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Determinants of urban bushmeat consumption in Río Muni, Equatorial Guinea

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Abstract

Understanding the factors driving demand for wild meat and its substitutes is crucial for predicting the effects of changing socio-economic conditions on consumption, and managing supplies sustainably. However urban demand for wild meat remains relatively understudied, particularly in West/Central Africa. We use interviews with consumers in households, markets and restaurants and a market survey to examine patterns of consumption of bushmeat, domestic meat and fish in Bata, Equatorial Guinea, a country currently undergoing a period of strong economic and population growth. Consumers make a much clearer distinction between fresh and frozen foods than between bushmeat, domestic meat and fish. Fresh foods are greatly preferred over frozen but are more expensive and less consumed. Consumption of all fresh foods increases with income. Controlling for income, native Equatoguineans consume more bushmeat than other nationalities, while of the two dominant Equatoguinean tribes, the continental Fang consume more bushmeat than the coastal Ndowe. Our findings indicate that increasing wealth of a growing urban population will greatly increase future demand for all fresh foods, including bushmeat. There is no evidence of a luxury bushmeat market based on rare species, thus controlled demand for bushmeat could be met from common, highly productive species that are relatively robust to exploitation. Improving the supply of under-developed commodities, particularly domestic livestock, could also offset demand for bushmeat.
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1. Introduction

There is growing concern that bushmeat consumption is at unsustainable levels, particularly in West/Central Africa (Bowen-Jones, 1998; Fa et al., 2003; Milner-Gulland and Bennett, 2003). Urban bushmeat consumption is a particular focus of policy concern, and there have been frequent calls for action to control the commercial trade in bushmeat (e.g., AZAA, 1998). Commonly, subsistence hunting is thought of as crucial to the food security of the rural poor (Ntiamoa-Baidu, 1998),

whilst commercial hunting is perceived to be predominately to supply a luxury market (Asibey and Child, 1991). Neither of these assumptions is necessarily correct. For example, de Merode et al. (2004) show that bushmeat is more important as a source of cash income than food for rural poor people in the Democratic Republic of Congo. Cowlishaw et al. (2005) show that the bushmeat commodity chain in an urban market in Ghana involves a wide range of actors. It seems likely that the urban bushmeat trade is an important component of livelihoods for many of those involved.

The role of bushmeat in the diets of urban people and the effect of wealth on consumption choices have not been well studied. However, it is important to understand consumer behaviour, both in order to predict the

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effect of changes in the profile of urban consumers on the sustainability of the bushmeat trade, and in order to understand the effects of policies on potentially vulnerable consumers. In particular, as African populations become more urbanised and as urban incomes increase, there are likely to be changes in consumption patterns. The direction and magnitude of these changes depend particularly on the income elasticity of demand. Comprehensive published studies of the elasticity of bushmeat consumption to prices and income are largely from rural areas of South America (Apaza et al, 2002; Wilkie and Godoy, 2001), with limited relevance to urban consumers in West and Central Africa. However, Wilkie et al. (2005) recently carried out a cross-sectional study of the role of prices and wealth in consumer demand for bushmeat in Gabon. They found that consumption of bushmeat, fish, chicken and livestock all increased with wealth (suggesting a positive income elasticity of demand) and that higher prices of these foods were associated with lower consumption (suggesting a negative own-price elasticity of demand).

Empirical studies of the role of preference in determining consumption patterns are scant. Anstey (1991) described changing consumption patterns and preferences for bushmeat in Liberia: preference for bushmeat in general decreased as consumption frequency decreased, as did preference for individual species as they became rarer. These results suggest that preferences are not static but linked to consumption frequency, which in turn may be linked to price or availability. Fa et al. (2002) found distinct differences in the preferences for different bushmeat species between the Fang and Bubi ethnic groups on Bioko Island, Equatorial Guinea. There was a lack of correspondence between preferred and consumed meats for the Fang, which the authors attributed to the fact that the Fang, having originated from the mainland, have historically been exposed to many more species, and therefore retain preferences for foods they no longer consume. For the Bubi, preference and consumption for bushmeat species were linked to price and availability, as they generally could only afford the cheaper and widely available bushmeat species. However, preferences for bushmeat substitutes such as fish and domestic meats must also be considered if we are to draw wider conclusions as to how conservation policies targeting bushmeat will affect consumer behaviour.

In this study, we analyse the consumption and preferences of consumers in the city of Bata, Río Muni, Equatorial Guinea. Bata is a particularly interesting location for such a study, because it is starting to experience a boom in income and population, caused by an emerging oil industry (Pigeonniere, 2001). The official monthly minimum wage has increased dramatically from 25,000 CFA (US $46) in 2000 to 97,000 CFA (US $177) in 2003 (J. Ferreiro Villarino, pers. comm.), representing an infla-

tion-adjusted increase of 219% (IMF, 2005). The country is attracting much foreign investment (Equatorial Guinea recently received the 4th largest investment from the USA in sub-Saharan Africa, EIA, 2003). However this economic improvement has yet to reach the majority of the population, with unemployment estimated at 30% and international debt at $290 million (CIA, 2002). The city of Bata has expanded rapidly in the last few years, with a population of 78,684 recorded in the 1994 National Census and 132,235 in the 2001 National Census.

The bushmeat trade in Equatorial Guinea is little known, particularly in Rio Muni (but see Fa et al., 2004). However, the trade is prevalent (Bowen-Jones, 1998) and likely to be at least locally unsustainable (Bakarr et al., 2001; Fa and Garcia Yuste, 2001; Fa et al., 1995). There are still extensive tracts of forest in the country, sheltering relatively rich wildlife populations, including great apes (Garcia and Mba, 1997, N. Kümpel, pers. obs.). The bushmeat trade is in theory regulated by official protection of particular species, but in practice laws are not enforced, and the trade is completely open regardless of a species' legal status.

Our aim in this study is to assess the relationships between consumption of different types of meat and fish, income, preferences, price and availability of these products. We carried out surveys of consumers in households, markets and restaurants in Bata, in order to get a detailed understanding of the different components of bushmeat consumption. By comparing bushmeat consumption and preferences to those for other commodities, we place it within the context of available substitutes. This allows us to predict the likely future trend in bushmeat consumption and suggest policy responses.

2. Methods

The study assessed factors associated with meat and fish consumption for two groups; an opportunistic sample of meat purchasers in Bata's Central Market and a stratified systematic sample of households. A non-random sample of restaurateurs and their clients was also interviewed. A survey of meat and fish on sale in the Central Market provided information on availability and price. Data collection was carried out from May to July 2003. Availability and price of all fresh and frozen food types is fairly constant throughout the year (N. Kümpel, unpublished data), so this period is representative of market dynamics year-round.

Sampling for the household survey involved randomly selecting 11 out of the 20 districts marked on a recent map of the city. Within each district, a zig-zag transect walk was carried out. After each 1 min period of walking, the nearest available house in which someone

was prepared to be interviewed was surveyed. Only two households declined to be interviewed. The zig-zag approach ensured that houses off the street were sampled as well as those on streets, and the 1 min interval between households allowed an entire district to be sampled with a sample size of approximately nine households per district. One hundred households were sampled, representing 847 people. Ninty-one percent of these were Equatoguinean, of whom 73% were of the Fang tribe, 25% were Ndowe, and the remaining 2% Bubi. The interview was conducted with the household head together with the person responsible for preparing the meals. Interviewees were questioned on actual food consumption the day before, typical food consumption, preferences, household structure and presence of selected wealth indicators.

The market consumer survey encompassed all the stalls in Bata's Central Market that sold fresh meat or fish (seven bushmeat, four fish and one butcher's stall selling domestic livestock). The Central Market is one of two main markets in Bata, and was identified as the source of 33% of the food eaten the day before in the household survey (see Section 3). Each stall was visited a number of times on different days of the week, with a higher visitation rate to the bushmeat stalls than the fish or butcher's stalls. One hundred and sixty interviews were conducted (100 at bushmeat stalls, 30 each at the fresh fish and butcher's stalls). The interviews were brief and took place immediately after an item had been purchased, in order to minimise disruption to stallholders and respondents. As many as possible of the purchasers at the stall were interviewed. The interviews took place throughout the opening times of the market (7 a.m.– 6 p.m.) but with more in the mornings when the market was busier.

The amount and price of each bushmeat species on sale in the market was recorded daily over 6 weeks during the study period. Data for fresh domestic meat and fish availability were limited, although prices were recorded on a daily basis.

There were up to 40 chopbar stalls selling cooked food within the Central Market (not all open every day); in these budget establishments bushmeat dishes were rarely available due to its relatively high cost. Two of the few chopbar stalls regularly selling bushmeat were chosen for detailed interviews. There were 11 small-scale restaurant-bars in the immediate vicinity of the market, which sold more expensive fresh meat or fish dishes, including bushmeat; such establishments abound in the streets of Bata. Three of these, which regularly sold bushmeat dishes, were chosen for interviews. There were only three large-scale restaurants in the entire city which sold bushmeat; all of these were also targeted for interviews. Interviews involved spending the day in the restaurant, talking to the owner and interviewing up to five independent customers per restaurant (not from the

same group). A total of eight chopbar and restaurant owners and 37 customers were interviewed.

Wealth is likely to be a key factor determining patterns of meat consumption (Wilkie and Godoy, 2001). In order to obtain a measure of wealth, we first interviewed a focus group of four key informants. These informants identified income rather than wealth as the major factor in consumption decisions, and employment as the key determinant of income. They also identified a number of indicators of wealth such as lighting and cooking facilities, house type and vehicles. A list of possible wealth indicators was drawn up based on the focus group discussion.

At the end of the household interviews, respondents were asked to indicate into which of 13 categories their total household earnings in the last month fell, but 45% of respondents declined to indicate a category. In order to obtain an income category for these non-responders, each indicator asset was tested for its association with income category for responding households, using both forward and backward stepwise regression. The best explanatory model included cooking method used (fire, petrol stove, gas hob, oven), number of fans in the household and number of mobile phones in the household ($R^2 = 0.706$, df = 6, $p < 0.000$). These indicator variables appeared from observation to correspond with income, and the first two were also identified as important in the focus group. The model was used to assign income categories to the 45% of non-responders, all of whom had been happy to provide information on household assets. Household income in the sample followed an approximately log-normal distribution, with a modal category of 50,000–100,000 CFAs/month (535 CFA = $1 at time of survey).

For the market surveys, it was not feasible to obtain information on income class or indicator assets, hence the occupation of the household head was recorded as a proxy for wealth, based on the focus group's assessment that this was the most important single wealth determinant.

3. Results

3.1. General consumer characteristics

Meat and fish are important components of the Equatoguinean diet. Only one of the 100 households interviewed claimed not to eat meat or fish every day. In the 24-h food recall, 5/100 households did not eat meat or fish the day before. The vast majority (96%) of the meat and fish consumed the day before was bought: 52% in one of the two main markets (33% in the Central Market and 19% in Mundoasi Market), 19% on the beach (fresh fish), 19% in local shops and 10% in supermarkets. The source of bushmeat was slightly different to that for
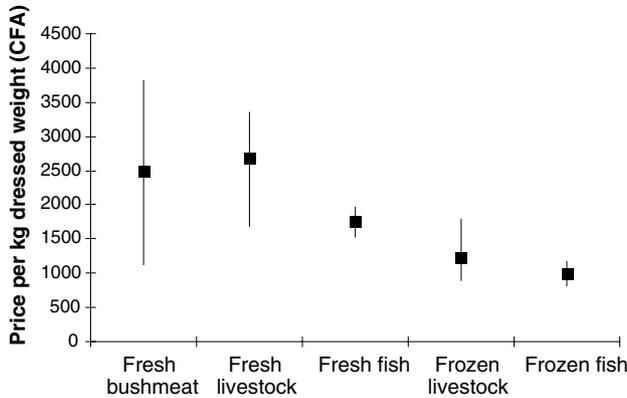
Fig. 1. Median price of fresh bushmeat, fresh livestock, fresh fish, frozen livestock and frozen fish available in Bata's Central Market during the study period, with 95% confidence intervals. Price variability is much greater for fresh foods, particularly bushmeat, whereas both variability and price itself are much lower for frozen foods.

produce in general. 69% came from the main markets (32% Central, 37% Mundoasi), 26% from outside Bata (purchased, a gift or personal hunting/gathering), 4% was bought directly from hunters or traders and 1% was bought in restaurants.

A key distinction made by consumers was based on food state, rather than food type. Imported frozen produce (particularly chicken, pork chops and mackerel) was widely and constantly available in Bata, price variability was low and generally it was substantially cheaper than fresh foods (Fig. 1). In other cities, smoked meat is preferred over fresh, and is widely available and more expensive than fresh meat (e.g., Cowlishaw et al., 2005). However in Bata there is little preference expressed for smoked meat, and it is cheaper and less available than fresh produce.

There were strong similarities between consumption the day before and typical food consumption. Eighty one percent of those who ate frozen food the day before listed it as the most usually consumed food, while 58% of those eating fresh food the day before typically ate it. As expected, a wider range of food types was eaten the day before than was listed as typically consumed (including smoked, tinned and dried foods). Overall, consumers were consistent in their specific and typical consumption patterns.

3.2. General market characteristics

There were three types of market stall selling fresh produce: predominately bushmeat, with local domestic animals such as poultry, pigs and goats; imported beef and goat; and fresh fish. Equatoguineans were much more likely than others to buy bushmeat (of 86 people interviewed buying bushmeat only one was foreign), while purchasers of fresh domestic meat were more likely to be from other African countries (mainly Cameroon or Nigeria); the nationality of interviewees purchas-
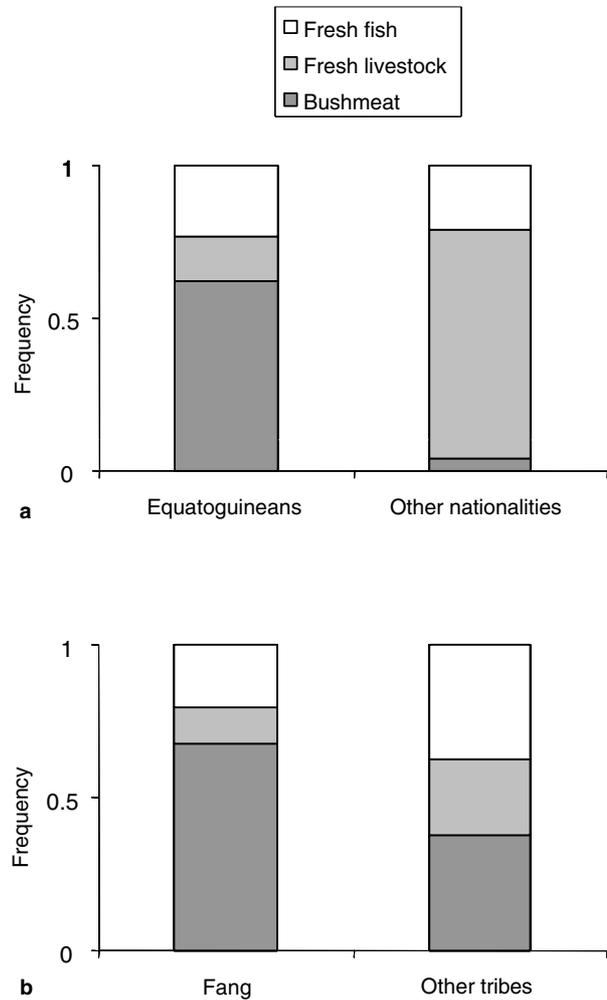

Fig. 2. Frequency of customers buying different fresh meat or fish types, split: (a) by nationality, and (b) within Equatoguineans, by tribe. Of 24 non-Fang Equatoguineans, 20 were Ndowe and 4 Bubi. In total, 86 customers were recorded buying bushmeat, and 37 each buying fresh domestic meat and fish, respectively. χ^2 tests for significant departure from random: (a) $\chi^2 = 65.35$, df = 2, $p < 0.01$; (b) $\chi^2 = 36.40$, df = 2, $p < 0.01$.

ing fish was more representative of the sample as a whole (Fig. 2(a)). Within Equatoguineans, the Fang bought more bushmeat, while other tribes (predominantly Ndowe) bought more fish and to some extent domestic meat (Fig. 2(b)). Seventy eight percent of the interviewees at restaurants were male, compared to 22% of the interviewees in the market.

Prices varied between outlets; for example fish was cheaper on the beach in the early morning than in markets, and frozen produce was slightly more expensive in supermarkets than market stalls. Availability varied with the day and the weather and between commodities. Cattle were imported live monthly from Cameroon, and one was slaughtered for sale every 1–2 days depending on demand. This fresh beef was only available from the butcher's stall in the Central Market, which also usually sold 2–3 goats per day. Beef and goat were available here

every day, but often sold out. Fresh fish was widely available except after heavy rains. Bushmeat was less available on Sundays and Mondays and after rain. A wide range of species was openly on sale, including those officially illegal to hunt or trade.

3.3. Consumption and preference scores

In the household interviews, respondents ranked their three most preferred and most consumed meat/fish types. One hundred and forty different types of meat/fish were given in response, 24 of which featured in both lists. Fig. 3 contrasts consumption with preference scores for all meat and fish types. There is a clear negative relationship between consumption and preference. The most preferred food types were bushmeat and fresh fish – the highest preference score was for red snapper, while 11 of the 48 most preferred food types were bushmeat species, with five of these in the top ten (porcupine, blue duiker, pangolin, monkey and red river hog). In contrast, only three bushmeat species appeared among the 46 most consumed types (blue duiker and porcupine, equal rank 28, and pangolin, rank 43), with the most consumed food types being frozen fish (e.g., mackerel) or frozen domestic meat.

We compared overall consumption and preference scores for the household and market samples (Fig. 4). In both samples, consumption patterns were very different to preferences, with the majority citing frozen food as their most consumed dish whilst preferring fresh food. However consumption patterns were significantly different between household and market samples, with the market sample being significantly more likely to consume fresh produce than the household sample. The

a

b

Fig. 4. Comparison of consumption and preference scores for different fresh and frozen food types, between (a) household, and (b) market samples. Scores are the frequency of first choice meat/fish only. Consumption patterns were highly significantly different between the household and market samples ($\chi^2 = 28.51$, df = 4, $p < 0.01$); preference patterns were still significantly different between the two samples, but less so ($\chi^2 = 9.86$, df = 4, $p < 0.05$).

preference scores of consumers also differed between the household and market samples, although less strongly. The majority of both household and market consumers chose a type of fresh fish as their most preferred dish (49% and 54%, respectively), with bushmeat the second most popular food type (36% and 31%, respectively), whilst only 5% and 1%, respectively, chose frozen food. Reasons for not consuming preferred products included cost, availability, providing variety in the diet and differing preferences within the household, and differed between the household and market samples. Although cost was the most cited reason in both cases, the market sample was significantly more likely to cite other reasons than the household sample ($\chi^2 = 6.4$, df = 1, $p < 0.05$). Hence, it appears that the market sample is less constrained by costs than the household sample.

3.4. Consumption and income

As income increases, consumption of fresh food increases and of frozen produce tends to decline (Table 1).
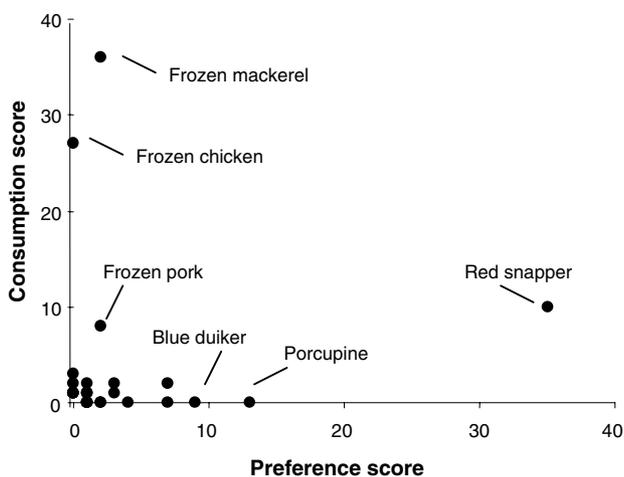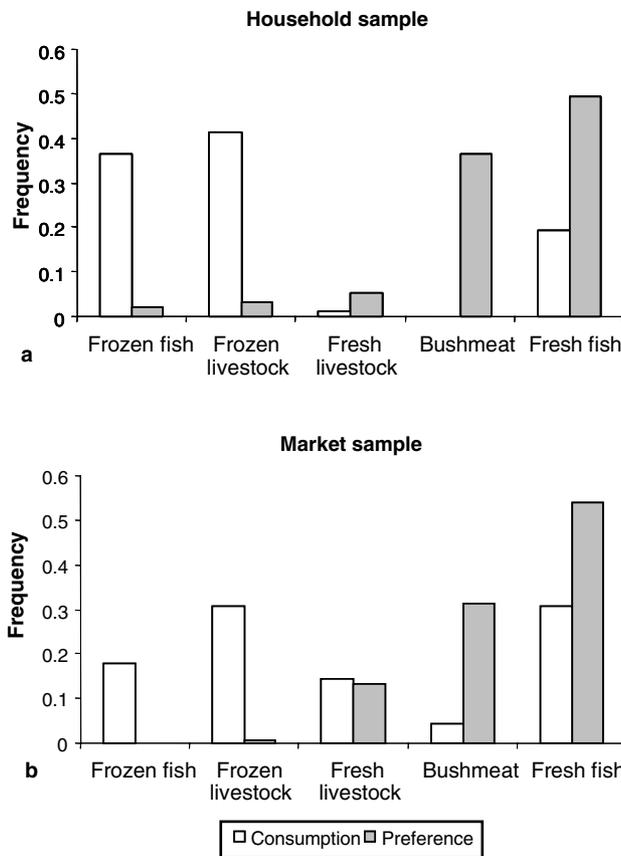

Fig. 3. First-choice consumption and preference scores for all types of meat and fish, based on the household surveys. Consumers were asked to name the type of meat or fish which they ate most frequently at home and the type that they found had the best flavour. The first choices for consumption and preference were then summed across respondents to give a total score for each food type. Highly preferred and consumed food types are indicated.

Table 1
Results of generalised linear models of the factors affecting consumption rate, based on the household surveys

Food type	Recall period	Explanatory variable	F	df	P	Coefficients[a]			
						Income	Fang	Ndowe	Other
Bushmeat	Day	Income	2.238	1.97	0.14	(0.55)[b]			
Bushmeat	Month[c]	Income	8.231	1.89	0.005	0.26			
		Tribe/nationality	6.809	2.89	0.002		−1.51	−2.43	−2.41
Fresh domestic	Day	Income	4.505	1.95	0.036	0.81			
		Tribe/nationality	4.498	2.95	0.014		−13.14	−20.08	−11.32
Fresh fish	Day	Income	4.246	1.97	0.042	0.55			
Frozen domestic	Day	Income	1.747	1.97	0.19	(0.11)			
Frozen fish	Day	Income	4.102	1.97	0.046	−0.27			

Rates of consumption are calculated as meals per unit recall period. Where possible, biomass consumed per unit recall period was also analysed, giving similar results.

[a] The coefficients for income are given, together with tribe/nationality if significant. Other factors were non-significant. Fang and Ndowe are primarily Equatoguinean tribes, while the "other" category represents primarily non-Equatoguineans.

[b] Consumption rate per household was regressed against $\log_e$ income (taken as the central value of each income category), with Poisson error structure and log link function. A slope of one would thus indicate that change in consumption is proportional to a change in income. Non-significant income coefficients are given in brackets.

[c] The recall of actual consumption the day before is used in all cases, while for bushmeat, which was rarely recorded by daily recall, typical frequency of consumption per month is also analysed.

The influence of ethnic origin, city district, educational level of the household head and religion were also tested for, but only the first of these had any significant effects on consumption (Table 1). Fang households showed higher bushmeat consumption than either Ndowe or non-Equatoguineans, while non-Equatoguineans were the most frequent consumers of fresh domestic meat, Ndowe the least frequent, and Fang intermediate. In contrast, the amount of frozen domestic meat consumed was highest in Fang households. Interactions were also tested between income and each factor, reflecting possible differences in income effects between groups, but none was significant.

3.5. Bushmeat consumption

Thirty six types of animal were identified as not being eaten in household surveys. The most frequently mentioned were snakes, monkeys, gorillas and chimpanzees, accounting for 44% of the responses. Reasons for avoidance were varied, but included tradition (20%), similarity to humans (13%, primates only), and an evil expression (12%, predominately reptiles).

For 12 bushmeat species, there were data available on household consumption and preference scores, as well as prices and availability in the market (Table 2). In a linear regression, consumption scores were significantly positively related to preference scores (adjusted $R^2 = 0.67$, $p < 0.005$), but there were no significant trends with either body mass or price. More available species tended to be more consumed (adjusted $R^2 = 0.48$, $p < 0.05$), but availability did not have a significant effect independent of preference. Preference itself was significantly related to availability (adjusted $R^2 = 0.54$, $p < 0.01$) but again not to either price or body mass. Hence within the bushmeat

Table 2
Information on consumption, preference and availability scores of the 12 main bushmeat food types mentioned by individuals, listed in decreasing order of consumption

Species (common English name)	Species (Latin name)	Mass (kg)	Consumption score	Preference score	# Sold/month	Dressed price/kg (CFA)	Price/carcass (CFA)
Blue duiker	*Cephalophus monticola*	4.9	0.2967	0.0874	139	2140	6984
Brush-tailed porcupine	*Atherurus africanus*	2.8	0.2637	0.1538	125	3668	6841
Tree pangolin	*Phataginus tricuspis*	1.5	0.0934	0.0840	53	3995	3991
Smoked porcupine	*Atherurus africanus*	1.9	0.0550	0.0018	13	4831	6000
Mandrill	*Mandrillus sphinx*	17.4	0.0549	0.0175	29	2435	28,219
Putty-nosed monkey	*Cercopithecus nictitans*	5.0	0.0440	0.0104	70	2106	7014
Red duiker	*Cephalophus spp.*	20.4	0.0385	0.0087	3	2534	34,425
Giant pouched rat	*Cricetomys emini*	1.1	0.0275	0.0104	1	3413	2500
Red river hog	*Potamochoerus porcus*	67.5	0.0219	0.0052	6	1234	55,455
Cane rat	*Thryonomys swinderianus*	5.1	0.0164	0.0052	2	2257	7667
Tortoise	*Kynixis erosa*	3.5	0.0110	0.0104	52	1287	3000
Northern talapoin	*Miopithecus ogouensis*	1.3	0.0110	0	1	2888	2500

Species are fresh unless otherwise stated. Average mass is calculated using the average weights in Fa and Garcia Yuste (2001), with smoked weights 2/3 of fresh weight. Numbers and prices were calculated from market observations in the Central Market for 6 weeks during the study period.

food type, the most available species appear to be both preferred and consumed more often, regardless of price or size. Large body size broadly reflects a low reproductive rate (Hennemann, 1983; Robinson and Redford, 1986), and hence vulnerability to unsustainable hunting. These results therefore suggest that demand is not biased towards more vulnerable species.

Purchasers from the bushmeat stall had a substantially higher bushmeat consumption frequency (twice a week, on average) than the household sample, and were buying a wide variety of species (Fig. 5(a)). The majority cited preference as the reason for buying a particular item (Fig. 5(b)). However 18% of the purchasers were buying the item for use in a restaurant, highlighting the importance of restaurants as customers for bushmeat traders. In comparison, <1% of households obtained their bushmeat from restaurants. Only one of the restaurateurs interviewed, the largest and most exclusive restaurant, obtained his bushmeat directly from hunters. All other restaurateurs bought from market traders, because of the small daily volumes of meat required. Hence, the volumes of bushmeat sold to restaurant buyers in the market should be a relatively accurate reflection of bushmeat consumption by restaurants. The same cannot be said for household consumers, a substantial proportion of whom obtained their bushmeat from sources other than market stalls.

4. Discussion

Bata's consumers have a strong preference for fresh meat and fish over frozen produce, but on cost grounds they most often eat frozen foods. The degree to which they are able to satisfy their preferences is significantly related to their income. In this city, it seems that frozen produce is an inferior good, with a negative income elasticity, while fresh produce, including bushmeat, is a normal good. Other studies of bushmeat consumption have not observed widespread use of frozen foods as a cheap source of protein, and usually do not differentiate between food state. Our findings show how important it is to differentiate between food state in studies of consumer behaviour.
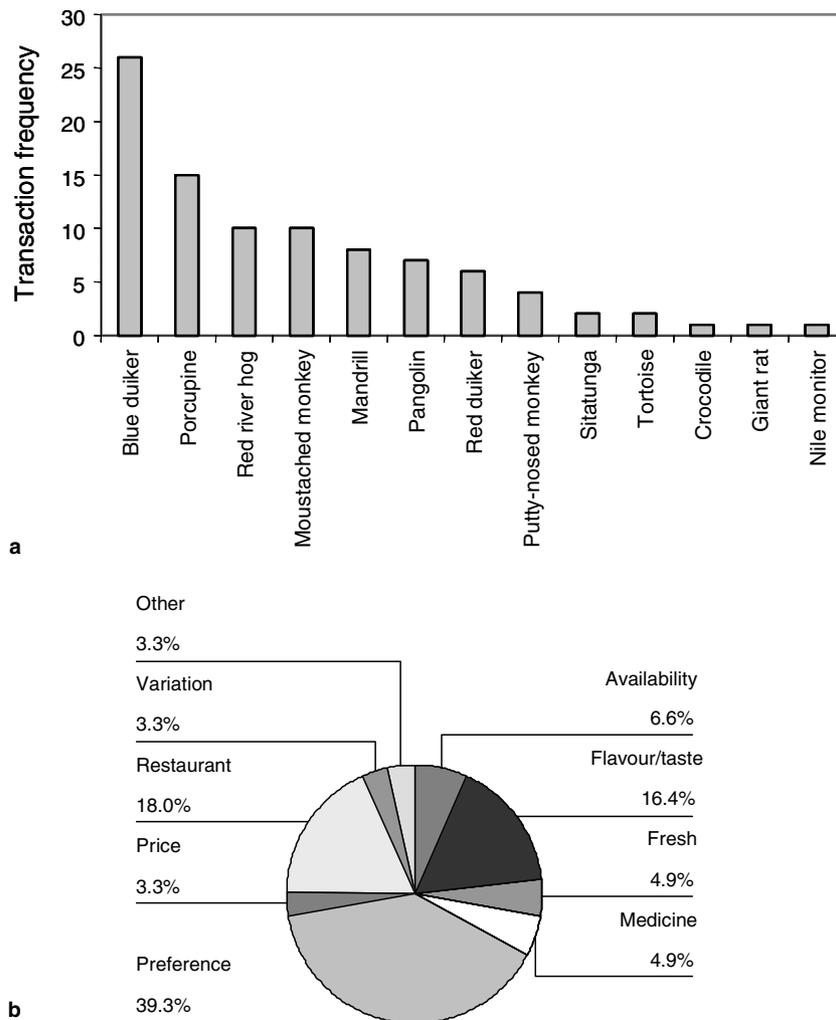

Fig. 5. Purchasing patterns of customers at market bushmeat stalls. (a) Frequencies of bushmeat species being bought by people interviewed in the market. (b) Reasons cited by purchasers for buying a particular piece of bushmeat.

The perception that bushmeat is a luxury good in urban settings is commonly cited in the bushmeat literature (e.g., Bowen-Jones et al., 2002). Wilkie and Godoy (2001) found positive income elasticities for bushmeat and negative elasticities for fish among Amerindian societies, suggesting that fish was an inferior good. However, our study has found a strong preference for fresh fish, followed by bushmeat and then fresh domestic meat. There were particular preferred items within these categories, including red snapper amongst the fish species, and porcupine, blue duiker and pangolin amongst the bushmeat species. Other studies in Central Africa have shown similar orders of preference among bushmeat species (e.g., Njiforti, 1996). These species were also amongst the most available items in the market. Preference and availability were correlated in our analysis of individual bushmeat species, and it is likely that there is strong feedback between them.

Consumption patterns were not only related to income, but also to tribe and nationality. Fa et al. (2002) clearly showed the importance of tribe in determining bushmeat consumption and preferences on Bioko Island, Equatorial Guinea. In their study, the Fang tribe had the broadest bushmeat preferences. In our study, the Fang also consumed more bushmeat, while the Ndowe tribe, a coastal fishing people, had a strong preference for fresh fish. The influence of nationality was shown most clearly in the strong preference for domestic meat and against bushmeat shown by Cameroonian people. This is in contrast to studies within Cameroon; for example 61% of Njiforti's (1996) sample preferred bushmeat over domestic livestock. This difference is probably due to religion rather than nationality; a large number of immigrants to Equatorial Guinea from elsewhere in Africa are Muslim, and are less inclined to eat bushmeat (in particular species such as monkeys) than Christian people (including Equatoguineans and fellow Cameroonians).

Bushmeat is widely available in Bata, with about 20 stalls selling it in the two main markets combined: seven stalls in the Central Market and 14 in Mundoasi Market (Puit, 2003). Many restaurants sell bushmeat regularly. The commodity chain is relatively simple, with the majority of the trade passing through the market, both to consumers and to restaurants. This contrasts with other urban commodity chains in which restaurants buy from intermediary traders, making their purchases less easy to track (e.g., Mendelson et al., 2003). The species composition of the bushmeat on sale in the market contrasts with that observed in other markets in the region. In a recent study in a Ghanaian market, for example, rodents comprised 59% of the available bushmeat, with primates absent (Cowlishaw et al., 2005), compared to 18% rodents and 20% primates in Bata's Central Market. There have been suggestions that the species composition of markets can act as an indicator of the degree of

depletion in the supply areas (Rowcliffe et al., 2003). On this basis, Bata appears to be being supplied from a relatively undepleted bushmeat resource. However, we are unable to make any judgements concerning sustainability without further information on the species composition and volume of hunter offtakes.

Our approach of triangulating the data by surveying households, market purchasers and restaurant clientele was useful, in that it allowed us to pick up subtleties of the drivers of bushmeat demand that might otherwise have been missed. It is crucial to carry out a representative survey of households in order to be able to generalise results to the wider population. However the market and restaurant surveys showed the contribution made by restaurant clients to the bushmeat trade, which went unrecorded in the household survey. This echoes the findings of Mendelson et al. (2003) that in Ghana, chopbars were an important source of demand for bushmeat. A comparison of the market and household surveys also clarified the basis for discrepancies between preferences and consumption. Although preferences differed relatively little between the samples, consumption patterns differed strongly, with the richer market sample consuming more bushmeat than the household sample. This adds strength to the argument that income is the main determinant of differences between preference and consumption.

Currently bushmeat is widely available and consumption is constrained primarily by income. Restaurant clients eating bushmeat are predominantly male workers. These findings suggest that bushmeat consumption is likely to increase rapidly as Bata's economic prosperity and population continue to grow. On the other hand, it is possible that this trend may be countered by a westernisation of tastes associated with economic development. For example, specific bushmeat preferences have shifted since the study of Sabater-Pi and Groves (1972), particularly away from mandrills, and our sample included a number of respondents who stated that they did not eat bushmeat because it was "dirty meat". However, whether tastes will continue to change in this way, and, if so, the speed at which the shift will occur, is unpredictable.

If the sustainability of bushmeat and fresh fish offtakes is to be ensured, the potential for substitute goods needs to be explored. The FAO has set up a project in Equatorial Guinea aimed at expanding the capacity of sustainable fisheries (FAO, 2003). However, there are concerns that the fisheries stocks of West Africa are already severely depleted, and that further expansion of the local fleet would only be possible with a reduction in fishing pressure from EU fleets (Brashares et al., 2004).

Livestock rearing in Equatorial Guinea is vastly underdeveloped, and our results reflect this. However, this does not necessarily mean that domestic meats could not become a more important component of the

Equatoguinean diet – in order for preferences to develop, a product must first be reasonably familiar (Turrell, 1998). Fresh domestic livestock meat is scarce in Bata. Goats, sheep, pigs and poultry are reared ad hoc in villages with no formal livestock husbandry or veterinary provision, and few of these animals reach the cities. The lack of cattle-rearing in the country is attributed to the presence of tsetse fly (Ministry of Agriculture, Republic of Equatorial Guinea, pers. comm.), which transmits trypanosomiasis (although Equatorial Guinea only has low endemicity for this disease, WHO, 2004). Fresh beef in Bata therefore comes from cows imported from northern Cameroon, but at the time of this study these supplied only one formal butcher's shop in the entire city. However, neighbouring parts of southern Cameroon have an established livestock industry (Teale, 2003), including poultry and other trypanosomiasis-resistant species. Thus, it appears that with political will, livestock rearing could be promoted more vigorously as a response to anticipated future demand for fresh produce. Controlled agricultural development, limited to the already degraded habitat immediately surrounding present villages, could be one component of a strategy to ensure the preservation of bushmeat hunting and biodiversity in Río Muni for future generations.

Acknowledgements

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