

## HUNTING PRESSURE ON CHIMPANZEES AND GORILLAS IN THE MOTABA RIVER AREA, NORTHEASTERN CONGO

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**ABSTRACT** An extensive survey was conducted in the Motaba River Area in northeastern Congo. It was based on interviews and line transect surveys. The following results were obtained: (1) Both chimpanzees and gorillas occur throughout this area. (2) The densities of both species decrease from the upper toward the lower streams, and also from inland forests to villages. (3) Overall densities are estimated at 0.3 chimpanzees per km<sup>2</sup> and 0.2 gorillas per km<sup>2</sup>. (4) Hunting of apes for meat occurs in every part of the area. Most resident people are willing to eat ape meat, and about half of them have a chance to eat it in a year. (5) Hunting pressures on apes are estimated at 0.020 chimpanzees and 0.010 gorillas per km<sup>2</sup> per year. These results strongly suggest that the survival of both species is seriously threatened by local hunting. The threat is expected to increase with human population growth and with forthcoming forest exploitation in northeastern Congo.

**Key Words:** Central chimpanzee; Western lowland gorilla; Hunting pressure; Density; Congo.

### INTRODUCTION

Tropical forest covers 65% of the land area of the Republic of the Congo (IUCN, 1990), making it the second most densely forested country in the Afro-tropical zone (Sayer et al., 1992). Most of its forests are suitable habitats for chimpanzees (*Pan troglodytes troglodytes*) and gorillas (*Gorilla gorilla gorilla*). Congo's low human population density of 6.4 people per km<sup>2</sup> (2,200,000 inhabitants over a total area of 341,500 km<sup>2</sup>, Sayer et al., 1992) also favors ape survival. Congo is undoubtedly one of the most important countries for the conservation of African apes, which are threatened throughout most of their geographical range.

There are verified records of apes from southwestern and northern Congo. In southern Congo which contains 43,400 km<sup>2</sup>, a recent survey in Mayombe and Chaillu Massifs indicates that gorillas are still widespread, though at low densities (Fay & Agnagna, 1992). Other surveys, conducted by Ihobe (1993) and Idani (unpublished) between 1992 and 1993, also indicate that both chimpanzees and gorillas are distributed throughout the forests of the Lekoumou, Niari, and Kouilou regions (Fig. 1).

Northern Congo is characterized by a huge swamp called the *Cuvette Congolaise*, or the Likouala swamp, which is surrounded by dry-land (*terra firma*) forest to the

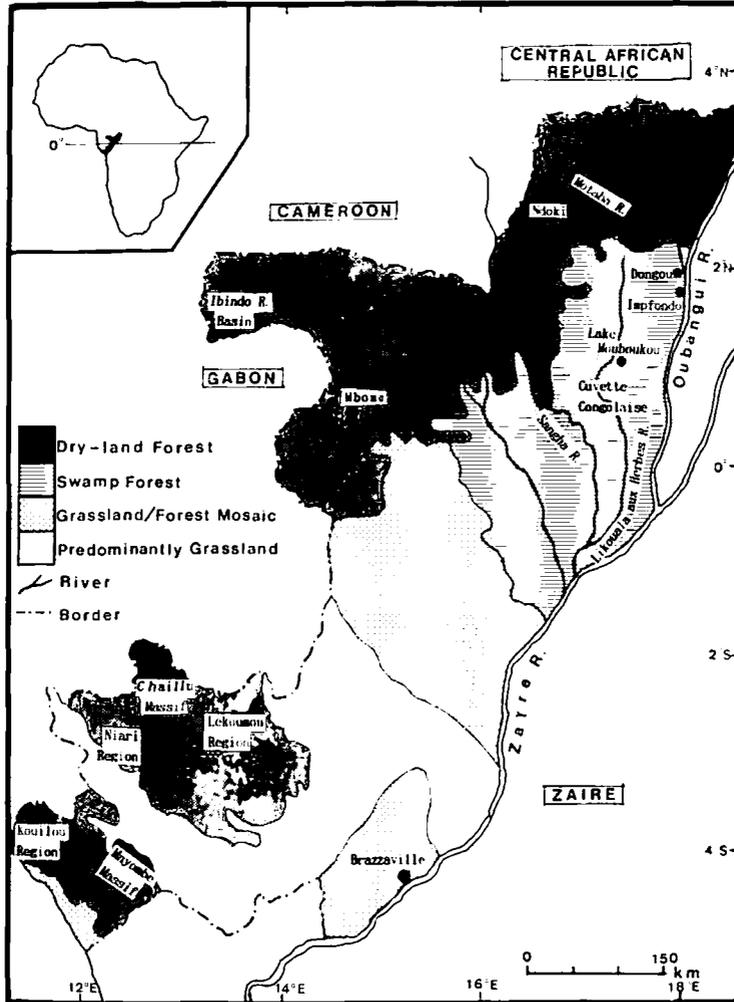


Fig. 1. Vegetation in Congo (Source: Sayer et al., 1992).

north and the west (Fig. 1). Intensive studies of sympatric gorillas and chimpanzees have been carried out in recently established Nouabale-Ndoki National Park, towards the border with the Central African Republic (CAR) (e.g., Mitani, 1990a, b, 1992; Kuroda, 1992; Nishihara, 1992; Suzuki, 1993), and a few extensive surveys have also been conducted in northern Congo (Fay et al., 1989; Fay & Agnagna, 1992; Agnagna et al., 1991). These studies have revealed that both species of ape occur in both swamp and dry forests.

The northern area has the lowest human population density in Congo, with an overall mean of 1–3 inhabitants per km<sup>2</sup> (Sayer et al., 1992), and 0.9 inhabitants per km<sup>2</sup> in the rural areas (Fay & Agnagna, 1992). It also retains a total of 170,000 km<sup>2</sup> of forest, 97,800 km<sup>2</sup> of which is intact (Sayer et al., 1992). It is, therefore,

probable that the bulk of the total ape population of Congo occurs in this block. On the other hand, a lot of reports (Mitani, 1990a, b; Agnagna et al., 1991; Fay & Agnagna, 1992) and other information from several sites (Sato, Kitanishi, Ichikawa, Takeuchi, Hanawa, pers. comm.) indicate that the poaching of apes for meat by local people is widespread in northern Congo. Little is known, however, about the effect of hunting on ape densities in this area.

The aim of our study was to inquire into the present distribution and density of chimpanzees and gorillas in northern Congo, with special reference to hunting pressure.

## STUDY AREA AND METHODS

### 1. Study Area and Human Population

Our survey was conducted along the Motaba River, (Fig. 2) which, together with the Ibenga River to the north, is located in the Dongou District (32,040 km<sup>2</sup>) of the Likouala Region. In contrast to the study site of Fay & Agnagna (1989), which was in the *Cuvette Congolaise* in the Epena District to the south, the Dongou District is mostly covered with dry-land forest.

The study area was located between 2° and 3° N., and between 17° and 18° E.

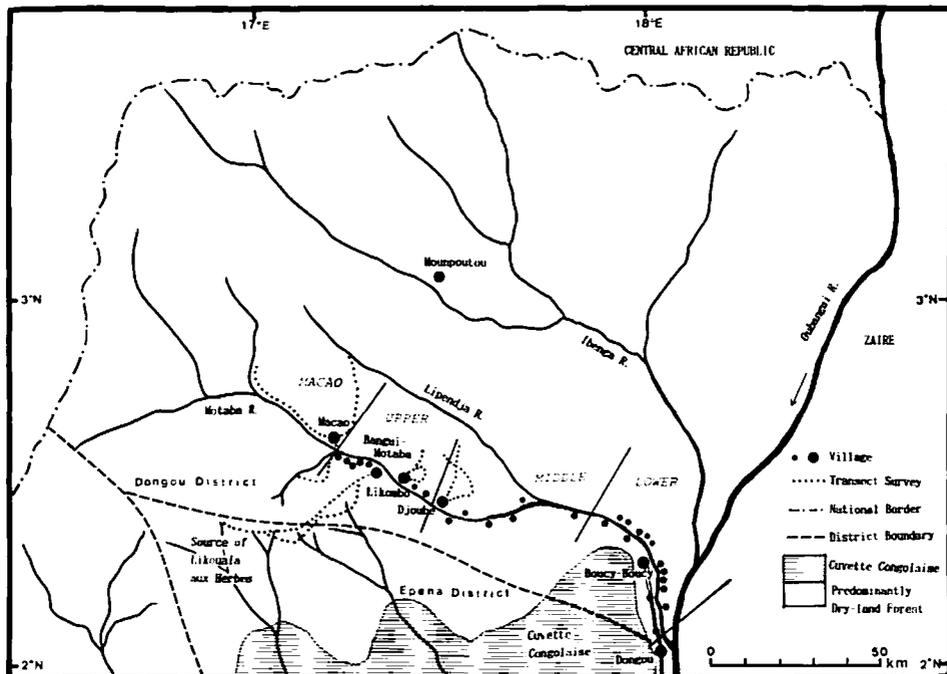


Fig. 2. Study area.

The altitude was between 350 and 500 meters above sea level, with the terrain being generally even. Northern Congo has around 1,800 mm of rainfall (Sayer et al., 1992). There are no totally dry months, but rainfall decreases to less than 100 mm per month between December and January (Takeuchi, in prep.). Our survey period, from the 11th December, 1992 to the 22nd January, 1993, fell within this dry season.

This paper is based on two sources of data: those obtained through interviews with resident people, and those obtained through transect surveys in the forests.

The people living along the Motaba depend for medical and other services, and for daily necessities, such as clothing, petrol, tableware and fishing/agriculture implements, on Dongou and Impfondo (Fig. 1), two large trading centers on the Oubangui River. They, in turn, supply these centers with food, such as cassava, fish, wild meat, and palm wine. Most transportation is by the waterway, since, excluding foot-paths, there is only one road, with extremely infrequent traffic, between Dongou and Boucy-Boucy along the right bank of the Motaba (Fig. 2).

Thirty-two villages, varying in size from less than ten to more than 600 inhabitants, are distributed along the main stream of the Motaba, within a stretch of 120 km between Dongou at the junction with the Oubangui, and Macao, the uppermost village (Fig. 2). There are no permanent settlements inland. The Motaba residents consist of three ethnic groups of cultivators, the Kaka, the Bondongo, and the Bomitaba, and also the Aka hunter-gatherers. Those cultivators will be referred to as "Bantu" hereafter, since most of them speak Bantu language, although according to Ichikawa (pers. comm.) a few Ubangian speaking groups are found in the Kaka area. The Bantu groups are spatially segregated, with the Kaka occupying the upper 10 villages, the Bondongo occupying the middle 7, and the Bomitaba occupying the lower 15 villages.

The distance between villages varies from a few to 15 km. Along the river, therefore, very limited land is available for each village. Instead, its activity range extends inland. People of each village appear to have their boundary at approximate 30 km from village. At the boundary, they meet people from the neighboring water systems, the Ibenga to the north and the Likouala aux Herbes to the south. Only the people of the uppermost village, Macao, have a much broader potential range, since a huge uninhabited forest extending westward is available to them.

No mechanised agriculture or logging occur in the study area. All three Bantu groups subsist mainly on the traditional forms of farming, i.e., slash-and-burn agriculture. They also engage in net-fishing, which is predominantly restricted to the Motaba mainstream. The Bondongo practice an additional type of traditional inland fishing, known locally as "*kombe*." In this, handmade fishpots are used to catch fish migrating back towards the larger streams from the swamp forests, as the waters recede during the transitional period from wet to drier season (Hanawa, pers. comm.).

The Bomitaba appear to be the most urbanized of the three ethnic groups. Their territory was within one day's journey by motor-driven canoe to Impfondo, the largest town in northeastern Congo.

Based on differences in ethnic group, lifestyle, and ecological conditions, the study area has been divided into four segments: (1) Macao, and (2) the upper, (3)

the middle, and (4) the lower Motaba (Fig. 2).

The Aka people had their settlements adjacent to most of the Bantu villages. They act as general servants for their Bantu masters during their stay at the village site, assisting them in subsistence activities, and other miscellaneous affairs. They frequently leave the villages, however, to spend periods of variable duration hunting and collecting, using their camps scattered in the forests. Thus, they show a marked difference from the Bantu in their degree of dependence on the forest. Information from these two sources is, therefore, dealt with separately in some analyses.

## 2. Interviews

A total of 23 Motaba villages were visited and interviews were held with a total of 309 male Akas and Bantus over 15 years. We focused our interviews on adult males because only they were involved in ape-hunting. Females and young participated only in net-hunting, and this method was not used for apes.

All informants were asked whether they had (1) seen, (2) hunted, or (3) eaten any chimpanzee or gorilla since "New Year's Day (*Bonne annee*)" of 1992, which was about one year before the interviews. They were also asked about (4) their experience of ape-hunting before 1992. Those who answered "yes" to the second question were asked about (5) the number and (6) age/sex class of apes killed, and (7) the method used. Those who answered "no" to the third question were asked (8) whether they would eat the meat of apes, if it were available. Those who answered "no" to the eighth question were asked the reason why they rejected eating. We wished to avoid becoming inquisitorial, and some informants did not answer some of our questions.

Rates reported (e.g., sighting rate, hunting rate, etc.) are the number of informants who answered "yes," to the number of the all informants who gave an answer.

## 3. Line Transects

Twelve line-transects of various length were made along paths of the Aka, starting from four villages on the middle and upper Motaba (i.e., Djoube, Likombo, Bangui-Motaba and Macao, Fig. 2). All direct sightings and signs of apes, including vocalizations, nests, feeding remnants, dung, and footprints, and all signs of human activities, such as hunting camps and honey-collecting sites, were recorded. A record was also kept of vegetation type.

Distances were measured using a pedometer (1 step=0.6 m, Kano) or a measure-rope of 50 m (Asato). The total distance surveyed covered more than 450 km, but the effective length of transects, excluding overlaps, was 222 km (215 km measured by the pedometer and 7 km by the measure-rope). The site where each major recording such as nest site was made were measured using a GPS (global positioning system), which is claimed to have an error-range between 30 and 100 m. Two Bantus and 4 to 5 Akas assisted each of us in finding signs of apes and in other survey activities.

#### 4. Estimation of Density

The density of apes was estimated indirectly from nest count, using the following two formulae:

*Formula 1* (modified from Tutin & Fernandez, 1984): Non-dependent (nesting) ape density = (number of nest sites) × (median number of nests per site) / (area sampled) / (observer efficiency) / (mean nest life-span).

*Formula 2* (Ghiglieri, 1984): (total number of nests within sampled area) / (area sampled) / (observer efficiency) / (mean nest life-span).

Groups consisting of only tree nests were attributed to chimpanzees, while groups containing at least one ground nest were attributed to gorillas (Tutin & Fernandez, 1984). The width of the transect was set at 40 m for chimpanzee and 10 m for gorilla nests, since the maximum perpendicular distances from the transect line at which chimpanzee nests and gorilla ground-nests were found were 20 m and 5 m, respectively. Thick undergrowth made it much more difficult to find nests of gorillas on the ground than those of chimpanzees in trees.

In most of the former studies, observer efficiency was assumed to be 100% within the transect width of 20 m (e.g., Tutin & Fernandez, 1984; Fay et al., 1989). It is, however, unrealistic that any observer can find all nests within sampled area, no matter how narrow the transect width is, and no matter how slow the survey speed is. In the present survey, based on data obtained by Hashimoto (1993), who made a detailed study of chimpanzee nests in the Kalinzu forest, Uganda, observer efficiency was assumed to be 0.56, with a transect width of 40 m. Observer efficiency for gorilla nests is not known. However, the same value for chimpanzees (0.56) was tentatively adopted, assuming the observer efficiency at the maximum perpendicular visible distances from the transect line to nests would be similar for nests of chimpanzees and those of gorillas. Mean nest life-span for chimpanzee/gorilla was found to be 113.6/53.6 days in Gabon (Tutin & Fernandez, 1984).

## RESULTS

### 1. Vegetation

Fay et al. (1989) classified the vegetation in the *Cuvette Congolaise* area into four broad categories, namely 'swamp,' 'flooded,' and '*terra firma*' forests, and 'savanna.' In the present survey, flooded forest was included in the category 'swamp forest.' *Terra firma* forest was subdivided into three types, namely, 'Bemba,' 'bushy' and 'mixed' forests. Finally, the categories 'secondary vegetation' and 'fields under cultivation,' were added. Thus, the vegetation was classified as follows:

#### (1) Dry-land (*terra firma*) forest

(a) Bemba forest: This type of forest was dominated by *Gilbertiodendron dewevrei* which the Aka of the upper Motaba called "Bemba." It occurred on dry, firm land falling to streams, and had little undergrowth.

(b) Bushy forest: This type contained sparse, tall trees with an open canopy, and

dense undergrowth characterized mainly by Marantaceae herbs, the young leaves and sprouts of which are major foods of both apes.

(c) Mixed forest: This type was a closed forest with denser tall trees of various species and relatively little undergrowth. Mixed forest was apparently the most productive type in terms of fruit.

#### (2) Swamp forest

Virtually all streams in the survey area were fringed by flooded forest of various sizes. This type is abundant in trees of medium/low trees and in undergrowth.

#### (3) Savanna

Numerous short grasslands of various sizes with scattered scrub were found around the source of the Lipendja River, the largest tributary of the Motaba to the north.

#### (4) Secondary vegetation

This included secondary forests of variable age and fallow land. This type was extremely rich in ground vegetation, including Marantaceae and Zingiberaceae herbs, which are favorite food plants of both apes.

#### (5) Fields under cultivation

Manioc and maize were the major crops. This vegetation type was apparently of least value to the apes.

According to the results of our transect survey, dry-land forest types were the

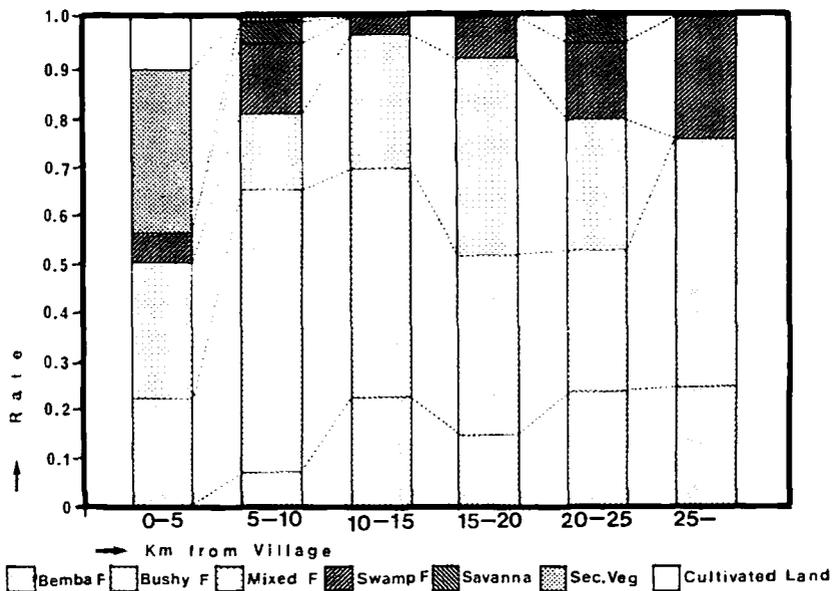


Fig. 3. Proportion of vegetation types.

Table 1. Data on sighting, hunting, eating of chimpanzees and gorillas by Akas and Bantus in the Motaba area.

	Chimpanzees			Gorillas		
	No. of Informants	No. of "Yes"	Rate of "Yes"	No. of Informants	No. of "Yes"	Rate of "Yes"
<b>Sighting</b>						
Aka	173	133	0.769	166	102	0.614
Bantu	120	54	0.450	115	29	0.252
Total	293	187	0.638	281	131	0.466
<b>Hunting</b>						
Aka	174	60	0.345	166	34	0.205
Bantu	120	9	0.075	115	7	0.061
Total	294	69	0.235	281	41	0.146
<b>Willingness to Eat</b>						
Aka	153	126	0.824	142	120	0.845
Bantu	120	68	0.567	112	79	0.705
Total	273	194	0.711	254	199	0.783
<b>Eating</b>						
Aka	153	60	0.444	127	46	0.362
Bantu	120	32	0.267	109	29	0.266
Total	255	92	0.361	236	75	0.318

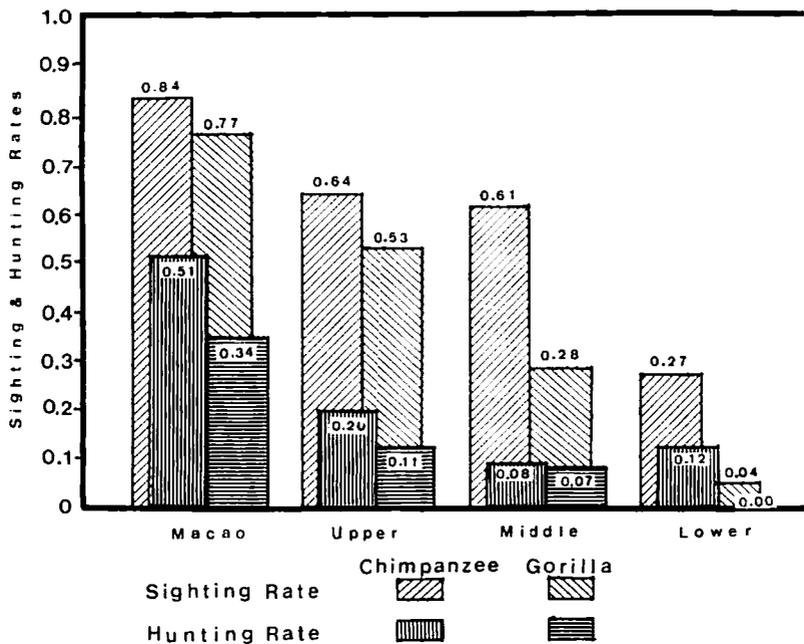


Fig. 4. Sighting & hunting rates.

most common throughout the area (Fig. 3). Secondary vegetation and cultivated land were restricted to the outskirts of the villages (mostly within 5 km of them), while Bemba forest did not occur in the vicinity of the villages.

## 2. Sightings of Apes

The reported sighting rates of chimpanzees were 0.769 for the Aka, and 0.450 for the Bantu (Table 1). Those of gorillas were 0.614, and 0.252, respectively. There were two distinct tendencies, that the rate was higher for the Aka than for the Bantu, and that the rates of sighting chimpanzees were higher than those of gorillas.

There was also a tendency for the sighting rate to decrease from the upper to the lower Motaba with the highest at Macao (Fig. 4). The fact that positive information was obtained from every site suggests a continuous distribution of both chimpanzees and gorillas in the study area, though at varying densities.

## 3. Hunting of Apes

The reported rates of hunting chimpanzees (for nondependent animals) were 0.345, and 0.075 for the Aka and the Bantu, respectively (Table 1). Those of gorillas were 0.205, and 0.061, respectively (Table 1). Once again the rates were higher for the Aka than the Bantu, also higher for chimpanzees than for gorillas (Table 1), and the rates decreased from the upper to the lower Motaba for both apes (Fig. 4). Since the hunting/sighting rate of chimpanzees was close that of gorillas (0.364 vs. 0.313), it is possible that the higher hunting rate of chimpanzees depended primarily on the higher sighting rate.

Data indicate that more Akas were involved in ape-hunting than Bantus. The latter, however, exceeded the former in the mean number of game per successful hunter (3.11 vs. 1.77 chimpanzees and 1.85 vs. 1.44 gorillas), suggesting that Bantu hunters were fewer but more habitual.

The total number of reports of chimpanzees and gorillas killed by the Aka informants ( $\sum X_i Y_i$ ;  $X_i$ : informant,  $Y_i$ : number of kills by  $X_i$ ) were 103 and 49, and those by Bantus were 28 and 13, respectively (Table 2). These figures were not regarded as the "net" number of apes killed by them, however, since hunting of apes was usually performed in groups, which means that each hunter contributed only a part to each successful hunt.

According to Bantu informants, the mean size of their hunting groups was three ( $N=4$ ). Reliable information on hunting group size was not obtained from Akas. The size of their hunting groups was indirectly estimated from the number of huts at their campsites in the forest. These huts were constructed by adult women, approximately 70% of whom had an adult men as a mating partner (Takeuchi, in prep.). The mean number of huts recorded was 5.17 per camp site which were observed during the transect survey (Range, 1-12,  $N=35$  sites). Assuming a hunting group consisted of all adult men sharing the same camp, the above figure suggests a mean size of hunting group of 3.6 male Akas. Thus, the estimated mean numbers of chimpanzees and gorillas killed by Akas was calculated at 0.164 and 0.082 per

Table 2. Hunting pressure between 1992/01 and 1993/01.

	Chimpanzees		Gorillas	
	Aka	Bantu	Aka	Bantu
No. of Informants	174	120	166	115
No. of Successful Hunters	60	9	34	7
Sum of Kills	103	28	49	13
Size of Hunting Group	3.6	3	3.6	3
No. of Kills per Informant	0.164	0.078	0.082	0.038
Human Density of Adult Male	0.10	0.05	0.10	0.05
No. of Kills per km <sup>2</sup> per Year	0.016	0.004	0.008	0.002

capita (per informant), and those killed by Bantus at 0.078 and 0.038 per capita, respectively (Table 2).

The 1992 census of human inhabitants conducted by the local government of Impfondo revealed that the male population in the Dongou District was 9,560 excluding the town of Dongou, that is, 0.30 males per km<sup>2</sup>. Japanese anthropologists who have studied the Aka or the Bantu in the district, estimate the Aka/Bantu ratio at about 2 : 1, and the mature/immature ratio at about 1 : 1 (pers. comm. from Takeuchi at Moumpoutou and Bangui-Motaba, Ichikawa and Kitanishi at Macao, and Hanawa and Komatsu at Djoube). Based on their assumption, an overall density of adult males as potential hunters of apes, was estimated at 0.10 Akas and 0.05 Bantus per km<sup>2</sup>. Since the mean toll of chimpanzees per year was 0.164 per Aka and 0.078 per Bantu, and those of gorillas were 0.082 per Aka and 0.038 per Bantu, hunting pressure on chimpanzees and gorillas in this area was estimated at 0.020 and 0.010 individuals per km<sup>2</sup> for the period between January, 1992 and January, 1993, respectively (Table 2).

Spears were most frequently used in ape-hunting by the Aka, constituting more than 80% of the total successful hunts (Fig. 5a). The next most important weapon was the shot-gun, which was used in more than 10%. All of these guns were loaned by their Bantu owners, who asked the Aka to bring them meat. Bantus used guns in most of their hunting of apes (more than 65%), though they used a greater variety of hunting implements in past (Fig. 5b).

The male/female ratio of nondependent chimpanzees, excluding solitary males, killed in hunting was 49 : 41, and that of gorillas was 26 : 9. In natural groups, the male/female ratio is between 1 : 1.0 and 1 : 3.5 for chimpanzees (Nishida & Hiraiwa-Hasegawa, 1986) and 1 : 3 on an average for gorillas (Stewart & Harcourt, 1986), females exceeding males in number in most groups of both apes. It can, therefore, be said that the hunting pressure upon adult males was much greater than that on adult females. This was the case for both apes, but especially for gorillas. Some hunters reported that most of their attempts to kill female or young gorillas evoked the silverback's charge. The high hunting rate of male gorillas may not have resulted from the hunter's choice, but from the high rate of counter-attacks by males, attempting to rescue other group members.

A total of 79 camp sites of the Aka (most of them were abandoned) were recorded on the transect lines. There were more or less evenly distributed at an average density of 0.46 sites per km of transect, between 5 and 30 km from the nearest

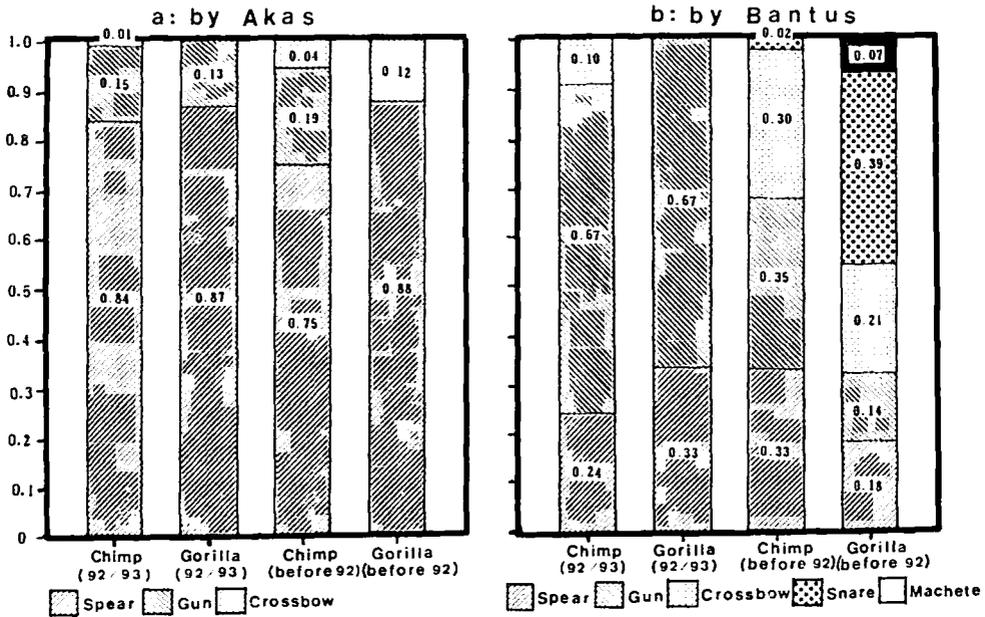


Fig. 5. Hunting implements.

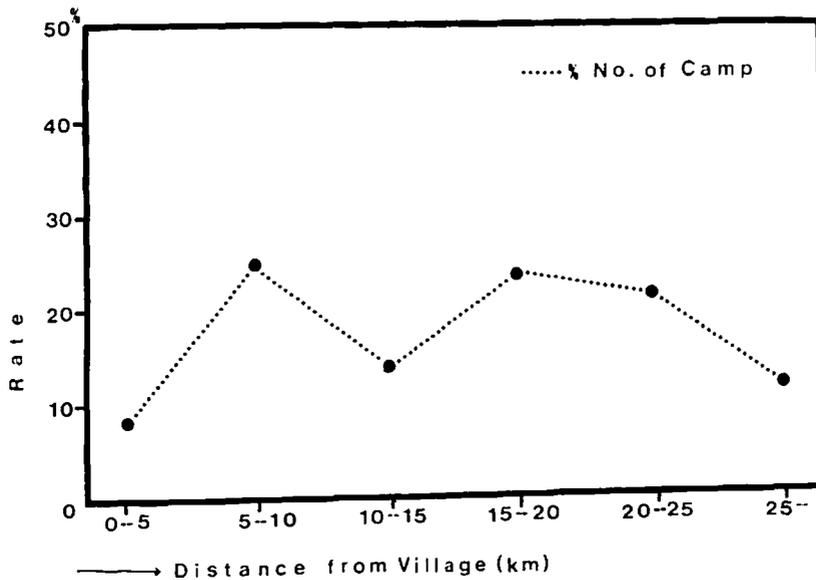


Fig. 6. Distribution of Aka camp-sites.

village (Fig. 6). The distribution of camp sites may reflect their hunting range.

#### 4. Eating Ape Meat

The proportions willing to eat chimpanzee meat were 0.823, 0.566 for the Aka, and the Bantu, respectively (Table 1). Those for gorillas were 0.845, and 0.705, respectively (Table 1). This indicates that most of the Aka were eaters of both apes, and that nearly half of the Bantus rejected the meat of chimpanzees, while most of them accepted gorilla meat.

Potential eaters of ape meat were found in every segment of the study area, with the rate decreasing from the upper to lower Motaba (Fig. 7). The eating rates indicated that about a half of all potential eaters had a chance to eat ape meat in a year (Table 1), although the chance was higher in Macao and the upper Motaba than in the middle and lower Motaba (Fig. 7).

Many of those who rejected ape-meat informed us that they were disgusted by it because of the human-like features of apes (Table 3). There was a commonly accepted notion that eating ape-meat would bring disease to pregnant or lactating females, their infants and/or their husbands. The notion did not, however, appear to operate as a strong food regulation, since only 6 and 3 informants presented it as the reason for their rejection of chimpanzee and gorilla meat, respectively (Table 3).

Most of the residents, including the Aka, knew the apes were protected by government law. Only one villager for chimpanzees and five for gorillas informed us that they would obey the law (Table 3). Most considered that their ape-eating should not be controlled by the law, since the former had a much longer history

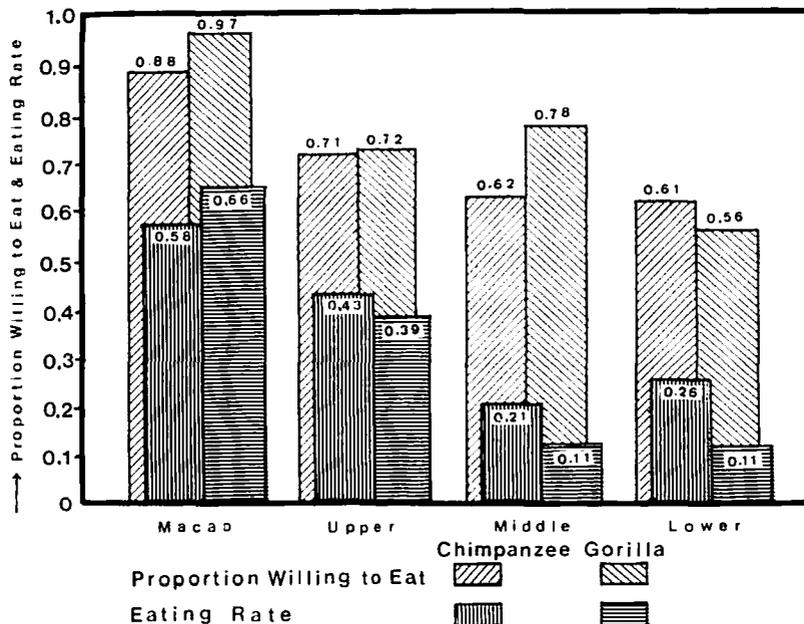


Fig. 7. Proportion willing to eat & eating rate.

**Table 3.** Reason for rejecting ape meat.

Reason	Chimpanzee	Gorilla
Like Human		
Like Human	35	19
Like Satan	1	1
Like White Man	1	
Food Taboo		
Personal	5	6
Familial	8	5
Tribal	6	3
Religion	1	1
Prohibited by Law	1	5
<b>Total</b>	<b>58</b>	<b>40</b>

than the latter.

### 5. Density of Apes

All records of chimpanzees and gorillas obtained during the transect survey are listed in Table 4. Only nests were found in abundance. 150 of the 164 nests recorded were attributed to chimpanzees and the remaining 14 to gorillas (Table 4). The former were found at an average height of 12.0 m (range: 4–20 m, N=133) in trees, while 12 of the latter were found on the ground.

Fifty five nest sites of chimpanzees were recorded, and the median and mean number of nests per site were 2 and 2.73, respectively. The area sampled was calculated at 8.88 km<sup>2</sup>, as the nests were visible within 20 m either side of the transect lines, which had a total length of 222 km. The observer efficiency and the mean lifespan of nests were assumed taken as 0.56 and 113.6 days, respectively, as mentioned earlier.

In addition, there was a sampling bias in the area censused. The total length of transect decreased, and the density of nests increased with distance from the nearest village (Fig. 8). To correct for this bias, the transect line was divided into six sections with 5 km intervals in terms of the distance from nearest village. The

**Table 4.** Encounters with and signs of apes recorded.

	Chimpanzee	Gorilla
Encounters	1	3
Vocalizations	1	5
Nest Sites	55	6
Nests	150	14
Food Remain Sites	24	22
Dung Sites	2	6
Dungs	2	10
Sites of Other Signs	2	5

Note: Some nests, food remains and/or dungs were found in the same sites.

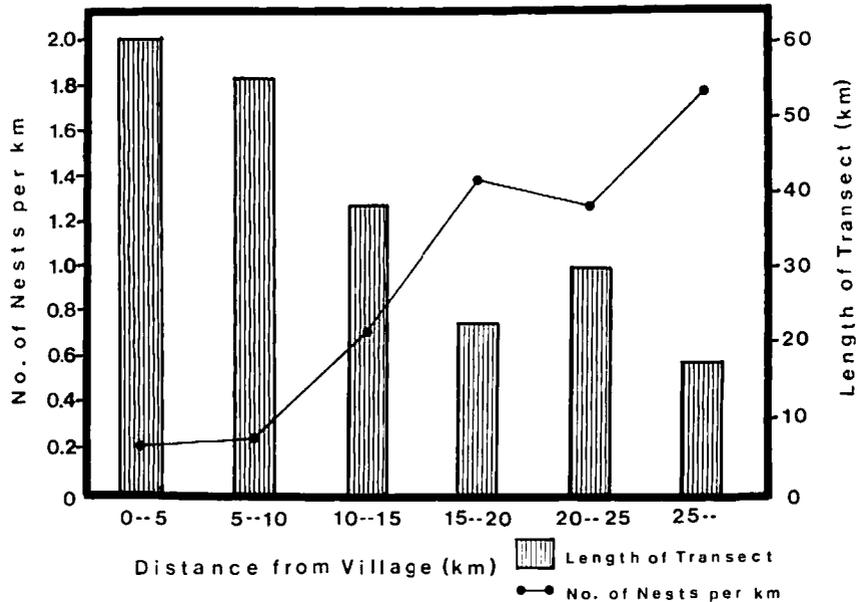


Fig. 8. Distribution of chimpanzee nest.

chimpanzee density was then calculated for each section and averaged. Thus, formulae 1 and 2 produced the means of 0.254 and 0.363 nondependent chimpanzees per km<sup>2</sup>, respectively (Table 5). This results suggest that the overall chimpanzee density in the upper Motaba area was around 0.3 nondependent individuals per km<sup>2</sup>.

Table 5. Estimation of density of chimpanzees and gorillas.

	Distance from Nearest Village (km)						Total/ (Average)
	0-5	5-10	10-15	15-20	20-25	25-	
<b>Chimpanzees</b>							
Number of Nests Counted	11	12	27	31	38	31	150
Number of Nest Sites	4	5	13	13	16	4	55
Median Number of Nests per Site	1.5	2	2	1	2	5.5	
Area Sampled (km <sup>2</sup> )	2.37	2.18	1.53	0.90	1.20	0.70	8.80
Estimated Density (Formula 1)	0.040	0.072	0.267	0.227	0.420	0.496	(0.254)
Estimated Density (Formula 2)	0.073	0.086	0.277	0.542	0.499	0.699	(0.363)
<b>Gorillas</b>							
Number of Nests Counted	0	4	0	0	3	5*	12*
Number of Nest Sites	0	3	0	0	1	2	6
Median Number of Nests per Site	0	1	0	0	3	2.5	
Area Sampled (km <sup>2</sup> )	0.59	0.55	0.38	0.23	0.30	0.17	2.22
Estimated Density (Formula 1)	0	0.244	0	0	0.334	0.956	(0.255)
Estimated Density (Formula 2)	0	0.183	0	0	0.334	0.956	(0.245)

\*: Two tree nests found over 5 m from the transect line were excluded.

The overall density of gorillas was calculated at 0.255 (formula 1) and 0.245 (formula 2), based on the same method (Table 5). The number of nests counted was, however, too small for a reliable density estimation. There is likely to be a much wider error margin. However, the results of interviews concerning sightings of apes also suggests gorillas are more sparse than chimpanzees. Assuming that the difference in sighting rate between the two species (0.603 vs. 0.422) reflects the difference in density, the gorilla density might be estimated at around 0.2 nondependent individuals per km<sup>2</sup>.

## DISCUSSION

The survey suggests that chimpanzees and gorillas are widely distributed over the area covering the Motaba and its tributaries. The habitat in these areas is relatively intact and free from large-scale human activities, such as plantation farming or mechanised logging. Nevertheless, the estimated densities of both chimpanzees (0.3 nondependent animals per km<sup>2</sup>) and gorillas (0.2) were in the lower part of the range of ape densities estimated from other sites in tropical rain forest areas of Africa (Table 6). Human activities, especially hunting, might be the principal cause of the low densities of apes in this area. This idea is supported by gradients found in the density distributions of both apes. The densities were highest in the inland forest, and gradually decreased towards the villages. They were also higher in the upper villages and decreased towards lower urban area.

Ape-hunting in this area was almost exclusively for meat. Other benefits such as selling infants as pets were only occasional by-products. In spite of extensive inquiries, only two informants reported that they had sold, or kept an infant as a pet, in the remote past.

Hunting apes for meat appears to be widespread throughout central Africa. For instance, hunting bonobos (*Pan paniscus*) for meat prevails over the forested area south of the Zaire river (Kano, 1985, 1992). In some ethnic group, such as the Ngandu, however, there is a strict taboo against eating bonobo-meat, and this has greatly contributed to the conservation of this species, though only in limited part of their geographical range. In the Motaba area, by contrast, there is no such strict taboo involving all members of the ethnic group. Willingness to eat ape meat, when available, was found at a high rate throughout all ethnic groups in the area. Rejection of ape meat occurred only as a result of personal fastidiousness, and involved a minority of individuals.

The Akas used spears most frequently for ape-hunting, as they had done in the past. Guns are likely to increase in importance, however, as in hunting by the Bantu, where they have now replaced almost all other hunting implements.

Toward the northern and eastern borders, the apes are exposed to the heavy poaching by people from Central African Republic (Fay & Takeuchi, pers. comm.). In the Motaba area, hunting generally takes place within a 30 km radius of the villages. Using this measure, the combined hunting ranges of all villages distributed along the various water systems (i.e., the Ibenga, Motaba and Likouala aux Herbes rivers), together with the poaching area by the people from CAR, encom-

Table 6. Density of apes in rain forest sites.

	Density (/km <sup>2</sup> )	Source
<i>Pan troglodytes</i> Sites		
SW. Central African Republic	0.01–0.13	Carrol (1986)
Unprotected Areas, Cote d' Ivoire	0.035	from Hoppe-Dominik (1991)
Protected Areas, Cote d' Ivoire	0.20	from Hoppe-Dominik (1991)
Lekoumou, Niari, Kouilou, SW. Congo*	0.26	Ihobe (1993)
Motata, Congo*	0.3	Kano & Asato, this study
Equatorial Guinea	0.31–1.53**	Jones & Sabater Pi (1971)
Gabon	0.32	Tutin & Fernandez (1984)
Ndoki, NE. Congo*	1.30**	Mitani (1992)
Kibale, Uganda	1.96	from Ghiglieri (1984)
Kalinzu, Uganda	2.5	Hashimoto (1993)
Ndoki, NE. Congo*	2.65**	Suzuki (1993)
Budongo, Uganda	2.90–3.90**	Reynolds & Reynolds (1965)
Tai, Cote d' Ivoire	2.92	Boesch & Boesch (1989)
Bossou, Guinea	4.0–5.0**	Sugiyama & Koman (1979)
Budongo, Uganda	6.7**	Sugiyama (1968)
<i>Gorilla g. gorilla</i> Sites		
Motaba, NE. Congo*	0.1	Fay & Agnagna (1992)
Gabon	0.18	Tutin & Fernandez (1984)
Motaba, NE. Congo*	0.2	Kano & Asato, this study
Ndoki, NE. Congo*	0.4	Fay & Agnagna (1992)
Ivindo R. basin, NW Congo	0.45	Agnagna et al. (1991)
Equatorial Guinea	0.58–0.86	Jones & Sabater Pi (1971)
Mbomo, NW Congo*	0.6	Fay & Agnagna (1992)
SW. Central Afr. Rep. (CAR)	0.89–1.45	Carrol (1986, 1988)
Lake Mboukou, NE. Congo*	1.1	Fay et al. (1989)
Upper Sangha (CAR)	1.6	Fay (1989)
Lake Mboukou swamp, NE. Congo*	2.6	Fay et al. (1989)

\*: The sites in Congo are plotted in Figure 1; \*\*: Estimated number including dependent individuals.

pass the whole distribution of apes in northeastern Congo.

Hunting pressure on chimpanzees and gorillas was estimated at 0.02 and 0.01 individuals per km<sup>2</sup> per year. This implies that 6.8% of chimpanzees and 5.0% of gorillas might have been removed from this area in approximately one year. It was reported that densities of some forest mammals are sustainable under considerable hunting pressure, e.g., about 8% annual offtake in the case of blue duikers (*Cephalophus monticola*) in Korup National Park, Cameroon (Sayer et al., 1992). The high rate of birth in duikers (females drop more than one calf annually, Kingdon, 1982; Nowak, 1991) must be related to their high sustainability. In contrast, the number of surviving offspring that a female ape produces in her lifetime of about 40 years is only two in chimpanzees (Tutin, 1980; Nishida et al., 1990) and two or three in gorillas (Harcourt et al., 1981) in rather undisturbed habitats. The low rate of reproduction in apes implies that a slight level of hunting pressure can be destructive to their local population. If 5–7% annual offtake by hunting in the Motaba area is maintained, the numbers of chimpanzees and gorillas will be reduced by one half in 11 and 15 years, respectively.

Since hunting of apes is opportunistic, the rate of success may be strongly depen-

dent on the probability of encounter with them, i.e., their densities. It is uncertain whether the increased difficulty of hunting resulting from the decrease in the ape density will mitigate the hunting level or not. The decrease in density may stimulate improvement of hunting implements or methods, which may again lead to an increase in hunting pressure.

The mean annual growth rate of the human population between 1984 and 1992 was 3.26% in the Likouala Region, northeastern Congo, according to censuses by the local government. The rise in human population will lead to increases, both in the demand for meat, and in the number of hunters, which may also accelerate the removal of apes from this area.

Recent surveys (Fay & Agnagna, 1992; Fay et al., 1989) have shown that western lowland gorillas are widely distributed throughout northern Congo, and that they are abundant in certain areas, especially in swamp forest such as the *Cuvette Congolaise*. Fay & Agnagna (1992) and Fay (1993) concluded that gorilla densities are correlated with the abundance of terrestrial herbaceous vegetation (THV), as swamp forest, where THV was abundant, had a higher gorilla density than dry primary forest, which was normally poor in THV. It was also reported that gorillas and chimpanzees were currently not threatened with extinction over much of northern Congo (Fay & Agnagna, 1992; Agnagna et al., 1991). Drastic reduction in gorilla population is only found in southern Congo where hunting occurs in association with large-scale forest exploitation, i.e., mechanised logging (Fay & Agnagna, 1992). Thus, they considered gorilla density in northern Congo to be primarily dependent on vegetation, suggesting that the human factor is negligible for the time being, although they informed that most of northern Congo would be opened up by logging operations in the near future, and that over 50% of the area had already been awarded to logging companies (Fay & Agnagna, 1992).

The present study area was predominantly covered with dry-land forest, while swamps were confined to limited areas along the streams. In this more or less dry, even habitat in northeastern Congo, however, human influence on the densities of both chimpanzees and gorillas is not negligible. Hunting pressure alone can be a serious threat to ape densities, even in the absence of mechanised logging. The future of apes in this area looks bleak, unless a strong system can be established which combines effective protection of the apes, with the provision of attractive substitutes for ape meat to the local people.

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