 2005 in Brazzaville. Zoning that takes into account the iron deposits of Bélinga is imperative.
Republic of Congo	The forests of Souanké-Garabinzam	900,000 ha	Have not yet been allocated for logging because they contain enormous marshy areas. A conservation corridor has been proposed to link Minkébé with the forests of the Djoua and the Odzala.
	Forest of Ntokou	300,000 ha	Located to the south of the IFO concession, it extends into the Pikounda area which has been proposed for logging (to the south of the UFA of Pikounda allocated to the CIB). The forest is home to very large populations of gorillas and elephants.

Reasons for the identification of the Landscape

(1) The value of the Landscape was estimated as very high in several fields (mammals, birds, etc.) at the time of the workshop in Libreville in 2000, which was aimed at establishing priorities for conservation in the ecoregions of the Congolese forests (Kamdem *et al.*, 2006).
(2) The Landscape is home to significant populations of large primates and forest elephants.
(3) The protected areas of the Landscape (Dja, Boumba-Bek, Nki, Odzala-Kokoua, Ipassa and Minkébé) have been recognized as important zones for the conservation of birds in Africa (Fishpool & Evans, 2001).
(4) The Landscape has been recognized since 1996 as offering unique possibilities for connecting a network of existing (Odzala, Dja) and proposed (Minkébé, Boumba-Bek, Nki) protected areas by means of corridors of intact and very sparsely populated forests in the areas of Ngoila, Mintom, Souanké and Mékambo.
(5) There are significant opportunities for conservation because of the low human density and overall low accessibility by road. The Tridom Landscape can be viewed as a collection of enormous blocks of forest that are demarcated by a few public roads, and which contain portions of interconnected and intact forests void of human activities.

Conservation

History

Odzala National Park was created in 1935 in the Republic of Congo. It covered an area of 126,600 ha and was surrounded by the Lékoli-Pandaka Fauna Reserve (68,200 ha) and the Mboko Game Reserve (90,000 ha). In Cameroon, the Dja Reserve was created in 1950 as a fauna and game reserve. It became a fauna reserve in 1973, a Biosphere reserve in 1981 and a World

Heritage site in 1983. In Gabon, the Ipassa Reserve (10,000 ha) was created in 1971 and became a Biosphere reserve in 1983. As of 1986, an IUCN-WWF report proposed the creation of a protected area in the Minkébé region (Nicholl & Langrand, 1986).

Between 1989 and 1990, the IUCN, with financing from the European Commission, carried out a series of national studies to assess the conservation of the forest ecosystems of Central Africa. Numerous existing and potential protected areas were identified as critical sites for conservation (Wilks, 1990; Hecketsweiler, 1990; Gartlan, 1989). This process generated numerous conservation projects focused on these sites, notably the ECOFAC program, which supported the protected areas of Dja and Odzala and will enter its fourth phase in 2007. In Gabon, work by the IUCN led to the creation in 1997 of the Minkébé Reserve (Christy *et al.,* 2003) with the support of WWF, the Dutch Cooperation and USAID. The reserve was enlarged and became a national park in 2002, at the same time as Ivindo, which incorporated the Ipassa Reserve, and Mwagna national parks were created. In the Republic of Congo, the same work gave rise to the extension of Odzala National Park. It officially became the Odzala-Koukoua National Park, encompassing enormous stretches of forests located further to the north and the adjacent protected areas (Lékoli-Pandaka and Mboko). This expansion led to the creation of the national parks of Boumba-Bek and Nki in Cameroon in 2005.

Players

(1) Governmental players

Until December 2004, the forest domain in Cameroon was managed by the Ministry of the Environment and Forests (MINEF) through the Directorate for Forests (DF) and the Directorate for Fauna and Protected Areas (DFAP). At the provincial level, it fell within the responsibility of the provincial delegation of MINEF, which provided supervision for the national park wardens and the district delegates established in Yokadouma, Abong Mbang and Sangmélima. The management of the Dja Fauna Reserve, which straddles two provinces, was monitored directly at the DFAP level. From December 2004 to December 2005, owing to the decree reorganizing the government after the presidential election of 11 October 2004, management of the protected areas was temporarily entrusted to the new Ministry of the Environment and for the Protection of Nature (MINEP), while responsibility for the forests and the fauna outside the protected areas fell within the jurisdiction of the Ministry of Forests and Fauna (MINFOF). An alteration of the organizational structure of the two Ministries, which occurred on 31 December 2005, brought the protected areas back under the authority of MINFOF.

In the Republic of Congo, the forest domain is administered by the Directorate for Forests (DF) of the Ministry of the Forest Economy and the Environment. The fauna and the protected areas are administered by the Directorate for Fauna and Protected Areas (DFAP). The provincial delegation of the Ministry is based in Ouesso, while the district delegations are based in Souanké and Sembé. Odzala-Kokoua National Park is managed by a national park warden with an assistant warden in Mbomo and an assistant warden in Sembé.

In Gabon, forests are administered by the Ministry of Forest Economy, Water, Fishing, the Environment and the Protection of Nature (MEFEPCEPN). This Ministry is represented in the field by the provincial inspectorates of Oyem and Makokou, which supervise activities at the Provincial level. These inspectorates are responsible for supervising activities concerned with both fauna and forests. The Directorate for Fauna and Hunting has brigades in Oyem and Makokou. The CNPN has appointed four wardens: one each for Minkébé-West, Minkébé-East, Ivindo National Park and Mwagna National park.

(2) Development programs

The national institutions have obtained the support of numerous and varied programs, including the following:

- The ECOFAC program of the European Commission, which has been involved since 1992 in the Dja Reserve and Odzala-Kokoua National Park; it will enter its fourth phase in 2007.
- The CARPE projects of USAID and CAWHFI, which target the entire Landscape.
- The CAWHFI-FFEM program aimed at strengthening conservation outside the protected areas and the UNDP-GEF conservation program of the Tridom will begin in 2006. The latter program will last a duration of seven years with a total budget of 10 million US dollars. It will target conservation in the whole of the Tridom, with a special focus on the interzone between protected areas.
- The Minkébé project of the European Union, which targets the management of fauna in the great forests of northeastern Gabon. The EU

is also providing support for the renovation of the IRET research station in Ipassa (Ivindo National Park).
- The GEF/Biodiversity Cameroon Program (1994–2003) made it possible to classify the Boumba-Bek and Nki national parks.
- The Project of Accompanying Measures around the Dja Fauna Reserve (2003–2006) financed by the European Union, provided support for social organization and community self-promotion in the northern periphery of the reserve.

(3) International NGOs

The international NGOs working in the Landscape are:

- WWF, active with the help of numerous sponsors (among others the EU, USAID, WWF Network, USFWS and DGIS) since 1994 in the southeast of Cameroon, since 1997 in the northeast of Gabon and since 2004 in the northwest of the Republic of Congo.
- WCS, active in Ivindo National Park in Gabon and in the IFO concession to the east of Odzala-Koukoua National Park.

(4) Logging companies

Consideration of logging companies in the Tridom is important because they manage enormous areas of forests that are essential for conservation. A number of companies (Rougier, IFO-Danzer, Pallisco, etc.) are involved in sustainable management based on rural development plans.

Direct threats

(1) Commercial hunting

Commercial hunting is carried out from the villages and affects a large part of the Tridom. Hunters move on foot and use rifles and/or metal snares. In Cameroon, where the meat is primarily sold smoked, some hunters venture up to 50 km into the forest, but normally do not go farther than 30 km. In Gabon and the Republic of Congo, where the meat is sold fresh, hunters may venture 15-20 km from the villages. The impact of the hunters will become much more significant, however, when they are able to benefit from roads and paths built for logging, which can extend up to 100 km into the forest. As the Landscape is gradually opened up by concessions, the impact of the hunters is increasing and the heart of the forests—the last refuge of the fauna—is being threatened.

However, hunting has an extremely variable impact on species. Monkeys, ungulates and bush pigs are the primary wild game, but the impact can be more serious on species that are only accessory or accidental victims. Opportunistic hunting of gorillas and chimpanzees presents a serious threat for these species that survive in significant numbers only in regions where there is no hunting. Leopards have very large territories and are likely to be caught when the density of traps is sufficiently high. Giant pangolins are also occasionally appreciated prizes. On the rivers, the slender-snouted crocodile and the softshell turtle are the most frequent opportunistic catches, while the Congo otter is often killed by fishermen.

Hunting is being pushed to excess by a strong demand for bushmeat in the villages and towns. This demand, however, can only be supplied thanks to the transport networks (roads, railways, watercourses). These networks play a very important role in the supply of bushmeat and must be carefully monitored and controlled.

(2) Hunting for ivory

Hunting elephants for their ivory and meat poses a significant threat to forest elephant populations within the Tridom Landscape. Unfortunately, these activities largely escape enfocement and monitoring control. Contrary to popularly held beliefs, forest elephants are very easy to ambush on forest tracks and they only survive far from inhabited areas. Given the elephants important ecological role, it can be predicted that a severe decrease in population numbers or the outright disappearance of elephants would have a significant impact on forest formations. The elephant is a key species in the forest, and can represent up to 50% of the biomass of vertebrates. It disperses great quantities of numerous species' seeds over vast distances and likely plays a role in the maintenance of certain types of plant formations, including the forest clearings and Marantaceae forests. The local disappearance of forest elephants could therefore lead to profound modifications in ecological processes[8].

(3) Epidemic diseases

In certain parts of the Tridom Landscape, particularly in the forests of Minkébé, the forests of Mwagna-Lossi and Djoua-East, and Odzala-Kokoua National Park, the populations of large primates have suffered an epidemic of Ebola fever, which has been raging for ten or so years.

(4) Logging

It is projected that soon 60% of the surface area of the Tridom will be allocated for industrial logging. This will lead to major changes in the

[8] The real impact of the disappearance of the elephant is very difficult to evaluate because of the fact that the forest 'reacts' slowly to any ecological modification. However, the elephant could play a very important role, especially in the case of the moabi *Baillonella toxisperma*, a species that is very slow growing, has very late fructification, and is highly desired by loggers. By transporting fruit from the protected areas to the concessions, the elephants may compensate for the increased scarcity of the trees.

forest. Although the volume of timber harvested was relatively low (5-15 m³/ha) at the time it was first cut, it was concentrated on a small number of species and therefore affected the population and the ecological role of these targeted species in a significant way. In addition, the trees were felled over very large areas and required the development of a major network of tracks of road for their removal. This caused substantial damage to the undergrowth and involved the felling of more trees than the logging itself. The development of the road network also opened the forests up to hunters. It is vital, therefore, that logging companies incorporate principles of conservation into their internal regulations.

(5) Traditional mining activities

Panning for gold is very common in the Gabonese and Congolese portions of the Landscape. It seriously disturbs the aquatic ecosystems and also brings significant human populations, who also hunt, into the intact forests. The gold-panning camps are often used by elephant poachers. In Gabon, with the help of WWF, a memorandum of understanding on hunting connected with panning for gold in the region of the Upper Ivindo has been written. The negotiations on this memorandum have also made it possible to develop a very constructive dialogue with the gold panners.

(6) Industrial mining

In Gabon, the mining of iron from the Bélinga and Minkébé mountains is envisaged. This assumes the construction of a Booué-Makokou railway line and a hydroelectric installation on the Ivindo. Without good coordination and exchange of information between the Ministry in charge of forests, the Ministry in charge of mining, the private sector and the conservation bodies, these developments could seriously affect the entire Gabonese section of the Tridom[9]. In Cameroon, there is a plan to mine cobalt and nickel in the Lomié area on the eastern periphery of the Dja reserve, and in the Republic of Congo, there is a plan to mine gold.

Indirect threats

(1) Immigration and the establishment of new villages.

There is a danger that some gold panning or hunting camps will one day be recognized as permanent villages, which would reduce the essential value of the Tridom as an area with significant connectivity between protected areas and vast continuous uninhabited areas. It should be possible to control this danger through well planned land usage in the medium term. In the short term, conservation departments must closely monitor this potential problem, because it is very difficult to revoke the status of a village once it has been accepted. Increasing the awareness of this matter to the administrative authorities is therefore essential to avoid the establishment of permanent camps in areas that are essential for connectivity.

(2) Destruction of crops

If nothing is done to reduce the damage caused to crops, the frequent human-elephant conflicts in the Odzala sector and Dja are likely to prevent the acceptance of ideas about conservation among the local populations.

State of the vegetation

The forests are largely intact and unfragmented; there are no significant stretches of agricultural land as of yet.

State of the fauna

The Tridom Landscape contains significant blocks of forest whose central areas lie outside of the hunting territories of the villages. Numerous reconnaissance missions carried out during the last ten years in different forest blocks of the Landscape provide evidence of the presence of intact groups of large mammals. This picture is not true for the great apes, however, which have suffered losses on the order of 98% in the heart of Minkébé due to the Ebola fever epidemic. Probably only a few individual lions remain on the savannahs of the Odzala and the hippopotamus and the Nile crocodile have become extremely rare[10].

Management and governance in the field of renewable natural resources

(1) At Landscape level

The three governments, as well as WWF, WCS and the ECOFAC program, actively participated in the development of the Tridom. During the second summit on conservation and sustainable management of the forest ecosystems, held in Brazzaville in February 2005, the Ministers of forestry for Cameroon, Gabon and the Republic of Congo signed the Tridom cooperation agreement in which they agreed to cooperate in management of the Landscape. This agreement defines the trinational governance structures. In Cameroon, the government has also introduced a moratorium on

[9] In addition to direct damage to environments, significant immigration, disruption of the aquatic ecosystems and an increase in hunting are to be expected.

[10] A few hippopotamuses survive in the Mambili (Odzala). The Nile crocodile survives only in the lower course of the Dja and in the Mambili.

the logging of 800,000 ha of the Ngoïla-Mintom forest, where logging was originally planned in the forest zoning plan, pending the results of the negotiations concerning its definitive use.

Everywhere in the Tridom, real management is oriented towards a Landscape approach. The Ministries in charge of the forests, the protected areas and fauna are working together with the partners at the Landscape level. Together they are trying to resolve the problem of poaching for ivory and bushmeat in the logging concessions and the protected areas. They are focused on increasing the surveillance capabilities, involvement of the communities in management of the natural resources (for example, memorandums of understanding on the management of the Oua River in Gabon), forest zoning, strengthening capacity and cross-border cooperation. Fruitful bilateral meetings have been held between Cameroon and Gabon and between the Republic of Congo and Gabon.

In the Republic of Congo, WWF has concluded an agreement with MEFE for cooperation within the Congolese interzone of the Tridom area.

At the Landscape level, management of natural resources based on customary zoning of hunting and the establishment of new rules is taking concrete shape. This management is based on innovative examples that are being replicated in other parts of the Landscape:

- The work of WCS with the CIB company, in the tri-national Landscape of the Sangha, has been replicated at IFO-Danzer.
- The WWF experiment at Bordamur in Gabon serves as an example in the majority of the other medium-sized concessions in Gabon.
- Agreements concerning panning for gold in the Minkébé region could inspire similar agreements in the Republic of Congo.
- The agreement on the management of the Oua River at Minkébé could inspire other agreements on management of the rivers.
- The experiment in southeast Cameroon on the community managed hunting concessions (ZICGC) and community based fauna resources committees (COVAREFS) around the Boumba-Bek and Lobéké national parks could be replicated elsewhere in the Tridom. This is true also for certain agreements (Mambélé agreement and agreement on action to combat poaching with the private sector).

(2) In the protected areas

In Ivindo National Park in Gabon:

- a warden has been appointed, based in Makokou (CNPN)
- demarcation has been completed (WCS)
- a permanent structure has been built near the Langoué forest clearing which can accommodate visitors (WCS)
- 16 eco-guards have been trained and 12 have been selected (WCS)
- a census of the great apes, elephants and traces of human activities has been carried out (WCS)
- a camp to host visitors has been constructed at the Kongou Falls (FIGET)

In Mwagna National Park in Gabon:

- a warden has been appointed (CNPN)
- surveys have been organized

(3) In extraction areas

Several logging companies are involved in sustainable planning and certification, but others have only a short term vision. Several are cooperating actively with the NGOs with a view to better conservation of the fauna, in particular IFO with WCS, Rougier, Pallisco and Decolvenaere with WWF. In Cameroon, the Decolvenaere, Pallisco and TTS-SCFS groups are in the process of FSC certification for the timber from their forest management unit. The first two companies have already completed the pre-audit and an action plan has been introduced. Inventories of fauna have been carried out in seven UFAs of southern Cameroon, as well as at IFO in the Republic of Congo and Rougier in Gabon.

(4) In rural areas

In the Republic of Congo, an awareness campaign among the local communities has been conducted by WCS and APEDTS concerning the problem of haemorrhagic fever caused by the Ebola virus. A prefectorial decree prohibiting the consumption of primates has been promulgated. The WCS Field Vet Program has continued to implement a strategy for identification of high risk areas in order to limit human loss.

Monitoring of natural resources

Information has been exchanged between Cameroon, Gabon and the Republic of the Congo, both at the level of NGOs and at the ministerial level.

Large mammals

Inventories using the 'recce-transect' method have been carried out within the framework of MIKE in Minkébé, Boumba-Bek and Odzala. A complete inventory of the large mammals has also been carried out in Ivindo National Park, with linear transects. There is a need to develop a follow up system at the Landscape scale. In the course of 2005, monitoring in the Congolese sector primarily targeted the distribution and abundance of large mammals in Odzala-Kokoua National Park and its periphery. In Odzala-Kokoua National Park, the study on large mammals has been completed (cooperation by ECOFAC, MEFE, and WCS). Sampling will continue in 2006 in the Ntokou forest and the IFO logging concession on the eastern periphery of the national park. Still in the Republic of Congo, MEFE and WWF have conducted reconnaissance missions in the forest of Souanké-Garabinzam. In 2005 in Gabon, WWF, CNPN and MEF cooperated on reconnaissance missions in Mwagna National Park, in the forest of LAFICO, and in the Minkébé-Mengame interzone. In Cameroon, WWF's reconnaissance missions in the Ngoïla Mintom forest and Boumba-Bek National Park demonstrate the importance of these areas for large mammals.

Health of the fauna

A program connected with the Ebola virus has been initiated in the Congolese sector.

Socioeconomic parameters

Throughout in the Landscape, studies have been carried out to evaluate the pressure of hunting on wild fauna and to evaluate the extent of the hunting areas in order to carry out zoning for hunting.

Elephants

In order to gain a better understanding of the movements of forest elephants in the Landscape, a monitoring program has been under way since 2003. Collars with incorporated GPS receivers and computers have been placed on nine elephants in Ivindo and Odzala-Kokoua national parks and two in Nki National Park. The movements of these elephants appears to be more limited than those observed in the Sangha Tri-national Landscape and movements from one protected area to another or from one Landscape to another have not been observed[11]. However, it has been found that some of them move over considerable distances outside the protected areas, including inside the logging concessions. This shows once again the importance of the concessions for fauna. Frequent movements of elephants have been confirmed between the forests of the Monts de Cristal and the forests of Minkébé, and between the forest of Minkébé and the forest of Ivindo. Signs of elephants have also been found across the interzone between Minkébé National Park and Odzala National Park, indicating a population of elephants that extends from Minkébé to Odzala. In Cameroon, the elephants of the Dja also move into the forest of Ngoïla Mintom (Djablé corridor).

Box 15.1. Towards a Landscape of Landscapes?

The Tridom, with its vast unhunted forests located in the center of great forest blocks, offers a major opportunity for the conservation of species vulnerable to hunting pressure (elephant, great apes, giant pangolin, panther, crowned-hawk eagle, etc.). All the forests of the Tridom still contain these species, but for their populations to endure it will be essential to control access via the logging trails and national roads. The traditional hunting areas of the villages must also be clearly established. It will be necessary for each forest area to establish a central area that is not hunted and where intact collections of species can be maintained. Village hunting should operate on the periphery of these non-hunted zones and its sustainability will be ensured by the flow of animals coming from the non-hunted areas. It is also important to maintain the connectivity between the forests, just as between the Landscapes. In order to achieve this connectivity the establishment of villages in corridors identified as critical must be prohibited. Moreover, the Tridom is ecologically connected to the Sangha Tri-national, Monte Alén - Monts de Cristal, and Lopé-Chaillu-Louesse Landscapes. The preservation of this connectivity within and between the Landscapes could be a formula for conserving the Congo Basin as a Landscape of Landscapes.

[11] The initial results show that the elephants use an area ranging from several hundred to more than 1,000 km² and the maximum distance covered was 54 km.

16. Sangha Tri-National Landscape

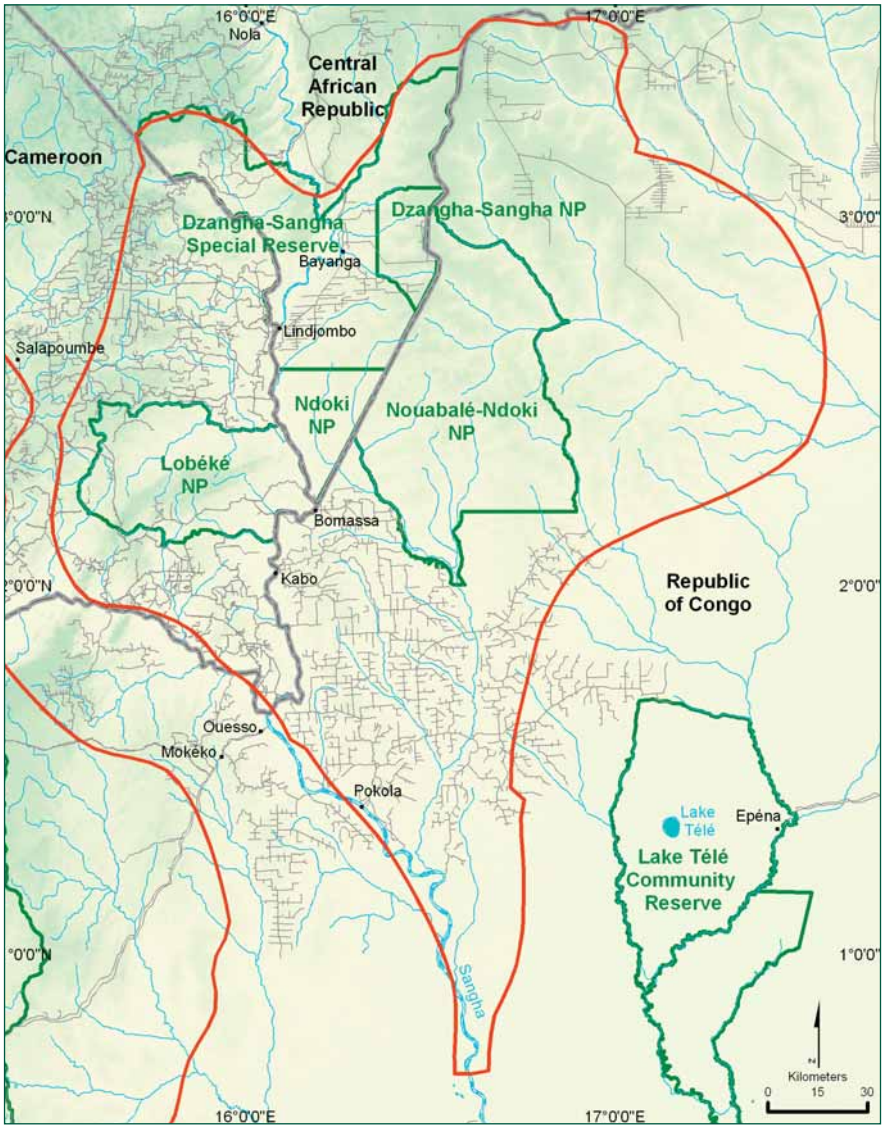


Figure 16.1. Map of Sangha Tri-National Landscape (Sources: Atlas of Cameroon GFW/WRI, CARPE, JRC, SRTM, WCS-Congo, WCS-Gabon, WWF-Jengi).

The Landscape in brief

Coordinates: 3°32'12"N – 0°40'29"N; 15°28'26"E – 17°34'8"E
Area: 36,236 km²
Elevation: 330-700 m
Land ecoregions: Northwest Congolese forests ecoregion
Aquatic ecoregion: Sangha ecoregion
Protected areas: Nouabalé-Ndoki National Park, 419,000 ha, 1993, Republic of Congo
Lobéké National Park, 43,000 ha, 2001, Cameroon
Dzanga-Ndoki National Park, 125,100 ha, 1990, Central African Republic
Dzanga-Sangha Special Reserve, 310,100 ha, 1990, Central African Republic

Location and area

The Sangha Tri-national Landscape is spread over three countries: Cameroon, the Central African Republic (CAR) and the Republic of Congo (Figure 16.1). The Congolese section of the Landscape extends over the administrative departments of Sangha and Likouala. It covers 21,470 km² and includes Nouabale-Ndoki National Park (PNNN) plus five forest management units (UFAs) which cover an overall area of 17,280 km² and form the buffer zone of the national park. In the north, the area is delimited by the UFA of Mokabi; in the south by the UFAs of Pokola and Toukoulaka; in the east by the UFA of Loundoungou and in the west by that of Kabo. In the west, Nouabale-Ndoki National Park borders on Dzanga-Ndoki National Park and Dzanga-Sangha Special Reserve in CAR. The CAR section covers 4,644 km² and includes Dzanga-Ndoki National Park and Dzanga-Sangha Special Reserve. The Cameroonian section is centered on Lobéké National Park.

Physical environment

Relief and altitude

The entire Landscape is located on plateaus broken up by alluvial plains. The altitude varies between 330 and 600 m in the Republic of Congo, but it reaches nearly 700 m in CAR.

Hydrology

The Landscape contains the headwaters of four major rivers that drain the north of the Congo River. Those of the Mabale, the Likouala and the Ndoki rivers are in PNNN; that of the Ibenga River is located in the UFA of Mokabi.

Climate

The average annual precipitation is on the order of 1,450 to 1,600 mm. The dry season lasts an average of two to three months and is centered on January-February. August is the rainiest month.

Vegetation

The Landscape essentially includes: semi-caducifoliated terra firma forests (Figure 16.2) rich in *Terminalia superba* (limba), Sterculiaceae, in particular *Triplochyton scleroxylon* (ayous), and Ulmaceae; forests with a monodominance of *Gilbertiodendron dewevrei;* forests of Marantaceae; mixed swamp forests; riparian forests of *Uapaca heudelotii;* and raffia palm groves. These forests are punctuated with grassy clearings and bais (Figure 16.3), as well as lakes, rivers and streams. In the areas that have been logged, rattan forests are growing.

In the Congolese section more than 1,700 species have been inventoried. Among the trees several species appear on the IUCN Red List: *Autranella congolensis*, *Pericopsis elata* (afrormosia), *Diospyros crassiflora* (ebony) and *Swartzia fistuloides* (pao rosa or African tulip wood). In addition, all the species of the genera *Entandrophragma* and *Khaya* that have been logged are considered vulnerable, as are other commercial species: *Aningeria altissima* (anigre), *Mansonia altissima, Pausinystalia macroveras* (tsanya) and *Gambeya pulpuchra* (longhi). PNNN is a sanctuary for all these species, but the surrounding concessions must also be managed in an intelligent way in order not to lose these important resources.

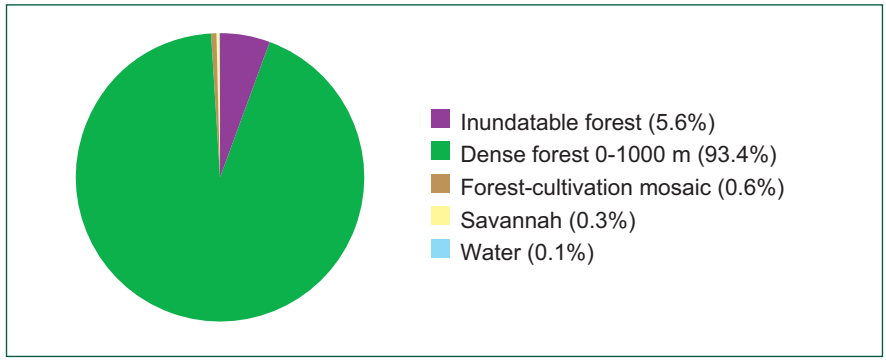


Figure 16.2. Main vegetation types (JRC).

Fauna

Mammals

In the CAR sector, 105 species of land mammals have been identified (Blom, 2001), in particular: the African forest elephant *Loxodonta africana cyclotis*; sixteen species of primates, among them the gorilla *Gorilla gorilla,* the chimpanzee *Pan troglodytes* and at least six small nocturnal species; fourteen species of ungulates, including the bongo antelope *Tragelaphus euryceros* (a species that is declining rapidly in Central Africa and is very rare in East Africa); and fourteen species of carnivores, including the leopard *Panthera pardus* and the spotted neck otter *Lutra maculicollis*. The hippopotamus *Hippopotamus amphibius* still has a significant population along the Sangha River.

Birds

The avifauna includes 428 species in the Congolese section, 379 in the CAR section and 350 in the Cameroonian section. A significant population of the Dja River warbler *Bradypterus grandis*, a species endemic to the marshes of *Rhynchospora* of Lower-Guinea, exists in Lobéké National Park; this species is also known in the marshes of PNNN. An as of yet undescribed species of night jar *Caprimulgus sp.* has been found in Lobéké National Park and PNNN. A new species of Turdidae, *Stiphrornis sanghae*, was described in 1999 in Dzanga-Sangha and has not yet been found elsewhere.

Herpetofauna

Species of reptiles found in this Landscape are typical for the region and include the Nile crocodile *Crocodylus niloticus*, the slender-snouted crocodile *Crocodylus cataphractus,* the dwarf crocodile *Osteolaemus tetraspis* (an endangered species), the Nile monitor lizard *Varanus ornatus,* the softshell turtle *Trionyx triunguis*, the African rock python *Python sebae,* the royal python *Python regius,* the coiled Gabon viper *Bitis gabonica* and the green mamba *Dendroaspis jamesoni*.

Figure 16.3. An elephant bai.

Ichthyofauna

The ichthyofauna is still insufficiently known, although it is very important for local populations. In the Cameroonian portion of the Sangha Basin, more than 200 species of fish have been identified, and the whole basin has nearly 300 identified species (Thieme *et al.,* 2005). The Sangha is a very dynamic environment because of silting and seasonal fluctuations that influence reproduction, the feeding regime and the distribution of the fish. Among the most remarkable families in the areas of the flooded or floodplain forests are the Alestiidae with *Hydrocynus goliath*, the Aplocheilidae, the Cichlidae with the genus *Tilapia*, the Claroteidae with the genus *Auchenoglanis*, the Cyprinidae with the genuses *Labeo* and *Barbus*, the Mochokidae with the genus *Synodontis*, the Malapteruridae with the electric catfish *Malapterurus sp*. and the Schilbeidae.

Humans in the Landscape

Density and distribution

In the Landscape as a whole, the density of human populations is estimated at 0.7 inhabitants/km², but this varies from one section to the next.

In CAR, the human population is estimated at 5,977 inhabitants in the protected areas of Dzanga Sangha, with an average density of 1.2 inhabitants/km². These inhabitants are distributed along the Bayanga-Lindjombo-Bomandjokou and Bayanga-Yobé axes in the interior of Dzanga Sangha Special Reserve. The urban and industrial area of Bayanga houses 60% of this population. In the north of the Salo reserve, there is another major site for industrial logging (Ngonda-Ngbalet, 1995).

In the Congolese section the density averages 1.5 inhabitants/km² (Mavah, 2005). Around PNNN, the indigenous Bangombe and Bambendzele traditionally led a semi-nomadic hunter-gatherer life, but in the last 30 years permanent villages have been established along the Sangha and in proximity to the logging bases of Kabo and Pokola. In the UFA of Mokabi, it appears that immigration and growth of the human population have increased significantly since the beginning of logging in 2000-2001 by Rougier. The concession of Pokola, currently assigned to CIB, has the largest population center in the region with 13,417 inhabitants, representing the greatest potential impact on the national park and its environs. CIB has strongly developed the infrastructure of Pokola, which has considerably improved the quality of life of the employees and of the community in general. Between 1999 and 2003, the growth rate of the population in Pokola was 11% per year, primarily due to immigration associated with job opportunities and the standard of living (Moukassa and Mavah, 2003). Other centers in the CIB concession are Kabo (2,600 inhabitants), the forest camp of Ndoki I (949 inhabitants), Ndoki II (1,000 inhabitants) and smaller villages along the Sangha and in the region of Kabounga (Mavah and Auzel, 2004). In this region, however, there has been a decrease in populations due to emigration toward the large population centers of Pokola and Kabo (Paget and Desmet, 2003).

Ethnic groups

In CAR, the ethnic groups originating in the region are the BaAka Pygmies, a hunter-gatherer people, and Sangha-Sangha, a fishing people. The other groups, such as the Ngoudi, Mpiemou and Bogongo are from the region of Sangha Mbaere. Foreign populations include the Gbaya, Banda, Nzakara, Nzande and Kaba, who come from other regions of CAR, as well as Chadians, Cameroonians and Mauritanians. The Pygmy populations constitute around 30% of the total human population of the reserve.

In the Congolese section, Pokola is home to nearly fifty different ethnic groups which cohabitate; 32% of the groups are indigenous to the region (Mavah, 2005). The principal ethnic groups in the villages are Pomo, Yasua, Ngondi and Sangha-Sangha. The semi-nomadic groups of Bambendzele represent 32% of the population. In Kabo, more than thirty ethnic groups are present, and more than 70% of the population are originally from the department of Sangha. The semi-nomadic communities of Bangombe and Bambendzele constitute 15% of the population. In the Loundoungou region 45% of the population is made up of semi-nomadic Bambendzele, 25% of Bomitaba, 25% of Bondongo and 5% of Kaka, all concentrated along the Motaba River, and with more than 95% of them originating in the department of Likouala (Mavah, 2005). Of the lands of Kabounga in the UFA of Toukoulaka, 61% are inhabited by Bomitaba and 39% by semi-nomadic Bambendzele.

Social organization

In the Congolese portion of the Landscape, the villages are organized geographically, as op-

posed to politically, because of the forced regrouping that they suffered during the colonial era. However, the villagers gather together according to the ethnolinguistic groups present: Pomo, Ngondi, Yasua or Bomassa. The organization connected with lineage membership has a tendency to give way to ethnolinguistic organization because of the rural exodus toward the urban centers and the establishment of logging. Inter-ethnic marriages have contributed to the merging of several ethnic groups. Semi-nomadic communities and the villagers form only one economic and social unit, most of the time using the same forest spaces and sharing forest and agricultural products. In the semi-nomadic communities, social organization connected with clan membership is still observed.

In the Republic of Congo, there are two kinds of chiefs within the local populations:

- the village chief, who represents the government and is often chosen for the influence that he has on the other villagers
- the customary chief and/or clan chief, who represents the ancestors and is chosen through a ritual

None of these chiefs have a great deal of influence on the population, except in the case of semi-nomads and the heads of clans. The societies are generally acephalous and the chiefs vary from one activity to another or from one rite to another.

Activities

In CAR, the principal human activities taking place in the interior of the Landscape are logging, mining, hunting, fishing, agriculture, livestock breeding, gathering, conservation, tourism and trade (Table 16.1).

In the Republic of Congo, the principal sources of income for the local populations include industrial logging, services for employees of the logging companies, hunting, fishing and agriculture. Fishing is mostly practiced in the dry season, hunting in the rainy season—legally, hunting is prohibited in the dry season. Rifles and metal cables, which are illegal, are used most often for hunting. Traditional nets and snares made of plant fibers are no longer used except sporadically by the semi-nomads. Activities are divided: the men hunt and fish, while the women do the gathering, take care of the household, and occasionally fish in the streams.

Table 16.1. Main activities in the human population in the Central African Republic of the Sangha Tri-national landscape.

Activity	Percentage
Fishing	20
Logging	17
Agriculture	16
Collecting NTFP	13
Public services	11
Hunting	7
Other activities	16

Land use

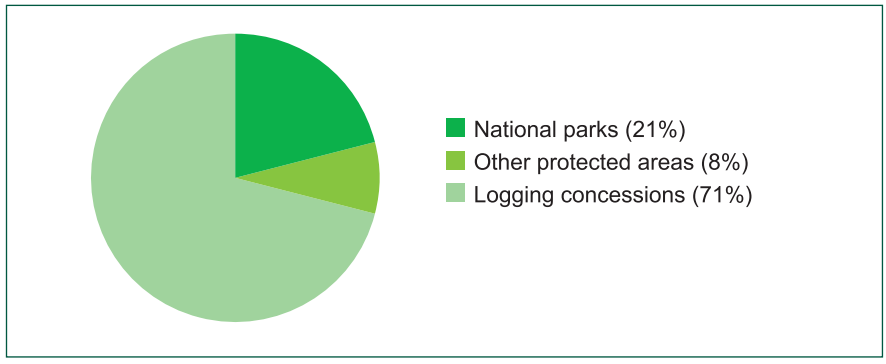
In CAR, Dzanga-Sangha Special Reserve represents 69% of the protected areas while the national park accounts for 27%. In the reserve, 70% of the land is allocated to hunting safaris and 83% to logging. The two activities therefore partly overlap. The community area for hunting covers around 14.6% and it is the only area where traditional hunting and gathering are authorized. The 'pre-park' area is a buffer zone that surrounds the two sectors of the national park over a width of 2 km.

In the Congolese section, PNNN covers 20% of the Landscape. The logging concessions, including areas reserved for the management of fauna by village communities and based on the traditional hunting lands, cover 80% of the Landscape (Figure 16.4).

Infrastructure

- In the Republic of Congo, the roads, all maintained by CIB, are in good condition.
- There are no bridges, but CIB and IFO manage a ferry on the Sangha and soon will do the

Figure 16.4. Main land use types.



same on the Motaba River to allow access to the Loundoungou-Ibendja concession to the northeast of PNNN.

- Three private primary schools built and subsidized by WCS are established near PNNN; in the concessions, there are relatively well-equipped primary and secondary schools subsidized by CIB.
- Pharmacies have been built, financed and supplied by WCS in the villages near the national park; there is a good hospital in Pokola and one is under construction by the CIB in Kabo.
- Portable telephones reach Pokola and will soon reach Kabo.

Logging

In CAR, logging began in the Dzanga-Sangha region around 1972, with the establishment of the Yugoslavian company Slovenia Bois (SB). This led to a rapid increase in the population of Bayanga. Following financial difficulties, activities were stopped in 1986. The company Sangha Bois took over in 1988, but due to a failure to respect commitments vis-à-vis the State it was closed in 1990. In 1992, this concession was bought out by a French group, *Sylvicole de Bayanga*, which operated between 1993 and 1997. In 1999, the *Société de bois de Bayanga* (SBB) restarted logging activities in the reserve over an area of 186,900 ha. These activities ended in December 2005. The *Société d'exploitation forestière de Sangha Mbaéré* (Sesam) has had a logging concession in the northwest of the reserve since 1991 and its logging permit covers 88,800 ha in the special reserve. Thanks to financing from the French Development Fund (CFD), it has established another industrial site in Salo in the north of the reserve, but logging activities have currently been stopped. Around 265,800 ha, that is 83% of the reserve, are being logged industrially and the loss of forest cover due to industrial logging is estimated at 2,500 ha/year.

In the Republic of Congo, the logging concessions of Kabo, Loundoungou and Pokola/Toukoulaka were assigned to CIB, which has been actively logging the concession of Pokola since 1962. The Kabo concession has been worked since the 1970s, initially by the company Bois Sangha, and the Loundoungou concession has never been logged. CIB acquired the rights to these two concessions in 1997. The concession of Mokabi, which borders PNNN to the north, was allocated to Rougier in 1999.

In 1999, cooperative work was initiated between WCS, the Congolese government, CIB and the local communities in order to promote responsible management of the fauna and the forest resources in the Kabo-Pokola-Toukoulaka-Loundoungou area that surrounds PNNN. The activities are focused on education, raising awareness about conservation, the development of alternative activities, community management of the fauna, protection of the fauna, socioeconomic studies, ecological research, monitoring and improving the exploitation of the forest. CIB is now drawing up overall development plans for its concessions, taking into account the conservation of biodiversity and the development of socioeconomic objectives.

Reasons for the identification of the Landscape

(1) The Landscape contains vast extents of intact forests of different types, a rare phenomenon in the world, and its ecological integrity is remarkable. It provides habitats for some of the largest intact communities of large mammals in Africa. It is particularly important for forest elephants and great apes. The presence of bais, environments very much sought after by many mammals and birds, is an essential asset.

(2) The forests of the Landscape have been recognized as critical for conservation in Africa (Monza, 1996) and as one of the priority areas for the conservation of forests in the northwest Congolese forests ecoregion (Kamdem Toham *et al.*, 2006).

(3) There are major opportunities for conservation: the protected areas cover 21.5% of the whole landscape (752,000 ha) and cross-border cooperation agreements were signed in 2000 by the three countries involved, with a view to improve conservation of the protected areas.

(4) Conservation of the protected areas could be strengthened by sustainable management of the buffer zones in two of the three countries.[1]

Conservation

History

In CAR, after the signing of agreements between the government and WWF in 1988, the Ministry in charge of forests initiated, in collaboration with WWF, the Dzanga-Sangha Project in 1988**.** Law no. 90.017 of 29 December 1990 clas-

[1] In the Republic of Congo and Cameroon, WCS and WWF are providing technical assistance to CIB and the company Decolvenaere in order to promote sustainable management of the fauna. In 2004, CIB requested FSC certification for its concessions, three of which directly border on PNNN. Other companies also seem to want to move towards sustainable logging.

sified 125,100 ha as a national park (category II of the IUCN) and law no. 90.018 of 29 December 1990 classified Dzanga-Sangha Special Reserve of around 335,900 ha for multiple use (category VI of the IUCN).

In the Republic of Congo, WCS signed an agreement with the Congolese government in 1991 to supply technical support for the creation and management of a national park through the Nouabalé-Ndoki Project. PNNN was consequently created in 1993. In 2003, the management plan for the park was officially adopted and the Goualougo triangle was included in the protected area. This area, previously included in the concession of Kabo, has a remarkable and intact biodiversity due to its isolation and its inaccessibility between the Ndoki and Goualougo rivers.

In Cameroon, Lobéké National Park was classified in 2001.

The cross-border dialogue between the conservation bodies operating in PNNN, the area of Lobéké and the Dzanga-Sangha complex began in 1996. In December 2000, the three countries involved signed a cross-border cooperation agreement. Certain cross-border activities in the form of patrols on the rivers and borders began in 2001 and have made it possible to reduce commercial hunting on the Sangha. The partners have been coordinating their efforts by focusing on the problems of cross-border conservation, specifically as concerns the application of laws, research, monitoring and the institutional framework.

Players

(1) Governmental players

Management of the protected areas is under the direction of the Ministries of Water and Forests in the three countries.

(2) NGOs

In CAR the Ministry is supported by WWF and GTZ-LUSO; in the Republic of Congo, by WCS; in Cameroon by WWF and GTZ. In CAR, WCS has also been carrying out research on forest elephants for the last 15 years.

(3) Private companies

The main logging companies are CIB and Rougier in the Congolese section, Decolvenaere in Cameroon and SBB in CAR. However, SSB was liquidated at the end of 2005. Hunting tourism is organized in CAR by three companies: Aouk Sangha Safari, National Safari and Safaria.

Direct threats

(1) Commercial hunting

Commercail hunting represents the primary threat for wildlife throughout the Landscape, but most notably in Cameroon and CAR. The animal populations in the concessions are subject to growing pressure because of the opening up of the forests by logging roads and the increase in the human populations.

(2) Ivory hunting

The pressure on the elephants from hunting for their ivory is substantial in the southern part of the concession of Pokola, and incursions by ivory hunters along the northern edge of PNNN from the CAR are becoming more and more frequent.

(3) Hunting by villagers

With the increase in the human populations in Kabo and Pokola, Republic of Congo, the pressure on animal populations is increasing greatly. Practiced in zones that are already emptied of game, it cannot be sustained. Responsible management of the hunting pressure is essential to bring this type of hunting back down to a sustainable level.

(4) Industrial logging

The primary threat posed by industrial logging is the opening up of the forests to hunters. Logging companies, however, are currently felling a larger and larger number of species and it is foreseeable that the loss of canopy is going to become a problem in certain regions. The poor planning of roads and tracks is also causing major unnecessary damage to the canopy. Non-sustainable logging of certain species will eventually change the composition of the forest around PNNN. The disturbance of the clearings and the bais by logging presents certain threats to the wildlife that depends on these habitats for their nutritive resources.

(5) Traditional mining

Diamond mining is a threat in the north of the special reserve in CAR (Ngakeu *et al.*, 2002).

Indirect threats

(1) Lack of information

The information necessary for management and planning is lacking. The ecological needs of endangered species, such as the forest elephant, the gorilla and the chimpanzee, are poorly known.

It is therefore very difficult to evaluate the direct impacts of industrial logging on these species and improve measures for conserving biodiversity.

(2) Lack of capacity

Capacity and support for conservation are weak. The governments of the three countries would have to increase their capacities enormously before being able to set up effective protection and management of the Landscape. Staff members have to be identified, trained and monitored.

(3) Lack of resources

Alternative resources for proteins and monetary income do ease pressure on wildlife. The logging companies therefore absolutely must facilitate the supply of alternative proteins in logging camps and towns.

(4) Poor standards of institutions

Policies and support in the areas of wildlife management and forest management are insufficiently developed. These aspects must be developed both for community logging and for industrial logging in order to control access, commercial hunting and immigration following logging activities. Wildlife management, the planning of land use at the Landscape level, the problems concerning indigenous peoples and conservation in areas adjacent to national parks have to be incorporated into the laws concerning the long term management of the forests. Guidelines must be developed for national and international policies for conservation and management in tropical forest areas supporting multiple uses.

State of the vegetation

A large part of the forests that cover the banks of the Sangha seem to have been inhabited between the years 2,300 and 900 BP, when they were transformed into palm groves of *Elaeis*. After the region was abandoned by these populations, they were covered by forests of *Entandrophragma*. However, industrial logging has once again affected a large part of these forests by opening up their canopy. The majority of the forests in the center of Lobéké National Park and all the forests of PNNN have never been logged.

State of the fauna

In CAR, the data gathered by the MIKE program in 2005 showed a clear reduction in the populations of large mammals and a contraction of the distribution area. Key species like the elephant, the chimpanzee and the gorilla are concentrated in the interior of Dzanga-Ndoki National Park[2] (Box 16.1).

In the Republic of Congo, populations of large mammals are still largely intact (Table 16.2). In the south of PNNN, in the concessions of Kabo, Pokola and Toukoulaka, animal populations are stable and in good health as a result of proper management. These concessions contain habitat for elephants and bongo antelope. The protection of these habitats is essential to allow the population of bongo antelope to recover from the epidemic caused by the *Stomoxys* flies in 1997. The concession of Mokabi, however, has lost a large part of its fauna since the beginning of activities in 2001. Human immigration and uncontrolled hunting have considerably reduced populations of elephants in the north of the concession (Box 16.1). Large populations of mammals nonetheless remain in the south of the concession bordering PNNN.

Tourism

In CAR, the concessions of the three hunting safari companies that are operating in the Landscape cover a large part of the special reserve and overlap with the logging concessions over an area of 225,400 ha. In terms of ecotourism, a reception center and a tourist hotel, Doli Lodge, have been developed. Around 820 tourists visited the site in 2004. The tourist activities available include: elephant viewing in the bai of Dzanga; primate watching (gorillas and mangabeys); participation in hunting, using snares and traps; the traditional dance of the BaAka; a trip on the Sangha; and collecting raffia palm wine.

In the Republic of Congo, the development of ecotourism expanded considerably in 2005 with the construction of new accommodation infrastructure in PNNN and the organization of cross-border excursions.

Management and governance in the field of renewable natural resources

(1) At the Landscape level

The TNS cooperation agreement created four cross-border management structures:

- the Tri-National Supervision and Arbitration Committee (CTSA) at the ministerial level
- the Tri-National Scientific Committee (CST)
- the Tri-National Monitoring Committee (CTS) at the level of the provincial administrations, which includes representatives from the agencies funding and/or executing pro-

[2] In Dzanga-Ndoki National Park the average density is 0.6 elephants/km², thanks to protection efforts carried out by the Dzanga-Sangha Project. In the Dzanga-Sangha Special Reserve, the density is reduced to 0.09 elephants/km². For the entire complex of protected areas, the population of gorillas is between 1,794 to 4,063 weaned individuals; the population of elephants is between 671 to 1,124 individuals.

grams, as well as the conservators or national directors of each site
- the Tri-National Planning and Execution Committee (CTPE) at the level of the sites, made up of conservators, project managers and associated technical assistants

The CTPE is the main administrative body of the Sangha Tri-national and the most active committee with meetings twice a year. It is responsible for monitoring all of the activities and problems that occur in the Landscape and planning future actions. It is the principal means of communication on the state of the Landscape to all the parties concerned, through periodic reports. Since it includes all the players in the Landscape, this committee has shown that it is very effective in identifying and carrying out activities, especially those relating to combating poaching.

The development of a land use plan at the Landscape level is well advanced. A working meeting was held in 2005 and a preliminary document has been prepared. The document brings together all available information relating to national development plans and land use plans in order to sum up the current and future focal points for development and overall strategies for the Landscape.

In the Congolese section, mobile guard patrols and fixed surveillance posts on the access roads have been maintained over the entire extent of the Congolese section of the Landscape, in the national park as well as in the concessions. Consequently, elephant poaching in PNNN has remained nil. Bi-national patrols have been organized every six months, with agents from the Republic of Congo and CAR.

(2) In the protected areas

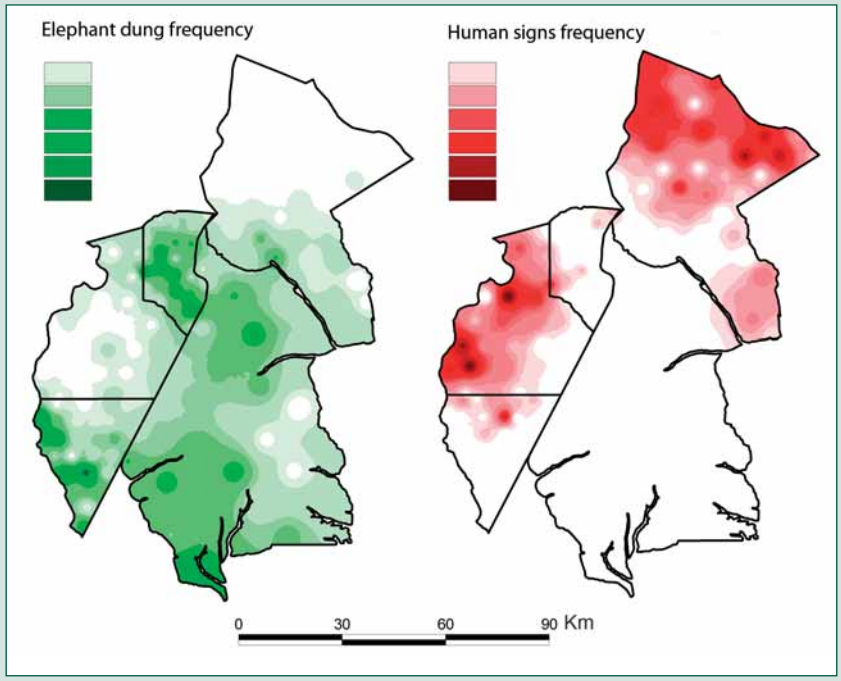
In CAR, in order to harmonize human activities in the protected areas of Dzanga-Sangha and possibly improve the use of renewable natural resources, the complex of Dzanga-Sangha has been organized according to a zoning plan, which implements the legal texts in force[3]. The two sectors of the national park are designated as conservation areas, excluding every activity other than those connected with tourism and research, and are surrounded by a buffer zone. Dzanga-Sangha Special Reserve is classified as a peripheral zone with multiple uses, where anthropogenic activities are authorized under certain conditions and in areas specifically planned for logging, sport hunting, traditional hunting, agriculture or fishing. In the interior of the special reserve there is a community hunting area where the traditional activities of local populations are permitted (camping, hunting, fishing and gathering) and hunting for non-native residents who hold a hunting permit is also allowed.

The activities developed by the Dzanga-Sangha Project in the protected areas include:
- action to combat poaching, promote ecological monitoring, continue the habituation of primates, and the formation and maintenance of local infrastructures
- support for the management of forest harvesting
- self-promotion of local initiatives and micro-projects
- elimination of illiteracy and provision of pre-schools for Pygmies
- ecotourism and environmental communication

The local arbitration committee of the Dzanga-Sangha Project is tasked with serving as an interface between the local population and the

Box 16.1. Elephants and humans in the Sangha Tri-National Landscape

During the MIKE program, inventories were undertaken by WCS and WWF in the Sangha Tri-national Landscape. These have demonstrated than indices of human presence and indices of elephant presence are inversely co-related. Elephant distribution and human distribution are totally in opposition.



[3] In CAR, the management of renewable natural resources is governed by the forest code of 1991, which expresses the need to conserve biological resources and confirms the customary rights of the populations while taking into account the status of the ecosystems and the interests of future generations, and the wildlife protection code, which regulates hunting and also recognizes the traditional right of usage of animal resources by the local residents of the forest ecosystems.

Table 16.2. Present situation as concerns wildlife and human presence in the Sangha Tri-national Landscape in the Republic of Congo.

Species	Density per km² [Confidence interval] (Rate of encounter / signs per km)					
	Logging concession					**National Park**
	CIB				**Rougier**	
	Kabo UFA	Pokola UFA	Loundoungou UFA	Toukoulaka UFA	Mokabi UFA	Nouabalé-Ndoki National Park (PNNN)
Gorilla (nests)	1.36 [1.05; 1.75] (1.05)	2.15 [1.51; 3.06] (1.00)	0.56 [0.04; 8.23] (0.42)	2.25 [1.60; 3.17] (1.17)	(1.4)*	(1.88)*
Chimpanzee (nests)	0.29 [0.24; 0.35] (0.67)	0.35 [0.28; 0.43] (0.88)	0.03 [0.11; 0.78] (0.86)	0.44 [0.35; 0.57] (1.21)	(0.43)*	(0.12)*
Great ape (indeterminate species)	-	-	-	-	(3.9)*	(6.2)*
Elephant (droppings)	1.23 [1.03; 1.48] (1.50)	1.06 [0.83; 1.35] (1.06)	0.39 [0.12; 1.31] (0.69)	0.23 [0.15; 0.34] (0.48)	0.30 [0; 0.6] (1.85)	1.40 [0.6; 2.2] (8.45)
Buffalo (signs)	(0.11)	(0.07)	(0.01)	(0.02)	-	-
Bongo antelope (signs)	(0.06)	(0.04)	(0.02)	(0.02)	-	-
Bushpig (droppings)	(0.01)	(0.08)	(0.04)	(0.04)	-	-
Forest hog (droppings)	(0.02)	(0.00)	(0.00)	(0.00)	-	-
Monticola Duiker (droppings)	(0.11)	(0.57)	(0.81)	(0.10)	-	-
Medium-sized duiker (droppings)	(1.38)	(3.54)	(2.40)	(1.89)	-	-
Yellow-backed duiker *silvicultor* (droppings)	(0.77)	(1.61)	(1.11)	(1.75)	-	-
Human (casings)	(0.18)	(0.21)	(0.01)	(0.06)	(0.15)	(0)
Transect Effort (km)	777	1181	889	610	46	25
Monitoring year	2001-2002	2002-2003	2002	2002-2003	2003-2004	2003-2004
Source	(Poulsen *et al*,. 2005)	(Poulsen *et al*,. 2005)	(Poulsen *et al*,. 2005)	(Poulsen *et al*,. 2005)	(Boudjan and Makoumbou, 2004)	(Boudjan and Makoumbou, 2004)

** an analysis of data concerning the great apes is under way*

Dzanga-Sangha Project, particularly in regards to the management of disputed issues concerning access to renewable natural resources and dividing up the benefits resulting from their development (taxes from the exploitation of resources and income from tourism)[4]. Access to biodiversity resources for hunting and gathering is unrestricted in the authorized areas of the special reserve, but it is strictly prohibited in the two sectors of the national park. The ancestral practices of hunting (rituals at the beginning of the hunting year) have been abandoned except by the BaAka[5].

(3) In the logging areas

In the Republic of Congo, CIB announced in November 2004 that it was setting aside large areas in the concession of Kabo as a part of FSC certification. Two areas cover more than 14,000 ha and are in the Bomassa triangle. They constitute a major addition to the network of protected areas in the Landscape by connecting the national parks of CAR and the Republic of Congo. In October 2005, CIB also presented its first development plan, which included measures for implementing sustainable practices that reduce environmental and social impacts.

Community projects were initiated by WCS in the four concessions of CIB through the formalization of management committees and the organization of a workshop to define a participatory process in the development of regulations concerning hunting, fishing and the harvesting of non-timber forest products in community areas.

Logging in the Bomassa triangle (concession of Kabo) was authorized for the next four years by the government, with the condition that this area would receive the status of a protected area in the future. Certain standards have been adopted by CIB and MEFE, with the support of WCS, in order to reduce the impact of logging and to provide surveillance of hunting in this sensitive area of the Landscape.

(4) In the rural areas

With the considerable increase in human populations connected to the development of industrial logging, conservation at the community level has become an increasingly important strategy in the Landscape. As part of an evaluation of the possible sustainable sources of proteins that could serve as an alternative to bushmeat, a tri-national project aimed at developing systems for managing fish was created and will be implemented in 2006.

The village chiefs and the local administrative authorities have become key players. They are consulted at times of decision making in regards to strategies for sustainable development and conservation. They are also tasked with managing the repercussions arising from the exploitation of biodiversity resources: 40% of the revenue from taxes on logging and 40% of the taxes on ecotourism are set aside for rural development organizations. However, there is a lack of capacity regarding the management of this revenue and a program for strengthening capacity in this area is essential.

The success of actions taken to combat poaching has led to an increase in the elephant population and elephants are found near the villages increasingly frequently. This phenomenon has caused an increase in crop damage. Experimental measures aimed at driving the elephants away from the fields using strong peppers (pili-pili) have been tried in Zimbabwe and are currently under way in the village of Bomassa, close to PNNN. These measures could be applied on a larger scale.

Monitoring renewable natural resources and their management

(1) Training

National and tri-national training programs in ecological and socioeconomic monitoring were continued in 2005:

- A training course in methods for monitoring bais was provided to national researchers of the three countries by a senior researcher at Dzanga-Sangha in CAR.
- An annual training course in methods of monitoring and research was given to national researchers in PNNN.
- A training course in GIS was given at both the tri-national and national levels.

(2) Ecological monitoring

The GIS databases have been updated and new remote sensing methods have been introduced. In the Congolese section, a program of ecological monitoring at the Landscape level has been designed and finalized. It will be implemented in 2006. This program covers 2.8 million hectares under improved development and will offer an effective tool for the evaluation of strategies for management in regards to conservation objectives in the different land use zones. Standardized methods are used throughout the Landscape and the three protected areas are within the framework of national and regional programs, such as MIKE.

In addition to monitoring at the Landscape level, there are also specific monitoring actions that focus on particular species or habitats, such as bais:

- In the Republic of Congo, a long term study of gorilla populations and their demography has been under way at the bais of Mbeli since 1995.
- A study of the eco-ethology of the chimpanzee has been underway in the Goualouago triangle in PNNN since 1999; it targets the impact of logging on this species.
- Studies of the impact of logging and hunting are also under way in the buffer zone of the national park.
- Monitoring of the bais frequented by elephants should make for a better understanding of the use of the environment by this species and its population structures; it is also meant to provide information on poaching.

In CAR, monitoring patrols in 2004 and 2005 made it possible to evaluate the frequentation of the bais[6] at a time when poaching around the salt marshes was diminishing and the poaching network in the area was being weakened. In 2005, the monthly rates of frequentation by elephants were higher than for 2004 and numerous species were seen more often than before[7].

(3) Monitoring wildlife health

Monitoring wildlife health was extended to the entire Landscape and focused on the development of a means of surveillance aimed at the rapid detection of epidemics such as Ebola.

[4] At the village level, the chiefs of groups that have authority over natural resources delegate their power to the village chiefs who are in a position to rule on disagreements and disputes. They are often chosen from the founding family of the village. Currently, within the framework of the participatory management of renewable natural resources, they are often consulted by projects at times of major decisions relating to zoning and other issues concerning access to the resources.

[5] The ritual of the beginning of the hunting year still exists among the BaAka Pygmies who follow the tradition of the Djengi personified by the patriarch of the village.

[6] Of a total of 3,500 patrols carried out in 2004, 11% were done in the north of the Dzanga sector of the national park, a sensitive area for poaching, 36.2% around the principal bais of Dzanga, Mongambe and Hokou and 1.6% in the Ndoki sector of the national park. On average there were 1.7 patrols a day in the whole of the protected areas of Dzanga-Sangha.

[7] These species include: the sitatunga, the forest buffalo, the bongo antelope, the forest hog, the bushpig, the black and white colobus monke, white-cheeked mangabey and the greater white-nosed monkey (Turkalo, 2005).

17. Léconi-Batéké-Léfini Landscape

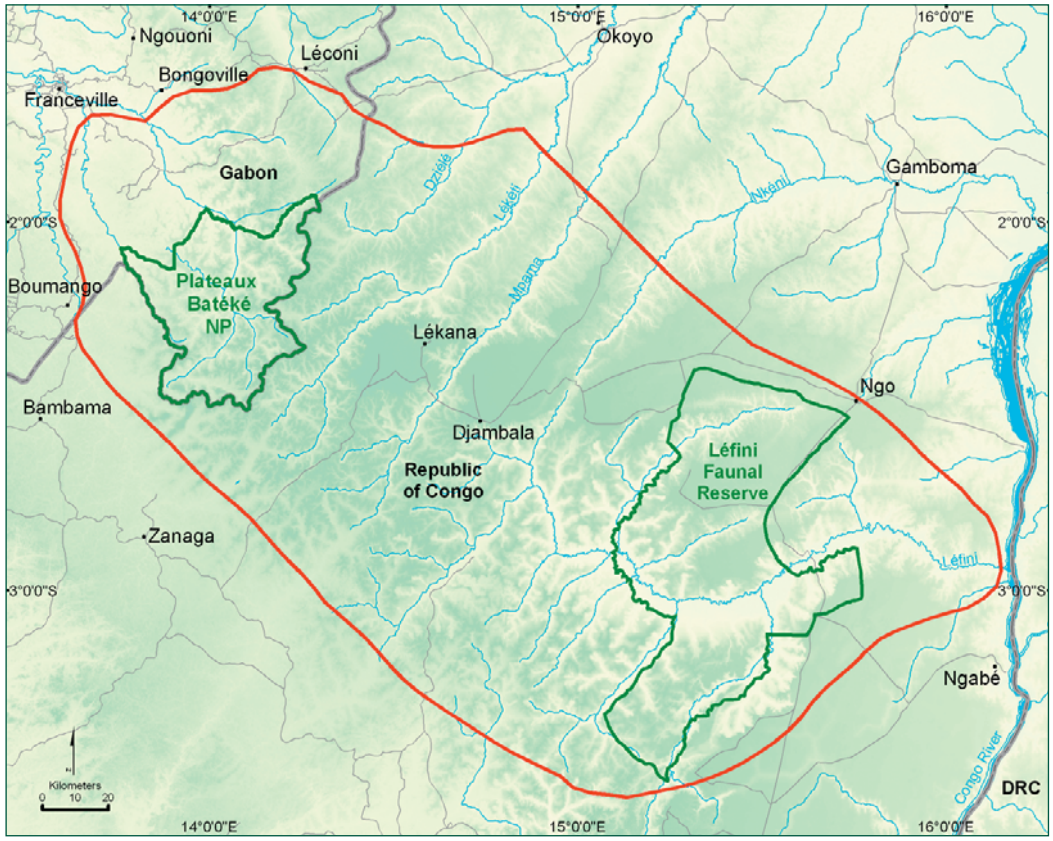


Figure 17.1. Map of Léconi-Batéké-Léfini Landscape (Sources: CARPE, JRC, SRTM, WCS-Congo, WCS-Gabon).

The Landscape in brief

Coordinates: 1°34'49"S – 3°33'42"S; 13°35'39"E – 16°8'57"E
Area: 35,164 km²
Elevation: 300-870 m
Terrestrial ecoregion: Southwest forest-savannah mosaic ecoregion
Aquatic ecoregions: Southwest equatorial coastal ecoregion
Sangha ecoregion
Protected areas: Batéké Plateau National Park, 205,000 hectares, 2002, Gabon
Léfini Wildlife Reserve, 125,000 hectares, 1956, Republic of Congo

Location and area

The Landscape is located in Gabon and the Republic of Congo (Figure 17.1). It covers a total area of 35,164 km², but the activities carried out within the framework of the CBFP are focused on a priority area of 35,350 km² covering the western part of the Léfini reserve and the Bambama-Lekana area in the Republic of Congo, together with Batéké Plateau National Park (BPNP) in Gabon.

Physical environment

Relief and altitude

The relief consists of plateaus that were deeply cut out by the hydrographical network (Figure 17.2) and, particularly in Gabon, are crisscrossed by areas of giant fossilized dunes which appear to be linked to the Kalahari Desert and are locally eroded by spectacular cirques (Figure 17.3). The lowest valley beds are at an altitude of about 350 m and the peaks reach 830 to 870 m.

Geology and soils

The Batéké plateaus form the western edge of the vast sedimentary basin from the Cretaceous to Miocene eras, stretching farther to the east into DRC. The oldest formations belong to the Stanley Pool group, which lies directly on the Precambrian bedrock. The most recent formations belong to the Batéké plateaus group, whose lower strata date from the Eocene and rest on Stanley Pool formations. These are mostly soft friable sandstone. The

most recent strata are composed of sandy silt or quartzose sand from a local alteration (Hudley & Belmonte, 1970) and eolian sand. The soils are mostly sandy, highly permeable and poor.

Hydrology

In Gabon, the Landscape is drained by the Ogooué River and its tributaries, particularly the Léconi and the Mpassa, whose sources are in the Republic of Congo in the Bambama-Zanaga region, converging in the Franceville region. In the Republic of Congo, most of Landscape is drained by parallel rivers flowing into the Congo River, especially the Leketi, Moama and Nkene, which run towards the northeast, and the Léfini, which runs to the east. The Landscape is also studded with numerous lavakas or fossil valleys. The masses of soft sandstone and sand form a major reservoir of good quality underground water that ensures that the rivers have a regular flow in all seasons (Beaujour, 1971) and which is commercially exploited. That is why the Batéké hills and plateaus, although dry on the surface are called the 'water tower' of the Republic of Congo and Gabon.

Climate

The Landscape as a whole has a tropical transitional climate. Average annual precipitation is around 1,700 to 2,000 mm. The dry season is from the end of May to September and in January-February there is a period of less rainfall.

Vegetation

Savannahs cover around 70% of the area of the Landscape (Figure 17.4). They comprise vast stretches of relatively short and sparse savannah and expanses of bush and tree savannah of *Hymenocardia acida* (Euphorbiaceae) and *Annona senegalensis* (Annonaceae). Valley bottoms are occupied by gallery forests (Figure 17.2) rich in rattan *Laccosperma* and *Eremospatha* (Arecaceae). The undergrowth is dominated by *Palisota* (Commelinaceae) and, among the trees, *Anonidium mannii* (Annonaceae) is common. At the heads of some valleys there are also drier forest formations, relics of an older more extensive cover, but these have not yet been studied. In Batéké Plateau National Park, the flora is being studied by the Missouri Botanical Garden and 800 species of plants have already been listed[1]. They include a new species (*Memecylon batekeanum* of the Melastomataceae family), discovered in the buffer zone of the national park in Gabon, and a second species that is in the process of being described.

Figure 17.2. The Batéké Plateau in Gabon.

Figure 17.3. Gallery forests in Batéké Plateau National Park, Gabon.

Fauna

Mammals

In the savannah, mammals are represented by widely distributed but rare species in the Congo Basin, notably the grey duiker *Sylvicapra grimmia*, the common reedbuck *Redunca arundinorum*[2], the defassa waterbuck *Kobus ellypsiprymnus*[3], the side-striped jackal *Canis adustus*, the Egyptian mongoose *Herpestes ichneumon* and the aardvark *Orycteropus afer*. The serval *Felis serval* and the

[1] Preliminary botanical explorations have been carried out, but more detailed work will begin in 2006 (Walters, 2004 and 2005).

[2] The common reedbuck now exists only in the Léfini; it seems to have disappeared from BPNP, but according to local hunters it was there previously.

[3] A small population of defassa waterbuck survives in the Léfini; along with those in the Nyanga valley in Gabon, it is probably the last existing population of the western form of this species.

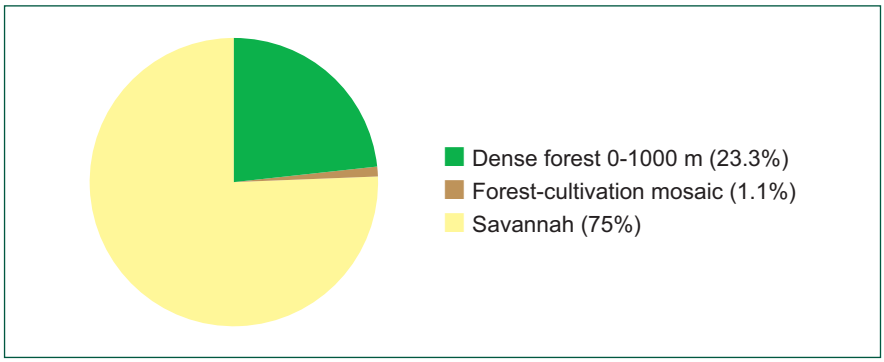


Figure 17.4. The main vegetation types (Source: JRC).

lion *Panthera leo* [4] could also still be present. In the forest area, live the elephant *Loxodonta africana cyclotis*, the buffalo *Syncerus caffer nanus*, the bush pig *Potamochoerus porcus*, six species of primates including the chimpanzee *Pan troglodytes*, the western gorilla *Gorilla gorilla* and Debrazza's monkey *Cercopithecus neglectus*, three species of pangolins (Manidae) and twelve species of carnivores other than the serval and the lion.

Birds

In terms of avifauna, 267 species of birds have been identified to date (Christy, 2001). They include species linked to very open environments, such as the Stanley bustard *Otis denhami*, the black-bellied korhaan *Eupodotis melanogaster* and the white-bellied bustard *E. senegalensis* (three species with a wide distribution but yet very vulnerable), the red-necked francolin *Francolinus afer*, the coqui francolin *Francolinus coqui*, Finsch's francolin *F. finschi*, the Congo moorchat *Myrmecocichla tholloni*, five species of pipits *Anthus sp*. and the rufous-naped lark *Mirafra africana*. However, the latter could be a species endemic to the Batéké plateau[5]. The Angola buff-back flycatcher *Batis minulla* and the black-chinned weaver *Ploceus nigrimentum* are endemic or quasi-endemic to the plateau. They like the wooded savannahs and dry gallery forests, which also contain Perrin's bush-shrike *Malaconotus viridis*, the African broadbill *Smithornis capensis* and the olive long-tailed cuckoo *Cercococcyx olivinus*. In the Congolese portion of the Landscape there are some species that have not been recorded in Gabon: Brazza's martin *Phedinopsis brazzae*, a species endemic to the plateau, and the Congo black-bellied sunbird *Nectarinia congensis*, endemic to the central basin and limited to the banks of the Congo River and some of its tributaries. On the savannahs of Gabon, perhaps also in the Republic of Congo, there is an as yet undescribed cisticola *Cisticola sp. nov*. (Christy, pers. comm.).

[4] In Gabon, a lion was killed and photographed in Moanda in 1969 (Trolez, pers. comm.), several individuals were poisoned when the Lekabi ranch was created in 1980-1981 and another was killed by an officer of the Water and Forests Department at the request of villagers in Léconi in 1996. In 2001 and 2002, no trace could be found (Henschel, 2003), but several tracks closely resembling lion prints were identified in September 2004 (Bout, 2005). Unfortunately, no photo was taken. Following the latest workshop on carnivores in Central Africa, held in Douala at the end of 2005, the presence of lions on the plateaus was classed as probable and studies on it are considered a priority.

[5] This lark was described by Chapin in 1946 as *Mirafra malbranti*, endemic to the Batéké plateau. It has subsequently become synonymous with *Mirafra africana*, but recent observations of its song indicate that could indeed be a different species of *Mirafra africana*.

Humans in the Landscape

Density and distribution

The average density of the human populations is around 0.2 inhabitants/km², but their distribution is uneven. A rural exodus has led to sizeable concentrations in the main district, departmental or provincial centers: Lekana, Zanaga and Djambala in the Republic of Congo and Léconi and Franceville in Gabon.

Ethnic groups

In the Republic of Congo, the main ethnic groups are the Teke-Kukuya, Teke-Kali (Lekana-Congo), Teke-Lali, Obamba and Ndassa. The Babongo Pygmies, who are in fact 'autochthonous' populations, live in the regions of Zanaga, Bambama, Dziku and Boma.

In Gabon, the savannahs around Léconi are exclusively occupied by Teke while the forests around Boumango are home to Bawoumbou and a smaller population of Teke.

Activities

In the Landscape, 90% of the population are involved in agriculture, 50% in hunting, 5% in fishing and 40% in collecting (Table 17.1).

Land use

As of yet there are no quantitative land use estimates for the Landscape as a whole (Figure 17.5), but a study is being carried out on the use of natural resources in the peripheral area around Batéké Plateau National Park. It should be noted, that pastoralism has never existed in the Landscape.

Logging

For the time being, there is no industrial logging in the Landscape, although logging did exist in the past in the western areas, particularly the Zanaga region of the Republic of Congo and the region in the northeast of Batéké Plateau National Park in Gabon. Presently, there is only small-scale logging in the regions of Lekana, Zanaga and Ngo in the Republic of Congo. The only people involved in logging are local craftsmen.

Reasons for the identification of the Landscape

(1) The Batéké plateau forms a unique landscape of very open savannahs which are an extension into the heart of the forests of Central Africa of the savannahs of western DRC and Angola.
(2) Batéké Plateau National Park in Gabon and the adjacent area of Bambama-Lekana in the Republic of Congo still contain fairly representative large fauna.
(3) The Léconi savannahs and the Léfini reserve have been designated as important areas for bird conservation (Fishpool & Evans, 2001).
(4) The two protected areas have an interesting and complementary tourist potential, capable of economically supporting a few villages.
(5) There is perhaps still a very small population of lions that could be protected.
(6) The Batéké plateau landscape is intimately linked to the kingdom of the Teke, whose population is severely threatened by acculturation; conservation of the Landscape's biological diversity could also permit specific aspects of the culture to be preserved.
(7) The beauty of the Landscape, particularly the erosion cirques, is largely due to the creation of protected areas.

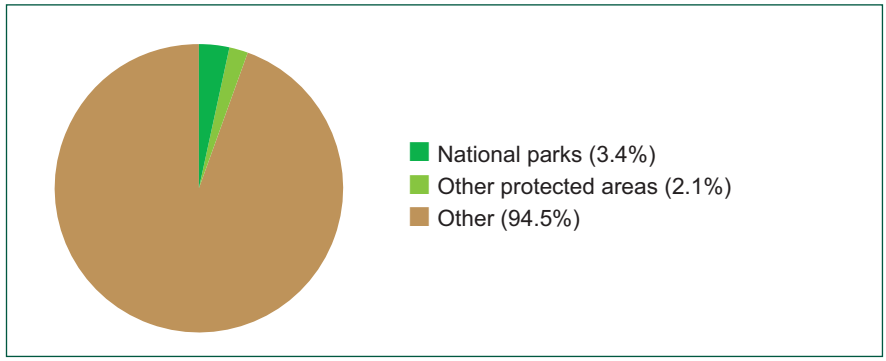


Figure 17.5. The main land use types.

Conservation

History

In the Republic of Congo, the Léfini reserve with an area of 600,000 ha was classified in 1961 and the Bambama-Zanaga-Lekana site was designated a critical site by the IUCN in 1986 (Hecketsweiler, 1990). There is currently a project to create a new protected area of 360,000 ha in the Bambama-Lekana zone.

In Gabon, the Léconi region had been designated a critical site by the IUCN and was proposed as a protected area in 1990 (Wilks, 1990). Batéké Plateau National Park was created on August 30, 2002 (decree 609/PR /MEFPEPN) farther to the south. It covers an area of 204,854 ha.

Players

In Gabon:
- The national park is managed by MEFEPPN, through the wildlife and hunting directorate, and CNPN.
- WCS carried out preliminary studies within the context of its assessment of the protected areas in 2001 and launched its Batéké project in the national park in April-May 2004.
- The Gorilla Protection Project (PPG) began its activities in the gorilla sanctuary in the national park in 1997.

In the Republic of Congo:
- The Ministry of Water and Forests (mainly the DFAP)
- The PPG, essentially financed by the John Aspinall Foundation, located in Brazzaville in 1987 and Lesio Louna in the Léfini reserve in 1994.
- WCS has been active in the Léfini reserve and since 2003, has been working on the creation of Bambama-Lekana National Park, as well as redefining the limits of the Léfini reserve within the framework of the CARPE-CBFP program.

Table 17.1. Relative importance of the principal activities in the Léconi-Batéké-Léfini Landscape.

Activity	Percentage
Agriculture	49
Hunting	27
Collecting	22
Fishing	2

Direct threats

(1) Poaching and the trade in bushmeat

Cross-border poaching is carried out by Congolese who come to hunt in Gabon and supply food to Brazzaville[6]. Hunters with 4x4 vehicles operate at night from Franceville, sometimes using official vehicles. Their activities are facilitated by the open nature of the terrain.

(2) Fires

Anthropogenic bush fires have probably become too frequent for biodiversity to be maintained: many sections of the national park catch fire at least twice a year.

Indirect threats

(1) Low management capacity

Human and financial resources, infrastructure and equipment are insufficient to be able to manage the national park effectively.

(2) Institutional weaknesses

In Gabon, there is no clearly defined wildlife management policy in the forest law, although the latter has a section entitled 'wildlife planning and management'. There is also no legal executive structure with the capacity necessary to manage the national parks. CNPN is an 'interdepartmental council' that was created for the guidance and supervision of the network of national parks. A bill to create a 'national parks agency' was drafted in 2005[7].

State of the vegetation

As in many other regions, the areas around the urban centers are subject to growing deforestation. There are extremely frequent fires on the savannahs (at least twice a year) and their plant cover has perhaps suffered irreversible degradation. However, this is very difficult to determine because the savannahs have been burning for centuries, perhaps even millennia[8].

State of the fauna

The lion and serval are in a critically endangered state and may have already disappeared. The spotted hyena and the African wild dog *Lycaon pictus* have surely disappeared, the latter from a large proportion of all sub-Saharan Africa during the second half of the 20th century[9] and the black rhinoceros *Diceros bicornis* even longer ago[10]. The hippopotamus *Hippopotamus amphibius* has disappeared from Batéké Plateau National Park[11].

Financing and conservation

In Gabon, current prospects for conservation financing are as follows:

- Financing from the John Aspinall Foundation for the PPG is ensured for the next ten years but there is still no cooperative agreement.
- USAID funds are anticipated for another three years.
- FORINFO financing for environmental education for a year is probable.
- GEF will probably provide three years of financing to monitor hunting in the peripheral area of the national park.
- The AFD could be interested in one-off investments in infrastructures and the FFEM in environmental education.

Environmental education and capacity building

Activities in this field have been very dynamic, thanks to the Gabonese official who has been in charge since July 2004 and a partnership forged with the specialized NGO RARE, which has assisted in training and supervision. A good part of the efforts (around 50%) in 2006 will be focused on this activity. On the other hand, there is no local NGO or even a tradition in 'collectivism', so there is no possibility of supporting local NGOs.

The creation of a new association based in Franceville (the '*Maison du tourisme et de la nature*') has received support. It has already organized several events and in 2006 is going to create an ecomuseum in Franceville with a budget from FFEM and the *Coopération française*.

Management of renewable natural resources

(1) At the Landscape level

Outside the protected areas, conservation activities are virtually non-existent. In March 2005, WCS supported a workshop in Franceville to bring together the technical directors of Water and Forests in the Republic of Congo (departments of Plateaus and Lekoumou) and Gabon involved in the Landscape, for an initial consultation to formulate cooperation strategies to address transborder poaching. In 2006, these meetings will continue with the involvement of sub-prefects and prefects from the districts and/or

[6] In Gabon, the village communities are far from the park; they are small communities with very limited impact on the park or its periphery. The main threat comes from commercial hunters from the towns and cities. Therefore, a plan to mobilize villagers so that they contribute towards the protection of their area and do not themselves pose a threat is set for 2006, within the context of environmental education activities (probably through the GEF project). With the USAID-CARPE budgets, it is impossible to work both within and outside of the park.

[7] In Gabon, the creation of the network of national parks has been a significant advancement. However, the process of setting up a management agency and recruiting and training personnel for the national parks has been slow. This process includes obtaining financing (governmental, national or international). The absence of a national policy or will to combat poaching is another handicap. The next two years will be critical to assess the progress being made.

[8] The savannahs of the Batéké Plateau have an edaphic and historical origin. Their present day extension is the result of the last glaciation and it is very difficult to know what they would look like without the long existing fires. An ethnobotanical study of this question (by Gretchen Walters) is to begin in April 2006.

departments concerned (Léconi and Boumango in Gabon; Lekana, Zanaga and Bambama in the Republic of Congo). The next meeting is to be held before the end of the first quarter of 2006. Ecological and socioeconomic studies carried out in the Congolese portion of the Landscape to demarcate the future protected area also constitute a beginning for the introduction of transborder strategies for the management of natural resources. They have allowed village territories to be identified, which over the course of 2006 will make it possible to propose an overall zoning plan. In 2006, additional participatory cartography will allow for more precise zoning around the Léfini reserve.

(2) In the protected areas

In the Léfini reserve, surveillance is very ineffective. In Batéké Plateau National Park, management was not in effect until 2004. It includes close cooperation with PPG, which manages the gorilla sanctuaries in the Republic of Congo and Gabon. On the ground, bases have been identified, platforms for the installation of tents have been laid and three qualified ecoguards have been assigned to surveillance. They are being assisted by three village trackers. Transborder poaching remains the main problem and measures have been taken to work with the authorities on either side of the border to try to stop this practice.

(3)In the rural areas

Discussions with IGAD took place to implement small rural development projects that would offer alternative resources to the populations. Following socioeconomic surveys, however, it emerged that the villagers around Batéké Plateau National Park were not interested in the 'intensification' of agriculture or stock farming (or perhaps aviculture). On the other hand, they welcomed the tourism studies organized in May 2005[12]. Community tourism, combined with the development of tourism in the park, may represent the only alternative economic activity in rural areas close to the park.

Natural resources and governance

Technical and administrative coordination of activities at the Landscape level began with a meeting of Gabonese and Congolese partners in Brazzaville in 2004. A technical follow up meeting was held in February 2005. The meeting focused on the monitoring of transborder poaching, which is still absent. Meetings with local communities have also taken place, but their involvement is only in its infancy. Cooperation between the technical support NGOs (WCS and PPG) and the Ministries of Water and Forests of the Republic of Congo and Gabon and the CNPN in Gabon is evolving.

Monitoring of natural resources

Ecological monitoring activities are being carried out at present in the existing protected areas (Batéké Plateau National Park and Léfini), as well as in the proposed protected area of Bambama-Lekana.

Unfortunately, there is still no metadata bank. Numerous data are available, but there is still no comprehensive collection of management information, spatial data or bibliographical references at the level of Batéké Plateau National Park or the Landscape[13].

[9] The African wild dog has never been mentioned in the Gabonese part of the Landscape, but it did exist in the Pool region in the 1940s and in the Niari valley. The spotted hyena also existed in the Niari valley and in the Pool region. It survives in Odzala (Henschel, pers. comm.).

[10] Two teeth of the black rhinoceros, dating from 7,000 BP, were found in Ntadi Yomba in the middle valley of the Niari in the 1980s (Van Neer and Lanfranchi, 1985). In addition, the presence of black rhinoceros was reported in the 20th century in the dense moist forests of southeast Cameroon and the Republic of Congo (Lavauden, 1934; Blancou, 1954), but this has never been confirmed. It cannot be ruled out that this species lived on the Batéké plateaus in recent millennia.

[11] Hippopotamuses used to live in the Lewou River, but they have since disappeared (Henschel, pers. comm.).

[12] A detailed review has been produced of the tourist studies conducted in the villages and the national park in May 2005 and a feasibility study on several ecotourism products was circulated in November 2005.

[13] The final ecological monitoring report on Batéké Plateau National Park is expected by March 2006, as is the final sociological report. A first meeting on the management plan for Batéké Plateau National Park could be organized at the end of March 2006 and a first draft could be available during the second half of 2006 for discussion.

18. Lake Télé-Lake Tumba Landscape

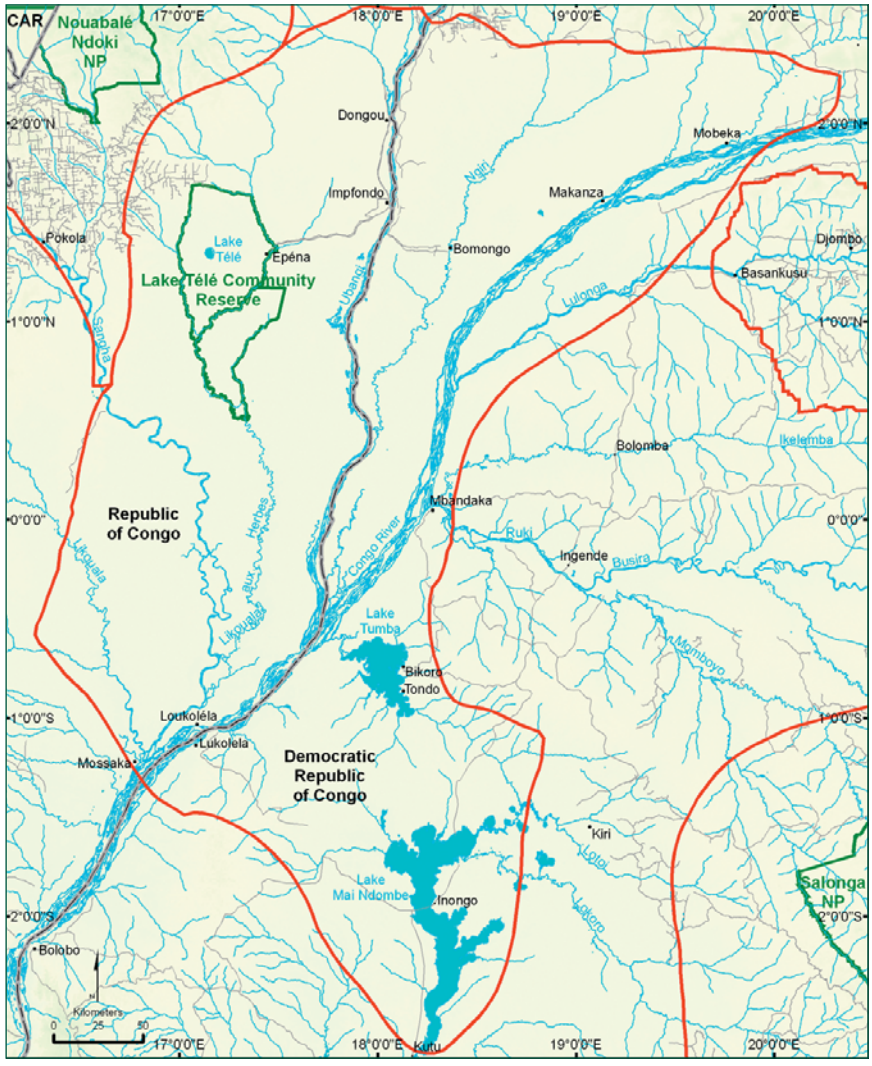


Figure 18.1. Map of Lake Télé-Lake Tumba Landscape (Sources: AWF-DRC, CARPE, JRC, SRTM, WCS-Congo, WWF-DRC).

The Landscape in brief

Coordinates: 2°35'2"N – 2°41'27"S; 16°16'15"E – 20°19'35"E
Area: 126,440 km²
Elevation: 300-330 m
Terrestrial ecoregions: Northwest Congolese forests ecoregion
Western Congolese swamp forests ecoregion
Eastern Congolese swamp forests ecoregion
Central Congolese forests ecoregion
Aquatic ecoregions: Ubangui ecoregion
Central Basin ecoregion
Lake Tumba ecoregion
Lake Mai-Ndombe ecoregion
Kasai ecoregion
Protected areas: Lake Télé Community Reserve, 440,000 ha, 2001, Republic of Congo
Mabali Scientific Reserve, 1,900 ha, Democratic Republic of Congo

Location and area

The Lake Télé-Lake Tumba Landscape is situated at the heart of the Congo Basin region, centering on Lake Télé in the Republic of Congo, and the Tumba and Mai-Ndombe lakes in DRC (Figure 18.1). It extends over an area of 126,440 km². The 54,001 km² western section is situated in the Republic of Congo and the 72,439 km² eastern section is in DRC. It includes one protected area: Lake Télé Community Reserve in the west.

Physical environment

Relief and altitude

The entire Landscape is located in the alluvial plain of the Central Basin region of the Congo

River. The altitude varies between 300 and 330 m and its relief is highly uniform, with very indeterminate watersheds separating the poorly-defined drainage basins.

Geology and soils

The bedrock of Cretaceous sediment is entirely covered by post-Upper Pliocene lacustrine or fluvio-lacustrine sediment forming yellow sandy-clay soils. The alluvial formations from the Holocene era, which occupy the floors of the large valleys and the whole region between the Congo and Ubangui rivers, have a low clay content and are characterized by a very fine sandy fraction. The soil is waterlogged throughout the year, often having a black, organic, peaty or semi-peaty superficial horizon. (Marlier, 1973).

Hydrology

The entire Landscape is located in the basin of the Congo River, which traverses this area over a length of nearly 500 km (Figure 18.2). It comprises the confluence of the Congo River with the Ubangui, Sangha, Likouala-aux-herbes and Ngiri rivers. Two very shallow lakes are located in the eastern section. Lake Tumba (765 km²) drains the Loko, Bituka, Lobambo and Nganga rivers; it flows directly into the Congo River via the Irebu channel and its maximum depth does not exceed 8 m, but seasonal variations in its level may reach 4 m (Figure 18.3). Lake Mai-Ndombe (2,300 km²) drains the Lokoro and Lotoi rivers and flows indirectly into the Congo River via the Fimi, Lukenie and Kasai rivers. Its average depth is 3 m. The waters of these lakes are black, humic, acidic, chemically poor and loaded with plant detritus[1]. In the western section, Lake Télé is smaller in size, at 23 km², but physically resembles the other large lakes in the Landscape. Unlike the waters of the swamp and floodable forests, water in the lakes is oxygenated to its full depth because of the violent winds that periodically agitate the surface. All watercourses have a very shallow incline (3 cm/km) and therefore run very slowly. Throughout the Landscape water levels vary by around 3 m, but in the Ubangui these variations may reach 5 m. During periods of flooding in the southern part of the Congo Basin, the direction of water flow is actually reversed and the water washes back hundreds of kilometers northwards. In addition to the principal waterways, the Landscape is crossed by a dense maze of narrow channels that link together the major watercourses. A large part of the Landscape is flooded permanently or during the flood period, which limits access and hampers road construction. During the main flood periods, water accumulates behind natural dams formed by alluvial levees and only flows very slowly through small channels.

Figure 18.2. The Congo River with its multiple side-arms.

Figure 18.3. Lake Tumba.

Climate

Annual rainfall ranges from 1,600 to 2,000 mm on average. Precipitation reaches a maximum in October-November and March-May, but there is no real dry season in the areas close to the equator. Hours of sunshine exceed 2000 per annum. The mean annual temperature is 25°C with very little seasonal variation (Marlier, 1973).

[1]The pH of the water in Lake Tumba is 4.5-5.5 and transparency is limited to 2 m (Corsi, 1984). Plankton are rare (Bailey, 1986).

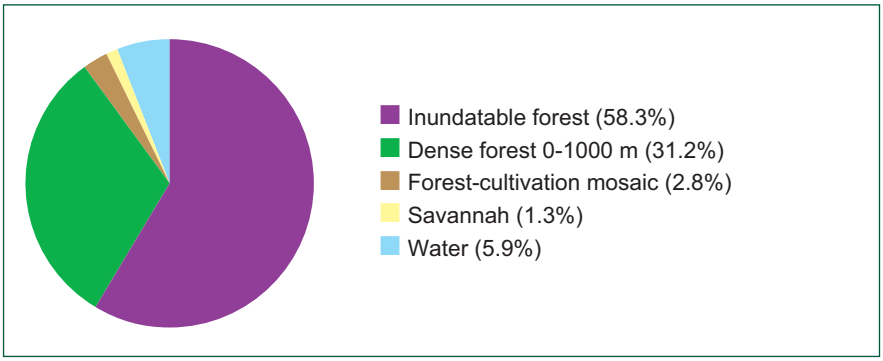


Figure 18.4. The main vegetation types (Source: JRC).

Vegetation

In the western section, apart from rare islands of dryland forest, the majority of the forests are permanently or temporarily flooded (Figure 18.4). According to estimates by Poulsen & Clark (2002) carried out for the community reserve of Lake Télé, dryland forests cover 44,000 ha (10%), swamp forests 215,600 ha (49%), riparian forests 35,200 ha (8%) and floodable forests 74,800 ha (17%). Floodable herbaceous vegetation covers 70,400 ha (16%).

The swamp forests, which are almost permanently flooded, are characterized by the presence of the following species: *Entandrophragma palustre*, *Coelocaryon botryoides*, *Hallea stipulosa*, *Alstonia boonei*, *Nauclea pobeguinii* and *Symphonia globulifera*. The swamps associated with small streams are occupied by forests of *Lasiodiscus mannii*. The floodable forests are characterized by the presence of *Lophira alata*, *Gambeya perpulchra* and *Uapaca heudelotii*. The riparian forests are dominated by *Uapaca heudelotii* and *Guibourtia demeusei*. The dryland forests, mainly situated at the center of the reserve, are characterized by the presence of various species of *Entandrophragma* and by *Terminalia superba*, *Pterocarpus soyauxii* and *Piptadeniastrum africanum*. There are also monodominant stands of *Gilbertiodendron dewevrei*. Herbaceous vegetation is dominated by *Hyparrhenia diplandra*. There are also extensive areas of raffia palms (*Raphia* spp.).

In the eastern section, swamps or floodable forests cover 60-65% of the area. They are characterized by the presence of numerous Euphorbiaceae (*Alchornea floribunda*, *A. hirtella*, *A. cordifolia*, *Uapaca guineensi*, etc.) and Caesalpinioideae, notably *Guibourtia demeusei*. The remaining 35-40% of dryland forests, chiefly located in the south of the Landscape, are punctuated by islands of savannah. These forests comprise mixed vegetation, characterized by the presence of Burseraceae, such as *Dacryodes edulis*, *D. yangambensis* and *Canarium schweinfurthii*, and a monodominance of *Gilbertiodendron dewevrei*. A large part of these forests were commercially harvested up until 1975 and were replaced by forests of Marantaceae (including *Haumania liebrechtsiana*, *Sarcophrynium sp*. and *Megaphrynium macrostachyum*).

Fauna

Mammals

In the western section, the forests of the community reserve are home to large populations of gorilla[2] and chimpanzee[3] (Fay *et al*. 1989, Fay & Agnagna 1992, Blake *et al*. 1994). In addition to primates, the four main species of large mammals are the elephant *Loxodonta africana cyclotis*, the hippopotamus *Hippopotamus amphibius*, the buffalo *Syncerus caffer* and the sitatunga *Tragelaphus spekei*. Nine species of diurnal primates are known, notably the agile mangabey *Cercocebus agilis*, the white-cheeked mangabey *Cercocebus albigena*, as well as the swamp monkey *Allenopithecus nigroviridis* and De Brazza's monkey *Cercopithecus neglectus* which are often found together. The mantled guereza *Colobus guereza* and Central African red colobus *Piliocolobus oustaleti* are found throughout the community reserve. Altogether, there are a total of 16 endangered species (Annex C).

In the eastern section, primates are represented by the bonobo *Pan paniscus* (on the left bank of the Congo River), the common chimpanzee *Pan troglodytes* (on the right bank of the Congo River), the Angola colobus *Colobus angolensis*, Thollon's red colobus *Piliocolobus tholloni*, the golden-bellied mangabey *Cercocebus chrysogaster*, the swamp monkey *Allenopithecus nigroviridis*, the black crested mangabey *Lophocebus aterrimus*, the red-tailed monkey *Cercopithecus ascanius*— which is replacing mustached guenon *C. cephus* in the eastern portion of the Landscape — and De Brazza's monkey *C. neglectus*. Among the other large mammals that are variably present are the elephant, buffalo and leopard *Panthera pardus*. The hippopotamus is also present.

Birds

In the western section, over 350 species have been found in the community reserve and this is considered to be an important area for bird conservation, particularly owing to the presence of large colonies of water birds: the African darter *Anhinga rufa* and the purple heron *Ardea purpurea* (Fishpool & Evans, 2001). There are three threatened species in the reserve: Hartlaub's duck

[2] Recent censuses (2002-2005, Poulsen & Clark, 2004) have recorded a density of gorillas of 3-4/km². Gorillas move seasonally between terra firma forests and swamps or floodable forests. Local density may reach 20/km². Blake (1994) also found gorillas in raffia palm areas at a density of 5/km².

[3] The density of chimpanzees is 0.7/km².

Pteronetta hartlaubi, the great snipe *Gallinago media* and the African skimmer *Rynchops flavirostris*.

Herpetofauna

In both sections (Republic of Congo and DRC), the three African species of crocodile are present. The Nile crocodile *Crocodylus niloticus* inhabits the large watercourses in small numbers, the slender-snouted crocodile *Crocodylus cataphractus* is very widespread, also in low-density populations, while the dwarf crocodile *Osteolaemus tetraspis* is restricted to the swamp forests. A complete inventory of herpetofauna has not been carried out.

Ichthyofauna

The Landscape is divided into five aquatic ecoregions: Ubangui, the Central Basin, Lake Tumba, Lake Mai-Ndombe and Kasai. It is probable that the ichthyofauna is very rich. In the western section, it has been studied by WCS and at least 40 species have already been recorded. In the eastern section, ichthyological studies have been conducted in the Tumba and Mai-Ndombe lakes (Corsi, 1984; Bailey, 1986). Lake Tumba is home to 119 fish species (Marlier, 1973; Compere & Simmoens, 1987) the most common of which are *Auchenoglanis occidentalis*, *Clarotes laticeps*, *Gephyloglanis congicus*, *Clarias buthopogon*, *Distichodus sp*. and *Channa obscurus* (Corsi, 1984). Several species are endemic to the lake or its immediate environs, in particular *Clupeocharax schoutedeni* and *Tylochromis microdon*. Lake Mai-Ndombe is much less well known, but its ichthyofauna was recorded at 41 species in 1918 and it is probable that the actual number is much higher. Three species are endemic: *Amphilius opisthophtalmus*, *Hemichromis cerasogaster* and *Nanochromis transvestitus*. The Landscape also comprises an extensive portion of the middle reaches of the Congo River, where 206 species of fish have been recorded, including *Protopterus dolloi*, *Hydrocyon vittiger* and *Hydrocyon goliath*, three species endemic to the Congo Basin.

Humans in the Landscape

Density and Distribution

In the western section, almost all the landscape villages are situated along roads and rivers. In 2001, 22 villages surveyed in the community reserve of Lake Télé had a total population of 13,400 inhabitants (Poulsen & Clark, 2002). New censuses in 2005 found a total population of 14,390 inhabitants (RCLT Project, not published), suggesting an increase of 1-2% a year. However, this second census included workers living temporarily in the reserve. The village populations range from 64 to 2,280 people. The population is young: 59% under 20 years of age. The regional capital, Impfondo, numbers at least 14,000 inhabitants.

In the eastern section, the population density is variable, with significant clusters around Mbandaka, the main town in the province of Equateur. Situated at the heart of the eastern section of the Landscape, this town has grown rapidly: in 1984 it had 124,263 inhabitants. The population rose to 136,738 in 1990 (De Saint Moulin, 1991) and is probably around 500,000 at present. The 300,000 people displaced by the war between 1998 and 2003 need to be added to this figure. Outside of Mbandaka, the population density is estimated to be 23.9 inhabitants/km² in the Bikoro area, 6.2 inhabitants/km² around Makanza, 18.5 inhabitants/km² around Lukolela and 7.9 inhabitants/km² around Bomongo (UNDP/UNOPS, 1988).

Ethnic groups

In the western section, 91% of the population in the community reserve belongs to the Bomitaba group, represented by the subgroups Babole, Nzobo and Bokolou. A small number of semi-nomadic Pygmies also live around the reserve, often for short periods. The rest of the population consists of Congolese from other regions of the country and some immigrants from neighboring countries.

In the eastern section, the southeast portion is inhabited by six Mongo groups: the Basengele, Bolia, Bokote, Ekonga, Ntomba and Losakanyi. They cohabit with a minority of Batwa Pygmies. The Ntomba are the dominant group in the area of Bikoro within Equateur province. The northwest part, between the Congo River and the Ubangui, is inhabited by a cultural mosaic of 13 ethnic groups with very different sensibilities and knowledge concerning the use of renewable natural resources. These groups are the Bobangi, Baloi, Libinza (or Balobo), Boloki (or Iboko-Mabale), Bapoto, Djamba, Lobala, Likoka (or Ngili or Likawe), Bamwe (or Djando), Bonkula, Bodzinga, Ndobo, Mbonji and Ngombe. This broad cultural diversity is further increased by the fact that certain groups are actually an amalgam of subgroups with different cultural characteristics[4]. However, what all these groups have in com-

[4] The Bamwe are divided into 12 smaller entities: the Monya, Giyando, Moliba, Ebuku-Lingonda, Sombe, Lifonga, Limpoko, Likata, Bomole, Libobi, Mondongo and Bobaza.

mon is that their livelihoods basically depend on aquatic resources, particularly fish.

Activities

In the western section of the Landscape, the greater part of the population is principally engaged in farming; as well as other activities: fishing, hunting, trade and livestock farming (Table 18.1). About 85% of the protein in the diet of the population is derived from fishing and 6% from hunting. The populations depend on the forest and rivers for more than 90% of their normal protein intake. The main staples are cassava, maize and bananas, with seasonal crops of the African plum. The main livestock are poultry, ducks, pigs, goats and sheep.

In the eastern section, socioeconomic studies by WWF around Lake Tumba have shown that farming, fishing and the gathering of non-timber forest products constitute the main occupations and generate the bulk of the income of local communities (Table 18.2). Approximately 15% of the population has permanent employment in education, local administration or the police, but these activities only provide very low incomes and the majority of these employees report that they have to supplement their salaries from farming and fishing.

Cassava, maize and bananas are the staple cultivated crops throughout the eastern section of the Landscape. Plantations of oil palms are the principal commercially cultivated product in the northern part of this section, particularly in the areas of Bomongo and Mankanza. Groundnuts and rice are cultivated in the southern part, but rice cultivation has also recently been introduced in the north. In addition, sweet potatoes and sugarcane are found throughout in small quantities.

Fishing is the second most important activity and fish is the most highly regarded food culturally in most areas of the Landscape. In certain regions (Mobeka, Mankanza, Bomongo) fish is also a commercial product: the fish is smoked and sold to the boats which go down to Mbandaka, Kinshasa and Brazzaville. In the region of the Tumba and Mai Ndombe lakes, studies have shown that fishing is also practiced by fishermen who come from distant towns situated outside the Landscape and who use a large number of nets. The local inhabitants complain about the commonly acknowledged reduction in fish stocks. This perception is confirmed by WWF studies carried out at Lake Tumba[6].

The gathering of non-timber forestry products is carried out on a large scale. The raffia palm *Raphia sese* and rattan *Laccosperma secundiflorum* are collected for craft activities. Other products sought include the bark of *Scorodophloeus zenkeri*, the roots of *Aframomum*, copal from *Guibourtia demeusei*, leaves or young shoots from Marantaceae, the fruits of *Dacryodes edulis*, *Coula edulis*, *Canarium schweinfurtii* and *Anonidium manni*, mushrooms and caterpillars. All these products are traded to different degrees, but apart from firewood, they generate very little monetary income. They are common property and collected within well defined areas for each village[7].

Land use

Within the Landscape, 3.5% of the area (440,000 ha) is occupied by the community reserve. The remainder (12,644,000 ha) is made up of land that has not been zoned (Figure 18.5). In the eastern section, there is the small Mabali Scientific Reserve (1,900 ha or 0.02% of the eastern part of the Landscape).

Logging

In the western section of the Landscape, industrial logging is restricted to the outskirts of the Landscape, where it adjoins the Sangha Tri-National Landscape. The poor quality of timber and logistical or access problems only permit very limited small-scale exploitation in the swamps or floodable forests.

In the eastern section of the Landscape there are 10 concessions—8 in the south, 2 in the north—four of which are in operation. These concessions have been awarded to six companies (CFT, SODEFOR, SCIBOIS, SOCOBELAM, BIMPEAI and SOMI-CONGO) who are engaged in prospecting or logging. These conces-

[5] Not to be confused with occupation: many children report 'going to school' as an activity and 60% of the women report working 'in the home'.

[6] These studies show that while there is a considerable amount of fishing, the fish catches per unit are extremely low and certain species formerly known to be in the lake seem to have disappeared.

[7] Each village has a clear knowledge of the boundaries of its territory, which is used not only for farming but also for foraging, hunting and fishing. These territories are administered by the traditional chief, assisted by a cohort of elders acting as advisers to the chief.

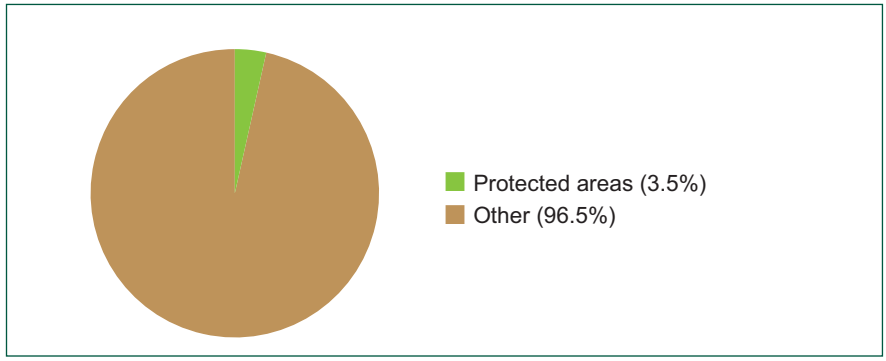
Table 18.1. Activities of populations in the community reserve of Lake Télé, Republic of Congo (Poulsen & Clark, 2002).

Activity [5]	% primary activity		% secondary activity		% tertiary activity	
	Men	Women	Men	Women	Men	Women
Farming	51	85	32	15	13	5
Fishing	22	12		77		
Hunting	10		13			
Small-scale trade		2		5		27
Stock farming			29		47	47
Crafts					10	

Table 18.2. Economic activities in the area surrounding Lake Tumba, DRC, calculated on the basis of 460 households surveyed in 36 villages selected at random.

Activities	Absolute frequency	Relative frequency
Farming	96.7 %	28.4 %
Hunting	36.1 %	10.6 %
Fishing	82.6 %	24.2 %
Foraging	54.6 %	16.0 %
Trade	33.7 %	9.9 %
Crafts	22.2 %	6.5 %
Traditional medicine	7.2 %	2.1 %
Temporary employment	2.2 %	0.65 %
Permanent employment	15.2 %	0.04 %
Retired	0.2 %	0.06 %
Other	1.7 %	0.50 %
Average number of activities per family	3.5 %	1.03 %

Figure 18.5. Main land use types.



sions cover almost 40% of this section of the Landscape. Most are concentrated in the south where there is an abundance of species such as tiama *Entandrophragma angolense*, sipo *E. utile*, dabema *Piptadeniastrum africanum*, afina *Strombosia tetrandra* and, above all, wenge *Millettia laurentii*. Wenge accounts for about 75% of the wood extracted between the Tumba and Mai Ndombe lakes.

Reasons for the identification of the Landscape.

(1) The region of flooded and floodable forests of the central region of the Congo Basin covers a total area of over 200,000 km², representing the second-largest swamp after the Pantanal in South America and the largest tract of floodable forest in the world (Vande weghe, 2004). It constitutes a unique ecosystem in Africa.

(2) The region plays a key role in regulating the hydrological conditions of the Congo Basin and the climate of Central Africa.

(3) The only protected area in this complex, the community reserve of Lake Télé (440,000 ha) in the Republic of Congo, is one of the few protected areas of Central Africa to preserve huge expanses of flooded and floodable forest. Initial surveys show that it is rich in both botanical and zoological species and that it has at least 23 species of mammals and birds on the IUCN red list, the highest density of gorillas observed in Central Africa, a highly diversified herpetofauna and ichthyofauna with several endemic species and a very large population of black crocodile, one of the most endangered crocodile species in the world.

(4) The Mai-Ndombe and Tumba lakes alone represent two aquatic ecoregions with their particular range of species and endemic species.

Conservation

History

In the Republic of the Congo, Lac Télé Community Reserve was created on 21 May 2001. It comes under category VI of protected areas according to the IUCN and covers 440,000 ha. In the DRC, the Landscape accommodates

[8] The Mabali reserve was created in 1949 by the Belgian government for the *Institut de recherche scientifique en Afrique centrale* (IRSAC) to study the regeneration of low altitude forest following timber extraction, the ecology of four primate species present at the time (the black crested mangabey, the red-tailed monkey, Wolf's mona monkey and the Angola colobus) and in particular the response of primates to forest exploitation.

the small Mabali Scientific Reserve of almost 1,900 ha and representing just 0.02% of this section of the Landscape[8].

Players

The community reserve of Lake Télé is managed in partnership by the Ministry of the Forest Economy and Environment and WCS. There are also local NGOs, the most effective of which is *Conservation de la Fauna Congolaise* (CFC). It is active on the outskirts of the reserve and assists in developing the sustainable management of resources in two villages. In the eastern sector, administration of the Mabali reserve has been entrusted to the *Centre de recherche en écologie et foresterie*, a body of the Scientific Research Ministry of DRC. Within this segment of the Landscape, WWF is working in cooperation with the Ministry for the Environment, Nature Conservation, Water and Forests, the Bonobo Conservation Initiative (BCI) and Innovative Resources Management (IRM).

Direct threats

(1) Commercial hunting.

In the western section of the Landscape, commercial hunting for bushmeat and ivory is the greatest immediate threat to the fauna. Much of this activity is organized by people who live outside the community reserve, but who supply guns and organize the export of the products. This hunting is carried out mainly along the roads and rivers and has had a devastating effect all along the road running from Impfondo to the reserve. In the northwest, logging companies have created new roads which now reach into the reserve and have opened up the forest to hunters and meat traders. This trade combines with that in ivory along the same roads. Ivory buyers, soldiers and police officers bring in weapons (AK47s and grenades) and leave with the tusks and meat which are resold in the markets of Brazzaville and Impfondo.

In the eastern section, hunting is also a serious threat, particularly in the southern part of the Landscape where there are larger tracts of terra firma forest. The greatest danger comes from the military training camp situated at the mouth of the Irebu Channel, 90 km southwest of Mbandaka. Unpaid and undisciplined soldiers live from hunting, notably elephant, hippopotamus, red river hog and buffalo (WWF/BCI, 2005). However, all the large mammals are hunted. Hunting using metal snares is very intensive and the most sought after species are those with significant meat: elephant, hippopotamus, buffalo, red river hog and all the diurnal primates.

One particular case of hunting is the hunting of the live young of great apes (bonobo and chimpanzee) for sale as domestic pets in the large towns. This hunting is all the more destructive as it necessitates slaughtering the adults.

(2) Village hunting and foraging

In the 22 villages situated in the community reserve there are some 14,000 people of whom 95% are highly dependent on fishing, hunting and the sale of other forest products for their survival. In the medium term, this situation cannot be sustainable.

(3) Fishing

In the eastern section of the Landscape, fishing is practiced in an intensive, anarchic and uncontrolled fashion, mainly by fishermen coming from regions outside the Landscape. National regulations concerning the mesh size of nets are completely disregarded.

(4) Brush fires

Each year huge tracts of forest around savannah areas, particularly riparian forests, are deliberately burned, creating problems that affect fishing, increase erosion, reduce the navigability of rivers and deplete available firewood.

(5) Diseases

No epidemic diseases have been recorded in the fauna, but owing to the high-density of gorillas, Ebola fever could have a devastating effect. Unvaccinated domestic animals could also transmit diseases to wild bovids, particularly as many cattle are imported into the region using opened roads.

(6) Oil extraction

Oil prospecting by ESSO has revealed the presence of hydrocarbon deposits in the Congo Basin near Mbandaka. For political reasons, these deposits have never been worked, but could be in the future. This would risk increasing immigration into the region and could have disastrous environmental impacts on the aquatic ecosystems and the very fragile environments of the flooded and floodable forests.

Indirect threats

(1) Geographical location

Situated at the confluence of several major waterways, large numbers of people are continually crossing through the Landscape in boats.

They trade products, such as soap, sugar, salt, fishing hooks, nets and clothing for smoked fish and bushmeat, which encourages non-sustainable hunting and fishing.

(2) Demography

With an internal demographic growth rate of 3.8% per year in the eastern section (De Saint Moulin, 1991), the increase in the population has accelerated, partly due to the immigration of labor for logging operations located at the heart of the eastern section of the Landscape and partly due to the displacement of people by war, specifically into the eastern part.

(3) Lack of knowledge

It is unknown if the fish catches, which provide 90% of protein intake for the human populations, are sustainable. A study to monitor the situation has been launched in the community reserve of Lake Télé and a study of fish stocks is in progress in Lake Tumba and the Congo River.

(4) Poverty and the lack of alternative means of subsistence

This is a very important factor in encouraging people to exploit the available forest resources in an ever more intensive and unsustainable manner.

(5) Absence of supervision

In the scientific reserve there is nobody to enforce laws and regulations[9].

(6) Climatic and hydrological disturbances

Currently, the hydrological balance in the central basin region appears to be negative and the level of Lake Tumba, for example, is dropping at an alarming rate[10]. This phenomenon may be temporary, cyclical or a manifestation of longer-term climatic changes. Any additional extraction of water from the Congo Basin, notably in connection with the planned construction of the Ubangui-Chari canal, however, could exacerbate and seriously affect the fragile ecosystem of flooded and floodable forests in the central basin region.

State of the vegetation

In the western section of the Landscape, the forests are still quite intact thanks to their impenetrability, both on foot and by vehicle. In the eastern section of the Landscape, a halo of rapid deforestation has developed around Mbandaka, not only for the construction of housing but also for producing firewood.

In the eastern section of the Landscape, the dryland forests in the south are chiefly older secondary forests. The last timber felling operations date back to 1975. In the scientific reserve, large expanses have been cleared to plant cassava crops by the staff at the research station[11]. The local population also uses the reserve for farming, fishing and illegal felling of wenge. A tree found in the riparian forest, *Guibourtia demeusei*, is highly prized as firewood and becoming increasingly rare around Mbandaka; gatherers have to go ever further into the forest to find it.

State of the fauna

In the western section, the swamp and floodable forests of the community reserve still contain substantial populations of large mammals, notably gorilla, but certain areas have nevertheless been overexploited by commercial hunting for meat and ivory[12].

In the eastern section, the Angola colobus has become very rare or has disappeared from the scientific reserve[13] and WWF studies underway at Lake Tumba indicate a severe decline both in the specific composition and in the abundance of fish. In addition, these studies have revealed the existence of small populations of forest elephants in the region situated between the Tumba and Mai Ndombe lakes, as well as between Bomongo and the Congo River. These studies have supplemented those conducted by BCI and make it possible to pinpoint six groups of bonobo in the area between the Tumba and Mai Ndombe lakes, as well as at the edge of the Landscape between Bolobo, Fimi and Mushie, in the province of Bandundu.

Environmental education and capacity building

Teams of training and information personnel regularly visit each village and two new staff members have been recruited.

Management and governance in the field of renewable natural resources

(1) Across the Landscape

No zoning or planning exists for the Landscape as a whole.

(2) In the community reserve

In the western section, management has been developed using a Landscape-wide approach and conservation of biodiversity has been included in a sustainable community management policy for

[9] Despite the support of the Bonobo Conservation Initiative (BCI) and in spite of its old but substantial infrastructures, the scientific reserve remains a reserve on paper only.

[10] These observations are confirmed by the Mabali research station.

[11] These personnel have not been paid for a long time and, all research having ceased, there were no means of survival other than cultivating crops.

[12] Blake (1995) counted 228 gorilla nests in 1993 near the road shortly after its completion. Observations in the same areas in 2005 did not record a single nest.

[13] According to a recent study conducted by WWF in the scientific reserve, no member of this species was observed (Mwanza, pers. comm.).

the reserve and for areas on the outskirts of the Landscape.

The Lake Télé Community Reserve project has the primary objective of implementing and improving a participatory approach to managing the renewable natural resources of the local communities. Each community has traditional territories in which it has the authority to utilize its resources for hunting, fishing and farming. All the territories were mapped in 2005 and, as 95% of the population is made up of indigenous Bomitaba, it is anticipated communities will be motivated to implement sustainable management. Participatory management is in the process of being implemented in the reserve. In 2006, pilot development programs will be launched for alternative means of subsistence.

Supervision is being provided by staff from the Ministry of Forest Economy and the Environment (MEFE): one conservation officer and seven ecoguards. In addition, the regional MEFE office in Impfondo is cooperating, within the limits of its resources, to organize joint patrols of the roads and rivers leading to this town. The regional office also takes part in monitoring cross-border movements of bushmeat. In 2005, ten military weapons with their ammunition and a grenade were seized by the staff of the community reserve. The establishment of a network of informers has allowed information to be obtained about individuals possessing weapons and their location in the reserve. Part of the development of participatory community management consists of encouraging observance of the law by the communities and visitors to the reserve.

In the eastern section, there are no protected areas—apart from the token scientific reserve—and in order to preserve the environment of this Landscape with its fauna, in particular the bonobo, it is essential that one be created. The government of DRC, in partnership with WWF and local communities, is therefore working on a project to create a reserve of 750,000 ha in category VI according to IUCN criteria. However, this project requires the involvement of donor funding, which could be achieved through the CBFP.

Monitoring renewable natural resources and their management

(1) Large mammals

Monitoring populations of large mammals entered its third year in 2006 and aims to evaluate the effects of management on the animal populations. The evaluations in 2004 showed that the populations are probably stable but that it will take four years of monitoring to determine the precise trends.

(2) Aquatic birds

In 2006, monitoring of aquatic bird populations entered its 10th year and showed that the populations are stable.

(3) Hunting, fishing and the trade in bushmeat

Programs to monitor levels of hunting and fishing were started in 2005 in the community reserve, by WCS, to establish whether these are sustainable. A program has been launched to determine the origin and volume of bushmeat going to Impfondo. Monitoring of the cross-border trade in bushmeat will be discussed at a meeting between the partners of the Republic of Congo and those of DRC in 2006.

19. Salonga-Lukenie-Sankuru Landscape

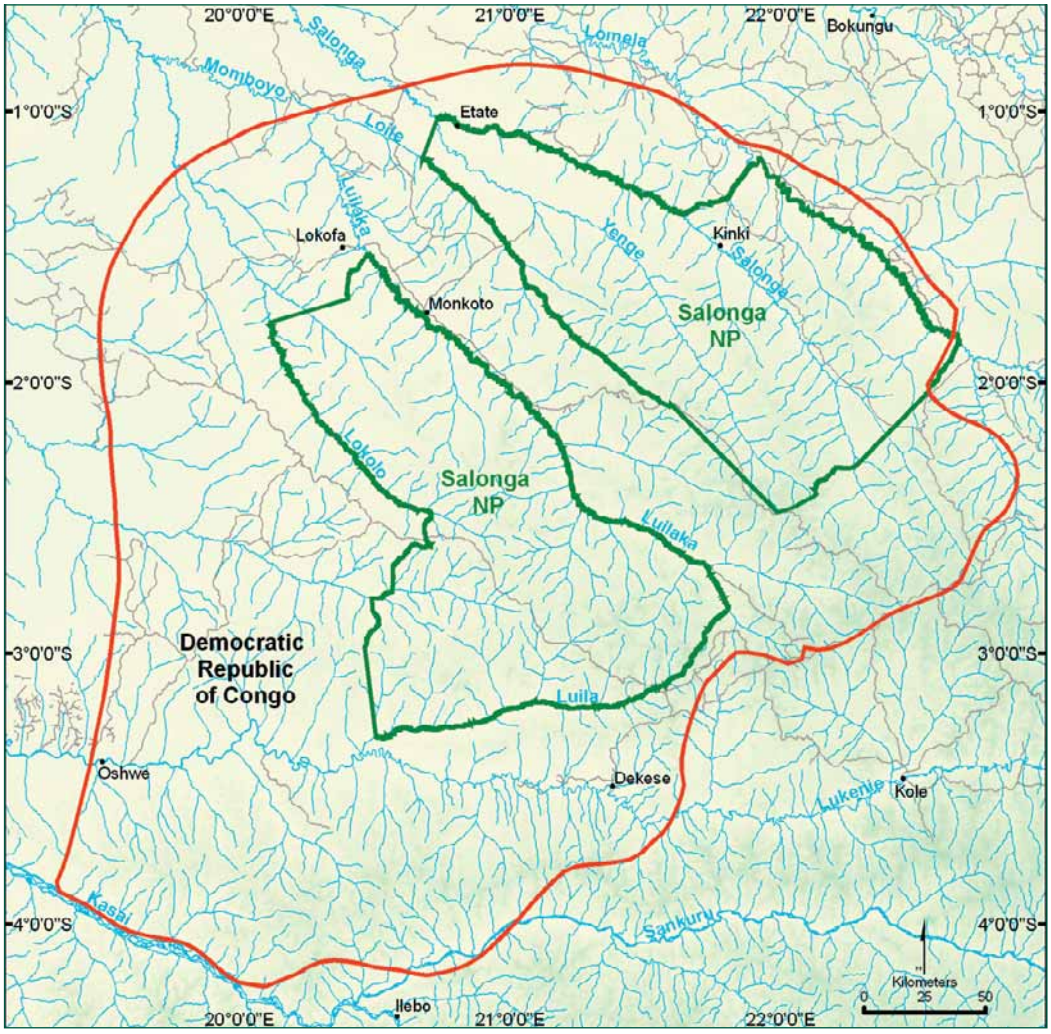


Figure 19.1. Map of Salonga-Lukenie-Sankuru Landscape (Sources: JRC, SRTM, SYGIAP, WWF-DRC).

Location and area

The Landscape lies in the heart of the central basin of the Congo River in the Democratic Republic of Congo, straddling the provinces of Equateur, Bandundu, Kasai-Occidental and Kasai-Oriental. It covers 102,847 km² and is centered on Salonga National Park. The latter has an area of 33,350 km² and is the second largest area of protected forest in the world, but it is divided into two separate blocks (Figure 19.1)

The Landscape in brief

Coordinates: 0°49'32"N – 4°13'49"S; 19°19'23"E – 22°52'24"E
Area: 102,847 km²
Elevation: 300-700 m
Terrestrial ecoregion: Central Congolese forests ecoregion
Aquatic ecoregions: Central Basin ecoregion
Kasai ecoregion
Protected areas: Salonga National Park, 33,350 km², 1970

Physical environment[1]

Relief and altitude

The relief comprises low-altitude plateaus, terraces and 'high' plateaus at an altitude of 300 m in the west and 700 m in the east. Most of the Landscape is occupied by low-lying marshy or flooded land. In places, cliffs reaching 80 m high line the rivers.

[1] This section is largely taken from Evrard (1968).

Geology and soils

The Landscape lies entirely within the alluvial basin of the Congo River. The youngest sediments are from the Pliocene, Pleistocene and Holocene ages; the oldest, which can be seen in the valleys, are Cretacean. In the east, south and center of the Landscape, the soils are sandy or sandy-clayey (arenoferrals and ferralsols). The valleys are covered with white sands and the marshy areas are covered by a horizon of organic matter showing little decomposition. In the lower part of the Landscape, in the north and northwest, hydromorphic soils are dominant and cover more than 50% of the surface area.

Hydrology

The northern half of the Landscape is drained to the northwest by more or less parallel rivers, notably the Lomela and the Salonga (Figure 19.2), tributaries of the Ruki which joins the Congo River at Mbandaka. In the southwest, part of the Landscape is within the basin of Lake Mai-Ndombe. In the far south, it is drained by the Lukenie and Sankuru rivers, tributaries of the Kasai, which flow into the Congo River at Kwamouth. Most of the Landscape is subject to major seasonal flooding.

Climate

Average annual rainfall is 2,100 mm in the north and 1,700 mm near Lukenie in the south. Monthly precipitation varies very little, but it does decrease slightly between June and August.

Vegetation

The Landscape forms part of the central Congolese forests ecoregion and 94% of it is covered by diverse forest formations (Figure 19.3): 23.6% swamp or floodplain forests and 70.8% terra firma forests, which constitute a mosaic of mostly evergreen formations (in the moist lowlands) or caducifoliated formations (on plateau peaks and crests). The different formations include: small expanses of forest with a monodominance of *Gilbertiodendron dewevrei, G. ogoouense* or *Brachystegia laurentii*; semi-caducifoliated forests of *Staudtia stipitata*, *Greenwayodendron suaveolens*, *Scorodophloeus zenkeri*, *Anonidium manni* and *Parinari glabra*; riparian forests of *Uapaca heudelotii* and *Parinari congensis*; floodplain forests of *Oubanguia africana*, *Scytopetalum pierreanum* and *Guibourtia demeusei*; and swamp forests of *Entandrophragma palustre*, *Coelocaryon botryoides* and *Symphonia globulifera*. The forest flora is dominated by legumes of the Caesalpiniaceae subfamily and then by Euphorbiaceae and Apocynaceae (Evrard 1968). Species with a high commercial value include various African mahoganies (*Entandrophragma spp*.) and various species of ebony (*Diospyros spp*.).

In the south, the Landscape has a transition area between the moist forests and the ecoregion of the mosaic of southern Congolese forests-savannahs represented by islands of savannahs (0.9%)

Figure 19.2. The Salonga River.

surrounded by forests. Finally, a very important habitat for fauna is formed by the swampy clearings rich in mineral salts and elephant baths or 'botoka njoku'. Several were identified during the initial survey work for the MIKE program and WCS studies; others have been mentioned by hunters in socioeconomic studies (WWF, 2006; WCS, 2005a; WCS, 2005b).

Fauna

Mammals

The Landscape is home to the bonobo *Pan paniscus*, a great ape endemic to the central Congolese forests ecoregion, and which lives in Salonga National Park, the only national park in the DRC to contain this species (Figure 19.4). Its fragmented distribution seems to be linked to the habitat (Alers *et al.*, 1992; Bila Isia *et al.*, 2000; Van Krunkelsven *et al.*, 2000; Reinartz, 2003). Nine other species of diurnal primates are present, notably the golden-bellied mangabey *Cercocebus chrysogaster*[2], the black mangabey *Lophocebus aterrimus*, Thollon's red colobus *Piliocolobus tholloni* and Wolf's monkey *Cercopithecus wolfi*. The riparian forests also contain Allen's swamp monkey *Allenopithecus nigroviridis*. Other species of particular interest are the forest elephant *Loxodonta africana cyclotis*, the bongo *Tragelaphus eurycerос*, the giant pangolin *Manis* (*Smutsia) gigantea* and the hippopotamus *Hippopotamus amphibius*.

Birds

The avifauna is not yet well known, but 101 of the 228 species typical of the Guinea-Congolese forests have already been inventoried and the number should rise to 153 (Fishpool *et al.,* 2001). Among the species identified is the Congo peafowl *Afropavo congensis*, whose distribution is limited to the forests in the center and the east of the Congo Basin.

Ichthyofauna

The aquatic ecosystems form part of two ecoregions: the Kasai ecoregion and the central Congo Basin ecoregion (Thieme *et al.*, 2005), which have over 200[3] and 300-400 species of fish respectively, but are still very little known[4].

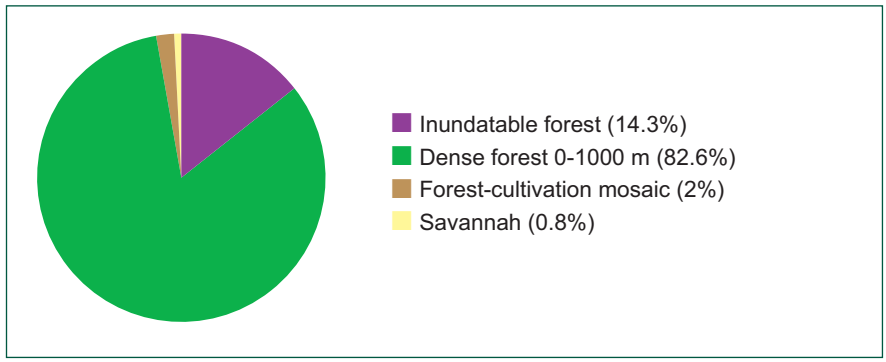


Figure 19.3. Main vegetation types (Source: JRC).

Human populations[5]

Density and distribution

The relatively low population density in the Landscape is estimated at 2.4 inhabitants/km², but there are some large human concentrations in the towns of Oshwe and Dekese and between the two sections of the national park, especially to the north of Monkoto. These densities are strongly influenced by the presence of the national park, which covers 35% of the Landscape. Two populations reside entirely or partly within the limits of the park: the Kitawalists[6] and the Iyaelima[7].

Ethnic groups

The Landscape is primarily inhabited by one of the largest ethnic groups of the DRC, the Mongo[8], represented by the subgroups Nkundo (81% of the Lokolama sector), Ndengese (99% of the Ndengese-Ikolombe-Isolu sector), Iyaelima (resident in the southern block of the park) and Isolu. Other groups include the Mbole (55.6% of the Wini sector), the Twa Pygmies (16.5% of the Lokolama sector) and a small population of Ngombe (4.4% in the Luay and Loombo sector).

Activities

Agriculture[9], hunting and fishing are quoted respectively as the main economic activities in the Landscape. All the other activities (traditional medicine, gathering, permanent or temporary jobs, retirement) concern fewer than 15% of the participants in socioeconomic surveys, except for in Monkoto where 20% of households say that they earn a living from temporary or permanent jobs. In the territories of Oshwe and Dekese, over 20% of households have only two sources of income: generally agriculture and hunting.

Agriculture is practiced year round, but the

[2] This species is limited to the northwest part of Salonga National Park and its conservation status is largely unknown at present.

[3] The Kasai aquatic ecoregion is very rich, with over 200 species of fish described, of which 25% are endemic. Some species are associated with the savannah watercourses, while others are only found in rivers bordered by flooded or floodplain forests. Little research has been done in recent decades (Thieme et al., 2005).

[4] In two inventories on the edge of Salonga National Park, 32 species of fish were identified by Inogwabini (2005).

[5] A lot of these data come from the findings of socioeconomic studies carried out by WWF (2006) (sample: 836 households) in the Landscape and by WCS (2004) in portions of the park corridor and the northern limits of its southern block.

[6] The Kitawalists are a religious sect of Watchtower origin. They live both inside and outside the park and cite the 1960s as the official date of their installation in the area.

[7] These are members of the Mongo group. Their villages are situated in the southern sector of the national park, where they apparently arrived in the 19th century from the province of Equateur, as did other Mongo groups in migratory movements just before the colonial era.

Figure 19.4. The bonobo Pan paniscus.

products grown or harvested vary according to the season. Fishing is almost entirely limited to the low-water season (June to August). Men, families and sometimes entire villages move to temporary fishing camps during the low-water season. In the communities that practice fishing, hunting probably falls off during periods of intensive fishing.

The gathering of non-timber forest products is widespread[10], but few inhabitants consider this activity as income-generating as the products are sold very cheaply at the village level. Caterpillars, mushrooms and some fruits are offered on the markets during certain seasons, but these products also contribute very little to household incomes. It is only in the Dekese territory that households mention this activity as generating income[11].

Technological changes are reaching even the most remote communities. While agricultural tools have not developed much, hunting and fishing equipment and methods are changing constantly. Fishing practices include the building of dams on small streams by women and the making of traps by both men and women. The men fish with hooks and nets of natural or synthetic fibers. Meshes are becoming smaller and smaller and some fishermen would now seem to be using mosquito nets. Men and women also fish by using plant poisons or chemicals such as DDT. Increased fishing pressure is also connected with the increase in the number of fishing instruments per family, the extension of the fishing season and the rise in the number of fishermen, particularly in the Salonga and Lomela rivers.

Changes in hunting date back to the end of the 1970s and beginning of the 1980s, when firearms became more accessible and poachers arrived. Political trouble and civil wars also contributed to the increase in firearms. Other hunting methods include the use of metal wires, nylon thread and liana traps. Men and boys often carry spears, and/or bows and arrows, which are frequently poisoned. The use of hunting dogs is very widespread. However, old people complain that youngsters are no longer interested in collective hunting with nets or in partitioning game according to clan membership and age. Growing individualism and the need for cash are mentioned as the reasons for these changes.

Trade

Formal markets have only been seen in the largest towns and cities, such as Oshwe, Monkoto and Dekese, and even then they are not very big. There is no system of weekly or twice weekly markets as known in other regions of the country. Trade is also hampered by transport and difficult access. Paradoxically, the lack of economic opportunities elsewhere in the country, as well as the high demand for bushmeat, fish and certain non-ligneous forest products in the expanding urban (Kinshasa, Mbandaka, etc.) and mining centers (Kananga, Tshikapa, etc.), encourages people to travel long distances by foot, bicycle or canoe to trade forest products for products of prime necessity (salt, soap, medicine, etc.). Sixty-five percent of households in the Landscape acknowledge that they barter to obtain products of prime necessity and manufactured goods.

Land use

Salonga National Park covers 36% of the Landscape, while concessions account for 26% and the remaining 38% can be classified as other land uses (Figure 19.5). The rural complex made up of cultivated land and young secondary forests covers only 2% of the surface area of the Salonga Landscape (Figure 19.3).

Logging

At present, there are 13 companies with logging or prospecting permits in 21 concessions, which cover 25.7% of the total area of the Landscape. Most have been inactive for the last few years, but at least one concession is preparing to carry out biological and socioeconomic inventories in 2006. With the exception of the Oshwe region, industrial logging is severely handicapped

[8] 99% in the sector of Ndengese-Ikolombe-Isolu, territory of Dekese, western Kasai; 91.3% in the sectors of Luay and Loombo, territory of Bokungu, Equateur; 83.7% in the sector of Lokolama, territory of Oshwe, Bandundu; 44.4% in the sector of Wini, territory of Boende, Equateur.

[9] Most fields are polyculture with an average of 4.5 different products. Their area varies from 0.5 to 1.5 ha. The main products include manioc, groundnuts, rice, maize and, to a lesser extent, beans, gourds, sweet potatoes and sugarcane. Fallow periods vary from 5 to 10 years. Fields are more extensive to offset portions of the harvest destroyed by animals or disease. Destruction of fields is also controlled by traps set around the fields.

[10] Over 95% of households include gathering of non-ligneous forest products in their activities, except for within the Lokolama sector where the figure was only 89%.

[11] Gathering is mentioned as the third biggest source of income by 28% of households in Dekese.

by isolation and difficulties associated with access and removal. Nevertheless, one case of illegal logging was observed recently in the northwest corner of the southern block of the park and other cases of illegal logging, albeit on a small scale, have been reported on the Lokolo River. Timber from this region is floated to Mbandaka.

Reasons for the identification of the Landscape

(1) The Salonga National Park region has been designated a priority area for conservation in the Guinea-Congolese forests (Kamdem Toham *et al.*, 2006).
(2) Although the animal populations are currently threatened by uncontrolled commercial hunting and poaching, the immense size of the forest blocks and the low human population density should offer good long term opportunities for conservation of wildlife endemic to the central Congolese forests ecoregion and important species like the forest elephant and bongo.
(3) Salonga National Park is an Important Bird Area (IBA) according to BirdLife International (Fishpool *et al.*, 2001).
(4) The forests in the Landscape play an important ecological role from the hydrological point of view and with regards to carbon sequestration.

Conservation

History

The Landscape is centered on Salonga National Park, the second largest protected area of tropical forest in the world, covering about 33,350 km² of intact forests and representing 36% of the Landscape. This national park (category II, IUCN) was created by presidential decree in 1970, became a World Heritage Site in 1984 and registered as a threatened World Heritage Site in 1999, but it has received little attention from national and international conservation bodies. At the beginning of the 1990s, Salonga National Park was slated to host the Zaire component of the ECOFAC program, financed by the European Commission, but the political events in 1991 meant that this program did not start up in Zaire[12]. However, during the decades of 1990 and 2000, several organizations (LWRP, MPI and ZSM) have begun research activities in and around the national park and are working to provide support to ICCN.

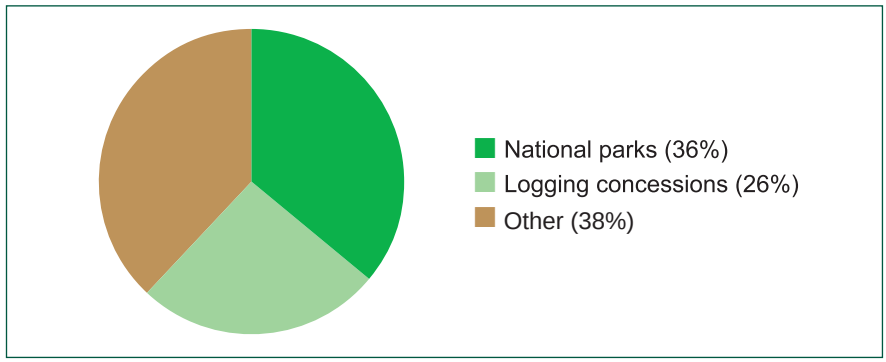


Figure 19.5. Main land use types.

Players

(1) Governmental institutions

ICCN is responsible for the management of Salonga National Park. Outside the national park, management is in the hands of MECNEF.

(2) International NGOs

- The Lukuru Wildlife Research Project (LWRP) has been working on bonobos in the south of the Landscape since 1992 and currently supports ICCN.
- The Max Planck Institute (MPI) has been managing a research site just outside the western limit of the southern block since 2000.
- The Zoological Society of Milwaukee (ZSM) has been active since 1997 in monitoring the bonobos and other large mammals in the northern block of the national park, in support of ICCN and actions to combat poaching.
- WCS played an important role in the MIKE surveys in 2003 and 2004. This NGO continues to focus its resources (CARPE/USAID, private donors, UNESCO) on the national park and its buffer zone. It is carrying out inventories of bonobos and other large mammals. In collaboration with ICCN and local communities, it is working on the settlement of disputes related to the limits of the national park. It is also helping to create a GIS unit.
- WWF has supported activities in the national park since 1997 through ZSM. In 2004, it accepted the role of 'Landscape Leader' under the USAID CARPE program with additional financing from the EU. WWF is involved in strengthening ICCN capacities, carrying out basic socioeconomic and biological surveys, exploring the possibilities offered by community joint management and identifying new partners to assist in matters concerning resources and community management.

[12] In 1988, following the tropical forestry action plan (TFAP), the IUCN, with financing from the European Commission, prepared a regional action plan for Central Africa (PARAC) from which the conception of the ECOFAC program derived. The Zairian component of this program was to be concentrated on Salonga National Park. A budget of 3.2 million ECU was written into the finance agreement for the first phase of the program in 1990. The specificity decided upon for this component was 'conservation and management of a forest park through the strengthening of regional infrastructure, the creation of a research station and the start-up of small development initiatives'. Due to the political events of 1991, this program was never started up. However, in 1991 and 1992, the EC financed field activities to prepare for the installation of a new station in Botsima in the northern block. Cartography of the region was also carried out on the basis of satellite images and some equipment was installed, but looted shortly afterwards (d'Huart, 2003).

Direct threats

(1) Trade in bushmeat

Surveys by ZSM, WCS and the MIKE program, socioeconomic studies and studies on the capacity of ICCN and direct observation by the managers of Salonga National Park have shown that uncontrolled hunting on a commercial scale and poaching in the park are the most serious threats to wildlife. The demand for bushmeat comes mostly from outside the Landscape, from remote urban and mining areas.

(2) Trade in live animals

Trade in live animals, especially bonobos, is a fact and officials based in the Landscape will issue a certificate of legal capture for a live bonobo for the sum of 4,500 Congolese francs (US $10).

(3) Ivory trade

There is no precise information on the ivory trade, but ivory hunting continues and several cases were recorded in 2005 and at the beginning of 2006 in Salonga National Park.

(4) Military poaching

Apart from hunting by the civilian populations, the national park is also threatened by the cynegetic activities of troops and armed gangs. This situation is a danger not only for wildlife but also for the human populations and undermines the authority of ICCN. To compensate for this, ICCN and its partners are actively lobbying the military, as well as provincial and national authorities.

(5) Destructive fishing

The use of dynamite, poison and nets with smaller and smaller meshes may contribute towards the increasing rarety of certain species of fish.

(6) Lack of regulations for human populations in the national park

The populations who live in the national park, either permanently or temporarily, clear land, grow crops, hunt and fish freely.

Indirect threats

(1) Collapse of the agricultural sector

According to the local communities, the collapse of the agricultural sector, following the civil war, would seem to be the most important reason young people are turning to hunting and fishing.

(2) Proliferation of arms

Hunting and poaching have been facilitated by the proliferation of arms.

(3) Limited accessibility

The Landscape is only accessible by airplane or boat and access to most of the villages is problematic. In the past, merchants and missionaries traveled in vehicles on the roads of the colonial era and a network of navigable rivers crossed all the Landscape and made travel and trade easier. During the 1990s, these transport networks disappeared following the general economic decline and the civil war. Bridges have fallen, ferries were destroyed during the civil war and roads have deteriorated to such a degree that it is even hard to ride bicycles on them. The State owned boats do not run any more and private boats go to some remote sectors just once a year. This problem of access is a serious impediment to obtaining basic data, carrying out activities (including alternative activities to the trade in bushmeat), and monitoring and controlling exploitation of the natural resources.

(4) Weakness of government departments

ICCN capacity is very limited and many wardens have received no training, have no specific knowledge and do not have the means to protect the national park. Furthermore, the authority of ICCN is diminished by its ill-defined involvement in the buffer zone. Outside the national park, the government agents responsible for management of the natural resources have suffered considerably from growing isolation following the war. They have neither the tools nor the knowledge to educate the populations in the field on environmental legislation and methods for managing natural resources.

(5) Lack of information

Other than basic information on the key species (elephant, bonobo), there is very little information on the fauna and flora. The local communities are ignorant of the environmental legislation in force in the Landscape.

State of the vegetation

The forests are basically intact.

State of the fauna

Although data are rare and probably imprecise, the findings of the MIKE inventories (WCS, 2005a) reveal a worrying absence of elephants in

most of the park and densities are extremely low in areas where the species still exists[13]. This phenomenon probably extends outside the national park because the local communities in savannah areas often refer to the elephant and the buffalo as two species whose numbers have fallen considerably over the last 10-20 years. Even less information exists on the bonobo[14] but more recent reconnaissance in the national park has led to several new populations being discovered. In general, the distribution of the bonobo is very irregular and is probably influenced by the habitat and pressure from poaching (Reinartz *et al.,* 2006). There is a protected population outside the national park in the south of the Landscape, between the Lukenie and Sankuru rivers, where LWRP is supporting efforts by villagers in the fields of conservation and development.

According to villagers in the south of the Landscape, the cane rat *Thryonomys sp*. has appeared over the last 20 years[15], but the lion seems to have disappeared[16]. The status of other savannah species is worthy of special attention.

As for the widespread small-scale fisheries, which export large quantities of smoked fish outside the Landscape, nothing is known about their impact on fish populations.

Financing and conservation

The funding agencies:

- CARPE/USAID finances activities at the level of the national park and the Landscape.
- The EU focuses on the national park, but also intervenes at the Landscape level.
- UNESCO/UNF has financed some socioeconomic studies (WCS, 2004) and the payment of bonuses to national park staff.
- UNDP/FEM is going to provide communication equipment to the ICCN stations.
- The Trust Fund of the European Union and the World Bank (No. 050991) is providing equipment to ICCN, through WWF, in addition to the European Union's own program.
- The European Union is going to start activities in the Landscape through the ECOFAC program.

There is no long term funding available, and tourism promotion is unrealistic because of the isolation of the area and the weakness of management structures.

Environmental education and capacity building

No structured environmental education program exists for Salonga National Park and the Landscape. A few rare consciousness raising concepts are provided by the teams of conservators or researchers during their working visits. The lack of a program does not help promote a good understanding of disputes, such as questions concerning the limits of the national park. To fill this gap, the Landscape partners are collaborating to define and apply an environmental education strategy.

Management in the field of renewable natural resources

(1) At the Landscape level

Basic data are necessary before a zoning plan can be produced for the Landscape. Socioeconomic studies have been carried out and will guide the future establishment of local partnerships, the choice of indicators for monitoring living standards and the identification of interventions in the field of sustainable use of natural resources. A map on the scale of the Landscape is being improved at present.

(2) In the national park

Inventories of large mammals were undertaken within the framework of the CITES MIKE program as of 2003. Since the beginning of CARPE activities in October 2003 and the European Commission's program to strengthen the management capacities of ICCN and support the rehabilitation of protected areas in the DRC in August 2004, the partners involved in the national park have joined forces with ICCN to collect basic data and strengthen management, research and monitoring capacities. Players previously excluded from this process were incorporated. Given the serious threats to this national park, the partners embarked upon the following interventions:

In the field of basic data collection:

- evaluation of ICCN capacities, including recommendations for staff recruitment, the development of infrastructure, equipment and anti-poaching strategies
- finalization of the basic map
- analysis of threats
- socioeconomic studies and surveys

[13] In 1989, the number of elephants in the national park was estimated at 8,300 (>2.2 individuals/km²) (Alers *et. al.,* 1992) and according to MIKE surveys in 2003-2004, it was estimated at only 2,000 (WCS, 2005a). It should be noted, however, as indicated in the WCS report, that it is difficult to compare these surveys given the enormous potential sources of errors in each of them. (WCS, 2005a, p. 98).

[14] In 1998 the density of the bonobo populations in the northern part of the northern block was estimated at 1.15 individuals/km² (Van Krunkelsven et al., 2000). A more recent density estimate indicates 0.73 adults/km² according to the surveys carried out in both the southern block (3 sites) and the northern block (8 sites) of the park, between October 2000 and May 2002 (Reinartz et al., 2006).

[15] Villagers living between Dekese and the national park say that this species has apparently arrived in their region from the south over the last 20 years.

[16] In Dekese, villagers talk of the well documented killing of the last lion (a man-eater) on the savannahs between Lukenie and Sankuru or south of Sankuru in 1999 (WWF, 2006).

In the field of training:

- creation of the site coordination committee (CoCoSi)
- support for ICCN as regards equipment, fuel and the training of administrators and wardens

In the field of surveillance:

- creating anti-poaching patrols at the six stations
- payment of bonuses to wardens
- creation of new jobs at Etate, Kinki, Beminyo and Lokofa

In 2006, the partners are going to finalize a strategic management plan for the national park with the technical support of USFS.

(3) In the extraction areas

Many coffee, palm-oil and rubber plantations have been listed, but none are active. Similarly, although 25% of the Landscape is allocated to logging companies, no logging on a commercial scale has been observed. The moratorium in place at present on industrial logging also prevents formal cooperation between conservation agents and logging companies, but the possibility of collaborating on biological or socioeconomic studies has nevertheless been informally discussed.

(4) In the rural areas

Although satellite imaging makes it possible to locate agricultural activities, only field work makes it feasible to identify the hunting and fishing areas. Some of this information was collected during the socioeconomic studies. Additional data will be collected as a part of the biological surveys. Two studies are planned to begin work with the local communities on improving the management of natural resources. Meetings were held with representatives of the communities, particularly with a view to resolving disputes concerning demarcation of the national park. In fact, one of the priority requests by the communities is to be able to fish the rivers that form the boundaries of the national park. During the dry season in 2006, a partner institution is going to carry out a study on the management systems on these rivers in order to put forward recommendations concerning collaborative management between the local communities and ICCN. A second study will explore the economic feasibility of marketing selected agricultural produce and non-ligneous products in the Landscape, in order to ease the pressure on wildlife and diversify the economic opportunities of the local communities. GTZ has supported MPI for a feasibility study on exporting ornamental fish (Schliewen, 2002).

The CARPE Small Grants Program is supporting local NGOs whose activities deal with the management of natural resources and conservation of biodiversity. The first year's results will allow long term partnerships to be better defined and additional resources and/or expertise to be brought in.

Governance in the field of renewable natural resources

Governance as regards renewable natural resources is based on a major ambiguity between theory and reality. According to the law, ownership and management of the land and its natural resources are a State mandate. This situation is common in Central Africa. In a Landscape characterized by its isolation and the low level of State services, it is very marked indeed: access to and management of resources are usually determined by the local communities or local authorities, such as the traditional chiefs. The ambiguity between the legal situation and the reality means that the communities come under external pressure from 'outsiders' who do not live in the Landscape and who have greater political and economic means to hunt and fish on village lands through authorizations and the payment of fees[17]. Most communities describe similar systems of local governance of the land and its natural resources.

Salonga National Park could be an exception given the presence of ICCN, a governmental authority. In practice, six ICCN management stations spread over the park are responsible for management of Salonga National Park. However, these stations do not operate well due to an insufficient budget, a lack of sufficient training[18], lack of equipment, inadequate staff and poor infrastructure. Nevertheless, local communities, displaced before and after the creation of the national park and excluded from its management, continue to demand a right of authority over their former lands and resources. They still gather fruit and other products in their old fields. The vague policies pursued by ICCN have caused much confusion, due to the fact that some cooperatives and individuals have obtained authorization to fish in the park by paying taxes. Another ambiguity concerns the fishing rights for the local populations in the rivers forming the limit to the national park: where does the national park begin? Midstream or on the bank? This exclusion and ambiguity, combined with the feeble capacity of ICCN, the civil war and centralized but inef-

[17] Village lands are separated by known limits, often based on streams or rivers. The inhabitants have access rights to the forests on their land for agriculture, the gathering of non-ligneous forest products, hunting and fishing. Neighboring villages can be invited to join in collective hunts, but this practice is disappearing. Outsiders interested in hunting on these lands must obtain the permission of the chief of the land and pay access fees in cash or munitions. Access to fishing lodges is more restricted: some villages even prohibit access completely, while others demand payment. However, the use of seasonal fishing camps can be extended to family members living as far away as Mbandaka. Gathering non-ligneous forest products is not regulated unless it is for commercial purposes.

[18] Between December 2003 and January 2004, 54 Salongo National Park wardens received paramilitary training in collaboration with the Ministry of Defense and organized by ICCN with financing from ZSM.

ficient governmental structures, have all contributed towards the anarchic use of natural resources in and around the park.

With a view to developing management and decision making capacities, a site coordination committee (CoCoSi) has been set up for management of the park. It includes ICCN and partner organizations (LWRP, MPI, ZSM, WCS and WWF). It is hoped that in time representation on CoCoSi can be extended to include representatives from the local communities. For the immediate future, several wardens have established standing committees for local consultation with the villages. ICCN is also working with partner organizations to better define the concept of community conservation. At the same time, there are also initiatives from the natural resources sector, such as the creation of community forests, which will encourage participation by the local communities at the Landscape level.

Monitoring of renewable natural resources

MIKE studies carried out in 2003-2004 provided some important basic information that will allow future monitoring of wildlife in the park to be put into place, particularly for forest elephants. These inventories of large mammals will continue and a preliminary study on the potential for biological monitoring is planned.

Several research institutions are studying the ecology, distribution and behavior of the bonobo.

A national database managed by ICCN's SYGIAP (*Système de gestion des informations des aires protégées*) already exists for the World Heritage Sites and a map of the park and its buffer zone has been produced. This database will be directly accompanied by the development of similar capacities for use in the field. A database at Landscape level is to be completed and will serve to produce a map like the one for the national park. The two databases will be the main tools for long term monitoring of conservation activities and sustainable management of natural resources.

Figure 19.6. Bicycles remain the last available transportation vehicle in many parts of the central Congo Basin.

20. Maringa-Lopori-Wamba Landscape

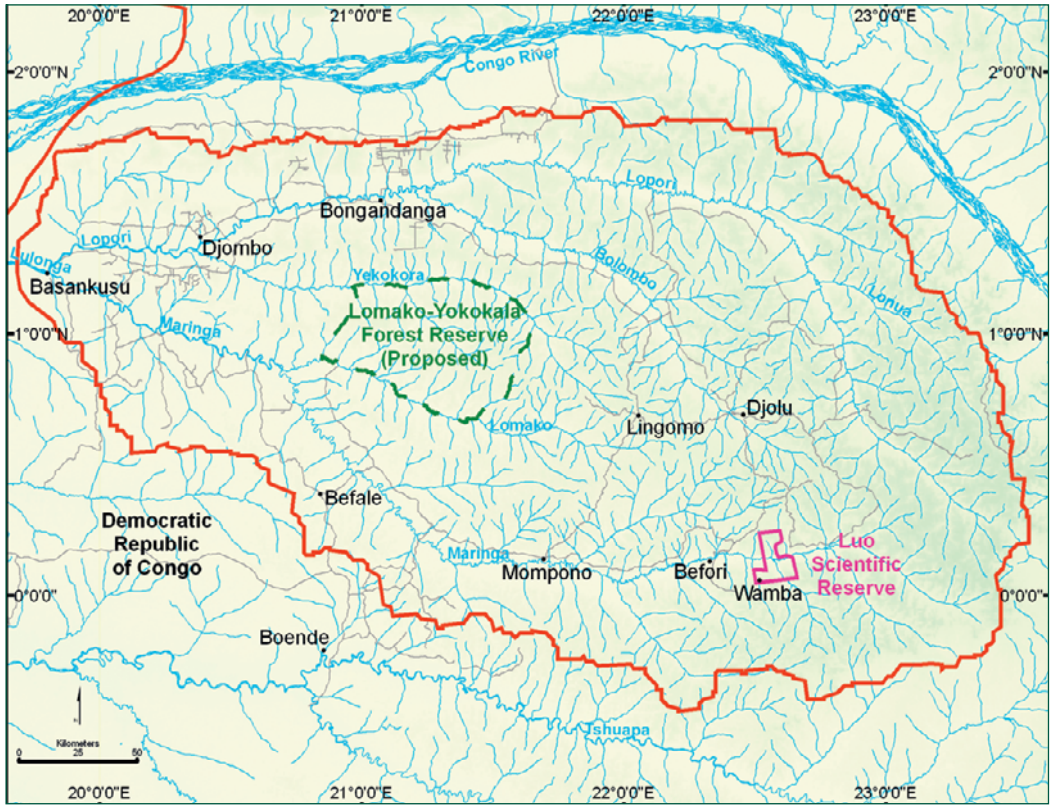


Figure 20.1. Map of Maringa-Lopori-Wamba Landscape (AWF-DRC, JRC, SRTM).

The Landscape in brief

Coordinates: 1°51'50"N – 0°26'28"N; 19°41'5"E – 23°32'43"E
Area: 74,544 km²
Elevation: 350-400 m
Terrestrial ecoregion: Ecoregion of the Central Congolese forests
Aquatic ecoregion: Central Basin ecoregion
Protected areas: Lomako-Yokokala Faunal Reserve (proposed, in process of designation)

Location and area

The operational limits of the Maringa-Lopori-Wamba Landscape have changed relative to the original limits identified within the framework of the CBFP (Figure 20.1). Today, the Landscape is limited to the basin of the Maringa and Lopori rivers and includes the administrative and territorial entities of Bongandanga, Basankusu, Befale and Djolu in the districts of Equateur, Mongala and Tshuapa in the province of Equateur. This change in the limits was based on ecological, socioeconomic and administrative realities. The Landscape covers 74,544 km² and is characterized by tropical forests and some inhabited strips along the rivers. It is a very isolated enclave, especially since the deterioration of the road infrastructures in the 1980s and 1990s and the discontinuation of river transport since the war.

Physical environment

Relief and altitude

The Landscape is situated entirely on the alluvial plain of the central basin, at an altitude of 350-400 m.

Geology and soils

The soils are composed of coarse sand derived from a peneplain dating from the Pleistocene.

Hydrology

The sources of the Maringa and Lopori rivers are in the southeast corner of the Landscape and encompass the whole of the Landscape with their tributaries: Lomako, Iyokokala and Bolombo. The Maringa and the Lopori join in the northwest at Basankusu in Lulonga. The high waters are from

October to December and the low waters last from February to August.

Climate

The Landscape has an equatorial-type climate with an average annual rainfall of around 2,000 mm with little seasonal variation. The wettest period is from August to October and the dry season (January-February) lasts less than two months.

Vegetation

The majority of the Landscape is covered by dense moist forests (Figure 20.2): 67% terra firma forests and 25% floodplain and/or swamp forests which stretch along the rivers and streams. The terra firma formations comprise semi-evergreen rainforests of *Scorodophloeus zenkeri* and evergreen rainforests with a monodominance of *Gilbertiodendron dewevrei* or *Brachystegia laurentii*. The edaphic formations include riparian forests of *Uapaca heudelotii*, floodplain forests of *Oubanguia africana* and swamp forests of *Entandrophragma palustre* and *Coelocaryon botryoides*.

The remainder (7%) is made up of degraded forests and cultivated areas for shifting agriculture. Forest plantations cover less than 1%. They are found primarily beside main roads and inhabited strips of land along the Maringa, the Lopori and the Bolombo, including the square formed by the roads linking Djolu, Lingomo, Mompono and Befori.

Fauna

Mammals

At least eleven species of diurnal primates have been observed. The dryas monkey *Cercopithecus dryas* is endemic to the basins of the Maringa and the Lopori and only two examples of the species are known[1]. The bonobo *Pan paniscus*, Tholan's red colobus *Piliocolobus tholloni*, the golden-bellied mangabey *Cercocebus chrysogaster* and the black mangabey *Lophocebus aterrimus* are endemic to the central Congolese forests. Allen's swamp monkey *Allenopithecus nigroviridis* is endemic to the flooded or floodplain forests of the Central Basin and the Angolan colobus *Colobus angolensis* is only known in the Central Basin, the northeast of DRC and the Great Lakes region. Other large mammals include the elephant *Loxodonta africana*, the buffalo *Syncerus caffer*, the bongo *Tragelaphus eurycerus*, the African golden cat *Felis aurata* and the leopard *Panthera pardus*.

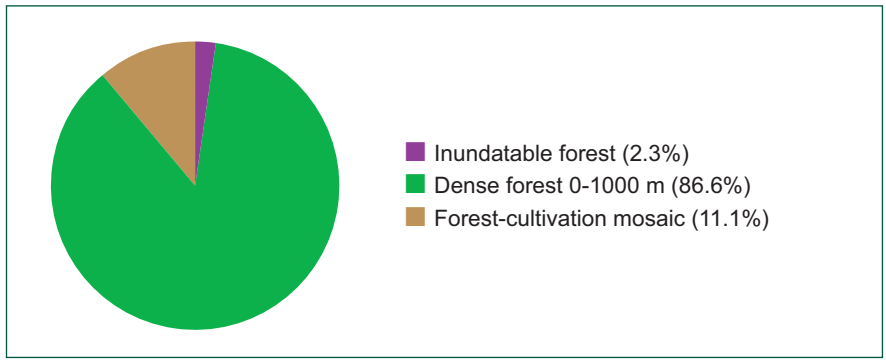


Figure 20.2. Main vegetation types (Source: JRC).

Birds

The avifauna comprises over 400 species. In certain places, the density of Congo peafowl *Afropavo congensis*, a species endemic to the center and the northeast of the Congolese forests and very sensitive to anthropogenic disturbances, is probably the highest in the country.

Ichthyofauna

The whole of the Landscape is situated in the Central Basin ecoregion, whose ichthyofauna comprises 240 identified species (probably 300-400 total species), with at least 12 endemic species. Few studies have been carried out since the 1960s (Thieme *et al.,* 2005).

Humans in the Landscape

Density and distribution

According to the data available (UNDP/UNOPS, 1998; *Monographie de la Province de l'Equateur*, PNSAR 1997-200; *Institut national de la Statistique,* 1995, *Totaux définitifs; Direction d'Etudes et Planification du Ministère de la Santé*, 2003), the population density in the Landscape is estimated at about 3-6 inhabitants/km². This population is mainly concentrated along the main roads and in the towns of Basankusu, Befale, Bongandanga, Mompono, Djolu and Lingomo.

Ethnic groups

The Landscape is almost entirely within the territory of the Mongo (Mongo and Mongando). Over the last few decades, there has been new immigration, by Ngombe who are regarded as great hunters, from the north to the hunting forests. Limited populations of Pygmies are scattered around the central northeast. In the middle of the Landscape, between the Lomako and Yokokala

[1] A juvenile was described in 1932 and an adult in 1985.

rivers, towards Lingomo, there are thousands of Kitiwalists (Jehovah's witnesses) who withdrew into the forest in the 1960s and do not accept the State authority.

Activities

The populations, centered on the main roads, focus their activities on agriculture (Figure 20.3). However, due to the collapse of agriculture and the lack of market access, the populations are turning to the forest to live off its available natural resources: bushmeat (Figure 20.4), fish and non-timber forest products. It can be estimated that almost 100% of the Landscape is influenced by hunting.

Logging

Industrial logging in the Landscape began in the 1970s and stopped in 1998 because of the war. Although almost 100% of the Landscape had been allocated in concessions, logging remains very limited due to difficulties associated with access (Figure 20.5). Today, 32% of the Landscape is in the official production forest (Figure 20.6), awaiting the conversion process to turn logging rights into forest concessions. The most well known and active company is SIFORCO (Danzer group), with 725,068 hectares of concessions in the Landscape. The Trans-M company obtained 358,513 hectares in the south of the proposed Lomako-Yokokala Reserve following the moratorium of 2 July 2004 (Ministerial Order No 050/CAB/MIN/ECN-EF/2004).

Reasons for the identification of the Landscape

(1) The main reason for the creation of this Landscape, which does not have a national park, was the fact that it had the richest history of scientific research on the bonobo. Primatologists have been working in the Wamba and Lomako forests since the 1970s. Over 90% of the scientific literature on bonobos in the wild comes from these two sites.

(2) The Lomako-Yokokala forest was identified in the 1950s as an area of great importance for biodiversity and in the 1980s as an area deserving protection. It is considered by BirdLife International to be an Important Bird Area (Fishpool & Evans, 2001). Full protection of this forest of 3,625 km² is still a priority for ICCN.

(3) Despite the biodiversity, most of the Landscape is covered by forest concessions and industrial forestry could endanger this richness. Developing partnerships with the private sector is one of the key objectives of the CARPE program and the Landscape provides ample opportunities for establishing such partnerships.

Conservation

History

The only protected zone in the Landscape is Luo Scientific Reserve, covering 22,700 hectares. This reserve is under the supervision of the Ministry for Scientific and Technological Research. The bonobos in the reserve are the subject of scientific

Figure 20.3. Shifting cultivation remains the main activity of human populations in the Landscape.

Figure 20.4. Smoked bushmeat.

Figure 20.5. Logging faces many problems because of the remoteness of the concessions.

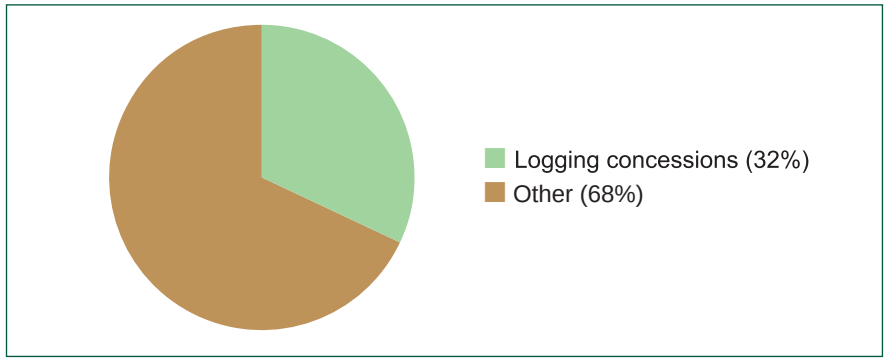


Figure 20.6. The main land use types.

studies by the University of Kyoto (WCBR) in collaboration with the *Centre de recherche en écologie et foresterie of Mabali* (CREF). At the beginning of the 1990s, a proposal for the creation of the Lomako Forest Reserve was submitted to the Ministry for the Environment, but because of political problems this proposal was never advanced. However, the creation of a protected area in the Lomako-Iyokokala forest, identified as a critical site for conservation (IUCN, 1990), is a priority for ICCN (2004) and measures for its creation are currently being facilitated by AWF.

Players

Very few conservation players are active in the Landscape. Representatives of the Ministry for Development are present in Basankusu, Bongandanga, Befale and Djolu, but have no resources or program of activities. The creation of the Luo Scientific Reserve around 1994 was initiated by the University of Kyoto, which still has a team working in Wamba. The NGO Bonobo Conservation Initiatives is working in collaboration with the local NGO *Vie sauvage* around Kokolopori and in Lonua with a view to creating community reserves. However, there are no official reports available as of yet.

Finally, AWF has been working throughout the Landscape since the beginning of 2004 in conjunction with five local NGOs based in Bongandanga, Basankusu, Befale, Mompono and Djolu. The latter have received development support in conjunction with some precise conservation objectives. In addition, a growing number of local NGOs are prepared to launch consciousness-raising activities for conservation, and have already achieved palpable results on the ground, in return for development support.

Direct threats

(1) Shifting agriculture

This form of agriculture gradually turns the primary forests into agricultural land and secondary forests.

(2) Hunting

Whether it is subsistence or commercial hunting, it contributes towards the disappearance of certain endemic animal species.

(3) Industrial logging

This changes the abundance and the specific composition of forests, the structure of their populations and the behavior of animal populations. Although it has not been developed to any great extent, it also indirectly causes social disturbances and encourages hunting.

Indirect threats

(1) Demography

Population growth, through a rising birth rate or immigration, places increasing pressure on resources.

(2) Economic collapse

The disappearance of infrastructure and the collapse of an economy essentially based on agriculture have caused a migration of populations towards what used to be undisturbed forests. Analyses of satellite photos by the University of Maryland clearly show this exodus to the forest and the creation of a growing number of small hamlets, which serve as bases for hunting.

(3) Loss of cultural values

This is leading to non-development of the original assets and the destabilization or degredation of a system that worked in the past.

State of the vegetation

The majority of the landscape is covered with virtually intact forest. Deforestation and degradation are limited. Nevertheless, satellite photos show an increase in destruction of the canopy in the middle of the Landscape. This destruction is far from the strips inhabited by humans and confirms the fact that populations are moving into these areas.

State of the fauna

Recent censuses (AWF, 2004) confirm the richness of the fauna in the Landscape, as well as the disappearance of fauna in specific areas. Between the years 1970 and 1980, poachers equipped with military weapons had already exterminated the large populations of elephants and hippopotamuses along the rivers, not only the Maringa and the Lopori but also along remote rivers like the Lomako and the Iyokokala. Over the last few years, however, traces of elephants have returned and there have been new observations of hippopotamuses. This can be explained by the difficulty that villagers have in gaining access to heavy arms and munitions.

Financing and conservation

Financing comes from USAID/CARPE and AWF, but FFEM, the Arcus Foundation, Columbus Zoo (USA), the Abraham Foundation and *Kreditanstallt für Wiederaufbau* (KFW) all show an interest in financing the Maringa-Lopori-Wamba Project. DGIS has obtained some indirect financing.

Management and governance in the field of renewable natural resources

(1) At the Landscape level

The AWF program is aimed at indicative zoning of the Landscape. This zoning is being organized in a participatory manner. The different zones identified, in particular the protected area being proposed, community-managed forests, logging areas and areas being used for sylvicultural-agricultural-pastoral purposes, are covered by a participatory process to formulate a management plan. This management plan will contain management and follow-up elements and establish cooperation with the State's supervisory bodies. At the very beginning of 2006, a mission with USFWS experts was scheduled to lay the first foundations for planning and utilization of land throughout the Landscape. However, AWF stresses that these areas must be subject to not only precise management, they must also be discussed beforehand with the real parties concerned in the Landscape.

(2) In the protected areas

As of yet there are no protected areas in the Landscape, but the AWF program supports the creation of such areas.

(3) In the extraction areas

Given the absence of governance and conservation players, logging companies have free scope for anarchic logging. Some logging companies have, however, expressed interest in being involved in the process of sustainable management of the forests through the development of a management plan and obtaining certification (particularly SIFORCO). Loggers admit that the lack of governance is a handicap when it comes to implementing a management plan. AWF aims to establish a partnership with a logging company, preferably within the proposed protected area. The area concerned would cover approximately 1,700,000 hectares.

(4) In the rural areas

The AWF's Maringa-Lopori-Wamba Project is involved in three community-management areas.

Monitoring of natural resources

As activities have just begun in the Landscape, no monitoring arrangements have been defined or implemented, but this will form part of the Landscape planning.

21. Maiko-Tayna-Kahuzi-Biega Landscape

Figure 21.1. Map of Maiko-Tayna-Kahuzi-Biega Landscape (CARPE, DFGFI, JRC, SRTM, WWF-EARPO).

Location and area

This Landscape is situated in the eastern part of the Democratic Republic of Congo (Figure 21.1). It covers an area of 67,121 km² and includes the Kahuzi-Biega and Maiko national parks as well as the Tayna Gorilla Reserve. Altogether, protected areas make up 27.4% of the Landscape.

The Landscape in brief

Coordinates: 0°20'30"N – 2°45'17"S; 26°35'8"E – 29°2'51"E
Area: 67,121 km²
Elevation: 495–3,279 m (average: 1,010 m)
Terrestrial ecoregions: Northeastern Congolese forests
Afromontane forests of the Albertine Rift
Aquatic ecoregions: Albertine Rift mountains
Upper Congo
Protected areas: Maiko National Park, 1,000,000 ha, 1970
Kahuzi-Biega National Park, 660,000 ha, 1970-1974
Tayna Gorilla Reserve, 88,600 ha, 2002

Physical environment

Relief and altitude

It is mountainous in the east, and the eastern part of Kahuzi-Biega National Park extends across the mountain chain forming the western rim of the Albertine Rift. Towards the west and in the direction of the Congo River, the land is lower, creating a significant altitudinal gradient (495-3,279 m). The western part of both national parks is relatively flat.

Geology and soils

The entire Landscape has a substrate of metamorphosed proterozoic rock belonging to the Kibarian system. There are two extinct volcanoes in the upper part of Kahuzi-Biega National Park dating from the end of the Tertiary or Quaternary era: Kahuzi and Biega.

Hydrology

The hydrographical system belongs entirely to the Congo Basin. All rivers originate in the mountains to the east and discharge into the Lualaba, which becomes the Congo River downstream of Kisangani.

Climate

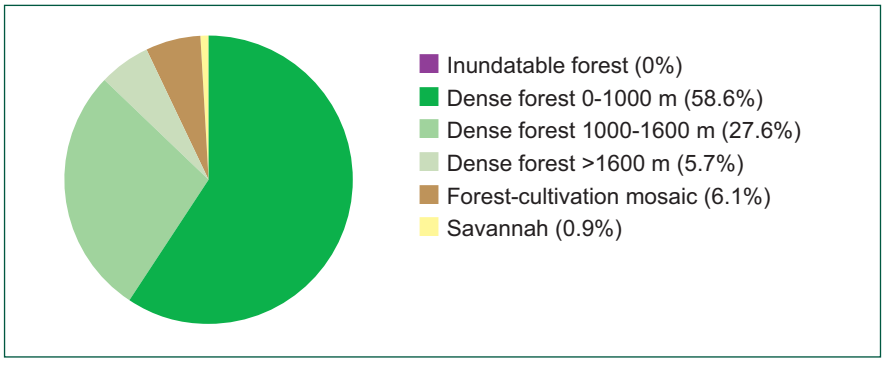
Annual rainfall averages between 1,800 and 2,300 mm. The driest season is July to August and the rainiest seasons are in October-November and March-April. The mean annual temperature varies depending on altitude.

Vegetation

Most of the Landscape is covered by dense terra firma forests (Figure 21.2), with varying composition and structure depending on altitude (Pierlot, 1966). The plain (lowland) forests extend up to an altitude of 1,000 m, with mixed vegetation of *Strombosia* and *Parinari* and a monodominance of *Gilbertiodendron dewevrei* or *Michelsonia microphylla.* Between 1,000 and 1,600 m are the submontane or transition forests, characterized by the presence in particular of the genera *Pentadesma*, *Lebrunia, Cynometra, Julbernardia, Pouteri* and *Staudtia* or by the local dominance of *Ocotea michelsonii* (Pierlot, 1966; Doumenge, 1998). Above 1,600 m are afromontane forests characterized by the genera *Diospyros*, *Entandrophragma*, *Ficalhoa*, *Olea*, *Parinari*, *Podocarpus*, *Prunus* and *Syzygium*. As of 2,300 m, but especially above 2,800 m, these forests are intermixed with thickets of bamboo *Synarundinaria alpina*. The afro-subalpine vegetation comprises high-altitude mountain forests of *Olea*, *Podocarpus* or *Hagenia abyssinica*, thickets of Ericaceae and mountain grasslands. At the summit of Kahuzi there is a small area of tree groundsel *Senecio sp.* and giant lobelias *Lobelia sp.* Below 1,300 m there are large stretches of swamp and riparian vegetation.

The flora is abundant, including many endemic species. It represents a transitional area between the Guinea-Congolese biogeographical region in the west and the Kivu-Ruwenzori region of the Albertine Rift in the east, which forms part of the biographical region of afromontane forest (Pierlot, 1966). A recent global analysis conducted by Conservation International (CI) has identified it as a unique region as it combines Congolese forest, a wilderness area of considerable biodiversity (Colyn *et al.*, 1988), and the Albertine Rift, a hotspot of worldwide importance: the eastern afromontane archipelago (Mittermeier *et al.*, 2003; Mittermeier *et al.*, 2004). Paleoecological studies also show that this region contained refuges of montane forest during the cold and dry periods of the Pleistocene era (Myers *et al.*, 2000; Kingdon, 1980; Hamilton, 1988; Pomeroy, 1993).

Figure 21.2. Main vegetation types (Source: JRC).



Fauna

Mammals

In tandem with its diverse habitats, the Landscape is also home to a rich variety of mammals, in particular the elephant *Loxodonta africana*, the chimpanzee *Pan troglodytes*, the eastern gorilla *Gorilla beringei* (including almost the entire population of the *graueri* form), numerous other primates, amongst which Hamlyn's monkey *Cercopithecus hamlyni*, L'Hoest's monkey *C. lhoesti*, Dent's mona monkey *C. denti*, the blue

monkey *C. mitis* (with notably an endemic hybrid form *kandti x stuhlmanni*), Schmidt's guenon form of the red-tailed monkey *C. ascanius*, the olive or anubis baboon *Papio anubis*, the grey-cheeked mangabey *Lophocebus albigena*, the *ruwenzori* form of the Angola colobus *Colobus angolensis,* the *ellioti* form of the red colobus *Piliocolobus oustaleti*, Thollon's red colobus *C. tholloni*, a hybrid form of these two colobus monkeys, the dusky bushbaby *Galago matschiei*, Prince Demidoff's bushbaby *Galagoides demidoff*, Bosman's potto *Perodicticus potto*, the giant forest hog *Hylochoerus meinertzhageni*, the okapi *Okapia johnstoni,* the bongo *Tragelaphus euryceros* and the panther *Panthera pardus*.

Birds

The bird fauna is rich, including most of the endemic montane or submontane species of the Albertine Rift, notably the handsome francolin *Francolinus nobilis*, Grauer's broadbill *Pseudocalytomena graueri*, the yellow-crested helmetshrike *Prionops alberti*, Grauer's cuckooshrike *Coracina graueri*, Chapin's mountain babbler *Kupeornis chapini*, the Kivu ground thrush *Zoothera tanganjicae*, Archer's robin-chat *Cossypha archeri*, the yellow-eyed black flycatcher *melaenornis ardesiaca*, the Ruwenzori batis *Batis diops*, Rockefeller's sunbird *Nectarinia rockefelleri*, the regal sunbird *N. regia* and Shelley's crimson-wing *Cryptospiza shelleyi* (Fishpool & Evans, 2001). The Congo peafowl *Afropavo congensis* is found in the low-altitude forests (Hart & Upoki, 1995).

Humans in the Landscape

Density and distribution

Reliable demographic data is very thin for this Landscape, particularly since the significant displacement of populations during recent conflicts. Generally speaking the population is unevenly distributed, with a rising density gradient moving from west to east: on the mountains of the Albertine Rift, the density is over 300 inhabitants/km^2; the western lowland regions are relatively sparsely populated and 80% of the Landscape is covered by forests without any permanent villages. The remaining 20% probably has an average density of under 30 inhabitants/km^2. The total population is estimated to be less than 400,000 inhabitants. Surveys by DFGFI suggest that more than 30% of this population is under 20 years of age.

Ethnic groups

The Landscape encompasses a mosaic of Bantu people characterized by their languages, notably Nande, Pere, Hunde, Nyanga, Rega, Kwame, Kumu and Shi. There are also small populations of Twa Pygmies, the majority of whom live near Kahuzi-Biega National Park in the south. Swahili is the most common language.

Activities

The principal economic activities in the Landscape are subsistence farming, hunting, extensive cattle farming, goat and/or sheep farming and small-scale mining. Most of the farming is carried out using slash and burn methods, but close to ancient villages there are oil palm, banana, coffee and cinchona tree plantations. At high altitude, around the upper regions of Kahuzi-Biega National Park, the Shi people carry out permanent agriculture.

Subsistence hunting takes place throughout the Landscape and active commercial hunting exists around the mining camps. The trade in bushmeat is not, or no longer,[1] as developed as in western Central Africa, but consumption of bushmeat is high in the smaller centers, such as Lubutu. Hunting for ivory also exists throughout the Landscape and is carried out by illegal armed groups.

There are no official mining concessions, but mining for gold, tin (tin-stone), coltan and diamonds is intensive in several areas of the Landscape (Tegera, 2002). In some places, notably Walikale, these operations are so successful that the inhabitants have abandoned farming. Consequently, large quantities of food are brought in by plane at very high prices, completely destabilizing the local economy.

There are few usable roads, but one asphalt surfaced road runs from Lubutu to Walikale in the center of the Landscape. At present, it is not accessible to vehicles except via a poor quality dirt road from Kisangani in the northeast. This road makes it possible for small planes used by the mining business to land.

Land use

Outside of protected areas the majority of land cannot be assigned to one particular use (Figure 21.3).

[1]During the 1980s bushmeat was traded intensively with the towns of Goma, Bukavu and Kisangani. This trade has probably suffered from the poor state of the road network and perhaps also from the sharp fall-off in game.

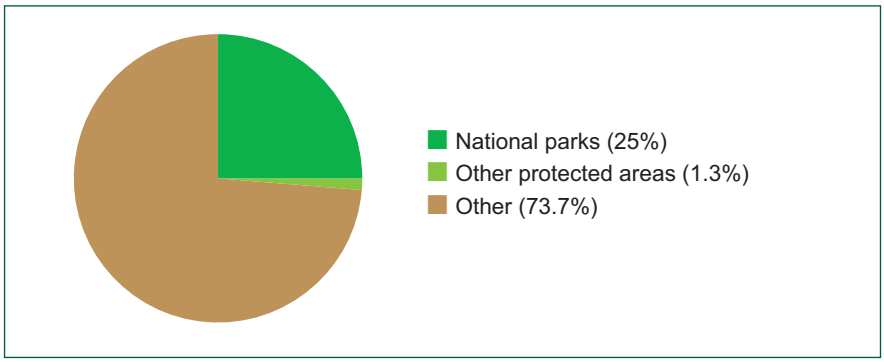


Figure 21.3. Land use types.

Logging

There are no official forestry concessions in the Landscape, but small-scale logging operations have long existed around certain villages. On the eastern fringes of the Landscape, charcoal production is also an important trade, supplying urban centers in the region.

Reasons for the identification of the Landscape

(1) The region includes two national parks that were already established in 1970.
(2) The region was recognized as having regional importance during the WWF workshop in Libreville in 2000 and designated a Landscape under the CARPE program.
(3) In a global context, the region in this Landscape is characterized by a high degree of irreplaceability and an average degree of vulnerability; the conservation programs therefore have high priority.
(4) The region is considered to be an Important Bird Area (IBA) by BirdLife International (Fishpool & Evans, 2001).
(5) The region harbored one or more forest refuges during the cold and dry periods of the Pleistocene era.
(6) The Landscape is a testing ground for innovative approaches to conservation, comprising a mosaic of national parks and community reserves managed in a traditional manner with the aim of matching conservation objectives to the needs and aspirations of local people.

Conservation

History

Maiko National Park (1,000,000 ha) was created in November 1970, replacing a former hunting reserve established in 1938. However, given the lack of human and financial resources, the difficulties of getting around the park, the presence of large human populations within the bounds of the park, their hostility to conservation and the large distance between monitoring facilities and the park boundaries (often several days' walk), it has never been possible to supervise the park effectively[2].

Kahuzi-Biega National Park was created in November 1970 with an initial area of 60,000 ha of high-altitude land. In 1975, the park was extended by the addition of 600,000 ha of transition and lowland forest to the west[3]. Since the end of the mid-1980s, the park has benefited from a GTZ support program. During its first phase, this program focused on the operation of the park, tourism development and raising awareness among local people and authorities. During its second phase, starting in 1991, the program concentrated on the park periphery and involving local people in its management.

These two national parks, managed by ICCN, suffered enormously from the war between 1996 and 2003. Apart from the high-altitude part of Kahuzi-Biega National Park, which continued to benefit from GTZ support during the conflicts, the parks were practically abandoned.

The Tayna Gorilla Reserve (88,600 ha) was recognized by the government in 2002 and supported by DFGFI via the US Congressional Gorilla Directive of USAID.

In October 2003, the CARPE program resumed support for conservation activities and management of natural resources in the Landscape. CI has been assigned responsibility for conservation in the Landscape. They work with numerous partners: WWF as concerns Kahuzi-Biega National Park and DFGFI for Maiko National Park and a series of projects for community reserves located between the two national parks. WCS also receives funding from CARPE for support to the two national parks.

[2] By the 1980s and early 1990s (well before the war) the park was partly occupied by gold panners and armed bands who tried to 'control' the former.
[3] The boundaries of this extension were determined by overflights and did not take account of the people inhabiting these forests.

Direct threats

(1) Crop and livestock farming

The expansion in these activities represents a direct threat to the forests and protected areas. Already the forest corridor linking the higher and lower parts of Kahuzi-Biega National Park has been completely opened up. At present, the greatest threat lies in the continuous immigration of people from the high-altitude to low-altitude regions. This phenomenon is not new and was already taking place in the 1970s and 1980s. At that time, Shi farmers had moved in and established permanent crop farming, which is ill-suited to lowland forests in the low-altitude regions accessible via the Bukavu-Walikale road.

(2) Hunting

Hunting for bushmeat and ivory are both important activities. Okapi skins are highly sought after. This hunting has always existed, but it increased significantely during the 1980s with the large-scale introduction of the Soviet-made *Baikal* gun. For the first time, hunters were able to kill monkeys in the treetops. In the space of a few years, populations of colobus monkeys were decimated over vast areas of the Landscape[4].

(3) Small-scale mining operations

Several areas of the Landscape are negatively affected by gold, coltan or tin-stone mining.

(4) Capture of live animals for export

Young gorillas[5] and chimpanzees continue to be captured alive; this activity is usually accompanied by the massacre of the adults. Many African grey parrots *Psittacus erithacus* are also captured.

Indirect threats

(1) Economic collapse

The local population currently has no other resources than those provided by the forest. Economic collapse was precipitated by the war, but its origins date back to the 1960s, when a rebellion took place. Subsequently, from the early 1970s, the process of 'zairianization' of foreign companies was followed by the virtual disappearance of tea, coffee, cinchona and oil palm plantations. The steady dilapidation of the road network and the disappearance of bridges has prevented the export of agricultural produce.

(2) Insecurity, political instability and corruption

Some of the destruction of the communication infrastructure was supported by populations in the 1970s and 1980s, in order to hamper movements by the army, which tended to seize anything it could. Now that the conflict is over, the situation has not really improved and uncontrolled armed bands are still occupying some parts of the Landscape, including the protected areas.

(3) Weak institutional capacity of ICCN

ICCN is currently unable to carry out its mandate owing to a lack of finance, equipment and manpower.

State of the vegetation

With 81% of its area covered by primary forest, the Landscape represents one of the largest expanses of intact forest in Central Africa.

State of the fauna

Despite the good state of the forests, the fauna is at serious risk.

The elephant population has shrunk dramatically since the mid-1980s and during the last decade this decline has gathered speed. Currently, the species has virtually vanished from many regions, in particular the high-altitude section of Kahuzi-Biega National Park and the southern part of Maiko National Park (Hart & Sikubwabo, 1996; Hart & Liengola, 2002). It is feared that only small isolated populations still survive.

The eastern gorilla populations are facing different threats. Their current population size is unknown, but is thought to be between 5,000 and 25,000 individuals (Hall *et al.,* 1998; Nixon *et al.*, 2005). Although most of the biologists working in the Landscape believe that the true figure is closer to 5,000, recent surveys are thought to have revealed significant previously undiscovered populations[6]. In areas where the gorillas are still protected, as in the high-altitude section of Kahuzi-Biega National Park where GTZ directly supports ICCN, the populations are still below their pre-war levels, but are rising (Yamagiwe *et al.,* 1993; Hall *et al.,* 1998; Mehlman, *in press*). The *schweinfurthi* form of the eastern chimpanzee lives in the same regions as the gorilla, while occupying a wider area, and its population density is thought to be half that of the gorilla. All other primates are under heavy pressure from hunting

[4] Until the end of the 1970s, five or six species of monkeys could easily be seen during a single day in the forests bordering the Bukavu-Walikale road, particularly in the Irangi region.

[5] Although eastern gorillas are from time to time killed for their meat or to protect crops, the groups are now regularly attacked by armed bands that kill the adults and capture the live young to sell to traffickers.

[6] This is based on research carried out in Maiko National Park by ICCN as well as research carried out by the staff of the Tayna Gorilla Reserve (Sivalingana-Matsitsi *et al.*, 2004).

in certain areas, particularly the two types of red colobus monkeys, Hamlyn's monkey and the other guenon monkeys.

A survey of the southern part of Maiko National Park in 2004 revealed frequent traces of large mammals (African river hog, buffalo, okapi and several species of duiker) on every transect. Recovery still seems possible provided that anti-poaching measures are stepped up and people are educated and provided with alternative sources of protein. The bongo may possibly still exist, but according to local inhabitants this species disappeared at least 20 years ago. The leopard still appears to be present and some village inhabitants have reported seeing the Ruwenzori form.

Financing and conservation

The success of the CARPE initiatives, an indication of the success of the overall CBFP, has drawn the attention of international financing agencies, such as the World Bank, UNDP and the European Union. These agencies have promised support at different levels. The private sector also wants to be involved: Pfizer Inc, in partnership with the DFGFI, has promised to give more than one million US dollars in medicines to meet the critical needs of the populations concerned and help provide health care for the personnel of community conservation and ICCN. CI has also promised to provide support via its Global Conservation Fund for sustainable conservation activities in the Landscape. With additional funding from DFGFI, established through the CARPE partnership approach, the first trust fund could come on-stream in 2007-2008.

Management and governance in the field of renewable natural resources

(1) At the Landscape level

No overall zoning exists for the Landscape as a whole, but a zoning procedure for the entire Landscape has been set in motion. This process has been strengthened by contributions from local communities involved in conservation and the sustainable use of their resources.

(2) In the national parks

The principal activities are focused on rehabilitating the national parks, through the CARPE program and GTZ, and enhancing skills of the personnel. Land use plans for the national parks are currently on the drawing board. ICCN patrols now cover over 30% of the two national parks, compared with just 10% prior to 2003, and then only in Kahuzi-Biega National Park. This figure is set to rise. The community reserves have added 230,000 ha to the network of protected areas. Anti-poaching measures and scientific activities are being organized in the parks by interested local parties. Other community reserves will be created. A partnership has been forged with ICCN and the new network of protected areas will be absorbed into the overall ICCN network. For Kahuzi-Biega National Park, other avenues of participatory conservation are being explored.

(3) In extraction areas

No particular activities to report.

(4) In rural areas

With support from the DFGFI, the program focuses on creating community reserves located strategically inside a corridor linking the two national parks and on enhancing the skills of personnel employed in these reserves. In order to stimulate the interest of those involved, the project makes provisions for financial incentives and rural development activities directed at people actively involved in the community conservation initiatives at the local level. The community development projects are supported by the Jane Goodall Institute which, in partnership with DFGFI and local communities, creates opportunities underpinned by USAID funding for improving standards of living, health care and family planning.

Education in conservation is also a high priority for the future of the Landscape:

- Primary and secondary schools receive support to include conservation lessons in their curricula.
- A community university, approved by the government, has been developed under the Tayna program: the Tayna Center for Conservation Biology offers three-year conservation diploma courses.

The creation of these community reserves is an innovative approach conceived by the parties concerned in the Tayna Gorilla Reserve. This process has been boosted by the DFGFI Community Conservation Program launched during the war in 2001. It now supports eight NGOs that have formed UGADEC, a collective federation of community projects aimed at creating State-approved community reserves (Kakule & Mehlman,

2004) which will form a corridor between the two national parks. A second reserve of 120,000 ha, the Bakambule Community Primate Reserve (ReCoPriBa), has already been recognized by the provincial government and is awaiting recognition by the Ministry of the Environment in Kinshasa. This approach has enabled players to work on conservation, as well as draw up land use plans. This should lead to long term, more sustainable management of renewable natural resources and increase the coverage of protected areas to more than 40% of the Landscape. The designated areas for full protection in Tayna and ReCoPriBa will offer identical protection to that in the national parks and will be managed in partnership with ICCN.

Within the Tayna reserve, the Tayna Center for Conservation Biology is currently helping to enhance skills in management, conservation biology and environmental education. The first students will receive their diplomas, with support from CARPE, and go out to work in their communities at the end of 2006. Other students from other regions of DRC will be joining the program: 14 new students have been accepted as members of ICCN staff.

Figure 21.4. The eastern gorilla Gorilla beringei graueri.

22. Ituri-Epulu-Aru Landscape

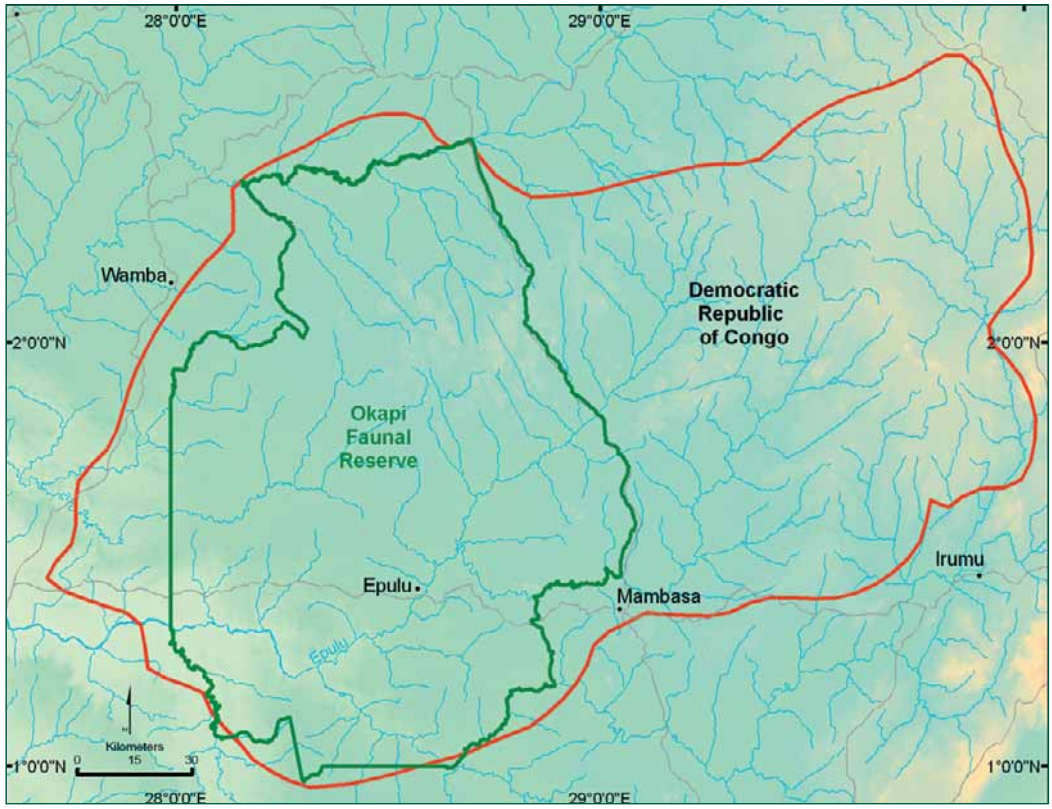


Figure 22.1. Map of Ituri-Epulu-Aru Landscape (Sources: CARPE, JRC, SRTM, SYGIAP).

The Landscape in brief

Coordinates: 2°40'37"N – 0°57'4"N; 27°41'41"E – 30°1'38"E
Area: 33,188 km²
Elevation: 700–1,300 m
Terrestrial ecoregions: Northeast Congolese forest
Northeast forest-savannah mosaic
Aquatic ecoregions: Central basin
Uélé
Protected areas: Okapi Wildlife Reserve, 1,370,000 ha, 1992

Location and area

The Landscape covers the upper basin of the Ituri River and thus the most northern part of the Congolese forest with its adjacent forest-savannah mosaic (Figure 22.1). It is mostly situated in the administrative territory of Mambasa (Ituri province). A strip of the Landscape is included in the territories of Irumu and Djugu in the Ituri province and the territories of Wamba and Watsa in the Haut-Uélé province. The Landscape touches on the province of Nord-Kivu, which is the origin of the most important demographic and economic developments affecting the Landscape.

Physical environment

Relief and altitude

Most of the Landscape consists of a slightly undulating peneplain at an altitude of 700 to 900 m, but rising up to 1,000 m in the east. The mostly gentle relief is punctuated by low massifs covering 20 km² or more and rising to 50 to 300 m above the peneplain along old fracture lines in the Gondwanian shield. These massifs join to form a spectacular chain of granite inselbergs exposing large stretches of naked rock. This extends for over 100 km from east to west along the Ituri and Nepoko watershed in the north of the Landscape and small isolated massifs extending over 50 km in the central part of the forest.

Geology and soils

The soils of the Landscape are mostly derived from degraded granite and quartzite of the Gondwanian shield. The soils range from red oxysol, fine and highly degraded, to yellow or brown sandy clay. Alluvium deposits occupy the banks of the watercourses and poorly drained basins of the heads of numerous rivers. The soils are generally very acidic[1] and this acidity is associated with low fertility, as well as a shortage of available nitrogen and phosphorus. More fertile areas exist, particularly in association with red oxysol. A systematic evaluation of the agricultural potential in the Landscape remains to be carried out.

Hydrology

Almost all the Landscape belongs to the Congo Basin and is covered with a dense network of permanent watercourses which flow into the Upper Ituri and its main tributaries: the Epulu, Nepoko, Nduye, Lenda, Ebiena and Ngayu rivers. A small part of the Landscape belongs to the Kibali-Bomokandi Basin, which constitutes the head of the Uélé-Oubangui system.

The region's rivers have moderate high waters with the maximum reached between September and November. After heavy rains, the small watercourses undergo brief high waters which disturb their beds and take away debris. Flood plains are rare in the Landscape and are limited to the largest rivers in the west, especially the Ituri, the Lower Ngayu and the Lower Lenda. The heads of numerous streams have poorly drained areas that create dendriform networks of marshy environments. So far, the heads of most of the basins draining the Landscape have been very little affected by human activities, unlike the case with rivers originating outside the Landscape. The latter often have more turbid waters associated with deforestation and other changes. The alluvium load in the Ebiena River, which has its sources in the denuded regions of Kivu, can be very high. The alluvium load of the Ituri River, which has its origin in the extensively logged areas in the east of the Landscape, has increased appreciably over the last ten years

There is still no hydroelectric development in the Landscape. With its extremely high gradients and vast volumes of water, the Upper Ituri and its main tributaries represent a substantial potential in this field.

Climate

The average daily temperature varies between 23°C and 25.5°C. Rainfall is bimodal, with rainy seasons centered on the equinoxes and dry periods centered on the solstices. Inter-annual variations can be considerable and are partly linked to the variability of the passing of the intertropical convergence. Rains often beat down during storms and are mainly caused by the climatic system of the Congo Basin. The monsoon effects of the Indian Ocean are not known[2], but it seems that the region's climate is influenced by dynamics outside the Congo Basin, leading one to suppose that it could undergo rapid changes.

The average annual rainfall in the Landscape is 1,600 to 2,000 mm. The driest month is January, the only time when the average rainfall dips below 50 mm in some parts of the Landscape. During the dry season, the sky is completely cloudless, humidity is low and evaporation very high. Even in dense forest, water losses are substantial. Some years, these dry periods are particularly long. In Epulu, in the center of the forest, during the span of the last 20 years, at least five years have had a sufficiently long dry period for forest fires to develop. As it is situated on the edge of the forest block and human impacts are increasing, the Ituri Landscape is very vulnerable to degradation and changes in its flora, even during relatively short periods of drought.

Vegetation

Most of the Landscape is covered with dense evergreen terra firma forests with a closed canopy (Figure 22.2). They comprise forests with a monodominance of *Gilbertiodendron dewevrei* (mbau), which forms both the canopy and the undergrowth, and mixed forests in which no species is predominant, but where other Caesalpinioideae, such as *Julbernardia seretii* and *Cynometra alexandri*, are abundant. In the north and the east of the Landscape, and on the dry slopes, there are semi-deciduous forests whose canopies contain more light-demanding species, such as *Entandrophragma spp*., *Khaya anthotheca*, *Albizia spp*. and *Canarium schweinfurthii*, and a growing proportion of dendritic Euphorbiaceae and Rubiaceae. At the northern and eastern ends of the forests, the dense forests turn into a mosaic of dry forests, evergreen forest galleries and wooded savannahs. Swamp forests grow along watercourses or in poorly drained areas. They are characterized by the presence of *Hallea stipulosa*, *Uapaca*

[1] The average pH values are around 4 in the Epulu area, where measurements were taken recently.

[2] At the end of the dry season, black rain fell on the Ituri forests during the first Gulf War in 1990-1991. Large fires in the oilfields caused enormous black clouds over the Persian Gulf and the northern Indian Ocean. These observations suggest an eastern influence on the Ituri climatic system.

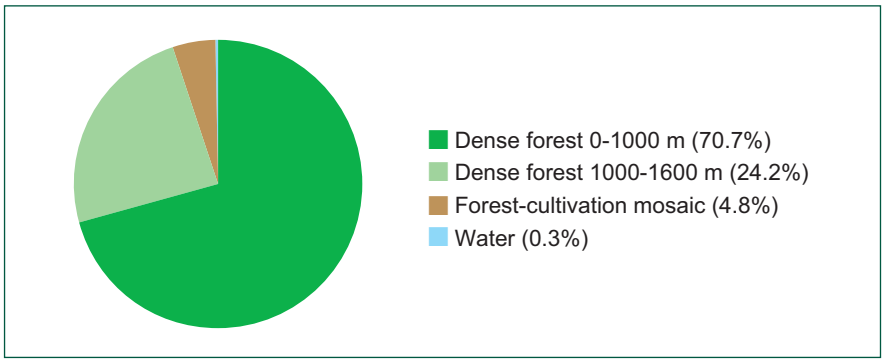


Figure 22.2. Main vegetation types (Source: JRC).

guineensis, and a local dominance of *Raphia sp.*. Lianas are abundant.

On the shallow and rocky soils on the granite inselbergs are highly specialized xerophile plant formations comprising many species of plants that have a limited distribution and are of global importance for conservation.

Throughout the Landscape there are also clearings, called *edo* locally, which are maintained by elephants, but used by a wide variety of fauna. The size of clearings varies from less than a hectare to several hectares. They are recolonized by the forest when the influence of elephants disappears.

Secondary forests of varying ages cover large parts of the Landscape, partly as a result of natural causes. Violent storms effectively tear large holes in the forest and a mosaic of primary and secondary forest develops. These mosaics can cover an area of more than 10,000 ha[3]. Over the last 25 years, three violent storms that affected the canopy over an area of more than 1,000 ha were recorded within an area of 500 km² around the Epulu station. Secondary forests are also the result of human activities: shifting agriculture and, to a lesser extent, small-scale logging. Around 2% of land in the reserve, as well as land outside, is covered with anthropogenic environments of different ages. This area of old agricultural land is limited to a 6-km wide strip along the road that passes through the Landscape. In the southeast of the Landscape, degradation of the forests and deforestation have increased over recent decades, causing the formation of vast areas covered with a mosaic of degraded forest and cultivated land. The extension of this area is a threat to the Landscape.

From a floristic point of view, the Ituri forest is very diverse. CEFRECOF data and additional collections reveal the presence of 1,190 species of plants in the dense forests around the Epulu station[4]. Collections in other areas of the Landscape could raise this number to 1,500 and perhaps even 2,500 if the forest-savannah mosaic is included.

[3] In these areas, the undergrowth, including advanced regrowth of canopy species, is not destroyed by storms and is 'liberated' by the opening-up of the canopy, which allows rapid regeneration.

[4] The botanical inventories carried out by the *Centre de formation et de recherche en conservation forestière* (CEFRECOF) since 1994 in the Epulu sector of the Landscape have revealed the presence of 700 woody plants with a stem diameter of over 1 cm in four parcels of 10 ha, including 460 species of trees and 243 species of lianas.

Fauna

Mammals

The Ituri forests are exceptionally rich in mammals and a total of 90 species have been found in the central sector. These forests are home to thirteen species of diurnal primates—the highest number for an African forest—and six species of duiker. The Landscape contains populations of world importance for several species with a limited distribution, endemic or almost endemic to the DRC: the okapi *Okapia johnstoni* (Figure 22.3), the aquatic genet *Osbornictis piscivora*, the giant genet *Genetta victoriae* and Hamlyn's monkey *Cercopithecus hamlyni*. It also has large populations of globally threatened species, such as the forest elephant *Loxodonta africana cyclotis* and the chimpanzee *Pan troglodytes*. Other important species are L'Hoest's monkey *Cercopithecus lhoesti*, the leopard *Panthera pardus*, the Cape buffalo *Syncerus caffer nanus*, the bongo *Tragelaphus euryceros*, the sitatunga *Tragelaphus spekei*, the African golden cat *Felis aurata*, the giant forest hog *Hylochoerus meinertzhageni*, the red river hog *Potamochoerus porcus*, the water chevrotain *Hyemoschus aquaticus* and the forest aardvark *Orycteropus afer eriksonni*.

The forest-savannah ecotone has not yet been systematically inventoried, but reports by missionaries before the recent civil war mention the lion *Panthera leo*, the spotted hyena *Crocuta crocuta,* the hippopotamus *Hippopotamus amphibius*, the East African Defassa waterbuck *Kobus ellipsiprymmus defassa*, the bongo *Tragelaphus euryceros,* the bushbuck *Tragelaphus scriptus*, the bohor reedbuck *Redunca redunca* and the vervet monkey *Cercopithecus aethiopicus*. The skin of a little known meerkat, Dyboswki's meerkat *Dologale dybowski*, a species which lives at the edge of forests, was collected recently. This suggests that the forest-savannah mosaic could contain specialized fauna that is rare or absent in other parts of the Congo Basin and absent from the more arid regions to the east and the north.

Birds

Ornithological inventories have only covered small portions of the Landscape, but at least 333 species have been observed in the central sector of the reserve. Systematic observations in the Epulu area have revealed a rich avifauna and a large number of specialized forest species, particularly among the ground thrushes *Zoothera sp.*, Timalidae and Accipitridae. The golden-naped

Figure 22.3. The Okapi Okapia johnstoni.

weaver *Ploceus aureonucha* is endemic to the Ituri forest.

Herpetofauna

There are no recent inventories and research will be necessary before the value of the Landscape for this group of animals can be estimated. However, collections in museums suggest that the Ituri forests are rich in reptiles, with three species of crocodiles, but that they do not constitute a 'hot spot' in this field. Very little is known of the amphibians.

Ichthyofauna

The Ituri River and its tributaries contain an ichthyofauna that is still largely unknown. It is fished locally, although not intensively at present. Given the fact that the Ituri Basin is well upstream in the Congo Basin, its fauna is not as rich as in the central basin. Furthermore, some major rapids on the middle course of the Ituri create a biogeographical barrier which isolates this river from the Congo River. Preliminary inventories carried out at the beginning of the 1980s showed that the ichthyofauna consisted primarily of generalist species that were usually widely distributed; it also included some species that have not yet been found elsewhere and specialist species such as rock browsers, which live in torrents and are probably endemic to the Ituri Basin. Some of these species were unknown to local fishermen whose methods are inappropriate for catching these specialist species.

Invertebrates

Diurnal butterflies are the only invertebrates that have been the subject of systematic inventories in the Landscape. Collections have been made in three places. In Epulu (altitude 750 m), the 6,251 specimens collected belong to 116 genera and 487 species. They include the most eastern collections for five species previously known only in West or Central-West Africa. These species are absent at the collection spots in the east of the Landscape, where the altitude exceeds 900 m and where there are species linked to the higher altitudes of the Albertine Rift (Ducarme, pers. comm.). These results confirm the importance of the Ituri forests as areas where species from separate biogeographical regions come together.

Humans in the Landscape

Density and distribution

Until recently, the Ituri forest was one of the least populated areas in the northeast of the DRC, despite a very long history of human occupation. Cut stone tools found at the eastern edge of the Landscape indicate human presence in the Middle Stone Age. However, it is not certain if the region was covered in forests at that time. Recent excavations in sheltered areas under rocks in the north of the Landscape show that a few millennia ago the forest was inhabited, but played only a minor role in the development of human cultures, particularly in the expansion of iron-working.

When the first Europeans arrived at the end of the 19th century and the first documents were written, the forests of Upper Ituri contained only small scattered villages and vast areas were not inhabited on a permanent basis[5].

The human populations in the Landscape increased during the colonial period, following the opening-up of the first roads and the development of mining and agricultural plantations in the region. Over the last 60 years, and most notably in the last 30, considerable migratory movements have invaded large portions of the Landscape. This immigration continued even during the latest conflicts between 1996 and 2003 and in spite of the clashes between rival militias who were present throughout the Landscape. Some immigrants were fleeing insecurity in their home region; however, even during the periods of conflict most of them were motivated by economic opportunities. These opportunities included easy access to cultivable land, jobs in mining or small-scale forestry and the small businesses that these activities generated.

Most recent immigrants in the Landscape come from the densely populated heights of the Albertine Rift, where the population density is over 100 inhabitants/km² and accessing new agricultural land is becoming difficult. The popula-

[5] The members of the first expedition, which visited the region around the end of the 1880s and had to obtain supplies from the local inhabitants, found so few villages that they nearly starved to death. The Arab slave trade and clashes between Westerners and Arabs in this region had perhaps reduced even further the already sparse populations. Whatever the case may be, the Ituri forests were less inhabited than the forests situated just to the west or the forest-savannah ecotone to the north.

tions of Beni, Butembo and Bunia, the major urban centers on the eastern edge of the Landscape, are increasing at the rate of 4.2% a year. In the northwest, the populations of the Isiro region are also growing quickly. An analysis of satellite images taken over the last 20 years shows that the regions adjacent to the Ituri Landscape are undergoing the most substantial deforestation in DRC.

Two vast blocks of the Landscape still have a low human population density:

- The wildlife reserve (around 1,400,000 ha), where a census in 2003, at the beginning of the CARPE-CBFP program, revealed that there were 17,000 people in the reserve (1.2/km²) and 37,000 people within 15 km of the limits.
- Immediately to the east of the reserve, the Mai-Tatu block (1,200,000 ha) has not yet been the subject of censuses, but is constantly occupied by military poachers, which suggests that it still contains sizeable animal populations.

The total human population of the Landscape is unknown. Mambasa and Nia-Nia, the two major centers, have fewer than 20,000 inhabitants, but are growing rapidly. Very roughly, the total population of the Landscape and its immediate periphery can be estimated at 300,000. The population of the Beni and Butembo region is about 1.5 million and has a growth rate of 2.5-2.8% a year.

Ethnic groups

The semi-nomadic Mbuti and Efe (Figure 22.4) were probably the first inhabitants of the region, but when they arrived is unknown. While their way of life today is similar to what it was originally, these Pygmies have not been able to live inside the forest independently of other ethnic groups and had to colonize the forest at the same time as groups practicing shifting agriculture. The latter are believed to have come to the region 2,000-3,000 years ago. At present, the number of Pygmies in the Landscape is estimated at 30,000. They continue to lead a semi-nomadic lifestyle, but still depend heavily on the Bantu populations.

Among the forest farmers, the main ethnic groups are the Bila, Ndaka, Lese, Mbo and Mamvu. They depend on shifting agriculture, supplemented by fishing and hunting. The Ngwana arrived in the Landscape with the Arab slave trade in the 19th century. During the colonial era, new populations were added. The most numerous are the Nande, from the mountains to the east of the landscape, and the Budu, from densely populated regions to the north and west. Many of the newcomers came to rejoin members of their family or clan. Today, all the centers where several families live contain several ethnic groups. The population of Epulu, with 2,000 inhabitants, comprises over 30 different ethnic groups.

Activities

Subsistence agriculture

Manioc, banana-plantain, rainfed rice, taro, yams and groundnuts are the main crops in the Landscape. Maize is used for the local production of alcohol. The agriculture practiced by the groups who traditionally live in the forest is based on a rotation system of two years of crops and ten years of fallow. Fields are small, generally less than 2 ha, and represent only a small proportion of the agricultural mosaic. The long periods of fallow allow the soil to regain its fertility and provide good habitats for fauna. The populations of certain animal species are denser in these secondary environments than in the adjacent forests. In areas where fallow periods are still long, clearing of the primary forest is very limited. The mosaic of secondary forests is rich in palm trees *Elaeis guineensis* and *Raphia sp*., which are rare in dense forests.

The recent immigrants practice a more intensive agriculture, with larger fields, shorter fallow periods and more extensive clearing of the primary forest. Although more research is necessary, studies show that fallow periods of five years or less lead to the soil becoming depleted, regeneration of forest coming to a halt and the forest being replaced by prairies of *Imperata* or thickets of bushes and lianas.

Cash-crop agriculture

During the late colonial period and up to the 1970s, there was substantial production in the Landscape of products for marketing: rainfed rice and palm oil were intended for the urban and mining centers and coffee for export. The traditional forest populations had very few cash crops. Coffee was produced by small family businesses, generally belonging to recent immigrants, or vast plantations typically owned by Europeans. In the 1970s, the expatriates' companies were nationalized and, subsequently, quickly abandoned. By the end of the 1970s, the road network began to deteriorate, access to markets became difficult, prices fell and crops were gradually abandoned. Today, production is minimal and there are no longer any coffee plantations. These plantations

Figure 22.4. Semi-nomadic hunters.

have been converted into land for subsistence agriculture or have been invaded by the forest.

Fishing

Small-scale fishing using nets, traps, lines and hooks is the most important activity after agriculture. In some communities near watercourses, fishing is the main activity. Immigrants from lower down the hydrological basin bring new methods and fish more intensively. An inventory of the ichthyofauna and its productivity is an essential priority in the Landscape.

Hunting

Hunting is practiced throughout the Landscape and is the primary activity of the Mbuti and Efe, who generally practice hunting by tracking. The use of nets and rounding-up methods is practiced in the center and south of the Landscape, while hunting with bows and arrows is dominant in the north and the east. Eight species of small ungulates are the main targets of this hunting. Hunters using dogs also catch several species of primates and small animals such as meerkats or rodents. When hunting with nets or bows and arrows, many animals manage to escape. This reduces the impact of hunting and makes it profitable only when there are large numbers of animals.

Mbuti hunters have hunting territories with more or less fixed camp locations, which are used on a periodic basis by clan or family groups[6]. The villagers hunt as well, but in their case this activity is carried out full-time by a few specialized individuals. Village hunters primarily use snares, which ensure a degree of success even when the animal populations are low. Budu hunters recently extended hunting with snares deep into the Landscape from the west. Few recent immigrants from Kivu are specialized hunters.

The use of firearms was not common until the civil war, when rival militia, joined by the national police, set themselves up in the Landscape to control access to gold and timber or to organize commercial and ivory hunting. At present, military arms are still circulating in the Landscape.

Incomes

Very few inhabitants of the Landscape have regular wages. Most of those with wages are employed through churches or international NGOs, including conservation NGOs.

The collapse of the road network in the 1970s has limited both access to markets and development possibilities. At present, bicycles are the main means of transport on what is left of the roads[7]. The economic context of the Landscape will probably change quickly when the roads are rebuilt. Repairs to the trans-African highway between Kisangani and Bunia are already under way. This road will facilitate immigration and improved access to markets will encourage the extraction of forest resources. In the absence of any controls, mitigation measures and management,

[6] Preliminary mapping of these hunting areas has been undertaken around Epulu and it remains to be seen whether this type of demarcation is as extensive in other sections of the Landscape.

[7] On the road that used to be trans-African, over 250 tons of goods were carried to Epulu on bicycles over a four-month period in 2002. Mostly, it consisted of cheap foodstuffs. There was no bushmeat and none of the agricultural products came from the Landscape.

the Landscape will come under unprecedented threats[8].

Mining

Ituri is rich in minerals: gold, coltan and diamonds. Gold mining dates back to the colonial period. Kilo-Moto was one of the main companies at that time, located near the eastern edge of the Landscape. Access to mining resources was a major issue in the civil war and is still at the heart of the present conflicts. Hundreds of small permanent or semi-permanent mines have become active since the legalization of small-scale mining in the 1980s. No Landscape-wide survey exists, but at least 25 camps are operational in the wildlife reserve. Today, all mining operations are on a small scale, even in the Kilo-Moto concession where miners work under contract. Most operations are concerned with alluvial gold, but a growing number of miners are trying to extract gold from the parent rock after grinding and washing it with mercury. This trend will increase as the price of gold increases.

Land use

Most of the Landscape is not managed or legally allocated (Figure 22.5). The largest legal area is the Okapi Wildlife Reserve. As concerns extractive areas, there is an ENRA concession.

Logging

Logging is concentrated in semi-deciduous forests, near the transitional area between the dense forests and the wooded savannahs in the east, where valuable species such as *Milicia excelsa*, *Entandrophragma sp*. and *Khaya anthotheca* are more abundant.

There were no concessions in the initial Landscape, but in 2004 the limits of the Landscape were extended to encompass the only legally registered logging area in eastern DRC. It covers about 52,000 ha and has been allocated to ENRA, which has its base in Beni. This small company produces 5,000-7,000 m^3 of sawn timber a year. Another company, Dara Forest, was active during the period of the rebellion, but it was unable to legalize its activities, most likely due to the fact that it was involved in illegal exploitation of the country's resources during the war. It is continuing with its illegal activities.

Most logging in the Landscape is in the form of small-scale activities stretching from the south and east right across the Landscape[9]. There is virtually no logging in the north or west, because of the very bad state of the roads. This illegal small-scale logging and agriculture are major threats for the ENRA concession.

Reasons for the identification of the Landscape

(1) The Landscape is one of the main reservoirs of biodiversity on the continent.
(2) The Landscape is one of the last refuges for large fauna in DRC, especially for okapi, the last large populations of chimpanzees and forest elephants[10].
(3) BirdLife International has included the Ituri forest among its Important Bird Areas (IBA).
(4) The Landscape has the last large forests where populations of semi-nomadic hunter-gatherers continue to live and the Okapi Wildlife Reserve constitutes a unique opportunity to develop participatory wildlife management with these populations, who represent 18% of the human population in the reserve. Without a legal definition of land uses, controls on immigration and regulations protecting traditional hunting, the Mbuti and the Efe will quickly become a minority on their own lands[11].

Conservation

History

The exceptionality of the Ituri forest was recognized as soon as the first biological explorations of the region were carried out at the beginning of the 20th century. Active conservation began with the installation of the station at Epulu, with a view to catching live okapis for zoos around the world. To this effect, the station set up a system of zones for catching the animals along the road running from the east of Nia-Nia to the west of Mambasa. In these zones, the okapis' habitat was left intact and those inside the zones were protected by the local populations, who were the first to be hired during the capturing campaigns.

Management of the station was taken over by ICCN, which continued the tradition of protected capture areas. During the 1980s, it became clear that the traditional authority was not going to be able to keep up this protection when faced with the level of immigration into the forest. Consequently, in 1992, the wildlife reserve was created and placed under the authority of ICCN. The legal text creating this protected area mentions conservation as a priority, but also allows for

[8] At the moment and for the foreseeable future, the populations of the Landscape have no means of generating income other than by intensifying and marketing the products of subsistence activities, especially agriculture, hunting, fishing, crafts, small-scale logging, mineral extraction or small businesses. All of these activities are going to have to be managed to prevent degradation of the Landscape.

[9] These small-scale loggers work in little associations using chainsaws to produce rough-sawn timber on the felling site and use modified bicycles to carry the wood as far as the road, where it is loaded onto vehicles for export to East Africa. About 150 loggers were active in the southeast of the Landscape, most of them without legal permits.

[10] Recent studies over 5,500 km^2 in the central part of the reserve showed that 3,000 elephants have survived the war. Elephants also exist in another area of 3,000 km^2 and in an unknown portion of the Mai-Tatu block, where surveys are planned.

[11] This tendency is already clearly visible with the Pygmies living in the immigration areas or outside the Landscape.

a lot of freedom in the management of the reserve to accommodate access by the local populations and traditional non-destructive hunting. The reserve covers 1,370,000 ha, which represents over a third of the Landscape. In 1996, it became a World Heritage Site, on the basis of its faunal richness and its importance for the traditional peoples of the forest.

A coalition comprising ICCN and some international NGOs (WCS, WWF and GIC) has worked on conservation of the reserve since the mid-1980s, particularly through the creation of a research and training center (CEFRECOF). At the beginning of the civil war, ICCN, WCS and GIC, with the support of the United Nations through UNESCO, formed a partnership ensuring the permanent presence of conservation personnel in the reserve throughout most of the troubles. This presence continues to supply information which has allowed the reserve to be supported at the international diplomatic level and has protected its headquarters and at least some of its resources.

Since the mid-1990s, in accordance with the ICCN mandate to manage the reserve, the original capture areas have been consolidated to serve as the basis for a formal zoning plan, which continued to be developed during the conflicts and still constitutes a priority management objective. This zoning provides for the creation of 22 agricultural areas—six already existed—linked to well-established communities living on the edge of or in the reserve. Clearing of land inside the reserve will be limited to these areas and demarcated according to the present and future needs of the populations. Two additional areas have been proposed, but their limits and management method are still to be defined. The first is a traditional hunting area which will cover most of the reserve and will be used exclusively by the Mbuti and the Efe. The second will be an integrated protection area intended to protect large animal populations from any form of exploitation.

Players

The players active at present are:

- ICCN
- the local populations involved in the zoning program for the reserve
- the territorial administration, comprising group leaders, three sector leaders and the administrator of the territory of Mambasa
- international NGOs: WCS and Gilman International Conservation (GIC)
- UNESCO in support of the information management unit based in the reserve, which is linked to ICCN
- ENRA, the private logging company which wants to improve the management of its resources
- the association of small-scale loggers

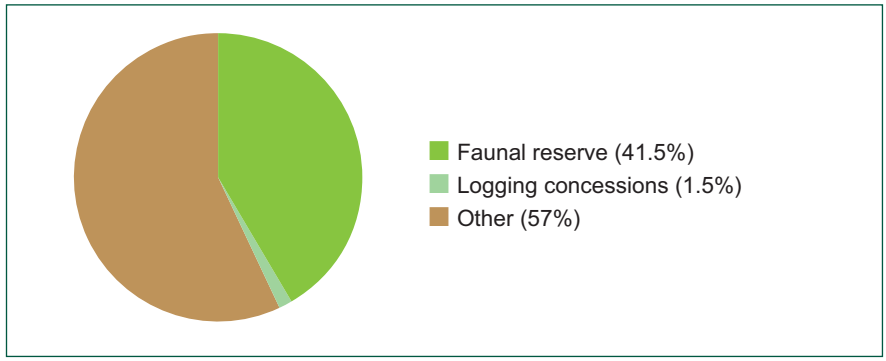


Figure 22.5. Main land uses.

Direct threats

(1) Small-scale logging and agriculture

These two activities fragment the forest. This process is well advanced at the southeastern edge of the Landscape, demonstrating what must absolutely be avoided if the Landscape is to retain its biological value and its importance for the traditional peoples of the forest[12]. New access to markets and the rise in prices could set cash-crop agriculture in motion. Without sound management, this could open up the forest to major clearing and the arrival of new populations.

(2) Ivory hunting

Elephant hunting and the illegal ivory trade started in 1996 with the beginning of the civil war. They expanded in 2002-2004 when rival militia, joined by the national police, established hunting camps in the Landscape, recruited and armed professional hunters and signed contracts with local dealers to sell the meat and ivory[13]. ICCN drew up a report on these massacres, which perhaps had the effect of the military and poaching camps being removed in 2004 and 2005. Elephant poaching has now been reduced considerably, but there are far fewer elephants to hunt and the animals that survived are harder to find. An unknown number of hunting units are still active in the Mai-Tatu block, where poaching continues. ICCN has found that the number of military arms in circulation has fallen, but they are still present in the reserve.

[12] The increase in the settlement of populations begins with the creation of small isolated hamlets and the introduction of small-scale logging from existing roads. These gaps grow and increase in number, forming a mosaic of secondary vegetation and fields. In the more advanced stages, the forest is severely fragmented and/or reduced and new villages spring up, connected by trails and footpaths.

[13] Over a 12-month period from 2002 to 2003, ICCN information gathering services identified 17 tons of ivory crossing the Landscape. They were unable to do anything about it due to the high-level of political protection enjoyed by some poachers.

(3) Hunting for meat

Hunting is very widespread and its impact on the fauna varies according to the methods used. Hunting with snares, which is very destructive, has grown considerably over the course of the last decade and has now reached remote regions of the Landscape. The trade in bushmeat has also increased significantly in the reserve and the Mai Tatu block. Animal populations in the southern part of the Landscape and the areas around large villages have been reduced to the point where meat consumption in these areas is virtually nonexistent. The trading network involves dealers and buyers in the regions of Beni, Butembo, Kisangani and Isiro, but there is also considerable meat consumption in Mambasa and Epulu, the headquarters of the reserve.

(4) Small-scale mining

This is a localized threat, but it can have major repercussions due to the fact that it is accompanied by uncontrolled population movements and an increase in the trade in bushmeat. Many small mines are characterized by significant variations in the level of activities; however, when mines are eventually abandoned the populations do not always leave the invaded areas. In this way, mining contributes towards the establishment of permanent communities. A recent census conducted in the reserve, where mining is illegal, reveals that many new immigrants are former miners who came from far away and have decided to become farmers.

(5) Commercial fishing

Recent observations suggest that small-scale fishing is growing in the Landscape, but it does not constitute a threat at the moment. With road repairs, this growth will continue and fish stocks will drop in the areas where fishing is heaviest.

Indirect threats

(1) Increase in human populations

A considerable increase in the populations, especially through immigration, has been observed in several places in the Landscape. The recent conflicts have not changed this trend and this increase will probably accelerate with improved access and the return of a certain level of security. In the reserve, censuses carried out by WCS between 1994 and 2003 reveal an increase of 6-16% in the major centers. Sometimes, this growth can be rapid: in 2004, the population of Epulu rose from 1,570 to 2,265 in six months when security returned and the NGOs supporting the reserve resumed their activities. Some of these increases can be temporary, but it is clear that the overall population of the Landscape has risen considerably over the last 50 years.

(2) Lack of management capacity

The weakness of the local government authorities, including a lack of funds, weak institutions, incompetence and corruption, means that the State agencies responsible for the monitoring and management of natural resources are unable to carry out their tasks. The development of any new institutional platform for the implementation of management in the Landscape is also handicapped by the lack of a mandate. This compromises efforts to resolve conflicts concerning the use of resources and weakens the ability to control abuses. Without a clear mandate, local management programs can be wiped out or brushed aside by external forces that are more politically powerful. Even when such a mandate exists, implementing it can be compromised: ENRA, for example, has logging rights on its concession, but cannot prevent either illegal logging or illegal installations.

The problem of a lack of mandates is one of the reasons why conservation activities are focused on the reserve. Within its limits, ICCN exercises a mandate that covers a large number of management activities and, although some of these activities still have to be legally and administratively confirmed, its authority is clear. This is not the case outside the reserve or in the Landscape. Establishing mandates for these areas remains a major challenge.

Financing and conservation

Most of the financing for the Landscape comes from CARPE. Additional funds from WCS and GIC are primarily devoted to the reserve. Anticipated finance includes 3 million euros for the reserve from the German development bank (KFW) between 2007 and 2012 and US $100,000 from UNESCO's emergency fund for 2007-2009. Outside the reserve, ENRA should be investing funds in the management of its concession, but as long as the limits are not respected and illegal logging continues, this company will not continue to make investments in sustainable forestry. The Catholic church of Mambasa and several humanitarian NGOs based in the Landscape are also injecting funds into development. Coordination among these players is only in its infancy. As for ICCN, the organization provides little financing for the reserve and the Ministries in charge of the environment and mines make even fewer funds available for the Landscape.

Environmental education and capacity building

Environmental education programs were first initiated by GIC in the reserve 15 years ago. Since the end of the civil war, these have been renewed and extended beyond the reserve. These programs are increasingly seen not only as a way of making the values of the reserve known, but also as a basis for a dialogue and exchange of information that can facilitate the development and implementation of the zoning of the reserve.

Management in the field of renewable natural resources

(1) At the Landscape level

There is no zoning or other activity in the pipeline at the Landscape level.

(2) In the reserve

Conservation-related activities are based in the reserve and focus on two crucial activities:

- anti-poaching patrols carried out by ICCN
- zoning of the different forms of land use undertaken by ICCN and its NGO partners

The reserve is to be split up into three types of areas:

- agricultural areas
- small areas where human settlements and land clearing will be permitted
- hunting areas, covering most of the reserve, where only traditional methods (nets, bows and arrows) will be allowed
- total protection areas for the conservation of key species

These activities require improved governance, particularly as relates to controls on immigration. To this effect, ICCN, in conjunction with its partners and the administrative authorities, is testing a pilot program to regulate access and the permitted length of residence in the reserve, through the introduction of a residence permit. Four types of status will be recognized:

- permanent resident
- temporary stay
- in transit
- returning to place of residence

Only the members of ethnic groups who traditionally used to live in the reserve and whose home villages were in the reserve can obtain the status of returning resident. The zoning program, including controls on immigration, has incorporated several administrative levels. Legalization of these activities must be pursued.

(3) In the extraction areas

The CARPE program for the Landscape is working with ENRA in an effort to establish a plan for the sustainable management of the concession. This plan will serve as a model for another proposed concession to be set up beyond the small-scale logging and agriculture front, so as to form a buffer zone at the edge of the reserve.

(4) In the rural areas

For zoning to be successful, shifting agriculture must be slowed down and agricultural production increased through improved methods. Towards this end, WCS and GIC have undertaken several assistance projects for farmers, which include technical support, the distribution of selected seeds and tools and the introduction of new crops, agro-forestry methods, composting and fish farming. These promising initiatives must now be assessed.

Human-animal conflicts must be controlled, especially as the animal populations around crops will increase.

Hunting must be managed. The present approach involves studying how traditional hunters use and manage access to their forests. The information collected will be used to develop culturally acceptable recommendations for controlling access and preventing the most intensive forms of commercial hunting, concurrently consolidating and confirming the rights and responsibilities of the traditional communities with respect to hunting.

Small-scale logging must be managed through support for legally recognized associations of small-scale loggers already established in the Landscape and its periphery. Major problems to be resolved concern the allocation and protection of concessions, working practices, controls on environmental attacks and taxation.

Research and monitoring

In the past, the wildlife reserve and the Ituri forest have served as a framework for basic research programs, which themselves serve as the basis for the management programs being developed today. These interventions must be continued and extended to address new challenges that are already taking shape.

The most important research over the last 30 years has concerned key species (okapi, duiker, elephant), basic studies on forest dynamics and phenology and socioeconomic subjects related to the traditional peoples of the forest and the new immigrants. Since it was created in 1990, CEFRECOF in Epulu has also served as a training and applied research center supporting the wildlife reserve.

Present work centers on obtaining post-conflict data on the biological and socioeconomic state of the Landscape and on the impacts of its utilization by human populations. Approximately 40% of the inventories have been completed. They have collected data on action to combat poaching and on the development of zoning. A program based at ICCN and supported by Belgium and UNESCO has produced a basic map of the wildlife reserve and is now developing capacity to manage data concerning the protected area in Epulu.

Transport and tourism

Before the war, Epulu was an important transit center for commercial and tourist vehicles traveling to or from Kisangani. Every day, 10-20 trucks stopped at Epulu and the local populations were able to sell their agricultural produce or buy salt, paraffin, cigarettes, food, clothing and many other items. Tourism was also an important source of income for local populations: between 1987 and 1993, 22,775 tourists visited Epulu to see the okapis in the captivity of their vast enclosures.

23. Virunga Landscape

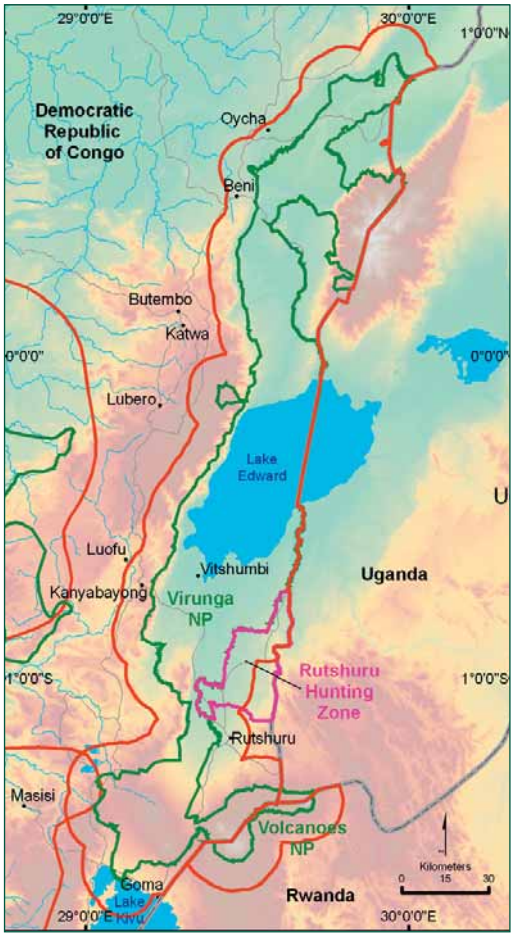


Figure 23.1. Map of Virunga Landscape (Sources: CARPE, DFGFI, JRC, SRTM, WWF-EARPO).

The Landscape in brief

Coordinates: 1°1'29"N – 1°44'21"S – 28°56'11"E – 30°5'2"E.
Area: 15,155 km²
Elevation: 680–5,119 m
Terrestrial ecoregions: Ecoregion of the Afroalpine barrens of Ruwenzori-Virunga
Ecoregion of the Afromontane forests of the Albertine Rift
Ecoregion of the forest-savannah mosaic of Lake Victoria
Aquatic ecoregions: Mountains of the Albertine Rift
Lakes Kivu, Edward, George and Victoria
Protected areas: Virunga National Park, DRC, 772,700 ha, 1925
Volcans National Park, Rwanda, 16,000 ha, 1925
Rutshuru Hunting Domain, 64,200 ha, 1946

Location and area

The Virunga Landscape covers 15,155 km² and includes two contiguous national parks, Virunga National Park in DRC and Volcans National Park in Rwanda, the Rutshuru Hunting Zone and a 10 km-wide strip at the edge of the national parks (Figure 23.1). It therefore contains human populations who have a direct impact on the protected areas. Although the more remote populations also have an influence, the conservation program has chosen to work with the immediate peripheral communities because they use the savannahs and forests in the parks to obtain firewood and building materials or to clear land for agriculture and the construction of infrastructure. Outside the Landscape, the two national parks are also contiguous with the national parks of Semuliki, Queen Elizabeth, Rwenzori and Mgahinga in Uganda. Together, these six national parks constitute the largest transborder complex of protected areas in Africa, to which must be added Bwindi-Impenetrable National Park situated a short distance away from the volcanoes in southwest Uganda. This complex functions as a single ecosystem and many animals move across the borders, which permits restoration of the populations[1].

Physical environment

Relief and altitude

The Landscape is focused on the central trough of the Albertine Rift, occupied by Lake Edward (916 m, 2,240 km²), and vast plains at an altitude of between 680 and 1,450 m. Its western edge stretches along the eastern bluff of the Mitumba Mountain Range forming the western ridge of the rift. In the northeast, it includes the western bluff of the Ruwenzori horst (fault block) with its active glaciers, whose peak reaches a height of 5,119 m and whose very steep relief comprises numerous old glacial valleys (Figure 23.2). In the south, on the border between DRC and Rwanda, it contains the Virungas, a series of eight large volcanoes surrounded by innumerable smaller volcanoes emerging from a vast plateau of lava. The highest volcano, Karisimbi, rises to a peak of 4,500 m (Figure 23.3).

Geology and soils

The mountains along the western fringe of the Landscape consist of metamorphosed rocks from the Proterozoic era. The Ruwenzori is a block of highly metamorphosed rocks (mainly gneiss) which was pushed and driven upwards in the middle of the graben, splitting it into two branches: the Semliki along the line of the rift and

[1] In the first half of the 1990s, following years of war and troubles in Uganda, hundreds of elephants reoccupied Queen Elizabeth National Park, very probably coming from DRC.

Figure 23.2. The high summits of the Rwenzori Range.

Figure 23.3. The Virunga.

Lake George farther east. The plains to the north and south of Lake Edward consist of Quaternary alluvions providing sandy or clayey-sandy soils, but there are also horizons of volcanic dust. The oldest volcanic formations date from the Miocene (12 million years); the most recent are present-day[2]. These volcanic formations provide highly permeable soils that are unable to hold water but are extremely fertile[3]. The soils of the plains around Lake Edward have also been influenced by the area of explosive volcanisms in Uganda, just to the east of the Landscape in Queen Elizabeth National Park.

Hydrology

The volcano region has no or very few watercourses, but most of the southern part of the Landscape drains into Lake Edward through the Rwindi, Ishaha and Rutshuru rivers. From Lake Edward, the waters descend into Lake Albert via the Semliki, which also receives the waters from Mitumba and the western slopes of Ruwenzori, and then on to the White Nile. Apart from Lake Edward, the Landscape also contains Lakes Bulera and Ruhondo in Rwanda, high-altitude lakes formed by the dam of high valleys following volcanic eruptions, together with the northern shore of Lake Kivu[4] in DRC. These lakes also belong to the Nile Basin via the Akagera River. Only the shores of Lake Kivu and the few streams that flow into this lake belong to the Congo Basin.

Climate

The climate is bimodal with two rainy seasons around October-November and April-May and two dry seasons around January and July. However, rainfall and temperatures vary enormously according to altitude and relief[5]. Gradients are very steep in places. The plains to the south of Lake Edward are hot and receive less than 1,000 mm of precipitation a year on average, while the saddle between the Karisimbi, Mikeno and Bisoke volcanoes receives over 2,000 mm at an altitude of 3,000 m. The flanks of the Ruwenzori are also very rainy, while the highest peaks, over 4,000 m, are dry[6]. Locally there are fog effects which accentuate rainfall. Above 3,500 m, night frost is frequent.

Vegetation

The main types of vegetation are (Figure 23.4):

(1) grassy savannahs; bush and tree savannahs of *Acacia* and *Combretum*; savannahs with xerophile thickets; and wooded savannahs having close floristic affinities with East Africa, dominant in the central part of the Landscape between the towns of Rutshuru and Beni and around Lake Edward

(2) sclerophyllous forests and thickets, associated with the lava fields in the south of the Landscape, in the Nyiragongo and Nyamulagira sectors

(3) xerophile forests of *Euphorbia dawei* and *Olea europea*, endemic to the piedmonts of the rift mountains

(4) Guinea-Congolese plain forests, limited to the northern part of the Landscape along the Semliki River and comprising mixed formations and formations dominated by *Cynometra alexandri*

(5) riparian forests

(6) submontane and montane forests with formations of *Podocarpus*, *Hagenia* and *Hypericum* and thickets of bamboo *Synarundinaria alpi-*

[2] The volcanoes are split into three groups, of which the group lying farthest west, formed by the Nyamulagira (3,058 m) and the Nyiragongo (3,470 m), is still active. The last major eruption in January 2002 seriously affected the city of Goma.

[3] Before the colonial power installed water supplies, mainly in the 1950s, this volcanic region was very sparsely populated, however, it was used in places as a pasture area by transhumant herdsmen.

[4] Lake Kivu is itself formed by the damming of a river, which flowed into Lake Edward following the formation of the Virungas.

na, limited to the flanks of Ruwenzori to the northeast and the volcanoes in the south

(7) high-altitude barrens and thickets of Ericaceae (*Philippia benguelensis*, *Ph. johnstoni*, *Erica arborea*, *E. kingaensis*)

(8) Afroalpine barrens with giant lobelia *Lobelia sp*. and dendritic senecios *Senecio sp*., above 3,500 m on the volcanoes and Ruwenzori[7] (Figure 23.5)

(9) degraded forests and cultivated land, generally outside the protected areas

(10) swampy areas around Lake Edward.

In Virunga National Park, 2,077 plant species have been recorded, of which 230 are endemic to the mountains of the Albertine Rift (Plumptre *et al*. 2003).

Fauna

Mammals

Over 210 species of mammals have been found in the Landscape. Of these, 21 are endemic to the Albertine Rift, particularly the Ruwenzori otter shrew *Micropotamogale ruwenzori* and the mountain gorilla *Gorilla beringei beringei* (Figure 23.6); others are endemic to the northeast of the Guinea-Congolese forests, especially Elliot's red colobus of Uganda *Piliocolobus oustaleti* and the giant genet *Genetta victoriae*. Among the important but widely distributed species, mention must be made of the chimpanzee *Pan troglodytes*, the elephant *Loxodonta africana*, L'Hoest's monkey *Cercopithecus lhoesti*, Hamlyn's monkey *Cercopithecus hamlyni* and the giant forest hog *Hylochoerus meinertzhageni*.

The savannah species include the lion *Panthera leo*, the spotted hyena *Crocuta crocuta*, the aardvark *Orycteropus afer*, the topi *Damaliscus lunatus* and Buffon's kob *Kobus kob*. The population of hippopotamuses *Hippopotamus amphibius* was the largest in Africa in 1959 with over 25,000 individuals.

Birds

The avifauna comprises 706 species of which 25 are endemic to the Albertine Rift. Most of these endemics are forest species, particularly the yellow-crested helmetshrike *Prionops alberti*, the Kivu ground-thrush *Zoothera tanganjicae*, Shelley's crimson-wing *Cryptospiza shelleyi* and Stuhlmann's double-collared sunbird *Nectarinia stuhlmanni,* which is known only in Ruwenzori; others live in high altitude vegetation, particularly the red-tufted sunbird *Nectarinia johnstoni*, while one species, Grauer's scrub-warbler *Bradypterus graueri*, only lives in high- altitude marshes with Cyperaceae. The papyrus gonolek *Laniarius mufumbiri*, which is specific to papyrus, is endemic to the Lake Victoria region[8]. Finally, the humid environments of the Landscape are also important for migratory populations of certain Palearctic birds, particularly many shorebirds and the white-winged tern *Chlidonias leucopterus*.

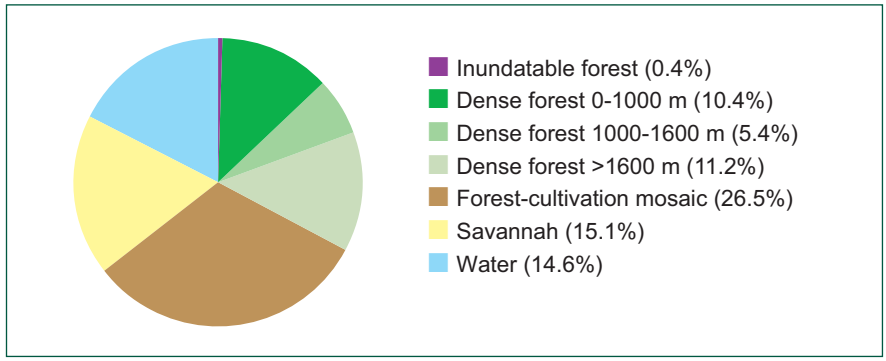


Figure 23.4. Main vegetation types (Source: JRC).

Herpetofauna

Reptiles are represented by 109 species of which 11 are endemic to the Albertine Rift (including the bush viper *Atheris nitschei*). The Nile crocodile *Crocodylus niloticus* has recolonized Lake Edward after an absence of probably several thousand years. Amphibians are represented by 78 species of which 21 are endemic.

[5] The average temperature falls by 0.6C° per 100 m rise in altitude.

[6] Rainfall on the summit of Karisimbi is estimated at 800 mm/year on average.

[7] The high-altitude environments of the volcanoes and Ruwenzori have a similar, but not identical flora; many species are common, but others are limited to a single massif.

[8] Of the 9 species connected with this region and known in the DRC, 6 have been found in the Landscape (Fishpool & Evans, 2001).

Figure 23.5. Afroalpine moorland with giant lobelias and groundsels.

Table 23.1. Percentage cover of different types of vegetation in the Virunga Landscape

Type of vegetation	Cover in the Virunga National Park (%)
Afroalpine moorland and thickets	1.42
Moorland and thickets with heath	2.81
Forest of *Hagenia*	0.37
Bamboo thickets	2.36
Forest galleries	1.4
Montane forests of *Podocarpus* and *Neoboutonia*	11.25
Sclerophyllous forests and thickets	10.95
Sclerophyllous forests of *Euphorbia dawei*	1.31
Dense moist forests	11.78
Savannahs	35.79
Recent lava flows (less than 10 years ago)	2.3
Lakes	18.26

Figure 23.6. The Mountain Gorilla
Gorilla beringei beringei.

Ichthyofauna

The ichthyofauna of Lake Edward has been shaped by several phases of mass extinction, probably on the occasion of volcanic events, the latest of which date back 8,000-10,000 years (Thieme *et al.*, 2005). Some families, particularly the Mastacembelidae, Characidae and Schilbaeidae, well represented in the waters of the Nile Basin, are absent now. The Cichlidae in Lake Edward, which constitute the majority of the fish biomass in the lake, are related to those in Lake Victoria[9]. About 80 species have been described to date, of which 60 or so are endemic to Lakes Edward and George, but some waters have not yet been explored and some species are still to be described. Lake Edward is therefore very important from the point of view of biodiversity and until recently it was also one of the least disturbed of African lakes.

Invertebrates

Of the diurnal butterflies, 21 species are endemic to the Albertine Rift, particularly *Papilio leucotaenia*, a species that has only been found in a very few places.

Humans in the Landscape

Density and distribution

The population density varies from 6 to 600 inhabitants/km², on average, it is 300 inhabitants/km². These populations are scattered throughout the Landscape, especially outside the protected areas, but locally they can also be found in the protected areas, particularly in the fishing villages around Lake Edward. The urban centers with more than 10,000 inhabitants include Goma, Beni, Rutshuru and Kiwanja in DRC and Ruhengeri in Rwanda. Before 1950, the volcanic land around the Virungas was practically only inhabited by transhumant herdsmen (Gogwe). Farmers did not move into this region until water supplies had been installed by the colonial authorities.

Ethnic groups

The main groups are the Nande of Lubero, Beni and Rutshuru, the Hunde of Masisi, Rutshuru and Goma, the Nyanga of Walikali, the Pere, the Kumu, the Twa and the *Banyarwanda* (Hutu and Tutsi).

Activities

The main activity is permanent intensive agriculture; about 80% of the population practices this activity. Around 5% of the population fishes—several thousands illegally—and fewer than 1% are involved in pastoralism. Many people hunt, but hunting is not a main activity; it is only a supplement to agriculture. About 14% of the Landscape's inhabitants are supported through other activities, mainly jobs in towns.

Land use

The main land use is conservation (52%); agriculture covers 45% and fishing 3% (Figure 23.7). Around 80% of land outside the national parks is used for permanent agriculture. Industrial crops include coffee, tea, cocoa and, in Rwanda, pyrethrum. Apart from fishing in Lake Edward, there are no protected areas with extractive activities and there are no forestry concessions.

Main reasons for the identification of the Landscape

(1) The Virunga (DRC) and Volcans (Rwanda) national parks form part of the first national park created in Africa (1925) for the spectacular large fauna that used to live on the savannahs around Lake Edward and for the unique mountain and lake landscapes; Virunga National Park has become a World Heritage Site (1979) and Volcans National Park is a Biosphere Reserve.

[9] A genetic study of the Cichlidae in Lakes Edward and Victoria shows, however, that the species of this family are derived from species in the Congo Basin and are not Nilotic. In fact, until 400,000 years ago, the waters in these regions drained into the Congo Basin and were not captured by the Nile until after the upheaval caused by the formation of the rift (Seehausen *et al.*, 2003).

(2) Given the extraordinary diversity of habitats, this Landscape is the most diversified in Central Africa, at least as far as vertebrates are concerned.

(3) The high-altitude ecosystems around the volcanoes and Ruwenzori are unique.

(4) It is an area of world importance for conservation due to the fact that it is home to a very large number of species of mammals endemic to the Albertine Rift and which do not exist in other CBFP Landscapes, apart from the Maiko-Tayna-Kahuzi-Biega Landscape.

(5) It is considered to be an important area for bird conservation (Fishpool & Evans, 2001).

(6) It is important for its ichthyofauna, notably its large number of endemic Cichlidae.

Conservation

History

Volcans National Park and Virunga National Park were created in 1925 as a single entity: Albert National Park. They were separated in 1960, with the independence of DRC. The Rutshuru Hunting Zone was created in 1946. Volcans National Park has had areas removed on two occasions, cutting its total area by about 50% and also reducing its habitat diversity[10]. Since the 1970s, the two national parks have benefited from some major support projects, particularly from the Belgian Cooperation and the European Community.

Players

(1) Governmental players

ICCN in DRC and ORTPN in Rwanda are in charge of managing of the protected areas.

(2) Conservation NGOs

These are represented by AWF, FFI, WWF, FZS, DFGF-Europe, DFGF-International, MGVP, ZSL, BRD, CBO and CBV.

(3) Conservation projects

The principal projects are the WWF project (800,000 US$/year), which covers the entire Virunga National Park, and the International Gorilla Conservation Program (AWF, FFI and WWF), which covers both national parks (800,000 US$/year for these two areas). The zoological societies of London and Frankfurt also have important projects in support of ICCN for Virunga National Park. WSC, DFGF and other organizations also support conservation efforts in this Landscape.

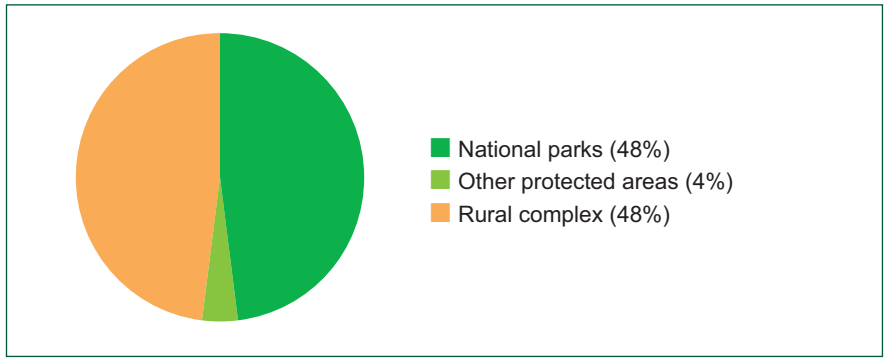


Figure 23.7. Main land use types.

Direct threats

(1) Conversion of habitats

This is the main threat to the Landscape, with irreversible effects (Box 23.1). Over 168,000 farmers have invaded Virunga National Park over the last seven years. They have degraded 90,000 ha. Although a number have been relocated elsewhere, 50,000 people still live in the Kilolirwa area and 30,000 on the western shore of Lake Edward.

(2) Military camps

The presence of military positions and camps in Virunga National Park has a negative impact on natural resources: uncontrolled and poorly paid troops poach, their families grow crops and the camps attract much human activity and trading.

(3) Small-scale mining

Small-scale mining concerns only 5% of the Landscape and is much less important than in other Landscapes in DRC.

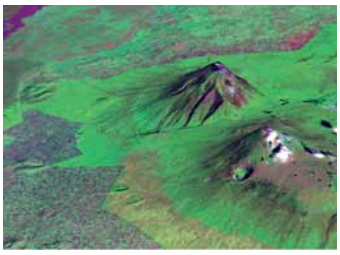
(4) Hunting

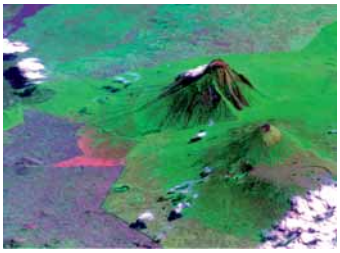
Hunting for meat has dramatically reduced all the populations of large mammals in Virunga National Park.

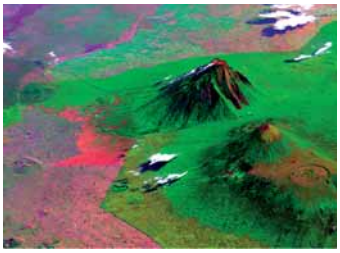
(5) Fishing

Illegal and unsustainable fishing is a serious threat to the resources of Lake Edward.

[10] In 1958, 70,000 ha were given over to agriculture and in 1969, 10,000 ha were cleared for the planting of pyrethrum. The *Prunus africanus* forests have thus disappeared (Vande weghe, 2004).







Box 23.1. Deforestation crisis in Virunga National Park

Virunga National Park, one of the most prominent World Heritage sites in DRC, lost more than 15 km² of forest between May 19 and July 3, 2004. The extent of the deforestation was derived from SPOT 10-m multitemporal images. Once alerted, ICCN, the WWF Albertine Rift Ecoregion Programme and UCL-Geomatics (Belgium) acquired high resolution imagery to quickly quantify the ongoing deforestation and make these images available to decision makers. More than 7 km² of forest was clear-cut and more than 8 km² degraded by about 6000 people; according to different NGO reports these people mainly came from Rwanda. The self-explanatory satellite images timely disseminated using the Internet provided visual evidence to raise the issue to the international community. Thanks to the NGO community, as well as to international diplomatic efforts, the deforestation process was stopped in early July 2004.

The Virunga continues to be monitored by both WWF and UCL through a combination of field and satellite remote sensing observations. Following this deforestation crisis in the Mikeno sector of the national park, UNEP, WWF, IGCP, FZS and the EU have released emergency funds to support ICCN with the construction of a dry stone wall to restore the integrity of the park boundary. By mid-August 2004 more than 7 km of the wall had already been completed by 12 Congolese and 6 Rwandan associations; more than 20 km were completed by November 2004. The rapid intervention and collaborative efforts of the NGO community, national and international bodies has demonstrated to locals and the international audience, the determination to protect this World Heritage site, the oldest national park in Africa.

(6) Logging

According to a recent study, the city of Goma alone consumes over 47,000 tons of charcoal a year, which represents more than 250,000 tons of wood. More than 90% of this wood comes from Virunga National Park. The human populations in the Landscape do not have any other sources of energy and burn about 6 kg per family per day. Construction timber is also harvested on a small scale.

(7) Disease

The hippopotamus populations have been hit by anthrax epidemics twice since 1975.

(8) Volcanic eruptions

A major eruption could have extremely serious impacts on the vegetation, the aquatic ecosystems and human populations. Emissions of toxic gases are a constant danger for humans and animals.

Indirect threats

(1) War, lack of security and political instability

The region has suffered recurrent troubles since 1960, but as of 1994 they have reached a paroxysm. The national parks have become battlefields and mass movements of human populations have had catastrophic effects on vegetation, fauna and all renewable resources. Between 1994 and 1996, several hundreds of thousands of Rwandan refugees lived in the south of Virunga National Park. Today, the Nyamulagira sector of Virunga National Park (about 30% of the Landscape) is still inaccessible because of the presence of armed gangs and about 14,000 displaced families are scattered throughout the Landscape. They affect 5% of the land.

(2) Lack of capacity for park management

With no capacity, it is impossible to enforce the laws.

(3) Lack of jobs

The communities in the Landscape have no alternative employment possibilities and can only survive on the naturally occurring resources.

(4) Political interference

Highly placed individuals are encouraging the populations to occupy the protected areas.

State of the vegetation

In 2004, Virunga National Park lost 1,500 ha of forests because of populations arriving from Rwanda. In 2005, large-scale deforestation for charcoal production continued in the Nyamulagira sector of Virunga National Park and land clearance for agriculture spread outside the protected areas. In the hunting domain of Rutshuru, 90% of the surface area has been entirely degraded. The dramatic drop in the elephant and hippopotamus populations is also leading to dense ligneous vegetation invading the remaining savannahs.

State of the fauna

Observations in 2003 reveal the following in particular:

- There were 400 gorillas, comprising 380 mountain gorillas *Gorilla b. beringei* around the volcanoes and 20 Grauer's gorillas G*orilla b. graueri* on Tshiaberimu.
- Elephants numbered 376, of which 286 were savannah elephants and 90 were forest elephants[11] in Volcans National Park and the Mikeno sector of Virunga National Park. The number of elephants in the north and south of Virunga National Park remains unknown because these areas are unsafe.
- The number of chimpanzees in Virunga National Park was estimated at 150, but decreased to only 130 in 2005 because of a loss of habitats due to the clearing of land for charcoal making and agriculture.
- The population of hippopotamuses in Virunga National Park was estimated at 26,359 in 1959 and 22,875 in 1989; it fell to 1,309 in 2003 and fewer than 900 in August 2005.
- On the plains of Rwindi-Rutshuru, the ungulate biomass fell from 27.6 tons/km² in 1980 to 2.5 tons/km² in 2005, a reduction of over 90%.
- Fish populations in Lake Edward are suffering from the effects of overharvesting.

Financing and conservation

The largest funding agencies are the European Union, USAID, SIDA and the MacArthur Foundation. When the first CoCoSi was created in 2005, a total of US $2,800,000/year was pledged by ICCN partners.

Tourism

Both in the DRC and in Rwanda, the national parks saw considerable tourism in the past, but this collapsed with the troubles and wars that have been raging there since the beginning of the 1990s. In Virunga National Park, most of the tourist infrastructure has been destroyed but parts are being rehabilitated. Ecotourism focusing on gorillas resumed in 2004 and in the month of December 2005 alone 180 visitors were checked into Virunga National Park.

In Rwanda, tourism started again at the end of the 1990s and in 2005 there were 10,641 visitors, bringing in about US $3 million. A new hotel for visitors to Volcans National Park was recently built in the Ruhengeri region.

Management in the field of renewable natural resources

(1) At the Landscape level

The Landscape is very complex, with a host of different land uses and several organizations active in conservation and the socioeconomic development of the local communities. Coordination of these activities is essential to ensure efficient use of the insufficient resources, synergy and impacts in the field. NGOs have been working in a partnership with the administrations of the protected areas to develop a coordinated plan covering the whole of the Albertine Rift. At the same time, a strategic transborder plan is also being formulated for all the central part of the Albertine Rift. An initial version of this plan has already been presented to those concerned and will be submitted to the executive directors of ICCN (DRC), UWA (Uganda) and ORTPN (Rwanda) at the beginning of 2006.

To strengthen conservation, a regional cooperation framework has been established with a view to transborder management of resources. This formalizes the unofficial cooperation that had been initiated by the different partners in the area of the gorillas back in 1991 and extends this cooperation to other areas in the Landscape.

An analysis of the policies, legislation and regional processes relating to conservation of the large primates in DRC, Rwanda and Uganda has been undertaken with a view to influencing the development of these regional processes and the legal frameworks for better conservation in the future.

[11] This figure may be too high because it is based on extrapolations and not actual counting.

(2) In the national parks

The research and monitoring plan for Virunga National Park was finalized in 2005 and a first planning meeting for the general plan was organized in June 2005. The process is set to continue in 2006. A management plan for Virunga National Park already exists and an assessment of the quality of its data is planned. The two plans will serve as the basis for the regional plan.

The legal texts demarcating Virunga National Park have been compiled and analyzed (Box 23.2). Previously, demarcation was determined by ten different decrees, which caused confusion and gave rise to poor interpretations. WWF and ICCN have started to consolidate these decrees in a single text so that all those involved start off on the same basis.

Despite this difficult context, there have been several successful activities in the field:

- Demarcation of the protected areas has been given tangible form on a participatory basis along 293 km of the limits of Virunga National Park by means of 235 posts and 989 planted trees.
- Meetings have been organized with those concerned.
- The authorities of the national parks have received material support (five patrol posts have been rehabilitated and equipment has been supplied) and technical support for training.
- 121,135 people who had illegally invaded the national park have been removed from the forests of Tshiaberimu, Nubilia, Lume, Kanyati, Kongo, Ishasha, Kibirizi and Mubambira; 70,667 ha have been recovered and the means of subsistence of the populations have been diversified (Box 23.3).

The strength of the CARPE program lies in the implementation of regional initiatives:

- Meetings between wardens from the different national parks have been organized to discuss law enforcement in the protected areas. At these meetings, information is exchanged on illicit or criminal activities with a view to improving management of the parks. These meetings were organized over the period covered by the report and one of the key themes was ivory hunting.
- Synchronized patrols have been organized by wardens from the two countries in their respective sectors. These patrols proved to be very important; they allowed snares to be removed, charcoal-making sites to be destroyed, loggers to be stopped, and poachers' camps and military camps to be uncovered. Consequently, observations of animals have already increased.
- In the north, 150 patrols were carried out in 199 days—some at night, others during the day.
- Two regional meetings have been held, (1) to conduct an analysis of key species in the Landscape and reach an agreement on the action to be taken and (2) to discuss law enforcement among conservators in DRC, Rwanda and Uganda; they led to the interception in Uganda of four leopard skins from DRC.

Institutional support aims to strengthen these coordinated patrols, along with training, surveys of the fauna, monitoring of ecosystems and populations and the compilation of existing data on the Landscape.

(3) In the rural areas

The second key component of the CARPE program for Virunga has been the development of a plan for community management of resources, which will show the way forward for the integration of conservation into community activities and support for the conservation action undertaken. This activity was initiated in Kinigi, Rwanda, in May 2005 with the drawing up of the terms of reference, the definition of key activities and players and the preparation of a timetable. The plan is expected to be finalized by the beginning of 2006.

The program has trained members of the communities in business management so as to ensure the sustainability of their enterprises. This training covered subjects such as enterprise development, management structures and their role, strategic planning, keeping records and specific aspects of beekeeping, mushroom-growing, community tourism and craftwork. A team of national park managers also did a tour to explain to personnel the lessons learned in Uganda. All in all, 354 entrepreneurs, 62 of them women, heads of community organizations and managers of protected areas were given training.

Monitoring renewable natural resources and their management

(1) Monitoring of hippopotamuses and elephants on the savannah

Surveys are planned for 2006.

(2) General monitoring

The Landscape has a great deal of available information that can be used to plan the moni-

toring and management of natural resources. This information comprises data obtained from:

- guard patrols (illegal activities, key species of flora and fauna, known gorillas)
- socioeconomic surveys
- remote sensing

Socioeconomic monitoring of the volcanoes area in 2002 was extended to the entire national park in 2005. A study on charcoal consumption and trade in the Goma area was also carried out in 2005 in order to define the area that needed to be planted with trees for sustainable supplies to the city.

(3) Monitoring of gorillas

The monitoring activities that began in the volcanoes area in 1997 have been extended to the entire Virunga National Park so as to complete the data on gorillas and provide ICCN with standardized information on the national park as a whole, for use in management and financing.

(4) Remote sensing

WWF has bought and analyzed a series of SPOT images taken in 2004-2005 over all the Landscape, so as to determine a basis for monitoring the forest cover in the Landscape and invasion of the protected areas.

Box 23.2. Properly documenting the legal boundaries of protected areas as a prerequisite for sound rehabilitation: the case of Virunga National Park

In order to find a lasting solution to high levels of encroachment, such as those into Virunga National Park, it is important to document properly the level of encroachment. This can only be accomplished if protected area boundaries are clearly identified and agreed upon by all.

Even in the case of a well-established national park, such as Virunga (created in 1925), clear identification of boundaries may be a very difficult process. This was exemplified in the difficulties experienced by ICCN and WWF who joined force to tackle this issue.

The process began by obtaining the legal texts delineating the national park, which was done by collating all legal decrees directly pertaining to the description of boundaries. In the case of Virunga National Park, there were eight such texts that dated from 1925 to 1950. The next step was to analyze and produce a consolidated text resulting from these various decrees. This was achieved in January 2005 and the document was subsequently published.

The next crucial step was to 'translate' the text into a means of physical identification in the field. This was a particularly difficult exercise in the case of Virunga National Park, because some of the old beacons no longer exist and where they do, they are often far-between. In addition, the texts make regular reference to human infrastructure (small villages, traditional paths, markets, local concessions) that existed in 1925 or 1935, but which has since disappeared or been displaced. Finally, the texts often refer to natural features whose names have since been forgotten, such as tiny rivers or summits of small hills.

To overcome these difficulties, several sources of information were overlaid into a Geographic Information System (GIS). The GIS layers included: 1/50.000 scale maps from 1948, which provided invaluable information on old toponyms; aerial photos from 1959; satellite images at 5m resolution from 2004 and 2005, which served as the map base and clearly identify areas of encroachment, as well as many features that are not visible from the ground; and numerous ground control points taken in the field.

The results of this exercise were sometimes dramatic and demonstrated how important this activity was. For example, in the Kilolirwe area, the exercise required overlaying the 1948 map, three sets of boundaries derived from different legal decrees, a 1959 aerial photo and SPOT images. The results showed that in some places the boundaries being used in the field are off by as much as 500 meters. In some cases these discrepancies may be the result of local arrangements between ICCN and local communities that have never been formalized or incorporated into delineation exercises.

Once the official boundaries of the park were established, it was possible to add an additional GIS layer showing the area of encroachment. Following this procedure allowed ICCN and WWF to make an official calculation of the area of encroachment, which totaled 10,000 hectares in the study area alone.

Box 23.3. Progress made towards the voluntary withdrawal of illegal cultivators from Virunga National Park

Virunga National Park in eastern DRC covers an area of approximately 780,000 ha in a region that has one of the highest human population densities in Africa. It is therefore only somewhat surprising that the wars and socio-economic crises that have hit eastern DRC during the last 8 years have increased the pressure for local cultivators to move into the national park. Due to strong political interference and a lack of logistical capacity, as well as a lack of security, ICCN has had little power to prevent this encroachment and, in total, close to 170,000 people have, at some point in time, invaded the World Heritage Site. This has been a dynamic process, with a continued influx of illegal settlers in some areas and people leaving from other areas. It should be noted that the majority of these 'settlers' were actually people from neighboring communities who extended their activities into the park or growing human settlements that spilled over the park boundaries, as opposed to long-distance immigrants (although the latter also exist). ICCN and WWF began to document and monitor the process, and have been working on a case-by-case basis to obtain as much voluntary evacuation of encroached areas as possible. Significant results have been achieved during the past three years in terms of recovered encroached areas and reaching agreements for local communities to stop cultivating inside the National Park, as can be seen in Table 1. These results (Table 2) were achieved, in part, with support from CARPE and other sources of funding, including the European Union and WWF.

Table 1. Degree of encroachment in Virunga National Park (DRC) between 1998-2004 and September 30, 2005.

	1998-2004	**Sept 2005**	**1998-2004**	**Sept 2005**
Site	Encroached area (ha)	Encroached area (ha)	Number of people	Number of people
Tshiaberimu	3,500	0	1,800	0
Lubylia	4,200	7	22,000	100
Mavivi	19,000	19,000	25,000	25,000
Kyavinyonge	5,000	0	0	0
Kanyatsi	3,000	0	7,000	0
Lume	2,300	0	4,600	0
Côte ouest	12,000	12,000	30,000	30,000
Kibirizi	19,000	0	0	0
Kongo	9,000	0	18,000	0
Ishasha	500	0	15	0
Kanyabayonga	2,100	1,200	0	0
Kilolirwe	10,200	10,200	60,000	60,000
Tongo	60	0	0	0
Total	**89,860 ha**	**42,407 ha**	**168,415**	**115,100**

Table 2. Surface area recovered and the number of people evacuated peacefully from Virunga National Park during the first two years of CARPE funding, with co-financing by the European Union and WWF. None of the people involved were displaced. All individuals were members of local communities who took advantage of the socio-political situation to spread their activities into the national park.

Site	**Area recovered (ha)**	**Number of people evacuated**
Tshiaberimu	3,500	1,800
Lubylia	4,193	21,900
Kyavinyonge	5,000	0
Kanyatsi	3,000	7,000
Lume	2,300	4,600
Kanyabayonga	900	0
Tongo	60	0
Total	**18,953**	**35,300**