

the biodiversity consultancy



# Sanaga Gas Project Biodiversity Assessment

Prepared for

**The International Finance Corporation**

Final Report

30 January 2008

# Sanaga Gas Project Biodiversity Assessment

Compiled by

Jonathan Ekstrom  
The Biodiversity Consultancy  
33 Horton Road  
London  
E8 1DP  
UK

[www.thebiodiversityconsultancy.com](http://www.thebiodiversityconsultancy.com)  
[jonathan@thebiodiversityconsultancy.com](mailto:jonathan@thebiodiversityconsultancy.com)

Suggested citation:

Ekstrom, JMM (2008) Sanaga Gas Project Biodiversity Assessment. Unpublished Report prepared for the International Finance Corporation. 75pp.

## 1. Executive summary

This report details the findings of a biodiversity assessment of the Perenco S.A. Sanaga Gas Project, Kribi, Cameroon, conducted by The Biodiversity Consultancy at the request of the International Finance Corporation. The gas project involves the re-boring of several existing offshore gas wells and the laying of five pipelines on the sea floor, mainly between the wells and a processing factory (hereafter “the CPF”) on land. The gas produced at the CPF site, which is the responsibility of Perenco S.A. and Societe Nationale des Hydrocarbures (SNH), will be delivered to the AES Sonel electricity generation plant situated at a separate site on the coast.

**EIA review:** The Sanaga Gas Project EIA was reviewed for quality of biodiversity information. The EIA was found to be general and broad in nature, lacking specific information on significant biodiversity components other than major terrestrial habitat types, dominant flora, and the possible presence of a few key mammals and large reptiles. This study, through, desktop analysis and fieldwork, presents data on: major terrestrial, aquatic and marine habitats occurring within the project area of influence; the presence, biodiversity significance and abundance of plants, birds, mammals and aquatic reptiles; and local livelihood and cultural use of available habitats and species.

**Project situation within global conservation priority regions:** The project area is located within several international conservation priorities, including Conservation International’s “Congo Forests of Central Africa High Biodiversity Wilderness Area”; WWF’s “Atlantic Equatorial Coastal Forest ecoregion”; and BirdLife’s “Cameroon-Gabon Lowlands Endemic Bird Area”. Its presence within these priority areas points towards the possible biodiversity importance and sensitivity of the project area.

**Priority species:** Key species (as defined by PS6) determined *definitely present* within the project area of influence include the following fauna: Leatherback Turtle *Dermochelys coriacea* (Critically Endangered), Olive Ridley Turtle *Lepidochelys olivacea* (Endangered), Green Turtle *Chelonia mydas* (Endangered), Hawksbill Turtle *Eretmochelys imbricata* (Critically Endangered), Sperm Whale *Physeter macrocephalus* (Vulnerable), African Dwarf Crocodile *Osteolaemus tetraspis* (Vulnerable), Allen's Bushbaby *Galago alleni* (Near Threatened), Collared Mangabey *Cercocebus torquatus* (Near Threatened), Yellow-backed Duiker *Cephalophus silvicultor* (Near Threatened), Bay Duiker *Cephalophus dorsalis* (Near Threatened), Sitatunga *Tragelaphus spekeii* (Near Threatened). Species listed by the Convention on International Trade of Endangered Species (CITES) and the Convention on Migratory Species (CMS) were also found. African Manatee *Trichechus senegalensis* was not determined to be within the immediate project area of influence, but a population exists c. 20km north in the mouth of the Nyong river. The following IUCN listed flora species were also found in the terrestrial impact sites: *Lophira alata* (Vulnerable), *Diospyros crassiflora* (Endangered), *Daniellia oblonga* (Vulnerable).

**Critical Habitat:** Four habitats within the project area of influence harbour IUCN red-listed species: pelagic waters (IUCN species, possibly fishing livelihoods), sandy shoreline (breeding of IUCN turtles), coastal humid forest (IUCN mammals and plants), and mangrove lagoon (IUCN crocodiles). However, the magnitude of the impacts on the species which would trigger qualification as Critical Habitat are small and the habitats could not be said to be of national importance for the IUCN species in question. In addition, significant mitigation options exist. Therefore these habitats are not deemed Critical Habitat under PS6.

**Biodiversity impacts:** The priority species identified will suffer some reduction in their population as a result of the project through direct habitat loss, possible chemical and noise pollution (particularly for marine mammals), and secondary impacts such as poaching. However the small size of the terrestrial project sites (forest and sandy coastline) means the global significance of these direct impacts will be comparatively small. The main risks to biodiversity and local ecosystem services (especially fishing resources) arise from the potential of hydrocarbon leaks, and secondary and cumulative impacts.

**Mitigation options:** The precautionary principle should be used in the design of mitigation options. Avoidance is possible through project redesign and siting. Significant minimisation is possible through management of secondary impacts and sensitive timing of construction. There are few options for restoration. Obvious opportunities exist for biodiversity offsets. Such management would significantly reduce residual impacts and appropriately manage biodiversity risk.

**Indicators and biodiversity monitoring** Biodiversity indicators (covering management, species, habitats and ecosystem integrity) for monitoring and adaptive management are suggested.

## 2. Introduction to the project and the region

### 2.1 Introduction to the project

This biodiversity assessment concerns the Sanaga South Gas Project. The gas field is located 10 km offshore, north-west of Kribi, Cameroon. The terrestrial processing facilities and power generation plant are to be located 5-10 km north of Kribi on coastal land. The gas project is being developed by a partnership between Perenco S.A. and SNH.

According to the Perenco EIA, the Project includes:

- Drilling 2 exploitation gas wells offshore (from existing and abandoned wells)
- Gas production units offshore
- A Central Processing Facility (CPF), onshore at Eboudavoye
- A pipeline between the 2 production wells
- A pipeline to carry the gas to be treated (from the wells to the CPF, 14km)
- A pipeline to inject the glycol (from the CPF to the wells, 14 km)
- A pipeline to transport the by-products (water + condensate) from the CPF to the existing well KB-4 (21km), where it will be connected and to the existing pipeline linking KB-4 to the Ebomé storage platform (USF La Lobé)
- A pipeline to transport the treated gas from the CPF to the onshore power station, between Ebousawaé et Kribi, in order to produce electricity from the gas provided by Perenco.

More details can be sought from the EIA.

### 2.2 Introduction to the region

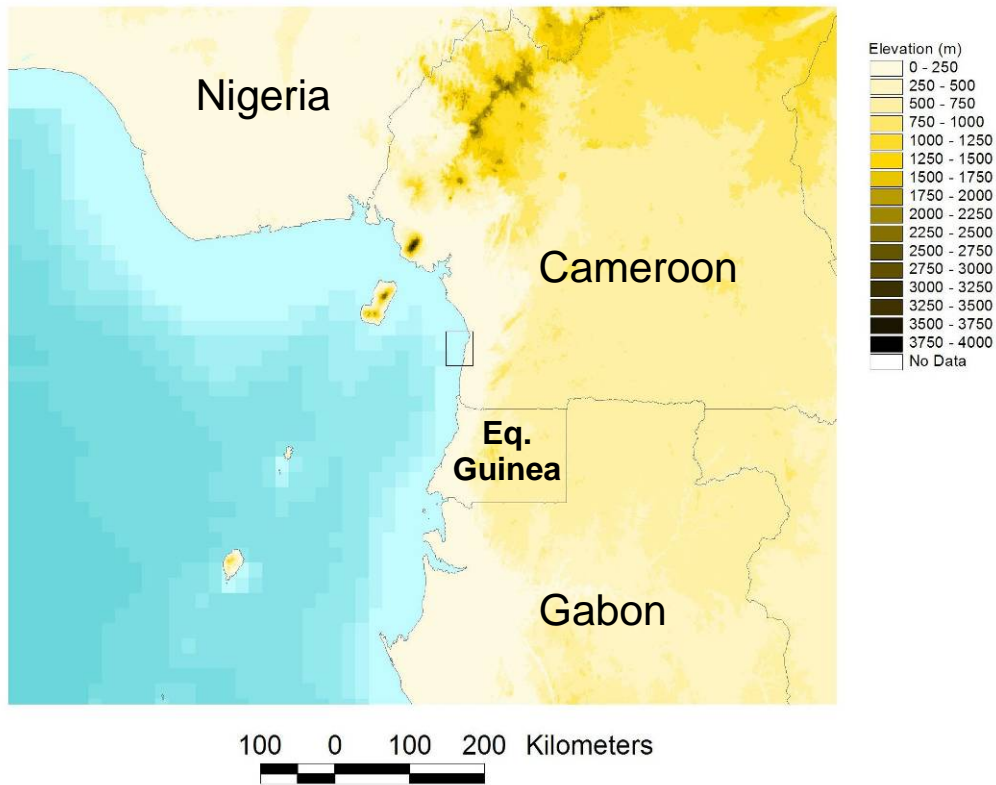
The project zone is the South Province of Cameroon, on the Atlantic coast. It is a lowland region of Cameroon close to the border with Equatorial Guinea (Figure 1). Biogeographically, it is located in the Guineo-Congolian region which is known for its extensive tracts of intact lowland humid forest. The project areas are located within several large scale international conservation priorities, including Conservation International's "Congo Forests of Central Africa High Biodiversity Wilderness Area" (Mittermeier et al. 02); WWF's "Atlantic Equatorial Coastal Forest ecoregion"; BirdLife's "Cameroon-Gabon Lowlands Endemic Bird Area". Its presence within these priority areas highlights the biodiversity importance and sensitivity of the region as a whole and points towards the possible importance of the project area itself for biodiversity conservation (see Biodiversity Review).

The coastal forests of southern Cameroon are described as Atlantic Biafran forest. Letouzey (1985) subdivided the forest into a number of types, all rich in Caesalpinioideae. Approximately 30% of coastal forest in the region is under logging concessions. Large-scale agro-industrial plantations have so far removed about 7.5% of the forest cover, while small private owners clear forest for the cultivation of oil palm, rubber or cocoa as well. Shifting cultivation is the major cause of deforestation around settlements. About a third of the area belongs to logging concessions.

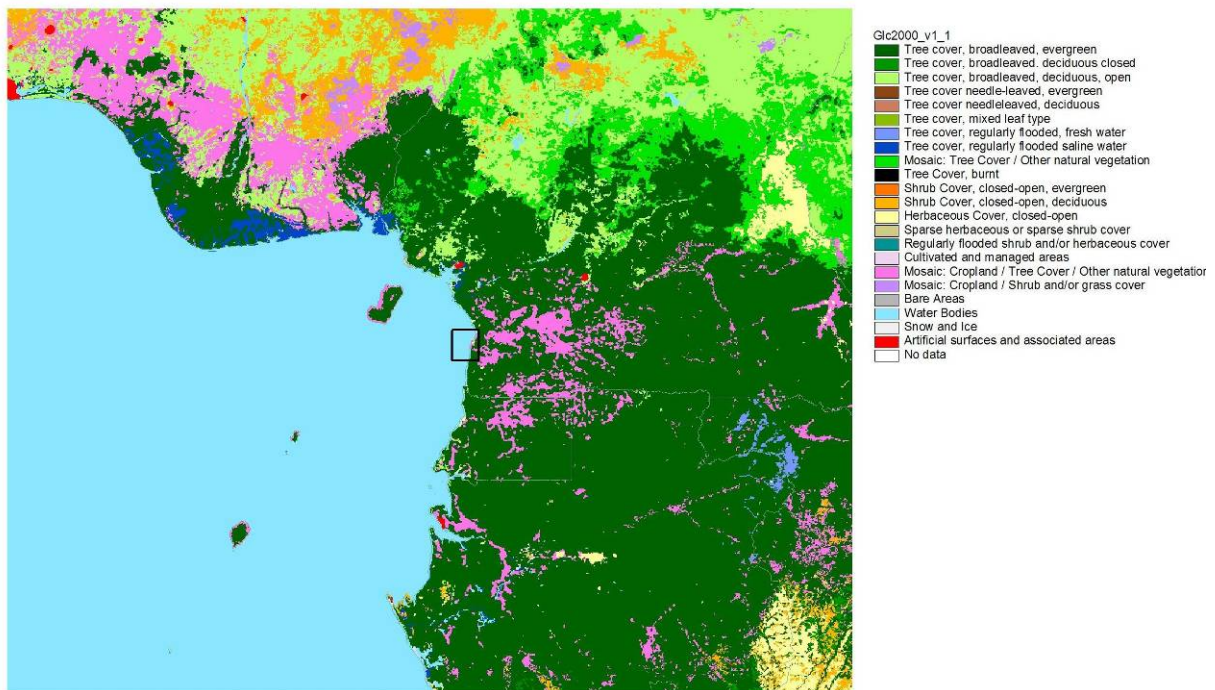
The area has a typical equatorial climate with two distinct dry seasons (November–March and July to mid-August) and two wet seasons (April–June and mid-August to October). The average annual rainfall is 2950 mm/year and the average annual temperature is about 25C with little variation between years (data for Kribi). The area shows a dense pattern of many rivers, small river basins, and fast-flowing streams (Tchouto et al 2006).

Generally, the rural areas surrounding the project have a low population density of about 10 inhabitants per square kilometer, with most people living around Kribi, along the coast, and in agro-industrial and logging camps. There are few employment opportunities, the local people are poor and rely mainly on natural resources, principally artisanal fishing, as their livelihood. Other activities include agriculture, logging, poaching and hunting to meet basic needs.

a)



b)



**Figure 1.** General geographic context: a) National boundaries and altitude. b) Landcover (from the GLC2000 – Global Land Cover in 2000). The box in the centre marks the approximate location of the project area.



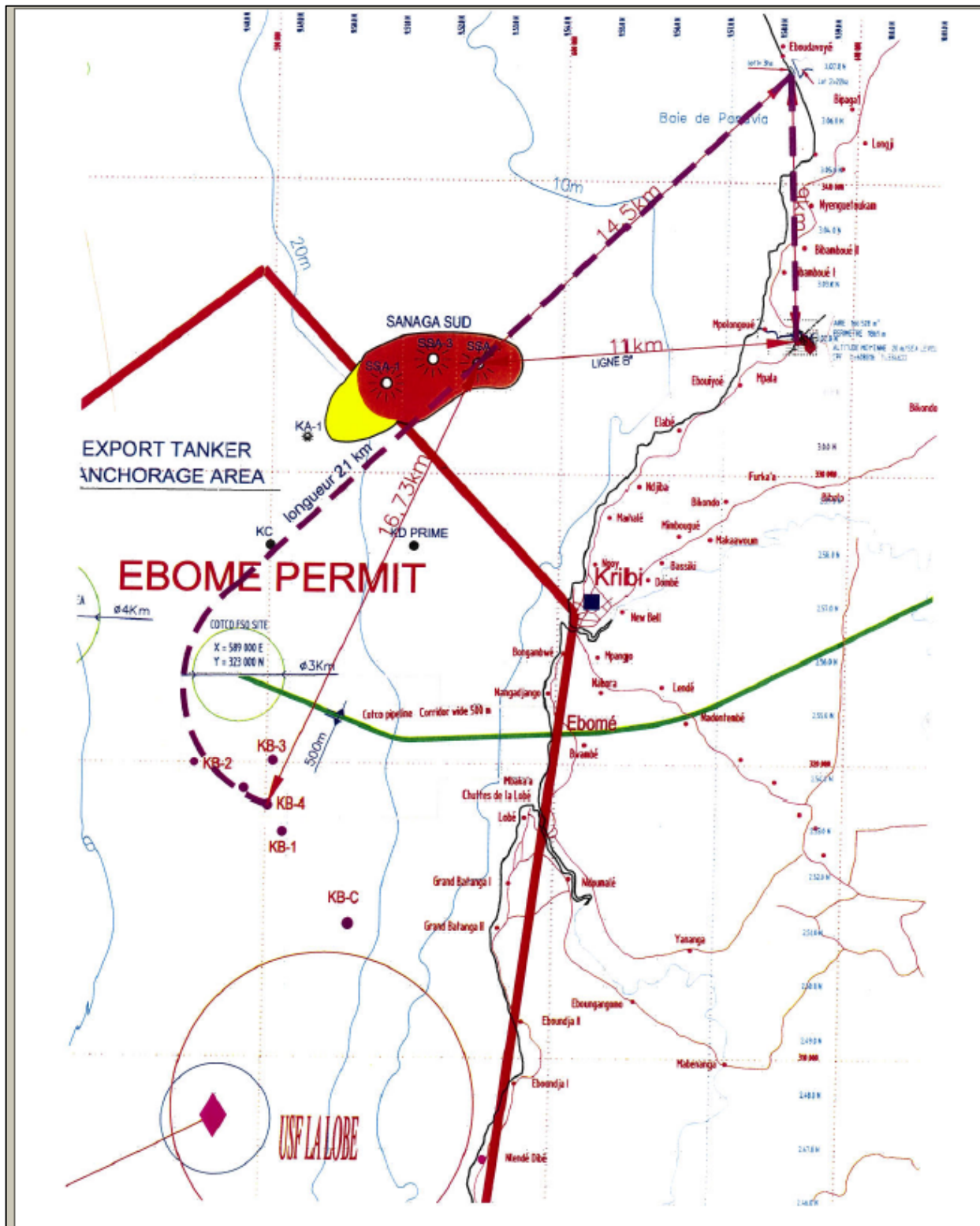


Figure 2. Map of project region from the Perenco EIA

### 3. Aim and objectives of the study

Following the Terms of Reference provided, the aim of this report is to provide an independent biodiversity review of the Sanaga Gas Project with the following principal objectives:

1. To evaluate basic baseline biodiversity data reported in the Sanaga Gas Project EIA on the presence, distribution, and relative abundance of biodiversity in the project zone;
2. To determine whether the area exhibits protected areas, critical ecosystem, and/or unique ecosystems critical for survival of species in the area,.
3. To ascertain as far as is possible from the available biodiversity data, whether any critical habitat (as defined by IFC's Performance Standard 6 – Biodiversity Conservation and Sustainable Natural Resource Management) is present in the Sanaga Gas Field Project zone,

These objectives result in the following deliverables:

1. A rapid scientific analysis describing the habitat types of offshore and onshore of the Project zone and species present, including relative abundances, with emphasis on species of conservation interest of the Project zone.
2. A professional opinion, based on the available information, as to whether any critical habitat (as defined by IFC's Performance Standard 6) is present in the Project zone. Critical habitat is defined as habitat required for the survival of critically endangered or endangered species (as defined by the IUCN Red List of Threatened Species, by CITES, or as defined in any national legislation); areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas with unique assemblages of species or which are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic or cultural importance to local communities.
3. A rapid analysis of the relationship/importance of the biodiversity characteristics of the Project zone, and the related proposed activities and impacts, with regard to the maintenance of the biodiversity value of the larger region surrounding the Project zone.
4. Key proposed mitigation measures needed to best manage the Sanaga Gas Project to address the potential impacts on biodiversity.
5. Recommendation on which indicator species should be the focus of any future ecological monitoring.

The report follows this structure.

Two areas in particular were explored in some detail due to the importance assigned to them by The Biodiversity Consultancy; one is the location of the project area in relation to global biodiversity conservation priorities (such as hotspots and endemic bird areas); the other is the opportunity for this project to use biodiversity offsets as a form of mitigation, which represents emerging best practice for biodiversity management.

## 4. Methods

The research involved two principle sets of methods: desktop biodiversity research, based in London and Cambridge, UK; and fieldwork (both biological surveys and community interviews) based at the project site near Kribi, Cameroon.

### 4.1 Desktop biodiversity research

#### *EIA review*

Data was extracted from the EIA [*Sanaga Gas Project EIA (Perenco Cameroon, Projet de Developpement du Gaz du Champ Sanaga, Rapport d'Etude d'Impact Environnemental EIE, September 2006)*] and gaps were analysed. This covered biodiversity data quality and stringency of impact assessment. This data was then compared to data available through desktop review, database analysis and rapid assessment-type fieldwork methods.

#### *Geographical position of project area in relation to global conservation priorities and protected areas*

The geographical coordinates of the project area were mapped onto the existing maps or databases of the world's currently recognised global priorities for conservation, most of which have been created by international conservation NGOs. The project area was also mapped against the locations for recognised protected areas found in World Database on Protected Areas (WDPA) of the World Conservation Monitoring Centre (WCMC).

#### *Species and habitats*

The species and habitats potentially occurring within the project area of influence were determined through database analysis and interviews with taxonomic authorities. As no direct data were available for the project area itself, an inference analysis was used to determine potentially occurring species. Inference analyses are commonly used by authorities in conservation planning and biodiversity distribution studies to interpolate species' ranges. An example of inference would be a species which is known north and south of the project area, and utilises habitat found within the project area. Such a species is likely to be found within the project area, subject to certain exceptions. Exceptions and caveats might be species heavily hunted, or those requiring very large tracts of intact habitat to survive (such as large mammals).

The inferred set of potential species and habitats provided a set of "target species" for use in our fieldwork and community interviews; and they were used to guide interviews with taxonomic experts. The resultant "potentially occurring species list" is provided in an appendix to this study, together with the "certainly occurring list" which was derived from fieldwork and interviews.

The following is a list of most of the databases and authorities consulted during this research.

- a. Key Biodiversity Areas (CI, PlantLife, BirdLife)
- b. Important Bird Areas (Terrestrial and Marine) (BirdLife)
- c. Global 200 (WWF)
- d. IUCN list of Threatened species
- e. The Global Amphibian Assessment.
- f. IUCN Species Specialist Groups
- g. Taxonomic experts
- h. Endemic Bird Areas, WWF Ecoregions, Conservation International Hotspots.
- i. CITES databases
- j. Convention on Migratory Species (CMS) databases.



## 4.2 Fieldwork

Fieldwork was conducted in Cameroon over a period of 6 days between 15 and 20 December 2007. A team of three researchers (one English, two Cameroonian) consisting of an ecologist, a zoologist and a botanist completed the surveys.

### *Study sites*

Research was principally conducted at two sites, although a broader local habitat survey was also carried out.

1. “CPF / Eboudavoyé” is the main terrestrial impact site covered in the Perenco EIA which is required for the gas processing factory. It includes sandy coastline, coastal forest and mangrove lagoon. The neighbouring village is Eboudavoyé. Four days were spent at this site.
2. “CPF – power plant pipeline route” is the potential route of the gas pipeline between the CPF factory and the power plant. Surveys were conducted along this coastal route to provide a basic understanding of the magnitude and type of biodiversity impacts to be expected.

### *Methods used*

For each site, the team, assessed habitat types and vegetation structure, completed species inventories for mammals, birds, aquatic reptiles and plants, and interviewed communities proximal to each impact site on their economic and cultural uses of local biodiversity and ecosystem services. The team also reconnoitred the local area north and south of the impact sites and assessed the local habitat condition using transects, to provide an approximate understanding of habitat connectivity and relative importance of the sites for biodiversity.

### *Habitat surveys*

Major habitats of each project site were determined by exploring each site with the use of a guide from each local community. Where necessary, formal transects were followed to assess the change in habitat types over distance. Data was collected on habitat type and condition. Forest condition was determined using basic ecological knowledge and some estimates of habitat structure (canopy cover, understorey density, presence of secondary plant species). Condition was expressed using a five-point scale: pristine, slightly degraded, quite degraded, severely degraded and very severely degraded. Where for example 15 year old selectively logged forest would be called “slightly degraded”; old secondary growth “severely degraded”; and farm / fallow mosaics “very severely degraded”.

### *Species surveys*

Species surveys were carried out for plants, birds, mammals and aquatic reptiles. For these groups, data was gathered on presence / absence and relative abundance. To gather this data, both direct biological fieldwork and interviews with knowledgeable members of the local communities (hunters, medicine women) were utilised.

Botanical surveys were carried out using pre-cut transects (at CPF site) and old transects cut with the help of a local guide (at CPF-AES potential pipeline route site). All species observed were noted, using observations of bark, leaves, form, tree structure, and fruit and flowers where possible. Local guides were used to determine the local names of some species; these were then translated into scientific names using reference guides, and later checked with a taxonomic expert.

Bird surveys were carried out early morning and late afternoon using transects and point counts. Particular attention was applied to particular micro-habitats such as interior forest, mangrove edge, *Raphia* and *Pandanus* clumps, streams, and forest edge. The number and identity of each species was noted. To calculate the relative abundance of birds, encounter rates were used. These are commonly used in rapid assessments and although they have limitations they provide the most efficient way to estimate species lists and relative abundance in a short space of time. For each species, the total number of individuals seen is divided by the survey effort in metrics of “man field hours”. Hence a bird seen 10 times over 5 hours has an encounter rate of 2 individuals / hour.

Mammal surveys were carried out concurrently with bird and plant surveys. Tracks (such as in soft mud) were used to infer the presence of species using experienced forest trackers. Mammals are particularly difficult to survey in a short space of time so the survey team relied on local knowledge of hunters and other community members to complete a mammal list for this site. This method is commonly used by mammalogists to compile species lists. These interviews were carried out using fieldguides to mammals

occurring in Cameroon. Standard interview techniques were used to determine the reliability of the information from each informant. For example, species definitely known not to occur in the area were pointed out and the informant asked “Do these occur here?”. Where the informant answered incorrectly to this type of question, the dataset from that informant was not used. Distribution maps of west and central African mammals were used to complement these interviews to ascertain their accuracy and to support interpretation of the results.

Aquatic reptiles surveys were carried out as for mammal surveys, mainly using interview techniques and combining this information with desktop knowledge of species distribution and abundance in west central Africa.

Socio-economic surveys were carried out in both Eboudavoyé and in Mpolongou (the village associated with the CPF-AES pipeline), using organised and opportunistic interviews with members of these communities. Care was taken to interview as broad a range of community members as possible (men, women, elders, hunters, medicine women etc). These interviews were particularly helpful in determining the bushmeat and non-timber forest products used by communities neighbouring the two impact sites. At Eboudavoyé, two formal interviews with groups of community members were carried out, and interviews with two local hunters and two medicine women were completed. At Mpolongou, two interviews were carried out with a local forest hunter / fisherman. Some time was also spent in necessary formal introductions with these communities, facilitated by representatives from Perenco SA and Societe Nationale des Hydrocarbures.

#### *Fieldwork effort*

Table 1 details the fieldwork effort (in man hours) expended at each site for each method; in some cases, such as botanical research, species surveys and habitat surveys were conducted simultaneously, in which case these hours are counted separately.

**Table 1. Fieldwork effort**

Survey type	Man hours		
	CPF / Eboudavoyé	CPF-AES pipeline / Mpolongou	Local coastal area
Habitat type and condition	10	8	14
Plant species	10	6	0
Bird species	16	6	0
Mammal species	8	4	0
Aquatic reptiles	4	4	0
Socio-economic	8	7	0
Introductions to local community	8	4	2
Total hours (minus introductions)	52	34	14

## **Data and Analysis**

The EIA is first summarised in “EIA Review”. Then the “Biodiversity Review” compares the location of the project to global conservation priority areas; then biodiversity data derived from desktop research and analysis is presented; finally fieldwork results are presented and interpreted. These data provide a comparison with the project EIA, and provide the opportunity to understand issues of critical habitat, regional relationships, mitigation options; and biodiversity indicators for long term monitoring.

## 5. EIA review

The “Projet De Developpement Du Gaz Du Champ Sanaga Rapport D’Etude D’Impact Environnemental” was reviewed for content and quality of biodiversity information. This section fulfills Objective 1 of the Terms of Reference.

### 5.1. Area of influence

Area of influence with respect to biodiversity values is necessary to ascertain the size of potential biodiversity risks and the value of mitigation options possible. A clearly demarcated area of influence is not presented in the EIA. It should include all infrastructures associated with the project, cumulative and secondary impacts which are a result of the project, as suggested in IFC Performance Standard 1. Given the potential magnitude of the secondary impacts (e.g. migration, roads) and lower-likelihood impacts (e.g. hydrocarbon leaks and spills) it is important to have a defined area of influence to delimit the biodiversity assessment. For example, reference is made several times to the “zone of mangroves nearby”, which could be either the mouth of the river Eboudavoyé or the mouth of the river Lokoundje a little further north. The latter is c. 15km north of the direct primary footprint but could be impacted by either secondary impacts or the effects of a hydrocarbon spill.

### 5.2. Operational activities and biodiversity risk assessment

No formal mapping of operational activities onto biodiversity values inferred or known to be present at the sites was undertaken in the EIA. Some informal assessments are made for particular aspects of fauna and flora such as fishing resources and marine mammals. However, overall, no attempt is made to map biodiversity values onto potential project impacts and derive management actions through a risk-based assessment process. The overall impression is one of a broad and incomplete scoping of possible biodiversity values and impacts upon them, rather than a rigorous attempt to identify, prioritise and manage biodiversity risk.

The following statements are exemplary of the type data available in the EIA (*translation*):

- *“Impacts on terrestrial fauna and flora: a number of relatively important protected species are found at the site and nearby. In addition, a mangrove zone is very close to the project site and could be affected by pollution from the project”*
- *“Impacts on marine fauna and flora, in a zone where a number of protected species are found (turtles, dolphins, whales)”*
- *“Disturbance or interruption of economic and social activities, in particular the artisanal fishing of Eboudavoyé”*
- *“Terrestrial fauna impacts due to increased risk of poaching”*

### 5.3. Mitigation measures proposed

A set of mitigation measures are proposed which include minimisation and restoration but not avoidance or offsets in any significant measure. These measures do not appear to have been linked to any type of risk assessment, and gaps undoubtedly exist. The Environmental Management Plan within the EIA is well organised and logical, and covers the broad range of environmental impacts. Specific additions will be required to bring it towards best practice for biodiversity management.

Mitigation statements in the EIA are of the following kind:

- *“Construction period (onshore and offshore) to be determined outside of the turtle’s egg laying period (November – March), the whale migration period (September – October), the dolphins’ reproduction period (March – April), the fishes’ reproduction period and outside the wet season (in order to decrease the erosion risk)”*
- *“Forbidden to feed, pest or chase the marine fauna.”*
- *“Forbidden to poach in the area of the project.”*
- *“Remediation of the site at the end of the construction works, especially remediation of the ecological and natural zones which have been disturbed.”*

## 5.4. The biodiversity information provided in the EIA

The information provided on biodiversity is accurate but minimal.

***Biodiversity components:*** Major habitats are presented, with information on terrestrial habitats being notably better quality. The types of forest habitat present at the CPF site are adequately described, with good floristic descriptions. Mention is made of “protected species” (presumably under Cameroon law), however little specific mention is made of possible priority species using international lists or conventions (e.g. IUCN Red List, CITES, CMS). Three crocodile species are described as listed by IUCN, when in fact only one species is truly Red Listed. Some priority species possibly present within the area of influence are considered, notably aquatic reptiles and mammals are briefly discussed; natural resources such as fish and prawns are considered and their economic importance detailed and discussed in some detail.

***Threats:*** Background threats to biodiversity are not analysed in any rigorous way. Poaching is mentioned a commonly practised, but no species are mentioned, nor is the relative importance of poaching vs fishing considered. Deforestation is mentioned as occurring, both for logging and agricultural purposes, but no figures are given on this, nor its relative importance as a threat to different components of Atlantic forest biodiversity.

Biodiversity components that should be included in a good EIA are discussed here in turn:

### 5.4.1 Habitats

Types of forest habitat at the CPF site are well described in terms of vegetation structure and dominant floral species. General descriptions are given for all habitats except forests, which are detailed into types and with some assessment of vegetal species present. Broader less detailed descriptions are given for other habitats: A general summary of the nature of benthic marine habitats and their productivity, mainly with reference to their ecosystem services. Pelagic marine habitats are discussed, particularly with reference to fish, but not using available FAO descriptions of these fish habitats for Cameroon. Sandy shoreline is mainly described as a nesting habitat for marine turtles.

### 5.4.2 Species and species groups – intrinsic values

#### 5.4.2.1 Marine and estuary species

1. Fish. The number of marine fish species occurring on this coast as recorded by biodiversity research such as Tropenbos is noted. No threatened species, such as Groupers, are listed as possibly occurring.
2. Cetaceans: it is noted that there are no Cameroon studies to date, but studies in neighbouring countries show that whales and dolphins are likely to occur in the area, including one which is IUCN listed Atlantic Hump-backed Dolphin *Sousa tseuzii* (Data Deficient) and the Humpback Whale *Megaptera novaeangliae*. For these species alone, some consideration of possible impacts is given. No reference is made to the last known records of these species in Cameroon. No list of possible whales is given, nor their likely migration routes and distant from the coast<sup>1</sup>.
3. African Manatee *Trichechus senegalensis*. The likely presence of the African Manatee is noted in the “zone de mangroves”. No assessment of the possible population, proportion of Cameroon or global population, or likelihood of biodiversity risk is made. No reference is made to Grigione (1996) who suggests that Manatees are not found in the Kribi region, at least not south of the Nyong river.
4. Three species of Crocodile: *Crocodylus niloticus*, *Crocodylus cataphractus*, *Osteolaemus tetraspis*. Incorrectly they are all noted as threatened under IUCN; only the latter is listed, although *C. Cataphractus* is Data Deficient (DD).
5. Caimans. It is unclear what species this name refers to.

---

<sup>1</sup> Interviews with the village of Eboudavoyé suggested that whales are only observed at distances >15km from the shore (“Far beyond the large boat” – at KB4), and therefore some way outside the project direct footprint.

#### 5.4.2.2 Terrestrial species

No methodology or general assessment by taxonomic group or habitat types appears to have been conducted in listing possible priority animal species present.

#### 5.4.2.3 Protected species listed in the EIA

The following protected species are listed. It is not clear by what authority (National Law? International Convention?) these species are regarded as protected.

1. Giant Pangolin *Manis gigantea*. This species is within range<sup>2</sup> but is not listed by IUCN.
2. "Varans" – generic term for monitor lizards. Monitors have not yet been assessed by IUCN.
3. Three species of Crocodile: *Crocodylus niloticus*, *Crocodylus cataphractus*, *Osteolaemus tetraspis* are listed. Incorrectly they are all noted as threatened under IUCN; only the latter is listed.
4. Caimans. It is unclear what species this name refers to; it is possibly the small African Dwarf Crocodile *Osteolaemus tetraspis*.

#### 5.4.2.4 Unprotected species listed in the EIA

A short list of possible mammals is given:

1. *Galago elegantulus*. This species is in range for the site, and is listed as Near Threatened by IUCN. It is unclear with what information this species presence has been determined.
2. *Arctocebus calabarensis*. This species is in range for the site, and is listed as Near Threatened by IUCN. It is unclear with what information this species presence has been determined.
3. "Monkeys". It is unclear which species this might refer to.
4. *Manis tricuspis*. This species is in range for the site, but is not listed by IUCN and it is unclear why it has been singled out.
5. The diversity of bird species was noted, including Grey Parrots *Psittacus erithacus*. No analysis is made of species possibly occurring using bird distribution maps or data from the Endemic Bird Area in which the project is located.

#### 5.4.2.5 Ecological processes and services

No specific assessment is made of major ecological processes within the project area of influence which may be important for the maintenance of biodiversity components. These might include ocean currents, forest dynamics, and forest connectedness.

### 5.4.3 Service values (*natural resources, livelihoods, culture and ecosystem services*)

#### 5.4.3.1 Species groups, marine and forest products

##### *Plankton*

A general paragraph on the nature of plankton and its importance to marine life.

##### *Prawns and shrimps*

Details of the major species caught, mainly in commercial fisheries, with details of the economic value and importance of this fishing to Eboudavoyé.

##### *Fish*

A relatively comprehensive analysis of fishing as a commercial and artisanal industry is presented, with main species, catch weights and economic importance noted. Fishing is clearly the most important human – natural resource interaction within the project zone. The number of commercial species, their distribution and importance to local livelihoods and industry, is noted. No analysis is made of the possible economic losses is made due to the required exclusion zone (a certain risk), or at risk through a hydrocarbon spill (a possible risk). No risk assessment of this biodiversity livelihood is presented. In

---

<sup>2</sup> According to the hunters of Eboudavoyé, the species present is Long-tailed Pangolin *Uromanis tetradactyla*, which is IUCN least concern, but listed by CITES.

addition, no analysis is made of the background threats facing this principal livelihood, most importantly overfishing and the pressures of illegal foreign fleets in particular.

#### *Non-timber forest products.*

The collection of such products from the forest by the people of Eboudavoyé is described in a general sense in a paragraph: “Les populations riveraines font la collecte des produits forestiers non ligneux (PFNL), notamment les fruits sauvages, les feuilles, les écorces, les racines, le rotin, le miel, les champignons et même certaines espèces animales telles que les escargots, les vers blancs, les chenilles”

#### **5.4.3.2 Ecosystem services**

There is no dedicated analysis of the ecosystem services provided within the project zone. Clearly, some are covered including provisioning resources such as marine fish; and regulating services such as mangroves for fish breeding is mentioned. However the concept of ecosystem services itself receives scant attention overall and the term is not specifically used. Following the Millenium Ecosystem Assessment ([www.maweb.org](http://www.maweb.org)), ecosystem services not sufficiently noted in the EIA within the project zone include:

*Provisioning services*, such as Non Timber Forest Products (NTFPs) such as medicinal plants, construction materials and indeed bushmeat (this being nevertheless illegal).

*Regulating services* such as mangrove flood protection and water de-sedimentation.

*Supporting services*, such as soil fertility and nutrient cycling; and in the marine realm, benthic habitats for fish reproduction.



## 6. Biodiversity review

### Summary

- a) Desktop and fieldwork methods were used to assess the proximity of the project to known sites for biodiversity conservation (protected areas, EBAs, etc) and the occurrence of major habitats and the following species groups within the project area of influence: plants, terrestrial mammals, marine mammals, terrestrial reptiles, aquatic reptiles, amphibians, birds, freshwater fish and marine fish.
- b) Key findings were the presence of several IUCN-listed species within the project area of influence, particularly endangered marine turtles; and a potential overlap of the project's impacts with the buffer zone of the Campo Ma'an National Park.
- c) The main conclusion of this review is that although globally significant biodiversity is present within the project area of influence, the magnitude of impacts (if appropriately managed) is relatively small and their global and national significance comparatively minor. This is principally due to the small area of the terrestrial impact sites.
- d) However, careful mitigation and environmental management will be required to limit biodiversity impacts, particularly risks concerning hydrocarbon leaks.

The biodiversity review included an assessment of the geographical biodiversity context of the site. The project area is located within several international conservation priorities, including Conservation International's "Congo Forests of Central Africa High Biodiversity Wilderness Area"; WWF's "Atlantic Equatorial Coastal Forest ecoregion"; and BirdLife's "Cameroon-Gabon Lowlands Endemic Bird Area". Its presence within these priority areas points towards the possible biodiversity importance and sensitivity of the project area. In addition, the main project sites are just north of the Campo Ma'an complex which is an Important Bird Area. In fact the area of influence of the project, following IFC PS1 guidelines concerning secondary and cumulative impacts, appears to overlap with the coastal edge of the Campo Ma'an "Unité Technique Opérationnelle" (UTO) which acts as a buffer zone to the National Park. Although this is not a formal part of the WDPA protected area, the UTO limit is recognised by the World Bank. Careful environmental management and judicious use of mitigation options may significantly reduce these biodiversity risks by limiting the spatial spread of project related impacts.

Fieldwork conducted for this study was targeted using the IFC's Performance Standard 6, particularly concerning the paragraph 9 criteria within the decision making process for Critical Habitat. These are covered below in turn below.

"Habitat required for the survival of IUCN species": Fieldwork confirmed the following IUCN-listed species within the project area of influence: Leatherback Turtle *Dermochelys coriacea* (Critically Endangered), Olive Ridley Turtle *Lepidochelys olivacea* (Endangered), Green Turtle *Chelonia mydas* (Endangered), Hawksbill Turtle *Eretmochelys imbricata* (Critically Endangered), African Dwarf Crocodile *Osteolaemus tetraspis* (Vulnerable), Allen's Bushbaby *Galago alleni* (Near Threatened), Collared Mangabey *Cercocebus torquatus* (Near Threatened), Yellow-backed Duiker *Cephalophus silvicultor* (Near Threatened), Bay Duiker *Cephalophus dorsalis* (Near Threatened) and Sitatunga *Tragelaphus spekeii* (Near Threatened). The following IUCN-listed flora species were also found *Lophira alata* (Vulnerable), *Diospyros crassiflora* (Endangered), *Daniellia oblonga* (Vulnerable).

However, the small size of the terrestrial impact site (CPF =25ha intact forest, CPF-AES pipeline = <100ha degraded forest) means that the global and national significance of the impacts on these IUCN listed species are low. In the marine environment, if hydrocarbon leak management and anti-poaching programmes are in place, the impacts on these species should also be small. Therefore it is decided that the presence of these IUCN species does not lead to qualification as Critical Habitat under PS6.

"Sites holding special significance for endemic and restricted range species": The site holds species endemic to Cameroon, but fieldwork did not reveal any locally endemic species. Some plant species may qualify as "restricted range" but few taxa other than birds have been adequately assessed in this way to date.

“Sites critical to the survival of migratory species”. Several other species listed by international conventions such as CITES and CMS were also found but the site could not be said to be critical for their widespread survival.

“Areas supporting globally significant concentrations of congregatory species”. No such concentrations occur in the project sphere of influence, except perhaps Atlantic Hump-Backed Dolphin whose presence was not confirmed but is likely.

“Areas with species associated with key evolutionary processes and ecosystem services”. The site did not qualify under this criterion, although clearly the terrestrial and marine impact sites do provide a number of ecosystem services, such as marine resources.

“Areas having biodiversity of significant social, economic or cultural significance to local communities”. The marine ecosystems within the project area of influence are part of the major coastal fishery of Cameroon which is the source of the majority of people’s livelihoods. This is of relevance not just at the site but over a large distance due to hydrocarbon leak risks. Fishing is of principle economic and cultural importance and the project may qualify under the criterion depending on mitigation options taken.

All the priority species identified will suffer some reduction in their local population as a result of the project through direct habitat loss and fragmentation, possible chemical and noise pollution (particularly for marine mammals), and secondary impacts such as poaching. However the small size of the terrestrial project sites (forest and sandy coastline) means the global significance of these direct impacts will be comparatively small. The magnitude of the marine impacts could be large (for both biodiversity itself and livelihoods) if hydrocarbon risks are not properly managed. In general, the main risks to biodiversity arise from the risks of hydrocarbon leaks, secondary and cumulative impacts. Mitigation options such as timing of construction, control of noise levels and control of poaching will significantly reduce biodiversity risks. Under this rationale the habitats within the project sphere of influence do not qualify as Critical Habitat.

In addition to the species confirmed present, a list of priority species *potentially present* within the project area of influence were also identified through desktop and mapping analysis. Further research would be required to ascertain their presence or absence within the project area of influence. African Manatee *Trichechus senegalensis* was not reported to exist locally by the inhabitants of Eboudavoyé. However desktop analysis revealed that a population exists in the mouth of the Nyong river just north the probable project area of influence but may represent significant biodiversity risks in the case of broader secondary impacts or hydrocarbon leaks.

Important habitats present within the project area of influence include coastal forest on sandy and lateritic soils (important for several IUCN species and for local livelihoods), fringing riverine mangrove (estimated to provide local ecosystem services such as fish breeding and flood protection), and pelagic marine waters (mainly important for fishing livelihoods).

The small area of the terrestrial impacts reduces risks presented to ecosystem services; in addition, the river system downstream of the impact site reaches the sea in a short distance (c. 5km). As with biodiversity itself, the main threats to regional ecosystem services are from hydrocarbon spill risks (fishing livelihoods), and secondary and cumulative impacts (watersheds, groundwater purity).

## 6.1 Project location in relation to international conservation priorities and protected areas

A review of international conservation priorities was made to determine their location and extent in relation to the project. The project location was mapped in relation to known regions and areas recognised as global conservation priorities. This exercise provides a global and regional biodiversity context to the project and allows an initial estimate of the potential biodiversity sensitivity of the site in question. This section partly fulfills objectives 1 and 2 of the Terms of Reference.

### Summary

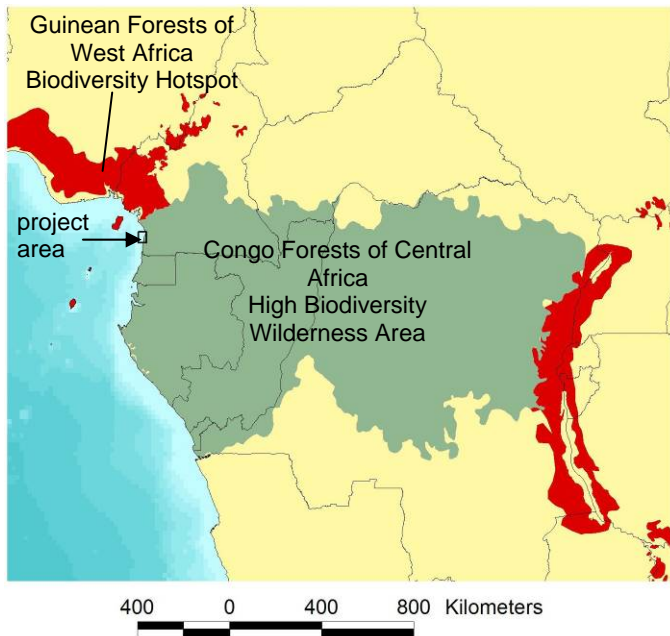
The project is located within several international conservation priorities. Its presence within these priority areas highlights the biodiversity importance and sensitivity of the region as a whole and points towards the possible importance of the project area itself for biodiversity conservation. The project is located within:

- Conservation International's "Congo Forests of Central Africa High Biodiversity Wilderness Area" (Mittermeier et al. 2002)
- WWF's [Atlantic Equatorial Coastal Forest Ecoregion](#)
- BirdLife's [Cameroon Gabon Lowlands Endemic Bird Area](#)
- Part of the project area seems to overlap the Campo-Kribi Centre of Plant Diversity and Endemism (WWF & IUCN 1994), although no map is available for this area.

The project sites are situated between two protected areas, the Douala-Edea Forest Reserve (IUCN Category IV) and Campo Ma'an National Park (IUCN Category II), part of the [Campo Ma'an Complex](#) which is a BirdLife International Important Bird Area. In fact, the northern edge of the project area of influence (following IFC PS1 guidelines concerning secondary and cumulative impacts) is estimated to be c. 20km south-east of the southern edge of the Douala-Edea Forest Reserve; and the southern part of the area of influence appears to abut with or (arguably overlap) the coastal edge of the Campo Ma'an "Unité Technique Opérationnelle" (UTO) which acts as a buffer zone to the National Park. Although this is not a formal part of the WDPA protected area, the UTO limit is recognised by the World Bank (see Figure 19). There are no Alliance for Zero Extinction (AZE) sites identified near to the project area, although AZE analysis does not consider plants, and the maps of Tchouto et al (2006b) suggest there are some potentially site-endemic plant species near Lobe just south of Kribi, in the north-western part of the Campo Ma'an UTO.

### 6.1.1 Conservation International's High Biodiversity Wilderness Areas and Biodiversity Hotspots

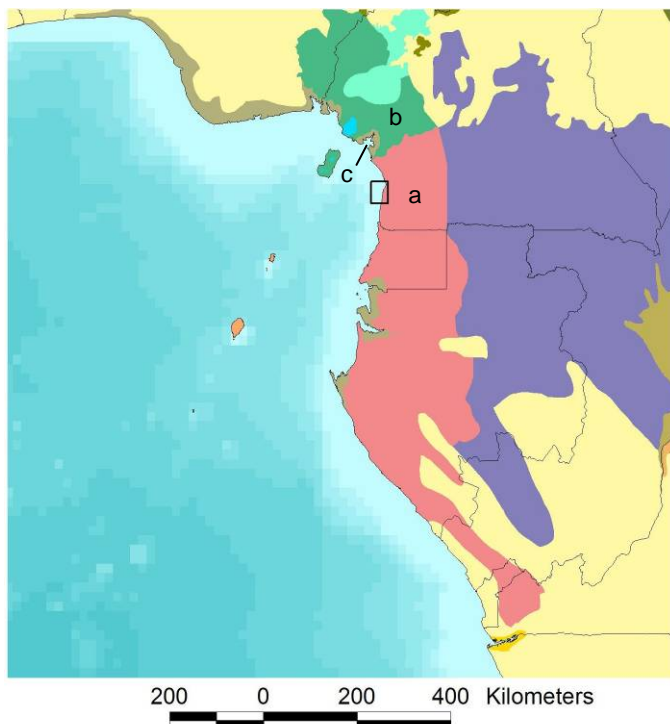
The project area is in the north-western region of the [Congo Forests of Central Africa High Biodiversity Wilderness Area](#) (Figure 3; Mittermeier et al. 2002). This is the second largest block of tropical rainforest left on Earth, known for its high diversity and endemism amongst groups such as plants and primates. The project area is also near the southern edge of the [Guinean Forests of West Africa Biodiversity Hotspot](#) (Figure 4; Mittermeier et al. 2004). This hotspot, highlighted because of exceptional levels of endemism and threat, harbours more than a quarter of Africa's mammals, including more than 20 species of primates. Logging, mining, hunting and human population growth are placing extreme stress on the forests. The Sanaga River (north of the project area), separates these two regions.



**Figure 3.** Position of the project area in relation to Conservation International's High Biodiversity Wilderness Areas (green) and Biodiversity Hotspots (red).

### 6.1.2 WWF's Global 200 Ecoregions

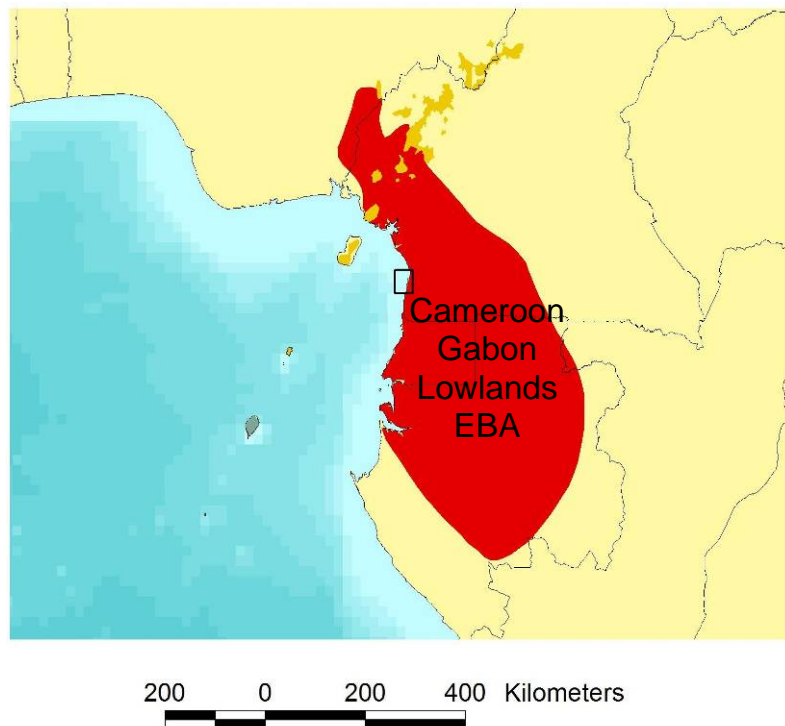
The project area is within the [Atlantic Equatorial Coastal Forest ecoregion](#), identified by WWF as one of the Global 200 ecoregions (Olson & Dinerstein 2002) for harboring exceptionally high levels of species richness and endemism (WWF 2001). Two other nearby Global 200 ecoregions are the [Cross-Sanaga-Bioko coastal forests](#) and the [Central African mangroves](#) (Olson & Dinerstein 2002; Figure 4).



**Figure 4.** Position of the project area in relation to WWF's priority Global 200 ecoregions: a) Atlantic Equatorial Coastal Forest; b) Cross-Sanaga-Bioko coastal forests; c) Central African mangroves.

### 6.1.3 BirdLife International's Endemic Bird Areas

The project area is within the [Cameroon Gabon Lowlands Endemic Bird Area](#) (Figure 5), identified by BirdLife International as a bird centre of endemism because it overlaps the range of six restricted-range species (range <50,000 km<sup>2</sup>): Gabon Batis (*Batis minima*); Dja River Warbler (*Bradypterus grandis*); Bates's Weaver (*Ploceus batesi*); Forest Swallow (*Hirundo fuliginosa*); Rachel's Malimbe (*Malimbus racheliae*); and Grey-necked Picathartes (*Picathartes oreas*) (Stattersfield et al. 1998; BirdLife International 2003). The last three species are in the range of the project area.



**Figure 5.** Position of the project area in relation to BirdLife International's Endemic Bird Area "Cameroon and Gabon Lowlands".

### 6.1.4 BirdLife International's Important Bird Areas

The [Campo Ma'an Complex](#) (500,000 ha) is an Important Bird Area (Fishpool & Evans 2001), including the Campo Ma'an National Park (270,000 ha) the UTO buffer zone (Unités Techniques Opérationelles) where much commercial logging has taken place. The IBA was identified due to the presence of 173 biome-restricted bird species, including the Vulnerable and restricted-range species Grey-necked Picathartes (*Picathartes oreas*), and the restricted-range Forest Swallow (*Hirundo fuliginosa*) and Rachel's Malimbe (*Malimbus racheliae*).

### 6.1.5 WWF and IUCN's Centres of Plant Diversity and Endemism

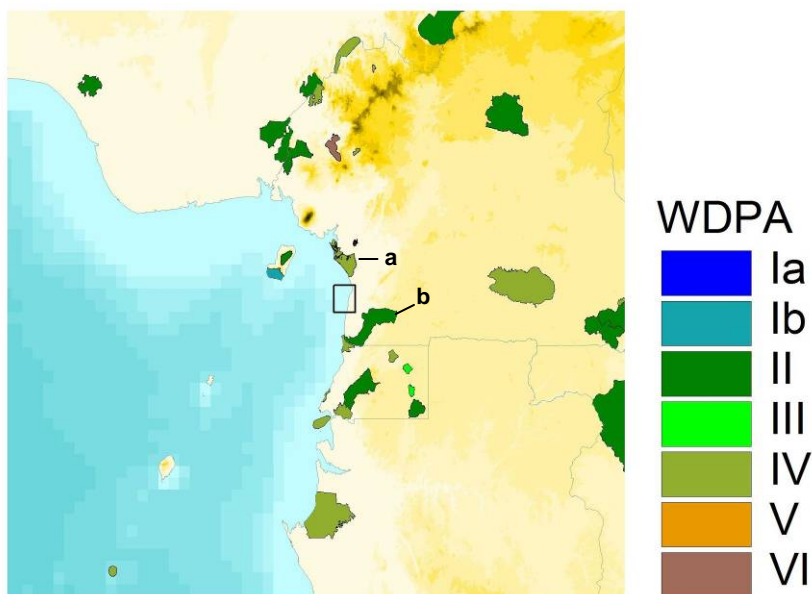
Although no map was available, part of the project area seems to overlap the Campo-Kribi Centre of Plant Diversity and Endemism (WWF & IUCN 1994). In a subsequent study, Tchouto et al. (2006 b) found that the Campo-Ma'an area is characterised by a rich and diverse flora including 114 plant species endemic to Cameroon, of which 29 are restricted to Campo-Ma'an and 29 to southwestern Cameroon.

### 6.1.6 Protected Areas (WDPA 2006)

The project area does not overlap any protected area as listed by the World Database on Protected Areas (WDPA 2006 version). However, the northern edge of the project area of influence (following IFC PS1 guidelines concerning secondary and cumulative impacts) is estimated to be c. 20km south-east of the southern edge of the Douala-Edea Forest Reserve. In addition, considering the potential secondary and cumulative impacts, the area of influence involving the offshore infrastructure such as pipelines to KB4 appears to abut with (or arguably overlap) the coastal edge of the Campo Ma'an "Unité Technique Opérationelle" (UTO) which acts as a buffer zone to the National Park. Although this is not a formal part of the WDPA protected area and many activities take place here (such as logging), the UTO limit is recognised by the World Bank (see Figure 19).

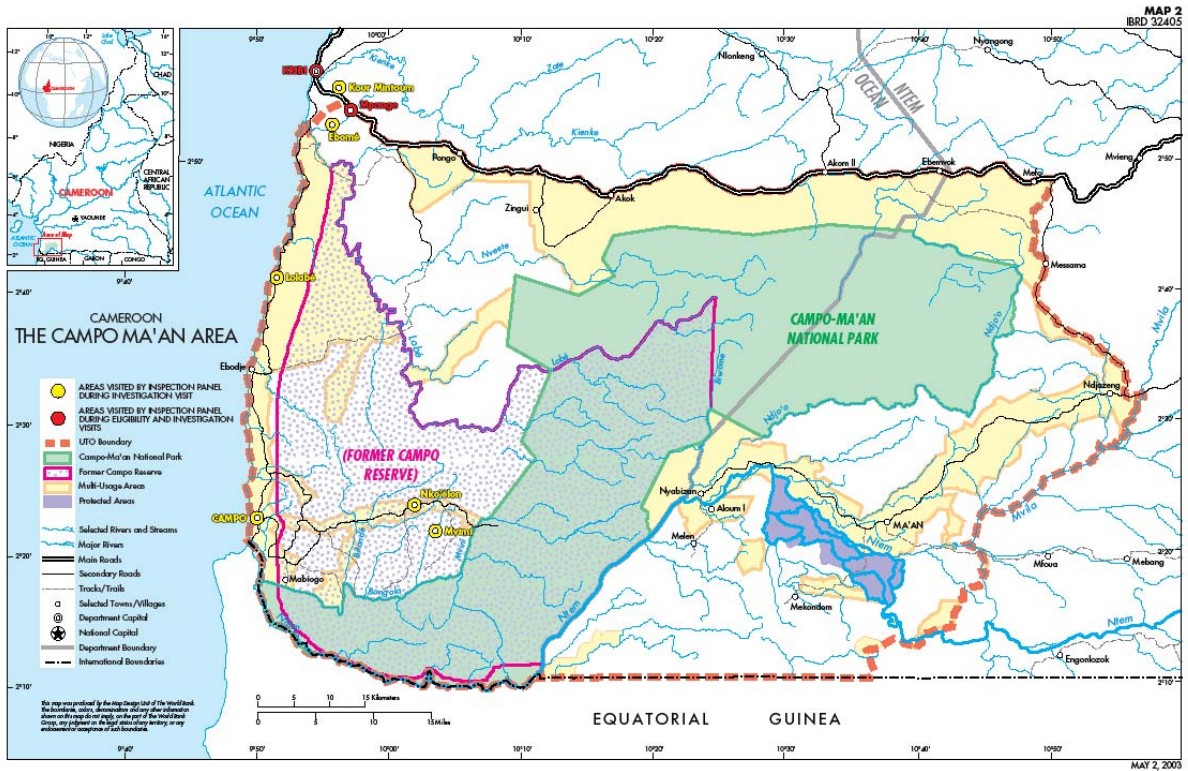
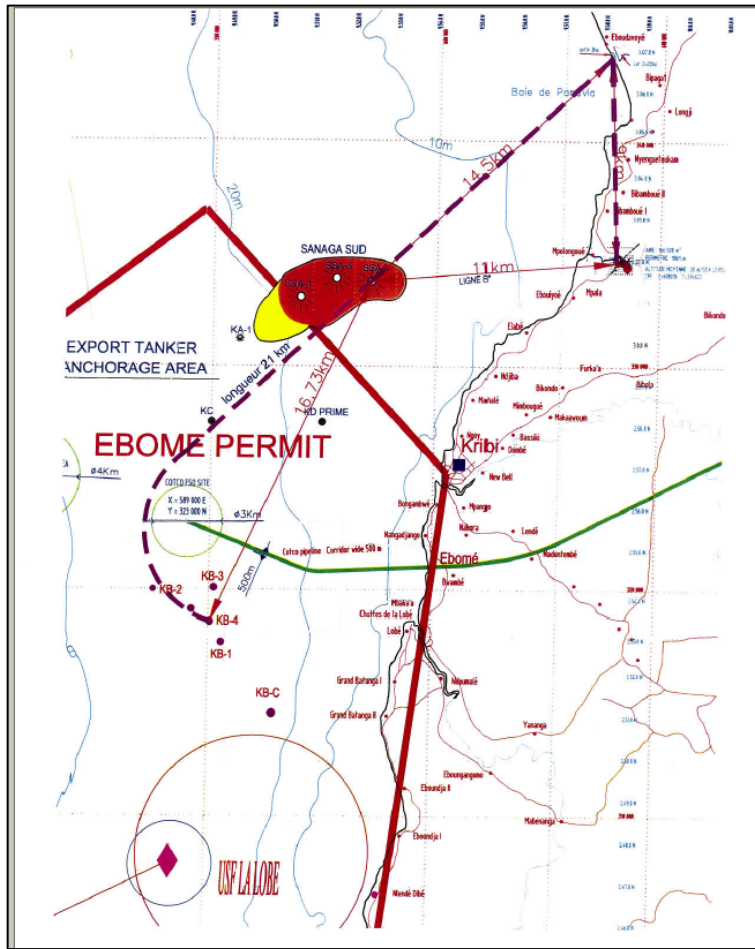
Douala Edéa Wildlife Reserve was created in 1932. Covering 160,000 ha, it is situated in the coastal plain of the Sanaga valley within the Kribi-Douala basin. Some 60 villages with a total estimated population of 10,000 people live within and around the Reserve. Its diversified vegetation comprises moist Congolese hill forests, mangrove forests, secondary forests and croplands. (source: [http://www.itto.or.jp/live/Live\\_Server/2043/E-PPD130-06R1F.pdf](http://www.itto.or.jp/live/Live_Server/2043/E-PPD130-06R1F.pdf)).

Campo–Ma’an National Park. Lies in the south-western corner of the country, against the international border with Equatorial Guinea and the Atlantic ocean. First protected as a game reserve (1932), subsequently reclassified as a Forest Reserve. The National Park (270,000 ha) was gazetted in January 2000 with boundaries that differ from the pre-existing forest reserve so that no logging concessions were included in its boundaries (Fishpool & Evans 2001). The western part of the park, which reaches the coast, is generally flat, with altitudes ranging between 0-300 m; more to the east, the topography is more varied, with altitudes ranging between 400-1,097 m. The vegetation is comprised largely of coastal evergreen rainforest.



**Figure 6.** Position of the project area in relation to formally designated protected areas (as per the WDPA 2006). Colour codes correspond to the IUCN protected area classification. a) Douala Edéa Wildlife Reserve; b) Campo – Ma’an National Park.





**Figure 7.** A comparison of the potential overlap of the project sphere of influence (from offshore infrastructure risks) with the Campo Ma'an UTO. By comparing the two maps it is clear that if an area of influence is drawn to include the coastline south of Kribi, due to hydrocarbon risks from the southern (e.g. KB4) infrastructure, then the project area of influence would overlap the UTO. Sensitive management and mitigation may significantly reduce this risk.



## 6.2 Desktop biodiversity review

### Summary

The desktop review found a remarkably large variety of threatened and other listed biodiversity potentially occurring within the project area of influence. Using published and unpublished data, range maps and other species distribution data, expert interview and opinion, global and national databases, at least 81 IUCN species were found to potentially occur in the area. A larger number of restricted range, CITES and CMS listed species probably also occur. In fact the high species diversity, levels of threat, irreplaceability and endemism, and large tracts of coastal forest intact make the area a priority for a new protected area (A. Rodrigues pers. comm.).

Information was gathered through desktop, interview and fieldwork methods to ascertain the priority species, habitats and ecological processes which constitute the principal, significant and critical biodiversity components within the project area of influence. This section mainly fulfills Objective 2 of the terms of reference. Brief note is made of likely impacts of the project on each biodiversity component noted, in anticipation of the subsequent section on mitigation options.

This section is divided into two parts: desktop review and fieldwork/interview assessment. Two different types of information are derived from these two methods. First, desktop assessments reveal the biodiversity potentially present in the project area based on, for example, a species known distribution and habitat requirements. Second, fieldwork and interview assessments reveal the biodiversity confirmed to be present at the site.

Desktop review provides a longer list of “likely presence”; fieldwork/interview assessment provides a shorter subset list of “confirmed presence”. Both sets of data are used in subsequent sections to determine the presence or not of critical habitat, options for mitigation, and indicators for monitoring.

### 6.2.1 Terrestrial habitat types / vegetation communities

The terrestrial habitat types in the area include a number of humid forest types and mangroves. The main forest type of relevance to the project is coastal forest rich in Caesalpinioideae on sandy and lateritic soils; a large area of coastal forest remains along the Cameroon, particularly in the south, but it is becoming degraded through various pressures. The project zone in Kribi consists of moist tropical evergreen littoral forest. The evergreen forest in this vicinity is dissected into blocks by disturbed road corridors. This area is one of the more disturbed corridors through this portion of the forest, with agriculture, fallows and disturbed forest habitats.

Small but relatively pristine areas of fringing mangrove exist along the Mpolongou river potentially within the CPF-AES pipeline route site; and at the mouth of the Eboudavoyé stream within the project area of influence. The nearest major mangrove areas are in river mouths (Lokoundje and Nyong) just north of the project area but possibly within the secondary or hydrocarbon leak footprint.

A first attempt to classify the vegetation types of Cameroon was made by Letouzey (1985), where he described and mapped several vegetation types and sub-types in the Campo-Ma'an area by using indicator species such as *Calpocalyx heitzii* and *Sacoglottis gabonensis*. The main vegetation type was defined as Atlantic Biafran forest rich in Caesalpinioideae with 5 sub-types dependent on the occurrence of Caesalpinioideae, *Calpocalyx heitzii* (Leguminosae-Mimosoideae), *Sacoglottis gabonensis* (Humiriaceae) and other coastal indicators. The forest types in the region of the project site are characterised by a rich and diverse flora with more than 2297 species of vascular plants, ferns and fern allies. Just south of the terrestrial project sites, the Campo Ma'an area has about 114 Cameroon endemic plant species, 29 of which are restricted to the area and 29 also occur in the southwestern part of Cameroon. Furthermore, 540 species recorded are Lower Guinea endemics and 1123 species are Guineo-Congolian biome endemics. All families endemic to this biogeographic region are found in the Kribi area (White, 1983). They include Hoplestigmataceae, Huaceae, Lepidobotryaceae, Medusandraceae, Pandaceae, Pentadiplandraceae and Scytropetalaceae. One of the explanations for the high occurrence of endemics might stem partly from the fact that the area falls within a series of postulated rain forest refugia in Central Africa.

## 6.2.2 Marine habitat types

The marine project area of influence extends from the coastline and associated brackish creeks and lagoons, to offshore pelagic waters 20m deep. This represents a certain diversity of marine habitats. No review of marine habitat types of Cameroon appears to exist. Mangroves are known to cover 270,000 hectares in Cameroon. A number of major marine habitat types can be readily identified. These include sandy and rocky coastlines, coarse sandy substrate nearshore waters, offshore benthic habitats, nearshore and offshore pelagic habitat. For example, the FAO classify the marine habitats off the coast of Cameroon with respect to fish communities in the following way, all of which are within the project area of influence.

- Coastal (suprathermocline) sciaenid community (on soft deposit). This community presents a particular estuarine facies very close inshore and in the creeks
- Shallow water (suprathermocline) sparid community (on more sandy, corally and rocky substrates) in the southern sector of Cameroon
- Deep water (subthermocline) sparid sub-community (on both hard and soft deposits) on and off the benthic slope.

## 6.2.3 Species

### 6.2.3.1 Terrestrial environment summary

The project area lies between Campo-Ma'an National Park / UTO and the Douala Edea Forest Reserve. Apart from favoured bushmeat species and those requiring very large ranges (mainly larger mammals) it can be assumed that regions with relatively intact habitat (such as the project area) between these two protected areas may hold a similar species composition. This assumption is used to determine a list of species potentially present within the project area as explained in the methods section.

The Campo Ma'an complex, which starts just south of Kribi, is an Important Bird Area, and also important for mammals (home to about 80 species of large and medium-sized mammals, including elephants, gorillas, giant pangolin; of the 29 species of primate found in Cameroon, 19 are in this area) and plants (with 114 plants endemic to Cameroon, including 29 restricted to the area [Tchouto et al. 2006b]). In total, 141 plant species of high conservation priority and 92 threatened plant species listed in the IUCN (2002) were identified for the Campo-Ma'an area. The project region is clearly particularly important for plants and primates.

The nearby Ntem basin (around the Ntem valley) is also reported to constitute an important refuge for wildlife and fish fauna because of the presence of many rare species of freshwater fishes (Vivien 1991; Matthews & Matthews 2000).

### 6.2.3.2 Amphibians

Forests on the littoral plain of Cameroon are expected to contain approximately 55-60 amphibian species. The Global Amphibian Assessment lists the following species as within range and habitat for the project area.

**Table 2.** Amphibians potentially occurring in the project sphere of influence.

<b>Amphibians</b>		
<b>Species</b>	<b>Family</b>	<b>IUCN status</b>
<i>Arthroleptis tuberosus</i>	Arthroleptidae	Data Deficient (DD)
<i>Hyperolius stenodactylus</i>	Hyperoliidae	Data Deficient (DD)
<i>Conraua goliath</i>	Ranidae	Endangered (EN)
<i>Petropedetes palmipes</i>	Petropedetidae	Endangered (EN)
<i>Cardioglossa nigromaculata</i>	Arthroleptidae	Near Threatened (NT)
<i>Hyperolius acutirostris</i>	Hyperoliidae	Near Threatened (NT)
<i>Hyperolius bopeleti</i>	Hyperoliidae	Near Threatened (NT)
<i>Petropedetes cameronensis</i>	Petropedetidae	Near Threatened (NT)
<i>Petropedetes johnstoni</i>	Petropedetidae	Near Threatened (NT)
<i>Hyperolius endjami</i>	Hyperoliidae	Vulnerable (VU)

<i>Leptodactylodon albiventris</i>	Astylosternidae	Vulnerable (VU)
<i>Leptodactylodon ventrimarmoratus</i>	Astylosternidae	Vulnerable (VU)

### 6.2.3.3 Mammals

The humid evergreen forests of Cameroon have a very high mammalian diversity, albeit much degraded by poaching. By interpolating species distributions, the following IUCN listed species potentially occur within the project area of influence.

**Table 3.** Mammals potentially occurring the the project area of influence

Scientific Name	English name	Status
<i>Cercopithecus preussi</i>	Preuss's guenon	Endangered
<i>Genetta cristata</i>	Crested genet	Endangered
<i>Gorilla gorilla</i>	Gorilla	Endangered
<i>Mandrillus leucophaeus</i>	Drill	Endangered
<i>Pan troglodytes</i>	Chimpanzee	Endangered
<i>Potamogale velox</i>	Giant otter shrew	Endangered
<i>Cercopithecus erythrotis</i>	Red-eared guenon	Vulnerable
<i>Colobus satanas</i>	Black colobus	Vulnerable
<i>Crocidura attila</i>	Hun shrew	Vulnerable
<i>Hydrictis maculicollis</i>	Speckle-throated otter	Vulnerable
<i>Mandrillus sphinx</i>	Mandrill	Vulnerable
<i>Myosciurus pumilio</i>	African pygmy squirrel	Vulnerable
<i>Nycteris major</i>	Ja slit-faced bat	Vulnerable
<i>Profelis aurata</i>	African golden cat	Vulnerable
<i>Galago alleni</i>	Allen's galago	Near Threatened
<i>Cercocebus torquatus</i>	Collared mangabey	Near Threatened
<i>Cephalophus silvicultor</i>	Yellow-backed Duiker	Near Threatened
<i>Cephalophus dorsalis</i>	Bay duiker	Near Threatened
<i>Tragelaphus spekeii</i>	Sitatunga	Near Threatened

### 6.2.3.4 Birds

A large number of biome restricted species are known from the humid forests in the region of the project zone (Appendix 2). These are birds restricted to the Guineo-Congolian forest biome. The large number of these biome-restricted birds is what makes the area an IBA, even though few of them are truly restricted range (with a range <50,000 sqkm). A subset of these are given below as the priority species which are either IUCN listed or restricted range.

**Table 4.** Birds potentially occurring in the project area of influence

Birds Scientific name	English name	Status
<i>Picathartes oreas</i>	Grey-necked Picathartes	Vulnerable, Restricted Range
<i>Hirundo fuliginosa</i>	Forest Swallow	Restricted Range
<i>Ploceus batesi</i>	Bates's Weaver	Vulnerable, Restricted Range
<i>Batis minima</i>	Gabon Batis	Near threatened, Restricted Range
<i>Malimbus racheliae</i>	Rachel's Malimbe	Restricted Range
<i>Bradypterus grandis</i>	Dja River Warbler	Near-Threatened, Restricted Range
<i>Sterna balaenarum</i>	Damara Tern	Near Threatened

### 6.2.3.5 Reptiles

There are three crocodile species in Cameroon: African sharp-nosed crocodile, *Crocodylus cataphractus* (DD); Nile crocodile, *Crocodylus niloticus* (LR/lc); African dwarf crocodile, *Osteolaemus tetraspis* (VU) (IUCN 2007). There are a large number of terrestrial reptiles, especially chameleons and Agamid lizards; virtually none have been assessed under IUCN criteria.

### 6.2.3.6 Invertebrates

A very large number of invertebrates remain unidentified in this region. Particularly diverse groups include land molluscs, insects and spiders. These groups often show complex and fine patterns of endemism, often to specific sites. To understand the biodiversity risks posed by these groups, and the threats this project may present, would require a significantly more in depth and resourced research project.

### 6.2.3.7 Flora

The Biafran forests of Cameroon are floristically diverse and harbour many threatened and locally endemic plants. The humid forests just south of the project area have been very well assessed. Tchouto et al (2006) and (2006b) present the species of most significant conservation concern, based on endemism and threat. The distribution of these species is imperfectly known and it remains possible that some may extend north into the project area.

**Table 5.** Flora potentially occurring within the project area of influence. This list is taken from Tchouto et al (2006) and IUCN, and requires further work to ascertain if these species represent possible species or not.

Flora Family	Species	IUCN Status
1 Acanthaceae	<i>Afrofittonia silvestris</i>	Vulnerable
2 Acanthaceae	<i>Sclerochiton preussii</i>	Endangered
3 Anacardiaceae	<i>Antrocaryon micraster</i>	Vulnerable
4 Anacardiaceae	<i>Trichoscypha bijuga</i>	Critically endangered
5 Anacardiaceae	<i>Trichoscypha mannii</i>	Vulnerable
6 Annonaceae	<i>Boutiquea platypetala</i>	Endangered
7 Annonaceae	<i>Pachypodanthium barteri</i>	Vulnerable
8 Annonaceae	<i>Uvariastrum zenkeri</i>	Vulnerable
9 Annonaceae	<i>Uvariadendron connivens</i>	Near Threatened
10 Asclepiadaceae	<i>Tylophora cameroonica</i>	Near Threatened
11 Boraginaceae	<i>Cordia platythyrsa</i>	Vulnerable
12 Burseraceae	<i>Aucoumea klaineana</i>	Vulnerable
13 Burseraceae	<i>Dacryodes igaganga</i>	Vulnerable
14 Celastraceae	<i>Salacia lehmbachii</i>	Vulnerable
15 Chrysobalanaceae	<i>Dactyladenia cinera</i>	Critically endangered
16 Combretaceae	<i>Terminalia ivorensis</i>	Vulnerable
17 Connaraceae	<i>Hemandradenia mannii</i>	Near Threatened
18 Ebenaceae	<i>Diospyros barteri</i>	Vulnerable
19 Ebenaceae	<i>Diospyros crassiflora</i>	Endangered
20 Euphorbiaceae	<i>Amanoa strobilacea</i>	Vulnerable
21 Euphorbiaceae	<i>Crotonogyne manniana</i>	Near Threatened
22 Euphorbiaceae	<i>Drypetes preussii</i>	Vulnerable
23 Euphorbiaceae	<i>Drypetes tessmanniana</i>	Critically endangered
24 Euphorbiaceae	<i>Neoboutonia mannii</i>	Near Threatened
25 Euphorbiaceae	<i>Pseudagrostistachys africana</i>	Vulnerable
26 Guttiferae	<i>Garcinia brevipedicellata</i>	Vulnerable
27 Guttiferae	<i>Garcinia kola</i>	Vulnerable
28 Guttiferae	<i>Garcinia staudtii</i>	Vulnerable
29 Hoplestigmataceae	<i>Hoplestigma pierreanum</i>	Critically endangered
30 Huaceae	<i>Afrostryrax kamerunensis</i>	Vulnerable

### 6.2.3.8 Freshwater fish

FishBase (<http://www.fishbase.org/>) lists 496 freshwater fish for Cameroon. However, freshwater fish are poorly known in Cameroon and central Africa in general. The IUCN lists 12 Critically Endangered and 14

Vulnerable freshwater species for Cameroon, however almost all of these are restricted to particular lake systems. WWF has conducted research on freshwater fish conservation in Campo Ma'an and report a significant number of rare and threatened species. Whether these, or others, occur within the project area of influence should be ascertained with in-depth field studies.

### 6.2.3.9 Marine environment

#### 6.2.3.10 Cetaceans

A range of whales including Humpback, Right, Sperm, Fin, Sei, Orca, and several species of dolphins, visits the waters off the coast of central west africa, but little is known about their spatial distribution, movement patterns, or behavior. There has been no formal study of cetaceans in Cameroon but their occurrence can be inferred from neighbouring countries. Eleven species are listed by IUCN as likely to occur in Cameroon waters (Table 6). Atlantic Hump-backed Dolphin is only known from historical records in Cameroon, but does inhabit inshore waters and estuaries – the marine habitats most likely to be impacted by the project. Other species, such as the large whales, are known to use migration routes a significant distance (often >10km) from the coast (a fact confirmed by the inhabitants of Eboudavoyé). This may reduce some project risks to these species.

**Table 6.** Cetacean species potentially occurring within the project area of influence

<b>Cetaceans</b>		
<b>Scientific Name</b>	<b>English Name</b>	<b>IUCN status</b>
<i>Stenella frontalis</i>	Atlantic spotted Dolphin	Data Deficient
<i>Stenella clymene</i>	Atlantic spinner dolphin	Data Deficient
<i>Mesoplodon europaeus</i>	Gervais' beaked whale	Data Deficient
<i>Sousa teuszii</i>	Atlantic Hump-backed Dolphin	Data Deficient
<i>Delphinus delphis</i>	Atlantic Dolphin	Least Concern
<i>Balaenoptera borealis</i>	Sei Whale	Endangered
<i>Megaptera novaeangliae</i>	Humpback Whale	Vulnerable
<i>Eubalaena glacialis</i>	Atlantic Right Whale	Endangered
<i>Physeter macrocephalus</i>	Sperm Whale	Vulnerable
<i>Balaenoptera physalus</i>	Fin Whale	Endangered
<i>Orcinus orca</i>	Orca	Conservation Dependent

#### 6.2.3.11 Marine turtles

The project area lies in the coastal zone of Cameroon along the Atlantic Ocean which constitutes one of the most important marine turtle breeding habitats in Central Africa (Formia et al. 2003). Five species of marine turtles are known to occur in the Atlantic Ocean near the coasts of Cameroon, Gabon, the Republic of Congo, the Democratic Republic of Congo, and Equatorial Guinea. These are the Loggerhead (*Caretta caretta*), Atlantic Green (*Chelonia mydas*), Leatherback (*Dermochelys coriacea*), Hawksbill (*Eretmochelys imbricata*), and the Olive Ridley (*Lepidochelys olivacea*) (Castroviejo et al. 1994). All five species of turtle are protected under Cameroonian legislation. Three of the five species—the Olive Ridley, Leatherback, and Green turtles—have been known to nest in Cameroon, along the sandy shoreline between Equatorial Guinea and the Wouri Estuary. Peak breeding season is between November and March for all species (Castroviejo et al. 1994). Little is known about the feeding grounds and migratory routes for turtles that nest on the beaches of central Africa.

#### 6.1.3.12 African Manatee

The African Manatee *Trichechus senegalensis* inhabits mangroves, rivers and some coastal waters throughout central Africa. In Cameroon the Manatees are found in suitable habitat from Korup on the Nigerian border, to the Edea region just north of the project area of influence (Grigione 1996). The Douala Edea Forest Reserve holds very significant mangrove areas with a large manatee population (CWCS pers. comm. 2007). The nearest river (to the project sites, CPF) with manatees recorded so far is the Nyong river (Grigione 1996) which enters the Atlantic c. 10km north of the Lokoundje rivermouth. Manatees have not been recorded from the rivers within the project area of influence including the Lokoundje, Mpolongou, Kienke and Lobe rivers (Grigione 1996; this study).

#### 6.2.3.13 Marine Fish

FishBase (<http://www.fishbase.org/>) lists 557 marine species for Cameroon, including 51 endemic species, 43 threatened, 59 reef associated, 131 pelagic, and 187 deep water. The IUCN Red List (IUCN 2007) lists: two CR species, one EN and three DD species marines. No doubt this taxonomic group is underassessed by IUCN at present.

**Table 7.** Marine fish potentially occurring within the project area of influence

<b>Marine fish Scientific Name</b>	<b>English Name</b>	<b>IUCN status</b>
<i>Epinephelus itajara</i>	Goliath grouper	Critically Endangered
<i>Epinephelus marginatus</i>	Dusky grouper	Endangered
<i>Mycteroperca rubra</i>	Mottled grouper	Data Deficient
<i>Thunnus alalunga</i>	Albacore tuna	Data Deficient
<i>Xiphias gladius</i>	Swordfish	Data Deficient
<i>Latimeria chalumnae</i>	Coelacanth	Critically Endangered

## 6.3 Fieldwork Assessment - habitats

Fieldwork was carried out at the two terrestrial project sites; one near the village of Eboudavoyé (Perenco CPF and onshore pipelines from wells); the other being the terrestrial and marine zones between the CPF site and the proposed AES-Sonel electricity generating plant site where a connecting pipeline is required.. Fieldwork was conducted between 16-21 December 2007, as detailed in the methods section. In the following sections, note is made of whether the data presented was derived from direct observation or from interview data with local communities concerning the presence, absence and abundance of certain species.

### 6.3.1 Eboudavoyé / CPF

#### 6.3.1.1 Habitats present

The CPF site consisting of two plots of 22ha and 3ha are coastal littoral forest as described in the EIA. Three types of forest vegetation can be identified within the site, as adequately described in the EIA.

These are:

1. Atlantic littoral type forest on strips of sand with *Saccoglotis gabonensis* and *Klainedoxa microphylla*, *Anthostema aubryanum* and *Ctenolophon engleranus* on silty areas. This is principally found on the 3ha plot.
2. Typical atlantic littoral forest with *Lophira alata* and *Saccoglotis gabonensis* inland of the sandier coastal soils. This is principally found in the 22ha plot.
3. Swamp forest periodically flooded upstream of the mangroves with *Guibourtia demeusi* and *Oxystigma mannii*. This is principally found in the 22ha plot

In this study, three other habitats are recognised as within the area of influence of the project at this site, which are:

4. Sandy coastline (where the pipeline will cross)
5. Lagoon and mangrove (a small area where the Eboudavoyé stream enters the sea). These areas of habitat are included as they may potentially be affected by downstream impacts such as pollution, and secondary or cumulative impacts in the area.
6. Pelagic waters (both nearshore and offshore), impacted by offshore infrastructure such as pipelines and wells.

#### 6.3.1.2 CPF / Eboudavoyé site description

The CPF site is atlantic forest in comparatively very good condition. It is slightly degraded, by historical logging (1984) and local use. The vegetation exists mainly on sandy substrate crossed by two small seasonal streams which were largely swampy stagnant areas during the dry season period of this study. The forest still holds many large trees and is in generally good condition. As a result this the forest still holds an important complement of flora and fauna species. The site is marked along the edge of the 22ha with a number of concrete posts, although the forest itself is contiguous with neighbouring regions. This connectivity is important and much of the faunal diversity of the forest owes itself to this fact; in other words, the birds and animals are here because the forest is part of the coastal forest massif. The forest is criss-crossed with a large number of regularly spaced transects / paths made by SNH during their surveys. Approximately 30-40% of the forest has virtually bare ground with no trees or understorey evident. This is caused by seasonal flooding which prevents the regular growth of understorey vegetation. Non-flooded areas have a dense understorey. The canopy is in good condition, estimated at c. 60-70% average cover over the entire site. The forest has abundant lianas, mostly in Rubiaceae. Nearer to the sea the soil is entirely sandy whereas the more inland areas of the site hold soils with progressively greater laterite content. Toward the Edea-Kribi road the soil is entirely laterite. These progressive edaphic changes are associated with some changes in floristic species composition.



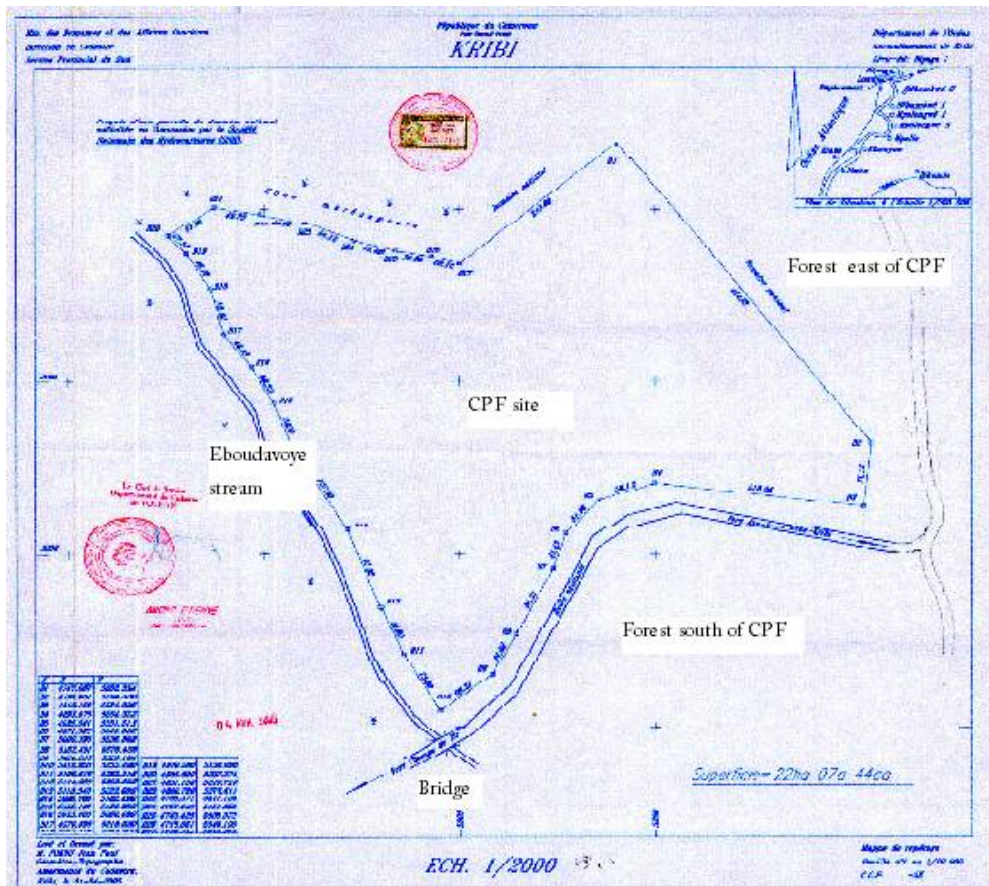


Figure 8. The CPF site. Map kindly provided by Perenco SA.

### Site history and forest condition

The CPF site was obtained as a type of lease by the Societe Nationale des Hydrocarbures (SNH) c. 20 years ago, approximately 3 years after the last historically noted commercial selective logging was carried out by WIJMA (1984). This selective logging was mainly for *Lophira alata* >70cm DBH. Neighbouring forests south of the track to Eboudavoyé (“**Forest south of the CPF**” on map) and east towards the road (“**Forest east of the CPF**” on map) and between the CPF and the Edea – Kribi road have been logged more recently, have fewer large trees and are in a poorer condition. It is possible that the existence of the SNH markers around the CPF site for the past 20 years have in some way protected the forest from other types of exploitation. This may be the reason why the forest is in slightly better condition than surrounding areas.

### Local forest areas – a habitat condition comparison

Brief habitat surveys were conducted in the coastal forest north and south of the project site to ascertain the biodiversity context and comparative habitat condition of the area. These surveys revealed that the coastal forest south of the project site (towards Kribi) was in a significantly more degraded state, having been logged more recently; whereas coastal forest areas north of the project site (towards the Lokoundje river) were in an equal or better condition compared with the project site. This pattern is presumably a result of proximity to Kribi and therefore logging economics.

### Project impacts on coastal forest

The forest within the 25ha will be impacted by the project through direct loss and disturbance<sup>3</sup>. This will lead to a reduction in the local population of at least three IUCN-listed trees and probably some other species of restricted range or notable local endemism. However the small size of the direct footprint means these impacts could not be said to have global or even national significance.

<sup>3</sup> Although Perenco have specified particular management measures to reduce impacts on forest where possible, such as a) limiting forest loss to the corner of the 22ha where the factory will be built; b) conserving the forest in the swamp zone which will not be developed; c) preserving the largest trees (and those of economic importance) wherever possible; and d) implementing an anti-poaching programme.





**Figures 9 and 10.** The forest edge of the CPF site. Interviews with inhabitants of Eboudavoyé.



**Figures 11 and 12.** A pre-cut transect in the CPF forest plot. The beach at Eboudavoyé, where the pipeline is planned to emerge from the sea.

### 6.3.2 CPF – power plant pipeline route

#### 6.3.2.1 Habitats present

The CPF – power plant pipeline route potentially involves both terrestrial and marine impact zones in the region between the CPF site and the power plant site. The land here is an increasingly degraded mosaic of coastal forest, agricultural land and human settlements, bordered by a sandy coastline as in Figure 12 above. The marine areas are similar to those described for the CPF site. The terrestrial habitats between the CPF and the power plant site (a distance of c. 15km), including the fringing habitats of the Mpolongou river which were surveyed.

The following habitat types were recognised:

1. Coastal littoral forest.
2. Fringing riverine mangrove forest.
3. Freshwater river of Mpolongou river
4. Brackish-water tidal river of the Mpolongou.
5. Sandy coastline (where the pipeline will cross)
6. Pelagic waters (both nearshore and offshore), impacted by offshore infrastructure such as pipelines and wells.



### 6.3.2.2 CPF – power plant pipeline route site description

This is a gently undulating coastal plain crossed by several rivers including the large Lokoundje river. It is a mosaic of slightly degraded to severely degraded forest, cultivated land (particularly manioc), fallow land and swamp forest. Four transects were surveyed between the Edea – Kribi road and the sea, including two disused logging tracks 3-8km south of the CPF site (sites A and B); one cut transect c. 1km south of the Mpolongou river (where the pipeline may come inland from the sea, site C); and the Mpolongou river itself (site D). Site C includes a small area of swamp forest which becomes a stream which empties into the Mpolongou river just east of the Edea-Kribi road where it runs through an area of fringing mangrove. This fringing mangrove borders the north and south bank of the Mpolongou river. This mangrove fringe is in excellent condition, the reason for which is unclear as mangrove wood is commonly cut for fish smoking in this part of Cameroon. The fringing mangrove itself is bordered by a thin belt of coastal forest in good condition; beyond this are cultivated fields used by the inhabitants of Mpolongou village. The coast itself, where the river empties into the sea, is an inhabited area with large well-constructed houses bordering the sea. No map is currently available of this site. A number of cultivated plants are common on the site, including oil palms, mangos, banana trees, sugar cane, Djakatu, Ndole, pineapple, avocado, guava, orange, potato, taro, manioc, and papaya. A number of indigenous medicinal plants are also found here and commonly used by the local population. Secondary plants are obvious in the fallow land previously used for shifting cultivation, such as *Anthocleista vogelii*, *Maranthus gabonensis*, *Terminalia capata*, *Irvingia gabonensis*, *Tetrapleura tetrapetra*, *Musanga cecropioides* etc.



**Figures 13 and 14.** The hamlet of Mpolongou. And typical semi-cultivated land, here banana and papaya.



**Figures 15 and 16.** The upper Mpolongou river. And the lower, mangrove fringed Mpolongou near to the proposed pipeline route.

## 6.4 Fieldwork Assessment - species

Species lists were compiled for plants, birds, terrestrial and marine mammals, and aquatic reptiles at the CPF site. The forest retains a high diversity of plant species typical of coastal humid forest, many individuals of which are of an exemplary size for the area by virtue of the lack of forestry exploitation since 1984; three (3) plant species listed by IUCN were found at the CPF site (identification pending). Surveys revealed 113 species of plant, 68 species of birds, 23 species of mammals and at least 10 species of terrestrial reptiles; and 7 species of aquatic reptiles. Seventeen (17) of these animals are listed by IUCN.

### 6.4.1 Plants

113 species of plant were identified within the project sphere of influence. This includes trees, bushes, lianas and herbs. Of these tree species, three are listed by IUCN<sup>4</sup> all found at the CPF site. The full plant lists for the CPF site and the CPF-AES pipeline (Mpolongou) site can be found in Appendix 3. The CPF site holds a number of good individuals of large timber species which are naturally more threatened in the area by logging. However it could not be said that the site is of national significance for these species. The magnitude of the direct footprint clearing impacts on these species is therefore comparatively minor.

**Table 8.** IUCN trees found at the Eboudavoyé / CPF site

Scientific Name	English Name	Abundance	IUCN status	CITES	CMS	Fieldwork or interview?
<i>Lophira alata</i>	None	Quite Common	Vulnerable	No	No	F
<i>Diospyros crassiflora</i>	None	Common	Endangered	No	No	F
<i>Daniellia oblonga</i>	None	Unassessed	Vulnerable	No	No	F

### 6.4.2 Terrestrial mammals

The site holds a significant diversity of mammals, as expected for coastal littoral forest in Cameroon. Six IUCN listed species were recorded. It is likely that several more exist. This mammal diversity is not owed to the CPF forest itself but to the larger tract of coastal forest of which it is a part. The populations of larger mammals at the site is much reduced due to poaching. The hunters of Eboudavoyé reported that bushmeat was now very difficult to find in the local forest; for example, monkey traps caught no more than 1-2 monkeys per year.

**Table 9.** Terrestrial mammals recorded at the Eboudavoyé / CPF site

Scientific Name	English Name	Abundance	Notes	IUCN status	CITES	CMS	Fieldwork (F) or Interview (I)?
<i>Galago alleni</i>	Allen's Bushbaby	Rare		Near Threatened	II	No	I
<i>Cercocebus torquatus</i>	Collared Mangabey	Quite Common	Commonly hunted	Near Threatened	II	No	I, F
<i>Miopithecus talapoin</i>	Southern Talapoin Monkey	Quite Common	Commonly hunted	Least Concern	II	No	I
<i>Myosciurus pumilio</i>	African Pygmy Squirrel	Common		Data Deficient	No	No	I
<i>Uromanis tetradactyla</i>	Long-tailed Pangolin	Uncommon	Check - giant pangolin	Least Concern	III	No	I

<sup>4</sup> It should be remembered that many plant species have not yet been assessed by IUCN.

<i>Cephalophus silvicultor</i>	Yellow-backed Duiker	Rare	Commonly hunted	Near Threatened	II	No	I, F
<i>Cephalophus dorsalis</i>	Bay Duiker	Rare	Commonly hunted	Near Threatened	II	No	I
<i>Tragelaphus spekeii</i>	Sitatunga	Rare	Commonly hunted	Near Threatened	III	No	I, F

### 6.4.3 Marine mammals

The only IUCN listed marine mammal positively identified within the Eboudavoyé area of influence was Sperm Whale *Physeter macrocephalus*. However a number of other cetacean species are likely to occur in the area. According to the inhabitants of Eboudavoyé, whales are almost only found a great distance out to sea (>10km) and only Sperm Whale is occasionally found closer inshore. Dolphins however are found closer inshore, and there are a number of IUCN, CITES and CMS listed species which may possibly occur. The inhabitants of Eboudavoyé did not readily distinguish between different dolphin species.

It should also be noted that African Manatee *Trichechus senegalensis* has populations just outside the currently identified area of influence, in the river mouths of the Nyong River. Secondary impacts or hydrocarbon leaks may extend the area of influence to include this species but the risks are not clearly assessed at present.

**Table 10.** Marine mammals recorded at the Eboudavoyé / CPF site

Scientific Name	English Name	CPF Abundance	Notes	IUCN status	CITES	CMS	Fieldwork or Interview?
<i>Physeter macrocephalus</i>	Sperm Whale	Uncommon	The only whale species which comes nearshore	Vulnerable	I	Yes	I

### 6.4.4 Birds

62 bird species were recorded at the CPF site. None of them are listed by IUCN nor are any of restricted range. Six species listed on CITES appendix II were found. However these are all common species in Cameroon. The site could not be said to be of national importance for birds. Nevertheless populations of these species will be negatively affected by the project. Further surveys may find some some rare species, but the site could not be said to be of national importance for birds.

**Table 11.** Listed birds recorded at the Eboudavoyé / CPF site

Scientific Name	English Name	Abundance	Notes	IUCN status	CITES	CMS	Field or Interview?
<i>Pandion haliaetus</i>	Osprey	Quite Common	Species listed by CITES but by IUCN as least concern are listed here but are not of comparable conservation status to Red-Listed species	Least Concern	II	II	F
<i>Kaupifalco monogrammicus</i>	Lizard Buzzard	Uncommon		Least Concern	II	No	F
<i>Agapornis swindernianus</i>	Black-collared Lovebird	Quite Common		Least Concern	II	No	F
<i>Psittacus erithacus</i>	Grey Parrot	Abundant		Least Concern	II	No	F
<i>Tauraco macrorhynchus</i>	Yellow-billed Turaco	Common		Least Concern	II	No	F
<i>Corythaeola cristata</i>	Great Blue Turaco	Common		Least Concern	III	No	F

### 6.4.5 Reptiles

The site holds populations or is a nesting area for six species of large reptile listed by IUCN (turtle and crocodile groups), two of which are Critically Endangered, two of which are Endangered, one is Vulnerable and one Data Deficient. All of the reptiles are on CITES appendix I and all except the African Dwarf Crocodile are listed by the Convention on Migratory Species. The turtles and the crocodiles are both protected under Cameroon law, but commonly hunted. The comparative importance of this site for these species compared with other beach sites in Cameroon was not assessed. However, many nesting sites are known in Cameroon for the species of marine turtle noted here.

The site is almost certainly not of national significance for turtles and crocodiles. Nevertheless, the project will lead to a reduction in population of these IUCN listed species. Terrestrial reptiles were not surveyed, although a certain diversity of chameleons were noted. A number of monitor lizards are present at the site, most likely *Varanus exanthematicus*, *V. niloticus* and *V. ornatus*, but these are not confirmed. Most Varanids have not yet been assessed by IUCN but may also represent conservation priorities.

**Table 12:** Aquatic reptiles found at Eboudavoyé / CPF

Scientific Name	English Name	Abundance	Notes	IUCN status	CITES	CMS	Fieldwork or Interview ?
<i>Dermochelys coriacea</i>	Leatherback Turtle	Quite Common	Nesting on beaches, feeding pelagic	Critically Endangered	I	Yes	I
<i>Lepidochelys olivacea</i>	Olive Ridley Turtle	Quite Common	Nesting on beaches, feeding pelagic	Endangered	I	Yes	I
<i>Chelonia mydas</i>	Green Turtle	Rare	Non-breeding, feeding pelagic only	Endangered	I	Yes	I
<i>Eretmochelys imbricata</i>	Hawksbill Turtle	Rare	Non-breeding, feeding pelagic only	Critically Endangered	I	Yes	I
<i>Crocodylus cataphractus</i>	African Sharp-nosed Crocodile	Uncommon	In rivers and swampy areas; previously more common	Data Deficient	I	Yes	I
<i>Osteolaemus tetraspis</i>	African Dwarf Crocodile	Rare	In rivers and swampy areas; previously more common	Vulnerable	I	No	I

**Table 13:** IUCN-listed species at Eboudavoyé / CPF categorised by habitat. The IUCN status for each of these species can be found in the summary priority species table for the site.

Coastal forest		Lagoon and mangrove		Sandy coastline		Neighbouring marine waters	
<i>Galago alleni</i>	Allen's Bushbaby	<i>Crocodylus cataphractus</i>	African Sharp-nosed Crocodile	<i>Dermochelys coriacea</i>	Leatherback Turtle	<i>Physeter macrocephalus</i>	Sperm whale
<i>Cercocebus torquatus</i>	Collared Mangabey	<i>Osteolaemus tetraspis</i>	African Dwarf Crocodile	<i>Lepidochelys olivacea</i>	Olive Ridley Turtle		
<i>Miopithecus talapoin</i>	Southern Talapoin Monkey			<i>Chelonia mydas</i>	Green Turtle		
<i>Myosciurus pumilio</i>	African Pygmy Squirrel			<i>Eretmochelys imbricata</i>	Hawksbill Turtle		
<i>Uromanis tetradactyla</i>	Long-tailed Pangolin						
<i>Cephalophus silvicultor</i>	Yellow-backed Duiker						
<i>Cephalophus dorsalis</i>	Bay Duiker						
<i>Tragelaphus spekeii</i>	Sitatunga						
<i>Lophira alata</i>	Tree sp						
<i>Diospyros crassiflora</i>	Tree sp						
<i>Daniellia oblonga</i>	Tree sp						



## 6.5 Fieldwork assessment

### – socioeconomic and cultural values of biodiversity of the CPF / Eboudavoyé site

#### 6.5.1 Forest and freshwater

It should be noted that the CPF forest is principally the socio-economic domain of the village of Eboudavoyé. The forest provides a secondary natural resource for the inhabitants of Eboudavoyé; the primary livelihood for Eboudavoyé is subsistence fishing. The CPF forest site provides a number of non-timber forest products such as medicinal plants, and bushmeat such as monkeys and small antelope. These forest resources are detailed in the Table 14. Culturally the forest represents an important aspect of life for the community of Eboudavoyé, being a part of their hunting domain. Hunting is a relatively important component of the lifestyle of some of the inhabitants. Inhabitants of other nearby villages such as Bipaga I and II and the two villages of Lokoundje also use neighbouring forest areas which may experience some impacts (such as a reduction in bushmeat as a result of disturbance) as a result of the project.

#### *What loss to livelihood and culture?*

When questioned as to the economic and cultural “opportunity cost” of the proposed project, all respondents (15 men, 3 women) noted they expected the positive economic impacts of the project for them (such as possible employment) would probably outweigh the economic and cultural loss the forest resources represent to them.

**Table 14:** Plants used by the community of Eboudavoyé.

Scientific name	Local Name, where noted	Use	Abundance
<b>Timber</b>			
<i>Sacoglottis gabonensis</i>		Construction wood	Quite Common
<i>Staudtia stipitata cameroonensis</i>	Niove	Pirogues and paddles	Uncommon
<i>Coelocaryon preussii</i>		Construction wood	Quite Common
<i>Pycnanthus angolensis</i>		Construction wood	Quite Common
<i>Exalobus sp.</i>		Construction wood	Quite Common
<i>Pterocarpus soyauxii</i>		Construction wood	Quite Common
<i>Erybroma oblongum</i>		Construction wood	Quite Common
<i>Alstonia boonei</i>		Construction wood	Quite Common
<i>Erythrophyllum guineensis</i>		Major columns of house	Quite Common
<i>Lophira alata</i>			
<b>NTFPs</b>			
<i>Exalobus sp.</i>			Common
<i>Calamus deërratus</i>		Furniture such as chairs and tables, in wicker	Abundant
<i>Rotin sp</i>		Furniture	Abundant
<i>Gentium sp.</i>			Common
<i>Intsia sp.</i>			Quite Common

<i>Lansianthera africana</i>			Common
<i>Raphia ssp</i>		Construction, weaving	Abundant
" <i>Ancis trocatus</i> "		Species name incorrect	Common
<i>Liana spp.</i>			Common
<i>scientific name not ascertained</i>	Mpole		?
<i>Pycnanthus angolensis</i>	Calabote		Quite Common
<i>Fagara spp.</i>	Bongo		Uncommon
<i>scientific name not ascertained</i>	Kakama		?
<i>Sacoglottis gabonensis</i>		Fermentation of palm wine	Quite Common
<i>Cola edulis</i>		Nuts eaten	Quite Common
<i>Irvingia gabonensis</i>		Fruits eaten	Quite Common
<b>Medicinal plants</b>			
<i>Enantia chloronta</i>		Malaria treatment	
<i>Alstonia boonei</i>		Source of quinine or quinine analogue	Uncommon
<i>Sacoglottis gabonensis</i>		Bad backs	Quite Common
<i>Pachypodantium barteri</i>		Skin parasites	
<i>Erythrophyllum guineensis</i>		Antibiotic	
<i>Solanum torvum</i>		?	Common
<i>Harungana madagascariensis</i>		Jaundice, Liver illnesses	Common
<i>Lantana africana</i>		Bad backs	Quite common
<i>Cassia alata</i>		Skin parasites	
<i>Emilia sp</i>		baby appetite	
<i>Costus sp.</i>		Antidote to poisons	
<i>Tetrapleura tetrapetra</i>		Contra-sorcery	
<i>Musanga cecropioides</i>		Eye medicine / to clear eyes	Abundant

**Table 15:** Animals hunted as bushmeat within the CPF forest by the inhabitants of Eboudavoyé (beach nesting turtles are included in this assessment)

Scientific name	English name
<i>Cercopithecus cephus</i>	Moustached Guenon
<i>Cercocebus torquatus</i>	Collared Mangabey
<i>Atherurus africanus</i>	African Brush-tailed Porcupine
<i>Paraxerus poensis</i>	Green Bush Squirrel
<i>Thryonomys swinderianus</i>	Greater Cane Rat
<i>Nandinia binotata</i>	African Palm Civet
<i>Genetta servalina</i>	Servaline Genet
<i>Potamochoerus larvatus</i>	Bushpig
<i>Potamochoerus porcis</i>	Red River Hog
<i>Cephalophus silvicultor</i>	Yellow-backed Duiker
<i>Cephalophus monticola</i>	Blue Duiker
<i>Cephalophus dorsalis</i>	Bay Duiker
<i>Tragelaphus spekeii</i>	Sitatunga
<i>Dermochelys coriacea</i>	Leatherback Turtle
<i>Lepidochelys olivacea</i>	Olive Ridley Turtle
<i>Chelonia mydas</i>	Green Turtle

### 6.5.2 Marine environment

The inhabitants of Eboudavoyé are artisanal fishers. The sea therefore provides their primary means of livelihood. A large variety of fish species are caught, although a few species predominate in the catches. In addition to fish, marine turtles are caught opportunistically and the eggs harvested from the beach. Although direct estimates at Eboudavoyé were not possible to make, marine turtle conservation programmes in Cameroon estimate that 90% of turtle nests are disturbed by humans.

The socio-economic importance of the Kribi fishery is well documented. The majority of inhabitants of the coast of Cameroon are artisanal fishers. The FAO<sup>5</sup> summarises the Cameroon fishery in the following way, and describes three major types of habitat which may all be used by the fishers of Eboudavoyé.

“There is a definite pattern in the distribution of fishes on the Cameroonian continental shelf. The available data indicate that the distribution of a number of species is limited by the depth of the thermocline and is influenced by the type of deposits (sand and silt) and the depths on the continental shelf, the slope of which is known to be quite variable.

Fish communities off the coast include coastal (suprathermoclinal) sciaenid community (on soft deposit) which presents a particular estuarine facies very close inshore and in the creeks; the shallow water (superathermoclinal) sparid community (on more sandy, corally and rocky substrates); and the deep water (subthermoclinal) sparid sub-community (on both hard and soft deposits) on and off the slope.”

<sup>5</sup> <http://www.fao.org/DOCREP/003/S4639E/S4639E04.htm#ch4>.

## 7. Critical habitat

This section interprets the PS6 definitions of Critical Habitat with respect to the biodiversity of the project area of influence.

### Summary

The main conclusion of this review is that although globally significant biodiversity is present within the project area of influence, the magnitude of impacts (if appropriately managed) is relatively small and their global and national significance comparatively minor. This is principally due to the small area of the terrestrial impact sites and the existence of mitigation options in the marine environment. Therefore the impacted habitats do not qualify as Critical Habitat under PS6. Careful mitigation and hydrocarbon leak management, as well as due exercise of biodiversity offsets, should be employed to achieve no net loss of biodiversity.

Four habitats (nearshore pelagic waters, sandy shoreline, coastal humid forest, mangrove lagoon) within the project area of influence harbour populations of IUCN species which inhabit, migrate and / or breed in these habitats. However these habitats are not deemed to be critical to the widespread survival of these species because of two factors. First, all these IUCN-listed species are of a relatively or very wide distribution and therefore the magnitude of the impacts within the project zone of influence is comparatively small and could not be said to be of global significance. For example the marine turtle species are found through several oceans. Secondly, many of these species will probably continue to exist alongside development if appropriate mitigation measures are put in place. For example, careful forest management can reduce deforestation, and careful hydrocarbon leak mitigation and anti-poaching programmes can minimise impacts on marine turtles.

1. Sandy shoreline provides nesting habitat for at least two IUCN-listed species of marine turtle (Leatherback *Dermochelys coriacea* and Olive Ridley *Lepidochelys olivacea*).

2. Pelagic waters almost certainly provide developmental habitat or migration routes for at least four IUCN listed turtle species (Leatherback *Dermochelys coriacea*, Olive Ridley *Lepidochelys olivacea*, Hawksbill *Eretmochelys imbricata* and Atlantic Green *Chelonia mydas*) and some cetaceans (Sperm Whale *Physeter macrocephalus*, possibly Atlantic Hump-backed Dolphin *Sousa tseuzii*, and possibly others dependent on migratio routes). Pelagic waters are also of unquantified importance for local livelihood use (subsistence fishing), the impacts depending on the size of the exclusion zone, degree of use and livelihood alternatives available.

3. Coastal humid forest (and associated small freshwater systems) provides habitat for at least six species of IUCN listed mammals and two crocodiles. The local livelihood importance of the 25ha plot of coastal forest is relatively small and other options for NTFP collection and bushmeat appear to exist in neighbouring forest areas.

4. A small area of mangrove and lagoon downstream of the CPF site is within the project area of influence and provides habitat for two species of IUCN listed crocodiles (*Osteolaemus tetraspis* and *Crocodylus cataphractus*) and possibly some other fauna of global conservation concern. However, the populations are not large.

The criteria of Paragraph 9 of Performance Standard 6 are analysed individually for the habitats and species in question.

### 1. "IUCN Red List of Threatened Species, by CITES, or as defined in any national legislation"

Four habitats within the project area of influence hold populations or constitute breeding sites for IUCN listed or CITES species, most of which are also covered by Cameroon legislation. These species are tabulated by habitat in Table 16 below. Sandy shoreline is nesting habitat for marine turtles; pelagic waters is almost certainly migratory and developmental habitat for marine turtles and some cetaceans; coastal forest is habitat for terrestrial mammals; and mangrove lagoon for crocodiles. The small area of the terrestrial impact sites means that the magnitude of impacts upon coastal forest and mangrove lagoon species is not of national significance for Cameroon. However it represents part of the cumulative impacts of gas development in Cameroon upon these globally threatened species. The potential impacts

on marine species (sandy shoreline and pelagic waters), and whether the impacts lead to significant reductions in the populations of the IUCN listed species of concern, will depend on the best practice management of the operations and the degree to which full mitigation options are exercised. Biodiversity offsets are strongly recommended as a risk management mitigation option.

## **2. “Areas having special significance for endemic or restricted-range species”**

The site holds species endemic to Cameroon, but fieldwork did not reveal any locally endemic species. Some plant species may qualify as “restricted range” but few taxa other than birds have been adequately assessed in this way to date. Therefore, from the data currently available, none of the habitats could be said to have special significance for any locally endemic or restricted-range species. However some species of restricted distribution do occur here, and the maps of Tchouto et al (2006b) suggest there may be several more as yet unmapped.

## **3. “Sites that are critical for the survival of migratory species” and “Areas supporting globally significant concentrations of congregatory species” and “Areas with unique assemblages of species or which are associated with key evolutionary processes or provide key ecosystem services”.**

The project area of influence does not hold any significant congregations of species or species associated with key evolutionary processes or ecosystem services. The sandy shoreline and pelagic waters are important for the survival of several migratory species listed by the Convention on Migratory Species and the IUCN. However given that the project area of influence is very similar to many other pieces of the Cameroon coastline, it could not be said that these areas are critical to the survival of these migratory species. However, due analysis is still required of the possible cumulative impacts of this project as a component of gas development on the coast of Cameroon.

## **4. “Areas having biodiversity of significant social, economic or cultural importance to local communities.”**

The marine ecosystems within the project area of influence are part of the coastal fishery of Cameroon which is the source of the majority of people’s livelihoods. This is of relevance not just at the site but over a large distance and with respect to cumulative impacts due to hydrocarbon leak risks, as fishing is of principle economic and cultural importance. All of the habitats surveyed are used in some economic or cultural way by the communities local to the impact sites. These uses include hunting, agriculture, collection of non-timber forest products and fishing. Full participatory community surveys were not completed, but it is probably true that apart from fishing none of the economic biodiversity uses within the project area of influence could be called significant (i.e. large and not reversible or able to be compensated). The significance of fishing for the local population means that further assessments concerning a) the possible impact of the marine exclusion zone and b) the hydrocarbon leak risk on fishing resources, should be carried out to understand this clause within paragraph 9 of PS6.

**Table 16.** Priority (IUCN, CITES, CMS) species recorded within the project sphere of influence

Scientific Name	English Name	Abundance	Notes	IUCN status	IUCN status details	CITES	CMS
<b>Reptiles</b>							
<i>Dermochelys coriacea</i>	Leatherback Turtle	Quite Common	Nesting on beaches, feeding pelagic	Critically Endangered	CR A1abd	I	Yes
<i>Lepidochelys olivacea</i>	Olive Ridley Turtle	Quite Common	Nesting on beaches, feeding pelagic	Endangered	EN A1bd	I	Yes
<i>Chelonia mydas</i>	Green Turtle	Unestimated	Non-breeding, feeding pelagic only	Endangered	EN A2bd	I	Yes
<i>Eretmochelys imbricata</i>	Hawksbill Turtle	Unestimated	Non-breeding, feeding pelagic only	Critically Endangered	CR A1bd	I	Yes
<i>Crocodylus cataphractus</i>	African Sharp-nosed Crocodile	Uncommon	In rivers and swampy areas; previously more common	Data Deficient	DD	I	Yes
<i>Osteolaemus tetraspis</i>	African Dwarf Crocodile	Rare	In rivers and swampy areas; previously more common	Vulnerable	VU A2cd	I	No
<b>Terrestrial Mammals</b>							
<i>Galago alleni</i>	Allen's Bushbaby	Rare		Near Threatened	NT	II	No
<i>Cercocebus torquatus</i>	Collared Mangabey	Quite Common	Commonly hunted	Near Threatened	NT	II	No
<i>Miopithecus talapoin</i>	Southern Talapoin Monkey	Quite Common	Commonly hunted	Least Concern	LC	II	No
<i>Myosciurus pumilio</i>	African Pygmy Squirrel	Common		Data Deficient	DD	No	No
<i>Uromanis tetradactyla</i>	Long-tailed Pangolin	Uncommon		Least Concern	LC	III	No
<i>Cephalophus silvicultor</i>	Yellow-backed Duiker	Rare	Commonly hunted	Near Threatened	NT	II	No
<i>Cephalophus dorsalis</i>	Bay Duiker	Rare	Commonly hunted	Near Threatened	NT	II	No

<i>Tragelaphus spekeii</i>	Sitatunga	Rare	Commonly hunted	Near Threatened	NT	III	No
<b>Marine Mammals</b>							
<i>Trichechus senegalensis</i>	African Manatee	Quite Common	Known north of project footprint but arguably within the sphere of influence, in mouth of river Nyong	Vulnerable	Vu	I	I
<i>Physeter macrocephalus</i>	Sperm Whale	Unestimated	The only large whale to sometimes occur within the project sphere of influence	Vulnerable	Vu	I	I
<b>Birds</b>							
<i>Pandion haliaetus</i>	Osprey	Quite Common	Species listed by CITES but by IUCN as least concern are listed here but are not of comparable conservation status to Red-Listed species	Least Concern	LC	II	II
<i>Kaupifalco monogrammicus</i>	Lizard Buzzard	Uncommon		Least Concern	LC	II	No
<i>Agapornis swindernianus</i>	Black-collared Lovebird	Quite Common		Least Concern	LC	II	No
<i>Psittacus erithacus</i>	Grey Parrot	Abundant		Least Concern	LC	II	No
<i>Tauraco macrorhynchus</i>	Yellow-billed Turaco	Common		Least Concern	LC	II	No
<i>Corythaeola cristata</i>	Great Blue Turaco	Common		Least Concern	LC	III	No
<b>Plants</b>							
<i>Lophira alata</i>	None	Quite Common		Vulnerable	Vu A1cd	No	No
<i>Diospyros crassiflora</i>	None	Common		Endangered	EN A1d	No	No
<i>Daniellia oblonga</i>	None	Unassessed		Vulnerable	VU A1c	No	No

## 8. Regional Analysis

### 8.1 Relationship to regional biodiversity priorities

As demonstrated in the Biodiversity Review section, the project sites are located within regions of very high significance for global biodiversity conservation, including a Conservation International “High Biodiversity Wilderness Area”; a BirdLife International “Endemic Bird Area”; a WWF “Global 200 Ecoregion”; and a WWF / IUCN “Centre of Plant Diversity”. The situation of the project within such globally recognised conservation areas means that most biodiversity impacts in this region are of global significance. The biodiversity of importance identified as potentially occurring within the project area of influence constitutes a component of the biodiversity used to identify these biodiversity priorities. As a result, any loss of this biodiversity does unavoidably represent a degradation of the biodiversity value of these globally recognised regions and sites.

### 8.1 Connectivity and biodiversity corridors

The CPF site is a delimited piece of forest within a relatively continuous, if patchily degraded, band of littoral forest along the coast between Kribi and the Douala-Edea Forest Reserve. Biodiversity survives best in larger fragments so to some degree the siting of the CPF factory within this forest area will result in some fragmentation. This will reduce the ability of some animals populations to migrate freely between forest areas such as feeding and breeding grounds.

### 8.3 Regional ecological processes

The area of influence in the terrestrial zone is relatively small. Few major ecological processes are likely to be affected. Freshwater systems are particularly prone to regional effects, such as downstream pollution; the regional impacts of this project are therefore limited by virtue of the largely terrestrial impacts and the small size of the Mpolongou and Lokoundje river catchments potentially within the CPF-AES pipeline route site.

Nevertheless, the project is part of the cumulative impact of development on the coastal forest of Cameroon, and the services it provides locally (water purification), regionally (migration, biodiversity corridors) and globally (biodiversity conservation, carbon sink). An assessment of the secondary and cumulative impacts of the project is recommended.

The area of influence in the marine realm is comparatively larger and the interconnectedness of the marine environment (currents, drift, migration) makes the ocean a much greater risk for regional biodiversity for this project. The potential impacts on regional marine biodiversity and processes is difficult to assess without reference to other gas developments in west Africa. This is recommended as a piece of work. The main risk to be assessed is clearly a hydrocarbon leak which could have catastrophic effects on regional biodiversity – both intrinsic and economic values.



## 9. Risk Assessment and Mitigation Options

### 9.1 Biodiversity risk assessment

In order to assess the risk represented by each biodiversity component or value identified, each requires individual assessment. This will result in a large number of species features having individually assigned risks. This does not mean that each risk must be individually managed. Often, many risks are satisfactorily managed with a single set of actions, such as habitat protection or control of poaching.

Risk assessment methods attempt to classify risks based on the consequence and the likelihood of the event. Thinking in this way for health and safety, gas explosions are of huge consequence but very unlikely in well managed operations; conversely, temporary dehydration of employees is of little consequence but quite likely to happen from time to time. Below is a template risk assessment matrix which combines likelihood and consequence to rank risk as low, moderate, high or critical. This kind of matrix can be used to assign magnitude to biodiversity risks. A formal set of “biodiversity consequence ranks” have been used in the below risk assessment, ranging from minor impacts on minor values which are spatially limited and reversible; to major impacts on major values which are widespread and irreversible. *[Full details of this risk assessment toolkit can be sought from The Biodiversity Consultancy.]*

Likelihood	Consequence				
	1-Minor	2-Medium	3-Serious	4-Major	5-Catastrophic
A-Almost Certain	Moderate	High	Critical	Critical	Critical <b>A5</b>
B-Likely	Moderate	High	High	Critical	Critical <b>B5</b>
C-Possible	Low	Moderate	High	Critical	Critical <b>C5</b>
D-Unlikely	Low	Low	Moderate	High	High*
E-Rare	Low	Low	Low	Moderate	High*

Table 17 is a draft risk assessment completed for the major biodiversity values identified within the project area of influence. The consequence and likelihood of various impacts has been impacted. Approximate risk assessments are postulated for the major habitats based on the greatest biodiversity values they hold, be it IUCN species of economic valued resources. A variety of operational activities may impact upon each value (for example, pelagic water fishing value may be impacted by an exclusion zone, or a hydrocarbon leak).

The risk assessment is mainly made up of High and Critical risks because the biodiversity values presented in the table are the priority values only, i.e. the more important values such as species listed by conservation authorities. Less significant values, which would hold lower scores in terms of consequence, have not been included due to the particular terms of reference of this assessment.

**Table 17.** Draft risk assessment for habitats and species confirmed present within the project area of influence

Components	Biodiversity values	Consequence	Likelihood	Score	Impact Magnitude
<b>Habitats</b>					
Coastal forest	Major habitat, globally rare and threatened	3	A	3A	CRITICAL
Freshwater streams	Some artisanal fishing	2	B	2B	HIGH
Mangrove lagoon	IUCN crocodiles	3	B	3B	HIGH
Sandy coastline	Turtle nesting	4	B	4B	CRITICAL
Pelagic waters	Cetaceans, fishing livelihood	4	C	4C	HIGH
Marine benthic habitat	Marine fish, ecosystem services, fishing livelihoods	4	C	4C	HIGH
<b>Species intrinsic values</b>					
<b>Reptiles</b>					
<i>Dermochelys coriacea</i>	IUCN	3	B	3B	HIGH
<i>Lepidochelys olivacea</i>	IUCN	3	B	3B	HIGH
<i>Chelonia mydas</i>	IUCN	3	B	3B	HIGH
<i>Eretmochelys imbricata</i>	IUCN	3	B	3B	HIGH
<i>Crocodylus cataphractus</i>	IUCN	3	B	3B	HIGH
<i>Osteolaemus tetraspis</i>	IUCN	3	B	3B	HIGH
<b>Terrestrial Mammals</b>					
<i>Galago alleni</i>	IUCN	2	B	2B	HIGH
<i>Cercocebus torquatus</i>	IUCN	2	B	2B	HIGH
<i>Miopithecus talapoin</i>	IUCN	2	B	2B	HIGH
<i>Myosciurus pumilio</i>	IUCN	2	B	2B	HIGH
<i>Uromanis tetradactyla</i>	IUCN	2	B	2B	HIGH
<i>Cephalophus silvicultor</i>	IUCN	2	B	2B	HIGH
<i>Cephalophus dorsalis</i>	IUCN	2	B	2B	HIGH
<i>Tragelaphus spekeii</i>	IUCN	2	B	2B	HIGH
<b>Marine Mammals</b>					
<i>Trichechus senegalensis</i>	IUCN	4	C	4C	CRITICAL

<i>Physeter macrocephalus</i>	IUCN	4	C	4C	CRITICAL
<b>Birds</b>					
<i>Pandion haliaetus</i>	CITES	1	A	1A	MODERATE
<i>Kaupifalco monogrammicus</i>	CITES	1	A	1A	MODERATE
<i>Agapornis swindernianus</i>	CITES	1	A	1A	MODERATE
<i>Psittacus erithacus</i>	CITES	1	A	1A	MODERATE
<i>Tauraco macrorhynchus</i>	CITES	1	A	1A	MODERATE
<i>Corythaeola cristata</i>	CITES	1	A	1A	MODERATE
<b>Flora</b>					
<i>Lophira alata</i>	IUCN	2	A	2A	HIGH
<i>Diospyros crassiflora</i>	IUCN	2	A	2A	HIGH
<i>Daniellia oblonga</i>	IUCN	2	A	2A	HIGH

## 9.2 Mitigation options

There are a number of clearly possible mitigation options available for this proposed project. Proper execution of these mitigation activities will significantly reduce the biodiversity risks faced by the company, and with the use of offsets have the possibility of achieving no net loss to biodiversity for most or all of the significantly impacted biodiversity components identified in this report.

This section looks at the mitigation options available for each project component, using the mitigation hierarchy (Figure 17). Proper use of the mitigation hierarchy means one must first seek to avoid impacts, then minimise, then restore, and finally only use offsets as an option to compensate for the residual impacts after all other options have been exercised (ten Kate et al. 2004; Ekstrom 2006). Mitigation options for each significant biodiversity are tabulated in Table 18.



**Figure 17.** The mitigation hierarchy

### 9.2.1 Avoidance options

#### *Eboudavoyé / CPF site*

Avoidance would involve siting the CPF in an alternative unforested plot. The CPF site is an area of high quality forest within the local area, and there is a wealth of already degraded land on which the CPF could be located. It is understood that the CPF location has been chosen due to the historical land tenure of SNH of this plot and the decision of the Government of Cameroon. However IFC Performance Standard 6 states that the client should not clear primary habitat unless other options are not feasible.

#### *CPF – AES associated pipeline route*

This pipeline would not be necessary if both the proposed terrestrial plant sites (CPF and AES-Sonel sites) were situated at a single location. Such impact avoidance has been pointed out by several stakeholders in the discussions presented in the Perenco EIA. However the decision for the siting of the CPF site and therefore the existence of the pipeline remains with the Government of Cameroon.

#### *Offshore infrastructure*

Offshore infrastructure is relatively fixed in location due to gas deposits and well locations. The engineering constraints and opportunities of the project are not known by The Biodiversity Consultancy. However, locating the CPF further south<sup>6</sup> would appear to greatly reduce the length of pipelines required, and therefore the risks of hydrocarbon leaks. This has been pointed out by several stakeholders in the discussions presented in the EIA. Since the pipelines lie on the seafloor and are not buried, there remains risks from anchors and trawlers (risks deemed low in the EIA). Shorter pipeline lengths would however reduce risks of damage from domestic or foreign fleets, and possibly also make economic sense and reduce monitoring costs.

### 9.2.2 Minimisation options

#### *Eboudavoyé / CPF site*

The Perenco EMP already describes several minimisation measures to reduce disturbance of the forest site and anti-poaching programmes. Minimisation can be further achieved by following best practice within the hydrocarbon industry concerning impact reduction in biodiversity sensitive sites, such as control of secondary impacts caused by the bitumen road to be constructed between the CPF and the Edea-Kribi road. It should be noted that the poaching programmes will not be managed by Perenco

<sup>6</sup> such as in the industrialised zone south of Kribi (MEAO pers. comm. 2007)

directly, but by la Ministere des Foret et Faune, which therefore remains a responsibility of the government of Cameroon.

#### *CPF – AES associated pipeline route*

The EIA for the associated facility will be commissioned as soon as the final route for this pipeline has been defined. If a terrestrial route is chosen, habitat fragmentation impacts should be minimised and construction should be limited to the dry season to reduce erosion. If a marine route is chosen, the shallow water (<10m) in this area means that the possibility of burying the pipeline to reduce leak risks caused by anchors and trawlers should be considered. Part of the potential pipeline route showed to the assessment team by the Mpolongou guide passes through secondary forest and fallow land beside the Mpolongou river. Impacts on these systems remain unassessed until further information comes available.

#### *Offshore infrastructure*

Offshore construction should be completed as quickly as safely possible and outside of the migration or breeding period for any cetacean or turtle (roughly May – August). The Perenco EMP includes a hydrocarbon leak monitoring and emergency response plan; this should follow best practice within the industry. The size of the fishing exclusion zone offshore could be minimised to reduce livelihood impacts.

#### *Associated infrastructure (roads etc) and secondary impacts*

For biodiversity, the secondary impacts of oil and gas projects are often larger than the primary impacts (Douglas and Ekstrom 2005). Impacts important to consider include habitat fragmentation and poaching. Effective minimisation of secondary impacts is therefore critical; they include reducing use of roads for poaching, and reducing poaching amongst staff and indeed amongst the growing population of Kribi as a whole, as gas developments proceed in the area.

### **9.2.3 Restoration options**

#### *Eboudavoyé / CPF site*

Restoration of tropical forest to restore impacted biodiversity values is difficult and has probably never been achieved to the level of No Net Loss. Basic site restoration such as revegetation is already included in the Perenco EMP, and this will replace certain basic ecosystem services such as erosion control.

#### *CPF – AES associated pipeline route*

Restoration in the fallow, agricultural or degraded areas of the potential terrestrial route will probably largely depend on the interests of local community stakeholders. There are few marine options for restoration. A hydrocarbon leak response plan, including restoration, should however be in place for such a shallow water pipeline in particular.

#### *Offshore infrastructure*

The benthic footprint of these structures is relatively small. During operations, a full response plan is required for hydrocarbon leaks, their management and restoration.

#### *Associated infrastructure (roads etc) and secondary impacts*

Best practice should be followed in restoring disturbed lands associated with roads and other infrastructure, to reduce habitat fragmentation. Care should be taken not to introduce invasive species, which are especially invasive in disturbed habitats.

## 9.2.4 Biodiversity Offset options<sup>7</sup>

The Biodiversity Consultancy specialises in biodiversity offset policy, design and implementation.

### 9.2.4.1 Biodiversity offsets have been defined as:

*“Conservation actions intended to compensate for the residual, unavoidable harm to biodiversity caused by development projects, so as to ensure no net loss of biodiversity. Before developers contemplate offsets, they should have first sought to avoid and minimise harm to biodiversity”* ten Kate et al 2004

Biodiversity offsets are here considered for intrinsic values of biodiversity only. Compensation for service values of biodiversity such as livelihoods and culture is not undertaken.

Best practice in the implementation of biodiversity offsets suggests that offsets should be designed to compensate for the residual impacts of the entire project, not just a single aspect of a project such as the factory site or marine impacts. Offsets need only be considered for *significant* residual impacts which remain after mitigation options have been exercised. For example, in the table below it is suggested that no offset requirements need be made for birds because the scale of impacts on the priority species identified is not significant.

The main impacts of the project from the point of view of species and habitat conservation (intrinsic values) can be summarised as follows.

1. Loss of 25ha of coastal humid forest (CPF / Eboudavoyé).
2. Loss of unquantified (probably <100ha) area of degraded coastal humid forest (CPF-AES Sonel electricity generation plant connecting pipeline, if chosen terrestrial route).
3. Loss of small populations of IUCN mammals, reptiles and plants within the coastal forest sites.
4. Some reduction in breeding capacity and possibly other life history components of 2-4 species of IUCN listed marine turtle (offshore infrastructure, CPF pipeline).
5. Unquantified impacts on other IUCN listed marine mammals such as Sperm Whale, Atlantic Hump-backed Dolphin and African Manatee.

### 9.2.4.2 Possible offset options for these impacts include:

#### *Loss of coastal forest*

Invest in the conservation of a piece of coastal forest in the Kribi region. There are many patches of unprotected forest in this region and many positive options exist, for example:

1. Quantity of forest offset  
Invest in the conservation of an area larger than that impacted to achieve a net positive impact. Offset best practice suggests that in threatened habitats, such as coastal humid forest in Cameroon, the ratio of area of forest gained (in the offset) to the area lost (at the impact site) should be greater than 1. For example, 3 hectares offset for each hectare lost is a ratio of 3:1.
2. Quality of forest offset  
Invest in an area of forest with higher biodiversity values such as higher priority species. For example, Tchouto et al (2006b) has identified several sites south of Kribi which hold populations of locally endemic plants which are highly threatened. For example:
  - a. At least 4 *Strychnos* spp. are likely to be Endangered, but have not been formally assessed according to Tchouto et al (2006b).
  - b. Several populations of locally endemic threatened plants exist in nearby locations such as the Lobe waterfalls. A map of locations for forest sites with some locally endemic plants is given in Figure 18, to provide an initial idea of the offset opportunities that exist.

---

<sup>7</sup> Current thinking in biodiversity offsets can be found in several recent publications (e.g. ten Kate et al 2004; see also [www.forest-trends.org/biodiversityoffsetprogram](http://www.forest-trends.org/biodiversityoffsetprogram); [www.biodiversityoffsets.org](http://www.biodiversityoffsets.org) )

*Loss of marine turtle breeding capacity / increased poaching*

Invest in a marine turtle conservation programme. This could either take the form of a new programme, or add to an existing programme such as that at Ebodje, south of Kribi. Careful quantification of likely losses incurred (e.g. number of turtle nests) and gains made (by the offset investment) should be undertaken to ensure no net loss or net positive impact. Averting losses at other threatened turtle nesting sites would constitute a viable offset through meeting the additionality criterion.

*Loss or disturbance to other marine biodiversity*

The marine impacts of the project include both pelagic and benthic waters and will lead to unquantified losses to some marine mammals and other species. This will especially be so in the case of any industrial accidents such as hydrocarbon spills. An obvious offset solution to these impacts is to invest in the creation of a new Marine Protected Area, possibly in partnership with other hydrocarbon developers in the region. A possible site for such an MPA is the coastal region bordering the Campo Ma'an complex area or "UTO", as shown in Figure 19. The Campo Ma'an UTO (dotted line below) encompasses an area much larger than the national park and extends to the coast but not into the sea. An extension of the protected area has already been suggested by regional conservation authorities (WWF 2006). An MPA along the UTO coast would also benefit the turtle programme at Ebodje.

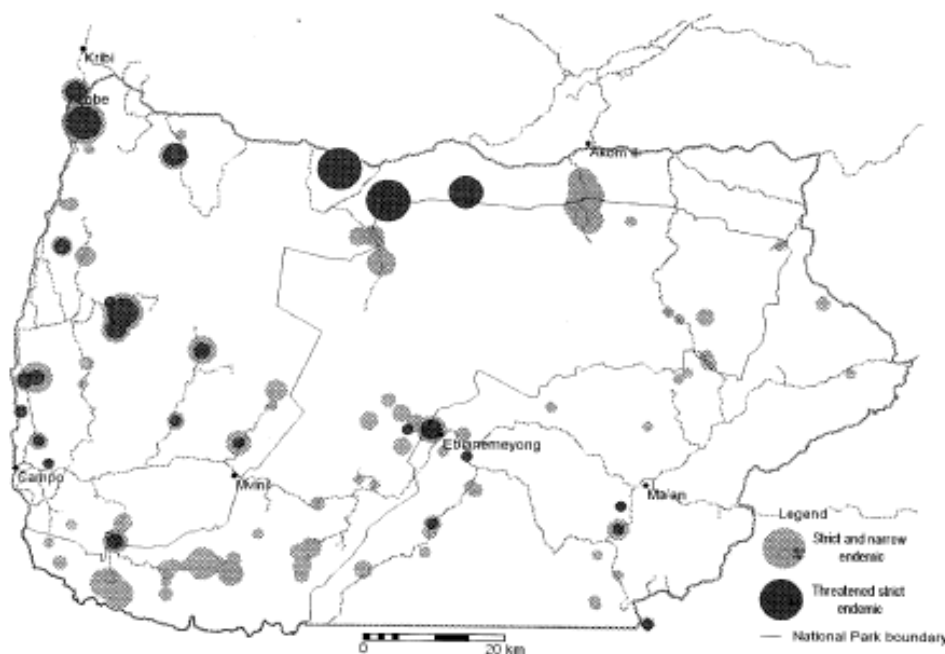


Figure 1. Distribution of 114 strict and narrow endemic plant species recorded in the Campo-Ma'an area (gray circle). Black circle represents the distribution of 17 threatened strict endemics that are not found in the National Park. The size of the circle represents the relative density of endemics at a given point.

**Figure 18.** From Tchouto et al. 2006b. The location of locally endemic plant populations in the Campo Ma'an area. The 17 locally endemic plant species in coastal forest outside of the protected area represent viable options for a coastal forest biodiversity offset.





**Table 18.** Mitigation options mapped out for each priority biodiversity component identified as of intrinsic value

Biodiversity Components	Project component / impact	Potential Consequences	Extent of change	Aim / Target	Summary of mitigation options			
					Avoidance	Minimisation	Restoration	Offset
<b>Habitats</b>								
Coastal forest	CPF factory, CPF-AES pipeline	Clearing of vegetation	Medium	No Net Loss	Situate CPF and AES factory at a single unforested site	Unnecessary disturbance to forest (EMP)	Basic rehabilitation for ecosystem services. Reforestation over long term; biodiversity values unlikely to be restored.	Invest in the conservation of a coastal forest site with similar or better biodiversity values
Freshwater streams	CPF factory	Change in quantity or quality of stream water (e.g. Pollution)	Medium	No Net Loss	Avoid factory construction near to stream	Pollution controls; Minimise disturbance to freshwater environment	Unlikely	Invest as above. Financial compensation for artisanal fishing?
Mangrove lagoon	CPF factory, CPF-AES pipeline	Change in habitat quality	Medium	No Net Loss	Locate CPF-AES pipeline away from mangroves of the Mpolongou river; locate CPF factory at a site which is not upstream of a mangrove lagoon.	Minimise mangrove damage during pipeline installation; minimise pollution downstream in Eboudavoyé	Possible	Ensure mangroves are present in offset site chosen
Sandy coastline	CPF wells – onshore pipelines and factory	Loss of beach habitat	Small	No Net Loss	Avoid construction, especially of pipeline, during turtle nesting period.	Minimise construction during nesting period; protect turtle nesting within are of project responsibility	Not possible	Invest in a marine turtle breeding programme.
Pelagic waters	Wells and Pipelines	Exclusion zone, pollution	Small - Large	No Net Loss	Avoid pipeline construction during whale, dolphin and turtle migration or breeding periods	Hydrocarbon leak monitoring and response plan throughout pipeline routes	Have adequate emergency plan in place for hydrocarbon leaks	Invest in a marine conservation zone;
Marine benthic habitat	Wells and Pipelines	Exclusion zone, pollution	Small- Large	No Net Loss	Avoid pipeline construction during whale, dolphin and turtle migration or breeding periods	Hydrocarbon leak monitoring and response plan throughout pipeline routes	Have adequate emergency plan in place for hydrocarbon leaks	Invest in a marine conservation zone;

Species intrinsic values								
Reptiles								
<i>Dermochelys coriacea</i>	CPF wells – onshore pipelines and factory	Loss of beach habitat; increased poaching; disturbance to migration routes.	Medium	No Net Loss	Avoid construction, especially of pipeline, during turtle nesting or migration period.	Ensure hydrocarbon leak system is working throughout pipeline routes; have poaching minimisation programme	Have adequate emergency plan in place for hydrocarbon leaks	Invest in a marine turtle breeding programme.
<i>Lepidochelys olivacea</i>	CPF wells – onshore pipelines and factory	Loss of beach habitat; increased poaching; disturbance to migration routes.	Medium	No Net Loss	Avoid construction, especially of pipeline, during turtle nesting or migration period.	Ensure hydrocarbon leak system is working throughout pipeline routes; have poaching minimisation programme	Have adequate emergency plan in place for hydrocarbon leaks	Invest in a marine turtle breeding programme.
<i>Chelonia mydas</i>	CPF wells – onshore pipelines and factory	Loss of beach habitat; increased poaching; disturbance to migration routes.	Medium	No Net Loss	Avoid construction, especially of pipeline, during turtle nesting or migration period.	Ensure hydrocarbon leak system is working throughout pipeline routes; have poaching minimisation programme	Have adequate emergency plan in place for hydrocarbon leaks	Invest in a marine turtle breeding programme.
<i>Eretmochelys imbricata</i>	CPF wells – onshore pipelines and factory	Loss of beach habitat; increased poaching; disturbance to migration and developmental waters	Medium	No Net Loss	Avoid construction, especially of pipeline, during turtle nesting or migration period.	Ensure hydrocarbon leak system is working throughout pipeline routes; have poaching minimisation programme	Have adequate emergency plan in place for hydrocarbon leaks	Invest in a marine turtle breeding programme.
<i>Crocodylus cataphractus</i>	CPF factory	Loss or degradation of aquatic habitat; poaching	Small	No Net Loss	Avoid construction during sensitive periods of crocodile life cycle	Ensure anti-poaching programme is in place	Have adequate emergency plan in place for hydrocarbon leaks	Preferably ensure this species is found within the offset site chosen
<i>Osteolaemus tetraspis</i>	CPF factory	Loss or degradation of aquatic habitat; poaching	Small	No Net Loss	Avoid construction during sensitive periods of crocodile life cycle	Ensure anti-poaching programme is in place	Have adequate emergency plan in place for hydrocarbon leaks	Preferably ensure this species is found within the offset site chosen

Terrestrial Mammals								
<i>Galago alleni</i>	CPF factory	Loss or degradation of forest habitat	Small	No Net Loss	Locate CPF at an alternative unforested site	Reduce forest disturbance	Restoration is unlikely to benefit this species;	Preferably ensure this species is found within the offset site chosen
<i>Cercocebus torquatus</i>	CPF factory	Loss or degradation of forest habitat; poaching	Small	No Net Loss	Locate CPF at an alternative unforested site	Minimise pollution; Reduce forest disturbance; ensure antipoaching programme is in place	Restoration is unlikely to benefit this species;	Preferably ensure this species is found within the offset site chosen
<i>Miopithecus talapoin</i>	CPF factory	Loss or degradation of forest habitat; poaching	Small	No Net Loss	Locate CPF at an alternative unforested site	Minimise pollution; Reduce forest disturbance; ensure antipoaching programme is in place	Restoration is unlikely to benefit this species;	Preferably ensure this species is found within the offset site chosen
<i>Myosciurus pumilio</i>	CPF factory	Loss or degradation of forest habitat; poaching	Small	No Net Loss	Locate CPF at an alternative unforested site	Minimise pollution; Reduce forest disturbance; ensure antipoaching programme is in place	Restoration is unlikely to benefit this species;	Preferably ensure this species is found within the offset site chosen
<i>Uromanis tetradactyla</i>	CPF factory	Loss or degradation of forest habitat	Small	No Net Loss	Locate CPF at an alternative unforested site	Minimise pollution; Reduce forest disturbance; ensure antipoaching programme is in place	Restoration is unlikely to benefit this species;	Preferably ensure this species is found within the offset site chosen
<i>Cephalophus silvicultor</i>	CPF factory	Loss or degradation of forest habitat; poaching	Small	No Net Loss	Locate CPF at an alternative unforested site	Minimise pollution; Reduce forest disturbance; ensure antipoaching programme is in place	Restoration is unlikely to benefit this species;	Preferably ensure this species is found within the offset site chosen
<i>Cephalophus dorsalis</i>	CPF factory	Loss or degradation of forest habitat; poaching	Small	No Net Loss	Locate CPF at an alternative unforested site	Minimise pollution; Reduce forest disturbance; ensure antipoaching programme is in place	Restoration is unlikely to benefit this species;	Preferably ensure this species is found within the offset site chosen

<i>Tragelaphus spekeii</i>	CPF factory	Loss or degradation of forest habitat; poaching	Small	No Net Loss	Locate CPF at an alternative unforested site	Reduce forest disturbance; ensure antipoaching programme is in place	Restoration is unlikely to benefit this species; Have adequate emergency plan in place for hydrocarbon leaks	Preferably ensure this species is found within the offset site chosen
<b>Marine Mammals</b>								
<i>Physeter macrocephalus</i>	Wells and pipeline	Disturbance	Medium	No Net Loss	Avoid construction during whale migration	Reduce disturbance of marine environment	None	Ensure this species occurs within offset site chosen (e.g. Marine area)
<i>Other cetaceans (data pending)</i>	Wells and pipeline	Disturbance	Medium	No Net Loss	Avoid construction during whale migration	Reduce disturbance of marine environment	None	Ensure this species occurs within offset site chosen (e.g. Marine area)
<i>Trichechus senegalensis</i>	CPF factory and associated infrastructure; secondary impacts and human migration	Pollution; poaching	Medium?	No Net Loss	Locate CPF further south, such as south of Kribi, where no Manatees occur	Reduce pollution risks; Reduce risks of secondary impacts in Manatee zone	None	Invest in a Manatee conservation programme if impacts occur for this species
<b>Birds</b>								
<i>Pandion haliaetus</i>	CPF factory	Loss of habitat	Small	No Net Loss	Locate CPF at an alternative unforested site	Reduce forest disturbance; ensure antipoaching programme is in place	Unlikely	The impacts on these species are too small to require an offset
<i>Kaupifalco monogrammicus</i>	CPF factory	Loss of habitat	Small	No Net Loss	Locate CPF at an alternative unforested site	Reduce forest disturbance; ensure antipoaching programme is in place	Unlikely	The impacts on these species are too small to require an offset
<i>Agapornis swindernianus</i>	CPF factory	Loss of habitat	Small	No Net Loss	Locate CPF at an alternative unforested site	Reduce forest disturbance; ensure antipoaching programme is in place	Unlikely	The impacts on these species are too small to require an offset
<i>Psittacus erithacus</i>	CPF factory	Loss of habitat	Small	No Net Loss	Locate CPF at an alternative unforested site	Reduce forest disturbance; ensure antipoaching programme is in place	Unlikely	The impacts on these species are too small to require an offset

<i>Tauraco macrorhynchus</i>	CPF factory	Loss of habitat	Small	No Net Loss	Locate CPF at an alternative unforested site	Reduce forest disturbance; ensure antipoaching programme is in place	Unlikely	The impacts on these species are too small to require an offset
<i>Corythaeola cristata</i>	CPF factory	Loss of habitat	Small	No Net Loss	Locate CPF at an alternative unforested site	Reduce forest disturbance; ensure antipoaching programme is in place	Unlikely	The impacts on these species are too small to require an offset
<b>Flora</b>								
<i>Lophira alata</i>	CPF factory	Loss of habitat	Small	No Net Loss	Locate CPF at an alternative unforested site	Reduce forest disturbance	Unlikely	The impacts on these species are too small to require an offset
<i>Diospyros crassiflora</i>	CPF factory	Loss of habitat	Small	No Net Loss	Locate CPF at an alternative unforested site	Reduce forest disturbance	Unlikely	The impacts on these species are too small to require an offset
<i>Daniellia oblonga</i>	CPF factory	Loss of habitat	Small	No Net Loss	Locate CPF at an alternative unforested site	Reduce forest disturbance	Unlikely	The impacts on these species are too small to require an offset

## 10. Biodiversity indicators for long term monitoring

The following indicators are suggested for piloting as an aid to long term monitoring of the project impacts. Importantly, these are status indicators only. No management indicators are suggested here (e.g. biodiversity action plan; employment of ecologist etc). Full details of the biodiversity indicators toolkit can be sought from The Biodiversity Consultancy.

### 10.1 Area / Habitat based indicators

#### *A1. Hectares of coastal humid forest*

Areas of coastal humid forest will be lost due to the project. Other areas may be gained through offsets. The hectares of intact coastal humid forest is therefore a valuable indicator of overall impacts.

#### *A2. Hectares or kilometres of coastline; hectares or sq km of pelagic waters*

In a similar manner to A1, the total area of marine systems impacted through the project or through an offset is a valuable indicator of overall impacts.

### 10.2 Species-based indicators

#### Marine

#### *S1. Frequency of turtle visits; Number of turtle nests*

Impacts on nesting marine turtle can be assessed by counting the number of active nests before, during and after project operations.

#### *S2. Cetacean counts*

Carefully designed counts of cetaceans within the project zone before, during and after operations will provide some measure of these impacts.

#### Terrestrial

#### *S3. IUCN mammal diversity and density*

The diversity and density of IUCN mammals remaining in the forest can be measured using tracks. Several tracks (Porcupine, Sitatunga, other duikers) were found in soft mud during surveys in the CPF forest.

#### *S4. IUCN reptile diversity and density*

Similar measures could be implemented for the IUCN listed reptiles within the project area of influence.

### 10.3 Ecosystem integrity indicators

#### *E1. Water quality in downstream areas*

Water quality (suspended solids, chemistry) in the downstream areas of Eboudavoyé and Mpolongou rivers will provide a measure of aquatic impacts in these systems.

#### *E2. Area of vegetation restored*

The area and quality of vegetation restored (e.g. from bare disturbed earth) at both the terrestrial impact sites will be an important measure of ecosystem integrity, concerning issues such as erosion control and soil fertility.

## Appendices



**Appendix 1. Photographs of the fieldwork**



Right: Field interviews with Eboudavoyé hunter; Left, the mangroves of the lower Mpolongou river



From right to left: The swampy Eboudavoye stream, a transect in the CPF forest, and a concrete border marker in the CPF forest.



Right, Robert Ambassa of Perenco speaks with the inhabitants of Mpolongou. Left, a monkey trap on the edge of the CPF forest.



## Appendix 2: Bird species recorded at Eboudavoyé / CPF with their relative abundance and encounter rates.

Note the encounter rate is a crude quantitative measure of abundance and is calculated by dividing the number of individuals recorded for each species by the number of hours of fieldwork. Hence a bird species recorded 10 times over 2 hours has an encounter rate of 5 / hour.

English Name	French Name	Scientific Name	IUCN status	Abundance	Encounter Rate / Hour
Hadada Ibis	Ibis hadeda	<i>Bostrychia hagedash</i>	LC	Uncommon	0.13
Black-crowned Night Heron	Bihoreau gris	<i>Nycticorax nycticorax</i>	LC	Rare	0.06
Cattle Egret	Héron garde-boeufs	<i>Bubulcus ibis</i>	LC	Rare	0.06
Green-backed Heron	Héron strié	<i>Butorides striatus</i>	LC	Uncommon	0.13
Osprey	Balbusard pecheur	<i>Pandion haliaetus</i>	LC	Quite common	0.13
Palm-nut Vulture	Palmiste africain	<i>Gypohierax angolensis</i>	LC	Quite common	0.31
African Harrier Hawk	Gymnogène d'Afrique	<i>Polyboroides typus</i>	LC	Common	0.38
Lizard Buzzard	Autour unibande	<i>Kaupifalco monogrammicus</i>	LC	Uncommon	0.06
Long-crested Eagle	Algle huppard	<i>Lophaetus occipitalis</i>	LC	Uncommon	0.06
White-spotted Flufftail	Râle perlé	<i>Sarothrura pulchra</i>	LC	Common	0.69
African Green Pigeon	Colombar à front nu	<i>Treron calva</i>	LC	Abundant	4.13
Blue-headed Wood Dove	Tourtelette demoiselle	<i>Turtur brehmeri</i>	LC	Common	0.94
Tambourine Dove	Tourtelette tambourette	<i>Turtur tympanistria</i>	LC	Uncommon	0.25
Blue-spotted Wood Dove	Tourtelette améthystine	<i>Turtur afer</i>	LC	Uncommon	0.13
Red-eyed Dove	Tourterelle à collier	<i>Streptopelia semitorquata</i>	LC	Uncommon	0.06
Grey Parrot	Perroquet jaco	<i>Psittacus erithacus</i>	LC	Abundant	2.00
Black-collared Lovebird	Inséparable à collier noir	<i>Agapornis swindernianus</i>	LC	Quite common	0.38
Great Blue Turaco		<i>Corythaeola cristata</i>	LC	Common	1.00
Yellow-billed Turaco	Touraco à gros bec	<i>Tauraco macrorhynchus</i>	LC	Common	0.31
Dusky Long-tailed Cuckoo	Coucou de Mechow	<i>Cercococcyx mechowi</i>	LC	Uncommon	0.13
African Emerald Cuckoo	Coucou foliotocol	<i>Chrysococcyx cupreus</i>	LC	Common	0.56
Yellowbill	Malcoha à bec jaune	<i>Ceuthmochares aereus</i>	LC	Common	0.38
Black-throated Coucal	Coucal à ventre blanc	<i>Centropus leucogaster</i>	LC	Uncommon	0.31
African Palm Swift	Martinet des palmes	<i>Cypsiurus parvus</i>	LC	Abundant	2.38
Little Swift	Martinet des maisons	<i>Apus affinis</i>	LC	Uncommon	0.13
Blue-breasted Kingfisher	Martin-chasseur à poitrine bleue	<i>Halcyon malimbica</i>	LC	Uncommon	0.19
African Pygmy Kingfisher	Martin-pêcheur pygmée	<i>Ceyx picta</i>	LC	Common	0.38
White-bellied Kingfisher	Martin-pêcheur à ventre blanc	<i>Alcedo leucogaster</i>	LC	Rare	0.06
Blue-breasted Bee-eater		<i>Merops variegatus</i>	LC	Rare	0.06
White-crested Hornbill	Calao à huppe	<i>Tropicranus</i>	LC	Uncommon	0.13

	blanche	<i>albocristatus</i>			
Red-billed Dwarf Hornbill	Calao pygmée	<i>Tockus camurus</i>	LC	Common	0.63
African Pied Hornbill	Calao longibande	<i>Tockus fasciatus</i>	LC	Abundant	0.63
Piping Hornbill	Calao siffleur	<i>Bycanistes fistulator</i>	LC	Abundant	0.94
Black-casqued Wattled Hornbill	Calao à casque noir	<i>Ceratogymna atrata</i>	LC	Abundant	0.81
Speckled Tinkerbird	Barbion grivelé	<i>Pogoniulus scolopaceus</i>	LC	Abundant	0.75
Yellow-billed Barbet	Barbican pourpré	<i>Trachyphonus purpuratus</i>	LC	Uc	0.06
Brown-eared Woodpecker	Pic à oreillons bruns	<i>Campethera caroli</i>	LC	Uncommon	0.06
Lesser Striped Swallow	Hirondelle striée	<i>Hirundo abyssinica</i> C67	LC	Uncommon	0.19
European (=Barn) Swallow	Hirondelle de cheminée	<i>Hirundo rustica</i>	LC	Abundant	6.25
Long-legged Pipit		<i>Anthus pallidiventris</i>	LC	Uncommon	0.06
Little Greenbul	Bulbul verdâtre	<i>Andropadus virens</i>	LC	Abundant	1.81
Ansorge's Greenbul	Bulbul d'Ansorge	<i>Andropadus ansorgei</i>	LC	Common	0.19
Slender-billed Greenbul	Bulbul à bec grêle	<i>Andropadus gracilirostris</i>	LC	Common	0.25
Yellow-whiskered Greenbul	Bulbul à moustaches jaunes	<i>Andropadus latirostris</i>	LC	Uncommon	0.38
Spotted Greenbul	Bulbul tacheté	<i>Ixonotus guttatus</i>	LC	Abundant	1.44
Swamp Palm Bulbul	Bulbul des raphias	<i>Thescelocichla leucopleura</i>	LC	Common	0.94
Icterine Greenbul	Bulbul ictérin	<i>Phyllastrephus icterinus</i>	LC	Abundant	1.31
Red-tailed Bristlebill	Bulbul moustac	<i>Bleda syndactyla</i>	LC	Uncommon	0.06
Green-tailed Bristlebill	Bulbul à queue verte	<i>Bleda notatus</i>	LC	Common	0.31
Red-tailed Greenbul	Bulbul à barbe blanche	<i>Criniger calurus</i>	LC	Common	0.63
Common Bulbul	Bulbul des jardins	<i>Pycnonotus barbatus</i>	LC	Quite common	0.56
Fire-crested Alethe	Alèthe à huppe rousse	<i>Alethe diademata</i>	LC	Common	0.88
Chattering Cisticola	Cisticole babillarde	<i>Cisticola anonymus</i>	LC	Common	0.94
Yellow-browed Camaroptera	Camaroptère à sourcils jaunes	<i>Camaroptera superciliaris</i>	LC	Common	0.56
Yellow Longbill	Nasique jaune	<i>Macrosphenus flavicans</i>	LC	Common	0.44
Green Hylia	Hylia verte	<i>Hylia prasina</i>	LC	Quite common	0.31
Red-bellied Paradise Flycatcher	Tchitrec à ventre roux	<i>Terpsiphone rufiventer</i>	LC	Quite common	0.94
Chestnut Wattle-eye	Pirit châtain	<i>Platysteira castanea</i>	LC	Common	0.81
Collared Sunbird	Souimanga à collier	<i>Anthreptes collaris</i>	LC	Uncommon	0.06
Blue-throated Brown Sunbird	Souimanga à gorge bleue	<i>Nectarinia cyanolaema</i>	LC	Abundant	0.75
Superb Sunbird	Souimanga superbe	<i>Nectarinia superba</i>	LC	Uncommon	0.06
Black-shouldered Puffback	Cubla aux yeux rouges	<i>Dryoscopus senegalensis</i>	LC	Uncommon	0.13
Western Nicator	Nicator vert	<i>Nicator chloris</i>	LC	Common	1.06
Velvet mantled Drongo	Drongo	<i>Dicrurus modestus</i>	LC	Uncommon	0.12
Pied Crow	Corbeau pie	<i>Corvus albus</i>	LC	Common	0.75
Vieillot's Black Weaver	Tisserin noir	<i>Ploceus nigerrimus</i>	LC	Uncommon	0.13

Village Weaver	Tisserin gendarme	<i>Ploceus cucullatus</i>	LC	Quite common	0.38
Cassin's Malimbe	Malimbe de Cassin	<i>Malimbus cassini</i>	LC	Uncommon	0.13

### Appendix 3: Flora lists for CPF/Eboudavoyé and Mpolongou

#### Flora of the CPF site

Scientific name	Relative abundance, where noted	Local name, where noted	Tree, Liana, Bush or Herb
<i>Remirea maritima</i> ,			
<i>Acrostichum aureum</i>	Common	Owe	T
<i>Acrostichum aureum</i>	Quite Common		
<i>Alstonia boonei</i>	Common		T
<i>Ancis trocatus</i>	Uncommon		L
<i>Andira inermis</i> sp.	Quite Common		
<i>Anthocleista vogelii</i>	Common	Elolomezam	T
<i>Anthostema aubryanum</i>	Quite Common		
<i>Antocleita</i> sp.			
<i>Araceae</i> sp.	Rare	Lomo Ndes	L
<i>Aukoumea klaineana</i>			
<i>Barteria fistulosa</i>	Uncommon	Mebenga	T
<i>Baya</i> sp	Uncommon		T
<i>Brasiliensis</i> sp	Quite Common		
<i>Brenania brieyi</i>		Oyo	T
<i>Calamus deërratus</i>	Common		B
<i>Callophyllum inophyllum</i> ,			
<i>Caloncoba glauca</i>		Miamingomo	B
<i>Carapa procera</i>			
<i>Cassia alata</i>			B
<i>Chromonella odorata</i>	Common	Ngukun	H
<i>Cicocephalophus ocoaco</i>		Bidu Eteng	T
<i>Cocos nucifera</i>			
<i>Coelocaryon preussii</i>	Common	Zoeteng	T
<i>Cola edulis</i>	Uncommon		T
<i>Cola lepidota</i>	Quite Common		T
<i>Cola lepidota</i>	Quite Common		
<i>Cola notida</i>	Quite Common		T
<i>Cola notida</i>	Quite Common		
<i>Costus</i> sp.	Common		B
<i>Ctenolophon engleranus</i>	Quite Common		
<i>Dalbergia escataphyllum</i>			
<i>Daniellia</i> sp.			T
<i>Desbordesia glaucescens</i>	Uncommon		T
<i>Diogoia zenkeri</i>		Oberebewoo	T
<i>Diogoia zenkeri</i>		Okos	T
<i>Diospyros crassiflora</i>	Common		T
<i>Emilia</i> sp	Common		H
<i>Enantia chlorantha</i>			T
<i>Erybroma oblongum</i>			T
<i>Erythrophyllum guineensis</i>	Quite Common		T
<i>Fagara heitzii</i>		Bongo	T
<i>Fagara macrophylla</i>		Bongo	T
<i>Fagara</i> sp.		Olong	T
<i>Garcinia</i> sp.	Quite Common		T

<i>Garcinia sp.</i>	Quite Common		
<i>Gentium sp.</i>			H
<i>Grewia coriacea</i>	Common	Okok	T
<i>Guibourtia demeusi</i>	Quite Common		
<i>Guibourtia ehie</i>		Otu	T
<i>Hallea stipulosa</i>	Quite Common		
<i>Harungana madagascariensis</i>	Common		T
<i>Hypselodelphis</i>	Rare		H
<i>Intsia sp.</i>	Common		B
<i>Ipomea pescapre</i>	Quite Common		
<i>Irvingia gabonensis</i>			T
<i>Irvingiaceae sp.</i>	Uncommon	Ngonn	T
<i>Klainedoxa microphylla</i>	Quite Common		
<i>Lansianthera africana</i>	Common		B
<i>Lantana africana</i>			H
<i>Liana sp</i>	Rare	Foforo	L
<i>Liana sp.</i>	Rare	Angoss	L
<i>Lophira alata</i>	Quite Common		T
<i>Macaranga spp.</i>			t
<i>Maesobotrys sp.</i>	Quite Common		
<i>Maesobotrys sp.</i>	Quite Common		
<i>Marantaceae sp</i>	Rare	Asuu	H
<i>Marantaceae sp</i>		See	H
<i>Meiocarpidium lepidotum</i>	Rare		T
<i>Monodora sp.</i>			T
<i>Musanga cecropioides</i>	Abundant		T
<i>Nomoniaceae</i>	Quite Common		
<i>Nomoniaceae</i>	Quite Common		
<i>Oxystigma mannii</i>	Quite Common		
<i>Pachypodanthium barteri</i>	Common		T
<i>Palisota barteri</i>	Quite Common		h
<i>Palisota hirsuta</i>	Common		h
<i>Palmae spp.</i>	Abundant		T
<i>Panda oleosa</i>	Common	Fan	T
<i>Pandanus candelabrum</i>	Quite Common		
<i>Pandanus candelabrum</i>	Quite Common		
<i>Picralima nitida</i>			T
<i>Podococus barteri</i>	Quite Common		B
<i>Poga oleosa</i>			T
<i>Pterocarpus soyauxii</i>			T
<i>Pycnanthus angolensis</i>	Common		T
<i>Raphia ssp</i>	Common		B
<i>Raphia vinefera</i>	Quite Common		
<i>Raphia vinefera</i>	Quite Common		
<i>Rhizophora racemora</i>	Quite Common		T
<i>Rhizophora racemora</i>	Quite Common		
<i>Rhizophora spp.</i>		Matande	T
<i>Rinorea</i>	Quite Common		
<i>Rinorea</i>	Quite Common		
<i>Rotin sp</i>	Common		B

<i>Saccoglottis gabonensis</i>	Quite Common		
<i>Sacoglottis gabonensis</i>	Common		T
<i>Santeria trimera</i>	Rare	Ebap Tom	T
<i>Solanum torvum</i>			H
<i>Sorindea sp</i>	Quite Common		
<i>Sorindea sp</i>	Quite Common		
<i>Staudtia (stipitata) cameroonensis</i>	Rare		T
<i>Strombosia sp.</i>	Rare		T
<i>Strombosiopsis tetrandra</i>	Common	Mbazoo	T
<i>Stylosanthes recta.</i>			
<i>Terminalia catappa</i>			
<i>Tetracera sp.</i>	Common	Fazok	L
<i>Tetrapleura tetrapetra</i>	Rare	Akpwa'a	T
<i>Tretracera alinifora.</i>			
<i>Uapaca heudelotii</i>	Common		T
<i>Unknown sp.</i>	Unknown to those interviewed	Kakama	?
<i>Unknown sp.</i>	Unknown to those interviewed	Mpole	?
<i>Unknown sp.</i>	Common	Ovini fam	T
<i>Unknown sp.</i>	Common	Tuimii	
<i>Unknown sp.</i>	Common	Set	T
<i>Unknown sp.</i>	Common	Koffi afan	
<i>Unknown sp.</i>	Quite common	Tom	
<i>Unknown sp.</i>	Common	Aboe	B
<i>Unknown sp., possibly Xylophia quintasii</i>	Quite common	Biabono	
<i>Vitex sp</i>	Rare		T
<i>Voacanga sp.</i>	Common		B
<i>Xilopia aethiopica</i>	Common	Oyang	T
<i>Xilopia quintasii</i>	Common	Mvoma	T

## Flora of Mpolongou

Scientific name	Relative Abundance, where noted	Local name, where noted	Tree, Liana, Bush or Herb
<i>Calamus deërratus</i>			B
<i>Cassia alata</i>	Common		B
<i>Chromonella odorata</i>		Ngukun	H
<i>Costus sp.</i>			B
<i>Daniellia sp.</i>	Common		T
<i>Desbordesia glaucescens</i>			T
<i>Diogoa zenkeri</i>	Uncommon	Oberebewoo	T
<i>Diogoa zenkeri</i>		Okos	T
<i>Emilia sp</i>			H
<i>Gentium sp.</i>	Common		H
<i>Guibourtia ehie</i>		Otu	T
<i>Harungana madagascariensis</i>			T
<i>Irvingia gabonensis</i>	Common		T
<i>Irvingiaceae sp.</i>		Ngonn	T
<i>Lansianthera africana</i>	Uncommon		B
<i>Lantana africana</i>	Common		H
<i>Liana sp.</i>		Angoss	L
<i>Marantaceae sp</i>	Rare	Asuu	H
<i>Marantaceae sp</i>	Rare	See	H
<i>Meiocarpidium lepidotum</i>			T
<i>Monodora sp.</i>	Rare		T
<i>Musanga cecropioides</i>			T
<i>Palisota hirsuta</i>	Abundant		h
<i>Podococcus barteri</i>	Common		B
<i>Poga oleosa</i>	Quite Common		T
<i>Pycnanthus angolensis</i>			T
<i>Rhizophora spp.</i>	Common	Matande	T
<i>Rotin sp</i>			B
<i>Santeria trimera</i>	Common	Ebap Tom	T
<i>Solanum torvum</i>	Rare		H
<i>Tetracera sp.</i>		Fazok	L
<i>Tetrapleura tetrapetra</i>	Common	Akpwa'a	T
<i>Uapaca heudelotii</i>	Rare		T
<i>Unknown sp.</i>	Common	Tuimii	
<i>Unknown sp.</i>	Common	Set	T
<i>Unknown sp.</i>	Common	Aboe	B
<i>Vitex sp</i>	Common		T



#### Appendix 4: Biome restricted bird species of the Cameroon Gabon Lowlands EBA

Biome restricted bird species of the Cameroon Gabon Lowlands EBA
Black Guinea fowl ( <i>Agelastes niger</i> )
Plumed Guinea fowl ( <i>Guttera plumifera</i> )
Forest Francolin ( <i>Francolinus lathamii</i> )
Hartlaub's Duck ( <i>Pteronetta hartlaubii</i> )
Spot-breasted Ibis ( <i>Bostrychia rara</i> )
White-crested Tiger-heron ( <i>Tigriornis leucolopha</i> )
Chestnut-flanked Sparrowhawk ( <i>Accipiter castanilius</i> )
Red-thighed Sparrowhawk ( <i>Accipiter erythropus</i> )
Long-tailed Hawk ( <i>Urotriorchis macrourus</i> )
Cassin's Hawk-eagle ( <i>Spizaetus africanus</i> )
White-spotted Flufftail ( <i>Sarothrura pulchra</i> )
Nkulengu Rail ( <i>Himantornis haematopus</i> )
Grey-throated Rail ( <i>Canirallus oculus</i> )
Afep Pigeon ( <i>Columba uncinata</i> )
Blue-headed Wood-dove ( <i>Turtur brehmeri</i> )
Black-collared Lovebird ( <i>Agapornis swindernianus</i> )
Grey Parrot ( <i>Psittacus erithacus</i> )
Guinea Turaco ( <i>Tauraco persa</i> )
Yellow-billed Turaco ( <i>Tauraco macrorhynchus</i> )
Dusky Long-tailed Cuckoo ( <i>Cercococcyx mechowi</i> )
Olive Long-tailed Cuckoo ( <i>Cercococcyx olivinus</i> )
Yellow-throated Cuckoo ( <i>Chrysococcyx flavigularis</i> )
Black-throated Coucal ( <i>Centropus leucogaster</i> )
Sandy Scops-owl ( <i>Otus icterorhynchus</i> )
Fraser's Eagle-owl ( <i>Bubo poensis</i> )
Akun Eagle-owl ( <i>Bubo leucostictus</i> )
Vermiculated Fishing-owl ( <i>Scotopelia bouvieri</i> )
Sjostedt's Owlet ( <i>Glaucidium sjostedti</i> )
Brown Nightjar ( <i>Caprimulgus binotatus</i> )
Black Spinetail ( <i>Telacanthura melanopygia</i> )
Sabine's Spinetail ( <i>Rhaphidura sabini</i> )
Cassin's Spinetail ( <i>Neafrapus cassinii</i> )
Bates's Swift ( <i>Apus batesi</i> )
Bare-cheeked Trogon ( <i>Apaloderma aequatoriale</i> )
Blue-throated Roller ( <i>Eurystomus gularis</i> )
Chocolate-backed Kingfisher ( <i>Halcyon badia</i> )
African Dwarf-kingfisher ( <i>Ceyx lecontei</i> )
White-bellied Kingfisher ( <i>Alcedo leucogaster</i> )
Black Bee-eater ( <i>Merops gularis</i> )
Blue-headed Bee-eater ( <i>Merops muelleri</i> )
Black Dwarf Hornbill ( <i>Tockus hartlaubi</i> )
Red-billed Dwarf Hornbill ( <i>Tockus camurus</i> )
African Pied Hornbill ( <i>Tockus fasciatus</i> )
White-crested Hornbill ( <i>Tropicranus albocristatus</i> )
Piping Hornbill ( <i>Bycanistes fistulator</i> )
Black-and-white-casqued Hornbill ( <i>Bycanistes subcylindricus</i> )
White-thighed Hornbill ( <i>Bycanistes albotibialis</i> )
Black-casqued Hornbill ( <i>Ceratogymna atrata</i> )
Speckled Tinkerbird ( <i>Pogoniulus scolopaceus</i> )
Red-rumped Tinkerbird ( <i>Pogoniulus atroflavus</i> )
Yellow-throated Tinkerbird ( <i>Pogoniulus subsulphureus</i> )
Yellow-spotted Barbet ( <i>Buccanodon duchailui</i> )

Hairy-breasted Barbet ( <i>Tricholaema hirsuta</i> )
Yellow-billed Barbet ( <i>Trachyphonus purpuratus</i> )
Cassin's Honeyguide ( <i>Prodotiscus insignis</i> )
Zenker's Honeyguide ( <i>Melignomon zenkeri</i> )
Lyre-tailed Honeyguide ( <i>Melichneutes robustus</i> )
African Piculet ( <i>Sasia africana</i> )
Buff-spotted Woodpecker ( <i>Campethera nivosa</i> )
Brown-eared Woodpecker ( <i>Campethera caroli</i> )
Gabon Woodpecker ( <i>Dendropicos gabonensis</i> )
Golden-crowned Woodpecker ( <i>Thripias xantholophus</i> )
Rufous-sided Broadbill ( <i>Smithornis rufolateralis</i> )
African Shrike-flycatcher ( <i>Megabyas flammulatus</i> )
West African Batis ( <i>Batis occulta</i> )
Chestnut Wattle-eye ( <i>Platysteira castanea</i> )
White-spotted Wattle-eye ( <i>Platysteira tonsa</i> )
Black-necked Wattle-eye ( <i>Platysteira chalybea</i> )
Chestnut-bellied Helmet-shrike ( <i>Prionops caniceps</i> )
Fiery-breasted Bush-shrike ( <i>Malaconotus cruentus</i> )
Red-eyed Puffback ( <i>Dryoscopus senegalensis</i> )
Large-billed Puffback ( <i>Dryoscopus sabinii</i> )
Sooty Boubou ( <i>Laniarius leucorhynchus</i> )
Blue Cuckooshrike ( <i>Coracina azurea</i> )
Eastern Wattled Cuckooshrike ( <i>Campephaga oriolina</i> )
Western Black-headed Oriole ( <i>Oriolus brachyrhynchus</i> )
Black-winged Oriole ( <i>Oriolus nigripennis</i> )
Shining Drongo ( <i>Dicrurus atripennis</i> )
Blue-headed Crested-flycatcher ( <i>Trochocercus nitens</i> )
Black-headed Paradise-flycatcher ( <i>Terpsiphone rufiventer</i> )
Rufous-vented Paradise-flycatcher ( <i>Terpsiphone rufocinerea</i> )
Dusky Crested-flycatcher ( <i>Elminia nigromitrata</i> )
Chestnut-capped Flycatcher ( <i>Erythrocerus mcallii</i> )
Grey-necked Picathartes ( <i>Picathartes oreas</i> )
Forest Penduline-tit ( <i>Anthoscopus flavifrons</i> )
Tit-hylia ( <i>Pholidornis rushiae</i> )
Square-tailed Saw-wing ( <i>Psaldiprocne nitens</i> )
White-throated Blue Swallow ( <i>Hirundo nigrita</i> )
Forest Swallow ( <i>Hirundo fuliginosa</i> )
Chattering Cisticola ( <i>Cisticola anonymus</i> )
Black-capped Apalis ( <i>Apalis nigriceps</i> )
Buff-throated Apalis ( <i>Apalis rufogularis</i> )
Gosling's Apalis ( <i>Apalis goslingi</i> )
Yellow-browed Camaroptera ( <i>Camaroptera superciliaris</i> )
Olive-green Camaroptera ( <i>Camaroptera chloronota</i> )
Grey Greenbul ( <i>Andropadus gracilis</i> )
Ansorge's Greenbul ( <i>Andropadus ansorgei</i> )
Plain Greenbul ( <i>Andropadus curvirostris</i> )
Golden Greenbul ( <i>Calyptocichla serina</i> )
Honeyguide Greenbul ( <i>Baeopogon indicator</i> )
White-tailed Greenbul ( <i>Baeopogon clamans</i> )
Spotted Greenbul ( <i>Ixonotus guttatus</i> )
Simple Greenbul ( <i>Chlorocichla simplex</i> )
Yellow-necked Greenbul ( <i>Chlorocichla falkensteini</i> )
Swamp Greenbul ( <i>Thescelocichla leucopleura</i> )
White-throated Greenbul ( <i>Phyllastrephus albigularis</i> )
Icterine Greenbul ( <i>Phyllastrephus icterinus</i> )
Xavier's Greenbul ( <i>Phyllastrephus xavieri</i> )

Common Bristlebill ( <i>Bleda syndactylus</i> )
Lesser Bristlebill ( <i>Bleda notatus</i> )
Green-backed Bulbul ( <i>Criniger chloronotus</i> )
Red-tailed Bulbul ( <i>Criniger calurus</i> )
White-bearded Bulbul ( <i>Criniger ndussumensis</i> )
Yellow-spotted Nicator ( <i>Nicator chloris</i> )
Yellow-throated Nicator ( <i>Nicator vireo</i> )
Yellow Longbill ( <i>Macrosphenus flavicans</i> )
Grey Longbill ( <i>Macrosphenus concolor</i> )
Violet-backed Hyliota ( <i>Hyliota violacea</i> )
Green Hylia ( <i>Hylia prasina</i> )
Uganda Woodland-warbler ( <i>Phylloscopus budongoensis</i> )
Rufous-crowned Eremomela ( <i>Eremomela badiceps</i> )
Green Crombec ( <i>Sylvietta virens</i> )
Lemon-bellied Crombec ( <i>Sylvietta denti</i> )
Blackcap Illadopsis ( <i>Illadopsis cleaveri</i> )
Brown Illadopsis ( <i>Illadopsis fulvescens</i> )
Purple-headed Glossy-starling ( <i>Lamprotornis purpureiceps</i> )
Chestnut-winged Starling ( <i>Onychognathus fulgidus</i> )
Narrow-tailed Starling ( <i>Poeoptera lugubris</i> )
White-tailed Ant-thrush ( <i>Neocossyphus poensis</i> )
Rufous Flycatcher-thrush ( <i>Stizorhina fraseri</i> )
Black-eared Ground-thrush ( <i>Zoothera camaronensis</i> )
Grey Ground-thrush ( <i>Zoothera princei</i> )
White-tailed Alethe ( <i>Alethe diademata</i> )
( <i>Stiphornis erythrothorax</i> )
Lowland Akalat ( <i>Sheppardia cyornithopsis</i> )
Blue-shouldered Robin-chat ( <i>Cossypha cyanocampter</i> )
African Forest Flycatcher ( <i>Fraseria ocreata</i> )
White-browed Forest Flycatcher ( <i>Fraseria cinerascens</i> )
Sooty Flycatcher ( <i>Muscicapa infuscata</i> )
Olivaceous Flycatcher ( <i>Muscicapa olivascens</i> )
Little Grey Flycatcher ( <i>Muscicapa epulata</i> )
Yellow-footed Flycatcher ( <i>Muscicapa sethsmithi</i> )
Dusky-blue Flycatcher ( <i>Muscicapa comitata</i> )
Cassin's Grey Flycatcher ( <i>Muscicapa cassini</i> )
Grey-throated Tit-flycatcher ( <i>Myioparus griseigularis</i> )
Scarlet-tufted Sunbird ( <i>Anthreptes fraseri</i> )
Mouse-brown Sunbird ( <i>Anthreptes gabonicus</i> )
Green Sunbird ( <i>Anthreptes rectirostris</i> )
Little Green Sunbird ( <i>Nectarinia seimundi</i> )
Bates's Sunbird ( <i>Nectarinia batesi</i> )
Reichenbach's Sunbird ( <i>Nectarinia reichenbachii</i> )
Blue-throated Brown Sunbird ( <i>Nectarinia cyanolaema</i> )
Carmelite Sunbird ( <i>Nectarinia fuliginosa</i> )
Green-throated Sunbird ( <i>Nectarinia rubescens</i> )
Tiny Sunbird ( <i>Nectarinia minulla</i> )
Johanna's Sunbird ( <i>Nectarinia johannae</i> )
Superb Sunbird ( <i>Nectarinia superba</i> )
Vieillot's Black Weaver ( <i>Ploceus nigerrimus</i> )
Yellow-mantled Weaver ( <i>Ploceus tricolor</i> )
Yellow-capped Weaver ( <i>Ploceus dorsomaculatus</i> )
Black-throated Malimbe ( <i>Malimbus cassini</i> )
Rachel's Malimbe ( <i>Malimbus racheliae</i> )
Red-bellied Malimbe ( <i>Malimbus erythrogaster</i> )
Gray's Malimbe ( <i>Malimbus nitens</i> )

Crested Malimbe ( <i>Malimbus malimbicus</i> )
Red-headed Malimbe ( <i>Malimbus rubricollis</i> )
Woodhouse's Antpecker ( <i>Parmoptila woodhousei</i> )
White-breasted Negrofinch ( <i>Nigrita fusconotus</i> )
Chestnut-breasted Negrofinch ( <i>Nigrita bicolor</i> )
Pale-fronted Negrofinch ( <i>Nigrita luteifrons</i> )
Western Bluebill ( <i>Spermophaga haematina</i> )
Long-legged Pipit ( <i>Anthus pallidiventris</i> )

## Appendix 5: IUCN threat categories

EX **Extinct** No reasonable doubt that the last individual has died.

EW **Extinct in the wild** Known only to survive in captivity or as a naturalized populations well outside its previous range.

CR **Critically Endangered** The species is in imminent risk of extinction in the wild.

EN **Endangered** The species is facing an extremely high risk of extinction in the wild.

VU **Vulnerable** The species is facing a high risk of extinction in the wild.

NT **Near Threatened** The species does not meet any of the criteria that would categorise it as risking extinction but it is likely to do so in the future.

LC **Least Concern** There are no current identifiable risks to the species.

DD **Data Deficient** There is inadequate information to make an assessment of the risks to this species.

NE **Not Evaluated** There has been no evaluation of the species status by IUCN.

## References

- BirdLife International 2003 *BirdLife's online World Bird Database: the site for bird conservation*. Version 2.0. Cambridge, UK: BirdLife International. Available: <http://www.birdlife.org> (accessed 5/12/2007)
- Caldecott & Miles (2005) *World Atlas of Great Apes and their Conservation*. UNEP-WCMC.
- Castroviejo, J., J. Juste, J. Pérez del val, R. Castelo & R. Gil. 1994. Diversity and status of sea turtle species in the Gulf of Guinea islands. *Biodiversity and Conservation* 3: 828-836
- Chapman C.A., Gautier-Hion A., Oates J.F. & Onderdonk D.A. (1999) African primate communities: determinants of structure and threats to survival. In: *Primate Communities* (eds. Feagle JG, Janson CH & Reed KE), pp. 1-37. Cambridge University Press, Cambridge.
- Ekstrom, JMM (2006) "Technical issues in the design and implementation of biodiversity offsets" Paper given at Conservation International conference, Madagascar, June 2006. Available from [www.biodiversityoffsets.org](http://www.biodiversityoffsets.org)
- Fishpool L.D.C. & Evans M.I. (2001) *Important Bird Areas in Africa and associated islands: Priority sites for conservation*. Pisces Publications and BirdLife International, Newbury and Cambridge.
- Formia A., Tiwari M., Fretey J. & Billes A. (2003) Sea Turtle Conservation along the Atlantic Coast of Africa. *Marine Turtle Newsletter*, 100, 33-37. Available: <http://www.seaturtle.org/mtn/archives/mtn100/mtn100p33.shtml>
- Grigione M.M. (1996) Observations on the status and distribution of the West African manatee in Cameroon. *African Journal of Ecology*, 34, 189-195
- IUCN (2007 [and all dates previous also]) 2007 IUCN Red List of Threatened Species. In: IUCN - The World Conservation Union [<http://www.iucnredlist.org>], [online: <http://www.iucnredlist.org>]
- IUCN, Conservation International & NatureServe (2004) Global Amphibian Assessment. In: IUCN, Conservation International, and NatureServe [<http://www.globalamphibians.org/>]
- Iverson J., Kiester A., Hughes L. & Kimerling A. (2003) The EMYSsystem - World Turtle Database 2003 (Available: <http://emys.geo.orst.edu/>).
- Letouzey, R. (1985). Notice de la carte phytogéographique du Cameroun. Institute de la Carte Internationale de la Vegetation, Toulouse, France.
- Matthews A. & Matthews A. (2002) Distribution, population density, and status of sympatric cercopithecids in the Campo-Ma'an area, southwestern cameroon. *Primates*, 43, 155-168
- Matthews A. & Matthews A. (2004) Survey of gorillas (*Gorilla gorilla gorilla*) and chimpanzees (*Pan troglodytes troglodytes*) in Southwestern Cameroon. *Primates*, 45, 15-24
- Mittermeier R.A., Mittermeier C.G., Robles Gil P., Fonseca G.A.B., Brooks T., Pilgrim J. & Konstant W.R. (2002) *Wilderness: Earth's Last Wild Places*. CEMEX, Conservation International and Agrupación Sierra Madre, Mexico City.
- Mittermeier R.A., Robles Gil P., Hoffmann M., Pilgrim J., Brooks T., Mittermeier C.G., Lamoreux J. & Fonseca G.A.B. (2004) *Hotspots Revisited: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions*. CEMEX, Conservation International and Agrupación Sierra Madre, Mexico City.
- Oliver K. and Ekstrom, JMM (2006) Secondary impacts of extractive industries: How big? Unpublished report, Cambridge University. Available from [www.thebiodiversityconsultancy.com](http://www.thebiodiversityconsultancy.com)
- Olson D. & Dinerstein E. (2002) The Global 200: priority ecoregions for global conservation. *Ann. Missouri Bot. Gard.*, 89, 199-224
- Stattersfield A.J., Crosby M.J., Long A.J. & Wege D.C. (1998) *Endemic Bird Areas of the World: Priorities for Biodiversity Conservation*. BirdLife International, Cambridge.
- ten Kate, Bishop, J and. Bayon, R (2004) Biodiversity Offsets: Views, experience and the business case. Insight Investment and IUCN.
- Tchouto M., De Boer W., De Wilde J. & Van der Maesen L. (2006a) Diversity Patterns in the Flora of the Campo-Ma'an Rain Forest, Cameroon: Do Tree Species Tell it All? *Biodiversity and Conservation*, 15, 1353-1374
- Tchouto M., Yemefack M., De Boer W., De Wilde J., Van Der Maesen L. & Cleef A. (2006b) Biodiversity Hotspots and Conservation Priorities in the Campo-Ma'an Rain Forests, Cameroon. *Biodiversity and Conservation*, 15, 1219-1252
- Vivien J. 1991. Faune du Cameroun, "Guide des mammifères et des poissons". Coopération française et GICAM, Yaoundé 271 pp
- White, R. (1983). The vegetation of Africa, a descriptive memoir to accompany the UNESCO/AETFAT/UNSO vegetation map of Africa. UNESCO, Natural Resour. Res. 20: 1-356.

WWF & IUCN (1994) *Centres of Plant Diversity, Volume 1: Europe, Africa, South West Asia and the Middle East*. IUCN Publications Unit for WWF (World Wide Fund for Nature) and IUCN (The World Conservation Union), Cambridge, U.K.

WWF (2001) Atlantic Equatorial coastal forests (AT0102). Available:  
[http://www.worldwildlife.org/wildworld/profiles/terrestrial/at/at0102\\_full.html](http://www.worldwildlife.org/wildworld/profiles/terrestrial/at/at0102_full.html)