

Studying the impacts of plant exploitation on habitat and lowland gorilla populations in the Itombwe Forest, Eastern Democratic Republic of Congo

Final Report September 2006 – May 2007

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Summary

The Itombwe Forest is globally recognized as a priority conservation area because of its rich biodiversity and endemism. It harbors lowland gorilla, *Gorilla beringei graueri* an endangered subspecies listed on the IUCN Red list. The lowland gorilla is threatened with extinction at local level by anthropogenic pressure. The current project aimed at studying the impact of plant exploitation on habitat and lowland gorilla populations. Surveys were carried out between September 2006 and May 2007. Using the transect methods we recorded plants and counted gorillas. A questionnaire and interview were used during the socio-economic survey. About, 108 individuals were counted indicating that gorillas are still present in small population in a polygon located on the western sides of the Itombwe Forest. We have also found out that before 1998, the gorilla groups were ranging more widely than today being, currently confined between Ulindi and Elila rivers, a small polygon of about 2384Km², and representing only 31.6% of the RNI's total area (14,025 Km²). The fact that gorillas are ranging in a smaller area than before is an evidence of habitat reduction. Conversion of forests into farmlands, agricultural expansion, timber and charcoal production and mine extraction are the major threats to the forest exacerbated by the political turmoil that occurred since 1996. People use plant materials for food, medicines, drinks, construction. Trees, shrubs, herbs, mushrooms are collected in the forest. Poverty is a factor that pushes community members to gather forest products including hunting. Bushmeat is consumed by forest dwellers. The entire wildlife has been decimated including gorillas. There is need for undertaking urgent conservation actions that should be focused on education, monitoring, law enforcement and community-based conservation of the Itombwe Forest. International NGOs, such as WCS, WWF, CLP and local CBOs, have been working together in order to obtain an official conservation status, and as result the site has been gazetted in October 2006 as Itombwe Natural Reserve (INR), but appropriate management and conservation plans should be established to ensure the protection of the reserve.

General introduction

The Itombwe Forest is a priority site for conservation because of its rich biodiversity and endemism. It is a beautiful landscape due to its vegetation cover and succession of hills, valleys and mountains. Historical data were instrumental to provide an overview of what is already known about the biogeography and biodiversity survey and the needs for conserving the whole Itombwe Mountains (Doumenge, 1998; Omari et al., 1999, Prigogine, 1971, 1978; Bashonga, 1998). The present report deals with the habitat and lowland gorilla population status. The recognition of the Itombwe Forest as a 'Natural Reserve' can be considered as a tool for undertaking some conservation actions and bringing the local communities to understand the goal of international NGOs which are dedicating in the conservation process in DR Congo.

I. Background

The lowland gorilla is an endangered species located in Eastern DR Congo, which is continuously threatened by human pressure. We have undertaken a study on the impact of plant exploitation on habitat and lowland gorilla populations. The results from this study should be used for defining appropriate measures to protect the habitat and the species.

A. Project Management

1. Offices

Headquarters : Bukavu

Field Stations : Irangi, Mwana-Nzombe, Miki, Mboko and Lusenge.

Liaison Office : Kinshasa

2. Personnel

Project Leader : Chifundera Kusamba Zacharie

Operations manager : Basilwango Lusolo Félicien

Staff members : Abulwa Bulimwengu, Mwenebatu Mlungu and Igulubyasigale Birhashwirwa

3. Gorilla trackers: Lukaba Lukelo and Ameli Mateso

4. Traditional tree finder and informant : Mbilizi Konda

5. Guide and cook: Amuli Mupila Gérôme

B. Supporting organization

The project has been financially supported by Conservation Leadership Programme, CLP (formerly BPCP). Conservation Leadership Programme (CLP) is supporting and encouraging conservation projects that address global priorities and aims to contribute to long-term environmental conservation and sustainable development in priority areas by engaging potential leaders in biodiversity conservation, and providing opportunities to gain practical skills and experience. CLP, is a partnership between five leading international organizations: BirdLife International, Fauna and Flora International (FFI), Wildlife Conservation Society (WCS), Conservation International (CI) and British Petroleum (BP).

CLP is established is currently established in Eastern DR Congo in the endeavor of protecting the habitat and gorilla populations in the Itombwe Massif.

C. The Itombwe Forest Conservation Initiative, IFCI

The Itombwe Forest Conservation Initiative, IFCI', has been a good experience for developing habitat and species-based conservation activities. The goal is to protect the Itombwe Forest and the whole biodiversity within it, by using an approach that includes research, education and community development project. IFCI is member of the technical working group named "GTI, Groupe de Travail pour Itombwe" established by the Act of the Ministry of Environment, Conservation of Nature, Water and Forests in Kinshasa, DR Congo.

D. Relationships with CBOs, NGOs and institutions

Collaborative actions were developed with local communities, Conservation-Based Organizations (CBOs), and international NGOs and state services.

1. Collaboration with local organizations

There were negotiations with people from local communities: customary chiefs, landowners and villagers. Meetings and workshops were organized with community representatives at Kasika, Irangi, Mboko and in Bukavu. The project was working in collaboration with three local CBOs: RGMB (Réserve des Gorilles de Muhuzi-Buzinda), ADA (Association pour la Défense des Animaux) and ASEF (Association Sauvons l'Enfant et l'Environnement de Fizi).

***RGMB, Réserve des Gorilles de Muhuzi Buzinda** is a CBO created in 2002. It is operating in Mwenga Territory and the collaboration was established since May 2004. Meetings and workshops were jointly organized and the project has delivered a training course for capacity building.

***ADA, Association pour la Défense des Animaux**, is a local CBO that is developing anti-poaching activities around the protected areas in South Kivu Province. Collaboration was established since 2003 and joint actions were organized in education campaigns, and confiscation of live animals kept in captivity. A survey of bushmeat trade and consumption in Eastern DR Congo was conducted.

***ASEF, Association Sauvons l'Enfant et l'Environnement de Fizi**, is located at Mboko, on the western shores of Lake Tanganyika. The project has established collaboration in 2006 for implementing gender-based activities for the exploitation of mushroom in the Miombo formation along the western shores of Lake Tanganyika.

2. Collaboration with International organizations

Collaboration between the project and international organizations was established through meetings that were occasionally held in Bukavu, Miki and Kamituga. A concentration frame named GTI or Groupe de Travail pour Itombwe, has been implemented as a forum for discussing some aspects related to the conservation of the Itombwe Massif. We have had good relations with **Wildlife Conservation Society (WCS, Congo Programme) and Worldwide Fund for Nature (WWF, Kahuzi-Biega Conservation Programme)** by exchanging information with their coordinators: Dr John Hart (WCS) and Mr. Bisidi Ya Lolo (WWF).

3. Collaboration with universities

ISEC, Institut Supérieur d'Ecologie pour la Conservation de la Nature is a private College University based at Katana. Three undergraduate students from the Department of Natural Resources Conservation and Management are members of the project. They are involved in socio-economic surveys; gorilla tracking and conservation education (see the Management section).

4. Collaboration with state services

The project has developed a close collaboration with the Institut Congolais pour la Conservation de la Nature, ICCN, the Congolese Wildlife Authority, through meetings. The project's activities were regularly reported to the Provincial Director in Bukavu. Meetings were organized to discuss the Itombwe conservation issues. From several meetings held in Kinshasa, Bukavu, Kamituga and Miki, agreement between the ICCN and community representatives was signed and inspired the Ministry to sign the governmental Act No 038 /CAB/MIN/ECN-EF on the 11th October 2006 in Kinshasa. The Itombwe Forest is now a protected area under the name 'Réserve Naturelle d'Itombwe, RNI or Itombwe Natural Reserve, INR'. The 'Réserve Naturelle d'Itombwe, RNI' will be managed according to the laws No 69-041 of 22 August 1969 determining the conservation of nature, No 75/023 of 29 July 1975 ruling the ICCN, and No 82-022 of May 1982 regulating the hunting activities in the DR Congo.

E. The Albertine Rift Ecoregion

The mountain chain comprising the Albertine Rift straddles the borders of six nations (Eastern DR Congo, Western Uganda, Rwanda, Burundi and Tanzania; and Northern Zambia: 03° N, 30° E to 08° S). The Albertine Rift has been formed from a combination of uplifted Pre-Cambrian basement rocks and recent volcanic activity. The uplift and volcanism are associated with the origins of Africa's Great Rift Valley and the large cracks in the crust are generally filled by lakes since the Quaternary Era. While the Rift is located in the centre of tropical Africa, the high mountains (1500-5119m) intensively modify the climate, with a more temperate climate occurring in the highlands. The ecoregion is dominated by montane rainforest (White 1983), but in the west, marginal fringes of the Guineo-Congolian rainforest impinge on the lower slopes (500-800m), and forest/savannah mosaic habitats border it to the eastern sides (Lind and Morrison, 1974). This ecoregion is one of Africa's most species and endemic rich regions, despite being one of most poorly documented (Prigogine 1985). Amphibians with 32 strict endemics have the highest number of range-restricted species. There are more or less 11 strict endemic reptiles. Birds also possess 30 strict endemics. The mammalian community contains 25 strictly endemic species. The large number of endemic species, some occupying only a small portion of the ecoregion, needs consideration in any conservation plan for the area. The ecoregion harbours the few remaining populations of the mountain gorilla (*Gorilla beringei beringei*) and Lowland Gorilla *Gorilla beringei graueri*. For all taxonomic groups additional field studies as well as synthesis of existing collections and inventories need to be undertaken. Throughout much of the ecoregion, the rural human population density is amongst the highest in Africa. This places considerable pressure on the remaining forest resources as most families live on cultivation under subsistence farming. Outside the protected areas the forests have been under severe human pressure and even within national parks they are not safe from serious disturbances. The ongoing conflicts in this region have made management extremely difficult. Especially the war in DR Congo and the genocide of Rwanda have caused major refugee problems, which resulted in serious environmental problems. Bands of rebels are known to use the forest to hide in between periods of raiding and fighting. Additional threats include conversion of most forest areas into farmlands, together with logging, firewood collection and bushmeat hunting. Available information on the protected areas of this 70,166 km² ecoregion gives roughly 13,500 km² of gazetted areas, representing 14 % of the ecoregion (Plumptre et al., 2003).

F. Priority for conserving the Itombwe Forest

Little is known from the huge expansion of Itombwe Forest which occupies the southern Albertine Rift. The site is the richest single forest area for birds in Africa: 563 birds with one endemic (*Caprimulgus prigoginei*), 21 amphibians with 6 endemic and 2 endemic shrews, as well as seven species of

butterflies. Further to the south, there are isolated mountain blocks, Mounts Kabobo and Marungu which are still unexplored areas (Plumptre et al., 2003).

Human population densities are lower on the DRC side of Lake Tanganyika, but considerable human movements have occurred between 1990 and 2003 and some areas may now have considerable population densities. The conflicts in this area have made forest conservation and management extremely difficult. The hostile attitude of local communities has also halted the conservation efforts. Deforestation, hunting and poaching are causing major problems in several areas. Many large mammal species, such as elephants and buffaloes, have been decimated during the turbulent political past. Bands of rebels from Rwanda and Burundi are known to use the forest to hide in between periods of raiding and fighting. There has been considerable intensification of the threats due to mass movement of refugees. Clearance of forest for livestock-grazing, particularly at higher altitudes, is also a serious threat.

Conducting surveys in suitable habitats in order to update the Itombwe Massif conservation status is a need for defining appropriate conservation strategies. Efforts are being made to collaborate with stakeholders to mitigate further habitat degradation. Fortunately, the Itombwe Massif is now being under consideration as a protected area, a reason why a Warden has been nominated for leading the ongoing conservation action plans.

G. The Lowland Gorilla

The Eastern Lowland Gorilla, *Gorilla beringei graueri* is classified as an Endangered subspecies (EN – A2cd)¹ on the IUCN Red List, and is also listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and protected under national wildlife legislation (Oates, 1996). The genus *Gorilla* comprises of two species and four subspecies.

Gorilla gorilla

Gorilla gorilla gorilla (10000 individuals, Cameroon, Congo, Central African Republic and Equatorial Guinea)

Gorilla gorilla diehlii (Nigeria, 120-150 individuals)

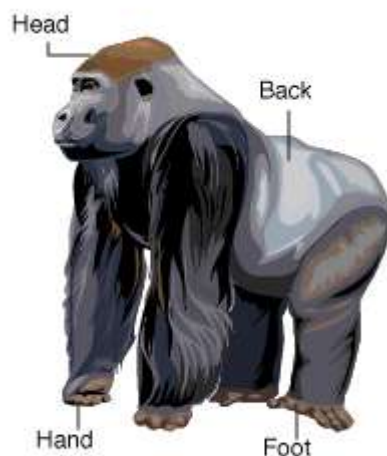
Gorilla beringei

Gorilla beringei beringei (Virunga Volcanoes and Bwindi, 720 individuals)

Gorilla beringei graueri (Maiko-Kahuzi-Itombwe landscape, 3000-5000 individuals, Eastern DR Congo)

¹A_{2cd} = A = rapid decline, 2= decline in near future A₂, c = actual or potential of exploitation A_{2c}, d= effects of parasites A_{2cd}.

Figure 2. The lowland gorilla



The eastern lowland gorilla has short black hair on the back and longer hair elsewhere on the body, small ears and broad nostrils.

The Eastern Lowland Gorilla lives in the dense primary, secondary forests and swamps between 600 and 2600m asl. The Lowland gorillas eat fruits, seeds, pith, mature leaves and stems. The diet includes parts of at least 87-97 plant species, as well as invertebrates, such as termites, ants, worms, caterpillars, and other insect larvae (Chifundera et al., 2003). They are diurnal and the majority of foraging occurs in the morning and late afternoon. They make nests of branches and leaves at night, by folding over vegetation, usually on the ground, and scientists use nest and scat information collected from these sites to estimate the number of gorillas in a group and to determine their diet. They live in stable, cohesive family groups, led by a dominant silverback male; the group sizes reaches up to 35 individuals. Each family group usually includes a dominant silverback, unrelated adult females offspring and subordinate males. There is no distinct breeding season and females give birth only once every 3-4 years. Surveys carried out in 1998 prior to the war revealed that there were perhaps 17,000 eastern lowland gorillas. Today, according to the latest rough estimates, fewer than 3000 may be remaining. The new population estimate is based on extrapolations of small surveys and information gathered from local people and fieldworks.

H. Threat assessment and conservation issues

The political turmoil in the region has caused increase in human pressure on lowland gorilla populations and habitats. Habitat loss, due to logging, mine extraction, conversion of forests into farmlands and

hunting for bushmeat are greater threats. The civil war which started in 1996, has severely threatened the species and its habitat, as rebels and poachers are hidden in the forests where lowland gorillas are also present.

Devastation from the war itself and a "modern day gold rush" for the precious tin and rare metallic ore coltan (which is in high demand for the manufacture of components for cell phones, laptops, and other electronic devices) have driven to the destruction of the montane forests.

One of the many reasons for civil conflict has been the scramble for access to these natural resources. Gorillas are killed in snares (traps) set for other animals and poaching for infant gorillas are major threat. The instability in the region has further added upon to the threats faced by gorillas, making guns more accessible to poachers.

The United Nations Environmental Programme (UNEP) has recently established a Great Ape Survival Project (GRASP), aiming at identifying the conservation initiatives required to secure the future of the apes and at obtaining political support and funding to allow these to be achieved. A multifaceted approach has been suggested to ensure the survival of lowland gorillas.

I. Risk assessment and encountered difficulties

Since the starting date of the project until now, we noted the presence of armed groups named Mai-Mai, fighting against Rwandese and Burundian forces. So it was very risky to carry out the fieldwork because of the insecurity. Interethnic conflicts arose between Bantu native communities and Banyamulenge of Rwandese origin. The war called 'liberation war' conducted by AFDL of Late President J.D. Kabila took place in September 1996 and had a serious impact on conservation actions. There was a serious political turmoil throughout the area and the whole country. However, since January 2005 the political situation has been improved and elections which led to peaceful environment were organized in 2006. Meanwhile, the armed groups from Rwanda are still present in the area, but MONUC (UN Peace Keeping Force in DR Congo) and FARDC (Congolese Defense Forces) are ensuring the security. The war has impacts on the habitat and species through deforestation, illegal animal hunting and illegal mine extraction. Moreover, it was very difficult to work in this area because of its remoteness, hostile environmental conditions, lack of means of transport and funding.

II. The project implementation and development

This chapter reports the results obtained during the fieldwork conducted between September 2006 and May 2007.

A. Title of the project

Studying the impact of plant exploitation on habitat and lowland gorilla populations in the Itombwe Forest, Eastern DR Congo.

B. Fieldwork (September 2006 – May 2007).

1. Introduction

The Eastern lowland gorilla or Grauer's gorilla, *Gorilla beringei graueri* (Hominidae) endemic to the Eastern forests of the D.R. Congo is one of the flagship species and remarkable endangered species listed on the IUCN Red List as EN-A2cd (Oates, 1996). The number of lowland gorilla individuals that was estimated to 17,000 in 1998 (Hall et al. 1998), has fallen to less than 3000 individuals today. However, field data are scarce and many aspects of ranging patterns are still poorly investigated. A preliminary survey has been made in 1908 by Grauer during his visit in the site and the first specimen was collected in 1914. However, range wide surveys were conducted in 1959 (Emlen and Schaller, 1963; Prigogine, 1971, 1978) and in 1996 (Omari et al., 1999). Presently, international organizations such as ARCOS, WWF, WCS, BirdLife International and CLP are involved in biodiversity surveys and conservation development projects, but despite these international efforts, lowland gorillas from the Itombwe forest are not well known about their population size and distributions. The political turmoil in the region has caused increase in human pressure on lowland gorilla populations and habitat.

The present study aims at determining the role played by the plant exploitation upon the habitat and lowland gorilla populations with the scope of suggesting appropriate conservation measures to the Congolese policy-makers.

2. The study area

Location of Itombwe Forest: The term used in the project's title refers to 'The Itombwe Mountains', also known as 'Itombwe Massif' (27°55' - 29°05' and 2°40' - 4°35'). The Itombwe Massif runs north-south beside the Albertine Rift to the West of the northernmost stretch of Lake Tanganyika, South Kivu Province, and Eastern DR Congo. This huge area encompasses several habitats from Tropical Rainforest to Montane Forest (c. 14,025 - 16200Km²). This is the largest, most diverse and most important of the montane forests in Africa, globally recognised as important area for priority conservation because of its rich biodiversity and high endemism. Although Itombwe forest is obviously of considerable conservation importance, it is an unstudied area and little is known about the whole biodiversity.

Location of surveyed polygon: The Itombwe Massif corresponds to the currently gazetted "RNI or Réserve Naturelle d'Itombwe" whose coordinates are 28°02' - 29°04'E et 2°41' - 3°52'S, a polygon of ca 14,0250Km², about 88% of 16200 Km² of the Itombwe Mountains and adjacent zones, and 2.16 times the Itombwe forested area. Gorilla surveys were carried out in the rectangular polygon extending on four Territories: Mwenga (entirely), Fizi (northern part), Uvira (half) and Walungu (third). These four Territories , 30126 Km² with altogether 832,280 inhabitants, with a density of 27.6 inhabitants/Km². The RNI represents 46,5% of the Territory's area. Our project was implemented and developed on western

sides of the Itombwe Massif, in the polygon ranging between Lake Lungwe, Kigogo, Irangi, Ngusa, Zombe, Miki and Ngusa.

Topography: The altitudes vary between 600 and 3475m (Mohi Summit). Mountains are characterized by escarpments with steep slopes on the Eastern sides. Lowland gorillas are found in geographically discrete sites, being absent from large areas, and occur in zones situated between 1100 and 2600m of altitude.

Surface area: The Itombwe Mountains have an area of 16200Km². The forests extend over 7500-8000 Km² (50%). This forested areas are roughly close to the estimates by Grauer in 1908 (7200 Km²). Above 1500m of altitude are montane forest (5000 Km²), bamboo formation (1500 Km²), gallery forest (500 Km²), and an area of 6700 Km² including transition and lowland forests between 600 and 1500m of altitude. Available data about the estimates of the surface area vary from a survey to another as shown in Table 1. Accordingly, all percentages are calculated from the areas of gorilla occurrence determined by Grauer in 1908.

Table 1. Estimates of the Itombwe Massif area according to several authors

Authors	Altitudes	Coordinates	Area
Chifundera, 2006		28°22'E-3°55'S	Polygon 2384Km ² Plant exploitation and gorilla surveys
Ministry of Environment, 2006	600-3475m	28°02'-29°02'E and 2°41'-3°52'S	RNI 14025Km ² , Act No 038 /CAB/MIN/ECN-EF on the 11 th October 2006.
BirdLife International, 2000	600-3475m		11.900 Km ² , Important Bird Conservation area
Omari et al.,1999		3°-4°S and 28°E	Survey site: 1600Km ² , biodiversity survey
Doumenge, 1998, 1999	900-3475m Lake Tanganyika 773m	2°40'-4°35'S and 27°55'-29°05'E	Total: 11732- 16200 Km ² Vegetation survey Montane forest: 6700 Km ²
Butynski et al., 1996	600-3450m	28°55'E-3°30'S	650.000ha (6500 Km ²) montane forest
	600-3470m		16000 Km ² , Itombwe Massif

Geology and soils: The Itombwe Mountains are formed by Precambrian rocks that are built on two old basement groups: the Rusizi group dating from the Archean period and the Urundian group of Algonkian period. Volcanic materials occurred in some sectors dating from the Tertiary era. The soils contain mines, such as coltan, gold and tin incrustated in the granite formations.

Hydrography: We noted the following water bodies:

Southwards: Luama, Kahama and Luiko

Eastwards: Luvubu, Kiliba, Mutambala, Kalimabenge, Lake Tanganyika, Lubarika, and Shange.

Middle: at 2700-2950m: Lake Lungwe running west by Kilungutwe river

Westwards: Elila, Ulindi, Mwana, Kilungutwe, Lulimbohwe, Kadugu.

***Rainfalls:** The climate is characterised by moderate rainfalls (1200-1600mm/annuum). Variations are observed from a location to another. 1400mm (Miki) - 2171mm (Lungwe)/year, dry season of 3-4 months placed between May and September (e.g. Miki: 50-70mm in July and 125mm in August).

The types of climate are defined as follows:

Af: equatorial forest, below 1000m of altitude

Am: at Mwenga, above 1200 - 1500m

Cf: higher altitudes at Mwana-Zombe, Miki, above 2100m

Cw: Minembwe, Lungwe, Kahanda, High Plateaus above 1900m asl.

Temperatures: The amplitudes are 3° - 5°C. The amplitude is the difference between the annual mean temperatures of the hottest and the coldest months. The temperatures vary between 6° – 30°C according to the altitudes (mean =15°C), e.g. Lake Lungwe 2950m: 6-16°C; Mwana 1550m: 9°-25°C; Kamituga 1050m: 15°-30°C.

Vegetation: The vegetation varies with the elevations. Above 1500m of altitude are found the gallery forests, the bamboo formation and the montane forest. The lowland forests or Tropical Rainforest is located below 800m of altitude and is connected to the Congo Basin. The savannah covers the Eastern and Southern portions of the Itombwe Massif. The canopy foliage forms a vertical wall reaching up to 45m and tree develops an extensive branch system. *Ekebergia capensis*, *Pentadesma lebrunii*, *Lebrunia bushaie*, *Ficalhoa laurifolia*, *Symphonia globulifera*, *Podocarpus usambarensis*, *Cassipourea gummiflua*, and *Macaranga capensis* are the dominant tree species. Patches of the Miombo formation, *Brachystegia* spp, is found on the eastern escarpments. A survey of the vegetation was conducted by Bashonga (1999) and Doumenge (1998).

Human demography and territorial administration: The Itombwe Massif is shared by four Territories: Mwenga, Fizi, Uvira and Walungu. Each Territory is composed of Chefferies (SubCounties), Groupement (Parishes) and locations (Villages). The main cities are: Mwenga, Fizi, Uvira and Baraka. Other important areas with higher human populations are: Miki, Mboko, Kalambi, Kasika, Namurhera, Lubanda, Birhala, Lemera, Minembwe, etc.. (Table 2). The total population in the Itombwe Forest within the Réserve Naturelle d'Itombwe (RNI) has been estimated to about 623.000 inhabitant (44.5 inhab/ Km²) according to the statistics of the Division of Interior of South Kivu Province recorded in 2005 (Table 2).

Table 2. Populations in the areas surrounding the Itombwe Massif

Territories or Counties	Sub/counties, Chefferies or sectors	Populations	Area Km ²	Densities Inhab/Km ²
Fizi		243,409	15,786	14
	Lulenge	25999		
	Nganda	40382		
	Mutambala	72735		
	Tanganika	104293		
Mwenga		249123	11,172	21
	Basile	28603		
	Itombwe	31906		
	Wamuzimu	110087		
	Luindi	18116		
	Burhinyi			
Uvira		310849	3,148	92
	Bavira	27500		
	Bifuliru	99293		
Walungu		405101	1,800	224
	Kaziba	28899		
Total	Itombwe Massif	1208482	31906	27
Total	RNI	623,000	14025	44.5

Agriculture: shifting agriculture is practiced for subsistence by forest dwellers. Crop production is composed of beans, bananas, cassava, sweet potatoes, Irish potatoes, maize and yam. Forest dwellers rely to bushmeat used as daily dietary staple. Hunting is their traditional main activity (see socio-economic survey). However, livestock and cattle are currently found on the higher plateaus of Mulenge and in the Bushi area.

Cultivated areas and fallows are observed at the edge of the forest. Human pressure on the habitat, in terms of logging, mine extraction and conversion of forests into farmlands, has led to changes in ranging patterns that gives the picture of the current distribution and area of occurrence of gorillas.

Sociocultural aspects: People living within and around the Itombwe Massif are composed by the following ethnic groups: the Bantu (Bembe, Fuliro, Vira, Tutsi, Lega and Shi), the Pygmy people and the Tutsi (Banyamulenge). The spoken languages are: Kivira, Kibembe, Kirega, Kinyindu, Mashi and Kinyarwanda. According to the religions and belief, people are either: protestant, catholic, muslim or animist.

Economy: The Itombwe Massif is an important economic area because of mine extraction, timber production, farming and fishing activities. The income is generated from commercial crops, fish and cattle. Despite these economic activities, the people are still living in poor life conditions.

Politics: Traditional warriors called Mai-Mai constitute the main political group besides other political movements such as PPRD and PALU that are forming the AMP, the presidential political group in Kinshasa. Unfortunately, armed groups from Rwanda and Burundi are still hidden in the forest and are causes of insecurity in the area.

Habitat features : The altitudes vary between 600 and 3475m, for a total surface area of 16200Km² (9800Km² upper 1500m of altitude and 4900Km² upper 2000m of altitude).

1000-1200 m: Lowland forest

1200-1500m: transitional forest

1500- 2100m: Montane forest (4500Km²) and forest galleries (500Km²)

2350-2700: Bamboo formation, 1500Km

Montane forest (4500Km) and gallery forest (500Km²) form together 5000Km² (40%) above 1500m of altitude, however, lowland forest and transitional forests sum up together 5400Km² (33%). It is reported that in 1978, the forested area was estimated to at about 73%, but now the remaining forest is about 27% including the open lands and the forest-savannah mosaics. In the altitudes below 2000m in the southern part of Itombwe Mountains, the Tropical Rainforest is replaced by the forest-savannah mosaics.

Land ownership: The Itombwe Forest is shared by several ethnic groups, but the lack of strong conservation laws and consensus are sources of conflicts between wildlife administration and local communities. Local communities are still claiming the ownership on the forest from which they extract food, beverage, firewood, medicines and mines (see socio-economic survey). Conflicts from land use are the root causes of delay in the implementation of conservation and management plans. Hopefully, following several meetings with stakeholders, the Itombwe Massif now has an official protection status. Gorillas may be seen in transition forest, bamboo formation, secondary vegetation, savannah borders, agricultural fields, and at the edge of human settlements.

3. MATERIALS AND METHODS

3.1. Materials

We used the following materials: Garmin eTrex Summit GPS unit, Vango Astral sleeping bags, one tent, Vintage style Olive Rip-Stop trousers, Nevis Rucksacks, rubberised wet weather jacket and trousers. The map at scale 1/1000.000 was used for defining the RNI polygon according to the Act No 038 /CAB/MIN/ECN-EF signed in Kinshasa, on the 11th October 2006 by the Ministry of Environment, Conservation of Nature, Water and Forests.

3.2. Methods

a). Gorilla population survey

-Trail and transect based survey was used for counting the weaned individuals in order to gather data on the population size, abundance, density, and group size, structure and composition (Hall et al., 1998a,b; Omari et al., 1999; Brockelman and Ali, 1987; Schaller, 1963, 1964).

-The sampling area was subdivided into sub sectors of about 10Km² surveyed from a starting randomly chosen point.

-One team per sector per month, and five days per sub sector: $4 \times 1 \text{ subsector} \times 5 \text{ days} \times 3 \times 10 \text{ Km}^2 = 600 \text{ Km}^2$ thus 7. 25 sectors, a surveyed area of more than 4350Km²

-Each sector was surveyed by walking in within an irregular network of reconnaissance routes. Routes were determined by terrain physical characters and availability of signs and existing gorilla trails.

-Four teams composed of two well-trained trackers were submitted to a one week training to learn how to conduct the population survey with emphasis on field exercises and demonstrations.

-Surveyors systematically traversed the survey area from a major axis oriented according to topography, habitat characteristics and probabilities of finding the gorillas, during a period of 15 days per month.

-The survey was conducted by four teams traversing the entire gorilla habitat range, searching for fresh signs of gorilla groups. Each gorilla makes a fresh nest to sleep in every each night, and these are used to establish the number of gorillas in each group.

-Indirect observations: signs such as trails, dung, nests, food remains, silverback's hairs were recorded. In each nest the population composition of adults, juveniles, males and females was determined by measurements of dung. The position of nest on the ground or on the tree was noted. At each nest site, nests were counted and measurements of dung size were used to establish the age and sex of all member of the group. Three similar nest sites confirm the group composition. Dung size allows the identification of age and sex categories:

SB = +7.2cm = Silverback

MED = 5.5-7.2cm = Female and Blackblack male

JUV = -5.5cm = sleeping in own nest including 3-6 years and 6-8 years sub adults

INF = <4cm = sleeping in mother's nest

-Direct observation: all animals seen were counted and recorded and their geographical position indicated on the map using a GPS apparatus and ArcView software.

-Trails used by walkers or recorders were planned so that distance between adjacent trails was never greater than 500m. Trail of five or less days old were walked until nest sites were found out using a GPS every 250m was located on a topographic map by putting readings of compass and altimeter. All paths taken and all gorilla trails were mapped. Efforts were made so that all of the groups are found out. We also made efforts so that none of the gorilla groups are counted twice. It is known that one third of babies can be missed during the census and this is the correction factor used for estimating the total population.

-Ranging and distribution patterns were studied thanks to prints, fresh trails, and nest site and their position were recorded with GPS. Habitat used was known from data recorded about the gorilla activities: nesting, resting, displacement, movements within the site when foraging (Schaller, 1965, Chifundera K. et al., 2003).

b) - Forest exploitation survey

A study on the forest structure and composition were carried out by using transect methods (2m x 500m, 0.1ha), and forestry inventory methods (Loetsch et al., 1973). Trees, shrubs and lianas that are exploited by local people were identified. A survey of forest products used by local people was done by conducting an interview with villagers and by direct observation (See the Socio-economic Section). The plant specimens were identified by reference to the Herbarium of Lwiro (DR Congo) where the voucher specimens are currently preserved. A questionnaire was administered to people living inside the Itombwe Forest in order to gather information about the use of forest and forest products. Data about tree cutting, farming and logging were gathered during walking within the transects. An estimate of the surface area was done thanks to GIS by using the ArcView 3.2 software.

c) - Socio-economic survey

Farmland dotted with settlements was located outside and inside the forest. We made a survey of plant, animal and land uses. Interviews and visits to local markets to gather data about the socio-economic situation and consumption of forest products.

4. Results

4.1. Gorilla populations

A total of 108 gorilla individuals was recorded in the random and nonrandom transects with a density of 0.02-0.7 gorilla/ Km².

4.2. Sites of gorilla occurrence

Gorilla occurrence was significantly influenced by habitat variables. In normal conditions, lowland gorilla populations are usually found in wider habitat and avoid sites with extensive thickets. During, a daily-base monitoring, a team from the project determined that the area in Upper Ulindi, from Kigogo-Muhuzi (Northwest) and Irangi-Kabilombo (Southwest) is occupied by gorillas, estimatey 2384 Km², about 33.1% of the area surveyed in 1959 and 21.4% of the area surveyed by Grauer in 1908. Gorilla occurrence was significantly influenced by habitat variables, and putting together historical and current data, we recognized and mapped sites of occurrence (see Discussion section).

4.3. Plant used by local communities

We recorded 20 sawpits and 16 mining sites. More than 1540 cubic meters are annually extracted from the Itombwe Mountains. This quantity gives a figure of trees cut of corresponding to a deforested area of more than 4350Km². The following tree species are the most exploited: *Millicia excelsa*, *Entandropagma cylindricum*, *Ekebergia capensis* and *Lebrunia bushaie*.

4.4. Socio-economic situation in the Itombwe Massif

A socio-economic survey was conducted in six villages (Lubumba, Miti, Kitopo, Kitibingi, Manja, and Kalingi) where people are hostile against the protected area policy and practicise hunting for bushmeat. One hundred and five people were interviewed, including 33 women (31.4%) and 72 men (68.6%). From this survey we found out that: 22.8% have been at school, 56.1% exploit the forest, and 36.19% are traditional hunters.

This survey shows that 79 persons (75.2%) agree and 20.9% do not agree with the Act creating the INR. People who did not agree with the status of protected area fear that they will not continue to have access to the forest.

In fact people use the forest and forest products for many purposes. From this table one notes that local people collect plant and animal materials for the various reasons identified in Table 3.

Table 3. Plant uses

Forest exploitation	Uses	Score	Percentages	Remarks
Plants	Medicines	14	29.7	
	House construction	13	27.6	
	Food	9	19.0	
	Timber	3	6.3	
	Net weaving	3	6.3	
	Ritual ceremony	2	4.2	
	Hunting	2	4.2	
	Fire making	1	2.1	
	Palm wine	1	2.1	
	Drinks	1	2.1	
	Bed making	1	2.1	
	Trap making	1	2.1	
	Bee keeping	1	2.1	
	Bridge construction	1	2.1	
	Roofing materials	1	2.1	
	Total	47	100.0	
Animals	Great apes	2	5.8	Chimp, gorilla
	Larger mammals	16	47.0	Elephant, buffalo, antelopes
	Small mammals	6	17.6	Rodents
	Monkeys	4	11.7	
	Unidentified animals	6	17.6	
	Total	34	100.0	

The results show that people use plants for house construction (53.1%), medicines (29.7%) and food (19%). We were interested in factors that accelerate the destruction of the forest and we found that tree cutting for timber and charcoal production are the main threats (see chapter 2). The plant morphologies are: tree (34.9%), shrubs (15.4%), lianas (13.6%) and herbs (27.2%). Big trees (*Lebrunia bushaie*, *Ekebergia capensis*, *Entandrophragma cylindricum* and *Millicia excelsa*) are exploited for timber. Shrubs are used as sticks for house construction and lianas are used as ropes for making bridges.

The parts of plant used are: fruits, leaves, stems, stem barks, and roots.

Animals are killed for meat supply, thus 91% of killed animals (larger and small mammals) are used as bushmeat. However, totemic animals are (9%). When we are writing this report no buffalo and elephant was seen, all them had been decimated.

From these findings we consider that conservation projects should be based on tree planting and small scale farming in order to provide wood and meat to indigenous people.

4.6. Threats to habitats and gorillas

Deforestation is mainly due to logging, charcoal burning, mine extraction (mining companies: BANRO and SAKIMA), and tree cutting for house construction. While the logging has seriously affected the area since 1996, people observe that a high level of habitat loss is also due to agricultural extension, human settlement, and conversion of lands into pastures, farmlands and firewood collection. Thus, lowland gorilla is threatened with disappearance at local level by habitat loss, poaching and hunting.

5. Discussion

Gorilla survey in the Itombwe Massif began in 1908 by Emlen Grauer, an Austrian Explorer, and continued in 1959, 1998 and 2006. Birds were intensively surveyed by Prigogine (1971, 1978) and vegetation surveys were done by Doumenge (1998) and Bashonga (1998).

Prospective and onground investigations have showed the following chronological changes in lowland gorilla ranging patterns.

A)-In 1908, the Eastern Lowland Gorilla populations were observed in the Itombwe Massif in a polygon ($3^{\circ}25'4''-4^{\circ}18'27''$ and $28^{\circ}19'-29^{\circ}00'$) of 11.126Km², about 68.6% of the total surface area of the Itombwe Massif (16200 Km²).

B)-In 1959, Emlen and Schaller surveyed the South and Southwest of the Itombwe Massif and identified 17 gorilla areas located from Miki (Southwards) to Zombe River (Northwards). This area of 7200 Km² ($3^{\circ}06'09''-3^{\circ}53'02''$ and $28^{\circ}30'-29^{\circ}09'01''$), is about 64.7% of the Itombwe Mountains. This area was submitted to deforestation due agricultural expansion.

C)-In 1996 Omari and colleagues counted 857 gorillas individuals in fifteen localities ($3^{\circ}06'09''-3^{\circ}52'6''$ and $28^{\circ}17'42''-29^{\circ}00'$), between Kapanga (Southwards) and Zombe (Northwards), about 1530 Km² (21.2%).

D)-In 2006, we recorded the presence of gorilla populations in the area from Kigogo-Muhuzi (Northwest) to Irangi-Kabilombo: 2384 Km² ($2^{\circ}57'-3^{\circ}12'18''$ and $28^{\circ}02'-28^{\circ}50'$), about 33.1% of the area surveyed in 1959 and 21.4% of the area surveyed by Grauer in 1908.

Gorilla density was 0.002 gorilla m² in the random transects and 0.07 gorilla m² in the non-random transects.

This study reports the distribution and habitat use of gorilla in the Itombwe Mountains with the aim of evaluating the impacts of plant exploitation on the ranging patterns. The distribution area has been dramatically reduced, so that gorillas are located in a small polygon of about 2384Km². Hunting, and deforestation (conversion of forests into grazing and farmlands), mine extraction, and logging and charcoal production are the major threats to habitat and gorillas. Changes that were observed in lowland gorilla populations are signs of decline. In fact, gorillas that were estimated to 17000 individuals in 1990 plunged to less than 3000 individuals in 2004 as released by the National Geographic News, information based on scientific reports from conservation agencies (WWF, DFGFI, CI and IGCP) based in the region. This dramatic decline of gorilla populations, about 80% in fifteen years, is crucial for the survival of the subspecies.

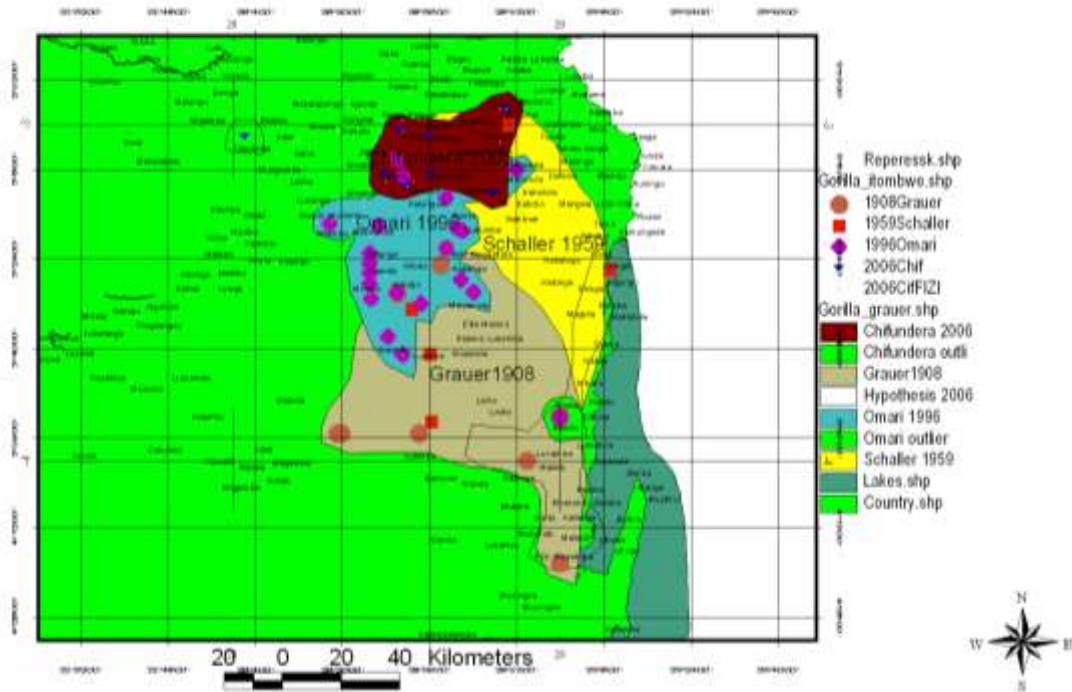
Grauer's gorilla occurs at naturally low densities and this makes it particularly susceptible to extirpation and extinction at local level. Lowland gorilla individuals are popular with people that share their range area as they are hunted for bushmeat, a factor that has led to death of many gorilla individuals. This situation has been exacerbated by the civil war because the forest has been used as refuge and place where militiamen from Rwanda and Burundi are hidden. The size of the ranging area is particularly important because 'edge effects' are pronounced for large mammals and especially great apes. This means that people living near the area have easier access to the forest for poaching and tree cutting or agricultural expansion. Deforestation rates have been at their highest during the last decade and have been caused by the unsustainable demand for natural resources. We recorded 20 sawpits and 16 mining sites. More than 1540 cubic meters are annually extracted from the Itombwe Mountains.

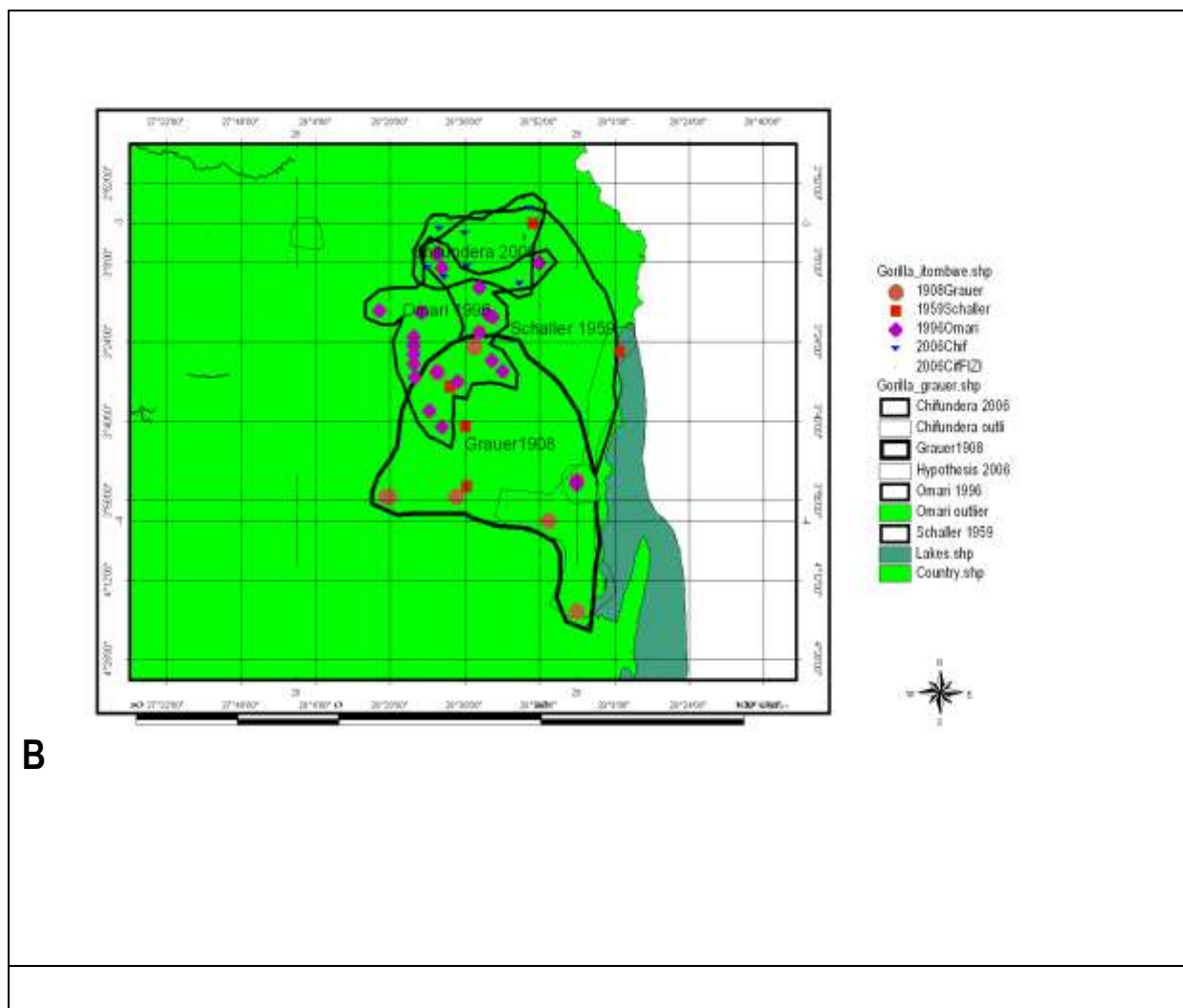
According to our findings the lowland gorillas are currently distributed between Ulindi and Elila rivers

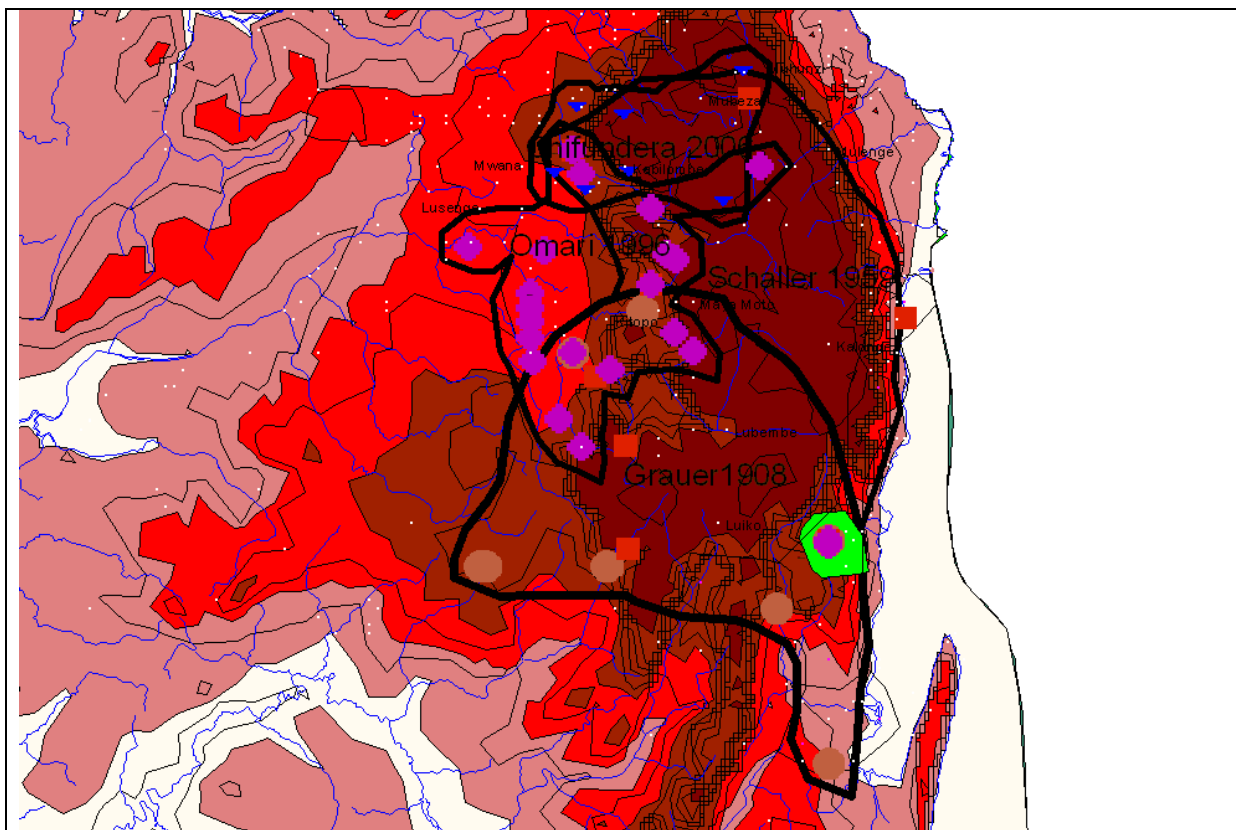
Figure 3. Surveyed polygons (A,B,C,D)

A

Historical distribution of lowland gorillas in the Itombwe Mountains

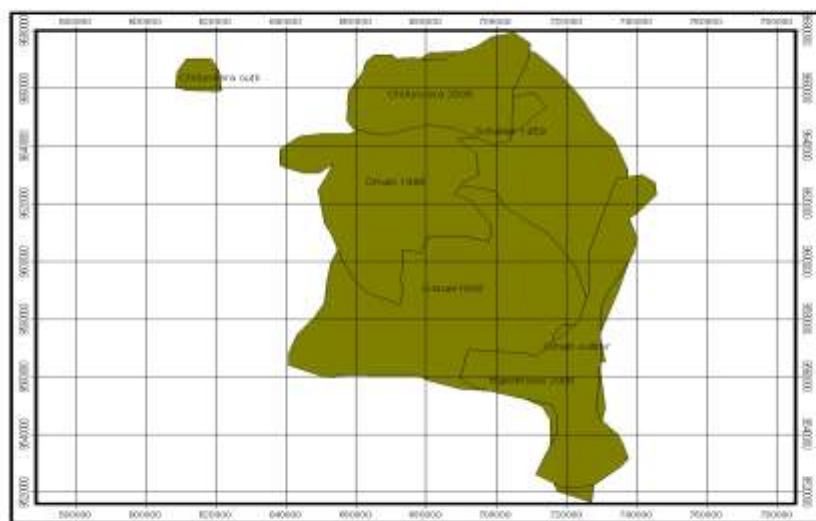






C

D



In 1990, population extinction prompted inclusion on the World Conservation Union's Red List of threatened species as critically endangered (Oates, 1996). The species is primary forest or secondary forest -dependent, and shows a distinct size-related habitat shift, foraging in diversity of habitat. No previous studies have been done on the habitat and ranging patterns until this one in the whole Itombwe Mountains provided an indication that the species might be suffering from disturbance of its distribution range.

Our results reveal a significant association between gorilla presence and some habitat features, namely sites located in the polygon were surveyed during dry and rainy seasons with undercuts and/or well-developed canopy, which provide both shade and structural complexity. Although only 108 gorilla individuals is a small number to make any strong conclusions about habitat use, small sample size is a limitation often encountered with endangered and protected species whose numbers have been reduced to a fraction of their original population size. Habitat use reported here are similar to those found in previous gorilla habitat studies conducted in Kahuzi-Biega National Park where gorillas are under a protection regime (Hall et al., 1998). Habitat structural complexity alone does not account for presence/absence of gorillas, it is rather the combination of structural complexity, food availability, and shelter from poachers from surrounding villagers. Based on the size of range surveyed it clearly appeared that plant exploitation plays a role in the gorilla movements and spatial occupancy. The need for structurally complex habitat reported above might explain the differences in gorilla abundance and distribution among sectors or sites. **Lowland gorilla high densities were only found in the few sectors of Mwana-Zombe. The area between Muhuzi and Mwana was relatively more populated by gorillas that are observed in structurally complex forests.** Forest habitats, although critical nursery areas for gorillas continue to be threatened from modification, degradation and destruction in the East and Southwest of the Itombwe Mountains. Well-established secondary forests with high understorey complexity contain the highest number of gorilla individuals. Results reported here show that gorillas are found in well-developed forests with high spatial complexity. From a gorilla conservation perspective, all the surveyed sites are the most valuable habitat in need of protection. Therefore, monitoring the abundance and distribution of gorilla in the habitats may help evaluate the population trends in the Itombwe Mountains.

The protection of the Itombwe should be undertaken with urgency taking into account: law enforcement (protection status, conservation and management plan), the education and awareness campaigns (meetings, workshops), implementation of community development projects (farming activities and alternatives to bushmeat), scientific knowledge about the whole biodiversity (inventories, censuses, surveys) and participatory demarcation of the protected area according to the Act of October 2006 (participatory cartography for reducing claims from local communities). These protection measures are herein suggested because we observed that threats to habitat and species are mainly due to mine extraction, firewood collection, logging, poaching, clearance for farmlands and charcoal production. Moreover, past tree cutting still have an impact on the forest with greatly reduced canopy cover, altered vegetation composition and few large herbivores remaining, such as elephants. It is reportedly known that the populations have declined since 1990. These current and historical threats raise questions about the ability of the montane forests to survive and regenerate in the long-term, and emphasize the importance of close monitoring of the forests and the wildlife populations they support.

a) - Grauer's survey in 1908

The Eastern Lowland gorilla populations have been identified in the Itombwe Massif by Emil Grauer in 1908. The first **systematic** survey of gorilla was done in 1959 and spotted 17 discrete areas of gorilla occurrence (Emlen and Schaller, 1960). Gorilla presence was observed in a polygon situated between Kisale I (North), Bitibingi, Sanje River, Kisale II (South) and Fizi, about 11.126Km² or 68.6% of the total surface of the Itombwe Massif (16200 Km²) as estimated by Prigogine when he was surveying birds between 1950 and 1967 (Prigogine, 1971, 1978). Unfortunately, the area was submitted to intensive

exploitation of minerals by a Belgian Company called Mines des Grands Lacs (MGL) since 1926. Roads, mining camps, mine extraction were implemented and timber production for house building took place. In fact lumbers were sent everywhere for the construction of towns (Miki, Zombe, Kamituga, Mwenga, Uvira, Kasika, Twangiza, Mwana, etc. Because of this habitat destruction gorillas moved from Eastern to the safer Western sites (3°25'-4°18.27' and 28°19'-29°00', 1300-1850m) between Elila River (Southwest) and Ulindi River (Northwest), so that Schaller encountered them there in 1959.

Table 4. Gorilla areas of occurrence in 1908 according to Grauer's expedition

Locations	Latitudes	Longitudes	Altitudes (m)
Sibatwa West Kisale II	3°55'	28°19'45''	
Kabonga village West Sibatwa	3°55'	28°19'	
Kisale I –Northward	3°25'	28°38'	
Kitibingi	3°30'	28°30'	
Upper Sandje River – Kapanga	3°52'	29°00'	1300-1850
Mutambala River crossing 4°S	4°00'	28°53'51''	
Kisale II –Southward	3°55'	28°34'	
Southern landmark	4°18.27'	29°00'	

b)-The situation in 1959

In 1959, Emlen and Schaller surveyed the South and Southwest of the Itombwe Massif and identified 17 gorilla areas located from Miki (Southwards) to Nzombe River (Northwards), about 7200 Km², 64.7% (7200/11126). During that year various mining activities stopped because of the political turmoil in the DR Congo, formerly Belgian Congo, because of the preparation of independence. However, the area was still submitted to human pressure from wildlife hunting and deforestation. The Congolese communities occupied the mining camps, sucked the infrastructures, but abandoned the maintenance of roads. They practised extensive agriculture and pastoralism. Gorilla areas (3°06'09'-3°53'02' and 28°30'-29°09'01') were reduced to 64% due to deforestation.

Table 5. Gorilla distribution in 1959 as indicated by the Schaller survey

Locations	Latitudes	Longitudes	Altitudes (m)
Kapanga	3°22'	28°39'	1850
Southern Small Mwana River	3°40'49''	28°36'09''	
Kikuzi River x Ulindi River at 28°30'	3°06'09''	28°30'	1000-2400
North point of Mt Mohi	3°53'02''	28°36'23''	
Point Latitude 3°S crossing escarpment	3°00'	28°50'34''	
Escarpment point 4	3°25'54''	29°09'01''	
Upper Sandje River	3°52'	29°00'	1300
Upper Elila River	3°32'52''	28°32'42''	

c)-The situation in 1998

In 1998 a team of biologists from WCS made a survey of gorillas in several localities, and firstly confirmed the presence of gorillas in 12 areas already mentioned by Schaller and Emlen in 1959, and secondly, discovered three new areas, giving a total of gorilla area, equivalent to about 1530 Km² or 21.2%. This area is located between Kapanga (Southwards) and Zombe (Northwards), zone delineated by Elila and Ulindi rivers (Table 8). However, the gorillas are considered extinct in the area located in a triangular sector of 1704.4 Km², about 23.7% after 1959. During this period, gorilla was seen ranging between 1170 and 2600m of altitude corresponding to a vegetation of montane forest and bamboo

formation. Gorillas were seen in secondary vegetation, clearings, and agricultural fields and at the edge of human settlement. A total number of 857 gorilla individuals were counted in the survey area (3°06'09"-3°52.6 and 28°17'42'-29°00').

Table 6. Gorilla distribution polygon in 1996

Locations	Latitudes	Longitudes	Altitudes (m)
Kabembwe	3°52.6'	29°00'	1850
Upper Sandje River	3°52'	29°00'	1300
Landmark	3°41'	28°31'	
Ibachilo	3°37.8'	28°28.4'	1550
Mt Kasondjo	3°32'	28°34.4'	2000
Mt Lundjei	3°29.9'	28°44.1'	2600
Kitibingi	3°30'	28°30'	1270
Ngomyano	3°18'	28°26'38"	
Kabelukwa	3°31.1'	28°25.3'	1170
Mt Ibenga	3°27.7'	28°41.8'	1970
Kiandjo	3°24.7'	28°25'	1850
Kapanga	3°22'	28°39'	1850
South Kiandjo River	3°28.3'	28°25'	1000-2600
Lueno	3°23'	28°25'	
Milanga	3°26.4'	28°25'	
Mt Kipapa	3°17'38"	28°17'42"	
Mt Ngusa	3°18.4'	28°41'	2600
Mt Nolabi	3°19'	28°42'	
Kakanga	3°13'	28°39'	

Zombe River	3°09'	28°31'	
Landmark	3°08'	28°52'	
Kikuzi	3°06'09"	28°30'	2300-2400
Mutambala River			2800

e) - Sites of occurrence in 2006

During, a survey based on daily monitoring, a team from our project have ascertained the presence of gorilla in the area located between Kigogo-Muhuzi (Northwest) and Irangi-Kabilombo (Southwest) in Upper Ulindi, estimated to 2384 Km², about 33.1% of the area surveyed in 1959 and 21.4% of the area surveyed by Grauer in 1908 (Table 4). A total number of 108 gorilla individuals were recorded in this sector (2°57'-3°12'18" and 28°02'-28°50').

Table 7. Gorilla distribution in 2006

Locations	Latitudes	Longitudes	Altitudes (m)
Kigogo	3°02'	28°36'	2200
Ilibo-Irangi	3°01'08"	28°30'31"	
Kabilombo	3°08'44"	28°36'31"	
Mwana	3°09'	28°28'	
Zombe	3°10'57"	28°31'37"	
Muhunzi	2°57'	28°50'	2400
Upper Ulindi	3°12'18"	28°47'42"	
Kibungwe	3°02'	28°02'	1250

Since 2001 until now CLP implemented this project and contributed to the creation of the INR. The Itombwe Massif is now gazetted and recognized as protected area named Itombwe Natural Reserve, Réserve Naturelle d'Itombwe, RNI' by the Act No 038 of 11 October 2006. Efforts must be done to strengthen the protection status, to continue the biodiversity surveys, to implement community-based conservation, and education programmes. International NGOs began to consider the area as site of conservation priority in 2000 when BirdLife, WCS and WWF started the work, but they did not get a conservation status for the site.

In regard to this, action plan for managing the INR must be established and appropriate conservation measures including research, community projects, education and capacity building for local CBOs should be undertaken.

The aim is to get through combined efforts the conservation of the Itombwe Forest taking into account the needs of local communities.

The results from the fieldwork show the following findings:

- the present ranging area of gorillas, is estimated to 2384Km²
- the number of gorilla is ca.108 individuals

-the plant exploitation practiced by local communities are major threats faced by the Itombwe Forest.

Accordingly, the original question has been answered, the plant exploitation has impacted on habitat and gorilla population by reduced the ranging area and the gorilla population. At the time we are writing this report killing of gorillas was reported from the locality of Lubumba, where an entire family was decimated including a baby. Traditional hunters are responsible for this massacre.

For reducing the effects of threats on the habitat and species we suggest the integrative solutions indicated in Table 8.

Table 8. Threats and alternatives

Threats	Control measures	Alternatives	Responsible for integrative process
1.Hunting	-Law enforcement (Law 082) -Education -INR 's management plan	-Small scale stock farming for meat	NGOs, ICCN, Government
2.Mine extraction	-Prohibition (Code Minier) -Law enforcement	-Income generating activities	Government
Shifting agriculture	-Training in modern agricultural methods -Improving the land use policy	-Providing seeds to cultivators	NGOs, Government, CBOs, Communities
4.Timber production	-Prohibition -Law enforcement (Code Forestier) -Training in sustainable production	-Afforestation	Government and ICCN
5.Charcoal production	-Prohibition -Law enforcement (Code Forestier) -Training in sustainable production (Code Forestier)	-New forms or sources of energy -Use improved ovens	Government and ICCN
6.Hostile attitude	-Community-based conservation	-Awareness raising	NGOs , CBOs, Communities and ICCN

	-Development projects -Education -Negotiation		
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The major limitations of the project have been the following:

- Time consuming surveys under hostile environmental conditions
- Insufficient funding to implement community -based conservation of the Itombwe Forest
- The remoteness of the huge area did not allow complete survey.
- Lack of means of transportations

For mitigating these problems or limitations we call for help for getting funding. We are writing a conservation follow-up project for:

- Undertaking actions that can mitigate the threats and develop conservation measures mentioned in Table 9.

e)-Local professional development

The project is linked to local CBOs (ASEF and ADA) and governmental bodies (ISEC, ICCN, and See Collaboration Section). People from these organizations are presently working with the project. They also were trained in conservation sciences by the project team in order to build local capacities (See Education Section). Two short training courses in conservation sciences were organized.

f) - Involvement of local community

People who were living around the Itombwe Forest were estimated to 623,000 inhabitants. Community representatives were associated with the project implementation. The fieldwork team included people recruited from grassroots community and are employed as gorilla trackers (See Management Section). However, the project intends to develop a community-based conservation of the Itombwe Forest (Mubalama and Chifundera, 1999).

g) - Dissemination

A poster was presented to the SCB 21 Annual Meeting held in Port Elizabeth in July 2007 (Chifundera and Basilwango, 2007). The full paper will be published in December 2007 in the Gorilla Journal, Germany.

h)-Education

The project has been running educational programmes consisting in meetings, workshops to raise the public awareness. Visits to the site were used as educational tool. Training sessions were organized in order to teach people the biodiversity values of the Itombwe Forest. Three meetings and one workshop, several visits to the site, and weekly broadcasts on the radio APIDE and RTNC (state Radio television) were organized. News from the field were sent to the CLP Newsletter, and also published in local newspapers of environmental education advocacy, such as *Kivu Safari* and *Le Gorille*.

The first three days workshop was held at Irangi Field Station in December 2006 with the scope of promoting the public awareness. Fifty six participants attended the workshop.

The second workshop has been held at Chai Bukavu, in May 2006. Thirty five persons attended the meeting. Participants learnt about population survey methods.

The selection of participants was done using the following criteria and scores.

Table 9. Target groups and criteria

Target groups	Impact level	Positive influence	Negative influence	Location
1. Customary chiefs	5	3	2	Luindi, Basile, Itombwe
2. Hunters	4	1	5	Surrounding villages
3. Governmental bodies	4	5	0	Administrations
4. CBOs and NGOs	4	4	1	Local, national, international
5. Villagers-layer populations	2	2	2	Surrounding villages
6. Armed groups	4	0	5	Inside the forest

- Training courses were delivered to students from ISEC and to workers from RGMB.
- Meeting was held at Kasika with the customary Chief Mubeza Bugoma of Luindi County
- Two meetings were held in Bukavu with international NGOs (WWF, WCS), national NGOs (Héritiers de la Justice) and Civil Society, ICCN, CBOs, and state services.
- A meeting was held at Mboko with women who harvest the mushrooms in the Miombo formation.
- Groupe de Travail pour Itombwe, (GTI) meetings were held in Bukavu and Kinshasa with the Congolese Wildlife Authority (ICCN).

From the meetings and workshops we derived the following useful information:

1. The research has been carried out at two levels to design the project, to determine behaviours and define alternatives as well as the related barriers or constraints.

-Level of NGOs

We contacted the NGOs that are working in the area for more than ten years (WCS). They gave information about the environmental problems and causal factors along with the proposed solutions or alternatives. Meetings were held in Bukavu in the frame of GTI. Barriers were noted.

-Level of communities

We visited the villages and interviews and questionnaire were administered to sampled households. Meetings were held at Miki, Irangi and Kamituga. Answers to questions gave information on the needs, perception of the p.a. We had data on current level of knowledge, skills and alternatives. Results from the research are summarized in table 24. We noted that attitude of landowners is a threat to INR implementation.

2. Preferred means of awareness

During the survey and research, we observed that people are receptive when grouped together in discussion forums or workshops. Meetings or reunion are not welcome, though suitable to leaders or decision-makers.

Accordingly, communities prefer:

*entertainment on the radio because no newspapers are available in the villages

*Discussion forums and workshops are welcomed for exchanging and information sharing

*Videos and movies for leisure

Accordingly, readings, booklets, leaflets, brochures are poorly used because the community members are illiterate.

3. Which attitude to promote conservation

* We observed that landowners, who are the chiefs of villages or customary chiefs, are hostile towards the protected area. They have a fear of spoliation or losing their lands

*Communities think that they will not have access to forest resources if the park is created. Accordingly, the hostility must be transformed into agreement, cooperation and collaboration if the incentive means and knowledge are provided.

4. The areas of conflicts have been assessed.

Access to forest products (exploitation, harvesting, gathering, cultivation, and hunting); the park administration can not accept the exploitation of wildlife and destruction of forest. This is the origin of conflicts.

5. Introduction and training to alternatives

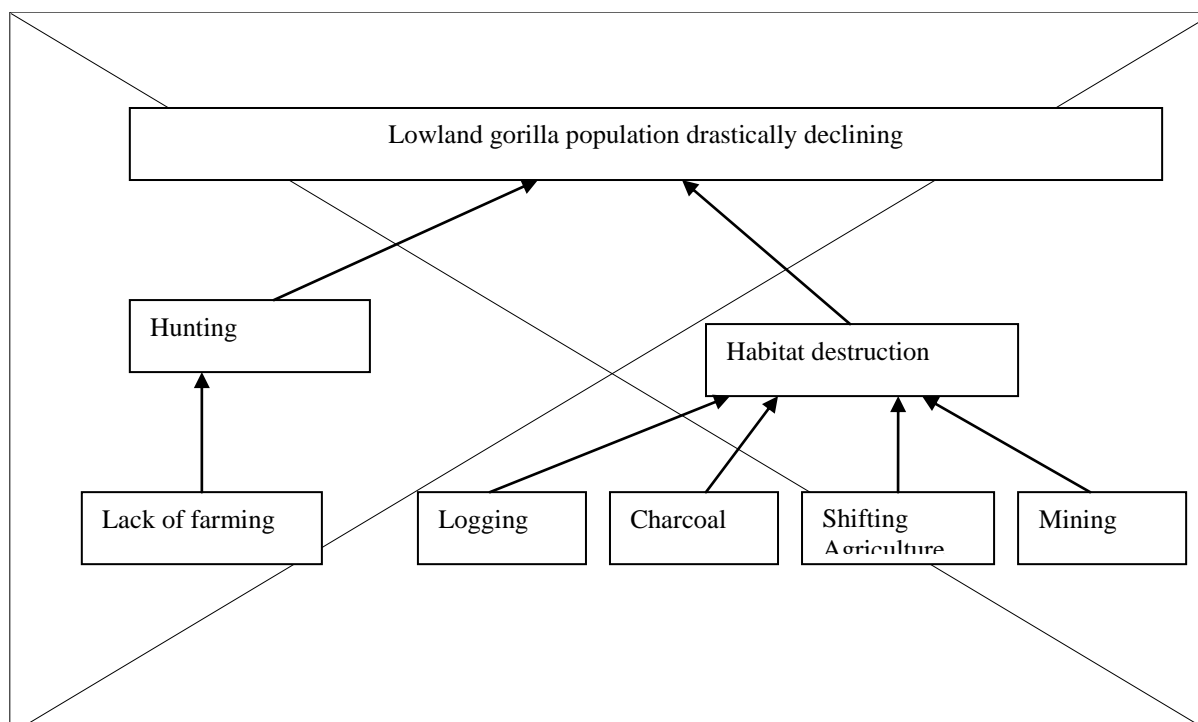
Our research has showed the threat behaviours, the root causes and optional alternatives. The alternatives fill the gap in accessing to natural resources. The following alternatives proposed are:

- ** Small scale farming and domestication of rodents for meat supply,
- **Modern agriculture and agroforestry to avoid shifting agriculture,
- **INR strengthening
- **New sources of energy

Table 10. Alternatives, training and investments

Alternatives	Training	Investments
Domestication	Veterinary to train Farming methods	Funding
Agroforestry	Agronomist to train Providing seeds Tree planting	Funding
New source of energy	Improved oven	Funding
INR	Management plans CBC	State support

Figure 3. Researching the elements of education programme



A) - Behavioral threats

- 1. Overkilling of gorillas:** hunting for bushmeat practised by traditional hunters and poachers from surrounding villages and armed groups hidden in the forest, forest dwellers do not farm.
- 2. Habitat destruction:** deforestation is due to logging, charcoal burning, shifting agriculture and mine extraction.

B)-Target groups carrying harmful behaviours

Table 11. Target groups carrying harmful behaviours

Behaviours	Drivers	Alternatives
Hunting	Hunters, poachers	Farming, domestication
Habitat destruction	Loggers	Delocalisation of the activity
	Charcoal burners	New sources of energy
	Cultivators	Training in modern methods
	Landowners	New form of resources

C)-Learning needs

Hunters: knowledge

Loggers: knowledge and skills

Charcoal burners: skills

Cultivators: training in modern methods of cultivation

Landowners: knowledge and change in attitude

-Implementing education project

Aims: bringing change in behaviours

Objective: Networking the education programme for changing community behaviours and attitudes towards conservation of the INR.

Specific objectives:

-Targeting behaviours

Change behaviour: what can motivate and enable to do better?

Knowledge, skills, attitude, alternatives, barriers = factors that can be influenced by education

Change behaviour and promote conservation

Knowledge is informing people about the nature and extent and environmental or conservation issues by education

Problem analysis

Overkilling: hunting for bushmeat, lack of protection status

Deforestation: logging, charcoal burning, mine extraction, firewood for energy, tree cutting for house construction, shifting agriculture expansion, lack of protection status

Table 12. Environmental problems

Problems	Level of impact on gorilla	Level impact on habitat
Hunting-poaching: overkilling, bushmeat	5	0
Habitat destruction:	5	5
-deforestation: logging	4	5
-deforestation: charcoal	4	5
-deforestation: mining	3	3
-deforestation: firewood	1	2
-deforestation: tree cutting for construction	1	2
-deforestation: shifting agriculture	2	2
Lacking the protection status	5	5

From the Table 12, we note that disappearance of gorillas can be caused by habitat loss and overkilling, and the disappearance of habitat is caused by deforestation, when there is not protection status for the site.

Table 13. Behaviours, drivers and target groups

Behaviors	Drivers	Target groups	Priority groups
Hunting-poaching	Sellers on market	Traditional hunters, poachers, customs	Hunters, communities
	Armed groups		
	Consumers		
Charcoal burning	Consumers	Burners, communities	Burners, communities
	Sellers on market		
	Military groups		
Logging	Transporters	Loggers, state and private agencies, customs	Loggers, states services and traders
	Sellers on market		
	Users in town		
Shifting agriculture	Consumers, harvesters	Cultivators, landowners	Cultivators, landowners
Mine extraction	Exporters, transporters		
		Mining companies, artisan miners, state and private agencies, customs	Mine exploiters, communities, state services

From the Table 13, we get the target education groups: traditional hunters, community members, loggers, burners, miners, state services, company workers, cultivators, and landowners.

Option/alternative ranking and matrix

A)-Hunting behaviour

Table 14. Hunting behaviour

	Target behaviour	Option 1	Option 2	Option 3
	Hunting	Livestock	Domestication	
Use/benefit	Meat supply	Income , market	Easy to practise	
Environmental impact	Decimation of wildlife	Grazing	Not harmful	
Barriers		Lacking funding	Lacking funding	

B)-Habitat destruction behaviour

Table 15. Habitat destruction behaviour

	Target behaviour	Option 1	Option 2	Option 3
	Deforestation	Providing improved ovens	Tree planting	Agroforestry methods
Use/benefit	High income	Easy to use	Income	Income
Environmental impact	Destructive	Not harmful	Not harmful	Not harmful
Barriers		Lacking funding	Providing seeds, investment	Lacking funding and inputs, investment
			Lacking funding	

From this table we get the alternatives: domestication of small mammals, tree planting, agroforestry, new sources of energy.

-Target groups:

Hunters: knowledge

Loggers: knowledge and skills

Charcoal burners: skills

Cultivators: training in modern methods of cultivation

Landowners: knowledge and change in attitude

- Learning needs

Knowledge, skills, changes of attitude, lack of options, external barriers.

-Content of education programmes:

Domestication of animals, tree planting, agroforestry, new sources of energy, agreement with the protection status

Conclusion

The project has conducted the field reconnaissance's between 2001-2004. The project started working on the ground in May 2006 carrying out survey on plant exploitation and gorilla populations. Fieldwork was conducted on a daily basis using a team of trackers hired from villages surrounding the Itombwe Forest. We observed that plant exploitation in terms of timber and charcoal production, logging, mine extraction and conversion of forests into farmlands have impacted on habitat. However hunting for bushmeat had a serious impact on gorilla populations. The plants used by local populations, and the estimated number of gorilla individuals, and the ranging area were determined (2384Km²). This is an indicator of that the project's goal has been reached.

The project has demonstrated the conservation values of the Itombwe Forest and was very strong in raising the awareness among local communities. However, the lack of sufficient funding was a serious handicap for responding to the needs of local communities who were asking for support for installation of health care centres, schools, improving the living conditions, road building and farming improvement.

The key project's achievements can be summarised as follows:

(A). the plant exploitation survey has demonstrated that timber and charcoal production are causes of habitat disturbance and loss. About 87,5Kg of charcoal were consumed by person and by year. The fuel wood is consumed at a rate of 1m³/p/y in the Lowlands and 3m³/p/y in the highlands. 98, 1% of domestic consumption of energy is from fuel wood with the following proportions: 60% from charcoal and 40% from firewood.

Communities that are living inside and outside of the Itombwe Forest are consuming tons of charcoal. An annual rate of deforestation has been estimated to about 0, 19% per year, or 13000ha, saying that the entire forest can disappear in 60 years if nothing is done now for its protection. Moreover, about 1540cubic meters and 15 tons of charcoal are produced per year, equivalent to a deforested area of

about 320SqKm. The reduction of habitats has modified the ranging area of gorillas presently found in a small polygon representing 36% of the original of the Itombwe Massif.

B).From the gorilla survey we have found 108 individuals in the present ranging area. This is evidence that gorillas are still present but in small declining population (10, 8%) than before 1998 when they were estimated to more than 857 individuals:

The project has wider significance and benefit to conservation activities because of the presence of an endangered subspecies gorilla that can draw attention of policy makers, persons and organizations for conserving the species and its habitat (WWF and IUCN, 1994).

Through meetings with stakeholders we have demonstrated the importance and urgency for conserving the Itombwe Forest. Collaborative actions with local CBOs, international NGOs and governmental bodies have produced a good result because the forest is now considered as protected area called 'Reserve Naturelle d'Itombwe RNI'. This is a contribution to the conservation efforts developed in the Albertine Rift (Stattersfield, et al., 1998; Stuart et al., 1990).

The Itombwe Forest is considered as protected area under the Act no 038 of 11 October 2007. The Congolese Wildlife Authority (ICCN) has nominated a Warden for leading the management plan. According to the ongoing conservation efforts we recommend:

- To consolidate the INR and bring all kind of support to this new structure,
- To implement medium-term research and long-term monitoring in order to document the biodiversity
- To implement community-base conservation action plan in order to reduce the human pressure on the habitat and species and to bring changes in attitude, because local communities are still hostile and to reduce the conflicts between the reserve and populations.

According to these recommendations, we need to implement a follow-up consisting in:

-Implementing ICDPs for responding to the needs of local communities and supporting the RNI.

-Paying attention particular to education

-Establishing monitoring programmes with the scope of updating the existing data about the biodiversity richness, gorilla populations and habitat requirements.

Accordingly, a follow-up project has been submitted to CLP in the frame of continuation award programme, and is entitled: ***Networking education programme for conserving the Itombwe Forest.***

C. Follow-up

Using the parameters related to the objectives, we can say that the project has been implemented but the objectives partly achieved. We still need to achieve the following activities:

1. Consolidating the achievements

It is very important to consolidate our achievement by: helping the ICCN:

- To strengthen the INR by establishing the conservation and management plans,
- To develop the education and awareness raising programmes, and
- To implement the development projects.

2. Ensuring the delineation of the INR

The INR has been created by the Act no 038 but it includes in its boundaries areas identified as 'undifferentiated montane vegetation' unit, comprising the western boundary adjacent to the Congolian Lowland Forest or Congo Basin Forest, the southern polygon encompassing Mounts Kabobo and Marungu. The polygon directly north of Lake Tanganyika that White (1982) portrays as a 'mosaic of East African evergreen bushland and secondary *Acacia* wooded grassland' was subsumed within the montane forest ecoregion, as this was considered more representative of the potential (non-anthropogenically influenced) vegetation. The areas from Irangi to Kigogo to Mwenga have been cleared and inhabited by Lega and Nyindu tribal people. It is important to delineate the appropriate zones for implementing conservation activities using the vegetation cover, species richness and threats as criteria.

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