Research

The species-specific role of wildlife in the Amazonian food system

Version: 3 Submitted: ABSTRACT We examine ways in which the role of wild animals in the Amazonian food system may be socially differentiated and species-specific. We combine a hybrid framework of food choice preferences and theorizing on access to natural resources with fieldwork in Brazilian Amazon, where social and environmental challenges coalesce around the role of wildlife in feeding a growing urban population. Based on 798 household surveys across four towns, we found that consumption of, and taste preferences for, selected species of mammals, fishes, birds, and reptiles are related to variation in means of access (e.g., level of social trust - the basis of reciprocity and informal urban safety nets), and having rural cultural origins (marginal to migrants' other socioeconomic differences). The likelihood of eating particular species was associated with taste preferences and household experiences of food insecurity. Hunting and fishing households consumed many wild species; it is unclear if they depend heavily on any in particular. Vulnerable species, including manatee, tortoise, and river turtle, were eaten mainly by relatively privileged households, and less so by other households (e.g., rural-urban migrants). Rural origins increased by 90% the likelihood of a strong wild meat preference, compared to other households. Evidently, wildlife consumption is a rural tradition that influences migrants' dietary practices in towns, through the interplay of preferences, means of access, and context. Finally, severe and moderate food insecurity was associated with eating howler monkey and catfishes (barred and redtail), and not eating manatee and turtle. Hence, urban consumption of some, but not all, wild species is associated with household disadvantage and food insecurity. Amazonian town-dwellers consume many wild species, drawing on diverse means of access, which are species-specific and reflect social inequalities. Species-specific governance of wildlife consumption may help balance the risks of overharvesting against the well-being of Amazonia's vulnerable town-dwellers.

Keywords: bushmeat; urbanization; social inequality; food choice; migration

INTRODUCTION

In this paper, we evaluate how the consumption of different wildlife species in Amazonian towns is influenced by social processes, and how species-specific consumption may relate to taste preferences and food insecurity.

First, we attempt to disentangle the ways in which the species consumed and preferred are shaped by diverse kinds of access, including social capital, practicing rural livelihoods, being a rural-urban migrant, and geographic context. Second, we explore the linkages between species preferences and their consumption. Third, we assess potential variation in the linkages between household food insecurity and consumption of different wildlife species; an overlooked issue yet vital for designing policy interventions that balance the trade-offs between biodiversity conservation and human welfare (Cawthorn and Hoffman 2015). This research engages with a strategic priority in wild meat research by evaluating the socially-constructed and complex, potentially species-specific, role of wild meat in food systems in tropical forest regions (Ingram et al. 2021). Throughout this paper, we use the terms *wildlife* to refer to wild mammals, birds, reptiles, and fish and *wild meat* to refer to meat from wild mammals, birds, and reptiles (but not fish).

The world is urbanizing at an unprecedented rate, due to the rapid growth of towns and cities, particularly in low- and middle-income countries (LMICs) (United Nations 2019). This century, population growth is expected to be greater in small and medium-sized urban areas, rather than in mega-cities (Guneralp et al. 2018). Secondary towns are key to achieving development goals given that rural-urban migrants, and urban poverty and food insecurity are concentrated in these places (Gibson et al. 2017, Ingelaere et al. 2018, Lanjouw and Marra 2018). Understanding the food practices of people living in urban areas is recognized as fundamental for achieving food security and developing sustainable, resilient food systems (Tendall et al. 2015, Meybeck and Gitz 2017, El Bilali et al. 2019). Indeed, there is growing interest in the role smaller towns, and their rural-urban connections, play within food systems (Tacoli and Agergaard 2017). Recently, however, a Lancet Commission concluded that achieving sustainable, equitable food systems requires going beyond agriculture, and elucidating the role of wild foods in urban diets (Willett et al. 2019). Not surprisingly, urban population growth is predicted to increase demand for natural resources, including wild meat (Guneralp et al. 2018).

Urban demand for wild meat in Amazonia is already significant (Van Vliet et al. 2011, Van Vliet et al. 2019, El Bizri et al. 2020, Chaves et al. 2021). Urban consumption may pose significant risks to vulnerable species of large vertebrates given that urban demand can be concentrated on a few preferred or valued species (e.g., tapir and white-lipped peccary in Amazonas state, Brazil; Carignano Torres et al. 2022). However, at least in rural contexts in the forested tropics, wild meat can provide ‘natural insurance’ in periods of food shortages, emergencies, or economic hardship (Brashares et al. 2004, Jambiya et al. 2007, Sunderland 2011) and contribute to food security (Williamson 2002, Cawthorn and Hoffman 2015, Fa et al. 2015), but this can vary seasonally - with declines in wildlife harvest being associated with greater food insecurity; Tregidgo et al. 2020). Food insecurity is the absence of reliable access to sufficient quality and quantity of food, affecting around 800 million people worldwide (FAO 2014, Schmeer and Piperata 2017). In some urban areas (e.g., Kisangani, in Democratic Republic of Congo) wild meat can be one of the cheapest, and relatively nutritious, animal-sourced foods available, which underlies

its apparent importance for poor households (Van Vliet et al. 2012). Yet, even within the same society, wild meat can have heterogeneous and species-specific linkages with poverty and social circumstances. For instance, although wild pigeons in Samoa are prestigious and expensive, their market-based consumption by wealthier households occurs alongside subsistence hunting for domestic consumption (Stirnemann et al. 2018). Hence, even 'expensive' species might be accessed by poor households if they can obtain these species outside of market exchange; through direct harvest or social relations (gifting and reciprocity; Hyden 1983).

Consumption of wildlife and related sustainability risks is typically framed as a rural issue (Ingram et al. 2021) and, to our knowledge, no study has evaluated the relationship(s) between wild meat species-specific consumption, diverse access mechanisms, urban food insecurity, and conservation of threatened species. We know that urban consumption of wildlife is influenced by social and economic factors including income, wealth and social status, earlier life (e.g. rural origins), gender, and age (e.g., Drury 2011, Parry et al. 2014, Shairp et al. 2016, Chaves et al. 2021). Understanding the socio-cultural and economic determinants of urban consumption of wildlife is key to informing appropriate policy interventions to avoid over-exploitation and promote sustainable use (sensu Cawthorn and Hoffman 2015). Nonetheless, most studies focus on urban consumption of wildlife in general and overlook whether preferences or social determinants of consumption are species-specific. Species-specific vulnerability to over-harvesting is well-established in the ecological sciences and conservation legislation (e.g., ICUN red-listing). However, ways in which the consumption patterns - which reflect food choices and constraints - of urban residents may vary by wildlife species are poorly understood.

Any social patterning (i.e., differentiation) in wild species' consumption is likely to reflect different kinds of households' preferences, opportunities, and choices to acquire different kinds of wildlife, and other animal-sourced foods. Here, we investigate how these preferences and opportunities shape urban consumption of wildlife by combining Sobal et al.'s (2006) food choice model with Ribot and Peluso's (2003) theorizing on access to natural resources. Sobal et al.'s model has been influential in public health research (e.g., in relation to food choice and social disadvantage, and policies to prevent obesity; Devine et al. 2006, Hawkes et al. 2015) and includes three components: (1) a person's life experiences related to the accumulation of eating experiences, food choice trajectories, and transitions through the life course; (2) the influences of culturally-learned ideals of what and how we should eat, resources including time, money, transportation, skills, social relationships and networks, and contexts (physical environment, social structures, political economy); and (3) personal factors, such as taste preferences, self-image, and identities. Linking across these components, research from Congo demonstrates that perceptions of wild meat (e.g., as natural, tasty, or healthy) are associated with social norms (e.g., as a luxury status symbol) to influence its consumption in urban areas (Chausson et al. 2019). According to Ribot and Peluso (2003), households derive benefits from (natural) things

through diverse means, relations and processes; mechanisms which together comprise a 'bundle of powers'. Hicks and Cinner (2014) classified (and then quantified related measures) these mechanisms into four categories: (1) right of access, (2) access through knowledge, (3) economic access (e.g., to markets, capital, technology, labor), and (4) social & institutional access (i.e., access to authority, social relations, or through social identities).

We apply this hybrid conceptual framework of access and preferences to understanding species-specific consumption in towns in the Brazilian Amazon (Fig. 1), where these intersecting social and environmental challenges coalesce around the apparent importance of wildlife as food for a growing urban population (Parry et al. 2014, El Bizri et al. 2020, Chaves et al. 2021); ~73% of people in the Brazilian Amazon live in urban areas (IBGE 2018). We then evaluate associations between wildlife consumption and household food insecurity. We do so by asking the following research questions: (1) How do access mechanisms, earlier life, and place influence urban consumption of different wild species? (2) How do access mechanisms, earlier life, and place influence wildlife food preferences? (3) Are wildlife taste preferences associated with consumption of different species? And, (4) How does food insecurity relate to consumption of different wild species? We expect that a household's access mechanisms interlink with their specific taste preferences and consumption patterns. First, people will use their bundle of powers to obtain preferred foods. Second, a household's particular bundle of powers will shape opportunities for acquiring different wild foods, and hence influence which foods they eat. The access mechanisms we assessed are: horizontal social capital (i.e., level of social trust, interpreted as forming the basis of reciprocity and informal urban safety nets; Ruel et al. 1999), vertical social capital (i.e., level of trust in authority), rural visits by household members, direct harvest (i.e., access through rural knowledge and skills), and cash income (i.e., economic access through markets, or as an indicator of household members' power and esteem). We also include place-based access (i.e., municipality, Brazil's lowest level of local governance) because a natural resource's availability, market presence, and cultural preferences can vary with context. Earlier life experience is represented by the rural origins (or not) of household heads.

Neither Access Theory nor Sobal's food choice model explicitly account for social position; a limitation for our study given that social norms may underlie wildlife food preferences and practices. We, therefore, additionally draw on Pierre Bourdieu's notion of *habitus*; slowly acquired, socially-learned habits of thinking and action, common to people of similar backgrounds, including class, education, and profession (see Castree et al. 2013). We thus also explore the effect of social background on urban Amazonians' wildlife food practices (as social actions) by using formal education (linked to social class) as an additional predictor. Any effect of *habitus* linked to education (and, hence, social class) is marginal to the effects of rural origin (early life experience of eating wildlife in rural areas will partly reflect context-specific social norms), and town (*habitus* also reflects local cultural norms which may be common

to a specific town).

We assessed the consumption of 13 species, including many of the ecologically, culturally, and economically important wildlife species consumed in Amazonia, capturing a spectrum of market prices, levels of consumption, taste preference, vulnerability to overhunting, and legality of consumption (Bodmer and Robinson 2004, Castello et al. 2011, Castello et al. 2015, Isaac et al. 2015, Van Vliet et al. 2015, Carignano Torres et al. 2016, Chaves et al. 2019, El Bizri et al. 2020, Mayor et al. 2021). Some species may be overharvested because they have low reproductive rates (such as tapir; Tobler et al. 2014) or take many years to achieve reproductive age (e.g., 12-20 years for turtle species; Vogt 2008). Other species may be able to sustain harvest because they have high rates of population increase or achieve reproductive age within a few years or even months such as paca (El Bizri et al. 2019). Some of the mammal, bird, and reptile species included in this study figure among the most consumed species in the region (e.g., paca, tapir, white-lipped peccary; Chaves et al. 2018 [Table 2]; Carignano Torres et al. 2022 [Fig. 4]), but other species are less consumed (e.g., manatee; Chaves et al. 2018 [Table 2]). We expect that some of these species may be more consumed by food-insecure families than others.

We acknowledge that some fish species are likely to be more heavily consumed in the four study towns, compared to the three fish species included in our consumption survey. Non-surveyed species widely consumed in Amazonian urban areas are in the Characidae family (e.g., *Semaprochilodus* spp. [local name, jaraqui], *Triportheus* spp. [sardinha], *Prochilodus nigricans* [curimatã], *Brycon amazonicus* [matrinxã], *Potamorhina latior*, 'Pacu' spp., *Potamorhina latior* [branquinha]), Cichlidae family (e.g., *Cichla* spp. [tucunaré], 'Acará' *spp.*), and Siluriforme *Pterygoplichthys pardalis* [bodó] (Santos et al. 2006; Gandra 2010; Parry et al. 2014). However, because some Characidae and Cichlidae fish species are so widely consumed across the region - at least when seasonally abundant in a particular location -, we considered them unsuitable candidate species for examining linkages between odds of consumption and a household's diversity in access mechanisms, taste preference, or food insecurity. Therefore, we focused on consumption of selected wildlife species to look at these relationships. Nonetheless, the three fishes in our survey are still significant in terms of their catches within the Amazonian fisheries. For instance, Tregidgo et al. (2021) assessed the catches of 22 rural communities (fishing for home consumption and urban markets) along the Purus river, finding that arapaima ranked third (9.9% of caught biomass); barred catfish ranked fifth (4.6%), and red-tailed catfish, ranked seventh (3.6%). Our approach does not intend to address reliance on the selected species. Rather, it aims to test how household consumption of different species relates to access mechanisms, taste preference, and food insecurity, and explore how a species-specific approach to managing wildlife harvesting and restrictions on market sale may be more appropriate than a general approach to wildlife management.

METHODS

Study sites and design

Urban areas in the Amazon have grown rapidly in recent decades, partly due to rural-to-urban migration (see Parry et al. 2010, and supplementary material in Parry et al. 2014). As a result, many urban residents in provincial towns have rural origins and maintain access to rural areas (Parry et al. 2010, Parry et al. 2014, Dodd 2020, Chaves et al. 2021). We used a cross-sectional design to assess how access (household access mechanisms, rural origin, and place-based effect) influences wild meat (i.e., meat from wild animals) and fish consumption (Q1), and preferences for the taste of wild meat (Q2; Fig. 1) among urban populations of four municipalities, namely Caapiranga, Ipixuna, Jutaí, and Maués, in Amazonas state, Brazil (Fig. A1.1). We also looked at associations between preferences for, and consumption of, wild meat (Q3), and between perceived food insecurity (defined below) and consumption of wildlife (Q4; Fig. 1).

These four municipalities have >90% forest cover remaining and their urban centers represent a gradient of remoteness within a hierarchical urban network (Prodes 2021). Caapiranga, Ipixuna, and Jutaí are small towns (<15,000 residents in the urban areas) and Maués is medium-sized (~ 35,000 residents; IBGE 2010). Their economies include services, small-scale commerce, and employment by the municipal government (IBGE 2010), and sale of agricultural produce, and natural resources (e.g., fishes, and non-timber forest products such as açai). Farming and natural resource harvesting (including in managed agro-forests) occurs in both peri-urban and more remote rural localities. Maués has more infrastructure and services than the smaller towns, including more grocery stores, markets, and diversity of labor (IBGE 2018). People in these municipalities mostly self-identify as being of mixed White, Black, and Indigenous (categorized as '*pardo*', median 71% of the population), with smaller proportions of White, Black, and Indigenous people (IBGE 2018).

We randomly selected households, adjusting sampling density to the household density per census sector from the national population census of 2010 (IBGE 2010). We geolocated sampling points using Open Street Map (2014), Google Earth (Google, 2014), and a purchased satellite image for Jutaí. We selected sampling points relative to the population density (i.e., density of households within each census sector; IBGE 2010) and limited to the potential inhabitable area of the towns, defined as located within a 20m radius of streets or river edge. We approached the nearest household at each location for interview and registered the coordinates for all households. All research was approved by Brazil's National Research Ethics Committee (CONEP/CNS; protocol 45383215.5.0000.0005) and [omitted for anonymity] University's Research Ethics Committee (S2014/126).

Data collection

We conducted household surveys using a standardized questionnaire (see Appendices 1 and 2). We collected

data during the dry season (fieldwork during August to December 2015), and wet season (fieldwork during March to July 2016), with a sample size of approximately 200 households per town (50% of these households in each season). Timing for dry and low seasons was based on long-term seasonality trends we derived using data from Brazil's National Water Agency (see E.D. Figure 4 in Chacón-Montalván et al. 2021). In other words, we carried out fieldwork first in the town with the earliest dry-season onset, and so on. We obtained a final sample of 798 households. The questionnaire was piloted in a small town (Autazes) in Amazonas.

Household consumption

We surveyed heads of households (men or women) and assessed the date of last consumption of 13 wildlife species in the household (Table 1) (i.e., not including consumption that may have occurred elsewhere in town, or when visiting a rural area). For the purpose of this study, we analyzed consumption (yes/no) within the last 12 months. For Amazonian manatee, which had very low rate of consumption within last 12 months, we considered household consumption in the last 60 months in order to have enough observations to generate a converging model.

Access

We examined how access (household access mechanisms, rural origin, and place-based effects) was associated with consumption of different wildlife species. Below we describe how we measured access.

Horizontal and vertical social capital

Access Theory does not refer to social capital but emphasizes 'relational access', which Ribot and Peluso (2003) describe as relying on social relations of friendship, trust, reciprocity, patronage, dependence, and obligation. We measure household's relational access to food and other resources using the cognitive dimensions of social capital, which refer to the norms of trust and reciprocity which emerge from networks and institutions (Putnam and Putnam, 2000). We developed measures of horizontal and vertical social capital using Likert-type 5-point questions from Grootaert et al. (2004). Each score is based on factor analysis using *psych* package within R (R Core Team, 2020). Horizontal social capital captures the level of social trust in other citizens. Our score is based on answers to 5 questions around bonding capital (trust towards similar people such as family and close friends) and bridging capital (trust within socially heterogeneous groups, potentially including other people in your neighborhood). Questions were: (i) Are the majority of people in your area trustworthy?; (ii) Would the majority of people in the neighborhood help you if you needed it? (iii) How much do you trust your friends? (iv) Do you feel safe walking alone at night in the street in front of your house? (v) Do you think the residents in your neighborhood are united? Vertical social capital (akin to linking social capital) connects people across gradients in formal power and authority. We asked about trust in: doctors and nurses; municipal

employees; local elected councilors; and local police. And 'do you think the town hall listens to what you and people like you request and suggest?' See Appendix 3 and Fig. A1.2. for more details about horizontal and social capital.

Rural origin and other means of access

In addition to horizontal and vertical social capital, we assessed: (1) rural origin, which refers to a binary variable on whether at least one of the household heads was originally from a rural area set to one, otherwise set to zero; (2) direct harvesting - i.e., whether someone in the household fishes or hunts, depending on whether the consumption referred to fish or other wildlife, respectively; (3) household monetary income in the previous 30 days (e.g., salaries, conditional cash transfers, retirement pensions, rent or other types of remuneration); (4) rural visits, specifically the approximate number of days any household member had spent in rural areas in past 12 months; and (5) town (fixed factor). In addition, we included formal education, specifically the highest level of education (number of schooling years) by anyone in the household, as a covariate in the model to capture class-based associations with food practices. See Appendix 3 for more details about rural visits and education variables.

Taste preference

We asked participants to list their three most preferred types of animal source foods, which included wild meat (mammals, birds, and reptiles), fish, and domesticated meat (beef, chicken, pork, etc.). We used this information to create a binary variable (0/1) for households who ranked (or not) wild meat among their three most-preferred food items. This information was collected only during the second year of fieldwork, in 2016, from 400 households. We looked at two questions regarding taste preference. First, we assessed how a taste preference for wild meat (i.e., whether wild meat was ranked in the top three preferred meats) was influenced by access mechanisms (social capital, direct harvesting, rural visits, income), earlier life (rural origin), and place (town). Second, we looked at associations between taste preference for wild meat and consumption of the 10 mammal, bird, and reptile species (i.e., excluding the 3 surveyed fish species).

Food insecurity

We measured perceptions of food insecurity using a questionnaire module modified from the Brazilian Household Food Insecurity Scale (EBIA) (see Rivero et al. 2022). The EBIA was developed and validated in Brazil in 2003, building on the Household Food Security Survey Module (HFSSM) from the US Department of Agriculture (Pérez-Escamilla et al. 2004). The EBIA is therefore similar to the widely-used Food Insecurity Access Scale (HFIAS), which also originated from the HFSSM, and was designed by USAID to be adapted for different cultural contexts (Coates et al. 2007).

We defined food insecurity levels using the definitions underlying the EBIA (PNAD 2013, p. 28). Mild food insecurity reflects anxiety about running out of food. Increasing severity indicates reduction of portion sizes (moderate) or skipping meals (moderate-to-severe). Severe food insecurity means going hungry, or not eating for an entire day due to lacking food or resources. Accordingly, we classified the level of each household by the number of related questions to which they responded 'yes', controlling for whether there were children in the household or not. See Appendix 3 for more details about the food insecurity scale used.

Data analyses

All analyses were conducted in R Studio (R Core Team 2020) and all continuous variables were standardized (i.e. mean of zero and SD of 1). There was no collinearity among the predictor variables used in this study.

Socioeconomic determinants of consumption and taste preference

We used a logistic regression model to assess factors associated with consumption of wildlife species (research question 1) and factors associated with taste preference for wild meat (research question 2). Specifically, to assess factors that influence consumption of individual species, we included the predictor variables: horizontal social capital, vertical social capital, rural origin, income, direct harvesting, rural visits, town (using Maués as the baseline), and education. To assess factors that influence taste preference for wild meat, we included the predictor variables: rural origin, income, direct harvesting, rural visits, town, and education. In both analyses of consumption and taste preference, results for each predictor variable correspond to marginal effects, after accounting for other variables in the model.

Association between consumption and preference and consumption and food insecurity

We used a log-linear model to look at correlations between consumption of individual wildlife species and preference for wild meat (research question 3). We also used a log-linear model to look at correlations between consumption of individual wildlife species and food insecurity (research question 4). We used a binary variable for food insecurity, with households that were moderately or severely food insecure set to one and households that were mildly food insecure or food secure set to zero.

RESULTS

How access mechanisms, place, and rural origin influence consumption of species

Seventy-three percent of households stated that they had consumed wild meat (i.e., at least one species of 10 species of wild mammal, bird, or reptile we included in this study) and 83% had consumed fish at

least one species of the three surveyed fish species in the household during the past 12 months. Among mammal species included in the survey, paca was consumed by 42.7% of households, tapir by 33.5%, white-lipped peccary by 32.8%, agouti by 13.5%, and howler monkey by 7.2%. Curassow was consumed by 9.8% of households. Among reptile species, yellow-headed turtle was consumed by 42.7% of households, tortoise by 11.9%, and caiman by 10.2%. Among fish species, arapaima was consumed by 72.0% of households, barred catfish by 49.1%, and redtail catfish by 8.5%. Manatee was consumed by 8.14% over the last 60 months.

For each unit increase in horizontal social capital (which varies on a scale of 1 to 5), there was an increase of 25% in the likelihood of consuming paca (odds ratio [OR]=1.25; 95% Confidence Interval [CI] 1.03-1.51; p=0.02) and 32% increase in the likelihood of consuming white-lipped peccary (OR=1.32; CI 1.07-1.57; p=0.01; Fig. 2 and Table A1.1), after accounting for other variables such as income. Vertical social capital, on the other hand, was not associated with consumption of any species assessed. Direct harvesting by a household member significantly increased the odds of consumption for all species.

In addition, rural origin was associated with an increase in the odds of consuming howler monkey (78% more likely to consume; OR=1.78; 95% CI 0.93-3.61; p=0.09) and redtail catfish (69% more likely to consume; OR=1.69; CI 0.93-3.21; p=0.10), and a decrease in consumption of river turtle (26% less likely to consume; OR=0.74; CI 0.53-1.03; p=0.09; Fig. 2 and Table A1.1). Among rural out-migrant households, 9.6% stated that they consumed howler monkeys, 11.5% stated they consumed redtail catfish, and 39.1% stated they consumed turtles. Among non-migrant households, 3.8% stated they consumed howler monkeys, 4.7% stated they consumed redtail catfish, and 45.9% stated they consumed turtles.

Income was associated with increased odds of consuming Amazonian manatee, tortoise, and river turtle. As *per capita* income increased by one standard deviation (equivalent to an increase of 696.6 Brazilian reais), households were 35% more likely to consume Amazonian manatee (OR=1.35; CI 1.06-1.70; p=0.01), 37% more likely to consume tortoise (OR=1.37; CI 1.11-1.68; p=0.002), and 23% more likely to consume river turtle (OR=1.23; CI 1.05-1.45; p=0.01; Fig. 2 and Table A1.1). Also, as educational level increased by one standard deviation (equivalent to 3.7 grade level increase), households were 44% more likely to consume tortoise (OR=1.44; CI 1.12-1.88; p=0.01), 18% more likely to consume river turtle (OR=1.18; 1.00-1.39; p=0.05), and 24% less likely to consume caiman (OR=0.76; CI 0.61-0.97; p=0.02). As time spent in rural areas increased by one standard deviation (equivalent to 73 days increase per year), households were 28% more likely to consume curassow (OR=1.28; CI 1.02-1.59; p=0.03; Fig. 2 and Table A1.1). Finally, the odds of consuming wildlife and fish varied by town and by species. For seven species (agouti, howler monkey, paca, tapir, white-lipped peccary, curassow, and barred catfish), the odds of consuming were higher in small towns than in Maués (Fig. A1.3; Table A1.1). For three species (manatee, arapaima, and redtail catfish), odds of consumption were higher in Maués than in small towns. For three species (tortoise, turtle, and caiman), the odds of consumption varied

across towns (Fig. A1.3 Table A1.1).

Associations between food preferences and access mechanisms

Wild meat (mammals and birds) was listed by 17% of 400 respondents as the first favorite food item, by 12% of respondents as the second favorite item, and by 10% of respondents as the third favorite item. Among the 39% of respondents who had wild meat in their 'top three' animal foods, preferred species included white-lipped peccary (by 28% of those respondents), tapir (27%), paca (19%), and other species combined (26%). White-lipped peccary was listed by 5% of all respondents as the top preferred item, by 3.8% as the second preferred, and 2.8% as the third preferred. Tapir was listed by 3.8% as the top preferred item, 3.8% as the second preferred, and 3.3% as the third preferred. Paca was listed by 3% of respondents as their top preferred item, 2.3% as the second preferred, and 2.3% as the third preferred. Tortoises and freshwater turtles (including various Amazonian species) were listed by 6.5% of respondents as the top preferred item, by 7.3% as the second preferred, and by 5.0% as the third preferred. Among these 18.8% of respondents, the preferred species listed were the yellow-spotted river turtle (90%) and tortoise (10%).

Rural origin, direct harvesting, and place were associated with taste preference for wild meat. Households with rural origins were 90% more likely to have a strong preference for wild meat than other households (OR=1.90; CI 1.19-3.07; p=0.01; Table A1.2). Direct harvesting was associated with an 83% increase in the odds of having a strong preference for wild meat (OR=1.83 [CI 1.10-3.10]; p=0.02; Table A1.2). Households in the town of Jutaí were 2.05 times more likely to have a strong preference for wild meat than households from Maués (Table A1.2). The other variables included in the model (rural visits, education, and income) were not associated with taste preference.

Association between taste preference and consumption

Wild-meat preference was correlated with consumption of six wildlife species. Preference for wild meat was positively associated with consumption of manatee (OR= 3.41; CI 1.70-6.98; p<0.001), paca (OR= 1.88; CI 1.23-2.89; p=0.004), tapir (OR= 1.67; CI 1.09-2.58; p=0.02), white-lipped peccary (OR= 1.82; CI 1.17-2.83; p=0.008), tortoise (OR=2.06; CI 1.09-3.85; p=0.02, and river turtle (OR= 2.51; CI 1.63-3.90; p<0.0001), but uncorrelated for agouti, howler monkey, caiman, curassow (Fig. 3 and Table A1.3).

Association between food insecurity and consumption

Of the 798 households surveyed, 50.8% were moderately or severely food insecure. Moderate and severe food insecurity, compared to mild food insecurity and food security, was positively correlated with eating howler monkey (OR=1.60; CI 0.93-2.82; p=0.10), barred catfish (OR=1.28; 0.97-1.70; p=0.08), and redtail catfish (OR=2.96; p<0.001), and negatively correlated with eating manatee (OR=0.58;

CI 0.34-0.97; p-value=0.04) and river turtle (OR=0.72; CI 0.54-0.96; p=0.02; Fig. 4 and Table A1.4). Among households where participants stated that they consumed howler monkeys, barred catfish, redtail catfish, manatee, and river turtles, 60.4%, 73.5%, 54%, 38%, and 45%, respectively, were moderately or severely food insecure. There was no correlation between food insecurity and consumption of the other nine species.

DISCUSSION

We examined the species-specific role of wildlife in the Amazonian food system, with a focus on urban consumption. We used an empirical, yet theoretically informed approach that included a hybrid framework to account for social understandings of food choices (Sobal et al. 2006), and the diverse means by which households can access natural resources (Ribot and Peluso 2003; Fig. 1). A main finding was that access mechanisms, earlier life, and place influenced consumption of different wildlife species and taste preferences for wild meat. An additional novel insight was that consumption was associated with taste preferences and with food insecurity, but the nature of these associations varied by species. Although long-standing assertions that wild meat underpins household food security (Milner-Gulland et al. 2003) are finally receiving empirical support (Nunes et al. 2019, Friant et al. 2020), we find that, at least in urban areas, the relationship between food (in)security and wildlife consumption may be species-specific. This specificity is perhaps unsurprising given that consuming a particular species reflects not only the ability to access it (e.g., through market exchange, harvesting, or social relations) but also food choices, which are embedded within preferences, identities, and cultural meanings (Sobal et al. 2006).

Urban consumers' access to wild meat is species-specific

Our research shows that access mechanisms, earlier life, and place all influenced wildlife consumption, but the type of access shaping consumption was species-specific. Some vulnerable species appear to enter illicit urban markets, based on our finding that their consumption was positively associated with higher monetary income (e.g., manatees, tortoises, and turtles). Although these same species were more likely to be consumed by urban households that hunted or fished, direct harvesting was positively associated with the odds of consuming all of the species we assessed. This suggests that those urban households which hunt or fish adopt (or maintain, if they have migrated from rural areas) livelihoods that draw on their ecological knowledge and harvesting skills in order to consume a broad variety of species.

Our findings demonstrate that culture, economic resources, and social class influence the choices around which wildlife species are consumed in urban households. Eating howler monkey or redtail catfish was more common among rural out-migrants, even after accounting for participation in harvesting livelihoods, and resources (levels of social capital, income, or education). In other words, earlier life rural experiences,

which presumably embed cultural ideals and taste preferences (Sobal et al. 2006), appear to influence the choice to eat (or avoid) these species. Conversely, eating yellow-spotted turtles was less likely in households with rural origins. It seems unlikely, though, that migrants are avoiding eating turtles due to particular rural cultural ideals or taste preferences, given that eating turtles is generally culturally desirable in Amazonas State (personal observations of the authors). Instead, perhaps rural-urban migrants tend to sell, barter, or gift turtles to others rather than consume themselves. Some species (manatee, tortoise, turtle) were seldom eaten in poorer households and were more likely to be eaten in wealthier households. Albeit we cannot distinguish whether wealthier households had superior access to these species within the towns' informal (often illicit) wildlife markets, or because their money interplayed with greater power and esteem (sensu Drury et al. 2011), which could plausibly lead to receiving wildlife through gifting. The consumption of several species was linked to social class, which we proxied using formal education; caiman was more likely to be consumed in lower-class households whereas turtle was more likely to be consumed among upper social strata. Given we accounted for household resources, such as rural origins and livelihoods, this variation between caiman and turtles may partly reflect class-based differences in *habitus* in these towns. Potentially, socially-learned food choices may reflect normative ideals of what wild species people in the region should or should not eat, which then plays out in terms of an individual's taste preferences, self-image, and identity (Sobal et al. 2006). Perhaps related to these habits in thinking and actions, (relatively) upper-class strata households appear to purposefully *avoid* eating caiman (see Swan et al. 2016), given they have the resources to acquire it within these towns, should they so wish (*sensu* Parry et al. 2014).

A major finding was that higher levels of social trust (i.e., horizontal social capital) translate into greater odds of consuming some species (two forest mammals; paca and white-lipped peccary). This demonstrates the role of relational forms of access to natural resources (Ribot & Peluso 2004), even among urban populations. This makes sense given that wild meat consumption in urban Amazonia partly depends on informal wild meat markets (van Vliet et al. 2015). Moreover, social trust is known to underlie social safety nets and hence our results also hint at a wild meat 'economy of affection' (gifting and reciprocity; Hyden 1983). These kinds of socio-economic relations in urban Amazonia had previously been identified for fruits and vegetables (WinklerPrins and Souza 2005), and fishes (Lee et al. 2018). The acquisition of wild meat outside of market exchange has previously been observed in both rural and urban areas in the region, where wild meat is gifted by relatives, friends, or neighbors (Chaves et al. 2019, Carignano Torres et al. 2021). Yet, to our knowledge, no other study has linked the consumption of different wildlife species with variation in household cognitive social capital. Based on our findings, wildlife consumption may have a role in maintaining and strengthening relationships, including social connections between rural and urban environments (see also Morsello et al 2015, Chaves et al. 2019, Carignano Torres et al. In press). Any interventions or stricter control to reduce consumption of vulnerable wildlife in urban

areas need to carefully consider the potential impacts of such actions on poorer households who may rely on their social capital to access wildlife species. Or conversely, when poorer urban households may gift wild meat in order to strengthen their social connectedness. Participatory approaches that also engage *urban* stakeholders in the decision-making process around wildlife management may help address these concerns.

Our results support the argument that policy for wildlife conservation and management should be species-specific. Vulnerable species that appear to be mainly consumed by wealthier, relatively privileged urban Amazonians (manatees, tortoises, turtles) do not seem directly relevant to the consumption of other households, such as rural out-migrants. Thus, there is potentially a case for stricter controls on these species and for interventions in urban areas to reduce demand. However, stricter controls could conflict with strong cultural food preferences (e.g., the strong preference we found for yellow-spotted turtles; see also Chaves et al. 2018) or the welfare of relatively disadvantaged urban households if they tend to sell higher-value species they acquire, instead of eating them at home. For species that are mainly consumed by poorer households, there is a strong case for ensuring equitable access to these species. At present, in Brazil we are unaware of any mechanism for allowing sustainable wildlife harvest to supply urban consumers, except for caiman harvesting in a larger management project (for sale) to major urban centers (see CEMAAM 2011, SEPROR 2011). However, caiman is not among the most consumed species in urban areas in Amazonas State (consumed within the previous 12 months by 28% of urban households surveyed by Parry et al. (2014)). To better inform such interventions, we will need to understand the reliance of poorer households on different species, as a source of food, importance of maintaining social relationships of trust and reciprocity, and income.

Place-based access (differences among the four towns, marginal to the effects of other household-scale predictors) influenced the consumption of several species. These differences are likely due to a combination of status of the wildlife populations (i.e., some species being more depleted in some locations in central Amazonia, than others), landscape and physical characteristics (e.g., floodplain versus *terra firme*, or remoteness from large urban centers; Parry and Peres 2015), histories of exploitation related to market access (Antunes et al. 2016), and conservation and management efforts (Campos-Silva et al. 2018, Eisemberg et al. 2019). These characteristics may influence the availability of different species to urban households in particular municipalities. For instance, for tapir and white-lipped peccary, both classified as Vulnerable by the IUCN, consumption was higher in smaller towns than in Maués. It is possible that these species populations are relatively more depleted around the larger town of Maués and, therefore, less available to urban residents.

Taste preferences and consumption

Our work shows that different access mechanisms are associated with varied wild meat taste preferences, supporting our hybrid conceptual framework which considers wildlife-related food practices as social

actions. For instance, rural origin (interpreted as a cultural influence given it is marginal to the effects of other socio-economic factors) and direct harvesting were associated with a strong preference for the taste of wild meat. Households in the small town of Jutaí also had higher taste preferences for wild meat when compared to Maués. These results indicate that wild meat consumption is a rural tradition that continues to influence households' preferences even when they live in urban areas, but urban context will also affect these preferences. In addition, greater preference for the taste of wild meat was associated with consumption of several species. Not surprisingly, consumption was positively associated with taste preference for species ranked by households to be the most preferred (peccary, tapir, paca, turtle, and tortoise). These results suggest that, although a large number of wildlife species are consumed in these towns, people may draw on their diverse means of access (i.e. their bundle of powers, according to Ribot and Peluso 2003) to acquire certain preferred species, and invest less time and resources in acquiring non-preferred species. These results support our framework under which food choices are shaped by social and economic resources (because they underpin access; Ribot and Peluso 2003) and personal preferences (Sobal et al. 2006). Our results also concur with Schenck et al. (2006) in that people make distinctions among wild species instead of treating them as a generic source of food. Unfortunately, in our study, most of the preferred species are also more vulnerable to overharvesting, when compared to the less vulnerable species we assessed. We argue that conservation efforts to reduce pressure on wildlife in urban areas need to prioritize species that are more vulnerable to overharvesting *and* preferred. More fully understanding the socio-cultural bases of these preferences would require additional qualitative research in order to explore the role of social norms, family influences, food safety perceptions, among other factors (Chausson et al. 2019). For instance, a recent qualitative study investigating primate consumption in Amazonia found the decision to eat related to a complex array of factors including taste perceptions, concerns about conservation, religious background, customs, and health concerns (Lemos et al. 2021).

Species-specific associations between food insecurity and wild meat consumption

Finally, our work shows complex associations between urban food insecurity and wildlife consumption, hence making an important contribution to the very limited literature on this subject. Since Milner-Gulland et al.'s seminal (2003) paper, the conservation literature repeats plausible yet largely untested assumptions, particularly lacking evidence for urban areas, that wild meat plays an important role in supporting food security in the forested tropics. A recent Amazonian study found that food-insecure urban households use small-scale fishing as a coping strategy (Rivero et al. 2022), but we are unaware of any previous study into the food (in)security dimensions of consuming other wild taxa (i.e., mammals, birds, chelonians, caimans) in urban areas. In rural Nigeria, Friant et al. (2020) found an overall positive relationship between bushmeat consumption and household food security, with some taxa-specific nuances (e.g., eating rodents was strongly associated with food security, with the opposite true for carnivores).

Although our work does not assess how much households rely on the species consumed, our species-specific, urban-centric research provides a novel insight that some wildlife species are more consumed among food-insecure households than relatively food-secure households. That is, some species (e.g., turtles, manatee) are less likely to be consumed by food-insecure urban households whereas other species are more likely to be eaten by food-insecure households (e.g., howler monkey, barred catfish, and red-tailed catfish; Fig 4). For example, although howler monkeys and redtail catfish were only eaten by 7.2% and 8.5% of surveyed households, respectively, 61.4% of consumers of howler monkeys and 73.5% of consumers of redtail catfish were moderately or severely food insecure. These species-specific differences are likely to be context-specific given their consumption will be related to socially-constructed preferences and food practices. For example, in Amazonas State, there are social taboos against the consumption of catfishes, yet Parry et al. (2014) found they were consumed by the poorest (often rural out-migrant) urban households. Similarly, Lemos et al. (2022) found that some Amazonian people consider eating primates (including howler monkeys) as taboo, while others have the custom of consuming primates. Given we found that eating howler monkeys was positively associated with rural origin and direct harvesting, but not associated with variation in monetary income, we interpret howler monkey consumption in Amazonian towns mainly in terms of socio-cultural practices. Albeit, we cannot rule out the possibility that some urban households consume (and perhaps hunt) these primates as a direct response to insufficient access to other foodstuffs. People's lived experiences in rural communities shape their different perceptions, knowledge, and attitudes towards a range of wildlife species (Mikolajczak et al. in press), which may partly explain why migrant households are more likely to consume howler monkeys and red-tailed catfish, beyond the effect of directly accessing them by going hunting or fishing. People's ecological knowledge, habits, and dispositions towards different species are socially constructed, emerging during the childhood socialization process in rural Amazonian communities (Menegaldo et al. 2013). In addition, although we did not investigate the different ways food-secure and food-insecure households may acquire wildmeat, it is likely that vulnerable households (more food insecure) rely less on purchasing than on hunting and gifts and that may influence their access to different species. Higher reliance on hunting and being gifted wild meat was more likely for rural out-migrants than for non-migrant in the study region (Carignano Torres et al. 2022).

We found that higher-income households tend to favor the same species that appear less likely to be consumed by food-insecure households. Turtles were ranked as highly preferred, so a lower probability of their consumption among food-insecure households may relate to barriers in accessing them for food, rather than to preferences. Although our work does not assess how much food-insecure households rely on the species consumed (which Ingram et al. (2021) define as a research priority), our results suggest that food-insecure households have greater access to some species but not others. These results highlight the importance of species-specific approaches regarding wildlife management and conservation.

Limitations and future research

Our data included binary response variables. While we acknowledge that having relative consumption frequency or quantity consumed of different species would have provided more detailed results about food systems in this region, our results still provide important insights into the relationships between access, taste preferences, food insecurity, and species-specific consumption. In addition, although exploring intra-household dynamics of food allocation (e.g., using participant observation) could have further our understanding of food choices and wild meat's linkages to food (in)security, it was beyond the scope of this paper. Although we looked at diverse forms of access, our survey design did not permit us to assess the potential importance of rights-based access, mentioned by (Ribot and Peluso 2003). Furthermore, future Amazonian research could explicitly examine how wildlife consumption preferences may relate to self-image and identities, such as in relation to forest livelihoods and historical struggles for rights, or identifying more strongly with cattle culture (Gomes et al. 2011). Finally, our work did not assess reliance on different species. Understanding how much poor, food-insecure households rely on different species for food and income will also be an important step to develop strategies (e.g., species-specific management, alternative livelihoods) to avoid unintended consequences of reducing urban demand for wild meat.

CONCLUSION

Despite claims that wild meat is important for food security in tropical forest regions (Milner-Gulland et al. 2003, Ingram et al. 2021), our research shows that its role is more nuanced, at least in Amazonian towns. Some species appear to be consumed more by poorer households than other species, depending on people's access to the species, which is linked to livelihoods, social networks, and markets. Drawing on Sobal et al. (2006), our results suggest that, within urban Amazonian households, decisions to acquire and eat different wildlife species reflect life course experiences (particularly, rural origins and practicing rural livelihoods) and cultural ideals (perhaps explaining low preferences, e.g., for catfish), personal and social factors (e.g., monetary income, educational attainment and horizontal social capital) and context (e.g., town). The interplay of these factors helps shape a household's food choice strategies, which in this urban context included wildlife. Ribot and Peluso's (2003) theory helps us understand these food strategies in terms of how a household's diverse means of access both reflect their food choices, and may limit which species they are able to acquire, given their knowledge, skills, and social and economic resources. For instance, we found that some species are accessed by households who are relatively wealthy or upper-class, the latter indicated by education. These same species appear less consumed by rural out-migrants and food-insecure households who may use harvesting and social capital as coping strategies. Other species are consumed more by rural out-migrants and food insecure households while not favored by wealthier households. Taken together, our results provide strong support for a species-specific approach to how to manage (from supporting sustainable harvest, or enforcing against harvest or exchange) the consumption of forest wildlife by Amazonia's growing urban populations.

559. Instead of either pursuing a blanket ban on wildlife harvesting or assuming all species are important
560. for food security, policy needs to aim at sustainably managing species that are important to poorer,
561. food-insecure households in particular contexts, and that are more resilient to harvesting pressure.
562. However, decisions on which species fit such criteria should be data-driven (e.g., which species would
563. be more resilient to harvesting and important for food security of poorer households) and part of participatory
564. approaches that engage local stakeholders, including diverse kinds of town-dwellers. Importantly, with
565. a growing urban demand for natural resources, sustainable harvest of resilient species to provide wild
566. meat is unlikely to be sufficient to meet that demand. Likewise, relying on harvesting a few resilient
567. species will unlikely fulfill the needs of poorer, food-insecure urban households. Considering the importance
568. of fisheries for the economy and as a food source in Amazonia (Rivero et al. 2022; Coomes et al. 2010),
569. investing in the management of inland fisheries (especially in ways that are inclusive of urban fishers)
570. could provide alternative food sources and livelihoods that are culturally appropriate to address the
571. needs not met by sustainable harvesting (see Ingram et al. 2021) while trying to avoid unintended consequences
572. (e.g., exacerbating human malnutrition; see Heilpern et al. 2021)

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Table 1. Species of wildmeat and fish for which we assessed consumption.

Species	Local name	Scientific name	% of households that consumed †	Status ‡
Agouti	Cutia	*Dasyprocta fuliginosa*	13.53	*LC*
Amazonian manatee	Peixe boi	*Trichechus inunguis*	8.15	*VU*
Howler monkey	Guariba	*Allouata* spp.	7.15	
Paca	Paca	*Cuniculus paca*	42.70	*LC*
Lowland tapir	Anta	*Tapirus terrestris*	33.46	*VU*
White-lipped peccary	Queixada	*Tayassu pecari*	32.70	*VU*
Curassow	Mutum	Multiple species	9.77	
Caiman	Jacaré	*Caiman crocodilus*; *Melanosuchus niger*	10.15	*LC; LR/CD*
Tortoise	Jabuti	*Chelonoidis* spp.	11.90	*LC* or *VU*
Yellow-spotted Amazonian river turtle	Tracajá	*Podocnemis unifilis*	42.01	*EN*
Arapaima	Pirarucu	*Arapaima gigas*	72.03	*DD; MO-HI*
Barred catfish	Surubim	*Pseudoplatystoma fasciatum*	49.10	*MO*
Redtail catfish	Pirarara	*Phractocephalus hemioliopterus*	8.55	*HI-VH*

† In the last 60 months for the manatee, and in the last 12 months for all other species.

‡ *LC*=Least concern; *LR/CD*=Lower risk/Conservation dependent; *VU*=Vulnerable; *EN*=Endangered; *DD*=Data deficient. *MO*=Moderate vulnerability; *HI*=High vulnerability; VH=Very high vulnerability. Status of mammals and fish from IUCN Redlist (IUCN 2020) and fishbase.org; status of tortoise and turtle from updated IUCN Tortoise and Freshwater Turtles Specialist Group (Rhodin 2017).

Fig. 1. Conceptual framework used in our study, drawing on Sobal's (2006) food choice model and Ribot and Peluso's (2003) theory of access. We ask four research questions: Q1: How do access mechanisms, earlier life, and place influence urban consumption of different wild species? Q2: How do access mechanisms, earlier life, and place influence wildlife food preferences? Q3: Are wildlife taste preferences associated with consumption of different species? Q4: How does food insecurity relate to consumption of different wild species? Dashed lines: association not explored in our study.

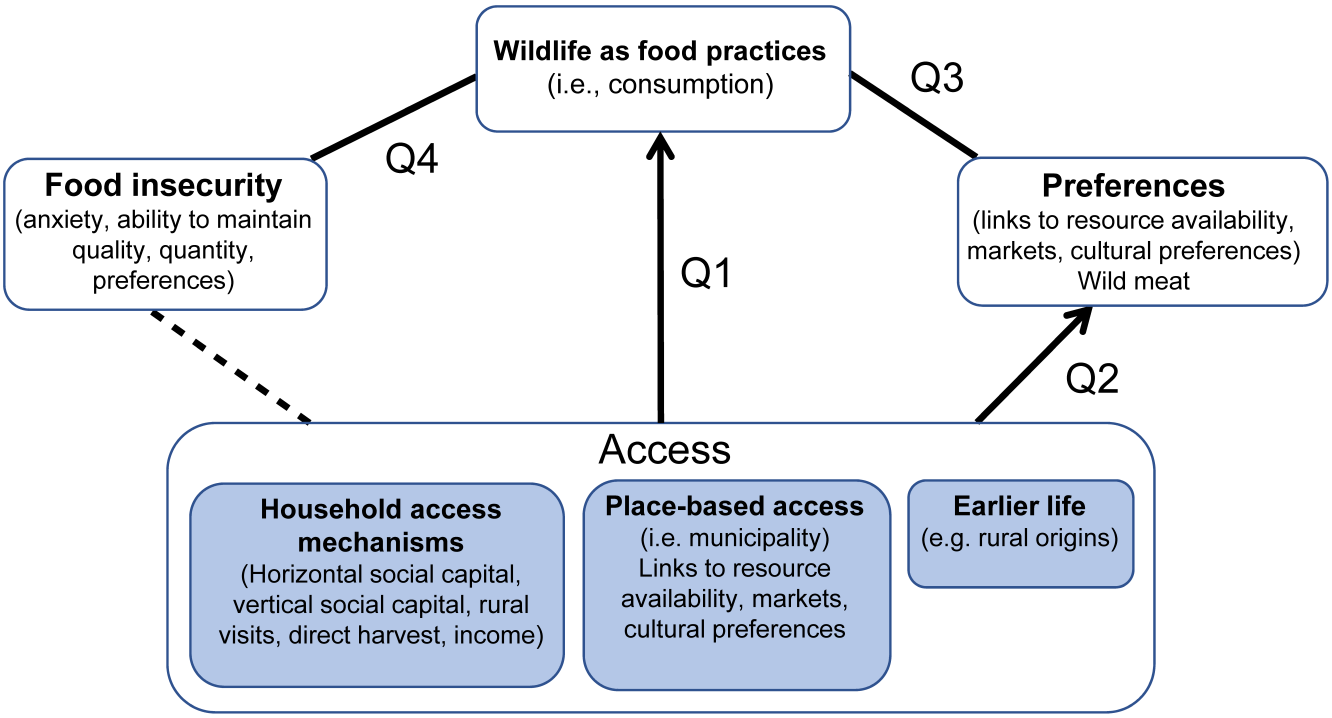


Fig. 2. Odds ratio of the effects of diverse access mechanisms on the consumption of wildlife species. Education does not refer to access mechanisms but instead is used as a proxy for social position. Horizontal social capital is a composite score derived from the average responses of four Likert-scale questions from 1 (low) to 5 (high horizontal social capital); rural visits refer to the number of days a member of the household spent in rural areas in the past 12 months; rural origin and directing harvesting are binary variables; income refers to per capita income in Brazilian reais; and education refers to highest level of formal education by anyone in the household. Errors are the 95% confidence intervals.

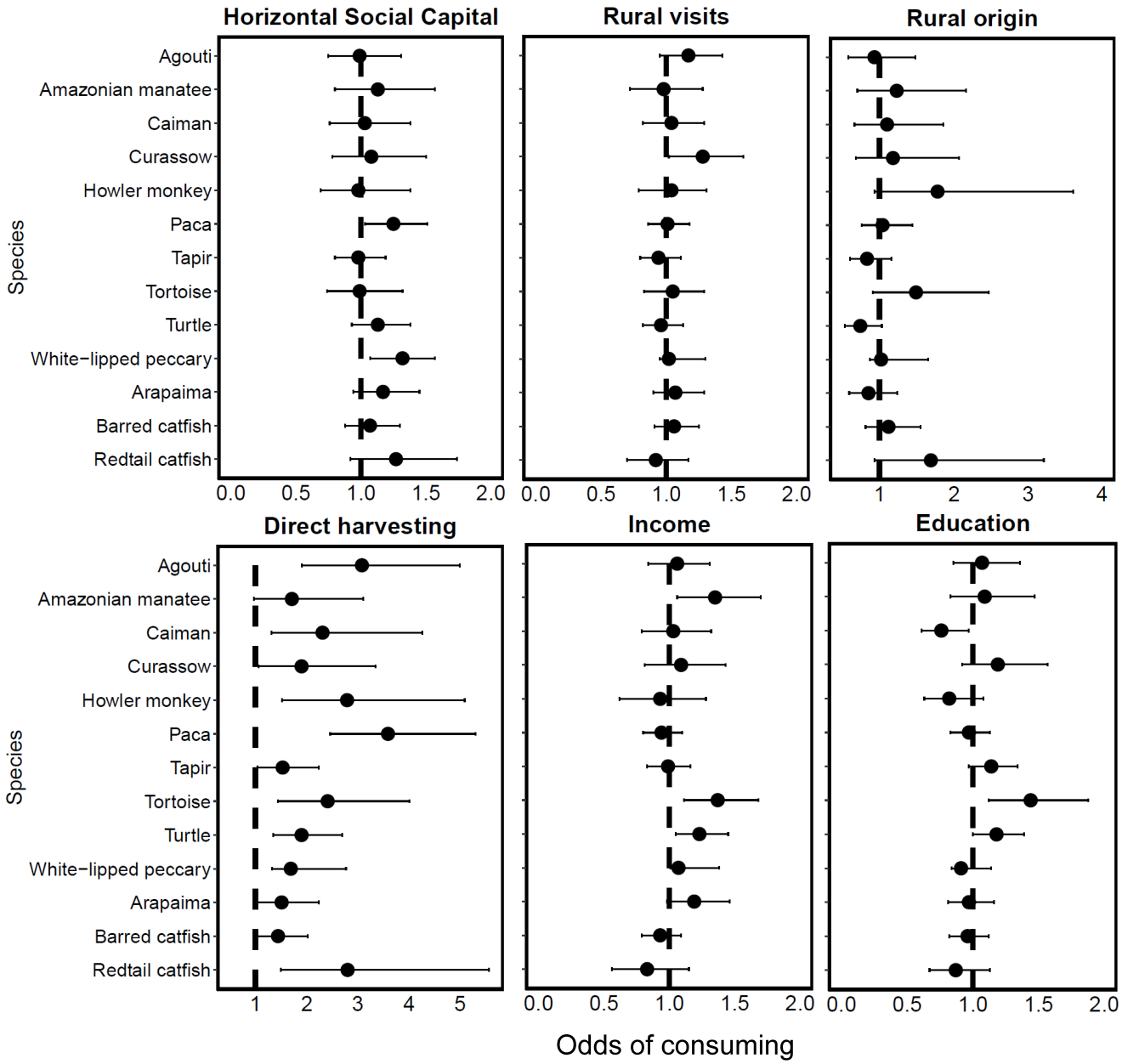


Fig. 3. Odds of consuming wildlife species for households that ranked wild meat among the top 3 favorite meat types compared to households that did not rank wild meat among the 3 top choices (dotted line). Higher odds indicate stronger association between taste preference and consumption. Errors are the 95% confidence intervals.

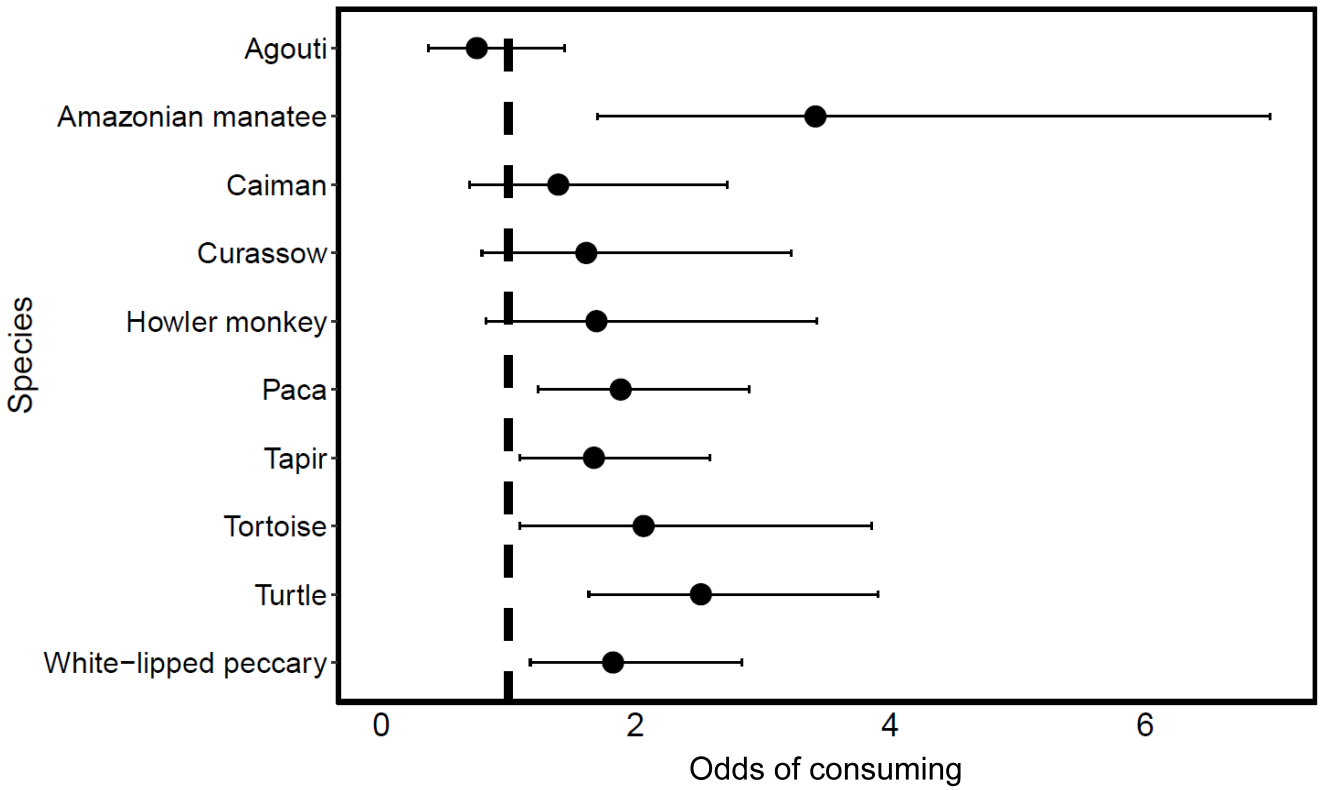
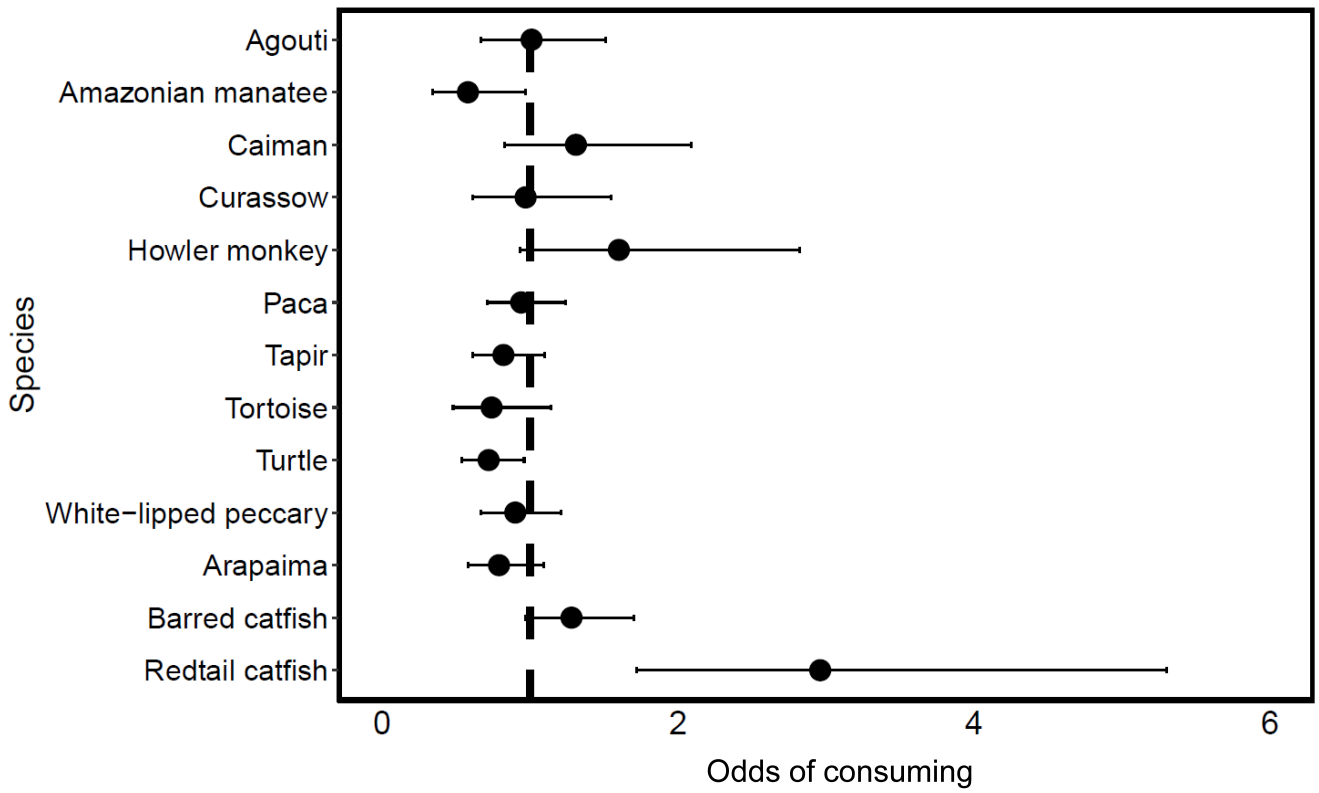


Fig. 4. Odds of consuming wildlife and fish species for households that were severely or moderately food insecure compared to households that were food secure or mildly food insecure (dotted line). Higher or lower odds indicate a stronger association between a species consumption and moderate/severe food insecurity. Errors are the 95% confidence intervals.



Appendix 1: Supplemental material for "The species-specific role of wildlife in the Amazonian food system"

Survey Questionnaire - English Version

This questionnaire is only showing relevant sections used in this paper. The complete questionnaire is part of a larger research project and can be available upon request

HOUSEHOLD	**Date:** ____/____/_____ **Time start:** ____:____ **Time end:** ___:___	**1**
	Interviewer:	
INTERVIEW HOUSEHOLD HEAD – Urban Area	**Household ID** |__| |__| |__||__||__|	

IDENTIFICATION

Municipality		**Household Coordinates**
Neighborhood		GPS point |__| |__||__||__|

I – HOUSEHOLD DEMOGRAPHY

1. To start, I would like to ask you to identify all people that live in this house, even those that may live here only during one period of the year or month (for example, someone that lives part-time in the rural area). Please, tell me what kind of kindship relationship each person has with you, their age, formal education, and if they are living in this house right now *(include the interviewee on the list below).*

	1.1	**1.2**	**1.3**	**1.4**	**1.5.**		**1.6**
	What is the first name of each person that lives here?	What kind of relationship do they have with you? (*code*)	Gender *m=man w=woman*	How old in years or months is this person?	Which school year did they finish up to today? *Indicate year and level* ***only for those whom are 15 yo or older***		Is this person living in this house right now? *1=yes 2= no – in another town 3 = no – in the rural area*
					YEAR	LEVEL (f=primary, m= secondary, s= undergrad)	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							

Codes 1.2: ***1****=interviewee;* ***2****=spouse;* ***3****=son/daughter;* ***4****= brother/sister in law;* ***5****=grandchild;* ***6****=parent;* ***7****=parent in law;* ***8****=grandparent;* ***9****=sibling;* ***10****= son/daughter in law;* ***11****=uncle/aunt;* ***12****=nephew/niece;* ***13****=stepfather/stepmother;* ***14****= godson/goddaughter;* ***15****=godfather/godmother;* ***16****=cousin;* ***17****= stepchild;* ***18****=compadre/comadre;* ***19****=friend;* ***20****= none of the above- explain.*

1.7. How long have you been living in this town? |__||__|years |__||__| months or |__|has always lived

1.8. And your spouse? |__||__| years |__||__| months or |__| has always lived *or* |__| *does not apply*

1.9. Did you used to live in the rural area just before moving to this town? |__| YES – in this municipality |__| YES – in another municipality |__| NO *or* |__| *does not apply*

1.10. And your spouse? |__| YES–in this municipality |__| YES–in another municipality |__| NO *or* |__| *does not apply*

Comments module I:

II – LINKS BETWEEN URBAN AREA-RURAL AREA

2.1. Does someone in this house visit the rural area, at least occasionally? |__| YES |__| NO

2.1.1. With which frequency does anyone in the household goes to the most visited rural location? |__| Once a year |__| Twice a year |__| 3-6 times a year |__| Once a month |__| Twice a month |__| Once a week |__| More than once a week

2.1.2. Do you own a house in this location? |__| YES |__| NO

2.1.3. In which year and month did someone go to this location the last time? |__||__|/20|__||__|

2.1.4. In the **past 30 days,** that is, from day ___ last month until today, how many days did someone spend there? |__||__|

2.1.5. Which activities do people from this house practice there? (***indicate all that apply***) |__| visit a relative |__| visit acquaintances |__| religious activity |__| leisure |__| subsistence agriculture |__| commercial agriculture |__| subsistence fishing |__| commercial fishing |__| hunting |__| subsistence extractivism |__| commercial extractivism |__| sports |__| Other _____

Comments module II:

III – CAPITAL SOCIAL

This section should be responded only by the main interviewee.

3. In this section, I will ask you about your neighborhood and some activities you, and the other people that live in the house, may take part in.

3.1. You or another person that lives in this house take part in any of the following associations, unions, or groups of people (e.g. church or cultural)?

	3.1.1. Take part ***0=no 1=yes***	**3.1.2.** Name of the association, union, or group
Fishermen's union		
Rural Workers' Union		
Another professional union or association		
Neighborhood Association		
Attend church (at least once per month)		
Church community group		
Sports group		
NGO		
Parent Student Association		
Political Party (active)		
Other		

3.2. In general, how much do you agree or disagree with the following sentences—5 if you strongly agree and 1 if you strongly disagree? ***Show the scale to the interviewee and write down the number in the box next to the sentence.***

a. Most people in the neighborhood are reliable. |__|

b. Most people in the neighborhood would help you if you need it. |__|

3.3. I would like to know how much you trust these different people or groups of people—5 if you trust a lot and 1 if you do not trust at all. ***Show the scale to the interviewee and write down the number in the box next to the sentence.***

A. Shop owners |__| / B. Doctors and nurses |__| / C. Other municipality's employee |__| / D. Police |__| E. City councillor |__| F. Teachers |__| / G. Friends |__| / H. Strangers |__|

3.4. In the past 12 months, that is, from _____ (*month*) last year until today, did anyone that lives in this house took part in any collective effort in the neighborhood? |__| YES |__| NO **– *Go to 3.5***

3.4.1. How many times? |__||__| |__| do not know

3.5. How often does anyone that lives in this house use the internet during the week? |__| everyday |__| a few times |__| once |__| less than once |__| do not use |__| do not know

3.6. How often does anyone that lives in this house listen to the radio during the week? |__| everyday |__| a few times |__| once |__| less than once |__| do not use |__| do not know

3.7. How safe do you feel walking alone at night in your street? —5 if you feel very safe and 1 if you do not feel safe at all. ***Show the scale to the interviewee and write down the number in the box next to the sentence.*** |__|

3.8. Do you think the residents in your neighborhood are united? —5 if you think they are very united and 1 if you think they are very disunited. ***Show the scale to the interviewee and write down the number in the box next to the sentence.*** |__|

3.9. Do you think the municipal authority listens to you and people like you when you have a request or a suggestion? —5 if you think they listen carefully and 1 if you think they do not listen at all. ***Show the scale to the interviewee and write down the number in the box next to the sentence.*** |__|

3.10. Do you think that you and other people that live in the same conditions as you can make changes to your neighborhood?— 5 if you think you can easily make changes and 1 if you think you cannot promote changes at all. ***Show the scale to the interviewee and write down the number in the box next to the sentence.*** |__|

3.11. Who do you think can contribute the most to change anything in your life? (***Do not read the options)*** |__|yourself |__| your family |__| municipal government |__| state government |__| federal government |__| other_____

Comments module III:

IV – INCOME AND WEALTH

Now I would like to ask you about some forms of payment you in this house may receive from the government or someone else.

4.1. Did anyone in this house received in the **PREVIOUS 30 DAYS**:

☐ Bolsa Família [conditional cash transfer program]: number of mothers |__||__| R$ _____

☐ Retirement pension: number of people |__||__| R$ _____

☐ Disabled pension: number of people |__||__| R$ _____

☐ Pension: number of people |__||__| R$ _____

☐ Closed fishing-season payment: number of people |__||__| R$ _____

☐ Unemployment pay: number of people |__||__| R$ _____

☐ Maternity pay: number of people |__||__| R$ _____

☐ Bolsa floresta [environmental conditional cash transfer program]: number of people |__||__| R$ _____

☐ Flood pay: R$ _____

☐ Rent: R$ _____

☐ Remittances from relatives: R$ _____

☐ Other _____ number of people |__||__| R$ _____

4.2. Now, I would like to ask you about activities that generate income that you and the other people in this house practiced in the **PREVIOUS 30 DAYS**:

☐ Regular job: # people |__||__| R$ _____(net) **|__| registered employee |__| public service |__| contract**

☐ Temporary job: # people |__||__| R$ _____(net) **|__| registered employee |__| public service |__| contract**

☐ Day job: # people |__||__| number of days |__||__| amount per day |__||__|

Total R$ _____ Type of job: _____, _____, _____

☐ Contract: # people |__||__| number of contracts |__||__| amount per contract |__||__|

Total R$ _____ Type of job: _____, _____, _____

☐ Agricultural product sale: # people |__||__| gross R$ _____

☐ Açaí sale: # people |__||__| net R$ _____ gross R$ _____

☐ Fish sale: # people |__||__| net R$ _____ gross R$ _____

☐ Other type of sale: # people |__||__| net R$ _____ gross R$ _____

☐ Other: _____ # people |__||__| net R$ _____ gross R$ _____

V – WILD MEAT CONSUMPTION

5.1. Which of these species did you eat in this house and when was the last time you eat it:

Tapir |__|*did not answer* |__| no |__| yes When (*at least month and year*) |__||__|/|__||__|/|__||__|

White-lipped peccary |__|*did not answer* |__| no |__| yes When (*at least month and year*) |__||__|/|__||__|/|__||__|

Lowland paca |__|*did not answer* |__| no |__| yes When (*at least month and year*) |__||__|/|__||__|/|__||__|

Agouti |__|*did not answer* |__| no |__| yes When (*at least month and year*) |__||__|/|__||__|/|__||__|

Curassow species:_____ |__|*did not answer* |__| no |__| yes When (*at least month and year*) |__||__|/|__||__|/|__||__|

Yellow-spotted Amazonian river turtle |__|*did not answer* |__| no |__| yes When (*at least month and year*) |__||__|/|__||__|/|__||__|

Alligator species _____ |__|*did not answer* |__| no |__| yes When (*at least month and year*) |__||__|/|__||__|/|__||__|

Arapaima [fish] |__|*did not answer* |__| no |__| yes When (*at least month and year*) |__||__|/|__||__|/|__||__|

Barred catfish [fish] |__|*did not answer* |__| no |__| yes When (*at least month and year*) |__||__|/|__||__|/|__||__|

Redtail catfish [fish] |__|*did not answer* |__| no |__| yes When (*at least month and year*) |__||__|/|__||__|/|__||__|

Woolly monkey |__|*did not answer* |__| no |__| yes When (*at least month and year*) |__||__|/|__||__|/|__||__|

Howler monkey |__|*did not answer* |__| no |__| yes When (*at least month and year*) |__||__|/|__||__|/|__||__|

Manatee |__|*did not answer* |__| no |__| yes When (*at least month and year*) |__||__|/|__||__|/|__||__|

Tortoise |__|*did not answer* |__| no |__| yes When (*at least month and year*) |__||__|/|__||__|/|__||__|

5.1.1. Now, I would like to know if you think that from 5 year ago up to today it is harder, easier or the same to get the species I am going to cite now in this town:

Lowland paca |__|*did not answer* |__| harder |__| did not change |__| easier |__| does not know/does not eat

Tapir |__|*did not answer* |__| harder |__| did not change |__| easier |__| does not know/does not eat

Tortoise |__|*did not answer* |__| harder |__| did not change |__| easier |__| does not know/does not eat

Manatee |__|*did not answer* |__| harder |__| did not change |__| easier |__| does not know/does not eat

Yellow-spotted Amazonian river turtle [freshwater turtle] |__|*did not answer* |__| harder |__| did not change |__| easier |__| does not know/does not eat

5.2. In how many meals did you eat wildmeat in this house in the previous 30 days, that is, from day _____ last month until today? |__||__| times

5.3. When was **the last time** you ate wildmeat in this house? *If the interviewee does not know the exact day ask whether it was at the beginning, middle or the end of the month – if beginning write 1, if middle write 15 and if end write 30.*

|__| never ate Date (*at least month and year*): |__||__|/|__||__|/|__||__|

5.**3.1.** Which species did you eat the last time? _____, _____, _____

5.3.2. How did you obtain this wild meat **this last time**? |__|gift |__| purchase |__|hunt

5.3.3. How much meat did you obtain **this last time**? Quantity: _____ Unit: _____

5.3.4. How many meals did you make with this quantity of meat? |__||__| meals

5.4. Now I would like to know what type of meat you like the most between beef, canned meat, pork, frozen chicken, free-range chicken, duck, wildmeat, fish, freshwater turtle, alligator, pepperoni and sausage? And as the second most preferred? And the third?

1st preferred:_____, 2nd _____, 3rd_____

If he/she mentioned terrestrial wild meat, freshwater turtle, or alligator:

5.4.1. Which species do you like the most? _____

5.5. Does anyone in this house fish, even if only occasionally? |__| YES |__| NO

5.6. Does anyone in this house hunt, even if only occasionally? |__| YES |__| NO

Comments module VI:

VI – FOOD SECURITY

Now I will ask some questions about how you think the food conditions are in your house.
In the last 30 days, that is, since day _____ (*today's date*) of month _____ (*the prior month*):

6.1. Did you worry you would run out of food before being able to buy or receive more food? |__| YES |__| NO |__| Don't know

6.2. Did you run out of food before having money to buy more? |__| YES |__| NO |__| Don't know

6.3. Did you eat only a few kinds of foods left because you ran out of money? |__| YES |__| NO |__| Don't know

Now I will ask only about you and other adults (18 years old and older) in the household. Did any of you, at any time in the past 30 days:

6.4. Skip a meal because there was no money to buy food? |__| YES |__| NO |__| Don't know

6.5. Eat less than what you felt you should because there was no money to buy food? |__| YES |__| NO |__| Don't know

6.6. Feel hungry but did not eat because there was no money to buy food? |__| YES |__| NO |__| Don't know

6.7. Have just one meal a day or didn't eat for a whole day because there was no money to buy food? |__| YES |__| NO |__| Don't know

***Note: Questions bellow should be made only in households where there are residents younger than 18 years-old (children or adolescents)**. If there isn't any, go to 7.14.*

Now I will ask only about residents younger than 18 years old in the household. Did any of them, at any time in the past 30 days:

6.8. Eat only a few kinds of foods they still had because they had run out of money? |__| YES |__| NO |__| Don't know

6.9. Not have enough to eat because there was no money to buy food?? |__| YES |__| NO |__| Don't know

6.10. Have to reduce the size of meals because there was no money to buy food? |__| YES |__| NO |__| Don't know

6.11. Skip a meal because there was no money to buy food? |__| YES |__| NO |__| Don't know

6.12. Feel hungry but did not eat because there was no money to buy more food? |__| YES |__| NO |__| Don't know

6.13. Have just one meal a day or go without eating for a whole day because there was no money to buy food? |__| YES |__| NO |__| Don't know

REGIONAL FOOD INSECURITY SCALE

In the last 30 days, that is, since day _____ (today's date) of month _____ (the prior month) did you or anyone in this household:

6.14. Reduce the quantity of meat in any meal to save? |__| YES |__| NO |__| Did not eat meat |__| Don't know

6.15. Reduce the quantity of fish in any meal to save? |__| YES |__| NO |__| Don't know

6.16. Swap meat (including chicken) for eggs, canned meat, or sausages because the latter are cheaper? |__| YES |__| NO |__| Don't know

6.17. Have any meal with only manioc flour or chibé (manioc flour with water) because you did not have any other food? |__| YES |__| NO |__| Don't know

6.18. Have to ask for a loan or buy on credit (to pay later) at the market or another vendor because you did not have money? |__| YES |__| NO |__| Don't know

6.19. Borrow food from another family because there was no food at home and you did not have money? |__| YES |__| NO |__| Don't know

6.20. Eat at a neighbor, friend, or relative's house because there was no food at home? |__| YES |__| NO |__| Don't know

Comments module VII:

Appendix 2: Supplemental material for "The species-specific role of wildlife in the Amazonian food system"

Survey Questionnaire – Portuguese Version

Este questionário inclui apenas seções relevantes para este artigo. Este questionário é parte de um projeto de pesquisa maior e pode ser disponibilizado mediante solicitação

DOMICÍLIO	**Data de entrevista:** ____/____/_____ **Início:** ____:____ **Término:** ____:____	**1**
	Entrevistador:	
ENTREVISTA CHEFE DO DOMICÍLIO – Zona Urbana	**Registro da UD** |__| |__| |__||__||__|	

IDENTIFICAÇÃO

Município		**Coordenadas do domicílio:**
Bairro/comunidade		Ponto GPS |__| |__||__||__|

I - DEMOGRAFIA DA UNIDADE DOMÉSTICA

1. Para começar, gostaria que o/a senhor(a) identificasse todas as pessoas que moram nesta casa, mesmo que morem só parte do ano ou parte do mês (como, por exemplo, alguém que mora uma parte do tempo no sítio/interior). Por favor, me diga que tipo de parentesco ou a relação que essa pessoa tem com o/a senhor(a), sua idade, estudo e se estão morando aqui nesta casa agora *(incluir o entrevistado na lista).*

	1.1	**1.2**	**1.3**	**1.4**	**1.5.**		**1.6**
	Qual é o primeiro nome de cada uma das pessoas que moram aqui?	Qual é a relação dele(a) com o/a senhor(a)? (*código*)	Sexo *m=masculino f=feminino*	Quantos anos ou meses completos ele/ela tem?	Qual série ele/ela terminou até agora? *Colocar ano e grau* ***só para quem tem 15 anos ou mais.***		Esta pessoa está morando nesta casa no momento? *1=sim 2= não – outra cidade 3 = não - zona rural*
					ANO	NÍVEL (f=fundamen., m= médio, s=superior)	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							

Códigos 1.2: ***1****=entrevistado;* ***2****=esposa(o);* ***3****=filho(a);* ***4****=cunhado(a);* ***5****=neto(a);* ***6****=mãe/pai;* ***7****=sogro(a);* ***8****=avô(ó);* ***9****=irmão/irmã;* ***10****=genro/nora;* ***11****=tio/tia;* ***12****=sobrinho(a);* ***13****=padrasto/madrasta;* ***14****=afilhado(a);* ***15****=padrinho/madrinha;* ***16****=primo(a);* ***17****= filho/filha de criação;* ***18****=compadre/comadre;* ***19****=amigo(a);* ***20****= nenhuma das anteriores- anotar o que é.*

1.7. Há quanto tempo o(a) senhor(a) mora aqui nessa cidade, no total?|__||__|anos |__||__|meses ou |__|sempre morou

1.8. E seu(a) esposo(a)? |__||__| anos ou |__| sempre morou nesta cidade *ou* |__| *não se aplica*

1.9. O(a) senhor(a) morava na zona rural logo antes de vir para cá? |__| SIM – neste município |__| SIM – outro munícipio |__| NÃO *ou* |__| *não se aplica*

1.10. E seu(a) esposo(a)? |__| SIM – neste município |__| SIM – outro município |__| NÃO *ou* |__| *não se aplica*

Comentários módulo I:

II – LIGAÇÕES ZONA URBANA – ZONA RURAL

2.1. Alguém aqui desta casa vai, pelo menos às vezes, para a zona rural/interior? |__| SIM |__| NÃO **-- *Ir para 2.3***

2.1.1. Com que frequência vai para o lugar mais visitado? |__| 1 vez ao ano |__| 2 vezes ao ano |__| 3-6 vezes por ano |__| 1 vez por mês |__| 2 vezes por mês |__| 1 vez por semana |__| mais de 1 vez por semana

2.1.2. Vocês têm casa própria neste lugar? |__| SIM |__| NÃO

2.1.3. Em qual mês e ano foi a última vez que alguém de casa foi para esse lugar? |__||__|/20|__||__|

2.1.4. Nos **últimos 30 dias,** ou seja, desde o dia ___ do mês passado até hoje, quantos dias alguém ficou lá? |__||__|

2.1.5. Quais atividades fazem lá? (***marcar todas que aplica***) |__| visitar parente |__| visitar colegas |__| atividade religiosa |__| lazer |__| agricultura-consumo |__| agricultura-venda |__| pescar-consumo |__| pescar-venda |__| caçar |__| extrativismo-consumo |__| extrativismo-venda |__| esporte |__| outro _____

Comentários módulo II:

III – CAPITAL SOCIAL

Apenas o entrevistado principal deve responder a esse módulo do questionário

3. Agora vou perguntar ao(à) senhor(a) algumas coisas sobre o bairro e algumas atividades que vocês podem ter.

3.1. Você ou outra pessoa desta casa participa de alguma dessas associações, sindicato ou grupo de pessoas (pode ser por exemplo da igreja ou cultural)?

	3.1.1. Participa ***0=não 1=sim***	**3.1.2.** Nome da associação, sindicato ou grupo
Colônia de pescadores		
Sindicato dos trabalhadores rurais		
Associação ou outro sindicato profissional		
Associação de bairro		
Frequenta igreja (pelo menos 1 vez por mês)		
Grupo da igreja		
Grupo de esporte/time		
ONG		
Associação de pais de alunos		
Partido político (militante)		
Outro		

3.2. De uma forma geral, quanto você concorda ou discorda das seguintes frases, sendo que 5 é se você concorda muito e 1 se você discorda muito? ***Mostrar a escala para o entrevistado e anotar o número nos quadrados ao lado das frases.***

a. A maioria das pessoas do bairro são confiáveis. |__|

b. A maioria das pessoas do bairro te ajudariam se você precisasse. |__|

3.3. Agora gostaria de saber o quanto você confia em diferentes pessoas, sendo que 5 é se você confia muito e 1 se você não confia nada. ***Mostrar a escala para o entrevistado e anotar o número nos quadrados ao lado das frases.***

A. Donos de mercadinho/taberna |__| / B. Médicos e enfermeiros |__| / C. Outros funcionários da prefeitura |__| / D. Polícia |__| E. Vereadores |__| F. Professores |__| / G. Amigos |__| / H. Estranhos |__|

3.4. Nos últimos 12 meses, ou seja, desde _____ (*mês*) do ano passado até hoje, alguém que mora aqui nesta casa participou de algum mutirão de bairro? |__| SIM |__| NÃO **– *Ir para 3.5***

3.4.1. Quantas vezes? |__||__| |__| não sabe

3.5. Quantas vezes alguém da casa usa a internet na semana? |__| todo dia |__| algumas vezes por semana |__| uma vez por semana |__| menos de uma vez por semana |__| nunca usa |__| não sabe

3.6. Quantas vezes alguém da casa ouve rádio na semana? |__| todo dia |__| algumas vezes por semana |__| uma vez por semana |__| menos de uma vez por semana |__| nunca ouve |__| não sabe

3.7. Quão seguro(a) você se sente andando à noite sozinho(a) na sua rua? Sendo que 5 é se você se sente muito seguro(a) e 1 não se sinta nada seguro(a). ***Mostrar a escala para o entrevistado e anotar o número no quadrado*** |__|

3.8. Você acha que os moradores do seu bairro são unidos? Sendo que 5 é se você acha muito unidos e 1 se acha muito desunidos. ***Mostrar a escala para o entrevistado e anotar o número no quadrado*** |__|

3.9. Você acha que a prefeitura ouve o que você e as pessoas como você pedem e sugerem? Sendo que 5 é se você acha que eles ouvem bastante e 1 se você acha que eles não ouvem nem um pouco? ***Mostrar a escala para o entrevistado e anotar o número no quadrado.*** |__|

3.10. Você acha que você e pessoas que vivem em condições iguais as suas podem mudar algo no seu bairro? Sendo que 5 é se você acha que podem facilmente promover mudanças e 1 se você acha que não podem ***Mostrar a escala para o entrevistado e anotar o número no quadrado.*** |__|

3.11. Quem você acha que vai contribuir mais para mudar alguma coisa na sua vida? (***Não ler as opções)*** |__|você mesma |__| sua família |__| a prefeitura |__| o governo do estado |__| o governo federal |__| outro_____

Comentários módulo III:

IV – RENDA E RIQUEZA

Agora vou perguntar sobre alguns tipos de pagamento que vocês podem receber do governo ou de alguém.

4.1. Alguém aqui desta casa recebeu nos **ÚLTIMOS 30 DIAS**:

- ☐ Bolsa Família: número de mães |__||__| R$ _____
- ☐ Aposentadoria: número de pessoas |__||__| R$ _____
- ☐ Aposentadoria por invalidez: número de pessoas |__||__| R$ _____
- ☐ Pensão: número de pessoas |__||__| R$ _____
- ☐ Seguro defeso: número de pessoas |__||__| R$ _____
- ☐ Seguro desemprego: número de pessoas |__||__| R$ _____
- ☐ Salário maternidade: número de pessoas |__||__| R$ _____
- ☐ Bolsa floresta: número de pessoas |__||__| R$ _____
- ☐ Auxílio enchente: R$ _____
- ☐ Aluguel: R$ _____

☐ Remessa de parentes: R$ _____

☐ Outro _____ número de pessoas |__||__| R$ _____

4.2. Agora gostaria de saber sobre as atividades que dão renda, que o(a) senhor(a) e os outros moradores desta casa podem ter realizado nos **ÚLTIMOS 30 DIAS**:

☐ Emprego regular: n. de pessoas|__||__| R$ _____(líquido) **|__|carteira assinada |__|concurso |__|contrato**

☐ Emprego temporário: n. de pessoas|__||__| R$ _____(líquido) **|__|carteira assinada |__|concurso |__|contrato**

☐ Diária: número de pessoas |__||__| número de diárias |__||__| preço por diária |__||__|

Total R$ _____ Qual tipo de trabalho: _____, _____, _____

☐ Empreita: número de pessoas |__||__| número de empreitas |__||__| preço por diária |__||__|

Total R$ _____ Qual tipo de trabalho: _____, _____, _____

☐ Venda de produto agrícola: número de pessoas |__||__| bruta R$ _____

☐ Venda de açaí: número de pessoas |__||__| líquida R$ _____ bruta R$ _____

☐ Venda de peixe: número de pessoas |__||__| líquida R$ _____ bruta R$ _____

☐ Outro tipo de comércio: número de pessoas |__||__| líquida R$ _____ bruta R$ _____

☐ Outros:_____ número de pessoas|__||__| líquida R$ _____ bruta R$ _____

V – CONSUMO DE CARNE SILVESTRE

5.1. Quais dessas espécies já foram consumidas aqui no domicílio e quando foi a última vez:

Anta |__|*não quis responder* |__| não |__| sim Quando (*pelo menos o mês e o ano*) |__||__|/|__||__|/|__||__|

Queixada |__|*não quis responder* |__| não |__| sim Quando (*pelo menos o mês e o ano*) |__||__|/|__||__|/|__||__|

Paca |__|*não quis responder* |__| não |__| sim Quando (*pelo menos o mês e o ano*) |__||__|/|__||__|/|__||__|

Cutia |__|*não quis responder* |__| não |__| sim Quando (*pelo menos o mês e o ano*) |__||__|/|__||__|/|__||__|

Mutum espécie:_____ |__| não quis responder |__| não |__| sim

Quando (*pelo menos o mês e o ano*) |__||__|/|__||__|/|__||__|

Tracajá |__|*não quis responder* |__| não |__| sim Quando (*pelo menos o mês e o ano*) |__||__|/|__||__|/|__||__|

Jacaré sp _____ |__| não quis responder |__| não |__| sim

Quando (*pelo menos o mês e o ano*) |__||__|/|__||__|/|__||__|

Pirarucu |__|*não quis responder* |__| não |__| sim Quando (*pelo menos o mês e o ano*) |__||__|/|__||__|/|__||__|

Surubim |__|*não quis responder* |__| não |__| sim Quando (*pelo menos o mês e o ano*) |__||__|/|__||__|/|__||__|

Pirarara |__|*não quis responder* |__| não |__| sim Quando (*pelo menos o mês e o ano*) |__||__|/|__||__|/|__||__|

Barrigudo |__|*não quis responder* |__| não |__| sim Quando (*pelo menos o mês e o ano*) |__||__|/|__||__|/|__||__|

Guariba/capelão |__|*não quis responder* |__|não |__|sim Quando (*pelo menos o mês e ano*) |__||__|/|__||__|/|__||__|

Peixe-boi |__|*não quis responder* |__|não |__|sim Quando (*pelo menos o mês e o ano*) |__||__|/|__||__|/|__||__|

Jabuti |__|*não quis responder* |__|não |__|sim Quando (*pelo menos o mês e o ano*) |__||__|/|__||__|/|__||__|

5.1.1. Agora gostaria de saber se o(a) senhor(a) acha que desde 5 anos atrás até agora está mais difícil, mais fácil ou não mudou conseguir os bichos que vou falar agora aqui no município:

Paca |__|*não quis responder* |__| mais difícil |__| não mudou |__| mais fácil |__| não sabe/não come

Anta |__|*não quis responder* |__| mais difícil |__| não mudou |__| mais fácil |__| não sabe/não come

Jabuti |__|*não quis responder* |__| mais difícil |__| não mudou |__| mais fácil |__| não sabe/não come

Peixe-boi |__|*não quis responder* |__| mais difícil |__| não mudou |__| mais fácil |__| não sabe/não come

Tracajá |__|*não quis responder* |__| mais difícil |__| não mudou |__| mais fácil |__| não sabe/não come

5.2. Em quantas refeições vocês consumiram carne de caça nos últimos 30 dias, ou seja, desde o dia _____ do mês passado até hoje, aqui na casa? |__||__| vezes

5.3. Quando foi **a última vez** que vocês consumiram caça no domicílio? *Se não souber o dia perguntar se foi no começo, meio ou fim do mês – se for começo colocar dia 1, se foi no meio colocar dia 15 e se foi no fim colocar dia 30.*

|__| nunca comeram Data (*pelo menos o mês e o ano*): |__||__|/|__||__|/|__||__|

5.**3.1.** Qual(is) bicho(s) comeram da última vez? _____, _____, _____

5.**3.2.** Como vocês conseguiram a caça **nessa última vez**? |__|ganharam |__| compraram |__|caçaram

5.**3.3.** Quanto vocês conseguiram **nessa última vez**? Quantidade: _____ Unidade: _____

5.**3.4.** Quantas refeições fizeram com essa caça? |__||__| refeições

5.4. Agora gostaria de saber qual tipo de carne o(a) senhor(a) gosta mais entre carne de boi, carne de boi enlatada, carne de porco, frango congelado, galinha caipira, pato, carne de caça, peixe, bicho de casco, jacaré, calabresa e salsicha? E em segundo lugar, qual o(a) senhor(a) gosta mais? E em terceiro lugar?

1ª preferência:_____, 2ª _____, 3ª _____

Se ele(a) listou carne de caça, bicho de casco ou jacaré:

5.4.1. De qual bicho (espécie) o(a) senhor(a) gosta mais? _____

5.5. Alguém desta casa pesca, mesmo que seja apenas de vez em quando? |__| SIM |__| NÃO

5.6. Alguém desta casa caça, mesmo que seja apenas de vez em quando? |__| SIM |__| NÃO

Comentários módulo VI:

VI – SEGURANCA ALIMENTAR

Agora vou fazer algumas perguntas sobre como você acha que são as condições de alimentação na sua casa.
Nos últimos 30 dias, ou seja, desde o dia _____ (*mesmo dia atual*) do mês de _____ (*1 mês atrás*):

6.1. Vocês, deste domicílio, já tiveram a preocupação de que os alimentos acabassem antes de poderem comprar ou receberem mais comida? |__| SIM |__| NÃO |__| Não sabe

6.2. Os alimentos acabaram antes que vocês tivessem condições para adquirir mais comida? |__| SIM |__| NÃO |__| Não sabe

6.3. Vocês comeram apenas alguns poucos tipos de alimentos que ainda tinham, porque o dinheiro acabou? |__| SIM |__| NÃO |__| Não sabe

Agora vou perguntar apenas sobre você e os outros adultos, com 18 anos ou mais, da sua casa. Algum de vocês, alguma vez, nos últimos 30 dias:

6.4. Deixou de fazer alguma refeição porque não havia dinheiro para comprar comida? |__|SIM |__|NÃO |__|Não sabe
6.5. Comeu menos do que achou que devia, porque não havia dinheiro para comprar comida? |__|SIM |__|NÃO |__|Não sabe
6.6. Sentiu fome, mas não comeu porque não havia dinheiro para comprar comida? |__|SIM |__|NÃO |__|Não sabe
6.7. Fez apenas uma refeição ao dia ou ficou um dia inteiro sem comer, porque não havia dinheiro para comprar a comida? |__| SIM |__| NÃO |__| Não sabe

Nota: *As perguntas abaixo devem ser feitas somente em domicílios com moradores menores de 18 anos (crianças e/ ou adolescentes). Se não houver menores de 18 anos, encerre esse módulo.*

Agora vou perguntar apenas sobre os moradores menores de 18 anos da sua casa. Algum deles, alguma vez, nos últimos 30 dias:

6.8. Comeu apenas alguns poucos tipos de alimentos que ainda tinham, porque o dinheiro acabou? |__| SIM |__| NÃO |__| Não sabe

6.9. Não comeu quantidade suficiente de comida porque não havia dinheiro para comprar comida? |__| SIM |__| NÃO |__| Não sabe

6.10. Foi diminuída a quantidade de alimentos das refeições de algum morador com menos de 18 anos de idade, porque não havia dinheiro para comprar a comida? |__| SIM |__| NÃO |__| Não sabe

6.11. Deixou de fazer alguma refeição, porque não havia dinheiro para comprar comida? |__|SIM |__|NÃO |__|Não sabe

6.12. Sentiu fome, mas não comeu porque não havia dinheiro para comprar mais comida? |__| SIM |__| NÃO |__| Não sabe

6.13. Fez apenas uma refeição ao dia ou ficou sem comer por um dia inteiro, porque não havia dinheiro para comprar comida? |__| SIM |__| NÃO |__| Não sabe

ESCALA SEGURANÇA ALIMENTAR REGIONALIZADA

Nos **últimos 30 dias,** ou seja, desde o dia_____ do mês passado, alguma vez, o(a) senhor(a) ou alguém aqui desta casa:

6.14. Diminuiu a quantidade de carne em alguma refeição para economizar? |__|SIM |__|NÃO |__|Não comeu |__|Não sabe **7.15.** Diminuiu a quantidade de peixe em alguma refeição para economizar? |__| SIM |__| NÃO |__| Não sabe

6.16. Trocou carne ou frango por ovo, conserva ou salsicha porque são mais baratos? |__| SIM |__| NÃO |__| Não sabe

6.17. Fez alguma refeição apenas com farinha ou chibé porque não tinha outro alimento? |__|SIM |__|NÃO |__|Não sabe

6.18. Teve que pegar crédito ou comprar fiado na taberna, mercadinho ou vendedor para comprar comida porque não tinha mais dinheiro? |__| SIM |__| NÃO |__| Não sabe

6.19. Emprestou comida de outra família porque faltou em casa e não tinha dinheiro? |__| SIM |__| NÃO |__| Não sabe

6.20. Fez as refeições na casa de vizinhos, amigos ou parentes porque não tinha comida em casa? |__| SIM |__| NÃO |__| Não sabe

Comentários módulo VII:

Appendix 3: Supplemental material for "The species-specific role of wildlife in the Amazonian food system"

Social capital

We used factor analysis in the *pysch* package to understand the inter-relations between the social capital variables in our survey. We tested whether these variables captured a coherent general factor (social capital), and examined evidence for *n* sub-dimensions. First, we eliminated certain variables for having very high/low means (e.g. trust in teachers was high and non-varying, whereas trust in strangers was low and non-varying) and skew. Radio and internet use had strong negative correlations with other variables, reducing their suitability for a combined scale. Level of participation in community volunteer activities was highly skewed and hence removed. Remaining variables were all on a Likert scale of 1 to 5. We then used a polychoric correlation matrix and tested factor coherence. The overall Alpha was 0.79 and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.84. The multiple R^2 of scores (constituent variables) with the general factor was 0.52. We calculated the internal consistency of these factors and identified variables in each sub-dimension using ordinal omega (see Figure A1.1). This showed a Hierarchical Omega score of 0.51. The Explained Common Variance of the general factor was 0.47. All loadings on the general factor were above zero but our binary variable of "you can change your life" did not link well with other questions and was poorly related to the general factor. We turned these sub-dimensions into two predictor variables: horizontal social capital and vertical social capital.

Rural visits

We used three question to estimate the approximate number of days any household member had spent in rural areas in past 12 months: (1) Does anyone from this household visit the rural area, at least sometimes? [ ] yes, [ ] no; (2) With which frequency does anyone in the household goes to the most visited rural location? [ ] once per year, [ ] twice per year, [ ] 3-6 times per year, [ ] once per month, [ ] twice per month, [ ] once per week, [ ] more than once per week; (3) How many days does anyone spends in that location during each visit? [the number of days]. When the answer to question (1) was 'no', rural visits was set to zero. For those that answered 'yes', we multiplied the number of visits (question 2) by the number of days spent in each visit (question 3). When the answer to question (2) was '3-6 times' per year, we considered it was 4 times. For 'one per month' we considered 11 times (assuming they missed one month). For 'twice per month' we considered 22 times (assuming they missed one month). For 'once per week' we considered 48 times (assuming they missed 4 weeks). For 'more than once per week' we considered 72 times (assuming 1.5 times per week and that they missed 4 weeks).

Education

We asked the level of formal education for all household members of 15 years old and older. The respondents indicated the level (primary school, high school, and college/university) and the year they had last completed. We then transformed that data into the number of schooling years, considering that complete primary school was 8 years, high school 3 years, and college/university 4 years.

Food insecurity

We asked about experiences during the previous 30 days in order to provide seasonally precise food insecurity measures, consistent with our sampling of peak wet and dry seasons. This contrasts with the EBIA norm of three months, instead aligning with the HFIAS. Our scale included 13 of 14 questions in the EBIA-14 (Segall-Corrêa et al. 2014), excluding "did household members run out of money to have a healthy and varied diet?" because our pilot work showed 'healthy' and 'varied' were not well understood in our study context and this created apparent embarrassment. We also added five questions to account for coping mechanisms, which our pilot work showed to indicate severe food insecurity in Amazonia. These included doing the following, through necessity: eating a meal with only toasted manioc flour; borrowing money or buying food on credit; borrowing food from another family; having a meal in someone else's home; reducing quantity of meat or fish in a meal. See Appendix and Chacon-Montalvan et al. (in final revision) for more validation details.

Wildlife species assessed

In addition to the 13 species assessed in this paper, we asked about consumption of the common wooly monkey (*Lagothrix lagothricha*). However, the proportion of respondents that stated consuming this species was too low to allow for viable model estimates (only 19 out of 798 respondents reported consuming this species in the last five years). Therefore, we did not include this species in the analysis.

Cited reference

Segall-Corrêa, A. M., L. Marin-León, H. Melgar-Quiñonez and R. Pérez-Escamilla. 2014. Refinement of the Brazilian Household Food Insecurity Measurement Scale: Recommendation for a 14-item EBIA. Revista de Nutrição*,* 27**,** 241–251.

Table A1.1. Factors associated with the odds of consuming wild meat and fish.

Species	Variable	Estimate	SE	z value	p-value	Odds ratio	2.5%	97.5%	
Agouti	Intercept	-2.87	0.56	-5.13	<0.0001	0.06	0.02	0.17	
	Ipixuna	0.30	0.38	0.78	0.44	1.35	0.64	2.92	
	Jutaí	-0.11	0.41	-0.27	0.79	0.90	0.40	2.03	
	Caapiranga	1.75	0.34	5.15	0.00	5.77	3.05	11.67	*
	N days visited/year	0.16	0.10	1.50	0.13	1.17	0.95	1.43	
	Education	0.07	0.12	0.59	0.56	1.07	0.85	1.36	
	Rural origin	-0.08	0.24	-0.33	0.74	0.93	0.58	1.48	
	Income	0.05	0.11	0.48	0.63	1.06	0.84	1.31	
	Vertical social capital	0.01	0.15	0.09	0.93	1.01	0.75	1.37	
	Horizontal social capital	-0.01	0.14	-0.07	0.95	0.99	0.75	1.31	
	Direct harvest	1.13	0.24	4.60	<0.0001	3.08	1.91	4.99	*
Amazonian manatee	Intercept	-2.57	0.64	-4.01	<0.0001	0.08	0.02	0.26	
	Ipixuna	-3.46	1.03	-3.36	<0.001	0.03	0.00	0.15	*
	Jutaí	-0.25	0.33	-0.76	0.45	0.78	0.40	1.49	
	Caapiranga	-0.40	0.34	-1.16	0.25	0.67	0.34	1.31	
	N days visited/year	-0.02	0.14	-0.14	0.89	0.98	0.72	1.28	
	Education	0.09	0.15	0.61	0.55	1.09	0.83	1.47	
	Rural origin	0.20	0.29	0.72	0.47	1.23	0.70	2.16	
	Income	0.30	0.12	2.55	0.01	1.35	1.06	1.70	*
	Vertical social capital	-0.07	0.19	-0.40	0.69	0.93	0.64	1.33	
	Horizontal social capital	0.12	0.17	0.70	0.49	1.13	0.80	1.57	
	Direct harvest	0.54	0.30	1.82	0.07	1.71	0.97	3.11	.
Howler monkey	Intercept	-4.05	0.81	-5.01	<0.0001	0.02	0.00	0.08	
	Ipixuna	1.48	0.57	2.61	0.01	4.40	1.59	15.55	*
	Jutaí	1.63	0.56	2.92	0.004	5.09	1.88	17.75	*
	Caapiranga	0.22	0.67	0.33	0.74	1.24	0.34	5.04	
	N days visited/year	0.04	0.13	0.28	0.78	1.04	0.79	1.31	
	Education	-0.20	0.13	-1.45	0.15	0.82	0.63	1.08	
	Rural origin	0.58	0.34	1.68	0.09	1.78	0.93	3.61	.
	Income	-0.08	0.18	-0.43	0.67	0.93	0.62	1.28	
	Vertical social capital	-0.12	0.20	-0.57	0.57	0.89	0.59	1.32	
	Horizontal social capital	-0.02	0.18	-0.14	0.89	0.98	0.69	1.38	
	Direct harvest	1.03	0.31	3.35	<0.001	2.79	1.52	5.09	*
Paca	Intercept	-1.41	0.37	-3.82	<0.001	0.24	0.12	0.50	

Species	Variable	Estimate	SE	z value	p-value	Odds ratio	2.5%	97.5%	
	Ipixuna	0.90	0.22	4.10	<0.0001	2.46	1.60	3.80	*
	Jutaí	-0.05	0.23	-0.23	0.82	0.95	0.61	1.49	
	Caapiranga	0.71	0.22	3.19	0.001	2.04	1.32	3.16	*
	N days visited/year	0.01	0.08	0.08	0.94	1.01	0.86	1.18	
	Education	-0.03	0.08	-0.43	0.67	0.97	0.83	1.13	
	Rural origin	0.04	0.16	0.26	0.79	1.04	0.76	1.44	
	Income	-0.06	0.08	-0.71	0.48	0.94	0.80	1.10	
	Vertical social capital	-0.11	0.11	-1.03	0.30	0.90	0.73	1.10	
	Horizontal social capital	0.22	0.10	2.28	0.02	1.25	1.03	1.51	*
	Direct harvest	1.28	0.20	6.53	<0.0001	3.59	2.46	5.30	*
Tapir	Intercept	-1.82	0.39	-4.62	<0.0001	0.16	0.07	0.35	
	Ipixuna	1.40	0.25	5.65	<0.0001	4.04	2.51	6.63	*
	Jutaí	1.73	0.25	7.02	<0.0001	5.64	3.51	9.24	*
	Caapiranga	0.51	0.26	1.94	0.05	1.66	1.00	2.78	*
	N days visited/year	-0.06	0.08	-0.69	0.49	0.94	0.80	1.11	
	Education	0.13	0.08	1.59	0.11	1.14	0.97	1.34	
	Rural origin	-0.18	0.17	-1.07	0.28	0.83	0.60	1.16	
	Income	-0.01	0.08	-0.16	0.87	0.99	0.83	1.16	
	Vertical social capital	0.09	0.11	0.81	0.42	1.09	0.88	1.36	
	Horizontal social capital	-0.02	0.10	-0.23	0.81	0.98	0.80	1.19	
	Direct harvest	0.43	0.19	2.19	0.03	1.53	1.04	2.24	*
White-lipped peccary	Intercept	-2.68	0.41	-6.55	<0.0001	0.07	0.04	0.18	
	Ipixuna	1.39	0.26	5.30	<0.0001	4.00	2.40	6.01	*
	Jutaí	1.15	0.27	4.36	<0.0001	3.17	2.23	5.60	*
	Caapiranga	1.48	0.26	5.65	<0.0001	4.38	2.41	6.05	*
	N days visited/year	0.02	0.08	0.22	0.82	1.02	0.95	1.30	
	Education	-0.09	0.08	-1.14	0.25	0.91	0.84	1.14	
	Rural origin	0.02	0.17	0.13	0.90	1.02	0.87	1.65	
	Income	0.06	0.08	0.76	0.45	1.07	1.01	1.38	*
	Vertical social capital	-0.05	0.11	-0.44	0.66	0.95	0.85	1.29	
	Horizontal social capital	0.28	0.10	2.75	0.01	1.32	1.07	1.57	*
	Direct harvest	0.53	2.75	0.01	1.69	1.32	2.77	2.75	*
Curassow	Intercept	-3.94	0.71	-5.55	<0.0001	0.02	0.00	0.07	
	Ipixuna	0.29	0.55	0.53	0.60	1.33	0.46	4.12	
	Jutaí	2.49	0.45	5.49	<0.0001	12.12	5.35	32.72	*

Species	Variable	Estimate	SE	z value	p-value	Odds ratio	2.5%	97.5%	
	Caapiranga	0.11	0.58	0.19	0.85	1.12	0.36	3.60	
	N days visited/year	0.24	0.11	2.16	0.03	1.28	1.02	1.59	*
	Education	0.17	0.14	1.27	0.20	1.19	0.92	1.57	
	Rural origin	0.16	0.28	0.58	0.56	1.18	0.68	2.07	
	Income	0.09	0.14	0.60	0.55	1.09	0.81	1.43	
	Vertical social capital	-0.02	0.18	-0.09	0.93	0.98	0.68	1.41	
	Horizontal social capital	0.08	0.16	0.49	0.62	1.08	0.78	1.50	
	Direct harvest	0.64	0.29	2.19	0.03	1.90	1.06	3.35	*
Tortoise	Intercept	-2.05	0.56	-3.66	<0.001	0.13	0.04	0.38	
	Ipixuna	0.70	0.31	2.30	0.02	2.02	1.12	3.73	*
	Jutaí	0.21	0.33	0.65	0.52	1.24	0.65	2.37	
	Caapiranga	-0.85	0.43	-2.00	0.05	0.43	0.18	0.95	*
	N days visited/year	0.04	0.11	0.39	0.69	1.05	0.83	1.29	
	Education	0.36	0.13	2.77	0.01	1.44	1.12	1.88	*
	Rural origin	0.40	0.25	1.58	0.11	1.49	0.91	2.47	
	Income	0.32	0.11	3.00	0.002	1.37	1.11	1.68	*
	Vertical social capital	-0.26	0.17	-1.55	0.12	0.77	0.56	1.07	
	Horizontal social capital	-0.01	0.15	-0.07	0.95	0.99	0.74	1.32	
	Direct harvest	0.88	0.26	3.39	<0.001	2.41	1.44	4.01	*
Yellow-spotted river turtle	Intercept	-1.06	0.39	-2.73	0.01	0.35	0.16	0.74	
	Ipixuna	-0.74	0.24	-3.17	0.002	0.48	0.30	0.75	*
	Jutaí	1.50	0.23	6.57	<0.0001	4.47	2.87	7.02	*
	Caapiranga	-0.03	0.22	-0.13	0.89	0.97	0.63	1.50	
	N days visited/year	-0.04	0.08	-0.46	0.65	0.96	0.82	1.13	
	Education	0.17	0.08	2.00	0.05	1.18	1.00	1.39	*
	Rural origin	-0.30	0.17	-1.80	0.07	0.74	0.53	1.03	.
	Income	0.21	0.08	2.51	0.01	1.23	1.05	1.45	*
	Vertical social capital	-0.03	0.11	-0.25	0.80	0.97	0.78	1.21	
	Horizontal social capital	0.12	0.10	1.23	0.22	1.13	0.93	1.38	
	Direct harvest	0.64	0.18	3.65	<0.001	1.90	1.35	2.69	*
Caiman	Intercept	-2.88	0.62	-4.68	0.0001	0.06	0.02	0.18	
	Ipixuna	-0.02	0.37	-0.04	0.96	0.98	0.47	2.07	
	Jutaí	-0.75	0.43	-1.73	0.08	0.47	0.20	1.09	.
	Caapiranga	0.70	0.35	2.02	0.04	2.01	1.04	4.05	*

Species	Variable	Estimate	SE	z value	p-value	Odds ratio	2.5%	97.5%	
	N days visited/year	0.04	0.12	0.32	0.75	1.04	0.82	1.29	
	Education	-0.27	0.12	-2.27	0.02	0.76	0.61	0.97	*
	Rural origin	0.10	0.26	0.38	0.70	1.10	0.66	1.86	
	Income	0.03	0.13	0.24	0.81	1.03	0.79	1.32	
	Vertical social capital	-0.05	0.17	-0.31	0.76	0.95	0.68	1.31	
	Horizontal social capital	0.03	0.15	0.18	0.86	1.03	0.76	1.38	
	Direct harvest	0.84	0.30	2.79	0.01	2.31	1.31	4.26	*
Arapaima	Intercept	1.72	0.44	3.88	<0.0001	5.59	2.37	13.50	
	Ipixuna	-2.28	0.27	-8.52	<0.0001	0.10	0.06	0.17	*
	Jutaí	-0.34	0.29	-1.17	0.24	0.71	0.40	1.26	
	Caapiranga	-0.81	0.29	-2.82	0.005	0.44	0.25	0.78	*
	N days visited/year	0.07	0.09	0.72	0.47	1.07	0.90	1.29	
	Education	-0.03	0.09	-0.29	0.77	0.97	0.81	1.16	
	Rural origin	-0.16	0.19	-0.83	0.41	0.85	0.59	1.24	
	Income	0.17	0.10	1.70	0.09	1.19	0.98	1.46	
	Vertical social capital	-0.16	0.12	-1.29	0.20	0.86	0.67	1.09	
	Horizontal social capital	0.15	0.11	1.37	0.17	1.17	0.94	1.45	
	Direct harvest	0.41	0.20	2.08	0.04	1.51	1.03	2.24	*
Barred catfish	Intercept	-1.26	0.39	-3.28	0.001	0.28	0.13	0.60	
	Ipixuna	1.54	0.23	6.77	<0.0001	4.65	2.99	7.30	*
	Jutaí	1.41	0.22	6.33	<0.0001	4.11	2.66	6.40	*
	Caapiranga	-0.09	0.23	-0.39	0.70	0.92	0.58	1.44	
	N days visited/year	0.06	0.08	0.73	0.46	1.06	0.91	1.25	
	Education	-0.04	0.08	-0.53	0.60	0.96	0.82	1.12	
	Rural origin	0.11	0.17	0.69	0.49	1.12	0.81	1.55	
	Income	-0.08	0.08	-0.90	0.37	0.93	0.79	1.09	
	Vertical social capital	0.01	0.11	0.12	0.90	1.01	0.82	1.25	
	Horizontal social capital	0.07	0.10	0.69	0.49	1.07	0.88	1.30	
	Direct harvest	0.36	0.17	2.11	0.03	1.44	1.03	2.02	*
Redtail catfish	Intercept	-3.95	0.69	-5.76	<0.0001	0.02	0.00	0.07	
	Ipixuna	0.17	0.36	0.48	0.63	1.19	0.59	2.45	
	Jutaí	0.26	0.36	0.72	0.47	1.30	0.65	2.66	
	Caapiranga	-2.44	0.77	-3.16	<0.0001	0.09	0.01	0.32	*
	N days visited/year	-0.09	0.13	-0.66	0.51	0.92	0.70	1.17	
	Education	-0.14	0.13	-1.07	0.28	0.87	0.67	1.13	

Species	Variable	Estimate	SE	z value	p-value	Odds ratio	2.5%	97.5%	
	Rural origin	0.52	0.32	1.66	0.10	1.69	0.93	3.21	.
	Income	-0.18	0.18	-1.00	0.32	0.83	0.56	1.15	
	Vertical social capital	-0.04	0.18	-0.19	0.85	0.97	0.67	1.38	
	Horizontal social capital	0.24	0.16	1.47	0.14	1.27	0.92	1.74	
	Direct harvest	1.03	0.33	3.09	0.002	2.80	1.49	5.56	*

73 * $p<0.05$

Table A1.2. Factors associated with the odds of preferring wildlife as favorite food item.

Variables	Estimate	SE	z value	p-value	Odds ratio	2.50%	97.50%	
Intercept	-1.59	0.31	-5.18	<0.001	0.20	0.11	0.36	
Ipixuna	-0.51	0.35	-1.48	0.14	0.60	0.30	1.18	
Jutaì	0.72	0.32	2.26	0.02	2.05	1.10	3.84	*
Caapiranga	-0.10	0.34	-0.31	0.76	0.90	0.46	1.75	
N visits/year	0.01	0.12	0.10	0.92	1.01	0.80	1.27	
Education	-0.13	0.12	-1.10	0.27	0.88	0.70	1.11	
Rural origin	0.64	0.24	2.67	0.01	1.90	1.19	3.07	*
Income	0.11	0.12	0.94	0.35	1.12	0.88	1.42	
Direct harvest	0.61	0.26	2.30	0.02	1.83	1.10	3.10	*

* $p<0.05$

76 **Table A1.3.** Association between preferring wild meat at the top three favorite food item and consumption of wildlife species.

Species	Variable	Estimate	SE	z value	p-value	Odds ratio	2.5%	97.5%	
Agouti	Intercept	5.47	0.06	84.18	<0.0001	237.00	208.09	268.47	
	Preference	-0.73	0.11	-6.42	<0.0001	0.48	0.38	0.60	
	Consumption	-1.88	0.18	-10.54	<0.0001	0.15	0.11	0.21	
	Preference*Consumption	-0.29	0.34	-0.84	0.403	0.75	0.37	1.44	
Amazonian manatee	Intercept	5.55	0.06	89.19	<0.0001	258.00	227.78	290.77	
	Preference	-0.89	0.12	-7.71	<0.0001	0.41	0.33	0.51	
	Consumption	-2.84	0.27	-10.71	<0.0001	0.06	0.03	0.09	
	Preference*Consumption	1.23	0.36	3.43	<0.001	3.41	1.70	6.98	*
Howler monkey	Intercept	5.53	0.06	88.01	<0.0001	253.00	223.09	285.47	
	Preference	-0.81	0.11	-7.18	<0.0001	0.44	0.35	0.55	
	Consumption	-2.54	0.23	-10.93	<0.0001	0.08	0.05	0.12	
	Preference*Consumption	0.53	0.36	1.47	0.143	1.69	0.82	3.42	
Paca	Intercept	5.15	0.08	67.51	<0.0001	172.00	147.56	199.00	
	Preference	-1.04	0.15	-6.96	<0.0001	0.35	0.26	0.47	
	Consumption	-0.55	0.13	-4.38	<0.0001	0.58	0.45	0.74	
	Preference*Consumption	0.63	0.22	2.90	0.004	1.88	1.23	2.89	*
Tapir	Intercept	5.21	0.07	70.47	<0.0001	183.00	157.75	210.81	
	Preference	-0.96	0.14	-6.84	<0.0001	0.38	0.29	0.50	
	Consumption	-0.72	0.13	-5.58	<0.0001	0.49	0.38	0.62	
	Preference*Consumption	0.52	0.22	2.34	0.02	1.67	1.09	2.58	*
White-lipped peccary	Intercept	5.26	0.07	72.85	< 2e-16	192.00	166.11	220.45	
	Preference	-0.97	0.14	-7.03	<0.0001	0.38	0.29	0.50	
	Consumption	-0.90	0.13	-6.71	<0.0001	0.41	0.31	0.53	
	Preference*Consumption	0.60	0.22	2.67	0.008	1.82	1.17	2.83	*
Curassow	Intercept	5.53	0.06	87.78	<0.0001	252.00	222.15	284.41	
	Preference	-0.81	0.11	-7.14	<0.0001	0.44	0.35	0.55	
	Consumption	-2.48	0.23	-10.94	<0.0001	0.08	0.05	0.13	
	Preference*Consumption	0.47	0.36	1.33	0.183	1.61	0.79	3.22	
Tortoise	Intercept	5.52	0.06	87.06	<0.0001	249.00	219.34	281.22	
	Preference	-0.85	0.12	-7.36	<0.0001	0.43	0.34	0.53	
	Consumption	-2.34	0.21	-10.95	<0.0001	0.10	0.06	0.14	
	Preference*Consumption	0.39	0.32	2.25	0.02	2.06	1.09	3.85	*
Yellow-spotted river turtle	Intercept	5.21	0.07	70.74	<0.0001	184.00	158.68	211.88	
	Preference	-1.17	0.15	-7.73	<0.0001	0.31	0.23	0.41	

Species	Variable	Estimate	SE	z value	p-value	Odds ratio	2.5%	97.5%	
	Consumption	-0.76	0.13	-5.82	<0.0001	0.47	0.36	0.60	
	Preference*Consumption	0.92	0.22	4.14	<0.0001	2.51	1.63	3.90	*
Caiman	Intercept	5.52	0.06	87.06	<0.0001	249.00	219.34	281.22	
	Preference	-0.80	0.11	-7.02	<0.0001	0.45	0.36	0.56	
	Consumption	-2.34	0.21	-10.95	<0.0001	0.10	0.06	0.14	
	Preference*Consumption	0.33	0.35	0.95	0.345	1.39	0.69	2.72	

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78 **Table A1.4.** Association between households that severely food insecure and consumption of fish and wildlife species.

Species	Variable	Estimate	SE	z value	p-value	Odds ratio	2.5%	97.5%	
Agouti	Intercept	5.83	0.05	107.48	<0.0001	340.00	305.13	377.43	
	Food insecurity[1]	0.03	0.08	0.38	0.703	1.03	0.89	1.20	
	Consumption	-1.86	0.15	-12.59	<0.0001	0.16	0.12	0.21	
	Food insecurity*Consumption	0.01	0.21	0.04	0.969	1.01	0.67	1.51	
Amazonian manatee	Intercept	5.87	0.05	110.22	<0.0001	353.00	317.44	391.11	
	Food insecurity[1]	0.07	0.07	1.00	0.3187	1.08	0.93	1.24	
	Consumption	-2.18	0.17	-13.05	<0.0001	0.11	0.08	0.16	
	Food insecurity*Consumption	-0.54	0.27	-2.05	0.04	0.58	0.34	0.97	*
Howler monkey	Intercept	5.92	0.05	113.954	<0.0001	371.00	334.52	410.04	
	Food insecurity[1]	-0.01	0.07	-0.074	0.9414	0.99	0.86	1.15	
	Consumption	-2.83	0.22	-12.875	<0.0001	0.06	0.04	0.09	
	Food insecurity*Consumption	0.47	0.28	1.667	0.10	1.60	0.93	2.82	.
Paca	Intercept	5.40	0.07	80.25	<0.0001	221.00	193.13	251.43	
	Food insecurity[1]	0.06	0.09	0.61	0.54	1.06	0.88	1.27	
	Consumption	-0.26	0.10	-2.57	0.01	0.77	0.63	0.94	
	Food insecurity*Consumption	-0.06	0.14	-0.44	0.66	0.94	0.71	1.24	
Tapir	Intercept	5.53	0.06	87.78	<0.0001	252.00	222.15	284.41	
	Food insecurity[1]	0.09	0.09	1.09	0.28	1.10	0.93	1.30	
	Consumption	-0.59	0.11	-5.58	<0.0001	0.56	0.45	0.68	
	Food insecurity*Consumption	-0.20	0.15	-1.33	0.18	0.82	0.61	1.10	
White-lipped peccary	Intercept	5.55	0.06	89.19	<0.0001	258.00	227.78	290.77	
	Food insecurity[1]	0.06	0.09	0.74	0.462	1.07	0.90	1.26	
	Consumption	-0.67	0.11	-6.26	<0.0001	0.51	0.41	0.63	
	Food insecurity*Consumption	-0.10	0.15	-0.68	0.499	0.90	0.67	1.21	
Curassow	Intercept	5.87	0.05	110.43	<0.0001	354.00	318.39	392.17	
	Food insecurity[1]	0.03	0.07	0.45	0.655	1.03	0.89	1.20	
	Consumption	-2.21	0.17	-13.07	<0.0001	0.11	0.08	0.15	
	Food insecurity*Consumption	-0.03	0.24	-0.14	0.889	0.97	0.61	1.55	
Tortoise	Intercept	5.83	0.05	107.48	<0.0001	340.00	305.13	377.43	
	Food insecurity[1]	0.07	0.08	0.87	0.39	1.07	0.92	1.24	
	Consumption	-1.86	0.15	-12.59	<0.0001	0.16	0.12	0.21	
	Food insecurity*Consumption	-0.30	0.22	-1.36	0.18	0.74	0.48	1.14	
Yellow-spotted river turtle	Intercept	5.35	0.07	77.487	<0.0001	210.00	182.86	239.70	
	Food insecurity[1]	0.16	0.09	1.729	0.0838	1.18	0.98	1.41	

Species	Variable	Estimate	SE	z value	p-value	Odds ratio	2.5%	97.5%	
	Consumption	-0.16	0.10	-1.57	0.1164	0.85	0.70	1.04	
	Food insecurity*Consumption	-0.33	0.14	-2.249	0.02	0.72	0.54	0.96	*
Caiman	Intercept	5.88	0.05	111.27	<0.0001	358.00	322.18	396.37	
	Food insecurity[1]	0.00	0.07	0.04	0.97	1.00	0.87	1.16	
	Consumption	-2.33	0.18	-13.13	<0.0001	0.10	0.07	0.14	
	Food insecurity*Consumption	0.27	0.24	1.14	0.253	1.31	0.83	2.09	
Arapaima	Intercept	4.56	0.10	44.72	<0.0001	96.00	78.05	116.50	
	Food insecurity[1]	0.21	0.14	1.50	0.133	1.23	0.94	1.61	
	Consumption	1.07	0.12	9.02	<0.0001	2.91	2.31	3.68	
	Food insecurity*Consumption	-0.23	0.16	-1.43	0.152	0.79	0.58	1.09	
Barred catfish	Intercept	5.34	0.07	76.98	<0.0001	208.00	181.00	237.56	
	Food insecurity[1]	-0.11	0.10	-1.06	0.29	0.90	0.74	1.10	
	Consumption	-0.16	0.10	-1.58	0.11	0.85	0.70	1.04	
	Food insecurity*Consumption	0.25	0.14	1.73	0.08	1.28	0.97	1.70	.
Redtail catfish	Intercept	5.93	0.05	114.77	<0.0001	375.00	338.31	414.24	
	Food insecurity[1]	-0.06	0.07	-0.85	0.39	0.94	0.81	1.09	
	Consumption	-3.04	0.24	-12.59	<0.0001	0.05	0.03	0.07	
	Food insecurity*Consumption	1.08	0.28	3.81	<0.001	2.96	1.72	5.30	*

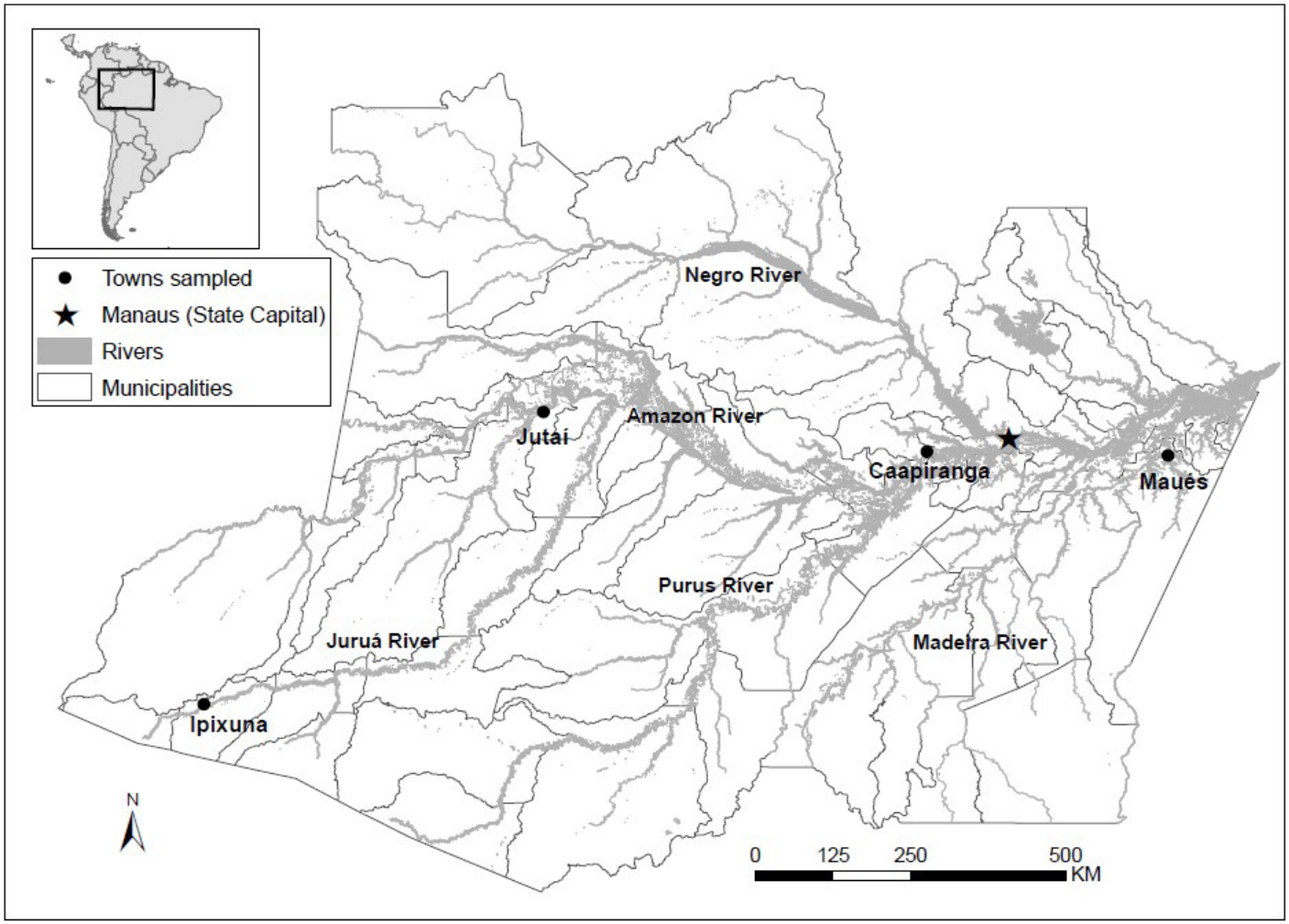

Fig. A1.1. Study sites in Amazonas state, Brazil.

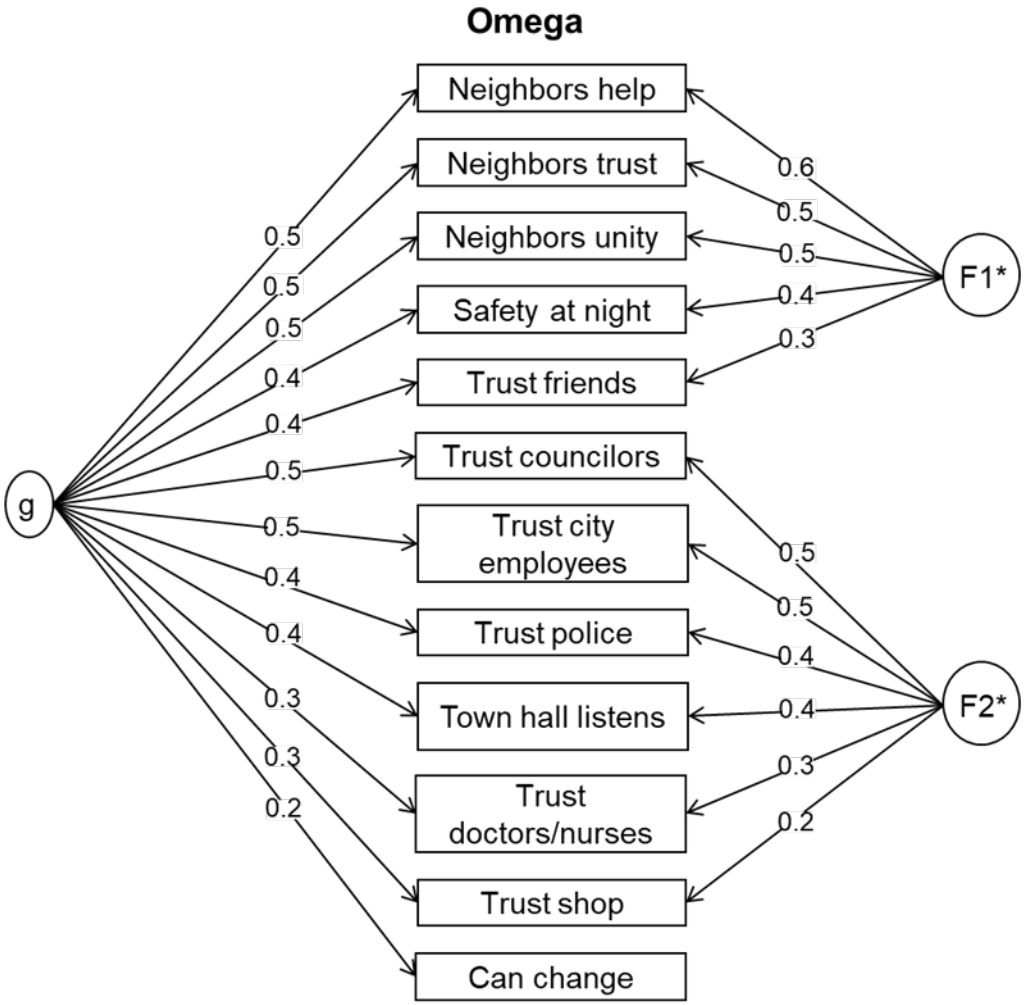

Fig. A1.2. Social capital analysis from polychoric correlations showing 2 sub-factors; (I) horizontal social capital; (ii) vertical social capital.

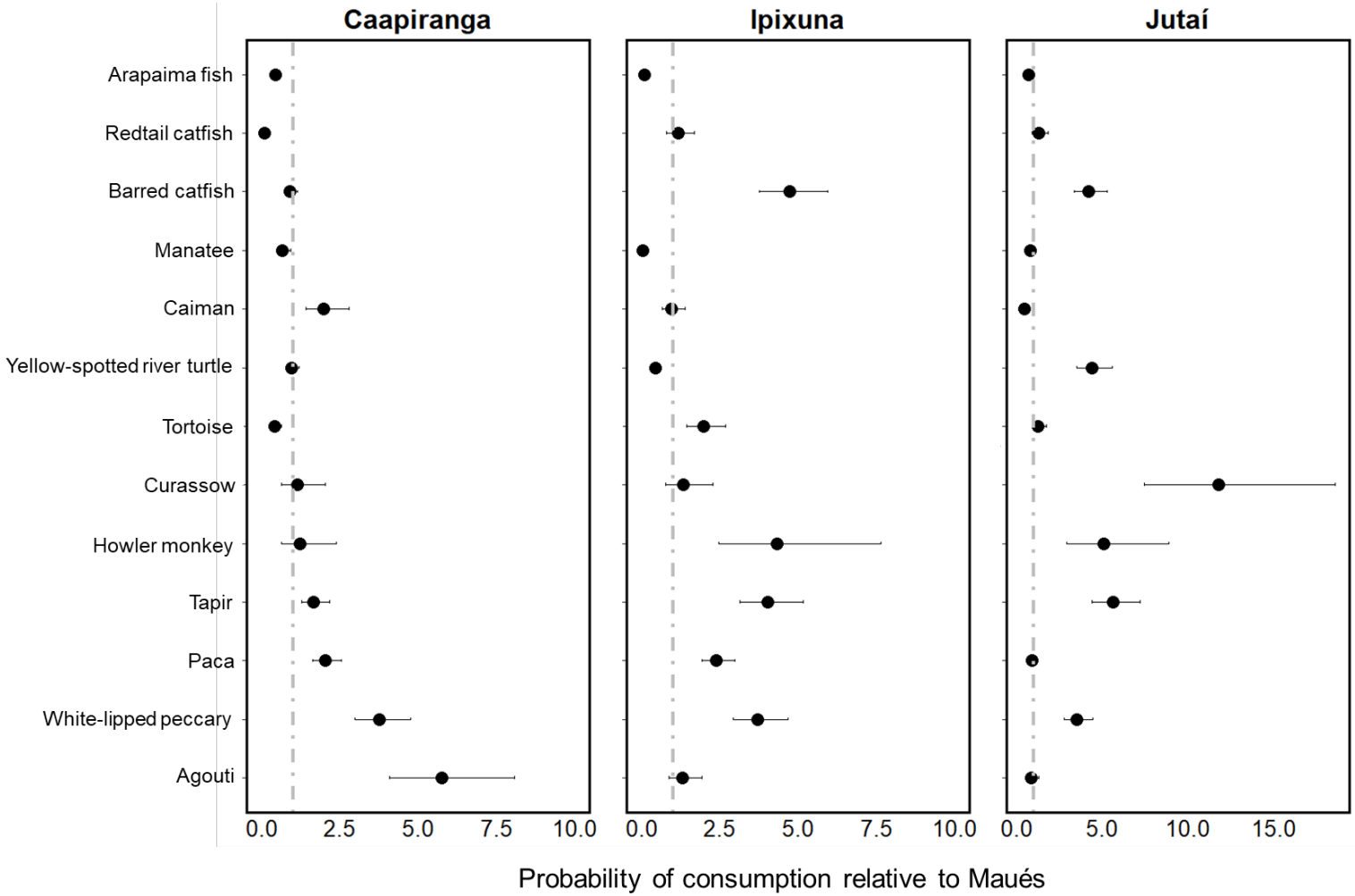

Fig. A1.3. Probability of consumption of wildmeat and fish species by households in Caapiranga, Ipixuna, and Jutaí, compared to consumption in Maués (grey dotted line), Amazonas.

Response to Reviewers

We thank the Editor and Reviewers for considering our paper for publication in Ecology and Society! We also thank them for their additional comments to improve the manuscript. We have revised our paper to address the reviewers' comments. Please see below for a detailed explanation of what we have added.

Reviewers comments:

Reviewer 1:

- Thank you for the thorough revision. All my comments and concerns have been addressed.

Response: Thank you!

Reviewer 2:

- I have enjoyed reading this new version of the manuscript. Authors have either made changes to incorporate suggestions made by reviewers or have provided a reasonable justification when a change was not incorporated. I only have two more comments that can help improving the manuscript:

1. In some parts of Methods section, authors still need to provide more detail so data gathering and analyses could be repeated by another researcher. For example, in pg. 8, the subsection "Access" under "Data collection" there is only one sentence that reads: "We examined how access (household access mechanisms, rural origin, and place-based effects) was associated with consumption of different wildlife species. As the section is data collection, authors should explain which questions were made to participants that helped to gather information on access.

Response: Thank you for bringing up this point. The section "Access" is just an introduction to the subsections "Horizontal and vertical social capital" and "Rural origin and other means of access". We have added a sentence to clarify this in the manuscript.

> Sentence added (underlined) – Ln 210: We examined how access (household access mechanisms, rural origin, and place-based effects) was associated with consumption of different wildlife species. Below we describe how we measured access.

We have also underlined the text for each subsection to make this clearer (Ln 230 and 241).

2. It would be excellent if authors can provide with more examples that help us to understand observed patterns of differential species consumption, such as the provided example that there is a taboo behind catfish that deters the consumption of these species for those who can

avoid it. Similarly, for example, I would like to see an explanation of why poorer households could consume more monkey.

Response: Thank you for this suggestion. We have added some details in the results and the discussion about the differential consumption of species, including the relationship between howler monkeys and food insecurity.

Text added (underlined):

Results:

Ln 287-294: Seventy-three percent of households stated that they had consumed wild meat (i.e., at least one species of 10 species of wild mammal, bird, or reptile we included in this study) and 83% had consumed fish at least one species of the three surveyed fish species in the household during the past 12 months. Among mammal species included in the survey, paca was consumed by 42.7% of households, tapir by 33.5%, white-lipped peccary by 32.8%, agouti by 13.5%, and howler monkey by 7.2%. Curassow was consumed by 9.8% of households. Among reptile species, yellow-headed turtle was consumed by 42.7% of households, tortoise by 11.9%, and caiman by 10.2%. Among fish species, arapaima was consumed by 72.0% of households, barred catfish by 49.1%, and redtail catfish by 8.5%. Manatee was consumed by 8.14% over the last 60 months.

Ln 301-307: In addition, rural origin was associated with an increase in the odds of consuming howler monkey (78% more likely to consume; OR=1.78; 95% CI 0.93–3.61; p=0.09) and redtail catfish (69% more likely to consume; OR=1.69; CI 0.93–3.21; p=0.10), and a decrease in consumption of river turtle (26% less likely to consume; OR=0.74; CI 0.53–1.03; p=0.09; Fig. 2 and Table A1.1). Among rural out-migrant households, 9.6% stated that they consumed howler monkeys, 11.5% stated they consumed redtail catfish, and 39.1% stated they consumed turtles. Among non-migrant households, 3.8% stated they consumed howler monkeys, 4.7% stated they consumed redtail catfish, and 45.9% stated they consumed turtles.

Ln 351-359: Of the 798 households surveyed, 50.8% were moderately or severely food insecure. Moderate and severe food insecurity, compared to mild food insecurity and food security, was positively correlated with eating howler monkey (OR=1.60; CI 0.93–2.82; p=0.10), barred catfish (OR=1.28; 0.97–1.70; p=0.08), and redtail catfish (OR=2.96; p<0.001), and negatively correlated with eating manatee (OR=0.58; CI 0.34–0.97; p-value=0.04) and river turtle (OR=0.72; CI 0.54–0.96; p=0.02; Fig. 4 and Table A1.4). Among households where participants stated that they consumed howler monkeys, barred catfish, redtail catfish, manatee, and river turtles, 60.4%, 73.5%, 54%, 38%, and 45%, respectively, were moderately or severely food insecure. There was no correlation between food insecurity and consumption of the other nine species.

Discussion:

Ln 481-524: Finally, our work shows complex associations between urban food insecurity and wildlife consumption, hence making an important contribution to the very limited literature on this subject. Since Milner-Gulland et al.'s seminal (2003) paper, the conservation literature

repeats plausible yet largely untested assumptions, particularly lacking evidence for urban areas, that wild meat plays an important role in supporting food security in the forested tropics. A recent Amazonian study found that food-insecure urban households use small-scale fishing as a coping strategy (Rivero et al. 2022), but we are unaware of any previous study into the food (in)security dimensions of consuming other wild taxa (i.e., mammals, birds, chelonians, caimans) in urban areas. In rural Nigeria, Friant et al. (2020) found an overall positive relationship between bushmeat consumption and household food security, with some taxa-specific nuances (e.g., eating rodents was strongly associated with food security, with the opposite true for carnivores).

Although our work does not assess how much households rely on the species consumed, our species-specific, urban-centric research provides a novel insight that some wildlife species are more consumed among food-insecure households than relatively food-secure households. That is, some species (e.g., turtles, manatee) are less likely to be consumed by food-insecure urban households whereas other species are more likely to be eaten by food-insecure households (e.g., howler monkey, barred catfish, and red-tailed catfish; Fig 4). For example, although howler monkeys and redtail catfish were only eaten by 7.2% and 8.5% of surveyed households, respectively, 61.4% of consumers of howler monkeys and 73.5% of consumers of redtail catfish were moderately or severely food insecure. These species-specific differences are likely to be context-specific given their consumption will be related to socially-constructed preferences and food practices. For example, in Amazonas State, there are social taboos against the consumption of catfishes, yet Parry et al. (2014) found they were consumed by the poorest (often rural out-migrant) urban households. Similarly, Lemos et al. (2022) found that some Amazonian people consider eating primates (including howler monkeys) as taboo, while others have the custom of consuming primates. Given we found that eating howler monkeys was positively associated with rural origin and direct harvesting, but not associated with variation in monetary income, we interpret howler monkey consumption in Amazonian towns mainly in terms of socio-cultural practices. Albeit, we cannot rule out the possibility that some urban households consume (and perhaps hunt) these primates as a direct response to insufficient access to other foodstuffs. People's lived experiences in rural communities shape their different perceptions, knowledge, and attitudes towards a range of wildlife species (Mikolajczak et al. in press), which may partly explain why migrant households are more likely to consume howler monkeys and red-tailed catfish, beyond the effect of directly accessing them by going hunting or fishing. People's ecological knowledge, habits, and dispositions towards different species are socially constructed, emerging during the childhood socialization process in rural Amazonian communities (Menegaldo et al. 2013). In addition, although we did not investigate the different ways food-secure and food-insecure households may acquire wildmeat, it is likely that vulnerable households (more food insecure) rely less on purchasing than on hunting and gifts and that may influence their access to different species. Higher reliance on hunting and being gifted wild meat was more likely for rural out-migrants than for non-migrant in the study region (Carignano Torres et al. 2022).

We found that higher-income households tend to favor the same species that appear less likely to be consumed by food-insecure households. Turtles were ranked as highly preferred, so a lower probability of their consumption among food-insecure households may relate to barriers in accessing them for food, rather than to preferences. Although our work does not assess how

much food-insecure households rely on the species consumed (which Ingram et al. (2021) define as a research priority), our results suggest that food-insecure households have greater access to some species but not others. These results highlight the importance of species-specific approaches regarding wildlife management and conservation.