



First quantitative survey delineates the distribution of chimpanzees in the Eastern Central African Republic



Aebischer Thierry^{a,b}, Siguindo Guy^b, Rochat Estelle^c, Arandjelovic Mimi^d, Heilman Amy^d, Hickisch Raffael^e, Vigilant Linda^d, Joost Stéphane^c, Wegmann Daniel^{a,*}

^a Department of Biology, University of Fribourg, Chemin du Musée 10, CH-1700 Fribourg, Switzerland

^b Chinko Project, 544 Rue de la Victoire, Bangui BP 3193, Central African Republic

^c Laboratory of Geographic Information Systems (LASIG), School of Architecture, Civil and Environmental Engineering (ENAC), École Polytechnique Fédérale de Lausanne (EPFL), CH-1015 Lausanne, Switzerland

^d Max Planck Institute for Evolutionary Anthropology, Department of Primatology, Deutscher Platz 6, DE-04103 Leipzig, Germany

^e WildCRU University of Oxford, Department of Zoology, Tubney, GB-ENG, UK

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ABSTRACT

Vast, pristine ecosystems and their biodiversity are vanishing globally at frightening speed, but many large tracts of wilderness have not yet been systematically inventoried and important natural populations of threatened species remain poorly characterized. The forest-savanna ecotone of the Eastern Central African Republic (CAR) is one such poorly studied area. Using camera traps, transect walks and collected fecal samples, we provide the first quantitative survey of chimpanzees (*Pan troglodytes*) in this region previously classified as a highly important chimpanzee conservation unit. In contrast to species distribution models and expert predictions, we did not find any evidence of chimpanzees in the large and remote forest blocks west of the Chinko River despite considerable search effort. Our study thus highlights the limitations of relying solely on remote sensing data to predict the presence or absence of endangered species and illustrates the necessity of extensive field surveys to accurately assess occurrence and density in remote areas. However, we did discover a sizeable and reproducing population of chimpanzees east of the Chinko River. Based on a density of 0.81 chimpanzees/km² in closed canopy forest that we inferred from nest count data, we estimate 910 weaned chimpanzees to inhabit the Chinko Nature Reserve (CNR) and further predict additional 2700 individuals in adjacent, unmanaged hunting zones and reserves. According to microsatellite data, these chimpanzees genetically cluster with *P. t. schweinfurthii* populations in East Africa. Conservation action and appropriate management plans are urgently needed to protect this important population and to prevent heavily-armed nomadic pastoralists from the Sahel, illegal miners, as well as elephant and meat poachers, from irretrievably destroying the natural vegetation and local biodiversity of the area.

1. Introduction

We are currently facing a dramatic loss of biodiversity as well as naturally functioning ecosystems, and the conservation and preservation of these require substantial international effort (UNEP-WCMC and IUCN, 2016; WWF, 2016). In order to assess current levels of threat, we prioritize focal areas and propose appropriate and cost-effective conservation actions, requiring detailed and localized knowledge on the status of biodiversity and endangered wildlife populations (Oates, 2006; Schipper et al., 2008; Stuart et al., 2004; Tear et al., 1993). Interestingly, the biodiversity of some of the largest remaining wilderness areas such as vast parts of the Amazonian basin or central Africa, have

not yet been systematically assessed and often not even inventoried (Hicks et al., 2014; Schipper et al., 2008). As a result, entire ecosystem communities, but also major populations of threatened species, are widely neglected in current conservation action plans (Darwall et al., 2011; Riggio et al., 2012).

A particularly understudied wilderness area is the Eastern Central African Republic (CAR), a heterogeneous ecotone of pristine moist forests and open savanna woodlands (Blom et al., 2004; East, 1999; Roulet et al., 2007). Our recent surveys in this region revealed an astonishingly large diversity of species, including chimpanzees (*Pan troglodytes*). Much of the forest and savanna-woodland of the southeastern CAR was traditionally assumed to be occupied by chimpanzees (Fig. 1,

* Corresponding author at: University of Fribourg, Chemin du Musée 10, CH-1700 Fribourg, Switzerland.
E-mail address: daniel.wegmann@unifr.ch (W. Daniel).

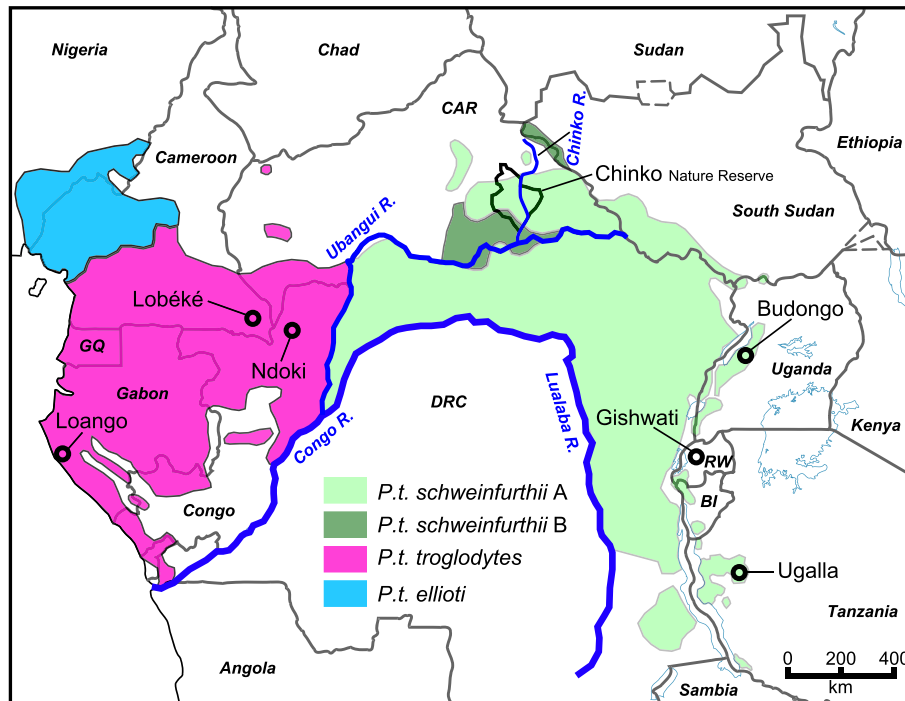


Fig. 1. Shown is the location of the Chinko Nature Reserve (CNR) in the Eastern Central African Republic (CAR) along with the assumed distribution of the Eastern (green), Central (magenta) and Nigerian-Cameroon (blue) chimpanzees. For Eastern Chimpanzee, two distributions are indicated: A) based on (Butynski, 2001) with updates from IUCN (IUCN SSC A.P.E.S. database, Drexel University and Jane Goodall Institute, 2016), B) additional areas based on revised map from (Plumptre et al., 2010). Dots indicate chimpanzee populations used to assign genotypes from the CNR. GQ = Equatorial Guinea, DRC = Democratic Republic Congo, RW = Rwanda, BI = Burundi. Map of Africa adapted from (Wikimedia, 16:45, 7 April 2011). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

(Butynski, 2001; Caldecott and Miles, 2005; Goodall, 1986; Hillman, 1982; Kormos et al., 2003; Oates et al., 2008; Plumptre et al., 2010; Tuttle, 1986), but to our knowledge, no systematic field survey was ever conducted in this region. In addition, historical reports of chimpanzees from this region are extremely rare and mostly vague (Henriot, 2014; Kormos et al., 2003), yet anecdotal evidence by safari hunters and operators suggested that chimpanzees had been observed east of the Vovodo River (Plumptre et al., 2010). In line with this, two chimpanzee nest sites and footprints were spotted during a two-week reconnaissance survey in the Zémongo Reserve (Roulet et al., 2007), but no evidence of chimpanzees was found during two elephant surveys west of the Chinko River including the Bangassou forest constituting the largest forest patch in the Eastern CAR (Fay, 1991; Williamson et al., 2004).

In contrast to these limited records, two recent ecological modeling approaches across all of Africa predicted the habitat of the Eastern CAR to be largely unsuitable for chimpanzees, except for isolated patches southwest of the Chinko river where occurrences were predicted to be more likely (Junker et al., 2012; Plumptre et al., 2010). Given the conflicting information, the Eastern Chimpanzee Status Survey and Conservation Action Plan 2010–2020 (Plumptre et al., 2010) predicted a chimpanzee conservation unit (CCU) east of the Vovodo river and ranked it as the 5th most important CCU for conservation given the expected ecological uniqueness of a chimpanzee population in the Eastern CAR, but identified the area southwest of the Chinko river as one of the five priority areas for further surveys. Interestingly, the area in between these rivers was largely considered void of chimpanzees. However, the report also acknowledged limitations of the modeling approaches used due to a clear lack of data, and emphasized an urgent need for surveys in that region to determine the current status of chimpanzees and to identify priority populations and major conservation threats.

Here we report the results of an extensive chimpanzee survey in the Eastern CAR that revealed the presence of a robust but threatened population of chimpanzees. Using the collected data we address four main questions about this population: 1. What is the current spatial distribution of chimpanzees in the Eastern CAR? 2. What is the density and structure of the chimpanzee population in the region? 3. What is the

habitat preference of chimpanzees in this forest-savanna ecotone? 4. What is the relationship with other known chimpanzee populations outside the CAR? Answers to these questions will provide critical information about chimpanzees in the Eastern CAR and form the basis for the development of a chimpanzee conservation action plan for that region.

2. Material and methods

2.1. Study area

The headwaters of the rivers Kotto, Mbari, Chinko and Ouara in Eastern CAR belong to the last continuous savanna and rainforest ecosystems in Africa without permanent human settlements (Fig. 1). Remotely accessible from few main roads surrounding the area and the four major rivers crossing it from north to south, the region encompasses about 85000 km² of virtually intact Medio-Sudanian and Sudano-Guinean savanna with patches of Congolian lowland rain forest along rivers, streams and gorges. Average annual precipitation varies from 1,000 (± 90) to 1500 (± 180) mm (Adler et al., 2003; Boulvert, 1986; Cmap and NOAA, 2012) on a gradient from northeast to southwest. There is one single rainy season from end of March until October peaking in August, followed by a dry season. Average monthly temperatures range between 22.5 °C (± 0.5) in December and 27.5 °C (± 1.0) in April. No forestry or agricultural exploitation takes place in the study area, but localized illegal mining, meat and ivory poaching as well as ever increasing temporal grazing by nomadic pastoralists from the Sahel are found throughout the region (Blom et al., 2004; Roulet et al., 2007; Tidjani, 2015). The entire Chinko River basin and adjacent regions in the Eastern CAR are officially classified as hunting zones or nature reserves and represent one of the largest formally protected wildlife areas in Africa. Currently only few hunting zones are actively managed and the Zémongo Faunal Reserve, as other reserves and national parks in the north, is currently not managed (Blom et al., 2004). This study took place in the Chinko Nature Reserve (CNR), an official conservation area created in 2014 and encompassing the former hunting zones Bas Chinko 48, Chinko 40, Mbari 39 and Vovodo Chinko 41. The reserve was created by the government of the CAR in close

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