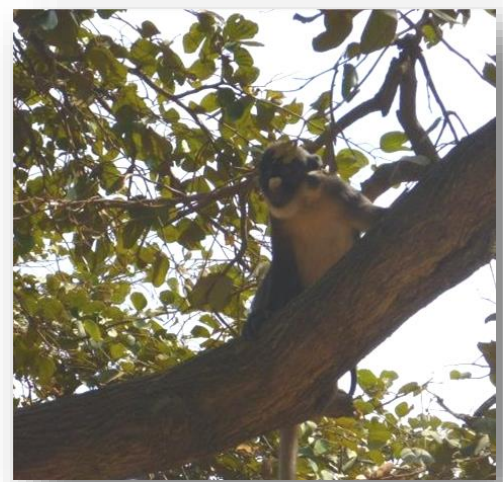


Appendix 14: Baseline Large Mammal Surveys Yaoure Gold Project, Côte d'Ivoire



Submitted to



Amara Mining Côte d'Ivoire SARL



Submitted By

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REPORT ISSUE FORM

Client Name	Amara Mining Côte d'Ivoire SARL		
Project Name	Yaoure Gold Project Environmental and Social Impact Assessment		
Report Title	Baseline Large Mammal Surveys		
Document Status	Final	Issue No.	1
Issue Date	12 November 2015		
Document Reference	7879140169	Report Number	A169-15-R2352
Author	Dr. Genevieve Campbell	 <small>Signature & Date</small>	
Reviewer	Dr. Suzanne Livingstone	<small>Signature & Date</small>	
Project Manager Approval	Dr. Christian Kunze	 <small>12 November 2015</small>	

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EXECUTIVE SUMMARY

An Environmental and Social Impact Assessment (ESIA) has been mandated to Amec Foster Wheeler by Amara Mining plc in preparation for project expansion at their Yaoure Gold Project, Côte d'Ivoire.

Baseline surveys were conducted to update the list of large mammal species present at the project site, and to understand their spatial distribution in relation to proposed infrastructure development. Interviews, camera trapping, reconnaissance walks and transects were conducted throughout the Inner Exploration Licence (IEL) and its vicinity between 15th November and 4th December 2014.

A total of 26 large mammal species were identified to occur within the project area. Three species are threatened and listed as Vulnerable under the IUCN Red List (i.e. *Phataginus tricuspis*, *Hippopotamus amphibius* and *Kobus kob kob*), and ten species are protected under the national law (i.e. Law 94-442 dated 16 August 1994).

The project area is located at the transition of the forest and savannah biomes, and thus could harbour a high diversity. However, the habitat was found to be generally highly degraded and the area densely populated. Agriculture is widespread and the majority of the IEL's surface is covered by crops and/or secondary growth vegetation. Artisanal mining is also prolific, and the area is used intensely, with many signs of current or past anthropogenic activities. During interviews, locals mentioned that degradation of the forest started during the 1970's after the construction of a hydroelectric dam on the Bandama River which flooded a large part of the forest. Therefore, the habitat is classified as 'modified' according to the definition provided by the IFC. Most of the species recorded during this study are common, and associated with disturbed habitat.

No protected area or internationally recognised areas intersect with the Project area, with the closest protected area being located approximately 12 km away from the IEL (namely the Marahoue Classified Forest). From looking at recent satellite imagery, Marahoue Classified Forest appears highly degraded, with many plantations, villages and roads within its boundaries.

Potential impacts related to expansion of planned project infrastructure are: habitat loss, direct mortality or injury from vehicle collision, in-migration of people to the surrounding area putting additional pressures on natural resources (through increase hunting pressure for example), habitat degradation (e.g. from noise and dust) and habitat fragmentation. The habitat is generally less degraded in the area where the infrastructure TMF3 is proposed, making this a key area for avoidance and mitigation of impacts.

Appropriate mitigation measures to reduce the magnitude of impacts on the identified large mammal populations are recommended, with a supporting monitoring plan throughout project life to monitor population trends and ensure mitigation measures are sufficient.

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List of Abbreviations and Acronyms

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora

ESIA: Environmental and Social Impact Assessment

IEL: Inner Exploration Licence

IFC: International Finance Corporation

IUCN: International Union for the Conservation of Nature

TMF: Tailings Management Facility

WRD: Waste Rock Dump

1.0 INTRODUCTION

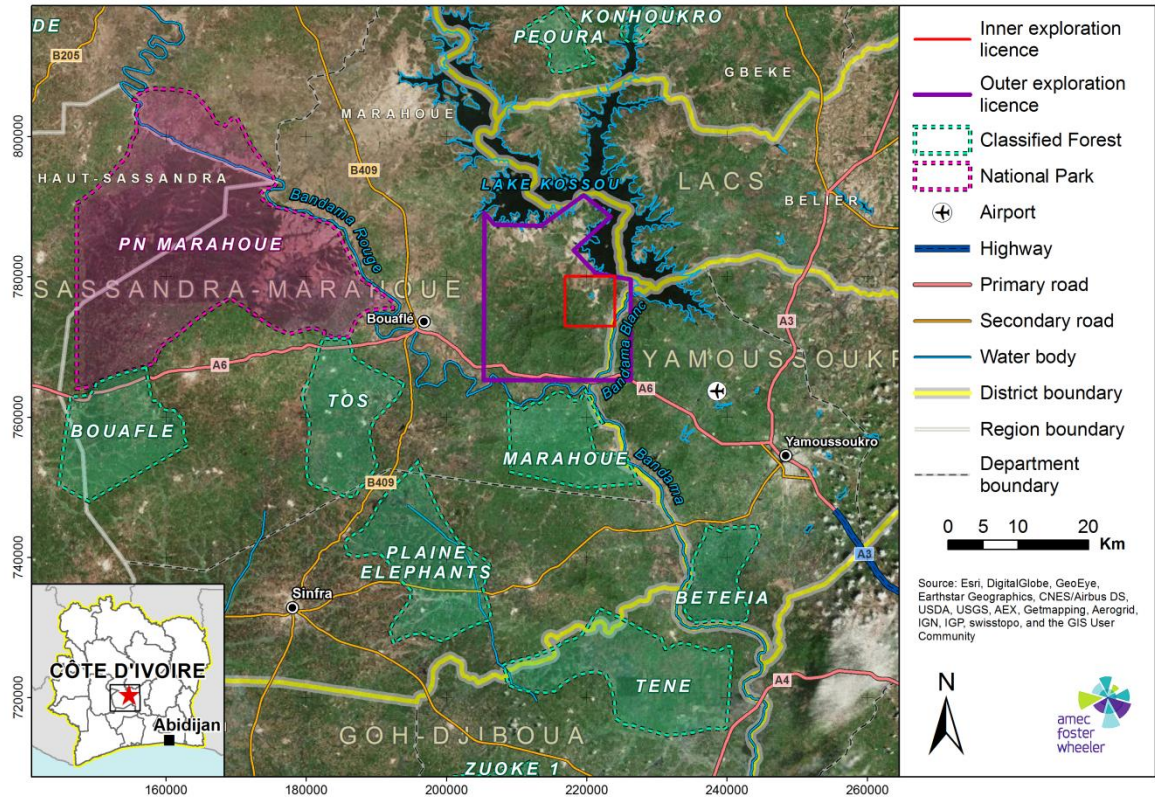
An Environmental and Social Impact Assessment (ESIA) has been mandated to Amec Foster Wheeler by Amara Mining plc in preparation for project expansion at their Yaoure Gold Project, in central Côte d'Ivoire. Previous studies on large mammals in the project area were conducted in 2007 for Cluff Gold plc (Tano *et al.*, 2007). These were rapid biodiversity assessment and identified 22 mammal species present in the area. The distribution of several Endangered species potentially overlap with the Project Area (e.g. West African chimpanzee (*Pan troglodytes verus*) and the western red colobus (*Procolobus badius badius*)), therefore more intensive and updated surveys were required to provide a robust baseline of large mammal for the ESIA. Data was collected on large mammal diversity, spatial distribution and relative abundance throughout the Inner Exploration Licence (IEL).

The surveys were conducted by Dr. Geneviève Campbell, large mammal monitoring specialist with over ten years of experience conducting large mammal surveys in West and Central Africa, and Dr. Jean-Claude Koffi Béné, an ecologist and primatologist with extensive survey experience in Cote d'Ivoire and West Africa.

1.1 Project Location

The Project is located in the center of Côte d'Ivoire, close to the political capital, Yamoussoukro (Figure 1-1). It consists of an Inner Exploration Licence (IEL) of approximately 50 km², included within an Outer Exploration Licence (OEL) or approximately 440 km². The Project is situated to the South of Kossou Lake. The Bandama River, a geographical barrier to the distribution of several mammal species, flows to its eastern side.

Figure 1-1: Location of the Project area



1.1.1 Regional and International Importance

The Project area is located at the northern limit of the Upper Guinea Forest, belonging to the Guinean Forests of Western Africa, an area classified as a 'biodiversity hotspot' by Conservation International (Myers et al., 2000). Several threatened species are associated with the Upper Guinean Forest's ecosystem, such as the Vulnerable Diana monkey (*Cercopithecus diana*) and the Endangered pygmy hippopotamus (*Choeropsis liberiensis*).

No protected area or internationally recognised areas intersect with the Project area, with the closest protected area being located approximately 12 km away from the IEL (namely the Marahoue Classified Forest, Figure 1-1). From looking at recent satellite imagery, Marahoue Classified Forest appears highly degraded, with many plantations, villages and roads within its boundaries. This is reflective of the high level of deforestation and encroachment in protected areas throughout the country (Fischer, 2004; Campbell et al., 2008; Bitty et al., 2015).

1.2 Desktop Findings

1.2.1 Previous Studies

Previous biodiversity surveys were conducted at this site for Cluff Golf plc in 2007 (Tano et al. 2007). As part of these surveys, large mammal surveys were conducted between January 7th and the 16th of 2007. A total of 22 large mammal species were confirmed for this area.

The closest area where other large mammal surveys have been conducted is Marahoue National Park (MNP), located approximately 24km West of the IEL. The vegetation and the wildlife of MNP were well-preserved until the early 2000s (Struhsaker et al., 1999) when civil unrest erupted in the country. This led to a massive encroachment of protected areas and a general decline in wildlife populations throughout the country (Fischer, 2004; Campbell et al., 2008; Bitty et al., 2015). Recent surveys of MNP have revealed dramatic reductions in wildlife abundance, mainly due to habitat loss (Gonedele et al., 2006; Campbell et al., 2008; N'Goran et al., 2008). Indeed, it was estimated that the MNP lost 93% of its forest cover between 2002 and 2008 (Campbell et al., 2008), which was converted into plantations, and this park now includes a significant human population, including illegal settlements and schools (N'Goran et al., 2008).

1.3 Legal Requirements

National laws pertaining to our field of study:

- Law 65-255 dated 4 August 1965 on wildlife protection and hunting regulations;
- Law 94-442 dated 16 August 1994, updates to law 65-255 described above;
- Law 96-766 dated 3 October 1996 concerning the environmental code.

International guidance:

- International Finance Corporation Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (IFC, 2012);
- Convention africaine pour la conservation de la nature et des ressources naturelles;
- Cote d'Ivoire adhere to the CITES agreement, which was signed on 19 February 1995.

1.4 Purpose of the Study

The purpose of this study is to:

- Conduct mammal surveys within the targeted area (mainly the IEL covering approximately 50 km²);
- List all recorded mammal species present within the targeted area;
- Determine the spatial distribution and relative abundance of threatened mammal species;
- Identify existing threats to mammal species; and
- Identify impacts and potentially sensitive areas in relation to the proposed project infrastructure.

1.5 Report Structure

This report contains the details of the methodology used to survey large mammal species in the Project area. The result section includes a large mammal species list, as well as the distribution and relative abundance of large mammal species identified during this study. The last section identifies potential impacts related to the proposed mining activities, and proposes mitigation measures to manage these impacts. Finally, some recommendations are made including the implementation of a long-term monitoring plan.

2.0 METHODOLOGY

2.1 Study Topic

The survey focused on large mammals, defined as animals larger than a hare (3-5 kg) (Hoffmann *et al.*, 2010).

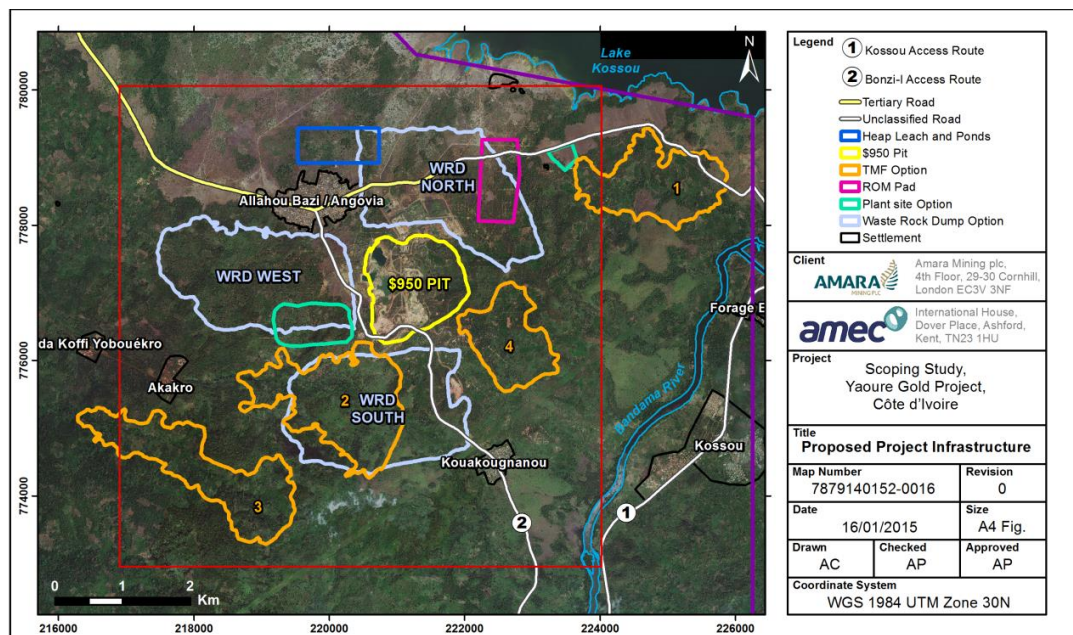
2.2 Surveyed Area

Surveys were concentrated within the Inner Exploration Licence (IEL), an area covering approximately 50 km² (Figure 2-1). Surveys were also conducted along the Bandama River, located East of the IEL, and along the Lake Kossou, to the North of the IEL. Studies were also conducted around the village of Bénou, located approximately 8 km north of the IEL, following preliminary results from interviews indicating a higher wildlife diversity and abundance in that location.

The direct area of influence related to the proposed mining activities was restricted to the footprint of infrastructure locations, and included the wider IEL to account for indirect impacts. From the project description provided to us, it is assumed that there will be no significant impact on surrounding watercourses given that abstraction is assumed insignificant and that this project aims for zero discharge.

Field work activities were conducted between 15th November and 4th December 2014. This corresponds to the onset of the dry season.

Figure 2-1: Targeted area for large mammal surveys. Mammal surveys were concentrated within the Inner Exploration Licence (IEL) indicated by the red square on the map, but also included its immediate vicinity



2.3 Habitat types

Following Tano *et al.* (2007), we classified the vegetation into six different habitat types:

1. *Degraded dense forest*

This category encompasses habitats where the canopy reaches approximately 30m and where there is little undergrowth. Tree species characteristic of these areas are *Anthonotha crassifolia*, *Baphia nitida*, *Baphia bancoensis* and *Nesogordonia papaverifera*. Most of the remaining forest patches can be found on hilltops and/or at cemeteries. Selective logging has been ongoing in the area since the 1990's; therefore most of the emergent trees have been logged.

2. *Woodland savanna*

This category is characterized by a canopy reaching about 15m, with tree species such as *Azelia Africana* and *Lophira lanceolata* scattered throughout grassland vegetation.

3. *Shrubland savanna*

Shrubland savanna consists of herbaceous vegetation averaging 1.2m, with shrubs of about 6m dispersed throughout.

4. *Grassland savanna/ Bowe*

This category is described as a grassland cover of about 2m without a canopy. This vegetation sits on a hard rocky surface. This habitat type is rare throughout the Project area.

5. *Secondary growth/ Fallow land*

This category likely covers the highest proportion of the area of interest. These areas have been exploited (e.g. logging and agriculture) in the past and are now represented by thick undergrowth with species such as *Chromolaena odorata*, and different liana species.

6. *Cultivated areas*

These areas are covered by crops, usually cocoa and coffee. Around villages more diverse cultures can be found such as pepper, maize and cassava.

Modified vs Natural habitats

Paragraphs 11 and 13 of the IFC Performance Standard 6 (2012) provide definitions for, respectively, modified and natural habitats:

- **Modified Habitats:** "are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially

modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands.”

- Natural Habitats: “are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.”

Given the high level of habitat degradation in the area caused by artisanal mining activities, agricultural activities, cattle grazing and previous commercial logging activities, the habitat present in the Project area has been classified as “modified”.

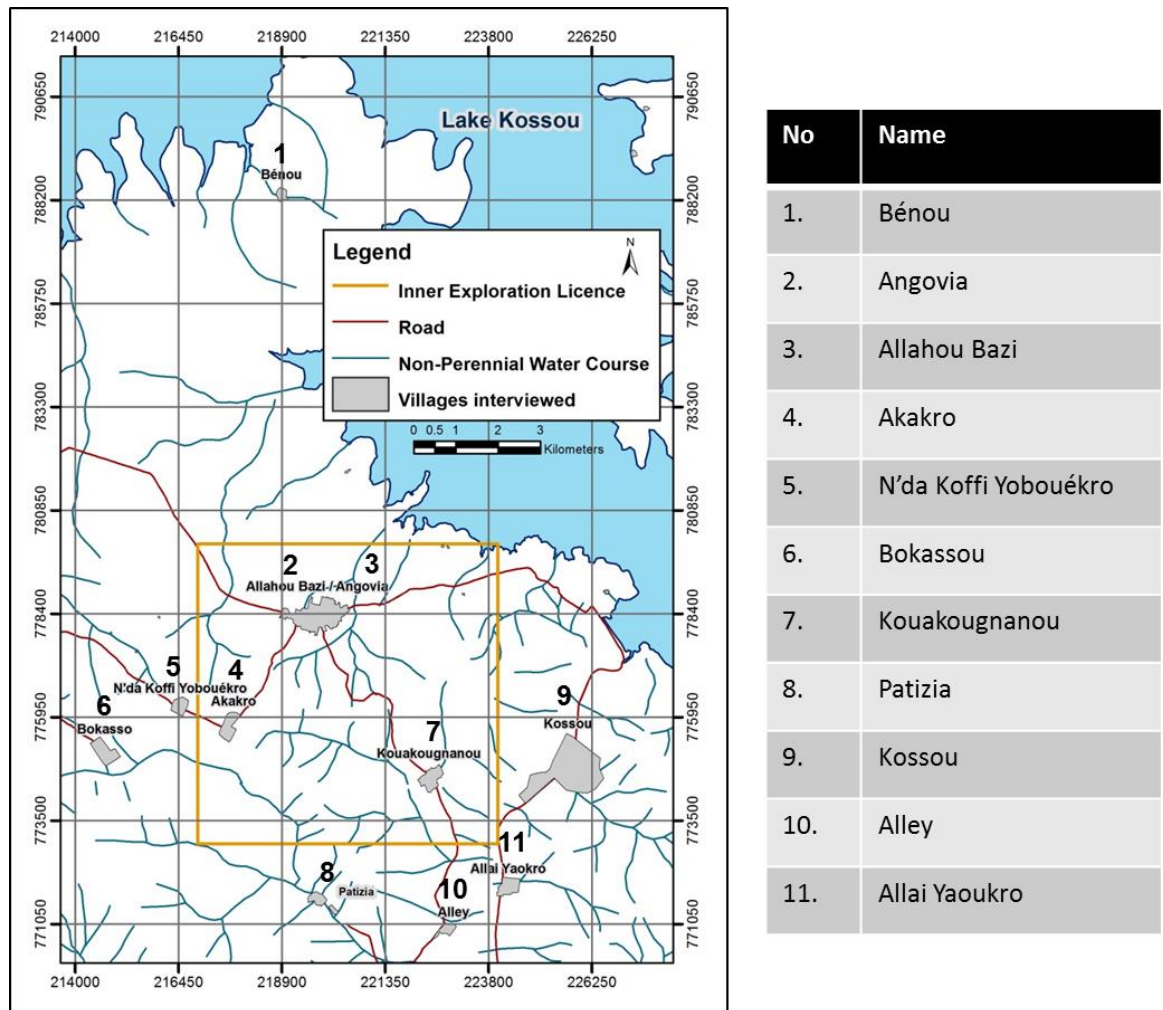
2.4 Sampling Methodology

Various survey techniques were employed to increase the probability of detecting as many mammal species as possible in the surveyed area.

2.4.1 Interview

Interviews were conducted in all the villages comprised within the IEL (four villages in total; Figure 2-2). This was done first, in order to inform the location of ground surveys. Further interviews were conducted in 6 additional villages surrounding the IEL, where habitat appeared less degraded on the satellite image, and where interviewees reported higher wildlife diversity. One village, Allai Yaokro, refused to be interviewed.

Figure 2-2: Location and name of villages where interviews were held.



We conducted semi-structured interviews in each village with a focus group composed of local hunters or elders with knowledge of wildlife present in the area. We showed a pre-selected sample of different mammal species' pictures thought to be present in this area, as well as several pictures of mammal species not known to occur within the area to assess reliability of picture identification.

Interviews helped to collate a list of mammal species thought to be present, and directed subsequent survey effort to areas where higher mammal diversity and density were reported, and/or potential locations of threatened species.

2.4.2 Ground surveys

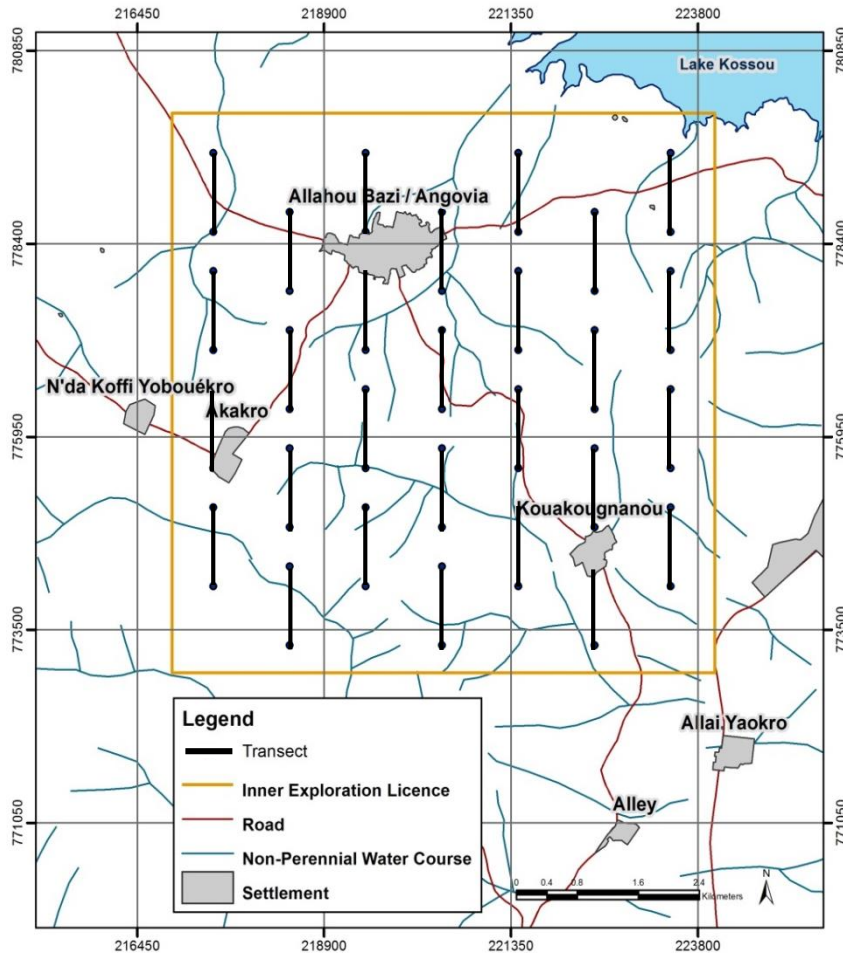
A combination of transects and reconnaissance walks ('recces') were used to cover the surveyed area. Transects are sampling units that follow a pre-determined direction, but where no deviation from the bearing is allowed. Recces are walks that follow a pre-

determined direction but during which one can deviate to use the path of least resistance (White & Edwards, 2000).

Recces have the advantage of allowing the team to travel faster through the environment, and thus cover more area in a short period of time, while at the same time having a minimum impact on the environment (Walsh & White, 1999; White & Edwards, 2000).

Transects of 1km in length were laid out in a systematic design to allow for un-biased comparison of the different areas of the IEL (Figure 2-3). Recces were used to increase survey effort in potentially high mammal diversity and density areas, and to detect threatened species.

Figure 2-3: Location of transects using a systematic sampling design.



While walking both transects and recces, the survey team consisted of a maximum of three individuals to minimize noise and thus increase the chances of detecting animals. The team walked slowly at a speed of between 0.5-1 km/hr to allow sufficient time to scan the canopy, and to record all direct (i.e. sighting) and indirect (e.g. tracks, dung) signs of mammal presence. All direct and indirect signs of anthropogenic presence were recorded (e.g. empty gunshells, hunting roads, mining, logging). For each observation, the habitat type was recorded according to the classification and definitions given in section 2.3.

2.4.3 Camera trapping

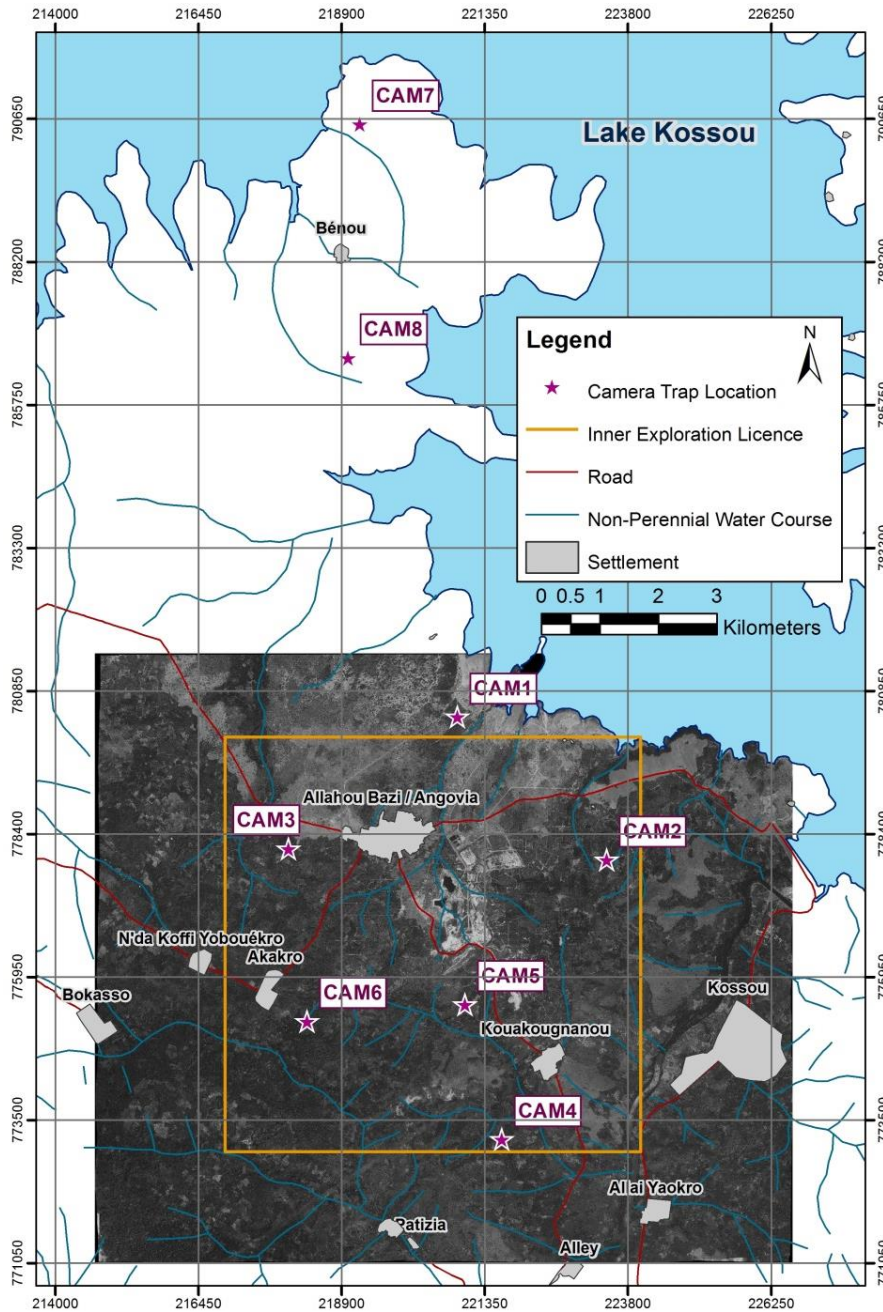
Camera trapping was used to detect the presence of terrestrial mammal species, especially nocturnal species that may be missed during ground surveys. Eight camera traps were placed throughout the area of interest (Table 2-1; Figure 2-4). General areas where camera traps had to be positioned were pre-determined, but the exact location was then guided by local hunters and observations during recces. One camera trap was

planned to be placed along the Bandama River, but given the high human pressure along the river, the decision was made against placing a camera at this location. Another camera trap was set aside for capturing hippopotami, however after walking along the Kossou Lake and interviewing fisherman, it appeared that hippopotami were not using this area of the lake at the time of the survey and the area was mainly used by cattle. Therefore, these two camera traps were placed around the village Bénou, where a higher wildlife diversity and density was reported during interviews. Most camera traps were placed in degraded dense forest, where more signs of large mammals could be found.

Table 2-1: Habitat type surrounding each of the camera trap's location.

Camera n°	Habitat type	Date installed	Date retrieved
Cam1	Woodland savanna	2014-11-18	2014-12-23
Cam2	Degraded dense forest	2014-11-18	2014-12-23
Cam3	Degraded dense forest	2014-11-18	2014-12-23
Cam4	Degraded dense forest	2014-11-19	2014-12-23
Cam5	Degraded dense forest	2014-11-19	2014-12-23
Cam6	Degraded dense forest	2014-11-20	2014-12-23
Cam7	Degraded dense forest	2014-11-21	2014-12-24
Cam8	Woodland savanna	2014-11-21	2014-12-24

Figure 2-4: Location of the eight camera traps.



2.5 Analyses

To assess spatial distribution of large mammal species and anthropogenic threats, we first summarized encounter rate for each transect walked. This summarized encounter rate was then associated with the middle point of its respective transect. The middle points were then used to produce our interpolated maps using the function 'Inverse Distance Weighted' in ArcGIS.

3.0 RESULTS

3.1 Interview

Interviews were conducted in ten villages. The results were generally similar, indicating that most large mammal and threatened species had disappeared about 40 years ago, coinciding with the construction of the Kossou hydroelectric dam, located approximately 3km to the East of the IEL. Mainly common species, such as the Maxwell's duiker (*Philantomba maxwellii*), were reported to still occur in the area. In the village of Bénou, located further North of the IEL, some species seemed to have disappeared more recently: the last individual and nest of the western chimpanzee (*Pan troglodytes verus*) was reported to have been seen there four years ago, and the last leopard (*Panthera p. pardus*) seen one year ago.

Some species were not recognised by local people we interviewed. For example, the pygmy hippopotamus (*Choeropsis liberiensis*) and the Roloway guenon (*Cercopithecus diana roloway*) were not known to occur or have historically occurred in this area.

When asked to identify species still occurring in their area from the pictures shown, the highest numbers of species reported were for the villages of Allahou Bazi, Angovia and Bénou. These three villages are located in the northwest of the concession where a mosaic of habitat types can be found, including woodland savanna. Therefore, this higher diversity reflects the presence of both forest and savanna species in their surroundings. Species such as the Buffon's Kob (*Kobus k. kob*) and the African buffalo (*Syncerus caffer*) were only reported to be present in the vicinity of these villages.

Relatively recent sightings of leopard were reported in both Patizia and Bénou. A tooth of a western forest hog (*Hylochoerus meinertzhageni ivoriensis*) was seen in Bénou, but this species was last seen in the area about five years ago and this species was only reported in this village and not within the IEL.

The interviewees were asked to classify primate species according to their abundance in the area. All ten villages listed the Eastern Lesser Spot-nosed monkey (*Cercopithecus p. petaurista*) as the most abundant. This was further substantiated by observations of this animal commonly kept as a pet in the villages visited (see Appendix A).

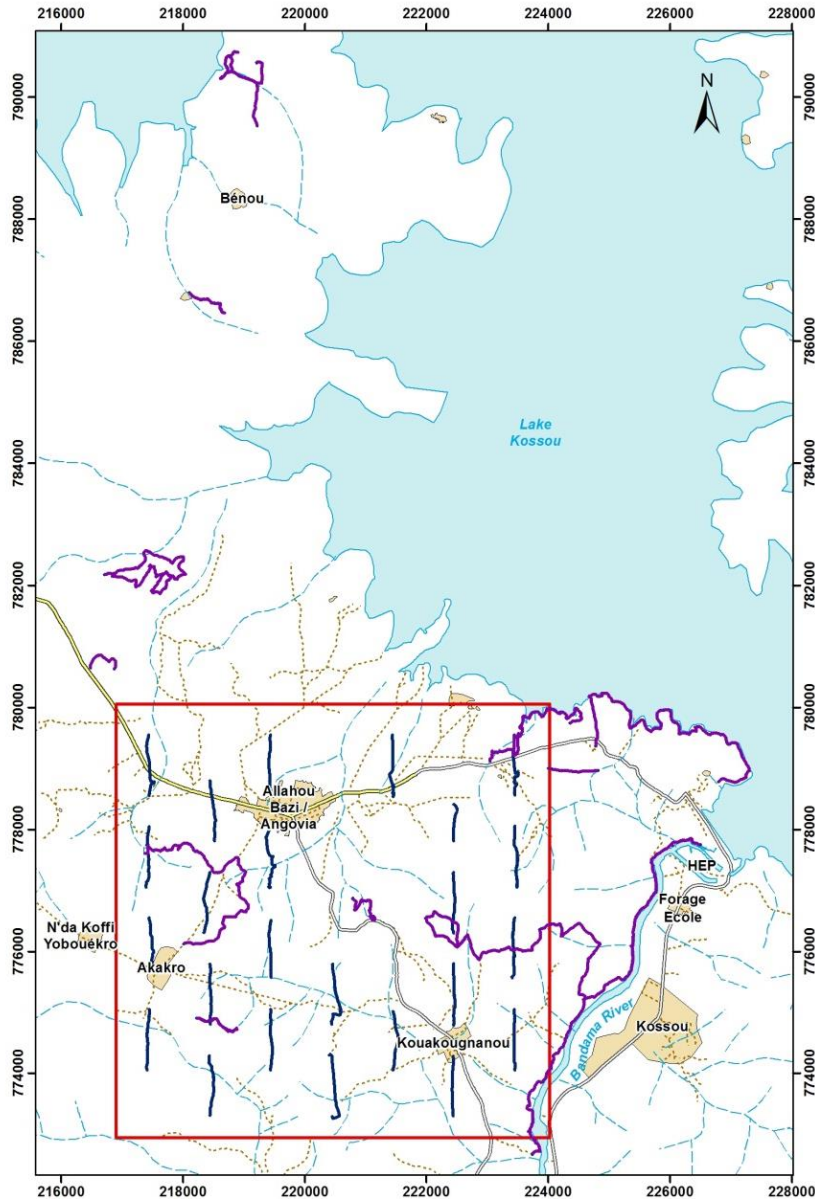
3.2 Ground surveys

3.2.1 Survey effort

A total of 14 recces and 24 transects were completed between 21st November and 4th December 2014 (Figure 3-1; Appendix B). Four transects, part of the initial design, were not completed because they either fell on the road or in the previous mine pit (i.e.

Cluff Gold Plc). Therefore, the total survey effort, for both recces and transects, was 149 hours and approximately 70 km spent surveying for large mammals.

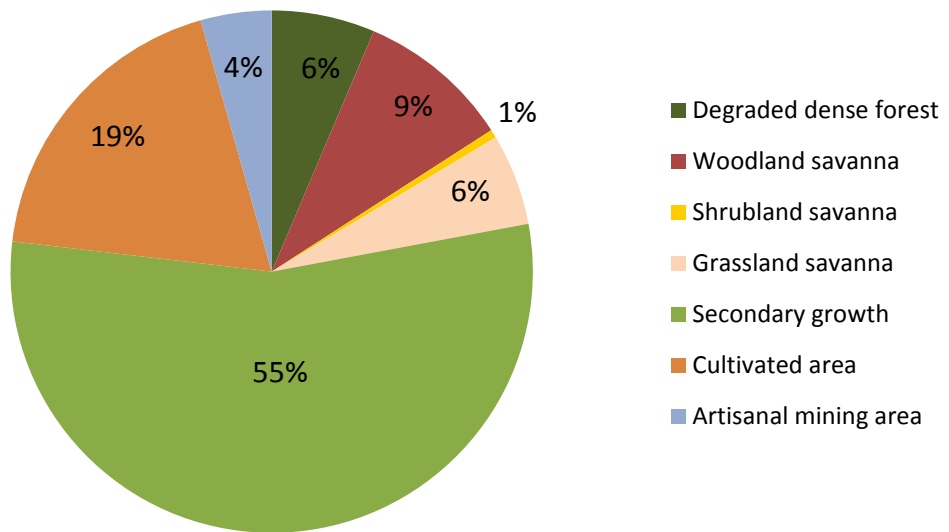
Figure 3-1: Location of recces and transects completed. Recces are indicated in purple and transects in blue.



Change in habitat types were noted along transects, therefore the percentage of survey effort per habitat type could be calculated (Figure 3-2). Given that the transects were laid out in a systematic design and provided a good coverage, this also gives an indication of the proportion of the different habitat types present within the IEL. The

main habitat type encountered along transects was secondary growth (i.e. 55%), followed by cultivated areas (i.e. 19%). Most cultivated areas were cocoa plantations of different ages, some newly established and others planted more than 30 years ago. Small fragments of degraded dense forest can be found throughout the concession, usually on hilltops, and towards the southwest of the IEL. Different types of savanna are found in the North of the IEL and because of the small portion of shrubland covered during our surveys, this category was combined with woodland savanna in further analyses.

Figure 3-2: Percentage of the different habitat types covered by transect surveys.

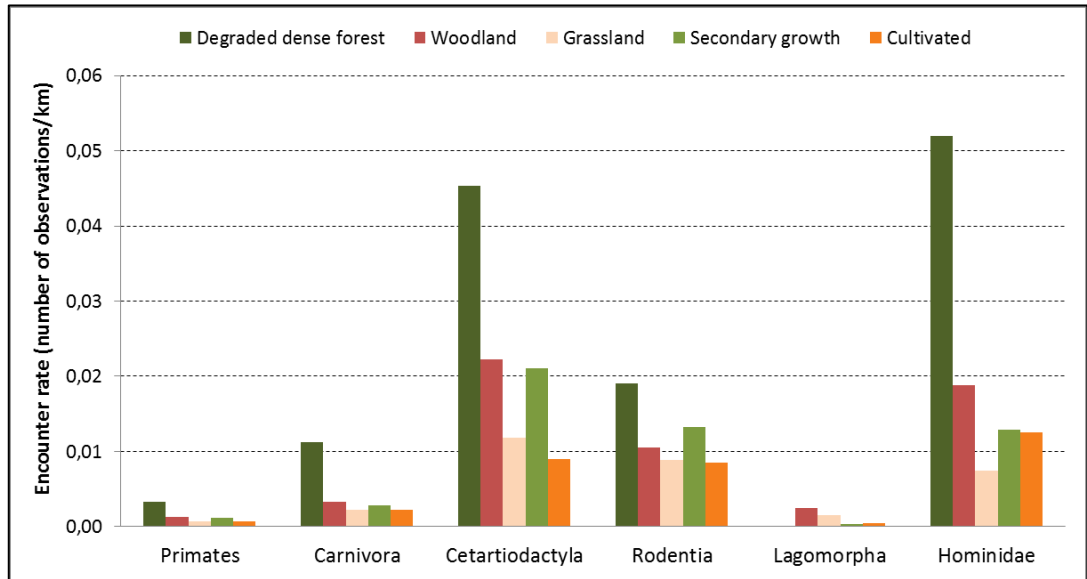


3.2.2 Large mammal spatial distribution

For all mammal orders, except Lagomorpha, the highest encounter rates were found in degraded dense forest, even though this habitat type is not well represented within the IEL (

Figure 3-3). Anthropogenic activities were also more frequent within this habitat type. The order Lagomorpha, with its only member the African savanna hare (*Lepus microtis*), was found in more savanna-like habitat types, habitats associated with this species.

Figure 3-3: Encounter rate per habitat type for species belonging to five different mammal orders and for anthropogenic activities (i.e. Hominidae).



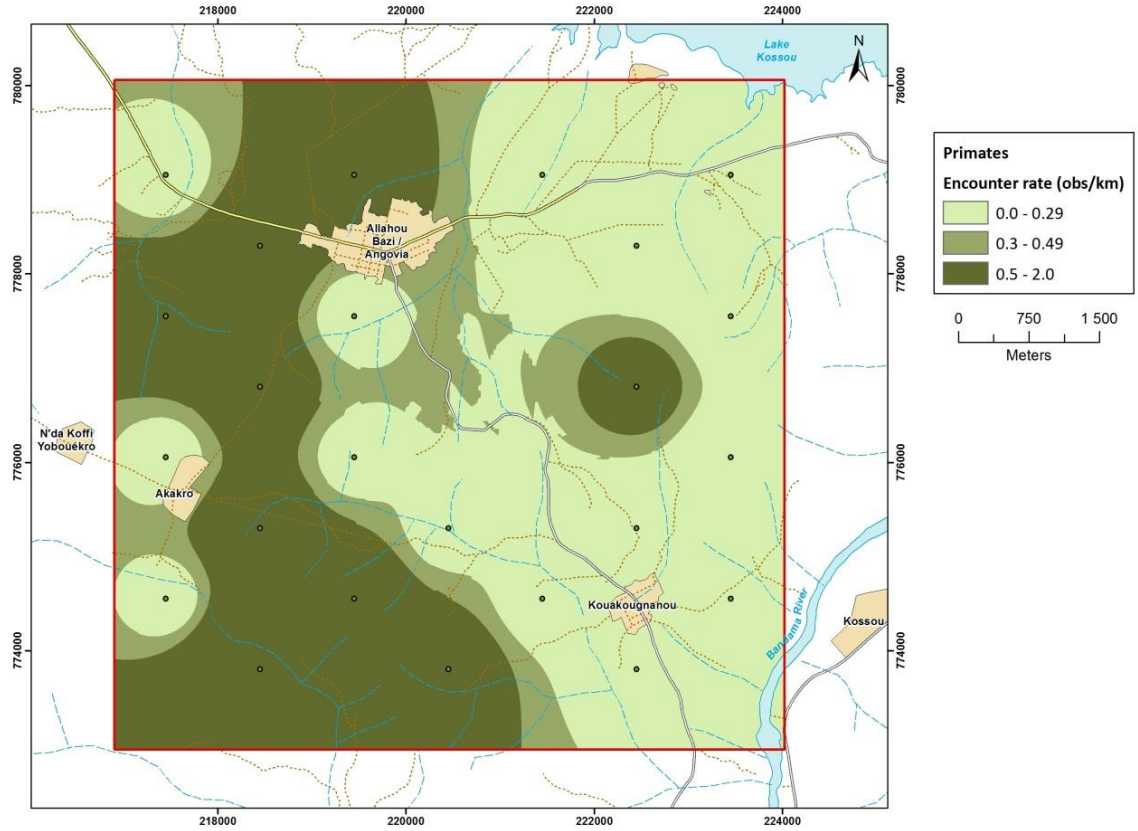
Different habitat preferences can be distinguished for individual species (Table 3-1). For example, within the order Carnivora, the African civet (*Civettictis civetta*) and the common cuisimanse (*Crossarchus obscurus*) had higher encounter rates in degraded dense forest, while signs of genet's (i.e. *Genetta spp.*) presence were mainly found in secondary growth. It should be noted that it was impossible to differentiate between tracks of *Cephalophus dorsalis* and *Cephalophus rufilatus*, therefore the results for these species were grouped under 'Cephalophus spp.'

Species	Habitat type				
	Degraded dense forest	Woodland savanna	Grassland savanna	Secondary growth	Cultivated area
Primates					
<i>Primate</i> spp.	0.00066	0.00000	0.00000	0.00046	0.00000
<i>Cercopithecus petaurista</i>	0.00000	0.00042	0.00000	0.00008	0.00000
<i>Galago</i> spp.	0.00000	0.00000	0.00000	0.00008	0.00000
Carnivora					
<i>Civettictis civetta</i>	0.00197	0.00042	0.00000	0.00046	0.00090
<i>Genetta</i> spp.	0.00000	0.00000	0.00000	0.00023	0.00000
<i>Crossarchus obscurus</i>	0.00197	0.00168	0.00148	0.00153	0.00045
Hyracoidea					
<i>Dendrohyrax arboreus</i>	0.00131	0.00000	0.00000	0.00000	0.00000
Cetartiodactyla					
<i>Cephalopus</i> spp.	0.00526	0.00335	0.00223	0.00605	0.00291
<i>Neotragus pygmaeus</i>	0.00000	0.00042	0.00074	0.00008	0.00000
<i>Philantomba maxwellii</i>	0.01183	0.00377	0.00297	0.00575	0.00112
<i>Tragelaphus scriptus</i>	0.01117	0.00712	0.00520	0.00559	0.00336
Rodentia					
<i>Atherurus africanus</i>	0.00657	0.00084	0.00000	0.00513	0.00157
<i>Cricetomys gambianus</i>	0.00197	0.00000	0.00148	0.00176	0.00224
<i>Thryonomys swinderianus</i>	0.00263	0.00671	0.00594	0.00399	0.00380
Lagomorpha					
<i>Lepus microtis</i>	0.00000	0.00042	0.00074	0.00008	0.00045
Hominidae					
<i>Homo sapiens</i>	0.01511	0.00754	0.00445	0.00935	0.00806

Table 3-1: Encounter rate per habitat type for all large mammal species encountered on transects

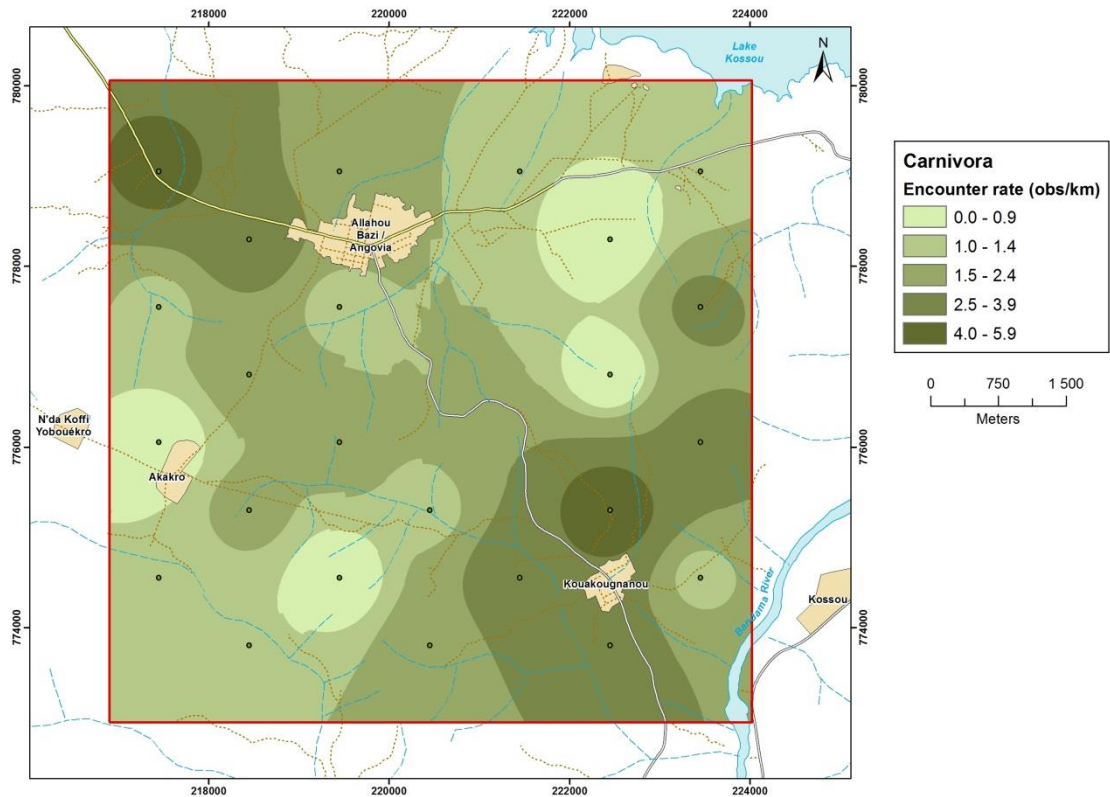
There were few encounters with primates along transects. The only evidence of primate species along transects were through indirect signs, such as feeding remains. Therefore the results should be interpreted with caution. There appears to be a higher encounter rate for primates to the West of the IEL, where there is more degraded dense forest (Figure 3-4).

Figure 3-4: Interpolated map of encounter rates with primates along transects within the IEL.
Dots indicate transect middle points.



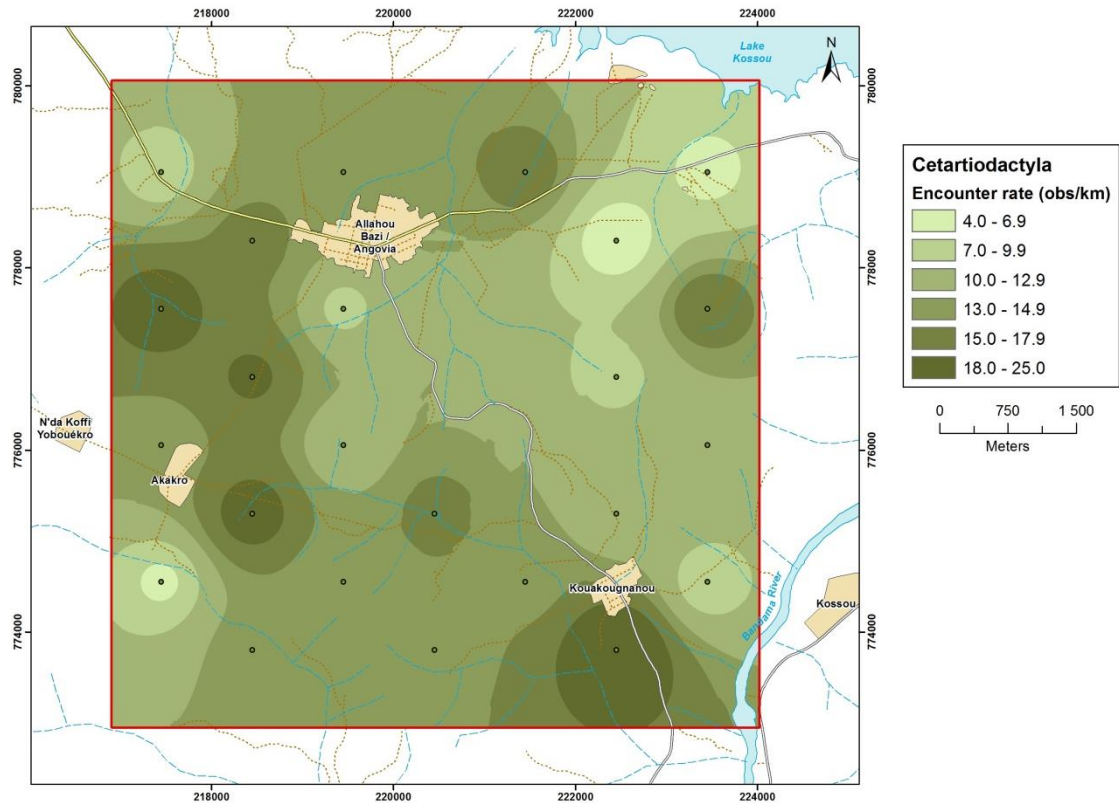
Carnivores were encountered throughout the IEL (Figure 3-5). The highest diversity was found around the village of Kouakougnanou in the southeast of the IEL, with records of species such as the African civet, the African palm civet, mongooses and genets.

Figure 3-5: Interpolated map of encounter rates with carnivores along transects within the IEL. Dots indicate transect middle points.



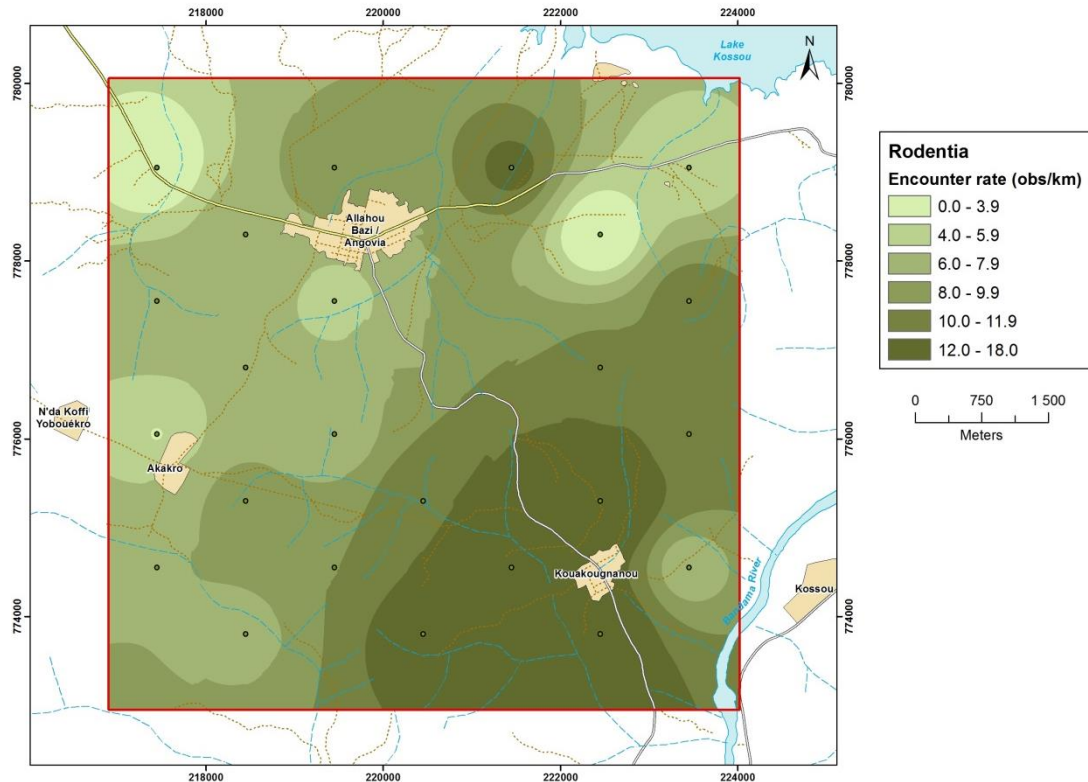
The order Cetartiodactyla encompasses eight species in this area, including the common Maxwell duiker, which explains the higher encounter rate on transects (Figure 3-6). A slightly higher encounter rate was found to the West of the IEL, where also a higher primate encounter rate was found.

Figure 3-6: Interpolated map of encounter rates with Cetartiodactyla along transects within the IEL. Dots indicate transect middle points.



Members of the Rodentia order were frequently encountered along transects (Figure 3-7). These species often feed in crops, thus we found high encounter rates in the southeast of the IEL, where many crops were also encountered.

Figure 3-7: Interpolated map of encounter rates with rodents along transects within the IEL. Dots indicate transect middle points.



3.2.3 Threats

Evidence for anthropogenic activities was recorded on all the transects (Figure 3-8). The majority of these signs were of mining, thus the similarity between the overall interpolated map of anthropogenic activities and the one for mining activities (Figures 3-8 & 3-9). The signs of mining recorded were mostly of artisanal gold mining. In some areas, there were so many signs of mining that they could not all be recorded, therefore these results represent a lower limit to actual encounter rates.

Hunting signs (i.e. snares, gunshot and gunshell) were concentrated towards the West of the concession (Figure 3-10), a similar distribution to that of primates and to a lesser

extent to the distribution of Cetartiodactyla. It might be an indication of higher wildlife density in this area, which is also reflected by a more intact vegetation cover.

Figure 3-8: Interpolated map of encounter rates with all signs of anthropogenic activities along transects within the IEL. Dots indicate transect middle points.

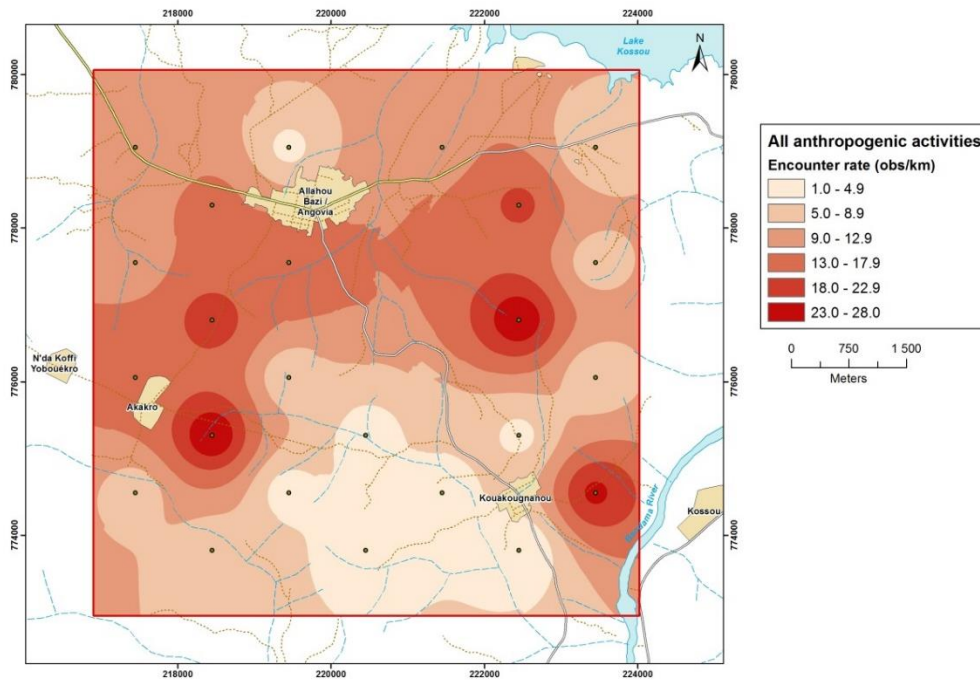


Figure 3-9: Interpolated map of encounter rates with signs of artisanal mining activities along transects within the IEL. Dots indicate transect middle points.

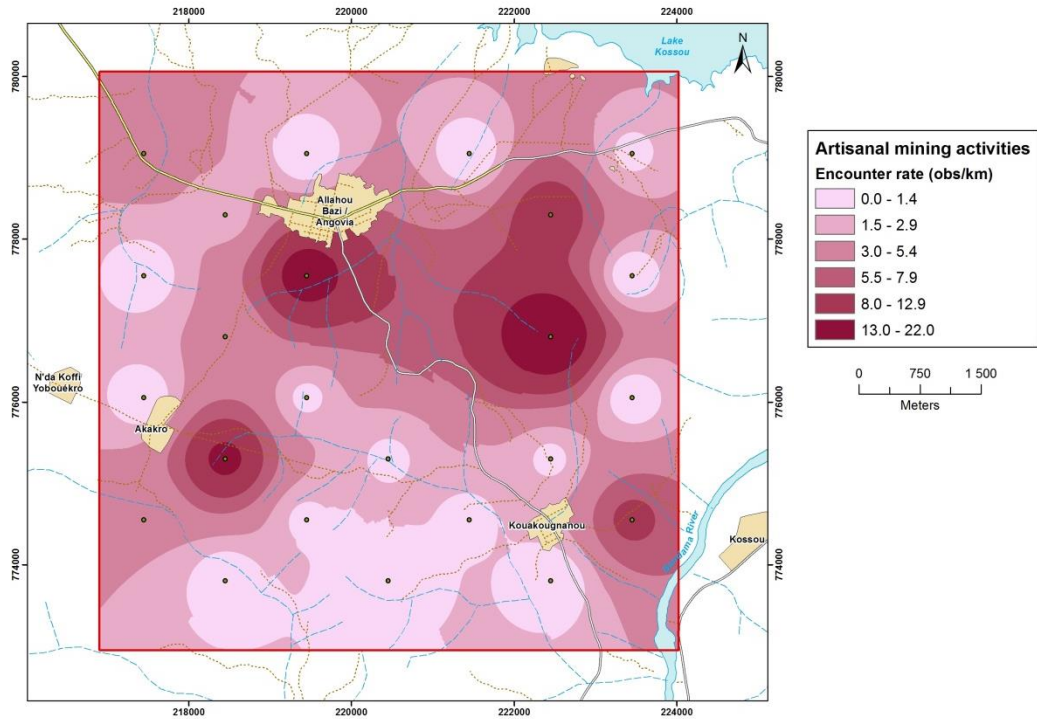
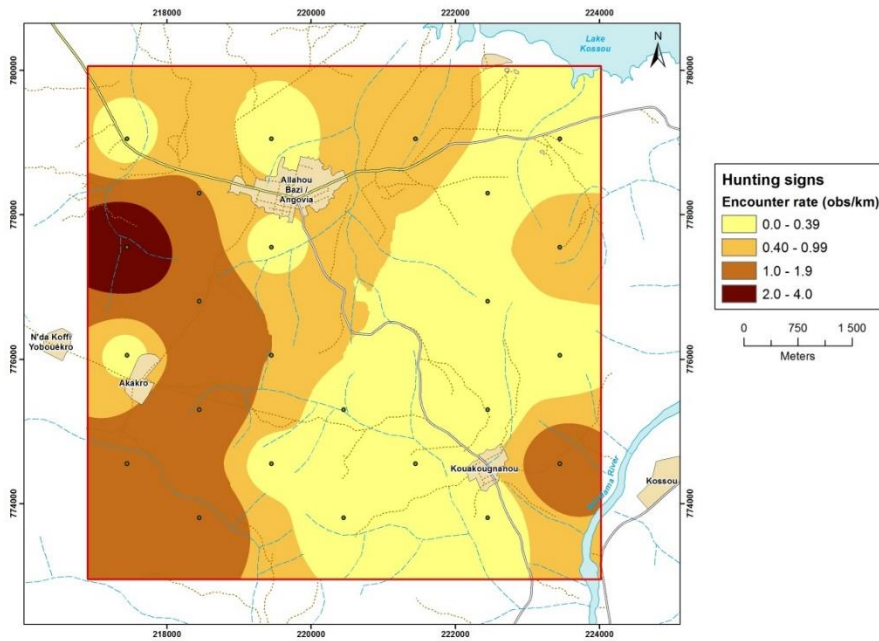
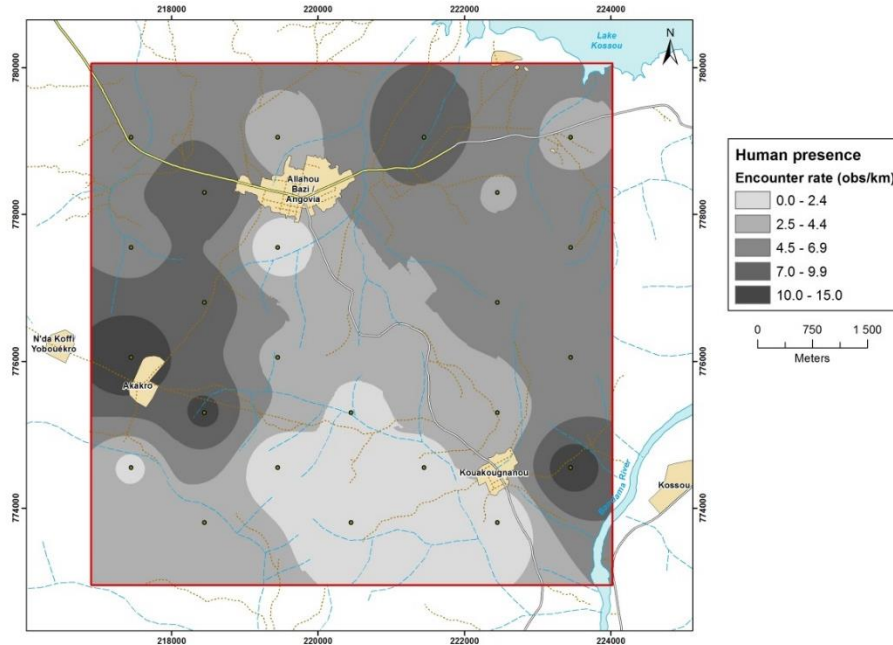


Figure 3-10: Interpolated map of encounter rates with hunting signs along transects within the IEL. Dots indicate transect middle points.



Signs of human presence were recorded (i.e. individuals seen, heard, trails, etc.) throughout the IEL (Figure 3-11). There appear to be less signs of human presence between the villages of Akakro and Kouakougnanhou, where no main roads exist.

Figure 3-11: Interpolated map of encounter rates with signs of human presence along transects within the IEL. Dots indicate transect middle points.

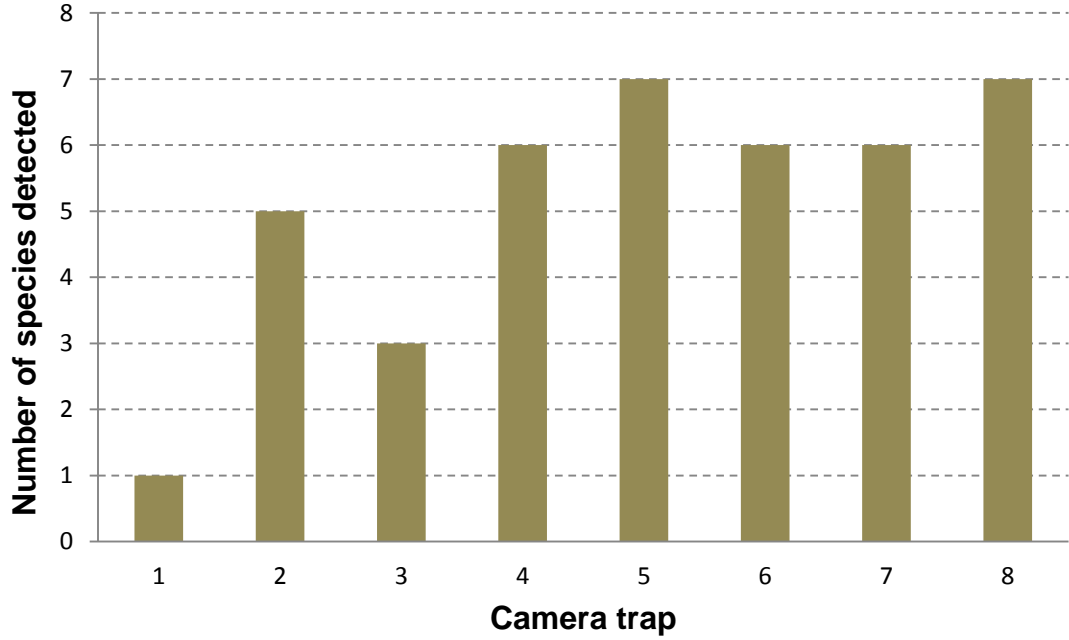


3.3 Camera Trapping

Ten species were recorded with camera traps. These species were also detected during ground surveys, except for the Green monkey (*Chlorocebus sabaeus*). Camera traps also allowed us to confirm the presence of the red-flanked duiker (*Cephalophus rufilatus*), which was difficult to ascertain based solely on tracks and dung (see Appendix C).

The maximum number of species detected at one camera trap location was seven and the minimum one (Figure 3-12). The highest numbers of species detected were at cameras 5 and 7. The lowest number of species was at camera 1 close to Angovia. Field assistants reported intense anthropogenic surrounding this camera, with people coming to cut down trees for charcoal production and many cattle moving in this area, which may have affected animal movement around this camera.

Figure 3-12: Number of species detected at each of the camera trap location.



3.4 Large mammal diversity

3.4.1 Large mammal species list

During this survey, evidences were gathered on the potential presence of 26 large mammal species within the Project area (Table 3-2). Three of these species are threatened according to the IUCN Red List (i.e. listed as Vulnerable). Our surveys confirmed the presence of 21 of these species. Five species: the olive colobus (*Procolobus verus*) (NT), the leopard (*Panthera p. pardus*) (NT), the white-bellied pangolin (*Phataginus tricuspis*) (VU), the western potto (*Perodicticus potto*) (LC) and the western forest hog (*Hylochoerus meinertzhageni ivoriensis*) (LC) were reported to be present from interviews, but their presence was not confirmed during our surveys. Among the total 26 species, five are integrally protected and five other partially protected according to the national law (i.e. Law 94-442 dated August 16 1994).

Table 3-2: Large mammal species list for the Project area

Family	Species	Common name	Method of detection ¹			Status ²	
			Interview	Recce	Cam.-trap	IUCN	National
Primates							
Cercopithecidae	<i>Cercopithecus campbelli lowei</i>	Lowe's monkey	R	S, H		LC	II
Cercopithecidae	<i>Cercopithecus p. petaurista</i>	Eastern Lesser Spot-nosed monkey	R	S, H	S	LC	III
Cercopithecidae	<i>Procolobus verus</i>	Olive colobus	R			NT	?
Cercopithecidae	<i>Chlorocebus sabaues</i>	Green monkey	R		S	LC	II
Lorisidae	<i>Perodicticus p. potto</i>	Western Potto	R			LC	I
Galagidae	<i>Galagoides demidovii</i>	Demidoff's Galago	R	H, N		LC	I
Carnivora							
Herpestidae	<i>Crossarchus obscurus</i>	Common Cusimanse	R	S, T	S	LC	III
Viverridae	<i>Genetta spp.</i>	Genet sp.	R		S		III
Viverridae	<i>Civettictis civetta</i>	African Civet	R	D, T	S	LC	III
Nandiniidae	<i>Nandinia binotata</i>	African Palm Civet	R	T		LC	II
Felidae	<i>Panthera p. pardus</i>	Leopard	R			NT	I
Hyracoidea							
Procaviidae	<i>Dendrohyrax dorsalis</i>	Western Tree Hyrax	R	H, D		LC	III
Cetartiodactyla							
Bovidae	<i>Cephalophus dorsalis</i>	Bay Duiker	R	D, T		LC	III
Bovidae	<i>Cephalophus rufilatus</i>	Red-Flanked Duiker	R	D, T	S	LC	III
Bovidae	<i>Philantomba maxwellii</i>	Maxwell's Duiker	R	D, T	S	LC	III
Bovidae	<i>Tragelaphus scriptus</i>	Bushbuck	R	D, T	S	LC	III
Bovidae	<i>Kobus k. kob</i>	Buffon's Kob	R	D, T		VU	III
Bovidae	<i>Syncerus caffer</i>	African Buffalo	R	T		LC	II
Bovidae	<i>Neotragus pygmaeus</i>	Royal Antelope	R	D, T		LC	I
Hippopotamidae	<i>Hippopotamus amphibius</i>	Hippopotamus	R	S		VU	?
Suidae	<i>Hylochoerus meinertzhageni ivoriensis</i>	Western Forest Hog	R ³			LC	I
Lagomorpha							
Leporidae	<i>Lepus microtis</i>	African Savanna Hare	R	S, T, D		LC	III
Rodentia							
Thryonomyidae	<i>Thryonomys swinderianus</i>	Greater Cane Rat	R	D, F		LC	III
Hystricidae	<i>Atherurus africanus</i>	African Brush-tailed porcupine	R	F	S	LC	III
Nesomyidae	<i>Cricetomys gambianus</i>	Gambian Rat	R	F	S	LC	III
Pholidota							
Manidae	<i>Phataginus tricuspis</i>	White-Bellied Pangolin	R			VU	II

- (1) Method of detection: R=reported during interviews; S=seen; H=heard; D=dung; T=tracks; N=nest; F=Food remains
- (2) IUCN Status: LC= Least Concern; NT= Near Threatened; VU=Vulnerable; EN= Endangered.
National status: Annexe I=Integrally protected species; Annexe II= Partially protected species; Annexe III=Non-protected species. According to Law 94-442, dated August 16 1994.
- (3) A tooth was seen in the village of Benou during interviews.

3.4.2 Globally threatened species

No Endangered or Critically Endangered species have been recorded or reported during our surveys. However, three species are listed as Vulnerable, also a globally threatened category on the IUCN Red List of Threatened Species (IUCN 2015). These are:

- Hippopotamus (*Hippopotamus amphibius*);
- Buffon's kob (*Kobus k. kob*); and
- White-bellied pangolin (*Phataginus tricuspis*).

Hippopotamus (*Hippopotamus amphibius*) (VU)

Hippopotami were reported all along the Kossou Lake by fisherman. Their presence was confirmed during surveys outside of the concession, where four individuals were seen, along with a newborn (

Figure 3-13). Hippopotami were not reported for the Bandama River, except for one individual that had ventured up the river approximately five years ago and was killed immediately. A fisherman from a fishing village (located approximately 8km South of the IEL) reported that he had never encountered a hippopotamus in the section of the Bandama River comprised between the hydroelectric dam and the national road.

Although the common hippopotamus is not listed as CR or EN on the IUCN Red List, their West African populations have undergone dramatic reductions in the last years, and since their IUCN Red List assessment was conducted over ten years ago (i.e. in 2004), it might not reflect their current status. In Côte d'Ivoire, this species is found in most of the main rivers of the country and their population size was estimated at between 300-400 individuals in 2004 (Lewison & Oliver, 2008).

A nationwide survey would be needed to update their population status within the country, but the few data we possess suggest that the Côte d'Ivoire population has suffered a drastic decline in recent years. Indeed, recent surveys conducted in 2012 in Marahoue and Sangbe National Parks (two of the areas thought to harbor significant populations of common hippopotamus) revealed no sign of hippopotamus presence in these parks (except for an old skull; Vergnes & Maho, 2012). Probably the only viable hippopotamus population left in the country would be in Comoe National Park, but this park has also suffered intense poaching activities since 2000s (Fisher, 2004). Therefore, the hippopotamus population of Kossou Lake may hold significant conservation value for the country.

Buffon's kob (*Kobus k. kob*) (VU)

Evidence for the presence of the Buffon's kob was only found in the northwest of the concession where there is more woodland savanna, habitat associated with this species (

Figure 3-13). It is only in this area that this species was reported during interviews.

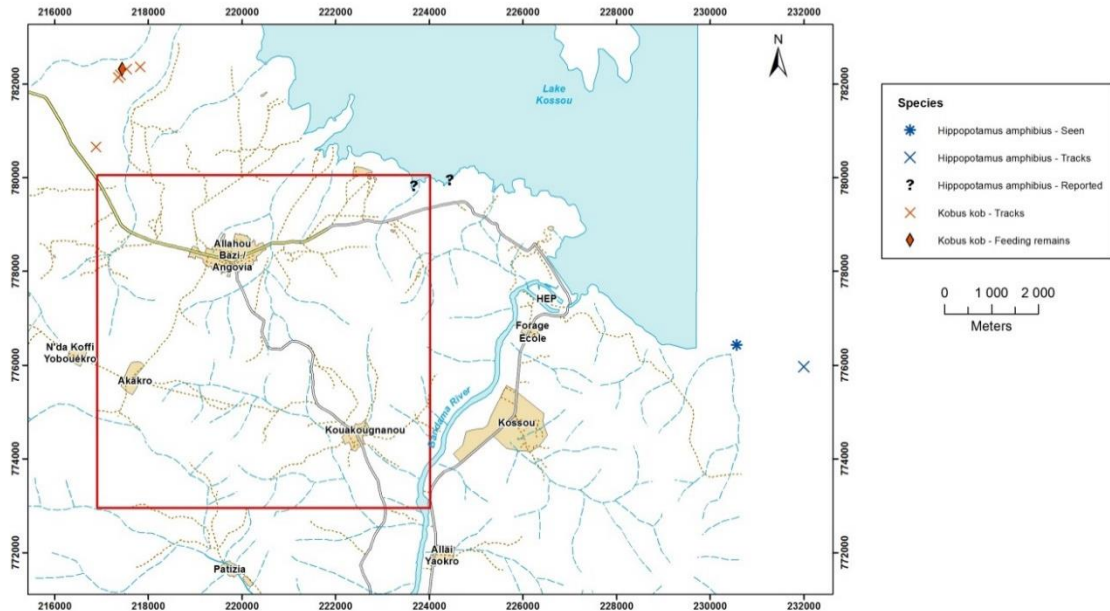
The listing of this subspecies as Vulnerable on the IUCN Red List is based on the scarce population estimates available and the estimation that numbers of Buffon's Kob have declined on the order of 30% over the past three generations (21 years), primarily as a result of hunting. This subspecies has already been extirpated from The Gambia, Sierra Leone, and possibly southern Mauritania, and they are rare in several other West African countries (IUCN, 2008).

White-bellied pangolin (*Phataginus tricuspis*) (VU)

The presence of the white-bellied pangolin was reported in all of the villages interviewed, but their presence was unconfirmed during our surveys. This species is extremely shy, emitting few vocalizations (Kingdon, 2003). Predominantly arboreal and nocturnal, it may have easily been missed during ground surveys and by the camera traps.

This species is listed as vulnerable on the IUCN Red List due mainly to the impacts of the bushmeat trade and a continued increase demand for this species on international markets (Waterman et al., 2014). There is a need to improve and standardize survey methods, in an effort to assess the status of this species globally. More effort should also be placed in trying to estimate its population parameters in order to understand the effects of anthropogenic factors on their population (Waterman et al., 2014).

Figure 3-13: Distribution of threatened species according to their IUCN status.



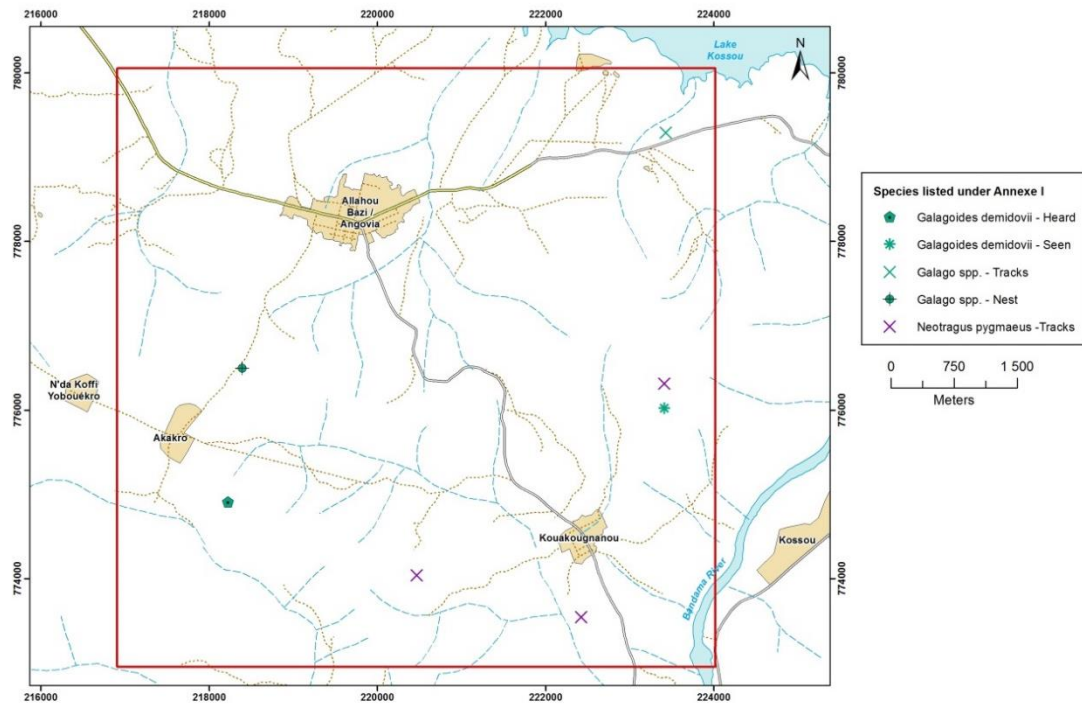
3.4.3 Nationally Threatened species (according to national legislation)

Species can be integrally (i.e. Annexe I) or partially (i.e. Annexe II) protected under the national law (i.e. Law 94-442 dated 16 August 1994). Five species listed under Annexe I and five species listed under the Annexe II were recorded during this study (Table 3-2). None of these species are listed as threatened by the IUCN, except the white-bellied pangolin.

Four primate species are protected under the national law. Three of these species were recorded in this study (i.e. *Cercopithecus campbelli*, *Galagoides demidovii*, and *Chlorocebus sabaeus*; Figures 3-14 & 3-15). The fourth species, the western potto (*Perodicticus potto*), was reported to be present around all the villages interviewed, but was not recorded during ground surveys or with camera trapping. This species is mostly silent and arboreal, therefore likely to be missed during surveys. All these species are listed as Least Concern (LC) on the IUCN Red List and are usually common species throughout their range.

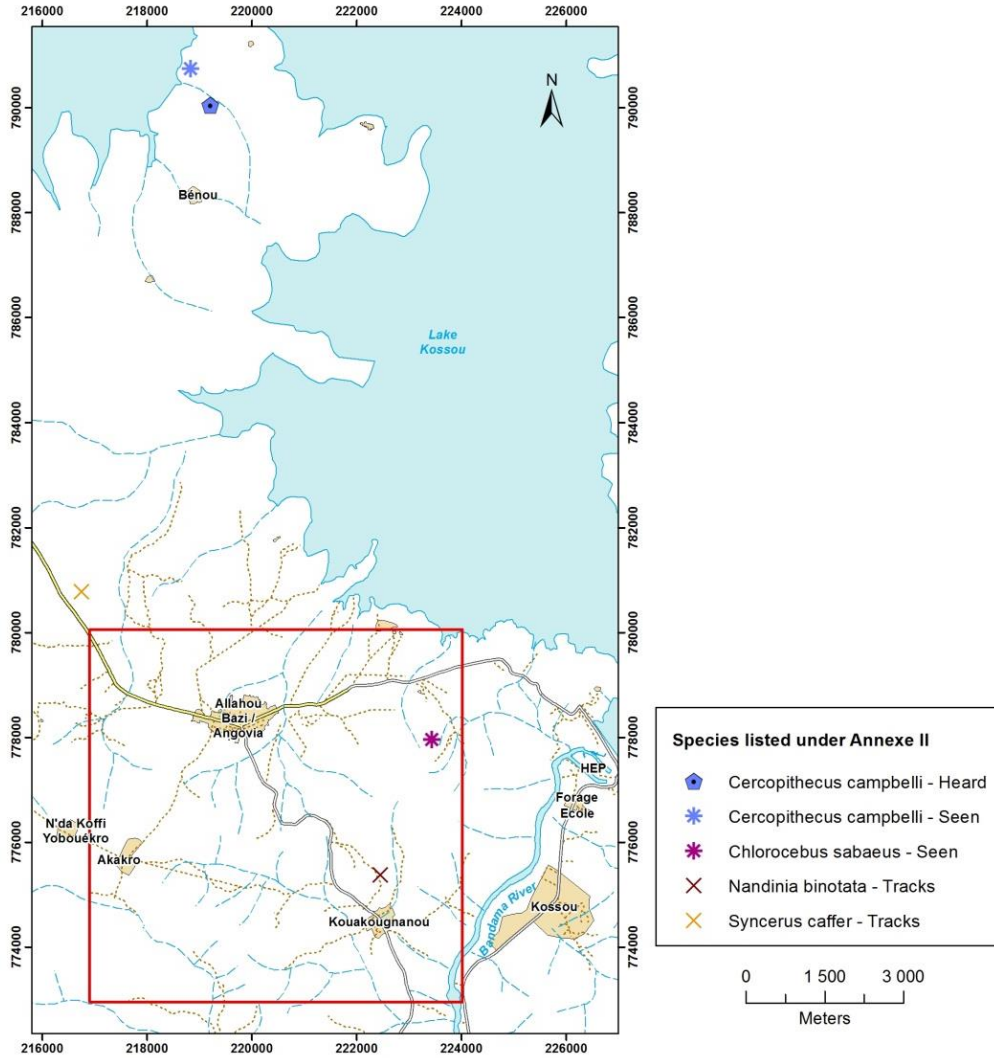
The royal antelope (*Neotragus pygmaeus*) was only reported and recorded in the southeastern part of the IEL (Figure 3-14). Tracks of the African palm civet were seen once with certainty around Kouakougnanou (Figure 3-15). Their tracks can be easily confused with that of genets, thus its presence may be more widespread throughout the Project area since this species was reported in all the villages interviewed.

Figure 3-14: Distribution of species protected under Annexe I.



Tracks of African buffalos were recorded in the North of the IEL (Figure 3-15). It is also in this area that buffalos were reported to range during interviews. Given the high number of cattle present in this part of the concession, it was often difficult to distinguish between tracks of buffalos and tracks of cows, therefore the results may underestimate their presence within the Project area.

Figure 3-15: Distribution of species protected under Annexe II.



4.0 IMPACT ASSESSMENT

4.1 Impact Description

Five impacts resulting from the proposed Project's gold mining activities have been identified:

- Habitat loss: the main impact will be habitat loss associated with vegetation clearance at infrastructure locations;
- Mortality/Injury resulting from project vehicle collision: a risk arise from potential mortality or injury following project's vehicle collision as it is likely that traffic will increase in the area;
- Influx of people into the area: the development of the mine will increase immigration of people into the area looking for work, which can lead to increased pressure on natural resources (e.g. through deforestation and hunting);
- Habitat degradation: an increase in noise pollution and dust related to the construction and operational activities is expected. There is also a risk of habitat pollution through disposal of mining waste; and
- Habitat fragmentation: vegetation clearance for infrastructure locations will lead to habitat fragmentation and can constrain animal movement for certain more mobile species.

Direct and indirect impacts associated with the Project's gold mining activities will exacerbate existing threats. This area has already been degraded by the large amount of people coming to the area to conduct artisanal mining activities; however the construction of an industrial gold mine facility will accelerate degradation of an already fragile environment.

4.2 Impact Assessment

4.2.1. Habitat loss

Impact	Habitat loss		
Nature	Negative ✓	Positive	
	Habitat loss will negatively impact species by removing potential important habitat from their home range.		
Nature of Impact	Direct ✓	Indirect	Cumulative
	Vegetation clearance for mine infrastructure will directly impact large mammal species present by entirely or partially removing their habitat. Some species may be able to shift their range slightly; however other territorial		

	species will be affected more intensively. This could lead to the mortality of some individuals.			
Likelihood Probability /	1 = Unlikely	2 = Possible	3 = Likely	4 = Definite likelihood ✓
	It is definite that this impact will affect large mammal species.			
Duration	1 = Short term	2 = Medium term	4 = Long term	4 = Permanent ✓
	In the eventually that reforestation programs are implemented, large mammal's populations may recover and extend their home range to reforested areas, however given the long timeframe necessary to ensure successful reforestation program (and given the low success rate of such programs), this is unlikely.			
Extent / Spatial	1 = Localised ✓	2 = Site	3 = Wider and Adjacent Region	4 = National / International
	Habitat loss will be localised to infrastructure locations.			
Magnitude / Scale	1 = Low	2 = Minor	3 = Moderate ✓	4 = High
	The magnitude will depend on the location of infrastructure components. As not many threatened species are present within the IEL, and given that the habitat is already degraded, most infrastructure locations would have minor impacts on wildlife populations.			
Resource/Receptor Sensitivity/ Importance of Value	2 = Low	4 = Moderate Low	6 = Moderate ✓	8 = High
	We have identified a few internationally and/or nationally threatened species occurring in the area that may be impacted by habitat loss.			
Significance of the impact	1 – 20 = Negligible	21 – 56 = Low	57 – 92 = Medium ✓	93 – 128 = High
	The significance of this impact is rated medium, and its rating is explained mainly by the fact that globally and nationally threatened species are present within this area.			

4.2.2. Mortality/Injury resulting from project vehicle collision

Impact	Mortality/Injury resulting from project vehicle collision	
Nature	Negative ✓	Positive

	There is a risk of collision with project vehicles during the construction and operational phases of this project. This can lead to injury or death of animals.			
Nature of Impact	Direct ✓	Indirect	Cumulative ✓	
	This impact will directly lead to the injury or death of individuals. This impact is also cumulative as there is already heavy traffic resulting from the presence of many artisanal miners that use the road on a daily basis.			
Likelihood Probability /	1 = Unlikely	2 = Possible ✓	3 = Likely	4 = Definite likelihood
	There is a risk of collision with project vehicles; however with the proper implementation of mitigation measures (e.g. speed limit/regulation) this risk could be controlled.			
Duration	1 = Short term	2 = Medium term	4 = Long term ✓	4 = Permanent
	This risk is expected to last for the duration of the mine construction and operational activities.			
Extent / Spatial	1 = Localised	2 = Site	3 = Wider and Adjacent Region ✓	4 = National / International
	This impact includes the wider adjacent region as some of the accommodation facilities are located outside of the IEL, and the activities at the mine involve frequent travel to the political and economical capitals.			
Magnitude / Scale	1 = Low	2 = Minor ✓	3 = Moderate	4 = High
	Existing traffic levels in the area is heavy and most roads already existing. Only a small portion of road around the mine pit is expected to be build. Given the low wildlife's abundance, and if appropriate mitigation measures are implemented, we expect this impact to have a minor effect on large mammal populations.			
Resource/Receptor Sensitivity/ Importance of Value	2 = Low	4 = Moderate Low	6 = Moderate ✓	8 = High
	Globally and/or nationally threatened species may be impacted by vehicle collision.			
Significance of the impact	1 – 20 = Negligible	21 – 56 = Low	57 – 92 = Medium ✓	93 – 128 = High
	The significance of this impact is rated medium, and its rating is explained mainly by the fact that globally and nationally threatened species are present within this area.			

4.2.3. Influx of people into the area

Impact	Influx of people into the area			
Nature	Negative ✓		Positive	
	The presence of a mining company in the area will attract people looking for employment. Some people may be employed by the company, but others may take part in the artisanal mining activities. The increase in the local population will have a negative impact by increasing the pressure on the wildlife and their habitat through an increase in hunting and deforestation and increased agriculture practices.			
Nature of Impact	Direct	Indirect ✓		Cumulative ✓
	This impact is cumulative as there is already a hunting pressure on the wildlife populations and most of the land has already been converted into plantations. The influx of people coming into the area looking for work, combined with the constant immigration of artisanal miners, will add pressure on the remaining forest patches and likely reduced wildlife populations.			
Likelihood Probability /	1 = Unlikely	2 = Possible	3 = Likely ✓	4 = Definite likelihood
	Immigration into the area appears to be constant, therefore it is likely that the local population will increase, exacerbating threats to the wildlife populations.			
Duration	1 = Short term	2 = Medium term	4 = Long term ✓	4 = Permanent
	This impact will likely remain for the whole duration of the mine activity and may persist beyond mine closure if the resource has not been depleted.			
Extent / Spatial	1 = Localised	2 = Site	3 = Wider and Adjacent Region ✓	4 = National / International
	People may go further to hunt as the wildlife abundance within the IEL is already low. If there is an increase in bushmeat demand, it is possible that bushmeat would come from other neighbouring cities, depleting their wildlife populations. Furthermore, as arable lands are also rare in the area, people may start to cultivate outside of the EIL where there is a lower human density.			
Magnitude / Scale	1 = Low	2 = Minor	3 = Moderate ✓	4 = High
	This impact is rated moderate and is considered one of the main threats to the wildlife populations in the area. Appropriate mitigation measures should be put in place to help reduce the potential negative effects of the immigration of people into the Project area.			

Resource/Receptor Sensitivity/ Importance of Value	2 = Low	4 = Moderate Low	6 = Moderate ✓	8 = High
	Globally and/or nationally threatened species occurring in the area may be targeted for hunting and/or could lose their habitat to cultivation.			
Significance of the impact	1 – 20 = Negligible	21 – 56 = Low	57 – 92 = Medium ✓	93 – 128 = High
	The significance of this impact is rated medium, and its rating is explained mainly by the fact that globally and nationally threatened species are present within this area.			

4.2.4. Habitat degradation

Impact	Habitat degradation			
Nature	Negative ✓	Positive		
	Habitat degradation through noise pollution, dust, and potential habitat pollution can impact negatively large mammal species, leading for example to a decrease in reproductive success, a decrease in feeding time, and in the case of species sensitive to pollution, to mortality.			
Nature of Impact	Direct ✓	Indirect	Cumulative ✓	
	Wildlife populations may be impacted indirectly by noise and dust pollution caused by blasting and general construction activities. They may alter their behaviour and avoid certain areas, increase their daily range and/or decrease their feeding time, which would generally increase stress levels. This may lead to a general decrease in reproductive success. However, certain species may have adapted to the high noise level given the high population density in the area. Pollution of the environment may cause mortality in some sensitive species.			
Likelihood Probability /	1 = Unlikely	2 = Possible	3 = Likely ✓	4 = Definite likelihood
	Habitat degradation through noise pollution is likely to happen during the construction and operational phases of the mine activity. The implementation of appropriate mitigate measures should minimize noise pollution and reduce the risk of habitat pollution.			
Duration	1 = Short term	2 = Medium term	4 = Long term ✓	4 = Permanent
	Habitat degradation is expected to be on-going during the whole duration of planned mining activities.			

Extent / Spatial	1 = Localised	2 = Site ✓	3 = Wider and Adjacent Region	4 = National / International
	Mitigation measures have been proposed to reduce noise levels therefore impacts should be restricted to the vicinity of noise emission source.			
Magnitude / Scale	1 = Low	2 = Minor ✓	3 = Moderate	4 = High
	As there is a high human density in the area and the noise pollution is already important, a major impact to wildlife populations is not expected.			
Resource/Receptor Sensitivity/ Importance of Value	2 = Low	4 = Moderate Low	6 = Moderate ✓	8 = High
	Globally and/or nationally threatened species may be affected by noise emission and may be sensitive to habitat pollution.			
Significance of the impact	1 – 20 = Negligible	21 – 56 = Low	57 – 92 = Medium ✓	93 – 128 = High
	The significance of this impact is rated medium, and its rating is explained mainly by the fact that globally and nationally threatened species are present within this area.			

4.2.5. Habitat fragmentation

Impact	Habitat fragmentation			
Nature	Negative ✓		Positive	
	Vegetation clearance for mine infrastructure and by further conversion of land into crops can impact negatively the species present by creating habitat fragmentation.			
Nature of Impact	Direct ✓	Indirect		Cumulative ✓
	Habitat fragmentation interferes with animal movement and/or migration routes. The impact is cumulative as habitat has already been fragmented by the construction of roads, deforestation and clearance of vegetation along power lines.			
Likelihood Probability /	1 = Unlikely	2 = Possible	3 = Likely ✓	4 = Definite likelihood
	This impact is likely to occur has the clearance of vegetation will cause further fragmentation of the habitat.			

Duration	1 = Short term	2 = Medium term	4 = Long term	4 = Permanent ✓
	This impact will last for the whole duration of the mine life and may be permanent unless reforestation programs are implemented after mine closure.			
Extent / Spatial	1 = Localised	2 = Site ✓	3 = Wider and Adjacent Region	4 = National / International
	The effects of this impact will be restricted to wildlife populations living in this area.			
Magnitude / Scale	1 = Low	2 = Minor ✓	3 = Moderate	4 = High
	It is not expected that this impact will have a major effect as the habitat is already fragmented, and further fragmentation is not expected to interfere with migration routes.			
Resource/Receptor Sensitivity/ Importance of Value	2 = Low	4 = Moderate Low	6 = Moderate ✓	8 = High
	Globally and/or nationally threatened species may be affected by habitat fragmentation.			
Significance of the impact	1 – 20 = Negligible	21 – 56 = Low	57 – 92 = Medium ✓	93 – 128 = High
	The significance of this impact is rated medium, and its rating is explained mainly by the fact that globally and nationally threatened species are present within this area.			

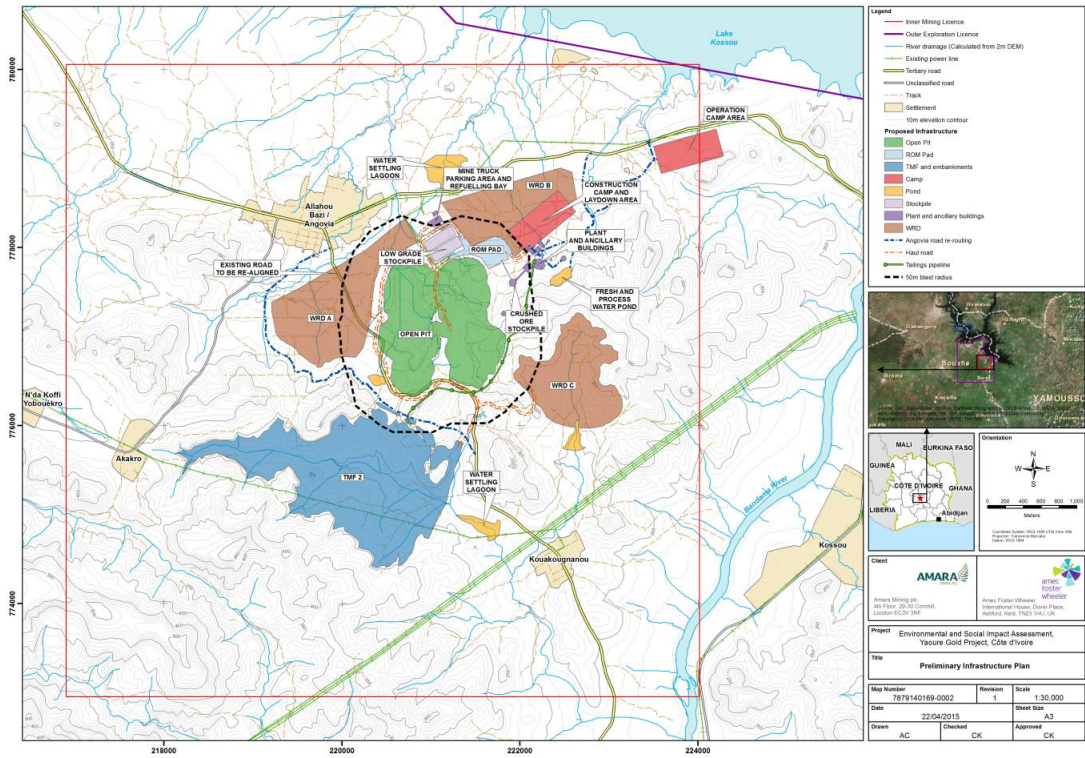
4.3 Infrastructure Options Assessment

The first map of alternative infrastructure options included four possible locations for Tailings Management Facility (TMF) and three for Waste Rock Dump (WRD). The results of the survey highlighted that one area had less degraded habitat, which was located at the proposed location for one of the TMF options - TMF3. It would have been recommended to avoid placing any infrastructure in this area. However, in the most recent infrastructure placement options (Figure 4-1), this alternative location was no longer considered.

The location of the proposed pit overlays with the location of the previous pit exploited by Cluff Gold plc, therefore this area is already highly degraded. The new location for the

TMF3 is a densely inhabited area by immigrant artisanal miners that have recently established a large mining camp at this location.

Figure 4-1 : Location of final infrastructure locations.



5.0 MANAGEMENT AND MONITORING REQUIREMENTS

5.1 Impact Mitigating and Management Requirements

Proposed mitigation measures to reduce the effect of identified impacts are summarised in Table 5-1.

Table 5-1: Proposed mitigation measures for identified impacts

Impact	Mitigation measure
1. Habitat loss	<ul style="list-style-type: none"> - The extent of vegetation clearance should be monitored not to exceed proposed area's surface to be cleared; - A reforestation program can be proposed, to take place after mine closure; - Reforestation of surrounding abandoned crops can start during the construction phase.
2. Mortality or injury resulting from project vehicle collision	<ul style="list-style-type: none"> - Provide driver awareness and training; - Institute speed limit or regulations.
3. Influx of people into the area	<ul style="list-style-type: none"> - Conduct local environmental sensitization campaign; - Develop Project staff conduct guidelines that would include a no hunting policy and the interdiction of transporting live or dead animals in Project related vehicles; - Install gates and inspect company vehicles for illegal wildlife products; - Develop alternative money generating activities.
4. Habitat degradation	<ul style="list-style-type: none"> - Noisy construction work should be carried out during daylight hours to limit noise levels in the quieter night-time noise environment; - Regular maintenance of equipment and vehicles in accordance with manufacturers specifications to prevent increases in noise emissions; - Damping down or covering stockpiles of friable material in dry and windy conditions, use of water sprays to control dust on roads and working areas, covering of dusty materials; - Use directional lighting, light shielding and hoods to mitigate light spill, and use motion sensors and timers to control lighting in areas that do not need to be permanently illuminated.
5. Habitat fragmentation	<ul style="list-style-type: none"> - Restore surrounding habitats to cleared areas to compensate habitat loss; - Recreate connectivity between habitat patches in the vicinity to cleared areas where possible.

5.2 Monitoring Requirements

A long-term management programme for large mammals should be implemented throughout the Project life to assess the effectiveness of mitigation measures, and to measure trends in local wildlife populations. This yearly programme would include:

- Camera trapping year round at pre-selected sampling locations;
- Recces to assess continued presence, relative abundance and spatial distribution of threatened species, along with anthropogenic threats;
- Hippopotami survey to monitor their population size and spatial distribution within the Kossou Lake;
- External audit to assess compliance of workers to the environmental policy; and
- Monitor deforestation rate through yearly land use mapping.

6.0 SUMMARY AND CONCLUSION

The presence of 26 species of large mammal was recorded in the survey area. Three of these species are listed as Vulnerable on the IUCN Red List, and ten species are protected at the national level. The majority of species present are common species that are resilient to hunting and habitat destruction.

The habitat is highly fragmented and degraded, with several patches of more intact forest remaining on hilltops. This habitat is under severe threat from an increasing population and constant immigration of people coming to this area to take part in artisanal mining activities. The expansion of the mine may exacerbate threats present in the area, however with appropriate mitigation measures and implementation of a long-term monitoring plan, the impacts are not expected to be significant.

6.1 Gaps

Five nationally or internationally threatened species were reported during interviews with local villagers but not recorded during the present surveys. Further surveys may help to confirm/refute presence of these species within the IEL. However, the mitigation measures proposed are broad and thus will also apply to these species. It is therefore sufficient to assume that they are present and include them in the long-term monitoring plan.

7.0 ACKNOWLEDGEMENTS

We would like to thank our devoted field assistants: Gérard, Mathieu, Maxime, Germain and Innocent for their hard work during these surveys, especially during transect surveys in secondary growth where we were stuck many hours in thick and thorny vegetation. A special thank you to Daniel Koffi Ano from Amara for assisting during the interviews and facilitating work in the villages.

For arranging logistics we would like to thank Sorin Blotor and Paul Williams from Amara. For overseeing our survey work, we thank Philip Rogers and Amanda Pyper from AMEC, as well as Michel Yao from Amara.

Finally we would like to thank all people who took care of us during our stay, including the drivers and cooks, who simplified our life while at the site.

8.0 REFERENCES

- Bitty, A.E., Gonedele Bi, S., Koffi Bene, J.C., Kouassi, P.K. and S.W. McGraw (2015). Cocoa farming and primate extirpation inside Côte d'Ivoire's protected areas. *Tropical Conservation Science*, 8(1): 95-113.
- Campbell, G., Kuehl, H., N'Goran, P.K., and C. Boesch (2008). Alarming decline of West African chimpanzees in Côte d'Ivoire. *Current Biology*, 18(19): 903-904.
- Fischer, F. (2004). Status of the Comoé National Park, Côte d'Ivoire and the effects of war. *Parks* 14(1): 17-25
- Fischer, F. (2005). Elephants in Côte d'Ivoire – a warning for West African conservation. *Pachyderm* 38: 64-75
- Gonedele Bi, S., Zinner, D., Kone, I., Gonedele Bi, Z., Akpatou, B., Koffi Bene, J.C., Sangare, A. and C. Boesch (2006). A West African Black and White Colobus Monkey, Schwarz, 1927, Facing Extinction. *Primate Conservation*, 21: 55-61.
- Hoffmann, A., Decher, J., Rovero, F., Schaer, J., Voigt, C. and G. Wibbelt (2010). Field methods and techniques for monitoring mammals. – In: Eymann, J., Degreef, J., Häuser, C.L., Monje, J.C., Samyn, Y. & VandenSpiegel, D. (eds.). *Manual on field recording techniques and protocols for All Taxa Biodiversity Inventories and Monitoring– Abc Taxa* 8 (2): 482-529.
- IFC (International Finance Corporation) (2012). Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. Washington: World Bank Group.
- IUCN SSC Antelope Specialist Group 2008. *Kobus kob ssp. kob*. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>. Downloaded on 10 July 2015.
- Kingdon, J. (2003). *The Kingdon field guide to African mammals*. Helm: London.
- Kone, I. and J. Refisch (2007). *Can monkey behaviour be used as an indicator for poaching pressure? A case study of the Western red colobus (Procolobus badius) and the diana guenon (Cercopithecus diana) in the Taï National Park, Côte d'Ivoire*. In *Monkeys of the Taï Forest* (eds W.S. McGraw, K. Zuberbühler and R. Noë), pp. 257-289. Cambridge University Press: Cambridge.
- Lewison, R. & Oliver, W. (IUCN SSC Hippo Specialist Subgroup) 2008. *Hippopotamus amphibius*. The IUCN Red List of Threatened Species. Version 2015.1. <www.iucnredlist.org>. Downloaded on 10 June 2015
- Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B., and J. Kent (2000). Biodiversity hotspots for conservation priorities. *Nature*, 403: 853-858.

N'Goran, K.P., Herbinger, I. and C. Boesch (2008). Résultats importants des activités de biomonitoring au Parc National de la Marahoué (mai 2007 – novembre 2007). Unpublished Report WCF/OIPR.

Struhsaker, T.T. and M.I. Bakarr (1999). A rapid survey of primates and other large mammals in Marahoué National Park, Côte d'Ivoire, pp. 49-52 in Une Evaluation Biologique du Parc National de la Marahoué Park, Côte d'Ivoire. Eds: Schulenberg, T.S., Short, C.A. and Stephenson, P.J. Rapid Assessment Program. Conservation International.

Tano, Y. *et al.* (2007). Projet aurifère d'Angovia : Étude de la faune terrestre. Report submitted to Cluff Gold.

Vergnes, V. and Maho, R. N. 2012. *Réalisation d'une étude sur l'état de la biodiversité des parcs nationaux et réserves de la Côte d'Ivoire*. Rapport non-publié d'Afrique Nature International.

Walsh, P.D. and L.J.T. White (1999). What will it take to monitor forest elephants. *Conservation Biology*, 13:1194-1202.

Waterman, C., Pietersen, D., Soewu, D., Hywood, L. & Rankin, P. 2014. *Phataginus tricuspis*. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>. Downloaded on 10 July 2015.

White, L. and A. Edwards (2000). *Conservation Research in the African Rain Forests. A Technical Handbook*. WCS, New York.

APPENDICES

APPENDIX A: Eastern lesser spot-nosed monkey (*Cercopithecus p. petaurista*) kept as a pet in a) Allahou Bazi and b) Bénou.



APPENDIX B: Details of recces and transects completed between November 21st and December 4th 2014.

Survey type and ID	Date	Start time	End time	Survey effort	
				Time (h :min)	Distance(m)
RECCE					
Akakro 1	2014-11-25	16:12	19:14	03:02	1,742
Akakro 2	2014-11-26	05:15	07:25	02:10	2,500
Akakro 3	2014-11-26	08:05	14:46	05:58	4,925
Allahou 1-1	2014-11-21	16:28	17:22	00:54	20
Allahou 1-2	2014-11-22	08:18	17:23	09:05	760
Angovia 1	2014-11-20	14:34	16:15	01:41	751
Angovia 2	2014-12-01	07:00	10:57	03:57	4,978
Bandama 1	2014-12-02	08:30	14:57	06:27	7,360
Benou 1	2014-12-04	05:43	07:44	02:01	3,533
Benou 2	2014-12-03	19:30	21:00	02:00	1,359
Kouakougnanou 1	2014-11-26	07:35	16:39	09:04	6,806
Lac Kossou 1	2014-11-30	08:02	15:35	07:33	6,076
Lac Kossou 2	2014-11-30	09:47	14:20	04:33	3,347
La Kossou 3	2014-12-04	07:30	09:30	02:00	2,000
Mine 1	2014-11-30	14:48	15:54	01:06	1,151
Sub-total				59:31	47,308
TRANSECT					
Transect 1	2014-12-01	12:30	16:27	03:57	1,000
Transect 2	2014-11-24	08:48	14:42	05:54	1,000
Transect 3	2014-11-24	15:08	16:44	01:36	760
Transect 4	2014-11-22	08:39	11:21	02:42	1,000
Transect 5	2014-12-01	13:09	16:40	03:31	1,000
Transect 6	2014-11-25	09:18	12:12	02:54	1,000
Transect 7	2014-11-23	11:34	15:57	04:23	1,000
Transect 8	2014-11-22	14:07	17:07	03:00	800
Transect 8	2014-11-23	08:31	10:11	01:40	200
Transect 9	2014-12-02	14:15	17:30	03:15	1,000
Transect 10	2014-12-02	07:33	11:22	03:49	1,000
Transect 11	2014-11-28	08:11	12:10	03:59	1,000
Transect 12	2014-11-28	13:30	17:50	04:20	1,000
Transect 15	2014-11-24	09:38	13:07	03:29	1,000
Transect 16	2014-11-24	14:00	17:15	03:15	1,000
Transect 17	2014-12-01	08:23	12:44	04:21	1,000
Transect 20	2014-11-25	08:31	11:43	03:12	1,000
Transect 21	2014-11-28	14:46	17:46	03:00	470
Transect 22	2014-11-28	09:08	13:50	04:42	1,000
Transect 23	2014-11-23	09:29	13:05	03:36	1,000
Transect 24	2014-11-23	13:46	16:58	03:12	1,000
Transect 25	2014-11-29	09:23	14:05	04:42	1,000
Transect 26	2014-11-29	14:48	17:34	02:46	700
Transect 26	2014-11-30	07:42	09:09	01:27	300
Transect 27	2014-11-29	08:50	13:21	04:31	1,000
Transect 28	2014-11-29	14:53	17:10	02:17	1,000
Sub-total				89:30	23,230
TOTAL				149:01	70,538

APPENDIX C: Examples of species detected using camera trapping.




a) An African Civet (*Civettictis civetta*).



b) A bushbuck (*Tragelaphus scriptus*).



 Camera Name 73°F22°C ● 12-20-2014 08:09:55

c) A red-flanked duiker (*Cephalophus rufilatus*).



 Camera Name 91°F32°C ● 12-01-2014 12:49:30

d) Green monkeys (*Chlorocebus sabaeus*).