

The Effects of War on Bonobos and Other Nonhuman Primates in the Democratic Republic of the Congo

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Introduction

More than 90 % of the major armed conflicts held between 1950 and 2000 occurred within countries that contain biodiversity “hotspots” (Hanson et al. 2009). And while there may be a few areas in the world such as the Demilitarized Zone between North and South Korea where standoffs result in a “war-zone refuge” that benefits wildlife (Martin and Szuter 1999), the majority of studies that have investigated the effects of war on biodiversity reveal a much bleaker picture. For example, chemical and biological warfare can alter landscapes and contaminate ecosystems. Herbicide combinations such as “Agent Orange” were sprayed on the forests of Vietnam in order to reduce cover for North Vietnamese soldiers (Westing 1971). Decades later, chlorinated dioxin contamination was measured in wildlife (Olie et al. 1989) and people (Schecter et al. 2001) and Agent Orange has been linked to cancer (Frumkin 2003), spina bifida (Ngo et al. 2010), and the decimation of mangrove forests in Vietnam (Arnaud-Haond et al. 2009).

Warfare is also coupled with extreme poverty due to a breakdown in economic systems, the disruption of governmental services, the collapse of infrastructure, and the reallocation of capital towards militarization (Collier 1999; Dudley et al. 2002). As a result, people living in war zones are often starving and malnourished and may be forced to turn to wild resources, exacerbating the stress that wildlife within these nations, most of which are developing, already face. Primates may be particularly

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susceptible to the effects of war. Many species are social and loud and therefore easy to hunt when other game is scarce. Moreover, while they are not always thought of as preferred prey (Chapter 3 this volume), an influx of weapons combined with starving populations can lead to an increase in primate hunting. With the number of armed conflicts increasing since the 1950s (Dudley et al. 2002), it is important to understand how humans and wildlife respond in order to protect endangered populations. The goal of this chapter is to better understand the armed conflicts of the 1990s and 2000s in the Democratic Republic of the Congo (DRC) and their effects on nonhuman primates living within and near the war zones with a specific focus on the primates living in the Lomako Forest.

The Great African War

In the mid-1990s, war erupted in the DRC. The “Great African War” (1996–2006), as it became known (Reyntjens 2009), was the result of complex interactions between nine African governments, warlords, several insurgent and rebel groups, and local people attempting to protect themselves (Williams 2013). The devastating war and resulting civil unrest that destabilized the social, political, and economic conditions within the DRC resulted in a massive human and environmental crisis. An estimated 3.9 million people died in the country due to the conflict and subsequent starvation (Coghlan 2004) making it the deadliest war in terms of human casualties in modern African history.

Wildlife suffered as well. The warfare spilled into protected areas, hundreds of park rangers were killed, and the extant threats to animals and the areas they inhabited grew. The influx of weapons and ammunition circulating in the country increased (Draulans and Van Krunkelsven 2002) while a variety of military factions and other people increasingly entered the forests in search of protection from other militarized groups and food (Nackoney et al. 2014). Hunting, the trade in ivory, and illegal timber harvesting increased as officials from Uganda and Rwanda used the political instability in the DRC as an opportunity to exploit those resources. Soldiers were also seen with live monkeys and parrots captured for use as pets (Draulans and Van Krunkelsven 2002).

One study in particular showed the effect of war on nearby wildlife. More specifically, de Merode and Cowlshaw (2006) investigated the amount and diversity of animals sold in a bushmeat market in the DRC. Their research focused on the bushmeat trade in Garamba National Park using market surveys, interviews, and direct observations. They found a significant increase in the number of protected species sold in an urban market during the war when compared with peacetime results. Most notable was the increase in elephants, buffalo, hippos, and antelope. They also noted a slight increase in the number of monkeys (multiple species) sold in a village market, although the change was not statistically significant. In general, they found that protected species accounted for over half of the bushmeat sold during peacetime and increased fivefold during the war due to a change in the commodity chain brought about by the war’s overall instability and an increase in access to protected areas for other actors.

Perhaps no species suffered as much during the war as the gorillas living in the North Kivu region of the DRC. Categorized as Critically Endangered by the IUCN (Robbins and Williamson 2008), the 700–800 remaining mountain gorillas (*Gorillas beringei beringei*) live near areas with some of the highest human population density levels in Africa (400–600 people per km²) and have been threatened by habitat loss and poaching for decades (Harcourt and Fossey 1981; Weber 1995; Weber and Vedder 2001). Ecotourism, education, and antipoaching patrols have helped stabilize the number of mountain gorillas to some degree, but few could have predicted the challenges gorilla populations would encounter as a result of the war. In Virunga National Park, between 12 and 17 gorillas (4–5 % of the entire population) died as a direct result of military activity with detrimental effects likely for surviving groups (Kalpers et al. 2003), as the loss of a silverback male often leads to the migration of females with infants, increasing the risk of infanticide to infants under 3 years old (Robbins 1995). Even after the war officially ended, mountain gorillas continued to face threats. In July of 2007, seven mountain gorillas living in Virunga were killed, not for food, but for political and economic purposes as their removal allowed increased exploitation of resources within the park (Jenkins 2008). Like the mountain gorillas, Grauer's gorillas (*Gorilla beringei graueri*) were also slaughtered in greater numbers during the war (Kasereka et al. 2006).

Gorillas were not the only ape species affected by the war. Bonobos populations living in the DRC have also decreased (Vogel 2000). Bonobos are endangered (Fruth et al. 2008) and face many of the same challenges of other nonhuman primates such as habitat loss and bushmeat hunting (Mohneke and Fruth 2008). As with gorillas, however, the war seems to have exacerbated these problems for bonobos. In the Wamba Forest, Idani and colleagues (2008) returned after the war and found a decrease in the population of three groups while three other groups were missing from their former ranges altogether. Additionally, one of the groups that did survive was forced to expand their range. These researchers speculate that the depreciation of the DRC currency and the decrease of employment opportunities forced many of the people to leave the area or turn to the forest to feed their families. Furthermore, they suggest that local taboos against eating bonobos (due to beliefs that these apes are ancient relatives) may have been lifted in the face of starvation.

Human activities also threaten bonobos at Lac Tumba (Inogwabini et al. 2008) and Salonga National Park (Hart et al. 2008). Meanwhile, the number of orphaned bonobos confiscated from the pet trade and brought to the Lola ya Bonobo sanctuary in Kinshasa increased dramatically during the war (André et al. 2008). It is clear, given the humanitarian and ecological pressures that were present in the DRC, that bonobos were killed or captured in large numbers during the war. This study looked at bonobo populations living in the Lomako Forest by analyzing changes in party size and ranging behavior from studies conducted before and after the war. Additionally, we looked at the changes in population density and group size estimates of monkeys living in the same area. Lastly, we comment on the people living there and how research projects affect bonobo conservation.

Methods

The Site

The N'deli site in the Lomako Forest (0.7994° N, 21.143° E) is located in the Congo River Basin within the Equateur Province of the DRC (Fig. 1). The 40-km² study area consists of climax evergreen and primary rain forest (75.2% of study site) with smaller areas of swamp forest (12.6%), bolafa (*Gilbertiodendron*) forest (9.9%) and secondary forest (2.3%) tracts (White 1992). The study area is also home to several primate species including bonobos, black and white colobus monkeys (*Colobus angolensis*), red-tailed monkeys (*Cercopithecus ascanius*), Wolf's mona monkey (*Cercopithecus wolfii*), DeBrazza's monkey (*Cercopithecus neglectus*), Black-crested mangabeys (*Lophocebus aterrimus*), Allen's swamp monkey (*Allenopithecus nigroviridis*), Demidoff's dwarf galagos (*Galagoides demidovii*), and the Eastern potto (*Perodicticus potto*).

The history of nonhuman primate studies at Lomako dates back to the early 1970s when preliminary studies on bonobos were conducted (Badrian and Badrian 1984; Susman et al. 1980). Long-term research, however, did not commence until 1980 when US-based researchers originally from the State University of New York at Stony Brook (Susman 1984; White 1992) and Yale (Thompson-Handler 1990) maintained a semi-permanent presence throughout the decade. During the 1990s, field seasons were carried out by Thompson-Handler (1990) and White (1996) and

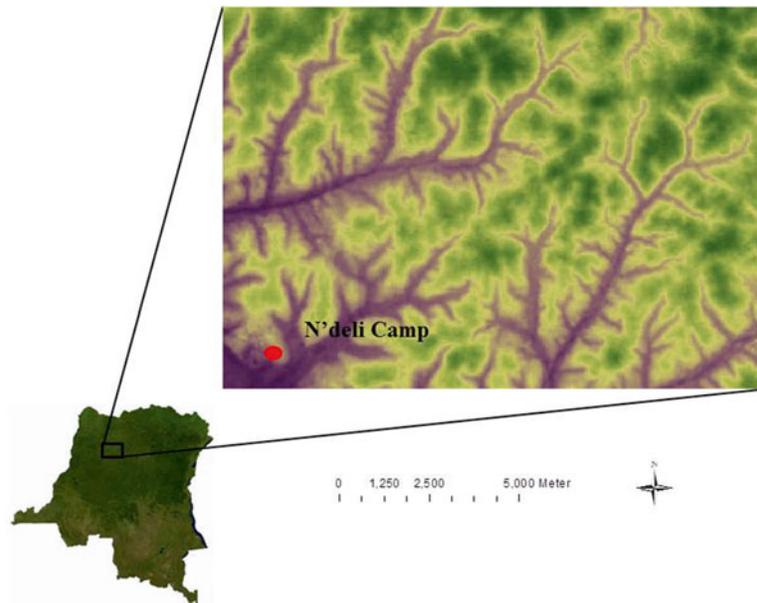


Fig. 1 This map shows the location of the N'deli field site in the Lomako Forest, DRC

her graduate students as well as researchers from the Max Planck Institute in Leipzig, Germany (Hohmann and Fruth 2002). Increasing difficulties from political unrest and the developing war resulted in evacuations and eventual complete exclusion in 1998.

For the US-based researchers, the local people were an important part of their studies and community conservation efforts. Belonging to the Lingala speaking Mongo ethnic group, the people who live along the Lomako River subsist primarily on small horticultural gardens, fishing, hunting, and gathering wild resources. Their knowledge of the forest and willingness to partner with researchers with formal agreements at high local levels made them indispensable as guides and local partners while providing them income and creating incentive to refrain from hunting in and around the study area.

Prewar Primate Populations

Data presented here comes from two separate eras of research that represent “prewar” and “postwar” periods. The “prewar” bonobo data was collected by FW during field seasons conducted from October 1984 to July 1985, June–August 1991, and June–August 1995. Her studies at Lomako focused on two communities of bonobos: the Bakumba community in the western portion of the study area and the Eyengo community in the east (Badrian and Malenky 1984; White 1998; Hohmann and Fruth 2002). Using age, sex, and facial characteristics, researchers were able to identify 28 individuals in the Bakumba community including four adult males, 11 adult females, and 13 sub-adults, adolescents, and infants. The Eyengo community consisted of 30 identifiable individuals including 10 adult males, 11 adult females, and nine sub-adults, adolescents, and infants. Party size estimates were based on focal animal sampling (see Chapman et al. 1994). Data presented here comes from 200 sightings and 448 h of focal animal observations.

To understand habitat use and ranging behavior, the trail system at Lomako was mapped using GPS in 2007 and imported into a GIS program (ArcGIS 9.3). The locations of sightings during the prewar period were hand-plotted into the program based on notes and hand drawn maps used by FW. All maps were made using a Transverse Mercator projection and the WGS 1984 UTM Zone 34 N coordinate system. Once plotted, the location data were analyzed using the RANGES8 (Anatrak Ltd. 2010) software program in order to determine the range area of the two communities for each field season and for all field seasons combined. This program uses fixed-kernel analysis to calculate a home range area in hectares (see Waller 2011).

There have been fewer studies on monkey populations at Lomako. McGraw (1994) conducted a preliminary census on the monkey species that lived in the N'deli study area before the wars began. The results included densities (individuals/km²) and average group size for *Lophocebus aterrimus* (73.1, 10.2), *Colobus*

angolensis (5.8, 5), *Cercopithecus ascanius* (42.8, 12.7), and *Cercopithecus wolffi* (44.2, 12). Altogether, McGraw found 165 monkeys/km². We use these data as the “prewar” numbers for the monkey density in the Lomako Forest.

Postwar Primate Populations

Field research resumed in 2007, after an initial visit in 2005, following the cessation of the war and the return of a modicum of political stability within the DRC. Informal interviews with local people about the war were conducted and researchers and guides searched the trails for signs of bonobos. When bonobos were located, focal animal sampling occurred and GPS points were taken. Because of the long time span between field seasons as well as research that suggests bonobo community composition may be more fluid over longer time spans than previously believed (Hashimoto et al. 2008), the relationship of the bonobos living near the study area to past groups is unclear. One female with a particularly striking facial complexion was recognized by FW as a former Eyengo community member. As such, the ranging behavior of the newly designated “New Eyengo” community (NE) located in the northeastern portion of the study area was used to look at changes in ranging areas of the Eyengo community since 1995. Although there were traces of bonobos in the Bakumba’s original range in the form of recent *Haumania* feeding remains in 2005 and 2007, these traces were sparse, northeast of their former range, and no members of the Bakumba community were located or observed. Data was collected on the NE group (18 sightings, 39 follow hours) during field seasons in June–August 2007 and June–August 2009. We were able to identify 16 individuals in the NE group including 2 adult males, 9 adult females and 5 sub-adults, adolescents, and infants. The composition of all the groups fluctuated to some degree during the field seasons and the data analyzed for this study are limited to individuals clearly identifiable within a community. As with the prewar population, the locations of the bonobos were analyzed using the ArcGIS and RANGES8 (Anatrak Ltd. 2010) software programs in order to determine the community’s ranging area.

Transects were monitored for monkey populations using methods similar to McGraw (1994) with the exception of detection distances used. We used detection distances of 20 m, whereas the detection distances used by McGraw varied depending on the species being counted. Surveys were conducted along established trails on 18 days in 2007 and on 26 days in 2009. The transects consisted of 5 km-long segments of the trails and counted monkeys that were 20 m on either side of the trail. A total of 90 km and 130 km from 10 different trails were included during the 2007 and 2009 field seasons, respectively. The surveys were conducted between 6:00 AM and 12:00 noon. Observations were made from the trail only and recorded the number of groups for each species, number of individuals per group, and whether the monkeys were in polyspecific groups.

Results

Bonobos

The extent to which local people, soldiers, and commercial bushmeat hunters entered the study area is not well understood. Evidence from bonobo ranging and local people gives us some hints, however. The changes in the observed locations of bonobos were used to assess the ape's response to the use of the forest by local people and soldiers during the war (Fig. 2). According to our guides and other local people, soldiers raided the local village and the research camp forcing families to flee into the forest. Food was scarce. As a result, hunting in the Lomako Forest increased during the period of instability (Dupain et al. 2000). At N'deli, the local guides moved into temporary camps in the study area, one within the Bakumba range, and one in the Eyengo range. According to the local guides, soldiers entered the research camp and shot monkeys around the camp area but did not enter the forest or shoot any bonobos. As the research camp is maintained approximately an hour's walk from the southernmost point where bonobos have been observed, it is possible that soldiers at this site would not have seen any of the bonobo study groups. On first contact with the Eyengo group after the war, there was no sign of alarm at observers. In subsequent field seasons, only younger individuals who were not previously habituated to observers showed any marked reaction to researchers. Nonetheless, there was evidence of monkey hunting around the research camps (see below) and habitat disturbance around the temporary hiding camps that the guides had used during the war. As mentioned above, surveys of the area formerly used by the Bakumba community found only some fresh feeding remains in 2005 but no nests or sightings, suggesting that those bonobos may have moved outside of the

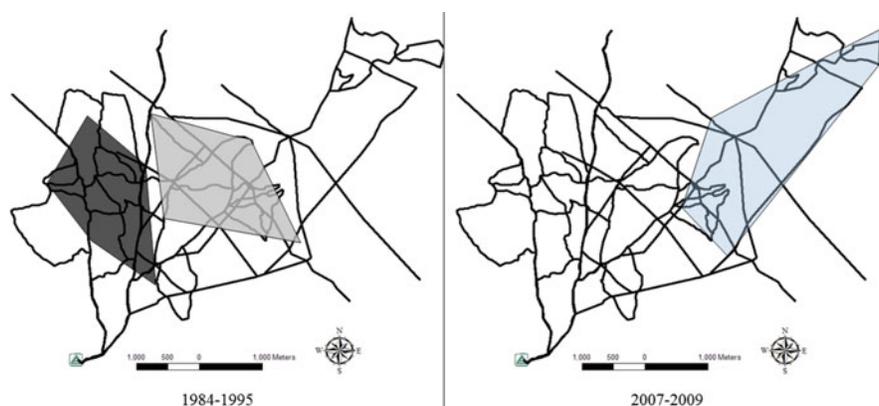


Fig. 2 These maps show the change in bonobo ranging and habitat use from field seasons conducted before the war (1984–1995) and after the war (2007–2009). In the first map, the Bakumba group's range is illustrated by the *black* polygon while the Eyengo group's range is shown by the *grey* polygon. The second map shows the ranging area of the New Eyengo group in *blue*

study area, either permanently or temporarily. Moreover, while it is difficult to say with certainty that the Eyengo and NE community are the same, we find that it is likely based on the presence of one recognizable female and the proximity to the old ranging area. Initial data shows that community size and average party size has decreased, while the ranging area has increased (Table 1).

Monkeys

The transects used to investigate monkey populations living in the Lomako Forest found the same four monkey species living there as McGraw's census conducted in 1994. *Lophocebus aterrimus*, *Colobus angolensis*, *Cercopithecus ascanius*, and *Cercopithecus wolfi* all still live in the forest, but the population density (Table 2) and average group size (Table 3), however, had changed. For each species with the exception of *angolensis*, the population density decreased. In fact, the overall population density of monkeys decreased notably from 165 to 83.6 individuals/km² in 2007. Of equal interest is the increase in population density from 2007 to 2009 to 109.6 individuals/km² suggesting that these populations may be rebounding. Similarly, the average group size for all four species decreased from 1994 to 2007

Table 1 This table shows the differences in community size, average party size, and ranging area of the communities at Lomako

Community	Community size	Average party size	Range area (ha)
Bakumba (1984–1995)	28	8.26	247.4
Eyengo (1984–1995)	30	7.86	225.95
NE (2007–2009)	16	5.5	480.67

Table 2 Population density (individuals/km²) of the four species of monkeys found during transects conducted at Lomako

	<i>Lophocebus aterrimus</i>	<i>Cercopithecus ascanius</i>	<i>Cercopithecus wolfi</i>	<i>Colobus angolensis</i>	All species combined
1994	73.1	42.8	44	5.8	165
2007	32	23.8	20.6	6.4	83.6
2009	37.3	34.2	26.2	11.9	109.6

Table 3 Average group size of the four species of monkeys found during transects conducted at Lomako

	<i>Lophocebus aterrimus</i>	<i>Cercopithecus ascanius</i>	<i>Cercopithecus wolfi</i>	<i>Colobus angolensis</i>
1994	10.2	12.7	12	5
2007	2.6	3.1	2.8	2.9
2009	2.5	5.6	5.6	2.7

with a slight increase in *ascanius* and *wolfi* group sizes from 2007 to 2009. The monkeys at Lomako were also found in polyspecific associations often. Of the 211 separate observations recorded, 77 included polyspecific associations. The most common associations were between *aterrimus*, *ascanius*, and *wolfi* (Waller, unpublished data).

Discussion

The Great African War was a catastrophic event for humans and wildlife living in the DRC. The data presented here quantifies the effect of the war on wildlife at Lomako to some extent. For the two bonobo communities, the increased human traffic in the forest altered their population size and ranging behavior. The Bakumba group appears to have moved out of the study area following the war and only future surveys and monitoring will tell if they will return. An interview with a local woman suggests that they may have moved to the east of the site, but attempts to locate signs of bonobos (i.e., sightings, nests, feces) were mostly unsuccessful. The Eyengo group seems to have moved north of the study area to an area outside of the trail system. Their numbers appear to have decreased and they have been forced to range over a larger area in order to find resources.

The monkey population at Lomako also appears to have decreased during the war. All four species regularly recorded during McGraw's census in 1994 showed marked decreases in population density and average group size with *Lophocebus* decreasing the most. And while slight differences in methodology may account for some of this decrease, particularly in regard to average group size, the reduced overall monkey density and density of each species suggests that the monkeys living in the field site were subjected to an increase in hunting pressure. Worthy of mentioning, however, is the fact that monkey populations seemed to have recovered slightly from 2007 to 2009.

It should also be pointed out that N'deli is very close to another field site in the Lomako Forest known as Iyema (Dupain et al. 2002). Yet because N'deli is more accessible from the river (a 2 km hike as opposed to a 9 km hike to Iyema) and had a more developed trail network, soldiers who entered the area during the war likely hunted more often at N'deli than at Iyema. While the results of this study show that bonobos and monkeys at N'deli were affected by the war, a recent survey at Iyema suggests that populations there were relatively unaffected (Waller, unpublished data).

The results of studies such as this have added to the discussion of ethical considerations field primatologists must weigh. Recently, it has been proposed that the habituation of primates should be carefully thought out (Fedigan 2010; Malone et al. 2010; Gruen et al. 2013). More specifically, it has been suggested that the habituation process and the presence of primatologists has the potential

Fig. 3 This photo shows confiscated bushmeat including an individual *Lophocebus* from the Lomako Forest



to make nonhuman primates more susceptible to hunting and capture for the pet trade by diminishing their fear of humans (Fedigan 2010). Other costs may include an increased chance of disease transmission, increased stress, and increased vulnerability to predators. Humans living near habituated primates may also incur costs. Nonhuman primates that are unafraid of humans may aggress against local people or researchers, conduct crop raids or engage in other pest-like behavior, and can increase the risk for zoonotic disease transmission.

Yet there are benefits too. Research projects bring in money, educate people about the importance of biodiversity, and instigate local conservation projects. For example, it is unlikely that the Reserve de Faune de Lomako-Yokokala (RFLY), officially protected as of 2006 under DRC law, would have been created without the efforts of bonobo researchers such as Jef Dupain and the African Wildlife Foundation (AWF). Furthermore, AWF along with the Institut Congolais pour la Conservation de la Nature (ICCN) have trained local people to protect the reserve from poachers and confiscate bushmeat found in the area (Figs. 3 and 4). It may also be possible that the return of researchers to the area played a role in the slight recovery seen between 2007 and 2009 in monkey density.



Fig. 4 This photo shows a confiscated leopard pelt taken from the Lomako Forest

Decisions regarding primate research that involves habituation should incorporate as much information on the economic, ecological, and ethical ramifications as possible. The fieldwork at Lomako demonstrates the challenges such decisions include. In essence, one has to ask whether the animals at Lomako would have been better off unhabituated and unstudied. The financial benefits brought to the area likely led to fewer local people using the forest and its inhabitants for food while promoting the area as suitable for protected status. But these benefits may only apply during periods of peace as the instability of wartime, transect system, and proximity to the river may have increased access of several primate populations to increased human contact. With new techniques such as genotyping and noninvasive hormonal assessments becoming more readily available, the need to habituate non-human primates may be decreasing. These new techniques should be considered in places where political stability is absent.

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