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Understanding the influence of non-wealth factors in determining bushmeat consumption: results from four West African countries

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Abstract

The meat of wild animals (bushmeat) is consumed extensively in many tropical regions. Over the past few decades bushmeat consumption has greatly increased, threatening the survival of some hunted species and the supply of animal protein to countless numbers of people. Understanding patterns of bushmeat consumption is thus vital to ensure the sustainable use of this resource. Although the economic drivers of bushmeat consumption has been well studied, non-wealth correlates have been poorly considered. Here, we analyse how factors such as age and gender influence bushmeat consumption in four West African countries, within the Guinean forests (Togo and Nigeria) and Sahel (Burkina Faso and Niger). We interviewed a total of 2,453 persons (1,253 urban, 1,200 in rural areas) to determine frequency of consumption of bushmeat as well as main species eaten. We found significant differences in bushmeat consumption between rural and urban areas in all four countries. In particular, the proportion of persons not consuming any bushmeat was highest in urban areas. Gender differences in bushmeat consumption was not generally important but young people consistently avoided eating bushmeat, especially in Togo and Nigeria, and in urban areas. The complicated interplay between tradition and evolution of social systems (especially the trends towards westernization) may explain the different perceptions that people may have towards consuming bushmeat in the four studied countries. In addition, we found considerable variation in types of bushmeat eaten, with antelopes and large rodents eaten by the great majority of interviewees, but bats, monkeys, and snakes being avoided, especially in urban settlements.

Key words: Age; gender; Togo; Burkina Faso; Nigeria; Niger; wildlife; species eaten; frequency.

1. Introduction

Terrestrial wild vertebrates are central to the nutritional wellbeing of many rural people, particularly those inhabiting the world's tropical regions (Fa et al., 2002; Golden et al., 2011). This reliance on wild meat is as much a consequence of the lack of alternative domestic meat resources (Mainka & Trivedi 2002; Nasi et al. 2008), as much as it is an attribute of centuries-old cultural traditions (Milner-Gulland et al., 2003). However, although wild animals have been hunted for millennia, their consumption has greatly increased over the past few decades (Nasi et al., 2011). In West and Central Africa, commercial hunting, especially to supply large urban centres, has risen dramatically, largely driven by a human population growth of 2–3% per year (Nasi et al., 2011). Such intensification of demand for bushmeat will have fatal consequences for many species but particularly large-bodied and slow-growing species if extraction exceeds their replacement rate (Wilkie et al., 2001). Indeed, the decline of some species as a consequence of bushmeat extraction has already been documented for tortoises (Luiselli, 2003) and antelopes (Fischer and Linsenmair, 2001; Grande-Vega et al., 2016; Hema et al., 2017). As a consequence, loss of wildlife may threaten the food security of many marginalized forest foragers, and farmer-forager communities that are isolated from markets and depend on bushmeat as their primary protein source (Eves and Ruggiero, 2001).

Few studies have centred on understanding why people eat bushmeat. Knowning what motivates people to eat bushmeat can help in developing politically acceptable ways to manage wildlife hunting and trading with the aim of halting unsustainable exploitation. Bushmeat may be eaten because it is cheaper or there are no alternatives available in the market place (Apaza et al., 2002; Wilkie and Godoy, 2001), because consumers prefer the taste of wildlife (Chardonnet et al., 1995; Trefon and de Maret, 1999) or to add variety to the diet and for special social events and occasions (Njiforti, 1996). Despite this variety of

78 possible reasons that may motivate buyers to eat bushmeat, most studies have focused on the
79 socioeconomic background of consumers as the main reason underpinning their choice (e.g.
80 Wilkie and Godoy, 2001; Brashares et al., 2011). In general, wealthier households consume
81 more bushmeat in settlements nearer urban areas, but the opposite pattern is observed in
82 more isolated settlements (Brashares et al., 2011). Nonetheless, Brashares et al. (2011) also
83 indicate that household wealth is only weakly linked to wildlife consumption, and thus such
84 a lack of a strong correlation could be explained by the undisclosed importance of other
85 factors e.g. spatial differences in wealth. Thus, understanding what may influence
86 consumption patterns, other than wealth, are urgently needed to disentangle the part played
87 by ecological, socioeconomic and cultural factors. Recent studies have shown that price and
88 income have significant roles in determining the level of consumption of bushmeat, fish,
89 chicken, and beef (Apaza et al., 2002; Wilkie and Godoy, 2001; Wilkie et al., 2005).
90 However, few investigations have focused on how bushmeat consumption is affected by
91 geographic location, gender or age of consumers; all attributes of a population that reflect
92 cultural influences (Hema et al., 2017; Luiselli et al., 2017).

93 Household surveys have been extensively used to understand potential linkages
94 between conservation and local livelihoods. Studies reporting on the amounts and
95 preferences of bushmeat consumed have focussed on the collection of quantitative
96 household-level data and have been useful in determining possible socioeconomic
97 characteristics of a community that may be linked to bushmeat consumption. However,
98 household surveys have both theoretical and logistical weaknesses. Logistically, these
99 surveys can be costly in terms of time and resources especially if adequate sample sizes are
100 collected. Theoretically, a given household often includes resident of different ages (from
101 over 80 to less than 5 years old) and scholarization levels (from complete illiteracy to
102 university-level students), and these may be linked to contrasting lifestyles and points of
103 view, including their perception towards bushmeat consumption (Luiselli et al., 2017). Thus,

104 focusing on just households can introduce biases to the overall conclusions. To avoid these
105 biases face-to-face interviews allow the collection of large amounts of qualitative
106 information that can be used to ascertain bushmeat consumption levels and factors that may
107 affect these. Here we use interview responses from inhabitants of rural communities and
108 urban centres in a number of localities in four West African countries to: 1) quantify the
109 frequency of consumption of bushmeat, 2) determine the influence of gender and age, and 3)
110 assess whether location (rural/urban; in forest versus in savannah habitats), and country
111 influenced bushmeat consumption.
112
113 **2. Methods**
114 *2.1. Study sites*
115 We interviewed a total of 2,453 individuals (1,253 urban, 1,200 in rural areas) from
116 27 separate human settlements in Nigeria, Togo, Burkina Faso and Niger (Fig. 1). Study
117 localities in Nigeria and Togo were located within the Guinean Forests of West Africa
118 region; swamp forest and moist rainforest vegetation zones in southern Nigeria (Niger Delta
119 Environmental Survey, 1998; Oates et al., 2004) and in the deciduous moist forest zone of
120 southwestern Togo (Ern, 1979). Sites in Burkina Faso and Niger were found within the
121 Sahel, in Sudanian and Sahel Acacia savannahs (Thiombiano and Kampmann, 2010).
122
123 *2.2. Interviews*
124 To obtain information on bushmeat use, we conducted face-to-face interviews using
125 a standardized questionnaire. All data were gathered during 2012-2016. We selected
126 interviewees at marketplaces, roadsides, canteens, restaurants, hairdressing salons, food
127 shops, and other gathering places. We stopped the first person we encountered after a given
128 time period (in minutes); the time interval was randomly generated by a Random Number
129 Generator. Local scientists (VO, NA, GP, DS, WG, EAE and other students) performed all

interviews. All interviewees were informed of the aims of the project and their consent was obtained before proceeding. All interviews were conducted in the local language.

We interviewed persons in Ouagadougou, Niamey, Lomé, Benin City, Port Harcourt, Calabar (all cities with more than 500,000 residents) as well as in rural villages (500 to 25,000 inhabitants, apart from Pama that has about 40,000 inhabitants). We recorded the interviewees' gender (male or female) and age (≤ 25 years, 26-50 years, ≥ 51 years) but not their names (St. John, 2010; Nuno et al., 2014; Luiselli et al., 2017). To avoid non-independence of the data, we never interviewed two persons of the same family or those living in the same house, even if they were not relatives (see also Hema et al., 2017, for similar procedure).

Interviewees were asked the following two questions: (1) Do you like eating bushmeat? (2) If yes, how often do you eat bushmeat? Interviewees would then be asked if they ate bushmeat frequently (at least once a week), rarely (about once per month or less) or never. Persons who answered that they consumed bushmeat only occasionally were then asked whether they selected the type of animal orwhether they would just buy/eat whatever kind of bushmeat was available.

2.3. Statistical analyses

We employed Generalized Linear Models (GLZs) to determine the relationship between bushmeat consumption frequency and site (rural versus urban), gender (male/female) and age classes (three categories) (Hosmer and Lemeshow, 2000). The codes for the variables used in the GLZs are given in Appendix 1. In the model, the response "never eat bushmeat" was the dependent variable (i.e. consumption data were converted into a binary variable, 1 = eat (often or rarely) and 0= never eat bushmeat) and the identity of the link function and a normal distribution of error were used (McCullagh and Nelder, 1989). Three age categories were used for all analyses: persons aged less than 25, aged less than 50,

and aged 51 years or more. In the GLZ models, a stepwise forward regression procedure was used to test the statistical significance of each variable in turn, and variables were excluded when they did not correlate significantly with the dependent variable (Wald test $P > 0.05$).

To explore deviance and hierarchical partitioning, the selected variables were analyzed in order to determine the comparative influence of each variable (Borcard et al., 1992). The decomposition of the variation into subsets of explanatory variables was carried out by means of a partial regression analysis (Legendre and Legendre, 1998).

Frequency differences between groups of interviewed people were analyzed using the χ^2 test, for comparing both differences among frequently-eating, rarely-eating and non-eating bushmeat respondents, and for determining differences in terms of type of bushmeat eaten. The statistical software PASW 11.0 was used for all analyses, and alpha was set at 5%.

3. Results

3.1. General patterns

A summary of the data gathered for this study is shown in Table 1, the raw dataset is given in Appendix 2. In general terms, bushmeat was consumed more often by rural than urban interviewees in all countries (Fig. 2). An average total of 70.3 ± 15.7% of rural respondents answered that they ate bushmeat (either eaten rarely or often) in contrast to only 42.8 ± 19.0% of urban interviewees. In all countries more rural than urban respondents ate bushmeat; 1.59 times more in Niger, 1.26 times more in Nigeria, 0.46 times in Togo and 0.14 times in Burkina Faso.

A general GLZ model using data from all countries pooled and type of bushmeat eaten as the dependent variable showed that, the probability of eating ungulates or birds was significantly affected by gender or age of the respondents respectively, while the eating of monkeys, bats, carnivores, crocodiles, snakes and turtles was influenced by the age of the respondents and their urban/rural location (Table 2).

We found significant differences in responses between interviewees in Guinean forests and the Sahel region. Age classes, followed by urban/rural location, accounted for the strongest pure effect in the Sahelian localities with gender explaining only a very small proportion of the variance (Fig. 3). Within the Guinean forest localities, urban/rural location was the predominant effect, age had a lesser relevance in terms of explained variance, but gender had almost no effect (Fig. 3).

We found a significant effect of distance (in km) of the interviewee to the nearest urban area where the probability of never-eating bushmeat increased in Sahelian countries, but not in the two countries within the Guinean forest region (for Sahel: GLZ estimate = 6.56, standard error = 1.34, Wald = 24.0, $P < 0.0001$; for age classes: estimate = -7.62, standard error = 2.32, Wald = 10.79, $P < 0.001$; for Guinean forests: in all cases $P > 0.165$).

3.2. Country effects

Our GLZ model revealed that effect of country on bushmeat consumed were relatively minor (Table 2). Nonetheless, country had a statistical effect on the consumption of primates, with people from the Guinean Forests countries being more likely to eat monkeys than people in the Sahel (Table 2). Thus, apart from primates, there were no other statistical differences between areas of Guinean forest countries and Sahelian countries in terms of the probability of consuming the various types of bushmeat.

Overall, there were no significant differences between countries (in all cases, at least $P > 0.225$ at χ^2 test) in the proportion of those respondents who declared that they never ate bushmeat (Table 3) as well as in those that declared to frequently eat bushmeat (Table 4). However, there were clear confounding effects of age, gender and urban/rural location on the pure effect of the country (see below). Overall, patterns for the frequency of 'often-eaten-bushmeat' responses were more consistent among countries than in the 'never-eating-bushmeat' answers (Table 4).

In Togo, there was a significant effect of age in urban and rural areas; the frequency of respondents never-eating bushmeat declined significantly with age in both locations (Table 3). No effect of gender was found, but the differences between rural and urban areas depended on the strength of the frequency decreases of never-eating-bushmeat respondents in these two locations, i.e. rural and urban people in Togo tended to respond similarly. In Nigeria (Table 3), there was no effect of age in urban areas (people do not eat bushmeat in general) but in rural areas (only young people did not eat bushmeat). In addition, there was a significant effect of gender in urban areas, with women avoiding eating bushmeat more than men. The overall differences between rural and urban areas were significant for both gender and age (Tables 3 and 4). In Burkina Faso, there was a significant effect of age in urban areas (more young people did not eat bushmeat) but not for rural areas, where people do generally eat bushmeat independent of their age (Tables 3 and 4). In Niger, there was only a significant effect of age, with more young people responding that they would never eat bushmeat compared to older people, in both urban and rural locations (Table 3).

3.3. Age effects

Our GLZ model revealed that the age of the interviewees affected the probability of consuming primates, bats, carnivores, crocodiles, snakes and chelonians, in all cases older people were more likely to consume these animals than younger people (Table 2).

225 Overall, age had a significantly stronger effect on the likelihood of consuming
226 bushmeat in the Sahelian region compared to the Guinean forest region (Fig. 3).
227 Nonetheless, the tendency was the same in both regions: young people tended to never or
228 very rarely consume bushmeat significantly more than people of >25 years age ($P < 0.001$ at
229 χ^2 test).
230
231 *3.4. Gender effects*
232 Overall, gender effects were negligible in both Sahelian and Guinean forests regions,
233 and contributed little to the hierarchical variance partitioning in the interview dataset (Figure
234 3). Nonetheless, some effects of gender were detected in the attitude of consuming a few
235 types of bushmeat as well as in a few local contexts. Indeed, although most people ate
236 ungulates and rodents, there were significant effects of gender on the consumption of these
237 animals, with men being more likely to eat them than women (Table 2). In addition, females
238 tended to avoid eating bushmeat more frequently than males in some countries such as
239 Nigeria. However, this was not a pure gender effect, as it was mediated by age and
240 rural/urban condition in a rather complicated way (Tables 3 and 4). Overall, the 'often-
241 eating-bushmeat' response was especially linked to men in either Guinean forests (e.g.Togo)
242 or Sahel (e.g. Burkina Faso) regions.
243
244 *3.5. Rural versus urban*
245 Whether living in rural or urban locations determined the outcome of the
246 interviewees' answers in the Guinean forest region but not in the Sahelian region (Fig. 3). In
247 other words, attitude towards bushmeat of people from Sahelian regions was similar in both
248 rural and urban locations, whereas in the Guinean forest region there were differences
249 between locations. In addition, in terms of frequency of never-eating bushmeat people,
250 statistical differences between rural versus urban conditions were much higher ($P < 0.001$ at

χ^2 test) than those occurring between countries (see above). Whether a person lived in an urban or rural location affected the probability of consuming bushmeat much more than their country of residence.

A total of 41.9% of urban and 67.3% of rural respondents stated they consumed bushmeat (Fig. 4); this difference being significant ($\chi^2 = 231.9$, df = 2, $P < 0.0001$). According to the different response categories, most interviewees in rural areas mentioned they frequently ate bushmeat ($\chi^2 = 7.3$, df = 2, $P < 0.05$), but in urban areas most said they never ate bushmeat ($\chi^2 = 193.4$, df = 2, $P < 0.0001$).

Overall, ungulates and rodents were eaten by almost all respondents in either rural or urban areas, but carnivores, monkeys and snakes were eaten rarely (differences significant at $P < 0.00001$ compared to ungulates and rodents, χ^2 test), and mainly in rural areas (Fig. 5). Contingency table analysis showed that there were no significant differences between urban and rural areas in terms of frequency of respondents eating the various bushmeat types ($\chi^2 = 14.48$, df = 8, $P = 0.0699$). However, our GLZ model revealed that primates, bats, carnivores, crocodiles, snakes and chelonians were significantly more likely to be eaten by rural than by urban people, with the highest estimates being for monkeys and bats (Table 2); it was unlikely that people from urban areas, in any of the surveyed countries, ate monkeys and bats.

Differences between urban and rural areas were also strongly mediated by the effects of age and gender (Tables 3 and 4). Overall, there were significant differences in both gender and age between rural and urban areas.

4. Discussion

Previous studies have suggested that bushmeat was universally preferred “due to its superior taste” (King, 1994) and thus African communities therefore preferred and thus primarily ate

bushmeat. These statements were not based on empirical evidence until a study reporting on two-choice taste tests showed that consumers in Gabon had only a weak preference for bushmeat and only rural consumers consistently preferred bushmeat over alternatives (Schenck et al., 2006). This result is particularly important given that it manifests that even though basic desires such as hunger and the need for nourishment can influence food choice, availability and cultural norms also affect these. Thus, it is not simply taste that is driving demand for bushmeat, but that price or other culturally mediated factors such as familiarity, tradition, and prestige play a role.

Our analyses indicate a very clear and significant difference in bushmeat consumption among rural and urban peoples in all countries. This effect appeared in 7 out of 7 models, in all four of the investigated countries. This difference has been demonstrated in a number of other studies in the African continent (e.g. in the Democratic Republic of Congo, see Van Vliet et al., 2014) and in Madagascar (Jenkins et al., 2011). This contrast between rural and urban dwellers is largely explained by the availability of bushmeat versus alternative protein sources. Rural dwellers are usually restricted in terms of the availability and accessibility of domestic meats but in a much better position to option these resources from the wild. By contrast, urban dwellers have greater access to alternative proteins (Apaza et al., 2002). Nonetheless, cultural complications also explain the preference of non-bushmeat proteins by urban people (see Luiselli et al., 2017 and below).

Our analyses clearly showed that age was important in most countries; the pure effect of age was significant in 5 out of 7 models, in Nigeria, Togo and Niger. Younger interviewees generally ate less bushmeat than older persons. That young people ate less bushmeat can in part be due to a growing ‘westernization’ of the lifestyles, especially among the middle classes. These sector of the community often do not see it as ‘socially acceptable’ to consume bushmeat, since this is perceived by them as a sign of ‘being very local’ (i.e. not

culturally advanced). In contrast the eating of 'fast foods' (hamburgers, pizza, kebab, etc.) is now the favourite 'social diet' of young people. This pattern is especially evident in urban Nigeria and Togo (our unpublished observations), where young interviewees not only declared that they would not eat bushmeat, but even commented that eating bushmeat was not acceptable because it produces a loss of personal prestige within their circle of friends. In this regard, it was particularly interesting that, among the rarely-eating bushmeat urban people, a sample of 7 young (<25 years) persons from Togo and 15 from Nigeria declared that they would never eat bushmeat in public, but that very occasionally they do during private family events, and only when they visit their rural relatives. Thus, among the respondents who declared that they rarely ate bushmeat, many would only consume bushmeat in special circumstances. We suggest that in urban areas the lower consumption of bushmeat is not because of lack of access, but that it responds to a more culturally-driven avoidance in response to the changing socio-economic context.

By contrast to the effects of age we observed in our study, the pure effect of gender was only apparent in 1 out of 7 models. In terms of mixed factors, 'Gender X Rural/Urban' were significant in 4/7 models and 'Age X Rural/Urban' were significant in 5/7 models, whereas 'Gender X Age' in 2/7 models. From these results, we conclude that rural/urban and age are much more important than gender in determining the probability for a person to consume bushmeat. The non-effect of gender is probably related to the enhanced equal rights of women and men in West African societies (especially in Nigeria), with young generations being much more equal in terms of gender and lifestyle (see Gender Equality Index database by the African Development Bank, available at www.afdb.org). Thus, since young men and women typically share a similar life-style (especially in urban areas), even their food preferences tend to be very similar.

Since, in all countries, and in urban areas in particular, most of the young respondents stated they never ate bushmeat, this would suggest that bushmeat consumption has been substantially decreasing among the new generations of West Africans, independently on their local culture, religion, ethnicity and level of human development. In Nigeria, where the level of human development (average wealth and scholarization standards) are clearly higher than in the other countries (the country being the 22th economy of the world; World Bank, 2016), only older people in rural areas (age > 51 years) answered that they consumed bushmeat more regularly (Table 2).

Although our study is the first to cover a broad spectrum of situations, it is important to note that bushmeat trade analysis are much easier to undertake in the Guinean forests region (such as Ivory Coast, Ghana, Nigeria; e.g. see Fa et al., 2002a, 2002b, 2006) than in Sahel. This difference is related to the fact that in the Sahel region there are no open bushmeat markets and people here may be more reluctant to answer interviewers openly because of social norms (Hema et al., 2017, but see Lindsey et al. 2013). This is also possibly linked to the fact that forest can occur close to urban areas in the Guinean Forest region (e.g., Niger Delta forests surrounding Port Harcourt), whereas the same is not true in the Sahel where all the forested or mature savannah sites (from which most of the bushmeat trade does originate) are situated far from larger urban centres (our unpublished observations). Therefore, 'hub' markets (Akani et al., 2015) are more likely to be found nearby large cities in the forest zone than in the savannah zone. In conclusion, we argue that the cultural drivers of wildlife use are crucial to take into account when seeking long-term sustainability solutions of wildlife resource extraction (e.g., Luiselli et al., 2017).

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430 Table 1. Synopsis of the interview raw data collected during the present surveys in the four studied countries.

	Urban			Total urban	**Rural**			Total rural
	Often eaten	Rarely eaten	Never eaten		Often eaten	Rarely eaten	Never eaten	
Burkina Faso								
Males (< 25 yr)	0	0	7	7	4	2	2	8
Males (< 50 yr)	7	69	43	119	66	24	7	97
Males (> 51)	7	12	1	20	17	9	3	29
Females (< 25 yr)	2	1	10	13	1	1	21	23
Females (< 50 yr)	6	52	30	88	17	21	33	71
Females (> 51)	1	8	6	15	9	5	3	17
TOTAL SAMPLE	23	142	97	262	114	62	69	245
Niger								
Males (< 25 yr)	2	2	56	60	20	11	45	76
Males (< 50 yr)	4	6	32	42	30	20	39	89
Males (> 51)	5	6	22	33	33	9	37	79
Females (< 25 yr)	1	0	46	47	14	9	44	67
Females (< 50 yr)	4	7	39	50	24	11	30	65
Females (> 51)	7	7	26	40	22	10	31	63
TOTAL SAMPLE	23	28	221	272	143	70	226	439
Togo								
Males (< 25 yr)	11	9	33	53	14	8	21	43
Males (< 50 yr)	12	16	15	43	33	24	2	59
Males (> 51)	14	12	5	31	24	7	1	32
Females (< 25 yr)	0	11	41	52	4	16	26	46
Females (< 50 yr)	7	17	23	47	14	7	4	25
Females (> 51)	16	11	11	38	16	2	2	20
TOTAL SAMPLE	60	76	128	264	105	64	56	225
Nigeria								
Males (< 25 yr)	7	14	56	77	17	31	11	59
Males (< 50 yr)	12	23	44	79	21	23	8	52
Males (> 51)	16	31	39	86	22	41	5	68

Females (< 25 yr)	3	6	62	71	13	43	14	70
Females (< 50 yr)	7	12	46	65	9	11	2	22
Females (> 51)	19	23	35	77	14	5	1	20
TOTAL SAMPLE	64	109	282	455	96	154	41	291
GRAND TOTAL	170	355	728	1253	458	350	392	1200

Table 2. Results of the Generalized Linear Model on the probability of eating bushmeat by type of animals by country, urban/rural locality, age, sex and gender (female/male). Intercepts are included in all models, and the explained deviance (in %) is also shown. Negative estimates for gender means a preponderance of male respondents. Positive estimates for age indicates a preponderance of older age classes respondents.

Variable	Estimate	St. error	Wald	P
Ungulates				
Intercept	211.71	72.41	8.55	0.003
Gender	-1.68	0.82	4.18	0.041
Explained deviance (%)	90.20			
Rodents				
Intercept	295.85	202.43	2.14	0.144
Gender	-5.14	2.29	5.02	0.025
Explained deviance (%)	88.08			
Monkeys				
Intercept	-2079.08	431.87	23.17	0.000001
Country	5.93	2.99	3.92	0.048
Urban/Rural	-31.26	4.89	40.89	0.000001
Age	14.92	2.99	24.85	0.000001
Explained deviance (%)	34.07			
Bats				
Intercept	-1596.00	376.76	17.94	0.000023
Urban/Rural	-29.26	6.03	23.54	0.000001
Age	16.13	3.69	19.08	0.000013
Explained deviance (%)	45.79			
Carnivores				
Intercept	-1408.96	335.10	17.68	0.000026
Urban/Rural	-17.45	5.36	10.58	0.0011
Age	14.22	3.28	18.74	0.000015
Explained deviance (%)	55.90			
Birds				
Intercept	-837.82	493.40	2.88	0.089

Age	7.33	3.42	4.60	0.032
Explained deviance (%)	88.74			
Crocodiles				
Intercept	-1439.25	453.05	10.09	0.0015
Urban/Rural	-22.29	5.13	18.89	0.000014
Age	15.28	3.14	23.68	0.000001
Explained deviance (%)	46.41			
Snakes				
Intercept	-1330.51	345.56	14.82	0.000118
Urban/Rural	-20.61	5.53	13.87	0.000195
Age	13.41	3.39	15.66	0.000076
Explained deviance (%)	55.05			
Turtles				
Intercept	-853.91	296.62	8.29	0.0039
Urban/Rural	-15.25	4.75	10.31	0.0013
Age	9.156	2.9079	9.91504	0.001639
Explained deviance (%)	64.03			

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436

437 Table 3. Summary of the results of contingency tables on the frequencies of the never-eating bushmeat respondents by country. In this table, 'towards' would

438 indicate the direction of the significant effect. For instance, if in a given area, there was a significantly higher number od 'never-eating-bushmeat' respondents for

439 young people (< 25 years age), this is highlighted in the table with 'towards young'.

	Differences between gender in rural	Differences between gender in urban	Differences by age in rural	Differences by age in urban	Differences between urban and rural by gender	Differences between urban and rural by age
Togo	P = n.s.	P = n.s.	P < 0.01 (towards young)	P < 0.01 (towards young)	P = n.s.	P = n.s.
Nigeria	P = n.s.	P < 0.05 (towards men)	P < 0.01 (towards old people)	P = n.s.	P < 0.01 (due to men in urban areas)	P < 0.05 (due to age in rural areas)
Burkina Faso	P < 0.01 (towards men)	P < 0.05 (towards women)	P = n.s.	P < 0.05 (towards young)	P < 0.0001 (due to opposite signs of differences)	P < 0.05 (due to consistent trends of age: young do not eat bushmeat)
Niger	P = n.s.	P = n.s.	P < 0.05 (towards young)	P < 0.05 (towards young)	P = n.s.	P = n.s.

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441

Table 4. Summary of the results of contingency tables on the frequencies of the often-eating bushmeat respondents by country. In this table, 'towards' would indicate the direction of the significant effect. For instance, if in a given area, there was a significantly higher number od 'never-eating-bushmeat' respondents for young people (< 25 years age), this is highlighted in the table with 'towards young'.

	Differences between gender in rural	Differences between gender in urban	Differences by age in rural	Differences by age in urban	Differences between urban and rural by gender	Differences between urban and rural by age
Togo	P < 0.05 (towards men)	P < 0.05 (towards men)	P < 0.05 (towards young)	P < 0.01 (towards young)	P = n.s.	P = n.s.
Nigeria	P = n.s.	P = n.s.	P = n.s.	P < 0.01 (towards young)	P = n.s.	P < 0.05 (due to young people responses negative effect)
Burkina Faso	P < 0.001 (towards men)	P < 0.001 (towards men)	P = n.s.	P < 0.0001 (towards young)	P < 0.05 (due to men)	P < 0.05 (due to young people responses negative effect)
Niger	P = n.s.	P = n.s.	P = n.s.	P < 0.05 (towards young)	P = n.s.	P = n.s.

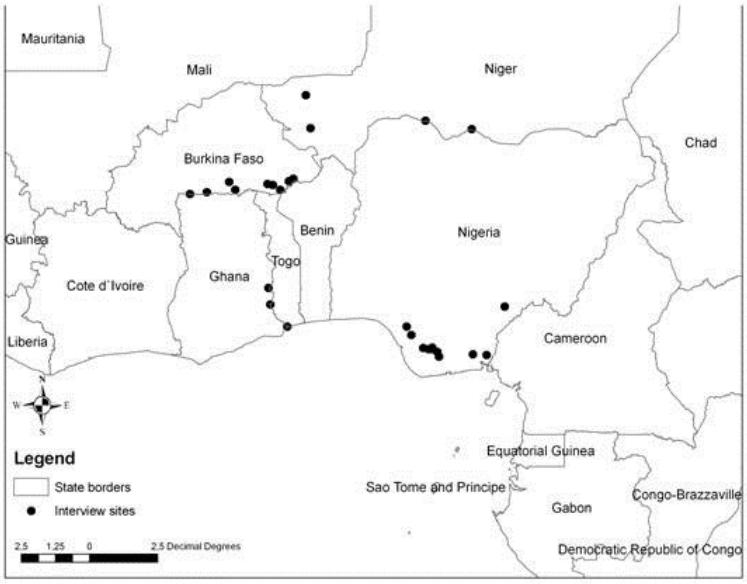
447 Table 5. Significant effects ($P < 0.05$; indicated with a X) of the various parameters on the frequency of

448 respondents claiming to eat bushmeat, by a GLM mixed model analysis.

	Nigeria	Togo	Burkina Faso	Niger	Guinean Forests	Sahel	All pooled
Gender			X				
Age	X	X		X	X		X
Rural/urban	X	X	X	X	X	X	X
Gender X Age		X			X		
Gender X Rural/Urban	X		X			X	X
Age X Rural/urban	X	X		X	X		X

449

450 Figure 1. Map of West Africa showing the study sites where interviews were carried out



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454 Figure 2. Percent interviewees responding whether bushmeat was eaten often, rarely or never in urban and
455 rural settlements in the four countries studied in West Africa.

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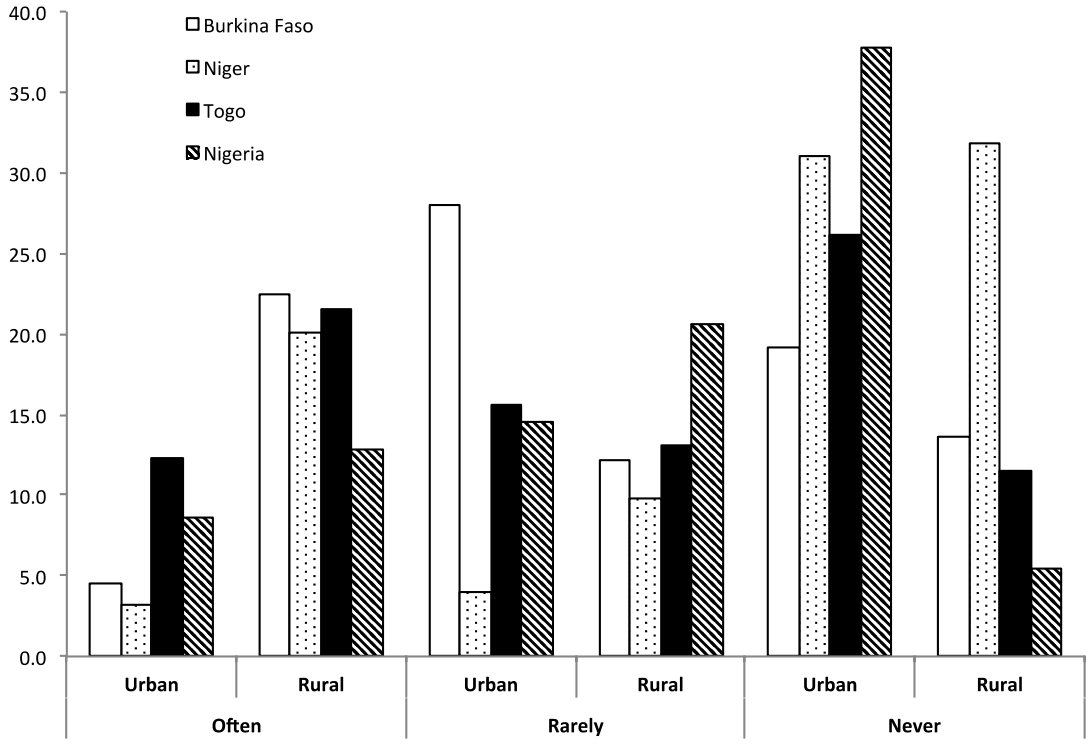
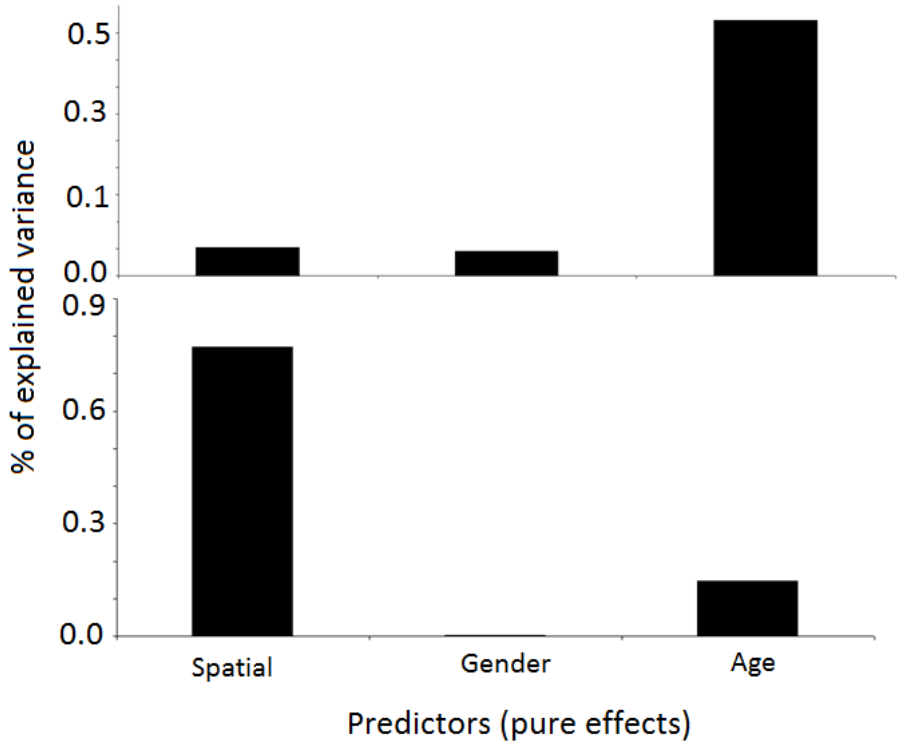


457 Figure 3. Relative importance of predictors (pure effect), as determined by hierarchical variation partitioning,
458 for the model considering all the interviewees' responses as dependent variable, for the Sahel countries
459 (upper graphic) and for the Guinean forests countries (lower graphic). Spatial = urban/rural.



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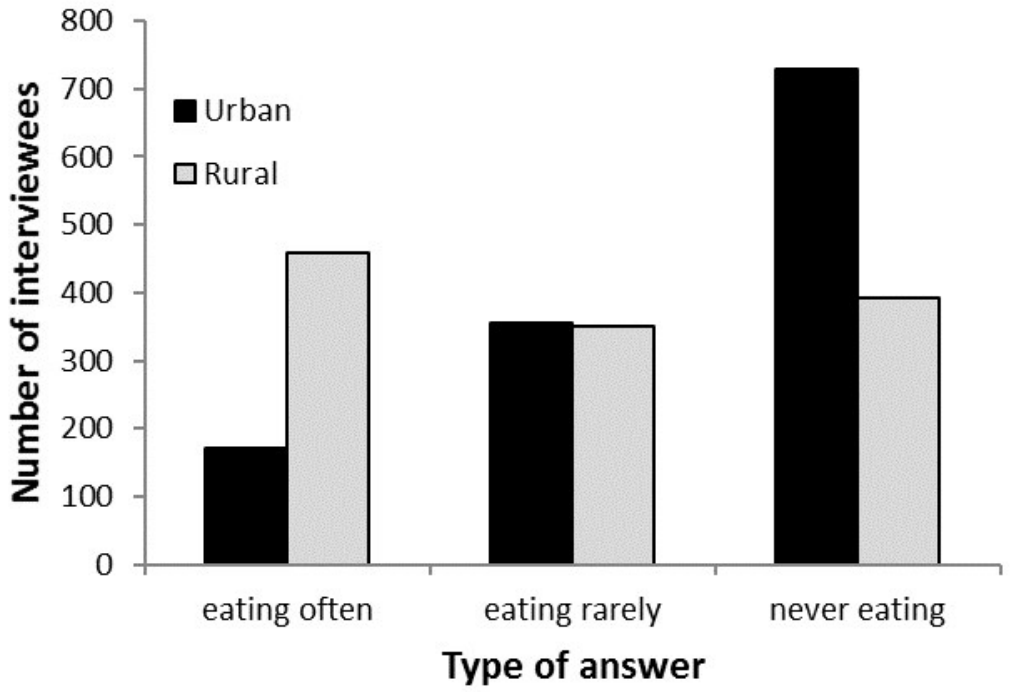
463 Figure 4. Distribution of the various types of answer by respondents in urban versus rural areas in the four
464 studied countries of West Africa as for whether they would eat bushmeat often, rarely or never. All data from
465 the different countries were pooled for this graphic



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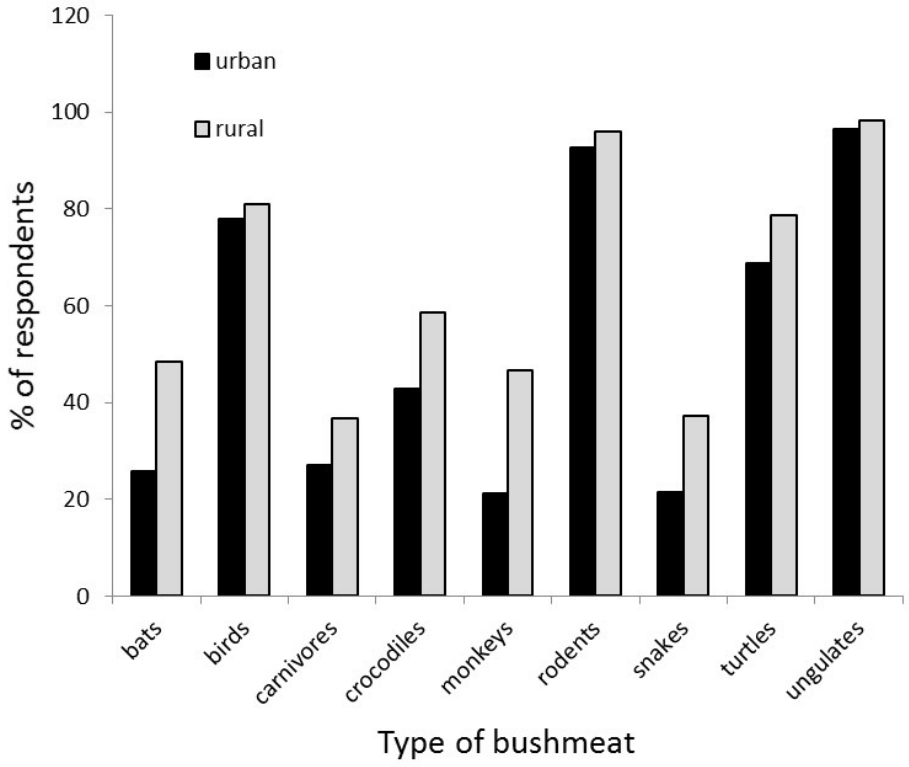
468 Figure 5. Distribution of the various types of answer by respondents in urban versus rural areas in the four
469 studied countries of West Africa as for the type of consumed bushmeat is concerned. All data from the
470 different countries were pooled for this graphic



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474 Appendix 1. Codes for the variables used in the Generalized Linear Models (GLZs).

Country	Class	Locality	Cod Loc	Cod age	Cod sex	Never eat bushmeat
Burkina Faso	Males (< 25 yr)	URBAN	1	g	1	7
Burkina Faso	Males (< 50 yr)	URBAN	1	m	1	43
Burkina Faso	Males (> 51)	URBAN	1	a	1	1
Burkina Faso	Females (< 25 yr)	URBAN	1	g	0	10
Burkina Faso	Females (< 50 yr)	URBAN	1	m	0	30
Burkina Faso	Females (> 51)	URBAN	1	a	0	6
Burkina Faso	Males (< 25 yr)	Rural	0	g	1	2
Burkina Faso	Males (< 50 yr)	Rural	0	m	1	7
Burkina Faso	Males (> 51)	Rural	0	a	1	3
Burkina Faso	Females (< 25 yr)	Rural	0	g	0	21
Burkina Faso	Females (< 50 yr)	Rural	0	m	0	33
Burkina Faso	Females (> 51)	Rural	0	a	0	3
Nigeria	Males (< 25 yr)	URBAN	1	g	1	77
Nigeria	Males (< 50 yr)	URBAN	1	m	1	79
Nigeria	Males (> 51)	URBAN	1	a	1	86
Nigeria	Females (< 25 yr)	URBAN	1	g	0	71
Nigeria	Females (< 50 yr)	URBAN	1	m	0	65
Nigeria	Females (> 51)	URBAN	1	a	0	77
Nigeria	Males (< 25 yr)	Rural	0	g	1	59
Nigeria	Males (< 50 yr)	Rural	0	m	1	52
Nigeria	Males (> 51)	Rural	0	a	1	68
Nigeria	Females (< 25 yr)	Rural	0	g	0	70
Nigeria	Females (< 50 yr)	Rural	0	m	0	22
Nigeria	Females (> 51)	Rural	0	a	0	20
Niger	Males (< 25 yr)	URBAN	1	g	1	4
Niger	Males (< 50 yr)	URBAN	1	m	1	4
Niger	Males (> 51)	URBAN	1	a	1	7
Niger	Females (< 25 yr)	URBAN	1	g	0	1
Niger	Females (< 50 yr)	URBAN	1	m	0	9
Niger	Females (> 51)	URBAN	1	a	0	6
Niger	Males (< 25 yr)	Rural	0	g	1	6
Niger	Males (< 50 yr)	Rural	0	m	1	5
Niger	Males (> 51)	Rural	0	a	1	9
Niger	Females (< 25 yr)	Rural	0	g	0	3
Niger	Females (< 50 yr)	Rural	0	m	0	7
Niger	Females (> 51)	Rural	0	a	0	9
Togo	Males (< 25 yr)	URBAN	1	g	1	33
Togo	Males (< 50 yr)	URBAN	1	m	1	15
Togo	Males (> 51)	URBAN	1	a	1	5
Togo	Females (< 25 yr)	URBAN	1	g	0	41
Togo	Females (< 50 yr)	URBAN	1	m	0	23
Togo	Females (> 51)	URBAN	1	a	0	11
Togo	Males (< 25 yr)	Rural	0	g	1	21
Togo	Males (< 50 yr)	Rural	0	m	1	2
Togo	Males (> 51)	Rural	0	a	1	1
Togo	Females (< 25 yr)	Rural	0	g	0	26
Togo	Females (< 50 yr)	Rural	0	m	0	4
Togo	Females (> 51)	Rural	0	a	0	2

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476

477 Appendix 2. Summary of the raw data on the types of eaten bushmeat by people in the investigated countries.

		Males (< 25 yr)	Males (< 50 yr)	Males (> 51)	Females (< 25 yr)	Females (< 50 yr)	Females (> 51)	Total interviewees
Nigeria		21	35	47	9	19	42	173
	ungulates	21	34	45	9	19	40	
	rodents	21	31	41	9	19	39	
Urban	monkeys	2	7	11	0	3	6	
	bats	3	7	8	1	3	11	
	carnivores	2	10	15	0	2	5	
	birds	15	26	33	5	15	28	
	crocodiles	8	15	27	1	5	9	
	snakes	1	3	5	0	0	3	
	turtles	16	22	26	6	14	32	
Nigeria		48	44	63	56	20	19	250
	ungulates	48	43	61	56	20	19	
	rodents	48	41	55	56	18	19	
Rural	monkeys	6	23	31	3	3	11	
	bats	7	17	22	7	5	13	
	carnivores	9	14	20	21	6	11	
	birds	39	40	55	45	17	17	
	crocodiles	23	21	38	32	9	17	
	snakes	2	8	19	4	6	9	
	turtles	44	33	51	36	16	19	
Togo		20	28	26	11	23	27	136
	ungulates	19	26	25	11	22	25	
	rodents	13	23	24	11	22	23	
Urban	monkeys	4	6	6	0	1	4	
	bats	4	9	6	0	1	3	
	carnivores	8	6	6	0	2	8	
	birds	15	21	21	10	17	23	
	crocodiles	3	18	8	3	6	11	
	snakes	2	4	4	0	1	6	

	turtles	9	16	16	5	15	24	
Togo		22	57	31	20	21	18	169
	ungulates	22	54	31	20	21	18	
	rodents	22	49	31	20	21	18	
Rural	monkeys	14	25	25	2	11	15	
	bats	13	27	27	0	8	17	
	carnivores	3	11	21	1	6	16	
	birds	16	24	31	17	19	18	
	crocodiles	13	26	28	3	8	14	
	snakes	11	22	20	1	6	11	
	turtles	14	41	27	16	17	16	
Niger		4	10	11	1	11	14	51
	ungulates	4	9	11	1	11	14	
	rodents	4	10	11	1	11	14	
Urban	monkeys	0	1	4	0	4	7	
	bats	0	2	3	0	5	11	
	carnivores	0	1	4	0	8	7	
	birds	4	8	9	0	10	12	
	crocodiles	1	6	6	0	7	8	
	snakes	1	4	6	0	7	5	
	turtles	3	8	9	0	10	9	
Niger		31	50	41	23	35	32	213
	ungulates	30	48	41	22	35	32	
	rodents	29	48	41	23	35	32	
Rural	monkeys	8	21	26	16	20	25	
	bats	12	33	27	14	20	27	
	carnivores	8	19	17	11	16	22	
	birds	21	41	37	18	31	31	
	crocodiles	9	28	33	13	28	28	
	snakes	8	21	27	9	18	25	
	turtles	23	33	38	16	28	30	

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