Can consumer demand for bushmeat be reduced?

Income and price elasticities of demand in lowland Amerindian societies

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Abstract

Consumption of bushmeat is an important component of household economies in most tropical forested regions of the world, and is resulting in unsustainable levels of hunting, even in relatively isolated regions. Household surveys from Amerindians societies in Central and South America show that: 1) demand for bushmeat appears to follow an inverted U pattern with income, and 2) a small decrease in the price of meat from domesticated animals leads to a large decrease in the consumption of bushmeat. Policy-makers may be able to reduce demand for bushmeat by providing animal protein substitutes that are cheaper or by raising household income.

Key words: Conservation, bushmeat, prices, tropical forests, elasticities

Introduction

Bushmeat is a primary source of protein in the diet of rural and urban households in most forested regions of poor nations (Chardonnet 1995; Redford 1993) and provides higher than average annual incomes to hunters and to many traders (Dethier 1995; Ngnegueu & Fotso 1998). But hunting for bushmeat, rather than habitat loss, is also the most significant threat to the conservation of biological diversity of the tropics in the next 15-25 years (Robinson et al. 1999; Wilkie & Carpenter 1999). Unsustainable hunting risks the extinction of species unique to tropical forests (Bodmer et al. 1988; Bodmer et al. 1997; Winterhalder & Lu 1997), and the irreversible loss of value they confer to communities and to the world (Bowen-Jones & Pendry 1999; Wilkie & Carpenter 1999). Moreover, loss of bushmeat species that are primarily frugivores will alter the seed dispersal potential of up to 80% of the tree species, affecting seed shadows, seed rain, and the probability of seedling survival (Gautier-Hion 1984; Howe 1984). Ultimately, overexploitation of bushmeat species will alter the dominance hierarchies of tree species and change forest composition, structure, and biomass (Chapman & Chapman 1997). How these changes in forest structure and in plant species composition will affect rates of succession, re-growth of fallow fields, accretion of soil nutrients, and carbon sequestration are unknown.

At least two broad approaches have been tried to reduce pressure on wildlife: 1) increase *in situ* supply of wildlife and 2) reduce demand for bushmeat, either by restricting the supply of bushmeat or by educating consumers about the use of other options besides bushmeat.

Increasing the supply of wildlife could be done in at least two ways. First, one could manipulate the habitat to both increase the food supply of hunted species and reduce predator-related mortality. This option would produce ecologically-undesirable effects. Forests for bushmeat production would become simplified to maximize food production for the subset of animals preferred as bushmeat. The second involves raising bushmeat

species in captivity. This makes little sense for low productivity species such as large antelope and primates, but is being attempted by Vétérinaires Sans Frontières in Gabon (Jori & Noel 1996) with a rodent – the cane rat (*Thryonomys swinderianus*). However, with a gestation of 5 months and 6-13 months to reach an adult size of 4-5 kgs (Houben 1999), overall production rates of cane rats are considerable lower than for domestic pigs and chickens (Delfi Messinger, pers. com.). Consequently increasing bushmeat supply appears untenable to mitigate the adverse impacts of market hunting of wildlife.

The second broad approach, constraining demand, also faces hurdles. Most efforts to reduce the consumption of bushmeat have focused on restricting supply to raise prices and assumedly reduce demand. For instance, researchers and non-government organizations are working with logging companies to stop the export of bushmeat from timber concessions, and are seeking ways to help governments enforce laws that prohibit the transport and the sale of bushmeat (Robinson et al. 1999). Other attempts to reduce the demand for bushmeat have focused on environmental education (ECOFAC 1998). Yet, many policy-makers and researchers believe that rural people prefer the taste of bushmeat over the taste of meat from domestic animals, and that bushmeat consumption is a deeply-rooted cultural behavior difficult to change (Hladik et al. 1990).

Conservation NGOs argue that by constraining supply they will increase the absolute scarcity of bushmeat in markets. However, if demand for bushmeat is exceedingly strong, scarcity of bushmeat will likely drive up prices, which will provide incentives for others to enter the market and seek ways around the supply constraints. Thus depending on the structure of demand, supply-side measures may only have short term success. Others argue that by augmenting or revitalizing cultural taboos associated with unsustainable bushmeat consumption demand will decrease (Rose 1999; Trefon & de Maret 1999). The rationale behind both of these approaches is predicated on the assumption that the demand for bushmeat changes significantly with availability and price (i.e., is elastic, in that a small change in price results in a large change in the quantity consumed).

Despite the importance of bushmeat in the diet and economy of many rural tropical forest societies, little has been done, to date, to understand what drives consumer demand for bushmeat (de Garine 1993; Wilkie & Carpenter 1999). Evidence exists that increases in household wealth appear to drive a shift in preference from bushmeat to the meat of domesticated animals (Schmink & Wood 1992; Stearman & Redford 1995) or to narrow the range of bushmeat species consumed (Hames 1991; Layton et al. 1991). Apocryphal accounts might lead one to believe that residents of, at least, the Congo Basin prefer the taste of bushmeat over the meat of domestic animals, and that bushmeat consumption is a deeply rooted and impossible to alter tradition. Yet food preference studies have often simply documented that consumers noted 'meat hunger' when their diet is composed primarily of starches (Bahuchet 1988; de Garine & Pagezy 1990; de Garine 1993; Harako 1981; Hawkes et al. 1987), and have not established that consumers have clear taste preferences for bushmeat relative to the meat of domesticated animal substitutes. If the taste preferences of consumers for bushmeat make them insensitive to the price of bushmeat, then attempts to constrain supply and consequently increase market price will: a) not reduce demand, and b) will prompt bushmeat producers and traders to seek ways around the supply constraints, and encourage others to enter the bushmeat industry. Similarly, a culturally, deep-rooted taste preference for bushmeat may impose a significant barrier to reducing demand through environmental education.

Despite the importance of bushmeat to rural populations and despite the threat that hunting poses to the conservation of biological diversity and the tropical forest, little quantitative research has been done to understand what drives consumer demand for bushmeat in poor tropical countries. We know relatively little about how the consumption of bushmeat responds to the price of bushmeat and of its substitutes or to changes in household income. If the quantity of bushmeat demanded does not respond to large changes in the price of bushmeat and if the short-run supply of meat is relatively fixed and inflexible, then increasing the supply of bushmeat, either by manipulating the forest or by raising animals in captivity, will have a modest impact on conservation. If the

consumption of game, like the consumption of firewood or charcoal, declines when incomes grow, then economic prosperity could enhance wildlife conservation.

To explore these issues, we draw on a unique data set from Amerindian households in Central and in South America. Using the same methods (Godoy 2000) to collect socioeconomic information, we surveyed 483 households in four lowland cultures in Bolivia and followed 32 households Tawahka Amerindians over $2^{1}/_{2}$ years in Honduras. The analysis of that information, discussed below, suggests that consumer demand for bushmeat is responsive to household income and to prices of game and its substitute. Below we provide empirical estimates of those relations and discuss the wider policy implications of the findings.

The role of income and price of animal proteins in bushmeat consumption and implications for wildlife conservation

All else held constant, an increase in income could produce three changes in the consumption of wildlife, depending on whether wildlife is an inferior or a superior good or a necessity. Superior animals are species whose consumption increases by more than one percent for every percent increase in income. Necessities are animals whose consumption increases by less than one percent for every percent increase in income. Inferior animals are species whose consumption falls when incomes rise. Normal goods are goods with a positive income elasticity of consumption and include necessities and superior goods. An animal may fall under more than one category depending on the level of income of the household. For instance, in poor households an increase in income may at first induce a steep increase in bushmeat consumption, but beyond a threshold of income bushmeat consumption may grow more slowly or perhaps fall. The words superior, normal, necessities, and inferior summarize an empirical relation between the consumption of an animal or a group of animals and income; the words do not imply that animals are better or worse than each other.

On the demand side, two prices will likely drive the consumption of game: the price or value of bushmeat itself and the price or value of close substitutes. All else held constant, an increase (decrease) in the price of bushmeat will reduce (increase) the consumption of bushmeat. We refer to this relation as the own-price elasticity of consumption, defined as the percent change in the consumption of a species of bushmeat brought about by a percent change in the price of that species. The higher the own-price elasticity of consumption, the greater the number of substitutes available to consumers since a small change in the price of the good will produce a large change in the quantity consumed.

A decrease in the price of another source of animal protein, such as poultry, beef, or pork, ought to decrease bushmeat consumption if meat from wildlife and meat from domesticated animals are substitutes for each other. If meat of domestic animals is a complement to bushmeat (i.e., cleaning solution is a complement to contact lenses) then an increase in the price of poultry or beef should result in a decrease in bushmeat consumption. We refer to the relation between a good and its substitutes or complements as the cross-price elasticity of consumption, defined, in this case, as the percent change in the consumption of a species of bushmeat produced by a percent change in the price of another type of meat or source of animal protein. A negative cross-price elasticity of consumption between meat from wildlife and meat from domesticated animals means the two goods are complements, much like bread and butter; a positive cross-price elasticity of consumption implies that the two goods are substitutes. A high, positive cross-price elasticity of consumption between meat from wildlife and meat from domesticated animals implies the potential to reduce pressure on wildlife through the development of cheaper alternative sources of animal protein.

Methods and variables

Between June, 1997, and July, 1998, 483 households were surveyed among Yuracaré, Chiquitano, Mojeño, and Tsimane' Amerindian communities in forested regions of the

Bolivian lowlands. The purpose of the surveys was to collect information on the consumption of game and fish, and on socioeconomic covariates of consumption, particularly income and prices. The information is used with multiple regressions to estimate income and own and cross-price elasticities of consumption of wildlife.

Dependent variables are the kilograms of bushmeat and fish brought into the household during the week before the interview. Seventy three percent of the interviews were done during the rainy season, between February and April, 1998. Weekly consumption per person of bushmeat and fish from the sample averaged 1.08 kilograms of bushmeat (standard deviation = 3.29) and 2.43 kilograms of fish (standard deviation=5.05). A third variable was created by adding the quantities of bushmeat and fish to capture the total weight of non-domesticated animal protein consumed each week per person. Explanatory variables included per capita income and wealth, household size, education of the male head of household, village prices for fish and for domesticated animals (chickens, ducks, pigs, and cattle), and dummy variables for villages and for ethnic groups. Income included imputed farm income from the harvest of maize, rice, and peanuts and cash income from the sale of farm products and forest goods (excluding bushmeat) and from wage labor. Income also included remittances received. Wealth included the value of one dozen diagnostic physical assets. Consumption, income, wealth, household size, education, and prices were transformed into natural logarithms. Ordinary least squares and with robust standard errors were used to estimate elasticities.

Results

In table 1 we present the estimates of the income, own-price, and cross-price elasticities of consumption for all animals, bushmeat, and for fish. We estimate the elasticities for the pooled sample of hosueholds and for the top and for the bottom half of the income distribution. The estimates allow one to decide if bushmeat is a normal or inferior good and explore how different types of elasticities of consumption change with income.

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Income elasticities

Results suggest that fish and other bushmeat, taken together, are an inferior good. The income elasticity of consumption for all wildlife (bushmeat & fish) in the pooled sample was -0.20 (p=0.037), suggesting that a doubling of income would reduce consumption of wildlife by 20%. An increase in income would seem to have a greater effect curbing consumption of wildlife in the bottom half than in the top half of the income distribution. The income elasticities of consumption in the bottom and in the top half were -0.27 (p=0.025) and -0.19 (p=0.555).

But these result gloss over differences between different types of animals. When the analysis is done separately for fish and for bushmeat a different story emerges. Fish appear to be a clear inferior good, with an income elasticity of consumption for the pooled sample of -0.16 (p=0.046). An increase in income seems to have a much stronger effect in curbing fish consumption in the bottom half (elasticity -0.28; p=0.005) than in the top half of the income distribution (elasticity -0.01; p=0.928). On the other hand, bushmeat appears to be a necessity in the pooled sample (elasticity 0.12; p=0.191) and in the bottom half of the income distribution (elasticity 0.20; p=0.146), but it seems to become an inferior good in the top half (elasticity -0.11; p=0.757). Since the income elasticities of consumption for bushmeat hover around zero and are statistically insignificant at the 90% confidence level or above, one could tentatively conclude that bushmeat is a necessity bordering on being an inferior good.

These results are echoed by other results (not shown) obtained from a panel estimation of 32 households of Tawahka Amerindians in the rain forest of eastern Honduras that were monitored over $2^1/_2$ years, from June, 1994, until December, 1996 (Godoy 2000). The income elasticity of consumption for fish was indistinguishable from zero and was statistically insignificant(-0.01; p=0.849) in a random-effect estimation. As in Bolivia,

game meat was a necessity in the pooled sample (elasticity of 0.19 in the random-effect estimation; p=0.089) and in the bottom half of the income distribution (elasticity of 0.50; p=0.003), but appears to become an inferior good in the top half of the income distribution (elasticity -0.6; p=0.741).

Own-price elasticities

As we did not have a village price for bushmeat but did have the village price of fish, the only own-price elasticity we could estimate with accuracy was that for the consumption of fish. If one assumes, however, that the price of fish and the price of game meat move in unison, then the price of fish could be used as a proxy for the price of game meat, which is the assumption we make in estimating the own-price elasticity for game meat. Care should be taken in reading the row labeled 'own-price' for bushmeat in table 1 as these estimates refer to changes in the consumption of bushmeat produced by a change in the price of fish, not of bushmeat.

Bearing this caveat in mind, one can infer from table 1 that wildlife has an elastic demand. For fish, bushmeat, and for all wildlife, consumption appears to be almost twice as elastic in the bottom half than in the top half of the income distribution. For instance, the own-price elasticity of consumption for fish in the bottom half of the income distribution was -4.02 (p=0.001), but it was only -1.98 (p=0.164) in the top half. The high own-price elasticity of consumption suggests that indigenous people may have many sources of animal protein available to them, a finding with positive and with negative implications for conservation, as discussed in the conclusion.

Cross-price elasticities

Because of multicollinearity we were unable to estimate cross-price elasticities of consumption for the top half of the income distribution. The results for the bottom half of the income distribution suggest that fish is a complement and bushmeat is a substitute for meat from domesticated animals. An increase in the price of domesticated animals reduces consumption of fish but increases consumption of game. A one percent increase in the

price of domesticated animals results in a 2.55% (p=0.053) decrease in fish consumption, but in a much larger increase in game consumption (elasticity 8.18; p=0.001).

Conclusions and policy implications

The results of this study suggest that: 1) an increase in income reduces consumption of fish, 2) an increase in income causes bushmeat consumption to increase but, beyond a threshold, causes bushmeat consumption to decline, 3) consumption of bushmeat and fish are responsive to changes in the price of bushmeat and fish, and 4) a decrease in the price of meat from domesticated animals is associated with a large decline in the consumption of bushmeat and fish.

Given that bushmeat consumption appears to be income and price sensitive, and assuming that consumers in other poor tropical forested nations behave like Amerindians in Bolivia and Honduras, then at least three specific lessons for policy-makers and donors flow from this study. First, economic development might result in enhanced wildlife conservation if household incomes rise fast enough and high enough to shift bushmeat from a necessity to an inferior good. Second, given the high own-price elasticity of demand for bushmeat any factor that lowers the cost of hunting (i.e., new weapons, cheaper market access, etc.) will increase hunting effort and the impact on wildlife. But any activity that raises the opportunity costs of labour, such as higher wages or more jobs in the countryside, could counterbalance the negative affects of new technologies. Lastly, the data suggest that demand for bushmeat may be reduced and wildlife conservation enhanced by promoting access to cheaper alternative sources of animal protein.

As the results of this study are preliminary, researchers need to validate that the demand for wildlife in other tropical forest regions of the world is as responsive to the price of substitutes and to income as it appears to be among Amerindians. However, given the severity of the threat to wildlife conservation in the tropics from bushmeat hunting, even these preliminary results suggest that donors and governments should consider supporting

and evaluating pilot projects designed to promote bushmeat substitution, and to use market-based mechanisms to increase both the price of bushmeat in markets, and the price of shotguns, ammunition and wire for snares. Lastly, donors and governments should continue to support and expand on initial efforts to encourage or coerce multinational logging and oil companies to halt illegal commercial bushmeat hunting in their concessions, and thus constrain the major source of supply of bushmeat to urban consumers.

Table 1 Income and own and cross-price elasticities of bushmeat and fish consumption: Bolivia

	Pooled	Bottom Mean $199/yr	Top Mean $884/yr
All wildlife			
Income	-0.20 **	-0.27**	-0.19
Own	-4.11***	-4.54***	-2.10
Cross	1.54	5.70***	Dropped
R^2	.56	.63	.53
N	461	230	231
Fish			
Income	-0.16**	-0.28***	-0.01
Own	-4.59***	-4.02***	-1.98
Cross	1.70***	-2.55**	Dropped
R^2	.73	.74	.76
N	461	230	231
Bushmeat			
Income	0.12	0.20	-0.11
Own	-2.88***	-3.65***	-1.82
Cross	1.22	8.18***	Dropped
R^2	.30	.46	.26
N	461	230	231

Notes: Regressions are ordinary least squares with robust standard errors and constant. Besides logarithm of income, prices of fish and domesticated animals, and of wealth, regressions also include logarithms of education of male head and household size, and dummies for ethnic groups and for villages. Own is the price of fish. Bottom refers to households with less than the median income (1877 bolivianos/household). 5.23 bolivianos=1 US$ in 1997. *, **, and *** significant at ≤10%, ≤5%, and ≤1%.

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