23. Virunga Landscape

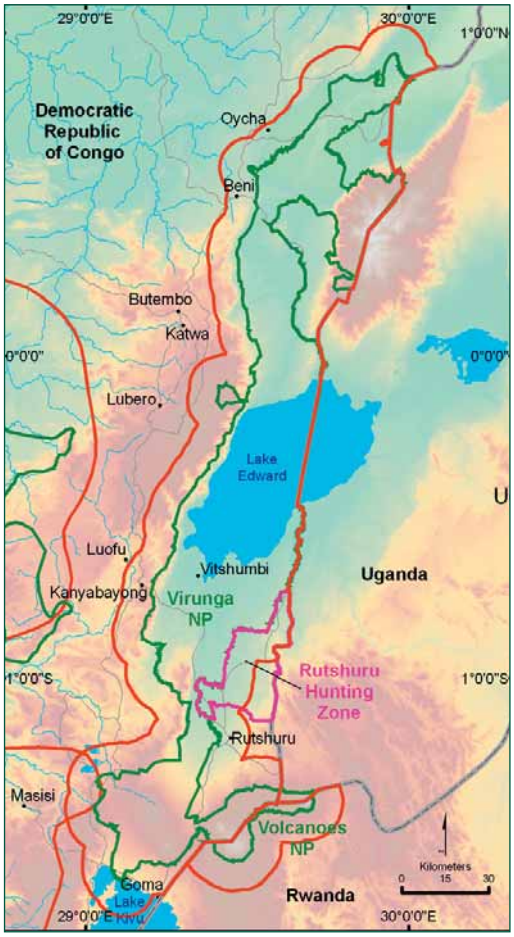


Figure 23.1. Map of Virunga Landscape (Sources: CARPE, DFGFI, JRC, SRTM, WWF-EARPO).

The Landscape in brief

Coordinates: 1°1'29"N – 1°44'21"S – 28°56'11"E – 30°5'2"E.
Area: 15,155 km²
Elevation: 680–5,119 m
Terrestrial ecoregions: Ecoregion of the Afroalpine barrens of Ruwenzori-Virunga
Ecoregion of the Afromontane forests of the Albertine Rift
Ecoregion of the forest-savannah mosaic of Lake Victoria
Aquatic ecoregions: Mountains of the Albertine Rift
Lakes Kivu, Edward, George and Victoria
Protected areas: Virunga National Park, DRC, 772,700 ha, 1925
Volcans National Park, Rwanda, 16,000 ha, 1925
Rutshuru Hunting Domain, 64,200 ha, 1946

Location and area

The Virunga Landscape covers 15,155 km² and includes two contiguous national parks, Virunga National Park in DRC and Volcans National Park in Rwanda, the Rutshuru Hunting Zone and a 10 km-wide strip at the edge of the national parks (Figure 23.1). It therefore contains human populations who have a direct impact on the protected areas. Although the more remote populations also have an influence, the conservation program has chosen to work with the immediate peripheral communities because they use the savannahs and forests in the parks to obtain firewood and building materials or to clear land for agriculture and the construction of infrastructure. Outside the Landscape, the two national parks are also contiguous with the national parks of Semuliki, Queen Elizabeth, Rwenzori and Mgahinga in Uganda. Together, these six national parks constitute the largest transborder complex of protected areas in Africa, to which must be added Bwindi-Impenetrable National Park situated a short distance away from the volcanoes in southwest Uganda. This complex functions as a single ecosystem and many animals move across the borders, which permits restoration of the populations[1].

Physical environment

Relief and altitude

The Landscape is focused on the central trough of the Albertine Rift, occupied by Lake Edward (916 m, 2,240 km²), and vast plains at an altitude of between 680 and 1,450 m. Its western edge stretches along the eastern bluff of the Mitumba Mountain Range forming the western ridge of the rift. In the northeast, it includes the western bluff of the Ruwenzori horst (fault block) with its active glaciers, whose peak reaches a height of 5,119 m and whose very steep relief comprises numerous old glacial valleys (Figure 23.2). In the south, on the border between DRC and Rwanda, it contains the Virungas, a series of eight large volcanoes surrounded by innumerable smaller volcanoes emerging from a vast plateau of lava. The highest volcano, Karisimbi, rises to a peak of 4,500 m (Figure 23.3).

Geology and soils

The mountains along the western fringe of the Landscape consist of metamorphosed rocks from the Proterozoic era. The Ruwenzori is a block of highly metamorphosed rocks (mainly gneiss) which was pushed and driven upwards in the middle of the graben, splitting it into two branches: the Semliki along the line of the rift and

[1] In the first half of the 1990s, following years of war and troubles in Uganda, hundreds of elephants reoccupied Queen Elizabeth National Park, very probably coming from DRC.

Figure 23.2. The high summits of the Rwenzori Range.

Figure 23.3. The Virunga.

Lake George farther east. The plains to the north and south of Lake Edward consist of Quaternary alluvions providing sandy or clayey-sandy soils, but there are also horizons of volcanic dust. The oldest volcanic formations date from the Miocene (12 million years); the most recent are present-day[2]. These volcanic formations provide highly permeable soils that are unable to hold water but are extremely fertile[3]. The soils of the plains around Lake Edward have also been influenced by the area of explosive volcanisms in Uganda, just to the east of the Landscape in Queen Elizabeth National Park.

Hydrology

The volcano region has no or very few watercourses, but most of the southern part of the Landscape drains into Lake Edward through the Rwindi, Ishaha and Rutshuru rivers. From Lake Edward, the waters descend into Lake Albert via the Semliki, which also receives the waters from Mitumba and the western slopes of Ruwenzori, and then on to the White Nile. Apart from Lake Edward, the Landscape also contains Lakes Bulera and Ruhondo in Rwanda, high-altitude lakes formed by the dam of high valleys following volcanic eruptions, together with the northern shore of Lake Kivu[4] in DRC. These lakes also belong to the Nile Basin via the Akagera River. Only the shores of Lake Kivu and the few streams that flow into this lake belong to the Congo Basin.

Climate

The climate is bimodal with two rainy seasons around October-November and April-May and two dry seasons around January and July. However, rainfall and temperatures vary enormously according to altitude and relief[5]. Gradients are very steep in places. The plains to the south of Lake Edward are hot and receive less than 1,000 mm of precipitation a year on average, while the saddle between the Karisimbi, Mikeno and Bisoke volcanoes receives over 2,000 mm at an altitude of 3,000 m. The flanks of the Ruwenzori are also very rainy, while the highest peaks, over 4,000 m, are dry[6]. Locally there are fog effects which accentuate rainfall. Above 3,500 m, night frost is frequent.

Vegetation

The main types of vegetation are (Figure 23.4):

(1) grassy savannahs; bush and tree savannahs of *Acacia* and *Combretum*; savannahs with xerophile thickets; and wooded savannahs having close floristic affinities with East Africa, dominant in the central part of the Landscape between the towns of Rutshuru and Beni and around Lake Edward

(2) sclerophyllous forests and thickets, associated with the lava fields in the south of the Landscape, in the Nyiragongo and Nyamulagira sectors

(3) xerophile forests of *Euphorbia dawei* and *Olea europea*, endemic to the piedmonts of the rift mountains

(4) Guinea-Congolese plain forests, limited to the northern part of the Landscape along the Semliki River and comprising mixed formations and formations dominated by *Cynometra alexandri*

(5) riparian forests

(6) submontane and montane forests with formations of *Podocarpus*, *Hagenia* and *Hypericum* and thickets of bamboo *Synarundinaria alpi-*

[2] The volcanoes are split into three groups, of which the group lying farthest west, formed by the Nyamulagira (3,058 m) and the Nyiragongo (3,470 m), is still active. The last major eruption in January 2002 seriously affected the city of Goma.

[3] Before the colonial power installed water supplies, mainly in the 1950s, this volcanic region was very sparsely populated, however, it was used in places as a pasture area by transhumant herdsmen.

[4] Lake Kivu is itself formed by the damming of a river, which flowed into Lake Edward following the formation of the Virungas.

na, limited to the flanks of Ruwenzori to the northeast and the volcanoes in the south
(7) high-altitude barrens and thickets of Ericaceae (*Philippia benguelensis*, *Ph. johnstoni*, *Erica arborea*, *E. kingaensis*)
(8) Afroalpine barrens with giant lobelia *Lobelia sp*. and dendritic senecios *Senecio sp*., above 3,500 m on the volcanoes and Ruwenzori[7] (Figure 23.5)
(9) degraded forests and cultivated land, generally outside the protected areas
(10) swampy areas around Lake Edward.

In Virunga National Park, 2,077 plant species have been recorded, of which 230 are endemic to the mountains of the Albertine Rift (Plumptre *et al*. 2003).

Fauna

Mammals

Over 210 species of mammals have been found in the Landscape. Of these, 21 are endemic to the Albertine Rift, particularly the Ruwenzori otter shrew *Micropotamogale ruwenzori* and the mountain gorilla *Gorilla beringei beringei* (Figure 23.6); others are endemic to the northeast of the Guinea-Congolese forests, especially Elliot's red colobus of Uganda *Piliocolobus oustaleti* and the giant genet *Genetta victoriae*. Among the important but widely distributed species, mention must be made of the chimpanzee *Pan troglodytes*, the elephant *Loxodonta africana*, L'Hoest's monkey *Cercopithecus lhoesti*, Hamlyn's monkey *Cercopithecus hamlyni* and the giant forest hog *Hylochoerus meinertzhageni*.

The savannah species include the lion *Panthera leo*, the spotted hyena *Crocuta crocuta*, the aardvark *Orycteropus afer*, the topi *Damaliscus lunatus* and Buffon's kob *Kobus kob*. The population of hippopotamuses *Hippopotamus amphibius* was the largest in Africa in 1959 with over 25,000 individuals.

Birds

The avifauna comprises 706 species of which 25 are endemic to the Albertine Rift. Most of these endemics are forest species, particularly the yellow-crested helmetshrike *Prionops alberti*, the Kivu ground-thrush *Zoothera tanganjicae*, Shelley's crimson-wing *Cryptospiza shelleyi* and Stuhlmann's double-collared sunbird *Nectarinia stuhlmanni,* which is known only in Ruwenzori; others live in high altitude vegetation, particularly the red-tufted sunbird *Nectarinia johnstoni*, while one species, Grauer's scrub-warbler *Bradypterus graueri*, only lives in high- altitude marshes with Cyperaceae. The papyrus gonolek *Laniarius mufumbiri*, which is specific to papyrus, is endemic to the Lake Victoria region[8]. Finally, the humid environments of the Landscape are also important for migratory populations of certain Palearctic birds, particularly many shorebirds and the white-winged tern *Chlidonias leucopterus*.

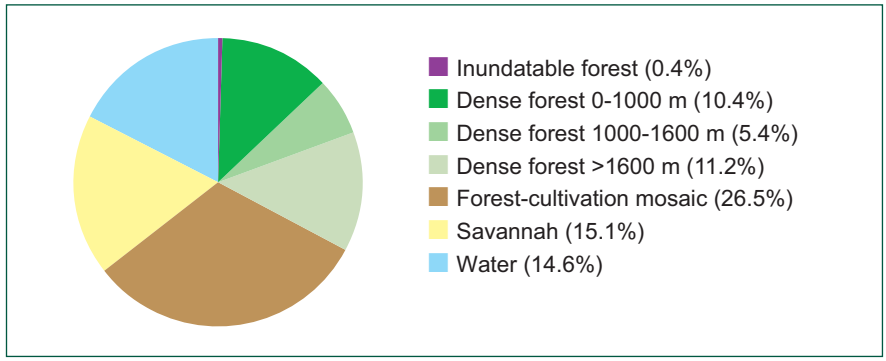


Figure 23.4. Main vegetation types (Source: JRC).

Herpetofauna

Reptiles are represented by 109 species of which 11 are endemic to the Albertine Rift (including the bush viper *Atheris nitschei*). The Nile crocodile *Crocodylus niloticus* has recolonized Lake Edward after an absence of probably several thousand years. Amphibians are represented by 78 species of which 21 are endemic.

[5] The average temperature falls by 0.6C° per 100 m rise in altitude.
[6] Rainfall on the summit of Karisimbi is estimated at 800 mm/year on average.
[7] The high-altitude environments of the volcanoes and Ruwenzori have a similar, but not identical flora; many species are common, but others are limited to a single massif.
[8] Of the 9 species connected with this region and known in the DRC, 6 have been found in the Landscape (Fishpool & Evans, 2001).

Figure 23.5. Afroalpine moorland with giant lobelias and groundsels.

Table 23.1. Percentage cover of different types of vegetation in the Virunga Landscape

Type of vegetation	Cover in the Virunga National Park (%)
Afroalpine moorland and thickets	1.42
Moorland and thickets with heath	2.81
Forest of *Hagenia*	0.37
Bamboo thickets	2.36
Forest galleries	1.4
Montane forests of *Podocarpus* and *Neoboutonia*	11.25
Sclerophyllous forests and thickets	10.95
Sclerophyllous forests of *Euphorbia dawei*	1.31
Dense moist forests	11.78
Savannahs	35.79
Recent lava flows (less than 10 years ago)	2.3
Lakes	18.26

Figure 23.6. The Mountain Gorilla
Gorilla beringei beringei.

Ichthyofauna

The ichthyofauna of Lake Edward has been shaped by several phases of mass extinction, probably on the occasion of volcanic events, the latest of which date back 8,000-10,000 years (Thieme *et al.*, 2005). Some families, particularly the Mastacembelidae, Characidae and Schilbaeidae, well represented in the waters of the Nile Basin, are absent now. The Cichlidae in Lake Edward, which constitute the majority of the fish biomass in the lake, are related to those in Lake Victoria[9]. About 80 species have been described to date, of which 60 or so are endemic to Lakes Edward and George, but some waters have not yet been explored and some species are still to be described. Lake Edward is therefore very important from the point of view of biodiversity and until recently it was also one of the least disturbed of African lakes.

Invertebrates

Of the diurnal butterflies, 21 species are endemic to the Albertine Rift, particularly *Papilio leucotaenia*, a species that has only been found in a very few places.

Humans in the Landscape

Density and distribution

The population density varies from 6 to 600 inhabitants/km², on average, it is 300 inhabitants/km². These populations are scattered throughout the Landscape, especially outside the protected areas, but locally they can also be found in the protected areas, particularly in the fishing villages around Lake Edward. The urban centers with more than 10,000 inhabitants include Goma, Beni, Rutshuru and Kiwanja in DRC and Ruhengeri in Rwanda. Before 1950, the volcanic land around the Virungas was practically only inhabited by transhumant herdsmen (Gogwe). Farmers did not move into this region until water supplies had been installed by the colonial authorities.

Ethnic groups

The main groups are the Nande of Lubero, Beni and Rutshuru, the Hunde of Masisi, Rutshuru and Goma, the Nyanga of Walikali, the Pere, the Kumu, the Twa and the *Banyarwanda* (Hutu and Tutsi).

Activities

The main activity is permanent intensive agriculture; about 80% of the population practices this activity. Around 5% of the population fishes—several thousands illegally—and fewer than 1% are involved in pastoralism. Many people hunt, but hunting is not a main activity; it is only a supplement to agriculture. About 14% of the Landscape's inhabitants are supported through other activities, mainly jobs in towns.

Land use

The main land use is conservation (52%); agriculture covers 45% and fishing 3% (Figure 23.7). Around 80% of land outside the national parks is used for permanent agriculture. Industrial crops include coffee, tea, cocoa and, in Rwanda, pyrethrum. Apart from fishing in Lake Edward, there are no protected areas with extractive activities and there are no forestry concessions.

Main reasons for the identification of the Landscape

(1) The Virunga (DRC) and Volcans (Rwanda) national parks form part of the first national park created in Africa (1925) for the spectacular large fauna that used to live on the savannahs around Lake Edward and for the unique mountain and lake landscapes; Virunga National Park has become a World Heritage Site (1979) and Volcans National Park is a Biosphere Reserve.

[9] A genetic study of the Cichlidae in Lakes Edward and Victoria shows, however, that the species of this family are derived from species in the Congo Basin and are not Nilotic. In fact, until 400,000 years ago, the waters in these regions drained into the Congo Basin and were not captured by the Nile until after the upheaval caused by the formation of the rift (Seehausen *et al.*, 2003).

(2) Given the extraordinary diversity of habitats, this Landscape is the most diversified in Central Africa, at least as far as vertebrates are concerned.

(3) The high-altitude ecosystems around the volcanoes and Ruwenzori are unique.

(4) It is an area of world importance for conservation due to the fact that it is home to a very large number of species of mammals endemic to the Albertine Rift and which do not exist in other CBFP Landscapes, apart from the Maiko-Tayna-Kahuzi-Biega Landscape.

(5) It is considered to be an important area for bird conservation (Fishpool & Evans, 2001).

(6) It is important for its ichthyofauna, notably its large number of endemic Cichlidae.

Conservation

History

Volcans National Park and Virunga National Park were created in 1925 as a single entity: Albert National Park. They were separated in 1960, with the independence of DRC. The Rutshuru Hunting Zone was created in 1946. Volcans National Park has had areas removed on two occasions, cutting its total area by about 50% and also reducing its habitat diversity[10]. Since the 1970s, the two national parks have benefited from some major support projects, particularly from the Belgian Cooperation and the European Community.

Players

(1) Governmental players

ICCN in DRC and ORTPN in Rwanda are in charge of managing of the protected areas.

(2) Conservation NGOs

These are represented by AWF, FFI, WWF, FZS, DFGF-Europe, DFGF-International, MGVP, ZSL, BRD, CBO and CBV.

(3) Conservation projects

The principal projects are the WWF project (800,000 US$/year), which covers the entire Virunga National Park, and the International Gorilla Conservation Program (AWF, FFI and WWF), which covers both national parks (800,000 US$/year for these two areas). The zoological societies of London and Frankfurt also have important projects in support of ICCN for Virunga National Park. WSC, DFGF and other organizations also support conservation efforts in this Landscape.

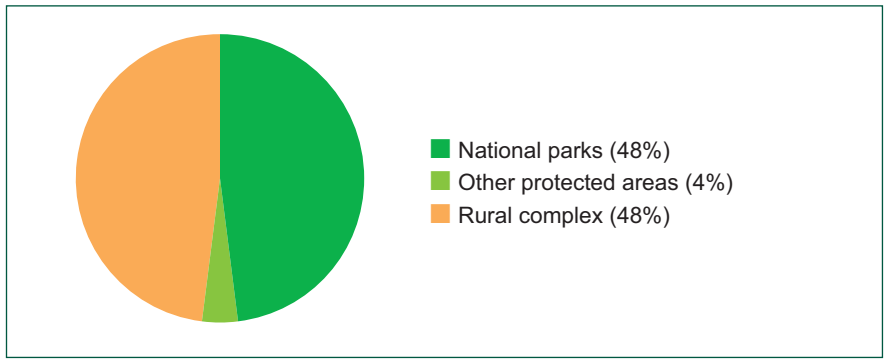


Figure 23.7. Main land use types.

Direct threats

(1) Conversion of habitats

This is the main threat to the Landscape, with irreversible effects (Box 23.1). Over 168,000 farmers have invaded Virunga National Park over the last seven years. They have degraded 90,000 ha. Although a number have been relocated elsewhere, 50,000 people still live in the Kilolirwa area and 30,000 on the western shore of Lake Edward.

(2) Military camps

The presence of military positions and camps in Virunga National Park has a negative impact on natural resources: uncontrolled and poorly paid troops poach, their families grow crops and the camps attract much human activity and trading.

(3) Small-scale mining

Small-scale mining concerns only 5% of the Landscape and is much less important than in other Landscapes in DRC.

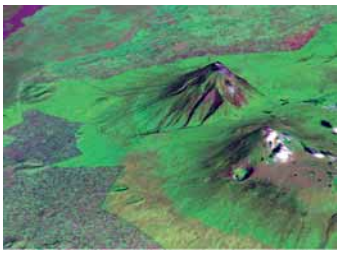
(4) Hunting

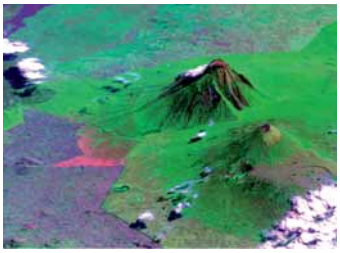
Hunting for meat has dramatically reduced all the populations of large mammals in Virunga National Park.

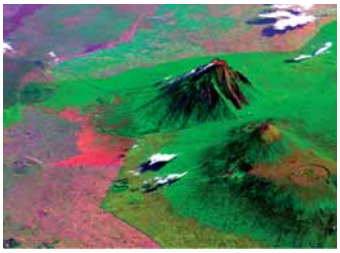
(5) Fishing

Illegal and unsustainable fishing is a serious threat to the resources of Lake Edward.

[10] In 1958, 70,000 ha were given over to agriculture and in 1969, 10,000 ha were cleared for the planting of pyrethrum. The *Prunus africanus* forests have thus disappeared (Vande weghe, 2004).







Box 23.1. Deforestation crisis in Virunga National Park

Virunga National Park, one of the most prominent World Heritage sites in DRC, lost more than 15 km² of forest between May 19 and July 3, 2004. The extent of the deforestation was derived from SPOT 10-m multitemporal images. Once alerted, ICCN, the WWF Albertine Rift Ecoregion Programme and UCL-Geomatics (Belgium) acquired high resolution imagery to quickly quantify the ongoing deforestation and make these images available to decision makers. More than 7 km² of forest was clear-cut and more than 8 km² degraded by about 6000 people; according to different NGO reports these people mainly came from Rwanda. The self-explanatory satellite images timely disseminated using the Internet provided visual evidence to raise the issue to the international community. Thanks to the NGO community, as well as to international diplomatic efforts, the deforestation process was stopped in early July 2004.

The Virunga continues to be monitored by both WWF and UCL through a combination of field and satellite remote sensing observations. Following this deforestation crisis in the Mikeno sector of the national park, UNEP, WWF, IGCP, FZS and the EU have released emergency funds to support ICCN with the construction of a dry stone wall to restore the integrity of the park boundary. By mid-August 2004 more than 7 km of the wall had already been completed by 12 Congolese and 6 Rwandan associations; more than 20 km were completed by November 2004. The rapid intervention and collaborative efforts of the NGO community, national and international bodies has demonstrated to locals and the international audience, the determination to protect this World Heritage site, the oldest national park in Africa.

(6) Logging

According to a recent study, the city of Goma alone consumes over 47,000 tons of charcoal a year, which represents more than 250,000 tons of wood. More than 90% of this wood comes from Virunga National Park. The human populations in the Landscape do not have any other sources of energy and burn about 6 kg per family per day. Construction timber is also harvested on a small scale.

(7) Disease

The hippopotamus populations have been hit by anthrax epidemics twice since 1975.

(8) Volcanic eruptions

A major eruption could have extremely serious impacts on the vegetation, the aquatic ecosystems and human populations. Emissions of toxic gases are a constant danger for humans and animals.

Indirect threats

(1) War, lack of security and political instability

The region has suffered recurrent troubles since 1960, but as of 1994 they have reached a paroxysm. The national parks have become battlefields and mass movements of human populations have had catastrophic effects on vegetation, fauna and all renewable resources. Between 1994 and 1996, several hundreds of thousands of Rwandan refugees lived in the south of Virunga National Park. Today, the Nyamulagira sector of Virunga National Park (about 30% of the Landscape) is still inaccessible because of the presence of armed gangs and about 14,000 displaced families are scattered throughout the Landscape. They affect 5% of the land.

(2) Lack of capacity for park management

With no capacity, it is impossible to enforce the laws.

(3) Lack of jobs

The communities in the Landscape have no alternative employment possibilities and can only survive on the naturally occurring resources.

(4) Political interference

Highly placed individuals are encouraging the populations to occupy the protected areas.

State of the vegetation

In 2004, Virunga National Park lost 1,500 ha of forests because of populations arriving from Rwanda. In 2005, large-scale deforestation for charcoal production continued in the Nyamulagira sector of Virunga National Park and land clearance for agriculture spread outside the protected areas. In the hunting domain of Rutshuru, 90% of the surface area has been entirely degraded. The dramatic drop in the elephant and hippopotamus populations is also leading to dense ligneous vegetation invading the remaining savannahs.

State of the fauna

Observations in 2003 reveal the following in particular:

- There were 400 gorillas, comprising 380 mountain gorillas *Gorilla b. beringei* around the volcanoes and 20 Grauer's gorillas G*orilla b. graueri* on Tshiaberimu.
- Elephants numbered 376, of which 286 were savannah elephants and 90 were forest elephants[11] in Volcans National Park and the Mikeno sector of Virunga National Park. The number of elephants in the north and south of Virunga National Park remains unknown because these areas are unsafe.
- The number of chimpanzees in Virunga National Park was estimated at 150, but decreased to only 130 in 2005 because of a loss of habitats due to the clearing of land for charcoal making and agriculture.
- The population of hippopotamuses in Virunga National Park was estimated at 26,359 in 1959 and 22,875 in 1989; it fell to 1,309 in 2003 and fewer than 900 in August 2005.
- On the plains of Rwindi-Rutshuru, the ungulate biomass fell from 27.6 tons/km² in 1980 to 2.5 tons/km² in 2005, a reduction of over 90%.
- Fish populations in Lake Edward are suffering from the effects of overharvesting.

Financing and conservation

The largest funding agencies are the European Union, USAID, SIDA and the MacArthur Foundation. When the first CoCoSi was created in 2005, a total of US $2,800,000/year was pledged by ICCN partners.

Tourism

Both in the DRC and in Rwanda, the national parks saw considerable tourism in the past, but this collapsed with the troubles and wars that have been raging there since the beginning of the 1990s. In Virunga National Park, most of the tourist infrastructure has been destroyed but parts are being rehabilitated. Ecotourism focusing on gorillas resumed in 2004 and in the month of December 2005 alone 180 visitors were checked into Virunga National Park.

In Rwanda, tourism started again at the end of the 1990s and in 2005 there were 10,641 visitors, bringing in about US $3 million. A new hotel for visitors to Volcans National Park was recently built in the Ruhengeri region.

Management in the field of renewable natural resources

(1) At the Landscape level

The Landscape is very complex, with a host of different land uses and several organizations active in conservation and the socioeconomic development of the local communities. Coordination of these activities is essential to ensure efficient use of the insufficient resources, synergy and impacts in the field. NGOs have been working in a partnership with the administrations of the protected areas to develop a coordinated plan covering the whole of the Albertine Rift. At the same time, a strategic transborder plan is also being formulated for all the central part of the Albertine Rift. An initial version of this plan has already been presented to those concerned and will be submitted to the executive directors of ICCN (DRC), UWA (Uganda) and ORTPN (Rwanda) at the beginning of 2006.

To strengthen conservation, a regional cooperation framework has been established with a view to transborder management of resources. This formalizes the unofficial cooperation that had been initiated by the different partners in the area of the gorillas back in 1991 and extends this cooperation to other areas in the Landscape.

An analysis of the policies, legislation and regional processes relating to conservation of the large primates in DRC, Rwanda and Uganda has been undertaken with a view to influencing the development of these regional processes and the legal frameworks for better conservation in the future.

[11] This figure may be too high because it is based on extrapolations and not actual counting.

(2) In the national parks

The research and monitoring plan for Virunga National Park was finalized in 2005 and a first planning meeting for the general plan was organized in June 2005. The process is set to continue in 2006. A management plan for Virunga National Park already exists and an assessment of the quality of its data is planned. The two plans will serve as the basis for the regional plan.

The legal texts demarcating Virunga National Park have been compiled and analyzed (Box 23.2). Previously, demarcation was determined by ten different decrees, which caused confusion and gave rise to poor interpretations. WWF and ICCN have started to consolidate these decrees in a single text so that all those involved start off on the same basis.

Despite this difficult context, there have been several successful activities in the field:

- Demarcation of the protected areas has been given tangible form on a participatory basis along 293 km of the limits of Virunga National Park by means of 235 posts and 989 planted trees.
- Meetings have been organized with those concerned.
- The authorities of the national parks have received material support (five patrol posts have been rehabilitated and equipment has been supplied) and technical support for training.
- 121,135 people who had illegally invaded the national park have been removed from the forests of Tshiaberimu, Nubilia, Lume, Kanyati, Kongo, Ishasha, Kibirizi and Mubambira; 70,667 ha have been recovered and the means of subsistence of the populations have been diversified (Box 23.3).

The strength of the CARPE program lies in the implementation of regional initiatives:

- Meetings between wardens from the different national parks have been organized to discuss law enforcement in the protected areas. At these meetings, information is exchanged on illicit or criminal activities with a view to improving management of the parks. These meetings were organized over the period covered by the report and one of the key themes was ivory hunting.
- Synchronized patrols have been organized by wardens from the two countries in their respective sectors. These patrols proved to be very important; they allowed snares to be removed, charcoal-making sites to be destroyed, loggers to be stopped, and poachers' camps and military camps to be uncovered. Consequently, observations of animals have already increased.
- In the north, 150 patrols were carried out in 199 days—some at night, others during the day.
- Two regional meetings have been held, (1) to conduct an analysis of key species in the Landscape and reach an agreement on the action to be taken and (2) to discuss law enforcement among conservators in DRC, Rwanda and Uganda; they led to the interception in Uganda of four leopard skins from DRC.

Institutional support aims to strengthen these coordinated patrols, along with training, surveys of the fauna, monitoring of ecosystems and populations and the compilation of existing data on the Landscape.

(3) In the rural areas

The second key component of the CARPE program for Virunga has been the development of a plan for community management of resources, which will show the way forward for the integration of conservation into community activities and support for the conservation action undertaken. This activity was initiated in Kinigi, Rwanda, in May 2005 with the drawing up of the terms of reference, the definition of key activities and players and the preparation of a timetable. The plan is expected to be finalized by the beginning of 2006.

The program has trained members of the communities in business management so as to ensure the sustainability of their enterprises. This training covered subjects such as enterprise development, management structures and their role, strategic planning, keeping records and specific aspects of beekeeping, mushroom-growing, community tourism and craftwork. A team of national park managers also did a tour to explain to personnel the lessons learned in Uganda. All in all, 354 entrepreneurs, 62 of them women, heads of community organizations and managers of protected areas were given training.

Monitoring renewable natural resources and their management

(1) Monitoring of hippopotamuses and elephants on the savannah

Surveys are planned for 2006.

(2) General monitoring

The Landscape has a great deal of available information that can be used to plan the moni-

toring and management of natural resources. This information comprises data obtained from:

- guard patrols (illegal activities, key species of flora and fauna, known gorillas)
- socioeconomic surveys
- remote sensing

Socioeconomic monitoring of the volcanoes area in 2002 was extended to the entire national park in 2005. A study on charcoal consumption and trade in the Goma area was also carried out in 2005 in order to define the area that needed to be planted with trees for sustainable supplies to the city.

(3) Monitoring of gorillas

The monitoring activities that began in the volcanoes area in 1997 have been extended to the entire Virunga National Park so as to complete the data on gorillas and provide ICCN with standardized information on the national park as a whole, for use in management and financing.

(4) Remote sensing

WWF has bought and analyzed a series of SPOT images taken in 2004-2005 over all the Landscape, so as to determine a basis for monitoring the forest cover in the Landscape and invasion of the protected areas.

Box 23.2. Properly documenting the legal boundaries of protected areas as a prerequisite for sound rehabilitation: the case of Virunga National Park

In order to find a lasting solution to high levels of encroachment, such as those into Virunga National Park, it is important to document properly the level of encroachment. This can only be accomplished if protected area boundaries are clearly identified and agreed upon by all.

Even in the case of a well-established national park, such as Virunga (created in 1925), clear identification of boundaries may be a very difficult process. This was exemplified in the difficulties experienced by ICCN and WWF who joined force to tackle this issue.

The process began by obtaining the legal texts delineating the national park, which was done by collating all legal decrees directly pertaining to the description of boundaries. In the case of Virunga National Park, there were eight such texts that dated from 1925 to 1950. The next step was to analyze and produce a consolidated text resulting from these various decrees. This was achieved in January 2005 and the document was subsequently published.

The next crucial step was to 'translate' the text into a means of physical identification in the field. This was a particularly difficult exercise in the case of Virunga National Park, because some of the old beacons no longer exist and where they do, they are often far-between. In addition, the texts make regular reference to human infrastructure (small villages, traditional paths, markets, local concessions) that existed in 1925 or 1935, but which has since disappeared or been displaced. Finally, the texts often refer to natural features whose names have since been forgotten, such as tiny rivers or summits of small hills.

To overcome these difficulties, several sources of information were overlaid into a Geographic Information System (GIS). The GIS layers included: 1/50.000 scale maps from 1948, which provided invaluable information on old toponyms; aerial photos from 1959; satellite images at 5m resolution from 2004 and 2005, which served as the map base and clearly identify areas of encroachment, as well as many features that are not visible from the ground; and numerous ground control points taken in the field.

The results of this exercise were sometimes dramatic and demonstrated how important this activity was. For example, in the Kilolirwe area, the exercise required overlaying the 1948 map, three sets of boundaries derived from different legal decrees, a 1959 aerial photo and SPOT images. The results showed that in some places the boundaries being used in the field are off by as much as 500 meters. In some cases these discrepancies may be the result of local arrangements between ICCN and local communities that have never been formalized or incorporated into delineation exercises.

Once the official boundaries of the park were established, it was possible to add an additional GIS layer showing the area of encroachment. Following this procedure allowed ICCN and WWF to make an official calculation of the area of encroachment, which totaled 10,000 hectares in the study area alone.

Box 23.3. Progress made towards the voluntary withdrawal of illegal cultivators from Virunga National Park

Virunga National Park in eastern DRC covers an area of approximately 780,000 ha in a region that has one of the highest human population densities in Africa. It is therefore only somewhat surprising that the wars and socio-economic crises that have hit eastern DRC during the last 8 years have increased the pressure for local cultivators to move into the national park. Due to strong political interference and a lack of logistical capacity, as well as a lack of security, ICCN has had little power to prevent this encroachment and, in total, close to 170,000 people have, at some point in time, invaded the World Heritage Site. This has been a dynamic process, with a continued influx of illegal settlers in some areas and people leaving from other areas. It should be noted that the majority of these 'settlers' were actually people from neighboring communities who extended their activities into the park or growing human settlements that spilled over the park boundaries, as opposed to long-distance immigrants (although the latter also exist). ICCN and WWF began to document and monitor the process, and have been working on a case-by-case basis to obtain as much voluntary evacuation of encroached areas as possible. Significant results have been achieved during the past three years in terms of recovered encroached areas and reaching agreements for local communities to stop cultivating inside the National Park, as can be seen in Table 1. These results (Table 2) were achieved, in part, with support from CARPE and other sources of funding, including the European Union and WWF.

Table 1. Degree of encroachment in Virunga National Park (DRC) between 1998-2004 and September 30, 2005.

	1998-2004	**Sept 2005**	**1998-2004**	**Sept 2005**
Site	Encroached area (ha)	Encroached area (ha)	Number of people	Number of people
Tshiaberimu	3,500	0	1,800	0
Lubylia	4,200	7	22,000	100
Mavivi	19,000	19,000	25,000	25,000
Kyavinyonge	5,000	0	0	0
Kanyatsi	3,000	0	7,000	0
Lume	2,300	0	4,600	0
Côte ouest	12,000	12,000	30,000	30,000
Kibirizi	19,000	0	0	0
Kongo	9,000	0	18,000	0
Ishasha	500	0	15	0
Kanyabayonga	2,100	1,200	0	0
Kilolirwe	10,200	10,200	60,000	60,000
Tongo	60	0	0	0
Total	**89,860 ha**	**42,407 ha**	**168,415**	**115,100**

Table 2. Surface area recovered and the number of people evacuated peacefully from Virunga National Park during the first two years of CARPE funding, with co-financing by the European Union and WWF. None of the people involved were displaced. All individuals were members of local communities who took advantage of the socio-political situation to spread their activities into the national park.

Site	**Area recovered (ha)**	**Number of people evacuated**
Tshiaberimu	3,500	1,800
Lubylia	4,193	21,900
Kyavinyonge	5,000	0
Kanyatsi	3,000	7,000
Lume	2,300	4,600
Kanyabayonga	900	0
Tongo	60	0
Total	**18,953**	**35,300**