



# Bushmeat in the tri-frontier region of Brazil, Peru and Colombia

Demise or persistence?

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Occasional Paper 118

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ISBN 978-602-1504-60-4

van Vliet N, Quiceno-Mesa MP, Cruz-Antia D, Morsello C, Adams C, Mori F, Yagüe B, Hernández S, Bonilla T, Tellez L, Neves de Aquino L, Moreno J, Schor T, De Oliveira Princi M, Haiden E, Trujillo F, Nasi R. 2014. *Bushmeat in the tri-frontier region of Brazil, Peru and Colombia: Demise or persistence?*. Occasional Paper 118. Bogor, Indonesia: CIFOR.

Cover photo by Nathalie van Vliet  
Hunter in Puerto Nariño, Colombia

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We would like to thank all donors who supported this research through their contributions to the CGIAR Fund. For a list of Fund donors please see: <https://www.cgiarfund.org/FundDonors>

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# Acknowledgments

We acknowledge the active contribution of all stakeholders in the trade chain that actively participated in this work, always maintaining a great spirit of collaboration and rigorous research principles. We are very thankful for the constructive comments from the reviewers Sebastián Restrepo and Natalia Hanazaki. This work would not have been possible without support from the University of Sao Paulo, Universidade Federal do Amazonas (UFAM) and Universidade do Estado do Amazonas (UEA) in Brazil, and the National University and Fundación Omacha in Colombia. This work was supported by funding from USAID and UKAID through the CGIAR research program on Forests, Trees and Agroforestry and the CIFOR bushmeat research initiative.

# Foreword

In our quest for sustainability in the use of natural resources, the question of bushmeat has been the source of heated and polarized debates. Overhunting, acting in synergies with other factors like habitat degradation or deforestation, is clearly one driver of extinction or extirpation. On the other hand the need for food, poverty alleviation, and the rights of local peoples, which may or may not hold specific knowledge and rules to handle a resource that thrives on their lands, are also at stake. This is not a biodiversity only crisis! The global debate about the forthcoming Sustainable Development Goals has amply demonstrated some of the contradictions that arise in the search of balancing human well-being and biodiversity persistence on the long term.

The evolution of “urban cultures” has also created some prejudice against the hunting and consumption of wildlife, often by rural people, increasing the gap between cities and the rural areas that provide resources for their living. Livelihoods, aligned with industrial consumption patterns and free trade, tend to cut links with the ecological processes that support society, thus

increasing conflicts and restricting options for building sustainability in using the natural gift of living resources. In the end, the ability or capacities of those social groups and their institutions to manage wildlife populations reaches a dead end: the science or knowledge behind the sustainable use of wildlife is no longer considered useful or needed, and ecological and social processes previously interlinked, become invisible.

Hence, the importance of studies such as this one, which combines research tools from many disciplines and gives us a broader picture of the situation of bushmeat consumption and its role on the contemporary society, as well as its potential for sustainable development. Hopefully, we shall not forget our ecological ties to the territory and to our living companions on Earth, even if we sometimes eat them as a way to acknowledge the rights of all to share the land.

**Brigitte Baptiste**  
**Director of the Instituto von Humboldt,**  
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# 1 Introduction



Household living along the Amazon River, Colombia (Photo by Daniel Cruz)

## 1.1 Forests, wildlife and nutrition

Tropical forest resources are inextricably linked to people's well-being in terms of food security, nutrition and health in a number of fundamental ways: forests maintain cultural identities expressed in traditional knowledge; local institutions and customary practices contribute to social resilience through the diversity of healthy foods, culturally valued products integral to local food systems and food sovereignty; and products that act occasionally as a 'safety net' or 'buffer' in times of shortages (de Merode et al. 2004; Shackleton and Shackleton 2004; Arnold et al. 2011; Termote et al. 2012). Until the mid- 90s, food consumption in tropical forests was still primarily related directly to the process of food acquisition and was dominated by foraging strategies and subsistence cultivation. Nowadays, the majority

of rural households in tropical regions, and a large proportion of urban households, still rely on forest products to meet part of their food, nutritional, health and livelihood needs. However, their current contribution has been poorly quantified, particularly in the rapidly growing urban centers of tropical forests. Lack of such evidence impairs biodiversity preservation strategies when setting benchmarks that include food security as a key principle. At the same time, strategies adopted to address food insecurity continue to narrow the diversity of the food supply by neglecting indigenous and traditional food systems based on wild products (Frison et al. 2011). To respond to this lack of knowledge, the inextricable link between biodiversity and nutrition security has attracted more and more interest from researchers all over the world (Johns and Eyzaguirre 2006; Burlingame et al. 2009; Kuhnlein et al. 2009;

Bharucha and Pretty 2010). Several recent studies have analyzed the contribution of wild sources of food in Africa (Jenkins et al. 2011; Cloete and Idsardi 2013; Sneyd et al. 2013), mostly focusing on edible plants (Weinberger and Swai 2006; Lualadio et al. 2010; Termote et al. 2012) and on the links between wild foods and poverty (Cloete and Idsardi 2013; Ladio et al. 2013). Forests still provide a huge range of natural resources used by locals for diverse purposes, including food, and contribute to poverty eradication (Arnold et al. 2011).

Bushmeat, understood as “non-domesticated terrestrial mammals, birds, reptiles and amphibians harvested for food” (Nasi et al. 2008) is among the main non-timber forest products that contribute



Hunter in Puerto Nariño, Colombia (Photo by Daniel Cruz)

to food security in rural tropical forest areas (van Vliet and Mbazza 2011; Sunderland et al. 2013). Bushmeat is often described as a “safety net” (Brown 2003; Gardner and Davies 2014), and for many rural families, it is the principal source of protein (Robinson and Bennett 2000; Wilkie and Godoy 2001; Sunderland et al. 2013). As it is consumed in both rural and urban contexts (Milner-Gulland et al. 2003; Milner-Gulland and Bennet 2003), bushmeat is also regarded as an economic resource because its trade contributes to household incomes (Valsecchi and Amaral 2009; Kümpel et al. 2010; Nasi et al. 2011), sometimes as the main source of regular cash, but usually also as a buffer in times of hardship or as an additional income when special needs must be met (van Vliet and Mbazza 2011). Several studies have described the role that bushmeat plays in rural traditional indigenous communities. In these contexts, hunting plays an important social and cultural role, also linked with identity (van Vliet and Mbazza 2011). Bushmeat contributes to food sovereignty, understood in a holistic manner (Arnold et al. 2011). Indeed, the political dimension of food sovereignty is closely related to territory management, decision making on food resources and the maintenance of traditional food cultures (Windfuhr and Jonsén 2005).

## 1.2 Food security in the Amazon under a changing environment

Nowadays most of the inhabitants of the Amazon are urban (Peluso and Alexiades 2005; Padoch et al. 2008; Yagüe 2013), with an estimation of more than 21 million people living in cities, representing 63% of the total population of the region (UNEP et al. 2009). The origins of the current Amazonian population are very heterogeneous and include *mestizos* or *caboclos* from the Amazon region, migrants from other regions of Amazonian countries, floating workers and tourists, and also urban indigenous people. Despite the fact that they represent a minority in many cities, urban indigenous people are increasingly present in urban and peri-urban areas around the whole region (Parry et al. 2010), basically searching for education, sanitary assistance and remunerated jobs. Inevitably, the contact with urban lifestyles leads to increased dependency on goods and services (Peluso and Alexiades 2005) and comes along with the adoption and incorporation of



**Harbor along the Amazon River in Leticia, Colombia (Photo by Maria Paula Quiceno)**

urban cultural models, including nutritional habits. Globalization, urbanization and the expansion of market economies in the last decades are transforming dietary patterns by replacing locally produced/harvested food with industrial and processed products (Popkin and Gordon-Larsen 2004; Popkin 2006). These changes in diet and activity patterns are commonly referred to as the “nutrition transition” (Popkin 2006). In tropical forest areas in general, the nutrition transition is characterized by a shift away from traditional foods, such as coarse grains, starchy roots (high in complex carbohydrates and fibers and low in fat) and wild sources of meat toward the consumption of staples such as rice and wheat, increased fat, including animal fat from domestic and industrial sources of meat, and refined sugar (Drewnowski and Popkin 1997). Because of the potential impacts on the increase of dietary and energy expenditure-related health problems such as obesity and high blood pressure, both commonly associated with cardiac diseases and type II diabetes (Silva and Padez 2010), it is important to assess the nutritional changes. Previously, changes in food consumption patterns were expensive to make and only people in medium to high strata levels were able to afford industrial food (Tagle 1988). A wide gap appeared between population groups that could afford more expensive, usually highly processed foods, and the poorer groups



**Three-wheel motorbike used for transportation of goods and people in Caballococha, Peru (Photo by Daniel Cruz)**

that maintained their traditional diets of mostly cereals, vegetables, roots and grains (Bermudez and Tucket 2003). Currently, signs of nutrition transition are also commonly observed among the poorer households in remote rural forest areas (Tavares et al. 2003; Benefice et al. 2007; Welch et al. 2009; Godoy et al. 2010; Silva et al. 2010; Nardoto et al. 2011; Piperata et al. 2011). Studies aimed at understanding the nutritional transitions that occur in Amazonian towns are increasingly available, showing the positive correlation between urbanization and change in food habits, particularly highlighting a change in the types of proteins consumed: from fish and bushmeat to processed and industrialized meats (Nardoto et al. 2011). However, these cultural transitions do not necessarily lead to the total demise of rural cultures, as migrating groups often maintain a link to the forest through rural–urban networks (Shackleton et al. 2013). There is currently a lack of knowledge about the contribution of Amazon forests to food security, particularly in urban and rural areas that are increasingly connected to markets.

### 1.3 Objectives of this research

This study aims to increase our understanding of the role that forests continue to play in the tri-frontier area of Brazil, Peru and Colombia for food security, cultural identities and local economies in the rapidly changing sociocultural context that is increasingly characteristic of medium-sized towns in the Amazon. We focus our research on bushmeat, which has been traditionally important in people's diets in the Amazon (Da Silveira and Thorbjarnarson 1999; Clayton and Milner-Gulland 2000; Robinson and Bennett 2000; Davies 2002). Our study provides a general description of the bushmeat catchment area in the tri-frontier region and covers the nutritional, cultural and economic value of bushmeat. Our research is guided by the following research questions:

- How important is bushmeat in people's nutrition, both in terms of quantity and quality?
- How important is the bushmeat trade for local economies?
- What cultural role does bushmeat play in urban indigenous identities?

# 2 our approach

## 2.1 Study site

The study was carried out from August 2012 to December 2013 in the tri-frontier region of Colombia, Peru and Brazil, at eight localities (Figure 1). Two localities were in Colombia — Leticia (37,832 inhab.) and Puerto Nariño (6983 inhab.) (including Loretoyacu River communities and peri-urban communities near Leticia); three were in Peru — Caballococha (7885 inhab.), Santa Rosa and Atacuari River communities; and three were in Brazil — Tabatinga (52,272 inhab.), Benjamin Constant (33,411 inhab.) and Atalaia do Norte (15,153 inhab.) (DANE 2007; INEI 2008, 2011; IBGE 2010).

Because of the geopolitical border, this region is subject to flows and exchanges of products, persons

from different origins, ideas and sociocultural identities. The population in the study results from different migration waves from a mixture of origins: indigenous (mostly Ticuna and Yagua in Peru; Ticuna, Cocama and Uitoto in Colombia), *colonos* and *mestizos* (INEI 2010; Suárez-Mutis et al. 2010). The original population of the area before colonization was dominated by the Ticuna ethnic group. Earlier Ticunas were well known as nomadic hunters and gatherers, who specialized in *terra firme* habitats. During the early 1900s, the Ticuna suffered profound changes due to their involvement in extractive economies such as rubber exploitation, the skin trade (e.g. big cat, caiman and otter skins) and the massive exploitation of different tortoise species for international markets (Riaño 2003; Franco 2006). During the 1960s, the high levels of wildlife trade drastically

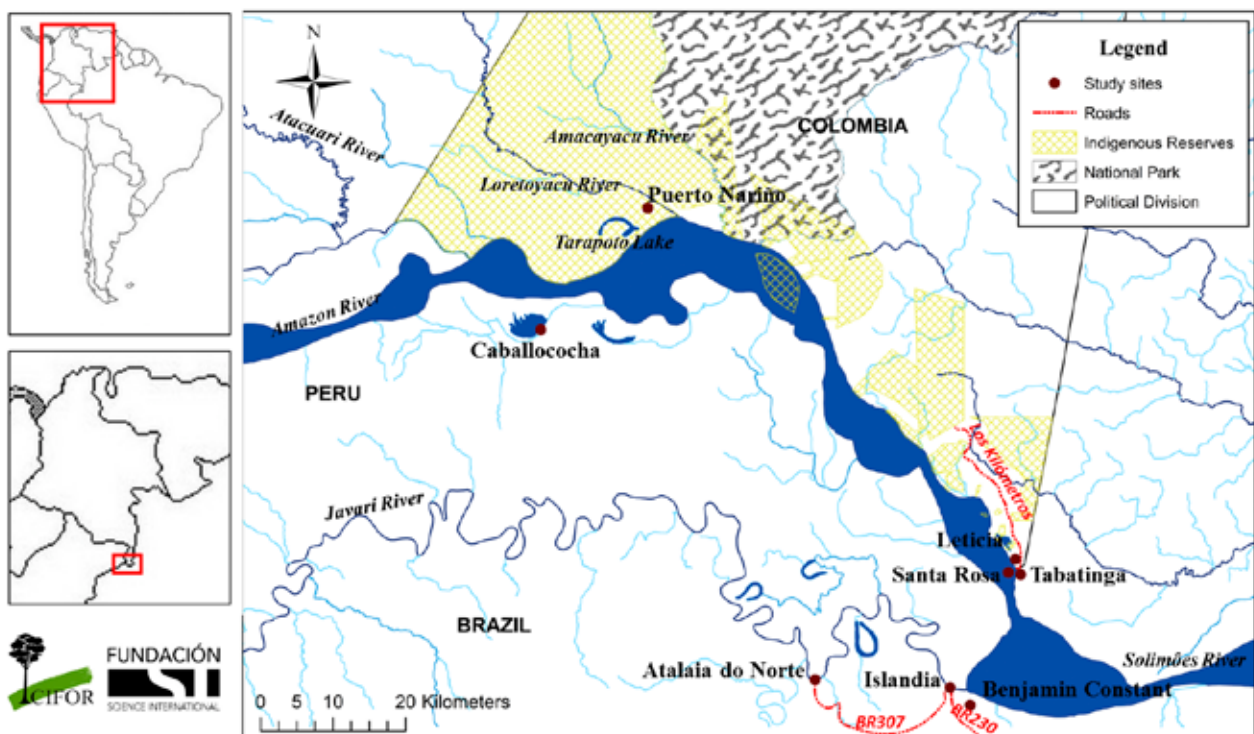


Figure 1. Map of the study area.

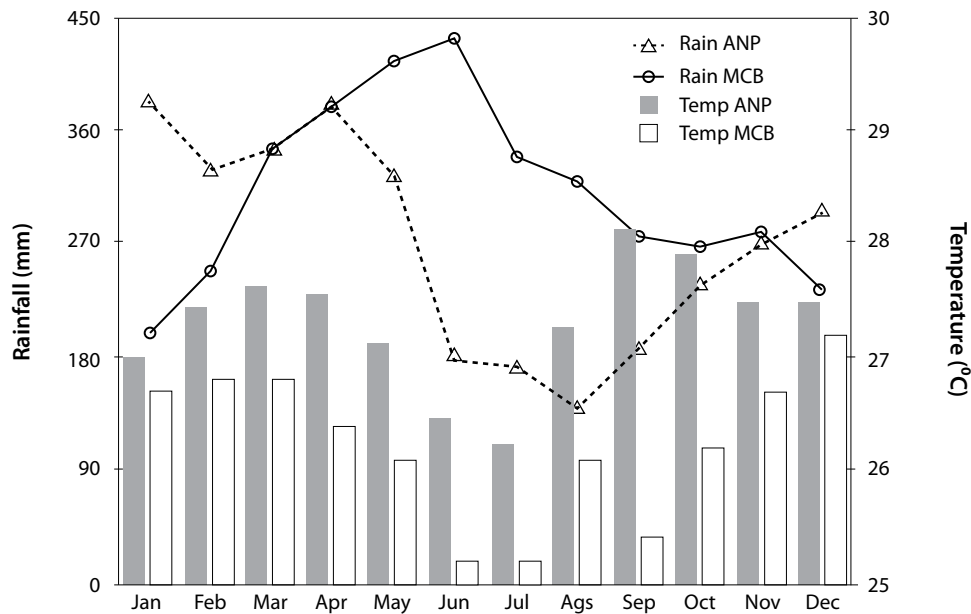
affected Ticunas' traditional use of resources, and commercial hunting was the main source of cash income in the area (Franco 2006). In the 1980s, the boom of the coca trade impacted on Ticuna society, as access to money became more common and traditional activities such as shifting cultivation were abandoned (Riaño 2003; Franco 2006).

Nowadays, the Ticuna indigenous group is widely distributed along the Amazon River in the tri-frontier region, with an approximate population of 40,000 inhabitants (between Colombia, Brazil and Peru), and is one of the largest indigenous groups in the area (López 2000; Franco 2006). Other minority ethnic groups such as the Cocamas, Boras, Yaguas and Uitotos, most of them coming from the interior of Colombia, also share indigenous territories with Ticunas in the study area (Riaño 2003). Farmers from the Andes region of Colombia (departments of Nariño, Cauca, Huila, Tolima, Valle, Cundinamarca, Boyacá, Meta) and Peru (Sierra region) have also migrated in consecutive waves of displacement or in search of new economic opportunities, triggered by agrarian reforms, directed colonization projects, armed conflict, forced displacement, improvement of infrastructure, and extractive booms, such as illegal crops of coca, logging, fisheries and

mining, mainly from the 1970s (INCORA 1974; Aramburú and Tavera 1993; Loker and Vosti 1993; Arcila et al. 2000; Fajardo 2008). Nowadays, despite its position as an enclave (only accessible by airplane or boat along the Amazon River), this region is globally connected to the world market. Leticia forms a single agglomeration with the neighboring city of Tabatinga on the Brazilian side and is also closely connected to communities and urban areas on the Peruvian side, just across the Amazon River. Commodities and people travel across frontiers by boat or by plane. Despite this relative isolation, the region is increasingly globalized, with manufactured goods and food products coming from different parts of Latin America: frozen chicken from the southeast and south of Brazil (Nardoto et al. 2011), live cows from the Putumayo region (Colombia) and Santarem (Pará, Brazil), vegetables from the Peruvian Andes and with cheap industrial items (pans, buckets, clothes, etc.) coming from Bogotá or Panamá. In the urban towns of the tri-frontier, the local economy relies on drug traffic, wood extraction, fishing and tourism. Besides the income obtained through state programs (*Bolsa familia* in Brazil or *Familias en acción* in Colombia), tourism and the illicit trade (drug trafficking and illegal extraction of cedar — *Cedrela* spp.) continue to



View from Puerto Nariño and the Loretoyacu River, Colombia (Photo by Daniel Cruz)



**Figure 2.** Monthly average rainfall and temperature at Amacayacu National Park (ANP) and the Middle Caquetá Basin (MCB) during the study period. Data are from IDEAM stations at Leticia and Araracuara.

contribute to the dynamic economy of the region (Riaño 2003; Zárate 2008).

The local economy in rural areas, where indigenous populations are still largely in the majority, relies mainly on land cultivation based on small slash-and-burn patches (*chagras*) and trade (particularly in urban areas). The agricultural food production, which is poor in protein, is complemented by hunting and fishing (Quiceno et al. 2014). Small tributaries, ox-bow lakes and *varzea* (seasonally flooded forest) adjacent to the Amazon provide an abundance of fish, particularly from July to October when the river is at its lowest and many fish are restricted to small pockets of deep water. Subsistence hunting of tapir, peccaries, monkeys, armadillo, paca and deer is most important during the rainy season when the yield from fishing diminishes (Quiceno et al. 2014). In addition, low numbers of domesticated livestock, especially pigs and chickens, also subsidize the protein economy (Hammond et al. 1995).

The study area is characterized by a unimodal–biseasonal rain regime with a multiannual average precipitation of 3270 mm and with a monthly average of 266 mm. The lowest rainfall is registered in August, with an increase in September and then a sharper increase from January to April

(Figure 2), the wettest months of the year (Rudas et al. 2005). Dry conditions at the site, in combination with similarly low rainfall upriver along the eastern slopes of the Andes, result in a substantial drop in the river level during the July–September interlude. The Amazon River reaches its maximum level in May (1686 cm) and drops to its lowest level in September (445 cm) (Maldonado-Rodríguez 2010). The average temperature is 26.2 °C and the average relative humidity is over 86%. *Terra firme* (or upland) soils at the site are predominantly Ultisols (low pH, high A1 saturation), while the more fertile soils covering the seasonally inundated *varzea* are generally classified as Inceptisols. Land tenure in the study area represents a mosaic of 1) forest reserves/agroextractivist settlements, 2) national park, 3) indigenous territories, 4) indigenous settlements, 5) private properties, and 6) illegally occupied areas by displaced populations (IGAC 1997). Amacayacu Natural National Park (ANNP) covers 2940 km<sup>2</sup> and is located on the Colombian side of the frontier with Peru. The forest mosaic presented in ANNP sustains a high assemblage of vertebrate fauna, including more than 150 terrestrial mammal species, four aquatic mammal species and 468 bird species of the 500 reported for the Colombian Amazon (Alberico et al. 2000; Defler 2004; PNNA 2005).

## 2.2 Gender as a cross-cutting entry point

The role of women in natural resource use has been a recurrent theme in social scientific research over recent decades (e.g. O’Shaughnessy and Krogman 2011), especially in relation to developing countries. While in the 1980s, seminal publications developed an ecofeminist perspective proposing that women in their resource use were generally more caring toward their environment than were men (Shiva 1989), this paradigm was heavily criticized in the 1990s. In particular, critics argued that the essentialist notion that women cared for their environment because of their intrinsic, close connection to nature ignored the social processes and contexts of gendering, the multiplicity of women’s identities beyond gender (e.g. related to class or caste), and importantly, power relations between social groups (Jackson 1993). More recent research on the role of women in resource use has thus abandoned essentialist ideas, and focused on differences between women and men, and their roles, behaviors and experiences (Aguilar et al. 2011). In this research, rather than concentrating *a priori* on gender differences and contradictions, we look at potential complementarities and mutual reinforcement of gendered activities throughout the bushmeat market chain. Our study explores the role of women and men in hunting, exchanging, preparing and consuming bushmeat.

## 2.3 General description of the methodology

This study combined a diversity of approaches to aid in our understanding of the nutritional, economic and cultural role of bushmeat in the tri-frontier, including participatory observation, monitoring, interviews and participatory mapping.

### 2.3.3 Nutritional role of bushmeat Bushmeat consumption frequencies and meat preferences

To study the nutritional role of bushmeat, we first investigated bushmeat consumption frequencies in rural-to-urban contexts. Our method of data collection follows van Vliet et al. (2014a) and is based on consumption surveys carried out with school children using a 24-hour recall. This method is particularly suitable for rapid



Wife of a hunter preparing the meat of a paca, Puerto Nariño, Colombia (Photo by Daniel Cruz)

assessments, because it allows data to be collected on numerous children, requires considerably fewer financial resources than household interviews and has the potential to be used to monitor consumption over time at larger scales (van Vliet et al. 2014a). We chose pupils between 12 to 16 years old in order to interview those old enough to understand the questions asked and to recall the composition of their meals. All children from a class were sampled concurrently by distributing a simple written questionnaire during classes, explaining each question one by one, and leaving some time between questions for the children to complete the questionnaire with assistance from the teacher and the researchers. We assessed 886 children from 11 schools during the dry season (between September and October 2012) and 1043 children from the same schools during the rainy season (March to May) (Table 1). In rural and peri-urban areas, we interviewed pupils at the only schools available, whereas in urban areas our sample included pupils at schools that were geographically well distributed in town, including private and public schools, to account for the



**Table 1. Sampling of children interviewed on their animal protein consumption using a 24-hour recall method during the rainy and dry seasons in Brazil and Colombia.**

Country	Location	# of surveys, dry season	# of surveys, rainy season
Brazil	Atalaia do Norte	107	94
	Benjamin Constant	91	101
	Tabatinga	197	194
Colombia	Leticia	274	353
	Puerto Narino	94	166
	Peri-urban areas of <i>los Kilometros</i>	63	59
	Indigenous communities	60	76
<b>Total</b>		<b>886</b>	<b>1,046</b>

socioeconomic diversity of the towns. Permissions for working with children were obtained with the informed consent from competent authorities (school directors, teachers, parents), following the ethical research guidelines from the Center for International Forestry Research.

The questionnaire contained general questions about the children and their families (age, ethnic group, religion, number of adults and children in the household), the composition of their meals consumed the day before the interview (breakfast, lunch and dinner) in terms of animal protein composition, and their preferred animal protein. For each of the meals consumed the day before the interview, children were asked if they had eaten any of the most common sources of animal protein available: fish, pork, chicken, eggs, mutton, beef, duck, or bushmeat. Here we use the definition of bushmeat from the Convention on Biological Diversity (CBD) Bushmeat Liaison Group, which defines bushmeat (or wild meat) as wild terrestrial animals (including mammals, amphibians, reptiles, birds) hunted or harvested in tropical and subtropical countries for food and for non-food purposes, including medicinal use (CBD 2011). However, we also include beetle larvae which, as insects, are not normally included in the definition of the CBD, but are important sources of protein from the wild in the tri-frontier region. If they had consumed bushmeat or fish, we asked about the species consumed. We compared the consumption frequency and species of wild animal sources of protein (bushmeat and fish) and domestic or industrial sources of animal protein among children from rural indigenous communities along the Amazon River, the small town of Puerto Nariño, peri-urban areas and the town of Leticia.

We also analyzed the diversity of animal protein types consumed at those different sites, using the Shannon index of diversity, based on the following formula:

$$H = -\sum p_i * \ln(p_i)$$

where H is the index of diversity of sources of protein and  $p_i$  is the frequency of meals with each source of protein,  $i$ .

Schoolchildren who participated in the protein consumption survey were requested to obtain the consent of their parents to include their household in the next steps of the research. The families that agreed to participate were asked to provide information about the household address and contact information, whereas the households that did not were excluded from the database. The database was then divided into two groups, depending on whether bushmeat had been consumed on the previous day or not. Both groups were subsequently distributed into two subgroups according to household assets, as a proxy for wealth. Households with five or more assets were considered high income, and households with four or fewer assets were considered low income, considering the median of the distribution of assets among the households in the sample. Lastly, households were stratified according to school location (small town, peri-urban and urban). Identical procedure was followed in each country (Colombia and Brazil), resulting in the 105 households sampled and interviewed for the food consumption frequency survey (49 in Brazil; 56 in Colombia). Adult men and women from those households (a total of 248 individuals) were interviewed on



School children being interviewed in Puerto Nariño, Colombia (Photo by Nathalie van Vliet)



Household head describing the animals most commonly consumed using a colored plate with birds, mammals and reptiles present in the study area (Photo by Blanca Yagüe)

their animal protein consumption frequencies and preferences so as to compare their answers with those obtained from their children.

#### **Nutritional value of bushmeat meals**

Data on household food intake were collected in a subsample of 35 households (selected among the sample mentioned above) during the dry season (June and July 2013, including working days and weekends) (Table 2). The 24-hour food recall method involves semistructured interviews with the adult responsible for preparing the meals of the household (Murrieta 2000; Murrieta and Dufour 2004; Adams et al. 2009). Weights of food items were obtained in grams using portable digital scales, and volumes were obtained using plastic jars and scales. Information on the origin of foods consumed (purchase, cultivation, extraction, donation, exchange, or sale) and on the number of participants present at the meals was gathered. Data collected were processed into a database containing information on the socioeconomic characteristics and food intake of the household members. The number of household members was converted into adult equivalent units, according to age and sex (Viacava et al. 1983), in order to minimize any potential underestimation of food consumption per capita (Claro et al. 2010). The



School kids being interviewed in a school in Puerto Nariño, Colombia (Photo by Nathalie van Vliet)

Table 2. Household sample characteristics.

Characteristics		Total		Hh <sup>a</sup> without BM Cons <sup>b</sup>		Hh with BM Cons	
		N	%	n	%	N	%
Country	Brazil	20	57%	17	57%	3	60%
	Colombia	15	43%	13	43%	2	40%
Income	High	8	23%	7	23%	1	20%
	Low	27	77%	23	77%	4	80%
		Avg <sup>c</sup>	SD <sup>d</sup>	Avg	SD	Avg	SD
Hh members	Individuals	6.5	3.1	6.4	3.3	7.0	2.3
	AE Units <sup>e</sup>	5.1	2.3	5.1	2.4	5.5	1.6

Obs.: <sup>a</sup>Hh = household; <sup>b</sup>BM Cons = bushmeat consumption; <sup>c</sup>Avg = average; <sup>d</sup>SD = standard deviation; <sup>e</sup>AE Units = adult equivalent units.

adult equivalent units were summed to indicate the number of adult equivalents in each household. The food intake was converted into calories, macronutrients (protein, carbohydrates and lipids) and micronutrients (fiber, cholesterol, vitamin C, iron, sodium and calcium) in accordance with food composition tables from Brazil (Ministério da Saúde et al. 2002; NEPA/UNICAMP 2011) and Colombia (ICBF 2014a, 2014b), complemented with the food composition table from the United States Department of Agriculture in the case of a few food items that were not available in the

regional tables (USDA 2014). The calories and nutrients available at each meal were distributed among the adult equivalents in the household, resulting in values of calories and nutrients per adult. In some cases, as indicated by the interview subjects, invited guests were also computed as participants of a specific meal, using the same adult equivalent conversion method. The nutritional intake per adult equivalent was compared with nutritional requirements proposed for the evaluation of a population's nutritional status (National



Smoked tapir meat, fresh deer meat and tortoise eggs in Leticia, Colombia (Photo by Nathalie van Vliet)

Research Council 1989; Institute of Medicine 1997; Food and Nutrition Board – Institute of Medicine 2002).

### **Bushmeat trade and its role in local economies**

Structure of the bushmeat trade, and volumes and species traded

Given the fact that the bushmeat trade occurs in hidden channels, we spent 3–4 months in 2012 exclusively observing the market, discussing with consumers, identifying and approaching the traders through informal discussions, sharing meals and traveling around to potential source areas. This investment of time was crucial in gaining the confidence of different stakeholders. We were able to explain our objectives and approaches and to include them as active informants of our research. The data obtained were synthesized to describe the sale points, the typology of stakeholders in the chain from the hunters to the urban consumers, the main trade routes and the transport means so as to define the overall catchment area and the relationship among stakeholders.

Once we had an exhaustive idea of the existing sale points and had developed a collaborative



Armadillo being sold in the market at Tabatinga, Brazil (Photo by Daniel Cruz)

relationship with the different stakeholders of the chain, we conducted two types of semistructured interviews: one designed for the hunters and another designed for market sellers and restaurants. A total of 95 interviews were carried out with 55 out of the 115 hunters participating in the trade (n=48%), 12 market sellers out of the 34 selling bushmeat in the market (n=35%), and 14 formal restaurants and 14 informal restaurants (street food stalls) out of the 46 that sell bushmeat (n=61%). The interview carried out with hunters sought to understand issues related to hunting techniques, frequency of hunting, motivations for hunting, prey composition, impact of seasonality on prey availability and prices, costs, impact of law enforcement, other sources of income and socioeconomic characteristics. These

interviews were carried out during visits to nearby communities and markets. The interviews were coupled to a participatory mapping exercise in order to locate the hunting grounds and landscape features (such as trails, rivers and hunting camps) most commonly used during their hunting activity. The interview developed for market sellers and restaurants aimed at exploring purchase and sale prices, diversity of products sold, type of bushmeat commercialized, customer types and preferences, costs involved, frequency of the trade, amount of bushmeat, impact of seasonality on bushmeat availability and prices, impact of law enforcement and socioeconomic characteristics.

To estimate the total amount of bushmeat being commercialized in the tri-frontier region

**Table 3. Number of interviews undertaken and total number of stakeholders identified.**

Country and City	Users	Number of interviews developed	Total number of actors identified	
Colombia	Puerto Nariño and Loretoyacu River communities	Hunters	8	40
		Market sellers	2	1
		Restaurants (formal)	5	5
		Restaurants (informal)	2	2
	Leticia	Hunters	7	8
		Market sellers	3	6
		Restaurants (formal)	4	5
		Restaurants (informal)	4	6
Peru	Caballococha and Atacuari River communities	Hunters	9	20
		Market sellers	6	9
		Restaurants (formal)	3	6
		Restaurants (informal)	8	15
	Santa Rosa	Hunters	0	1
		Restaurants (formal)	0	2
		Restaurants (informal)	0	1
	Islandia	Market sellers	0	2
Brazil	Tabatinga	Hunters	1	3
		Market sellers	1	6
		Restaurants (informal)	0	1
	Benjamin Constant	Hunters	23	31
		Market sellers	0	5
		Restaurants (formal)	2	3
		Restaurants (informal)	0	3
	Atalaia do Norte	Hunters	7	12
Market sellers		0	5	
<b>Number of interviews developed and total number of actors identified</b>		<b>95 (49%)</b>	<b>195</b>	

as well as the main trade routes, we developed a participatory monitoring protocol in which local hunters and market sellers were responsible for data collection (see Table 3 for the sampling effort). Monitors were chosen based on two criteria: 1) the level of willingness to participate and the interest in the research shown during the initial informal conversations, and 2) the degree to which the person trusted the researchers, especially in Colombia, where legal restrictions make people feel unsafe when providing this type of information. A monitoring notebook was designed to register data related to costs of the activity, incentives, seasonality, main customers, prices, type of bushmeat (fresh, salted, smoked), law enforcement and quantity sold. For the hunters, additional questions concerning hunting areas, main types of prey, and utilization patterns (bushmeat being sold or being used for family consumption) were also asked. The monitoring period covered two hydroclimatic phases: one in May and one in September 2013 (high and low waters, respectively). Market sellers were asked to register data for 10 consecutive days, whereas hunters monitored their activities during a 30-day period. The difference lies in the fact that market sellers practice their activity on a daily basis whereas hunters only hunt on 1 out of 3–5 days, which means that over a month we collected data for about 10 hunting days for each actor in each period. To ensure the quality of self-reported data, the researchers visited market sellers on a daily basis and the hunters every 5 days during the monitoring period. Finally, direct-observation monitoring was also developed for the duration of the study (from August 2012 to September 2013) in order to triangulate the data recorded. Frequent informal visits to the main marketplaces were carried out in selected settlements of the tri-frontier region from 5 am to 8 am when the meat stalls were being set up and just before closing time, between 11 am to 12 noon.

**Economic importance of bushmeat use and trade**  
In this section, we estimate the net profit generated at the hunters' level, based on an estimation of the value of total production (understood as the value of the biomass harvested) and the costs associated with hunting activities. We analyze the economic value both in terms of self-consumption and trade. Our geographical unit of analysis is the tri-frontier catchment area, which includes the area that provides bushmeat to the main towns of the

region: Leticia and Puerto Nariño in Colombia; Tabatinga, Benjamin Constant and Atalia do Norte in Brazil; and Caballococha and Santa Rosa in Peru. Our estimations are based on information gathered from the 55 hunters interviewed, from a total of 115 identified. The sample is representative because both specialized and diversified hunters were taken into account and the sample includes hunters providing bushmeat to the main markets of the three countries. Out of the scope are occasional hunters or hunters who only hunt for their own consumption, because our aim was to concentrate on those hunters for whom the bushmeat trade is part of their livelihoods. This methodological choice is based on the fact that “subsistence,” under national laws in the Amazon, does not question self-consumption but bans bushmeat trade. The questionnaires collected information on the type of species and the number of specimens hunted in the last week, last month and over the last 3 months. We used as unit of analysis the monthly data and checked their coherence with the weekly and trimestral data. Our analysis consisted in estimating the net profit function (including both trade and self-consumption) as follows:

$$\pi = (\sum P_i Q_i) - \sum C$$

where

$\pi$ : net profit of hunting

$Q_i$ : volumes hunted for species  $i$  (in kilograms) ( $i$  = peccaries, large rodents, brocket deer, etc.)

$P_i$ : market price per kilogram for species  $i$

$C$ : cost of hunting.

The price ( $P_i$ ) was estimated per kilogram of specimen  $i$  and per country. We estimated these prices in Colombian pesos and US dollars using the exchange rates on 1 May 2013.<sup>1</sup>

To assess the quantities of wild meat (in kilograms) per species ( $Q_i$ ), we used the information provided by the hunters concerning their catch in the month immediately prior to the survey. We considered that hunting levels were relatively stable throughout the year regardless of the season, which is true for diversified hunters (as observed during the monitoring). Since half of our surveys were

<sup>1</sup> 1 USD = 0.000489 Colombian pesos; 1 sol = 703.029 Colombian pesos; 1 real = 909.0909 Colombian pesos.

conducted during high waters and the other half during low waters, we consider that the amount reported in the month immediately prior to the survey is representative of what could be observed throughout the year. We first listed the number of species hunted in each country. We then estimated the average weight per specimen in kilograms (based on Emmons and Feer (1997), taking into account that we used 75% of the average adult weight to compensate for the weight of bones and head for the biggest species<sup>2</sup>).

The cost (C) of hunting for the region was estimated as the sum of the monthly costs for each country (Peru, n=9; Brazil, n=31; Colombia, n=15) to take into account differences in costs across the three borders. The function of costs took into account the following items:

1. Variable costs (such as the equipment, food, ammunition and petrol necessary for hunting).
2. Depreciated fixed costs (initial commercial cost/product lifespan/month).
3. Cost of time invested in hunting (average time spent hunting in hours per month × minimum wage for each country per hour). We did not include the cost of illegality in the estimation of total costs, but we have provided an estimation of the loss that hunters could incur if enforcement was optimal. The cost of illegality was estimated by multiplying the total production of bushmeat harvested (kilograms of bushmeat from n=55 hunters) by a fine of USD 222 per kilogram of bushmeat seized, following the norms of Brazil's legislation (since legal texts in Colombia and Peru do not state the amount of the fine per kilogram, but rather per case reported<sup>3</sup>).

#### Preliminary ethnographic study of the role of bushmeat from a cultural perspective

We described bushmeat networks from a social and cultural perspective using an ethnographic

2 This corresponds to the tapir (*Tapirus terrestris*), the collared peccary (*Pecari tajacu*), the white-lipped peccary (*Tayassu pecari*) and the red brocket deer (*Mazama americana*).

3 Legal texts in Colombia state that the penalization for illegal hunting or trade can lead to a maximum of 3 years in prison and a fine equivalent to 5000 annual minimum wages, equivalent to USD 150,000; and for the case of Peru it can reach up to 5 years in prison and a fine equivalent to 400 annual minimum wages, equivalent to USD 100,000.



**Participatory mapping exercise developed with hunters in Puerto Nariño, Colombia (Photo by Daniel Cruz)**

approach, combining semistructured interviews, participant observation and visits to sites of bushmeat exchange. This component of the research does not represent an in-depth ethnographic study (given the duration of the field work), but presents generalities about bushmeat networks that complement other aspects of the project. Our point of departure for this study was a sample of three families on the Colombian side of the frontier, who share some common characteristics (multiethnic but predominantly indigenous families having diversified livelihoods who are well connected to an urban lifestyle), but who differ in that they are located along a peri-urban to urban continuum. These families were selected using purposive sampling (Patton 1990; Maxwell 2008), as they were deliberately selected



**A hunter's house in a rural indigenous community near Puerto Nariño, Colombia (Photo by Daniel Cruz)**

because of the importance and representativeness of the information they could provide (Maxwell 2008). The purposive sampling technique is a type of nonprobability sampling that is most effective when one needs to study a certain cultural domain using specific local residents with expert local knowledge. In our case, our sampling comprises a peri-urban indigenous household with strong and direct links to the forest and the city (family 1), an urban indigenous household with strong links to the forest (family 2) and an urban indigenous household with less tangible relationships to the forest (family 3).

The choice of the families was also driven by the degree of trust that the researchers could build. As Gardner and Davies (2014) point out, asking about hunting and bushmeat consumption can be a sensitive issue, as its commercialization is illegal in the three countries of the tri-frontier, and environmental authorities exert some kind of enforcement, mainly along the Colombian border. This was the principal reason for working with families with whom trust was built from previous research (Yaguë 2013), enabling open discussions about the topic. It is important to clarify that the Amazonian households are not static entities, and are often characterized by a high mobility of people

and settlements, even if they live in cities (Eloy 2009; Pinedo-Vázquez and Padoch 2009). As a result, the composition of the families we studied varied considerably in terms of their members, economical activities and even the places of living throughout the year. The three families were initially characterized during pre-arranged visits, where semistructured interviews were carried out in order to characterize the household in terms of the age and gender of the most permanent members, their origin and ethnic identity, as well as to gain a general understanding of the main economic activities of the household members.

From April to December 2013, further visits to each household were arranged on a regular basis, following a participant observation approach. In addition, the researchers asked the households to call them, particularly when bushmeat arrived at the house, so that they could participate in the process of preparation, cooking and consumption of bushmeat and ask about the species and origin of the meat. Researchers were also informed when different activities involving bushmeat were going to take place and participated in three *mingas* (communal work), one dance ritual, two airport visits and three hunting journeys into the forest. On these occasions, following the ethnographic



approach, we observed what was going on, posed some questions and registered everything in our notebooks (Spedding 2006) as we interacted with the other participants. In addition, one of our researchers lived for a month (April 2013) with family 2 and more specific data about daily protein consumption was registered.

We registered every occasion on which bushmeat was hunted, traded, exchanged, shared or consumed by any of the family members, and we added to this information, further information about the network of stakeholders involved, paying particular attention to the person responsible for each action and the type of interaction established. Moreover, we visited the families and went with them to the different places where bushmeat was pursued, exchanged (either given or received), traded (bought or sold) and consumed. The main places we considered were: the houses of each family; the forest; the *chagra* (shifting cultivation

field); the market (daily market and indigenous market); restaurants and food stalls; the airport; and indigenous *malocas* (traditional housing). During fieldwork, informal conversations took place among hunters, sellers and consumers of bushmeat, adding relevant details to our understanding of bushmeat transactions within indigenous networks.

To ensure the ‘trustworthiness’ of our research (Marshall and Rossman 2011), we triangulated our results with those obtained for other components of the project. Triangulation refers to cross-checking the data (Schwandt 2007) so as to reduce the potential systematic bias that can occur when using only a limited data source, method or procedure (Maxwell 2008). Triangulation was done using multiple data sources from the bushmeat market chain study and bushmeat consumption studies carried out simultaneously in the same region (van Vliet et al. 2014b).

# 3 Bushmeat and food security: Demise or persistence?

## 3.1 Bushmeat consumption frequencies and preferences for different types of animal protein

Our results show that less than 1% of the sampled children did not eat any type of animal protein the day before the interview (including those in indigenous communities, small towns, peri-urban areas and towns). As we move from rural indigenous communities to urban areas, we show a clear gradient characterized by an increased frequency of children having consumed poultry or eggs, beef and industrialized meats, and a decreased frequency of those having consumed fish and bushmeat the day before the interview (Figure 3). In urban areas, only 2% of the children ate bushmeat the day before the interview and 9% ate fish, whereas in rural communities the percentage of children having consumed bushmeat or fish was

equal to 11% and 40%, respectively. The most consumed bushmeat species was paca (*Cuniculus paca*, 58% of the meals containing bushmeat) during the dry season, whereas during the rainy season, species consumed were paca (56%), red brocket deer (*Mazama americana*, 22%) and tapir (*Tapirus terrestris*, 17%) (Table 4).

The most consumed fish species were palometa (*Mylossoma duriventis*, 34% of the meals containing fish) and surubí (*Pseudoplatystoma fasciatum*, 17%) during the dry season, and bocachico (*Prochilodus* sp., 43%), palometa (*Mylossoma duriventis*, 21%) and pintadillo (*Pseudoplatystoma tigrinum*, 14%) during the rainy season.

The diversity of sources of animal protein consumed was twice as high in rural communities, small towns and peri-urban areas as in towns



Deer meat ready for lunch in Leticia, Colombia (Photo by Nathalie van Vliet)

**Table 4. Percentage of meals with each bushmeat and fish species consumed during the rainy and dry seasons.**

	Common name	Scientific name	Percentage of meals containing each species during the rainy season	Percentage of meals containing each species during the dry season
Bushmeat species	Tapir	<i>Tapirus terrestris</i>	<b>17%</b>	3%
	Paca	<i>Cuniculus paca</i>	56%	58%
	Peccari	<i>Pecari tajacu</i> ; <i>Tayassu pecari</i>	0%	6%
	Agouti	<i>Dasyprocta fuliginosa</i>	6%	6%
	Deer	<i>Mazama americana</i>	<b>22%</b>	3%
	Capybara	<i>Hydrochoerus hydrochaeris</i>	0%	6%
	Caiman	<i>Caiman crocodilus</i>	0%	6%
	Tortoise	<i>Chelonoidis denticulata</i>	0%	6%
Fish species	Mojojoi (beetle larvae)	<i>Rhynchophorus palmarum</i>	0%	8%
	Palometa	<i>Mylossoma duriventis</i>	22%	33%
	Pintadillo	<i>Pseudoplatystoma tigrinum</i>	<b>14%</b>	8%
	Cucha	<i>Hypostomus plecostomus</i>	2%	0%
	Bocachico	<i>Prochilodus</i> sp.	<b>43%</b>	0%
	Arenga	<i>Pellona castelnaeana</i>	0%	8%
	Surubí	<i>Pseudoplatystoma fasciatum</i>	2%	<b>17%</b>
	Yaguariche	<i>Potamorhina latior</i>	2%	0%
	Carahuasú	<i>Astronotus ocellatus</i>	2%	0%
	Paco	<i>Piaractus brachypomus</i>	6%	8%
	Pirarucu	<i>Arapaima gigas</i>	4%	8%
	Tucunare	<i>Cichla</i> sp.	2%	0%
	Sábalo	<i>Brycon melanopterus</i>	2%	0%
	Mota	<i>Calophysus macropterus</i>	0%	8%
	Tambaqui	<i>Colossoma macropomum</i>	0%	8%

(indigenous rural communities:  $H=0.33$ ; small towns:  $H=0.37$ ; peri-urban areas:  $H=0.32$ ; urban areas:  $H=0.14$ ). The comparison between consumption patterns among indigenous children in rural and urban areas shows that indigenous children in urban areas ate significantly less bushmeat and fish and significantly more chicken and eggs than did indigenous children from rural areas (Figure 4).

In rural and urban settings, around 50–60% of the children interviewed stated a preference for eggs and about 20–35% a preference for beef. In contrast, adults, stated a preference for beef, locally produced chicken, fish or bushmeat, but ate industrial chicken, eggs or fish most often (see Figure 5). Among the adults interviewed, a total of 34.5% had consumed bushmeat at least once in

the 30 days prior, and the pattern was maintained across genders (men=37.15%; women=32.3%;  $Q_2=0.615$ ,  $p=0.433$ ) and countries (Colombia=33.85%; Brazil=35.1%,  $Q_2=0.053$ ,  $p=0.818$ ). When considering their lifetimes, from a list of 71 species available locally, people in the sample reported having already tasted an average of 23.3 different species ( $SD=13.9$ ), and the same pattern was found in the two countries ( $t$  test= $-0.525$ ,  $p=0.458$ ). In contrast, there was a small but consistent gender difference in the average number of species tasted: while men had eaten an average of 26.4 species ( $SD=13.6$ ), women had eaten 20.6 species in their lifetimes ( $SD=13.7$ ;  $t$  test= $-3.348$ ,  $p<0.001$ ). Only three people in the sample (-1%) had never tasted any bushmeat, while 15% had tasted 40 or more species.

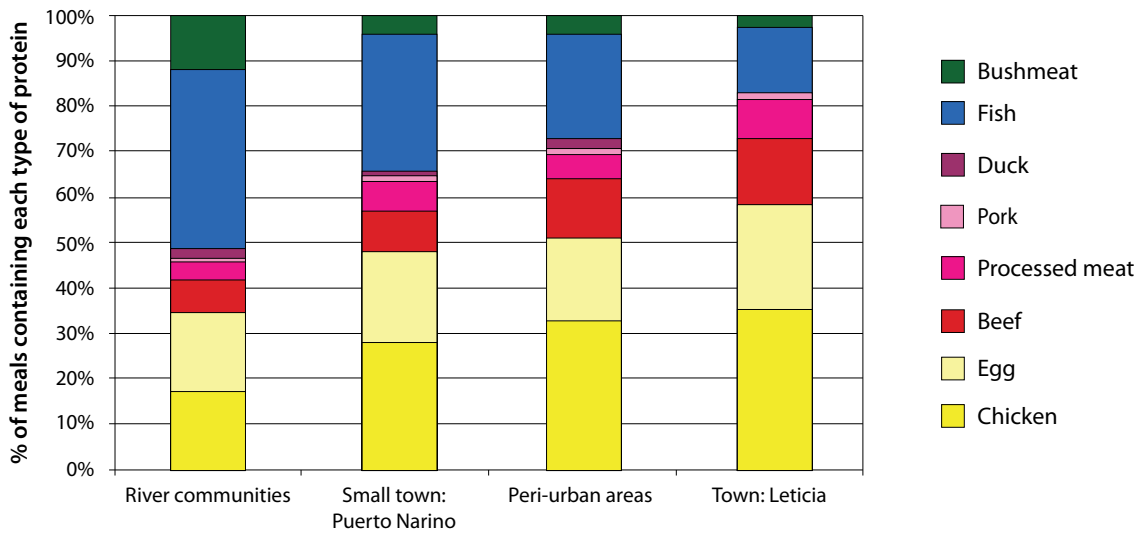


Figure 3. Percentage of meals containing each type of protein, from rural to urban areas in the tri-frontier area.

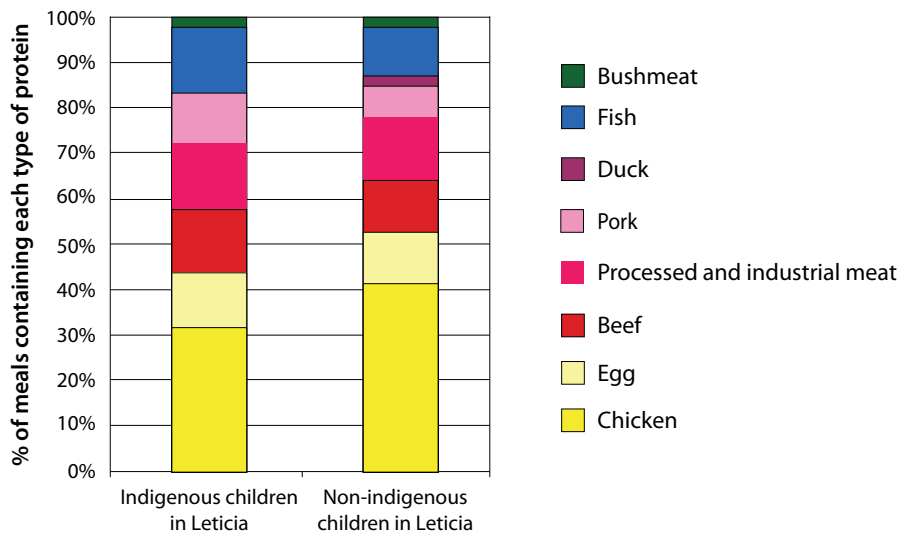


Figure 4. Percentage of meals containing each type of protein, consumed by indigenous children and non-indigenous children in Leticia (Colombia).



Fish for sale in the market of Tabatinga, Brazil (Photo by Maria Paula Quiceno)

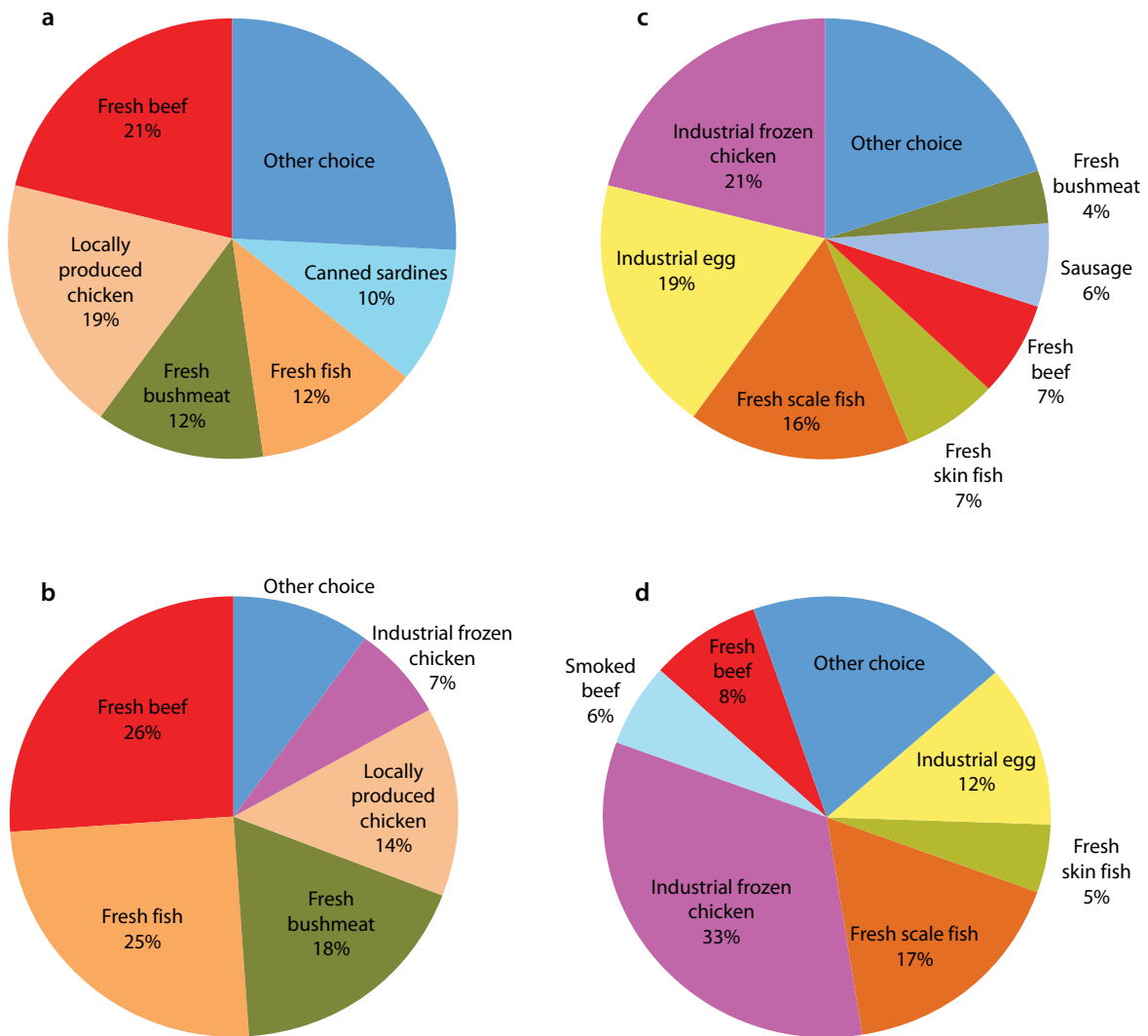


Figure 5. Preferences for different sources of animal protein: a (Leticia), b (Tabatinga); and consumption frequencies of different sources of animal protein: c (Leticia), d (Tabatinga), among adults from Tabatinga, Brazil (N=108) and Leticia, Colombia (N=119).

### 3.2 The importance of bushmeat as a source of micronutrients

The results obtained in household food intake surveys indicate that households in the Amazonian region barely achieved recommended caloric intake per adult in the periods analyzed. The intake of other nutrients considered markers of healthy diets, such as fiber, calcium and vitamin C were also usually inferior to nutritional recommendations adopted by the World Health Organization, indicating low consumption of fruits and vegetables (Table 5). For nutrients associated with unhealthy diets (sodium, cholesterol and

saturated fatty acids), households in the survey usually presented as having an excessive intake of sodium and a low intake of cholesterol and saturated fatty acids in relation to the nutritional recommendations. As regards such nutrients, households that registered that they consumed bushmeat had a nutrient intake that may be considered marginally higher (respectively, +8% in sodium, +20% in cholesterol and +25% in saturated fatty acids), since in the first case both groups of households exceeded the maximum level of recommended intake by far, and in the second and third cases both groups of households did not reach the maximum level of recommended intake.



Women preparing bushmeat in Leticia, Colombia  
(Photo by Nathalie van Vliet)



Hunter preparing meat from a paca in Puerto Nariño, Colombia  
(Photo by Daniel Cruz)

**Table 5. Nutrient intake per day per adult in households according to their declaration of bushmeat consumption.**

Nutrient	Total			Hh <sup>a</sup> without BM Cons <sup>b</sup>			Hh with BM Cons			DRI <sup>c</sup>
	Avg <sup>d</sup>	SD <sup>e</sup>	Adeq <sup>f</sup>	Avg	SD	Adeq	Avg	SD	Adeq	
Calories (kcal)	1762.62	656.26	-39.2%	1727.85	654.63	-40.4%	1971.25	700.22	-32.0%	2900.00
Fiber (g)	14.75	8.94	-61.2%	15.10	9.06	-60.3%	12.66	8.77	-66.7%	38.00
Calcium (mg)	410.61	207.74	-68.4%	408.70	191.45	-68.6%	422.09	317.63	-67.5%	1300.00
Iron (mg)	8.00	6.13	-55.5%	6.59	3.02	-63.4%	16.51	12.17	-8.3%	18.00
Sodium (mg)	3712.46	2039.93	642.5%	3672.46	1955.06	634.5%	3952.46	2752.37	690.5%	500.00
Vitamin C (mg)	20.12	20.02	-77.6%	20.77	21.20	-76.9%	16.26	11.23	-81.9%	90.00
Cholesterol (mg)	374.65	175.19	24.9%	364.11	155.87	21.4%	437.88	280.90	46.0%	300.00
Protein (g)	95.93	50.61	21.8%	89.97	41.43	20.8%	131.72	86.38	26.7%	10–15%
Lipids (g)	60.22	31.01	30.7%	57.75	31.93	30.1%	75.01	21.53	34.2%	15–30%
Carbohydrates (g)	206.51	102.65	46.9%	209.59	104.40	48.5%	188.00	100.20	38.1%	55–75%
Saturated FA <sup>g</sup> (g)	15.96	7.82	8.2%	15.41	7.84	8.0%	19.28	7.57	8.8%	<10%
Monounsaturated FA (g)	18.97	10.44	18.2%	18.44	10.88	17.7%	22.18	7.30	20.5%	>6%
Polyunsaturated FA (g)	16.62	9.57		15.62	9.53		22.64	8.17		

<sup>a</sup>Hh = household; <sup>b</sup>BM Cons = bushmeat consumption; <sup>c</sup>DRI = Dietary Reference Intakes; <sup>d</sup>Avg = average intake; <sup>e</sup>SD = standard deviation; <sup>f</sup>Adeq = adequacy in relation to nutritional recommendations; <sup>g</sup>FA = fatty acids.



**Armadillo meat being sold in Tabatinga, Brazil (Photo by Maria Paula Quiceno)**



**Paca meat dish in Caballococha, Peru (Photo by Daniel Cruz)**

Food consumption patterns per day per adult in households that did not register bushmeat consumption during the survey indicated the presence of a higher intake of carbohydrates (+12%), and a lower intake of proteins (−32%) and iron (−60%). It is worth noticing that one of the main food items registered in the sample of Amazonian households surveyed for food intake was manioc flour, referred to in 69 of the 302

meals documented. Moreover, in households that did not consume bushmeat, the main protein sources were chicken (40), fish (39), eggs (34) and processed meat (32). Beef (18) and pork (6) were the sources of protein referred to least in the households that did not consume bushmeat. Bushmeat intake was registered for seven meals in five households during the household food intake survey (two households consumed

**Table 6. Comparison of nutrient intake from bushmeat per meal per day in relation to nutritional value of the meal and usual daily household consumption.**

Nutrient	Hh <sup>a</sup> with BM Cons <sup>b</sup>		BM Cons		Nutritional value of BM <sup>c</sup> in 1 day	
	Avg <sup>d</sup>	SD <sup>e</sup>	Avg	SD	Day	3-day Avg
Calories (kcal)	1971.25	700.22	628.25	571.34	28.5%	31.8%
Fiber (g)	12.66	8.77	0.00	0.00	0.0%	0.0%
Calcium (mg)	422.09	317.63	55.49	62.80	18.4%	19.5%
Iron (mg)	16.51	12.17	25.65	28.32	74.1%	139.9%
Sodium (mg)	3952.46	2752.37	175.86	164.63	6.1%	5.1%
Vitamin C (mg)	16.26	11.23	6.01	9.47	30.8%	41.1%
Cholesterol (mg)	437.88	280.90	317.94	323.98	59.6%	72.8%
Protein (g)	131.72	86.38	96.22	94.51	59.5%	71.4%
Lipids (g)	75.01	21.53	24.04	20.63	30.6%	34.0%
Carbohydrates (g)	188.00	100.20	0.22	0.59	0.2%	0.1%
Saturated FA <sup>f</sup> (g)	19.28	7.57	6.86	6.20	35.0%	38.4%
Monounsaturated FA (g)	22.18	7.30	7.44	6.52	32.8%	35.5%
Polyunsaturated FA (g)	22.64	8.17	3.99	3.97	16.7%	20.9%

<sup>a</sup>Hh = household; <sup>b</sup>BM Cons = bushmeat consumption; <sup>c</sup>BM = bushmeat; <sup>d</sup>Avg = average intake; <sup>e</sup>SD = standard deviation; <sup>f</sup>FA = fatty acids.

bushmeat and supplied 24-hour recall records from two different days). In general, bushmeat consumption represents around 32% of usual caloric intake and approximately 72% of protein intake in the households that adopt such a practice, being the main food source of iron for these individuals (Table 6).

In relation to nutrients considered markers of unhealthy diets, bushmeat intake represented around 73% of cholesterol in the usual food consumption pattern and 38% of saturated fatty acids. Although it did not contribute significantly to sodium intake by itself, it is

important to consider that most protein-based dishes require additional seasoning, especially salt.

The study suggests that bushmeat seems to be gradually substituted with other protein sources, such as chicken and processed meats, food items that do not contribute significantly to iron intake. Additionally, processed meats present higher levels of added fat and salt, resulting in an increase of lipids and sodium in the diet of Amazonian populations. Moreover, in some cases, it seems to be frequently replaced by other food items that present little or no nutritional gain, most of which are markers of unhealthy diets that have lower protein and iron contents in relation to bushmeat.



# 4 Evidence of the uncovered bushmeat trade chain in the Tri frontier

## 4.1 Catchment area and trade routes

The most important and longer trade routes providing markets with bushmeat are: 1) from the Javari River and communities along the Amazon River to the peri-urban areas of Leticia, Atalaia do Norte, Benjamin Constant and Tabatinga; 2) from Peruvian villages along the Atacuari and Amazon Rivers to Caballococha; and 3) two other bushmeat trade routes that occur locally: a) from communities along the Loretoyacu and Amacayacu Rivers and in the wetlands of Tarapoto Lakes to Puerto Nariño, and b) from the peri-urban areas to the towns of Leticia, Tabatinga, Atalaia do Norte and Benjamin Constant (Figure 6).

## 4.2 Stakeholders in the bushmeat market chain

A total of 195 active stakeholders of the bushmeat trade chain were identified in the eight localities (115 hunters, 34 market sellers, 18 formal restaurants and 28 informal restaurants). In the following section we describe the different types of stakeholders involved in the trade.

### Hunters

In Puerto Nariño (n=8) and Atacuari River (n=9), hunters identified and interviewed were indigenous, whereas in Benjamin Constant and

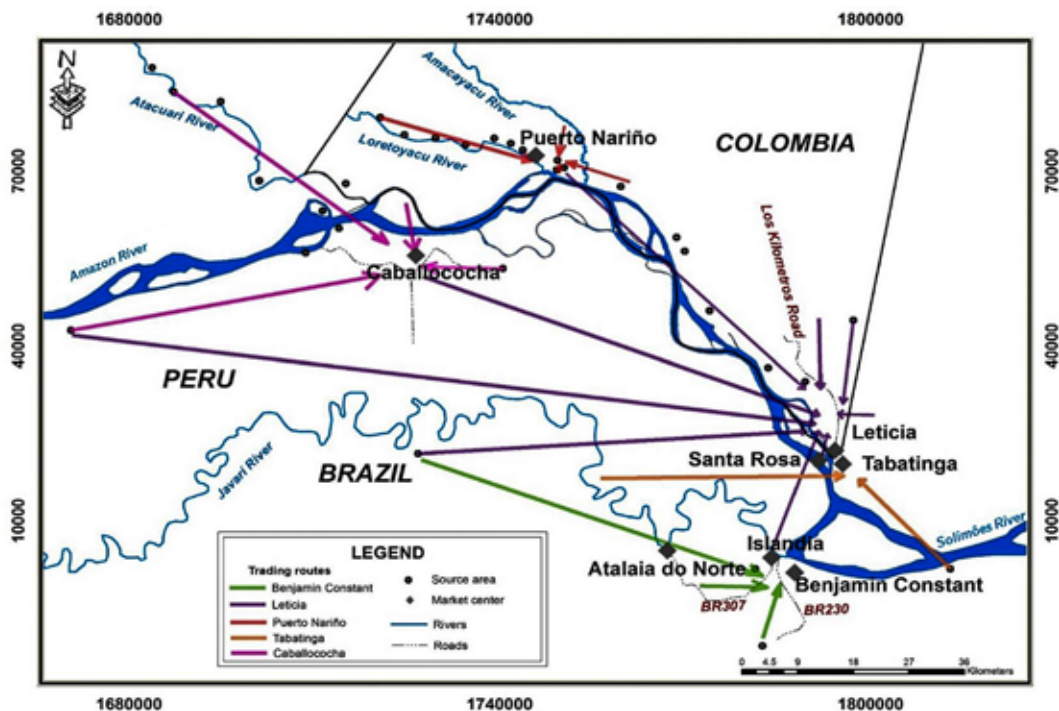


Figure 6. Bushmeat trade routes in the tri-frontier region.



Hunter going on a hunting trip in Benjamin Constant, Brazil (Photo by Daniel Cruz)

Atalaia do Norte hunters were *colonos* or *mestizos* (n=30). In peri-urban areas around Leticia, both indigenous (n=6) and *mestizo* (n=2) hunters were identified. The majority of the hunters interviewed alternate hunting with other economic activities such as logging, carpentry, farm caretaking, grocery trading and laboring in construction duties, often based on a daily wage. Selling agricultural products and fishing are the main complementary activities. However, we found that 25% of hunters interviewed (n=14) relied solely on hunting as their economic and subsistence activity. Members of hunters' families are housewives, students or work as traders of basic products and as local transporters.

The proportion of bushmeat sold compared with bushmeat consumed, as well as the level of participation in the bushmeat market chain allowed us to identify 'specialized' and 'diversified' hunters. Specialized hunters sell 90% of bushmeat caught to known regular clients in the city (families, teachers, public employees, traders, workers) or to intermediaries who visit their communities (as in the Atacuari River). Specialized hunters respond to specific orders made in advance by wholesalers. Diversified hunters, on the other hand, consume 65% of their total catch with their family and friends.

Their main incentive for hunting is subsistence, being either a direct source of food or a means to obtain money to buy food and beverages (chicken, beef, fish, beans, rice, sugar, bread, manioc, salt, coffee, onion, oil, spaghetti, beer) and basic products (soap, detergent, school supplies, clothing, pots, buckets, dishes), as well as hunting supplies (gasoline, cigarettes, matches, cartridges, batteries, lanterns, motorbike or bike parts). Additional incentives such as healthy nutrition and pleasure were reported. They sell directly, avoiding intermediaries. In fact, they prefer to sell bushmeat within the peri-urban area or inside the community as a result of the controls effected in the market centers. Differences in the frequency of hunting, and the type of hunting tools, effort and success show that specialized hunters spend more days per hunting trip and use more cartridges, which results in a much higher offtake than that of diversified hunters (Table 7).

#### **Intermediaries, market sellers, restaurants and street food stalls**

Intermediaries and market sellers are most often *mestizos* or indigenous. Intermediaries usually contact hunters directly (often using a cell phone) and buy bushmeat at a low price (USD 1.09/kg) at the hunter's house. They sell the meat directly to

**Table 7. Description of practices of diversified and specialized hunters (average figures).**

Type of hunter/ Practices	Mean cartridges per hunting trip	Mean number of animals caught per hunting trip	Mean number of hunting trips per month	Mean number of days per hunting trip	Mean number of cartridges bought per month
Diversified hunters	7.7	3.5	3.5	2.24	24
Specialized hunters	16.4	7.4	3.7	4.6	44

known consumers, door to door, to restaurants or to a second level of intermediaries who purchase bushmeat at the harbor or close to the market in the early morning for an average price of USD 3.29/kg, which varies according to whether it is fresh, smoked, salted or if it is a preferred species such as *Cuniculus paca*. Afterwards, this second level of intermediaries increases the price by about USD 0.75 per kilo and offers it to market traders (Figure 7). Market traders purchase the meat and have fixed stalls that involve monthly rental fees, public services, and costs of refrigerators, ice, salt, fuel and transport. Usually, they store bushmeat at home or in refrigerators at the harbor or at marketplaces. If after 2 days fresh meat has not been sold, they smoke or salt the meat to avoid decomposition and putrefaction, even if the price

decreases. Market traders diversify the sale of bushmeat with fish (mostly skin fish) in Leticia and Atalia do Norte, or with chicken and even clothing in Caballococha. In the market of Benjamin Constant, market traders are specialized in the bushmeat trade and are employees of a wholesaler that provides them with a stock of bushmeat, and pays them monthly for their job.

Bushmeat is often sold fresh (in Leticia, Puerto Nariño and Atalia do Norte), smoked or salted (in Tabatinga, Benjamin Constant and Caballococha) or alive in the case of turtles. The main clients of bushmeat traders in markets are *colono* or *mestizo* families, restaurant owners and public authorities. Coca workers are the main clients of market sellers in Caballococha. Bushmeat in Caballococha is

**Market in Caballococha, Peru (Photo by Nathalie van Vliet)**

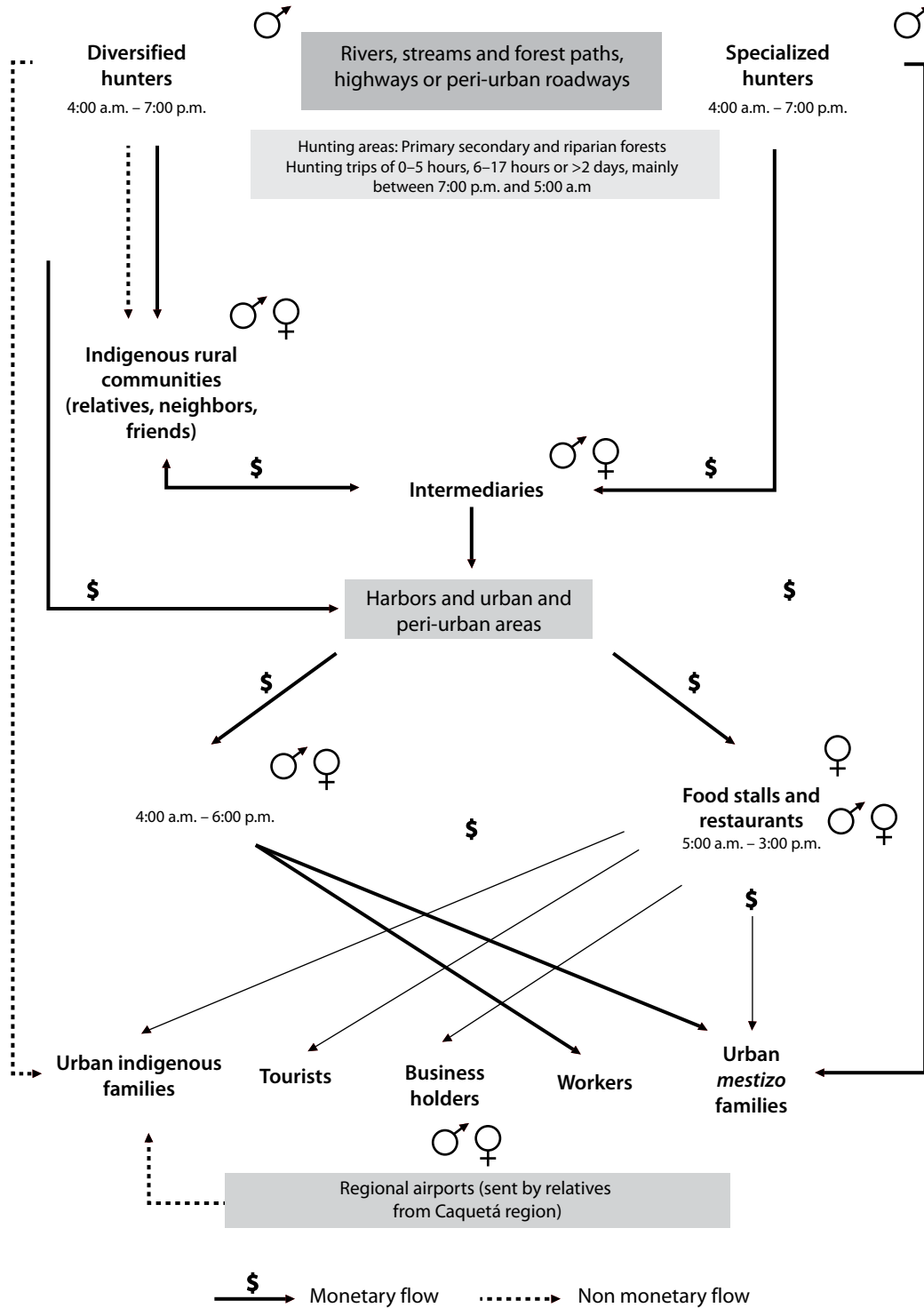


Figure 7. Trade-flow patterns in the bushmeat market chain of the tri-frontier region.

sold smoked and salted for two reasons: 1) hunters from the Atacuari River harvest big quantities of bushmeat (around 300 kg per trip, especially large mammals) that have to be preserved during the 8–12-hour trip to the city, and 2) because

the main customers are laborers who need to have bushmeat available for several days of work in the coca fields where they have no access to other ways of preserving food. Restaurants get bushmeat from market sellers and trusted hunters.

The average price per dish of bushmeat is around USD 3.50. One-third of the dishes sold utilize bushmeat and the rest are usually chicken, livestock and fish. Formal restaurants selling bushmeat, most often open during the weekend, are common in Santa Rosa (Peru) or along the peri-urban road of *Los Kilometros*. Formal restaurants pay rent and usually have medium- and high-income *colono* customers, civil servants and tourists, whereas informal street food stalls offer more accessible prices to local customers (indigenous, *mestizo* or *colono*). Food stall owners usually have a small table, an umbrella and some pans as the only infrastructure for their business.



**Tortoise and smoked tapir being sold in the market of Caballococha, Peru (Photo by Daniel Cruz)**

# 5 Species composition and quantities of bushmeat at each level of the market chain

## 5.1 At the hunters' level

The most representative taxa traded were mammals (60% of reports) and the rest were birds (26%) and reptiles (14%). In total, 485 individuals, equivalent to 13 tons were hunted in 60 days. Species diversity was equal to 27 species in Colombia and 17 species in Brazil. During the first period (high waters), hunters extracted a total of 5.24 tons of bushmeat. In the second period (low waters), we



Thatched roof with hunting trophies at a hunter's house in a rural indigenous community near Puerto Nariño, Colombia (Photo by Daniel Cruz)

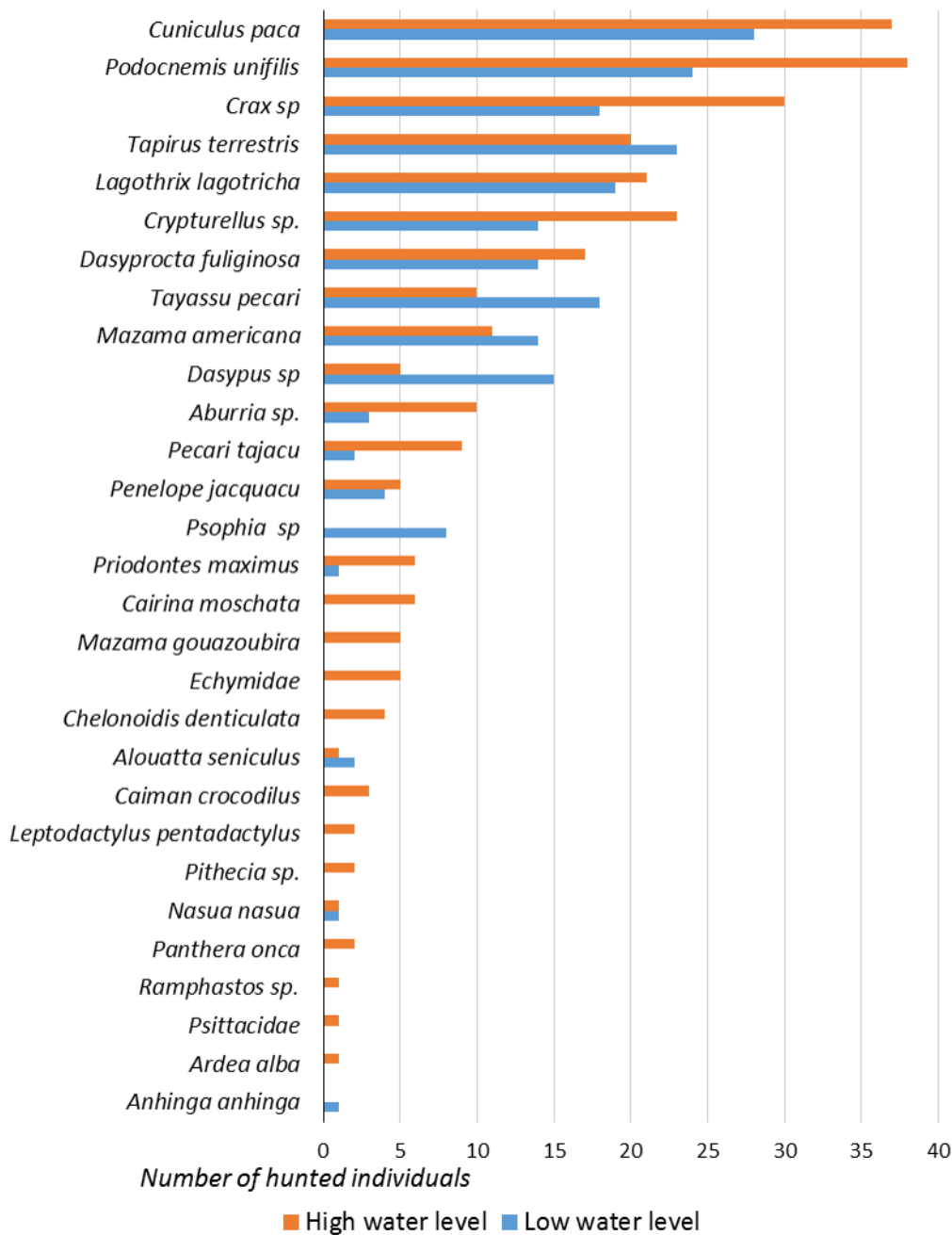
registered a considerable increase with a total of 7.75 tons harvested. We found that Colombian hunters mostly used bushmeat for personal consumption (74% of the biomass was self-consumed), whereas Brazilian hunters sold most of the meat extracted (96% of the biomass was sold).

The following species contributed to 61% of the total catch during the two periods: paca (*Cuniculus paca*), yellow-spotted river turtle (*Podocnemis unifilis*), curassow (*Crax globulosa*), tapir (*Tapirus terrestris*), woolly monkey (*Lagothrix lagotricha*), and tinamou (*Crypturellus* sp.) (Figure 8).

Regarding hunting areas, our data show that the majority of animals were hunted in primary forests (62% of the catch). Brazilian hunters took most of their catch in primary forests (74%), while Colombian hunters diversified their harvest across the landscape mosaic by using primary forests (33% of the catch), secondary forests (31%) and riparian forests (23%). During the low waters, most of the catch came from primary forests (71%) and streams (19%), while at high waters the catch originated from secondary forests (22%), flooded areas (21%), riparian forests (16%) and primary forests (38%). We also found that out of 100 hunting trips registered in the two periods by Colombian hunters, 72% lasted between 0 and 5.9 hours of effort, 13% took from 6 hours to 2 days and 2% were hunting trips of more than two days. On the opposite side, from 53 hunting trips registered in the two periods by Brazilian hunters, 64% took from 6 hours to 2 days and 36% were hunting trips of more than two days.

## 5.2 In marketplaces

Nineteen bushmeat species were recorded as being sold by market traders during the two periods (Figure 9). Mammals contributed to 74% of the total catch, whereas birds and reptiles



**Figure 8. Species and number of individuals hunted during high and low waters.**

accounted for 16% and 10% respectively. The most commercialized species were paca (*Cuniculus paca*), tapir (*Tapirus terrestris*), collared peccary (*Pecari tajacu*) and the red brocket deer (*Mazama americana*).

A total of 3.7 tons and 3 tons of bushmeat were sold in the 10 days monitored during the high water period and the 10 days monitored during the

low period, respectively, by the eight traders from Brazil, Colombia and Peru who participated in the monitoring program. This amounts to 473 tons of bushmeat sold in markets of the tri-frontier region (considering that bushmeat sales are constant within the low and the high water periods and that sales are equal throughout the week, with a constant number of sellers throughout the year). During the two periods, traders on the Brazilian

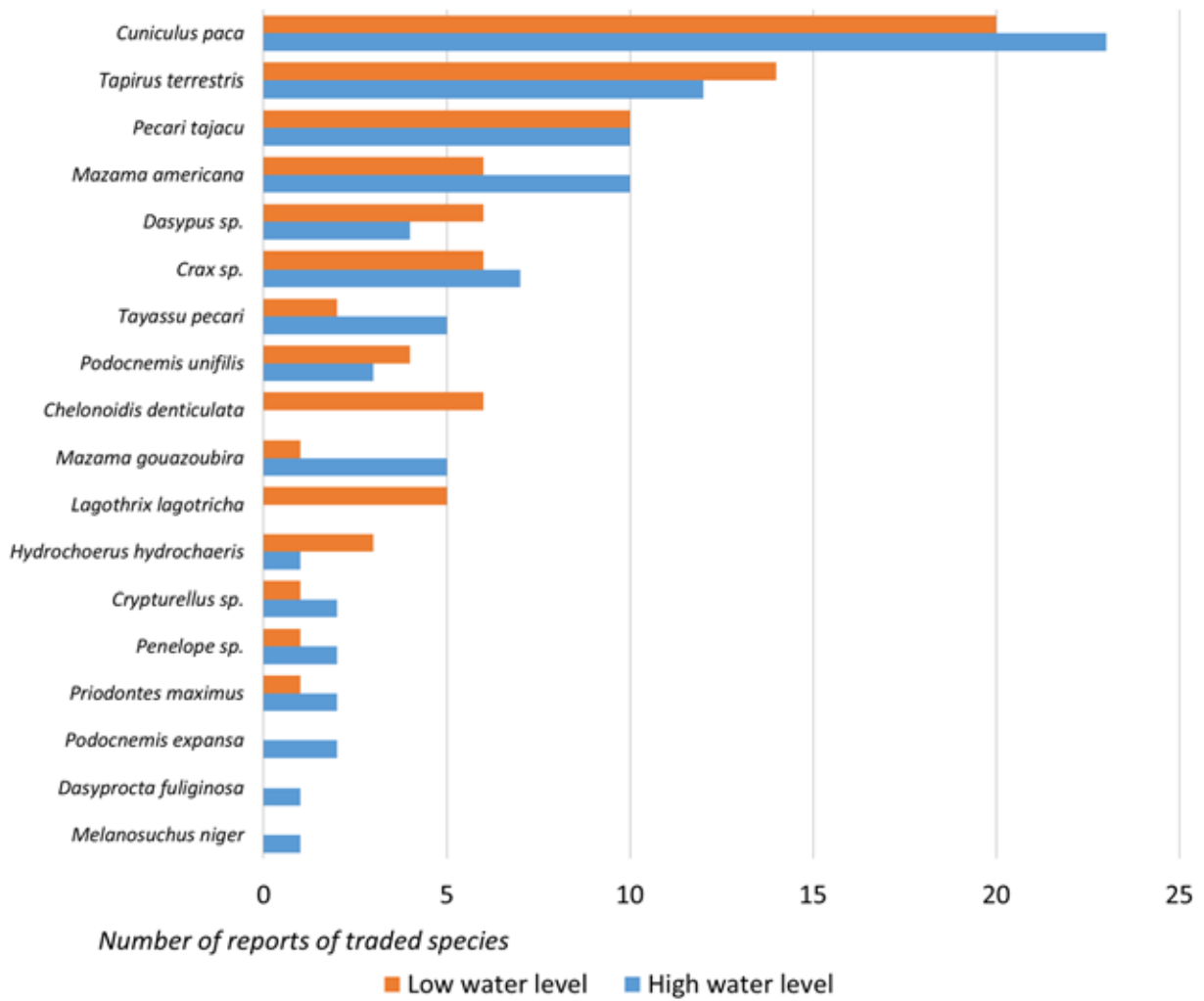


Figure 9. Number of reports of traded species during high and low waters in marketplaces.



Restaurant selling bushmeat in the peri-urban area of Leticia, Colombia (Photo by Nathalie van Vliet)



**Table 8. Commercialization form and average sale prices (USD) of kilograms of the most traded species during the first and the second periods.**

Most commercialized species	Commercialization form	Average selling price (USD) per kilogram					
		Brazil		Colombia		Peru	
		High-water period	Low-water period	High-water period	Low-water period	High-water period	Low-water period
<i>Cuniculus paca</i>	Fresh	5.13	4.17	6.92	7.10	4.3	4.3
	Chilled	5.13	5.13				
	Salted	5.13	5.13				
	Smoked					3.82	4.3
<i>Tapirus terrestris</i>	Fresh	5.13	5.13				
	Chilled	5.13					
	Salted	5.13	5.13			3.23	3.11
	Smoked						3.58
<i>Pecari tajacu</i>	Fresh	5.13	5.13		6.20		4.3
	Chilled	5.13	5.13				
	Salted	5.13	5.13				4.3
	Smoked					4.12	6.17
<i>Mazama americana</i>	Fresh	5.13	4.49		6.20	3.58	
	Chilled	5.13					
	Salted		5.13				
	Smoked					3.58	
<i>Dasypus sp.</i>	Fresh	5.13	3.21				
	Salted		5.13				

side made up the bulk of the total amount sold, having sold 80% of the total in the first period (equivalent to 3 tons) and 75% in the second (equivalent to 2.3 tons). During the two periods monitored, fresh bushmeat was purchased at a price of USD 3.81/kg by market traders to the hunter or intermediary. The average price for customers in the marketplace was USD 5.32/kg. Prices remained relatively stable all throughout the year and among traders at the same market (Table 8). Given enforcement issues, market sellers are unable to increase prices when bushmeat becomes rarer (in the dry season). Smoked or salted bushmeat is about 20% cheaper than fresh bushmeat.

### 5.3 In restaurants and street food stalls

Preferences for certain species sold by restaurants (formal and informal) varied by country. *Cuniculus paca* was the most preferred in Colombia and Peru, for both types of restaurants. *Mazama americana*, *Cuniculus paca* and *Pecari tajacu* were reported as the most sold species at informal and formal restaurants in all three countries. In the Brazilian localities, no formal restaurants selling bushmeat were identified due to frequent controls. In Colombia, informal restaurants charge between USD 2.50 and 3.50 for a dish of bushmeat, whereas in Peru, street food stalls offer it from USD 1.06 to 1.77. In the case of formal restaurants, prices in Colombia vary from USD 4 to 10 and in Peru from USD 1.77 to 3.54 per dish.

# 6 Bushmeat trade: Invisible but not invaluable for the primary producers

## 6.1 Value of hunting offtakes

The estimation of the total value of offtakes in the region amounted to USD 42,300 per month for the 55 hunters surveyed in the study area. If extrapolated to the 115 hunters identified as participating in the market chain, the total value of offtakes is about USD 88,500 per month, or about USD 1,062,000 per year. Regarding the economic value per country, 70% of the value of the total production of hunting activities goes to Brazil, 7% to Colombia and 24% to Peru. Table 9 shows the value of the total production harvested per hunted species by the 55 hunters during in a period of one month (in USD). The highest value is generated by tapirs (*Tapirus terrestris*).

## 6.2 Costs of hunting

Time invested in hunting is the variable that has the heaviest weight on the total value of costs.

Fixed costs are low for all countries because most of the tools used for hunting and transportation are very old (>10 years) and in bad repair. Variable costs include gasoline, cartridges, salt, batteries and ice, among which gasoline and cartridges are the most important. The total costs of hunting per month have been estimated at USD 16,506 for the 115 hunters in the region, and USD 190,072 per year. Peruvian hunters incurred higher costs than hunters in the other two countries due to the isolation of their communities in relation to the marketplaces (about a 16-hour round trip); this in incurred higher costs for gasoline (for their outboard motors) and salt (to preserve the meat) (Table 10).

We did not include the cost of illegality in the estimation of total costs. However, we provide an estimation of the loss that hunters could incur if enforcement was optimal. Surveillance activities are frequent in the tri-frontier area and affect all



Fish market in Benjamin Constant, Brazil (Photo by Nathalie van Vliet)

Table 9. Assessment of the value of total production from hunting activities in the tri-frontier catchment area.

Species	Number of specimens Brazil	Number of specimens Colombia	Number of specimens Peru	Total number of specimens	Total kg per specie	Average price in USD (kg)	Total production in USD (N=55 hunters/month)
Armadillo ( <i>Dasyus</i> sp.)	15	3	4	22	160.6	4.21	676.1
Giant Armadillo ( <i>Priodontes maximus</i> )	1	1	0	2	60	3.81	228.6
Paca ( <i>Cuniculus paca</i> )	96	19	6	121	1089	4.51	4911.4
Tapir ( <i>Tapirus terrestris</i> )	28	1	3	32	5728	3.8	21,766.4
Collared peccary ( <i>Pecari tajacu</i> )	2	2	15	19	404.7	4.06	1643.1
White-lipped peccary ( <i>Tayassu pecari</i> )	13	5	57	75	1852.5	3.75	6946.9
Red-footed tortoise ( <i>Chelonoidis denticulata</i> )	0	1	14	15	225	0.92	207.8
Curassow ( <i>Crax tomentosa</i> )	12	5	0	17	78.2	3.99	312.0
Capivara ( <i>Hydrochoerus hydrochaeris</i> )	12	0	0	12	576	4.06	2338.6
Gray brocket deer ( <i>Mazama americana</i> )	8	0	5	13	351	3.73	1309.2
Red brocket deer ( <i>Mazama gouazoubira</i> )	13	2	1	16	232	3.91	907.1
South American coati ( <i>Nasua nasua</i> )	1	0	0	1	4.5	1.96	8.8
Gray-winged trumpeter ( <i>Psophia crepitans</i> )	2	0	0	2	2	4	8.0
White-throated tinamou ( <i>Tinamu guttatus</i> )	3	0	0	3	3	1.96	5.9
Anhinga ( <i>Anhinga anhinga</i> )	0	3	0	3	3.9	1.96	7.6
Black agouti ( <i>Dasyprocta fuliginosa</i> )	3	2	0	5	13.25	3.79	50.2
Tinamou ( <i>Crypturellus</i> sp.)	9	5	0	14	18.2	3.67	66.8
Caiman ( <i>Caiman crocodilus</i> , <i>Paleosuchus</i> sp.)	0	1	4	5	110	2.4	269.0
Moorhen (Rallidae)	5	0	0	5	5	1.96	9.8
Yellow-spotted river turtle ( <i>Podocnemis unifilis</i> )	5	0	0	5	40	3.65	146.1
Spix's guan ( <i>Penelope jaquacu</i> )	0	6	0	6	19.2	4.45	85.4
Red howler monkey ( <i>Alouatta seniculus</i> )	14	5	0	19	104.5	4.16	434.7
	<b>242</b>	<b>61</b>	<b>109</b>	<b>412</b>	<b>11,080.55</b>		<b>42,339.5</b>

**Table 10. Analysis of monthly costs associated with hunting activities per country.**

Type of costs	Hunting supplies	Peru		Colombia		Brazil	
		Monthly costs per hunter (USD)	Monthly variable costs for 21 hunters (USD)	Monthly costs per hunter (USD)	Monthly variable costs for 48 hunters (USD)	Monthly costs per hunter (USD)	Monthly variable costs for 46 hunters (USD)
Variable costs	Gasoline (gallon)	56.1	1178.5	19.3	924.2	26.4	1212.5
	Cartridges (box)	51.6	1082.9	24.5	1173.6	53.3	2453.9
	Salt (kg)	34.0	714.7	0.0	0.0	3.0	139.1
	Batteries (pair)	2.8	58.7	2.4	117.4	7.6	351.7
	Ice	-	-	-	-	17.0	782.0
Initial costs (depreciated prices)	Shotgun	7.3	154.0	7.3	352.1	7.3	337.4
	Boat (wood)	1.2	25.7	1.2	58.7	1.2	56.2
	Outboard motor	15.5	325.2	15.5	743.3	15.5	712.3
Effort (time invested in hunting)		127.7	2680.7	12.2	256.7	29.3	614.6
<b>TOTAL COSTS</b>		<b>296.2</b>	<b>6220.3</b>	<b>82.4</b>	<b>3625.9</b>	<b>160.7</b>	<b>6659.7</b>

levels of the market chain. Thirty-eight percent of the hunters interviewed reported they had been penalized through seizures (58%), fines (21%) and community work (13%).

### 6.3 Net profit generated by the hunters

The net profit from hunting (including personal consumption) of bushmeat has been estimated to be USD 839,441 per year for the 115 hunters identified (Table 11). This amount is equivalent to around 2986 minimum wages of the region per year that can sustain the basic needs of 248 people per year, including the benefits generated by personal consumption.

### 6.4 Economic rent of hunting as compared with other activities practiced by the hunters

Hunters usually benefit from a range of activities that generate income, besides that from hunting. These are mainly fishing, timber, and small businesses related to food or goods. In our sample of hunters, the total economic rent derived from these activities amounted to USD 56 per month/hunter. For the hunters interviewed, hunting (including personal consumption) represented 13 times more rent than that provided by other



**Bushmeat market in Benjamin Constant, Brazil (Photo by Nathalie van Vliet)**

**Table 11. Summary of economic analysis of hunting.**

	Total value of bushmeat harvested per year in USD (N=115)	Total costs per year in USD (N=115)	Net profit from hunting per year in USD (N=115)
Total	1,062,000	190,072	839,441

activities. Clearly, bushmeat provides a non-negligible source of food and income for those families, which, combined with their formal economic activities, constitute their overall wealth.



Firearm used for hunting in Benjamin Constant, Brazil (Photo by Daniel Cruz)



a



b



c

a) Artisanal (handmade) gun, b) cartridges and c) purchased gun used for hunting in the tri-frontier region (Photos by Daniel Cruz)

# 7 Bushmeat as a festival food for urban indigenous families

## 7.1 Bushmeat species consumed by urban indigenous families

The list of animals consumed by different family members in the year prior to the study comprised tortoises, deer, a wide variety of birds, and several monkey species. Insects such as beetle larvae or *mojojoi* (*Rhynchophorus palmarum*) and ants (*Atta* spp.) were frequently consumed. During the period of study, we registered the exchange and consumption of different animal species by some or all the members of the households (Table 12). From a total of 10 species (six mammals, two reptiles, two birds), bushmeat from *Cuniculus paca* appeared three times, and both *Dasyprocta fuliginosa* and *Tayassu tajacu* appeared twice. The only animal for which these families paid was

*Cuniculus paca*, while all the others were obtained by directly hunting in the forest or through their exchange networks.

Several species were reported to be harvested and consumed to avoid damage in the *chagras*, as was the case for *Dasyprocta fuliginosa*, *Myoprocta pratti*, *Cuniculus paca* and *Eira barbara* as well as *Ara* spp. However, only parrots were hunted during the period of study. On one occasion, three parrots were hunted in family 1's *chagra*, because the parrots were eating too much of the *chontaduro* (*Bactris gasipaes*) that the family had been waiting to harvest. All 14 family members ate the parrots, which were prepared as soup by the grandmother.

**Table 12. Species recorded, their origin and final use by three families.**

Family	Species	Origin	Final use	Other uses/notes
1	<i>Tayassu tajacu</i>	Networks	Networks	Shared at a <i>minga</i> <sup>a</sup>
	<i>Tayassu tajacu</i>	Hunted	Family consumption and networks	
	Chestnut-fronted macaw ( <i>Ara severus</i> ) (2 animals)	Hunted	Family consumption	Feathers: for traditional costumes
	Parrot (3 animals)	Hunted	Family consumption	Prepared as a soup
	<i>Cuniculus paca</i>	Restaurant	Consumption	
	<i>Lagothrix lagothricha</i>	Hunted	Eaten in the forest, and family consumption	
	<i>Cuniculus paca</i>	Networks	Family consumption	Smoked. From indigenous community
	<i>Tapirus terrestris</i>	Networks	Family consumption	Salted. From indigenous community
	<i>Podocnemis expansa</i> (eggs)	Networks	Family consumption	From indigenous community
2	<i>Nasua nasua</i>	Networks	Traditional dance	
	<i>Dasyprocta fuliginosa</i>			
	<i>Caiman crocodilus</i>			
	<i>Lagothrix lagothricha</i>			
3	<i>Cuniculus paca</i>	Bought	Consumption	

<sup>a</sup> Collective work that is traditional among indigenous communities

## 7.2 Places where bushmeat was exchanged

Bushmeat was exchanged in different places: at the household level, in forests, on shifting cultivation plots (*chagras*), at markets, restaurants and food stalls, and airports, as well as in urban traditional indigenous houses (*malocas*).

### Household level

This is the main level where bushmeat is shared, exchanged and consumed. Bushmeat is often brought directly from the forest to the house. The whole carcass is brought to the house, so the process of preparing meat for consumption (cutting, removing entrails, etc.) occurs at the household level. Parts of the animal not eaten by the family, such as skin, some of the innards and the bones, are given to household pets, usually cats and dogs. Bushmeat is stored in the house for future consumption, and usually cooked in the household, in different forms, depending on the type of animal, whether or not there is a special event, the amount of meat and the number of family members expecting to eat it. The cooking process also depends on the culinary knowledge of the cook, as only some household members know how to prepare specific traditional meals such as *mazamorra* or *zarapaté*. Men are usually the ones who bring meat home. During the study period, no instances of women hunting were reported but some report that a few women do hunt occasionally. Hunters are responsible for distributing meat to other families from the network when they return from the forest. Different members of the family; men and women, participate in cleaning and cutting the meat. Women are usually the ones who smoke or cook it, and also the ones who distribute cooked meat during meals.

At the household level, other non-household members from the network participate in the meals, either because they are invited or arrive when a meal is being served. During our visits, no unexpected visitors rejected a meal of bushmeat, which was accepted with gratitude and curiosity. This was often when the opportunity arose to ask about the origin of the meat leading to stories of hunting trips being shared, with everybody listening carefully to the hunter's tale. This is an important moment of socializing not just about

sharing food, but also the knowledge hunters and their relatives have about the territory and associated resources.

### The forest

The forest is where hunting activities take place, and also a place where bushmeat is consumed and shared. Hunters usually hunt alone, but sometimes go to the forest in groups, looking for large animals such as tapirs or for a herd of peccaries. On occasions, the hunter goes to the forest along with his family: the elder sons and the wife. When spending more than one day in the forest, they hunt bushmeat for food. "*Why do I need to carry a lot of weight in canned food and rubbish when I have the food right there, good meat to eat?*", asked a hunter. He explained that he prefers eating bushmeat when he stays in forest camps, but when taking tourists or scientists to the forest, he is often asked not to hunt during the trip.

### Chagra

These are where crops are traditionally grown, but also where small animals are hunted, sometimes by women, who tend the crops and spend most of their time working there. Only one instance of garden hunting was recorded during the study period, when hunter 1 shot three parrots. The *chagra* is also a place for socializing, where relatives and neighbors work together doing *mingas* (community work) to help the organizer with a particular task (clearing, house building, etc.). In return, the organizer must offer food and traditional drinks, such as caguana made from manioc starch and fruit juice, to the participants. Offering good food in sufficient quantities guarantees participants will work hard and participate in other *mingas* in the future. During the study period, we recorded three *mingas*, two on one family's *chagra*, and another in their community. Bushmeat was offered at one of the *mingas*, at the family's *chagra*. The meat was from a collared peccary (*Tayassu pecari*) hunted by a relative who gave most of the game to family 1 as a way to thank them for lending him a gun for his hunting trip. At least 25 people participated that day. The *minga* was successful and was mentioned around the community because the participants were happy to have consumed bushmeat as part of the meal.



Family members and a hunter in Puerto Nariño, Colombia (Photo by Daniel Cruz)

### The market

In the daily markets in Leticia and Tabatinga, bushmeat is sold by fish traders. Indigenous families rarely purchase meat at the regular market but prefer to purchase it at the indigenous markets, which are only organized on Saturdays and where people from different ethnic groups come from their communities to sell such products as cassava (manioc bread), *tucupi*, beetle larvae and bushmeat.

### Airport

The airport is an important place, contributing as it does to bushmeat exchange networks, since bushmeat is often sent by relatives on small weekly flights from the *corregimientos* (indigenous territories in the interior of the Amazonas region or from La Pedredera in Caquetá) to Leticia. The airport was regularly visited by the families, who regularly receive gifts from their relatives. The gifts received are mostly food (particularly bushmeat —

normally sent smoked) and *mambe*.<sup>4</sup> The luggage is either sent alone, or with another passenger. The environmental police inspect luggage arriving at Leticia, but often tolerate bushmeat if they can confirm it was sent for personal consumption among indigenous people. As opposed to other indigenous products, bushmeat rarely travels out of the region by plane, but we have recorded some cases (not from the households of this study) in which bushmeat was taken to Bogotá, for personal consumption and to share with other relatives living in the capital city.

### Urban and peri-urban *malocas*

Bushmeat is sought for the preparation of traditional dance rituals or festivals celebrated in the urban and peri-urban *malocas*. Some of these festivals took place during the study period, and we recorded bushmeat being present at these events. The amount was not sufficient to feed all

<sup>4</sup> Product of high cultural and economic importance that results from mixing toasted coca leaf (*Erythroxylum coca*) with yarumo ash (*Cecropia peltata*), usually accompanied by “*ambil*,” which is a thick liquid obtained by mixing *Nicotiana spp.* and salt.



the 200 assistants, but it was shared between them and highly appreciated. Family 2 participates the most in such events, which are often organized in their own *maloca*. At these festivals, the dance ritual implies the exchange of cultivated food produced by a residential unit (the one which holds the ritual) for wild game and songs brought by other invited residential units (Echeverri 1997). When this takes place in urban and peri-urban *malocas*, these social rules are not strictly applied as most of the food is purchased. These events are very important in urban areas because they bring relatives and people from different ethnic groups together, and constitute places for socializing and exchange where culture is reproduced and political alliances may be strengthened. When bushmeat is present, it makes everyone remember about the festivals celebrated in their territories of origin, where game is abundant and more present in daily life.

### 7.3 Bushmeat exchange types

We identified different ways of exchanging bushmeat: immediate exchange, and long-term exchange (reciprocity). These exchange types are similar to those observed for other food items.

**Immediate exchange:** In this case, bushmeat is given or received at the same time as any other product or favor. The *mingas* are an example of this, as bushmeat is offered in return for the work provided by the participants in the *chagra*. Sometimes, bushmeat acts more directly in place of a coin, in payment for some kind of service. In this way, one family received bushmeat in return for medical attention, as one of the members is a traditional healer.

**Long-term exchange:** In this case, bushmeat is exchanged based on the logic of reciprocity, which is deeply rooted among indigenous groups. Families share bushmeat with visitors or neighbors during meals to stimulate social interaction and demonstrate abundance. Food, and bushmeat in particular, is shared as a way to maintain social networks that work as a safety net in case of a specific need (sending a child to school, medical care, etc.). During this study, one family received a gift from their daughter living in the *corregimiento* of an entire *Cuniculus paca*, a piece of *Tapirus*

*terrestris* they shared with other relatives in their community, and eggs of *Podocnemis expansa*. The family did not immediately thank the daughter for this food, but the gift is part of the logic of reciprocity.

### 7.4 Cultural importance of bushmeat in urban indigenous families

Our results highlight the fact that bushmeat is no longer consumed as a daily meal among urban and peri-urban indigenous families in Leticia, but constitutes what could be called festival food. Ethnic festival food refers to the expression of food in terms of attitudes, values, behaviors, beliefs of a culture, traditions or heritage, religion or national origin for native or ethnic groups. While there are many factors that influence food choice, such as convenience, affordability and taste, for racial/ethnic minority groups, food choice is an important means of relating with their ethnic background. The originality of our results is that they highlight the continued role that traditional foods may have, even in modern and highly transformed indigenous cultures. Typical traditional food items, such as bushmeat, have not completely disappeared from modern indigenous nutrition patterns in Leticia. As are many wild plants, bushmeat is part of the intangible cultural heritage of local populations and can be related to cultural identity. In Leticia, bushmeat is consumed at home on occasion, as well as during traditional festivities. These ethnic festivals are events that center on community and family, evoking positive emotions. The consumption of particular and specific festival foods may be a way for minority groups to express their ethnic identity, promote family togetherness, and even deal with the stressors of adapting to a new culture. Bushmeat is received and accepted with satisfaction by all participants of the meals and contributes to collective happiness. Comfort foods, such as bushmeat, result in a positive association between the food and emotional well-being. Food preferences and habits are formed in large part through childhood experiences and actually persist throughout the course of an individual's life, helping to maintain memories and strengthen connections with their traditional origins, their territory and with associated resources. Since indigenous peoples define happiness as being



**Life along the Amazon River, Peru (Photo by Jessica Moreno)**

closely linked with the state of nature and their environment, indigenous people's well-being necessarily encompasses their access, management and control over lands, territories and resources under customary use and management, all of which are critical for their own sustainable

development. Our results also highlight the fact that bushmeat sharing is embedded in a generalized logic of reciprocity, and constitutes an 'insurance' or safety net. It is on this basis that sharing arrangements can be interpreted as a 'coping mechanism,' one that addresses short-term inequities in resource availability.

# 8 Conclusions

Our results call for better attention to be paid to the changes observed in diets in the Amazon and their potential health and nutritional consequences, particularly among indigenous peoples. Bushmeat and fish are no longer the main sources of meat for urban people (only 3% of the households consumed bushmeat and about 15% consumed fish the day before the interview). Instead, industrial chicken and canned meats are by far the main sources of protein consumed. In urban communities, fish is still the main source of protein, but industrial chicken, eggs and canned meats are becoming increasingly popular. Bushmeat is not consumed regularly, except in families where the household head is an active hunter (about 12% of the households consumed bushmeat in rural communities). In urban and peri-urban areas, bushmeat remains an important

festival food for indigenous peoples, even if it is only consumed occasionally. The nutritional diet of households that consume bushmeat is richer in iron and poorer in fat and salts compared with households that consume chicken and industrial meats.

Our results further emphasize the fact that the bushmeat trade to urban areas in the tri-frontier region is far from negligible (473 tons are potentially being sold per year in tri-frontier markets), despite the (little) attention being given to this clandestine trade by government authorities. The most commercialized species were paca (*Cuniculus paca*), tapir (*Tapirus terrestris*), collared peccary (*Pecari tajacu*) and the red brocket deer (*Mazama americana*). Most of the animals sold are listed as being of 'least concern' by the IUCN Red



Meeting with indigenous hunters in Puerto Nariño, Colombia (Photo by Daniel Cruz)

list, and are resilient species that adapt to different habitat types and hunting pressures. However, the trade of protected species (e.g. tapir) needs close attention. Per year, the trade at the hunters' level is worth USD 1,062,000 and generates the equivalent of 248 annual, full-time, minimum salaries in Colombia, thereby contributing markedly to local economies and food security.

In methodological terms, our approach shows that participatory protocols are a valuable tool that can be used to involve stakeholders in local monitoring mechanisms. As pointed out by van Vliet et al. (2012), market monitoring data such as those presented in this study can provide valuable information to policy makers and managers by raising the alarm when rapid changes are observed. When these data are combined with longitudinal information from along the supply chain (wildlife

populations, hunters, traders and consumers) and with information about the political, social, economic and ecological contexts, decision making will be better grounded.

Our results emphasize the need for a better integration of biodiversity conservation and food security policies, incorporating the social and cultural dimensions in policy agendas. There is a need to acknowledge the role that forest products, and bushmeat in particular, continue to play for enhancing social cohesion, food security and local economies. The existing but clandestine market described here calls for conditions to be explored whereby it would be possible to legalize a local-scale trade for resilient species so as to maintain the cultural, economic and social services provided by wildlife, while policing the trade of more vulnerable and protected species.

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Bushmeat use in urban areas of the Amazon has received very little attention by NGOs, and environmental and research institutions, either because it is assumed that urban consumption is negligible and bound to disappear, or because of the illegality of the trade, which makes it difficult to assess. Our study shows animal protein consumption moves along a rural-to-urban gradient, with a decrease of fish and bushmeat consumption and an increase in consumption of industrial chicken and canned meats as we move to more urban areas. The nutritional transition that occurs alongside urbanization is also characterized by a decrease in both dietary diversity and the nutritional value of the food consumed. Despite the fact that bushmeat is not frequently consumed in urban areas as compared with rural settings, it is still consumed by urban households, particularly for cultural reasons. In fact, the assumed demise of urban bushmeat consumption has not taken place. Bushmeat is provided to urban consumers either through a well-organized and lucrative trade chain from the hunter to markets and restaurants, or through a rural-urban non-monetary flow of exchange, particularly among indigenous householders who have relatives living in forest areas. Our results call for more attention to be paid to the role that forests continue to play in providing food and income in urban areas of the Amazon. We also call for the need to invest in preservation and sustainable use strategies in the Amazon, to ensure biodiversity conservation while maintaining the diversity of roles that wildlife plays among rural and urban households in the Amazon.



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