

Report
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Investigating artisanal mining and bushmeat around protected areas: Kahuzi-Biega National Park and Itombwe Reserve



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1. Introduction

Protected areas in less economically developed countries are facing major anthropogenic threats towards their biodiversity and land use integrity. These activities range from collection of firewood and non-timber forest products to mining and timber exploitation. The latter two are seen to cause more damage since they are often considered as drivers for other human activities such as hunting and clearance of the forest (Hayes & Burge 2003; Amsini et al. 2008)

In Kahuzi-Biega National Park (KBNP), artisanal mining is seen as one of major threats to gorillas and their habitats (Amsini et al. 2008), and is mainly conducted in areas that are not accessible to eco-guards due to the presence of armed groups and militia (Nellemann et al. 2010).

Despite many reports on mining in eastern Democratic Republic of Congo (DRC), few have investigated the miners themselves and the connections between mining, livelihoods and bushmeat hunting.

1.1 Artisanal mining in DRC

Artisanal and small scale mining (ASM) refers to mining done with minimal or no mechanisation (Hentschel et al. 2002) (Figure 1). The sector is well known for its high environmental costs, negative social costs, economic short term gains, poor states of health and safety, as well as an essential source of people's livelihood and rural development (Hentschel et al. 2002; Ingram et al. 2011; Cuvelier 2010).



Figure 1. Artisanal mine site on the edge of the park, near Bunyakiri. Credit: Blandine Bahati, WCS.

There are varying estimates of the total number of people working directly in small scale mines throughout the world; Hentschel et al. (2002) estimated that in 2002 there were around 13 million people working directly in small mines throughout the world, mainly in developing countries, while other estimates puts number of people at 15 million with 100 million indirectly (workers and their families) dependent on ASM (Dorner et al. 2012). ASM in DRC now is estimated to provide a source of livelihood for 14% to 16% of the country's population, directly involving two million people (World Bank, 2008).

In terms of mineral abundance, DRC is known to have more than half the world's known reserves of coltan and significant amounts of cassiterite (Freeborn et al. 2014). The eastern region of the DRC is seen as one of the major suppliers of gold, cassiterite (tin ore), coltan (columbite and tantalite) and wolframite (tungsten). The latter three minerals are used in essential components of common electronic products such as mobile phones, laptop computers, digital cameras and others. The exploitation of these minerals is mainly done through ASM with no industrial exploitation on-going in the South Kivu. The global demand of raw materials used in electronics continues to encourage ASM in the east of the country (Hayes & Perks 2012).

Historically, the rich minerals beneath the people of DRC have been their curse, causing, sustaining, and fuelling armed conflict through competing groups (local and international) for revenues from mining. Mining and land rights have historically gone back and forth between traditional land ownership, national and cooperative. In the DRC, artisanal mining was legalised in the 1970s by President Mobutu following the collapse of the mining industry (Byemba 2012; IPIS & CIFOR 2012). Eventually in the early 2000s, the government of President Joseph Kabila started a process of legal reforms for mining. New laws recognise artisanal mining and allows any person to apply for a research permit for a period of four years with the ability for renewal up to eight years. If the holder of the permit finds mineral deposits, he can apply for an exploitation permit, valid for up to 30 years and subject to a liberal tax regime. Deposits that are seen as minor can be exploited under a small scale mining permit (Kating 2014; Geenen & Claessens 2013). The Ministry of Mines is legally able to demarcate 'artisanal exploitation zones' (AEZ), for areas that are not seen as suitable for industrial exploitation. However the law also provides the possibility for it to be closed down if factors justifying its creation cease to exist, allowing large-scale actors to have priority in the industry. Miners in AEZ need to apply for one year valid permits (approximately \$10 then provided with a *Creuseur's* ID card) and are required to comply with regulations on security, hygiene, water use and environmental protection specified by the mining regulations (Geenen & Claessens 2013; Nelson 2011; D'Souza 2003).

Unfortunately, the sector continues to be scrutinised due to lack of enforcement of laws, especially the eastern DRC (Cuvelier 2010). Mining authority estimate that the number of miners with ID cards probably represent 1% of the actual number of miners (D'Souza 2003).

Due to population growth, opportunistic behaviour of local elites and an increasing number of land claims for different motivations have put land ownership agreements under serious

pressure (Code minier 2002, Geenen & Claessens 2013). This, coupled with an institutional environmental gap between law and practice, makes the distinction between legal and illegal vague (Geenen & Claessens 2013).

Mining in Eastern DRC continues to be a double edged sword, still being taken advantage of at the cost of the local society and the environment, yet is acknowledged as a potential and sometimes necessary tool to sustain and improve people's livelihoods in post conflict reconstruction where few alternative options exist (Bashwira et al. 2014; Freeborn et al. 2014).

1.2 Study Site - Kahuzi-Biega National Park and Itombwe Reserve

Kahuzi-Biega National Park (KBNP), located in eastern DRC, is not only the most important site for the conservation of the endemic Grauer's gorilla (*Gorilla gorilla graueri*) (Figure 2), but also harbours endangered species including elephants, eastern chimpanzees (*Pan troglodytes schweinfurthii*) and many others that are endemic to the Albertine Rift (Plumptre et al. 2007). KBNP was first gazetted in 1970 to include the current highland sector and was then extended in 1975 to include the lowland sector, creating a 6,000km² protected area. In 1980 KBNP was recognized as a World Heritage Site (WHS) by UNESCO and categorized as a WHS in danger in 1994.

Since the park's creation, l'Institut Congolais pour la Conservation de la Nature (ICCN) has been the mandated organisation responsible for the management of the park. Their mission is to conserve KBNP's biodiversity in order to maintain the landscape's ecological, socioeconomic and cultural values (Cabinet du Président de la République, 2014). The Wildlife Conservation Society (WCS) has been undertaking surveys in Kahuzi-Biega since the late 1950s and developed its site-based conservation in 2002, where it continues to work closely with ICCN and other conservation and governmental organizations.

The Itombwe Massif is located south east of KBNP has long been recognized as a site of importance for biodiversity conservation. In the 1950s it was surveyed by Belgian scientists who identified it as being very rich in species, with its own endemic birds and amphibians (Prigogine, 1971-84; 1985; Laurent 1964; Wilson and Catsis, 1990).



Figure 2 Mother and infant Grauer's gorilla in Kahuzi-Biega National Park, Eastern DRC. Credit Diane Detoef. WCS.

In an assessment of the Albertine Rift Region of Africa, Plumptre *et al.* (2007) showed that this region was the most species rich for vertebrates, and contained more endemic and threatened

species than any other region in Africa. Also managed by ICCN with the help of conservation organizations, it is in the process of zonation and formal demarcation of its limits.

Overall, the region is one of the most populous regions in Africa with densities up to 300 persons per square kilometre (Basimine et al. 2014). This dense population places great pressure on land and natural resources leading to rapid deforestation, soil erosion and overexploitation of the soils due to poorly adapted farming techniques.

DRC regulations on natural resource exploitation (mining, timber exploitation and oil) prohibit any activity within designated and protected areas (Code minier 2002, Code forestier 2002, Loi sur la conservation de la nature, 2014). This means that it is illegal to mine in National Parks. In 2002 when coltan prices shot up, the region experienced a boom in mining, and thousands of people rushed within and outside the park to mine (Kamundala 2012; D'Souza 2003). The situation attracted people of all professions including students, teachers, farmers and soldiers, all deserting their activities to gain their fortune in the coltan mines. At the peak it was estimated that there were around 12,000 artisanal miners working illegally within the KBNP (D'Souza 2003).

Prices eventually dropped and many abandoned artisanal mining, or began to treat it as a seasonal activity in the unproductive agricultural months. Many diversified their mining to also exploit other materials including cassiterite, gold and wolframite. Mining in Lulingu and Nzovu villages on the edge of the park are often labelled as extracting coltan from outside the park, conversely it is well known that it is actually being extracted from within (Nellemann et al. 2010).

Within and around the park coltan and cassiterite are found in existing streambeds and soft rock of alluvial deposits. Most miners have no geological knowledge and dig where the deposits outcrop on surface leaving many deposits unexploited. The method used by artisanal miners is to clear the area of vegetation, dig to loosen the substrate, then the loose gravel mixed in a washing bowl with water and passing it through a sieve so that only large mineral particles remain. Minerals are then generally transported in a variety of containers including old paraffin containers, oil barrels, or nylon food sacks (D'Souza 2003). There have been accounts of women and children being employed to smuggle minerals out of the park as well as small planes landing on airstrips on the periphery of the park to buy minerals (ICCN anon. 2014).

1.3 Rationale

Survival of Great Apes is threatened by human activities especially in eastern DRC where their habitat has been under siege by armed groups (Rainer et al. 2014; Nellemann et al. 2010). In order to halt the decline in great apes population, ARCUS Foundation supported the development and implementation of a Conservation Action Plan for Great Apes in eastern DRC. One of the strategic activities included survey of mining sites and their incidence on great ape populations (Maldonado & Aveling 2011). At the same time, USAID funded project under CAFEC

highlighted the priority to identify and better understand areas with high concentrations of illegal activities that threaten the biodiversity and the park's integrity.

This study aimed to update the current information of the state of mining around the park, including the characteristics of mine sites, individuals involved, prices and supply chains as well as to better understand some of the connections between mining and bushmeat hunting.

This report is an independent assessment of the situation of mining within and around KBNP. It is based on field interviews and was conducted between September and November 2014 with community members who were either directly involved in mining or in the mining supply chain.

The study was designed by WCS and conducted in collaboration with ICCN and students from different local universities of Bukavu (Institut Supérieur de Développement Rural, Université Catholique de Bukavu and Université Evangélique en Afrique).

2. Method

Four regions around the park were chosen to conduct interviews. Teams then travelled to known mining towns to conduct semi-structured interviews that covered topics of characteristics of mine sites, mineral value chain, demography of miners, motivations, livelihoods, and bushmeat hunting and consumption (Figure 3).

Once arriving at a village, interviewers met with local leaders to inform them about the study. Snowballing sampling techniques were used to identify individuals who conducted mining and were knowledgeable about the sector. Snowballing process starts with initial contact such as a 'key informant' to develop a list of potential respondents that are applicable to the study. This process is redone with each following respondent until the target sample size has been reached (Angelsen et al. 2011). Surveys were conducted in the local dialect of Swahili by students from regional universities supervised by WCS's socio-economic staff.



Figure 3. Photograph of a WCS researcher arriving at a mining camp to interview miners. Credit: Blandine Bahati, WCS

Due to insecurity and armed presence at mine sites, surveyors were not able to interview individuals at mine sites with the exception of four mines. Instead surveys were conducted in villages on the edge of mine sites where security permitted them to visit. Often cameras and GPS equipment were temporarily confiscated by armed groups, but returned on departure from the village.

The survey questionnaire was divided into 2 parts, the first part exploring mining and the second part investigating bushmeat hunting (cf Appendix 1 – Survey questionnaire). Interviews were conducted with individuals from 40 villages within four *groupements* - Lulingu, Bunyakiri, Nzovu (around KBNP) and Itombwe (within Itombwe Reserve) (Figure 4).

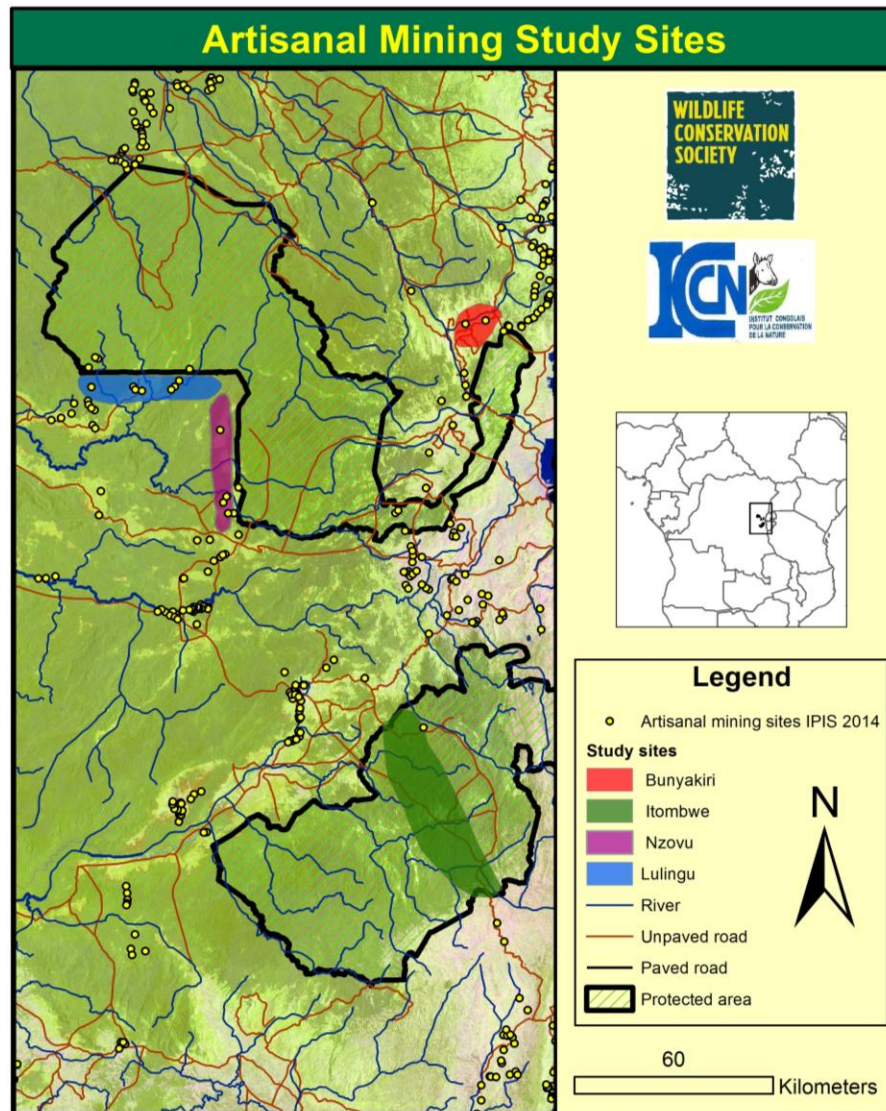


Figure 4. Map displaying the four groupements where mine sites were surveyed - Bunyakiri (red), Lulingu (blue) and Nzovu (purple) around Kahuzi-Biega National Park; Itombwe (green) in Itombwe Reserve.

For the first part of the questionnaire (cf Appendix 1, A – QUESTIONS LIEES A L'EXPLOITATION MINIERE), a total of 613 semi-structured interviews were conducted, of which 41% were conducted in Itombwe, 33% in Lulingu, 16% in Nzovu and 9% in Bunyakiri. The results from these interviews are presented in sections 3.1 to 3.5.

For the second part of the questionnaire (cf Appendix 1, B – QUESTIONS LIEES A LA CHASSE), a total of 727 interviews were conducted, of which 35% were conducted in Itombwe, 20% in Lulingu, 16% in Nzovu and 29% in Bunyakiri. Sample sizes differ between the 2 parts of the questionnaire because many respondents were not comfortable to discuss about mining, but were comfortable to talk about bushmeat hunting.

3. Results

3.1 Mine sites

Survey participants spoke of their personal experience from 40 mine sites within and around the region of Kahuzi-Biega National Park.

The majority of sites exploited multiple minerals (73%) and a quarter of sites (24%) exploited all four minerals. Most were quoted to have an average of 50 mine workers per site, with Zombe ($\bar{x} = 249$), Miki ($\bar{x} = 107$), Lugundu ($\bar{x} = 169$) and Bikonge ($\bar{x} = 120$) having the highest average quoted number of workers at the site.

Mine sizes ranged from less than 2.5 km² to larger than 40 km² (Table 1). Mines sites in Itombwe were significantly larger than in other *groupements* (Chi-squared test: $\chi^2 = 169.4$, $df=12$, $p<0.001$), with 48% ($n=$) of sites being 40 km² or larger. Most mine sites have been active for about 20 years, however their age ranged from less than one year to over 80, with sites that have been active for significantly longer in Lulingu (41 years on average) than in other *groupements* (Kruskal-Wallis rank sum test: $H = 160$, $df = 3$, $p < 0.001$).

Table 1. Details of mine sites

Mine size – km ² (n=601)	
2.5 and less	31%
10	21%
20	4%
30	11%
40 and larger	32%
Number of mine workers at site (n=391)	
minimum	1
median	18
mean	50
maximum	600
Age of mine sites (years)(n=434)	
minimum	0.1
median	7
mean	16
maximum	80
Minerals that miners exploited (n=770)	
Cassiterite	46%
Coltan	16%
Gold	21%
Wolframite	16%



Figure 5. A block of Wolframite at a mine in Bunyakiri, South Kivu. Credit: Blandine Bahati, WCS.

The main exploited minerals included cassiterite (65% of responses), gold (21%), coltan (16%) and wolframite (16%). Wolframite (Figure 5) was reported to be extracted in Bunyakiri mine sites only. Sites in Lulingu and Nzovu exploited cassiterite significantly more than other minerals, while mining in Itombwe was significantly more for gold and cassiterite (Fisher's exact test: $p < 0.001$).

Seventy-five percent of individuals surveyed ($n=457$) stated that they worked at mines that had no certification. Mining sites that had certification often involved multiple certifiers, mostly agents and individuals. Agent certifiers were generally individuals with some sort of authorization (legal or illegal) that then leased the site for exploitation to others without authorization.

3.2 Market value chain

Minerals are sold at a wide range of prices depending on the supply chain, with lowest prices found at the mine sites. Mineral traders on average made profit margins of 2 USD per kilo (or gram for gold) through buying at mine sites and selling elsewhere (Table 2). Differences between local and global market prices were greatest for coltan and least for gold.

Most miners sold their minerals at the mine site (57%), however some took the minerals as far as Bukavu and Goma to get better prices.

Table 2. Locations and market prices of minerals.

Average price of minerals (\$)			
	Cassiterite (USD/kg) (n=589)	Coltan (USD/kg) (n=48)	Gold (USD/g) (n=227)
At mine site (n=249)	2.6	19.8	34.0
Village trader (n=24)	4.2	22.6	34.5
Global market value (March 2015)	17.4	17.6	37.4
Places where minerals are bought (n=454)			
At the mine	49%		
In villages	25%		
Large urban centres	17%		
Outside the country	1%		
Where miners sell minerals (n=250)			
Traders/buyers at the mine	57%		
In villages	30%		
Large urban centres	13%		

3.3 Demography of miners

This survey found that most miners were men (99%), aged 26-45, married with either a secondary or primary education and had families of 6-10 individuals (Figure 6).

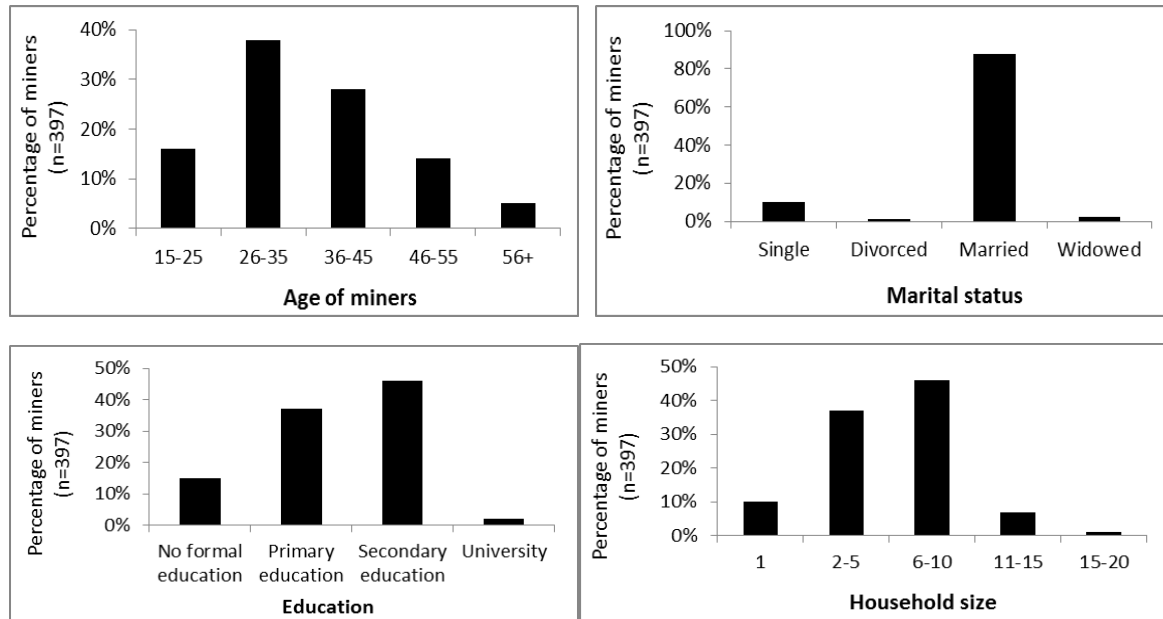


Figure 6. Age (top left), marital status (top right), education (bottom left) and household size (bottom right) of miners surveyed across all sites.

About 44% of miners' families had moved to the mine site or were living in villages near the mine site, while 48% stayed at their village of origin or lived in Bukavu (8%). Although not quantified in this survey, women and children were present at mine sites, but were mostly involved in other activities besides mining including household activities and food preparation.

3.4 Motivations of miners

When miners were asked why they had left their previous occupation, the main motivations were to support their families, for personal survival or for direct economic gains (Table 3). Most miners had only been at the sites for less than 6 months (78%, n=278), suggesting that mining is a 'fall-back' and opportunistic profession. Many miners also used to be miners, indicating a cyclical process of occupation. Many who were previously students were looking for fees to continue their education. Significantly more individuals chose to exploit minerals as an additional livelihood to support their family, while a minority do it for personal gains (Chi squared test: $\chi^2 = 113$, df = 4, $p < 0.001$).

Miner's previous occupation (n=260)		Reason for exploiting minerals (n=357)	
Mining	32%	To support the family	39%
Agriculture	19%	Survival	20%
Student	19%	Lack of work	19%
No occupation	7%	Gain money	18%
Small commerce	6%	School fees for kids	3%
Teacher	5%		
Military/Mai Mai militia	6%		
Park guard	3%		
Other	3%		

Table 3. Miners' previous employment and reasons for choosing to exploit minerals.

Individuals that considered leaving the mining sector (64%, n=395) stated that they would support themselves through small commerce (39% of responses, n=132), livestock (28%, n=95) and agriculture (14%, n=46). However of respondents who stated they would like to leave mining, 15% (n=50) stated they would have no way of supporting themselves. Among the four *groupements* surveyed, Bunyakiri had significantly the highest proportion of miners who considered leaving the mining sector (80%, n=45) and Itombwe the lowest although still being the majority (57%, n=107; Chi-squared test: $\chi^2 = 13.6$, df = 3, p = 0.004).

When respondents were asked what would make them stop mining, motivations to leave were similar to those that brought them there, including if they found an economic activity that could compete with the benefits that mining provides for them and their family. Many miners were motivated to leave due to the risks and difficulty of the work involved. Risks stated included landslides (87%, n=411), wounds sustained from mining activities (10%, n=47) and killings (3%, n=12).

3.5 Livelihoods of miners

On average, miners earned significantly higher monthly revenues than non-miners (Wilcoxon rank sum test: $W = 5,283$, p < 0.001). The average revenue miners stated they received from mining was about 116 USD per month per individual, with a minority making up to about 1,000 USD (Figure 7), while non-miners were earning on average 62 USD per month. Those who earned the most money from mining were those who had control over the mines and collected taxes from other miners – these individuals were often either military/militia or had strong connections to those individuals.

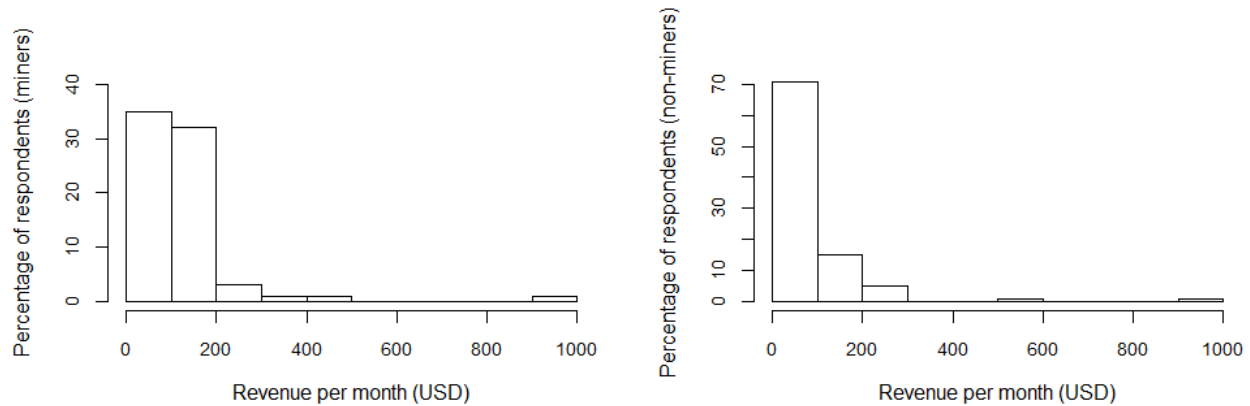


Figure 7. Histograms displaying the amount of revenue made per month by artisanal miners (left) and non-miners (right) in the sites surveyed.

At the site, money made from mining is used to buy supplies (36% of responses, n=214), cover health costs (20% of responses, n=119), buy new clothes (16%, n=95), buy alcohol and other royalties (14%, n=83), support their families (9%, n=53) and to pay taxes to those in control of the mines (5%, n=30).

Most miners were not comfortable to state how much they spent on their families, so no meaningful estimate of revenues from mining allocated to monthly family expenses could be made.

About half (52%) of the miners interviewed conducted additional economic activities along with mining. Main additional activities included small commercial activities (80%), followed by hunting (68%), and agriculture (10%). When miners were asked about what livelihood activity their family was most dependent on, 72% (n=359) stated mining, while 13% relied primarily on agriculture, 13% on commerce and 2% on hunting.

3.6 Bushmeat hunting methods

From 727 responses of individuals surveyed, 57% (n=414) stated that bushmeat hunting occurred around the mine sites.

Individuals who were involved in hunting included hunters (35%, n=255), miners (14%, n=102), local militia/military (5%, n=33) and local population (2%, n=14), with a large proportion of respondents not willing to say who hunts (44%, n=323).

When respondents were asked where hunting took place, 47% (n=340) stated that hunting took place outside protected areas, while 41% (n=297) knew that hunting took place within a protected areas. Others were not sure or not comfortable to state where hunting occurred (12%, n=90).

Hunting took place all year round, and tools used by hunters included dogs, fire arms, spears, snares (nylon and metallic), as well as hunting nets (Figure 8).

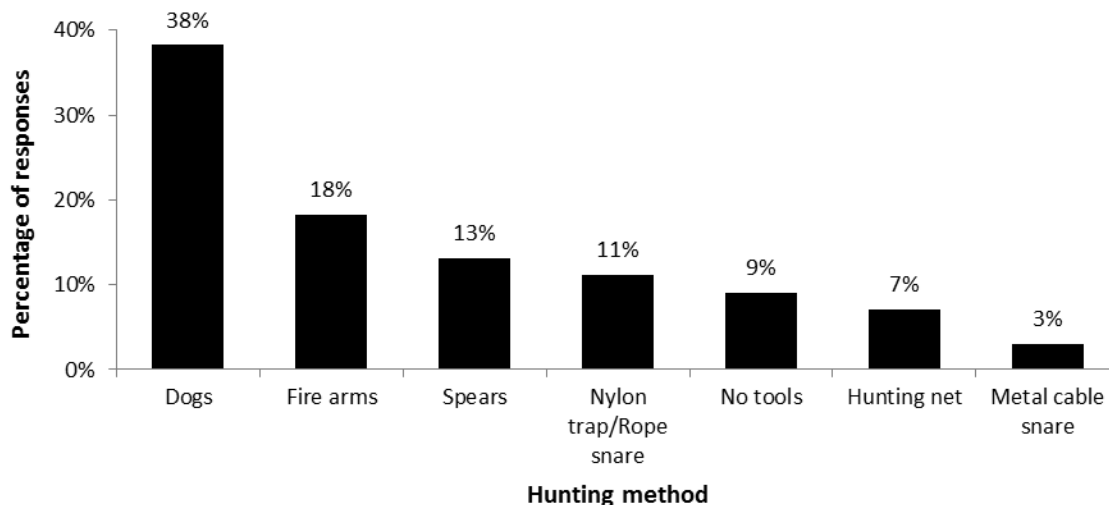


Figure 8. Graph displaying tools identified by respondents used for hunting around artisanal mines.

3.7 Motivations for hunting

Half of respondents (49%, n=359) stated they knew of miners that were involved in hunting. The main motivations for hunting were: 1) for personal consumption and to sell excess bushmeat (49%, n=354), 2) for personal consumption only (31%, n=226) and 3) a small minority hunted only to sell (3%, n=23), with statistically significant differences in motivations for hunting between *groupements*, as personal consumption only was the main motivation in Bunyakiri, while consumption and sale of excess was the most stated reason in Itombwe, Nzovu and Lulingu (Fisher's exact test: $p < 0.001$).

Among both miners (n=212) and non-miners (n=515), almost all consumed bushmeat (91%, n=664), however they did not see hunting as a major source of food necessary for their survival (85%, n=619). There was no significant difference in the responses given by miners and non-miners.

The main motivation to consume bushmeat compared to domestic alternatives was its availability (68%, n=492), followed by taste (57%, n=412) and cost (23%, n=170) (Figure 9), with significant differences between the *groupements* surveyed as people in Itombwe and Lulingu mostly consume bushmeat because of its availability, while respondents in Bunyakiri mainly consume because of taste preferences and people in Nzovu mostly because it is cheaper than domestic meat (Chi-squared test: $\chi^2 = 246$, $df = 6$, $p < 0.001$).

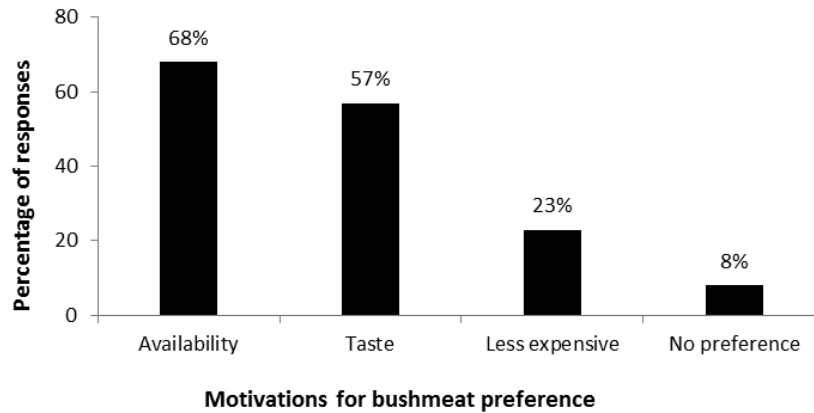


Figure 9. Graph displaying preference for bushmeat compared to domestic meat options. Number of responses exceeds number of respondents due to multiple responses given.

When miners were asked what would make them stop hunting (Figure 10) responses included:

- Income and availability of domestic meat (having their own livestock, aquaculture, income from business and availability of other domestic meats)
- Regulation (banning of fire arms and bushmeat sales),
- Culture (openly stated they would not stop hunting).

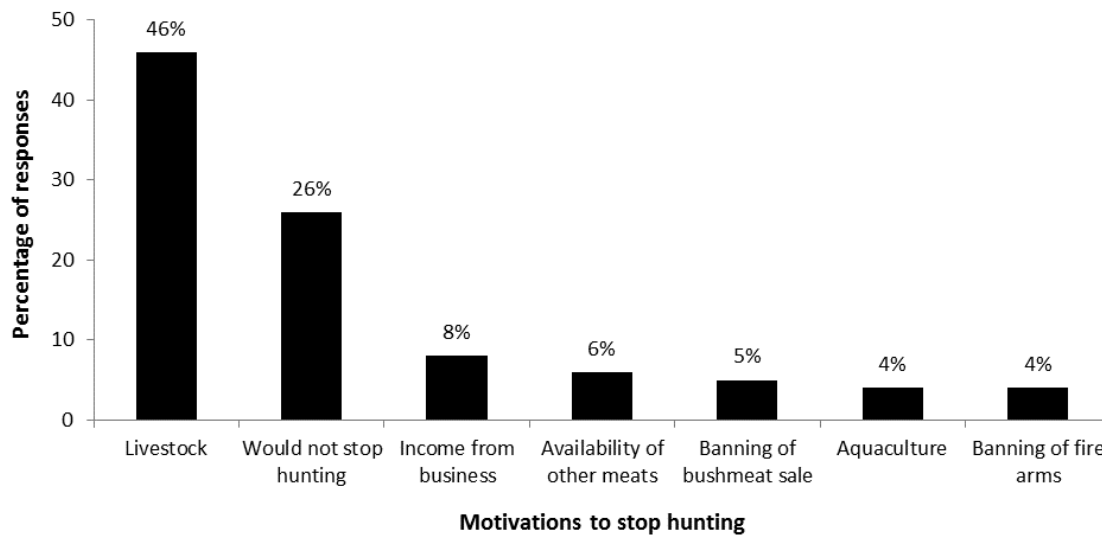


Figure 10. Graph displaying responses to the question of what would make miners reduce or stop hunting.

Statistically significant differences were found between the *groupements* surveyed in the reasons why respondents would stop hunting bushmeat, with those around KBNP (Bunyakiri, Lulingu and Nzovu) most likely to stop hunting if they had their own livestock, while those in

Itombwe were more inclined to stop if regulations against hunting were enforced or if other meat sources became available (Fisher's exact test: $p < 0.001$). A considerable number of respondents stated they were not willing to stop hunting (24%, $n=173$), of which the highest proportions were in villages in Bunyakiri and in Itombwe (44%, $n=169$ and 27%, $n=57$ respectively).

3.8 Species exploited

Most hunting appeared to be opportunistic and indiscriminate (Figure 11). Highly targeted animals included: porcupine, Gambian rat, duikers and smaller primate species. Chimpanzees were the main endangered species that appear to be currently hunted at mine sites.

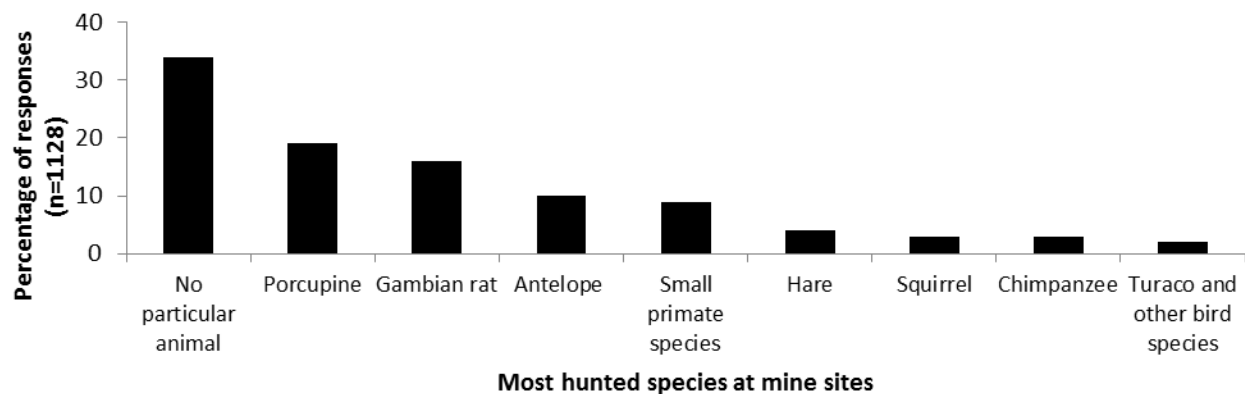


Figure 11. Graph displaying most cited species hunted. Number of responses exceeds number of respondents due to multiple responses given.

Using animals for medicinal treatment was reported by 24% of respondents ($n=175$), including:

- Porcupine - intestinal worms and blood loss ($n=39$)
- Tortoise species - blood loss ($n=23$)
- Gambian rat – no response ($n=21$)
- Snakes - rheumatism and blood loss ($n=10$)
- Pangolin - blood loss ($n=7$)
- Chimpanzee – no response ($n=4$)
- Buffalo - skin illnesses and ring worm ($n=4$)
- Caracal - skin illnesses and poison antidote ($n=3$)
- Mole - scabies ($n=3$)

Species that had no response for what they were used to treat were too sensitive to discuss.

Many respondents (68%, $n=416$) identified species that used to be around mine sites but were no longer found there. No time scale was mentioned and as many miners have only been around the mine site for a short period of time, this can be mostly taken as anecdotal evidence.

Species quoted as disappearing included:

- Gorillas (34%, n=248)
- Chimpanzees (30%, n=215)
- Elephants (27%, n=196)
- Other primate species (15%, n=106)
- Buffalo (7%, n=51)
- Lions (6%, n=44)

The main causes for their disappearance were believed to be:

- Hunting caused by demand for bushmeat (38%, n=274)
- Destruction of their habitat (16%, n=119)
- Hunting with guns (3%, n=22)
- Other human activities (2%, n=16)

Despite the large perceived effect that hunting has had on great apes, 26% (n=190) of respondents quoted that they still existed near the mine sites (65% identified chimpanzees and 35% gorillas).

4. Discussion

4.1 Revenues from mining

Data from the 40 mine sites indicated the continued presence of mining in the region (within and around the protected areas), sustaining large numbers of people who are exploiting cassiterite, gold, coltan and wolframite (in order of most exploited to least). Only about 25% of respondents from mine sites had knowledge of, or had any certification to allow them to exploit minerals legally.

Minerals being sold at mine sites included cassiterite (\$2.6/kg) coltan (\$20/kg) and gold (\$34/kg). D'Souza's study in 2003 around Kahuzi-Biega National Park (KBNP) found that coltan prices were about \$10-15 per kg, suggesting that coltan prices have slightly increased since then.

Most mines were controlled by armed groups and while mine workers were earning on average 116 USD per month, those controlling mines were getting revenues up to 1,000 USD per month. These prices are consistent with other studies from North and South Kivu which found that artisanal mining could provide an individual worker between 80 and 150 USD per month (Nelson 2011), which demonstrates the attractiveness of mining compared to other livelihoods.

In North and South Kivu, DRC, 80% of the population rely on a daily income of less than one dollar per day when the national average is 2 to 2.5 USD per day (Global Witness 2012; Nelson 2011). When comparing the opportunity of earning 100 USD per month compared to 25 USD, it is understandable why many rural communities are attracted to mining opportunities.

4.2 Characteristics of miners

Contrary to the belief that artisanal miners are uneducated youth willing to take risks, the demographic results from this study further support trends found across the region according to which mining attracts an array of people from professional and social classes into its workforce (Nelson 2011).

About half of miners' families had moved to the mine site or were living in villages near the mine site, suggesting that mining opportunities drive people's migrations to a certain extent. Providing alternative income sources to communities living in villages outside protected areas could therefore contribute to keep people out of KBNP and Itombwe Reserve. The fact that the majority of miners were considering leaving the mining sector indicates they don't consider mining as a long-term livelihood. It is therefore necessary to find and develop incentives for miners to engage in other livelihood activities that are more stable on the long term.

Most miners had only been working at the site for less than 6 months, and had been mining elsewhere or use to be farmers, students, or unemployed. This has also been found in other studies that often identified miners as seasonal and mobile workers (Global Witness 2012). Motivations to leave mine sites were economic or related to safety (see Figure 12), as found by D'Souza (2003).



Figure 12. Photograph illustrating the basic structures used to support an artisanal mining site near Bunyakiri - community neighbouring the park. Credit: Blandine Bahati. WCS

4.3 Bushmeat hunting

Bushmeat hunting occurred at almost all sites, and nearly all participants stated they consumed bushmeat. Those who participated included not only miners, but other populations that were driven by the micro-economy that the mines created. Both miners and non-miners were open to the idea of not hunting if alternative meats were available. As respondents stated that hunting takes place both inside and outside known protected areas throughout the year, conservation projects aimed at addressing bushmeat hunting should target villages located both around and within KBNP and Itombwe Reserve. Providing alternative meat sources through livestock raising has the potential to greatly reduce bushmeat hunting in all *groupements* surveyed, while only respondents from Itombwe seemed likely to be deterred if laws against hunting were enforced. Further studies should be conducted in areas where the likelihood of people to stop hunting is highest (Itombwe and Lulingu) to ensure the drivers of bushmeat hunting are effectively addressed, keeping in consideration the high proportion of interviewees who stated they would not stop hunting because of taste and cultural preferences.

Most hunting was indiscriminate of species, however porcupines, Gambian rats, duiker species and primates were some of the most hunted groups. Many quoted that chimps, gorillas and elephants had disappeared in recent years due to bushmeat hunting and habitat destruction. However 27% of respondents were aware of great apes still existing near mine sites.

4.4 Improving the situation of artisanal and small-scale mining

The debate of conflict minerals in DRC has been widely documented and it has been acknowledged that the abolition of artisanal mining would result in the loss of livelihoods of millions of small-scale miners and cause conflict as armed groups battle to hold onto the resource for revenue (Kelly 2014).

The ultimate aim is for mining in the region to be ‘conflict free’ – following equitable rule of law, eliminating human rights abuses, respecting indigenous rights, land rights, freedom of information, and conserving the environment and biodiversity. The main strategies include improving the mining sector as a whole and helping to providing alternatives to help people leave the mining sector in areas that are environmentally sensitive and difficult to manage – both of which are extremely challenging with multiple barriers.

Conflict minerals have been identified as more of a problem of security rather than one of informal or legal trade (Koning 2011). Insecurity and lack of access to markets have been blamed for the lack of change in poverty levels within the region. In order to begin working toward a state of conflict free minerals, one of the first steps that has been identified is the demilitarization of mine sites, one by one (Koning 2011). The following steps would then include improving governance while closing gaps in infrastructure, rule of law and practice (Dranginis 2014).

State and regional institutions are beginning to advance reforms in the minerals sector, and there is a growing push for foreign private investment as a solution, with better regulations and

safety procedures. However, historical transitions of artisanal mining to multi-national companies with government support have been documented to cause clashes with local people and displacement (such as with Twangiza gold concession in South Kivu Province, DRC) (Geenen 2014). This highlighted the need to consider artisanal miners and how they conceptualize notions of poverty legitimacy and livelihoods, as well as what is their on-look on development.

The growing importance of corporate social responsibilities has greatly helped improve the mineral sector, with companies being required to attend to core principles of peacebuilding, transparency, human rights and environmental management. Draginis (2014) quoted that at least 112 mines in Congo sourcing minerals to 21 companies have been labelled as 'conflict-free'.

With improved security and governance, mining has the potential to economically empower and provide support to communities where limited access to markets and alternative activities exists. In many cases, mining has been found to be better adapted in unstable contexts compared to traditional agriculture – providing quick cash-in-hand benefits, low start-up costs and low demand for specialized knowledge. As mining becomes the primary source of income, it starts to shape social, economic and political structures, making it difficult to enact change (Kelly 2014). Agriculture is often perceived as an appropriate exit strategy, however moving back to it from mining has the same barriers that entice people to take up mining, including - limited access to land, tenure, economic start-ups, relevant skills, willingness to accept lower economic returns and uncertainty of stability or other risks (Nelson 2011; Geenen & Claessens 2013).

As this study has shown the negative impacts mining can have on protected areas, particularly threatening endangered species through bushmeat hunting, there is an urgent need to help demilitarise mines, enforce mining and environmental laws, and help miners reduce reliance on mining and bushmeat hunting.

This study recommends bridging the gaps that prevent miners from leaving:

- Helping to build the support for the demilitarisation of mines, particularly those that are within and around the edge of protected areas to improve security and allow eco-guards to conduct patrols to reduce illegal activities within the park.
- Utilizing park law enforcement to prevent the development of new mines within protected areas and to maintain security to reduce the opportunity of armed groups to take advantage of the security situation and to take control over mine sites. If migrant miners' families leave protected areas in pursuit of better opportunities, improved law enforcement would also contribute to prevent new people from coming in. Improving enforcement would have a high effect in Itombwe where interviewees stated that they would be most likely to stop hunting through enforcement of laws.
- Working to reduce bushmeat hunting in mining areas through environmental education and providing alternative meat supply. Sites around KBNP were most likely to stop

hunting through livestock as an alternative activity as well as increasing the availability of alternative meats. In Bunyakiri, motivations were mainly for personal consumption however an alternative meat would need to compete for taste as respondents stated this was a high driver. In Nzovu alternative meats would need to be cheaper than bushmeat to attract villagers to change. Itombwe respondents were the least likely to change behaviour concerning bushmeat hunting, however law enforcement and improving availability were still drivers for changing behaviours.

- Using micro-financing mechanisms to help narrow the gap to help miners interested in leaving the mining sector. Micro-credit schemes can help initiate small businesses by contributing to cover start-up costs, while supporting individuals in times of need. Such schemes have already been implemented in some communities around KBNP. Likewise, micro-insurance schemes can be used to reduce risks associated with livelihood activities such as business or crop failure, making alternative economic activities more attractive. Interventions should target Bunyakiri, which had statistically significant more respondents considering leaving the mining sector.
- Helping to develop agriculture and make farming more profitable through the development of high value crops such as coffee and improving farming systems and knowledge to increase crop productivity and products sale.
- Helping to develop community farming cooperatives as well as community conservation committees around the park that can strengthen community coordination, create a platform where alternative activities can be conducted, help find solutions to natural resource use conflict and help to build support for conservation of the protected areas.

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6. Appendix 1 – Survey questionnaire

QUESTIONNAIRE D'ENQUETE

Thème: L'IMPACT DE L'EXPLOITATION MINIERE ET LA FILIERE VIANDE DE BROUSSE SUR LA CONSERVATION DES GRANDS SINGES

I. IDENTITE DE L'ENQUETE

Date : Age :

Localité : Groupement : Chefferie :

Sexe : Masculin ☐ Féminin ☐

Etat civil : a) Maré(e) ☐ b) Célibataire ☐ c) Veuve ☐

d) Divorcé(e) ☐

Nationalité :

Niveau d'étude : a) Universitaire ☐ b) Secondaire ☐ c) Primaire ☐ d) Aucun ☐

Autres à préciser.....

Taille du ménage..... (Nbre. des personnes), Occupation antérieure.....

Occupation actuelle.....

Pourquoi avez-vous changé d'occupations ?

II. LOCALISATION DE LA CARRIERE

Carrière/ site d'exploitation : Localité :

Groupement de : Chefferie/ Secteur :

Territoire de Coordonnées

QUESTIONNAIRE PROPREMENT- DIT

A. QUESTIONS LIEES A L'EXPLOITATION MINIERE

1. Quelles sont les raisons qui vous ont poussé à vous intéresser à l'exploitation minière ?

.....
.....
.....

2. Quels types d'accident de travail observez-vous dans les sites ? *Préciser le nombre d'accidents et personnes affectées*

3. Quelles sont les dépenses supportées par les creuseurs dans les mines (montants mensuels) ?

*Santé..... Alimentation..... Habits..... Boissons..... Famille.....
..... Taxe..... Redevances.....*

4. Quelle est la superficie de votre site minier ?

a. 100 x 100 m b. 100 x 200 m c. 100 x 300 m d. 200 x 200 m e. Plus large

5. Y a-t-il aussi des activités connexes dans le site ou les environs ? OUI NON lesquelles

.....
.....

6. Combien de temps exploitez-vous un site ?
7. Qu'est ce qui détermine la rotation/l'abandon du site ?
.....
8. Quelle est votre revenu mensuel à partir des mines ? autres activités
9. L'exploitation est exercée par :
- a. Les paysans artisanaux Oui ☐ Non ☐
 - b. Les sociétés étatiques Oui ☐ ou ☐
 - c. Les organisations Non Gouvernementales Oui ☐ Non ☐
 - d. Les coopératives minières Oui ☐ Non ☐
 - e. Autres à spécifier.....
10. Les produits du carré sont-ils certifiés ? OUI NON ou reconnu légalement ?.....
Par qui?
11. Quels sont les minerais les plus exploités dans ce milieu ? (cochez dans la/ les case(e)
correspondante à la réponse). **Indiquez le prix et l'unité**
- a. Coltan Prix Unité.....
 - b. Cassitérite Prix Unité.....
 - c. Diamant..... Prix Unité.....
 - d. Or..... Prix Unité.....
 - e. Uranium..... Prix Unité.....
 - f. Orflam..... Prix Unité.....
 - g. Autres à spécifier.....
12. Quels sont les produits et matériaux utilisés dans l'exploitation des mines ? Et combien cela coûte ?
13. Où est-ce que vous vendez vos minerais après exploitation ?
- a. Auprès des négociants dans les carrières Oui ☐ Non ☐
 - b. Au village Oui ☐ Non ☐
 - c. Aux propriétaires des mines: Oui ☐ Non ☐
 - d. Dans des grandes agglomérations (ville) Oui ☐ ou Non ☐
 - e. En dehors du pays, oui ☐ non ☐
14. Depuis quand exploitez-vous ce site ? Nombre d'exploitants
15. Quels sont les autres acteurs qui sont en place et leur nombre :
- a. Commerçants
 - b. Vendeurs de boissons
 - c. Artisans
 - d. Autres
16. Si vous avez de famille, vit-elle avec vous ? OUI..... NON
17. Combien de temps passez-vous dans le site minier ? dans votre famille
..... Où vivent-ils? avec quels revenus

18. Comment utilisez-vous les revenus des exploitations chaque mois ? *Mettre les montants*
- a. Prise en charge familiale
 - b. Prise en charge dans le site Nourriture..... Boissons Vêtements
 - c. Investissement lequel
19. Pensez-vous abandonner une fois le métier d'exploitant minier ? OUI NON
 Pourquoi?

20. Quelles autres activités économiques pensez-vous faire?

B. QUESTIONS LIEES A LA CHASSE

21. Est-ce que la chasse se pratique dans les sites miniers ?
- a. Oui
 - b. Non
- Si oui, qui le fait ?*

22. Quelles sont les espèces ciblées ?.....

23. Est-ce que les creuseurs pratiquent aussi la chasse ?
- a. Oui
 - b. Non
- Si oui. Quelles espèces?.....*

24. Quels sont les outils utilisés pour la chasse des animaux ? *(Mettre l'ordre d'importance 1-5)*
- a. Câble métallique
 - b. Piège à corde/nylon
 - c. Filet de chasse
 - d. Arme à feu (préciser le type d'arme)
 - e. Chien
 - f. Autres à préciser
25. Quelles sont les motivations qui vous poussent à pratiquer la chasse des animaux ?
- a. Consommation dans le ménage
 - b. Vente locale aux ménages
 - c. Vente locale aux restaurants
 - d. Vente extérieure
 - e. Autres à préciser
26. Connaissez-vous quelques espèces animales qui existaient dans ce site et qui ne sont plus visibles ?
- a. Oui
 - b. Non
- Si oui, lesquelles?*

27. Quelle serait la cause de leur absence actuellement ?

- a. Forte demande en viande de brousse
- b. Destruction de leurs habitats
- c. Autres à préciser

28. Quelles sont les espèces les plus chassées actuellement ?.....

.....
Quelle fréquence?

29. A quelle saison la chasse est-elle pratiquée ?

- a. Saison pluvieuse
- b. Saison sèche

30. Quels sont les marchés d'écoulement des viandes de brousse ? Indiquez l'ordre d'importance

.....
.....

31. Pouvez-vous estimer la quantité fournie au marché par semaine et par espèce, en plus du prix ?

.....
.....
.....

32. La chasse constitue-t-elle la source principale de votre survie ?

- a. Oui
- b. Non

33. Comment s'organise la filière ? Parlez des chasseurs, les intermédiaires, les marchés locaux et environnants.

.....
.....

34. L'accès à la viande de brousse dans le site se fait-il par troc (échange) ? OUI.... NON...

Si oui... quelles espèces..... quantités viande quantité et type minerais

- a.
- b.
- c.
- d.

C. QUESTIONS LIEES A LA CONSOMMATION DE LA VIANDE DE BROUSSE

35. Quelle est la composition des repas des exploitants miniers :

- a. PrixOrigine
- b. PrixOrigine.....
- c. PrixOrigine.....
- d. PrixOrigine.....

36. Avez-vous déjà consommé la viande sauvage ?

- a. Oui
- b. Non

37. Si oui, pourquoi la préférez-vous?

- a. Goût
- b. Disponible
- c. Moins chère
- d. Autre à préciser

38. De quel coin de votre milieu vous en procurez-vous ?.....

39. De quel coin proviennent ces viandes de brousse pour entrer dans le carré ?

.....

40. A quel prix vous acheter la viande boucanée par espèce ?

41. Qui sont les fournisseurs et qui vous approvisionnent ?.....

.....

42. Quelles sont les espèces animales incluses dans votre alimentation ? Ajoutez l'état de la viande

- a. Gorilles Fréquence (/semaine) Quantité Prix
- b. Antilopes Fréquence (/semaine) QuantitéPrix.....
- c. Chimpanzés..... Fréquence (/semaine) QuantitéPrix.....
- d. Eléphant..... Fréquence (/semaine) QuantitéPrix.....
- e. Singes..... Fréquence (/semaine) QuantitéPrix.....
- f. Autres à préciser.....

43. Qu'est-ce qui peut vous pousser à réduire ou abandonner la consommation de viande de brousse ?

D. QUESTIONS LIEES A L'UTILISATION DES ANIMAUX

44. Utilisez-vous les animaux pour soigner certaines maladies ?

- a. Oui
- b. Non

45. Si oui, comment ?

Animal	Partie utilisée	Traitement	Dose

46. Y-a-t-il des grands singes dans la forêt qui est proche de cette zone où vous exploitez les minerais ?

OUI NON

a. Si oui, lesquelles ?

.....

b. Si non, leur absence serait due à quoi ?

.....

E. QUESTIONS RELATIVES A LA RATION DES EXPLOITANTS DANS LES CARRIERES

47. Occupez-vous un campement dans la carrière minière en brousse ?

Oui

non

a. Si oui, comment cela s'organise ?

b. Si non, comment travaillez-vous ?

48. A qui appartient le site minier ?..... Comment sont répartis les revenus avec le propriétaire : Quantité/par acteur

.....

.....

49. Y a-t-il certains chasseurs qui vendent les produits de chasse dans les sites d'exploitation des minerais ? **Oui** **Non**

Si oui, pouvez-vous estimer la fréquence, le prix et la quantité ?

a. Chaque jour Quantité Prix

b. Une fois par semaine.....Quantité Prix

c. Deux fois par semaine..... Quantité Prix

d. Trois fois par semaine.....Quantité Prix

e. Quatre fois par semaine.....Quantité Prix

f. Cinq fois par semaine.....Quantité Prix

g. Six fois par semaine..... Quantité Prix

50. Quels sont les singes que l'on peut trouver dans cette forêt voisine du lieu où vous exploitez les minerais ? **Demander l'abondance des différentes espèces sur l'échelle 1-5**

a..... b c
d.....e..... f

51. Est- ce que les exploitants miniers pratiquent aussi la chasse aux animaux sauvages et surtout celle des grand singes ?

Oui Non

A. Si Oui, quelles sont les quantités par espèce ?

.....
.....
.....

52. Est-ce que les exploitants miniers s'impliquent aussi dans le trafic de la commercialisation des singes vivants ?

Oui Non

Si Oui,

Quelle espèce nombre destination Prix

Quelle espèce nombre destination Prix

Quelle espèce nombre destination Prix

Quelle espèce nombre destination Prix

Quelle espèce nombre destination Prix

Autres à spécifier.....

53. Parmi les acheteurs viande de brousse, y a- t- il certains qui font la commande des animaux vivants ?

Oui Non

54. Comparativement aux années antérieures, est- ce que les grands singes existent encore?

Oui Non

55. Qu'est- ce qu'il faut faire pour que les grands singes se multiplient davantage encore ?

.....
.....

F. QUESTIONS RELATIVES A L'HABITAT DE GRANDS SINGES

56. Est- ce qu'il vous arrive d'abattre les arbres pendant l'exploitation des minerais ?

Oui ou Non

Si oui, pour quelle utilité ? **Indiquez l'ordre d'importance de 1 à 5**

- a. Bois de chauffage
- b. Construction des campements
- c. Soutènement des mines
- d. Ponts de rigoles
- e. Charbons de bois
- f. Fabrication des planches

g. Autres à préciser

57. Y a-t-il des espèces végétales indicatrices des minerais ?

Oui

non

a. Si oui, quelles sont ces espèces ?

.....

b. Quel type de minerais ?

.....

c. Est-ce que ces plantes sont consommées par les grands singes ?

.....

58. Quelles sont les conséquences des facteurs anthropiques vis-à-vis des grands singes et autres ressources naturelles de la forêt environnante du lieu d'exploitation minière ?

- a. La déforestation due à l'exploitation et au défrichage des petits champs
- b. La pollution de l'eau des rivières et sources
- c. La délocalisation de la faune d'un milieu de vie vers un autre son milieu habituel
- d. La diminution des espèces fauniques et floristiques
- e. La carence des plantes préférées par les grands singes
- f. Le feu de brousse y est fréquent
- g. Les conditions écologiquement viables ne sont plus réunies
- h. Les exploitants miniers appliquaient et continuent à appliquer la chasse

G. INFORMATION SUR TRANSMISSION DES MALADIES ENTRE L'HOMME ET LES GRANDS SINGES

59. Savez-vous que certaines maladies peuvent se transmettre de grands singes à l'homme et de l'homme aux grands singes (La zoonose) ?

Oui

Non

Si oui, lesquelles.....

MERCI !