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ARTICLE

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'Non-protected' primates as bushmeat, pets and pests in southeastern Democratic Republic of Congo

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PLATINUM OPEN ACCESS

Abstract: This article reports the uses of primates in a fast-expanding city, and human-primate interactions in the vicinity of a protected area in southeastern Democratic Republic of Congo (DRC). Surveys in markets, households and restaurants suggested that primate meat is frequently sold and consumed in the city of Lubumbashi. Carcasses of diurnal monkeys accounted for almost 10% of the total weight of smoked bushmeat sold between March and July 2016 in urban markets, and in 21% of households the last bushmeat consumed prior the date of the survey was of a primate species. Kinda Baboons *Papio kindae*, Malbrouck Monkeys *Chlorocebus cynosuros* and Blue Monkeys *Cercopithecus mitis* were found illegally kept as pets. Occasional observations and questionnaire surveys carried out in both the Sector North of Upemba National Park and its neighboring areas, indicated wild populations of these species which were mentioned as "pest primates" by 73% of respondents. There is no compensation scheme for damages caused by wildlife to crops, and culling problematic animals was listed by a majority (70%) of respondents as the most effective way to repel crop-raiding primates. Given the current population growth, and considering the increasing spatial overlap between human activities and wildlife, wild populations of these primates are no doubt at risk, but all the three species belong to the Least Concern category on the latest version of the IUCN Red List. The Blue Monkey is a 'partially protected' species in DRC, while the two other benefit from less strict conservation measures and their legal status of 'non-protected' remains. This situation illustrates the necessity of updating legal status and establishing a Red List of species at the country level.

Keywords: Cercopithecine monkeys, human-wildlife interactions, poaching, wildlife conservation.

French Abstract: Cet article décrit les utilisations des primates dans une ville en expansion et les interactions humains-primates à proximité d'une aire protégée dans le sud-est de la République démocratique du Congo (RDC). Des enquêtes conduites au niveau des marchés, des ménages et des restaurants ont suggéré que la viande des primates est fréquemment vendue et consommée dans la ville de Lubumbashi. En effet, les carcasses des primates représentaient près de 10% du poids de la viande de brousse vendue entre mars et juillet 2016 sur les marchés communaux. Dans 21% des ménages, la dernière viande consommée avant la période de l'enquête était d'une espèce de primate. Des babouins (Papio kindae), des singes de Malbrouck (Chlorocebus cynosuros) et singes bleus (Cercopithecus mits) ont été trouvés illégalement détenus comme animaux de compagnie. Des observations occasionnelles et des enquêtes réalisées dans le Parc national de l'Upemba et ses environs ont indiqué la présence de ces trois espèces, qui ont été qualifiées de «primates nuisibles» par 73% des répondants. Il n'existe aucun système de compensation des dommages causés par les animaux sauvages, et l'abattage des animaux à problèmes a été mentionné par la majorité (70%) des répondants comme le meilleur moyen de répulsion des primates ravageurs des cultures. Etant donné le rythme actuel de croissance démographique et le chevauchement croissant entre les activités humaines et la faune, ces primates sont sans doute en péril. Ils restent néanmoins dans la catégorie « Préoccupation mineure » sur la Liste rouge de l'UICN; le singe bleu est une espèce «partiellement protégée», tandis que les deux autres espèces conservent leur statut juridique «animaux non encore protégés». Cette situation illustre la nécessité de mettre à jour le statut juridique et d'établir une liste rouge des espèces au niveau des pays.

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INTRODUCTION

The latest (2018-19) Red List published by the International Union for Conservation of Nature (IUCN) suggests that more than 60% of the 440 species of primates (hereafter used in reference to non-human primates) evaluated are threatened with extinction (listed Vulnerable, Endangered or Critically Endangered). Indeed, the status of the majority of primates is worsening (Schwitzer et al. 2014), mainly because of habitat loss and fragmentation (Roberts et al. 2016) and poaching (Cheyne 2009; Ceballos-Mago et al. 2010; Oates 2013; Mallon et al. 2015; Estrada et al. 2017) across the world.

In Africa, primates are poached for bushmeat (Fa et al. 1995; Refisch & Koné 2005; Mossoun et al. 2015) and for multiple uses in traditional medicine (Carpaneto & Germi 1989; Alves et al. 2010; Svensson et al. 2015). In addition, the illegal keeping and trafficking of live primates has been mentioned in several articles (Gambalemoke et al. 2000; van Lavieren 2008; Kabasawa 2009; Ebua et al. 2014; van Uhm 2016). Poaching and illegal trade are among the major impediments to the survival of many primate species in several countries across the continent.

The Democratic Republic of Congo (DRC) has a significant role to play in primate conservation (Chapman et al. 2006; Estrada et al. 2017). This country is characterized by a large diversity of habitats and a considerable variety of primates, represented by more than 30 species, including three of the four types of great apes (Rainer et al. 2014) and the recently described Lesula (*Cercopithecus lomamiensis*) (Hart et al. 2012). Overall, Congolese wildlife is protected by a set of legal instruments and a large network of protected areas (Inogwabini 2014). Unfortunately, challenges in managing parks and reserves (IUCN, 2010) and the lack of local evaluation and updates of both conservation and legal status of species, make wildlife increasingly vulnerable to anthropogenic threats.

Primates are threatened across all ecoregions of the DRC; for example in the west, center and east of the country characterized by diverse types of rainforests, endangered great apes (Bonobos, Chimpanzees and Gorillas) as well as smaller primates are poached for the consumption of their meat, and for trade as pets (Hart et al. 2008; Hicks et al. 2010; Stiles et al. 2013). In the south-east Zambezian part of the country (White 1983), which, is covered mainly by savannas and Miombo woodlands (Malaisse 2010; Kabulu et al. 2008; Munyemba & Bogaert 2014), some primates deemed opportunistic and less-threatened to date are also hunted (Tshikung & Pongombo 2009) and survive in human-disturbed areas.

This study examines the use of primates in Lubumbashi, a fast-expanding city in the south-east of the DRC, and presents a preliminary appraisal of their situation in the wild. This was done by analyzing data on: (i) the bushmeat trade and consumption, (ii) primates kept as pets in Lubumbashi, and (iii) the presence of primates and human-primate conflicts in the vicinity of Upemba National Park.

MATERIALS AND METHODS

Study Area

The study was conducted in seven municipalities of Lubumbashi (11.450–11.783 ^{0}S & 27.327–27.667 ^{0}E) and at three locations in rural areas: Lusinga Station (8.933^{0}S & 27.205^{0}E) in the Sector North of Upemba National Park, and Kasungeshi (8.938^{0}S & 27.380^{0}E) and Mumbolo (9.109^{0}S & 27.258^{0}E), two villages neighboring the park (Fig. 1). With an estimated population of 2.088 million in 2018 (UN-Habitats 2014), Lubumbashi, the second largest city of DRC, is connected to other cities by railway and a number of roads, some of which cross both Upemba and Kundelungu National Parks in southeastern DRC.

The major part of the study area is under a tropical climate coded Cw, according to the Köppen's Classification (Malaisse 2010), with a rainy season lasting from November to March, and a dry season from May to September; October and April are considered as transitional months (Assani 1999). With an annual average of 20°C, temperatures vary from 16 to 33°C; the annual mean rainfall is 1300mm (Saad et al. 2012). Around both Lubumbashi and the Sector North of Upemba National Park, open forests (Miombo woodlands), the main forest type of the south of the DRC, are human-dominated and highly fragmented (Kabulu et al. 2008; Munyemba & Bogaert 2014).

Surveys on the Trade and Consumption of Primate Meat

Data on the trade of primate meat were collected in the major markets of the seven municipalities of Lubumbashi. To avoid bias due to the possible negative perception of the consumption or trade of primate meat, surveys were extended to all types of bushmeat, which were grouped into four categories for statistical analyses: reptiles and three orders in mammals (rodents,

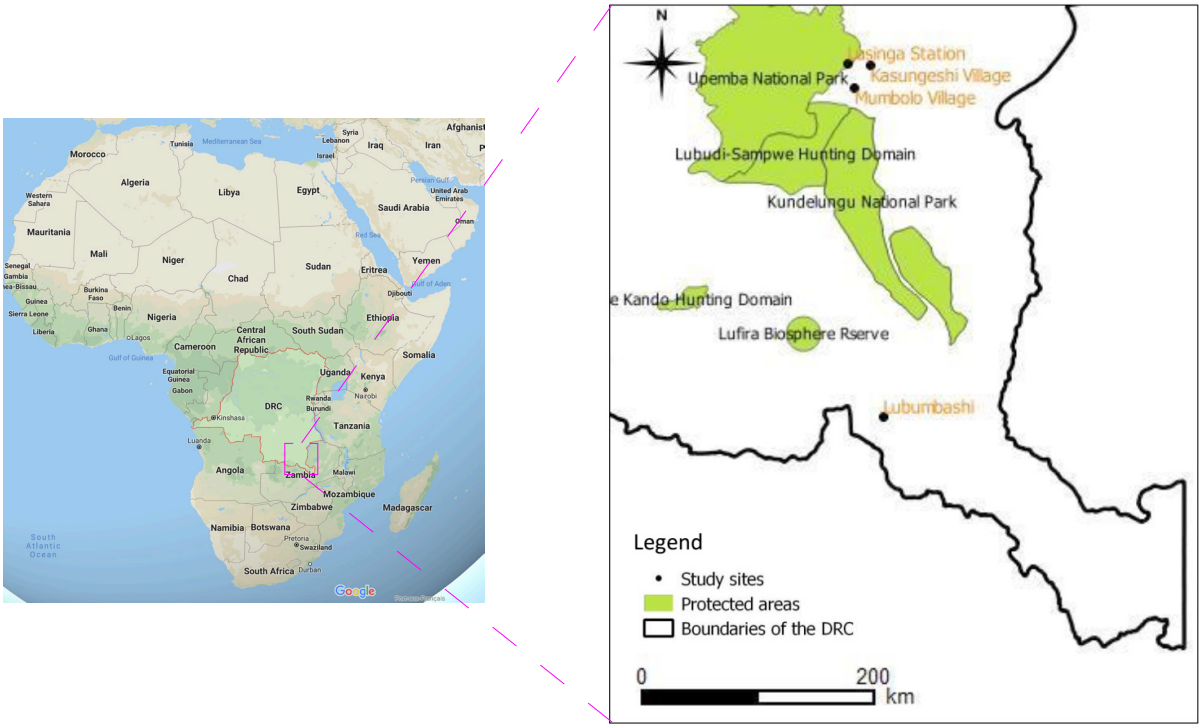

Figure 1. Lubumbashi City and the three villages surveyed in the vicinities of Upemba National Park, southeastern Democratic Republic of Congo (DRC).

artiodactyls and primates). A total of 30 vendors who regularly sell bushmeat were selected for the first part of the survey. Questionnaires consisted of both open-ended and close-ended questions formulated in order to collect and collate information on characteristics of the trade, quantities of carcasses, sites of origin, and trends in the availability of bushmeat.

Eighteen of the 30 selected vendors agreed to participate in the second part of the survey and to provide qualitative and quantitative data on arrivals of bushmeat during the five months (March–July 2016) of repeated surveys. Throughout this period, carcasses were counted and weighed at a two-week interval and each time vendors reported new arrivals of bushmeat. This interval was fixed based on data from previous surveys (Tshikung & Pongombo 2009) on bushmeat trade in Lubumbashi.

Carcasses were preliminarily identified by macroscopic observation. Although smoked, many primates were clearly visible and readily recognizable by body parts such as hands, feet and heads. Local names used by respondents were linked with results of molecular identification of the bushmeat frequently sold in Lubumbashi (Didier Tshikung pers. comm. 25.vi.2016) and served to confirm two species of primates which were traded during the survey period.

With respect to the preference and consumption of primate meat, surveys were carried out in all the seven municipalities of Lubumbashi and were focused on a total of 140 households and 20 restaurants selected randomly. Questionnaires were addressed to household members who usually purchase and/or prepare food. For the same reason as in surveys at the market level, we collected information on the consumption of bushmeat without any particular emphasis on primate meat.

Surveys on Primates Kept as Pets

This part of the study took place in three stages. First, information from veterinarian services of the seven municipalities and occasional observations served for identifying pet primates' owners in Lubumbashi. Second, the purpose of the study was presented to the 74 pet primate owners identified, and only 34 of them consented to participate in the survey. Third, interviews were conducted between August 2015 and February 2016.

Respondents provided information on local names, sites of origins, acquisition, uses and living conditions of captive primates. Additional information and photographs were subsequently collected in March and April 2016 in order to identify these animals at the species level. Species' range data on the IUCN Red List

(Butynski 2008; Kingdon 2008; Kingdon et al. 2016) and pictorial identification guides (Rowe 1996; Mittermeier et al. 2013), as well as the verification by an expert (Marie-Claude Huynen, pers. comm. 02.viii.2016) were used to confirm the identification of these primates.

Collection of Data on Primates in the Wild

In order to gather preliminary information on the status of primates in the wild, surveys targeted human settlements in the Sector North of the Upemba National Park and were conducted in August and September 2017. Questions were addressed to a sample of 117 respondents randomly selected at the three study locations (Fig. 1).

Questionnaires were used to obtain preliminary information on abundance and distribution of the three diurnal primates identified at Lubumbashi. Data on human-wildlife interactions, as well as respondents' appreciations of the trends in wild populations of these species in the area were also collected. Both park managers and rangers were also contacted for verification purposes.

Data Synthesis and Analysis

Data from surveys were encoded on MS Excel spreadsheets for descriptive statistics. Quantitative variables such as age, income of bushmeat vendors and purchase prices of primates were described mainly on the basis maximum, minimum, mean and standard deviation. For most close-ended questions, frequency distributions of responses were plotted and presented by bar charts and pie chart. Also, we performed a chi-square test of independence in order to examine the relationship between the geographic location of respondents (within or out of the protected area) and their perception of primates as crop-raiders.

Bushmeat vendors and pet primate owners mentioned a number of sites around which primates were captured. Geographic coordinates of these sites were found in the Google Earth application and then exported as shapefiles to Quantum GIS software (version 2.10.1) as a layer of points, each representing one site. The final map (Fig. 2) was obtained by overlapping this layer on four other data layers presenting cities (points), the road network (lines) and, protected areas and boundaries of DRC (polygons).

RESULTS

Hunting Sites of Primates Used as Food and Pets

A majority (almost 80%) of the 30 vendors declared they buy primate carcasses (and other bushmeat) directly from hunters, who take specimens from a number of sites located more than 200km north of Lubumbashi. This information was used for mapping purposes and helped locate these sites (Fig. 2).

Almost two-third of the 36 primates kept as pets in surveyed households were captured in the vicinities of Kyubo (9.529^{0}S & 27.043^{0}E), Sampwe (9.353^{0}S & 27.438^{0}E) and Bunkeya (10.398^{0}S & 26.968^{0}E). These villages are in the neighborhood of the Upemba-Kundelungu complex of protected areas. The rest of the sites are located in different landscapes of four provinces in southeastern DRC: Upper Katanga, Upper Lomami, Lualaba and Tanganyika.

Trade of Primate Meat in Markets

In surveyed markets of Lubumbashi, data on socio-demographic characteristics of respondents indicated that bushmeat is sold only by women, aged 18–60 (38.2 ± 10.6 years). About 70% of the 30 respondents declared that monthly profits generated by the bushmeat trade, ranging from 100 to 300 United States Dollars (USD), represent more than half of the total income of their households. Also, 50% of the vendors declared that these profits are primarily spent for schooling children. Paying rent, purchasing food and savings were mentioned by 26%, 13% and 10%, respectvely.

The choice of primate meat is motivated mainly by supply: almost all (90%) vendors claimed they sell primate meat because when compared to other bushmeat it has been the most available in recent years. Few vendors mentioned the preferences of their customers. Notable quantities of bushmeat were weighed throughout the five months covered by the surveys in markets. We recorded 6,773kg of smoked meat of many species. In this set, artiodactyls (buffaloes, warthogs and antelopes) are the most represented, with carcass weights accounting for almost 70% of the total. Primates (diurnal monkeys found in the area) accounted for about 10% of the total carcasses recorded during the same period (Fig. 3).

Consumption of Primate Meat in Households and Restaurants

Respondents estimated the average weight of smoked bushmeat consumed monthly was less than 3kg for two out of three households. For almost 28%

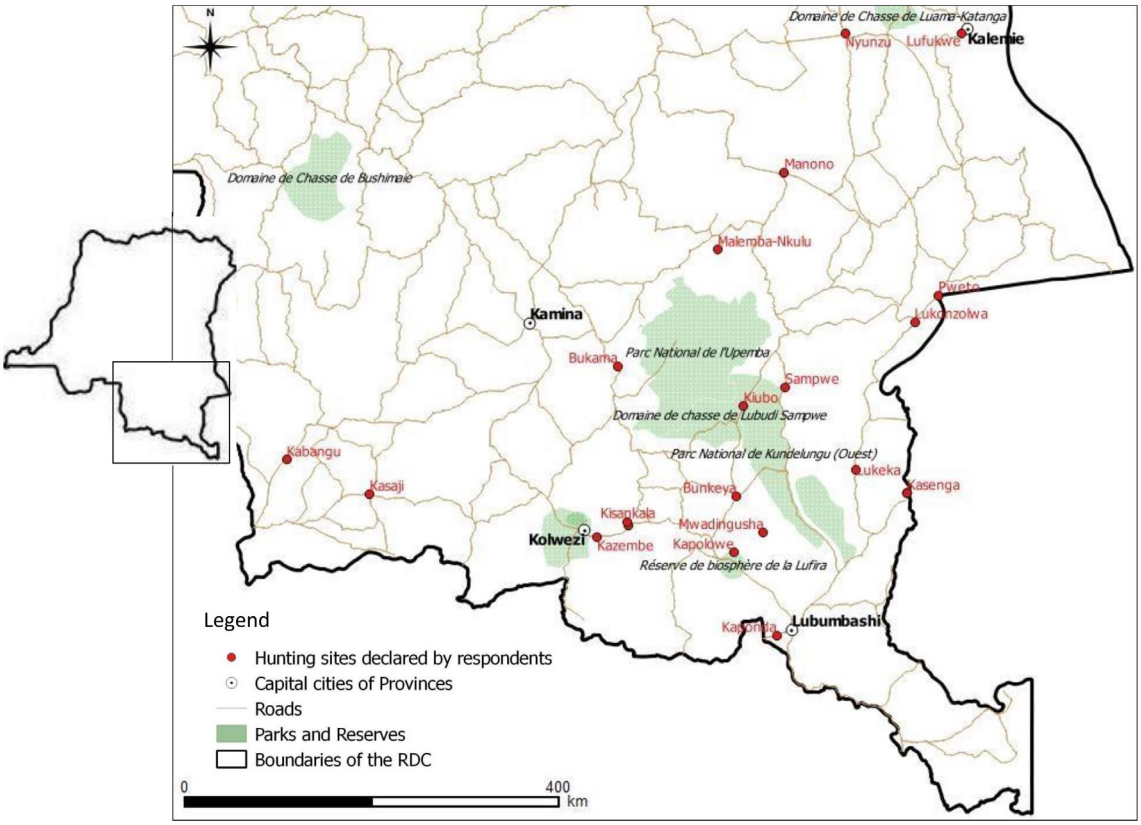

Figure 2. Sites where primates are hunted in the southern Democratic Republic of Congo. Parks and reserves are presented as: 'Parc National' (French: National Park), 'Domaine de Chasse' (hunting domains) and 'Réserve de la Biosphère' (biosphere reserve).

of 140 households, respondents listed "monkey meat" among the main three types of bushmeat consumed frequently (more than once a month). Further, in 21% of the households, the last bushmeat consumed prior to the date of the survey was of a primate species.

The main reasons provided for primate meat consumption included availability (46% of 140 respondents) and preferences of household members (37%). However, in 14% of households, the meat of primates, especially that of great apes, was listed among the three types of bushmeat never consumed. To justify such a choice, a number of reasons, mainly cultural beliefs, were mentioned.

Primate meat was served frequently in only two of the surveyed restaurants. Profitability (for 45% of the 20 respondents) and preferences of consumers (35%) were the main factors influencing the choice of bushmeat served in restaurants. In half of the surveyed restaurants, as well as in 21% of households, bushmeat was directly ordered from hunters rather than purchased in urban markets.

Primates Used as Pets

In the 34 households surveyed, a total of 36 monkeys including 19 Kinda Baboons (*Papio kindae*), 16 Malbrouck Monkeys (*Chlorocebus cynosuros*) and a Blue Monkey (*Cercopithecus mitis*) were identified as pets in the study area (Image 1). All three species are found in the south-east of the DRC. Bought from hunters (nearly 44%), third persons (31%) or offered by a relative (25%), all of the 36 pet primates were owned illegally. Indeed, all the respondents declared not to possess any official document authorizing either the acquisition or the keeping of a wild animal in captivity. For bought animals, respondents mentioned a wide range of purchase prices (21 ± 13 USD). The cheapest monkey, a male Baboon, had been purchased for the equivalent of 3 USD in 2008, and the most expensive one, a juvenile Malbrouck Monkey had cost 50 USD in 2014. Nearly half of the primates used as pets were acquired within a one-year period prior the survey (Fig. 4). Eighty percent were infants when captured in the wild.

The knowledge of the status of wild populations of primates in the area was assessed. About 70% of respondents estimated that the populations of these

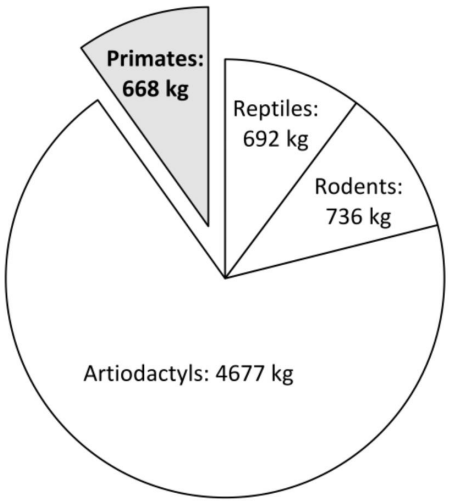

Figure 3. Proportion of primates' meat (10%) in the batch of 6,773kg of smoked bushmeat carcasses sold by 18 vendors between March and July 2016 in Lubumbashi. Artiodactyls included species of warthogs, antelopes and buffaloes found in the region.

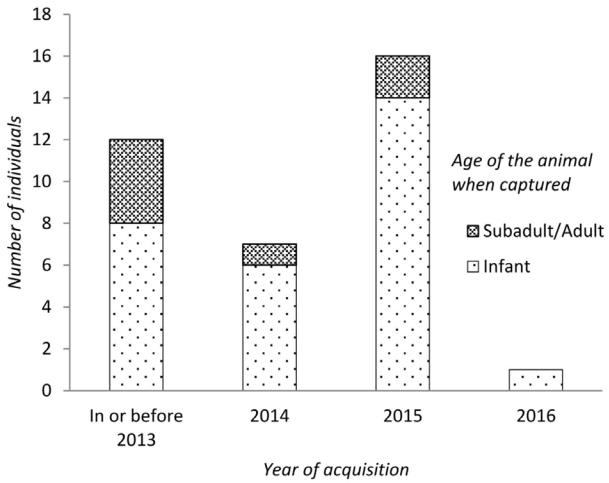

Figure 4. Distribution of the 36 primates used as pets per date of acquisition and age classes when they were captured in the wild. Data have been collected between August 2015 and February 2016.

species were decreasing. According to the others, primate populations were stable (6%) or increasing (24%). Respondents also considered that keeping primates as pets was: beneficial (44% of the 34); with no influence (32%), and a form of threat to wild populations (24%). In addition, for 58% of respondents who claimed that primate populations were decreasing, among the types of threats listed, trade of live primates ranked the third after primate meat consumption and habitats loss. More than 75% of the pet primate owners affirmed not to be aware of the existence of any law regulating the detention of wild animals in DRC.

Image 1. Photos of primates used as pets in some households surveyed in Lubumbashi City. (A) an adult and (B) an infant Baboon *Papio kindae*; (C) a subadult Malbrouck Monkey *Chlorocebus cynosuros*. © P. Kazaba.

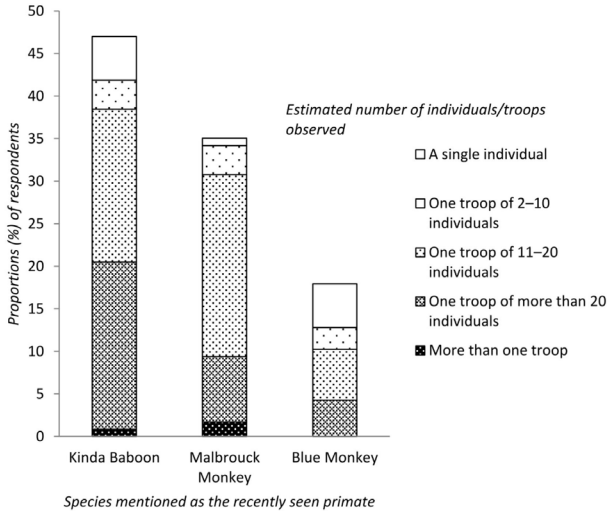

Figure 5. Species and estimated number of individuals/troops of primates declared to be seen more recently in the Sector North of Upemba National Park by the 117 respondents. Overall, the last sighting of these species was: less than one month (for 33% of respondents); between one and three months (22%), and more than three months (45%) before the survey period.

Primates in the Sector North of Upemba National Park

Occasional observations and survey data suggest the existence of all the three primate species in the Sector North of Upemba National Park and its vicinities. The Kinda Baboon was mentioned by 47% of the 117 respondents as the diurnal primate seen more recently (this was less than a month before the survey period for 33% of respondents) in the area. In fact, troops of baboons are frequently reported (Vanleeuwe 2008, Rodrigue Katembo pers. comm. 21 December 2016) and have been observed during our fieldwork. Malbrouck Monkeys and Blue Monkeys were mentioned by 35% and 18% of the respondents, respectively (Fig. 5). Overall, these animals were reported to occur in a variety of environments: dense forests galleries (for 26% of respondents), Miombo woodlands (27%), savannas (38%) and human settlements, including cultivated lands (9%).

All three species were listed as crop-raiding primates. More than 85% of the respondents mentioned "damage to crops" as the main problem caused by these primates in the area. Rangers reported several cases of human-wildlife conflict involving Kinda Baboons and Malbrouck monkeys, which are apparently more frequent outside of protected areas. According to the management of the park, dialogue with local people is often used as a way of addressing these conflicts, and there is no compensation scheme for damage caused by wildlife in the area. Culling problematic animals was listed by the majority (70%) of respondents as the most effective way to repel crop-raiding primates.

Although most respondents (30 out of the 37) living within the protected area (at the Lusinga Station) listed agriculture among their livelihood activities, only a small proportion (38%) of them showed a perception of these species as "pest primates" at first glance, unlike in the two villages neighboring the park (almost 90%, N=80). Results of a chi-square test confirmed that mentioning a fact related to crop-raiding when questioned "what do you know about this primate?" significantly depended on where respondents lived, X^2 (1, N =117) = 33, P < 0.001. This is probably due to the fact that most of the respondents settled at Lusinga are relatives of staff members of the Upemba National Park, and thus rely one way or another on wildlife conservation, or are more aware of conservation-related benefits such as ecotourism.

DISCUSSION

Illegality and Complexity in the Trade of Primates

Geographic data presented in Fig. 2 reflects the illegal nature of the trade of both bushmeat and live primates. In fact, it is shown that primates are captured out of the sites (hunting domains) clearly defined by the Congolese legislation. Moreover, the sites mentioned the most are located in proximity or at junction points of main roads, some of which cross protected areas such as Upemba and Kundelungu national parks. A number of studies have pointed out the impact of road networks on wildlife. In the Congo Basin, Wilkie et al. (2000) noted that the road density was closely linked with natural resources exploitation and the disappearance of wildlands and wildlife, among others. Poulsen et al. (2009) suggested that the road network facilitated access to remote areas and accelerated the exploitation of wildlife by creating markets to wildlife products in the Northern Congo. This situation has also been raised in the specific case of logging in DRC (Ngabinzeke et al. 2014), in the Congo Basin (Kleinschroth et al. 2015) and in tropical Africa as a whole (Laurance et al. 2017). In the study area, it is frequent to observe wildlife products being sold along roadsides.

From the results of the surveys carried out in Lubumbashi, it can be noted that quantities of bushmeat sold in markets are far lower than those observed in the north-east (van Vliet et al. 2012) and the west of DRC (Ngabinzeke et al. 2014), however, similar trends are observed in terms of proportions of weight of carcasses

when grouped per taxonomic groups: like in this study, carcasses of artiodactyls accounted for about 70% of bushmeat sold in markets of Kisangani city (van Vliet et al. 2012) and around a forest concession (Ngabinzeke et al. 2014). Monkeys were ranked the second taxonomic group, representing nearly 30% (van Vliet et al. 2012) and 15% (Ngabinzeke et al. 2014) of bushmeat carcasses. Like the aforementioned studies, we support the view that consuming primate meat reflects the scarcity of animals usually and mostly consumed such as artiodactyls. From this point of view, and considering the increase in hunting pressure reported in DRC, primates will certainly be increasingly targeted and threatened across the country.

Results also indicate that almost all live primates, as well as a notable proportion of the bushmeat consumed in households and restaurants (21%), are purchased and sometimes ordered directly from hunters. Therefore, data from formal markets are not sufficient to represent the whole extent of the bushmeat trade, and should not be considered the only way to determine quantities of bushmeat consumed locally. Also, as an illustration, certain food items such as sugar, rice, corn flour, vegetables, fishes and meats are commonly sold in a kind of informal market starting around 5 p.m in downtown Lubumbashi and called 'marchés de nuit' (literally, night markets) (Kesonga et al. 2016). It is possible that bushmeat is also sold in these markets, but for logistical reasons data from them was not collected.

Globally Evaluated 'Least Concern' but Locally at Risk?

Trends observed in both the city and the wild raise concerns about the fate of affected species. Apart from being consumed as bushmeat, used as pets or regarded as pests, Kinda Baboons, Malbrouck Monkeys and Blue Monkeys are all found in the Miombo ecoregion, where increasing fragmentation of natural habitats has been reported (Kabulu et al. 2008). For example, in the hinterland of Lubumbashi, Miombo woodlands (occupying 85% of the area in 1956) experienced a decline of 76% between 1956 and 1984 and 40% between 1984 and 2009 (Munyemba & Bogaert 2014). Adding the hunting pressure to the increasing spatial overlap between human activities and wildlife, due to (among others) the current population growth (UN-Habitats 2014; Useni et al. 2017), wild populations of these primates are no doubt at risk in that area.

In addition, all the three species are not sufficiently protected from the legal point of view. Indeed, unlike great apes such as Bonobos, Chimpanzees and Gorillas listed as 'Fully Protected' species (Appendix I) by the Congolese Hunting Act (Mpoyi 2012), many diurnal monkeys are still 'Partially Protected' (Appendix II) or 'Non-Protected' (Appendix III) and thus may be hunted under less strict conditions. These include the Blue Monkey (Appendix II), and the Kinda Baboon and the Malbrouck monkey (Appendix III). According to this Act, except under a scientific license, capturing, trading and possessing specimens of 'Fully Protected' species are strictly prohibited and severely punished. Like in Lubumbashi (Tshikung & Pongombo 2009; this study), Kisangani (van Vliet et al. 2012) and Oshwe (Ngabinzeke et al. 2014), several monkey species are part of the bushmeat commonly sold and are kept as pets (Gambalemoke et al. 2000) across the country.

The IUCN has a key role to play in raising awareness about the conservation status of species and thus guiding conservation efforts (Rodrigues et al. 2006; Hermoso et al. 2017). As in many countries, DRC relies on the IUCN evaluations and many other international instruments for defining conservation priorities and strategies. It should be highlighted, however, that the three species of diurnal monkeys sold as bushmeat, kept as pets or considered as pest animals remain part of the Category 'Least Concern' on the IUCN Red List, the latest evaluation being published in 2008 for both the Malbrouck Monkey (Butynski 2008) and the Blue Monkey (Kingdon et al. 2008), and in 2016 for the Kinda Baboon (Kingdon 2016) . Considering the results of this study and the insufficient level of legal protection for these species, their conservation status resulting from a global evaluation does not reflect their true conservation status in DRC. A similar contrast has also been raised by many scholars (Gärdenfors et al. 2001; Maes et al. 2015; Erinjery et al. 2017; Thakur et al. 2018) for several taxa worldwide.

CONCLUSION

This study presents a preliminary appraisal of the extent of human-driven threats to the remaining primate populations in the south-east of DRC. Results revealed that three Cercopithecine monkeys: Kinda Baboons, Malbrouck monkeys and Blue Monkeys, account for a significant part of the bushmeat frequently sold and consumed; are illegally kept as pets in Lubumbashi, and are regarded as pests because of their crop-raiding behavior in the Sector North of Upemba National Park and its vicinities. The uses of primates as studied in Lubumbashi are likely to undergo a rapid evolution, and considering the increasing trends in spatial overlap

between human activities and wildlife, the three species are likely at risk in the area. It is obvious that putting in relation the dynamic of habitats, levels of hunting and data on the abundance and distribution of these species in the wild is the best path towards the prediction of human-driven threats and their impacts on these species. This study provides an overview of these threats, from which two main lessons emerge:

1. Data from markets may not suffice to reflect the extent of a phenomenon such as the illegal bushmeat trade, given that significant quantities of wildlife products may be directly delivered to households by hunters.

2. The decline in wild populations of artiodactyls, which account for most of the bushmeat currently being traded and consumed, may increase hunting pressure on other taxa such as primates. Thus addressing the bushmeat crisis will require predicting changes in the availability of bushmeat and the resulting trends in consumer preferences for taxonomic wildlife groups. This will identify potentially threatened taxa and help to judiciously guide conservation strategies.

The fact that the majority of the respondents depending (directly or not) on the Upemba National Park do not perceive the three primate species as pests supports the idea that sharing wildlife-related benefits can improve the attitudes of populations neighboring protected areas towards wildlife, and thus facilitate the implementation of conservation tools. Conversely, the perception of wild animals as pests may hinder conservation efforts, as highlighted in many studies.

Finally, this study illustrates the problem of evaluating species without considering local and rapidly-changing threats. The necessity of local and country-level Red Lists of threatened taxa should be emphasized. In this respect, there is also a need for updating the legal status of species based on fresh data on trends in both wild populations and anthropogenic threats.

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