A Qualitative Assessment of Guinea-Bissau's Hunting History and Culture - and Their Implications for Primate Conservation

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Abstract: Illegal hunting and trade threaten the high biodiversity of Guinea-Bissau (GB) in West Africa, particularly for nonhuman primates (NHP). Primate carcasses are sold at bushmeat markets and at restaurants and the primate pet trade is active. Traditional medicine practitioners also use NHP body-parts further promoting the commerce of NHP skins. A better understanding of hunting and related trade activities, including the profile of hunters and their motivations, would improve NHP conservation in GB. However, information on commercial hunting is incomplete due to a general unwillingness to describe illegal activities by the local communities. Here, we investigated aspects of hunting practice and related commercial activities targeting NHP in GB by collecting qualitative ethnographic information using semi-structured interviews. Participants were asked about hunted species, techniques and hunting locations, their motivations to hunt wild NHP, uses of carcasses, and their perceptions on the demographic trajectory of hunted species. Eight participants in the study listed species hunted in GB, which included a total of seven NHP. Hunting areas described were spread across southern GB and included locations within the limits of national protected areas and formalized ecological corridors. Participants mentioned the trade in NHP meat at bushmeat restaurants as the primary motivation for primate-targeted hunting, with the exception of western chimpanzees, which are specifically targeted for the exotic pet trade. Several strategies are used in hunting NHP, including traps, firearms, and hunting dogs. The majority of hunted NHP were perceived as having declined in population size during recent decades. Episodes when military groups hunted NHP intensively using more sophisticated weapons and methods in the 1980s were also described. This study highlights how hunting and related activities are complex and multi-dimensional and illustrates the use of ethnographic methods to improve knowledge about illegal and concealed practices impacting NHP conservation. Our results suggest an urgent need to raise awareness of local communities and subsistence hunters living within protected areas about the environmental and social impacts of hunting.

Key words: *Cercopithecus campbelli, Chlorocebus sabaeus, Papio papio*, extinction risk, bushmeat, pet trade, commercial trade, war

INTRODUCTION

Commercial hunting for bushmeat, exotic pets, and body-parts is amongst the most important proximate causes of the worldwide decline of nonhuman primates (primates or NHP hereafter) (Lootvoet *et al.* 2015; Estrada *et al.* 2017). When compared to many other mammals, NHP display

intrinsic biological and ecological traits that increase their vulnerability to local extinction by hunting (Chapman *et al.* 2006; Lootvoet *et al.* 2015; Estrada *et al.* 2017). NHP that live in large social groups, vocalize frequently, or use shared sleeping sites are more visible to hunters, increasing harvesting rates of individuals during hunting episodes (Chapman *et al.* 2006). Moreover, although behavioural resilience allows NHP populations to persist in human altered habitats at considerable densities after more sensitive species have disappeared (Fa *et al.* 2005), the low reproductive rates of NHP (via long gestation and generation times) is expected to constrain recovery of hunted NHP populations (Fa & Brown 2009; Lootvoet *et al.* 2015; Estrada *et al.* 2017).

Along with intrinsic vulnerability, hunting offtake and extinction risk may be dependent on local hunting systems, which can be attributed to hunter behavior (e.g., the temporal and spatial distribution of activities), the type of equipment used, and the underlying motivation and selection process for targeted species (Kümpel *et al.* 2009; Dobson *et al.* 2019). Local hunting systems may be influenced by external factors, in which the hunter´s social, environmental, and economic circumstances are considered, and by a set of intrinsic factors linked to the hunter´s profile (Dobson *et al.* 2019). The hunters´ intrinsic factors may include their levels of environmental awareness and education (e.g., Bachmann *et al.* 2020), health and nutritional needs (e.g., Remis & Robinson 2014), value orientations, cultural habits, traditions and personal preferences (e.g., van Vliet 2018), past experience and skills, and perceived past or present species abundance (e.g., Jerozolimski & Peres 2003). Characterizing hunting behaviour, hunter motivations and the social, cultural, and historical aspects of local hunting systems is important to understand human/NHP interactions and to improve NHP conservation locally (Setchell *et al.* 2017).

In Guinea-Bissau (GB), West Africa, at least ten NHP occur (Gippoliti & Dell'Omo 2003; Casanova & Sousa 2007; Colmonero-Costeira *et al.* 2019; Ferreira da Silva *et al.* 2020b, see Table 1), including the endangered and emblematic western chimpanzee (*Pan troglodytes verus*) and two colobus monkeys (*Colobus polykomos* and *Piliocolobus badius temminckii*). NHP are generally threatened by habitat loss and fragmentation and by hunting activities in the country (Gippoliti & Dell'Omo 2003; Ferreira da Silva *et al.* 2014; Bersacola *et al.* 2018), but the degree to which each threat affects the persistence of populations is virtually unknown for most species (but see Ferreira da Silva *et al.* 2014; Minhós *et al.*

2016). It is commonly known that a large quantity of NHP carcasses is sold at bushmeat markets in the capital (Bissau) or in other important urban areas such as Buba, Quebo, Empada, Catió, Bambadinca, Bubaque, and Bedanda (Casanova & Sousa 2007; Minhós *et al.* 2013b). Consumption of bushmeat along with alcoholic drinks (a practice locally known as "*Abafatórios*" or "*Bafatório*") is carried out in restaurants scattered throughout urban areas (Starin 2010; Minhós *et al.* 2013b; Ferreira da Silva *et al.* 2021). A DNA barcoding survey of the two main bushmeat markets in the capital city in 2010 revealed that six primate species are traded (Minhós *et al.* 2013b). Moreover, NHP represent approximately 92% of all species consumed at specialist bushmeat restaurants in the south of the country (Ferreira da Silva *et al.* 2021). In addition to trade for food consumption, NHP body parts are sold in urban markets for traditional medicine (Sá *et al.* 2012) and an active exotic pet trade of young individuals has been suggested through the common observation of NHP kept as pets in homes (Hockings & Sousa 2013; Ferreira da Silva *et al.* 2020a).

Although commercial NHP hunting is widely practiced in GB, this activity is illegal under the law (Anon. 2011). Locals, hunters, or vendors are hesitant to report illegal trade activities (Costa 2010) and usually do not allow the direct and systematic observation of activities (Minhós *et al.* 2013b; Ferreira da Silva *et al.* 2021). Accordingly, data on commercial hunting and bushmeat consumption have been gathered from reports (e.g., Casanova & Sousa 2007; Amador *et al.* 2014), during short visits to bushmeat trading locations, and via remote molecular techniques (Minhós *et al.* 2013b; Ferreira da Silva *et al.* 2021) and has important gaps. Previous studies suggested that local communities hunt NHP in GB rural areas to trade meat and obtain cash, and also to prevent crop-raiding of oranges, cashew, pineapple, cassava, and species from other orchards (see Amador *et al.* 2014; Casanova *et al.* 2014) but few studies have investigated commercial hunting. NHP species are targeted at different rates (e.g., Casanova & Sousa 2007; Minhós *et al.* 2013b; Amador *et al.* 2014) but the rationale behind hunter preferences is not clear. Moreover, the location of hunting areas and time of year when most hunting occurs have been largely unreported. For instance, the origin of carcasses found in markets in Bissau was described to be "the south of the country" (Minhós *et al.* 2013b), which is a sizable region where the majority of NHP occur (Gippoliti & Dell'Omo 2003). Among other limitations, incomplete data on NHP-targeted hunting prevents species-specific extinction risk

evaluation and the identification of over-hunted populations.

As direct observation of hunting practices is difficult or unfeasible, the use of social science methods may be a useful approach to access information on sensitive topics surrounding NHP conservation (Drury *et al.* 2011; Setchell *et al.* 2017). Qualitative ethnography, a group of methods including semi-structured interviews, emphasizes the attributes of information associated with each interview and can be based on a small sample size (Drury *et al.* 2011). Semi-structured interviews aim to describe a respondent's own experience and view of reality in detail (Bernard 2006; Drury *et al.* 2011). These methods contrast to qualitative approaches (such as questionnaires), which use a large sample to attempt a statistical analysis at the population level (Drury *et al.* 2011; Guess *et al.* 2013). The integration of quantitative biological and qualitative social data within the field of ethnoprimatology (Fuentes 2012) has allowed a deeper understanding of conservation issues than single approach studies (Setchell *et al.* 2017; Hofner *et al.* 2018).

The main goal of this study was to describe aspects of hunting practices focusing on NHP and the context in which hunting occurs in GB using qualitative information collected during semi-structured interviews. We aimed to: 1) evaluate which species are frequently hunted and the use of carcasses; 2) identify possible hunting locations; 3) improve current knowledge on hunting techniques and motivations; and 4) discern local perceptions of the demographic dynamics of hunted species and hunting history in GB. Our ultimate goal is to expand the information on illegal hunting and related trade activities in GB and suggest directions for research and management actions to improve primate conservation in the country.

METHODS

The study area included Cantanhez Forests National Park (CNP, north to south limits: 11.389835° -14.810265° to 11.010386° -15.234415°), and Cufada Lagoons Natural Park (CLNP, north to south limits: 11.753801° -15.185281° to 11.627405° -14.903575°) (Figure 1). Both protected areas are managed by a governmental agency (IBAP - Institute for Biodiversity and Protected areas) and are located in southern GB, where commercial hunting supplying the bushmeat markets in the capital city has been described (Minhós *et al.* 2013a). CNP is situated on a peninsula located in the Tombali administrative region (106,767 ha total

area). This area was a combat zone during the war of independence against Portuguese colonization (1963 – 1974), was classified as a hunting reserve in 1985, and was formally established as a protected area in 2011 (IBAP 2014). CNP has about 24,000 residents, mainly from the Nalus ethnic group (the oldest ethnic group in CNP and considered "the owners of the land," translated from the Creole expression *donos di tchon*) plus the Balanta, the Tandas, the Fulas, and the Sussos (IBAP 2014). Communities living inside CNP depend on subsistence agriculture and cash crops. Bushmeat hunting and consumption, collection of forest resources and slash-and-burn farming were common before the establishment of the park and these activities were regulated at the time of the study. Restrictions on these activities were not perceived as positive by local communities and farmers were not being compensated for wildlife-related crop losses (Costa *et al.* 2017).

CLNP (total area of 89,000 ha, formally established in 2000) is located in the administrative region of Quinara, delimited by Fulacunda village in the east and southwest region and by Buba village in the northeast (IBAP 2014). In 2006, there were approximately 5128 residents mostly of the Beafada ethnic group (considered the "owners of the land") plus the Mandinga, Fula, Balanta, Majanco, and Papel, distributed in 33 villages (Amador *et al.* 2014; IBAP 2014). Local communities depend on subsistence agriculture, cash crops (cashew), fishing, hunting, and livestock (Amador *et al.* 2014). Subsistence hunting of a limited number of animals for family consumption is allowed within CLNP during the dry season (Amador *et al.* 2014). Penalties for those observed hunting outside the dry season or for hunting for trade include seizure of weapons and meat (Amador *et al.* 2014).

Semi-structured interviews (Bernard 2006; Guess et al. 2013; Setchell *et al.* 2017) were conducted between 2008 and 2010 and were administered by MJFS. Respondents were identified using a "snowball" approach (i.e., participants identified other community members who could describe hunting practices). Interviews were conducted in Creole, Portuguese, or Susso (the latter were translated to Creole by an interpreter) and recorded using an electronic device after formal authorization by all participants. Here, one US dollar ($) equated to 542 West African CFA francs (FCA). When a different currency was mentioned, we requested a conversion to FCA.

The semi-structured interviews started by gathering socio-economic information for each participant (age, place of birth, number of family
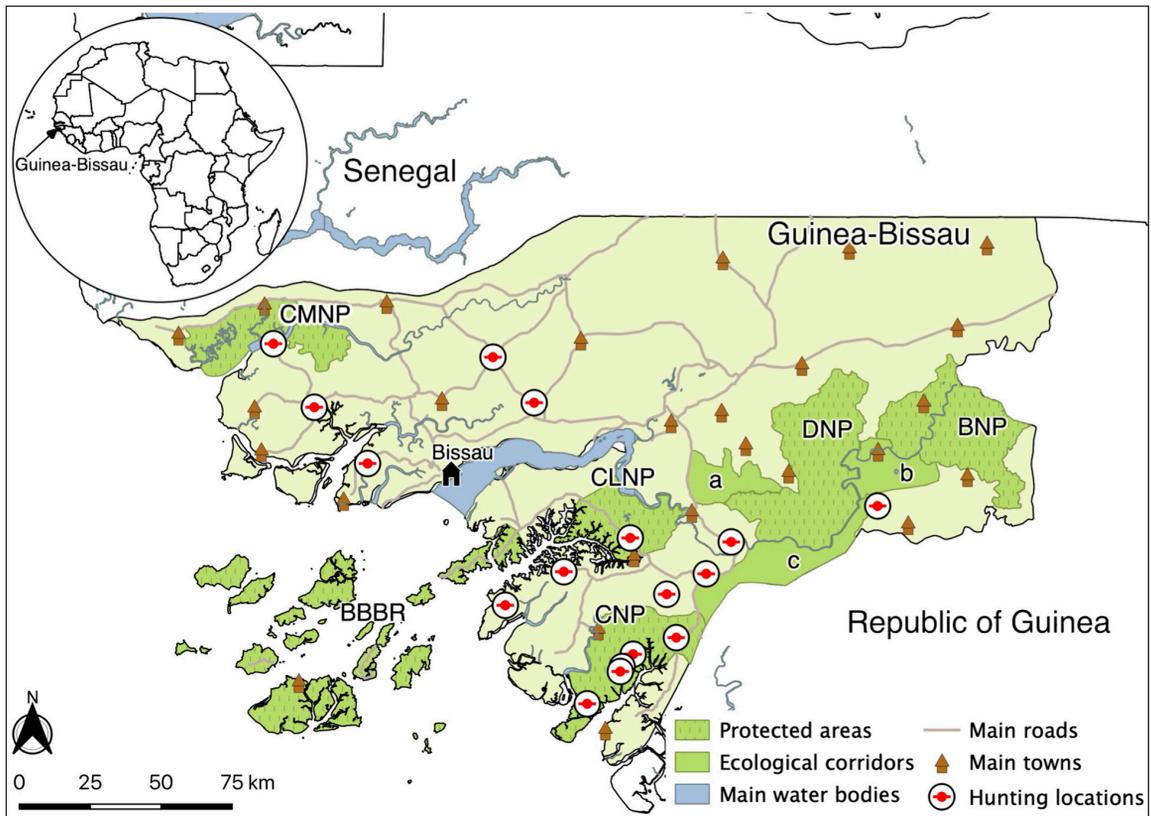
Figure 1. Location of Guinea-Bissau in West-Africa. Map showing Guinea-Bissau and main water bodies, paved roads and towns. The capital Bissau is indicated. Also illustrated: the network of protected areas (CMNP - Cacheu mangroves Natural Park; BBBR (Bolama Bijagós Biosphere Reserve), CLNP - Cufada Lagoons Natural Park; CNP -Cantanhez Forests National Park; DNP - Dulombi National Park; BNP - Boé National Park, a: Cuntabane ecological corridor, b: Salifo ecological corridor and c: Tché-Tché ecological corridor). Approximate locations of hunting areas (mentioned by respondents) are identified by a red dot symbol.

members, main daily activities) and focused on hunting practices before the implementation of protected areas to avoid posing incriminating questions on more recent activities. Participants were asked information on which species were hunted, trade prices for carcasses, their experience and hunting behaviour, and on the location of hunting areas. We specifically asked about hunting practices targeting NHP if not spontaneously referred to. Questions were open-ended and first addressed broad concepts (e.g., "Which animals are hunted? Which NHP are hunted?") and, subsequently, included species-specific questions (e.g., "What can you tell me about the hunting of baboons?"). We also enquired about which species were observed in the past and their perceptions on current abundance. When in doubt of the identification of species named in Creole, we requested the identification of the species using drawings from Kingdon's (2005) African mammals field guide.

Interviews were transcribed verbatim from Creole to English by MJFS. Interviews were studied and transcripts read several times to ensure a correct interpretation and contextualization of the participants' statements (Rubin & Rubin 2004). We use Bardin's proposed content analysis (following Hsieh & Shannon 2005) and defined codes capturing key thoughts or concepts during data analysis. Codes were organized into the following categories: i) description of participants' background, main income activities and experience; ii) description of hunting activities, including a list of hunted species, hunting locations, time of year when hunting took place, techniques and procedures to process carcasses; iii) respondents' motivations to hunt and use of body parts, their preferences towards species and quantities obtained; and iv) the participants' description of local hunting history, perceptions of changing presence and abundance of hunted species.

All interviews followed ethical guidelines proposed by the Association of Social Anthropologists of the UK and the Commonwealth (ASA). All participants were informed about the aims of the study and that they could withdraw consent

at any stage of the research. Oral informed consent to participate and to record interviews was obtained before beginning each interview. Confidentiality and anonymity, including home village and activities, were guaranteed to all respondents. Interviewees were not paid to participate in this study. Original records of interviews and field notes were coded for anonymity purposes and securely stored. All interview data saved in electronic documents were stored and password protected. Research in protected areas in Guinea-Bissau, the timeline, and the activities and methods used were approved by IBAP.

RESULTS

Seven semi-structured interviews were conducted, which were on average 66.12 minutes long. A total of 529 minutes of interview time was transcribed. Quotes from participants are in italics and identified in the text using quotation marks and/or using their identification code (e.g., ID #N). Interruptions in the participant's quote are indicated by (…) and supplementary notes by the authors are in square brackets or after (e.g.,).

The age of the hunters ranged between 34 and 80 years old. With the exception of ID #5 and ID #6, their birthplace did not correspond to where they were living at the time of the interview. They were all married and responsible for sustaining a family. Although two described their main income activities to be directly connected to hunting (e.g., full-time hunters and hunting guides for foreigners), most of the participants defined themselves as having multiple occupations, including farming and fishing - "*I am a farmer. This is my work. I grow rice, peanuts and cassava*" (ID #4) or "*I am hunter, fisherman and married*" (ID #7). All interviewees started to hunt at a young age (the youngest being 15 years old) and, with the exception of one, all had hunted for more than 40 years. They hunted using firearms and reported employing different types during their lifetime: 12-gauge ammunition shotguns (locally named "*calibre 12*"), craftsman guns (mentioned as being about five times cheaper), and weapons usually used by military forces during the war of independence (i.e., against Portuguese colonisation, 1963 to 1974), such as "*mausers,*" "*automatic,*" "*AKA*," "*AKA 47*," and "*Kalashnikov*" rifles. Most of the interviewees owned their guns. One reported that he borrowed a shotgun from colleagues when necessary because the park guards had seized his shotgun. They typically learned hunting methods from older family members or older men living in

their community, locally called in Creole "*homem garandi*." One learned how to hunt with his grandmother, and another learned how to shoot firearms at a Portuguese army headquarters during the war of independence. Two reported targeting NHP frequently.

Hunting activities

Twenty non-primate species and seven NHP were identified as being hunted (Table 1). Hunters mentioned targeting large mammals such as the Lake Chad buffalo (*Syncerus caffer brachyceros)*, gazelles (*Tragelaphus spekii* or *Kobus kob)*, and in one case, elephant (*Loxodonta africana*) before smaller species (e.g., nonhuman primates, Table 1). Hunting of larger animals was generally associated with a memorable hunting event that was spontaneously described. Hunting areas referred to were spatially spread (Figure 1) and were chosen because of the presence of certain species and constrained by the action of official personnel and law enforcers from IBAP. Hunting was reported as taking place all year round (dry and wet season) and firearms (e.g., 12-gauge shotguns), nets, and traps (locally called in Creole "*lastros*") (Table 1) were used. Hunting practices targeting NHP occurred during the night at sleeping sites or during the day at drinking spots and at the edge of mangrove forests (e.g., hunting targeting green monkeys, *Chlorocebus sabaeus*). Baboons (*Papio papio*) were described to be hunted by teams with the help of dogs: "*You go to the place where baboons often sleep. You go there and shoot your weapon (...). Sometimes, we imitate the sound of baboons and they (...) answer back. (...) Dogs chase baboons. They grab them or baboons may climb a tree where we shoot at them*" (ID #3). To preserve the meat for several days, the primate's hair is usually burnt and removed with a blade, and the carcasses are opened from the neck to the hips along the ventral side to remove the internal organs.

Hunting motivations and preferences

Participants hunted wildlife to consume meat in their households, to distribute the meat in nearby villages, and to trade the animal's meat and body parts (e.g., horns, skin) (Table 1). The carcasses could be sold at nearby villages or at urban centres, such as Bissau and Buba, or to drivers on the main roads that connect to the capital city. NHP hunting was described to be a widespread activity to obtain money quickly and solve "*urgent problems.*" Participants mentioned that immature and inexperienced hunters were mostly involved in these practices. Notably, the youngest hunter (ID

Table 1. List of hunted species referred to by respondents during interviews (primate species are highlighted in bold). Guinea-Bissau (GB) common names in Creole and the English name are indicated, along with the scientific name. Hunting techniques and use of carcasses referred to during interviews and the participants' perceptions regarding current abundance when compared to the past is also indicated. CLNP – Cufada Lagoons Natural Park, CNP – Cantanhez Forests National Park. Note that participants were not asked to rank species according to their relative abundance. The global conservation status (CR – Critically Endangered; E – Endangered; V – Vulnerable, NT – Near Threatened, LC – Least Concern) by the International Union for Conservation of Nature (IUCN) global and year of the latest assessment in between brackets is indicated along with the citation and the global population trend (D – decreasing, I – increasing, S – stable, U – unknown) as established by IUCN (http://www.iucnredlist.org/). * indicates global assessment for the species and not for the subspecies.

GB Creole Name	English Name	Scientific Name	Hunting Technique	Use	Perception of Current Abundance Compared with the Past	Global Conservation Status and Year Assessed	Red List Reference	Global population trend
Baka di matu/ bufalu	Lake Chad Buffalo	*Syncerus caffer brachyceros*	Shotgun	Meat consumption	Disappeared	NT (2018)*	IUCN SSC Antelope Specialist Group (2019)	D
Kabra di matu	Maxwell's Duiker	*Philantomba maxwelli*	Shotgun	Meat consumption	Still abundant (CNP) Decreasing (CLNP)	LC (2016)	IUCN SSC Antelope Specialist Group (2016a)	D
Gazela-pintado	Western Sitatunga, Marshbuck	*Tragelaphus spekii*	Shotgun	Meat consumption	Decreasing	LC (2016)	IUCN SSC Antelope Specialist Group (2016b)	D
Gazela di lala	Buffon's Kob	*Kobus kob*	Shotgun	Meat consumption	Disappeared/ decreasing	LC (2016)	IUCN SSC Antelope Specialist Group (2016c)	D
Frintamba	Red-flanked Duiker	*Cephalophus rufilatus*	Shotgun	Meat consumption/ Trade of horns for traditional medicine	Decreasing	LC (2016)	IUCN SSC Antelope Specialist Group (2016d)	D
Muntu	Western Yellow-backed Duiker	*Cephalophus silvicultor*	Shotgun	Meat consumption	No information	NT (2016)	IUCN SSC Antelope Specialist Group (2016e)	D
Lifanti	African Savannah Elephant	*Loxodonta africana*	Shotgun	Meat consumption	Disappeared (CNP); Still present (CLNP)	EN (2016)	Gobush *et al.* (2021)	I

Table 1. List of hunted species referred to by respondents during interviews. (Continued)

Local name	Common name	Scientific name	Method	Use	Detection/Status	IUCN	Reference	Code
Pis-kabalu	Common Hippopotamus	*Hippopotamus amphibius*	Shotgun	Meat consumption	Easy to detect	V (2017)	Lewison & Pluháček (2017)	S
Lagartu	Nile Crocodile	*Crocodylus niloticus*	Shotgun/Nets	Skin trade	Harder to trap	LC (2019)	Isberg *et al.* (2019)	S
Purku di matu	Red River Hog	*Potamochoerus porcus*	Shotgun	Meat consumption	Easy to detect	LC (2016)	Reyna *et al.* (2016)	D
Purku di matu	Common Warthog	*Phacochoerus africanus*	Shotgun	Meat consumption	Not mentioned	LC (2016)	de Jong *et al.* (2016)	D
Sinsin	Defassa Waterbuck	*Kobus ellipsiprymnus*	Shotgun	Meat consumption	Decreasing	LC (2016)	IUCN SSC Antelope Specialist Group (2016f)	D
Boka-branku	Roan Antelope	*Hippotragus equinus*	Shotgun	Meat consumption	Disappeared, decreased	LC (2017)	IUCN SSC Antelope Specialist Group (2017)	D
Purku-spinha	Crested Porcupine	*Hystrix cristata*	Shotgun	Meat consumption	Not mentioned	LC (2016)	Amori & De Smet (2016)	U
Pangolim	Common African Pangolin	*Manis tricuspis*	Shotgun	Meat consumption	No information	E (2019)	Pietersen *et al.* (2019)	D
	Giant Pangolin	*Smutsia gigantea*	Shotgun	Meat consumption	Not mentioned	E (2019)	Nixon *et al.* (2019)	
Farfana	Greater Cane Rat	*Thryonomys swinderianus*	Shotgun	Meat consumption	Not mentioned	LC (2016)	Child (2016)	U
Galinha di matu	Helmeted Guinea Fowl	*Numida meleagris*	Shotgun	Meat consumption	Not mentioned	LC (2018)	BirdLife International (2018)	S
Pis-bus	West African Manatee	*Trichechus senegalensis*	Nets	Meat consumption	Not mentioned	V (2015)	Keith Diagne (2015)	U
Onsa	Leopard	*Panthera pardus*	Shotgun	Meat consumption/Skin trade	Harder to detect	V (2020)	Stein *et al.* (2020)	D

Table 1. List of hunted species referred to by respondents during interviews. (Continued)

Macaco Kon	Guinea Baboon	*Papio papio*	Shotgun/ Traps/Dogs	Meat trade and consumption/ Pet trade/ Skin trade for traditional medicine	Harder to detect, decreasing, still abundant	NT (2020)	Wallis *et al.* (2021)	U
Fatangu	Western Red Colobus	*Piliocolobus badius temminckii*	Shotgun	Meat consumption/ Meat trade	Almost disappeared	E (2020)	Minhós *et al.* (2020)	D
Santcu-fidalgu	Western Black-and-White Colobus	*Colobus polykomos*	Shotgun	Meat consumption/ Meat trade	Almost disappeared	E (2020)	Gonedelé *et al.* (2020a)	U
Santcu di tarafe	Green Monkey	*Chlorocebus sabaeus*	Shotgun	Meat consumption/ Meat trade	Harder to see (only next to mangroves)	LC (2020)	Gonedelé *et al.* (2020b)	S
Santcu-fula	Patas Monkey	*Erythrocebus patas*	Shotgun	Meat consumption/ Meat trade	Still possible to observe (CLNP)	NT (2020)	de Jong *et al.* (2020)	D
Santcu Canculmena	Campbell's Monkey	*Cercopithecus campbelli*	Shotgun	Meat consumption/ Meat trade	More common	NT (2020)	Matsuda Goodwin *et al.* (2020)	U
Dari	Western Chimpanzee	*Pan troglodytes verus*	Shotgun	Pet trade/skin trade for traditional medicine	Increased	CR (2016)	Humle *et al.* (2016)	D

#3) justified his behaviour: "*As a young person, every morning you wake up, but you do not have a job. However, you need clothes, and if you are a smoker, you need cigarettes. If you do not hunt, you will not have anything*" (ID #3).

The consumption of primate meat in restaurants and bars and the associated high profits was mentioned as one of the main motivations for commercial hunting, which in turn is regarded as the leading reason for a perceived rarity of NHP: "*They prepare the monkey with onions and garlic, cook it well (…) then with beer (…) and other drinks, they serve a monkey meat dish. While people are eating, they are buying drinks. They earn lots of money with that. (...) since they started to eat primate meat, they all got killed*" (ID #2). The price of the dish was reported as varying between US $1.58 and $5.54 and the use of primate meat was justified by a lower cost when compared to domestic animals: "*A bullet is US $0.63, a chicken is US $1.85, so it is better to buy a bullet and go hunting*" (ID #5).

Chimpanzees were mentioned to be frequently targeted for the pet trade since an infant chimpanzee could be sold at considerably higher prices than other NHP (e.g., infant chimpanzee: US $46 - 56 vs. infant baboon: US $2.69). Customers were referred to as foreigners ("*white people*"). Infant baboons were not often traded because, as described by participants, they were considered to be "*stupid*" and "*restless*" pets that "*can break everything in the house*" (ID #3). Harvesting live infant chimpanzees was not considered to be a straightforward task: "(…) *it is not easy to catch a chimp baby; you have to kill his mother (...). You need to shoot (…) during the day. You sit down and wait. With mauser* [rifle]*, you can kill the mother without hurting the baby but not with shotgun*" (ID #6).

Regarding preferences to hunt a particular species, respondents initially described that they hunted what they could find: "*We hunters, we don't have feelings because we are hunters. The first thing that you see, you try to shoot it*" (ID #6); "*depends on what God allows you to kill*" (ID #6). Later in the interview, they tended to mention that they would obtain different quantities per species depending on i) the NHP's behaviour after shooting, ii) their body size, abundance and frequency of encounters, iii) the urgency for meat or money, iv) the trade prices, and v) consumer demand. Red colobus was mentioned as one of the easiest to hunt: "*Red colobus. (…) they don't go down* [the tree] *(…) they don't run away and you shoot at them and they fall down, and another one stays in the tree*" (ID #7); "[red colobus] *it could be 10, 20 up to 30, 40. You can't see that number of baboons*" (ID #3). The number of baboons hunted at one time seemed to be constrained by the ability of the group to escape after the first shot, the species' rarity, and difficulties in transporting a large number of carcasses ("*more than five*," ID #3) from the hunting spot due to their large body weight. Participants focused on primate-hunting claimed to hunt "*one or two baboons per day, four or five times a week*" (ID #3). Two preferred to hunt male baboons: "*at the site where they sleep, we look for nothing else than the male baboon. (...) We can then try to get a female, but frequently we shoot the male first*" (ID #3). Regarding consumer demand for NHP, Campbell's monkey (*Cercopithecus campbelli*) was mentioned to be the most consumed primate (ID #3), green monkey meat to be particularly appreciated by customers (ID #2), baboon meat was considered to have an excessively strong smell (ID #7) and, there was little demand for red colobus meat.

Description of bushmeat trade and hunting history

According to the participants, commercial bushmeat trade and consumption started during the 1980s and 1990s. At that time, baboon carcasses could be sold for US $0.44, and a large male baboon could be worth US $0.78 to $2.53. Higher prices were mentioned in more recent trading. Participants reported that a "*large male baboon*" was worth US $8-$11 and a "*female baboon*" was worth US $6.34-$7.44. Other primate species included: "*normal*" sized monkey for US $1.27-$2.53 and "*large*" monkey for US $2.77-$3.69. "*Large*" monkeys could reach higher trade prices in Bissau (e.g., US $33) if sold directly to bushmeat vendors or consumers. The participants described episodes during the 1980s in which militia came from Bissau to the "*south of the country*" to hunt large numbers of animals of different species, such as the red river hog (*Potamochoerus porcus*), the sitatunga (*Tragelaphus spekii*), the Lake Chad buffalo (*Syncerus caffer brachyceros*), the common hippopotamus (*Hippopotamus amphibious*) (ID #2), the red colobus (ID #3) and the Guinea baboon (ID #1), using sophisticated weapons and techniques. In their own words: "*They hunted with Kalashnikov. (…) They would find out where* [baboons] *sleep and would stay, killing, until the sunrise. They (…) filled up the trucks and went to Bissau (…) to gain money*" (ID #2); *"*[militaries came to Cufada?] *Yes, with helicopters. They shot everything in the savannah, and they would catch what they killed. 1985, 1986, 1987, gazela di lala* [Kobus kob] *were finished by them*" (ID #7). *"At that time, they* [militaries] *came to the main road in Cufada. They went hunting wild-pig*

[*Potamochoerus porcus or Phacochoerus africanus*] (...) *we went to see them* (...) *they put in the helicopter, and they go to Bissau*" (ID #3). These episodes would happen when "*militaries did not have any money. They came here just to have something to eat*" (ID #3).

Perceived demographic history of hunted species

When questioned about animals that were currently harder to find, the general response was that all large-bodied species have either decreased in number or were locally extinct (Table 1). Respondents cited the increasing rarity of one species to justify their behaviour of targeting another and described that the lower abundance of large-bodied animals lead to primate-targeted hunting. For example: "[in the 1980s] (…) *you would walk 1 km to see a buffalo. Now, they all ran away because they were shot. So, I need to kill gazelle to eat*" (ID #3). "*At that time [in the 1980s] there were a lot of animals. I would come back with 5-6 gazelles. I would not shoot baboons*" (ID #7); "*Red colobus were more hunted because they were easily found* (…) *I would prefer baboon but the others were easier to detect*" (ID #7). With the exception of Campbell's monkey, which was considered to be the most abundant primate, and the Western chimpanzee, mentioned to be frequently observed currently, participants stated that it was easier to see large numbers of NHP in the past, which for them could be explained as a consequence of hunting-driven mortality and NHP behaviour of avoiding areas located near human settlements. Participants were not asked to rank NHP according to species-specific abundance.

DISCUSSION

This study describes qualitative aspects of hunting practices targeting NHP and related trading activities in GB. Our ultimate goal is to expand the information on illegal hunting and related trade activities in GB and suggest directions for research and management actions to improve primate conservation in the country. This study identified hunted species and possible uses of their body parts, located hunting areas, described techniques and motivations to hunt, and reported interview respondents' perceptions on the demographic dynamics of hunted species. Aspects of local hunting history in GB were also depicted.

Only two of the seven participants described themselves as hunters while the others mentioned farming and fishing as their main occupations. Lack of self-identification as "*hunters*" has been described by participants of past studies at CLNP (Amador

et al. 2014). The respondents in the Amador *et al.* (2014) study were men, mostly belonging to the Balanta ethnic group, who considered themselves as "*amateur*" hunters. According to Amador *et al.* (2014), the respondents did not consider themselves as hunters most likely because they had other occupations, such as farming and fishing, hunted for personal consumption, or do not rely on weapons - in contrast to "*professional*" hunters, who were people working in the bushmeat trade (Amador *et al.* 2014). The participants in our study, although not describing themselves as hunters, described hunting activities in detail and reported owning a gun and to have hunted from a young age, to have learned from older family members (including female hunters), and to have used different types of firearms during their lifetime. Thus, similar to the findings of Amador *et al.* (2014) and, with the exception of the two respondents whose main income was through hunting, the other participants in our study practiced hunting activities and local bushmeat consumption during their lifetimes and were probably experienced subsistence hunters but did not self-identify as hunters because they were not involved in commercial hunting.

The species mentioned by the participants to be harvested/hunted (Table 1) have been identified in previous research, with two important omissions - the sooty mangabey (*Cercocebus atys*) and the spot-nosed monkey (*Cercopithecus petaurista*) (Brugiére *et al.* 2005; Brugiére *et al.* 2006; Casanova & Sousa 2007; Costa 2010; Sá *et al.* 2012; Minhós *et al.* 2013b; Amador *et al.* 2014; Casanova *et al.* 2014). These species were not mentioned by the respondents in this work but are known to be hunted in CLNP and Boé National Park (Amador *et al.* 2014; Ferreira da Silva *et al.* 2020b).

Techniques used for hunting NHP included traps, firearms, and dogs. According to the hunting legislation of the Republic of Guinea-Bissau (Anon. 1980; Anon. 2004), it is illegal to hunt some of the species mentioned in Table 1 (e.g., species classified as rare, to harvest and trade live animals, non-adults of any species, lactating females) and it is illegal to use machine guns for hunting. Our results highlight the need for governmental agencies managing protected areas to educate and raise awareness in local communities about current GB hunting legislation.

Participants mentioned that hunting occurs throughout the year, although stall owners in urban markets in Bissau describe the bushmeat trade to be more active during the dry season (Minhós *et al.* 2013b) and hunters and other men from CLNP

report that they sell NHP carcasses mainly (but not only) during the dry season (Casanova & Sousa 2007; Amador *et al.* 2014). Given our results, one probable reason behind the reduced urban trade of bushmeat during the rainy season is lower accessibility to the south of the country since the roads become impassable at that time.

Hunting hotspots seem to be widespread (Figure 1) but an underestimation of their number is likely. Not only was the information gathered based on the experience of a small number of participants (N = 7) but firearm possession by civilians is common and observations of empty shells or cartridges on forest trails and the selling of shells in village shops (Casanova & Sousa 2007; M.J. Ferreira da Silva and T. Minhós pers. obs. in 2010 and 2015-2017) suggest that hunting occurs in protected areas (Figure 2). The concomitant effect of hunting and habitat loss has been proposed as a driver for modified behaviours observed in several primate species in southern GB, such as the use of mangrove trees as sleeping sites by Guinea baboons (C. Casanova, pers. comm.; Minhós & Ferreira da Silva 2020) and disrupted sex-biased gene-flow patterns (colobus monkeys, Minhós *et al.* 2013a; Guinea baboons, Ferreira da Silva *et al.* 2018). Moreover, the increased rarity of NHP outside protected areas has been suggested by genetic-based population surveys (Minhós *et al.* 2013a; Ferreira da Silva *et al.* 2014). The information gathered suggests that protected areas are in danger of becoming the source of individuals that are hunted outside park limits, via a source-sink dynamic (e.g., Ferreira da Silva *et al.* 2014). Thus, our results suggest that law enforcement should also be extended to the areas functioning as dispersal corridors between protected areas to guarantee the maintenance of demographic connectivity among populations.

All respondents stated that commercial primate-targeted hunting is mainly motivated by the trade of primate meat at restaurants and bars, and this activity was associated with the younger generations and the need to obtain cash quickly. Interestingly, the youngest participant mentioned a lack of stable sources of income to justify primate hunting. The trade of primate meat for Abafatório practices in GB involves an organized supply chain with

Figure 2. A carcass of a Guinea baboon (*Papio papio*). The Guinea baboon is one of the most frequently hunted primates in the country (Minhós *et al.* 2013). After hunting, the hair and the guts are removed to preserve the meat. The tail is used by the hunter to carry the carcass on the back from the hunting spot to the road. The specimen in the photo was found by chance in a forest trail within the limits of a protected area in southern Guinea-Bissau. Photograph by A. Barata, 2006.

multiple actors, including hunters, predominantly female vendors (locally called "*bideiras*" in Creole) who contract/buy primate carcasses from local or commercial hunters and transport them to Bissau to sell in bushmeat markets and at restaurants and bars (Amador *et al.* 2014). Four pieces of primate meat can cost around US $2.63 at establishments in the capital city (Minhós *et al.* 2013b). The meal is considered expensive since most of the population live on less than US $2 per day (World Bank 2020) and, thus, it has been described as a luxury/gourmet practice for urban consumers (Minhós *et al.* 2013b). Our results suggest a different profile for rural Abafatório consumers. The price of primate meat was lower in rural areas (starting at US $1.58 vs. US $2.63 at Bissau) and was preferred over more expensive domestic meat. This result is corroborated by studies carried out in establishments in the south of the country, where primate meat is sold at very accessible prices for locals (Ferreira da Silva *et al.* 2021, Figure 3) and the lower price of bushmeat compared to domestic meat has been described by Amador *et al.* (2014) at CLNP. Considering that the supply/production, conservation, and distribution of domestic meat and fish seems to be insufficient in GB (Costa 2010), the regular supply of rural Abafatório practices with non-bushmeat may not be possible. Further research is needed to understand the underlying cultural and socio-economic differences in the use of primate meat at these establishments in urban and rural areas.

Participants described a low preference for trading infant baboons as pets, in contrast to the common observation of infant baboons and green monkeys in people's houses (Hockings & Sousa 2013; M. J. Ferreira da Silva, pers. obs.). Pet trading of species such as Guinea baboons and green monkeys may be a byproduct of meat-targeted hunting, for instance, when the hunter kills a lactating female for meat and her infant is sold as a pet. Chimpanzees, on the other hand, may be particularly valuable in the exotic pet trade, but do not seem to be hunted for meat consumption (Casanova & Sousa 2007) as in other locations of West and Central Africa. GB nationals perceive chimpanzees as similar to humans (Gippoliti & Dell'Omo 2003; Karibuhoye 2004; Sousa *et al.* 2017), their meat is considered non-edible (Amador *et al.* 2014), and no evidence for the trade of chimpanzee meat was found at surveyed bushmeat markets (e.g., Minhós *et al.* 2013b). Infant chimpanzees and other NHPs tend to live in very poor conditions at people's homes until their death. Law enforcers (e.g., Direcção Geral de Fauna e Flora) claim they cannot seize captive NHPs and apply penalties to their owners since they do not have the capacity to support them and there is no rescue centre in the country. In 2018, the national organizations IBAP and DGFF seized three chimpanzees from private hands and the first translocation for the country of two chimpanzees to an international sanctuary was successful (Ferreira da Silva *et al.* 2020a) (Figure 4).

Hunting by militia during the '80s during which a large number of animals (including NHP) would have been killed by sophisticated methods, were also described. These narratives have been described before in unpublished reports and are thought to occur during periods of political instability when the government interrupted the payment of salaries to public servants and militia used their weapons for hunting "*trucks full of baboons*" and consumed or traded these carcasses in bushmeat markets to replace lost income (Casanova & Sousa 2007). GB experienced political and socio-economic instability during the 80s, the period after the end of the war of independence (1963 – 1974). In post-war periods, spreading of firearms and interruption of livestock production and law may increase hunting of wildlife by civilians and ex-fighters (e.g., Gaynor *et al.* 2016). The relationship of armed military forces and wildlife depletion has been observed before in other locations (McNeely 2003; Brito *et al.* 2018) and might have also contributed to a decrease of primate populations in GB.

A decrease or disappearance of all large-bodied animals in recent decades was mentioned by

Figure 3. Aspect of the meal containing primate meat that is served in restaurants and bars in Guinea-Bissau. Bushmeat is consumed along with alcoholic drinks (a practice locally known as *Abafatório* or *Bafatório*). The bushmeat is cooked in a stew and eaten with bread (see description by participants). Photograph by M. Camará (more details in Ferreira da Silva *et al.*, 2021).

Figure 4. Captive chimpanzees live in poor conditions in Guinea-Bissau. The figure shows photos of Bo, Emilia, and Bella, the three chimpanzees who were seized by IBAP (Institute for Biodiversity and Protected Areas) and DGFF (Direcção Geral de Florestas e Fauna) from private hands. Bo and Bella were successfully relocated to an international sanctuary in 2018 (Sweetwaters chimpanzee sanctuary, Kenya, see Ferreira da Silva *et al.* 2020a). This operation was the first relocation of live chimpanzees to a sanctuary for the country's agencies and was done in collaboration between IBAP (Dr. A. Regalla), the EU-Bissau, H. Foito, MJFS, P. Melo and VetNatura, D. Stiles and PEGAS and was funded by The Born Free Foundation. Photographs courtesy of P. Melo, H. Foito, and C. Casanova. See https://www.youtube.com/watch?v=GxXMk2UPvUM.

interviewees (Table 1), which supports reports from the two most represented ethnic groups in CLNP (Amador *et al.* 2014) and an increased rarity of GB ungulates, elephants, and felids (Brugiére *et al.* 2005; Brugiére *et al.* 2006). The disappearance of large mammals was related to the beginning of primate hunting. At other locations, medium to large-bodied species tend to be preferentially targeted and become overharvested first regardless of frequency of encounters possibly because hunters are inclined to boost profit per unit of effort (measured in time spent hunting and number of cartridges and traps used) (e.g., Peres & Dolman 2000; Topp-Jørgensen *et al.* 2009). Thus, it is possible that, while other larger species disappeared or became rare, generalist and large-bodied NHPs that display high behavioural adaptability persisted and were targeted by hunters. Among GB NHPs, Guinea baboons may be particularly conspicuous for hunters, due to large social groups (e.g., 50-100 in Senegal, Fischer *et al.* 2017) and loud and frequent vocalizations (Byrne 1981) and may represent a more substantial economic revenue to hunters and traders given their larger body mass. Male baboons were said to be targeted first because their larger carcasses could reach a higher price in trading sites. Guinea baboons were probably one of the most targeted NHPs and has been reported by hunters to have substantially decreased over recent decades (Casanova & Sousa 2007, this work). Thus, despite being considered as an adaptable species that is not classified as

Endangered across its range (see Table 1), the Guinea baboon is currently listed as Near Threatened (Wallis *et al.* 2021) and deserves a higher protection status in GB. The Temminck's red colobus monkeys are reported to be easily detected and hunted in GB, with participants mentioning shooting dozens of individuals from one social group in the same hunting event. Although this species is not a primary choice by the consumers for its taste, it seems to be targeted by hunters due to easy access. Participants perceive red colobus to have almost disappeared (Table 1), which supports evidence of population decline found using molecular data for CNP (Minhós *et al.* 2016). The Temminck's red colobus hold an Endangered IUCN Red List conservation status and is considered very susceptible to local extinctions by commercial and subsistence hunting (Linder *et al.* 2021). In GB, hunting activities may be one important cause for the species population decline (Minhós *et al.* 2016).

In contrast to the reports about monkeys, chimpanzees were perceived by study participants to be increasing, which seems to be highly unlikely. The western chimpanzee has been upgraded to Critically Endangered on the IUCN Red List (Humle *et al.* 2016; IUCN 2020). Although population trends are lacking for GB, the western chimpanzee is estimated to have declined approximately by 80% between 1990 and 2014 across its range (Heinicke *et al.* 2019). Most likely, the perception of participants is biased by a higher frequency of encounters with

wild groups promoted by an increase of accessibility to previously remote areas of the forest via habitat loss. Higher frequency of encounters with wildlife in fragmented habitats corresponds with an increasing in reported attacks by chimpanzees on children in southern areas in GB (Casanova *et al.* 2019).

Our study highlights how hunting and related activities are a complex phenomenon, largely affected by the combination of local cultural, economic, and legal factors and the species' biology and demography. We acknowledge some limitations in our study. First, since it was based on a relatively small sample, this information is not representative of all hunters in GB (Rubin & Rubin 2004). Second, interviews were conducted during DNA sampling for a genetic study (Ferreira da Silva *et al.* 2014) that had the logistical support of national organizations usually associated by locals with law enforcement. The hesitation of locals to identify other possible participants could be explained by a fear of exposing friends or family members. Third, most respondents are not systematically part of the commercial hunting supply chain, with only two of the interviewees reporting that their main income was connected to hunting activities. Thus, our results do not directly address commercial bushmeat hunting, which is probably one of the largest threats in the country to the conservation of wildlife and is yet to be well studied.

It is urgent to understand commercial bushmeat hunting in GB since this activity is widespread and has a major impact in the extinction risk of all nonhuman primates (and possibly other large mammals) across Guinea-Bissau. The use of ethnographic qualitative information, as illustrated by this work, has the potential to improve our knowledge on illegal and concealed wildlife trafficking in the dimensions that influence the hunter's choices, decisions, and techniques and can inform managers aiming to improve NHP conservation.

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REFERENCES

Amador, R., C. Casanova & P. Lee. 2014. Ethnicity and perceptions of bushmeat hunting inside Lagoas de Cufada Natural Park (LCNP), Guinea-Bissau. *Journal of Primatology* 3:121.

Amori, G. & K. De Smet. 2016. *Hystrix cristata. The IUCN Red List of Threatened Species* 2016: e.T10746A22232484. Downloaded on 20 September 2021.

Anon. 1980. *Boletim Oficial*. In 20 (ed. República da Guiné-Bissau), Bissau. Guiné-Bissau.

Anon. 2004. *Boletim Oficial*. In 24 (ed. República da Guiné-Bissau), Bissau. Guiné-Bissau.

Anon. 2011. Law decree 5/2011, pp. 1-13, Guinea-Bissau Republic Official Boletim. (ed. República da Guiné-Bissau), Bissau, Guiné-Bissau.

Bachmann, M.E., M.R. Nielsen, H. Cohen, D. Haase, J.A.K. Kouassi, R. Mundry, & H.S. Kuehl. 2020. Saving rodents, losing primates – why we need tailored bushmeat management strategies. *People and Nature* 2: 889–902.

Bernard, H. R. 2006. *Research Methods in Anthropology. Qualitative and Quantitative Approaches.* Altamira Press, New York.

Bersacola, H., J. Bessa, A. Frazão-Moreira, D. Biro, C. Sousa & K.J. Hockings. 2018. Primate occurrence across a human-impacted landscape in Guinea-Bissau and neighbouring regions in West Africa: using a systematic literature review to highlight the next conservation steps. *PeerJ* 6: e4847.

BirdLife International. 2018. *Numida meleagris. The IUCN Red List of Threatened Species* 2018: e.T22679555A132052202. Downloaded on 20 September 2021.

Brito, J., S. Durant, N. Pettorelli, J. Newby, S. Canney, W. Algadafi, T. Rabeil, P.A. Crochet, J.M. Pleguezuelos, T. Wacher, K. de Smet, D. V. Gonçalves, M.J. Ferreira da Silva, F. Martínez-Freiría, T. Abáigar, J.C. Campos, P. Comizzoli, S. Fahd, A. Fellous, H.H.M. Garba, D. Hamidou, A. Harouna, M.H. Hatcha, A. Nagy, T. L. Silva, A.S. Sow, C.G. Vale, Z. Boratyński, H. Rebelo & S.B. Carvalho. 2018. Armed conflicts and wildlife decline: challenges and recommendations for effective conservation policy in the Sahara-Sahel. *Conservation Letters* 11: e12446.

Brugiére, D., I. Badjinca, C. Silva, A. Serra & M.

Barry. 2005. Distribution and status of lions and leopards in southern Guinea Bissau and western Guinea, West Africa. *Cat News* 43: 13–17.

Brugiére, D., I. Badjinca, C. Silva, A. Serra & M. Barry. 2006. On the road to extinction? The status of elephant *Loxodonta africana* in Guinea Bissau and western Guinea, West Africa. *Oryx* 40: 442–446.

Byrne, R.W. 1981. Distance vocalisations of Guinea baboons (*Papio papio*) in Senegal: an analysis of function. *Behaviour* 78: 283–313.

Casanova, C. & C. Sousa. 2007. Plano de acção nacional para a conservação das populações de chimpanzés, cólubus vermelhos ocidentais e cólubus brancos e pretos ocidentais na República da Guiné-Bissau. IBAP, Bissau.

Casanova, C., S. Costa; C. Sousa. 2014. Are animals and forests forever? Perceptions of wildlife at Cantanhez Forest National Park, Guinea-Bissau Republic. In Casanova C. & S. Frias, eds. MEMÓRIA: http://www.socgeografialisboa.pt/wp/wp-content/uploads/2017/11/Mem%C3%B3rias-16.pdf.

Casanova, C. R Sá & J. Sousa. 2019. Wild chimpanzee (*Pan troglodytes verus*) attacks on children in Guinea-Bissau. *Folia Primatologica* 89(3-4): 175–175.

Chapman, C.A., M.J. Lawes & H.A.C. Eeley. 2006. What hope for African primate diversity? *African Journal of Ecology* 44: 116–33.

Child, M.F. 2016. *Thryonomys swinderianus* (errata version published in 2017). *The IUCN Red List of Threatened Species* 2016: e.T21847A115163896. Downloaded on 20 September 2021.

Colmonero-Costeira, I., T. Minhós, B. Djaló, N. Fernandes & M.J. Ferreira da Silva. 2019. Distribuição de primatas não-humanos no arquipélago dos Bijagós, Guiné-Bissau: actualização da presença de Chlorocebus sabaeus, Cercopithecus campbelli e Cercopithecus petaurista buettikoferi em sete ilhas com base em técnicas moleculares não invasivas. *Sintidus* 2: 145–179.

Costa, S. 2010. Social Perceptions of nonhumans in Tombali (Guinea Bissau, West Africa): a contribution to chimpanzee (*Pan troglodytes verus*) conservation PhD thesis, University of Stirling, UK.

Costa, S., C. Casanova & P. Lee. 2017. What does conservation mean for women? The case of the Cantanhez Forest National Park. *Conservation and Society* 15(2): 168–178.

de Jong, Y.A., D. Cumming, J. d'Huart & T. Butynski. 2016. *Phacochoerus africanus* (errata version published in 2017). *The IUCN Red List of Threatened Species* 2016: e.T41768A109669842. Downloaded on 20 September 2021.

de Jong, Y.A., A.B. Rylands & T.M. Butynski. 2020. *Erythrocebus patas. The IUCN Red List of Threatened Species* 2020: e.T174391079A17940998. Downloaded on 20 September 2021.

Dobson, A. D. M., E.J. Milner-Gulland, D.J. Ingram & A. Keane. 2019. A framework for assessing impacts of wild meat hunting practices in the tropics. *Human Ecology* 47(3): 449–464.

Drury, R., K. Homewood & S. Randall. 2011. Less is more: the potential of qualitative approaches in conservation research. *Animal Conservation* 14: 18–24.

Estrada, A., P.A. Garber, A. B. Rylands, C. Roos et al. 2017. Impending extinction crisis of the world's primates: why primates matter. *Science Advances* 3(1): e1600946.

Fa, J. & D. Brown. 2009. Impacts of hunting on mammals in African tropical moist forests: a review and synthesis. *Mammal Reviews* 39(4): 231–264.

Fa, J., S. Ryan & D. Bell. 2005. Hunting vulnerability, ecological characteristics and harvest rates of bushmeat species in afrotropical forests. *Biological Conservation* 121: 167–176.

Ferreira da Silva, M.J., R. Godinho, C. Casanova, T. Minhós, R. Sá & M. W. Bruford. 2014. Assessing the impact of hunting pressure on population structure of Guinea baboons (*Papio papio*) in Guinea-Bissau. *Conservation Genetics* 15: 1339–1355.

Ferreira da Silva, M.J., G. Kopp, C. Casanova, R. Godinho, T. Minhós, R. Sá, D. Zinner & M.W. Bruford. 2018. Disrupted dispersal and its genetic consequences: comparing protected and threatened baboon populations (*Papio papio*) in West Africa. *PLos ONE* 13(4): e0194189.

Ferreira da Silva, M.J., H. Foito, A. Regalla, P. Melo & D. Stiles. 2020a. Lessons from the transference of the chimpanzees Bo and Bella from Guinea-Bissau to the Sweetwater's sanctuary in Kenya. In: *Conference Action for Chimpanzees*, PASA - Pan African Sanctuary Alliance, Conakry, Republic of Guinea.

Ferreira da Silva, M.J., C. Paddock, F. Gerini, F. Borges, I. Aleixo-Pais, M. Costa, I. A. Colmonero-Costeira, C. Casanova, M. Lecoq, C. Silva, M. W. Bruford, J. Varanda & T. Minhós. 2020b. Chasing a ghost: notes on the present distribution and conservation of the sooty mangabey (*Cercocebus atys*) in Guinea-Bissau, West Africa. *Primates* 61:

357–363.

Ferreira da Silva, M.J., M. Camará, B. Egeter, T. Minhós, M.W. Bruford, R. Godinho. 2021. Using meta-barcoding tools to monitor primate meat consumption at dedicated establishments in Guinea-Bissau, West Africa. *ARPHA Conference Abstracts* 4: e65575.

Fischer, J., G.K. Kopp, F. Dal Pesco, A. Goffe, K. Hammerschmidt, U. Kalbitzer, M. Klapproth, P. Maciej, I. Ndao, A. Patzelt, & D. Zinner. 2017. Charting the neglected West: the social system of Guinea baboons. *American Journal of Physical Anthropology* 162: 15–31.

Fuentes, A. 2012. Ethnoprimatology and the anthropology of the human–primate interface. *Annual Review of Anthropology* 41: 101–117.

Gaynor, K.M., K.J. Fiorella, J.H. Gregory, D.J. Kurz, K.L Seto, L.S. Withey & J.S. Brashares. 2016. War and wildlife: linking armed conflict to conservation. *Frontiers in Ecology and Environment* 14: 533–542.

Gippoliti, S. & Dell'Omo G. 2003. Primates of Guinea-Bissau, West Africa: distribution and conservation status. *Primate Conservation* 19: 73–76.

Gobush, K.S., C.T.T. Edwards, D. Balfour, G. Wittemyer, F. Maisels & R.D. Taylor. 2021. *Loxodonta africana* (amended version of 2021 assessment). *The IUCN Red List of Threatened Species* 2021: e.T181008073A204401095. Downloaded on 20 September 2021.

Gonedelé Bi, S., I. Koné, R. Matsuda Goodwin, C. Alonso, A. Hernansaiz & J.F. Oates. 2020b. *Colobus polykomos*. *The IUCN Red List of Threatened Species* 2020: e.T5144A17944855. Downloaded on 20 September 2021.

Gonedelé Bi, S., G. Galat, A. Galat-Luong, I. Koné, D. Osei, J. Wallis, E. Wiafe & D. Zinner. 2020a. *Chlorocebus sabaeus*. *The IUCN Red List of Threatened Species* 2020: e.T136265A17958099. Downloaded on 20 September 2021.

Guess, G., E.E. Namey & M.L. Mitchell. 2013. *Collecting Qualitative Data: A Field Manual for Applied Research*. Sage Publications Ltd, London.

Heinicke, S., R. Mundry, C. Boesch, B. Amarasekaran, A. Barrie, T. Brncic, D. Brugiere, G. Campbell, J. Carvalho, E. Danquah, D. Dowd, H. Eshuis, M. Fleury-Brugiere, F. Maisels & E.A. Williamson E. 2019. Advancing conservation planning for western chimpanzees using IUCN SSC A.P.E.S. - the case of a taxon-specific database. *Environmental Research Letters* 14(6): 064001.

Hockings, K.J. & C. Sousa. 2013. Human-chimpanzee sympatry and interactions in Cantanhez National Park, Guinea-Bissau: current research and future directions. *Primate Conservation* 26: 57–65.

Hofner, A.N., C.A. Jost Robinson & K.A.I. Nekaris. 2018. Preserving Preuss's red colobus (*Piliocolobus preussi*): an ethnographic analysis of hunting, conservation, and changing perceptions of primates in Ikenge-Bakoko, Cameroon. *International Journal of Primatology* 39: 895–917.

Hsieh, H.F. & S.E. Shannon. 2005. Three approaches to qualitative content analysis. *Qualitative Health Research* 15: 1277–1288.

Humle, T., Boesch, C., Campbell, G., Junker, J., Koops, K., Kuehl, H. & Sop, T. 2016. *Pan troglodytes* ssp. *verus* (errata version published in 2016). *The IUCN Red List of Threatened Species* 2016: e.T15935A102327574. Downloaded on 20 September 2021.

IBAP (Instituto da Biodiversidade e das Áreas Protegidas). 2014. National Strategy for Protected Areas and Biodiversity Conservation in Guinea-Bissau (2014 – 2020). Bissau, Republic of Guinea-Bissau, Pp. 70.

Isberg, S., X. Combrink, C. Lippai & S.A. Balaguera-Reina. 2019. *Crocodylus niloticus*. *The IUCN Red List of Threatened Species* 2019: e.T45433088A3010181. Downloaded on 20 September 2021.

IUCN SSC Antelope Specialist Group. 2016a. *Philantomba maxwellii*. *The IUCN Red List of Threatened Species* 2016: e.T4142A50182944. Downloaded on 20 September 2021.

IUCN SSC Antelope Specialist Group. 2016b. *Tragelaphus spekii* (errata version published in 2017). *The IUCN Red List of Threatened Species* 2016: e.T22050A115164901. Downloaded on 20 September 2021.

IUCN SSC Antelope Specialist Group. 2016c. *Kobus kob*. *The IUCN Red List of Threatened Species* 2016: e.T11036A50189609. Downloaded on 20 September 2021.

IUCN SSC Antelope Specialist Group. 2016d. *Cephalophus rufilatus*. *The IUCN Red List of Threatened Species* 2016: e.T4149A50183959, Downloaded on 20 September 2021.

IUCN SSC Antelope Specialist Group. 2016e. *Cephalophus silvicultor*. *The IUCN Red List of Threatened Species* 2016: e.T4150A50184147. Downloaded on 20 September 2021.

IUCN SSC Antelope Specialist Group. 2016f. *Kobus ellipsiprymnus*. *The IUCN Red List of Threatened Species* 2016: e.T11035A50189324. Downloaded on 20 September 2021.

IUCN SSC Antelope Specialist Group. 2017. *Hippotragus equinus*. *The IUCN Red List of*

Threatened Species 2017: e.T10167A50188287. Downloaded on 20 September 2021.

IUCN SSC Antelope Specialist Group. 2019. *Syncerus caffer. The IUCN Red List of Threatened Species* 2019: e.T21251A50195031. Downloaded on 20 September 2021.

IUCN SSC Primate Specialist Group. 2020. *Regional action plan for the conservation of western chimpanzees (*Pan troglodytes verus*) 2020–2030.* Gland, Switzerland: IUCN, pp. 86.

Jerozolimski, A. & C.A. Peres. 2003. Bringing home the biggest bacon: a cross-site analysis of the structure of hunter-kill profiles in Neotropical forests. *Biological Conservation* 111(3): 415–25.

Karibuhoye, C. 2004. Mammal Conservation status and Prospects for community-based wildlife management in coastal Guinea-Bissau, West Africa, Göttingen, Georg-August-Universität. Germany, Ph.D. thesis, 287 pp.

Keith Diagne, L. 2015. *Trichechus senegalensis* (errata version published in 2016). *The IUCN Red List of Threatened Species* 2015: e.T22104A97168578. Downloaded on 20 September 2021.

Kingdon, J. 2005. *The Kingdon Pocket Guide to African Mammals.* Second edition. Academic Press, London.

Kümpel, N.F., J.M. Rowcliffe, G. Cowlishaw & E.J. Milner-Gulland. 2009. Trapper profiles and strategies: insights into sustainability from hunter behaviour. *Animal Conservation* 12: 531–539.

Lewison, R. & J. Pluháček. 2017. *Hippopotamus amphibius. The IUCN Red List of Threatened Species* 2017: e.T10103A18567364. Downloaded on 20 September 2021.

Linder, J.M., D.T. Cronin, N. Ting, E.E. Abwe, T.R.B. Davenport, K. Detwiler, G. Galat, A. Galat-Luong, J. Hart, R.A. Ikemeh, S. Kivai, I. Koné, D. Kujirakwinja, F. Maisels, W.S. McGraw, J.F. Oates & T.T. Struhsaker. 2021. Red colobus (*Piliocolobus*) conservation action plan 2021–2026. Gland, Switzerland: IUCN.

Lootvoet, A.C., J. Philippon & C. Bessa-Gomes. 2015. Behavioral correlates of primates conservation status: intrinsic vulnerability to anthropogenic threats. *PLoS ONE* 10(10): e0135585.

Matsuda Goodwin, R., S. Gonedelé Bi & I. Koné. 2020. *Cercopithecus campbelli. The IUCN Red List of Threatened Species* 2020: e.T136930A92374066. Downloaded on 20 September 2021.

McNeely, J.A. 2003. Conserving forest biodiversity in times of violent conflict. *Oryx* 37: 142–152.

Minhós, T. & M.J. Ferreira da Silva. 2020. Primate Behavioural Adaptations to Anthropogenic Habitats - the Case of Cantanhez National Park in Guinea-Bissau. In Peoples, Nature and Environments - Learning to Live Together, edited by AC Roque, Brito C, & Veracini C. Newcastle upon Tyne: Cambridge Scholars Publishing.

Minhós, T., L. Chikhi, C. Sousa, L.M. Vicente, M.J. Ferreira da Silva, R. Heller, C. Casanova, & M.W. Bruford. 2016. Genetic consequences of human forest exploitation in two colobus monkeys in Guinea Bissau. *Biological Conservation* 194: 194–208.

Minhós, T., E. Nixon, C. Sousa, L.M. Vicente, M.J. Ferreira da Silva, R. Sá & M.W. Bruford. 2013a. Genetic evidence for spatio-temporal changes in the dispersal patterns of two sympatric African Colobine monkeys. *American Journal of Physical Anthropology* 150: 464–474.

Minhós, T., E. Wallace, M.J. Ferreira da Silva, R.M. Sá, M. Carmo, A. Barata & M.W. Bruford. 2013b. DNA Identification of primate bushmeat from urban markets in Guinea-Bissau and its implications for conservation. *Biological Conservation* 167: 43–49.

Minhós, T., M.J. Ferreira da Silva, E. Bersacola, G. Galat, A. Galat-Luong, M. Mayhew, & E.D. Starin. 2020. *Piliocolobus badius* ssp. *temminckii. The IUCN Red List of Threatened Species* 2020: e.T18247A92648587. Downloaded on 20 September 2021.

Nixon, S., D. Pietersen, D. Challender, M. Hoffmann, I. Godwill Ichu, T. Bruce, D.J. Ingram, N. Matthews & M.H. Shirley. 2019. *Smutsia gigantea. The IUCN Red List of Threatened Species* 2019: e.T12762A123584478. Downloaded on 20 September 2021.

Peres, C.A. & P.M. Dolman. 2000. Density compensation in neotropical primate communities: evidence from 56 hunted and nonhunted Amazonian forests of varying productivity. *Oecologia* 122: 175–189.

Pietersen, D., C. Moumbolou, D.J. Ingram, D. Soewu, R. Jansen, O. Sodeinde, C. Keboy Mov Linkey Iflankoy, D. Challender & M.H. Shirley. 2019. *Phataginus tricuspis. The IUCN Red List of Threatened Species* 2019: e.T12767A123586469. Downloaded on 20 September 2021.

Remis, M.J. & J.C.A. Robinson. 2014. Examining short-term nutritional status among BaAka foragers in transitional economies. *American Journal Physical Anthropology* 154(3): 365–375.

Reyna, R., F. Jori, S. Querouil & K. Leus. 2016. *Potamochoerus porcus* (errata version published in 2016). *The IUCN Red List of Threatened Species* 2016: e.T41771A100469961. Downloaded on 20 September 2021.

Rubin, H.J. & I.S. Rubin. 2004. *Qualitative Interviewing: the Art of Hearing Data.* 2nd ed. Sage Publications, Thousand Oaks, CA.

Sá R., M.J. Ferreira da Silva, F. Sousa & T. Minhós. 2012. The trade in and ethnobiological use of chimpanzee body parts in Guinea-Bissau: implications for conservation. *Traffic* 24: 30–34.

Setchell, J.M., E. Fairet, K. Shutt, S. Waters & S. Bell. 2017. Biosocial conservation: integrating biological and ethnographic methods to study human–primate interactions. *International Journal of Primatology* 38: 401–426.

Sousa, J., A. Ainslie & C.M. Hill. 2017. Sorcery and nature conservation. *Environmental Conservation* 45(1): 90–95.

Starin, D. 2010. How corruption and deforestation fuel horrific trade in west-African primates. *Wildlife Trade* 16: 1–4.

Stein, A.B., V. Athreya, P. Gerngross, G. Balme, P. Henschel, U. Karanth, D. Miquelle, S. Rostro-Garcia, J.F. Kamler, A. Laguardia, I. Khorozyan & A. Ghoddousi. 2020. *Panthera pardus* (amended version of 2019 assessment). *The IUCN Red List of Threatened Species* 2020: e.T15954A163991139. Downloaded on 20 September 2021.

Topp-Jørgensen, E., M. Reinhardt, N. Andrew, R. Marshall & U. Pedersen. 2009. Relative densities of mammals in response to different levels of bushmeat hunting in the Udzungwa Mountains, Tanzania. T*ropical Conservation Science* 2: 70–87.

van Vliet, N. 2018. "Bushmeat Crisis" and "Cultural Imperialism" in wildlife management? Taking value orientations into account for a more sustainable and culturally acceptable wildmeat sector. *Frontiers in Ecology and Evolution* 6: 112.

Wallis, J., Alonso, C., Barlow, C., Brito, J., Ferreira da Silva, M.J., Hernansaiz, A., Kopp, G.H., Vale, C. & Zinner, D. 2021. *Papio papio* (amended version of 2020 assessment). *The IUCN Red List of Threatened Species* 2021: e.T16018A190269269. Downloaded on 20 September 2021.

World Bank. 2020. *Escaping the Low-Growth Trap: Guinea-Bissau Country Economic Memorandum.* World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/34752 License: CC BY 3.0 IGO.