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# AFRICAN PRIMATES

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**Front Cover:** A White-naped Mangabey (*Cercocebus lunulatus*) in the forested enclosure at Kumasi Zoological Garden, Ghana. Photo by Callum Carpenter.

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# Vocal Individuality in Adult White-naped Mangabey (*Cercocebus lunulatus*) Males at WAPCA's Endangered Primate Breeding Centre, Ghana

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**Abstract:** Many primate species show vocal individuality. The white-naped mangabey (*Cercocebus lunulatus*) is an Endangered West African primate species, with current feasibility projects aimed at reinforcing wild populations of this species with captive-bred individuals. However, non-invasive monitoring methods to detect translocated individuals are lacking. Passive Acoustic Monitoring (PAM), where self-contained audio devices detect sounds of the target species, can be used to monitor them in the wild. As of today, however, it is not known if individual white-naped mangabeys can be reliably distinguished by their vocalizations. This study aims to answer whether white-naped mangabey males can be differentiated by their voices. We recorded three captive adult mangabey males at the Accra Zoo and extracted vocal features from the resulting spectrograms. Data analysis was carried out using a linear discriminant function analysis and leave-one-out cross validation. The result showed that the adult white-naped mangabey males can be distinguished by their vocalizations with a 59% accuracy. This study, therefore, provides the first evidence of vocal individuality in *C. lunulatus* males. However, further studies are needed to identify translocated mangabey individuals reliably.

**Key words:** Passive Acoustic Monitoring, vocal individuality, *Cercocebus lunulatus*, acoustic analysis

## INTRODUCTION

Vocal individuality is the characteristic of being vocally distinguishable from other individuals and is present in a variety of taxa, e.g., wood owls (*Strix woodfordii*), bottlenose dolphins (*Tursiops truncatus*), blue monkeys (*Cercopithecus mitis stuhlmani*), coppery titi monkeys (*Plecturocebus cupreus*), and baboons (*Papio ursinus*) (Butynski *et al.* 1992; Janik 2000; Delport *et al.* 2002; Rendall 2003; Lau *et al.* 2020). The ability to identify conspecifics is important for a range of behaviors such as mating, resource acquisition, and defense. Many primate species rely on vocal cues for the identification of their group members (Fischer *et al.* 2002; Fukushima

*et al.* 2015; Lau *et al.* 2020). The white-naped mangabey (*Cercocebus lunulatus*) is an Endangered primate species endemic to the Upper Guinean rainforest of west Africa (Nolan *et al.* 2019). Habitat loss due to forest fragmentation and degradation and hunting for bushmeat threaten the remaining wild populations of white-naped mangabeys. To reinforce wild populations and hopefully save this species from extinction, individuals can be bred in captivity and released into the wild.

The NGO West African Primate Conservation Action (WAPCA) constructed an Endangered Primate Breeding Centre (EPBC) on the Accra

Zoo's grounds in Ghana in 2005. In collaboration and coordination with the white-naped mangabey EAZA Ex-situ Program (EEP) the species is bred in captivity to maintain various groups. The primates living in the EPBC participate in this program, which aims to maintain a healthy, genetically viable, and self-sustaining ex-situ population as stock for a translocation program. Four of the mangabeys in the EPBC were confiscated from the pet trade. These originally wild-caught animals add to a higher genetic variability of the reserve population. WAPCA is currently conducting a long-term feasibility study on translocating captive-bred mangabeys into the wild to reinforce wild populations. However, classical methods to monitor released individuals are often invasive as they involve capturing and marking the animals, negatively impacting their health and behavior (Butynski *et al.* 1992; Stowell *et al.* 2019). Passive Acoustic Monitoring (PAM) is a non-invasive monitoring method based on detecting sounds produced by target animals through self-contained audio devices placed in the target animal's habitat. Its biggest advantage is its much wider detection area than camera traps. As seen in the studies by Trolliet *et al.* (2014) and Enari *et al.* (2019) on Japanese macaques, PAM had a higher detectability rate of individuals than camera traps. Other studies have used PAM to estimate occupancy probability, movement patterns, population density and to monitor behavior (Kalan *et al.* 2015, 2016; Wrege *et al.* 2017; Clink & Klinck 2020). The use of vocal features to differentiate between individuals has also been widely established (Butynski *et al.* 1992; Mitani *et al.* 1996; Rendall 2003; Price *et al.* 2009; Budka *et al.* 2015; Clink & Klinck 2020). The production of sound starts with the lungs providing an airstream. The larynx, by opening or closing the laryngeal valve controlled by the vocal folds, modulates the airstream, converting it into sound in a series of puffs (Fitch 2002). Longer and thicker vocal folds can create lower pitches, and therefore a lower fundamental frequency. For this reason, the larynx can be described as the "source" of the sound. The created source signal then radiates through the supralaryngeal vocal tract (i.e., the airways of the pharynx, mouth, nasal cavities, lips, and nostrils).

Primate alarm calls can be heard over long distances and are emitted frequently, making them easier to record in the wild than other calls (Butynski *et al.* 1992; Mitani *et al.* 1996). Little is known about the white-naped mangabey's vocal repertoire, but studies on its close relatives, the sooty mangabey (*Cercocebus atys*) and the red-capped mangabey (*Cercocebus torquatus*), reveal similarities in alarm

calls (Range & Fischer 2004; Bouchet *et al.* 2012). Both male and female red-capped mangabeys emit a "wahoo" call that consists of two syllables the "wa" and the "hoo". During "wahoo" calls, males often carry their tails arched over their back, gape, yawn and shake. These signs of physical agitation are associated with the "wahoo" call, which is associated with a high level of alertness in red-capped mangabeys. Similarly, baboons (*Papio ursinus*) have a "wahoo" call, which, depending on the situation, can either function as contact, alarm, or contest calls (Fischer *et al.* 2002). Therefore, it can be presumed that the white-naped mangabey's "wahoo" call functions primarily as an alarm call because of the close relationship of *C. lunulatus* to *C. torquatus* (Bouchet *et al.* 2012).

This study aims to answer whether white-naped mangabey adult males can be distinguished by their "wahoo" calls. Recognizing the individuality in their calls will allow us to inform monitoring techniques for the released primates further and assess the translocation success. We chose the "wahoo" call specifically because it is a loud and frequently emitted call of the mangabey and can, therefore, be easily recorded in the field (Range & Fischer 2004). Our hypothesis is that individual males can be reliably distinguished by their vocalizations and vocal cues because many other primate species show vocal individuality. This would introduce a new non-invasive monitoring method for this species, which would be especially useful after releasing captive-bred mangabeys into the wild.

## METHODOLOGY

### Study Site and Subjects

Data were collected at the EPBC at Accra Zoo in Accra, Ghana (Figure 1). Accra is the capital city of Ghana and is located at the coast with two wet seasons (March-July, September-November) where the average temperature ranges from 22°C to 25°C and from 25°C to 28°C in the dry seasons (Kayaga *et al.* 2021).

Accra Zoo houses four white-naped mangabey groups. For this study only three were considered, since one enclosure did not house any adult males (see Table 1). From here on, the first group is designated as the "Ape's group" and consists of the adult alpha male Ape and two other adult males, Klaus and Kwame. Ape is a former pet that was confiscated and rehabilitated at the EPBC. The female Accra and the two juvenile males, Yellow and Austin, live in this group. Klaus and Kwame were not considered in



**Figure 1.** Location of Accra Zoo, where the Endangered Primate Breeding Centre is located, within the Achimot Forest in the city of Accra, Ghana.

this analysis since, as non-dominant males, they did not emit calls frequently enough. The second group, from here on called “Yaw’s group”, consists of the adult male Yaw, the adult female Ivy, the subadult female Mama and the juvenile female Esi. Lastly, the third group, from here on named “Kweku’s group”, consists of the adult male Kweku the two adult females Ziggy and Chaachele, the juvenile female Mercedes and the two juvenile males Tommaso and Peter. The enclosure of Ape’s group is 100 m<sup>2</sup>, Yaw’s group 108 m<sup>2</sup> and Kweku’s group is 131 m<sup>2</sup>. All groups are fed with fruits and vegetables twice a day. Water is available ad libitum. The individuals of each group can hear and see each other. Additionally, the zoo allows visitors from 9 am to 5 pm daily.

## Data Collection

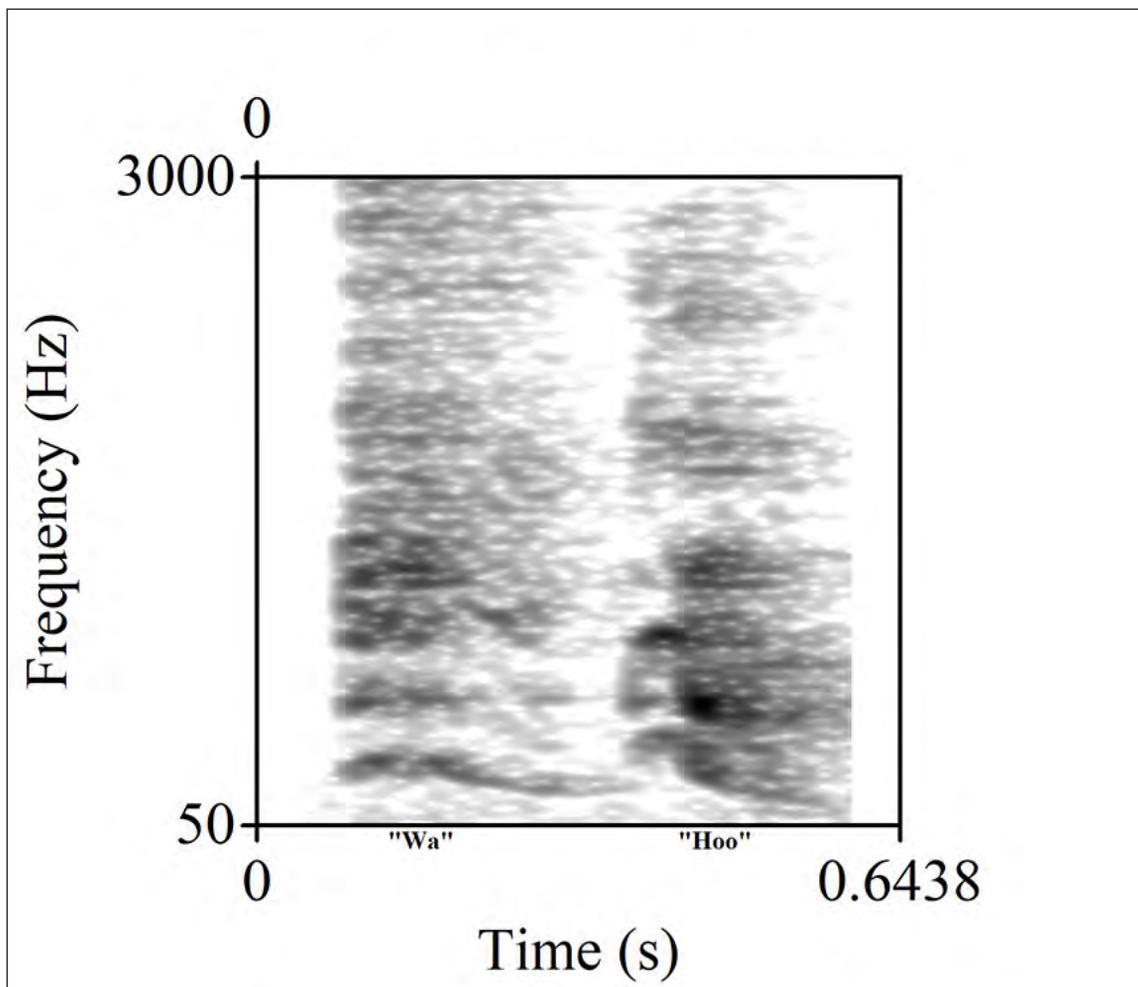
The “wahoo” calls of the adult males of each group were recorded using a H4next Handy Recorder and a windshield. The recorder was positioned on the ground, outside the keeper’s entrance of each enclosure. The distance from the calling individual and the recorder ranged from 2 to 17 m. Data were collected from May to June 2022, between 6am to 9am Monday to Friday. The adult males of each group were recorded opportunistically before visitors arrived at the zoo. Each call was followed by a note of the individual’s name, location in the enclosure, and behavior shown during the call. The ethogram by Abelló *et al.* (2018) was used to identify the individuals’ behaviors, even though it did not play a role in the analysis.

## Analysis

The fourteen audio recordings of the “wahoo” call with the least background noise were selected from each alpha male (Ape, Yaw, Kweku). The call was divided into two syllables “wa” and “hoo”. Praat version 6.3.23 (Boersma & Weenink 2023) was used to extract the following acoustic features: duration, dominant frequency, and fundamental frequency of each syllable of the “wahoo” call, and the first to fourth formants of the full call (N = 10 acoustic features). Additionally, spectrograms were drawn in Praat to extract features visually with the following settings: view range (Hz) 50.0 to 3000.0, window length 0.008 and dynamic range 50.0. Advance settings were left with the standard values. A representative spectrogram is presented in Figure 2. The call duration was extracted visually from the spectrogram. The dominant frequency was determined by selecting the syllable in the

**Table 1.** White-naped mangabey (*C. lunulatus*) groups in the Endangered Primate Breeding Centre at Accra Zoo included in this study, with their dominant males highlighted in bold letters. See McGraw *et al.* 2011 for age categories.

	Adult Males (> 7 or 8 years)	Adult Females	Juvenile Males (1 to 6 years)	Juvenile Females (1 to 4.5 years)
Group 1: Ape’s group	<b>Ape (former pet)</b> , Kwame, Klaus	Accra	Yellow, Austin	/
Group 2: Yaw’s group	<b>Yaw (captive bred)</b>	Ivy	/	Mama, Esi
Group 3: Kweku’s group	<b>Kweku (captive bred)</b>	Ziggy, Chaachele	Tommaso, Peter	Mercedes



**Figure 2.** Representative spectrogram of a white-naped mangabey (*C. lunulatus*) male (Yaw) “wahoo” alarm call at Accra Zoo.

spectrogram and then viewing the spectral slice with dominant frequency automatically appearing on the top axis. The fundamental frequency was determined using Praat’s pitch tracker in the standard settings, and the four formants were identified using spectrum analysis to formants. It should be noted that whilst we used Praat’s formant tracker to identify the first four formants of each “wahoo” recording, we did not test if these bands result from resonances in the vocal tract, or if they are independent from the fundamental frequency and its harmonics (Price *et al.* 2009). The recorded “wahoo” calls had a higher fundamental frequency than human voices (around 200-300 Hz), which might have affected Praat’s formant tracker in extracting formant frequencies. Previous studies have conducted similar analyses using Praat for non-human primate recordings and yielded reliable results (Price *et al.* 2009; Gamba *et al.* 2012; Grawunder *et al.* 2022).

We tested all features for normal distribution to find out significant differences in these acoustic features between individuals. We also conducted a one-way ANOVA for the normally distributed features and the Kruskal-Wallis test for non-normally distributed features with the significance level set at 0.05 (Butynski *et al.* 1992; Price *et al.* 2009). We conducted a linear discriminant function analysis (DFA) to identify differences in the vocalizations between individuals (Fischer *et al.* 2002). DFA is a commonly used data classification method that maximizes the ratio of the between-class variance to the within-class variance, guaranteeing maximum class separability (Tharwat *et al.* 2017). By using input features DFA estimates the maximum difference between calls from each individual and provides a classification procedure that assigns each call to its appropriate individual (correct assignment) or another individual (incorrect assignment) (Fischer

*et al.* 2002; Lau *et al.* 2020). Additionally, to identify the model's accuracy, we conducted a leave-one out cross validation where each unit is classified by the functions derived from all units other than one (Bouchet *et al.* 2012, Price *et al.* 2009).

## RESULTS

We found significant differences in seven acoustic features of the “wahoo” call between the white-naped mangabey (*C. lunulatus*) males at Accra Zoo, presented in Table 2. Differences were found in the dominant frequency of the “hoo” ( $p = 0.0048$ ), the fundamental frequency of the “wa” ( $p = 0.0154$ ), formant 2 ( $p = 0.0128$ ), formant 3 ( $p = 0.0004$ ), formant 4 ( $p = 0.0056$ ), duration of the “wa” ( $p = 0.0011$ ), and duration of the “hoo” ( $p = 0.0019$ ).

The linear discriminant function analysis yielded an average correct assignment of 59% and the leave one out cross validation validated it with 76% accuracy. The scatter plot of the two linear discriminant functions to illustrate the clustering of “wahoo” alarm calls in relation to caller identity is presented in Figure 3.

## DISCUSSION

This study provided the first evidence of vocal individuality in white-naped mangabey (*C. lunulatus*) males. We successfully identified males based on multiple acoustic features of their “wahoo” calls using linear discriminant function analysis. The leave-one-out cross validation revealed that the DFA was accurate when this data set was used.

Vocal individuality occurs because of differences in the morphology of the sound-producing organs, e.g., lungs, larynx, nose, and mouth, between individuals (Fitch & Hauser 1995; Lau *et al.* 2020). The vocal tract acts as a filter by removing certain frequencies from the source signal. The size of an individual changes the size of the vocal tract, leading to larger individuals having lower fundamental frequencies while formant dispersion decreases with size (Fischer *et al.* 2002).

Larger lung capacities allow longer calls, increasing the duration of the “wa” in the “wahoo” calls of baboons. Furthermore, macaques can tell an individual's body size by the formants of its call (Fukushima *et al.* 2015).

We successfully classified 59% of the recorded calls in the test data set. Compared to similar studies, this probability rate is lower (blue monkeys: 100% [Butynski *et al.* 1992], baboons: 71.2% [Fischer *et al.* 2002] and 65% [Rendall 2003], coppery titi

monkeys: 83% [Lau *et al.* 2020]). We believe this is because we analyzed the “wahoo” call of white-naped mangabey males that, similar to the “wahoo” call of baboons, may have multiple functions (i.e., alarm and contest call, Fischer *et al.* 2002). Bouchet *et al.* 2012 found that individual distinctiveness varied between the call types in the vocal repertoire of red-capped mangabeys. They found the highest level of individual distinctiveness in threat and contact calls and lower levels of individuality in loud or alarm calls. This is supported by Price *et al.* 2009 who found that the multifunctional “pyow” call (alarm and contact call) of putty-nosed monkeys can be distinguished between individuals while the “hack” alarm call cannot. The social function hypothesis aims to explain these observations by stating that there is a positive correlation between a call's relevance during social interactions and its morphological complexity (Bouchet *et al.* 2012). Individual discrimination is important during intragroup social interactions, so calls used for social purposes are more individually distinctive than calls used in other situations. However, identifying the alarm calling individual can still be useful to respond in accordance with the caller's reliability. This might explain why vocal individuality is still present in alarm calls (Price *et al.* 2009).

Our low probability rate could be attributed to our small data set. According to the leave-one-out cross validation, the data set was large enough to prevent overfitting; however, a larger training data set could increase the probability of correctly assigned recordings. Another reason for our low probability rate could be that a large portion of our acoustic features were formants analyzed using PRAAT's formant tracker using default settings. Although previous studies have achieved significant results with this methodology, PRAAT's formant tracker—when using default parameters—is optimized for human voices and may not be well-suited for white-naped mangabey vocalizations (Price *et al.* 2009). Previous studies have found that tracker results were biased considerably by the sex of the human speaker (Schiel & Zitzelberger 2018). Therefore, more acoustic features would likely have increased our probability, and future studies should consider adjusting the formant analyzer to the research subject's vocal tract (Chapman & Weary 1990; Lau *et al.* 2020).

Because white-naped mangabey males show vocal individuality in their “wahoo” calls, we believe that PAM can be a great addition to previous monitoring methods for this species. As DFA needs a training data set to identify individuals, as many

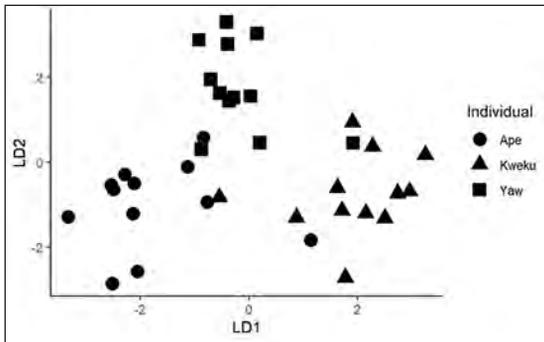
**Table 2. Means of the acoustic features of the male white-naped mangabey “wahoo” call per individual and the p-values calculated with one-way ANOVA and Kruskal-Wallis test. Statistically significant features are highlighted in bold letters. aNon-normally distributed data calculated with the Kruskal-Wallis test.**

Acoustic Feature	Individual	Mean	p-value
Dominant Frequency "Wa" in Hz	Ape	675.86	0.0964a
	Kweku	775.64	
	Yaw	635.43	
Dominant Frequency "Hoo" in Hz	Ape	269.07	0.0048
	Kweku	252.14	
	Yaw	284.50	
Fundamental Frequency "Wa" in Hz	Ape	269.07	0.0154a
	Kweku	252.14	
	Yaw	284.50	
Fundamental Frequency "Hoo" in Hz	Ape	198.21	0.7070
	Kweku	204.07	
	Yaw	205.86	
Formant 1 in Hz	Ape	1040.37	0.1630
	Kweku	1127.86	
	Yaw	1089.79	
Formant 2 in Hz	Ape	1892.38	0.0128
	Kweku	2004.20	
	Yaw	1981.37	
Formant 3 in Hz	Ape	2900.00	0.0004
	Kweku	3068.57	
	Yaw	2934.59	
Formant 4 in Hz	Ape	3973.96	0.0056
	Kweku	4097.80	
	Yaw	3940.12	
Duration "Wa" in seconds	Ape	0.26	0.0011
	Kweku	0.24	
	Yaw	0.28	
Duration "Hoo" in seconds	Ape	0.19	0.0019
	Kweku	0.24	
	Yaw	0.25	

individuals as possible (ideally all) would need to be recorded and identified in a habitat or wild population to reliably identify the released ones (Budka *et al.* 2015).

With the ongoing advancement of artificial intelligence, the question arises whether this technology can be utilized for future monitoring

methods (Ang *et al.* 2023). Bird recognition apps that use artificial intelligence to identify bird species by their voices have already been developed (Tian & Sun 2022, Ware *et al.* 2023). Similar apps for identifying monkey species are conceivable. However, there are currently no apps that offer acoustic detection at the individual level rather at



**Figure 3.** Scatter plot using the two linear discriminant functions of the “wahoo” calls of three adult male white-naped mangabeys showing scores from 10 acoustic features, overlaid with caller identity. LD1 and LD2 are the two axes created by the linear discriminant function analysis.

a species level. Furthermore, actively recording spontaneous calls of white-naped mangabeys with a smartphone instead of a PAM system seems difficult. The possibility of encountering a pre-recorded individual in the field is very slim.

Future studies should analyze the white-naped mangabey’s vocal repertoire to understand better this species’ contact, loud, and alarm calls. According to Range & Fischer (2004), sooty mangabeys’ social calls include grunts, twitters, screams, growls, and other threat and copulation calls. It can be assumed that this is similar for members of the same taxon - *Cercocebus*, and our study should be repeated using social calls to see if this increases the probability rate of the DFA. However, social calls are difficult to record in the wild since often they cannot be heard over long distances. Furthermore, future studies should investigate the exact purposes of the “wahoo” call because of its similarity to the baboon’s “wahoo” call, which can be used in different contexts (Fischer *et al.* 2002). Additionally, further research is needed to determine if an individual’s acoustic features remain constant over long periods of time, over individual growth, and after changes in group composition to ensure reliable monitoring (Butynski *et al.* 1992; Price *et al.* 2009). Lastly, future studies should also investigate vocal individuality in white-naped mangabey females.

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# Assessment of Primate Presence and Anthropogenic Activity in Cape Three Points Forest Reserve, Ghana

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**Abstract:** Anthropogenic impacts like mining, unsustainable hunting, timber felling, and climate change have led to population declines and species-level extinctions of primates. The Guinean Forest primates are some of the most endangered primates listed on the IUCN Red List of Threatened Species. Forest primate species, including the white-naped mangabey *Cercocebus lunulatus*, Roloway monkey *Cercopithecus roloway*, and Miss Waldron's red colobus *Piliocolobus waldroni* are found from western Ghana to C te d'Ivoire. Cape Three Points Forest Reserve is home to primates threatened by anthropogenic activity. Previous surveys in the reserve reported white-thighed colobus *Colobus vellerosus*, white-naped mangabey *Cercocebus lunulatus*, eastern spot-nosed monkey *Cercopithecus petaurista petaurista* and Lowe's monkey *Cercopithecus lowei*. To assess the current primate presence in Cape Three Points Forest Reserve, line transect surveys and camera trap surveys were conducted to record mammal and anthropogenic activity across the reserve. The survey was carried out in partnership with West African Primate Conservation Association (WAPCA), who surveyed previously in 2018, and results were compared to those prior results. There have been changes to primate distribution within the reserve since 2018 with primates no longer detected in the north of the reserve. The results showed repeat detections of Lowe's monkey, white-thighed colobus, and eastern spot-nosed monkey. Hunting and logging were detected across all areas of the reserve (north, central and south), while mining was recorded in the northern portion. Our results showed that there was a significant decrease in the encounter rate of anthropogenic activity since the last surveys in 2018. This suggests that in five years the current conservation methods, such as community-based patrols within the reserve, may have contributed to reducing illegal anthropogenic activities and therefore threats to endangered primates. Despite this, there was no significant change in primate or mammal encounters within the reserve.

**Key words:** *Cercocebus lunulatus*, Anthropogenic disturbance, primate presence, Cape Three Points Reserve, Ghana

## INTRODUCTION

The Guinean Forest ecosystem extends from Guinea into eastern Sierra Leone and across into Ghana and western Togo. The Guinean Forest, which is a designated biodiversity hotspot (Conservation International 2023), was originally covered by tropical rainforest but has been reduced to a series

of forest fragments retaining 141,000 km<sup>2</sup> of closed canopy forest (Critical Ecosystem Partnership Fund 2021).

Globally, forests have been degraded through increased land use changes driven by human impacts, leading to biodiversity loss (Owusu *et al.* 2018). The

22 countries in West and Central Africa have an increasing human population, which is projected to rise to over 600 million people by 2050. This has led to extensive deforestation and forest fragmentation where wide-scale clearing is replacing forests with agricultural land in West Africa. As a result, 10% of amphibian, bird, and mammal species in West and Central Africa are threatened with extinction (Conservation International 2023).

The Guinean Forest primates are some of the most endangered primates globally and five of its species are listed as Critically Endangered on the IUCN Red List of Threatened Species. Wildlife conservation in Ghana has previously focused on protected areas and national parks due to their potential to protect threatened primate species. However, seventy-five percent of forest reserves not defined as national parks are being managed for timber production and the impact of this land use change on wildlife is unknown. There are limited efforts currently made to conserve wildlife in these forests that do not have the protection of national parks and protected areas (Mallon *et al.* 2015; Wiawe 2020).

Previous surveys in several reserves in Ghana have attempted to assess primate populations and threats. Oates (2006) concluded that the status of reserves across Ghana should be upgraded to that of national parks and research should focus on the long-term study of Ghana's primates.

In 2018, West African Primate Conservation Action (WAPCA) and the University of Chester carried out data collection on human encroachment and endangered primates in the Cape Three Forest Reserve (Nolan *et al.* 2019). Line transect surveys were used to determine human impact and 21 camera traps were deployed to assess wildlife across the reserve (Welsh 2018). Nolan *et al.* (2019) identified six independent sightings of primate species. This included sightings of white-thighed colobus, white-naped mangabey, eastern spot-nosed monkey, and Lowe's monkey in surveys conducted in 2018. A second independent survey in the reserve by Wiawe (2020) confirmed five independent sightings of Lowe's monkeys and a group of white-naped mangabeys.

Both studies reported evidence that hunting was common and widespread, including wire snares, empty cartridges, and gunshot sounds (Nolan *et al.* 2019; Wiawe 2020). Evidence of illegal mining and logging was also reported across the entirety of the Cape Three Points Forest Reserve, suggesting there is a possibility that anthropogenic activities may affect the distribution of primates (Nolan *et al.* 2019).

In 2020 a joint initiative by Hen Mpoano (a Ghanaian non-governmental organization) and WAPCA established a Community Resource Management Area (CREMA) to encourage protection of Cape Three Points Forest Reserve (WAPCA 2018). The methods of the CREMA focuses on creating an awareness campaign, establishing forest nurseries with local communities, and recruiting and training locals to form a Community Rainforest Monitoring Team. The project is designed to mitigate the threats to the reserve and primates.

The aim of this present study was to assess anthropogenic activities and primate species presence across the Cape Three Points Forest Reserve. The study objectives were to 1) determine primate presence across the reserve, 2) determine the rates of anthropogenic activities across the reserve and, where they were most dominant, and 3) compare the previous results (primate presence and anthropogenic activity) of surveys from 2018 to this survey from 2023 and determine if changes are significant.

## METHODS

### Study site

Cape Three Points Forest Reserve is a small reserve (51 km<sup>2</sup>) located in the western region of Ghana; it is unique with the coast located only 3 km away (Figure 1). The reserve was originally established in 1949 as a protected area (Wiawe 2020). It is under management of the government Forest Services Division of the Forestry Commission (Gatti 2010).

Prior to starting field work, ethical approval was obtained from Nottingham Trent University, and a permit was obtained from the Ghanaian Forestry Commission to conduct surveys in the Cape Three Points Forest Reserve. Field work was conducted in collaboration with WAPCA. The reserve was split into north, central, and south for the purpose of the survey. The field team included a lead surveyor, two students, a member of the Forest Services Division, and a local community member as an experienced guide.

### Line Transects

Line transects were used to survey the diurnal primates. Twelve transect routes were walked in total with each transect being walked twice throughout the survey period. Transect surveys were walked



**Figure 1.** Cape Three Points Forest Reserve shaded in red in the western region of Ghana (Created in QGIS v.10.0238, 2023).

west to east in as straight a line as possible using a GPS and compass (Figure 2). When not possible, the path of least resistance was walked and no new paths were cut.

For comparisons to be made, the same transect routes and camera trap locations established during the 2018 WAPCA and the University of Chester project were used (Nolan *et al.* 2019). The previous survey determined start and end points for each of the 12 transects (Nolan *et al.* 2019). The transects measured an average of 3 km in a straight line. Researchers walked silently at an average pace of 1.3 km per hour. The survey start time was adjusted according to visibility and weather, with transects starting between 5:30am and 7:00am to cover times when primates are most likely to be active (Wiafe 2020).

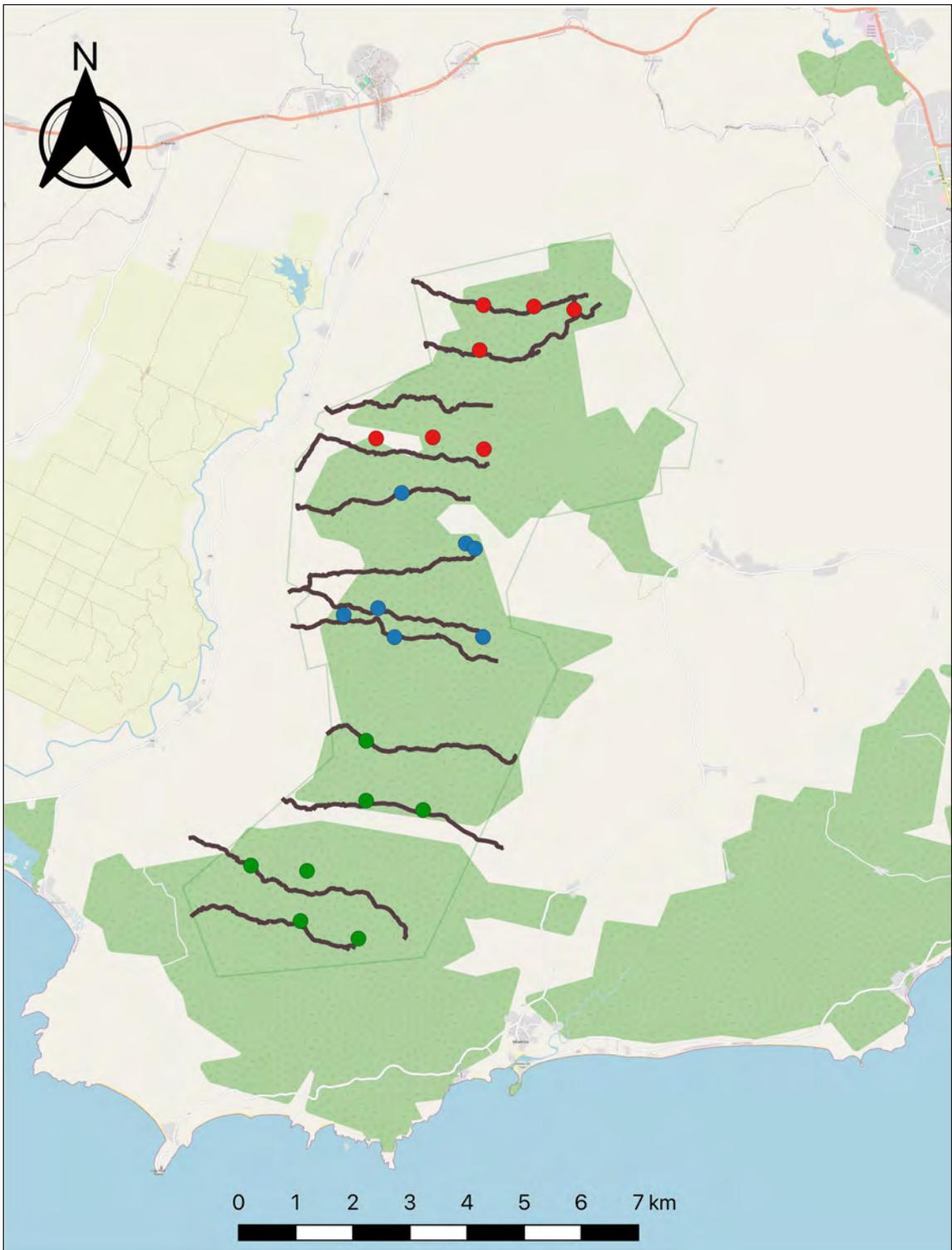
While traversing the transects, all indirect and direct sightings of mammals and human activity were recorded. Indirect sightings of mammals included droppings, footprints, feeding signs, and calls. When a direct sighting was made, the species and number of individuals were recorded. Each mammal sighting throughout the transect surveys was considered an independent event. Anthropogenic activities observed during the transects were also recorded. This included empty cartridge shells, traps, poachers' paths, active mining, inactive mining, soil testing sites, litter, logging, gunshots (heard) and mining camps. Observers briefly deviated from transects when there was evidence of anthropogenic activity nearby, such as broken branches or a disturbed path.

For all observations, the GPS location was recorded with the Garmin 64s. Data collection for line transect surveys lasted from 11 March 2023 until 10 May 2023.

### Camera trap surveys

Camera traps were deployed equally between the north, central, and south divisions of the reserve (Figure 2). Camera traps were placed no less than 500 m apart and positioned approximately 50 cm above ground. Ground camera locations were pre-determined from the previous survey carried out in 2018 (Nolan *et al.* 2019). Cameras were directed towards habitat and routes that arboreal mammals may use such as vines and climbers (Houle *et al.* 2004).

Bushnell Trophy Cam HD (model #119677) were programmed to take bursts of two photos and a 60-second video when triggered by movement in the direction range. An interval of 60 seconds was set between bursts. To ensure independence between captures, records of the same species within 30 minutes of the last capture at the same location were removed (Nolan *et al.* 2019). Camera traps are considered a suitable method for standardisation, as errors are reduced to installation/removal and maintenance of camera traps (Johnson *et al.* 2020). To reduce photograph identification error, mammals were identified alongside local guides with experienced knowledge. Camera trap data collection lasted from 10 March 2023 until 13 May



**Figure 2.** Locations of line transects in Cape Three Point Reserve, Ghana, which were walked twice during the period of the data collection. Seven camera traps were deployed in each of the north (red), central (blue) and south (green) areas of the reserve.

2023. Camera traps were deployed and collected so that at least one camera was deployed in each area (north, central, and south) of the reserve throughout the entire survey period. Once set up, each camera was left for 20 days undisturbed. In total, 21 locations were sampled across the survey period (Figure 2).

### Statistical analysis

Species locations and line transect routes were mapped using QGIS v.10.0238 (QGIS development team 2023) and Garmin BaseCamp. Distance matrix analysis was run in QGIS to determine the average distance of hunting, logging, and mining from each camera trap location. These data were then used to determine the differences between distance to anthropogenic locations and where primates did and did not occur (as confirmed by camera traps). Camera trap data were transformed into a binomial dataset, where primates were observed (1) or not observed (0) at each camera site. Transforming the data this way allowed for the use of a Generalized Linear Model (GLM) with binomial error (Conde & Manohar 2022).

Encounter rates (observations/total km walked) were calculated for both mammals (grouped as all indirect and direct sightings) and anthropogenic (all human activity recorded) activity along each transect. The encounter rates from previous surveys (2018) were determined for mammals and anthropogenic activities to standardise the data. Encounter rates for logging and hunting individually were also calculated for each transect. Encounter rates were collated for the whole reserve as well as separately for north, central, and south.

Analysis was carried out using R studio (R Studio 2023, v2023.06.0+42). Differences in the average distance from logging, mining, and hunting activities between the locations where primates were present and absent were tested with Mann-Whitney U tests. Statistical correlations were performed to determine if there was a possible linear association between the encounter rates of primates versus logging or hunting. These were the only anthropogenic variables tested individually as they are considered the primates' biggest threats (Wich & Marshall 2016; Pinto-Marroquin *et al.* 2021). Spearman's rank was used but the presence of a tie was suggested; due to this occurrence Kendall's tau correlation is preferred and was used for analysis (Puth *et al.* 2015). Correlation between primate presence and mammal encounters was determined with the use of Point-Biserial Correlation, as one variable was normally

distributed while primate presence data is a binary (Luck 2020).

To assess changes between surveys in 2018 and this survey, differences between anthropogenic encounter rates from 2018 and 2023 were determined using the Welch's t-test for unpaired data as detections of human activity are random encounters (Kim 2015). This was repeated for mammal encounter rates in 2018 and 2023 (WAPCA 2018; Nolan *et al.* 2019).

Total counts of primates from the study carried out in 2018 (WAPCA 2018; Nolan *et al.* 2019) and 2023 were used to assess differences in primate presence within the reserve since the CREMA has been implemented. Mann-Whitney U tests were used to carry out the statistical tests.

## RESULTS

### Mammal species detected in Cape Three Points Forest Reserve

The sampling effort for camera traps amounted to 8,810 days, resulting in seven primate species records and other records of 59 rodents, one carnivore, 18 ungulates, and one pangolin (Table 1). In total, 12 mammal species were captured across the reserve. Two white-naped mangabey troops were captured in the central and southern part of the reserve with a total of four records (Figure 3). Lowe's monkey and eastern spot-nosed monkey were recorded on camera traps in the central and south portions of the reserve. Previously in 2018, only white-naped mangabeys were confirmed in the centre of reserve (Nolan *et al.* 2019).

In total, six species of primates were recorded in the study period in either direct or indirect sightings (Table 2). These records included 17 direct visual sightings during transects that occurred in the southern portion of reserve on 27 April 2023. White-thighed colobus monkeys (*Colobus vellerosus*) were seen and heard during transect surveys. Suspected Roloway monkey (*Cercopithecus roloway*) calls were heard during transects in the central and south areas of the reserve, but these calls can be easily mistaken with other guenon primate species. Lowe's monkey (*Cercopithecus lowei*) had the highest number of detections with 11 records (Table 1). The southern portion of the reserve had the highest detections of primates when combining line and camera trap survey data.

Maxwell's duiker (*Philantomba maxwellii*) had the greatest number of combined detections (n =

**Table 1. Total records of mammal species identified during the survey period. Camera records are independent records captured, not individual counts of each species. Line transect records are direct and indirect signs of the species.**

Species	Common name	Line Transect records	Camera records	Locations
<i>Cercocebus lunulatus</i>	White-naped mangabey	-	4	Central and south
<i>Cercopithecus lowei</i>	Lowe's monkey	10	1	South
<i>Cercopithecus petaurista petaurista</i>	Eastern spot-nosed monkey	5	2	Central and south
<i>Colobus vellerosus</i>	White-thighed colobus	3	-	Central and south
<i>Cercopithecus roloway</i>	Roloway monkey	7	-	central and South
<i>Procolobus verus</i>	Olive colobus	1	-	South
<i>Oenomys ornatus</i>	Giant rat	-	19	North, central and south
<i>Genetta genetta</i>	Genet cat	-	1	Central
<i>Civettictis civetta</i>	African civet cat	1	-	Central
<i>Cephalophus dorsalis</i>	Bay duiker	49	1	North, Central and south
<i>Cephalophus niger</i>	Black duiker	-	1	South
<i>Philantomba maxwellii</i>	Maxwell's duiker	65	14	North, central and South
<i>Tragelaphus sylvaticus</i>	Bushbuck	3	2	North, central and south
<i>Potamochoerus porcus</i>	Red river hog	1	-	Central
<i>Atherurus africanus</i>	Brush-tailed porcupine	1	5	South
<i>Pholidota spp.</i>	Pangolin	-	1	North
<i>Protoxerus aubinnii</i>	Slender-tailed squirrel	-	35	North, central and south



**Figure 3.** *C. lunulatus* confirmed in the southern portion of Cape Three Points reserve for the first time in 2023 (a) and re-confirmed five years in the centre of the reserve after initially being recorded in 2018 (b). Photograph by Charlotte Hammond.

**Table 2. Indirect and direct recordings of primate records during line transect surveys.**

Species	Common name	Indirect Line Transect records	Direct Line Transect records
<i>Cercocebus lunulatus</i>	White-naped Mangabey	-	-
<i>Cercopithecus lowei</i>	Lowe's monkey	-	10
<i>Cercopithecus petaurista</i>	Eastern spot-nosed monkey	5	-
<i>Colobus vellerosus</i>	White-thighed colobus	2	1
<i>Cercopithecus roloway</i>	Roloway monkey	1	6
<i>Procolobus verus</i>	Olive colobus	1	-

79). Signs of this species were clearly identified by droppings on transects and camera trap triggers at three different locations across the southern portion of the reserve. No primates were confirmed during transects or camera traps in the northern portion of the reserve; feeding signs were noted in the north but not counted as the species responsible could not be confirmed.

There was no significant correlation between primate presence and encountering other mammal species found within the reserve (Point-biserial correlation,  $r = 0.04$ ,  $df = 10$ ,  $p = 0.88$ ; Figure 4).

#### The effects of human activity on primate presence

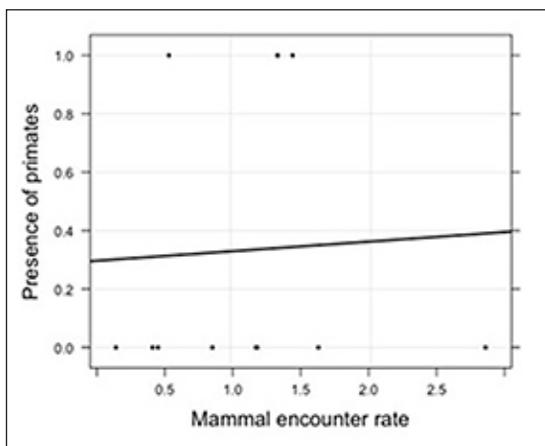
There was no significant difference in the average distance from illegal logging sites where primates occurred and where they did not (Mann-Whitney,  $w = 59$ ,  $p = 0.1297$ ). Likewise, there was no significant difference in the average distance from hunting or mining in sites where primates occurred and did

not (Hunting; Mann-Whitney,  $w = 41$ ,  $p = 0.9671$ ; Mining; Mann-Whitney,  $W = 23$ ,  $p = 0.1279$ ).

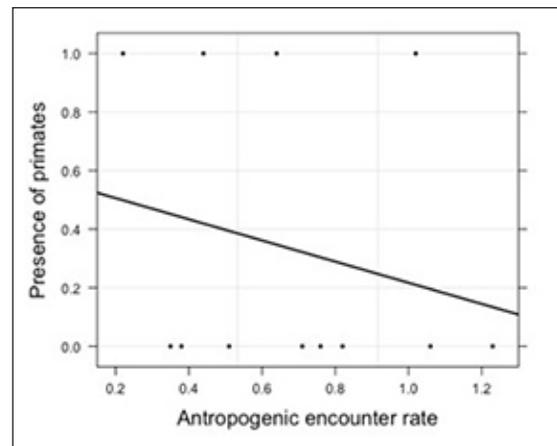
There was no correlation between primate presence and the rate of encountering anthropogenic activities (Point-biserial correlation,  $r = 0.23$ ,  $df = 10$ ,  $p = 0.47$ ) (Figure 5). Encounter rates for anthropogenic activities were highest in the northern section of the reserve ( $n = 0.82$ ) and no primates were confirmed within the northern section of the reserve via the camera trap data. The average distance from anthropogenic activities was greatest for primates occurring away from mining sites (Table 3).

#### Human activity within the Cape Three Points Forest Reserve

Several types of anthropogenic activity were recorded during transect surveys. Total anthropogenic activity was greatest in the north and south. Hunting had an encounter rate of 0.20–0.22



**Figure 4.** No correlation between mammal encounters and primate presence.



**Figure 5.** Correlation between anthropogenic encounter rates and primate presence or absence in Cape Three Points Reserve.

**Table 3. The mean distance of primates from hunting, logging and mining locations where primates were present and absent.**

Primates	Hunting (km)	Logging (km)	Mining (km)
Presence	4.3	4.2	6.1
Absence	4.5	5.6	4.6

across the northern, central, and southern portions of the reserve. Empty cartridge shells were detected three times and gunshots were also heard three times. Man-made traps were the most dominant signs of hunting in the reserve.

Illegal logging was recorded predominantly in the southern portion of the reserve, with evidence of trees being logged and manufactured into canoes (Figure 6). During transect 3.3 in the southern portion of the reserve, the last 967 m consisted of farms and formed a highly fragmented portion of

the reserve. The farms were established prior to the area receiving any form of protection or designation but continue to be accessed and worked on despite the reserve's new designations (Figure 7a).

There was no significant correlation between hunting and logging encounter rates within the Cape Three Points Forest Reserve (Kendall's tau,  $z = 0.489$ ,  $\tau = 0.112$ ). Within the reserve, mining had notable effects by causing large areas of fragmentation (Figure 7b). Mining was most dominant in the northern portion of the reserve (Figure 8).

### Changes since previous surveys in 2018

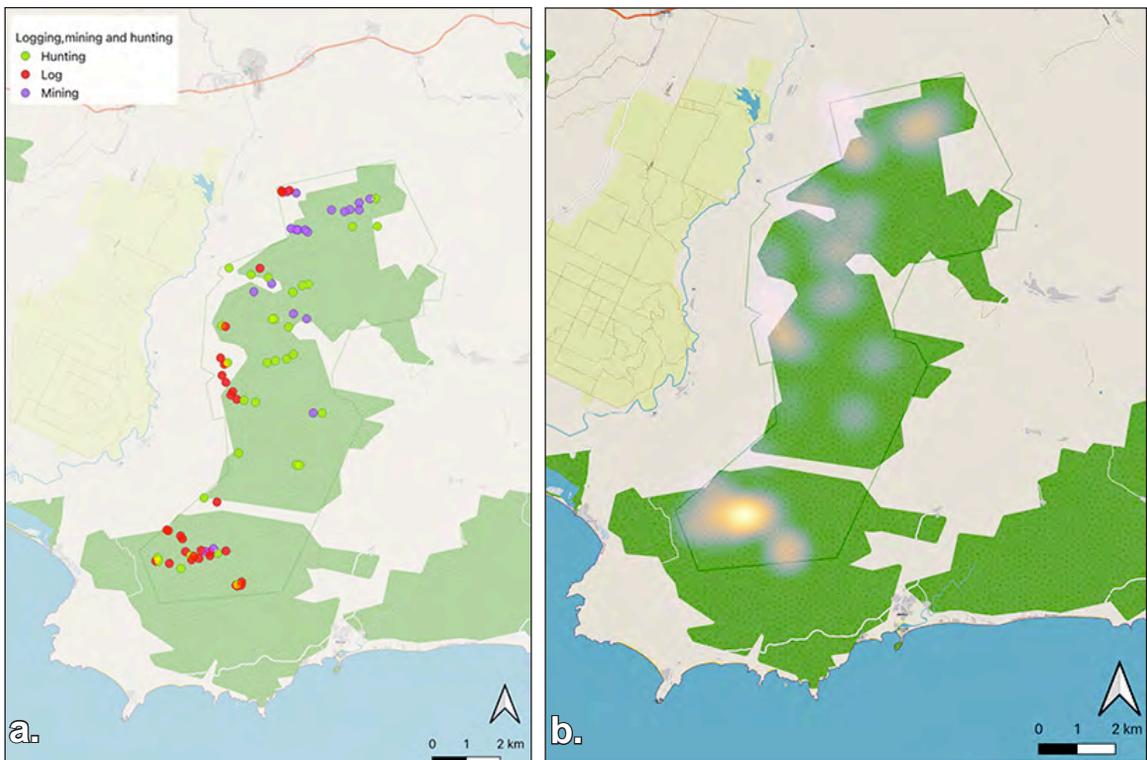
There was no significant difference in the mammal encounter rates between the surveys carried out in 2018 and 2023 ( $t = 0.57696$ ,  $df = 21.996$ ,  $p = 0.5698$ ). The mean encounter rate of mammals had decreased since the CREMA was implemented (Table 4). There has, however, been a significant decrease in anthropogenic encounters



**Figure 6.** a) A canoe carved out within the woods from logged trees. b) An example of one of the logging sites within the reserve. Photographs by Charlotte Hammond.



**Figure 7.** a) One of the farms within the south eastern corner of the reserve forming a large patch of open land. b) An illegal mining site with the reserve were large portions of the ground are dug and water is pumped into the streams. Photographs by Charlotte Hammond.



**Figure 8.** a) The locations and density of illegal anthropogenic activities including logging, hunting and mining. b) The density of combined anthropogenic activity is demonstrated with the heat map feature in QGIS (maps created on QGIS v.10.0238).

across the reserve since 2018 ( $t = 4.6846$ ,  $df = 18.161$ ,  $p = 0.0001$ ).

A comparison was carried out between primate observations in 2018 and 2023 (Table 5). There was no significant difference in the presence of primates detected across the reserve in 2018 and 2023 (Mann-Whitney test:  $W = 28$ ,  $df = 0.99$ ,  $p = 0.342$ ).

## DISCUSSION

The presence of primates has not significantly changed in Cape Three Points Forest Reserve since 2018, but there have been distribution changes to primate presence within the reserve.

**Table 4.** Mean encounter rates for mammals and anthropogenic activities across the cape three points reserve.

Survey year	Mammals	Anthropogenic
2018 (previous)	2.11	1.5
2023 (current)	1.77	0.67

## Primates' presence

In 2018, primate species were detected across the entire reserve (Nolan *et al.* 2019) but they were absent from the northern portion of the reserve in the present study. Since the 2018 survey, there has been an increase in the total detections of Lowe's monkey, white-thighed colobus, and eastern spot-nosed monkey (Table 5). While individual count rates provide useful information, they should be considered with caution, as they provide only estimates rather than actual population assessments since multiple variables could impact primate sightings (Vallecillo *et al.* 2021).

White-naped mangabeys were first visually confirmed by camera traps in the north and central portions of the reserve in 2018 (Nolan *et al.* 2019). The present study reconfirmed a troop of white-naped mangabeys in the centre of the reserve and additionally confirmed their presence in the southern portion of the reserve. There was no difference in distances from anthropogenic activities where primates were confirmed and unconfirmed, so it cannot be determined if primates avoid areas that are closer in proximity to high rates of

**Table 5. Combined sightings of primates across camera traps and line transects for previous surveys in 2018 and this survey in 2023.**

Species	Common name	2018 line transect records and camera records (Nolan 2018)	2023 line transect records and camera records
<i>Cercocebus lunulatus</i>	White-naped mangabey	5	4
<i>Cercopithecus lowei</i>	Lowe's monkey	3	11
<i>Cercopithecus petaurista</i>	Eastern spot-nosed monkey	3	7
<i>Colobus vellerosus</i>	White-thighed colobus	1	3
<i>Cercopithecus roloway</i>	Roloway monkey	1	7
<i>Procolobus verus</i>	Olive colobus	1	1
<b>Total Primate sightings</b>		<b>14</b>	<b>33</b>

anthropogenic activity and disturbance. Despite the southern portion of the reserve being highly logged, it also has the highest primate presence during the present survey.

The olive colobus and white-thighed colobus were detected only in the southern portion of the reserve, which is also where higher densities of logging were observed. It has also been observed that primate densities are generally lower in disturbed forests, but a few studies have found an increase in primates following forest disturbance (Johns & Skorupa 1987). During the present study, a direct visual sighting of the Critically Endangered white-thighed colobus was observed in highly disturbed habitats. Previous studies have found that white-thighed colobus may benefit from logging and will feed on the increased leaf production as a result of the trees being felled (Skorupa 1986; Plumtre & Reynolds 1994).

Logging will affect primate species differently; folivore species can endure areas where trees are removed once new growth begins, but there is ecological delay in this benefit to primates. Omnivorous primates such as mangabey species rely on fruit and insects, so they are less likely to occur in recently logged areas of forests (Swift 2012). Primates may occur in logged areas with closed canopies and open floors as they provide more protection from predators (Swift 2012). Eastern spot-nosed monkeys feed on a range of insects and fruits (Lambert 2012). This may be why they were present in the centre of the reserve, towards the western boundary where no evidence of logging was detected.

### Anthropogenic Activities

Hunting and logging have previously been reported as the largest threats in tropical forests (Houle *et al.* 2004). This was consistent with the encounter rates determined during the survey. Hunting was detected across all areas of the reserve and had an encounter rate of 0.20–0.22. The most dominant hunting method was snares made from sticks and wire, which are effective by trapping an animal that passes through. There were six detections of shooting used as a hunting method during the survey. It is important to understand if there are correlations between logging and hunting as it may affect certain mammals more extensively. No significant correlation between hunting and logging was found during this survey; conservation programs targeting these threats should focus on separate strategies (Brodie *et al.* 2014). It is not possible to determine whether encounter rates with anthropogenic activities impact primates' presence (Figure 5).

Logging had the most detections in the southern portion of the reserve which has direct access to the coast. Felled logs within the reserve were carved into two canoe boats and collected by loggers during the survey period (Figure 6a).

Illegal mining sites were detected only in the northern portion of the reserve. There were no primates confirmed to be present within that area during this survey. Previous surveys by WAPCA declared that human impact levels were extremely high in the northern portion of Cape Three Points

Forest Reserve (Welsh 2018). Mining provides economic growth and development opportunities, but the negative impacts include long lasting habitat loss, along with air and water pollution (Owusu *et al.* 2018). In addition to the direct ecological damage caused by mining, active mining causes a large amount of noise disturbance, negatively affecting mammals. Mining creates pits within the forests removing exploitable ground for food, limiting suitable habitat for predominately terrestrial primate species. Areas of forest with previous extensive mining do not allow for primates and other mammals to recover to previous rates (Owusu *et al.* 2018).

### Changes in 5 years

To evaluate the success of conservation efforts, it is necessary to assess and compare the previous and current states of species (Schwartz *et al.* 2018). Comparison was made between the surveys conducted in 2018 and 2023. The differences in anthropogenic activities, mammal encounter rate, and primate counts were assessed against the 2018 results. There was a significant decrease in the encounter rate of anthropogenic activity since 2018. This suggests that in the past five years the current methods such as community-based patrols within the reserve are effective in reducing illegal anthropogenic activities and, therefore, threats to already endangered primates. Despite this, there was no significant change in primates or mammal encounters within the reserve. This may be due to a relatively short amount of time since the previous mammal and primate assessment.

### CONCLUSIONS

This study has shown that the current conservation methods are effective in reducing threats to Critically Endangered and Endangered primates within the Cape Three Point Forest Reserve as anthropogenic activity rates have decreased across the entirety of the reserve.

The previous survey in 2018 managed to provide the first photographic evidence of white-naped mangabeys in Cape Three Points Reserve, which was reconfirmed twice during this survey. It is recommended that the works of WAPCA and the CREMA continue within the reserve and that the survey methodology is repeated and compared to findings in 2018 and 2023. Long-term reassessments to monitor changes in species presence and anthropogenic rates would provide

adequate evidence for future CREMA projects to be implemented across Africa.

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# The Primate Community of the Lac Télé Community Reserve, Republic of Congo: Insights from a Camera Trap Survey in Flooded Forests and Comparison with Other Sites in Northern Congo

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**Abstract:** The Lac Télé Community Reserve (LTCR), created in 2001 in northern Republic of Congo to protect swamp forests, hosts a rich yet understudied primate community. While western lowland gorillas (*Gorilla gorilla gorilla*) and central chimpanzees (*Pan troglodytes troglodytes*) have been the focus of earlier research, data on the Reserve's monkey species remain sparse. To address this gap, we conducted a camera trap survey in nine forest clearings within seasonally flooded forests between January 2020 and May 2023, deploying 83 camera traps for a total of 6,399 camera days. The survey recorded 2,021 photos of eight primate species—two great apes and six monkeys—and over 5,000 photos of humans. Three monkey species known to occur in the Reserve have not been photographed in the clearings. Agile mangabeys (*Cercocebus agilis*) and gorillas were the most frequently recorded, while eastern putty-nosed monkeys (*Cercopithecus nictitans nictitans*) and Gray's crowned monkeys (*Cercopithecus pogonias grayi*) were least photographed. Gorilla photographs were mainly confined to one clearing. Primate visits to clearings (all species combined) occurred throughout the year, with no marked seasonal pattern. However, at species level, gorillas visited clearings mainly during the second half of the year (when clearings are filled with water), whereas agile mangabeys and Allen's swamp monkeys (*Allenopithecus nigroviridis*) were observed almost exclusively the first six months (when clearings are dry or starting to fill). Naïve occupancy was highest for agile mangabeys and eastern putty-nosed monkeys. Allen's swamp monkey was recorded in three of the nine forest clearings. We found a significant positive correlation between primate occupancy and distance from villages, suggesting human pressure reduces primate visits to these areas. Comparison with three northern Congo's protected areas revealed differences in species richness, community composition, and relative abundance of primates, likely related to biogeographic barriers and habitat types. Notably, the LTCR's flooded forests support both habitat specialist and generalist species. The Reserve is a key protected area for the conservation of the swamp monkey, a species restricted to the flooded forests of the Congo basin. This study provides the first systematic assessment of the monkey community in LTCR. Conservation efforts should consider the impacts of human activity on primate behavior and distribution.

**Resume:** La Réserve Communautaire du Lac Télé (RCTL), créée en 2001 dans le nord de la République du Congo pour protéger les forêts marécageuses, abrite une communauté de primates riche mais peu étudiée. Bien que les gorilles de plaine de l'ouest (*Gorilla gorilla gorilla*) et les chimpanzés (*Pan troglodytes troglodytes*) aient été au centre des recherches précédentes, les données sur les autres espèces de singes restent rares. Pour combler cette lacune, nous avons mené une étude avec des caméras pièges dans neuf clairières forestières situées dans des forêts inondées saisonnièrement entre janvier 2020 et mai 2023. Un total de 83 caméras pièges a été déployé pour un total cumulé de 6 399 caméra-jours. L'étude a enregistré 2 021 photos de huit espèces de primates – deux grands singes et six Cercopithecidae – et plus de 5 000 photos d'humains. Trois espèces de Cercopithecidae connues pour habiter la Réserve n'ont pas été photographiées dans les clairières.

Les mangabeys agiles (*Cercocebus agilis*) et les gorilles ont été les plus fréquemment enregistrés, tandis que le hocheur (*Cercopithecus nictitans nictitans*) et la mone couronnée (*Cercopithecus pogonias grayi*) ont été les moins photographiés. Les photos de gorilles étaient principalement concentrées dans une seule clairière. Les visites de primates dans les clairières (toutes les espèces confondues) s'est produite tout au long de l'année, sans schéma saisonnier marqué. Cependant, au niveau des espèces, les gorilles visitaient les clairières principalement durant la seconde moitié de l'année (lorsque les clairières sont remplies d'eau), tandis que les mangabeys agiles et les singes des marais (*Allenopithecus nigroviridis*) ont été observés presque exclusivement durant les six premiers mois (lorsque les clairières sont sèches ou commencent à se remplir). L'occupation naïve était la plus élevée pour les mangabeys agiles et les hocheurs. Le singe des marais a été enregistré dans trois des neuf clairières forestières. Nous avons trouvé une corrélation positive significative entre la fréquence des visites de primates dans les clairières et la distance entre les clairières et les villages, suggérant que la pression humaine réduit la fréquentation des primates. La comparaison avec trois zones protégées du nord du Congo a révélé des différences dans la richesse spécifique, la composition de la communauté et l'abondance relative des primates, probablement en lien avec les types d'habitat présent et les barrières biogéographiques. Il est à noter que les forêts inondées de la LTCR abritent à la fois des espèces de primates généralistes et des espèces spécialistes. La LTCR est une aire protégée d'importance internationale pour la conservation du singe des marais, une espèce restreinte aux forêts inondées du bassin du Congo. Cette étude fournit la première évaluation systématique de la communauté de singes dans le LTCR. Les efforts de conservation devraient tenir compte des impacts des activités humaines sur le comportement et la distribution des primates.

**Key words:** primate community, flooded forests, camera trap survey, forest clearings, Allen's swamp monkey, Congo

## INTRODUCTION

The Lac Télé Community Reserve (LTCR) was established in 2001 in northern Republic of Congo (hereafter Congo) to protect swamp forests, an ecosystem that was not represented in the national protected area network at the time. The Reserve encompasses a mosaic of permanent and seasonally flooded forests, terra firma forests, and seasonally flooded savannas.

The nonhuman primate community (hereafter primate community) of the LTCR has been partially studied. The Reserve is known for its population of western lowland gorillas (*Gorilla gorilla gorilla*), which reach some of the highest recorded densities in central Africa (Rainey *et al.* 2009). This species has been the subject of numerous studies in the LTCR (e.g., Poulsen & Clark 2004; Kalan & Rainey 2009; Kalan *et al.* 2010). Data on central chimpanzee (*Pan troglodytes troglodytes*) densities are also available for different periods (Stokes *et al.* 2010; Brncic *et al.* 2018; Estienne *et al.* 2025) and the ecology of this species has recently been studied (Redjali 2024). In contrast to the great apes, the Reserve's monkey community (Cercopithecidae) has not been studied. In fact, monkey species occurring in LTCR are known only from opportunistic field observations by the Reserve's staff and researchers; the structure of the primate community, such as distribution, densities, and relative abundance remains unknown.

In central African rainforests, forest clearings are frequently visited by a wide variety of animals,

including primates and other mammals, for feeding and social activities (Vanleeuwe *et al.* 1998; Gessner *et al.* 2014). Therefore, we conducted a camera trap study focused on these clearings to provide baseline data on the occurrence, distribution, and activity patterns of large and medium-sized terrestrial mammals in the LTCR. Here, we present the results of this survey concerning primate species. We compare our findings with those from three other sites in northern Congo and discuss the conservation status of primates in the LTCR.

## METHODS

### Study area

The Lac Télé Community Reserve is located in northern Congo (Likouala département) and covers an area of 4,851 km<sup>2</sup> (Figure 1). The primary objective of the Reserve is to promote the sustainable use of natural resources by local communities. Activities implemented by the Reserve's management team include monitoring the offtake of natural resources (e.g., fish, game) by communities and developing by-laws to ensure sustainable use. The Reserve includes 27 villages - 22 along its boundaries and five within its borders - with a total human population estimated at 20,000 people (Brugière 2024). Fishing and subsistence agriculture (mainly cassava) are the primary sources of livelihood and income (Bondeko

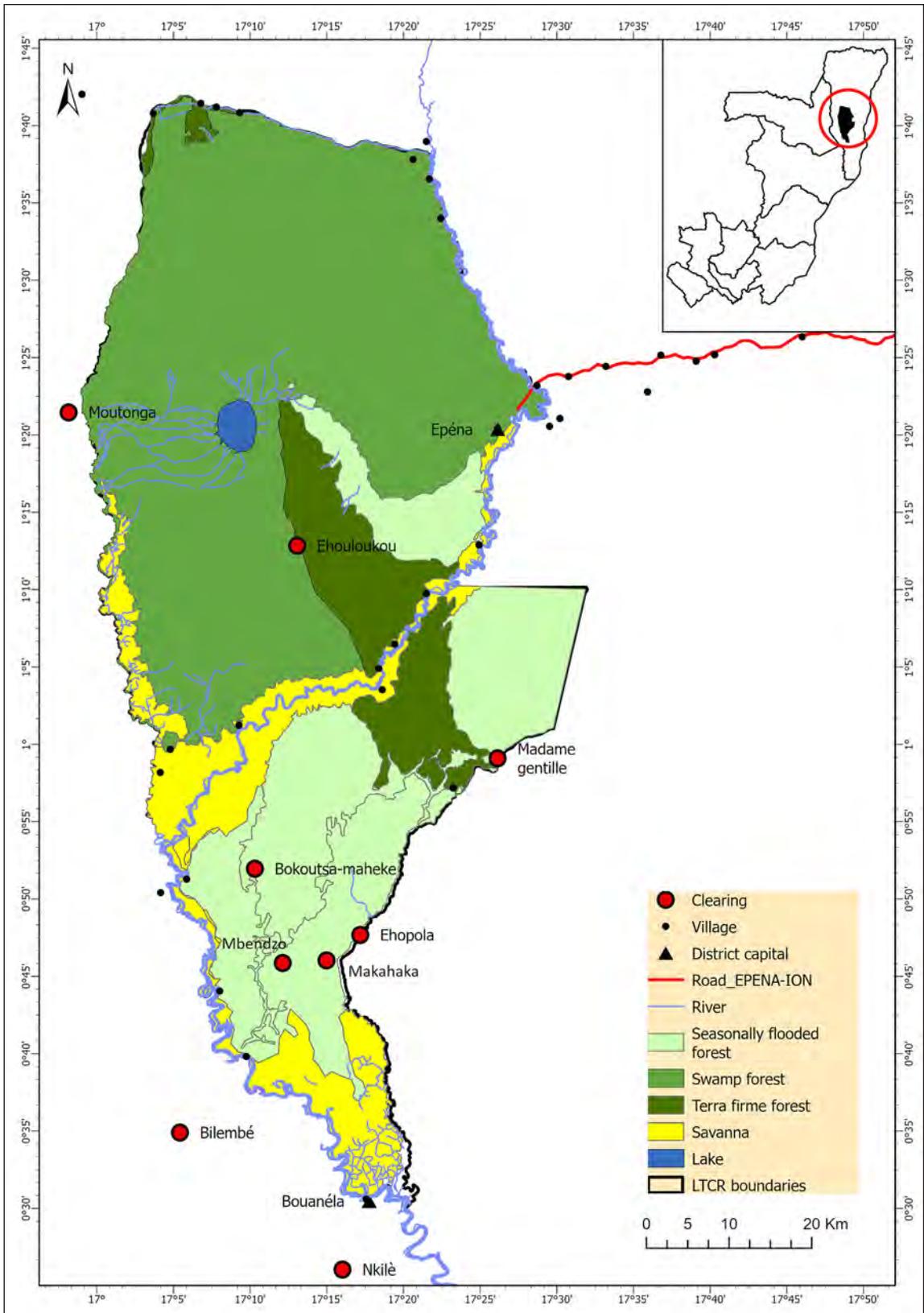


Figure 1. Map of the Lahe Télé Community Reserve showing the clearings surveyed.

*et al.* 2022). Subsistence hunting is permitted in the Reserve but bushmeat trade is forbidden. Hunting complements fishing, and people tend to hunt mainly during the major rainy season when fish catches in the Likouala-aux-herbes river decline due to widespread flooding (Bondeko *et al.* 2024).

The LTCR comprises four main terrestrial ecosystems: (i) permanently flooded forests (also called swamp forests; 50% of the Reserve), (ii) seasonally flooded forests (24%), (iii) terra firma forests (9%), and (iv) seasonally flooded savannas (17%). The Reserve is bisected by the Likouala-aux-herbes river and large savannas extend 2-3 km away from the river. Annual rainfall is 1,691 mm (SD = 273; n = 13) and there are two rainy seasons: a minor one from May to July, and a major one from September to November (Romani & Ossere 2025). During the latter, approximately 90% of the LTCR is flooded.

Although there has been no formal assessment of the number, size, and spatial distribution of forest clearings in the LTCR, field observations suggest that they are few in number (< 20) and of limited size (in general < 1 ha) compared to other forests in northern Congo (e.g., Odzala Kokoua National Park, which has 36 clearings in a sample area of ca. 3,000 km<sup>2</sup>; Vanleeuwe *et al.* 1998).

### Camera trap survey: data collection and analysis

We selected nine clearings, including six located within the Reserve and three clearings on its periphery (Figure 1). All the clearings were situated in seasonally flooded forests. We deployed 83 camera traps from January 2020 to May 2023 in the nine clearings resulting in a cumulative sampling effort of 6,399 camera-days. We used motion-triggered infrared camera traps (Browning Dark Ops Extreme 16MP model), set to operate 24 hours a day and trigger immediately upon detecting movement.

Cameras were placed in two types of locations: (i) along animal trails leading to clearings (no further than 100 m from the clearing edge), and (ii) on the edges of clearings. We mounted camera traps on trees at an average height of 0.8 m above ground to prevent submersion during the major rainy season when clearings are filled with water. We programmed the camera to take one photo per second on animal trails and every five seconds in clearing edges once triggered. Cameras continued recording as long as an animal was detected. Days when camera traps failed to take photos due to technical issues were excluded from the analysis.

We analyzed the data using four metrics: number of photos, number of photo events, Relative

Abundance Index (RAI), and naïve occupancy. A photo event was defined as all recordings of one or more individuals of the same species taken within a 20-minute interval at the same location. This threshold is higher than the 5-minute interval commonly used in similar studies (e.g., Hedwig *et al.* 2018; Morgan *et al.* 2024). We opted for a longer interval to avoid artificially inflating capture frequencies, as our analysis of photo sequences indicated that animals often remain relatively stationary while engaged in social or feeding activities in forest clearings. Following Hedwig *et al.* (2018), the RAI was calculated as the number of photo events for a given species per 100 camera-trapping days. The primate community RAI was defined as the sum of the RAI values of all detected primate species, either for individual clearings or across all clearings surveyed. The naïve occupancy was calculated as the proportion of clearings where a species was detected, i.e., the number of clearings with detections divided by the total number of clearings surveyed (nine).

We also analyzed monthly activity patterns for species with more than 30 photo events. As the sampling effort was not the same for each clearing, we divided the number of events by the number of camera-days for each month then multiplied the result by 100 to express the rate as the monthly number of events per 100 days.

To investigate potential influences of human activity on primate presence, we tested for correlations (Spearman rank correlation test) between primate community RAI and two variables: (i) linear distance (in km) between each clearing and the nearest village, and (ii) the human RAI in each clearing. We also used a two-sided Wilcoxon rank-sum test to compare primate and human RAI in clearings inside (n = 6) and outside (n = 3) the Reserve.

The linear clearing distance from the nearest village was calculated in QGIS version 3.63.3 (QGIS 2025). All statistical analyses were performed in R version 4.4.0 (R Core Team 2024), using non-parametric tests. In particular, the Spearman rank correlation test was computed using the `stats` package, and the Wilcoxon rank-sum test was performed using the `wilcox.test` function.

### Comparison with nearby sites

We compared the structure of the LTCR's primate community with that of the three nearest protected areas in northern Congo: Ntoukou-Pikounda National Park (NPNP; located 120 km to the South-east), Nouabalé-Ndoki National Park (NNNP; 160

km to the North-west) and Odzala-Kokoua National Park (OKNP, 250 km to the West). For OKNP and NPNP, the comparison was limited to species richness and composition (data from Bermejo 1999 and N'Goran *et al.* 2020, respectively). For NNNP, in addition to species richness and composition (PNNN 2021), we also compared species abundance based on RAI (data from Morgan *et al.* 2024). To facilitate comparison with LTCR, where subsistence hunting is permitted, we used data from the Djéké site in NNNP. This site is located in the Bomassa multi-use forest, on the periphery of the park, where subsistence hunting is also allowed. Although the sampling effort at both sites was similar, species abundance comparison should be interpreted with caution as photo events (from which RAIs are derived) were defined differently: 5 minutes at Djéké versus 20 minutes at LTCR.

Taxonomy used in this study follows Mittermeier *et al.* (2013) and the most recent IUCN Red List assessments (IUCN 2025).

## RESULTS

### Camera trap survey

We recorded a total of 2,021 photos (268 events) of eight primate species including two Hominidae and six Cercopithecidae (Figures 2-8, Table 1). The monkey community comprised five Cercopithecinae species and one Colobinae. Additionally, we

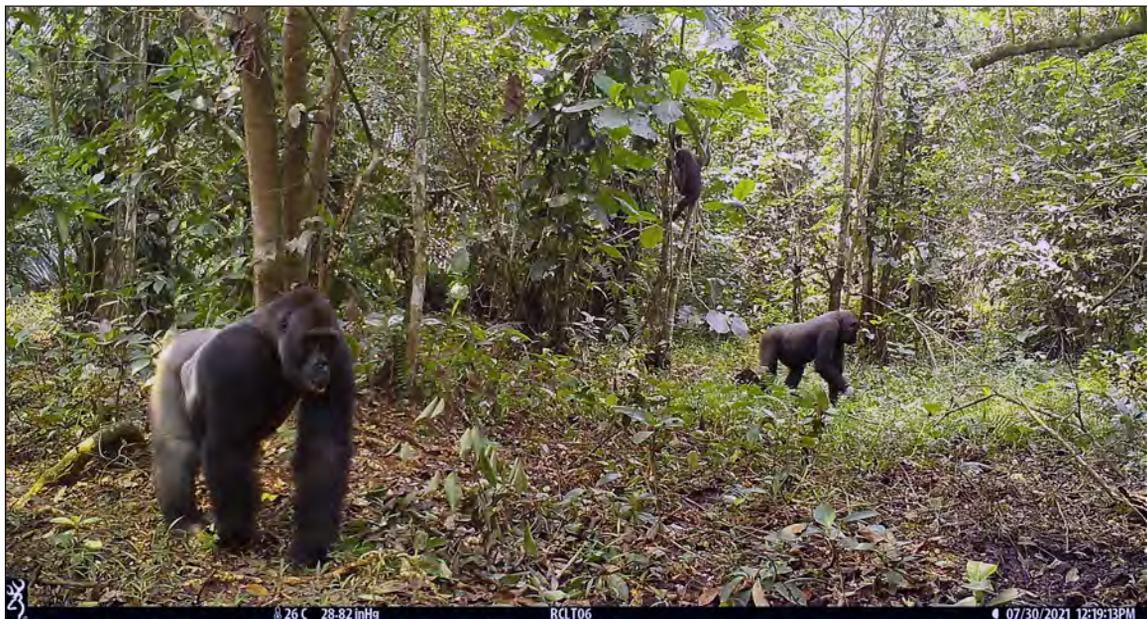
recorded 5,192 photos of humans, corresponding to 740 events.

Three monkey species known to occur in the LTCR were not recorded at clearings: the grey-checked mangabey (*Lophocebus albigena albigena*), red-tailed moustached monkey (*Cercopithecus cephus cephus*) and western guereza (*Colobus guereza occidentalis*).

Western lowland gorillas and agile mangabeys (*Cercocebus agilis*) were the most frequently captured species, both in terms of photos (771 and 646, respectively) and events (87 and 55, respectively). In contrast, eastern putty-nosed monkeys (*Cercopithecus nictitans nictitans*) and Gray's crowned monkeys (*Cercopithecus pogonias grayi*) were the least frequently recorded, with only 30 and 6 photos, respectively.

In terms of naïve occupancy, agile mangabeys and eastern putty-nosed monkeys were detected at seven out of nine clearings. Despite being the most photographed species, western lowland gorillas were observed at only three clearings (naïve occupancy: 0.33), with most events (85.0%) occurring at a single site (Ehouloukou). Allen's swamp monkey (*Allenopithecus nigroviridis*), a species restricted to flooded forests, was also observed at only three clearings. Humans were recorded at seven of the nine clearings.

When pooling all nonhuman primate species, the clearings were visited during all months with no clear pattern (Figure 9). At the species level, there



**Figure 2.** An adult male western lowland gorilla (*Gorilla gorilla gorilla*) with female and offspring recorded at the Ehouloukou clearing.



**Figure 3.** A central chimpanzee (*Pan troglodytes troglodytes*) recorded at the Mahakaka clearing.

was a strong contrast between western lowland gorillas and agile mangabeys and Allen's swamp monkey: while the gorillas visited clearings mainly in the second half of the year (Figure 10a), the two monkey species were observed almost exclusively the first six months of the year (Figure 10b and 10c). Given the rainfall pattern at LTCR, clearings are dry (January to March, major dry season) and start filling (April to June, minor rainy season) the

first part of the year while they are fully filled with water the second part of the year. In contrast to nonhuman primates, we found that human visits to the clearings peaked from November to January, during the major rainy season and the early part of the major dry season) (Figure 10d).

The most visited clearing by nonhuman primates was Ehepola, with a community RAI equal to 13.0. The second most visited clearing, Ehouloukou,



**Figure 4.** A Gray's crowned monkey (*Cercopithecus pogonias grayi*) at the Nkile clearing.



Figure 5. A De Brazza's monkey (*Cercopithecus neglectus*) captured on camera in the Nkile clearing.

had a primate community RAI that was 37% lower (RAI = 8.2). Those two clearings are located inside the Reserve. Primate community RAIs were not significantly different between clearings inside and outside the Reserve (Wilcoxon rank-sum test,  $W = 7$ ,  $p = 0.71$ ). Similarly human RAI did not differ significantly in clearings located inside and outside the Reserve (Wilcoxon rank-sum test,  $W$

= 11.5,  $p = 0.60$ ). We found a significant positive correlation between the primate community RAI and the distance between clearings and the nearest village (Spearman rank correlation test,  $R_s = 0.83$ ,  $p = 0.008$ ). We found a negative but non-significant correlation between human RAI and the primate community RAI in clearings ( $R_s = -0.32$ ,  $p = 0.38$ ).



Figure 6. An Allen's swamp monkey (*Allenopithecus nigroviridis*) captured on a camera trap in the Mme Gentille clearing.



Figure 7. Agile mangabeys (*Cercocebus agilis*) explore the water at the Moutonga clearing.

### Comparison with nearby sites

In terms of species richness, the LTCR hosts 11 primates, a figure similar to NNNP but higher than OKNP and NPNP (Table 2). Likewise, the species composition of the LTCR primate community is similar to that of NNNP but differs from the two other sites: the northern talapoin monkey (*Miopithecus ogouensis*) is found in OKNP but

absent from LTCR, whereas the Allen's swamp monkey and Oustalet's red colobus (*Ptilocolobus oustaleti*) are not found in OKNP. Similarly, the Allen's swamp monkey is not found in NPNP, and that area hosts a different species of red colobus, Bouvier's red colobus (*Ptilocolobus bouvieri*).

When comparing the RAI of primate species between LTCR and NNNP- Djéké site (Table 3), notable differences emerge. The community RAI at

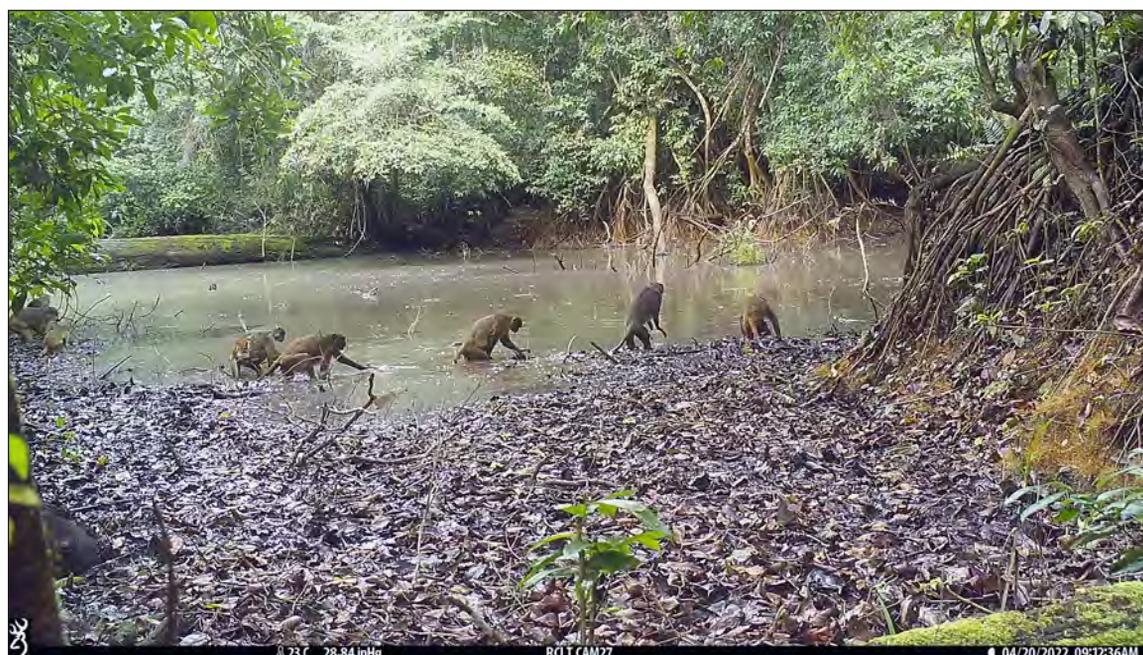
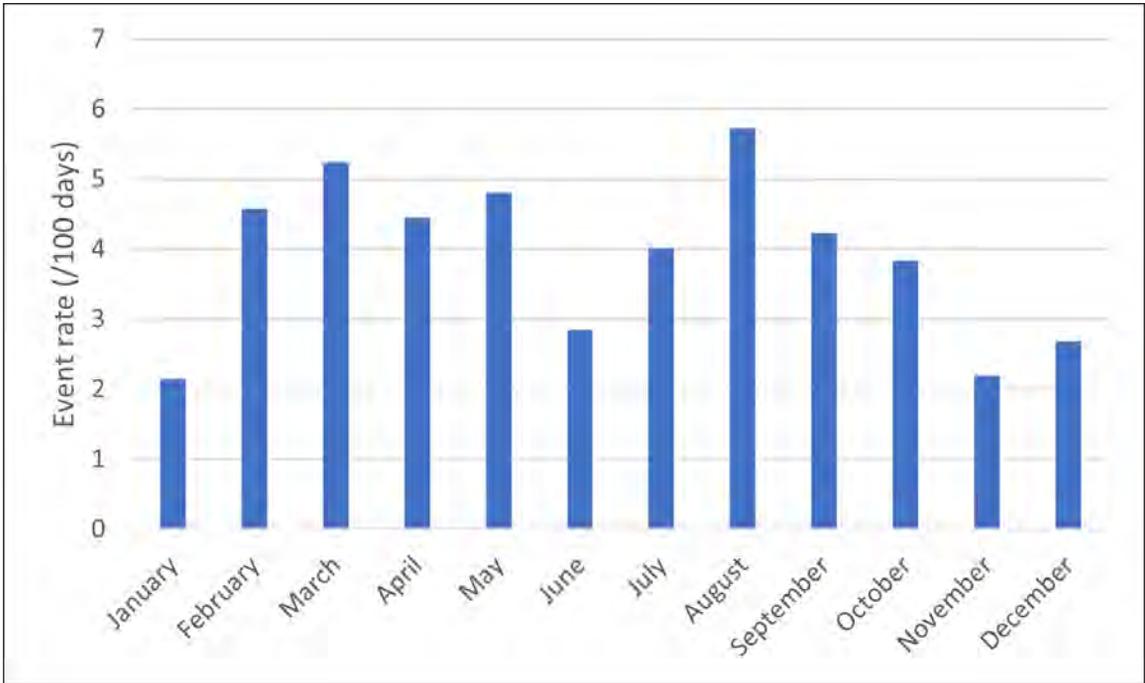
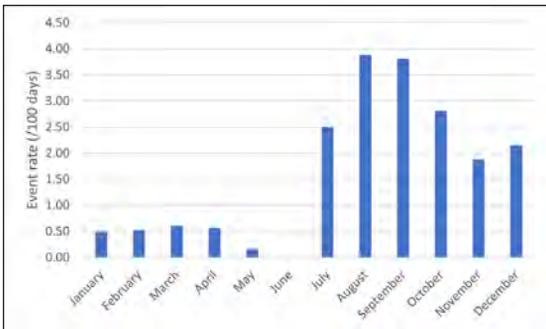


Figure 8. A group of Oustalet's red colobus (*Ptilocolobus oustaleti*) recorded in the Moutonga clearing.

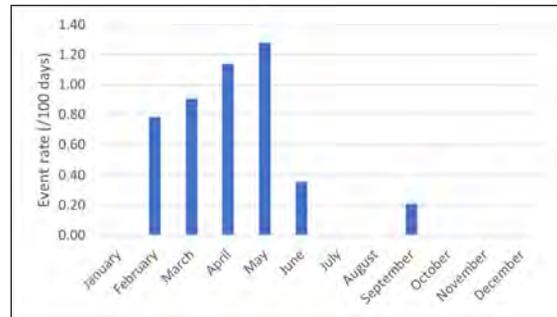




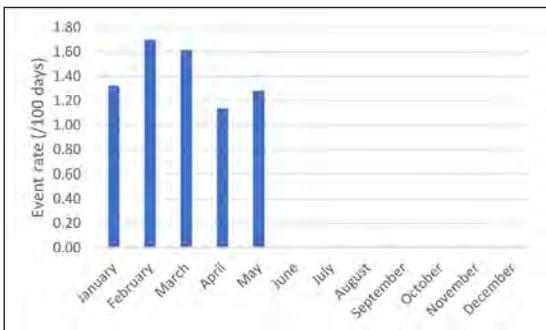
**Figure 9.** Monthly visits (event rate) to clearings by primate species (all species pooled; n = 268).



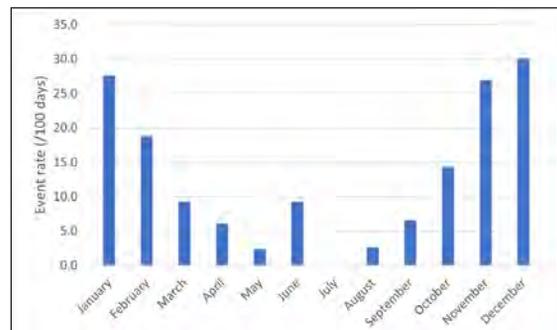
**Figure 10a.** Monthly visits (event rate) to clearings by western lowland gorillas (n = 87).



**Figure 10c.** Monthly visits (event rate) to clearings by Allen's swamp monkeys (n = 35).



**Figure 10b.** Monthly visits (event rate) to clearings by agile mangabeys (n = 55).



**Figure 10d.** Monthly visits (event rate) to clearings by humans (n = 740).

**Table 2. Comparison of the LTCR primate community structure with those of three other sites in northern Congo.**

	Lac Télé Community Réserve (LTCR)	Ntoukou Pikounda National Park (NPNP)	Nouabalé Ndoki National Park (NPNP)	Odzala Kokoua National Park (OKNP)
Distance to LTCR (km)	/	120	160	250
Geographic coordinates	1°20'25"N 17°09'06"E	00°22'30"N 16°42'04"E	02°42'08"N 16°33'14"E	01°03'40"N 14°54'52 E
Number of species	11	10	11	10
Number of species shared with LTCR	/	9	11	9
Species found in referred park and not in LTCR	/	<i>Ptilocolobus bouvieri</i>	0	<i>Miopithecus talapoin</i>
Species found in LTCR and not in referred park	/	<i>Ptilocolobus oustaleti</i> <i>Allenopithecus nigroviridis</i>	0	<i>Ptilocolobus oustaleti</i> <i>Allenopithecus nigroviridis</i>
Reference	This study	N'Goran <i>et al.</i> 2020	PNNN 2021	Bermejo 1999

**Table 3. Comparison of the Relative Abundance Index of primate species between LTCR and Nouabalé-Ndoki National Park (Djéké site), Congo. Note that subsistence hunting is permitted in both sites.**

	Lac Télé Community Réserve (LTCR)	Nouabalé Ndoki National Park (Djéké Triangle)
Sampling effort (camera days)	6 399	7 257
Hominidae		
<i>Gorilla gorilla gorilla</i>	1.36	2.18
<i>Pan troglodytes troglodytes</i>	0.45	4.50
Cercopithecidae		
<i>Allenopithecus nigroviridis</i>	0.55	Not recorded
<i>Lophocebus albigena albigena</i>	Not recorded	0.01
<i>Cercocebus agilis</i>	0.86	0.79
<i>Cercopithecus nictitans nictitans</i>	0.27	0.06
<i>Cercopithecus pogonias grayi</i>	0.06	Not recorded
<i>Cercopithecus cephus cephus</i>	Not recorded	0.07
<i>Cercopithecus neglectus</i>	0.47	0.03
<i>Ptilocolobus oustaleti</i>	0.17	Not recorded
All species	4.19	7.69
Reference	This study	Morgan <i>et al.</i> 2024

Djéké RAI is 83% higher than that of LTCR. At Djéké, the community RAI is heavily dominated by a single species, the central chimpanzee (which accounts for 58.5% of the total). In contrast, the community RAI at LTCR is more evenly distributed across species. At the species level, the abundance of chimpanzees and gorillas is 10 times higher and 60% higher at Djéké, respectively, than at LTCR. This difference may be explained by the fact that 58% of the sampling effort ( $n = 7,257$  camera days) at Djéké came from cameras placed at above-ground epigeal termite mounds. These sites are known to be highly attractive to great apes, in particular chimpanzees (Sanz *et al.* 2004). For monkeys, species closely associated with aquatic habitats, such as the agile mangabey, De Brazza's monkey (*Cercopithecus neglectus*), and Allen's swamp monkey, are more abundant in LTCR.

## DISCUSSION

### Community composition in LTCR

Our study recorded the presence of eight out of the 11 primate species known to occur in LTCR. With cameras positioned at 0.8 meters, our study primarily captured semi-terrestrial species, while the three missing species (grey-checked mangabey, red-tailed moustached monkey, and western guereza) are predominantly arboreal. However, other arboreal species such as the eastern putty-nosed monkey and the Gray's crowned monkey were recorded, and the absence of the three unobserved species remains unclear. This is particularly surprising for the western guereza which is the most terrestrial Colobine species (Fashing & Oates 2013) and is frequently observed in forest clearings in central African rain forests (Vanleeuwe *et al.* 1998). Its absence in our dataset may reflect the overall rarity of the species in the LTCR, as it is very rarely seen or heard by the Reserve staff or local communities. In the Congo basin, guerezas occur mainly in riparian forests along rivers (Gautier-Hion *et al.* 1999). Along with red colobus, it is one of the first species to be hunted out in sites with high hunting pressure (Butynski & De Jong 2022). In the LTCR, all the villages are located along the Likouala-aux-herbes and its two tributaries. The combined preference of guerezas for riparian forests and the high hunting pressure along LTCR rivers may explain the rarity of this monkey in the Reserve. Nevertheless, the presence of western guerezas was confirmed in January 2023 when a solitary individual was filmed moving in the canopy of a terra firma forest (A. Michel, pers. comm.).

### Inter site comparison

LTCR and NNNP-Djéké sites share the same species composition, except for Allen's swamp monkey which has not been recorded in Djéké. However, this species has been observed along the Ndoki and Mbeli rivers inside the NNNP (Maisels *et al.* 2006). In contrast, the species composition differs significantly with the two other sites even though NPNP is closer to LTCR than NNNP. LTCR and NNNP are located on the left bank of the Sangha River while OKNP and NPNP are located on the right bank of the river. The Sangha River flows from the north to the south and is a large tributary of the Congo River. In central Africa, large rivers represent biogeographic barriers to a whole host of species, and primate community structures have been shaped by the network of large rivers resulting in different primate assemblages across large interfluvial areas (Colyn & Delporte 2002).

Considering that Allen's swamp monkey occurs marginally in NNNP, the highest species richness of the LTCR confirms that sites with extensive riparian forests are key areas for primate conservation in central Africa, as they support both habitat specialist and generalist species (Gaution-Hion & Brugière 2005; Nowak *et al.* 2019).

### Clearing visit by primate and humans

The significant positive correlation between primate RAI and distance to the nearest village suggests that human activity in clearings negatively affects primate visits. Local people frequent clearings to collect fish and non-timber forest products, and hunt. Their presence, particularly during the major rainy season, is best explained by the fact that it is the only period where fishing with nets is possible due to high water levels. To our knowledge, clearings are not specifically targeted by hunters as primate hunting grounds. However, the presence of humans, regardless of their activities, likely deters primate visits, as hunting is known to increase vigilance and promote human avoidance among primates (Croes *et al.* 2007).

### Primate conservation

Out of the 11 diurnal primate species occurring in the LTCR, five are considered threatened according to the IUCN Red List (Wallis 2023): the western lowland gorilla and central chimpanzee, categorized as Critically endangered and Endangered

respectively, and the grey-cheeked mangabey, eastern putty-nosed monkey, and Oustalet's red colobus, are listed as Vulnerable. The remaining six are classified as either Near Threatened or Least Concern at the subspecies level.

From a regional perspective, the LTCR has been identified as a key protected area for the conservation of the western lowland gorillas (IUCN 2014). We consider that the LTCR is also a critical site for the conservation of Allen's swamp monkey, as it is one of only six protected areas in central Africa to harbor this species (Maisels *et al.* 2020). This poorly known monkey is endemic to the flooded forests of the Congo basin and is threatened by hunting for subsistence and for the bushmeat trade (Gautier-Hion 2013; Maisels *et al.* 2020). As this monkey occurs marginally in NNNP due to the absence of flooded forests in this area, the LTCR is the most important site in Congo for the conservation of this species.

In the LTCR, monitoring of hunting catches from 50 hunters over six months in 2023 revealed that primates accounted for 24.6% (n = 537) of the total carcasses collected (n = 2,182; Bondeko *et al.* 2024). All the Cercopithecidae species were found among the carcasses, with the exception of the western guereza (no great apes were recorded, but one case of smoked gorilla was seized at the Reserve's road checkpoint in July 2024, Romani *et al.* 2025). A total of 32 Allen's swamp monkeys were killed, representing 1.5% of the total carcasses (all species combined) and 5.9% of the primate carcasses (Bondeko *et al.* 2024). However, no Allen's swamp monkey carcasses were seized at LTCR's road checkpoint from 2021 to 2024 (Romani *et al.* 2025).

Given the lack of information on monkey population dynamics in the LTCR, it is currently unclear whether the existing hunting pressure poses a significant threat to primate populations. In early 2025, we started a survey to estimate monkey densities using distance sampling along line transects in the different forest habitats of the LTCR, with the aim of establishing baseline data information. Repeated surveys are scheduled every three years to monitor population trends regarding relation the hunting pressure. If necessary, local laws on primate hunting will be developed by the Reserve's management team to ensure the long-term viability of primate populations.

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## Brief Communication:

# **Photography Inspiring Children in Conservation: Empowering East Africa's Youth for Wildlife Preservation with Skills in Visual Arts**

**Julie A. Vogt, Sasha Montero-De La Torre, and Kathy West**

*Photography Inspiring Children in Conservation (PICC), Davis, California, USA*

In recent years, conservation initiatives in Africa have evolved beyond traditional methods, embracing creative approaches to effectively engage local communities in preserving endangered wildlife (Wallis & Lonsdorf 2010; Bettinger & Leighty 2021; Razafindravony *et al.* 2023; Leavendusky & Ellis 2024). One such initiative is Photography Inspiring Children in Conservation, which has impacted the youth and the conservation landscape in the East African countries of Uganda and Rwanda.

### **Photography and Art in Conservation Education through PICC**

Photography Inspiring Children in Conservation (PICC, based in Davis, California, USA), was founded with the goal of inspiring students living alongside endangered primate species habitats to become conservation leaders within their communities. The program provides them with skills and knowledge regarding primate ecology and conservation issues and solutions, through the arts of photography, illustration, and storytelling, and builds an effective foundation upon which the students can seek conservation-oriented careers.

PICC works to have both immediate and sustainable impact on building capacity in local communities to protect primates and their habitats (West *et al.* 2023). In addition to the students, it actively involves elders, teachers, and community leaders, integrating their wealth of knowledge and the invaluable traditional wisdom they hold regarding local animals and ecosystems. PICC deeply appreciates the respect for wildlife and

their habitats shown by its partner organizations, and its workshops are designed to build upon that foundation.

### **PICC Philosophies and Goals**

When conducting PICC sessions, the focus is on engaging with the forest and animals through “Attentive Stillness”, a method of slowing down, thinking carefully, and improving focus on what is in the surrounding area. The sessions include practicing sitting quietly and through stillness observing with their eyes – focus in on a small area and see how many living things they can find, then zooming out and looking at the big picture to see how the entire ecosystem fits together, ears – tune out extraneous noises to hear the animal sounds, and, nose – close their eyes and see how many smells they can identify.

### **The Value of Photography and Field Sketching**

We often (rightfully) celebrate photography as an influential tool to inform people worldwide about conservation issues. Similarly, the PICC program also uses images to educate and influence people’s engagement with primate conservation, but it takes a different approach to achieve this goal with people in critical habitat communities. Using the process of *becoming* a photographer or making sketches and seeing the natural world through a focused lens gives a powerful, new perspective. By slowing down as one walks through a habitat, by finding interesting plants and animals through looking more closely, by

putting an eye to the viewfinder and composing the image, and by enlarging that image to see even more details, one gains entirely new insights.

One of the aims in teaching photography is for the students to learn the technical details of their camera and how to use light, composition, and perspective to make great images. However, the PICC program stresses that being a good photographer transcends technical proficiency and gadgetry. It hinges on demonstrating respect for wildlife, upholding ethical standards, and effectively conveying one's passion for animals and a commitment to conservation efforts through the images captured. We also emphasize the importance of being prepared by gaining a deep understanding and appreciation of animal behavior, the habitat and ecosystem they are visiting, and how to use this knowledge to be respectful and patient in the animals' habitat, ensuring that interactions with wildlife are non-intrusive. We want them to be aware of how they affect the animals and the ecosystem by their presence and follow the principles recommended by the IUCN SCC Primate Specialists Group (Maréchal *et al.* 2023; Waters *et al.* 2023).

By teaching students these skills, PICC instills a deep understanding of wildlife and the importance of protecting endangered species like the mountain gorilla (*Gorilla beringei beringei*), empowering future generations in conservation issues and solutions.

### Cultivating Conservation Ambassadors

One of the key successes of PICC is its collaboration with conservation partners in Uganda such as the Rafiki Memorial Wildlife Conservation Initiative (Rafiki), Save Wildlife Uganda/Women in Wildlife, Banyabutumbi Cultural Heritage Organization-Kanungu (BACHO-K), and in Rwanda with Conservation Heritage-Turambe. These partnerships have been instrumental in educating local children about endangered primate species conservation in areas surrounding Bwindi Impenetrable National Park, Queen Elizabeth National Park (Uganda), and Volcanoes National Park (Rwanda).

In 2022, over 150 students from the Bwindi Plus Primary School and the Rafiki Art group in Buhoma-Bwindi, at the northern gate of Bwindi Impenetrable National Park, Uganda, participated in PICC's educational sessions. The students were encouraged to express their knowledge of local wildlife through learning photography and practicing art. The program also included storytelling and sketching, which allowed students to convey the cultural and ecological importance of their surroundings.

During PICC's sessions, students are taught how to use Canon DSLR cameras to capture wildlife images, and their images are printed and displayed using the PICC-donated high-resolution printers. They continue to have access to their digital files and can use the PICC-donated DSLR camera to continue developing their photography skills. In learning field sketching, students are taught to look carefully at their surroundings, and to notice the animals and small parts of the ecosystems that they might normally walk past. They gain experience in creating detailed notes and sketches to accompany their photographs, recording their observations in a small, personal notebook. We encourage the students to develop their own conservation actions to empower local populations. We support them in developing skills that can help protect biodiversity in their area by utilizing their capabilities and knowledge to communicate primate conservation effectively and share this information with both in-country and international audiences. These workshops are not only educational but also celebratory, with the students' creative works showcased in a gallery-style exhibition at the school, often followed by vibrant drumming and dancing performances.

In 2024, the PICC team returned to the village of Buhoma-Bwindi, to continue the multi-year collaboration with Mushamba Moses, Director of the Rafiki Memorial Wildlife Conservation Initiative. The focus of this visit was to provide older youth with a more defined experience with a three-day gorilla trekking and photography workshop, and to also expand the Buhoma programs to include a public school and a private high school. Building upon the relationships developed in a previous 2022 visit, the team, led in the local language by Mushamba, worked with students at Rubona Primary School, a government-funded institution with over 350 children.

During the visit, approximately 150 younger students participated in conservation lessons and used coloring worksheets with watercolor pencils, while 120 older students focused on learning about mountain gorillas and their forest habitat (Figure 1). Each child received a copy of the PICC mountain gorilla conservation coloring book, in English and in the local language, Lukiga. At the Rubona school that day, a reformed poacher led the older children through the PICC book and expanded on the lessons by sharing his extensive knowledge of mountain gorillas.

As demonstrated throughout the workshops and interactions with students, one of our goals is to support them in developing conservation-compatible



**Figure 1.** Rubona school children using PICC worksheets and coloring pencils to engage with conservation issues, Buhoma, Uganda 2024. Photograph by Julie Vogt.

careers, which includes providing them with the resources needed to nurture those developments. To successfully provide these resources and content, we work with the teachers and aides at the schools and locations where we run programs to translate our lessons for the youth who participate. We also provide resources in their local language when possible (i.e., with coloring books with facts about animals). During one of our programs, Mushamba led additional sessions with 40 older art students at Bwindi Heritage High School, in Buhoma-Bwindi. Students practiced nature photography with Canon DSLR cameras, capturing images of local “wildlife” such as chickens and wild birds, while also creating detailed illustrations in field notebooks using field identification guides (East African Wildlife field guide, Primates of East Africa Pocket Identification Guide, and the Birds of East Africa field guide) and watercolor pencils. PICC supplied the art teachers and students with field sketchbooks, watercolor pencils, and copies of the PICC mountain gorilla conservation coloring book so that every student

could continue their learning and share their new knowledge with their peers.

After a full day of practicing photography and discussing mountain gorilla conservation issues, the PICC team, in collaboration with the Rafiki Wildlife organization, printed enlargements of the students’ best images (using the printer and supplies provided by PICC) and returned a few days later to hang the enlargements in a gallery exhibit at the school (Figure 2). The students proudly shared their photographs and also their sketchbook drawings and discussed the images as a group. They received celebratory PICC Conservation Ambassador certificates in recognition of their success in both photography and art. This hands-on experience not only fostered their appreciation for wildlife but also equipped them with skills that could be applied professionally in ecotourism and conservation.

On the most recent PICC visit to Buhoma, the Rafiki Conservation Youth program was significantly enhanced through a gorilla trekking opportunity for a select group of local youth. The



**Figure 2.** Bwindi Heritage High School students discuss their photography workshop success as they view their enlarged photos, Buhoma, Uganda 2024. Photograph by Kathy West.

students were chosen by the local community leaders, based upon their passion for conservation and interest in expanding their creative and communication skills. Only one of the students had prior experience with a DSLR camera from the 2022 PICC-Rafiki photography workshop. Gathering at the Sahaya Rafiki Guesthouse on the edge of Bwindi Impenetrable National Park, they participated in a three-day photography workshop led by the PICC team that included a photography skills and mountain gorilla knowledge day, the trek day, and a photo processing day. On the first day, they learned technical camera skills and practiced ethical wildlife photography. During the pre-trek workshop and on the trek, they used the Canon DSLR camera and zoom lens that was given to them in 2022 and a set of PICC student DSLR cameras so that each person could have their own equipment. We also provided a field bag with binoculars, IUCN primate tourism resources, notebooks, East African Wildlife field guide, Primates of East Africa Pocket ID Guide, and other resources for sustainable practice and learning.

A special guest, Gad Kanyagyeyo, a retired ranger of the Uganda Wildlife Authority, shared his 20-year

expertise on mountain gorilla behavior, preparing the students for their gorilla trekking experience.

During the trek workshop day, each student captured stunning images of the Muyambi mountain gorilla family (Figures 3 and 4). The 8-hour hike was filled with learning opportunities, animal sightings, and lively discussions with rangers and trackers. The following day, everyone reviewed their photos, discussing best practices, composition, technique, and future possible uses for their images. Each student selected images they had taken for printing and received their enlarged prints. The students' efforts were celebrated with UWA Gorilla Trekking and PICC Conservation Ambassador certificates, marking a deeply meaningful experience as expressed in a heartfelt letter from Onesmus Rutaro, a local artist whose passion for conservation was strengthened by the trek. For some, like fine-art painter Isaiah, these images will inspire future drawings and paintings, while others, like Onesmus, will incorporate the photos into woodcarvings. Elizabeth and Melorine, conservation refugees from the local Batwa village, look forward to using and sharing their images, experience, and positive



**Figure 3.** Muyambi family members, photographs by students as noted. Bwindi Impenetrable National Park, Uganda, 2024.

relationship with the mountain gorillas and forest with their community. This program not only developed the students' technical skills but also strengthened their commitment to conservation and provided them with a deeper understanding of the tourists' trekking experience. The participants expressed their thanks with letters directed at those who generously donated to the programs:

*“Dear Donors: I am writing to express my heartfelt gratitude for your generous donation towards my gorilla trekking adventure. Your support has enabled me to experience something truly unforgettable, and I am forever grateful. As*

*a local artist dedicated to gorilla conservation through my carvings, this experience has deepened my connection with these magnificent creatures. Witnessing them in their natural habitat has inspired new ideas and creativity, which I will channel into my art to continue raising awareness and funds for conservation efforts. ... Your kindness has made a significant impact on my life and the lives of the gorillas I am dedicated to protecting. Thank you for believing in me and my art. I am honored to have supporters like you who share my passion for conservation and art. Sincerely, Onesmus Rutaro.”*

One of the most impactful aspects of PICC is its ability to equip students with the tools and resources necessary for sustained learning. By providing conservation partner organizations with cameras, printers, and educational materials, PICC ensures that students can continue to hone their skills long after the workshops have ended. The US team continues to send electronic learning resources to students and is working on providing software for their continued photography skills. The US team also helps program leaders in assisting the students with answers to questions, concepts, and further discussion of ethics and communication methods. Since becoming PICC Conservation Ambassadors, many of the students have used the donated cameras to document visits from the mountain gorillas to their local community, social development programs with the Batwa, and take images of other primate species in the Bwindi Forest. Additionally, their photography and storytelling abilities have raised awareness in their communities to inspire others to protect local wildlife.

In the rural community of Rwenshama, located in Southwest Uganda's Rukungiri District, our conservation partners face unique challenges. This local population frequently encounters wildlife within their community such as elephants, hippopotamuses, and lions, which pose daily threats to their safety and livelihoods (Figure 5). Despite these dangers, the community, through BACHO-K (Banyabutumbi Cultural Heritage Organization-Kanungu), has embraced the importance of wildlife conservation. Under the leadership of Akiih



**Figure 4.** Rafiki students photographing the Muyambi mountain gorilla family in Bwindi Impenetrable National Park, Uganda, 2024. Photograph by Kathy West.

Apollo, BACHO-K has made great strides in integrating conservation education with cultural preservation.

PICC's sessions in Rwenshama in 2022 and 2024 included training older students in wildlife photography and guiding them on game drives through Queen Elizabeth National Park. These game drives provided the youth with opportunities to capture images of the animals they live alongside, including elephants and buffalo, in their natural



**Figure 5.** Hippopotamus in Queen Elizabeth NP, Uganda, 2024. Photograph by Byamukama Daniel, BACHO-K – PICC workshop student.



**Figure 6.** BACHO-K student displaying her illustration of an elephant which had just walked by the schoolyard, Rwenshama, Uganda, 2024. Photograph by Julie Vogt.

habitat. The program also incorporated art sessions where students sketched wildlife next to their school and used field guides to create accurate wildlife illustrations, further strengthening their connection to the local wildlife (Figure 6). The collaboration with BACHO-K has opened doors for local youth, allowing them to consider pursuing careers in ecotourism and conservation. By providing binoculars, cameras, and professional resources, PICC has empowered these students to continue their education and become better advocates for wildlife preservation. The cameras and printers are left with these groups so that they can use the learned photography skills and hopefully share these skills with other peers through the help of their teachers. In early 2025, many PICC students won top honors in a regional photo competition, using wildlife images taken in their village (read more).

### **Expanding PICC Conservation Efforts in Rwanda**

In 2024, PICC expanded its outreach to Rwanda, partnering with Valerie Akuredusenge,

director of Conservation-Heritage Turambe (CHT) in Musanze, near Volcanoes National Park. This region, home to a population of endangered mountain gorillas, provided the perfect backdrop for PICC's workshops. Staff from CHT participated in a photography workshop to enhance their photography skills and to prepare them to help teach school children the following day. The CHT staff and PICC team collaborated to provide 10 students and their teacher from GS Kagano Primary School with photography and art sessions at their rural school. The students learned to use their photographs and illustrations to explore and document their surroundings and shared their own wildlife stories. The two-day workshop culminated in a visit to the Ellen DeGeneres Campus of the Dian Fossey Gorilla Fund, where students deepened their understanding and knowledge of mountain gorillas and conservation issues, and had the opportunity to practice their photography skills with birds and flowers on the Campus grounds (Figure 7). PICC's work in Rwanda mirrors its success in Uganda. Provided with a DSLR camera, printer, binoculars, and guiding resources, and with continued online

support from PICC, conservation leaders are equipped with skills that can be used to encourage local youth to develop their artistic and technical skills, furthering their contributions to conservation efforts in their communities (Figure 8).

### Conclusion: Inspiring the Next Generation of Conservationists

Through its innovative approach to conservation education, Photography Inspiring Children in Conservation has made a great impact on the lives of many young people in East Africa. By fostering creativity, instilling ethical values, and providing resources for sustainable learning, PICC is helping to cultivate a new generation of conservation leaders. These youth, armed with cameras, sketchbooks, and a deep respect for wildlife, can play a critical role in ensuring the survival of endangered species and the protection of their habitats.

As PICC continues to grow, it remains committed to expanding its reach to more communities that could benefit from conservation education. We will encourage interested communities to take part in the PICC sessions to build and expand upon their current knowledge and skillset, much like we have done with our partner organizations around the globe. Conservation partners and PICC participants have been sharing their knowledge with teachers, community leaders, and other students, building on sustainable capacity. By inspiring children to see the world through the lens of a camera and the pages of a sketchbook, PICC participants are not only documenting the beauty of East Africa's wildlife but also building a legacy of conservationists.

### ACKNOWLEDGMENTS

A special thanks to the IUCN Primate Specialist Group for the generous donation of re:wild *Primates of East Africa Pocket Identification Guides* (authors Y. de Jong and T. Butynski; edited by Mittermeier and Ryland and illustrated by Stephen D. Nash). PICC was able to provide the pocket guides to all of the schools and conservation groups that we worked with in both Rwanda and Uganda.

Photography Inspiring Children in Conservation relies on ongoing funding from private donors. We would like to thank everyone who has donated to the PICC sessions in Madagascar, Uganda, and Rwanda over the years to allow us to provide the students with resources. Fundraising events are organized and directed by volunteers, with special recognition



**Figure 7.** Conservation Heritage– Turambe, Rwanda; Eric Mutabazi, Studio Artist and Conservation Educator, working with student at Primary School Groupe Scolaire Kagano, Nuyange Sector, Musanze District, Rwanda, 2024. Photograph by Kathy West.

to Julie Vogt, Sasha Montero-De La Torre, Abigail Greene, and Bob Vogt.

We acknowledge the creative term “Attentive Stillness,” shared with us through a conservation organization, Saguaro Juniper, Arizona, USA.

In the field, our partners are always laying the groundwork for our visits and we couldn't be successful without help from Akiikih Apollo (BACHO-K), Mushamba Moses (Rafiki), Valerie Akuredusenge (CHT), Eric Ndorere (SWU), Robert Tweheyo (Rafiki birding guide, community liaison and UWA trekking permits), and Isaac Atuheire (Sahaya Rafiki Guesthouse). Thank you to Benjamin Aine for all of his help with transportation and trekking permits, and our driver/guide Isaac Nduhukire for not only his cheerful help with getting us around East Africa, but also his willingness to help with the PICC programs. Our drive/guide in Queen Elizabeth NP, Herbert, was excellent and a great role model for the student guides-in-training. And finally, our deepest thanks to Dr. Koen Van Rompay of Sahaya International, whose guidance, connections and knowledge have been invaluable to our success.



**Figure 8.** Primary School Groupe Scolaire Kagano student using re:wild *Primates of East Africa Pocket Identification Guide* (De Jong & Butynski, 2023), illustrated and designed by Stephen D. Nash, during a PICC exercise, Nuyange Sector, Musanze District, Rwanda, 2024. Photograph by Kathy West.

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## Links:

- PICC Projects: [https://photographyinspiringconservation.org/?page\\_id=1671](https://photographyinspiringconservation.org/?page_id=1671)
- PICC website: <https://photographyinspiringconservation.org>
- Rafiki Memorial Wildlife Conservation Initiative: <https://rafikiwildlife.org>
- BACHO-K: <https://bacho.sahaya.org>
- Conservation Heritage-Turambe: <https://www.forgorillas.org/>
- PICC Activities and Media: Coloring & Activity Books, Introductory Reels and Interviews

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*Accepted:* 11 June 2025

Brief Communication:

## A New Primate for South Sudan: Boutourline's Blue Monkey *Cercopithecus mitis boutourlinii* Giglioli, 1887

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The gentle monkey *Cercopithecus mitis* Wolf, 1822, is a widespread, arboreal, polytypic species endemic to the forests of sub-Saharan Africa. The most recent taxonomic arrangements recognize 16–21 subspecies of *C. mitis* (Grubb *et al.* 2003; Kingdon 2013; Lawes *et al.* 2013; Butynski & De Jong 2020, 2024). All of these authors recognize Boutourline's blue monkey *Cercopithecus mitis boutourlinii* Giglioli, 1887. Giglioli, however, described *boutourlinii* as a species – *C. boutourlinii*. Groves (2001) distinguished four species within the 'Cercopithecus mitis Group': Stuhlmann's blue monkey *C. mitis* Wolf, 1822, Zanzibar Sykes's monkey *C. albogularis* (Sykes, 1831), golden monkey *C. kandti* Matschie, 1905, Doggett's silver monkey *C. doggetti* Pocock, 1907. His taxonomy was followed by Zinner *et al.* (2013). Furthermore, Groves (2001) suggested that *boutourlinii* might also be a distinct species based on the craniometric data presented in Colyn (1991).

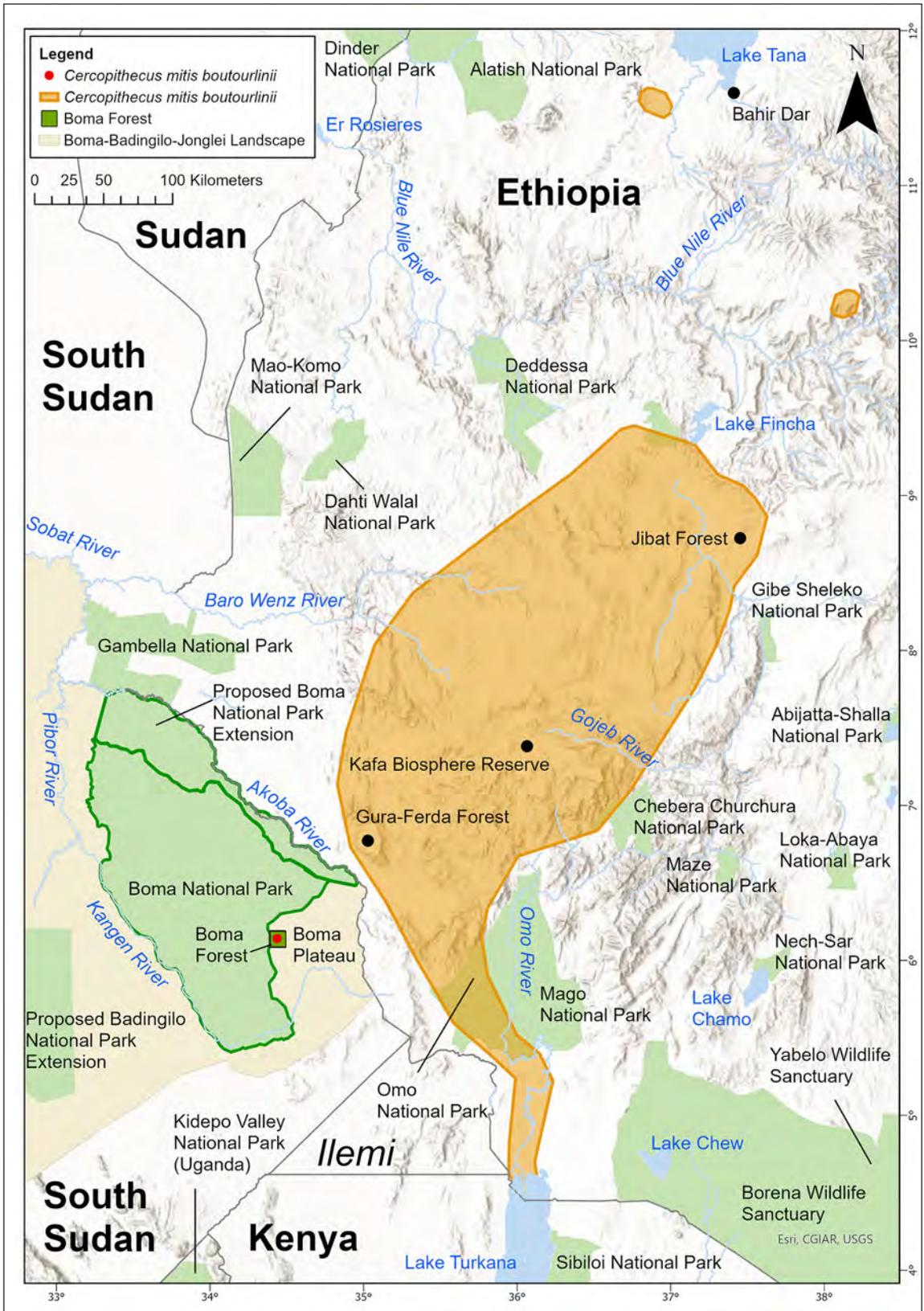
Prior to this article, the vernacular used for *C. m. boutourlinii* was 'Boutourlini's blue monkey'. As pointed out by Spartaco Gippoliti (pers. comm. 2025), Giglioli (1887) named this monkey in honor of Count Augusto Boutourline. As such, the correct vernacular is 'Boutourline's blue monkey'.

*Cercopithecus m. boutourlinii* is the subspecies with the northeasternmost geographic distribution and is considered to be endemic to western Ethiopia (Kingdon 2013; Lawes *et al.* 2013; Tesfaye *et al.* 2013; Mekonnen *et al.* 2020; Gippoliti 2022; Butynski & De Jong 2024). Its reported geographic distribution extends from near the northern end of Lake

Turkana, northwards along the western side of the Eastern (Gregory) Rift Valley, with two, presumably isolated, populations between Lake Fincha and Lake Tana, northwestern Ethiopia (Figure 1; Yalden *et al.* 1977, 1996; De Jong & Butynski 2020; Mekonnen *et al.* 2020; Butynski & De Jong 2022b). The geographic limits are poorly understood. *Cercopithecus m. boutourlinii* occurs in riverine, lowland, mid-altitude, montane, and bamboo forest between 360 m asl and 2,780 m asl (De Jong & Butynski 2020; Mekonnen *et al.* 2020; Butynski & De Jong 2022b). Here we present the first record for *C. m. boutourlinii* in South Sudan.

Boma National Park (Boma NP; 19,747 km<sup>2</sup>, 450–1,050 m asl), situated in southeastern South Sudan, was established in 1977 but has not been formally gazetted, and has been managed by African Parks since 2022 (World Bank 2024). Boma NP is an Important Bird Area (IBA) and a proposed UNESCO World Heritage Site. It lies within the larger Great Nile Migration Landscape (GNML), ~150,000 km<sup>2</sup> (~130,000 km<sup>2</sup> in South Sudan and ~20,000 km<sup>2</sup> in Ethiopia, including Gambella National Park). The South Sudan section of the GNML is referred to as the 'Boma-Badingilo-Jonglei Landscape' (BBJL; Figure 1). Boma NP, together with a proposed extension to the north and east, forms the eastern extent of the BBJL which is contiguous to the north with Gambella National Park (Morjan *et al.* 2018; African Parks 2024; UNESCO 2024). The GNML supports the largest, and least studied, ungulate migration in the world; the 'Great Nile Migration'. Large herds of white-eared kob *Kobus kob leucotis*,

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**Figure 1.** Geographic distribution of Boutourline’s blue monkey *Cercopithecus mitis boutourlinii*. Location of *C. m. boutourlinii* in Boma Forest, southeastern South Sudan, is depicted by the red dot (06° 08' 14" N, 34° 26' 27" E). Map based on Yalden et al. (1977, 1996), De Jong & Butynski (2020), Mekonnen et al. (2020), and Butynski & De Jong (2022b).

tiang *Damaliscus lunatus* tiang, Mongalla gazelle *Eudorcas albonotata*, and bohor reedbuck *Redunca redunca* seasonally move across the vast grasslands of South Sudan, with the white-eared kob moving into Gambella National Park (Morjan *et al.* 2018; African Parks 2024; Fearnhead 2024; UNESCO 2024).

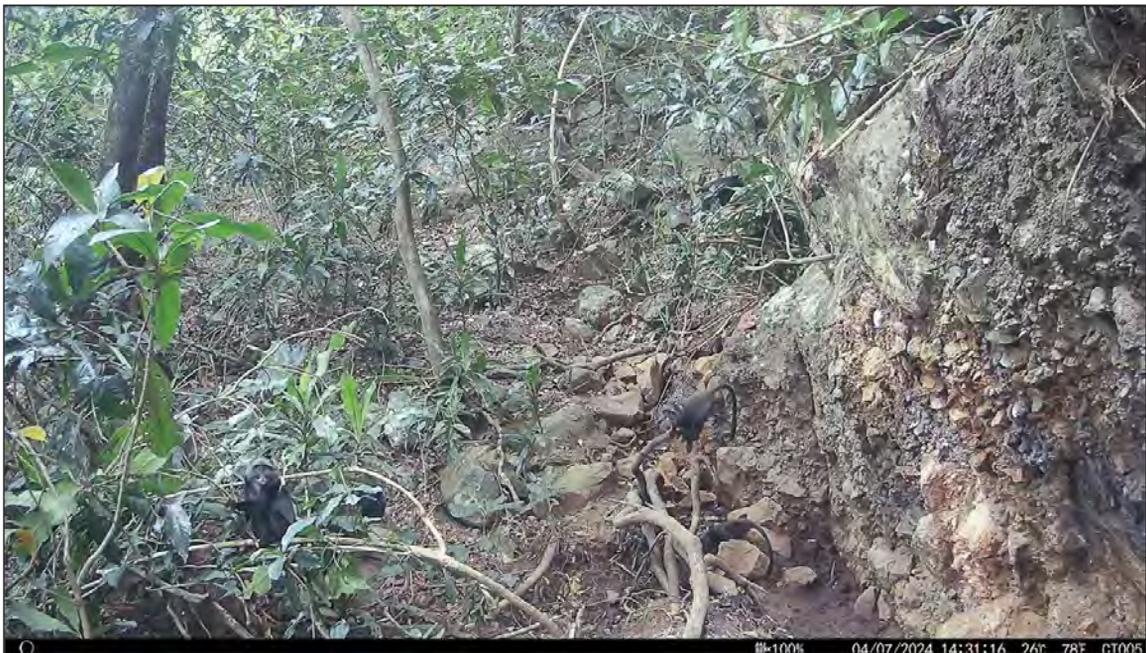
The majority of Boma NP consists of floodplains with open grasslands and scattered isolated hills (<1,000 m asl; Birdlife International 2025). Mean annual rainfall over the Boma NP ranges from 40 cm to 140 cm. Mean monthly temperature ranges from 28°C to 36°C (Morjan *et al.* 2018). Contiguous with the eastern boundary of Boma NP is the Boma Plateau (mostly ~1,100 m asl but reaches 1,700 m asl). This represents the southwestern terminus of the Ethiopian Highlands (Figure 1). The Boma Plateau is mainly covered by open plains and woodlands but there are patches of evergreen mid-altitude and lower montane forest at 850–1,640 m asl on the western escarpment of the plateau.

On the western escarpment, ~3.5 km outside of the eastern boundary of Boma NP, lies an evergreen lower montane forest fragment that we refer to as 'Boma Forest' (~6 km<sup>2</sup>; 1,200–1,640 m asl; 06° 08' 14" N, 34° 26' 27" E; Figure 1). The most common larger tree species in Boma Forest include *Antiaris toxicaria*, *Baphia abyssinica*, *Celtis africana*, *Pouteria*

*alnifolia*, *Pouteria altissima*, and *Manilkara* sp. (Quentin Luke, pers. comm. 2025). We consider this forest to be a previously unrecognized outlier of the Eastern Afromontane Biodiversity Hotspot (Mittermeier *et al.* 2004). The Boma Forest is one of the few places in the world with wild Arabica coffee *Coffea arabica* and has been identified as a center of origin for this species. The *C. arabica* here is genetically distinct from that in Ethiopia and, therefore, has considerable potential for improving *C. arabica* crops through breeding programs (Krishnan *et al.* 2021; Fay *et al.* 2024).

Three camera traps were deployed during 24 June–11 November 2024 and a biodiversity walking survey was conducted during 6–9 December 2024 above 1,500 m asl in Boma Forest within an area of ~1 km<sup>2</sup>. *Cercopithecus mitis* were captured on the camera traps seven times during June–October 2024 (Figure 2). All three camera traps captured *C. mitis* at least once.

The pelage of these monkeys was as follows: fore-crown blends with the diadem; fringe of long hairs all along edge of ears bright white; throat, chin, and lips white; center of lower back with greenish-grey tint; arms, legs, and ventrum black. This combination of traits is diagnostic of *C. m. boutourlinii* (Giglioli 1887; Colyn 1991; Groves 2001; Kingdon 2013; Lawes *et al.* 2013). To the best of our knowledge,



**Figure 2.** Boutourline's blue monkeys *Cercopithecus mitis boutourlinii* captured on a camera trap in Boma Forest, southeastern South Sudan, on 4 July 2024. This is the first record of *C. m. boutourlinii* in South Sudan. Photograph by African Parks.

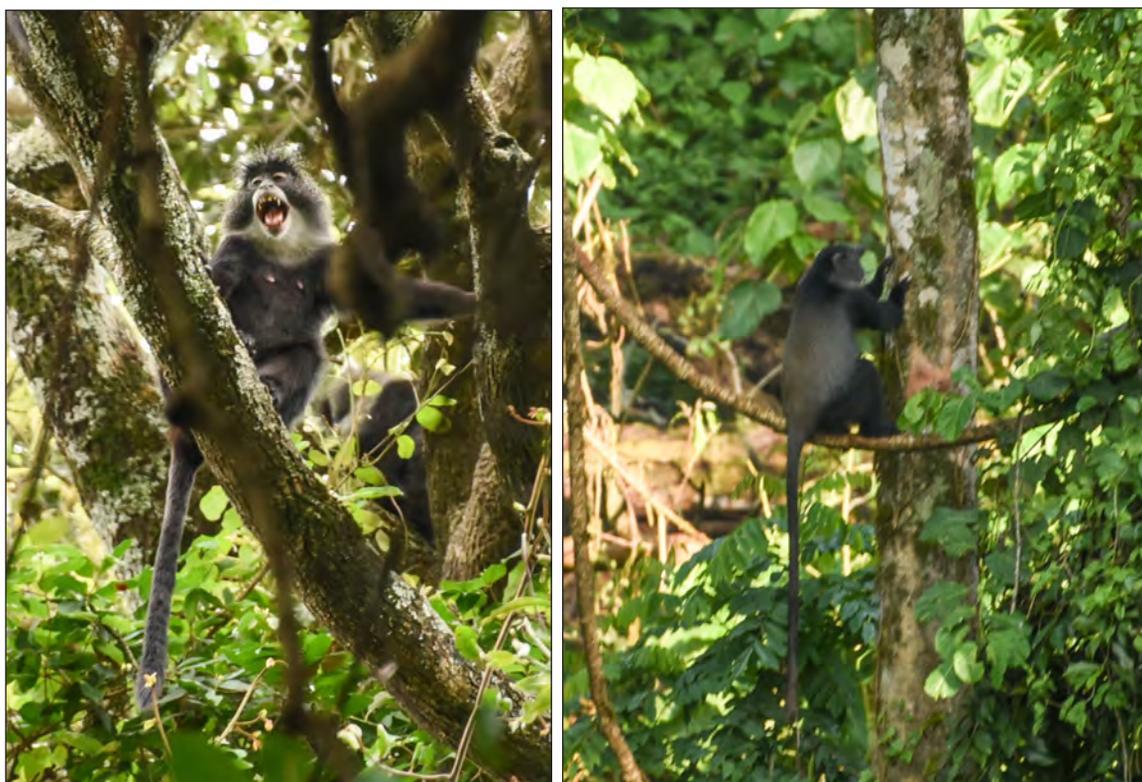
this is the first record for *C. m. boutourlinii* in South Sudan. This is a range extension of at least 85 km to the west of this subspecies' geographic distribution in Ethiopia (Figure 1; Kock 1969; Yalden *et al.* 1977; Lawes *et al.* 2013; Foquet *et al.* 2018; De Jong & Butynski 2020; Butynski & De Jong 2022b). The interlying region is <800 m asl and comprised of habitats that are unsuitable for *C. mitis*. With this record, *C. m. boutourlinii* is no longer a subspecies endemic to Ethiopia.

In December 2024, at least eight groups (total of about 59 individuals) were encountered at 1,450–1,640 m asl during walking surveys (Figure 3). Estimated group size ranged from 3 to 20 individuals. Chirps and at least three single 'boom' and four 'pyow' calls were heard. The boom and pyow are produced only by adult male *C. mitis* living in mixed-sex groups (Butynski *et al.* 1992; Fuller 2013; Lawes *et al.* 2013).

Currently, two other species of monkey are known from Boma Forest; black-and-white colobus (or guereza) *Colobus guereza* Rüppell, 1835, and olive baboons *Papio anubis* (Lesson, 1827). Of the three species of monkey in Boma Forest, *C. m. boutourlinii* appears to be the most common.

Other monkeys in the area are eastern patas monkey *Erythrocebus patas pyrrhonotus* (Hemprich & Ehrenberg, 1829) and a grivet, probably common grivet *Chlorocebus aethiops aethiops* (Linnaeus, 1758). De Brazza's monkey *Cercopithecus neglectus* Schlegel, 1876, occurs ~85 km to the northeast of Boma Forest in Gura Ferda Forest, southwestern Ethiopia (Foquet *et al.* 2018). If *C. neglectus* is present in Boma NP or Boma Forest, it is likely to be found below 1,500 m asl. The northern lesser galago *Galago senegalensis* É. Geoffroy, 1796, probably occurs in Boma NP and on the edge of Boma Forest but there is no record. The residents of Zoch Village (~200 people) near Boma Forest report knowing five primate species in this forest; the three confirmed species, as well as two others. The two unconfirmed species are probably *E. p. pyrrhonotus* and *G. senegalensis*. Surveys in Boma NP and Boma Forest are encouraged so as to further document primate diversity and assess the geographic distribution, abundance, threats, and conservation status of all species of primate.

The IUCN Red List of Threatened Species considers *C. m. boutourlinii* to be 'Vulnerable' to extinction (De Jong & Butynski 2020). In Ethiopia,



**Figure 3.** Adult female (left) and adult male (right) Boutourline's blue monkeys *Cercopithecus mitis boutourlinii*, Boma Forest, southeastern South Sudan. Note the white lips, chin, throat, and fringe of the ears, black arms and legs, and greenish-grey tint on the lower back. Photographs by Megan Claase.

this monkey is suspected to have undergone a population reduction of 30% over the last three generations (~39 years). *Cercopithecus m. boutourlinii* has a declining geographic distribution due to extensive habitat degradation, loss, and fragmentation. This is primarily the result of the unsustainable extraction of forest products (e.g., timber, poles, firewood), browsing by livestock, and conversion of forest to agriculture. In Ethiopia, *C. m. boutourlinii* raids crops (Tesfaye *et al.* 2013; Schell & Schell 2017; De Jong & Butynski 2020; Mekonnen *et al.* 2020). This being the case, *C. m. boutourlinii* is probably hunted so as to reduce damage to crops.

A second subspecies of *C. mitis*, Stuhlmann's blue monkey *C. m. stuhlmanni* Matschie, 1893, is present on the South Sudan-Uganda border in the Imatong Mountains, Dongotona Mountains, and Didinga Mountains (Kock 1969; Butynski & De Jong 2022a,b). These two subspecies are separated by ~215 km of mostly unsuitable habitat (i.e., bushland, grassland, swamp). In total, 8 genera, 12 species, and 15 primate taxa are known to occur in South Sudan, including *C. m. boutourlinii* (Kock 1969; Butynski & De Jong 2022b). Of these 15 primate taxa, five are categorized as threatened with extinction (i.e., 'Vulnerable', 'Endangered', or 'Critically Endangered'; IUCN 2025). We anticipate that additional taxa will be added to South Sudan's list of primates given that knowledge of this nation's mammal fauna remains unsatisfactory. This is not a surprise given the constraints imposed on field research during South Sudan's complex colonial and post-colonial periods (Maina 2007; Winter 2007, 2024; Gippoliti 2024).

The BBJL faces many threats, including hunting, large-scale movements of displaced people, rapidly growing human and livestock populations, expanding agriculture, charcoal production, mining, oil extraction, and infrastructure development. Hunting by armed forces is particularly high during armed and political conflicts. In Boma NP and vicinity, large numbers of livestock compete with wildlife for food, particularly during the dry season (Maina 2007; Winter 2007, 2024; Morjan *et al.* 2018; African Parks 2024; Fearnhead 2024; UNESCO 2024; Birdlife International 2025).

Longer-term climate change is also a threat to BBJL. Although mean annual rainfall is projected to increase 5–20% prior to 2090, droughts are predicted to increase and to become more erratic (Müller *et al.* 2014; Quinn *et al.* 2019). Mean annual temperature has increased by more than 0.4°C per decade over the last 30 years. The models suggest a rise in mean annual, minimum, and maximum temperatures of 1.5–3.4°C by 2090. These changes are expected to

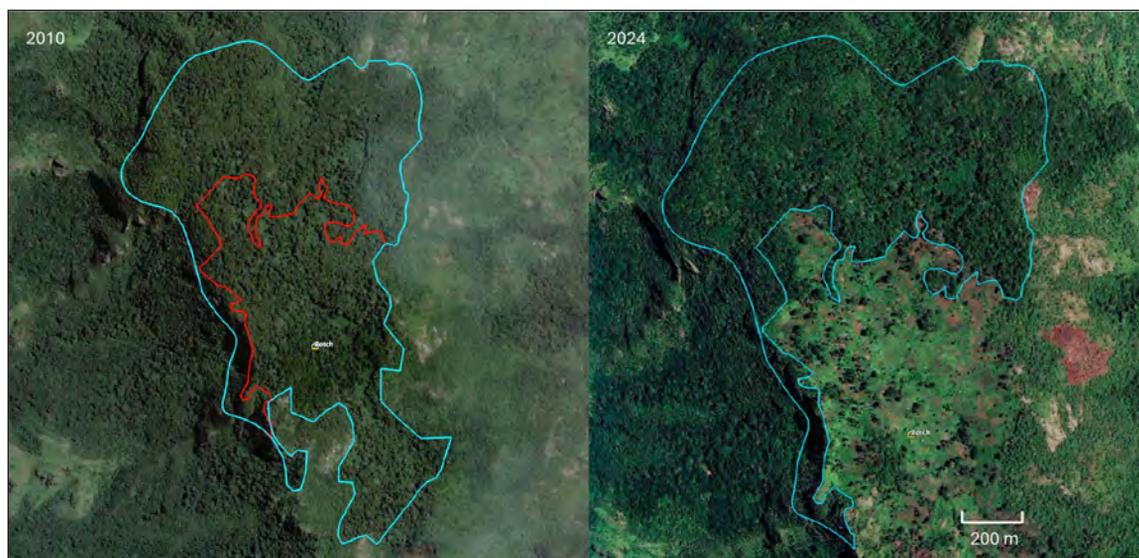
yield more extreme heat days, longer heat waves, and an increase in droughts (Quinn *et al.* 2019).

Many of the threats to the BBJL are also threats for the nearby, unprotected, Boma Forest. Krishnan *et al.* (2021) determined that above 1,200 m asl, the potential area of Boma Forest suitable for supporting humid forest (and, therefore, habitat for *C. arabica*) was 97 km<sup>2</sup>, and that this had been reduced to 15 km<sup>2</sup> as of 2020—an 84% loss of humid forest. They established that, between 2000 and 2020, there was a 6% loss of humid forest, with only 15 km<sup>2</sup> of humid forest remaining in 2020. Fay *et al.* (2024) found that the area of forest above 1,500 m asl almost halved during 2010–2024, from 2.1 km<sup>2</sup> to only 1.1 km<sup>2</sup> (Figure 4). Slash-and-burn agriculture for crops (primarily maize and beans) for local consumption is the primary threat to Boma Forest, while the conservation values of the forest that remains are being degraded as a result of the unsustainable hunting for bushmeat and the taking of forest products, including timber and building poles. These authors were told by the residents of Zoch Village that *C. m. boutourlinii* regularly raids crops. Although not consumed by people, monkeys are killed in response to crop raiding. Tails of *C. guereza* are used as decoration by some people in Zoch Village.

There is little closed-canopy forest remaining in southeastern South Sudan for forest-dependent species. Additional surveys are needed to better understand which forest-dependent species occur on the Boma Escarpment and their distribution, abundance, conservation status, and threats, and the possibilities for their long-term conservation. This particularly applies to the larger mammals, including the primates. Among the conservation actions that should be considered for Boma Forest are: (1) gazette into Boma NP; (2) improve protection; (3) assess potential for restoration of the area of natural forest lost due to anthropogenic activities; (4) establish mixed indigenous tree plantations (e.g., *C. arabica* forests) that are sustainably managed and utilized by local communities; (5) promote conservation education and community engagement that centers on protection of the Boma Forest and improvement of livelihoods; (6) highlight *C. arabica* as the 'flagship species' for the protection and reestablishment of Boma Forest.

## ACKNOWLEDGMENTS

We thank Quentin Luke for the list of the more common species of large trees present in Boma



**Figure 4.** Boma Forest, southeastern South Sudan. The area of Boma Forest above 1,500 m asl lies within the outer (blue) polygon. The area of forest above 1,500 m asl was 2.1 km<sup>2</sup> in 2010 (left) and 1.1 km<sup>2</sup> in 2024 (right), a 48% loss of forested area in 14 years. Image from Fay *et al.* (2024).

Forest. We are grateful to Lorna Depew, Carly Butynski, Spartaco Gippoliti, and one anonymous person for their review of the manuscript.

We acknowledge African Parks for enabling the collection of data presented in this note. Special thanks are due to the Boma Ranger Team for deploying and collecting the camera traps, the videos from which were vital to this study, and to the people of Zoch Village who welcomed us during this survey.

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**Supplement:** Four camera trap video clips of Boutourline's blue monkey *Cercopithecus mitis boutourlinii* in Boma Forest, southeastern South Sudan, can be viewed here: [www.wildsolutions.nl/boma/](http://www.wildsolutions.nl/boma/).

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Brief Communication:

## When to Use Parentheses Around the Author's Name and Date of Publication when Citing the Authority for Species' or Subspecies' Name --- and Why?

Thomas M. Butynski and Yvonne A. de Jong

*Eastern Africa Primate Diversity and Conservation Program, Nanyuki, Kenya*

Why are the name and year of the authority for a species' or subspecies' scientific name sometimes enclosed within parentheses---and sometimes not?

Here is an example of this combination as presented in Claase *et al.* (2025: 45) in this issue of *African Primates*.

“Groves (2001) distinguished four species within the ‘*Cercopithecus mitis* Group’: Stuhlmann’s blue monkey *C. mitis* Wolf, 1822, Zanzibar Sykes’s monkey *C. albogularis* (Sykes, 1831), golden monkey *C. kandti* Matschie, 1905, Doggett’s silver monkey *C. doggetti* Pocock, 1907.”

In the above sentence, parentheses enclose the name of the author who described and named the Zanzibar Sykes’s monkey *Cercopithecus albogularis* (Sykes, 1831), but the names of the three authors who described and named the other three *C. mitis* taxa are not within parentheses. Some readers might think that this is inconsistent. That is not the case. Instead, Claase *et al.* (2025) were following the rules for zoological nomenclature as presented in Article 51.3 of the 4th edition of the *International Code of Zoological Nomenclature*.

The *International Code of Zoological Nomenclature* requires that when a species’ name is currently recognized in the genus to which it was ‘originally’ allocated, the name of the author and year of publication should not appear within parentheses. According to Article 51.3, however, when a species or subspecies name is transferred from the genus under which it was ‘originally’ named, to another genus, the name of the authority author and date of publication should be placed within parentheses. This alerts the reader that such a transfer has occurred. Thus, Claase *et al.* (2025) are essentially informing the reader that *Cercopithecus mitis*, *C. kandti*, and *C. doggetti* were

all originally named in the genus ‘*Cercopithecus*’, but not *C. albogularis*. Sykes (1831) originally named it ‘*Semnopithecus albogularis*’.

Here is Article 51.3 as presented in the *International Code of Zoological Nomenclature* of the International Commission on Zoological Nomenclature (1999: 55).

“**Use of parentheses around authors’ names (and dates) in changed combinations.** When a species-group name is combined with a generic name other than the original one, the name of the author of the species-group name, if cited, is to be enclosed in parentheses (the date, if cited, is to be enclosed within the same parentheses). **Example.** *Taenia diminuta* Rudolphi, when transferred to the genus *Hymenolepis*, is cited as *Hymenolepis diminuta* (Rudolphi) or *Hymenolepis diminuta* (Rudolphi, 1819).”

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## Obituary:

### **Antoine (Tony) Mudakikwa (1955 - 2024)**

#### **A Tribute to Our First African *Gorilla Doctor*: Contributions from Colleagues and Friends**

On September 20th 2024, the mountain gorilla conservation family bid farewell to our esteemed colleague and friend, Dr. Antoine Mudakikwa, known as Dr. Tony. Through testimonies from those who knew him, we were filled with immense gratitude for the paths Dr. Tony has paved for the younger generation, along with the discovery, joy, and wildlife passion that he showed us over the years. For those who knew him well, Dr. Tony was the epitome of a dedicated protector of endangered species (gorillas, chimpanzees and the “Big 5” in Rwanda) and a One Health researcher.

Born in the Democratic Republic of Congo, Dr Tony completed studies in Veterinary Medicine at the University of Lubumbashi (Katanga Province) after formative years in the Jesuit school of Alfajiri in Bukavu (South Kivu). Students, mentees, and colleagues like myself from One Health Approach for Conservation (OHAC) - Gorilla Health (<https://gorillahealth.org/about-us/>), remember tales of the University of Lubumbashi’s Alumnus Dr. Tony being lauded by professors as a role model for younger students at the university and as one of the best temporary assistant professors.

Dr. Tony’s career started in 1980 as a Veterinarian Manager in Masisi on one of the largest livestock farms in North Kivu. Then he returned to Bukavu where he opened a private Veterinary Clinic and Pharmacy. From there, he held various positions as a University professor, and consultant in the Food and Agriculture Organization (FAO), and in the Kahuzi-Biega National Park of DRC where he began his wildlife conservation work. In between training with other experts from US zoos and animal sanctuaries, Dr. Tony resettled in Rwanda in 1995 as a University Professor, then successively worked for the Morris Animal Foundation’s Mountain Gorilla Veterinary Project (MGVP) from



Dr. Tony at the One World Health Symposium in 2015.

1995 to 2002 as the main gorilla doctor for Africa. He implemented and coordinated the mountain gorilla health project in the region (<https://www.morrisanimalfoundation.org/article/mountain-gorilla-veterinary-project-and-morris-animal-foundation>). In 2003, he joined the Rwanda Development Board until his retirement in 2020.

Dr. Tony mentored many experts from all over the world and contributed to extensive wildlife Conservation. With One Health champions of Rwanda, he was a great collaborator to multi-disciplinary colleagues passionate about incorporating One Health principles into Rwanda’s strategic environmental, livestock, and health plans (<https://gh.bmj.com/content/2/1/e000121>). Dr. Tony’s research collaborations on zoonotic diseases, especially those originating from bats and humans, highlighted the complex interrelationships between species and the environment. His co-workers at Volcanoes National Park remember how we enforced infection prevention and control at the national park, requiring mask-wearing and exceptionality temperature checks for anyone visiting the national park during the COVID-19 pandemic (and he meant ANYONE without exception), to protect the mountain gorillas from infection. Dr. Tony’s work with mountain gorillas not only advanced our understanding of these magnificent creatures but has also significantly contributed to their protection from emerging threats, particularly from human viruses. Together, we trained wildlife veterinarians and researchers on how to ensure the survival of gorillas in captivity after rescuing some from DRC poachers.

Dr. Tony led us towards the success of several projects such as the survival of mountain gorillas in their natural environment by monitoring them and providing effective healthcare. This was done even for other wild animals from national parks in Uganda and DRC.

Some of the notable accomplishments and results we achieved with Dr. Tony are:

- facilitating the transfer of mountain gorillas to the Senkwekwe Centre in Virunga National Park and of Grauer's gorillas to the GRACE sanctuary, both in DRC;
- establishing a clinic for the reception and care of gorillas and monkeys confiscated from poachers in the region (Kinigi Quarantine Facility);
- the rescue and transfer to different sanctuaries of chimpanzees trafficked from DRC;
- the establishment of a wildlife laboratory for mountain gorillas in Rwanda;
- training, mentoring of in-country conservationists and gorilla doctors;
- enforcing the protocol of mountain gorilla visits for the prevention of diseases affecting great apes.

Dr. Tony also supported several other projects with the Rwanda Tourism and National Parks Office (ORTPN), which became the current Rwanda Development Board (RDB). There, he managed to transform the conservation and tourism sector, along with other initiatives led by the RDB in line with our country's conservation vision, such as the reintroduction of lions and the introduction of rhinos to Akagera National Park in Rwanda.

Dr. Tony was a board member or a Scientific Advisor of different organizations in Rwanda and in the region. He was a scholar who supervised several studies, contributing to more than 64 publications in international journals (<https://www.researchgate.net/profile/Antoine-Mudakikwa>). He was not only a mentor and a teacher but also an inspiration to those who care deeply about wildlife conservation and public health. It was a proud moment for mountain gorilla veterinarians when Dr. Tony was bestowed by the government of Rwanda the honor of naming a baby gorilla in 2020 during the yearly ceremony of Kwita Izina (an event held for naming all the newborn mountain gorillas). He named the gorilla "Umuganga" (translated to [Gorilla] Veterinarian in Kinyarwanda) in honor of gorilla veterinarians like us, for their long service, dedication, and outstanding contribution to the protection of the mountain gorilla population.

As we remember Dr. Tony, we cannot help but overstate how his insights have left a mark on each one of us and the future of conservation. With Rwanda currently facing its first-ever outbreak of the Marburg Virus Disease (a deadly haemorrhagic fever virus that can be transmitted by exposure to one species of fruit bat), we remember Dr. Tony's research on bats and sequencing technology years ago to study evidence of infection with viruses of zoonotic potential. We are comforted that his legacy continues through his mentees and colleagues who are now equipped to face the challenges posed by pandemics, armed with the knowledge Dr. Tony shared and the protocols he established.



Chimpanzee intervention in Kigali by Dr. Tony Mudakikwa and Dr. Jean Felix Kinani Sangwa.

Dr. Tony will be sorely missed. His legacy will continue through researchers, conservationists, and wildlife advocates from Rwanda and beyond. We are grateful for his contributions, his life, and his friendship. I continue to teach discoveries we made together (<https://gorillahealth.org/scientific-publications/>) at universities, international institutions, and regularly in the field with younger conservationists.

*Jean Felix Kinani Sangwa*

*One Health Approach for Conservation (OHAC) - Gorilla Health*

Further to Jean Felix's tribute, Tony's second career began soon after the 1994 genocide when he moved to Rwanda. For eight years, he worked as a field vet for an international NGO, followed by 18 years working for the Rwandan government, first as the head veterinarian for the protected area authority, latterly as head of the Wildlife Veterinary Unit.

Tony's contributions to mountain gorilla conservation through veterinary medicine are widely recognized. Less well known is how critical Tony's guidance and support to the Karisoke Research Centre was during the period that I was director. He helped us to navigate the insecurity and politics of two exceptionally difficult years in the northwest of Rwanda, when Volcanoes National Park was closed and our field activities were suspended. Tony was planning to write a book about that period when he retired, but sadly his testimony will not see the light of day.

An incident for which Tony was infamous was when he was badly bitten by Guhonda, a silverback male gorilla, following a successful snare removal. When he was injured, Tony's primary concern was that the park staff should not become scared of Guhonda, so he was careful not to display any fear, or to reveal how much pain he was in, and he would not let us see his savaged leg. Tony showed enormous self-control and considerable bravery during this incident.

Another of Tony's remarkable traits was his fierce intellect, which was on display when he represented the Rwandan government at meetings of the United Nations Conventions, especially at CITES, the Convention on International Trade in Endangered Species. Tony was a formidable advocate and adversary in these and other fora.

*Liz Williamson*

My first meeting with Dr. Tony was in 2004 as a student from Makerere University doing research in Bwindi Impenetrable National Park. Tony came to support the efforts against scabies in mountain gorillas. When he arrived, he changed the mood in the camp, as all the trackers knew him with his jokes and stories and fun. Since then we kept in touch, as he was also a good friend to my late dad.

Fast forward to 2008, I came to Rwanda to look for a job working with wildlife and met Tony at the Rwandan Office of Tourism and National Parks. He gave me a job with my friend Dr. Noel Arintereho and used to describe us as his dream team. In 2010, I joined PREDICT under the Mountain Gorilla Veterinary Project so that we could continue to strengthen capacity for wildlife health surveillance countrywide.

Dr. Tony was a mentor, a friend and above all very much interested in seeing Rwanda become a beacon of wildlife health practices in the region. I will forever miss him. The veterinary fraternity in Rwanda and the region will equally miss him.

*Julius Nziza  
Gorilla Doctors*

It was with great sadness that I learned of the passing of Tony Mudakikwa, a cherished friend and dedicated mountain gorilla veterinarian and conservation technician. I knew Tony for nearly 30 years, having first met him in 1996 when I arrived in Rwanda to work alongside Liz Williamson and her dedicated team of mountain gorilla researchers. As a young conservationist entering a country experiencing considerable instability, it was incredibly reassuring to have our conservation partner Tony around to offer his wisdom, guidance, and unconditional support. Tony was like a big brother to me and took it upon himself to help ensure that I remained safe during this difficult period in Rwanda's history.



In 1996, Dr. Tony at a routine health check with Shinda. Photo by Liz Williamson.

Upon leaving Rwanda for Central Africa in 1997, I only had intermittent contact with Tony until he invited me to Kigali in 2011 to give a talk on my work in the Central African Republic, where we were developing western gorilla research and tourism. Not long after this meeting, I decided to move with my family from Yaoundé, Cameroon, to Kigali. Over the next decade, I saw a lot more of Tony, by now a well-established and respected figure in the Rwandan government entity responsible for overseeing wildlife conservation.

Although it was no longer necessary for Tony to look out for me as he did in our early days, during this recent tenure in the now safe, secure and prosperous Rwanda we remained close, and our occasional meetings were always warm and memorable. The Rwanda conservation community lost a great leader in Tony and I lost a great friend. My heart goes out to his son Rudy and the rest of Tony's family and friends. I'll miss you dearly, Ndugu Yangu.

*David Greer*

With Dr. Tony Mudakikwa's recent passing, we say goodbye too soon to a skilled veterinarian, committed conservation practitioner, dedicated teacher and mentor, collaborative colleague, and dear friend.

Tony fundamentally enriched my years living in Rwanda and working in mountain gorilla conservation. It was a privilege to experience his technical skills in action, benefiting gorillas and other wildlife and improving the quality of park management and sustainability of nature-based tourism in Rwanda.

His thoughtful approach to training reached young practitioners and seasoned park staff alike. Tony's deeply kind nature enriched many lives as it improved conservation practice. And, he had a special quality that made you feel better about the world simply by being in his company.

Tony blazed an enormously positive and important trail - creating the conditions, removing barriers and inspiring veterinarians and other practitioners from mountain gorilla range states to lead in the delivery of essential protection services for gorillas and their habitat. This is a powerful part of Tony's legacy.

*Katie Frohardt  
Wild Earth Allies*

# Announcements

## Biodiversity Report Series from Uganda (1996) Now Available Online

The results of the first systematic work to document the biological diversity in Uganda's major forests - the Biodiversity Report Series (1996) - is now available on [wildsolutions.nl](http://wildsolutions.nl).

These 33 reports present the results of fieldwork carried out by the Uganda Forest Department during 1991-1995. They list the trees and scrubs, birds, butterflies, moths, and small mammals of the country's 65 most important forests for the conservation of biodiversity. The purpose of this work is to provide data on the biological value of each forest and establish priorities for the designation of Nature Reserves and other conservation areas.

Each report in this series provides a summary of the data collected at one major forest, or a group of similar adjacent forests. The primary purpose of presenting these data is to provide a permanent



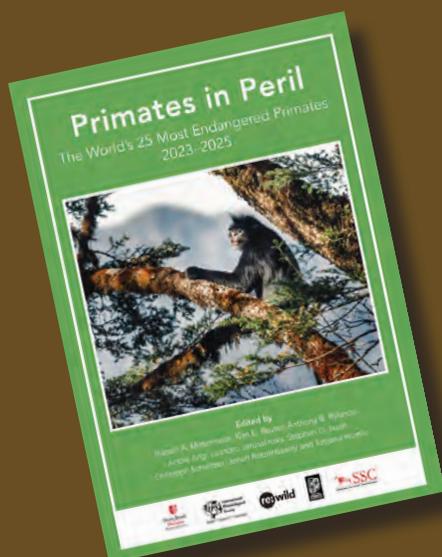
record of the findings as a basis for comparative work among sites, and as a baseline for their long-term ecological monitoring.

The Biodiversity Report series demonstrates Uganda's commitment to biodiversity conservation and makes a major contribution towards addressing the country's obligations under the International Convention on

Biological Diversity, signed in Rio de Janeiro in 1992 and ratified by the Uganda Government in September 1993.

- Yvonne de Jong and Tom Butynski

To access the entire Series of Uganda Biodiversity Reports (1996), go to: <https://www.wildsolutions.nl/publications/publications/uganda-biodiversity-reports/>



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[http://www.primates-g.org/storage/pdf/Top\\_25\\_Primates\\_2023-2025.pdf](http://www.primates-g.org/storage/pdf/Top_25_Primates_2023-2025.pdf)

## Connections: E-News, Web Sites, and Social Media

### **Africa Biodiversity Collaborative Group**

Website: [www.abcg.org](http://www.abcg.org)  
Facebook: [facebook.com/ABCgconserve](https://facebook.com/ABCgconserve)  
Twitter: [twitter.com/ABCgconserve](https://twitter.com/ABCgconserve)

### **African Primates (for journal and group)**

Website: [primate-sg.org/african\\_primates/](http://primate-sg.org/african_primates/)  
Facebook: [facebook.com/groups/AfricanPrimates/](https://facebook.com/groups/AfricanPrimates/)  
Twitter: [twitter.com/africanprimates](https://twitter.com/africanprimates)

### **African Primatological Society**

Facebook: [facebook.com/African.Primatological.Society/](https://facebook.com/African.Primatological.Society/)  
Twitter: [twitter.com/AfricanPs](https://twitter.com/AfricanPs)

### **African Wildlife Foundation**

Website: [www.awf.org](http://www.awf.org)  
Facebook: [facebook.com/AfricanWildlifeFoundation](https://facebook.com/AfricanWildlifeFoundation)  
Twitter: [twitter.com/AWF\\_Official](https://twitter.com/AWF_Official)  
Bluesky: [awf-official.bsky.social](https://bluesky.com/awf-official.bsky.social)

### **Amboseli Baboon Research Project**

Website: [www.amboselibaboons.nd.edu](http://www.amboselibaboons.nd.edu)  
Facebook: [facebook.com/Amboseli-Baboon-Research-Project-296131010593283](https://facebook.com/Amboseli-Baboon-Research-Project-296131010593283)  
Bluesky: [amboselibaboonrp.bsky.social](https://bluesky.com/amboselibaboonrp.bsky.social)

### **Barbary Macaque Awareness and Conservation**

Website: [www.barbarymacaqueconservation.org](http://www.barbarymacaqueconservation.org)  
Newsletter: Contact [sian@barbarymacaque.org](mailto:sian@barbarymacaque.org)  
Facebook: [facebook.com/BarbaryMacaqueAwarenessandConservation](https://facebook.com/BarbaryMacaqueAwarenessandConservation)

### **The Bioko Biodiversity Protection Program (BBPP)**

Facebook: English - [facebook.com/pages/Bioko-Biodiversity-Protection-Program/107673299261496](https://facebook.com/pages/Bioko-Biodiversity-Protection-Program/107673299261496);  
Spanish - [facebook.com/BiokoBiodiversidad](https://facebook.com/BiokoBiodiversidad)  
Twitter: [twitter.com/Bioko\\_BBPP](https://twitter.com/Bioko_BBPP)  
Instagram: [instagram.com/bioko\\_BBPP/](https://instagram.com/bioko_BBPP/)

### **The Bonobo Conservation Initiative (BCI)**

Website: [www.bonobo.org](http://www.bonobo.org)  
Facebook: [facebook.com/bonobodotorg](https://facebook.com/bonobodotorg)  
Twitter: [twitter.com/Bonobodotorg](https://twitter.com/Bonobodotorg)

### **Budongo Conservation Field Station**

Website: [www.budongo.org](http://www.budongo.org)  
Facebook: [facebook.com/pages/Budongo-Conservation-Field-Station/111160629076237](https://facebook.com/pages/Budongo-Conservation-Field-Station/111160629076237)  
Twitter: [twitter.com/budongochimps](https://twitter.com/budongochimps)

### **Bugoma Primate Conservation Project**

Twitter: [twitter.com/BugomaPrimates](https://twitter.com/BugomaPrimates)

### **Bulindi Chimpanzee and Community Project**

Website: [bulindichimpanzees.weebly.com/](http://bulindichimpanzees.weebly.com/)  
Facebook: [facebook.com/bulindichimpanzees](https://facebook.com/bulindichimpanzees)  
Twitter: [twitter.com/bulindichimps](https://twitter.com/bulindichimps)  
YouTube: [youtube.com/bulindichimpanzees](https://youtube.com/bulindichimpanzees)

### **Cameroon Primatological Society**

Twitter: [twitter.com/Camer\\_primates](https://twitter.com/Camer_primates)

### **Canadian-Cameroon Ape Network**

Facebook: [facebook.com/cancamapenetwork/](https://facebook.com/cancamapenetwork/)  
Twitter: [twitter.com/CanCamApeNetwrk](https://twitter.com/CanCamApeNetwrk)

### **Centre de Conservation pour Chimpanzes**

Website: [www.projetprimates.com/en/](http://www.projetprimates.com/en/)  
Facebook: [facebook.com/](https://facebook.com/CentreDeConservationPourChimpanzes)  
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### **Chimp Eden (JGI Sanctuary, South Africa)**

Facebook: [facebook.com/JGISA](https://facebook.com/JGISA)  
Twitter: [twitter.com/jgisachimpeden](https://twitter.com/jgisachimpeden)

### **Chimpanzee Sanctuary & Wildlife Conservation Trust (Ngamba Island)**

Website: [www.ngambaisland.org/](http://www.ngambaisland.org/)  
E-newsletter contact: [info@ngambaisland.org](mailto:info@ngambaisland.org)  
Facebook: [facebook.com/ngambaisland](https://facebook.com/ngambaisland)  
Twitter: [twitter.com/ngambaisland](https://twitter.com/ngambaisland)

### **Colobus Conservation**

Facebook: [facebook.com/pages/Colobus-Conservation/137445029669543](https://facebook.com/pages/Colobus-Conservation/137445029669543)  
Twitter: [twitter.com/Team\\_Colobus](https://twitter.com/Team_Colobus)

### **Comoe Chimpanzee**

Facebook: [facebook.com/comoechimpanzeeep/](https://facebook.com/comoechimpanzeeep/)

### **Comoé Monkey Project**

Facebook: [facebook.com/ComoeMonkeyProject](https://facebook.com/ComoeMonkeyProject)

### **Conservation through Public Health**

Facebook: Conservation Through Public Health  
[facebook.com/pages/Conservation-Through-Public-Health/115176086614](https://facebook.com/pages/Conservation-Through-Public-Health/115176086614); CTPH Gorilla Conservation Camp: [facebook.com/pages/CTPH-Gorilla-Conservation-Camp/239975179417714](https://facebook.com/pages/CTPH-Gorilla-Conservation-Camp/239975179417714)  
Twitter: [twitter.com/CTPHuganda](https://twitter.com/CTPHuganda)

### **Cross River Gorilla Project**

Website: [www.crossrivergorillaproject.co.uk/](http://www.crossrivergorillaproject.co.uk/)  
Twitter: [twitter.com/crossriverGP](https://twitter.com/crossriverGP)

### **Eastern Africa Primate Diversity and Conservation Program**

Website: [www.wildsolutions.nl/](http://www.wildsolutions.nl/)  
Twitter: [twitter.com/WildSolutions](https://twitter.com/WildSolutions)

### **Ebo Forest Research Project**

Website: [www.eboforest.org](http://www.eboforest.org)  
E-Newsletter contact: [ekwoje@eboforest.org](mailto:ekwoje@eboforest.org)

### **Filoha Hamadryas Project**

Facebook: [facebook.com/filoha](https://facebook.com/filoha)

### **Fossey Gorilla Fund**

Website: [www.gorillafund.org/](http://www.gorillafund.org/)  
Facebook: [facebook.com/savinggorillas](https://facebook.com/savinggorillas)  
Twitter: [twitter.com/SavingGorillas](https://twitter.com/SavingGorillas)

# Connections: E-News, Web Sites, and Social Media

## Gorilla Doctors

Website: [www.gorilladoctors.org](http://www.gorilladoctors.org)  
 Facebook: [facebook.com/gorilladoctors/](https://facebook.com/gorilladoctors/)  
 Bluesky: [gorilladoctors.bsky.social](https://gorilladoctors.bsky.social)

## Gorillas Across Africa

Facebook: [facebook.com/GorillasAcrossAfrica](https://facebook.com/GorillasAcrossAfrica)

## Gorilla Rehabilitation and Conservation Education (GRACE) Center

Website: [www.gracegorillas.org](http://www.gracegorillas.org)  
 Facebook: [facebook.com/gracegorillas](https://facebook.com/gracegorillas)  
 Twitter: [twitter.com/GRACEgorillas](https://twitter.com/GRACEgorillas)  
 Instagram: [instagram.com/gracegorillas](https://instagram.com/gracegorillas)

## Goulougo Triangle Ape Project

Website: [www.congo-apes.org/](http://www.congo-apes.org/)  
 Facebook: [facebook.com/Goulougo-Triangle-Ape-Project-282194681876/](https://facebook.com/Goulougo-Triangle-Ape-Project-282194681876/)

## Great Ape Survival Partnership (GRASP)

Website: [www.un-grasp.org](http://www.un-grasp.org)  
 Facebook: [facebook.com/graspunep?ref=stream](https://facebook.com/graspunep?ref=stream)  
 Twitter: [twitter.com/graspunep](https://twitter.com/graspunep)

## Guenon Conservation Community

Facebook: [facebook.com/pages/Guenon-Conservation-Community/](https://facebook.com/pages/Guenon-Conservation-Community/)

## HELP Congo (Chimpanzee Sanctuary)

Website: [www.help-primates.org/](http://www.help-primates.org/)  
 Facebook: [facebook.com/HELP-Congo-29693148237/](https://facebook.com/HELP-Congo-29693148237/)

## Imfene Education and Conservation (Baboons)

Facebook: [facebook.com/ImfeneOutreach](https://facebook.com/ImfeneOutreach)

## International Gorilla Conservation Programme

Website: [www.igcp.org](http://www.igcp.org)  
 Facebook: [facebook.com/theIGCP](https://facebook.com/theIGCP)  
 Twitter: [twitter.com/IGCP](https://twitter.com/IGCP)

## International Primate Protection League

Website: [www.ippl.org](http://www.ippl.org)  
 Facebook: [facebook.com/InternationalPrimateProtectionLeague](https://facebook.com/InternationalPrimateProtectionLeague)  
 Twitter: [twitter.com/ipplprimate](https://twitter.com/ipplprimate)

## International Primatological Society – Conservation

Website: <https://internationalprimatologicalsociety.org/#StartView>  
 Bluesky: [ips-primatenews.bsky.social](https://ips-primatenews.bsky.social)

## IUCN SSC Primate Specialist Group Section for Human-Primate Interactions

Webpage: [www.human-primate-interactions.org/](http://www.human-primate-interactions.org/)  
 Facebook: [facebook.com/peopleprimate](https://facebook.com/peopleprimate)  
 Twitter: [twitter.com/peopleprimate](https://twitter.com/peopleprimate)  
 Bluesky: [peopleprimate.bsky.social](https://peopleprimate.bsky.social)

## Jane Goodall Institute

Website: [www.janegoodall.org](http://www.janegoodall.org)  
 Facebook: [facebook.com/janegoodallinst/](https://facebook.com/janegoodallinst/)  
 Twitter: [twitter.com/JaneGoodallInst](https://twitter.com/JaneGoodallInst)

## Kasokwa-Kityedo Forest Project

Facebook: [facebook.com/KasokwaKityedo/](https://facebook.com/KasokwaKityedo/)

## Kibale Chimpanzee Project

Facebook: [facebook.com/kibalechimpanzeeproject/](https://facebook.com/kibalechimpanzeeproject/)  
 Blog: <https://kibalechimpanzees.wordpress.com/>

## Kyambura Gorge Chimpanzee Community

Facebook: [facebook.com/Kyambura-Gorge-Chimpanzee-Community-119478481457652/](https://facebook.com/Kyambura-Gorge-Chimpanzee-Community-119478481457652/)

## La Société Francophone de Primatologie – SFDP

Twitter: [twitter.com/LaSFDP](https://twitter.com/LaSFDP)  
 Bluesky: [lasfdp.bsky.social](https://lasfdp.bsky.social)

## Le Projet Gorille Fernan-Vaz (Gabon)

Website: [www.gorillasgabon.org/](http://www.gorillasgabon.org/)  
 Facebook: [facebook.com/gorillasgabon](https://facebook.com/gorillasgabon)  
 Twitter: [twitter.com/gorillasgabon](https://twitter.com/gorillasgabon)

## Liberia Chimpanzee Rescue & Protection

Website: [www.liberiachimpanzeerescue.org](http://www.liberiachimpanzeerescue.org)  
 Facebook: [facebook.com/liberiachimpanzeerescue.org](https://facebook.com/liberiachimpanzeerescue.org)  
 Twitter: [twitter.com/liberiachimps](https://twitter.com/liberiachimps)  
 Instagram: [instagram.com/liberiachimprescueprotection](https://instagram.com/liberiachimprescueprotection)

## Limbe Wildlife Centre

Facebook: [facebook.com/pages/Limbe-Wildlife-Centre/504832002861894](https://facebook.com/pages/Limbe-Wildlife-Centre/504832002861894)  
 Twitter: [twitter.com/LimbeWildlife](https://twitter.com/LimbeWildlife)

## Loango Chimpanzee Project

Twitter: [twitter.com/loangochimps](https://twitter.com/loangochimps)

## Lola ya Bonobo

Website: [lodayabonobo.org](http://lodayabonobo.org)  
 Twitter: [twitter.com/lola\\_ya\\_bonobo](https://twitter.com/lola_ya_bonobo)

## Lukuru Foundation

Website: [www.lukuru.org](http://www.lukuru.org)  
 Facebook: [facebook.com/LukuruFoundation](https://facebook.com/LukuruFoundation)

## Lwiro Sanctuary

Website: [www.lwiroprimates.org](http://www.lwiroprimates.org)  
 Facebook: [facebook.com/lwiroprimates](https://facebook.com/lwiroprimates)  
 Twitter: [twitter.com/lwiroprimates](https://twitter.com/lwiroprimates)

## Mandrillus Project

Twitter: [twitter.com/mandrillusP](https://twitter.com/mandrillusP)  
 Bluesky: [mandrillusproject.bsky.social](https://mandrillusproject.bsky.social)

## Mbeli Bai Study

Twitter: [twitter.com/mbelibai](https://twitter.com/mbelibai)

## Ngogo Chim Project

Website: [www.ngogochimpanzeeproject.org/](http://www.ngogochimpanzeeproject.org/)  
 Facebook: [facebook.com/NgogoChimps/](https://facebook.com/NgogoChimps/)  
 Twitter: [twitter.com/ngogochimps](https://twitter.com/ngogochimps)

## Nigerian Montane Forest Project

Facebook: [facebook.com/groups/4829132147/](https://facebook.com/groups/4829132147/)  
 Twitter: [twitter.com/Ngel\\_Nyaki](https://twitter.com/Ngel_Nyaki)



## AFRICAN PRIMATES - Instructions to Contributors

*African Primates*, a journal of the IUCN SSC Primate Specialist Group, publishes research articles, field reports, review articles, position papers, book reviews, and other news focused on the nonhuman primates of Africa. We welcome submissions focused on behavior, ecology, taxonomy, or conservation. The journal is produced in both print and digital versions and is provided free of charge. The aim of *African Primates* is to promote conservation of Africa's primates by:

- 1) enhancing interest in Africa's primates and increasing knowledge about them that is relevant to their survival;
- 2) transmitting information about factors and situations that promote or work against conservation of African primate species or populations; and
- 3) providing a forum for discussion and debate regarding all aspects of knowledge relevant to conserving Africa's primate fauna and their habitats.

*African Primates* encourages submission of relevant information in the form of research findings, field survey results, advances in field and laboratory techniques, field action alerts, and book reviews, as well as notification of events, funding opportunities, grassroots efforts such as letter-writing campaigns, and recent publications in other formats (including reports and theses). All submissions should be sent to the Editor-in-Chief; research articles will be peer-reviewed before acceptance for publication. Contributors may consult past issues of *African Primates* for stylistic guidance. (Previous volumes are accessible through the PSG website. See [http://www.primates-sg.org/african\\_primates/](http://www.primates-sg.org/african_primates/).)

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- Manuscripts (not to exceed 15 pages) should be in English **only**, double-spaced, with 1-inch margins. All articles must include an English abstract. If possible, please provide a French abstract.
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- Manuscripts should be produced with PC-compatible software (e.g., Microsoft Word) and submitted as an e-mail attachment in \*.doc; \*.docx, or \*.rtf format. All reviews and revisions will be conducted via e-mail.
- Use metric units only and define all abbreviations.
- Current taxonomic classifications should be used. If species or subspecies' names have undergone recent revision, please include mention of recent names as a service to readers adjusting to new naming conventions.
- Tables, figures, and photographs are encouraged. All require accurate and concise captions listed on a separate sheet.
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- All photographs must be of high quality and submitted electronically. Each should be labeled on a separate page with a caption and photographer credit.
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- Each author should provide name, affiliation, address, telephone and/or fax number, and E-mail address.

Please use the following formats:

### Book:

Groves, C.P. 2001. *Primate Taxonomy*. Smithsonian Institution Press, Washington, D.C.

### Journal Article:

Chapman, C.A., L. Naughton-Treves, M.J. Lawes, M.D. Wasserman & T.R. Gillespie. 2007. Population declines of colobus in western Uganda and conservation value of forest fragments. *International Journal of Primatology* 28(3): 513–528.

### Book Chapter:

Eniang, E.A. 2003. Effects of habitat fragmentation on the Cross River gorilla (*Gorilla gorilla diehli*): Recommendations for conservation. In *Primates in Fragments: Ecology and Conservation*. L.K. Marsh, ed. Kluwer Academic/Plenum Publishers, New York. Pp. 343–363.

### Unpublished Report:

Hearn, G.W., W.A. Morra, M.A. Ela Mba & C. Posa Bohome. 2001. The approaching extinction of monkeys and duikers on Bioko Island, Equatorial Guinea, Africa. Unpublished report of the Bioko Biodiversity Protection Program, Arcadia University, Glenside PA.

### Government Document:

Ministry of Environment and Natural Resources. 1994. *The Kenya National Environment Action Plan (NEAP)*. Ministry of Environment and Natural Resources, Nairobi, Kenya.

It is recommended that contributors consult recent issues of *African Primates* for more details on the journal's format and content.

Please submit all manuscripts and materials electronically to: [wallis@africanprimates.net](mailto:wallis@africanprimates.net)

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# *African Primates*

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