Received: 16 May 2020 | Revised: 13 March 2021 | Accepted: 18 March 2021

DOI: 10.1111/csp2.419

CONTRIBUTED PAPER

Conservation Science and Practice
A journal of the Society for Conservation Biology
Open Access

WILEY

Understanding consumer demand for bushmeat in urban centers of Cameroon with a focus on pangolin species

Linh Bao Nguyen[1,2] | **Etogekwe Esua Fossung**[1] | **Camille Affana Nkoa**[3] | **Tatyana Humle**[1]

[1]Durrell Institute of Conservation and Ecology, School of Anthropology and Conservation, Marlowe Building, The University of Kent, Canterbury, Kent, UK

[2]College of Environmental Studies, National Dong Hwa University, Hualien, Taiwan

[3]Noé – Cameroon, Bastos, Yaoundé, Cameroon

Correspondence
Linh Bao Nguyen, College of Environmental Studies, National Dong Hwa University, No. 1, Sec. 2, Da Hsueh Rd., Shoufeng, Hualien 97401, Taiwan.
Email: linh.mentorpop@gmail.com

Funding information
U.S. Fish and Wildlife Service and Zoological Society of London; MENTOR-POP (Progress on Pangolins) Programme; Foreign and Commonwealth Office and University of Kent, Grant/Award Number: Chevening Scholarship

Abstract

Bushmeat consumption remains significant in urban Central Africa. Increasing urbanization has fueled bushmeat trade and become a threat to endangered species like the pangolin. Behavioral change interventions may help reduce demand for pangolins in urban centers. However, there is still a lack of adequate locally-specific research on consumer behavior and drivers of demand to effectively guide such interventions. Our study addressed this knowledge gap through semistructured interviews to investigate consumer preferences and bushmeat consumption habits and perceptions of 597 participants in Bertoua and Ebolowa, Cameroon. Bushmeat, in general, was positively perceived as a tasty, healthy, and luxurious item that meets cultural needs, while domestic meat was negatively perceived as an unhealthy and intensively processed product. The biggest barriers to bushmeat consumption were its illegality and high price. Pangolin was among the most desired types of bushmeat. Nearly half of pangolin consumers were willing to pay more for a pangolin meal. Despite being fully protected by national laws, pangolins were consistently found in local bushmeat markets and restaurants, suggesting the ineffectiveness in law enforcement and/or communication with the public about the legal protection and current status of pangolins. Our findings provide an understanding of sociocultural consumer behavior and drivers that can help guide bushmeat demand reduction interventions in urban centers of Cameroon.

KEYWORDS

Central Africa, demand reduction, pangolin, urban bushmeat consumption, wildmeat

1 | INTRODUCTION

Central Africa's Congo Basin is the second-largest tropical rainforest in the world, and while it is one of the most important biodiversity hotspots on Earth, it is highly essential for the livelihoods of millions of inhabitants (Somorin et al., 2012). Overhunting for bushmeat is considered a major threat to global biodiversity and to people who rely on nature for food and income (Nasi, Taber, & Vliet, 2011). Exploitation of wildlife to supply growing

urban and rural bushmeat markets is currently at crisis levels across Central Africa (van Vliet & Mbazza, 2011). Hunting provides about five million tonnes of game each year in the Congo Basin (Fa, Currie, & Meeuwig, 2003), where wildlife is being hunted at more than six times the sustainable rate (Bennett, 2002). This raises obvious ecological concerns as overexploitation of wildlife for food and medicine is driving at least 8,775 species, including the pangolin, towards extinction (Scheffers, Oliveira, Lamb, & Edwards, 2019).

Pangolins (family Manidae) are hunted across their ranges in Africa and Asia (Ingram et al., 2017; Wu, Liu, Zhang, & Ma, 2004). African pangolins are often consumed locally as bushmeat, and their scales are used for traditional medicines and spiritual practices (Soewu, Ingram, Jansen, Sodeinde, & Pietersen, 2020). In Asia, pangolins are highly desired and prized, especially in China and Vietnam, where their meat is considered a delicacy, and their scales are commonly used in traditional Chinese medicines (Challender, 2011; Pantel & Chin, 2008; Wu & Ma, 2007). Commercial trade has led to drastic population declines in Asian pangolins (Challender, Heinrich, Shepherd, & Katsis, 2020; Heinrich et al., 2016). Consequently, over the past two decades, demand for pangolin scales from Africa to supply the markets in Asia has been increasing (Ingram, Cronin, Challender, Venditti, & Gonder, 2019).

Cameroon is one of the most common export countries in Central Africa for the international trade of pangolins (Ingram et al., 2019). During the past few years, numerous seizures of pangolin scales and meat trafficked within the country have been recorded (Ingram et al., 2019; Randolph, 2016). Cameroon harbors three of the four African pangolin species, the giant pangolin (Smutsia gigantea), the white-bellied pangolin (Phataginus tricuspis), and the black-bellied pangolin (Phataginus tetradactyla). Order No.0648/MINFOF of December 18th, 2006 from the Ministry of Forest and Wildlife (MINFOF) in Cameroon established a categorical list of wildlife species (i.e., A, B, and C in descending level of protection), and the giant pangolin, classified as Class A species, has been fully protected since December 2006. Since January 2017, following the uplisting of pangolins to Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), all species of pangolin in Cameroon are listed under Class A, banning the hunting, capture, killing, and trade within the country, and all international commercial trade. Despite strict regulations, pangolins are consistently found in local bushmeat markets and restaurants (Ingram et al., 2017) and international trafficking (Mambeya et al., 2018), suggesting ineffective law enforcement. Comparison of data from before and after 2000 indicates that the number of pangolins hunted has increased by approximately 150% (Ingram et al., 2017). It is estimated that 0.4–2.7 million pangolins are extracted annually from Congo Basin forests (Ingram et al., 2017). While existing studies have confirmed that pangolins have been trafficked to supply both domestic and international markets, information on the impacts of the compounding threats to the species is scarce. Combined with the largest threat, which is the intercontinental trade between Central Africa and Asia, an increasing local demand for bushmeat and pangolin scales will have severe impacts on wild pangolin populations.

Rapid population growth, urbanization, and growing demand for food are exacerbating the bushmeat crisis in Central Africa (Starkey, 2004; van Vliet & Mbazza, 2011). Reduction of urban demand for bushmeat is therefore crucial for ensuring the survival of endangered species and the well-being of rural dwellers. Disciplines such as social marketing have been widely applied in Asia, and are advocated in recent literature for their potential to reduce demand for illegal wildlife products (Burgess, Olmedo, Veríssimo, & Waterman, 2020; Challender & Macmillan, 2014; Drury, 2011; Verissimo, Challender, & Nijman, 2012). These tools may help reduce bushmeat consumption in Cameroon. However, there is the lack of research on consumer behavior and drivers of demand for bushmeat, especially pangolins (Burgess et al., 2020), that would be helpful to guide such interventions.

This study addressed this knowledge gap through semistructured interviews to investigate (a) consumer preferences for bushmeat, (b) perceptions of bushmeat compared to domestic meat, and (c) barriers to bushmeat consumption. Findings of the study will be useful in developing effective consumer-centered interventions and sustainable commercial bushmeat policies aimed at reducing demand for threatened species, particularly pangolins, in urban centers of Cameroon.

2 | METHODS

2.1 | Study areas

The first study site was Bertoua (Figure 1), the capital of the eastern region of Cameroon, with population of 218,111 (World Population Review, 2020). Approximately the lower two thirds of the region are covered in rainforest where four protected areas are located, including Dja Faunal Reserve, Nki National Park, Boumba-Bek National Park, and Lobéké National Park (170 km, 250 km, 360 km, and 470 km from Bertoua respectively). The closest forested area to the site is Deng Deng National Park (69 km south to Bertoua). The region is

inhabited by a high proportion of rural dwellers who depend heavily on natural resources and subsistence agriculture for livelihood (Mbatu, 2010).

The second study area was the Ebolowa region of the southern province (Figure 1) with population of 87,875 (World Population Review, 2020), located 170 km from Yaoundé, the capital of Cameroon. The most important protected area in the region is Campo-Ma'an National Park (70 km south-west of Ebolowa) that exhibits high levels of species richness and endemism (White, 1979; Wickens & White, 1985). Local inhabitants are mostly forest dependent people. Apart from agriculture, there are other livelihood activities practiced in the area, including hunting, poaching, and logging (Tchouto et al., 2006).

Lowland forests of the South and East of Cameroon contain significant sites for the conservation of endangered species such as lowland western gorillas, central chimpanzees, forest elephants, and pangolins. Logging and hunting have led to deforestation and habitat fragmentation, exerting pressure on these vulnerable species (Rose, 1996; Tchouto et al., 2006). Bushmeat markets and restaurants commonly operate in Bertoua and Ebolowa (Akana, 2006; Randolph, 2016) where pangolins and their derived parts are easily found (Ichu, 2019; Talla & Sipehouo, 2018). Both regions often serve as major road transport routes of bushmeat into eating places and markets in Yaoundé (Edderai & Dame, 2006).

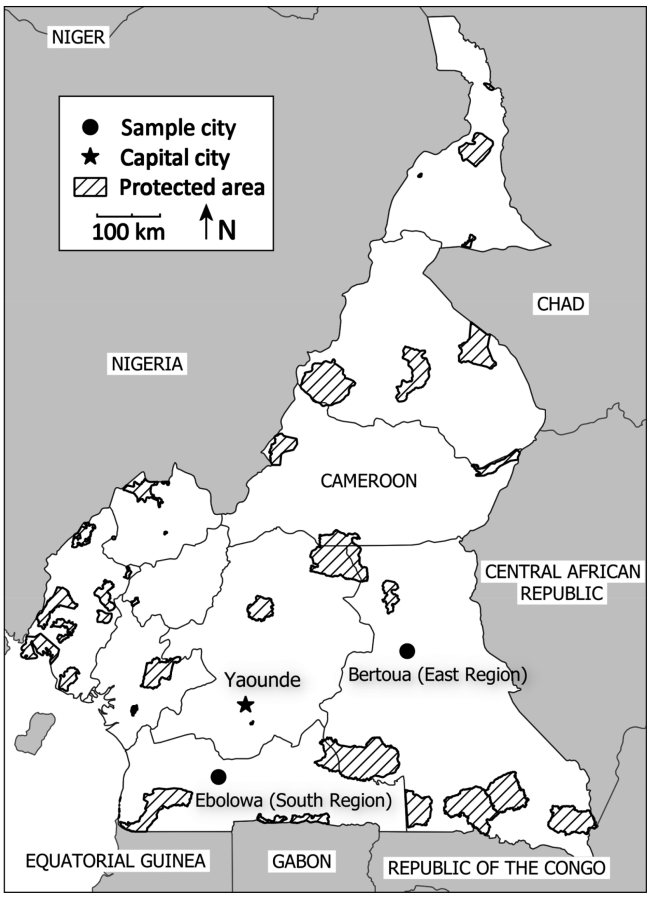

FIGURE 1 Map of Bertoua and Ebolowa, Cameroon

2.2 | Data collection

A power analysis using the G*Power3.1 software (Faul, Erdfelder, Lang, & Buchner, 2007) was first conducted to determine the appropriate sample size for each site to achieve 95% power using chi-square test with $\alpha = .05$.

We developed a questionnaire (Supporting Information) comprised a set of structured and semistructured questions. The questionnaire was constructed in English and translated into French, which is the main language spoken in both study locations. We first conducted 10 pilot interviews in Yaoundé to test the feasibility of the questionnaire. The questionnaire and interview protocol were reviewed and approved by the U.S. Fish and Wildlife Service (USFWS) and the Zoological Society of London (ZSL) who served as the ethics committee of the study. The Ministry of Forest and Wildlife granted a research permit and assigned the field team an officer who introduced us to a staff member of a local conservation organization who assisted us in arranging local guides. These individuals identified key bushmeat restaurants, helped in interpreting and building rapport with local people, and facilitated the interviews.

Interviews were conducted during 15 consecutive days in May 2017, respectively at Bertoua and Ebolowa. Respondents seated in bushmeat restaurants and street stalls were opportunistically sampled during brunch, lunch, and dinner time; these included customers who were available at the present time to participate (e.g., who finished eating, were waiting for food, and were talking to each other). This appeared to be the most pragmatic sampling strategy to gather as much information on bushmeat consumer behavior. Verbal consent was obtained and participation was voluntary and respondents were informed that they could stop the interview at any time. Most interviews were completed in French, some in English or local languages, using printed questionnaires, and lasted 20–25 min. All respondents were over 18 years old; their identities were kept anonymous.

Respondents were first asked about their sociodemographic backgrounds, followed by questions regarding bushmeat consumption experience and preferences. They were asked to choose their three most favorites amongst 10 listed species or preferred species if not on the list, rank them, and specify the reasons for their preferences.

The listed species included the pangolin and nine other species (antelope-type, chimpanzee, civet, crocodile, elephant, gorilla, monitor lizard, porcupine, and snake) ranging from common bushmeat species to high-profile species of interest to ZSL and TRAFFIC Cameroon (*pers. comm*. 2017). Incorporating a wide range of species in the interview was intended to obscure the research focus on the target species, the pangolin. We assumed that in this way respondents would be more open to report potentially sensitive information about the species (Pan et al., 2015; Turvey et al., 2014).

The next questions concerned gorillas, porcupines, and pangolins; including the frequency of consumption of, prices of, and willingness to pay for these three species. The aim was to determine the degree of association between patterns of consumption and the legal status of the species and/or public awareness towards the species, because these species receive different levels of protection and public awareness. Both species of gorilla in Cameroon (Western lowland gorilla, *Gorilla gorilla gorilla*; Cross river gorilla, *Gorilla gorilla dehli*) are listed as Class A species that are fully protected and may not be killed. We assumed that the general public would be aware of the protection status of gorillas because they have been in Class A since 1994 and have received extensive conservation efforts in the last two decades. There are numerous site-based, national, and international projects focusing on gorillas across Cameroon, including at the protected areas around the study sites (IUCN, 2014). Public sensitization programs on great apes/gorillas have also been produced in the last few years on national television, local radio, and newspapers (GAFI, n.d.; Dinsi, 2016). Both species of porcupine in Cameroon (African brush-tailed porcupine, *Atherurus africanus*; Crested porcupine, *Hystrix cristata*) are in Class C, which means they can be hunted in permitted zones. As these species are commonly hunted and available in markets (Muchaal & Ndjangui, 1995), highly preferred by consumers (Njiforti, 1996), and not part of any conservation initiative, we assumed that people might also be aware of the legal status of the porcupine. Although all three species of pangolins in Cameroon are fully protected (Class A), two species were still in Class C until January 2017, less than 6 months before this survey was conducted. Questions related to respondents' knowledge of law and species conservation status were not included to minimize the sensitive nature of the questionnaire. However, at previous public outreach events that we conducted on the World Pangolin Day in Yaoundé in 2016 and 2017, visitors exhibited low awareness of the species. Thus, we predicted that pangolins would be perceived and treated as least-concern species like porcupines.

Finally, we asked further questions about respondent perceptions of bushmeat compared with domestic meat, and barriers towards consuming bushmeat.

2.3 | Data analysis

We used IBM SPSS Analysis 25 to analyze both open-ended and pre-coded questions. To enable quantitative analysis of qualitative data, open-ended responses relating to preferences of bushmeat and perceptions of bushmeat and domesticated meat were first recorded verbatim and processed thematically (i.e., categorized into distinct themes according to their prevalence) and then coded into SPSS. These themes were subsequently refined on the basis of literature on reasons for bushmeat consumption (Chausson, Rowcliffe, Escouflaire, Wieland, & Wright, 2019; van Vliet & Mbazza, 2011).Descriptive statistics were used to provide sample size summaries. Chi-squared tests were used to test the association between bushmeat consumption and sociodemographic factors. When a chi-squared test had greater than one degree of freedom (i.e., larger than a 2×2 contingency table), the adjusted residual method (given a critical value adjusted using the Bonferroni method) was used to identify the source of a statistically significant result (MacDonald & Gardner, 2000). Alternatively, we used the likelihood ratio test where the chi-squared test could not be used. Means with standard deviation were reported to measure the degree of agreement towards conservation messages.

The Chi-squared Automatic Interaction Detection (CHAID) decision tree growing method was used with two dependent variables and five independent variables (predictors) (Table 1). The CHAID analysis helped in determining the predictors that had the strongest interaction with each dependent variable in the sub-populations of the sample (Ritschard, 2013). All variables in the tree growth algorithm were either categorical or ordinal. Six different decision tree models were analyzed (Supporting Information). Three of them were used to identify respondents' consumption frequency of the three target species, and the other three were used to determine respondents' willingness to pay more for the species. Five sociodemographic factors (Gender, Age, Religion, Education level, and Monthly household income) were specified as predictors, but only two (Age and Monthly household income) were identified in the final models. Significance was set at .05.

3 | RESULTS

3.1 | Bushmeat consumption

A total of 597 responses were obtained (Bertoua $N = 290$, Ebolowa $N = 307$) (see Table 2 for a summary of respondent sociodemographic characteristics) which met the computed sample size from G*Power. The majority of respondents (91%, $N = 544$) claimed to consume

TABLE 1 Description of dependent variables (bushmeat consumption frequency and willingness to pay) and independent variables (sociodemographic factors) used in CHAID

Variable type	Study variables	Definition for variables	Name	Values
Dependent	Bushmeat consumption frequency	Respondents' consumption frequency of the 3 target species: Gorilla, pangolin, and porcupine	FRE	1 = at least once a week 2 = at least once a month 3 = at least once every 6 months 4 = other
	Willingness to pay	Respondents' willingness to pay more to consume the 3 target species: Gorilla, pangolin, and porcupine	WIL	1 = yes 2 = no
Independent	Demographic factors	Respondents' gender	GEN	1 = male 2 = female
		Respondents' age	AGE	1 = 18–25 years old 2 = 26–35 years old 3 = 36–45 years old 4 = 45–55 years old 5 = over 55 years old
		Respondents' religion	REL	1 = Christian 2 = Muslim 3 = no religion
		Respondents' educational level	EDU	1 = no formal education 2 = primary school 3 = secondary school 4 = higher education
		Respondents' monthly household income	INC	1 = up to 50,000 FCFA (up to 86 USD) 2 = 50,001–100,000 FCFA (86–172 USD) 3 = 100,001–150,000 FCFA (172–258 USD) 4 = 150,001–300,000 FCFA (258–516 USD) 5 = over 300,000 FCFA (over 516 USD)

Note: FCFA: Central African Francs; 1 FCFA = 0.00172 USD (United Nations Conference on Trade and Development Statistics 2017).

bushmeat. Results from chi-squared tests of independence showed no significant association within the sample between bushmeat consumption experience and gender, age, or education level. However, there was a significant difference between reported bushmeat consumption and religion ($\chi^2 = 100.15$, $df = 2$, $p < .001$). Muslim respondents were less likely to consume bushmeat than Christian respondents. Those who did not have any religion all claimed to have eaten bushmeat. The relation between monthly household income and bushmeat consumption experience was also significant ($\chi^2 = 15.67$, $df = 4$, $p < .05$). The poorest people, whose monthly household income was less than 50,001 FCFA (86 USD), were more likely to consume bushmeat than others.

Asked what they had eaten at the restaurant that day, 55% of participants ($N = 330$) claimed to have had bushmeat related dishes. Pangolins (10%, $N = 61$), porcupines (9%, $N = 55$), and antelope-type (8%, $N = 49$) were the most frequently reported species. Only 8% ($N = 47$) had eaten domestic meat and 9% ($N = 53$) had eaten fish. In many cases (15%, $N = 92$), respondents reported that they had had local food mixed with pepper sauce and that they could not tell whether the sauce contained bushmeat.

3.2 | Bushmeat preferences

Porcupines were the most popular species with 72% ($N = 389$) of participants ranking them among their top 3 of preferred bushmeat, followed by pangolins (69%, $N = 375$) and snakes (44%, $N = 237$). Elephants (8%, $N = 46$), chimpanzees (4%, $N = 24$), and gorillas (3%, $N = 19$) were the least reported bushmeat of preference.

TABLE 2 Summary of surveyed respondent sociodemographic characteristics ($N = 597$)

Variable	Frequency	Percentage
Gender		
Male	413	69
Female	184	31
Age		
18–25	73	12
26–35	209	35
36–45	215	36
46–55	85	14
Over 55	15	3
Religion		
Christian	536	90
Muslim	43	7
No religion	18	3
Education		
No formal education	71	12
Primary school	102	17
Secondary school	274	46
Higher education	145	24
Missing	5	1
Monthly household income		
Up to 50,000 FCFA (up to 86 USD)	169	28
50,001–100,000 FCFA (86–172 USD)	177	30
100,001–150,000 FCFA (172–258 USD)	115	19
150,001–300,000 FCFA (258–516 USD)	89	15
Over 300,000 FCFA (over 516 USD)	14	2
Missing	33	6

Note: FCFA: Central African Francs; 1 FCFA = 0.00172 USD (United Nations Conference on Trade and Development Statistics 2017).

Other species that were not in the questionnaire list but were favored by respondents included monkey (3%, $N = 17$), cane rat (2%, $N = 12$), bush pig (0.7%, $N = 4$), and turtle (0.4%, $N = 2$).

3.3 | Consumption of the three target species: Gorilla, pangolin, and porcupine

Most bushmeat consumers reported eating porcupines (94%, $N = 512$) and pangolins (88%, $N = 480$) while only a small number of people claimed to consume gorillas (18%, $N = 97$). Results from chi-squared tests of independence showed no significant association between demographic factor variables and the consumption of any of the three target species.

The majority of respondents who had reported consuming pangolins and porcupines claimed to consume them frequently. Nearly 66% ($N = 336$) of participants ate porcupines at least once a week and 23% ($N = 117$) ate them at least once a month; while these percentages for pangolins were 53% ($N = 256$) and 20% ($N = 138$) respectively. Thirteen percent ($N = 13$) reported high levels of consumption of gorilla (at least once a week/month) and 43% of participants ($N = 42$) claimed to eat the species at least once every 6 months. Many of those who selected the option "other" (43%, $N = 42$) stated that they could not remember the exact time when they had last eaten gorilla, because it had happened a very long time ago or during childhood. The average price for a gorilla meal was 1,395 FCFA (2.4 USD); that of pangolin and porcupine were 975 FCFA (1.7 USD) and 904 FCFA (1.6 USD), respectively. On average, 16% ($N = 16$) customers were willing to spend an additional 75% on the average stated price for gorilla, 48% ($N = 231$) were willing to pay 113% more on pangolin, while 40% ($N = 207$) said they would pay 117% more for porcupine.

Results from the CHAID decision trees showed no significant association between independent variables and either consumption frequency of or willingness to pay for gorillas. In the case of pangolins, age and income contributed significantly to both the consumption frequency model and the willingness to pay model. People aged 36–45 years with a household income of less than 50,001 FCFA (86 USD) per month consumed pangolins most frequently (once a week) ($N = 57$). Respondents above 35 years with a household income of less than 50,001 FCFA were the most numerous in reporting to agree to pay more to consume the species ($N = 53$). For porcupines, there was a significant relationship between income and consumption frequency. Respondents whose monthly household income was less than 100,001 FCFA (172 USD) consumed the species most frequently (once a week) ($N = 247$). Both age and income significantly associated with the willingness to pay for porcupines. Respondents who were most willing to pay for porcupines shared similar traits with those who consumed pangolins (over 35 years old and household income less than 50,001 FCFA/month; $N = 53$).

3.4 | Perceptions of bushmeat and domestic meat

Six major reasons for bushmeat preference emerged from the data: affordability, availability, cultural influences,

TABLE 3 Respondents' reasons to choose top 3 preferred species

	Most preferred species		Second most preferred species		Third most preferred species	
Reasons	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Taste	435	73	448	75	432	72
Health	52	9	46	8	64	11
Cultural influences	51	9	29	5	40	67
Affordability	10	2	5	1	5	1
Prestige	6	1	7	1	6	1
Availability	6	1	5	1	0	0
Unspecified	13	2	8	1	12	2
Others	8	1	16	3	14	2

health, prestige, and taste. Cultural influences included responses regarding local tradition, family tradition, and habit. Health included factors pertaining to the perception of bushmeat as healthy, nutritious, fat-free, rich in protein and vitamin, natural and clean meat, as well as perceived medical benefits such as being an aphrodisiac or antibiotic and curing cancer and other diseases. For those who did not specify their reasons, the answers were classified as "unspecified." Taste was the most popular reason for a species to be ranked as preferred species, regardless of its ranking (over 70% of respondents), followed by health, cultural influence, affordability, prestige, and availability (Table 3).

Concerning the preference of bushmeat over domestic meat, respondents provided similar reasons. Taste was the most reported reason (38%, $N = 224$). These respondents claimed that wildlife was far more delicious than domestic animals because it had very strong and special flavors, regardless of whether fresh or smoked. Health was also one of the main concerns of consumers (27%, $N = 161$). Most participants perceived bushmeat as healthy because it originates in the wild, unlike raised animals fed with "chemical and contaminated food" that present health risks (quoted by 15 respondents). A few respondents also emphasized the importance of bushmeat as part of their cultural identity (13%, $N = 80$). Fewer people chose bushmeat because it was always available to buy (9%, $N = 54$) and also affordable (5%, $N = 31$). Bushmeat was occasionally considered a luxury cuisine (4%, $N = 22$), especially rare species (e.g., elephants, great apes) and species with distinctive look (e.g., pangolins).

3.5 | Barriers to bushmeat consumption

A total of 33% ($N = 241$) of respondents emphasized the illegality of consuming bushmeat as their major concern, making it the most frequently cited barrier, followed by high price (24%, $N = 177$), unavailability (10%, $N = 73$), pressure from family/children (4%, $N = 27$), and not their social norm (3%, $N = 25$). Meanwhile, 26% ($N = 190$) claimed that they did not face any barriers when consuming and purchasing bushmeat. Other reasons accounted for 1% ($N = 4$). "Pressure from family/children" refers to tribal/personal beliefs and family habits. There are people who only eat bushmeat outside but not at home because their families do not cook bushmeat at home, or other family members do not consume bushmeat. These family members often discourage them from eating bushmeat.

4 | DISCUSSION

4.1 | Sociocultural drivers of bushmeat consumption

The findings of this study indicate a strong preference towards bushmeat in urban centers of Cameroon compared to livestock. Participants perceived wildmeat as tasty, healthy, nutritious, and a luxurious product that meets cultural needs. For many people who were born and raised in or near the forest, bushmeat was the primary source of protein and also a tradition of their ethnic groups (Starkey, 2004; van Vliet, Bregt, & Hagen-Zanker, 2011). Numerous respondents highlighted how eating bushmeat helped reconnect them to the roots of their cultures and that was the reason why they maintained this habit after moving to the city. This might suggest a high proportion of population which are rural–urban migrants at the sites. By contrast, people associated domestic meat with high dissatisfaction. They were concerned about farmed animals being fed intensively with processed, "chemical" foods, and claimed that their meat is harmful to health and not recommended especially for the elderly. Our findings reflect those of previous studies

on bushmeat in urban Central Africa that show consumers to regard bushmeat as having positive cultural connotations, good taste, and valuable nutrients (East, Kümpel, Milner-Gulland, & Rowcliffe, 2005; Fargeot, 2005; van Vliet et al., 2011; van Vliet & Mbazza, 2011; Wilkie et al., 2016) and domestic meat as having negative perceptions (Chausson et al., 2019; van Vliet & Mbazza, 2011).

Price and income, along with the sociocultural factors, also drive urban demand for bushmeat. For many urban consumers, bushmeat could be a necessity for poorer households, because some species are cheaper than others and domestic meat, and easier to access at local markets and restaurants (Fargeot, 2010; van Vliet et al., 2011). On the other hand, some bushmeat species, usually large-sized and/or protected animals, are considered luxury products that are often bought by wealthier elites driven by status-seeking behavior (Brashares, Golden, Weinbaum, Barrett, & Okello, 2011). According to our results, these prized species were the least preferred ones and were less likely to be paid more for by customers (e.g., gorilla).

4.2 | Consumption of pangolins

Our survey confirms the popularity of pangolins in bushmeat consumption. Pangolins were ranked second place, after the porcupine, to be the most preferred species. The animals were cherished for their taste and perceived medicinal benefits (e.g., aphrodisiac, antibiotic). Nearly half of pangolin consumers were willing to pay higher prices for a pangolin meal suggesting a high demand for the species in these urban centers. People with low incomes were among the most willing consumers agreeing to pay more for pangolins. However, some respondents referred to pangolins as a status symbol because of their high price. In Yaoundé, Cameroon and Lagos, Nigeria, pangolins are also regarded as desired and expensive bushmeat species (O.Excellence, Routh, & Temitope, 2018; Randolph, 2016). Pangolins appeared to meet the demand from both the poor and the elites because customers could get a pangolin meal from 500 to 2,500 FCFA (0.9–4.3 USD). Prices of bushmeat dishes should be treated with caution as there is no data to differentiate these dishes. This could depend on the differences between the three species of pangolin, the size/type of restaurants (e.g., well-known restaurant versus small food stall), the way a dish was prepared/cooked (e.g., fresh/smoked meat, big/small portion, different cooking techniques and added ingredients), or the consumption settings (e.g., casual versus business).

Despite being subject to the highest level of protection in Cameroon like the gorilla (Class A), pangolins were among the most consumed species, together with porcupines (Class C). In Cameroon, the consumption of well-known endangered species such as chimpanzees, gorillas, and elephants is often associated with tribal or personal totemic beliefs (Etiendem, Hens, & Pereboom, 2011; Randolph, 2016). Many people fear killing or eating them because of consequences their family, their communities, or themselves might endure (e.g., illness or death). Species such as great apes are often avoided because of their behavioral and morphological similarities to humans. Law enforcement and awareness-raising efforts also play important roles in reducing demand for these species. Besides, low preference in high-profile bushmeat species is likely linked to scarcity as they are often unavailable and costly. This corroborates our results as they were reported the least desired bushmeat species. By contrast, the pangolin, a slow-reproducing (procreating one offspring per year), harvest-sensitive, and fully protected species, is following the consumption trend of the porcupine, which is abundant and of least concern yet popular in the trade. This could be explained by the ineffectiveness in law enforcement and/or communication with the public about wildlife laws and regulations resulting in a lack of knowledge regarding up-to-date legal protection and current status of pangolins.

4.3 | Implications for behavior change and policy

While international and regional seizures of pangolin products from African pangolins are exponentially increasing, it is not yet clear whether this is a result of more effective law enforcement or an indication of increasing illegal trafficking (Mambeya et al., 2018). Our study suggests that pangolins are highly vulnerable to bushmeat trade in urban areas. The survival of pangolins will depend on enforcing existing regulations while reducing demand for the species. It is crucial to ensure that the public first be aware of the legal status of the pangolin considering the biggest barrier to bushmeat consumption appeared to be its illegality when it comes to protected species. Well-designed and research-based public awareness and environmental education programs are suggested as the first step of a suite of social strategies to attain changes in consumption behavior (Ardoin, Bowers, & Gaillard, 2020; Ardoin & Heimlich, 2013; Fien, Scott, & Tilbury, 2001).

Influencing human attitudes and behavior towards bushmeat consumption is challenging, time-consuming, and requires an in-depth understanding of multiple sociocultural drivers (Chausson et al., 2019). Conservation messages, thus, need to be tailored in accordance

with specific targeted audiences and their sociocultural backgrounds. It is notable that in urban Cameroon, bushmeat is often consumed not as a dietary necessity but driven by personal preferences (e.g., taste, health concerns) and cultural reasons. The importance of wildlife in food as well as in medicinal and spiritual cultures of urban Cameroonians suggests the need for culturally sensitive conservation interventions. Public figures such as religious leaders or influential celebrities can be important agents in effectively communicating conservation messages as is apparent from the literature (Dell'Apa, Smith, & Kaneshiro-Pineiro, 2014; Fath & Mayrargue, 2014).

4.4 | Facilitating alternative protein sources

Bushmeat consumer demand can be altered by shifting customers towards domestic substitutes. Conservation tactics could integrate messages that dispel negative notions about domestic meat while promoting positive perceptions associated with it. Fresh fish, locally reared livestock, and free-ranging poultry might meet customer expectations when it comes to healthy foods that do not contain artificial additives. Understanding preferences and perceptions associated with alternative protein sources thus needs to be investigated to provide insights into better promotion of these substitutes. However, it is also important to oversee the negative environmental impacts caused by increasing fishing and animal agriculture (Scanes, 2018; Wilkie et al., 2005).

Shifting consumer behaviors and reducing demand for bushmeat in an urban context will remain a complex effort. Results from our study indicate that bushmeat, particularly pangolins, is subject to intensive consumption by urban residents. We thus stress the need for increased public awareness of the legal protection and current status of pangolins, as well as law enforcement in regulating bushmeat markets and restaurants. Importantly, behavior change interventions should always take local context into account to develop effective conservation messages. Future investigation on the roles and impacts of rural–urban migration on wildlife consumption is essential. This study provides an initial understanding of sociocultural perspectives and preferences influencing bushmeat consumption in urban centers of Cameroon with a focus on pangolin species. Our findings could inform further data collection and help guide consumer-targeted interventions aimed at reducing demand for bushmeat in urban centers of Cameroon. Further research on consumption and trade of pangolins in both urban areas and forested areas where hunting takes place is needed to tackle the pangolin crisis nationally and globally.

ACKNOWLEDGMENTS

This research was funded by the U.S. Fish and Wildlife Service and the Zoological Society of London under the MENTOR-POP (Progress on Pangolins) Programme. We acknowledge the Chevening Scholarships, the UK government's global scholarship programme and the University of Kent for sponsoring the main author's Masters as this project was a part of her dissertation. We thank USFWS, ZSL, Save Pangolins, the IUCN Pangolin Specialist Group, the Last Great Ape Organization, TRAFFIC Cameroon, WCS Cameroon, and WWF Cameroon for their guidance and collaboration, and lastly Seekings TBW for his critical revision and consistency check.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Linh Bao Nguyen designed and coordinated the project, designed the questionnaire, conducted the interviews, analyzed the data, and wrote the manuscript. Etogekwe Esua Fossung and Camille Affana Nkoa planned the project, designed the questionnaire, and conducted the interviews. Tatyana Humle supported with analyses and revisions as research advisor.

DATA AVAILABILITY STATEMENT

All data used to generate this article are presented in the article and the supplemental materials.

ETHICS STATEMENT

This research protocols were approved by the U.S. Fish and Wildlife Service, the Zoological Society of London, and Durrell Institute of Conservation and Ecology's ethics committees; research permission was granted by the Ministry of Forestry and Wildlife of Cameroon.

ORCID

Linh Bao Nguyen https://orcid.org/0000-0003-2210-6933

REFERENCES

Akana, D. (2006). *Consumption patterns decimating Africa's wildlife*, InfoCongo. Retrieved from https://infocongo.org/fr/consumption-patterns-decimating-africas-wildlife-3/.

Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation*, *241*, 108224.

Ardoin, N. M., & Heimlich, J. E. (2013). Views from the field: Conservation educators' and practitioners' perceptions of education

as a strategy for achieving conservation outcomes. *The Journal of Environmental Education*, *44*, 97–115.

Bennett, E. L. (2002). Is there a link between wild meat and food security? *Conservation Biology*, *16*, 590–592.

Brashares, J. S., Golden, C. D., Weinbaum, K. Z., Barrett, C. B., & Okello, G. V. (2011). Economic and geographic drivers of wildlife consumption in rural Africa. *Proceedings of the National Academy of Sciences*, *108*, 13931–13936.

Burgess, G., Olmedo, A., Veríssimo, D., & Waterman, C. (2020). Chapter 22 – Changing consumer behavior for pangolin products. In D. W. S. Challender, H. C. Nash, & C. Waterman (Eds.), *Pangolins* (pp. 349–366). London, United Kingdom: Academic Press.

Challender, D. W. S. (2011). Asian pangolins: Increasing affluence driving hunting pressure. *TRAFFIC Bulletin*, *23*, 92–93.

Challender, D. W. S., Heinrich, S., Shepherd, C. R., & Katsis, L. K. D. (2020). Chapter 16 – International trade and trafficking in pangolins, 1900–2019. In D. W. S. Challender, H. C. Nash, & C. Waterman (Eds.), *Pangolins* (pp. 259–276). London, United Kingdom: Academic Press.

Challender, D. W. S., & Macmillan, D. C. (2014). Poaching is more than an enforcement problem. *Conservation Letters*, *7*, 484–494.

Chausson, A. M., Rowcliffe, J. M., Escouflaire, L., Wieland, M., & Wright, J. (2019). Understanding the sociocultural drivers of urban bushmeat consumption for behavior change interventions in pointe noire, Republic of Congo. *Human Ecology*, *47*, 179–191.

Dell'Apa, A., Smith, M., & Kaneshiro-Pineiro, M. (2014). The influence of culture on the international management of shark finning. *Environmental Management*, *54*, 151–161.

Dinsi, S. C. (2016). *Raising awareness of the links between great ape conservation, poverty alleviation and private sector investments in Cameroon*. Cameroon: Cameroon PCLG.

Drury, R. (2011). Hungry for success: Urban consumer demand for wild animal products in Vietnam. *Conservation and Society*, *9*, 247–257.

East, T., Kümpel, N., Milner-Gulland, E., & Rowcliffe, M. (2005). Determinants of urban bushmeat consumption in Río Muni, Equatorial Guinea. *Biological Conservation*, *126*, 206–215.

Edderai, D., & Dame, M. (2006). A census of the commercial bushmeat market in YaoundÈ, Cameroon. *Oryx*, *40*, 472–475.

Etiendem, D. N., Hens, L., & Pereboom, Z. (2011). Traditional knowledge systems and the conservation of Cross River gorillas: A case study of Bechati, Fossimondi, Besali, Cameroon. *Ecology and Society*, *16*, 22.

Fa, J. E., Currie, D., & Meeuwig, J. (2003). Bushmeat and food security in The Congo Basin: Linkages between wildlife and people's future. *Environmental Conservation*, *30*, 71–78.

Fargeot, C. (2005). *La chasse commerciale en Afrique centrale: Une activité territoriale de rente*. France: Cirad-forêt.

Fargeot, C. (2010). Bushmeat consumption in Central African Republic. In *Paper presented at the 23rd IUFRO congress*. Seoul, South Korea.

Fath, S., & Mayrargue, C. (2014). Les nouveaux christianismes en Afrique. *Afrique Contemporaine*, *252*, 13.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175–191.

Fien, J., Scott, W., & Tilbury, D. (2001). Education and conservation: Lessons from an evaluation. *Environmental Education Research*, *7*, 379–395.

GAFI. (n.d.) *How GAFI can help gorillas*. Retrieved from https://www.gafi4apes.org/great-apes/gorillas/how-gafi-can-help-gorillas.html.

Heinrich, S., Wittmann, T. A., Prowse, T. A. A., Ross, J. V., Delean, S., Shepherd, C. R., & Cassey, P. (2016). Where did all the pangolins go? International CITES trade in pangolin species. *Global Ecology and Conservation*, *8*, 241–253.

Ichu, G. I. (2019). *Status of pangolin trade in Cameroon and between Cameroon and destination countries*. Yaoundé, Cameroon and Cambridge, UK: TRAFFIC.

Ingram, D. J., Coad, L., Abernethy, K. A., Maisels, F., Stokes, E. J., Bobo, K. S., … Scharlemann, J. P. (2017). Assessing Africa-wide pangolin exploitation by scaling local data. *Conservation Letters*, *11*, e12389.

Ingram, D. J., Cronin, D. T., Challender, D. W. S., Venditti, D. M., & Gonder, M. K. (2019). Characterising trafficking and trade of pangolins in the Gulf of Guinea. *Global Ecology and Conservation*, *17*, e00576.

IUCN. (2014). *Regional action plan for the conservation of Western lowland gorillas and central chimpanzees 2015–2025*. Gland, Switzerland: IUCN SSC Primate Specialist Group.

MacDonald, P., & Gardner, R. (2000). Type I error rate comparisons of post hoc procedures for I j Chi-Square tables. *Educational and Psychological Measurement – EDUC PSYCHOL MEAS*, *60*, 735–754.

Mambeya, M. M., Baker, F., Momboua, B. R., Koumba, P. A. F., Hega, M., Okouyi, O. V. J., … Abernethy, K. (2018). The emergence of a commercial trade in pangolins from Gabon. *African Journal of Ecology*, *56*, 601–609.

Mbatu, R. (2010). Deforestation in the Buea-Limbe and Bertoua regions in southern Cameroon (1984-2000): Modernization, world-systems, and neo-Malthusian outlook. *GeoJournal*, *75*, 443–458.

Muchaal, P. K., & Ndjangui, G. (1995). *Wildlife populations in the Western Dja Reserve (Cameroon). An assessment of the impact of village hunting and alternatives for sustainable utilisation. Ecofac Report*. Brussels: EEC.

Nasi, R., Taber, A., & Vliet, N. (2011). Empty forests, empty stomachs? Bushmeat and livelihoods in Congo and Amazon Basins. *International Forestry Review*, *13*, 14.

Njiforti, H. (1996). Preferences and present demand for bushmeat in north Cameroon: Some implications for wildlife conservation. *Environmental Conservation*, *23*, 149–155.

O.Excellence, A., Routh, A., & Temitope, O. (2018). *Trade and the decline of the African tree pangolin in Lagos State, Nigeria*. https://www.researchgate.net/publication/323676612_Trade_and_the_decline_of_the_African_tree_pangolin_in_Lagos_State_Nigeria.

Pan, Y., Wei, G., Cunningham, A., Shize, L., Chen, S., Milner-Gulland, E., & Turvey, S. (2015). Using local ecological knowledge to assess the status of the Critically Endangered Chinese giant salamander *Andrias davidianus* in Guizhou Province, China. *Oryx*, *50*(2), 257–264.

Pantel, S., & Chin, S. Y. (2008). *Proceedings of the Workshop on Trade and Conservation of Pangolins Native to South and Southeast Asia*.

Randolph, S. (2016). *The social, economic and cultural dimensions of bushmeat in Yaoundé, Cameroon*.

Ritschard, G. (2013). CHAID and earlier supervised tree methods. In J. J. McArdle & G. Ritschard (Eds.), *Contemporary Issues in Exploratory Data Mining in Behavioral Sciences* (pp. 48–74). New York: Routeledge.

Rose, A. (1996). The African great ape Bushmeat crisis. *Pan Africa News*, *3*, 1–6.

Scanes, C. G. (2018). Chapter 18 - Impact of agricultural animals on the environment. In Scanes C. G, and Toukhsati S. R. (Eds.). *Animals and Human Society*. United States: Academic Press.

Scheffers, B., Oliveira, B., Lamb, I., & Edwards, D. (2019). Global wildlife trade across the tree of life. *Science*, *366*, 71–76.

Soewu, D., Ingram, D. J., Jansen, R., Sodeinde, O., & Pietersen, D. W. (2020). Chapter 15 – Bushmeat and beyond: Historic and contemporary use in Africa. In D. W. S. Challender, H. C. Nash, & C. Waterman (Eds.), *Pangolins* (pp. 241–258). London, United Kingdom: Academic Press.

Somorin, O., Brown, H., Visseren-Hamakers, I., Sonwa, D., Arts, B., & Nkem, J. (2012). The Congo Basin forests in a changing climate: Policy discourses on adaptation and mitigation (REDD+). *Global Environmental Change-Human and Policy Dimensions*, *22*, 288–298.

Starkey, M. P. (2004). *Commerce and subsistence: The hunting, sale and consumption of bushmeat in Gabon*. Doctoral thesis, England: University of Cambridge.

Talla, M., & Sipehouo, J. (2018). *Integral Pangolin protection: Myth or reality? Assessment of pangolin integral protection decision regard by CITES in Central Africa through Cameroon case study, Action for Environmental Governance*. Retrieved from http://ageafrique.org/images/documents/Etude_sur_le_Pangolin_VE_072018.pdf.

Tchouto, M., Yemefack, M., de Boer, W. F., Wilde, J., van der Maesen, L., & Cleef, A. M. (2006). Biodiversity hotspots and conservation priorities in the Campo-Ma'an rain forests, Cameroon. *Biodiversity and Conservation*, *15*, 1219–1252.

Turvey, S. T., Trung, C. T., Quyet, V. D., Nhu, H. V., Thoai, D. V., Tuan, V. C. A., … Wilkinson, N. M. (2014). Interview-based sighting histories can inform regional conservation prioritisation for highly threatened cryptic species. *Journal of Applied Ecology*, *52*, 422–433.

van Vliet, J., Bregt, A., & Hagen-Zanker, A. (2011). Revisiting kappa to account for change in the accuracy assessment of land-use change models. *Ecological Modelling*, *222*, 1367–1375.

van Vliet, N., & Mbazza, P. (2011). Recognizing the multiple reasons for bushmeat consumption in urban areas: A necessary step toward the sustainable use of wildlife for food in Central Africa. *Human Dimensions of Wildlife*, *16*, 45–54.

Verissimo, D., Challender, D., & Nijman, V. (2012). Wildlife trade in Asia: Start with the consumer. *Asian Journal of Conservation Biology*, *2*, 139–140.

White, F. (1979). The Guineo-Congolian region and its relationships to other phytochoria. *Bulletin du Jardin Botanique National de Belgique*, *49*, 11–55.

Wickens, G., & White, F. (1985). The vegetation of Africa. A descriptive memoir to accompany the Unesco/AETFAT/UNSO vegetation map of Africa. *Kew Bulletin*, *40*, 453.

Wilkie, D., Starkey, M., Abernethy, K., Effa, E., Telfer, P., & Godoy, R. (2005). Role of prices and wealth in consumer demand for Bushmeat in Gabon, Central Africa. *Conservation Biology*, *19*, 268–274.

Wilkie, D. S., Wieland, M., Boulet, H., Le Bel, S., van Vliet, N., Cornelis, D., … Fa, J. E. (2016). Eating and conserving bushmeat in Africa. *African Journal of Ecology*, *54*, 402–414.

World Population Review. (2020). *Population of Cities in Cameroon (2020)*. Retrieved from https://worldpopulationreview.com/countries/cities/cameroon.

Wu, S. B., Liu, N., Zhang, Y., & Ma, G. (2004). Assessment of threatened status of Chinese Pangolin (*Manis pentadactyla*). *Chinese Journal of Applied and Environmental Biology*, *10*, 456–461.

Wu, S. B., & Ma, G. (2007). The status and conservation of pangolins in China. *TRAFFIC East Asia Newsletter*, *4*, 1–5.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

How to cite this article: Nguyen LB, Fossung EE, Affana Nkoa C, Humle T. Understanding consumer demand for bushmeat in urban centers of Cameroon with a focus on pangolin species. *Conservation Science and Practice*. 2021;3:e419. https://doi.org/10.1111/csp2.419