

## Chimpanzee (*Pan troglodytes schweinfurthii*) Population Density and Abundance in Kibira National Park, Burundi

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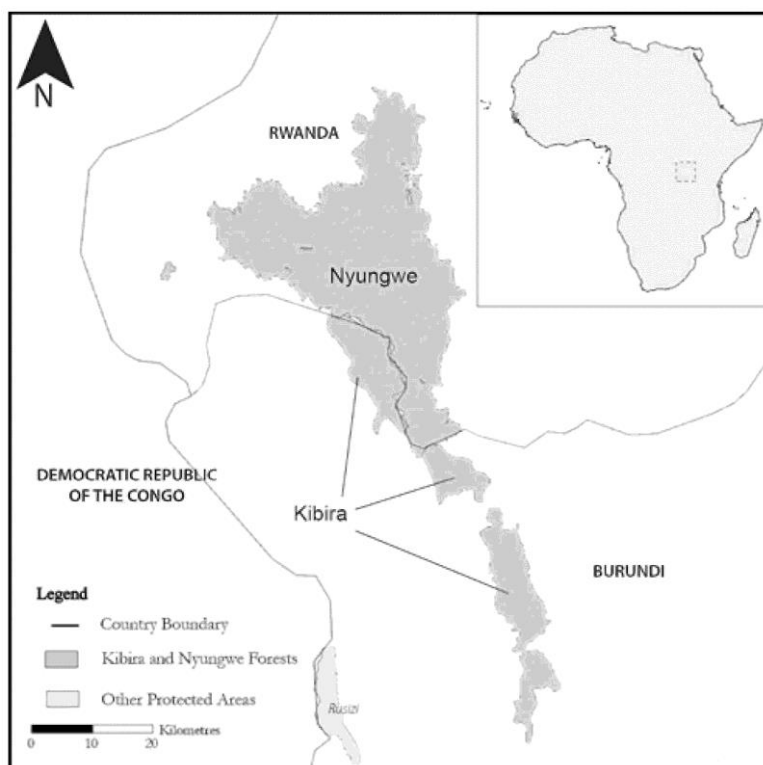
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### INTRODUCTION

The eastern chimpanzee, *Pan troglodytes schweinfurthii*, is an "endangered" chimpanzee subspecies of global conservation concern, living at low density (less than 1 individual/km<sup>2</sup>) in most of its range (Keele *et al.* 2006; Plumptre *et al.* 2011) in eastern Africa. As chimpanzees have a relatively low reproductive rate (Caldecott & Miles 2009), their ability to recover from population decline is limited. Documenting the extent and severity of such decline events, as well as targeting adequate conservation plans, requires reliable baseline data on density estimates of great apes (Oates 1996) in area of occurrence.

In Burundi, eastern chimpanzees are mostly reported to occur from the North-Western Kibira National Park (KNP), which is contiguous with Nyungwe National Park (NNP) in Rwanda, both forming one continuous landscape (Figure 1). Unfortunately, during the 1993-2007 conflict, KNP was permanently occupied by armed groups and its biodiversity has been extensively destroyed by armed gangs' progression, bush fires, poaching, illegal logging and clearing for agriculture. The purposes of our survey were to provide reliable information on chimpanzee abundance in the KNP and to identify sectors where conservation efforts should be prioritized.

**Figure 1.** Location of Kibira and Nyungwe National parks.  
(Reproduced from Africa: Atlas of Our Changing Environment by UNEP (2008).)

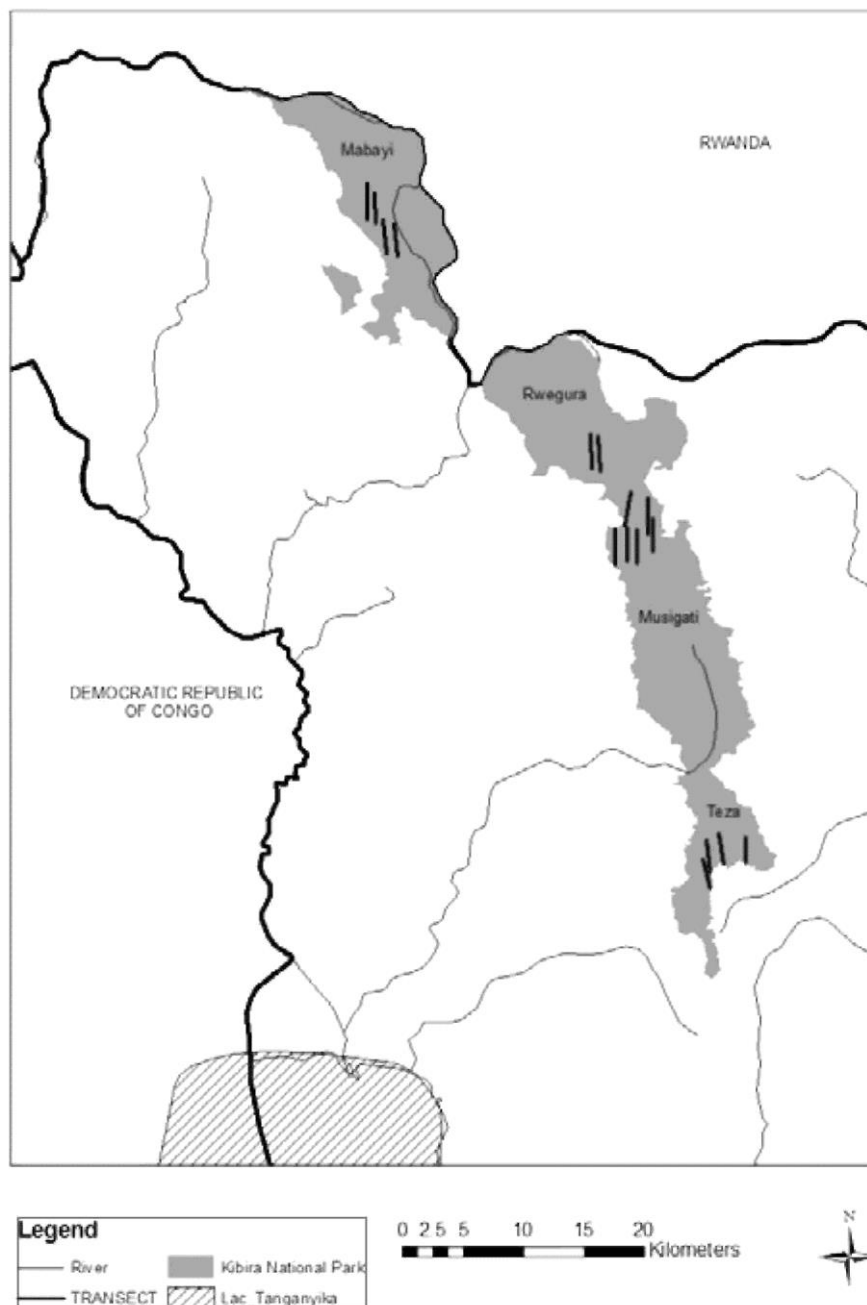


## METHODS

### Study area

KNP is located in the North-West of Burundi on the Congo-Nile Divide, between 2°36'52" and 3°17'08" south latitude and between 29°13'31" and 29°39'09" east longitude. It covers 400 km<sup>2</sup> of montane forest, lying from 1,600 to 2,666 m of altitude (Arbomer 1996). Relief, more marked on the western side, is characterized by steep slopes on both sides of the Congo Nile Divide. The park is shaped into four sectors, from south to north: Teza, Musigati, Rwegura and Mabayi, covering respectively 57.94 km<sup>2</sup>, 154.24 km<sup>2</sup>, 124.23 km<sup>2</sup> and 63.59 km<sup>2</sup> (Figure 2).

**Figure 2.** The four sectors of the KNP with location of the research transects.



## Data collection

Between September 2011 and February 2013, we repeatedly surveyed sixteen linear transects of 3 km each, to census chimpanzee populations density and abundance using the marked nest count method (Kouakou *et al.* 2009). The inter-visit interval was of three weeks, and each transect was censused eighteen times over the entire study period.

We walked along the census transects with two field assistants at an average speed of 0.7 km per hour to ensure detection of all chimpanzee nests. During the first walk, we marked all existing nests with a piece of flagging tape attached to nesting trees (Plumptre & Reynolds 1996). During the following visits, only new nests built since the last passage were recorded and marked. For each nest we systematically recorded the perpendicular distance to transect line, GPS position and altitude.

## Data analysis

To estimate chimpanzee density for the whole park, we combined nest counts from all transects. We used the DISTANCE software (version 6.0) (Thomas *et al.* 2009) to obtain chimpanzee density estimates. According to Buckland *et al.* (2001), 5% of observations occurring at the furthest distance from transect were truncated. Four mathematical key (Uniform, Half-normal, Hazard rate and Negative exponential) modeling nest detection function were tested, in combination with 3 adjustments terms (Cosine, Simple polynomial and Hermite polynomial). We calculated Akaike's Information Criterion (AIC) for each model and the best model had a lowest AIC value (Buckland *et al.* 2001). Nest-building chimpanzee density was estimated by following Plumptre & Reynolds (1996).

## RESULTS

A total of 864 km of line transects were surveyed and we recorded 471 new nests of chimpanzees, at an altitude ranging between 1,956 - 2,552 m.

Half-normal key with simple polynomial adjustment was the model fitting the best our distribution of perpendicular distances. Chimpanzee density estimate in the entire park was 0.509 individual/km<sup>2</sup> (95% CL: 0.305 - 0.847, CV: 24.37%), which corresponds to a total population size of 204 weaned individuals (95% CL: 122 - 339). Chimpanzee densities for each sector of the park are given in Table 1.

Mabayi has an important chimpanzee density compared with other sectors. Its chimpanzee density is four times greater than Rwegura, six times greater than Musigati and three times greater than Teza.

**Table 1.** Population density and abundance, with confidence limits (CL) of nest-building chimpanzees in the four sectors composing the Kibira National Park.

Location	Area (km <sup>2</sup> )	Estimated density	95% CL	Number of individuals	95% CL
Teza	57.94	0.352	0.159-0.778	20	9-45
Musigati	154.24	0.190	0.093-0.390	29	14-60
Rwegura	124.23	0.293	0.106-0.812	36	13-101
Mabayi	63.59	1.172	0.744-1.847	75	47-117
Entire park	400	0.509	0.305-0.847	204	122-339

## DISCUSSION

### Chimpanzee density and abundance in the Kibira National Park

Our results are markedly lower than previous estimates by Barakabuye *et al.* (2007) who reported a density estimate of 0.984 individual/km<sup>2</sup> (95% CL: 0.601 - 1.612), and a total population of 394 chimpanzees (95% CL: 240 - 645). This discrepancy is likely due to different sampling efforts. First, our estimated chimpanzee density is based on 18 months of survey while Barakabuye *et al.* (2007) survey only covered a three-month period. Short-time survey provides less reliable information, especially for *P. troglodytes* known to use large home

ranges (Johns & Skorupa 1987). In order to take into account seasonal variations in behavior, Baldwin *et al.* (1982) suggested a minimum of one year for such survey. Second, we applied an equal sampling effort throughout the four sectors of the KNP while Barakabuye *et al.* (2007) placed half of their transect lines in the sole Mabayi sector, which is most likely the one harboring the largest chimpanzee population. Extrapolation of their estimates to the entire park logically leads to an overestimation (Buckland *et al.* 2010). The longer time we devoted to data collection and the use of the marked nest count method leads us to say that our estimate would be more representative of the KNP.

The lower estimate of the chimpanzee population size in our study is in logical agreement with the region recent history. Biodiversity of the KNP suffered from several years of armed conflict. Armed groups practiced poaching and subsistence hunting. As chimpanzee is the largest animal of the park, it is evident that it was a war victim.

### **Comparison within sectors**

Determining the variation of distribution of chimpanzees between given areas is very important for researchers and conservationists (Morgan *et al.* 2006). Our results show that chimpanzees are more abundant in the Mabayi sector, directly contiguous with the NNP in Rwanda. This might be because this area was less affected by armed conflicts compared to Teza and Musigati which were permanently occupied by rebels. Another reason might be that some tree species primordial as food sources and nest supports for chimpanzees, are only or more represented in this part of the park (Hakizimana, unpublished data).

### **Comparison within Kibira and Nyungwe National Parks**

Kibira and Nyungwe are two contiguous national parks, but Nyungwe (1,080 km<sup>2</sup>) is twice larger than Kibira (400 km<sup>2</sup>). Barakabuye *et al.* (2007) found a chimpanzee density much higher in the Kibira compared to Nyungwe (0.984 individuals/km<sup>2</sup>, 394 individuals in Kibira; 0.353 individuals/km<sup>2</sup>, 382 individuals in Nyungwe). This is a puzzling difference, as Nyungwe is known to have been better protected (Barakabuye *et al.* 2007). If confirmed, the highest chimpanzee density they found in Kibira might result from the high density of tree species on which chimpanzees rely heavily (Balcomb *et al.* 2000; Tweheyo *et al.* 2004). To ensure a robust comparison and solve ambiguities, a rigorous study should be led by the same team in both parks focusing on census and resource availability.

### **Conservation implications**

Intensive effort must be devoted to the chimpanzee's long-term conservation throughout their range. Research on the species is still young in Burundi compared to neighboring countries. Therefore, it is very important to implement a monitoring program of chimpanzee populations to constitute a database allowing detecting population trends. Given the low rate reproduction of chimpanzees, Kühl *et al.* (2009) suggested that an inventory should be repeated every one to five years in order to quickly detect population changes. Also, further studies must emphasize more detailed data on tree phenology that chimpanzees rely on. As Nyungwe and Kibira National Parks are contiguous, an effective transboundary strategic plan to conserve both parks as one landscape is necessary to maintain viable population of chimpanzees.

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