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Market access and wild meat consumption in the central Amazon, Brazil

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ABSTRACT

Wild meat is an important source of food and income for people across the tropics, but overhunting is driving species declines. Comprehension of the interrelated factors that influence wild meat consumption is needed to help address this important issue. A central hypothesis is that market access in the tropics drives consumption. We tested this hypothesis by comparing households with high (living in a town) and low (living in rural areas) market access in the central Amazon. When comparing households in rural communities only, we used travel frequency to town and boat traffic as proxies for market access. To determine interrelationships, we assessed other factors that may influence meat consumption, such as occupation, wealth, and number of people in households. As predicted, town residents consumed more domesticated meat and less wild meat than rural residents. Among rural communities, travel frequency was negatively, and boat traffic was positively, associated with wild meat consumption. Occupation was an important predictor of consumption, with farmers (occupation more common in rural areas) consuming more wild meat than people with other occupations. Number of people in the household was negatively associated with beef consumption. Wealth was associated with wild meat and beef consumption but its effect on consumption was negligible (effect size near zero). When comparing urban and rural residents, we detected a strong relationship between market access and wild meat consumption, but this was influenced by the diversity of livelihood options available to town versus rural residents. Among rural residents, we detected a relationship between market access and wild meat consumption, but this relationship depended on the nature of the market access (household travel frequency to town versus boat traffic at rural communities). Our findings suggest that greater access to market may lead to a decrease in wild meat consumption at the household level. Key factors we did not address, however, require further research in rural communities; namely whether reduced consumption leads to overall reduction in hunting or merely a shift from consumption to trade.

1. Introduction

Wild meat is a fundamental source of food and income for people across the tropics (Abernethy et al., 2013; Golden et al., 2011; Taylor et al., 2015). Tragically however, overhunting is one of the major threats to biodiversity resources (Milner-Gulland et al., 2003; Vié et al., 2009). Hunting of wildlife for food already is, or will soon be, unsustainable throughout the tropical regions of the world (Benítez-López et al., 2017; Fa et al., 2006; Milner-Gulland et al., 2003). In Central Africa, hunting rates are around six times the estimated sustainable rates (Bennett, 2002); > 4.5 million tons of wild meat consumed per year in the Congo Basin (Nasi et al., 2011). In the Amazon, estimates suggest > 1.2 million tons of wild meat are consumed per year (Nasi et al., 2011). Sustainability of the wildlife harvest varies across Amazonia where it is clear that many areas are already unsustainably hunted but others remain lightly hunted (Peres and Palacios, 2007). Despite the ancient history and traditional practices of hunting and wild meat consumption, increasing human populations, commercial hunting, access to previously remote areas, and technological improvements have intensified pressures on wildlife throughout the tropics (Fa et al., 2006; Weinbaum et al., 2013).

Hunting to fulfil subsistence needs is deeply rooted in Amazonian culture (Luz et al., 2015; Robinson and Redford, 1991), but as the population becomes more urbanized, hunting of wildlife for market is likely to increase (see Parry et al., 2014; Parry et al., 2010). Consumption of wild meat is pervasive across small towns of the Amazon

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and meat is obtained mostly through purchase (Morsello et al., 2015; Parry et al., 2014). This consumption, in turn, can cause severe wildlife declines in surrounding forested areas (Morsello et al., 2015; Parry and Peres, 2015). To address the issue of increasing commercial hunting throughout Amazonia, we need to understand the factors affecting wild meat consumption by people living in both urban and rural areas.

Several factors driving wild meat consumption are already identified in the Amazon, including market prices and household income and wealth. For example, in Bolivia, as prices of fish and meat from livestock decrease, wild meat consumption decreases (Apaza et al., 2002), indicating that domesticated and wild meat are dietary substitutes. Wild meat consumption is positively associated with wealth (Godoy et al., 2010) and demand for wild meat increases with an initial increase in income and decreases as income continue to increase, suggesting a nonlinear relationship (Wilkie and Godoy, 2000, 2001). Access to markets can be an important determinant of household consumption (Kramer et al., 2009), yet the relationship between market access and wild meat consumption in both urban and rural setting has not been addressed in Amazonia (but see Espinosa et al., 2014; Franzen and Eaves, 2007).

Market access should influence wild meat consumption as it increases people's opportunity to transition from a barter-based to a monetary economy, which can lead to increases in wealth, livelihood diversification, and changes in consumer behavior (Kramer et al., 2009; Schmitt and Kramer, 2009). If wild meat is an inferior good (i.e., demand for wild meat decreases as wealth increases; Brashares et al., 2011; Wilkie and Godoy, 2001) and domesticated meat is a normal good (i.e., demand for domesticated meat increases as wealth increases; Brashares et al., 2011; Wilkie and Godoy, 2001), increased market access should lead to a decrease in wild meat consumption and an increase in domesticated meat consumption. However, if consumption is driven by peoples' preferences for wild over domesticated meats and wild meat is a normal good, greater market access is unlikely to reduce wild meat consumption (Brashares et al., 2011; Fa et al., 2009). Using a comparative assessment of meat consumption (wild and other kinds) in the central Amazon, a region where people live and move along rivers instead of roads (see Ibisch et al., 2016 on roadless areas and their conservation value), we tested whether access to markets influences wild meat consumption by households in town versus rural communities. This work is relevant for future efforts to reduce demand for wild meat in this and other regions where communities are isolated from major cities and where towns and villages are situated along major rivers that provide the dominant form of transportation, which applies to many towns and rural villages across the Amazon (see IBGE, 2010).

2. Methods

2.1. Study site

This study took place in central Amazonia, Brazil, in the town of Tapauá and 12 outlying rural communities (Fig. 1). The town of Tapauá has approximately 10,600 people (IBGE, 2010) and is only accessible by boat, plane, or foot. Tapauá's population is comprised mainly of families who migrated from rural communities in the region. The rural area of Tapauá's surrounding municipality has approximately 8450 people (IBGE, 2010), and the size of distinct rural communities we studied varied from 05 to 25 families. Most town and rural community residents are of mixed races; smaller proportions are white, black, or indigenous (Ferrarini, 1980; IBGE, 2010). People with whom we worked did not identify themselves as indigenous. Transportation between the town of Tapauá and rural communities occurs only by boat, and primarily on the Purus and Ipixuna Rivers (Fig. 1). Tapauá's economy is based on local commerce, local government employment, fishing, and small-scale farming (IBGE, 2010). Rural residents are mostly fishers and farmers who sell their products in Tapauá or to commercial riverboat traders.

2.2. Study design

We used a cross-sectional design (Bernard, 2011) and compared meat consumption of people from town and rural communities who had varying access to markets. When comparing rural communities to town, we assumed households had low and high access to market, respectively. As proxy measures of market access among rural communities only, we used frequency of trips to town (travel frequency) and boat traffic (Table 1).

To select survey participants, we first mapped all households in the town and rural communities. We only included rural communities < 200 km from Tapauá to avoid including rural communities that were closer to another market village (Foz do Tapauá; Fig. 1). In town, we randomly selected 200 households. In rural areas, we stratified the communities by fluvial travel distance to the closest market (< 50 km, 50–100 km, > 100 km) and by river (the Purus and Ipixuna Rivers) to account for the influence of these factors on meat consumption. We randomly selected three communities located at < 50 km from town, regardless of river (Fig. 1). Along the Purus River, we randomly selected six communities – two located at 50–100 km and four located at > 100 km from town. Along the Ipixuna River, we included all communities located at 50–100 km (one community) and at > 100 km from town (two communities) because the limited number of communities did not allow for a random selection.

After selecting households in town and rural communities, we visited each household and, using protocols approved by the Institutional Review Board of the University of Florida (protocol 2012-U-677), asked the heads of households (men or women) to participate in the study. If they agreed to participate, we scheduled a face-to-face interview with them. We performed 151 interviews in town (of 200 randomly selected households) and 100 interviews (of 103 households) from 12 rural communities. Each interview lasted approximately 30 min.

Rural communities downstream of Tapauá were excluded from this study because they are located within a strictly protected area (Abufari Biological Reserve; Fig. 1) and would have introduced confounding factors associated with restricted resource access and use rights that may affect consumption. Although some communities along the Ipixuna River are located within a multiple use protected area (Tapauá State Forest; Fig. 1), this protected area is relatively new (less than ten years; Amazonas, 2009) and is still in the process of establishment. Thus, we did not expect that resource access and use regulations for communities within Tapauá State Forest would differ from communities living outside of the protected area.

We assessed meat consumption by asking participants to estimate the number of days per week, per month, per season, or per year that they usually consumed wild meat (i.e., mammals, birds, and river turtles), domesticated meat (i.e., chicken, beef, processed meat, and eggs), and fish in their household. To account for seasonality, we asked participants to estimate the number of days consumed during periods of high and low availability of wild meat and fish. We then combined the two estimates of consumption (during high and low availability) to perform our analysis. To assess seasonality, we identified experienced hunters and fishers within our sample and asked them what months of the year they considered to have high and low availability of wild meat and fish. We also measured perceived availability of wild meat and fish, from zero (not at all available) to 10 (readily available), throughout the year (see Fig. A.1 in Appendix A for details). Based on this information, we estimated the length of seasons of high and low availability of wild meat and fish (high availability: from April to July for wild mammals and birds, from July to September for river turtles, and from June to September for fish; low availability: the remaining months). Participants perceived availability of domesticated meat to be high in town and low in rural communities throughout the year.

We assessed consumption of six types of meat: 1) wild mammals and birds, 2) river turtles, 3) fish, 4) chicken, 5) beef, and 6) eggs and processed meat (Table 1). We report consumption of wild mammals and