ETHNOBIOLOGY AND CONSERVATION

RESEARCH ARTICLE

Ethnobiology and Conservation, 11:17 (06 August 2022)
doi:10.15451/ec2022-08-11.17-1-13
ISSN 2238-4782 ethnobioconservation.com

From the forest to the coast: the wild meat trade chain on the Coast of Guyana

Nathalie van Vliet[1*], Puran Anupa[1], David Oswin[2] and Nasi Robert[1]

ABSTRACT

In the Caribbean region, very little is known about wild meat use and trade. To contribute to this knowledge gap, we studied the wild meat trade chain on the coastal area of Guyana, which geographically and culturally connects the Caribbean and the Amazon Region. In Guyana, the wildmeat sector is legal and in the process of being regulated. Our study shows that the market chain on the coast of Guyana is a short and direct market chain where the harvester most often sells directly to the consumer or through one level of intermediary (market vendors, home-based traders, roadside traders, restaurants, food stalls or rum shops). In coastal Guyana, wild meat can be considered a luxury, rather than a necessity: the price is higher compared to other alternative sources of meat and demand rises for special events. The topmost sold species are *Cuniculus paca*, *Mazama americana*, *Tapirus terrestris*, *Dicotyles tajacu*, *Tayassu pecari*, and *Hydrochoerus hydrochaeris*. The volumes traded to the coast of Guyana are equivalent to 361 tons of wild meat sold per year. Considering the population size on the coast of Guyana, this amount is equivalent to 1,4 g/capita/day and 4% of the protein intake from animal origin. These values are below those observed in urban towns from Central Amazonia in Brazil where wild meat consumption per capita equals to 18 g/capita/day. From a one health perspective, further attention is required with regards to food safety aspects along this legal trade chain.

Keywords: Wildmeat, Caribbean, Trade Chain, Coast of Guyana.

1 Center for International Forestry Research (CIFOR), Jalan CIFOR Situ Gede, Bogor Barat Bogor 16115. Indonesia.
2 Guyana Wildlife Management and Conservation Commission, Ganges Street Sophia, Guyana.
* Corresponding author ✉. E-mail address: NVV (nathalievanvliet@yahoo.com), PA (anupanapuran@gmail.com), DO (david.wyn100@gmail.com), RN (r.nasi@cgiar.org)

SIGNIFICANCE STATEMENT

Our study contributes to a better understanding of wildmeat trade in the Caribbean region, a region overlooked in previous studies. We describe a short and direct market chain where the harvester most often sells directly to the consumer or through one level of intermediary (market vendors, home-based traders, roadside traders, restaurants, food stalls or rum shops). We provide key information on stakeholders, trade routes, volumes and species sold that can all inform the current process to regulate the trade of this important resource.

INTRODUCTION

The role hunting plays for local communities across tropical areas has evolved over the last decades from a purely subsistence activity to a semi-commercial or commercial activity, generating value across trade chains from the forest to urban areas, and significantly contributing to household income and to a growing food demand from urban populations in the tropics (Ingram et al., 2021). Inspired by concerns about the ecological sustainability of this trade, Cowlishaw et al. (2005) showed the need to understand the economic and social processes that determine the profitability of wild meat trade at each level of the chain to identify the different possible entry points for interventions. Since then, a growing body of literature has quantified the economic importance of national wild meat trade to urban towns located amid tropical forests (Fa et al., 2005; Chaves et al 2017; Parry et al. 2014; van Vliet et al., 2018; El Bizri et al., 2020; Lescuyer and Nasi, 2016).

The economic valuation of the wildmeat sector requires prior knowledge about the structure and operation of wild meat value chains, the actors involved, the direction of flows, and the amounts of wild meat traded. Several studies provide a good understanding of these trade chain characteristics in African contexts (Cowlishaw et al. 2005; Lescuyer and Nasi 2016; Nielsen et al. 2016; van Vliet et al. 2015a; van Vliet et al. 2019), but also more recently in South America (van Vliet et al. 2017) and Asia (Pattiselanno et al., 2020). These studies suggest that no wild meat trade chain is alike, and that different factors explain the differences observed. Some wild meat trade chains are rather local and are fully absorbed by regional towns (van Vliet et al. 2017), while others involve long national or international trade chains (Chaber et al., 2010). In some contexts, wild meat is mostly traded at the local food markets (Fa, 2005; van Vliet et al., 2012), while in others wild meat is either traded directly from the hunter to the urban consumers (van Vliet et al., 2015a), or mostly sold in restaurants or food stalls (Cowlishaw et al., 2005). Wild meat is sold fresh or frozen where there is access to electricity or in short market chains (van Vliet et al., 2017), but may also be sold smoked or salted where catchment areas imply long transportation time in rough road or boat conditions before they reach the final consumer (Fa 2005). Wild meat is either supplied by highly organized commercial hunters or by rural hunters who sell their surplus or carry their wild meat to town in response to a short-term cash need (van Vliet et al., 2015a). In many contexts, wild meat is sold openly in public markets (Fa, 2005), but depending on the level of enforcement of wildlife regulations the trade channels may become more secretive and underground (Gore et al., 2021), making it very difficult to quantify this informal sector.

In the Caribbean region, very little is known about wild meat use. The available literature shows that hunting plays a socially cohesive role in Jamaica (Gibson, 2020) and continues to be part of subsistence strategies in both creole and Indigenous communities in the Caribbean (Doherty, 2005; Wilk, 2005; Pacheco-Cobos and Winterhalder; 2021). Some species play a key cultural role, such as the mountain chicken frog (*Leptodactylus fallax*) in Dominica (Nicholson et al., 2020; James 2012). "Gibnut" (labba, lappe or paca; *Cuniculus paca*) and red brocket deer (*Mazama americana*) are preferred over other types of bushmeat in Belize (Jones and Young, 2004). Wild meat in the Caribbean region is known to be a specialty dish (Richards-Greaves, 2013), with curry labba, stewed agouti (*Dasyprocta* sp.), or coconut curry wild meat, being a few examples of recipes widely found on the internet, suggesting that there is demand for such species. However, there is little or no available knowledge about the trade in wild meat and even less so about the wild meat trade chains in this region.

To contribute to this knowledge gap, we studied the wild meat trade chain on the coastal area of Guyana, which geographically and culturally connects the Caribbean and the Amazon Region. No previous study has been published on the wild meat trade in Guyana, despite the trade being legal and occurring openly. With its species richness similar to that of the Amazon Region in a mostly Caribbean culture, Guyana presents a unique case of wild meat use. We describe the structure of the trade chain, the direction of the flows, the species and volumes traded, and food safety and handling practices associated with wild meat trade.

MATERIAL AND METHODS

Study Site

Our study was conducted in Guyana, situated in Northern South America. Its population counts 786,559 inhabitants, of which 90% lives along the coast in urban and suburban settings between Charity along the Pomeroon River, and Corriverton near the border with Suriname. Guyanese citizens consist of multiple ethnic groups; Indo-Guyanese make up 43.5% and Afro-Guyanese 30.2% (Bureau of statistics 2016). Indigenous people constitute 9.1% of the population. We focused on country-wide trade chains for wild meat reaching the coastal area, conducting the study in the low coastal plain of Guyana (hereafter the coast of Guyana). The coastal sites are all connected by one main paved road and a ferry to

cross the country's largest river: the Essequibo. This coastal zone is connected with interior only through rivers and mostly unpaved roads of highly variable condition.

Data collection

First, we identified all possible wild meat sale points in the urban centres and in the peri-urban areas located on the coast of Guyana. Given the legality of the trade at the moment of the study, we did not encounter any obstacles in identifying wild meat vendors. We used a preliminary list of wild meat vendors provided to us by the Guyana Wildlife Conservation and Management Commission (GWCMC) to start with the visits. The list included those selling raw wild meat and those selling meals with wild-meat. Visits occurred from May to July 2019. We introduced our team and explained the purpose of our work to each of the business owners. We asked permission to spend time in the business to observe how it operated. Mostly, the vendors were happy to show us their wild meat stocks. They talked freely about their sales, the species they sold and where it was sourced from. Conversations were based on open questions following a semi-structured format. Central questions were: What are the main wild meat species sold here? Where does the meat come from? Who brings it here? Who buys it? With the help of the vendors, we mapped the trade routes and estimated the catchment area from where they were getting their wild meat. In each location, we took GPS points and photographs with previous permission from the business owner. Before leaving and following a snowball approach, we asked about other locations where wild meat was sold and visited those that we had not visited yet. We did so as many times as necessary to ensure that we had covered most, if not all, possible established wild meat sale points on the coast of Guyana. Additionally, we conducted an online search for wild meat sales. This stakeholder identification process lasted for a month and allowed enough time for participant observation during each of our visits.

To complement this information, we conducted structured interviews with the same vendors during the same visit or schedule a subsequent visit, when the vendors stated preference for that option. The questionnaire was structured around four topics. The first section inquired about the vendors' socio-economic characteristics (ethnic group, age, gender, main economic activities of the owner). The second section inquired about the sourcing of wild meat (origin, supplier, regularity, potential agreements in place with supplier). The third section concerned the wild meat sold: top five species sold, hunting method, state (fresh, frozen, smoked, salted etc..), volumes sold. Finally, we asked about food safety and handling methods. To estimate the total amount of wild meat sold per month, we multiplied the average daily amount of wild meat sold by raw meat vendors by the number of days per month spent in the business and multiplied by 12 months. The sum of this value for all raw meat vendors resulted in an estimate of total biomass of wild meat extracted and sold per year on the coast of Guyana.

RESULTS

Typology of vendors

In total, we identified 83 vendors of which 72 were willing to participate in the surveys. They were distributed across 6 regions in 29 locations on the coast: 7 market vendors, 13 meat shops, 14 restaurants, 17 rum shops, 18 home-based traders and 3 roadside traders. Our rigorous method for locating vendors, together with the openness of sales resulted in high confidence of identifying most of the established vendors at the time. In this typology (Figure 1), we distinguish raw meat vendors from cooked meat vendors. Raw meat vendors include market vendors, home based traders, and roadside traders. Cooked meat vendors include restaurants, food stalls and rum shops.

- Market vendors sell raw meat in stalls or at the back of their pickup truck or van. Markets only take place on weekends (except Charity market, which operates on Mondays). Vendors sell whole animals or parts depending on the species and they will butcher the carcass according to the client's need.

- Home based traders store large amounts of raw wild meat in their freezers at home and they sell it to known clients in the neighbourhood, who call them or come by when they need wild meat. "In this business, we don't need to know anyone, but people need to know us", said a wild meat vendor selling from his home.

- Roadside traders often specialize in iguana trade but may sell other common species (such as agouti), depending on availability. Iguanas are sold alive to passing clients.

- Restaurants (high-end restaurants or specialty restaurants) and food stalls (roadside places serving mostly travellers or market-based food stalls) serve wild meat on their menus. Wild meat is most often prepared with curry (e.g., curry labba) or stewed with cassareep, a sauce made from cassava root.

- Rum shops are bars, where groups of friends (mostly men) gather after work or on weekends and share drinks (e.g., rum) and cutters (small pieces of fried meat served as finger food), often including wild meat.

In addition to the physical sale points, we also identified an online trade system via WhatsApp and social media (mostly Facebook). We did not systematically attempt to quantify the posts on social media but observed that those posts concerned opportunistic sales of raw or cooked meat, particularly during the month of September, which is Indigenous Heritage month in Guyana. Some of the established restaurants and home vendors would also promote their products on Facebook.

Out of the vendors interviewed, the majority are Indo-Guyanese (48%), but Amerindians also participate as wild meat traders (19%), followed by Afro-Guyanese (16%) and those of mixed origins (16%). The business is dominated by men (75%), but 25% of them are women. Most (82%) sell other meat (chicken, mutton, beef, duck etc.) or fish products in addition to wild meat. Only 16% of the vendors only sell wild meat and these usually solely depend on wild meat sales as their primary source of income for the household. The other vendors have other sources of income for the household, mostly related to running a grocery shop or a restaurant (35%), farming (16%) or other (33%) (e.g. fishermen, employees in private companies or craftsman/woman). Their ages vary between 17 to 65 years old, and they have been in the business for 1 to 55 years (SD = 10.8). The vendors are evenly distributed across different categories of years of experience showing that this is a dynamic system allowing for newcomers into the business. Most vendors have reached secondary education (56%), while the others have only completed primary school.

Trade chain

Out of the 72 wildmeat vendors interviewed, 39% sell what they have hunted themselves (n = 28) meaning that they are the primary harvesters and have no intermediaries upstream: they hunt and sell (Figure 1). These urban hunters are passionate about hunting and organize hunting trips on regular occasions to known hunting grounds where they have acquaintances or family in their hunting grounds. They provide the cartridges, fuel, coolers, and ice and plan the hunting party with their local contacts (group of 5-8 hunters). Most of them sell the raw meat directly to the final consumer or to restaurants, food stalls and rum bars. Road-side traders specialize in the iguana trade: they hunt and sell iguanas directly to consumers or to cooked meat vendors. Raw meat vendors that do not hunt themselves have agreements with hunters living in the interior (mostly Indigenous or African Guyanese), with whom they have good personal relationships (often from childhood) and who supply them with wild meat on a regular basis. Cooked meat vendors purchase wildmeat from raw meat vendors and sell it to final consumers.

Trade routes to the coast

Wild meat is sourced from several areas located in the interior, but mostly from Region 7 and Region

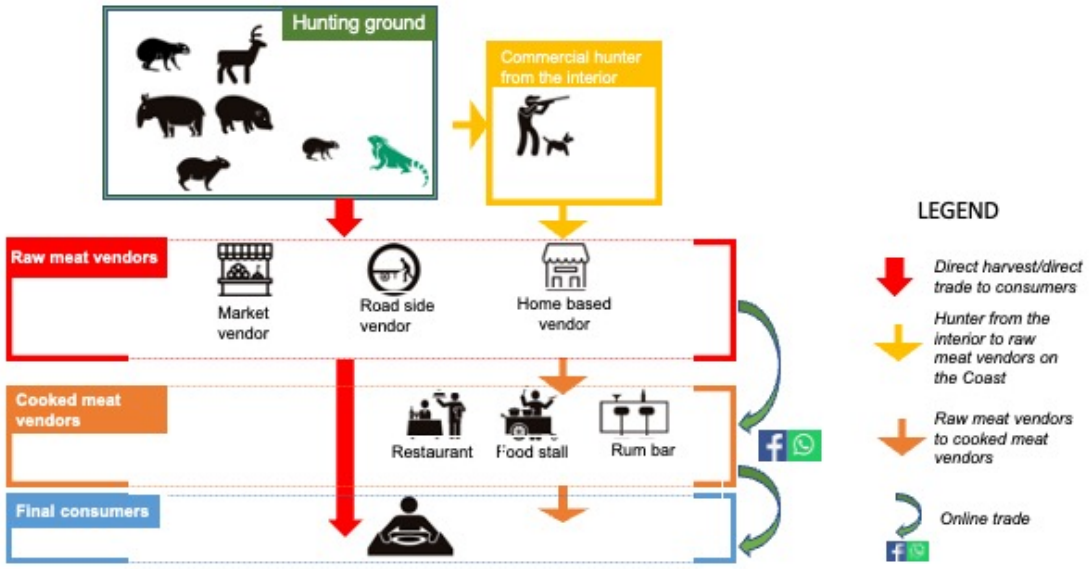

Figure 1. Structure of the wildmeat trade chain on the Coast of Guyana

10 (Figure 2). Most of vendors (83%) mention that their wildmeat is transported to the coast on vehicles or trucks. Outboard boats were mentioned by 61% of them, and motorcycles by 15% of the traders. Source areas for wildmeat are located at about 50-80 km along the roads or rivers from the low plain coastal line. Logging and mining areas, like Kwakwani/Ituni and the larger Mabura area are important sources of wild meat (Table 1). The presence of mining and logging operations in those areas often implies access to generators that can produce ice, access to cartridges and transportation in and out on trucks or outboard boats. The road from Georgetown to Lethem is paved until Linden, which makes it possible for coastal hunters to reach some of the hunting grounds in Region 10 and 8 within 3 hours on their vehicle. Hunting grounds along main rivers (Berbice, Demerara, Essequibo, Pomeroon and Corentyne) are also particularly important source areas. Wild meat is transported on outboard boats in coolers full of ice to keep the wild meat cool for about 2-3 days. The ice is often the limiting factor to the length of the hunting trips and the distance of the hunting grounds. In some cases, the hunters must find ice along the way to ensure proper conservation of the meat. Out of 72 vendors on the coast, 7 occasionally get wild meat from as far as Region 9, which is the region located at the southern end of Guyana, bor-

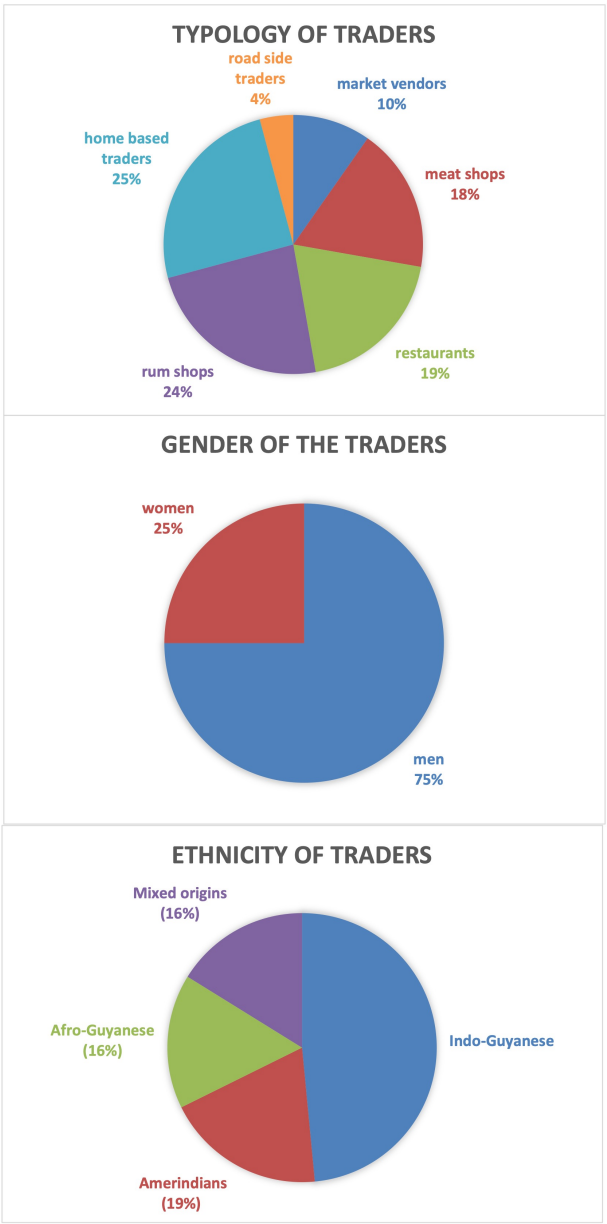

Figure 2. Typology of wildmeat traders, gender and ethnicity

dering Brazil. Wild meat from Region 9 travels to the coast on the mining trucks coming from the Marudi mining area or is sourced from ranches or Indigenous land from North Rupununi. This, however, is not an established trade route and is of opportunistic nature, given the distance and conditions of the road from Linden to Lethem. A few vendors mentioned that wild meat harvested in Guyana is sometimes exported to neighbouring countries, particularly labba (*Cuniculus paca*) and agouti (*Dasyprocta leporine*). Seizures of such wild meat have occurred during the year of the study period. Existence of a closed hunting season in Suriname, a (temporary) ban on hunting in Trinidad and Tobago, and the general illegality of hunting in Brazil may stimulate such trade. However, based on the vendors' appreciation, this only occurs opportunistically without any structured trade outside of the Guyanese border.

Hunting methods, species and volumes of wild meat sold

Guns were mentioned by 74% ($n = 54$) of the vendors as the main way in which the meat is obtained. Dogs are often used by gun hunters. Traps are mentioned by 19% ($n = 14$) of the vendors and bow and arrow by 7% ($n = 5$) of them (and only used by Indigenous hunters). The top five most sold species are labba (*Cuniculus paca*), bush deer (Mazama americana), tapir (*Tapirus terrestris*), peccary (*Dicotyles tajacu*, *Tayassu pecari*), and capybara (*Hydrochoerus hydrochaeris*) (Figure 4). Other species commonly sold are agouti (*Dasyprocta leporina*), powis (*Crax alector*) caimans and armadillos (although no identification of species was possible for those two groups). Within this list of species the tapir and white-lipped peccary are listed as globally threatened, but none of these species are protected in Guyana. Peccaries and armadillos could not be identified to species by most vendors. Armadillos present in Guyana include giant armadillo (*Priodontes maximus*), nine- banded armadillo (*Dasypus novemcinctus*), six- banded armadillo (*Eupharctus sexcinctus*), southern naked-tailed armadillo (*Cabassous unicinctus*), of which the giant armadillo and southern naked- tailed armadillo are listed as vulnerable. According to the vendors, sales of wild meat are stable throughout the year but slight peaks are observed in December (Christmas) and September (Indigenous Heritage month). Based on estimations made by the primary harvesters, the amounts sold per day (kg/day) varied between 1 to 150 kg with a mean of 14,9 kg/day. Based on those primary harvesters, and considering a steady trade all along the year, we estimate that about 361,080 kg of wild meat is sold per year on the coast, which can be considered as an under-estimation of the amounts harvested (since this calculation does account for own consumption and non-commercial wild meat networks). Among the 72 vendors, 55 report having difficulties obtaining wild meat for their business. Primary harvesters are particularly concerned by the lack of supply (80% of them mentioned lack of supply as their main challenge), basically because they must go further to find enough wild meat or because they do not get enough of the most popular species such as labba, deer, peccary and tapir.

Prices and economic value of the trade

Wild meat prices for consumers range from 3,25US/kg to 4,25 USD/kg dollars depending on the species and show a positive relationship with order of preference (Table 2). Deer, tapir and peccary are among the most expensive wild meat species. Beef, chicken and pork are all below the mean price of wild meat (about half the price). The difference between the price of purchase to the hunter and the price of sell to the consumer is about 1,25 USD/kg, meaning that the vendors that are not primary producers have a margin of about 38% (excluding costs). The main costs associated with wild meat trade at the level of the vendors are transportation (mentioned by 70% of vendors), and electricity to produce ice and to stock and conserve wild meat (64%). Transportation costs are associated with fuel and maintenance costs for the vehicle or outboard engine. The rough road conditions can demand maintenance after every trip. Vendors that hunt for themselves (45,8% of the total) also incur costs related to hunting (ammunition, guides, fuel, ice), because they have no intermediaries, the benefit is concentrated at their level. Benefits made after deduction of the costs are used mostly for household expenses, such as food (mentioned by 57% of the vendors) or housing (28%). Most vendors are motivated by this activity because it generates good income (75%) or because they enjoy it (24%). Only one vendor mentioned doing this activity because he had no other option. The total value of the wild meat trade is estimated to range between 1 173 510 USD and 1 534 590 USD per year based on the min and max price of wild meat and a total amount of wild meat traded estimated at 361 080 kg/year.

Handling and safety on the coast

Wild meat is transported to the place of sale either gutted on ice or as fresh kill (this was mentioned by 68% of the vendors). Only iguanas are transported alive. Only 10% of the raw meat vendors may sell frozen, smoked or salted meat. Freezing the meat to preserve it until sale is the most common way of

Table 1. Main Sources of Wild meat to the coast of Guyana

Region	Location	% of vendors indicating this region as the main source of wild meat
Region 2	Pomeroon Supernaam Golden fleece	12.5
Region 3	West Bank demerara	1.4
Region 4	Upper Demerara Mahaica	5.5
Region 5	Great falls Melali	7
Region 6	Skeldon Black bush polder Orealla Crabwood creek	8.3
Region 7	Bartica Cuyuni Hororabo	26.4
Region 8	Orinduik Siparuni	5.5
Region 9	Aishalton Ruperti Apoteri	7
Region 10	Linden Ituni Mabura Kwakwani Rockstone	26.4

preservation and stocking (77%), but some just keep it on ice (23%). Primary harvesters usually skin and eviscerate the game at the place of harvest. Vendors butcher (and cook if in restaurant) according to the preference of the consumer. Among the sale points, 16% did not have access to tapped water at their sale point and use water from the river or rainfall. Electricity is available at 83% of the sale points (10% get it from solar panels and the rest from the general electrical service). Only 5% of the vendors on the coast reported losses of wild meat due to bad conservation methods, but some vendors mention having lost more than 50% of their product on occasions, mostly in cases where ice had melted during the transportation. No special equipment is worn during the handling of wild meat, aside from an apron.

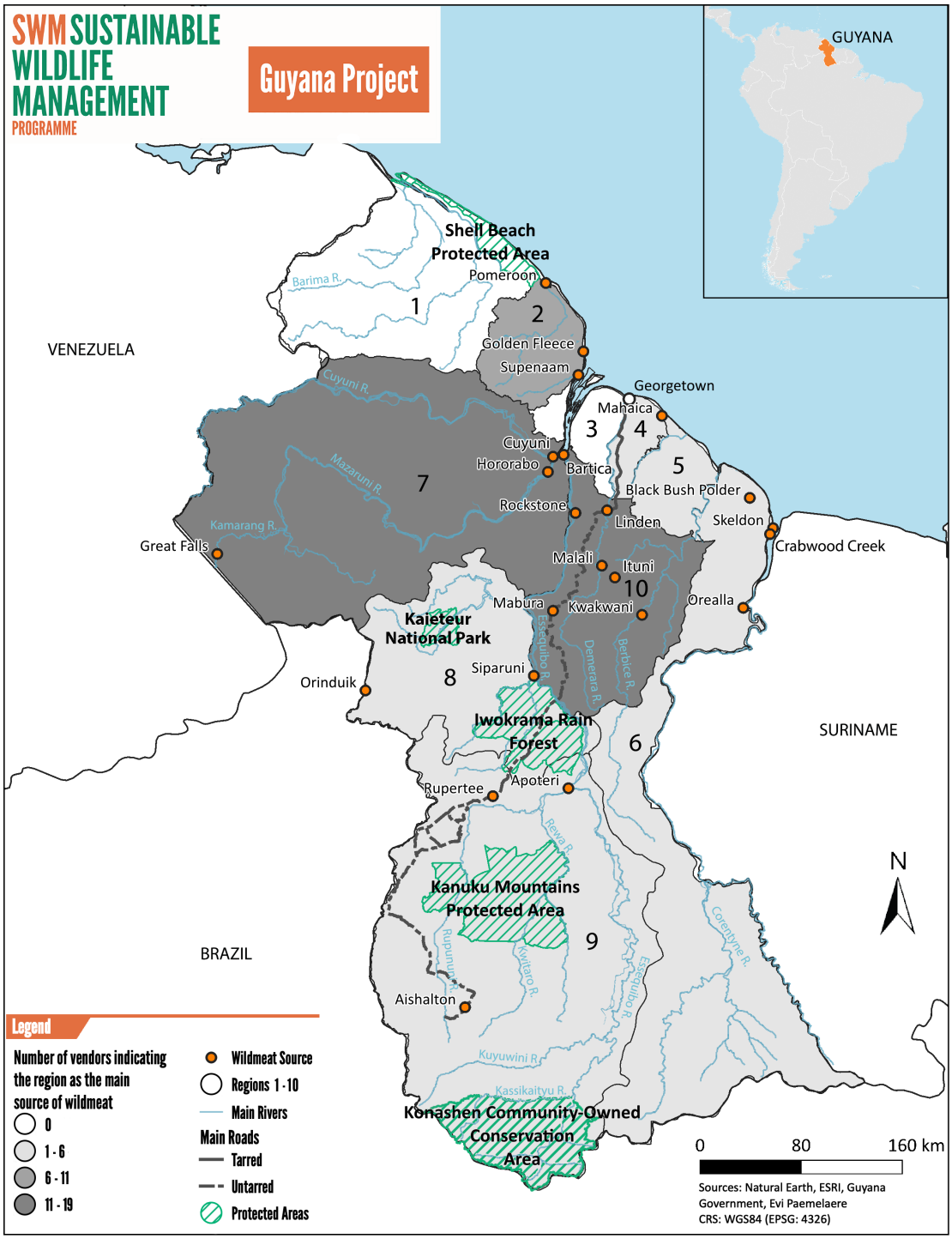

Figure 3. Map of main source areas for wildmeat to the Coast of Guyana and regions from where most wildmeat originates.

DISCUSSION

In this study, we provided a detailed description of the wild meat trade chain on the coast of Guyana, therefore contributing to a better understanding of wild meat trade in the Caribbean, a region that has been historically overlooked in the literature for this topic (Ingram et al, 2021). Our study covers the trade happening in the most populated natural region of Guyana, one that represents the larger share of the human population (90%) and where larger urban ar-

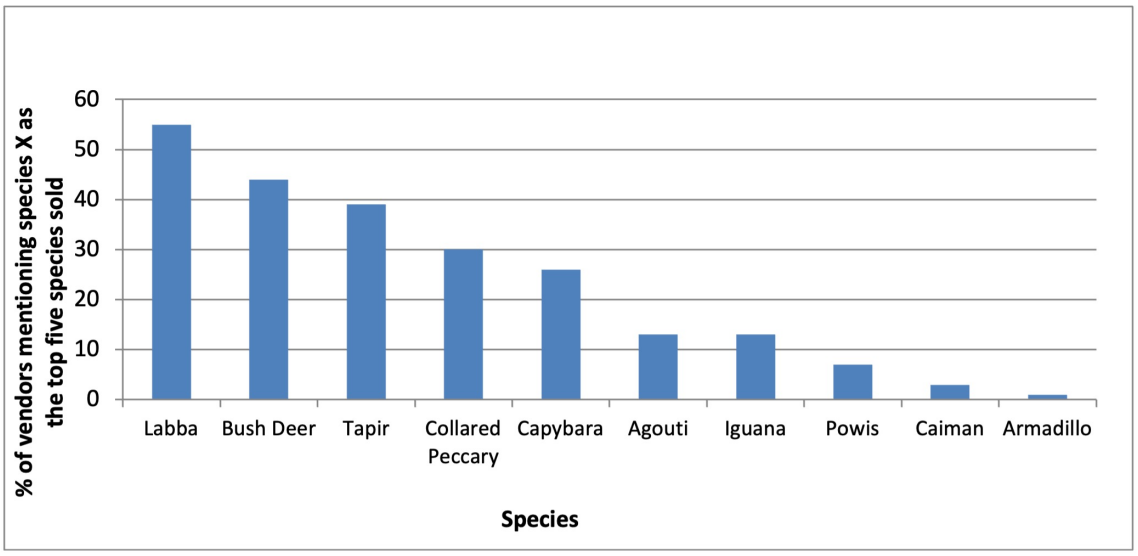

Figure 4. Top five species sold on the coast of Guyana: % of vendors mentioning species X as among the top five wild meat species sold

eas are located.

Our study shows that the market chain on the coast of Guyana is a short and direct market chain where the harvester most often sells directly to the consumer (Phelps 2016). This market chain structure is unique as compared to other well-known wild meat market chain structures characterized by redundant channels as observed in Yangambi, Democratic Republic of Congo (van Vliet et al., 2019), multiple barriers to entry as observed in Takoradi, Ghana (Cowlishaw et al., 2005) or gate keepers as described in Leticia, Colombia (van Vliet et al., 2015a), all depicting channels where the added value is shared across multiple actors along the chain. In Guyana, the primary harvester is a "specialized commercial harvester" according to the typology by Phelps (2016). Specialized commercial harvesting not only requires sophisticated technologies for meat conservation and hunting, but also networks and coordination to harvest (Phelps 2016). Finding consumers is not a problem in this context where supply does not meet the demand and trade is legal (or unregulated at the time of the study). The main limiting factor for urban hunters to enter the wild meat trade business is access to hunting grounds. External hunters often require strong networks within the communities

Table 2. Mean prices of wild meat (top five most sold species) and domestic meat on the coast of Guyana

	Species	Mean Price for final costumer (US $/Kg)
Wild meat	Bush deer	4.25
	Labba	3.5
	Capybara	3.25
	Collared peccary	4
	Tapir	4
Domestic	Beef	2.4
	Chicken	1.65
	Pork	1.65
	Mutton	5

to access the resource, and count on acquaintances as guides. In Indigenous community lands, outsiders are not normally allowed to hunt without prior permission from local traditional authorities, unless they have become part of the community through a rights claim secured by family or friendship linkages with residents of the community (McDonald, 2016).

In coastal Guyana, wild meat can be considered a luxury, rather than a necessity: the price is higher compared to other alternative sources of meat and demand rises for special events (such as Christmas or Heritage month). Examples across the world show that in large metropolitan cities, consumers usually have the choice of several sources of domestic animal protein and there is a tendency for wild meat to become a luxury product or a festive food, associated with cultural identity and social status (Fa et al., 2019; Chausson et al 2019; Shairp et al 2016; Wilkie et al 2016; Luiselli et al., 2017). For example, in the Colombian Amazon, despite increased access to cheap chicken and processed foods in the region (van Vliet et al., 2015b), demand for wild meat remains high as an occasional luxury meal, given the cultural attachment to traditional and tasty meats (Morsello et al., 2015). Guyanese food is regarded as a distinctive culinary entity that continues to be a crucial symbol of collective national Guyanese identity and wild meat is used in several specialty dishes, such as pepperpot and curry meats (Richards-Greaves, 2013). Pepperpot, an Indigenous specialty dish particularly consumed for Christmas, is a thick, dark-brown, stew-like dish that is made with various types of meats (including wild meat) and boiled in cassava-based cassareep with various spices. Curries can be prepared with all sorts of meats, but "curry labba" (labba meat prepared with curry) is a Guyanese specialty, consumed in high end restaurants or in rum bars as finger food. Curries originated in Southern Asia and were transported to Guyana with East Indians who migrated as indentured laborers in the early nineteenth century (Richards-Greaves, 2013).

The volumes traded to the coast of Guyana are equivalent to 361 tons of wild meat sold per year. Considering the population size of the low plain coastal line would be equivalent to 0,5 kg/year/-capita or 1,4 g/capita/day. This value is far below values observed in urban towns from Central Amazonia in Brazil where wild meat consumption per capita equals to 18 g/capita/day (El Bizri et al., 2020). As compared to their Brazilian neighbour, wild meat consumption in Guyana may be limited by religious affiliations: the Muslim community (7,3% of the population) does not eat non-halal meats, Hindus (24,8% of the population) promote vegetarianism and Seventh Day Adventists (8% of the population) do not eat pork (or the wild cousin: peccary) (Richards-Greaves, 2013). According to FAOSTAT, the intake of proteins from animal origin in Guyana is equal to 35,3 g/day/capita (data from 2018), which means that wild meat contributes to satisfy close to 4% of the protein intake from animal origin on the coast of Guyana. While the coast of Guyana includes more than 90% of the human population, the volumes presented in this study may significantly increase as medium sized towns start flourishing in the interior as a result of extractive activities, potentially becoming other mayor wild meat trade hubs over the coming decades.

Most source areas for wildmeat are at less than 50-80 km from the low plain coastal line along the main access routes (main rivers and roads), leaving large forest tracks far from commercial hunting pressure. However, having to travel further over time is one of the main constraints mentioned by the primary harvesters we interviewed. This may be an indication that wildlife populations could be declining in accessible hunting grounds. Evidence from the rural areas in Guyana shows that wildlife decline is linked to human population size (Iwamura, 2014), distance to village (Read et al., 2010; Hallett et al., 2019), and the increased use of shotguns (Shaffer et al. 2017). While current levels of hunting may be considered sustainable in remote communities from the interior, small shifts in activity patterns and distribution of some game species are already indicating possible over-harvest, particularly for lowland tapir and the long-nosed armadillos (Hallett et al., 2019; Shaffer et al., 2017). As shown in many other wild meat studies across tropical forest areas, the bulk of the wild meat volumes sold on the coast of Guyana involves mostly non-endangered species (labba, collared peccary bush deer, iguana). However, tapir and white-lipped peccary, listed as threatened and vulnerable respectively, are mentioned among the top species sold, which is a matter of concern.

To regulate the trade for sustainability, the Government of Guyana through the Guyana Wildlife Conservation and Management Commission is in the process of developing and enforcing regulations, which will include a licensing system for commercial hunting and trade, hunting seasons and a quota system. While regulations and enforcement will certainly contribute to avoid unsustainable use, behaviour change campaigns, such as those developed by Chavez et al. (2019) in Brazil may help curve the demand for vulnerable species (such as tapir and armadillo). In parallel, processes that strengthen local governance systems and encourage co-management models (for example through the titling of Indigenous lands) may help maintain customary access rules and avoid open access scenarios. As mentioned by Ingram et al. (2021), there is clearly no one-size-fits-all solu-

tion to address the challenges of managing the wild meat sector, but certainly a multisectoral and multilevel approach, combining law revisions and enforcement, innovative and inclusive management options and demand reduction strategies must be explored. From a one health perspective, further attention is also required with regards to food safety aspects along this legal trade chain.

ACKNOWLEDGMENT

We are particularly thankful to the wildmeat traders who agreed to take part in this study and the Guyana Wildlife Conservation and Management Commission for their institutional and technical support. This research is part of the SWM Programme, an Initiative of the Organisation of African, Caribbean, and the Pacific States, which is funded by the European Union with co-funding from the French Facility for Global Environment (FFEM) and the French Development Agency (AFD), implemented through a consortium partnership, which includes the Centre for International Forestry Research (CIFOR), the Food and Agriculture Organization of the United Nations (FAO), Wildlife Conservation Society (WCS) and the French Agricultural Research Centre for International Development (CIRAD).

DATA AVAILABILITY

Data collected in this research is available upon request to the corresponding author

CONFLICT OF INTEREST

None.

CONTRIBUTION STATEMENT

NvV was in charge of the concept of the paper, the analysis of data and the writing of the first draft.
PA was in charge of data collection, data analysis and interpretation.
ODprovided support for the data collection, organized the logistics and participated in the writing.
RN participated in final revisions and checking the overall logic behind the paper.

REFERENCES

Chaber AL, Allebone-Webb S, Lignereux Y, Cunningham AA, Marcus Rowcliffe J (2010) **The scale of illegal meat importation from Africa to Europe via Paris.** *Conservation Letters* 3:317-321.

Chausson AM, Rowcliffe JM, Escouflaire L, Wieland M, Wright JH (2019) **Understanding the sociocultural drivers of urban bushmeat consumption for behavior change interventions in Pointe Noire, Republic of Congo.** *Human Ecology* 47:179-191.

Chaves WA, Wilkie DS, Monroe MC, Sieving KE (2017) **Market access and wild meat consumption in the central Amazon, Brazil.** *Biological Conservation* 212:240-248.

Cowlishaw G, Mendelson S, Rowcliffe JM (2005) **Structure and operation of a bushmeat commodity chain in southwestern Ghana.** *Conservation Biology* 19:139-149.

Doherty DA (2005) **Hunting and the Implications for Mammals in Belize.** University of California, Davis.

El Bizri HR, Morcatty TQ, Valsecchi J, Mayor P, Ribeiro JE, Vasconcelos Neto CF, Oliveira JS, Furtado KM, Ferreira UC, Miranda CFS, Silva CH, Lopes VL, Lopes GP, Florindo CCF, Chagas RC, Nijman V, Fa JE (2020) **Urban wild meat consumption and trade in central Amazonia.** *Conservation Biology* 34:438-448.

Fa JE, Ryan SF, Bell DJ (2005) **Hunting vulnerability, ecological characteristics and harvest rates of bushmeat species in afrotropical forests.** *Biological Conservation* 121:167-176.

Gibson L (2020) **Bycatch of the Day: Wild Meat Consumption, Ecological Knowledge, and Symbolic Capital among Indigenous Maroon Parrot Hunters of Jamaica.** *Journal of Ethnobiology* 40:167-182.

Gore ML, Mwinyihali R, Mayet L, Baku-Bumb GDM, Plowman C, Wieland M (2021) **Typologies of urban wildlife traffickers and sellers.** *Global Ecology and Conservation* 27:e01557.

Hallett MT, Kinahan AA, McGregor R, Baggallay T, Babb T, Barnabus H, Wilson A, Li, FM, Boone WW, Bankovich BA (2019) **Impact of low-intensity hunting on game species in and around the Kanuku Mountains Protected Area, Guyana.** *Frontiers in Ecology and Evolution* 7:412.

Ingram DJ, Coad L, Milner-Gulland EJ, Parry L, Wilkie D, Bakarr MI, Mohamed I, Benítez-López A, Bennett EL, Bodmer R, Cowlishaw G, El Bizri HR, Eves HE, Fa JE, Golden CD, Iponga DM, Minh NV, Morcatty TQ, Mwinyihali R, Nasi R, Nijman

V, Ntiamoa-Baidu Y, Pattiselanno F, Peres CA, Rao M, Robinson JG, Rowcliffe JM, Stafford C, Supuma M, Tarla FNi, van Vliet N, Wieland M, Abernethy K (2021) **Wild meat is still on the menu: progress in wild meat research, policy, and practice from 2002 to 2020.** *Annual Review of Environment and Resources* 46:221-254.

Iwamura T, Lambin EF, Silvius KM, Luzar JB, Fragoso JM (2014) **Agent-based modeling of hunting and subsistence agriculture on indigenous lands: Understanding interactions between social and ecological systems.** *Environmental Modelling* & Software 58:109-127.

James AM (2012) **The Agouti of the Commonwealth of Dominica, Dasyprocta leporina.**

Jones CB, Young J (2004) **Hunting restraint by Creoles at the Community Baboon Sanctuary, Belize: a preliminary survey.** *Journal of Applied Animal Welfare Science* 7:127-141.

Lescuyer G, Nasi R (2016) **Financial and economic values of bushmeat in rural and urban livelihoods in Cameroon: Inputs to the development of public policy.** *International Forestry Review* 18:93-107.

Luiselli L, Petrozzi F, Akani GC, Di Vittorio M, Amadi N, Ebere N, Dendi D, Amori G, Eniang EA (2017) **Rehashing bushmeat–interview campaigns reveal some controversial issues about the bushmeat trade dynamics in Nigeria.** *Revue d'Ecologie Terre et Vie* 72:3-18.

MacDonald K (2016) **"No trespassing": changing and contested rights to land in the Guyanese Amazon.** *Journal of Latin American Geography* 59-82.

Nicholson DJ, Kanagavel A, Baron J, Durand S, Murray C, Tapley B (2020) **Cultural association and its role in garnering support for conservation: the case of the Mountain Chicken Frog on Dominica.** *Amphibian and Repfile Conservafion* 14:133-144.

Nielsen MR, Meilby H, Smith-Hall C (2016) **How could the bushmeat trade in the Kilombero Valley of Tanzania be regulated? Insights from the rural value chain.** *Oryx* 50:84-93.

Pacheco-Cobos L, Winterhalder B (2021) **Ethnographic Observations on the Role of Domestic Dogs in the Lowland Tropics of Belize with Emphasis on Crop Protection and Subsistence Hunting.** *Human Ecology* 49:779-794.

Parry L, Barlow J, Pereira H (2014) **Wildlife harvest and consumption in Amazonia's urbanized wilderness.** *Conservation Letters* 7:565-574.

Phelps J, Biggs D, Webb EL (2016) **Tools and terms for understanding illegal wildlife trade.** *Frontiers in Ecology and the Environment* 14:479-489.

Read JM, Fragoso JM, Silvius KM, Luzar J, Overman H, Cummings A, Giey ST, Oliveira LF (2010) **Space, place, and hunting patterns among indigenous peoples of the Guyanese Rupununi region.** *Journal of Latin American Geography* 213-243.

Richards-Greaves G (2013) **The Intersections of 'Guyanese Food'and Constructions of Gender, Race, and Nationhood.** *Food and Identity in the Caribbean* 75-94.

Shaffer CA, Milstein MS, Yukuma C, Marawanaru E, Suse P (2017) **Sustainability and comanagement of subsistence hunting in an indigenous reserve in Guyana.** *Conservation Biology* 31:1119-1131.

Shairp R, Veríssimo D, Fraser I, Challender D, MacMillan D (2016) **Understanding urban demand for wild meat in Vietnam: implications for conservation actions.** *PloS one* 11: e0134787.

van Vliet N, Nebesse CASIMIR, Gambalemoke S, Akaibe D, Nasi R (2012) **The bushmeat market in Kisangani, Democratic Republic of Congo: implications for conservation and food security.** *Oryx* 46:196-203.

van Vliet N, Cruz D, Quiceno-Mesa MP, Aquino LJN, Moreno J, Ribeiro R, Fa J (2015a) **Ride, shoot, and call: wildlife use among contemporary urban hunters in Três Fronteiras, Brazilian Amazon.** *Ecology and Society* 20.

van Vliet N, Quiceno-Mesa MP, Cruz-Antia D, Tellez L, Martins C, Haiden E, Oliveira MR, Adams C, Morsello C, Valencia L, Bonilla T, Yagüe B, Nasi R (2015b) **From fish and bushmeat to chicken nuggets: the nutrition transition in a continuum from rural to urban settings in the Tri frontier Amazon region.** *Ethnobiology and Conservation* 4. doi: 10.15451/ec2015-7-4.6-1-12

van Vliet N, Schulte-Herbruggen B, Vanegas L, Yair-Cuesta E, Sandrin F, Nasi R (2018) **Wild animals (fish and wildmeat) contribute to dietary diversity among food insecure urban teenagers the case of Quibdó, Colombia.** *Ethnobiology and Conservation* 7. doi: 10.15451/ec2018-01-7.02-1-15.

van Vliet N, Muhindo J, Nyumu JK, Nasi R (2019) **From the forest to the dish: a comprehensive study of the wildmeat value**

chain in Yangambi, Democratic Republic of Congo. *Frontiers in Ecology and Evolution* 132.

van Vliet N, Quiceno M, Moreno J, Cruz D, Fa JE, Nasi R (2017) **Is urban bushmeat trade in Colombia really insignificant?.** *Oryx* 51:305-314.

Wilk R (2005) **Colonialism and wildlife in Belize.** *Belizean Studies* 27:4-12.

Wilkie DS, Wieland M, Boulet H, Le Bel S, van Vliet N, Cornelis D, BriacWarnon C, Nasi R, Fa JE (2016) **Eating and conserving bushmeat in Africa.** *African Journal of Ecology* 54:402-414.

Received: 01 June 2022
Accepted: 29 July 2022
Published: 06 August 2022

Editor: Rômulo Alves