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Source: Primate Conservation, 2014(28) : 129-138

Published By: Conservation International

URL: https://doi.org/10.1896/052.028.0106

Primate Conservation 2014 (28): 129−138

The First Survey of the Conservation Status of Primates in Southern Burkina Faso, West Africa

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Abstract: Little is known about the extent of primate abundance and distribution in Burkina Faso, West Africa. Only two prior surveys have been reported, each in just one protected area and one dating as far back as 1976. With this study, we aimed to update our understanding of primate presence in Burkina Faso. Between 11 May and 16 July 2012, we surveyed nearly 250 km in five protected areas along the southern border of the country, collecting data on the presence of primates, predators, and poaching activities. Although several sources have listed up to nine primate species as present in Burkina Faso, we were only able to confirm five of four genera: *Galago senegalensis*, *Papio anubis*, *Erythrocebus patas*, *Chlorocebus sabaeus*, and *Chlorocebus tantalus.* With the results of the surveys, and in-depth interviews with 24 workers, farmers and protected area officials, we indicate that *Pan troglodytes verus* has been extirpated from Burkina Faso, and that *Colobus vellerosus* and *Cercocebus lunulatus* are either already gone or are close to extirpation. We report encounter rates for *Papio anubis*, *Erythrocebus patas*, *Chlorocebus*, *Panthera leo*, *Panthera pardus*, and poaching activities. The threats to the remaining primate species include legal and illegal hunting, and inconsistent and ineffective law enforcement in protected areas. Agricultural expansion will continue to rise as a threat to these species, particularly *Papio anubis* and *Erythrocebus patas*, through habitat alteration as well as increasing human-wildlife conflict over crop-feeding behaviors.

Key Words: *Colobus vellerosus*, *Cercocebus lunulatus*, *Chlorocebus*, *Galago senegalensis*, *Erythrocebus patas*, *Papio anubis*, reconnaissance

Introduction

The landlocked country of Burkina Faso, West Africa, encompasses a range of ecosystems, from the Sahelian deserts bordering Mali in the north to the savanna woodland mosaics along the borders of Côte d'Ivoire and Ghana in the south. The southern portion of Burkina Faso marks the outer limits for the ranges of several West African primates, though little research has been conducted to determine their presence, distribution and abundance in the country. Although nine primate species have been reported as occurring in Burkina Faso (see Table 1), including *Pan troglodytes verus*, only two primatological surveys had been conducted. Nearly 40 years ago, Poché (1976) reported the presence of *Galago senegalensis*, *Erythrocebus patas*, *Papio anubis*, and *Cercopithecus aethiops tantalus* (now *Chlorocebus tantalus*) in W National Park, southeastern Burkina Faso.

Galat and Galat-Luong (2006), following a six-day survey in the southwestern Comoé-Léraba Partial Reserve, reported sightings of *E. patas*, *Chlorocebus sabaeus*, *Colobus vellerosus*, and *Cercocebus atys lunulatus*. Populations of *Colobus vellerosus* have declined by more than 30% over the last 30 years, and the species has been classified as Vulnerable since 1994. Gonedelé-Bi *et al*. (2010) argued that it should be ranked as Endangered. Populations are often too small for estimates; they are present in neighboring Ghana, Togo, Benin and Côte d'Ivoire but may be extinct in Nigeria (Oates 2011).

The white-naped mangabey *Cercocebus atys lunulatus* is now considered a full species, *C. lunulatus* (see Oates 2011). *Cercocebus lunulatus* was listed as one of the World's 25 Most Endangered Primates in 2005 (McGraw *et al*. 2005). Its range is now limited to only a few forest patches in Ghana (Oates 2000, 2011) and Côte d'Ivoire (Fischer *et al*. 2002; Gonedelé Bi *et al*. 2008), with all wild populations threatened

by illegal hunting (Oates 2011). Populations are thought to have decreased by at least 50% over the last few decades (Oates *et al.* 2008b).

Grubb *et al.* (1998) followed Booth (1956) in indicating that *Chlorocebus sabaeus* occurs to the west of the White Volta River in Ghana, and is replaced by *C. tantalus* to the east of the river and on the Accra Plain. Haus *et al.* (2013) have recently reported on the geographic distribution of *C. sabaeus* and *C. tantalus* in Burkina Faso however, and the easternmost sample of *C. sabaeus* was from Krachi, east of the White Volta River in Ghana. They suggested that the Oti or Pendjari River, a left bank tributary of the Volta River, not the White Volta as Booth suggested, separates the two species in Ghana and Burkina Faso. The westernmost limits for *C. tantalus* are still not clearly defined, however, and hybridization within the contact zone of *C. tantalus* and *C. sabaeus* is likely (Haus *et al.* 2013).

The only direct report of a galago in Burkina Faso comes from Poché (1976), but both *Galago senegalensis* and *Galagoides demidovii* have been listed as present (Table 1). While the wide distribution of *G. senegalensis* across the continent makes its presence likely, there are currently no direct accounts of *G. demidovii*—either live or through trade—in Burkina Faso. The case for *P. t. verus* is similar. Scant reports of at least seasonal migrations from Côte d'Ivoire were reported by Teleki (1989), with occasional sightings reported across the southern border of the country (Redmond, pers. comm.; Redmond 2005). No surveys had been conducted, however, and at the time of this study, no new reports had been documented for decades.

Of the nine species considered present in Burkina Faso, the IUCN Red List (IUCN 2014) classifies two as Endangered (*P. t. verus* and *Cercocebus lunulatus*) and one as Vulnerable (*Colobus vellerosus*) (Table 1). *Erythrocebus patas* is classified as Least Concern but is in decline (Kingdon *et al.* 2008). *Papio anubis*, also Least Concern, is recorded as increasing in numbers. The remaining four (*Galagoides demidovii*, *Galago senegalensis*, *Chlorocebus sabaeus* and *C. tantalus*) are considered Least Concern with stable or increasing populations.

The human population of Burkina Faso is extremely poor. The country is ranked as the fifth least developed by the United Nations' Human Development Report (UNDP 2013), and it is the eighth fastest growing population (CIA 2013). This rapid population growth is contributing to the overexploitation of land and, with 90% of the population relying on subsistence agriculture, we can expect agricultural land conversion and land degradation to continue and worsen (Bance *et al*. 1999; Kristensen and Lykke 2003; CIA 2013). As of 1999, only 14% of Burkina Faso's land cover and 25% of forests were within protected areas (Bance *et al*. 1999). Law enforcement is weak (Gnoumou *et al*. 2011), allowing the threats of agricultural expansion and illegal hunting of wildlife to persist even in national parks and reserves. In protected areas around the world, hunting is a greater threat to wildlife than habitat loss (Fa *et al*. 2005; Kümpel *et al*. 2008), particularly for large mammals, including primates.

Primate population estimates and distribution data are needed in order to monitor and mitigate the effects of habitat loss, degradation and fragmentation, and hunting on the primates of Burkina Faso. Our aim here is to provide a preliminary assessment of the primates of Burkina Faso to be used as baseline information for future comparative analyses, and to narrow future research inquiries. Our objectives were to (a) investigate the presence/absence and relative distribution of Burkina Faso's primates, (b) gather follow-up data on the status of *Cercocebus lunulatus*, *Colobus vellerosus*, and *Pan troglodytes verus* in Comoé-Léraba Partial Reserve, and (c) determine the potential or actual threats to primate habitats in southern Burkina Faso. The unfortunate results regarding the likely extirpation of *Pan troglodytes verus* from this historic range country were reported by Ginn *et al*. (2013), and here we focus on the other eight primates.

Methods

Survey areas

We (Ginn, research assistants, and locally hired guides and translators) surveyed along 237.73 km in five protected areas across the southern border of Burkina Faso as follows: Pama Partial Reserve, Kompienga province (36.45 km); Arly National Forest, Gourma province (50.37 km); Comoé-Léraba Partial Reserve, Comoé and Léraba provinces (55.21 km); Koulbi Protected Forest, Poni province (47.40 km); and Nazinga Game Ranch and Reserve, Nahouri province (48.30 km) (Figs. 1 and 2). These sites are in the South Sudanian sector of Burkina Faso, characterized by 900–1100 mm of annual rainfall and rich soils (Sambaré *et al*. 2011), and a shrub-forest mosaic (Fig. 1). The protected areas are government-owned lands, and managed by the Burkina Faso Ministry of Environment (MOE) except for Comoé-Léraba which is managed by the *Association interVillageoise de Gestion des Resources Naturelles et de la Faune* (AGEREF/CL).

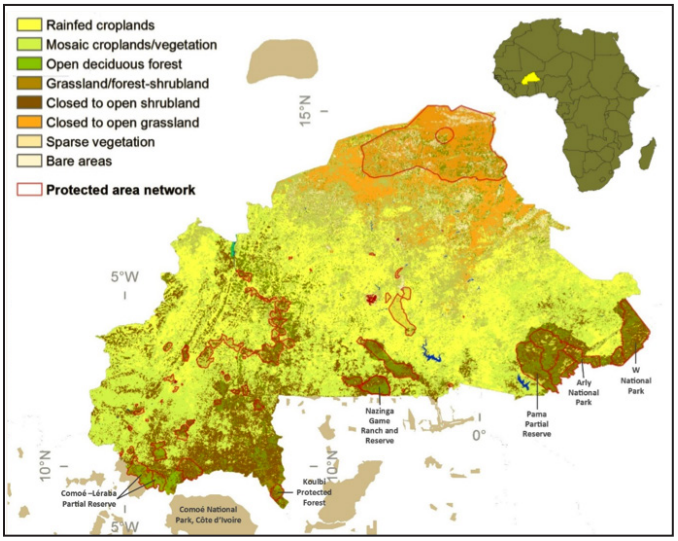

Figure 1. Vegetation zones and protected areas of Burkina Faso, West Africa.

AGEREF/CL is a cooperative of eleven bordering communities that share fishing rights and access to forest resources for the sale of shea butter, honey, and fuelwood. Seasonal hunting, mostly by international hunters, of primarily ungulates but also the occasional primate, provides the cooperative with an additional source of income. Comoé-Léraba is in the most biodiverse region of Burkina Faso, particularly in its riparian forests (Sambaré *et al*. 2011). This region is facing several threats, namely agricultural expansion in and around the reserve, desertification, and an increase in illegal hunting activities. Poaching activities in bordering northern Côte d'Ivoire increased dramatically during and after the country's political unrest of the early 2000s (Fischer 2004); with decreasing wildlife already noted in Comoé-Léraba (Bance *et al*. 1999), we expected the Ivorian political unrest and increase in poaching to have negatively impacted Comoé as well.

Pama Partial Reserve and Arly National Park, in the southeast of Burkina Faso, are part of what is often referred to as the WAP Complex: W National Park (a transfrontier collaborative of Benin, Burkina Faso and Niger), Arly National Park (including bordering Pama Partial Reserve) and Pendjari National Park, Benin (Clerici *et al*. 2007). This network of protected areas is best known for hosting the largest population of *Loxodonta africana* in West Africa (Bouché *et al*. 2011). Seasonal hunting is permitted in Pama, with the assistance of guides hired through either the local MOE office or from nearby safari lodges. Neighboring Arly National Park, however, is strictly protected. In its peak, roughly 10,000 tourists visited Arly per year, using a local airport for access. The airport and the on-site tourist lodge have both closed, and access roads have deteriorated, nearly eliminating the flow of tourism and thus income to the park.

Nazinga Game Ranch and Reserve, in south-central Burkina Faso, is the most consistently managed and well-studied of Burkina Faso's protected areas and, likely as a result, has experienced large mammal population increases. Bouché *et al*. (2011) estimated that populations of *Loxodonta africana* more than doubled between 1991 and 2010, and Marchal *et al*. (2010) found that between 2001 and 2010, most ungulate populations in the western portion of Nazinga increased. The reserve conducts regular anti-poaching patrols, engages in community outreach with 12 neighboring villages, and is easily accessed from the capital, Ouagadougou, by both wildlife tourists and international hunters.

The newest protected area in Burkina Faso, Koulbi Protected Forest was created in 2009 through the displacement of 14 villages. The park is bordered on the west by Côte d'Ivoire and on the east by Ghana, creating more international access than the other study sites. At the time of this study, several families were secretly living, hunting and farming in the forest, and there was limited presence or enforcement of the law.

Survey methods

We collected data between 11 May and 16 July 2012 through reconnaissance (recce) surveys. Recces follow paths of least resistance, covering only new ground; they provide the ability to survey four times more land than line transects (Walsh and White 1999). During the recces, we walked at

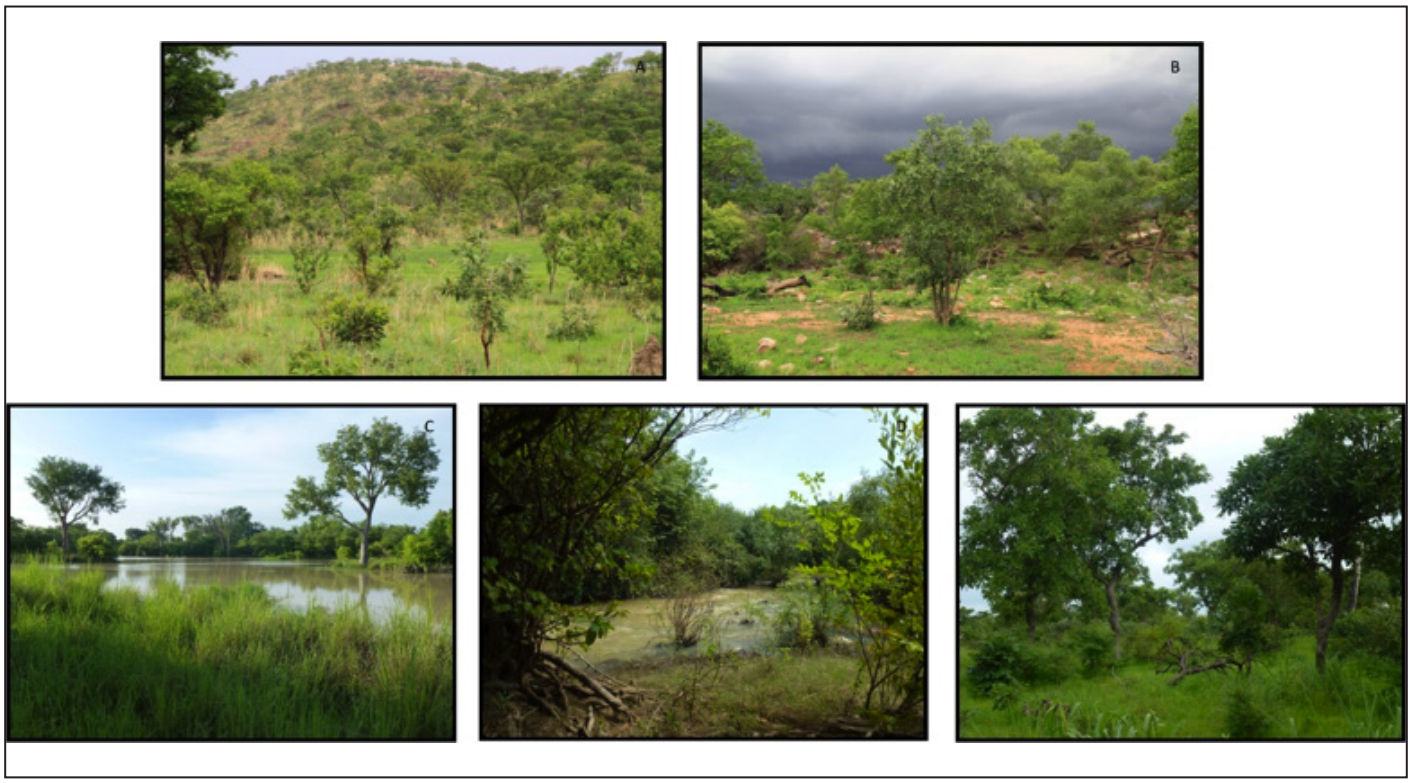

Figure 2. The typical habitat types of the five protected areas surveyed: (A) Pama Partial Reserve, (B) Arly National Park, (C) Nazinga Game Ranch and Reserve, (D) Comoé-Léraba Partial Reserve, and (E) Koulbi Protected Forest. Photos A and B by Josh Robison. Photos C, D, and E by Laura Ginn.

speeds of 1–3 km/hr (average 1.25 km/hr), documenting with Garmin 60CS GPS all signs of primate presence (sightings as well as secondary signs such as feces, tracks, vocalizations, evidence of feeding), predator signs and signs of presence, and all instances of anthropogenic disturbances and poaching activities (shotgun shells, human tracks, poaching camps, gunshots heard, and traps or snares). Because data were collected outside of the legal hunting season, we were able to consider all signs of hunting as poaching activities. Encounter rates were too low to use the DISTANCE software, so we analyzed the data using descriptive statistics and compared the results to poaching and predator encounter rates using non-parametric Spearman's Rho (Dytham 2011). In addition, we conducted nocturnal surveys in each location except Nazinga, for a total of at least 11.58 km (some nocturnal GPS data were corrupted). We employed the same methods as the diurnal recces, using red-filtered headlamps to search for the reflective gaze of galagos (Perkin 2006). Sightings were photographed for later identification by Nekaris and the Nocturnal Primate Research Group based at Oxford Brookes University.

To supplement the survey findings, we conducted semi-structured interviews with park management, guides, and farmers regarding management, anti-poaching policies, and human-wildlife conflicts. Interviewees (N = 24) had an average of 23 years of working knowledge in their respective locations. The interviews were conducted in the interviewees' preferred language using a locally hired, English-speaking translator. Participants were shown photographs of 22 animals, nine of which known to not occur in Burkina Faso. The remaining 13 pictures were the presumed nine species of primates, *Loxodonta africana*, *Lycaon pictus*, *Crocuta crocuta* and *Hippopotamus amphibius*. This method was used to test for individual reliability based on the methods of De Jong *et al*. (2008). Participants were asked to identify which animals they have seen in their respective forests, after which we asked follow-up questions regarding perceived distribution, abundance, and human-primate interactions

This research was approved by the Oxford Brookes University Research Ethics Committee, the *Centre National de la Recherche Scientifique et Technologique du Burkina Faso*, and the Burkina Faso Ministry of Environment. Interviews were also approved by local MOE authorities and village chiefs.

Results

Of the nine species believed to be present in Burkina Faso, we confirmed five in four genera: *Galago senegalensis*, *Papio anubis*, *Erythrocebus patas*, *Chlorocebus sabaeus*, and *Chlorocebus tantalus* (Table 1).

Galago senegalensis

No galagos were observed in the study sites, though we did encounter two individual *Galago senegalensis* on the southwestern range of Pama, near Yaryanga Safari and the village of Pama (Table 1; Fig. 3). Interviewees quickly recognized photographs of *G. senegalensis* and reported that the animals prefer fruiting shea butter (*Vitellaria paradoxa*: Sapotaceae) trees in or near villages and cities, including the capital of Ouagadougou.

Papio anubis

We encountered a total of 17 troops of baboons in four of the study sites, with an average observed group size of 7.12 individuals. *Papio anubis* was not seen in Koulbi. Group encounter rates were highest in Nazinga (0.166/km) and Arly (0.099/km) (Fig. 4). Pama and Comoé had lower, and comparable, encounter rates of 0.042/km and 0.037/km, respectively (Tables 2 and 4). Like *E. patas* (see below), *P. anubis* was reported to feed frequently on crops, and baboons were also reported to feed on livestock. The most commonly reported deterrent for this behavior was guarding by dogs and family members.

Erythrocebus patas

Sightings of *E. patas* were rare, with a total of only five encounters: Pama (1 individual); Arly (one group); Comoé (none); Koulbi (two groups); Nazinga (one group) (Tables 2 and 4). The average observed group size was 2.25 individuals, although patas were difficult to see and quick to flee. The one individual we saw in Pama was well-known to park officials and employees who reported that it had been alone for 10 years. In Koulbi, where group encounter rates were

Figure 3. *Galago senegalensis* observed on the edge of Pama Partial Reserve, Burkina Faso. Photo by Josh Robison.

highest, indirect observations (feeding signs) were also highest at 0.316 signs/km. *Erythrocebus patas* was reported by interviewees to occur regularly around forest edges, in agricultural zones and, while they were not observed in Comoé, they were reported to be frequent crop-feeders by villagers on the border of the AGEREF/CL park.

Figure 4. *Papio anubis* in Arly National Park. Photo by Josh Robison.

Chlorocebus sabaeus and C. tantalus

We observed *Chlorocebus* in all five reserves, for a total of 14 group encounters and an average observed group size of four (Tables 2 and 4). Only one individual was observed in Koulbi Protected Forest where interviewees reported that they were not present. Although we were unable to identify the species during the study, recent mitochondrial DNA analyses by Haus *et al*. (2013) suggest that our sightings of *Chlorocebus* in Comoé, Koulbi, and Nazinga would be of *C. sabaeus*, and in Pama and Arly *C. tantalus* (Fig. 5). Haus *et* al. (2013) did not collect fecal samples from Pama, however, or any of the land between Nazinga and Arly in Burkina, so it remains unclear where the geographic separation between these two species lies, or if hybridization is occurring at the boundary.

Cercocebus lunulatus

Our research team did not observe, or find signs of, *C. lunulatus* in Comoé-Léraba Partial Reserve, nor in any other location. Interviews with Comoé forest guides and farmers living in or near Folonzo, the village closest to the reserve, suggest that *C. lunulatus* may still be present though sightings are rare, even for people who frequent the forest.

Table 1. Primate species reported to occur in Burkina Faso, their IUCN Red List status, and the findings of our surveys. Citations in bold are of primary research; all others are secondary distribution maps.

Species	Common name	IUCN Red List status	Listed as present in Burkina Faso by:	Presence in Burkina Faso (this study, 2012)	Conservation status in Burkina Faso
Galagoides demidovii	Demidoff's galago	LC – Stable	Bearder (2008); Oates (2011)	Presence not confirmed.	Status unknown.
Galago senegalensis	Northern lesser galago	LC – Stable	**Poché (1976)**: present in W National Park, SE; Bearder *et al*. (2008); Oates (2011)	Presence confirmed.	Status unknown.
Cercocebus lunulatus	White-naped mangabey	EN – In decline	**Galat and Galat-Luong (2006)**: present in Comoé-Léraba Partial Reserve, SW; Oates *et al.* (2008b); Oates (2011)	Presence not confirmed.	Highly threatened by hunting and habitat fragmentation. Possibly extirpated.
Papio anubis	Olive baboon	LC – Increasing	**Poché (1976)**: present in W National Park, SE; Kingdon *et al*. (2008); Oates (2011)	Presence confirmed.	Threatened by hunting. Distribution gap between Comoé-Léraba and Nazinga.
Erythrocebus patas	Patas monkey	LC – In decline	**Poché (1976)**: present in W National Park, SE; **Galat and Galat-Luong (2006)**: present in Comoé-Léraba Partial Reserve, SW; Kingdon *et al*. (2008); Oates (2011)	Presence confirmed.	Only present in small, elusive groups. Extirpated from Pama Partial Reserve.
Chlorocebus sabaeus	Green monkey	LC – Stable	**Galat and Galat-Luong (2006)**: present in Comoé-Léraba Partial Reserve, SW; Kingdon and Gippoliti (2008a); Oates (2011)	Presence confirmed Corroborated by **Haus *et al.* (2013)**: restricted to the west of the Pendjari River.	Threatened by hunting. Extirpated from Koulbi Protected Forest.
Chlorocebus tantalus	Tantalus monkey	LC – Stable	Kingdon and Gippoliti (2008b); Oates (2011)	Presence confirmed Corroborated by **Haus *et al.* (2013)**: restricted to the east of the Pendjari River.	Threatened by hunting.
Colobus vellerosus	White-thighed colobus	VU – Unknown	**Galat and Galat-Luong (2006)**: present in Comoé-Léraba Partial Reserve, SW; Oates (2011)	Presence not confirmed.	Highly threatened by hunting and habitat fragmentation. Possibly extirpated.
Pan troglodytes verus	Western chimpanzee	EN – In decline	Teleki (1989): at least seasonal reports in the southwest; Redmond (2005): presence unknown; Humle *et al*. (2008): possibly extinct; Oates (2011)	Presence not confirmed.	Probably extirpated **(Ginn *et al.* 2013).**

The last reported sighting by an interviewee was in 2010, of seven individuals along the River Comoé.

Colobus vellerosus

We did not observe *C. vellerosus*, nor see any signs of its presence, in Comoé. Each of our five interviewees in or near Comoé told us that *C. vellerosus* used to be more common; three interviewees said that it had been four, 10, and 20 years respectively since they had last observed this species, and two suggested that their numbers have greatly decreased since the inception of AGEREF/CL in 1996.

Table 2. Signs and sightings observed for *Chlorocebus*, *Erythrocebus patas*, and *Papio anubis* across the study sites, by type, and overall encounter rates as groups per kilometer surveyed.

Species	Study site	Sightings	Calls	Tracks	Feces	Feeding	Group encounter rate (groups/km)
Chlorocebus sabaeus	Comoé	3	-	3	1	7	0.054
	Koulbi	1	-	-	-	-	0.021
	Nazinga	5	-	1	-	1	0.104
Chlorocebus tantalus	Pama	3	-	-	-	-	0.062
	Arly	3	-	-	1	-	0.060
Erythrocebus patas	Comoé	-	-	-	-	-	*
	Koulbi	2	2	5	2	15	0.042
	Nazinga	1	-	4	1	-	0.021
	Pama	1	-	-	-	-	0.021
	Arly	1	-	1	1	-	0.020
Papio anubis	Comoé	2	-	5	1	7	0.036
	Koulbi	-	-	-	-	-	*
	Nazinga	8	3	16	6	30	0.166
	Pama	2	3	2	-	-	0.042
	Arly	5	4	3	-	-	0.099

* No direct or indirect observations.

Table 3. Indications of poaching in each study site.

Study Site	Direct	Camp/Stove	Gunshots	Cartridges	Traps	Tracks	Encounter rate (per km)
Pama	-	-	-	-	-	-	-*
Arly	-	1	2	-	-	1	0.079
Comoé	-	3	7	1	-	5	0.290
Koulbi	1	2	6	3	1	9	0.443
Nazinga	-	-	1	-	-	2	0.062

*One *ad libitum* observation of poaching activities.

Table 4. Presence/absence of primates, poaching activities, and *Panthera* for each study site, and encounter rates where available. The following species were not observed nor confirmed through interviews: *Galagoides demidovii*, *Cercocebus lunulatus*, *Colobus vellerosus*, *Pan troglodytes verus*.

Locations	*C. sabaeus*	*C. tantalus*	*E. patas*	*P. anubis*	*G. senegalensis*	*Panthera leo*	*Panthera pardus*	Poaching
Pama	-	P I (0.062	P I° (0.021)	P S I (0.042)	P I	P S (0.042)	-	P* (0)
Arly	-	P S I (0.060)	P S I (0.020)	P S I (0.099)	I	S (0.020)	S (0.020)	S (0.079)
Comoé-Léraba	P S I (0.054)	-	I	P S I (0.037)	I	-	S (0.018)	S (0.290)
Koulbi	P (0.021)	-	P S I (0.042)	-	-	-	-	P S (0.443)
Nazinga	P S I (0.014)	-	P S I (0.021)	P S I (0.166)	I	-	-	S (0.062)

P = Primary signs of presence (sightings); S = secondary signs (tracks, feces, feeding signs, vocalizations); I = Reported present by interviewees. Parenthetical values represent encounter rates: encounter rates for primate species are for groups encountered per km surveyed, whereas encounter rates for predators and poaching activities are signs encountered per km surveyed.

* While we report an encounter rate of zero for signs of poaching in Pama Partial Reserve, we did have one confirmation of poaching activities while we were not carrying out surveys.

° Interviewees confirmed that our sighting of one patas monkey was of a male who has been known to be the last surviving patas monkey in Pama Partial Reserve for possibly ten years.

Poaching

Encounter rates for signs of poaching were highest in Koulbi (0.443/km), followed by Comoé (0.290/km), Arly (0.079/km) and Nazinga (0.062/km) (Tables 3 and 4). Only one *ad libitum* sign of poaching was observed in Pama. Poaching in Burkina Faso is primarily through gun hunting; we found only one trap and no snares. We found an inverse relationship between the signs of poaching and the presence of *P. anubis* and *Chlorocebus*; namely between encounter rates for shotgun shells and encounter rates for both *P. anubis* ($r_s[5] = -0.894$, $p < 0.05$) and *Chlorocebus* spp. ($r_s[5] = -0.900$, $p < 0.05$). The presence of shotgun shells was also negatively correlated with the presence of *Panthera leo* and *P. pardus* ($r_s[5] = -0.894$, $p < 0.05$). We found no relationship between the presence of *E. patas* and encounter rates for signs of poaching. This was likely due to the low overall encounter rates for the species.

Discussion

Illegal Hunting

We were only able to confirm the presence of those species considered "common and widespread," but we suggest that their distributions in Burkina Faso are patchy and relatively low, primarily due to hunting. The impact of illegal hunting of primate populations should not be underestimated (Oates 1996), and in some cases it can be more detrimental than habitat alteration and loss (Fa *et al*. 2003; Kümpel *et al*. 2008). This may be particularly true for opportunistic and omnivorous primates that more readily adapt to human habitat alteration. These species, for example *Papio* ssp. and *Chlorocebus* ssp., tend to receive little conservation attention. Even species considered to be common and widespread, however, are susceptible to local extinction; the lack of *P. anubis* and *Chlorocebus* in Koulbi Protected Forest and *E. patas* in Pama Partial Reserve may represent two such local extinctions.

Figure 5. *Chlorocebus tantalus* in Arly National Park, Burkina Faso. Photo by Josh Robison.

West African populations of baboons, guenons, and patas monkeys are not well-studied, affording little opportunity for comparative analyses. Encounter rates for *P. anubis* in Gashaka-Gumti, Nigeria, have been reported as 0.04–0.28 groups/km surveyed (Dunn 1993, cited by Oates 2011), and our highest encounter rates across five locations did not exceed 0.17 groups/km. This provides only one comparison, however when viewed in the context of (a) high encounter rates for signs of poaching, (b) highly limited or non-existent law enforcement or anti-poaching patrols in protected areas, (c) a strong inverse relationship between *P. anubis* and *Chlorocebus* encounter rates, and poaching activities, and (d) low and/or decreasing populations of other large mammals (for example, *Panthera leo*: Henschel *et al*. 2014 and this study; *Loxodonta africana*: Bouché *et al*. 2011 and our interviews; *Pan troglodytes verus*: Ginn *et al*. 2013), we suggest that these "common" Burkinabé primates may in fact be threatened.

The threat of hunting in Burkina Faso may not be limited to illegal hunting. Several parks, including Pama Partial Reserve, Comoé Léraba Partial Reserve (Fig. 6), and Nazinga Game Ranch and Reserve, permit legal, seasonal hunting of primates. While these were reported to be primarily opportunistic additions to hunting for larger game such as kob antelope (*Kobus kob*), these locations (except for Nazinga) tend to have little or no procedures for ongoing assessments of primate populations to ensure sustainable permit provisions. Permit hunting in reserves can be an important source of income, and in Burkina Faso, where wildlife tourism is low compared to many African nations, this funding source may be of critical importance until alternative systems such as ecotourism are developed.

Our interviews with park officials and anti-poaching patrollers revealed an overall lack in anti-poaching patrol effort and the inability of patrollers to enact the laws in place. These individuals are often placed in dangerous situations, but have been fined or even imprisoned for retaliatory action. Effective and consistent law enforcement in protected areas is vital to species' survival (Hilborn *et al*. 2006; Tranquilli *et al*. 2011; N'Goran *et al*. 2012). We recommend that the MOE implement a uniform system for assessing and managing wildlife across its protected areas (for example, incorporating data collection into anti-poaching patrols) and that anti-poaching patrollers are trained as law enforcement officials with the authority to detain and prosecute individuals.

Figure 6. The hands and feet of *Papio anubis* (left) found near a poaching camp (right) in Comoé-Léraba Partial Reserve, Burkina Faso. Photos by Laura Ginn.

Crop feeding

It is important to note that our relatively low encounter rates could be, at least in part, a reflection of primate distribution in response to agricultural expansion. Wildlife, especially those species with a proclivity toward feeding on crops, may cluster around agricultural zones and lead to low encounter rates in forest zones. Each protected area we surveyed was surrounded by agriculture, and *P. anubis* and *E. patas* were consistently reported to be avid crop feeders across the entire region surveyed. In the central and east regions, participants also reported *P. anubis* eating livestock. The most commonly stated means of preventing crop feeding was guarding, mostly by farmers or their children, and in some cases by dogs. Although trapping and/or killing were reported as methods, this was not common. Several studies have found that guarding can be effective, but the unfortunate down side to guarding is that it often falls to the children to guard, and they may be kept from school as a result (Hill 2004; Strum 2010). Guarding by adults can be just as detrimental to a family's livelihood, by keeping an individual from otherwise being productive or working for pay, and by increasing the risk of malaria by guarding at night (Hill 2004), a measure reported as necessary by participants in the villages surrounding the parks of Pama and Arly.

Cercocebus lunulatus

The Endangered *Cercocebus lunulatus* is likely nearing extinction in Burkina Faso. Comoé-Léraba is the only known location for the species in the country, and it was last seen in 2010 by a local guide, who reported seeing seven individuals along the river Comoé. Prior to this, the only sighting was by Galat and Galat-Luong (2006) in 2005. Interviews with guides and management revealed no other sightings of *C. lunulatus* in the park. It is possible that there is or was only one small group that migrated north from Comoé National Park (CNP) in Côte d'Ivoire (Fig. 1), where they were last reported in 2002 (Fischer *et al*. 2002). There were once plans to connect the unprotected land between CNP and Comoé-Léraba to form one large, protected area that would increase protection for the species in each reserve (Galat and Galat-Luong 2006) and provide a corridor to connect populations of animals that reside in both parks. Our interviews with AGEREF/CL revealed no plans currently underway; this leaves a 30-km gap of unprotected, unmanaged land which likely experiences heavy poaching, as do Comoé (this study) and CNP (Fischer 2004). With all populations of *C. lunulatus* experiencing high levels of fragmentation and hunting (Oates *et al*. 2000; Fischer *et al*. 2002; Gonedelé Bi *et al*. 2008; Oates 2011), the potential for safe travel between distant forest patches to maintain populations and genetic diversity is decreasing rapidly. Without a corridor connecting CNP and Comoé, and a drastic reduction in poaching in this region, the single group of *C. lunulatus* living in Comoé could be the last in the country.

Colobus vellerosus

Colobus vellerosus is in a similarly dire situation. We found no signs of *C. vellerosus* in Comoé, and interviews suggested they have been rapidly declining over the past 15 years. The last reported sighting was by a local guide in 2008. Other guides reported having not seen *C. vellerosus* for more than ten years. It is possible that their decline is due to the political unrest that began in Côte d'Ivoire in 2002; at this time, poaching in northern Côte d'Ivoire greatly increased, and decimated mammal populations in CNP (Fischer 2004). *Colobus vellerosus* only occurs in fragmented locations across Côte d'Ivoire, Ghana, Togo, and Benin (Galat and Galat-Luong 2006; Campbell *et al*. 2008; Oates 2011) and is susceptible to hunting (Refisch and Koné 2005). Vocalizations of both *C. vellerosus* and *C. lunulatus* have recently been heard in CNP, Côte d'Ivoire (K. Linsenmair, pers. comm.). After several years without active research or law enforcement, and

heavy poaching, this is evidence of their resilience. This population should be investigated further and, with increased protection along the border of Côte d'Ivoire, these species may be able to extend and survive in Burkina Faso.

Conclusion

We have confirmed the presence of *Galago senegalensis, Papio anubis*, *Erythrocebus patas*, *Chlorocebus sabaeus* and *C. tantalus* in Burkina Faso. We were unable to confirm the presence of *Galagoides demidovii, Cercocebus lunulatus*, *Colobus vellerosus*, and *Pan troglodytes verus* (see Ginn *et al.* 2013). If small populations of *Cercocebus lunulatus* and *Colobus vellerosus* remain in southwestern Burkina Faso, they are highly threatened by hunting and habitat loss and degradation. Like chimpanzees, they are either already extirpated or nearing extirpation from the region. More in-depth surveys are needed to determine the actual abundance of primates and contribute to the regional distribution information for large-scale species monitoring. We recommend that, in the forests where anti-poaching patrols are regularly conducted such as Nazinga, patrol units are trained in data collection techniques in order to combine anti-poaching patrols and reconnaissance surveys to maintain encounter rates for all mammal species that can be monitored over time, and to ensure that legal hunting practices are not negatively impacting primate populations. Studies of the human-wildlife interactions in Burkina Faso, and in ways to mitigate the effects of human-wildlife conflict, are necessary to alleviate the negative effects of agricultural expansion for both humans and non-human primates as human populations increase.

Acknowledgments

We thank Conservation International's Primate Action Fund (Grant #62007), Primate Conservation, Inc. (Grant #1046), and the Mohamed Bin Zayed Species Conservation Fund (Grant #12053597) for their generous financial support, the Nocturnal Primate Research Group and Fisco Tools, Ltd. for the donation of equipment, and the Burkina Faso Ministry of Environment and *Centre Nationale de Recherche Scientifique et Technologique*, the Ranch de Gibier de Nazinga, and the AGEREF/CL for permission to conduct this research expedition. Thank you to Josh Robison, Hangari 'Ahandi' Thiombiano, Bernard Ouedrago, Noémie Cluytens Sion, and Giovanni Caruso for data collection and translation. An additional thank you to Ian Redmond for guidance, and to Anthony Rylands for his helpful editorial advice.

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Received for publication: 30 December 2014
Revised: 29 January 2015