

CONTRIBUTED PAPER

Using conservation criminology to understand the role of restaurants in the urban wild meat trade

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Abstract

At unsustainable rates and in illegal contexts, the wild meat trade is a driver of species extinction; it can also threaten ecosystem services, local food security and contribute to the risk of zoonotic disease spread. The restaurant and catering sectors are understudied groups in conservation, both with regards to the legal and illegal wild meat trade and particularly in urban areas. Restaurateurs are key actors between wild meat consumers and suppliers and thus play a central role in the supply chain. This study applied a crime science hot product approach to characterize: (a) restaurateur perceptions of urban wild meat consumption; (b) wildlife species most at risk in the urban wild meat trade; and (c) the differences between restaurants in Kinshasa (Democratic Republic of the Congo) and Brazzaville (Republic of the Congo). Through focus groups in both cities, participants affirmed that in urban centers wild meat is considered a luxury item and sign of wealth. Monkeys were seen as a hot product in both cities, but we found a greater variety of hot wild meat products in Brazzaville. When looking at the differences between the restaurant tier levels, middle-tiered restaurants identified pangolin and antelopes as being hot products, rather than monkeys as with upper and lower-tiered restaurants. By applying a hot product analysis, we identified the wild meat groups most likely to be targeted by the urban wild meat trade. Findings herein offer novel opportunities to better tailor and prioritize conservation interventions against illegal trade using design against crime or other crime prevention strategies.

KEYWORDS

bushmeat, Congo Forest Basin, elephant, hot product analysis, illegal wildlife trade, monkeys, pangolins, wildlife trafficking

[†] The views expressed herein are those of the author(s) and do not necessarily reflect the views of the United Nations.

1 | INTRODUCTION

1.1 | The urban wild meat trade

Wild meat is traded as a form of commerce involving multifaceted supply chains (Bennett et al., 2007) and is an essential part of the diet of millions of people globally, contributing 20–70% of all protein intake (Fa et al., 2015). At unsustainable rates and in illegal contexts, the wild meat trade is a driver of species extinction (Ripple et al., 2016); it can threaten ecosystem services, local food security, and contribute to risk of zoonotic disease spread (Fa, Currie, & Meeuwig, 2003; Smith et al., 2012; Whytock et al., 2018). Although wild meat trade can and does exist in a legal capacity, it becomes illegal when species that are protected by various laws (e.g., local hunting seasons, national-level laws or international conventions) are poached from the wild or trafficked across borders.

Both growing human populations and the illegal trade for urban wild meat markets intensifies pressure on wildlife species. The United Nations' World Urbanization Prospects (UN, 2018) projected the world will hold over 40 megacities (i.e., cities with populations of more than 10 million people) by 2030. This urbanization and sprawl coupled with human population growth and migration portends the illegal urban wild meat trade is a threat for conservation and sustainable development (Luiselli et al., 2019). With the continued growth and wealth of urban populations globally, urban demand for wild meat easily crests beyond sustainable levels (East, Kumpel, Milner-Gulland, & Rowcliffe, 2005; Robinson & Bennett 2005; Wilkie, Wieland, & Poulsen, 2019; Bizri et al., 2020). As such, urban areas are becoming a key geographic space for illegal wild meat trade. Urban geographies often necessitate different approaches to conservation than rural areas, and urban centers also embody different crime ecosystems (i.e., the environments within which crime/illegal activity occurs) than periurban or rural ones (e.g., Bandara & Tisdell, 2003).

Unsurprisingly, over time, the wild meat trade has evolved to accommodate increased demand from urban centers; for example recent estimates project approximately 6 million tons of wild meat is exported from the Congo and Amazon Basins every year destined for local and international markets (Lindsey et al., 2013; Nasi & Van Vliet, 2011). In many African cities, wild meat is overwhelmingly considered a luxury dietary option (Wilkie et al., 2016), although there are important nuanced differences (Chausson, Rowcliffe, Escouflaire, Wieland, & Wright, 2019). Wealthy residents in urban markets have the monetary means to purchase wild meat, while less affluent and often rural residents hunt wild meat for sustenance (Bizri et al., 2020; McNamara,

Fa, & Ntiamoa-Baidu, 2019). It is thus noteworthy that as the second fastest urbanizing continent, Africa is expected to double its number of megacities in the next decade (Bello-Schünemann & Aucoin, 2016). Although wild meat consumption by urban populations in Africa is not a new phenomenon (Wilkie & Carpenter, 1999), wild meat is now exported regularly from Africa to cities in Europe (Chaber, Allebone-Webb, Lignereux, Cunningham, & Rowcliffe, 2010; Falk et al., 2013; Musing, Norwicz, Kloda, & Kecse-Nagy, 2018). There is currently limited understanding of how the urban wild meat trade operates, globally and specifically for Africa. Extant literature overwhelmingly focuses on consumers. For instance, East et al. (2005) and Wilkie et al. (2005) characterized urban wild meat consumption in households, markets and restaurants, describing price sensitivity, dietary substitutes and protein balances. Mbete et al. (2011) conducted a survey on households in Brazzaville, one of the cities chosen for this study, and found that 88.3% of households reported consuming wild meat, sourced mostly from markets. However, the study did not further explore wild meat consumption and trade beyond the household level.

Going beyond hunters and households to understand additional actors in illegal wild meat trade to urban African cities may help inform creative solutions to reduce risks to wildlife and humans associated with the trade. Restaurateurs simultaneously play a role as locations for suppliers and end-users in the urban trade of wild meat, because they are placed at the end of the supply chain where both the final sale and consumption takes place. They also have great power to promote sustainable natural resource use through their menu offerings and choice of suppliers. For example, through their procuring decisions, they can be strong agents of change for promoting sustainably and legally sourced wild meat and suitable alternatives to endangered species and those that pose health risks (such as transfer of zoonotic diseases). They have potential to influence consumer behavior through menu selections, and labeling. Their involvement in the wild meat trade also means they have valuable insights into the decision-making process for sourcing wild meat and the reasons why customers select wild meat over other protein options on the menu. The restaurant and catering sectors are understudied groups in conservation, both with regards to the legal and illegal wild meat trade, despite indication that in some regions, up to half of consumers procure wild meat from local restaurants (Chausson et al., 2019). Fa et al. (2019) randomly sampled restaurants in both Kinshasa and Brazzaville, and found that 24% of restaurants in both study areas sold wild meat to patrons. Restaurateurs are key actors between wild meat consumers and suppliers and thus

play a central role in the supply chain. In this regard, they may be more directly engaged in prevention of illegal trade (vs. strict enforcement and judicial responses) (Ekblom, 2008).

1.2 | The science of conservation crime

Conservation criminology is one conceptual framework that can help guide efforts to fill gaps in knowledge by synthesizing principles from natural resource management, criminology, and risk and decision science (Gore, 2017). The urban wild meat trade exhibits the overlapping elements of conservation biology (e.g., endangered species), criminology (e.g., illicit trade) and decision science (e.g., human behavioral choices to buy and eat wild meat); thus, we used conservation criminology as a guiding interdisciplinary approach for thinking about and interpreting the urban wild meat trade. Specifically, criminology's opportunity theories of crime can guide understanding of the occurrence of the illegal trade of wild meat in urban contexts and provide suggestions about how to best prevent it. Opportunity theories outline the situational factors that facilitate the commission of crimes, such as the illegal wild meat trade. These theories reference crime as a result of opportunity—namely that a target (e.g., a wildlife species) and offender must coincide at a particular place and time, where a suitable guardian is absent, and the benefits of the crime outweigh the costs (Clarke & Felson, 1993; Cornish & Clarke, 1987). Opportunity theories have been used in crime science to identify which items over others are most likely to be targeted for theft in urban ecosystems—also known as “hot products”—(Clarke, 1999). Better knowledge of the patterns of situational factors that facilitate a crime, and which targets are at higher risk, can enable practitioners to establish enhanced intelligence-led crime prevention measures (i.e., based on assessment and management of risk as opposed to reactive policing encompassing immediate response to illegal activity; Ratcliff, 2016). Design against crime (Ekblom, 2008), for example, encourages conservationists to “think thief” for crime prevention by identifying processes that make products, places, or people more crime resistant. Products (e.g., wild meat, porcupine bezoars or weapons) can feature in illegal trade in a number of ways, either as a target of crime (i.e., stolen for itself), target enclosure (i.e., carried off for its contents), or target resource (i.e., tool for stealing) (Ekblom, 2008).

The VIVA hot product analysis is the simplest application for identifying vulnerable targets. As crime is not spread evenly throughout a community of interest (e.g., restaurateurs), criminological tools that help distill

down the characteristics of hotspots and targeted species can inform crime prevention activities, policies, or resource allocation VIVA is used to observe the *Value*, *Inertia*, *Visibility* and *Accessibility* of a target (Cohen & Felson, 1979), in this case, the wild meat species that are most likely at risk to be trafficked (i.e., be the target of a crime). All of VIVA's categories refer to what makes a target attractive to an offender in a particular setting, in this case urban restaurateurs. Value refers to the real or symbolic worth of the target to the offender. Inertia is about the physical aspects of the target that make it suitable for theft. Visibility is the exposure of the target to offenders, making it more likely to be attacked, while accessibility refers to placement of the object that makes it easier to attack. Note that four of these categories are assessed from the offender's perspective (i.e., the restaurateur buying it for resale).

Varying and more nuanced applications of the hot product analysis have previously been used in conservation to identify which wildlife species are most threatened by the illegal wildlife trade (Moreto & Lemieux, 2015; Pires & Clarke, 2012; Pires & Petrossian, 2016). It has not yet been used for wildlife species targeted for wild meat or the decision choices made by wild meat procurers and consumers in an urban setting. The use of VIVA can be viewed as a starting point for future hot product analysis of the wild meat trade in urban areas using more nuanced frameworks like CRAVED/CRAAVED and CAPTURED (Moreto & Lemieux, 2015; Pires & Clarke, 2012; Pires & Petrossian, 2016), or prevention strategies like design against crime (Ekblom, 2008). For example, CRAVED characterizes additional variables, such as how disposable a particular stolen item is (i.e., how easy it is to sell). This characteristic influences an offender's decision-making rationale when choosing which items to steal, a variable that does not factor into VIVA. This study adapted VIVA within a conservation criminology framework to characterize: (a) restaurateur perceptions of urban wild meat consumption; (b) wildlife species most at risk in the urban wild meat trade; and (c) the criminogenic differences between restaurants in the twin cities of Kinshasa and Brazzaville. Both integrally and partially protected species as well as unprotected species were taken into account.

2 | METHODS

2.1 | Study site

We achieved the study objectives by focusing research in Kinshasa and Brazzaville, the respective capitals of the

TABLE 1 The list of seven predesignated wild meat groups used as a baseline in the restaurant focus groups in Kinshasa and Brazzaville. Each wild meat group included a range of species

Wild meat group	Antelope	Crocodile	Great ape	Monkey	Pangolin	Rodent	Wild pig
Species within group	<ul style="list-style-type: none"> • Buffalo duiker spp., • Sitatunga • Other antelope species 	<ul style="list-style-type: none"> • African dwarf • Nile • Slender-snouted 	<ul style="list-style-type: none"> • Bonobo • Chimpanzees • Gorillas 	<ul style="list-style-type: none"> • Colobus • Mandrill • Mangabey • Other monkey species 	<ul style="list-style-type: none"> • Black-bellied • Giant • White-bellied 	<ul style="list-style-type: none"> • Cane rats • Porcupines • Other rodent species 	<ul style="list-style-type: none"> • Giant forest hog • Red river hog

Democratic Republic of the Congo (DRC) and Republic of the Congo (RoC). These cities were selected because of their large urban population size (currently 14 million for Kinshasa and 2 million, or 70% of RoC, for Brazzaville; CIA, 2020) and proximity to a wide array of biodiversity in the Congo Forest Basin. Two thirds of the Congo forest is located in the DRC; the basin is home to over 400 mammal species (CARPE, 2018). Kinshasa and Brazzaville were also chosen because they exemplify the wild meat trade in many parts of Africa with thriving and established wild meat cultures (Fa et al., 2019). Endangered species such as great apes (*Pan* spp. and *gorilla* spp.), as well as vulnerable groups such as monkeys (Cercopithecidae), pangolins (Manidae) and duiker (Cephalophinae) are found in the region and are among those species targeted by the wild meat trade. The Congo River provides transportation infrastructure rivaling regional roads and air travel; the river connects these cities to one another, to the Congo forest and also to Angola. Geopolitical instability and civil war in central Africa, as well as the lure of urban opportunity has contributed to the migration of people and increased levels of wild meat poaching destined for both cities (De Merode et al., 2007). All of these contextual factors interact with other socio-ecological dimensions to reinforce a thriving wild meat trade in both Kinshasa and Brazzaville.

2.2 | Research approach

We used an inductive strategy and mixed method approach to achieve the research objectives (Boratto & Gibbs, 2019; Newing, 2010). Quantitative approaches alone are not always appropriate when attempting to research culturally-sensitive and complex topics, such as illegal activity (Drury, Homewood, & Randall, 2011). Mixed methods are appropriate when there is a need to inform decisions about applied conservation problems that span disciplinary boundaries; interdisciplinarity is a means for answering questions that cannot be answered by single methods alone (Drury et al., 2011; Newing, 2010). Our methodological goal was to make sure enough data was gathered to give an accurate understanding of the issues under investigation and the different perspectives that are present in the study population via saturation (i.e., sensemaking); the work was exploratory and an initial foray into the conservation problem.

2.3 | Measurement

We established a baseline list of key wild meat animal groups sold in restaurants, comprised of antelopes,

	All predefined species (Table 1)	Protected species (Table 2)
V Most requested	Antelope / Monkey / Rodent	Monkey
I Easiest to cook	Wild pig	Antelope
V Easiest to find	Easiest to find fresh	Monkey
	Easiest to find smoked	Antelope / Monkey
	Easiest to find alive	Antelope / Monkey
A Cheapest to buy	Cheapest to buy fresh (per kg)	Crocodile
	Cheapest to buy smoked (per kg)	Crocodile
	Cheapest to buy alive	Crocodile
A Cheapest to buy	Cheapest to buy fresh (per kg)	Pangolin / Rodent
	Cheapest to buy smoked (per kg)	Monkey / Pangolin
	Cheapest to buy alive	Monkey / Pangolin
A Cheapest to buy	Cheapest to buy fresh (per kg)	Pangolin / Rodent
	Cheapest to buy smoked (per kg)	Monkey
	Cheapest to buy alive	Pangolin

FIGURE 1 Overall hot product analysis, broken down by VIVA categories, where value = most requested by customers; inertia = easier to cook; visibility = easier to find (fresh, smoked and alive); and accessibility = cheaper to buy (fresh, smoked and alive) [Correction added on 9 March 2021, after first online publication: Figure 1 was revised.]

crocodiles, great apes, monkeys, pangolins, rodents, and wild pigs (Table 1). Each wild meat group contained several species that were both legal (in principle, during open seasons and with hunting permits) and illegal to trade according to federal laws in both the DRC and RoC as well as international agreements like the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Under these federal laws it is illegal to hunt or trade any integrally protected species at all times or partially protected species either outside of the outlined hunting season or if the animal comes from a protected area. The legality can become complex or unclear when the origin of partially protected animals, or when they were killed (as wild meat can be stored for months before sale), is not known.

We used the VIVA hot product analysis with restaurateurs to identify the wild meat species most at risk from the urban wild meat trade. For the purpose of this study, wild meat species were more *Valuable* to restaurateurs if they were more requested by customers, were less *Inert* if they were easier to cook, were more *Visible* if they were easier to find, and were more *Accessible* if they were cheaper to buy (Figure 1). This is how the VIVA criteria were described to focus group participants (Supporting Information).

We considered restaurateur perceptions and the “hot” wild meat products across restaurant tiers and cities. We categorized restaurant tier levels into three groups: upper-tier restaurants with menu prices approximately in the USD\$10–\$30 range, mid-range restaurants with menu

TABLE 2 Breakdown of participants at the focus groups by gender and restaurant tier level in Kinshasa and Brazzaville

	Total	Gender	
		Female	Male
<i>Kinshasa</i>	23		
Upper tier	8	4	4
Middle tier	6	4	2
Lower tier	9	5	4
<i>Brazzaville</i>	18		
Upper tier	5	0	5
Middle tier	5	3	2
Lower tier	8	4	4

prices in the USD \$5–\$10 range, and lower-level/street restaurants with menu prices in the USD \$1–\$5 range. This approach enabled our exploration of differences in the wild meat trades in each city. Each of these restaurant tiers attracted a different type of clientele based on socio-economic background, with each type of clientele having different meat preferences and/or species they can afford. As a result, restaurateurs in different restaurant tiers valued species based on the VIVA criteria differently, depending on what their consumers wanted and could afford. Identifying these differences allow us to consider more situational, tailored and context-specific suggestions for intervention that local stakeholders feel are adapted to local needs and ensures that actions taken are as effective as possible.

3 | DATA COLLECTION

We collected data over a two-week period in November and December 2017, holding three focus groups in each city; a total of 23 individuals in Kinshasa and 18 individuals in Brazzaville. Focus groups are widely used in conservation and their strength is that they are based upon discussion among a group of participants rather than independent statements by each individual (Newing, 2010). They are excellent for generating ideas and in revealing opinions behind ideas but poor in providing generalizations to a wider population. Each focus group represented one of the three levels of restaurants, which included cooks, waiters, hosts/hostesses and managers, and all but one group had almost equal gender representation (Table 2). Participants were identified and invited from restaurants that were already known to sell wild meat through non-probability, purposive sampling. To build trust and encourage truthful responses, we implemented three measures to minimize (but not

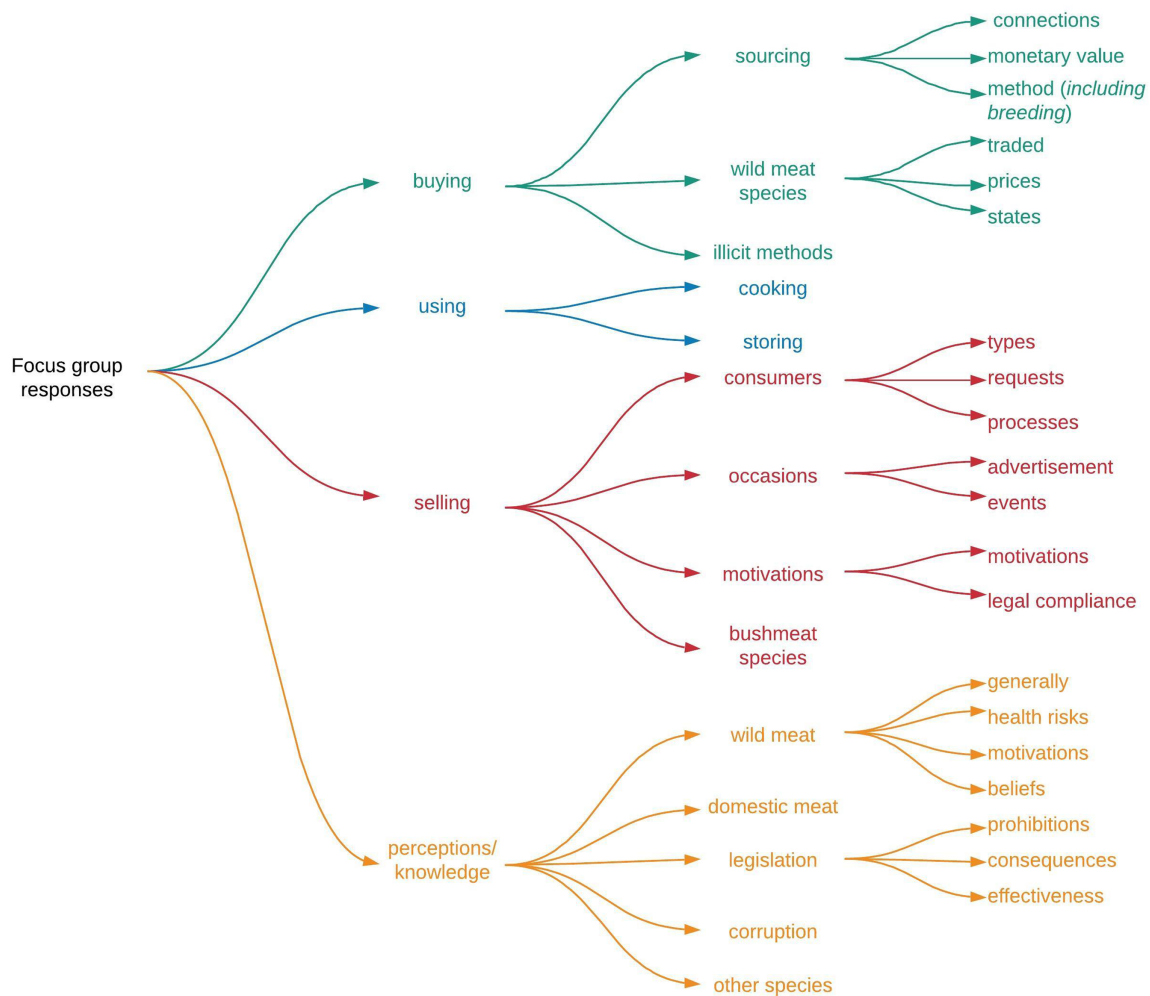


FIGURE 2 The four categories used to code and consolidate the responses from the focus groups and the themes within these that were uncovered during the qualitative framework analysis

eliminate) bias: (a) highlighting the independence of the researcher from any local or national organizations, (b) including legally and illegally traded wild meat groups, and (c) empowering restaurateurs by reiterating from the beginning the importance of their involvement in discussions on combating the unsustainability of the urban wild meat trade. We mentioned our aim was to ensure that their livelihoods were not negatively impacted and wanted to measure their unique perspective and ability to help broker viable solutions. We intended to maximize their own self-interest in being honest. Given participants answered questions in a focus group setting, there is potential that they were impacted by the presence of and social pressures from their peers, although the range and depth of the discussions suggested otherwise. It is just as likely that being in a group allowed for a deeper development of answers and thinking around them (Madriz, 2000).

In each focus group, we asked participants to organize picture cards in hierarchical order for questions

structured around VIVA categories and included wild meat species in their live, fresh and smoked states (Gore & Kahler, 2015). Each picture card represented a wild meat group that was known to be traded in the cities (Table 1). Participants were invited to suggest additional wild meat groups if needed. Additional wild meat suggestions were written on blank cards and included in the hierarchical rankings. After each focus group the lead author conferred with the interpreter and transcribed additional notes about the session (Guba & Lincoln, 2002). All focus group participants provided written informed consent to participate in the session. A local male interpreter was used in each city to communicate in English, French and Lingala.

4 | ANALYSIS

We first carried out a qualitative framework analysis in Microsoft Excel on all the notes compiled from the focus

TABLE 3 The range of wild meat groups and wildlife species included in the urban wild meat study, along with their national and/or international level protections under various laws and conventions at the time of the study

Wild meat group	Species within group	IUCN statuses within group	Protected by National Law in DRC	Protected by National Law in ROC	CITES appendix
<i>Antelope</i>	Buffalo, Duiker spp. , Sitatunga and other antelope species	Near Threatened, Least Concern	Integrally, Partially	Integrally, Partially	II
<i>Crocodile</i>	African dwarf, Nile and Slender-snouted	Critically Endangered, Vulnerable, Least Concern	Integrally, Partially	Integrally, Partially	I and II
<i>Great ape</i>	Bonobo, Chimpanzees and Gorillas	Critically Endangered, Endangered	Integrally	Integrally	I
<i>Monkey</i>	Colobus, Mandrill, Mangabey and other monkey species	Critically Endangered, Vulnerable, Near Threatened, Least Concern, Data Deficient	Integrally, Partially	Integrally, Partially	II
<i>Pangolin</i>	Black-bellied, Giant, White-bellied	Vulnerable	Integrally, Partially	Integrally, Partially	I

Note: The International Union for the Conservation of Nature (IUCN) ranks species across a range of endangerment levels, national laws in Democratic Republic of the Congo and Republic of Congo provides a range of protections, and the Convention on International Trade in Endangered Fauna and Flora (CITES) regulates trade in species based on species' placement on one of three Appendices. Within wild meat groups, wildlife species that are threatened with extinction and under strict protection by key national and international laws and conventions are highlighted in **bold**.

groups to characterize restaurateur perceptions (Srivastava & Thomson, 2008). Participant responses were coded and consolidated by one researcher on the basis of whether they covered topics related to *buying*, *using* and *selling* wild meat. Responses outside of these topics were coded under *perceptions/knowledge* and covered themes such as knowledge of wildlife laws, and perceptions of health risks associated with wild meat consumption. By using this systematic process to analyze the data, the framework helped uncover patterns within these categories and to identify additional themes across all the focus groups (Figure 2). The systematic nature of this qualitative analysis contributes to the robustness of our approach (Newing, 2010).

Our analysis of urban wild meat hot products compared groups containing at least one protected or endangered species (Table 3; Clarke, 1999). Protected species were identified as those integrally or partially protected under national DRC and RoC laws and listed under Appendices I and II of CITES. To determine which wild meat groups contained endangered species, we used the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. Wild meat groups with species that had a threat status of Near Threatened or higher at the time of the study were included in the analysis. We selected the highest ranked wild meat groups from each of the VIVA categories in each focus group to identify an overview of which wild meat species were hot

products. We then compared the highest-ranked wild meat groups by city, restaurant tier level, and VIVA category.

5 | RESULTS

5.1 | Perceptions and knowledge of urban wild meat consumption

Across all focus groups, participants affirmed that in urban centers wild meat is considered a luxury item and a sign of wealth, and thus the meat is the product featured as the target of illegal trade. Participants generalized that wild meat is eaten for a variety in diet, for its taste and featured opportunistically during social gatherings. They explained that anyone who can afford wild meat will eat it in the city, although it is more expensive there than in the countryside. One focus group from Brazzaville stated that the local urban population does not depend on wild meat for nutrition and would not suffer if it was replaced by fish or other proteins (BU001). Amongst all groups, there was awareness over the health risks associated with wild meat and also from spoilage due to poor refrigeration. One group also indicated that locally farmed meat can be expensive compared to imported meat and believed that imported meat is less healthy as it is transported over longer distances (BM001). Participants in both cities mentioned corruption in law

enforcement as being associated with wild meat supply chains. The difficulty in knowing the origin or date of killing of animals that can be hunted within set limitations contributes to the ambiguity around the wildlife trade in the cities, including the role of corruption.

5.2 | Wild meat species at risk from illegal urban trade

In addition to the wild meat groups pre-identified as being relevant for scientific exploration (Table 1), all of the focus groups unanimously added snakes as being traded within Kinshasa and Brazzaville. Four of the six focus groups, two from each city, stated that elephant meat could be occasionally found in these urban centers (BU001; BM001; KU001; KL001). Two groups from Brazzaville also mentioned that hippopotamus meat was being traded within the city, albeit only every 1 or 2 years (BU001; BM001). Several groups claimed that great apes were not found in the marketplace, except as babies for the pet trade. There was also mention of an unspecified small feline species, potentially a civet, being traded as wild meat. This information is important because knowing which products feature as the target of crime informs crime prevention strategies (i.e., restricting the resources of offenders by limiting knowledge of where the target products can be found and what their vulnerabilities are).

5.3 | Wild meat as hot products

Among wild meat groups deemed by participants as being easiest to procure in an urban setting, crocodile was identified as the easiest to find alive, antelope and monkey the easiest to find fresh, and monkey the easiest to find smoked. Regarding the value of the wild meat groups, monkey was said to be the cheapest to buy fresh and smoked, and pangolin the cheapest to buy alive out of those sold alive. One focus group from Brazzaville stated that pangolin was rare to find alive (BM001). We found the monetary value of live wildlife was not comparative to its size, rather price appeared to be tied to the value placed on different species groups. Some participants highlighted a difference in price between antelopes and buffalos within the antelope wild meat group, with buffalo being more expensive (BU001; BL001; KL001). Other groups indicated that species were more expensive when they were rarer, prohibited and harder to access (BU001; BM001). One group reported that smoked elephant meat doubled in size when cooked and so that was

used as a selling point for restaurateurs to procure the meat to sell in their stores (KL001).

5.4 | Cooking with wild meat

Antelope was generally cited as the easiest to cook. Overall, the ability to cook certain species was framed as being dependent on the chef's regional cooking training. Some species were said to require specialized methods to cook, such as porcupine and its bitter pancreas. In terms of when wild meat is cut and has its innards removed, it was said to be done either by the hunter, market seller, restaurant cook, or taken to a butcher. Participants highlighted that species with scales or hard skin, such as elephants, crocodiles, and turtles, required boiling to remove the outer shell or skin prior to cooking.

5.5 | Restaurant clients

Wild meat was said to be advertised to restaurant clients through menu boards outside restaurants, print media advertising and online. Participants identified that some restaurants were known to be specialized in certain species or known as selling a particular species on a set day each week. A wild meat species could therefore be linked to the name and/or image of a restaurant. Requests for particular species apparently depended on the individual preference of restaurant clients or on their ethnic affiliation. Restaurateurs mentioned that they might ask a client to select a few preferred species of wild meat, so that they were more likely to secure one of their chosen species for them. One focus group thought crocodiles and

	All predefined species (Table 1)	Protected species (Table 2)
Overall	Monkey / Rodent	Monkey
Kinshasa	Monkey	Monkey
Brazzaville	Pangolin / Rodent	Monkey / Pangolin
Upper tier	Monkey	Monkey
Middle tier	Wild pig	Antelope
Lower tier	Antelope / Monkey	Monkey

FIGURE 3 Overall hot product analysis, comparable by city and restaurant tier level

turtles were favored by customers in positions of authority (BM001). Other groups discussed the importance of sauce (KL001) and presentation of a dish (BM001), and this becoming more important for clients. In general, wild meat was ordered for special events such as weddings, birthdays, anniversaries, or traditional celebrations, but also on rest days like Sundays.

5.6 | Comparison between cities and restaurant tier levels

Although monkeys were seen as a hot product in both cities, a comparison between cities highlighted a greater variety of wild meat hot products in Brazzaville (Figure 3). Responses from focus groups in Brazzaville indicated that in addition to monkeys, pangolins, antelopes, and crocodiles were also hot wild meat products. Equally, when looking at the differences between the restaurant tier levels, middle-tiered restaurants identified antelopes as being hot products, and not monkeys. Upper and lower-tiered restaurants, on the other hand, reflected a higher prevalence of monkeys as hot products.

6 | DISCUSSION

With the growing urban demand for wild meat and the dynamic interplay between legal and illegal trade, urban areas are a key source of pressure on wildlife species that merit increasing attention by conservationists. Introducing the perspectives of city restaurateurs into discussions can broaden understanding of the nature, scope, and actors involved in urban wild meat trade. Specifically, this sector can provide unique insight into the “what” and the “how” of the urban wild meat trade, which can complement the more traditional paradigms elucidating the “who” and the “why” (e.g., Chausson et al., 2019).

This interdisciplinary case study, despite its small sample size, provides baseline information on what species are most sought after in an urban ecosystem. By applying criminology's VIVA hot product analysis, we disaggregated the wild meat groups most likely to be targeted by the urban wild meat trade to better tailor and prioritize conservation and other interventions for “hot” wildlife species that are already threatened with a high risk of extinction. This disaggregation offers a number of advantages for designing tools for deterrence and prevention (Naylor, 2003).

The illegal wild meat trade has often been viewed as an opportunistic poaching problem (e.g., Kahler & Gore, 2012). This VIVA analysis showed more targeted rather than opportunistic choices of wildlife species at

the end-user level, confirming findings from other studies like East et al. (2005) that recognized targeted decision-making behind wild meat consumption. This suggests that market reduction approaches aiming to reduce and disrupt stolen good markets may hold promise for reducing wild meat poaching and consumption in certain contexts (Schneider, 2008). Focusing solely on the *Value* of wild meat species, in this instance those that were most requested at restaurants, differences can be seen across tiers and between the cities. For example, antelope was identified as most requested by customers in middle-tier restaurants in Kinshasa and lower-tier restaurants in Brazzaville, compared to more requests for monkeys in all other tiers. This highlights the level of insight restaurateurs have into consumer choices and warrants further research to understand the nuanced motivations behind the consumption choices of different clientele, which can help inform demand reduction messaging for customers frequenting those establishments.

Restaurateurs equally play the role of pseudo-consumer, acting on behalf of their customers but ultimately making their own purchasing decisions. This adds an important power dynamic that can be teased out by the VIVA analysis. Whereas the customer requests above show monkey and antelope as the most popular choices, the full VIVA introduces pangolin as an additional hot product in Brazzaville when accounting for broader restaurateur considerations. In both cities, pangolins were considered to be the cheapest to buy alive (of those available to buy alive), cheapest to buy smoked, and also the cheapest to buy fresh (per kg) in Brazzaville [Correction added on 9 March 2021, after first online publication: the sentence “easiest to find smoked” has been changed to “cheapest to buy smoked”]. Although consumer demand is an important consideration for restaurateurs, and likely forms a large basis behind purchasing decisions, cost and effort to attain a tradable product are also factored into cost-benefit rationale when choosing wild meat products. The VIVA analysis can help to understand the nuances in restaurateur decision-making, highlight additional wildlife species at risk of harvest that consumer demand studies might overlook, and guide conservation strategies on how to approach restaurateurs as dynamic actors in the illegal wildlife trade chain.

The VIVA analysis further provides an opportunity to understand how at risk certain species consumed for wild meat are in the broader context of wildlife trafficking trends. For example, in addition to being a hot product for restaurants and the catering industry, pangolins regionally are also heavily trafficked for their scales (Ingram, Cronin, Challender, Venditti, & Gonder, 2019; UNODC, 2020). The finding that pangolin was the cheapest wild meat group to buy alive of those available,

could be indicative that the full potential of the trade in pangolin scales had not yet been locally realized at this point in the supply chain or at this geographic location at the time of the study. If those selling to restaurants had easy access to buyers for pangolin scales, pangolins would likely not be kept alive for sale this way. Sellers would be more likely to kill the animal early and sell the meat and scales separately for far more profit rather than keep them alive. Further research is needed to understand why these live pangolin prices are lower than for other species that are available to buy alive, if and how this trade in pangolin meat interfaces with the trade in pangolin scales in urban settings (and if this has evolved since), and the role restaurants might play in onward trade. Restaurateurs could be a valuable source of information of the reasons and logistics behind buying and storing live pangolins, and what happens to the scales once a pangolin is processed for consumption. They could also provide insights into broader wildlife trafficking dynamics if restaurants and the catering industry are involved in the trade in pangolin scales, and if this has contributed to the growing level of trade from the region.

The VIVA analysis overall demonstrated the vulnerability of monkeys in the urban wild meat trade, being the most requested by customers, and when in fresh and smoked forms, being the easiest to find and cheapest to buy [Correction added on 9 March 2021, after first online publication: The sentence was being revised.] Compared at restaurant tier-level, monkeys were hot products at both upper and lower tiers, and are likely to be trafficked in higher volumes to feed this broader consumer base. Although it is difficult to identify the exact species of monkey when sold as smoked or even fresh wild meat, given that restaurateurs stated that rare and endangered species generally fetch higher prices, species listed as endangered by the IUCN Red List are likely more at risk and should therefore command special attention when designing market reduction strategies. It would be beneficial to devise monkey-specific behavior change strategies targeted at restaurant consumers and restaurateurs, and to focus conservation policies on better implementation of existing legal frameworks in the cities, especially when it comes to critically endangered species. Whilst managing hunting at species-level in the field is complex, the trade of endangered species in cities might have a better chance of direct enforcement with species-specific rules, such as with monkeys. Design against crime strategies might suggest limiting knowledge of where such monkeys can be found (e.g., by monitoring and removing menus with monkey dishes from online platforms) (Ekblom, 2008).

The mention of elephant meat by two thirds of the focus groups and hippopotamus meat by a third of the

groups is consistent with Mbete et al. (2011) but surprising given the protection status of these species. Although these species are less commonly found in the urban wild meat trade, the fact that they are still traded could be suggestive of a lack of law enforcement—intentional or unintentional—of highly vulnerable species with strong legal protection. This trend is noteworthy and could equally indicate that the trade of high-value, highly protected species has been partially pushed underground in an effort to avoid detection, but remains a concern for conservation. This is an empirical question that warrants additional research, particularly through an urban ecosystem lens. Law enforcement efforts, and specifically crime prevention strategies, could also be more targeted to protect species *in situ* and could be enhanced with the development of genetic identification at markets and restaurants. While logistical and capacity (financial and technical) issues make the latter difficult to deploy at scale, knowing which restaurant tiers favor these species through analyses like VIVA provides an opportunity to target the deployment of such tools, making their use more manageable and effective.

Study participants identified Brazzaville as having a greater variety of wild meat groups identified as hot products, particularly when broken down by restaurant tier level as well as a greater awareness of the laws when compared to Kinshasa, cognizance of rules is not a sufficient deterrent to curtail the trade. It might even contribute to higher pricing/demand (as suggested by groups in Brazzaville) and an expansion of the range of products offered to limit specialization and its associated risks, for example, the predictability of illegal activity if species are sourced from one specialized supplier or location (leading to possible detection by law enforcement) and the risk, if caught, of losing a niche market. Again, these are ultimately empirical questions that warrant additional research.

Ekblom (2008) suggested that designing crime prevention strategies for particular niches can help reduce the incidence and adverse consequences of crime. Our results make clear that tackling the wild meat trade in Brazzaville restaurants (i.e., a niche market by Ekblom's standards), especially middle-tier ones that offer more meat variety generally, will require a tailored approach that addresses the underlying reasons for this species diversification. The disaggregated information about geographic product choice obtained from this VIVA analysis helps highlight the differences in trade dynamics and can inform more contextually-specific and nuanced interventions in Kinshasa and Brazzaville (as called for by Jones et al., 2019, Bachmann et al., 2019, Bachmann et al., 2020).

This research introduces the hot product analysis into a conservation-based study of the urban wild meat trade,

including decision-making perspectives of restaurateurs. Alternative analytic approaches could be adapted in future research. For example, the CRAVED/CRAAVED and CAPTURED models of crime target selection have been applied in other areas of wildlife crime and could also provide further insight into wild meat species selection in this context (Moreto & Lemieux, 2015; Pires & Clarke, 2012; Pires & Petrossian, 2016). CRAVED/CRAAVED/CAPTURED analyses could help provide insights into additional variables behind offender decision-making, such as ease of concealing different protected, illegally-sourced or live species. It can also be extended to understand trade with other urban actors, for example, restaurant consumers and international traders. Other interdisciplinary approaches, for example, incorporating the business/economics sector through value stream mapping of hot products, also could be beneficial to better understand the dynamics of the trade, consumer choices, and how to best target wild meat reduction interventions (e.g., Martin & Osterling, 2013). Value stream maps can be effective when they are very specific and provide a possible follow-up methodology for understanding this research discovery of monkeys as hot products. Value stream mapping could identify important places/points where value is added along the supply chain for monkey wild meat. This could identify places/points in the supply chain where wildlife crime responses can be maximally disruptive to offenders.

Harnessing the knowledge and collective action potential of restaurateurs to help reduce risks from the illegal wild meat trade and make their livelihoods more sustainable is an up-till-now untapped resource to enhance solutions to problems associated with the wild meat trade. At a time when the importance of local community involvement in wildlife crime enforcement efforts is widely endorsed in the conservation community (Coad et al., 2019; Cooney et al., 2016; Hubschle & Shearing, 2018; Skinner, Dublin, Niskanen, Roe, & Vishwanath, 2018), restaurateurs could be the first step in building a community of wild meat informal guardians (as opposed to formal law enforcement personnel) that use their knowledge of customers' motivations and needs to find alternative solutions to illegal wild meat consumption (Reynald, 2018). Harnessing their talents and influence among their peers and customers could contribute to existing behavior change initiatives and increase local buy-in to these efforts to guarantee their success. Such efforts would complement law enforcement interventions and legislative action, and create a multi-pronged strategy for effective conservation.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

AUTHOR CONTRIBUTIONS

Sarah Gluszek, Robert Mwinyihali, Michelle Wieland, and Meredith L. Gore involved in study concept and design, and obtained funding. Sarah Gluszek, Julie Viollaz, Michelle Wieland, and Meredith L. Gore involved in analysis and interpretation of data and critical revision of the manuscript for important intellectual content. Sarah Gluszek involved in drafting of the manuscript.

DATA AVAILABILITY STATEMENT

Data available within the article.

ETHICS STATEMENT

The Social Science, Behavioral, Education Institutional Review Board (SIRB) at Michigan State University approved this research (IRB x16-684e).

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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