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A wealth of Wildlife Endangered in northern Nimba County, Liberia

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ABSTRACT: Mount Nimba is one of the most famous sites for biodiversity conservation in West Africa because of it high level of richness. People are concerned about the decline of tropical forest ecosystems and the decrease or disappearance of animal species has been attributed mainly to the destruction of habitat through human activities. In Liberia, the iron ore that constitutes the mountain body on Mont Nimba is now exploited by Arcelor Mittal Company. In the framework of its impact assessment process, Arcelor Mittal asked for a bushmeat study in its mining concession. We conducted a hunter's survey to better understand the motivations of the town communities and the human – wildlife relationship. Then, the hunter's activities have been monitored to identify the animal species encountered in the game and to evaluate their local conservation status. The study reveals that all kind of wild animals in the area are considered to be potential prey and several species have been recorded in the hunting game. Through this study, it seems that many species are probably being driven or facing extinction in the area due mainly to agriculture and hunting activity; whereas in addition to hunting pressure, there are new threats to animals with mining activities and their direct and indirect consequences.

KEYWORDS: Biodiversity, ecosystem, wildlife, hunting activity, animal species.

INTRODUCTION

Liberia lies at the southwest corner of West Africa, bordered by Sierra Leone to the northwest, Guinea to the northeast, and Côte d'Ivoire to the east. The landscape is dominated by generally flat coastal plains, rising to rolling plateaus and low mountains in the northeast, highest of which is the Nimba range in North Nimba County. This country is the only West African country thought to have been totally covered in tropical rainforest before the influence of human settlement [1]. Actually, this forest is estimated to cover about 49% of the total landmass of the country. The importance of these forests is such that the Guinean Forests of West Africa (GFWA) ecosystem was designated as one of the world's 35 Hotspots, areas of highest biodiversity richness under the greatest threat. Liberia's forests are considered the top priority for conservation in West Africa; Liberia holding the most intact remaining forest in the Hotspot [2].

The Nimba range and its surroundings which are part of the forest block of Upper Guinea are listed by international organizations (IUCN, CEPF, FFI, CI, etc.) among the most important zones for the conservation of the biodiversity of moist forests of the sub-region. In western Africa 8,500 plant species have been listed and 403 species of orchids recorded. The

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pygmy hippopotamus, the giant forest hog, and a number of insectivores, rodents and bats, tree frogs, bird species inhabit the area. Liberia, being one of the countries whose forest makes up the West African Rain Forest, includes many of the species of plants and animals found through the West African Rain forest.

Unfortunately, the Upper Guinea Ecoregion is highly threatened and is one of the most critically fragmented regions on the planet. Increased rates of forest loss, particularly in biodiversity rich areas, have reached crisis proportions [3], [4]. Humankind's economic activities are undoubtedly responsible for the erosion of biodiversity, in particular, the extinction of species, populations, and their habitats. The danger is particularly acute in the tropics where conservation resources are scarcest, where habitat conversion is more rapid and where the threat to biodiversity is greatest [5]. Extinction risk is considered highest in the case of taxa that have received little attention and live in parts of the world that are not a major focus of biologists and conservationists [6]. This seems to be the case for the entire Nimba County, Liberia and its Mammals species including monkeys, chimpanzees, leopard, pygmy hippopotamus, zebra duiker and jentink duiker...

Nimba County is located in the north-central portion of Liberia. Much of the remaining forest of this region is exploited for timber or threatened by hunting and does not represent intact habitat [7]. Large-scale mining for iron ore, diamonds, gold, and bauxite, particularly in mountain areas, and small-scale mining for gold and diamonds also pose a major threat to the forests and biodiversity. Furthermore, in many areas, loggers, miners and other introduced populations further stress the forest resources through hunting of wild animals. Several animal species have been extirpated from many forests in all the countries of Upper Guinea as a direct result of forest loss and overhunting [8]-[10]. Despite of the recognized importance ecosystem roles (prey species, fruit eaters and seeds dispersers), economic importance for Humans (used for food, pets, and in medical research) and cultural importance, large mammals are facing several direct and indirect threats in Nimba County.

The area allocated to AML by the Liberian authorities, in the northern Nimba County cover, for the most part, the hunting territories of the communities where they find animal protein consisted of large and medium mammals such as rodents, ungulates, primates and carnivores [11]-[13]. Among these animals, some such as chimpanzees, diana monkey, mangabey, leopard and others that live in this region are species of conservation concerned. The greater part of these species occurring in the area operated by the mining company, the aim of this paper is to pull the alarm on to involve all organization that care about the preservation of biodiversity in general and its wildlife component in particular, in a joint action to save these animals from local extinction. This disappearance will also have repercussion on the communities that depend on this fauna as part of food security.

OBJECTIVES

The main goal of this study is to pull on the alarm bell by making the Scientists, policy makers and conservation NGOs, know the wealth of wildlife in northern Nimba County and the threats that they are facing. This should bring all these agencies to find solutions for long-term conservation of the wildlife whose habitat is threatened with extinction in the coming years.

METHODOLOGY

STUDY AREA

Nimba County is located in the northeastern region of Liberia. The Nimba Mountain Range is located at the border between Guinea, Côte d'Ivoire and Liberia and is part of the Guinea Highlands, a series of discontinued mountains rising over a large plateau of an altitude of 500 to 600 m and extending northwest to southeast from Fouta-Djalon in Guinea to the Man region in Côte d'Ivoire. The main mountain range reaches an altitude of 1,752 m (Mount Richard-Molard) and extends about 40 kilometers northeast to southwest. The lower southern part reaches Liberia. The northwestern side is closely bordered by several peaks and smaller ranges while the opposite side plunges abruptly to the foothills.

SAMPLING

- Hunter's survey: To better understand the motivations of the town communities and the human – wildlife relationship we conducted a hunters surveys by sending hunters' questionnaire in the four study towns.
- Hunter activity monitoring: we followed regularly hunting activities of some hunters. It was then possible to determine the time spent to hunt and all animals killed were registered, weighed and measured.
- Identification of animal species**:** We have not experienced any problems in the specific determination of the dominant species, particularly in regards to ungulates, primates and large rodents. Personal knowledge, practical guides, English and French versions of Kingdon 1997 were used for this purpose.

- Evaluation of conservation status: We used the national (Liberia) conservation status of the new "an act adopting the national wildlife conservation and protected area management law of Liberia" and the IUCN Red List of Threatened Species 2008 and 2011 to determine each species' conservation status.

RESULTS

ANIMAL SPECIES ENCOUNTERED IN THE HUNTING TAKE OFF

The results of this chapter concern both the interview of the hunters and the regular monitoring of hunting activities. According to the hunters interviewed, about 3065 animals were killed in 2009, averaging 31 animals per hunter. From June to December 2010, approximately 1626 animals have been killed with an average of 16 animals per hunter for the first six months of the year. From January 2011 to August 2011 a total of 4982 animals have been killed by 147 hunters giving an average of 34 animals per hunter (table 1). These animals are mainly composed of rodents (46% of yes) and ungulates (43% of yes). Then, at a low rate, we have primates and carnivores with respectively 11% (of yes) and 20% (of yes) of the animals killed by hunting with shotgun.

Table 1. Data on animals killed in 2009, midyear 2010 and 2011, according to respondents

	Number of hunters	2009	Animal / hunter	2010	Animal / hunter	Number of hunters	2011	Animal / hunter
Bonlah	24	1073	47	547	24	52	992	19
Gbapa	23	605	26	378	16	24	813	34
Zolowee	23	899	39	425	18	36	2029	56
Zortapa	21	488	23	276	13	35	1148	33
Total	**91**	**3065**	**34**	**1626**	**18**	**147**	**4982**	**34**

Regular monitoring of the hunting activity of some hunters identified the game that they catch per trap or killed with guns. According to these data, hunting with gun killed 58% of the total game against 41% for trap and around 1% for other means. At the genus level, these animals are mainly constituted of Rodents (57.45%), Ungulates (20.41%), Carnivores (12.97%), Primates (5.27%) and Pholidota (3.38%). At specific level, the analysis shows that at least 25 mammal species have been recorded in the game (see table 2).

CONSERVATION STATUS

Among these mammal species, the Brush-tailed porcupine (*Atherurus africanus*) is the most encountered in the game, but is not listed in Liberian's protected animals and is Least Concern (LC) by IUCN. At the second place, the striped ground squirrel (*Euxerus erythropus*) is not in liberian's list and is Low Risk and Least Concern (LR/lc) on IUCN red list. The Giant pouched rats *(Cricetomys gambianus*) and the marsh cane rate (*Tryonomys swinderianus*), are at the third and fourth places and are not listed by Liberia and are Least Concern by IUCN. The first Ungulate in the list is the Bay duiker (*Cephalophus dorsalis*), then the Maxwell duiker (*C. maxwelli*). All of them are absent in Liberian's protected animals and are listed as Low Risk and Near threaten (LR/nt). Among the Carnivores, the most encountered is the Cusimanse (*Crossarchus obscurus*), not listed in Liberia and Least Concern by IUCN. The bushbuck (*Tragelaphus scriptus*), not listed in Liberia is Low Risk and Least Concern (LR/lc) in IUCN red list. Some species are encountered at low rate : the Red-legged sun squirrel (*Heliosciurus rufobrachium*) not listed in Liberia and LC by IUCN , the Potto (*Perodicticus potto*) not listed in Liberia and LC (IUCN), the African palm civet (*Nandini binotata*) partially protected in Liberia and Neat Threaten in IUCN red list, the Long-tailed pangolin (*Uromanis tetradactyla)* fully protected in Liberia and LC in IUCN red list, the Tree pangolin (*Phataginus tricuspis)* fully protected in Liberia and NT in IUCN red list, the Black duiker (*Cephalophus niger)* not listed in Liberia and LR/nt by IUCN, the Slender mongoose (*Herpestes sanguinea*) is not protected in Liberia and is LC in IUCN. The Western tree hyrax (*Dendrohyrax dorsalis),* the lesser spot-nose (*Cercopithecus petaurista buttikofferi) are* fully protected in Liberia and LC (IUCN), Campbell's monkey (*Cercopithecus mona campbelli)* fully protected in Liberia is LC and the African civet (*Civettictis civetta)* partially protected by Liberia law and LR/lc are the less encountered in that list (see table 2).

Table 2. Catches list based on their encounter rate and their conservation status

Order	Scientific name	English name	Number	Encounter rate	National status	IUCN status
Artiodactyla	*Cephalophus dorsalis*	Bay duiker	60	8,11	Not listed	LR/nt
	Tragelaphus scriptus	Bushbuck	37	5	Not listed	LR/lc
	Cephalophus maxwelli	Maxwell's duiker	42	5,68	Not listed	LR/nt
	Cephalophus niger	Black duiker	12	1,62	Not listed	LR/nt
Carnivora	*Crossarchus obscurus*	Cusimanse	43	5,81	Not listed	LC
	Herpestes sanguinea	Slender mongoose	14	1,89	Not listed	LR/lc
	Nandinia binotata	African palm civet	24	3,24	Partially protected	LR/lc
	Genetta sp	Genet	8	1,08	Partially protected	?
	Civettictis civetta	African civet	7	0,95	Partially protected	LR/lc
Chiroptera	*Hypsignathus monstrosus*	Bat	1	0,14	Not listed	LC
Pholidota	*Phataginus tricuspis*	Tree pangolin	13	1,76	Fully protected	NT
	Uromanis tetradactyla	Long-tailed pangolin	10	1,35	Fully protected	LC
Primates	*Perodicticus potto*	Potto	26	3,51	Not listed	LC
	Cercopithecus petaurista b.	Lesser spot-nose	6	0,81	Fully protected	LC
	Cercopithecus m. campbelli	Campbell's monkey	7	0,95	Fully protected	LC
Hyracoidae	*Dendrohyrax dorsalis*	Western tree hyrax	2	0,27	Partially protected	LC
Reptila	*Python spp*	Python	3	0,41	Fully protected	LC
Rodentia	*Anomalurus sp*	Anomalure	1	0,14	Fully protected	?
	Artherurus africanus	brush-tailed porcupine	90	12,16	Not listed	LC
	Thryonomys swinderianus	marsh cane rat	74	10	Not listed	LC
	Cricetomys emini	Giant pouched rats	26	3,51	Not listed	LC
	Cricetomys gambianus	Giant pouched rats	77	10,41	Not listed	LC
	Euxerus erythropus	Striped ground squirrel	87	11,76	Not listed	LR/lc
	Protoxerus stangeri	African giant squirrel	40	5,41	Not listed	LC
	Heliosciurus rufobrachium	Red-legged sun Squirrel	29	3,92	Not listed	LC
		Squirrel	1	0,14	Not listed	?
TOTAL			**740**	**100**		

MAIN THREATS ON ANIMAL

Beside collection of animals, digging or putting fire in warren in order to bring out their tenants, all the hunters use two main types of tools to hunt in Nimba County: the gun and the trap. Some hunters use both shotguns and traps and constitute the majority (44%). Others use exclusively either shotguns (28%) or traps (28%). Among these hunters (67%) have their own shotguns that they often lend to friends (57%). According to hunters (60%), these shotguns are registered by the authorities. The hunters use an average of 7 cartridges in a week and a hunting period lasts in average 9 hours. And the hunting takes place day and night. Besides the firearms, hunters in Nimba County use the trap for capturing wild animals. Most farmers use trapping as a means to fight against the harmful animal species to their crops, but other traps are set for the sole purpose of harvesting bushmeat. There are several types of traps and none of them is selective.

During the study, a few hunters hunt during all seven days of the week. They represent only 5% of the study group. The most part of these hunters practice their hunting activity three days a week (35%), four times a week (26%) or once a week (15%). Some of them go to hunt two days in the week (14%), five days (4%) or six days a week (1%) (fig. 1). Whatever the number of hunting days in the week, the hunt takes place mainly day and night (46%) or only the day (43%), only at night (11%).

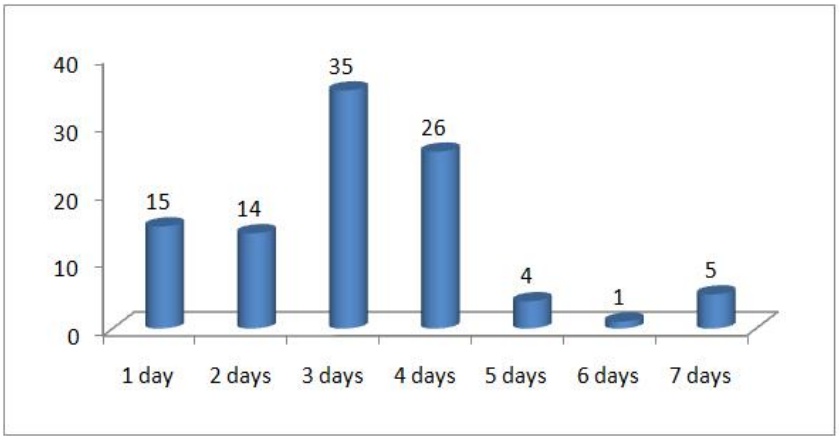

Fig. 1. Number of hunting days in a week in the surveyed towns

During the first monitoring period (August 2010 to November 2010), we identified a total of 242 animals killed by 91 hunters. We notice that more animals were killed by the gun (65%, N = 157) during a total of 37 hunting days, compared to traps (35%, N = 85) for 3688 traps laid 120 nights. For the second period (May 2011 to August 2011), 146 hunters were involved in the study and 504 animals were killed. The animals killed by shotgun (76 hunters) represent 55% (N = 279) during 107 hunting day, against 45% (N = 225) for traps (70 trappers) laid 121 nights.

Table 3 below shows the captured biomass, the theoretical biomass and the lost biomass depending on the species caught:

- Average weight = theoretical weight of an adult
- Theoretical biomass (kg) = sum of averages weights x number of caught
- Real biomass (kg)= sum of weight recorded or estimated
- Lost biomass (kg) = theoretical average weight - real biomass
- Percentage of lost biomass (%) = biomass lost x 100 / theoretical biomass

We note that the catch could theoretically yield 6429 kg for the hunters if all the animals captured were represented by adult individuals. The majority of animals killed are represented by young and sub-adults individuals. Indeed, the real biomass captured is about 3616 kg corresponding to a loss of about 2812 kg on all catches, which represents approximately 44% loss in biomass.

The fig. 2 shows the causes of wildlife depletion according to hunters. Most of them (94%) agreed that animals are no longer abundant in the forest. Over half of the hunters (56%) attributed this decline to intensive hunting and recently the increase in number of hunters, then to mining underway in the region (26%) and to some phenomena such as the increase in population (5%), farm (4%) and bushfires (1%). Or the destruction of animal habitats (5%) and the fact that animals are not protected (3%).

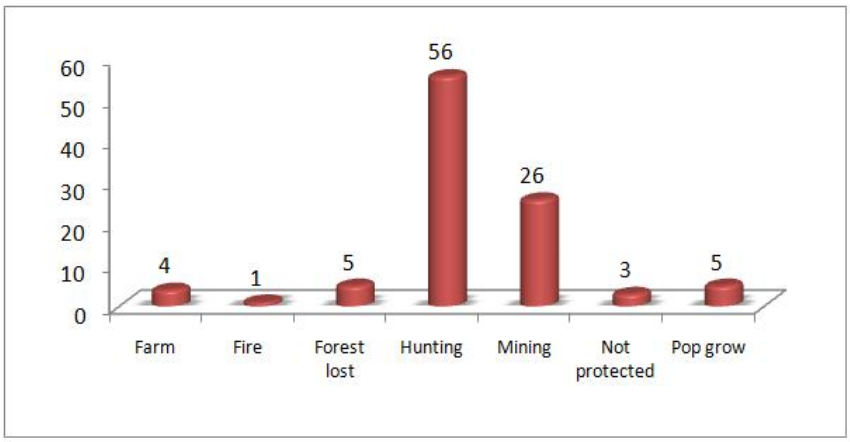

Fig. 2. Causes of wildlife decrease in surveyed area according to hunters

Table 3. Catch presentation based on their weight values

Order	Scientific name	English name	Local name	average weight	Number	theorical biomass (kg)	Real biomass (kg)	Lost biomass (kg)	pourcentage of lost biomass (%)
Artiodactyla	*Cephalophus dorsalis*	Bay duiker	Belleh	20	60	1200,00	785,25	414,75	34,56
	Tragelaphus scriptus	Bushbuck	Zolo	71,25	37	2636,25	1165,50	1470,75	55,79
	Cephalophus maxwelli	Maxwell's duiker	Velleh	10	42	420,00	343,75	76,25	18,15
	Cephalophus niger	Black duiker	Gba	24	12	288,00	162,00	126,00	43,75
Carnivora	*Crossarchus obscurus*	Cusimanse	Wehin	1,5	43	64,50	53,44	11,06	17,15
	Herpestes sanguinea	Slender mongoose	Kelin	0,85	14	11,90	10,60	1,30	10,92
	Nandinia binotata	African palm civet	Gouo	15	24	360,00	72,35	287,65	79,90
	Genetta sp	Genet	Blohou	2	8	16,00	15,50	0,50	3,13
	Civettictis civetta	African civet	Goua	3,5	7	24,50	24,00	0,50	2,04
Hyracoidae	*Dendrohyrax dorsalis*	Western tree hyrax	Weeh	4	2	8,00	4,00	4,00	50,00
Chiroptera		Bat	Laye	0,4	1	0,40	0,20	0,20	50,00
Pholidota	*Phataginus tricuspis*	Tree pangolin	Balakelezeh	3	13	39,00	26,95	12,05	30,90
	Uromanis tetradactyla	Long-tailed pangolin	Balakelezeh	3,25	10	32,50	32,05	0,45	1,38
Primates	*Perodicticus potto*	Potto	Zohon	1,4	26	36,40	32,90	3,50	9,62
	Cercopithecus petaurista b.	Lesser spot-nose	Golo	3,7	6	22,20	13,80	8,40	37,84
	Cercopithecus m. campbelli	Campbell's monkey	Kanh	4	7	28,00	16,40	11,60	41,43
Reptila	*Python spp*	Python	Bili	8	3	24,00	8,00	16,00	66,67
Rodentia	*Anomalurus sp*		Kpelleh	0,7	1	0,70	0,50	0,20	28,57
	Artherurus africanus	brush-tailed porcupine	The	4	90	360,00	312,50	47,50	13,19
	Tryonomys swinderianus	marsh cane rat	Sobeh	8	74	592,00	298,90	293,10	49,51
	Cricetomys emini	Giant pouched rats	Bonon	1,4	26	36,40	33,60	2,80	7,69
	Cricetomys gambianus	Giant pouched rats	Bonon	1,4	77	107,80	104,25	3,55	3,29
	Euxerus erythropus	Striped ground squirrel	Loo	0,75	87	65,25	64,40	0,85	1,30
	Protoxerus stangeri	African giant squirrel	Wankpo	1	40	40,00	22,60	17,40	43,50
	Heliosciurus rufobrachium	Red-legged sun squirrel	Gben	0,5	29	14,50	12,65	1,85	12,76
			Korokoro	0,7	1	0,70	0,50	0,20	28,57
TOTAL				**194,3**	**740**	**6429,00**	**3616,59**	**2812,41**	**43,75%**

Almost all the hunters (95%) agreed that forest cover has also decreased and that the reasons for forest degradation are mainly agriculture (42%), mining activity (21%), brushfire (12%), sawing activity (12%) and hunting (10%) (Fig. 3). The mining operations indicated by the hunters here is especially in reference to the past activities of LAMCO with the resulting degradation of the vegetation on some mountains and open road.

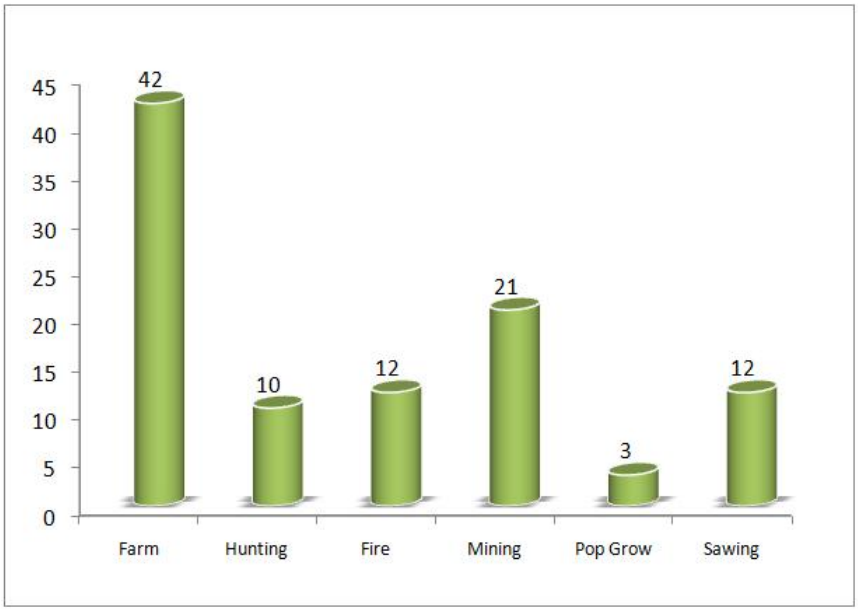

Fig. 3. Causes of forest decrease in Nimba County according to hunters

Even if we did not collect quantitative data, time spent in the bush with hunters to visit the hunting areas showed that one of the ecological impacts of hunting is pollution, especially physical pollution. Indeed, during the hunting party, hunters leave empty bags in which they often carry their food, batteries, the packaging of these batteries, cans. These are all physical elements that animals can swallow on or choke on or cause intoxication. Hunting tools used by hunters from Nimba County are not selective. The cables used for traps catch all animals coming in irrespective of gender, age, conservation status of this animal, nor it state of pregnancy. Also, hunting with firearms is practiced most often at night and hunters do not also distinguish the above parameters.

DISCUSSION

FAUNA RICHNESS

Monitoring of hunting for eight months has recorded 25 different species of mammals in Nimba County, among which we note representative of the main genera (Artiodactyla, Carnivora, Hyracoidae, Chiroptera, Pholidota et Rodentia). Indeed, the Nimba Range has a remarkable fauna population, in terms of variety and specificity due to presence of mountainous landscapes, diversity of plant formations and influence of microclimates. Hundreds of species have been described by scientists from the *Institut Fondamental d'Afrique Noire, Fauna and Flora International, Afrique Nature International and Sylvatrop* [14]-[19]. The Nimba Range is also characterized by its richness in primate species with *Perodicticus potto*, *Galagoides demidovii, G. senegalensis, Colobus polykomos polykomos, C. badius badius, Cercophitecus campbelli campbelli, C. diana diana, C. petaurista buettikoferi, Cercocebus atys atys,* and *Pan troglodytes verus*][20]. Among these primate species, only three species (*P. potto, C. campbelli campbelli, C. petaurista buettikoferi*) were recorded in the game of hunting during the eleven months of study. In addition to these three species should also report chimpanzee bones seen in one of the study town (Gbapa) and a carcass of green monkey seen with a hunter who did not cooperate with our team in one town (zolowee). As can be seen, this study confirms that several primate species have become locally rare, if they have not completely disappeared.

In addition to the primates species confirmed during this study, the tree pangolin *(Phataginus tricuspis)* and the long-tailed pangolin (*Uromanis tetradactyla)* were encountered. Several species of rodents are also mentioned. Almost twelve species of carnivores are supposed to live in this region [21]. Among them, five have been encountered in the game: the African civet (*Civettictis civetta)*, the African palm civet (*Nandinia binotata)*, the pardine genet (*Genetta pardina)*, the Cusimanse (*Crossarchus obscurus)* and the Slender mongoose (*Herpestes sanguinea).* Artiodactyla are also represented with, the bushbuck (*Tragelaphus scriptus)*, the black duiker (*Cephalophus niger)*, the bay duiker (*C. dorsalis)* and the Maxwell's duiker (*C. maxwelli).* However, these animals are represented by more than juvenile and sub-adult individuals than adults with more than 44% loss of biomass. For "reference [20]", most big mammals have become rare in Nimba County, due to habitat degradation and uncontrolled hunting.

A part from this mammal species, some 400 bird species are known in the Nimba Mountains, of which 16 are of global conservation concern [22]. There are also 69 species of reptiles including six species of global conservation concern. Amphibians and chiropterans are represented respectively by 66 and 46 species [23], [24].

MAIN THREATS

Despite of the recognized importance, ecosystem roles (prey species, fruit eaters and seeds dispersers), economic importance for Humans (used for food, pets, and in medical research) and cultural importance, large mammals are facing several threats. In the Nimba County, the current direct threats are those that are found throughout sub-Saharan Africa: extension of farmlands, logging, wildfires, bushfires, hunting, impact of past mining and preparation of future mining activities…The future direct threats in the study area are those that will be generated by the implementation of the mining activity and the development of infrastructures (building, opening of roads, noise disturbances...). All large mammal species will be concerned somehow. Large mobile species will probably flee away from the site. Large mammals like ungulates, primates and large carnivores in particular will try to reach safer areas if possible. However, smaller species or species which cannot move quickly might not have that possibility at all.

The current indirect threats are expressed at the population level. Indeed, as stated above, it seems that the populations of large mammals in the region are low especially for some species. It is known that the chance for survival of a species is reduced when the number of individuals in the population decreases, mainly for animal that have their reproductive potential reduced, and their genetic diversity reduced, which increases the risk of extinction [20]. The future indirect threats are almost close to those presented above, but here a particular attention must be paid to the future growth of human population in the region. The ongoing mining activities will increase job opportunities (either directly or indirectly), which will attract peoples and increase human pressure on natural resources, especially hunting pressure [25] for wildlife.

It is also known that one of the reasons of the scarcity of some Primates species in much of West Africa is the result of unregulated forest exploitation, habitat loss and the increasing demand for bushmeat [26]-[29]. Indeed, populations of forest-dependent animals have been reduced to such low levels that a number of them can no longer be considered viable. Large mammals are become the first to be eliminated from forest areas. As in most other countries in West and Central Africa, people in Liberia and in Nimba County have always hunted and relied on bushmeat to provide them with protein [30], [25]. The bushmeat trade is a lucrative business in Liberia, as in other parts of Africa [31]-[33]. The apparent extinction of some species such as the Red Colobus (*Piliocolobus badius badius),* in the study area can be attributed to hunting and the demand for bushmeat as good forest cover steel existing in the region. West African Chimpanzees are the most threatened of the three subspecies mainly due to habitat loss, high hunting pressure and the pet trade [34]. Despite international conservation of this ape, it continues to be the target of hunters in Nimba County.

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