

Gorilla gorilla gorilla

Status report

**Document based essentially on
the Gorilla report prepared by IRSNB for CMS in 2005,
the World Atlas of Great Apes and their Conservation (published in 2005),
and numerous additional primary publications**

**IRSNB
January 2007**

1. TAXONOMY AND NOMENCLATURE

1.1. Taxonomical remark

The taxonomy currently followed by CMS (Wilson & Reeder, 1993) recognises a single species of gorilla, *Gorilla gorilla*, with three subspecies. This comprised one western subspecies, *Gorilla gorilla gorilla* and two eastern subspecies, *Gorilla gorilla graueri* (eastern lowland gorilla) and *Gorilla gorilla beringei* (mountain gorilla).

Recently however, western and eastern populations have been widely recognised as separate full species, *Gorilla gorilla* and *Gorilla beringei* respectively. The eastern and western populations are separated by approximately 1,000 km (Garner & Ryder, 1996). Western and eastern populations can be distinguished based on external features (Groves, 2002) and clear geographic and morphological distinctions can also be seen (Garner & Ryder, 1996). Additionally in the western group, the isolated Nigeria-Cameroon gorillas are now recognised as a subspecies, Cross River Gorilla *G. g. diehli*, of the Western Lowland Gorilla, *G. g. gorilla*, though there is much divergence even within this subgroup. The eastern group includes both the Eastern lowland *G. beringei graueri* and the two mountain populations of *G. b. beringei*. Following the newer taxonomic classification, among the mountain gorillas, the Bwindi mountain gorilla may form a third subspecies, *Gorilla beringei bwindi* (Sarmiento *et al.*, 1996) although the taxonomic status of the populations is as yet unclear (McNeilage *et al.*, 2001). Sarmiento *et al.* (1996) list a number of morphological and ecological differences between the gorillas of Bwindi-Impenetrable Forest and the Virunga volcanoes, and insist that Bwindi gorillas do not belong to *G. g. beringei* and so should not be called mountain gorillas. Stanford (2001) contests this and suggests that the evidence showing the Bwindi and Virunga gorillas to be taxonomically distinct is not well supported. Garner and Ryder (1996) found that the populations of mountain gorilla in the Virungas Volcanoes region and the Bwindi forest were indistinguishable using a particular mitochondrial DNA region.

We present here the status report for Western Lowland Gorilla, *Gorilla gorilla gorilla* (Savage & Wyman, 1847) the nominal form of western gorilla living in the western congolian forest, west of the Congo/Oubangi Rivers and south of the Sanaga. River.

1.2 Nomenclature

The American physician and missionary Thomas Staughton Savage first described the Western Gorilla (he called it *Troglodytes gorilla*) in 1847 from specimens obtained in Liberia. The name was derived from the Greek word *Gorillai* (a "tribe of hairy women") described by Hanno the Navigator, a Carthaginian navigator and possible visitor (circa 480 BC) to the area that later became Sierra Leone.

1.2.1 Scientific name

Gorilla gorilla gorilla (Savage & Wyman, 1847)

1.2.2 Synonyms

Troglodytes gorilla, *Troglodytes savagei*, *Gorilla gina*, *Pseudogorilla gorilla*, *Satyros adrotes*, *Satyros africanus*, *Pithecius gesilla*, *Gorilla castaneiceps*, *Gorilla mayema*, *Gorilla gorilla matschiei*, *Gorilla gorilla halli*, *Gorilla jacobi*, *Gorilla gorilla schwarzi*, *Gorilla hansmeyeri*.

1.2.3 Common names

English – Western Lowland Gorilla, Coast Gorilla

French – Gorille de plaine de l'ouest

German – Gorilla

Spanish - Gorila de llanura del oeste *ou* Gorila de planicie occidental

1.2.4 Description

Very large, the largest living primates. Barrel-chested ape with relatively even hair, a bare black face and chest and small ears. The bare shaped brows are joined and the nostril margins are raised. Females are much smaller than males. Adult males range in height from 165-175 cm (5 ft 5 in-5 ft 9 in), and in weight from 140-200 kg (310-440 lb). Dominant adult males, called silverbacks, have a prominent sagittal crest and striking silver coloration from their shoulders to rump. Adult females are often half the size of a silverback, averaging about 140 cm (4 ft 7 in) tall and 100 kg (220 lb). Occasionally, a silverback of over 183 cm (6 feet) and 225 kg (500 lb) have been recorded in the wild. Gorillas move around by quadrupedal knuckle-walking. The belly of wild gorillas is very much more massive than in captive specimens.

The western lowland gorilla is the smallest and lightest of the four subspecies, and also the one in which sexual dimorphism is more pronounced (Gauthier & al, 1999). The shape of the nose provides a point of difference between the eastern and western forms; the western race has an overhanging tip to its nose that is absent in the eastern forms. Western Lowland Gorilla have chestnut-brown, not black, hair on their heads. Western gorillas have more rounded faces and slender chests than eastern gorillas (Rowe 1996; Nowak 1999).

2. BIOLOGY OF THE SUBSPECIES

2.1 General Biology

Gorillas are mainly terrestrial. The gorilla's large size and folivorous habits mean that the animals must spend long hours feeding everyday to maintain their body weight. Of all the great apes, the gorilla shows the most stable grouping patterns. The same adult individuals ravel together for months and usually years at a time. It is because gorillas are mainly foliage eating that they can afford to live in these relatively permanent groups. Foliage, unlike fruit generally and especially the ripe fruits that the ape gut require, comes in large patches than can in turn support large groups of animals. In west Africa, where fruit form a far higher proportion of the gorilla's diet than in the East, gorilla groups tend much more often to split into temporary feeding subgroups that they do in east Africa, as animals range far apart searching for the relatively scarce ripe fruit. Sleeping subgroups have also been reported but are anecdotal and seems to occur in the process of permanent splitting of a multi-male group into two one male groups. Lowland gorilla groups usually number 5 to 10 individuals, but some groups can count as many as 20 to 32 animals (Bermejo, 2004).

2.1.1 Habitat

The Gorilla is a forest species. They inhabit tropical rain forests, swamp forest, forest edges and clearings, riverine forests, swamps, and abandoned cultivated fields. Western Lowland Gorillas have occasionally been observed nesting along savanna-forest edges or in the savanna itself. But they do not live permanently in these savanna habitats. They have recently been observed feeding in seasonally fruiting trees along seashore.

Western Lowland Gorillas inhabit primary and secondary lowland tropical forests at elevations from 200 to 1300 m (e.a. in Monte Alen and Monte Mitra in Equatorial Guinea). Gorilla occurrence and density seems to be positively correlated with terrestrial herbaceous vegetation, particularly monocotyledonous plants (including gingers and palms).

Western lowland gorillas experience unimodal or bimodal pattern of rainy season depending of their location. Average rainfall is around 1500 mm with the greatest amount of rain falling between August and November and diminishing during December through March (Poulsen & Cramp; Clark 2004).

The habitats occupied by Western Lowland Gorilla are described by Tutin and Fernandez (1984) as dense primary forest, dense swamp forest, thicket, undisturbed secondary vegetation, exploited forest and coastal scrub. Western gorillas appeared to be absent from areas close to human settlement and disturbed secondary forests, avoiding roads and plantations. Gorillas favour areas where edible herbs are more abundant and it is often the case in old secondary forest. The fairly high density of western gorillas seen in the Dzanga Sector

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of the Dzanga-Ndoki NP in Central African Republic have been attributed to the presence of moderately disturbed or secondary forest, which is rich in nutritious folivore food such as herbs (Blom et al., 2001).

In the Odzala-Koukoua NP in Congo, Western Lowland Gorilla occupies a large variety of habitats. Here they primarily live in open-canopy forest with a richly understory vegetation of Marantaceae. This forest type is dominant in the northeastern part of the park. The ground vegetation is dominated by an almost impenetrable thicket of Marantaceae species, including *Haumania liebrechtsiana*, *Megaphrynium macrostachyum*, and *Sarcophrynium* spp. Western Lowland Gorillas are also found in more closed-canopy primary forests. In and around the northern part of the Odzala-Koukoua NP there are more than 100 forest clearings. They have a particularly sodium-rich herbaceous vegetation and are known as saline or bais. Gorillas are known to visit these clearings on a regular basis to feed on plants from families such as *Cyperaceae* and *Asteraceae*. Swamp forests are now considered important habitats and feeding areas for western gorillas, supporting them in high densities both in the wet and the dry season (Fay et al., 1989). The soils of these swamps tend to be waterlogged or permanently flooded and the aquatic plants such as *Hydrocharis* spp. provide an important food resource for western gorillas (Nishihara, 1995).

Common species in swamp forest include those belonging to the genera *Xylopia*, *Raphia*, *Klaineanthus*, *Trichilia*, *Lophira*, *Guibourtia* and *Aframomum* gingers (Bermejo, 1999; Fay et al., 1989). In Northern Congo western gorillas favoured swamps forests where *Raphia* is common, a palm used both for food and nest construction (Blake et al, 1995). In south-western CAR the distribution of gorillas seems to be influenced by the availability of *Aframomum* spp. (Carroll, 1988).

2.1.2 Adaptation

Gorillas are closely related to humans and are considered highly intelligent. It is possible that western gorillas have a food culture, with learned preferences passed on between individuals and generations (Nishihara, 1995). Use of tools has also recently been observed in the wild (Breuer, 2006).

Gorillas are herbivorous (plant-eating). Plant material contains cellulose which is indigestible to many non-herbivorous animals. With regard to digestion, herbivorous animals that do not ruminate (re-chew their food as part of the digestive process) rely solely on the microbes (microscopic bacteria) living in their colon. The bacteria function to breakdown the indigestible plant cellulose and turn it into valuable digestible carbohydrates through the fermentation process.

Food availability affects both diet and foraging behaviour of gorillas. High quality herbs that are easily digestible and rich in proteins and minerals are scarce and patchily distributed in western gorilla habitat, outside swamp forest areas. Fruit is relatively widely available in their habitats and are an important part of the diet of Western Lowland Gorillas, at least in comparison with their eastern counterparts. The seasonal importance of fruit and herbs in the diet of the western gorilla has been much discussed. The availability of seasonal fruit appears to shape the foraging and ranging patterns of western gorillas (Remis, 1997). When fruit is abundant seasonally, it may constitute most of the diet. High-quality herbs (rich in minerals and proteins contents) are eaten all year round, while low-quality herbs are eaten only when fruit is scarce. More leaves and woody vegetation are consumed during the dry season (January-March) when few fleshy fruits are available, more fruit is eaten at other times. In habitat where the leguminous tree *Gilbertiodendron dewevrei* is present, gorillas feed heavily on this seeds and can travel some distance during mass fruiting events (occurring at five years intervals) to congregate in stands of *G. dewevrei* (Blake & Fay, 1997). Insects are also part of their diet (termites and ants), although their relative importance is still undetermined (Tutin & Fernandez 1992; Remis, 1997; Deblauwe, 2003; 2006).

Western gorillas travel farther when more fruit (and termites) are available in the forest and have shorter day ranges when they must rely on leaves and woody vegetation (Goldsmith, 1999).

2.1.3 Social behaviour

As far as group structure is concerned, gorillas do form harem. Groups of reproductive active western gorillas almost always contain only one dominant silver-backed adult plus three or four females and four or five offspring (Fay, 1989). Groups that contain more than one silverback have only very occasionally been reported among Western lowland gorillas. Adult female in anyone silverbacks harem are mostly unrelated, and the social ties that exist between them are weak. In contrast to many other primates, it is the bond between each individual female and the silverback, rather than bonds between the females that hold the group together. Upon reaching maturity, both the males and females leave the natal group. The females usually join another group or a lone young adult male, whereas the males remain solitary until they can attract females and establish their own groups (Masicot, 2003). After emigration, some males may spend a large proportion of their time in their natal group's home range (Harcourt *et al.*, 1981).

Western Lowland Gorilla generally forms stable cohesive groups. The takeover of a group in which its silverback is ousted by another from outside has never been reported, and group fission has been reported on only one occasion (Remis, 1997). However, western gorillas do not appear to be as cohesive on a daily basis as their eastern counterparts. In some groups members spread out with distances of over 500m between them, other groups split up during the day and then reunite at the nest site. Recent studies at bais also suggest that around those particularly attractive locations, population dynamic might be much more active than previously thought (Gatti & al, [xxxx](#)), with frequent migration and exchange of individuals between groups. All-male groups have been observed in bais (Levrero & al, [xxxx](#)) which is the first report of that kind in lowland gorillas.

The very large groups sometimes observed among eastern gorillas rarely occur in western gorillas. Group size appears to be influenced by the size of the foraging patches and fruit abundance. Western gorillas eat considerably more fruit than eastern gorillas, this dependence on clumped food resources may constrains their group size. Total group size range from two to 32 individuals with an average of four to six adults. Larger groups typically contain a higher proportion of adult females, as most groups are single male harems.

2.2 Distribution (current and historical)

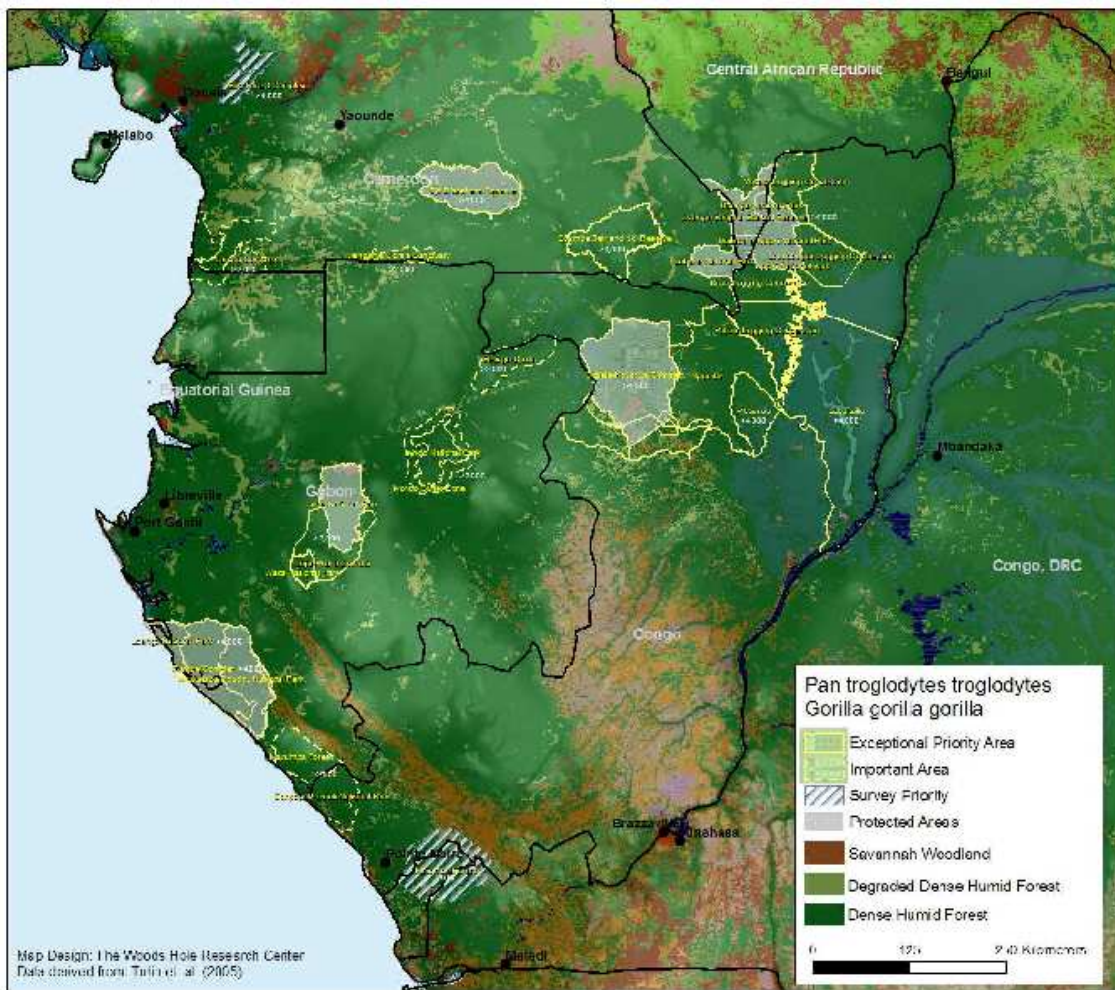
The western lowland gorilla inhabits the tropical forests of Cameroon, Central African Republic, Gabon, Congo, and Equatorial Guinea. It was also present at least until recently in the Mayombe forests in extreme south-west DRC, north of the Congo River.

The Congo/Oubangi River seems to be the eastern limit of the distribution, the Sanaga River represents the northern limits of the closed forest and concomitantly of the western lowland gorillas, nevertheless a small population exists North of the river. The Atlantic Ocean represents the western boundary of the distribution and the southern edge of the Western Lowland gorilla's distribution is defined by the forest-savanna ecotone.

Western Lowland Gorilla is still a relatively widespread species. Distribution has locally been reduced but extinction is only suspected in the extreme western tip of DRC, but recent data suggest that he is still present, even there.

But if the recent decline of western gorillas continues, more reduction in the distribution shall soon be noted. Surveys conducted in the 1980s indicated that healthy populations existed in many areas remote from human settlements until then. However, despite the fact that western equatorial Africa has one of the lowest human population densities of any tropical forest area in the world, gorillas (and chimpanzees) populations in this region are, today, in dramatic decline. This is because of increased commercial hunting, the spread of logging, which alters forest structure and facilitates poaching, and because of Ebola haemorrhagic fever. Figures in areas where studies are taking place are frightening: the alarming apes average annual rate of decline of 4.7% in Gabon between 1983–2000 (Walsh *et al.*, 2003), for example, and the high mortality (>80%) recorded in two studied populations affected by Ebola (Bermejo & al, 2006; Caillaud & al, 2006) underline a critical state for conservation and the need for urgent reinforcement of their protection.

Figure 1. The distribution (brown areas) of the Western Lowland Gorilla, *Gorilla gorilla gorilla*



2.3. Evaluation and evolution of populations

Accurate population estimates for gorillas are often difficult to establish, because their hugely vast range has not yet been thoroughly surveyed. Population counts and estimates of gorillas are commonly carried out on the basis of nest or sleeping site counts (e.g. Inogwabini et al., 2000). Adults and immature weaned animals build new nests to sleep in each night. The nests are counted and any dung adjacent to each nest examined gives a reliable indication of group size as well as age of animal, particularly when the counts are repeated over several nights.

Distribution often indicates likely rather than confirmed presence, and in many areas numbers may be higher than previously thought. Surveys of Western Lowland Gorilla are usually carried out on a site or eventually country basis rather than with references to contiguous populations. It is difficult to assess population status and trends because censuses have not yet been conducted across large areas. The importance of swamp as habitat for Western Lowland Gorilla has only recently been identified. The presence of gorilla in swamp forests, a widespread habitat that was previously considered unsuitable for them, was reported only as recently as 1989 (Fay, 1989) and confirmed to be a general pattern in the 1990s (Blake et al, 1995;

Olejniczak, 2001). On the other hand, the impacts of Ebola and poaching have not been comprehensively quantified, leading to caution against overoptimism.

Little information is available on numbers, status or trends for population at most sites in most countries. In the early 1980s, it was thought that there were only 40,000 western lowland gorillas. More recent estimates have ranged from 94,500 (Butynski, 2001) to over 100,000 individuals (Harcourt, 1996; Oates et al., 1990; Plumptre et al., 2003) but several reports have indicated that numbers are declining. Based on the information provided in the country profiles included in the World Atlas of Great Apes and their Conservation, an estimate of 82,000 remaining western lowland gorillas seems possible. This estimate takes into account a loss of half of Gabon's gorillas from 1983 to 2000s (Walsh et al., 2003) but many other western gorilla populations have since suffered declines due notably to outbreaks of Ebola disease (Walsh et al., 2003; WHO, 2003).

The Western Lowland Gorilla was considered extinct from its former range in the Mayombe (Bas-Fleuve region) in the extreme southwest of DRC, as a result of the combined effects of habitat loss, fragmentation, and poaching. The gorilla numbers in the contiguous Cabinda province (Angola) are unknown but probably very low. However, Redmond (2006) reports on recent sightings and observations indicating that a small population of western gorillas subsists in western DRC (Bas-Congo Province) and that those gorillas probably migrate seasonally across the international border shared by DRC, Angola (Cabinda) and Congo Brazzaville.

The Western Lowland Gorilla (*Gorilla gorilla gorilla*) (IUCN 2000, EN A2cd) occurs over a wide area where there is relatively low human population densities. The subpopulations are in general in low density and the distribution is patchy. 80% of the population live outside protected area (Harcourt 1996).

2.4. Migrations - movements

Western lowland gorilla groups travel within a home range averaging 5.6 to 15.4 km². Gorillas do not display territorial behaviour, and neighbouring groups often overlap ranges (Dixson, 1981, Bermejo, 2004, Doran et al., 2004). The group usually favours a certain area within the home range but seems to follow a seasonal pattern depending upon the availability of ripening fruits and, at some sites, localised large open clearings (swamps and "bais"). Gorillas normally travel 0.5-2.0 km per day (Dixson, 1981, Doran et al., 2004).

Food availability affects foraging behaviour of Western Lowland gorillas. Populations feeding on high-energy foods that vary spatially and seasonally tend to have greater day ranges (average distance travelled by a group per day) than those feeding on lower-quality but more consistently available foods. Western gorillas fit this pattern as they travel farther when more fruit and termites are available in the forest, and have shorter day ranges when they must rely on leaves and woody vegetation. At Bai Hokou in CAR, the distance travelled varies between about 3 km/day during frugivorous month, and 2 km/day during folivorous month. Larger group travel greater distances in order to obtain sufficient food (Remis, 1997b). Human hunters and leopards (*Panthera pardus*) influence the movement patterns of some western gorilla groups. Very long or very short distances are travelled when predators are in the vicinity.

The annual home ranges (the areas used by a group over a year) of western gorillas are larger than those of mountain and eastern lowland gorillas and here the home range of different groups overlap quite extensively. Estimated minimum home range is 22.9 km² in Bai Hokou (CAR).

Recent sightings (Redmond, 2006) indicate that a small population of western gorillas subsists in western DRC, probably migrating seasonally across the international border shared by DRC, Angola (Cabinda) and Congo Brazzaville.

3. CONSERVATION STATUS, BY PARTY

Angola (Cabinda enclave) status unknown?: The Western Lowland gorilla reaches the northern part of the Cabinda enclave of Angola in the Mayombe forests.

Cameroon (Endangered): The nominal form (*Gorilla gorilla gorilla*) is distributed in Cameroon south of ca 3° North, usually South of the Sanaga River with a small outpost North of it, along the border with Rio Muni, Gabon, Congo Republic and Central African Republic in the East.

Central African Republic (Vulnerable): The nominal form of Gorilla is found in the south-western corner of Central African Republic. It is present in Dzanga-Nodki National Park and in the Dzanga-Sangha Reserve (ca 5000 km²). This area is contiguous with good habitats in the Congo (Sangha Region) and in Cameroon (Dja/Boumaka/Lobéké).

Congo (Vulnerable): The Western Lowland gorilla is relatively widespread in Congo north of the Equator, and also present in the south-western regions of Lékoumou and Bandondo. But although Gabon and Congo hold 80 percent of the world's gorillas and most of the Central African chimpanzees, there are reports stating that the population of apes in Congo declined by more than half between 1983 and 2000 (GRASP and IPS, 2004).

Democratic Republic of Congo (Probably Extinct): The Western Lowland gorilla was until very recently considered as probably extinct in the Mayombe forests (Bas-Congo, extreme western DRC). Recent reports (Redmond, 2006) suggest that a small (transboundary) migrating population might subsist.

Gabon (Vulnerable): The Western Lowland gorilla is widely spread in Gabon. It occurs in particular in the three protected area of lowland forest, Lopé, Moukala-Dougoua and Wonga-Wongué (covering respectively ca 5000 km², ca 1000 km² and 5000 km²).

Equatorial Guinea (Critically endangered): The Western Lowland gorilla is widely spread throughout Rio Muni, the continental part of the country.

4. ACTUAL AND POTENTIAL THREAT

In evaluating threats to gorillas in western equatorial Africa it is useful to think on two time scales. In the short term, by far the most serious threats are poaching and disease epidemics. In the longer term habitat loss and disturbance will increase as a threat and is likely to become, in perhaps three to five decades, as serious a threat as hunting and disease.

Although still widely distributed across a large forested region, and occurring in numerous Protected Areas, the western lowland gorilla is considered as endangered because of a series of cumulative threats of increasing scale: poaching and commercial hunting is identified as a major real or potential threat for every site of the Gorillas range; diseases, and Ebola hemorrhagic fever epidemics in particular, are identified as a potent actual threat for the Odzala-Lossi-Pikounda-Ngombe-Ntokou complex and a potential future threat to gorillas elsewhere; logging emerged as one of the greatest future threats, especially in concessions surrounding protected areas, without strict control, the roads and transport opportunities created by industrial logging systematically lead to a massive increase in commercial bushmeat hunting; commercial and artisanal mineral exploitation affect some areas and require specific responses; lack of knowledge regarding numbers and distribution, and acute insufficiency in biological information.

4.1 Direct exploitation

Western Lowland gorillas are hunted for their meat, for sale to private collections, for trophies and for traditional ritual or medical purposes. Although this is illegal everywhere, the regulations are often poorly enforced. Poaching/hunting has been reported in every range state.

The intensity of hunting of Western Lowland Gorillas varies throughout their range. Factors affecting the intensity of bushmeat hunting are local taboos, enforcement of the legislation, the availability of ammunition and guns, and the accessibility of hunting grounds. Logging roads contribute to this by allowing greater access to remote areas, making the entire fauna more vulnerable to hunting in areas under exploitation or previously exploited.

- **the bushmeat trade**

In the forested region of western Africa bushmeat hunting for subsistence is the major threat for the western gorillas. Although bushmeat has been, and still is culturally and nutritionally important in many regions, the impact of bushmeat hunting is now more widespread and serious on many species because it is increasing rapidly with increasing access into remote areas, and new markets are being developed to serve rising demand among urban populations, where it is considered a delicacy. Gorilla meat forms only a small proportion of the commercial bushmeat trade, but the impact on ape populations is disproportionately great because of their slow reproductive rate and the social consequences of silverback's being killed (infanticide may ensue when nursing mothers join a new male).

There is no estimates of either the overall western lowland gorilla population losses specifically due to hunting, or on their impact on population trends, although the negative impact of hunting on other gorilla population is well known.

In the northeast of Congo (Motaba River region) it has been estimated that about 5 percent of the western lowland gorilla population is killed by hunters each year, despite the low density of local human population. This level of taking is unsustainable for a slow breeding animal like the Gorilla (Kano & Asato, 1994).

In contrast, effective control on hunting are in place in Nouabaé-Ndoki NP (Congo) and its buffer zone, in Odzala-Koukoua NP (Congo) and in the Dzanga Sector of Dzanga-Ndoki NP (Cameroon) where gorillas are rarely hunted (Blom et al., 2001). The controls are the result of successful collaborations between national administration and international agencies or NGOs.

- **Other forms of direct exploitation**

In the past at least, they have been killed for their heads, hands, and feet, which were sold to collectors. Infants were sold to zoos, researchers, and people who want them as pets. The abduction of infants generally involves the loss of at least one adult, as members of a group will fight to the death to protect their young.

4.3. Diseases

Disease is a potentially devastating threat to gorillas and other great apes. Western gorillas are susceptible to many of the same diseases as humans, such as Ebola virus, common cold, pneumonia, smallpox, chicken pox, tuberculosis, measles, rubella, yellow fever, etc...

Beside severe impacts on human populations, several outbreaks of the Ebola virus since 2000 might have claimed thousands of great apes in Africa. The first, in 2000 and 2001, was centred in Uganda, the second outbreak occurred in 2001 and 2002 in Uganda and the Republic of Congo. Ebola hemorrhagic fever is a severe, often-fatal disease that affects humans and non-human primates, such as monkeys, gorillas and chimpanzees. Many scientists believe the disease is spread through the butchering and handling of primate bushmeat. The disease has been confirmed in six African nations: the Democratic Republic of Congo, the Republic of Congo, Gabon, Sudan, Ivory Coast, and Uganda.

Ebola hemorrhagic fever is an incurable human disease that kills about 80 percent of its victims. This virus has an even higher mortality rate of 95-99 percent among western gorillas (and chimpanzees). Recent Ebola epidemics in West Africa have affected the gorilla in Gabon and Congo. Ebola outbreaks are thought to have strongly contributed to decline of great ape populations in Gabon, where four outbreaks are known to have occurred, two of which originated in the Minkébé NP. Farther East, declines in Western Gorilla populations attributed to Ebola have also been reported in the Lossi Gorilla Sanctuary of Congo (Anon, 2003;

GRASP/IPS, 2004; Walsh et al., 2003; Bermejo & al., 2006), and has lately decimated gorilla population in the Odzala-Koukoua NP (Caillaud & al., 2006; Devos & al., submitted).

Another potential general threat to gorillas is exposure to human diseases (e.g. Graczyk *et al.*, 2001a; Graczyk *et al.*, 2001b) particularly for habituated gorillas that come into contact with humans, in areas of gorilla tourism (UNEP-WCMC and WWF, 2001). Gorilla tourism exposes gorillas to humans and hence to any diseases that humans may be carrying, some of which the gorillas may never have been exposed to before.

At present, this threat is not significant for the Western Lowland Gorilla. Western Lowland Gorilla has proved to be difficult to habituate, particularly as the dense vegetation of its habitat does not allow it to be tracked easily (Williamson & Feistner, 2003). Gorilla tourism is therefore not as well established as it is for eastern gorillas. However the discovery that Western lowland Gorilla could easily be seen at *bais* has increased the likelihood of successful gorilla tourism and can conduct to increase contacts with humans like it happens in Rwanda or Uganda.

Williamson (1999) reported that in Volcans National Park the most serious threat to the gorillas may be the acquisition of human parasites and disease and recently a number of gorillas in this Park have died of an unknown illness (UNEP-WCMC, 2003c). An outbreak of a respiratory disease, with the possibility of measles as the primary infection, in the Parc National des Volcans in Rwanda claimed six gorilla lives, and 27 other gorillas were successfully treated (Wallis and Lee, 1999). However, there are few data on the impacts of disease, particularly outside the Virungas (Plumptre *et al.*, 2003). In Rwanda, strict rules are in place to regulate tourist visiting times and the number of tourists per group (Plumptre *et al.*, 2003). Other measures are in place and include limiting the approach of humans to 5 m, burying human excrement deeper than 30 cm and chasing gorillas from private lands surrounding the parks (Kalema-Zikusoka *et al.*, 2002). Such regulations need to be initiated as soon as possible in areas where Western Lowland Gorilla tourism shall be established.

4.3 Degradation and decline of habitats

Throughout the gorilla's range, the forests on which it depends for survival are being cut down for timber and to make way for agriculture. Habitat loss is a major threat to gorillas as forests are rapidly being lost to commercial logging interests and subsistence agriculture.

Until recently, there has been relatively little habitat degradation over much of the Congo Basin, with little conversion to agricultural land. As late as the 1980s West and Central African timber was considered to be of low commercial value (?) which limited the pressure posed by selective logging. This changed dramatically during the 1990s.

By 2000, more than half of Gabon's forests had been allocated as logging concessions, and log production has increased to some 3 million m³/year (Anon, 1999). In Cameroon, over 170,000 km² of the country's forests have either been logged or allocated for logging. Satellite images have revealed that networks of new logging roads have now spread into what had previously been considered the least accessible forests in the country (Minnemeyer et al., 2002). Other parts of the range of Western Lowland Gorilla to have undergone extensive logging include Rio Muni (continental Equatorial Guinea) and the Congolese Mayombe forests.

Logging roads and access routes fragment forest and improve access for hunters. Forest fragmentation poses a potential threat to Western Lowland gorillas in that it can block movements between groups and access to seasonal food resources.

4.4 Impact of Conflict

The impact of wars and political conflicts, particularly well documented for the Mountain gorilla in Rwanda and adjacent RDC and Eastern Lowland Gorilla in RDC could have affected the Western Lowland Gorilla in

a similar way. Civil wars and unrests have also increased hunting levels by exacerbating poverty and dependence on wild resources, particularly among displaced peoples and refugees.

In addition to the influx of refugees, the forests that are home to gorillas have served as hiding places and retreats for rebel forces leading to disturbance and hunting. This is a common phenomenon at times of war particularly in forests close to international borders.

4.5 Other threats

Lack of fundamental knowledge regarding numbers and distribution, and acute insufficiency in biological information crucial to assessing population viability and actual mechanisms of population decline

Accidental entrapment in wire snares used to trap other wild animals is also a potential threat to western gorillas. Plumtre *et al.* (1997) stated that the setting of snares for ungulates in the Volcans National Park, Rwanda is one of the greatest threats to *Gorilla beringei beringei*. However, Williamson (1999) reported that at least 99% of the three research groups in the Volcans National Park, Rwanda were in good physical shape. These threats need to be assessed over the whole distribution area of Western Lowland Gorilla.

International trade in live gorillas and gorilla parts, which used to be a threat, has declined since the gorilla was listed in Appendix I of CITES.

5. Regulatory provisions

5.1 International

International trade in live gorillas and gorilla products, formerly a significant threat to the species, has greatly declined since the gorilla was listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1977.

5.2 National

Angola ratified or acceded to the Convention on Migratory Species in 2006, the Convention on Biological Diversity in 1998, the UN Convention to Combat Desertification in 1997, the African Convention on the Conservation of Nature and Natural Resources in 1976, and the World Heritage Convention in 1991. There are no World Heritage Site designated yet. Angola has also acceded to the UN Framework Convention on Climate Change in 2000.

Is NOT a party in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Cameroon ratified or acceded to the Convention on Migratory Species in 1983, ...

The **Central African Republic** ratified or acceded to the Convention on Biological Diversity in 1995, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1980, the African Convention on the Conservation of Nature and Natural Resources in 1969, the UN Convention to Combat Desertification in 1996, and the World Heritage Convention in 1980. There is one World Heritage Site: Manovo-Gounda-Saint Floris NP. **CAR** also participates in UNESCO's Man and Biosphere (MAB) Programme and has designated two Biosphere Reserves.

Is NOT a Party to the Convention on Migratory Species

The **Republic of the Congo** ratified or acceded to the Convention on Migratory Species in 2000, the Convention on Biological Diversity in 1993, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1983, the UN Convention to Combat Desertification in 1999, the African Convention on the Conservation of Nature and Natural Resources in 1981, and the World Heritage

Convention in 1987. Two Biosphere Reserves are designated under Unesco's Man and Biosphere Programme: Odzala-Koukoua NP and Dimonika (Mayombe mountains)

Is NOT a Party to the African Convention on the Conservation of Nature and Natural Resources

DRC ratified or acceded to the Convention on Migratory Species in 1990, the Convention on Biological Diversity in 1994, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1976, the UN Convention to Combat Desertification in 1997, the African Convention on the Conservation of Nature and Natural Resources in 1976, and the World Heritage Convention in 1974. There are five World Heritage Sites: Garamba NP, Kahuzi-Biega NP, Salong NP, Okapi Faunal Reserve and Virunga NP. All are listed as World Heritage Sites in Danger to human pressures. DRC also participates in UNESCO's Man and Biosphere (MAB) Programme.

The Ministry of Environment, Nature Conservation, and Tourism is the government body responsible for nature conservation.

Gabon has acceded to or ratified the Convention on Biological Diversity in 1997, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1989. Gabon has also acceded to the UN Framework Convention on Climate Change in 1997. He is also a party to both the 1983 International Tropical Timber Agreement and the 1994 International Tropical Timber Agreement.

Is NOT a Party to the Convention on Migratory Species, the African Convention on the Conservation of Nature and Natural Resources

Equatorial Guinea ratified or acceded to the Convention on Biological Diversity in 1994, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2002, the UN Convention to Combat Desertification in 1997, the African Convention on the Conservation of Nature and Natural Resources in 1976, and the World Heritage Convention in 1974.

Is NOT a Party to the Convention on Migratory Species, to the African Convention on the Conservation of Nature and Natural Resources, to WHC

6. Conservation measures

6.1 National protection status

National laws for control of hunting and capture exist in all countries with gorilla populations, but lack of funds and inaccessibility make wide enforcement of this legislation rare.

In **Angola**, Article 24 of the National Constitution invests the state with responsibilities for environmental protection, and it was consolidated by decree n°40040 of 1955. Since 1998, all biodiversity conservation and protected area management has been governed by Law 5/98 "basic law of environment". The biodiversity protection and management are under the responsibility of the Ministry of Urban affairs and Environment, but in practice the Forestry Development Institute (IFD) remains in overall charge of forest sector, with the National Directorate of Agriculture and Forest (DNAF) with which it shares responsibilities in relation to policy formulation and guidance. But it is reported that wildlife protection laws are scarcely enforced either inside or outside PA, and poaching, harvesting and settlements inside PA occur regularly.

In **Cameroon**, law n° 94/01 (1994) sets out the country's forestry, wildlife and fishery regulations, and list gorillas as Category A species, which are fully protected against hunting, capture, or sale; in whole or in part. Protected areas such as national parks and wildlife reserves may be established under the auspices of the Direction de la Faune and des Aires Protégées (DFAP) of the Ministry of Environment and Forestry (MINEF), which is also responsible for the protection of the country's biodiversity in general.

In **Central African Republic**, the Ministry of the Environment, Waters, Forests, Hunting and Fishing is responsible for wildlife conservation and the use of natural resources in CAR. These are governed by

Ordinance n°84.045 (1984) and Law n°90.003 (1990). Great Apes are listed in Category A as ‘completely protected’ under Ordinance N° 84.045.

In the **Republic of the Congo**, the main laws dealing with wildlife conservation and use are Law 48/83, Law 49/83 and Decree 85/879. The Ministry of Forest Economy and the Environment (MFEE) is responsible for wildlife conservation and regulated use, including the management of protected areas.

In **Gabon** the Gabonese Ministry of Water and Forests is responsible for the management of natural resources. Under Law 1746/PR/MEFCR, Gabon has set up a wildlife management service and an antipoaching service. Gorillas (and chimpanzees) are now fully protected species under Gabonese law, having had temporary protected status since 1981 under previous law.

In **Equatorial Guinea**, conservation issues are administered by the Instituto Nacional de Desarrollo Forestal y Gestion del Sistema de Areas Protegidas (INDEFOR), within the Ministry of Infrastructure and Forests. The Law on Protected Areas of EG was passed in 2000, and the numbers PA increased to 13 in total, out of which 10 are located in Rio Muni: 2 NP (Monte Allen and Los Altos de Nsok), 5 Natural Reserves, one scientific reserve and 2 natural monuments.

Many of the priority populations identified BY the Wood Hole Research Center for Western Lowland Gorilla are at least partly protected and occur within (proposed) National Parks, Biosphere Reserve or Community Managed Nature Reserves, but many are also, at least partly, in logging concessions.

Table 1. Priority Populations for Western Lowland Gorillas (*G. g. gorilla*)

Country Countries	Population Name	Pop. Size	Area km2	Habitat Type(s)	Habitat or Biogeographic Uniqueness	Land Use Status	Scientific Importance	Other Important Conservation Features	Major Threats	Rationale for Prioritization
Republic of Congo	Odzala/Lossi/Pikounda / Ngombe/Ntokou complex	>4000 ***	41900	Lowland forest		National park, Logging concessions	Gorilla research at 'bais' or forest Clearings	High faunal diversity; particularly large and endangered mammals	Ebola, commercial hunting, commercial logging	Large population and area, protected area, research
Republic of Congo	Lac Tele/Likouala Complex	>4000 ***	29545	Swamp, riparian & lowland forest, savanna		Community Reserve, Un-zoned land		High faunal diversity; particularly large and endangered mammals	Commercial and subsistence hunting	Large population and area
Republic of Congo, Central African Republic, Cameroon	Sangha Trinational Complex	>4000 ***	27908	Lowland forest		National Park, Special Reserve, Logging concessions	On-going gorilla And chimpanzee research	High faunal diversity; particularly large and endangered mammals	Commercial hunting, commercial logging, artisanal mining	Large population and area, protected area, research
Gabon	Loango/Moukalaba-Doudou/Gamboua Complex	>4000 ***	13062	Lowland coastal forest, savanna		National Park, Reserve	On-going gorilla Research	High faunal diversity; particularly large and endangered terrestrial and aquatic mammals	Commercial hunting, oil exploitation, subsistence hunting	Large population and area, protected area, research
Cameroon	Dja conservation Complex	>4000 ***	6,238	Lowland forest		Biosphere Reserve, Logging and mining concessions community-use forests, agroforestry zones	Gorilla research	High faunal diversity; particularly large and endangered mammals	Commercial hunting, commercial logging, habitat fragmentation	Large population, protected area, research
Cameroon	Boumba Bek/Nki	>4000 **	6,110	Lowland forest		National Park		High faunal diversity; particularly large and endangered mammals	Commercial hunting and logging, illegal trafficking of military weapons	Large population, protected area
Gabon	Lopé/Waka Complex	>2000 **	10,129	Lowland Forest savanna mosaic		National park, Logging Concessions	Long-term gorilla and chimpanzee Research	High faunal and floral Diversity(importance as pleistocene	Commercial hunting, commercial logging, disease	Large population and area, protected area, research

								refugia); archaeological interest of > 400,000 years		
Gabon	Ivindo complex	>2000 **	6,527	Lowland forest		National park, Logging Concessions	Gorilla research	High faunal diversity; particularly large and endangered mammals	Commercial hunting, commercial logging	Large population, protected area, research
Equatorial Guinea, Cameroon	Rio Campo/ Campo Ma'an Complex	>2000 ***	5,843	Lowland coastal forest		National Park, Reserve, Logging concessions, agroforestry zones	Site of prior Gorilla research	Rich faunal and floral diversity; several endemic plant species	Commercial hunting, habitat destruction due to develop. projects	Large population, protected area, research
Gabon	Belinga-Djoua	>2000 *	5,843	Lowland forest		Un-zoned		High faunal diversity; particularly large and endangered mammals	Mineral exploitation, Ebola, commercial hunting	Large population
Cameroon	Mengamé	>2000 **	1,219	Lowland forest		Proposed Sanctuary, forest reserve, logging concessions		High faunal diversity; particularly large and endangered mammals	Commercial and subsistence hunting, habitat destruction due to agriculture	Large population
Gabon, Republic of Congo	Conkouati/ Mayumba Complex	>2000 **	7,066	Lowland coastal forest, savanna		National Park		High faunal diversity; particularly large, endangered terrestrial & aquatic mammals; world's largest nesting population of leatherback turtles	Commercial hunting, commercial logging, artisanal mining	Large population, protected area
Cameroon	Ebo/Ndokbou Conservation Complex	>1000 *	2,677	Lowland to mid-altitude forest	Unknown taxonomy - possible range extension for western lowland gorillas	Proposed National Park, logging concession	Gorilla research	High faunal and floral diversity; high degree of endemism	Commercial hunting, commercial logging and road development	Relatively large population; unknown taxonomy - possible range extension for western lowland gorillas, research, proposed NP
Angola (Cabinda), DRC, Republic of Congo	Mayombe Forest Trans-boundary Initiative	> 500 *	8,000	Lowland forest	Fragmented populations at limits of geographic range	Biosphere Reserve, unzoned		Faunal and floral diversity poorly documented	Commercial and subsistence hunting, illegal mining and logging, armed conflict	Fragmented populations at limits of geographic range; Biosphere Reserve

Accuracy of population estimate is scored as follows: ***indicates the estimate from good transect surveys spread over areas or habitats of population; **indicates estimate based on adequate set of transects from one location, and estimate extrapolated to the rest of the areas/habitats of population; *no scientific estimate of ape density from any location

6.2 International protection status

The gorilla, *Gorilla gorilla sl*, is listed in CITES Appendix I since 1st July, 1975, and all Range States are Parties. The gorilla is listed in Class A of the African Convention on the Conservation of Nature and Natural Resources (1969).

The Western Lowland gorilla, *Gorilla gorilla gorilla*, is the nominal taxon of *Gorilla gorilla* and as such listed in Appendix I of the Convention on Migratory Species (CMS).

6.3 Additional protection needs

Implementation of recommendations from International Primatology Society, concerning Ebola epidemics.

7. Additional Remarks

8. References

- Anon (1999) The endangered primary forests of Gabon. WRM Bulletin 28. <http://www.wrm.org.uy/bulletin/28/Gabon.html>. Accessed November 28 2004
- Anon. (2002) International Gorilla Conservation Programme. Programme Profile, November 2002. <http://www.awf.org/documents/IGCPPProgramProfile1102.pdf> Downloaded 27 may, 2003.
- Anon (2003) Massive great ape die-off in Africa – Ebola suspected. National Geographic February 6 2003. http://news.nationalgeographic.com/news/2003/02/0205_030205_ebola.html.
- AWF (2003) Mountain gorilla poachers jailed in Rwanda. African Wildlife Foundation <http://www.awf.org/wildlives/149> Downloaded 27/10/2003.
- Barnes, R.F.W. (1990). Deforestation trends in tropical Africa. *Afr. J. Ecol.*, 28, 161-173.
- Bermejo, M. (1999) Status and conservation of primates in Odzala National Park, Republic of the Congo. *Oryx* 33 (4): 323–331.
- Bermejo, M. (2004) Home-range use and intergroup encounters in western gorillas (*Gorilla g. gorilla*) at Lossi Forest, North Congo. *American Journal of Primatology* 64, 223-232.
- Binyeri, D. K., Hibukabake, D. M and Kiyengo, C. S. (2002) The Mikeno gorillas. *Gorilla Journal*, 25: 5-7.
- Blake, S., Fay, J.M. (1997) Seed production by *Gilbertiodendron dewevrei* in the Nouabale-Ndoki National Park, Congo, and its implications for large mammals. *Journal of Tropical Ecology* 13: 885–891.
- Blake S., M. Rogers, J. Fay, M. Ngangoue & G. Ebeke. 1995. Swamp gorillas in the northern Congo. *Afr J Ecol* 33:285-290.
- Blom, A., Almasi, A., Heitkonig, I.M.A., Kpanou, J.B., Prins, H.H.T. (2001) A survey of the apes in the Dzanga-Ndoki National Park, Central African Republic: a comparison between the census and survey methods of estimating the gorilla (*Gorilla gorilla gorilla*) and chimpanzee (*Pan troglodytes*) nest group density. *African Journal of Ecology* 39 (1): 98–105.
- Butynski, T. M. (2001) Africa's Great Apes. In: *Great Apes and Humans: The ethics of Coexistence*. Beck, B., Stoinski, T. S., Hutchins, M., Maple, T.L., Norton, B., Rowan, A., Stevens, E. F. and Arluke, A. (eds). Smithsonian Institution Press, Washington D.C. Pp.3-56.
- Byrne, R. W. and Byrne, J. M. E. (1993). Complex leaf gathering skills of mountain gorillas (*Gorilla g. beringei*): Variability and standardization. *American Journal of Primatology*, 31: 241-261.
- Carroll, R.W. (1988) Relative density, range extension, and conservation potential of the lowland gorilla (*Gorilla gorilla gorilla*) in the Dzanga-Sangha region of southwestern Central African Republic. *Mammalia* 52 (3): 309–323.
- Doran, DM & A. McNeilage. 1998. Gorilla ecology and behavior. *Evol Anthropol* 6:120-131.
- Doran, DM & A. McNeilage. 2001. Subspecific variation in gorilla behavior: the influence of ecological and social factors. In: Robbins MM, Sicotte P, Stewart KJ, editors. Mountain gorillas: three decades of research at Karisoke.
- Doran, D. M., D. Greer, P. Mongo & D. Schwind. (2004) Impact of ecological and social factors on ranging in western gorillas. *American Journal of Primatology* 64, 207-222.
- Dudley, J. P., Ginsberg, J. R., Plumptre, A. J., Hart, J. A. & Campos, L. C. (2002). Effects of war and civil strife on wildlife and wildlife habitats. *Conservation Biology*, 16 (2): 319-329.
- ECOLEX (2003) ECOLEX – A gateway to environmental law. http://www.ecolex.org/SPECIES/search/FA_search.htm Downloaded 28/07/2003.
- Fay, J.M. (1989) Partial completion of a census of the western lowland gorilla (*Gorilla gorilla gorilla*), Savage and Wyman) in south-western Central African Republic. *Mammalia* 53 (2): 203–215.
- Fay, JM, M. Agnagna, J. Moore & R. Oko. 1989. Gorillas (*Gorilla gorilla gorilla*) in the Likouala swamp forests of north central Congo: preliminary data on population and ecology. *Int J Primatol* 10:477-486.
- Fay, J.M., Agnagna, M. (1992) Census of gorillas in northern Republic-of-Congo. *American Journal of Primatology* 27 (4): 275–284.
- Garner, K. J. & Ryder, O. A. (1996). Mitochondrial DNA diversity in gorillas. *Molecular and Phylogenetic and Evolution*, 6 (1): 39-48.
- Goldsmith, M.L. (1999) Ecological constraints on the foraging effort of western gorillas (*Gorilla gorilla gorilla*) at Bai Hokou, Central African Republic. *International Journal of Primatology* 20 (1): 1–23.
- GRASP (2004) http://www.unep.org/grasp/Fact_gorilla.asp
- GRASP/IPS (2004) Scientists Fear Ebola May Be Responsible for Sudden Gorilla Disappearance. Press release. Great Ape Survival Project, International Primatological Society. http://www.unep.org/grasp/Documents/PR_Ebola2.doc. Accessed September 19 2004.
- Graczyk, T. K. & Cranfield, M. R. (2003) Coprophagy and intestinal parasites: Implications to human-habituated mountain gorillas (*Gorilla gorilla beringei*) of the Virunga mountains Bwindi Impenetrable Forest. *Primate Conservation*, 19: 58-64.
- Graczyk, T. K., Cranfield, M. R., & Eilenberger, U. (2001a) Hyperkeratotic mange caused by *Sarcoptes scabiei* (Acariformes: Sarcoptidae) in juvenile human-habituated mountain gorillas (*Gorilla gorilla beringei*). *Parasitol. Res.*, 87: 1024-1028.

- Graczyk, T. K., DaSilva, A. J., Cranfield, M. R., Nizeyi, J. B., Kalema, G. R. N. N. & Pieniazek, N. J. (2001b) *Cryptosporidium parvum* Genotype 2 infections in free-ranging mountain gorillas (*Gorilla gorilla beringei*) of the Bwindi Impenetrable National Park, Uganda. *Parasitol. Res.*, 87: 368-370.
- GROMS (2002) Species Fact Sheet – Gorilla gorilla. http://www.biologie.uni-freiburg.de/data/zoology/riede/groms/Species_HTMLs/Ggorilla.html Downloaded on 30 April 2003.
- Groves, C. (2002) *Primate Taxonomy*. Smithsonian Institution Press, Washington and London.
- Hamilton, A., Cunningham, A., Byarugaba, D. & Kayanja, F. (2000) Conservation in a region of political instability: Bwindi Impenetrable forest, Uganda. *Conservation Biology*, 14(6): 1722-1725.
- Harcourt, A.H., 1996. Is the Gorilla a threatened species? How should we judge? *Biological Conservation* 75. 165-186.
- Harcourt, A. H., Fossey, D. & Sabater-Pi, J. (1981) Demography of *Gorilla gorilla*. *Journal of Zoology, London*, 195: 215-233.
- Inogwabini, B., Hall, J. S., Vedder, A., Curran, B., Yamagiwa, J. & Basabose, K. (2000) Status of large mammals in the mountain sector of Kahuzi-Biega National Park, Democratic Republic of Congo, in 1996. *African Journal of Ecology*, 38: 269-276.
- IPS, International Primatology Society. 2004. <http://www.ips2004.unito.it/about.html>.
- IUCN (1982) *The conservation status of the great apes*. The World Conservation Union.
- IUCN (1996) *African Primates. Status survey and conservation action plan*. Revised edition. IUCN, Gland, Switzerland, 88 pp.
- IUCN (2002) 2002 IUCN Red List of Threatened Species. <http://www.redlist.org> Downloaded on 30 April 2003.
- Kaiza, D. (2001) Bushmeat: Trade in endangered species threatens apes in Uganda. *The East African Business*, September 3-9, 2001.
- Kalema-Zikusoka, G., Kock, R.A. & Macfie, E. J. (2002) Scabies in free ranging gorilla (*Gorilla beringei beringei*) in Bwindi Impenetrable National Park, Uganda. *The Veterinary Record*, 150: 12-15.
- Kalpers, J., Williamson, E. A., Robbins, M. M., McNeilage, A., Nzamurambaho, A., Lola N. & Mugiri, G. (2003) Gorillas in the crossfire: population dynamics of the Virunga mountain gorillas over the past three decades. *Oryx*, 37 (3): 326-337.
- Kano, T., Asato, R. (1994) Hunting pressure on chimpanzees and gorillas in the Motaba River area, northeastern Congo. *African Study Monographs* 15 (3): 143–162.
- Kemf, E. & Wilson, A. (1997) *Great apes in the wild – 1997 WWF Species Status Report*. WWF – World Wide Fund for Nature.
- Magliocca F., S. Querouil, A. Gautier-Hion. 1999. Population structure and group composition of western lowland gorillas in north-western Republic of Congo. *Am J. Primatol* 48:1-14.
- Mahaney, W. C., Watts, D. P. & Hancock, R. G. V. (1990) Geophagia by mountain gorillas (*Gorilla gorilla beringei*) in the Virunga Mountains, Rwanda. *Primates*, 31 (1): 113-120.
- Masicot, P. (2003) Animal Info <http://www.animalinfo.org/species/primate/gorilla.htm>
- McNeilage, A., Plumtre, A. J., Brock-Doyle, A. & Vedder, A. (2001) Bwindi Impenetrable National Park, Uganda: gorilla census 1997. *Oryx*, 35 (1): 39-47.
- Minemeyer, S., Walker, T., Collomb, J.G., Cotton, L., Bryant, D. (2002) An Analysis of Access to Central Africa's Rainforests. World Resources Institute.
- Mudakikwa, A. (2001) An outbreak of mange hits the Bwindi gorillas. *Gorilla Journal*, 22. <http://www.berggorilla.de/english/gjournal/texte/22scabies.html>.
- Muruthi, P., Proce, M. S., Soorae, P., Moss, C. & Lanjouw, A. (2000) Conservation of Large Mammals in Africa. What lessons and challenges for the future? In: *Priorities for the Conservation of Mammalian Diversity: Has the Panda had its Day?* Eds A. Entwistle & N. Dunstone. Conservation Biology 3.
- Nellemann & Newton (eds) (2002) The Great Apes – the road ahead. A Globio perspective on the impacts of infrastructural developments on the Great Apes. United Nations Environment Programme. http://www.globio.info/download.cfm?File=region/africa/GRASP_5.pdf
- Nishihara T. 1995. Feeding ecology of western lowland gorillas in the Nouabale-Ndoki National Park, Congo. *Primates* 36:151-168.
- Nowak, R. (1995) Uganda enlists locals in the Battle to save the Gorillas. *Science*, 267: 1761- 1762.
- Nowak, R.M. (1999) *Walker's Mammals of the World*. 6th Ed. The Johns Hopkins Univ. Press, Baltimore.
- Oates, J.F., White, D., Gadsby, E.L., Bisong, P.O. (1990) Conservation of gorillas and other species. In: Caldecott, J.O., Oates, J.F., Ruitenbeek, H.J., Cross River National Park (Okwangwo Division): Plan for Developing the Park and its Support Zone. WWF-UK. Appendix 1.
- Oates, J.F., McFarland, K.L., Groves, J.L., Bergl, R.A., Linder, J.M., Disotell, T.R. (2002) The Cross River gorilla: natural history and status of a neglected and critically endangered subspecies. In: Taylor, A.B., Goldsmith, M., eds, *Cambridge Studies in Biological and Evolutionary Anthropology*, vol. 34: *Gorilla Biology: a Multidisciplinary Perspective*. Cambridge University Press, Cambridge, UK. pp 472–497.
- Olejniczak, C. (2001) The 21st century gorilla: progress or perish? In: Brookfield Zoo (2001) *The Apes: Challenges for the 21st Century*. Conference proceedings. Chicago Zoological Society, Brookfield, Illinois. <http://www.brookfieldzoo.org/content0.asp?pageID=773>. pp. 36–42.
- Parnell R.J. 2002. Group size and structure in western lowland gorillas (*Gorilla gorilla gorilla*) at Mbeli Bai, Republic of Congo. *Am J Primatol* 56:193-206.

- Plumptre, A. J. (1995) The Chemical-Composition of Montane Plants and Its Influence on the Diet of the Large Mammalian Herbivores in the Parc National-Des-Volcans, Rwanda. *Journal of Zoology* 235:323-337.
- Plumptre, A. J. & Harris, S. (1995) Estimating the biomass of large mammalian herbivores in a tropical montane forest: a method of faecal counting that avoids assuming a 'steady state' system. *Journal of Applied Ecology*, 32: 111-120.
- Plumptre, A. J., Bizumuremyi, J. B., Uwimana, F. & Ndaruhebeye, J. D., (1997) The effects of the Rwandan civil war on poaching of ungulates in the Parc National des Volcans. *Oryx*, 31(4): 265-273.
- Plumptre, A. J., McNeilage, A., Hall, J. S. & Williamson, E. A. (2003) The current status of gorillas and threats to their existence at the beginning of the new millennium. In: *Gorilla Biology, A Multidisciplinary Perspective* (Taylor & Goldsmith, ed.s). Cambridge University Press.
- Redmond, I. (2006) Presence of Great Apes in Bas-Congo. *Gorilla Journal* 33: 10-12.
- Remis, M.J. (1997) Western lowland gorillas (*Gorilla gorilla gorilla*) as seasonal frugivores: Use of variable resources. *American Journal of Primatology* 43 (2): 87-109.
- Remis, M.J. (1997) Ranging and grouping patterns of a western lowland gorilla group at Bai Hokou, Central African Republic. *American Journal of Primatology* 43 (2): 111-133.
- Robbins, M. M. (1995) A demographic analysis of male life history and social structure of mountain gorillas. *Behaviour*, 132 (1-2): 21-47.
- Robbins, M. M. (1996) Male-male interactions in heterosexual and all-male wild mountain gorilla groups. *Ethology*, 102: 942-965.
- Robbins, M. M. (1999) Male mating patterns in wild multimale mountain gorilla groups. *Animal Behaviour*, 57: 1013-1020.
- Sarmiento, E. E., Butynski, T.M. & Kalina, J. (1996) Gorillas of Bwindi-Impenetrable Forest and the Virunga volcanoes: Taxonomic implications of morphological and ecological differences. *American Journal of Primatology*, 40: 1-21.
- Sarmiento, E. E. & Oates, J. F. (2000) The Cross River gorillas : a distinct subspecies, *Gorilla gorilla diehli* Matschie 1904. *American Museum novitates* , n° 3304.
- Sicotte, P. (1995) Interpositions in conflicts between males in bimale groups of mountain gorillas. *Folia Primatol.*, 65: 14-24.
- Stanford, C. B. (1999) Bwindi-Impenetrable Great Ape Project: Progress Report for 1999. <http://www.anthro.ucdavis.edu/gcn/g13bwindi.htm> Downloaded 14/05/03.
- Stanford, C. R. (2001) The subspecies concept in primatology: The case of mountain gorillas. *Primates*, 42 (4): 309-318.
- Tamale, E. S. (1996) Incentive measures for the conservation and sustainable use of biological diversity in Uganda; A case study of the 'Development Through Conservation' Project in communities around Bwindi National park. Presented at a Workshop on Incentives for Biodiversity: Sharing Experiences, Montreal, Canada, 20 August -1 September 1996.
- Taylor, D., Marchant, R.A. & Robertshaw, P. (1999) A sediment-based history of medium altitude forest in central Africa: a record from Kabata Swamp, Ndale volcanic field, Uganda. *Journal of Ecology*, 87: 303-315.
- Uganda Wildlife Division (2002a) Uganda National Report to CMS (2002) Prepared by Wildlife Division, (in the Ministry of Tourism, Trade and Industry, - P.O. Box 4241, Kampala, Uganda. http://www.unep-wcmc.org/cms/cop7/proceedings/pdf/national_reports/national_report_uganda.pdf Downloaded 30/10/2003.
- Uganda Wildlife Authority (2002b) <http://www.uwa.or.ug/research.html> Downloaded 26 May, 2003.
- UNEP (2002) The Great Apes Survival Project partnership (GRASP): Strategy. United Nations Environment Programme.
- UNEP-WCMC (2001) Gorilla - Species sheet. http://www.wcmc.org.uk/species/data/species_sheets/gorilla.htm Downloaded 16 May, 2003.
- UNEP-WCMC (2003a) World Conservation Monitoring Centre Protected Areas Database. http://www.wcmc.org.uk/protected_areas/data/wh/bwindi.html Downloaded 16 May, 2003.
- UNEP-WCMC (2003b) World Conservation Monitoring Centre Protected Areas Database. http://www.wcmc.org.uk/protected_areas/data/wh/virunga.html Downloaded 16 May, 2003.
- UNEP-WCMC (2003c) World Conservation Monitoring Centre Protected Areas Database. http://www.unep-wcmc.org/protected_areas/data/sample/0360p.htm Downloaded 16 May, 2003.
- UNEP-WCMC (2003d) World Conservation Monitoring Centre Protected Areas Database. http://www.unep-wcmc.org/protected_areas/data/sample/0238p.htm Downloaded 16 May, 2003.
- UNEP-WCMC & WWF International (2001) Gorillas. Threatened Species Account. World Conservation Monitoring Centre and World Wildlife Fund for Nature, International. <http://www.panda.org/resources/publications/species/threatened/downloads/GORILLs1.doc> Downloaded 15 May, 2003.
- UNESCO (1994) United Nations Educational, Scientific and Cultural Organization, Convention concerning the Protection of the World Cultural and Natural Heritage, World Heritage Committee, Eighteenth session, Phuket, Thailand, 12-17 December 1994. <http://whc.unesco.org/toc/mainf4.htm> Dpwnloaded 16 May, 2003.
- Vedder, A. L. (1984) Movement patterns of a group of free-ranging mountain gorillas (*Gorilla gorilla beringei*) and their relation to food availability. *American Journal of Primatology*, 7: 73-88.

- Vesperini, H. (2002) Poachers kill two mountain gorillas in bungled raid. *Times*, 15 May 2002. <http://abcnews.go.com/sections/science/DailyNews/gorillas990305.html>
- Wallis, J. & Lee, D. R. (1999) Primate conservation: the prevention of disease transmission. *International Journal of Primatology*, 20 (6): 803-826.
- Walsh, P., Abernethy, K., Bermejo, M., Beyers, R., de Wachter, P., Ella Akou, M., Huijbregts, B., Idiata Mambounga, D., Kamdem Toham, A., Kilbourn, A.M., Lahm, S., Latour, S., Maisels, F., Mbina, C., Mihindou, Y., Ndong Obiang, S., Ntsame Effa, E., Starkey, M.P., Telfer, P., Thibault, M., Tutin, C.E.G., White, L.J.T., Wilkie, D. (2003) Catastrophic ape decline in western Equatorial Africa. *Nature* 422: 1–3.
- Watts, D. P. (1984) Composition and variability of mountain gorilla diets in Central Virungas. *American Journal of Primatology*, 7: 323-356.
- Watts, D. P. (1994) The Influence of male mating tactics on habitat use by mountain gorillas (*Gorilla gorilla beringei*). *Primates*, 35 (1): 35-47.
- Watts, D. P. (1997) Agonistic interventions in wild mountain gorilla groups. *Behaviour*, 134: 23-57.
- Watts, D. P. (1998) Long term habitat use by mountain gorillas (*Gorilla gorilla beringei*). I. Consistency, variation, and home range size and stability. *International Journal of Primatology*, 19 (4): 651-680.
- Whitfield, J. (2002) Gorillas go into virtual reserve: computer model of mountain forest to keep track of threatened apes. *Nature, Science Update*, <http://www.nature.com/nsu/021104/021104-18.html>
- WHO (2003) Ebola Haemorrhagic Fever in the Republic of Congo – Update 4. World Health Organization, www.who.int/csr/don/2003_02_18/en/. Accessed February 18 2003.
- Williamson, E.A., Feistner, A.T.C. (2003) Habituating primates: Processes, techniques, variables and ethics. In: Setchell, J.M., Curtis, D.J., eds, *Field and Laboratory Methods in Primatology: A Practical Guide*. Cambridge University Press, Cambridge, UK. pp. 25–39.
- Williamson, L. (1999) Report from the Karisoke Research Centre, Rwanda. *Gorilla Conservation News*, 13, May 1999.
- WWF (2002) Gorillas Under Threat. World Wildlife Fund for Nature. http://www.panda.org/downloads/species/Gorillas_Final.pdf Downloaded 26 May, 2003.
- WWF (2003) Flagship Species: Eastern Gorillas. World Wildlife Fund for Nature. http://www.panda.org/about_wwf/what_we_do/species/what_we_do/flagship_species/great_apes/eastern_gorilla/index.cfm . Downloaded 26 May, 2003.
- Yamagiwa, J. (1987) Intra- and inter-group interactions of an all-male group of Virunga mountain gorillas. *Primate*, 28 (1): 1-30.
- Yamagiwa, J. (1999) Socioecological factors influencing population structure of gorillas and chimpanzees. *Primates*, 40 (1): 87-104.