A stated preference investigation of household demand for illegally-hunted bushmeat in the Serengeti, Tanzania.

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Abstract

Illegal hunting for bushmeat is regarded as an important cause of biodiversity decline in Africa. We use a stated preferences method to obtain information on determinants of demand for bushmeat and two other protein sources, fish and chicken, in villages around the Serengeti National Park, Tanzania. Our study focuses particularly on the impact of price changes, as anticipating and understanding the impact of price changes (whether caused by conservation interventions or market changes) on demand for bushmeat enables effective responses to be planned. We estimate the effects of changes in the price of bushmeat and in the prices of two substitute protein sources – fish and chicken – on household demand for bushmeat. Results suggest that the availability of lower-priced protein substitutes would reduce demand for bushmeat, and therefore potentially pressure on wildlife populations. However, raising the price of bushmeat (e.g. as a result of reducing illegal hunting) would reduce household demand to a greater degree than equivalent decreases in the price of alternative protein sources. In both cases, elasticities are reported which summarise the relative response to households to these alternative interventions: a 10% rise in bushmeat prices would reduce demand by around 6-7%, whilst a 10% fall in chicken or fish prices would reduce bushmeat demand by around 3-4%. The response to price changes varied between ethnic groups, and also according to household size (with the direction of the effect depending on whether the substitute was chicken or fish), but was not significantly affected by wealth or income. (248 words)

Keywords: conservation policy, illegal bushmeat, stated preferences, price elasticity of demand, alternative protein sources, Tanzania.

1. Introduction

Hunting of wildlife for food is believed to be a key driver of serious wildlife population declines and local species extinctions in many parts of the world (Bennett *et al.*, 2007, Davies & Brown, 2007). Hunting of bushmeat is of particular concern in Africa, where populations of bushmeat species appear to be declining in many areas, both in savannahs (Lindsey *et al.*, 2013) and in forests (Macdonald *et al.*, 2012). Reductions in the availability of bushmeat adversely impact the food security of the rural poor in particular, as bushmeat makes up a disproportionately large fraction of their protein intake (Allebone-Webb, 2009; Davies & Brown, 2007). Actions to improve the sustainability of bushmeat hunting can target both supply, for example through providing alternative livelihoods for hunters (Van Vliet, 2011; Moro *et al.*, 2013); or demand, through changing the purchasing habits of consumers (Rentsch & Damon, 2013). Among the many approaches that have been suggested to reduce demand for bushmeat is the provision of affordable protein sources that can act as substitutes of bushmeat (Wilkie *et al.*, 2005; Poulsen, Clark & Mavah*et al.*, 2007). In the Serengeti region of Tanzania, the provision of veterinary care to improve chicken health and productivity was initiated as an approach to reduce the illegal hunting of bushmeat in the National Park (Rentsch 2012). However, there is still very little evidence of the impact of these types of approach in terms of actual reductions in bushmeat consumption. Without such evidence, the quantitative effects of conservation policies aimed at reducing household demand for bushmeat are unknown.

Changes in the quantity of bushmeat consumed depend on a number of factors which affect both the own price and cross-price elasticities of demand for bushmeat (the proportional effect of changes in price of the good itself and price and quantity of appropriate substitutes on quantity of the good demanded). These factors include consumer tastes and habits, household income and, more generally, cultural context (Schenck *et al*., 2006; Fa *et al*., 2009; Lowassa, Tadie & Fischer, 2012). Such drivers of bushmeat consumption need to be understood if demand-focussed conservation interventions are to succeed in reducing pressures on wildlife populations. Furthermore, it is important to be able to predict the effects of externally-driven changes in the price or availability of substitutes like fish or domestic livestock, so as to act proactively in the face of changes in substitute prices (Brashares *et al.*, 2004).

Evidence on the sign and magnitude of such elasticities of demand for bushmeat is to date rather limited. This is partly due to the difficulty of observing prices for an informal, often illegal commodity such as bushmeat in poor countries with low institutional capacity for regular monitoring. Long-term datasets on prices and quantities of bushmeat are rare (Crookes, Ankudey and Milner-Gulland, 2005; Rentsch and Damon, 2013). The first study to estimate the cross-price elasticities of bushmeat and substitutes (Wilkie & Godoy, 2001) used a dataset for households in Bolivia, and found that bushmeat consumption did not respond to the price of some protein substitutes. However, the authors were only able to generate proxies for bushmeat prices. Wilkie *et al.* (2005) surveyed rural and urban households in Gabon and found a negative own-price elasticity of demand for bushmeat, with a statistically significant and positive cross-price elasticity between bushmeat and fish. However, there was no significant effect of chicken prices on household bushmeat consumption. Brashares *et al.* (2011) found a negative effect of the ratio of bushmeat price to alternative protein prices on bushmeat consumption. Rentsch and Damon (2013) found that beef, dried sardines and other fish all acted as substitutes for bushmeat in western Serengeti, Tanzania. They also found that increases in the price of bushmeat would lead to reduced bushmeat consumption.

A range of non-price factors which potentially influence bushmeat consumption have been investigated. These include household income and cultural context. Bushmeat consumption can be rising or falling with income, depending on whether rural or urban demands are considered (Brashares *et al.*, 2011). In rural areas, the evidence to date suggests that poor rural households are generally disproportionately reliant on bushmeat both for protein and income (e.g. Allebone-Webb, 2009; Coad *et* *al.*, 2010; Macdonald *et al.*, 2012; Nielsen, 2006), while in urban areas bushmeat is likely to be more of a luxury good for the rich (Wilkie *et al.*, 2005; East *et al.*, 2005). Rentsch and Damon (2013) show that in the western Serengeti, increasing income would lead to growing demand for bushmeat, as well as for other protein types. Brashares *et al.* (2011) find a significant interaction effect between household wealth (rather than income) and the price of bushmeat relative to the prices of other protein sources. Preferences for bushmeat may also differ between ethnic groups. In the western Serengeti, studies into cultural aspects of bushmeat hunting suggest strong preferences for bushmeat over other low-price proteins such as dried sardines (dagaa; Lowassa *et al.*, 2012). Ndibalemma and Songorwa (2007) in western Serengeti found that Ikoma tended to consume more meat, including more bushmeat, than Sukuma. Fa *et al.* (2002) found clear cultural differences in preference for bushmeat over other meats between two ethnic groups on Bioko island, Equatorial Guinea.

The literature thus shows the need to understand the socio-demographic factors underlying the demand for bushmeat, as well as the effects of changes in prices and quantities of bushmeat and substitute protein sources. In this paper, we investigate the effects of changes in the price of bushmeat and other (substitute) protein sources on the demand for bushmeat by local people around the Serengeti National Park, Tanzania. In particular, we are interested in the relative effects of changes in prices of two potential substitute protein sources (chicken and fish) in relation to the price of illegally-hunted bushmeat. This focus is relevant because if price matters, policies could instigate appropriate price changes for protein alternatives, thus steering food demand in a way that is more compatible with wildlife conservation. Using a stated preference approach, we estimate own-price and cross-price elasticities of demand for bushmeat, and show how these elasticities vary across socio-economic and cultural groups. This kind of information assists in the targeting of demand-side initiatives such as the provision of substitute protein sources to reduce pressure on threatened wildlife populations. We argue that the use of stated preference data has significant advantages in this context over the use of revealed preference data such as consumer purchases.

2. Materials and Methods

Stated preference approaches have become increasingly popular empirical methods for measuring demand in a range of fields, including environmental economics, health economics and transport research. A stated preference approach, in which individuals state their choices for alternative hypothetical consumption options rather than revealing their preferences through actual purchases, permits the analyst to consider intended behavioural responses to changes in attribute levels both across and beyond the range of current observations. This supports the design of interventions which aim to promote substantial changes in system dynamics.

Stated preference methods offer advantages over revealed preference methods in the specific context of household demand for bushmeat. These are (i) revealed preference data based on historic household consumption can be subject to recall errors; (ii) a stated preference approach allows us to look at potential substitution opportunities which are not currently available to consumers; and (iii) stated preference data are not confounded with seasonal variations in the populations of wildlife which is hunted for bushmeat (e.g. seasonal wildebeest migrations in the Serengeti: Thirgood *et al.*, 2004). A stated preference approach also allows one to investigate the variations in bushmeat demand across a wide set of household characteristics. Of course, problems also exist with stated preference methods, notably the extent to which stated choices predict actual choices (Vossler, Doyon & Rondeau, 2012) and the sensitivity of preference and value estimates to the information provided to respondents (Munro &

Hanley, 2002). However, the advantages were judged to outweigh these disadvantages in the present context.

Survey area and experimental design

We carried out this study in the area west of the Serengeti National Park, a location important both for conservation and because it is home to a poor and growing rural population (Sinclair & Packer, 2008). Hunting within the National Park is illegal, and hunting outside the Park is de facto illegal because it requires a permit which is rarely obtained. Despite this, hunting still occurs to a considerable degree (Nuno *et al.*, 2013).

Four features of the stated preference experimental design were crucial. The first concerns the choice of substitute protein sources. In the western Serengeti, bushmeat is bought dried in informal markets in units of “pieces”. Qualitative survey development work with households in the area suggested that a series of three-way choices between bushmeat, fish and chicken would be too complex for respondents. Thus, choices were simplified to two-way choices between bushmeat and fish, and between bushmeat and chicken. Pilot-tests, feedback from survey enumerators and responses from households to the survey all showed that people understood well the hypothetical choices that they were being asked to make.

The second important design feature concerned the selection of price levels. The range of prices used was based on the experience of enumerators in the study area. The price levels for 1 piece of bushmeat consisted of Tanzanian Shilling (TSh) 500, TSh 1,500, TSh 3,000 and TSh 4,500; the price levels for 1 piece of good quality fish were TSh 1,000, TSh 3,000, TSh 5,000 and TSh 7,000; whilst chicken had price levels of TSh 6,000; TSh 9,000; TSh 12,000 and TSh 15,000 (at the time of writing, 1 EUR = 2000 TSh).

The third consideration was the need to reduce possible hypothetical bias arising in such experiments. The questionnaire thus reminded participants to think about their budget constraints in deciding how much they would buy at any price, and that it was perfectly acceptable to state that they were not willing to buy any quantity at a given price. A “cheap talk” script was also used, reminding people that respondents often overstate their willingness to pay in stated preference studies (List, Sinha & Taylor, 2006). Such scripts have been found to be effective in significantly reducing hypothetical bias.

The fourth feature is how respondents were asked to state their preferences. Every respondent was confronted with a number of choice situations and asked how many pieces of bushmeat and fish (or chicken) they would buy at specified price levels. This format was based on the study by Corrigan *et al.* (2009) into consumption demand for new varieties of rice in the Philippines, and mimics the consumption decision which households face when purchasing bushmeat and other proteins in real markets (Figure 1). Attribute combinations were obtained using a fractional factorial design. We generated 12 choice situations randomly from the full set and included a blocking factor so that each respondent was shown 6 choice tasks.

Data collection

We conducted our survey in six villages in western Serengeti, located between the Serengeti National Park, Lake Victoria and Grumeti Game Reserve. Bushmeat hunting takes place either locally near the villages when the wildebeest and zebra migration moves through the western corridor – usually twice a year – or occurs illegally in protected areas, often through hunting trips that can take several weeks (Moro *et al.*, 2013). Surveyed villages were located between 2 and 24 km from the national park, and between 0 and 40 km from the game reserve. Lake Victoria is an important source of fish for this area, and is available in markets mostly in a dried form.

Frankfurt Zoological Society (FZS) and the Tanzania Wildlife Research Institute (TAWIRI) have conducted regular surveys in these villages over several years, and enumerators and respondents had built up trust with both organisations. Members of 16 households per village were interviewed by two local enumerators in each village, leading to an overall sample size of *n*=200. The person in the household who usually did the food purchase and preparation was asked to respond, usually the wife of the household head. Where these were not available, we interviewed the household head or another male in the household. Overall, around 45% of respondents were female. All enumerators were thoroughly trained and conducted several interviews supervised by the team. After a qualitative pre-test and a quantitative pilot test, the enumerators conducted the main survey between December 2010 and February 2011. Each version of the stated preference exercise was administered to 100 households, with a final sample size of n=87 for the survey version which included fish, and n=94 for the version that included chicken. Table 1 summarises the data used in the analysis.

Statistical specification

We estimated elasticities of demand for bushmeat while controlling for factors suggested by the literature to be important determinants of bushmeat consumption. Specifically, we controlled for the effects of household wealth (proxied by cattle ownership and number of people in employment), tastes, cultural factors as proxied by ethnic group, and household size, as bigger households might be more sensitive to price changes than smaller ones . We also included the education level of the head of household, and the gender and age of the respondent. The basic model to be estimated from each of the two sub-samples (fish, chicken) was specified as:

$$bq_{i,t} = \alpha_i + \beta_1 \log(bp_{i,t}) + \beta_2 \log(sp_{i,t}) + \gamma' \big(\log(bp_{i,t})\big)(h_i) + \vartheta' \big(\log(sp_{i,t})\big)(h_i) + \varepsilon_{i.t} \qquad (1)$$

where:

- $bq_{i,t}$ is a count variable of the quantity (pieces) of bushmeat chosen by individual *i* in choice set t,
- $bp_{i,t}$ is the price of bushmeat,
- $sp_{i,t}$ is the price of the substitute good, either fish or chicken,
- h_i is a vector of variables which represents household characteristics which are household size, ethnicity, and household wealth, here operationalised as cattle ownership and number of occasional/full time workers in the household, and individual characteristics related to respondent's taste preferences towards fish/chicken and bushmeat (measured on a Likert scale), respondent's education, gender and age.

Given the count nature of our dependent variable, we chose to use the Poisson quasi-maximum likelihood estimator as it produces robust standard errors and consistent estimates under the relatively weak assumption that only the conditional mean is correctly specified (Wooldridge, 1999; 2002). Because the same respondent answered multiple choice sets we also include individual fixed-effects in the results reported in Table 2. Differences in bushmeat demand brought about by wealth and other socio-demographic characteristics are controlled for by these individual fixed effects. The coefficients β_1 and β_2 can be interpreted as elasticities, while the parameters on the interaction terms, γ' and ϑ', between prices and socio-demographic characteristics provide a test of whether these elasticities vary statistically significantly across different socio-economic groups.

3. Results

Table 2 reports the results of the simplest models in which bushmeat quantity is regressed on the log of prices of bushmeat and either chicken prices (column A) or fish prices (column B). Both of these models control for variations in observed and unobserved characteristics of respondents, as a fixed effects estimator has been used. The coefficients on the log of prices can be directly interpreted as elasticities.

As expected, the quantity of bushmeat demanded was negatively associated with the price of bushmeat, while it was positively associated with prices of the other two protein sources. Elasticity estimates were statistically significant in each of the specifications shown. The demand for bushmeat was "inelastic" with regard to its price and to the price of protein substitutes, since in absolute terms it takes a value of between zero and one. A 10% increase in the bushmeat price would lead to a decrease in the quantity of bushmeat demanded of 7%. The change in the price of fish had a slightly bigger effect on the bushmeat quantity demanded than a change in the price of chicken. A 10% increase in the fish price was associated with a 3.7% increase in the quantity demanded for bushmeat, while a 10% increase in chicken price was related to an increase of bushmeat demanded of 2.9%. Given that households consume on average 2.7 kg of bushmeat a week (Rentsch & Damon, 2013), and there are around 52,600 households in the area (calculation based on household size estimated in the study and population estimate from the 2002 census; NBS Tanzania 2006), a 10% bushmeat price increase would lead to a drop in weekly bushmeat consumption in the area of about 10 tonnes.

Table 3 extends the analysis by running regressions in which the log of the price of bushmeat and the log of the price of each substitute protein is interacted with individual or household characteristics as described in Table 1. We report two versions for chicken and for fish, the first excluding household size and household wealth, and the second including these variables. Interaction terms effectively test for the equality of elasticity values across the characteristics reported in Table 1. The bottom row of the table reports the average marginal effects for each focal variable (bushmeat or substitute price). The effect of a marginal change in the price on bushmeat quantity is computed for every observation and the effects are then averaged. These average marginal effects correspond to elasticities that are directly comparable with Table 2. The own-price elasticity of demand for bushmeat is robustly estimated to be around 0.66-0.69 across all models. Cross price elasticities are somewhat higher than in Table 2, around 0.32 for chicken and around 0.48-0.53 for fish.

The effects of these household and individual factors on consumption choices were generally much less strong than the price effects, and they differed between the two substitute goods. Many of these variables had insignificant effects on choices. Household size, however, seemed to matter; in surveys that included chicken, consumption of bushmeat was more sensitive to the price of bushmeat for larger households than for smaller ones. In the version of the survey that used fish as a protein substitute, the cross-price elasticity was higher in larger households. Individuals stating stronger preferences towards bushmeat were less sensitive to changes in its price, and more responsive to the price of the substitute protein. Consumption of bushmeat was not affected by the price of chicken for individuals who expressed a strong preference for chicken. Neither household wealth (as proxied by cattle holding) nor household income (as proxied by number of household members with a paid job) were significant determinants of own- or cross-price elasticity estimates.

There were some effects of ethnic group on the reaction to a change in the price of bushmeat and the protein substitute. Relative to people from the Sukuma group, people from the Ngoreme group were more responsive to changes in bushmeat prices. Relative to the Sukuma group, people from Ngoreme and Kurya groups were more responsive to changes in the substitute protein price when the substitute was chicken. When the substitute was fish, Ngoreme reacted again more strongly to substitute price changes, but Kurya were less sensitive. We note that most Ngoreme in our sample lived relatively far from the protected areas and thus from the main hunting areas, and were hence used to relatively high bushmeat prices. No significant effects were found for the education level of the head of the household, or for the gender and age of respondent as interactions with own- and cross-price elasticities.

4. Discussion

This study used a stated preference approach to measure own- and cross-price elasticities for bushmeat consumption. We undertook this work in an iconic ecosystem where illegal bushmeat hunting is widespread (Nuno *et al.*, 2013) and perceived as a threat to biodiversity and ultimately to the livelihoods of poor rural households. The stated preference exercise method produced highly significant and robust estimates of demand elasticities. We also showed that fish and chicken are, in principle, indeed substitute goods for bushmeat in the region, as evidenced by the significance of the elasticity estimates; this has been shown elsewhere in various other studies (e.g. Brashares *et al.*, 2004; Wilkie *et al.*, 2005; Brashares *et al.*, 2011). This is evidence in support of policies which aim to reduce hunting pressure on threatened wildlife populations by reducing the demand for bushmeat through making it more expensive (for example, by reducing illegal hunting activity), or by reducing the costs of alternative sources of protein for households. However, care would have to be taken to minimise negative ecological and social impacts caused by a stark increase in fish and other meat consumption (Rentsch and Damon 2013).

Rentsch and Damon (2013) used a revealed preference technique based on dietary recall surveys of protein consumption by 131 households over a 34 month period in the same study area as ours. Rentsch and Damon could not estimate a chicken model because chicken is usually slaughtered at home rather than bought, so that only 15% of their observations had associated prices for chicken. Their cross-price elasticity estimate for fish of 0.61-0.83 is higher than our estimate of 0.48-0.53 (Table 3), whilst their bushmeat own price estimate of -0.69 is very close to our estimate of -0.66 to -0.69.

Our cross-price elasticity results suggest that any reduction in the price of either fish or chicken would decrease bushmeat consumption. As chicken is a low input product that is produced by individual households, there is the potential to target it for livelihood improvement projects that could raise the nutritional status of poor households while reducing the demand for bushmeat. This was the rationale behind the chicken health project instituted by FZS and reported in Rentsch (2012). However, according to our enumerators, for many families, chicken is a valuable source of income. Live chickens are often sold on the market to purchase bushmeat, because for the same price, a much larger amount of bushmeat can be bought than the amount of meat one single chicken provides. This implies that conservation support for chicken husbandry might indirectly increase demand for bushmeat. Aquaculture may have potential as a way of increasing fish availability and thereby reducing price; however, lack of water in dry season and malaria risks related to fish ponds can be seen as obstacles to the local production of fish.

Conversely, an increase in the price of substitutes would increase demand for bushmeat. Such increases may be due to factors such as an increase in the population of the area, or a decline in the Lake Victoria fishery (Sinclair & Packer, 2008). The coefficient on the own-price elasticity of bushmeat is higher that of the substitutes, however, and so consumption is more sensitive to increases in the bushmeat price than to substitute prices. Increasing the price of bushmeat is potentially more achievable by conservation authorities, and has a higher effect on bushmeat demand. An increase in law enforcement that raised the cost of poaching in the National Park would simultaneously protect wildlife and raise bushmeat prices. Transport costs are significant components of the cost of bushmeat supply (Crookes *et al.*, 2005), and therefore if it needed to be sourced from elsewhere, the price would be likely to rise.

In conclusion, this research shows that it would be worthwhile for conservationists to explore the potential both of demand-side measures focussed on alternative protein sources as well as of supply-side measures, such as increased law enforcement or providing livelihood alternatives to illegal hunting, in reducing pressures on endangered wildlife populations. We quantify the relative effects on demand of these two types of intervention, showing that demand is more sensitive to increases in bushmeat prices (driven by supply-side policies) than the prices of protein substitutes.

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Table 1. Descriptive statistics of respondents.

Variable	Description	Chicken as an alternative sub-sample				Fish as an alternative sub-sample			
		Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Log of bushmeat quantity	Continuous variable	1.91	2.00	0	10	1.81	2.45	0	20
Log of bushmeat price	Continuous variable	7.49	0.83	6.21	8.41	7.48	0.83	6.21	8.41
Log of substitute price	Continuous variable	9.20	0.34	8.70	9.62	8.07	0.73	6.91	8.85
HH Wealth	Dummy variable taking the value of 1 if household owns # of cattle > than median	0.57	0.49	0	1	0.52	0.50	0	1
# of HH in full-time job	Continuous variable indicating number of household members with full-time job	0.14	0.43	0	2	0.27	0.61	0	3
# of HH members w/ job	Continuous variable indicating number of household members with some job	1.11	1.39	0	8	0.79	1.17	0	5
HH size	Continuous variable indicating total number of household members	7.59	3.45	2	18	8.13	3.60	1	22
Bushmeat rating	Continuous variable rating preference for bushmeat on a scale from 0 to 10	6.29	3.41	0	10	7.04	2.86	0	10
Substitute rating	Continuous variable rating preference for substitute on a scale from 0 to 10	8.25	2.68	0	10	7.48	2.89	0	10
Sukuma	Dummy variable taking the value of 1 if household belongs to the Sukuma ethnic group	0.16	0.37	0	1	0.20	0.40	0	1
Ngoreme	Dummy variable taking the value of 1 if household belongs to the Ngoreme ethnic group	0.17	0.38	0	1	0.16	0.37	0	1
Nata	Dummy variable taking the value of 1 if household belongs to the Nata ethnic group	0.13	0.33	0	1	0.09	0.29	0	1

Ikoma	Dummy variable taking the value of 1 if household belongs to the Ikoma ethnic group	0.28	0.45	0	1	0.32	0.47	0	1
Kurya	Dummy variable taking the value of 1 if household belongs to the Kurya ethnic group	0.17	0.38	0	1	0.13	0.33	0	1
Others	Dummy variable taking the value of 1 if household belongs to the Singita, Jita, Zanaki, Isenye, Ikizu, Manyema, Luo, Kisii, Hangaza, Simbiti ethnic groups	0.09	0.29	0	1	0.10	0.29	0	1
Female	Dummy variable taking the value of 1 if the respondent is female	0.37	0.48	0	1	0.50	0.50	0	1
Old	Dummy variable taking the value of 1 if the respondent's age is above sample median age	0.49	0.50	0	1	0.51	0.50	0	1
Education	Continuous variable indicating years of education of respondent	6.33	2.99	0	12	6.50	2.91	0	13
CE difficult	Variable taking the value of 1 if the respondent answered "no" or "so-so" if the respondent found the CE difficult, = 2 otherwise.	1.60	0.49	1	2	1.51	0.50	1	2

Table 2. Bushmeat price and cross price elasticities from a simple stated choice model. Column A shows a regression on bushmeat and chicken prices; column B shows a regression on bushmeat and fish prices.

	A:Chicken	B:Fish
Log of bushmeat price	-0.657**	-0.703**
	(0.06)	(0.058)
Log of substitute price	0.286**	0.371**
	(0.078)	(0.052)
Number of observations	522	562
Number of individuals	87	94
Log-likelihood	-534.5	-498.9

Notes: Fixed Effects QMLE indicates coefficients obtained by estimating fixed effects (QMLE) Poisson regressions. Heteroskedastic and overdispersion-robust standard errors in parentheses. Fixed effects at the level of the individual respondent are included. The number of observations is determined by the number of respondents in each sample (chicken or fish), and how many price-quantity choices each person made.

Table 3. Models of stated choice when household and individual-level characteristics are included in the regressions.

	Regressions of bushmeat quantity when substitute is...			
	Chicken		Fish	
	(1)	(2)	(3)	(4)
Log of bushmeat price	-0.215	-0.138	-0.478	-0.551
	(0.378)	(0.358)	(0.336)	(0.350)
Log of substitute price	0.125	0.101	0.974**	0.734**
	(0.274)	(0.351)	(0.256)	(0.250)
(# of HH in full-time job)*(Log of bushmeat price)	-0.163	-0.072	-0.008	-0.041
	(0.133)	(0.127)	(0.070)	(0.062)
(# of HH in full-time job)*(Log of substitute price)	0.122	0.122	-0.034	-0.059
	(0.106)	(0.109)	(0.080)	(0.080)
(# of HH members w/ job)*(Log of bushmeat price)	-0.037	-0.035	0.006	0.003
	(0.035)	(0.038)	(0.059)	(0.057)
(# of HH members w/ job)*(Log of substitute price)	-0.038	-0.037	0.048	0.047
	(0.033)	(0.037)	(0.060)	(0.058)
(Rating of bushmeat)*(Log of bushmeat price)	-0.008	-0.005	-0.028	-0.039
	(0.015)	(0.015)	(0.023)	(0.023)
(Rating of bushmeat)*(Log of substitute price)	-0.048*	-0.047*	-0.047**	-0.054**
	(0.023)	(0.023)	(0.018)	(0.018)
(Rating of substitute)*(Log of bushmeat price)	-0.043	-0.031	-0.008	-0.014
	(0.035)	(0.030)	(0.021)	(0.020)
(Rating of substitute)*(Log of substitute price)	0.015	0.016	-0.032	-0.040*
	(0.023)	(0.023)	(0.018)	(0.017)
(Others)*(Log of bushmeat price)	-0.333	-0.377	-0.051	0.005
	(0.257)	(0.257)	(0.209)	(0.215)
(Ngoreme)*(Log of bushmeat price)	0.303*	0.303*	0.224	0.207
	(0.144)	(0.151)	(0.214)	(0.212)
(Nata)*(Log of bushmeat price)	0.114	0.088	-0.250	-0.246
	(0.194)	(0.193)	(0.151)	(0.159)
(Ikoma)*(Log of bushmeat price)	-0.060	-0.101	0.150	0.157
	(0.178)	(0.173)	(0.185)	(0.189)
(Kurya)*(Log of bushmeat price)	0.047	-0.078	-0.141	-0.272
	(0.153)	(0.180)	(0.200)	(0.206)
(Others)*(Log of substitute price)	0.317	0.321	0.198	0.305
	(0.256)	(0.262)	(0.246)	(0.243)
(Ngoreme)*(Log of substitute price)	0.899**	0.907**	0.719*	0.727*
	(0.266)	(0.252)	(0.336)	(0.328)
(Nata)*(Log of substitute price)	0.120	0.126	-0.116	-0.035
	(0.199)	(0.193)	(0.164)	(0.172)

(Ikoma)*(Log of substitute price)	0.371	0.370	-0.098	-0.047
	(0.276)	(0.286)	(0.163)	(0.155)
(Kurya)*(Log of substitute price)	0.615**	0.617**	-0.311	-0.434*
	(0.229)	(0.224)	(0.194)	(0.188)
(HH Wealth)*(Log of bushmeat price)		0.161		0.081
		(0.130)		(0.124)
(HH Wealth)*(Log of substitute price)		0.005		-0.101
		(0.157)		(0.085)
(HH size)*(Log of bushmeat price)		-0.037*		0.020
		(0.017)		(0.015)
(HH size)*(Log of substitute price)		-0.0001		0.047**
		(0.024)		(0.014)
Average marginal effect of bushmeat price	-0.660**	-0.669**	-0.699**	-0.697**
	(0.051)	(0.048)	(0.049)	(0.048)
Average marginal effect of substitute price	0.329**	0.326**	0.489**	0.537**
	(0.073)	(0.072)	(0.062)	(0.059)
Observations	522	522	557	557
Number of id	87	87	93	93
Log-likelihood	-516.2	-511.3	-479.9	-476.3

Figure 1: Extract from stated preference experiment (chicken and bushmeat sub-sample)

"Now we are going to do a little experiment. I am going to ask you to imagine being in a situation in which you can buy 1 piece of dried bushmeat and 1 chicken for your **household** at the prices given below. Have a look at this piece (show piece of paper), this is how big the piece of bushmeat would be. The chicken would be a live adult male, healthy chicken. How many pieces of bushmeat and how many chicken would you buy?"

"Let me explain to you with the help of a simple example.

So, for example, imagine that I am a vendor who is coming to your house and is offering you 1 piece of dried bushmeat for TSh 2000 and 1 cockerel for TSh10,000. You have to imagine that you **cannot find** bushmeat or chicken at any other price than this. You can also buy chicken AND bushmeat if you like, and you can buy as many as you can afford.

(*Show the respondent the following prices)*."

	Desired number of pieces of bushmeat	Desired number of chickens
Price of 1 piece of dried bushmeat TSh 2000 Price of 1 chicken TSh 10000		

Now we are going to show you 8 combinations of prices like the one we just showed you. Each represents a different situation with different combinations of prices.