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Policy analysis

Predicting behaviour change by urban bushmeat trade actors in Central Africa under different potential futures

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ABSTRACT

The urban bushmeat trade in Central Africa is an activity carried out mostly illegally within the informal sector and provides an income for thousands of people. The trade is estimated to be worth hundreds of millions of dollars but also raises concerns since bushmeat is a source of emerging infectious diseases and a cause of decline for many threatened species. Addressing these issues through appropriate interventions is therefore of vital importance. To make meaningful predictions about the ways in which future interventions and exogenous factors could influence the behaviour of bushmeat trade actors, we conducted scenario-based interviews with bushmeat vendors in urban markets in two of the main bushmeat trading cities in Central Africa – Yaoundé in Cameroon and Kinshasa in the Democratic Republic of the Congo. We found that three of the five scenarios – successful demand-reduction campaign, improved enforcement, and providing livelihood or enterprise training – could encourage market vendors to stop selling protected species or leave the trade altogether. Reasons given for the willingness to change included the increased risk of being arrested or a significant drop in the level of profit. On the other hand, our exogenous scenario – the increased cost of domestic meat – could make bushmeat more competitively priced and encourage more consumption. We recommend tightening control of bushmeat supply to urban markets, reducing urban demand and providing appropriate training to encourage market vendors to leave the trade. We also recommend supporting local producers of alternative proteins to increase the supply of viable alternatives at a competitive price.

1. Introduction

The trade in bushmeat (also known as wild meat) from rural to urban areas provides an economic opportunity for many people across the tropics, but particularly so in Central Africa (Lescuyer and Nasi, 2016). The selling of wild terrestrial vertebrates is driven by demand from city dwellers who consider bushmeat to be healthier than imported protein options (Chausson et al., 2019), forms part of their cultural identity and a sign of prestige (Duda et al., 2018; Nguyen et al., 2021). The trade involves several actors along the supply chain and has clear distinctions in gender roles, with women dominating the selling of bushmeat in urban markets (La Cerva, 2016; Randolph et al., 2022). The trade is largely carried out illegally as the actors involved often do not have the necessary authorisations or the species have been hunted illegally. However, it is often tolerated by law enforcement as an informal sector of the economy since the sale and consumption of bushmeat is perceived by many as a legitimate right and it is known to provide a source of income both for rural communities and under-educated urban people living in poverty, whose lack of education opportunities has left them with few employment alternatives (Nasi et al., 2011; Lescuyer and Nasi, 2016; Trefon, 2023). More than 140 species are hunted for bushmeat across West and Central Africa (Ingram et al., 2025), and the scale of the trade negatively affects ecosystems by driving species to local extinction, particularly where demand from urban areas is high (Lindsey et al., 2011; Petrozzi et al., 2016). Another major concern is that the bushmeat trade is a potential source of emerging infectious diseases, like Ebola and Mpox, making it a public health risk (Karesh and Noble, 2009). This has drawn increasing conservation and public health attention, particularly in Central Africa (Ingram, 2020).

Addressing the above issues through appropriate conservation

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interventions, and by reforming legal frameworks and instigating broader societal change where necessary, is of vital importance and could bring about behaviour change among key actors in the supply chain. Key actors include urban market vendors, who receive what hunters harvest from the forest and supply urban consumers, yet are relatively few compared to other bushmeat actors, representing a pinch point in the supply chain. Achieving behaviour change in a fair and equitable way among urban market vendors should be a priority to avoid unfairly impacting vulnerable people with limited resources. Yet this is hampered by gaps in understanding of how such actors would respond and be impacted under different scenarios. An effective way to understand how such actors would respond to different interventions is to use scenario-based interviews. Scenarios can be used to provide valuable insights to decision-makers into the probable outcome of planned interventions that will affect local livelihoods, including how people are likely to respond (Travers et al., 2017). This approach has proven to be effective in other parts of the world, such as in Cambodia where it was successfully used to predict which interventions would limit forest clearance (Travers et al., 2016), and in Malawi in predicting community responses to interventions for reducing wild meat hunting and consumption (van Velden et al., 2020). This study therefore uses scenarios to understand the likely outcome of planned interventions on urban market vendors to improve intervention design and effectiveness, and check assumptions.

Our goal is to determine how future changes, including conservation interventions currently under consideration to address the urban bushmeat trade and current economic trends, would be perceived by urban market vendors, how these changes would affect their behaviour, and the likely social and conservation impact of different scenarios.

2. Methods

2.1. Study location

We carried out this study with bushmeat sellers in urban markets in the capital cities of Yaoundé in Cameroon (CMR) and Kinshasa in the Democratic Republic of the Congo (DRC). The city of Yaoundé is made up of seven subdivisions and each subdivision contains a main market. Bushmeat is mostly sold in three subdivisions, with a few bushmeat vendors also trading seasonally in other areas of the city, typically in the dry season from November to February. The city of Kinshasa is divided into 24 municipalities with each containing a market in which bushmeat is sold in a separate section. Bushmeat is sold year-round. Few vendors also sell seasonally in other parts of the city, and this is mostly during the dry season.

In both cities, bushmeat vendors occupy a separate section in each market, however they sometimes also sell other commodities, such as rice, maize, smoked and salted fish, onion, tomatoes, and cigarettes. Bushmeat is sold both fresh and smoked, with fresh bushmeat sold at higher prices. Bushmeat is supplied to market vendors by middlemen who travel for long distances (primarily along the Congo River in DRC and rural roads in Cameroon). The most sold species in both countries are summarised in Table 1 below.

The wildlife laws in both countries require bushmeat traders (intermediaries and market vendors) to have a sales permit which is the official documentation authorising the trade of species not classified as totally protected by national wildlife laws. Permits are given to those who apply provided they fulfil all requirements such as proving they have established contact with hunters with a valid hunting permit. Adherence to these requirements however is limited. The reference number of the hunter's hunting permit is printed on the sales permit. These permits are valid for six months, which corresponds to the duration of the hunting season yearly in both countries (Cameroon wildlife law No. 2024/008 & Democratic Republic of the Congo wildlife law No. 82–002).

In both countries, the wildlife laws classify wildlife into three categories:

- Class A (Cameroon)/Appendix I (DRC): totally protected (IUCN Critically Endangered, and Endangered species, CITES Appendix I & II species, and those reported locally to be disappearing).
- Class B (Cameroon)/Appendix II (DRC): partially protected species (IUCN Vulnerable species, some Near Threatened species, CITES Appendix III species).
- Class C (Cameroon)/Appendix III (DRC): partially protected species (IUCN Least Concern species: resilient and fast reproducing species that can tolerate higher offtakes).

Table 1
Most common species sold by market vendors in urban markets in both Yaoundé and Kinshasa.

Common name	Scientific name	Order	IUCN status	Primary hunting technique
Brush-tailed Porcupine	*Atherurus africanus*	Rodentia	Least Concern	Snare
Blue Duiker	*Philantomba monticola*	Artiodactyla	Least Concern	Snare, gun
Cercocebus monkeys	*Cercocebus spp*	Primata	Vulnerable, Endangered	Gun
White-bellied pangolin	*Phatagrimus tricuspis*	Pholidota	Endangered	Snare
Cane rat	*Thryonomys swinderianus*	Rodentia	Least Concern	Snare
African Dwarf crocodile	*Osteolaemus tetraspis*	Reptilia	Vulnerable	Net trap
Monitor lizard	*Varanus niloticus*	Reptilia	Least Concern	Snare, net trap
Bay Duiker	*Cephalophus Dorsalis*	Artiodactyla	Near Threatened	Snare, gun
Servaline Genet	*Genetta servalina*	Carnivora	Least Concern	Snare, gun
Bushpig	*Potamochoerus porcus*		Least Concern	Gun, snare

Source: Randolph, 2016; Lucas et al., 2022.

Bushmeat is consumed by the majority city dwellers (> 80 %) occasionally including both wealthy and poor because they find it tasty, healthy, and is part of their cultural identity (Wright, 2018: report for WCS), but wealthy citizens consume more because they have more disposable income to buy more meat in general, and bushmeat is more expensive than domestic meat (Randolph, 2016). However, the urban poor can only afford bushmeat leftovers sold in little bundles of US$ 1 (Pers. Obs. EN). In both cities, market vendors tend to sell without a sales permit. In Yaoundé, law enforcement agents usually carry out market raids to control species sold on stalls, causing market vendors to sell Class C species on their stalls and Class A & B species underground. In Kinshasa, market raids are so infrequent as to be non-existent and market vendors feel free to sell on their stalls all categories of species. This is the business-as-usual (BAU) scenario.

2.2. Data collection

To gain greater understanding of the potential for change in the context within which bushmeat is sold, we used scenario-based interviews. This is a method that enables researchers to collect evidence in a structured way to understand the mechanisms by which human decision-making feeds through to conservation outcomes at different scales (Larrosa et al., 2016). It makes meaningful predictions of behaviour under future changes in policy, external circumstances, or conservation interventions (Cinner et al., 2009; van Velden et al., 2020). In scenario interviews, respondents are presented with a future in which a specific change has occurred and asked how they would be impacted

and respond (van Velden et al., 2020). We therefore conducted the scenario-based interviews in a semi-structured format with market vendors in all urban markets where bushmeat is sold in Yaoundé and Kinshasa. Interviews were conducted using a two-stage approach. Firstly, a scoping study was conducted from June to August 2022 where we gathered information from opportunistically selected market vendors (179 in DRC, 50 in CMR) on themes related to law enforcement, livelihoods, and financial benefits from bushmeat to gain the trust of vendors. We aimed to achieve an exhaustive sampling approach and reach all bushmeat market vendors across the two cities (following Mathers et al., 2007; Kaiser, 2009). Our research approach was designed to maintain respondent confidentiality by not taking any personal information of participants or information that could enable them to be identified. The first author (EN), accompanied by two research assistants, walked up each aisle in markets (24 in Kinshasa and 7 in Yaoundé) where bushmeat sales were observed to be taking place and interviewed all market vendors willing to be interviewed. In Kinshasa, market vendors preferred to be interviewed at their stalls because, despite the illegal nature of their activity, they were never worried by law enforcement agents and so felt comfortable responding to questions asked. In Yaoundé, market vendors preferred to be interviewed outside the markets in areas they chose, e.g., nearby restaurants, because law enforcement agents sometimes carry out interventions in the markets to seize all their bushmeat. These different interview methods reduced any sources of bias. Interviews ranged in time from 30 to 90 min. This information was then used to develop the scenario interviews, which were carried out from November 2022 to February 2023 with market vendors who had agreed to participate in a follow-up interview (168 in DRC – 94 % of the original sample - and 45 in CMR - 90 % of the original sample).

2.3. Scenario interviews

Market vendors who agreed to participate in scenario interviews were first presented with a "business as usual" (BAU) scenario asking them to imagine that the current situation and trends would continue for the next five years. This was followed by a further five scenarios, each representing potential interventions being considered by decision-makers and conservation organisations or exogenous changes. To minimise order effects, we randomised the order in which scenarios were presented to market vendors.

We used four indicators to investigate how different scenarios (including BAU) may be received by the market vendors: 1) their perception of the fairness of a given scenario; 2) whether they would sell protected species or not under a given scenario; 3) whether they would switch to a different activity under a given scenario; and 4) how different scenarios would affect profit made from selling bushmeat relative to BAU. The fairness indicator gives a measure of the social acceptability of each scenario, which is a crucial predictor of the success of any intervention. The second indicator about selling protected species was expected to indicate whether market vendors may switch to selling only those species authorised by the law or whose sale is generally tolerated because they are considered of less conservation concern. The third indicator gives a measure of what may trigger a market vendor to switch completely to an alternative activity. The fourth indicator of relative profitability of selling bushmeat is expected to indicate whether market vendors would consider further diversifying their sources of income.

To understand the reasoning behind market vendor responses, we asked follow-up questions to triangulate answers and check for consistency within and between scenarios (Blair et al., 2013; van Velden et al., 2020). We obtained respondent consent verbally before conducting interviews, which were conducted either in French (in Yaoundé all vendors could understand French) or French and Lingala (in Kinshasa many vendors could not understand French). Interviews in Lingala were conducted with the help of field assistants trained prior to interviews. All interviews were recorded, transcribed, and translated into English. Ethics approval was granted by the Central University Research Ethics Committee of the University of Oxford in the UK (Reference No: R81619/RE001).

2.4. Scenarios

We developed the scenarios based on initial discussions with market vendors during the scoping study, and through consultation with key informants, including law enforcement agents and staff of civil society organisations helping to conserve wildlife and enhance livelihoods of local communities. Methods followed those used in previous scenario interview studies (Cinner et al., 2009; Travers et al., 2016; van Velden et al., 2020; Knott et al., 2022). Each scenario represents an option for conservation action, either those under consideration by the wildlife management departments in each country or types of interventions that are already underway or reflect broader economic trends. The scenarios were checked for their clarity and credibility with market vendors, including the levels of change that were being proposed. For two of the scenarios, we included an element of conditionality such that, if a market vendor breached the agreement, there was a consequence such as removal from the scheme, a heavy fine (in line with proposed legal reforms), or imprisonment for up to 15 years. Conditionality has been shown to be an important factor influencing compliance with rules (Blom et al., 2010; Wicander and Coad, 2014; van Velden et al., 2020).

2.4.1. S1: Increased enforcement along trade routes resulting in reduced supply of bushmeat

In this scenario, respondents were told that the likelihood of arrest by law enforcement officials would double for bushmeat traders coming to the city because permanent checkpoints would be installed along rural to urban roads enroute to Yaoundé (CMR), and along the Congo River and at all river ports in Kinshasa (DRC). These checkpoints would be patrolled by law enforcement officials and staff of civil society organisations to make it harder for law enforcement officials to accept bribes. Bushmeat traders arrested without a sales permit would face a jail term of two years for trafficking class C/appendix III species (common species; e.g., blue duikers *Cephalophus monticola*), five years for trafficking class B/appendix II species (partially protected and under CITES II; e.g., bay duikers *Cephalophus dorsalis*) and 15 years for trafficking class A/appendix I species (totally protected and under CITES I; e.g., all pangolins). The BAU situation related to this scenario is that there are non-permanent checkpoints along rural to urban roads in Cameroon and at river ports in DRC, which are made up of only law enforcement officials, who often accept bribes from bushmeat traders to allow the transportation and sale of all classes of animals as bushmeat.

2.4.2. S2: Authorising the trade of resilient species (Class C/Appendix III) without a sales permit

This scenario allowed hunting and trade of resilient species (i.e., laws left unenforced) while enforcing the law for protected species. Respondents were offered the option of selling meat from resilient species (e.g., rodents and blue duikers), without a sales permit, if they agreed not to sell protected species. If caught selling meat from protected species such as bay duikers or pangolins, they would face a jail term, be fined up to $2000, and be denied permission to sell bushmeat again. The BAU situation related to this scenario is that market vendors sell all three categories year-round in both countries but in CMR they mostly expose class C species on their market stalls and sell class A and B through an underground channel, while in DRC they sell all three categories relatively freely.

2.4.3. S3: Successful demand-reduction campaign

In this scenario, respondents were presented with a situation in which current demand for bushmeat halved because a demand-reduction campaign had successfully convinced urban consumers to eat less bushmeat. The BAU is that bushmeat is widely eaten by urban

consumers in the region (Chausson et al., 2019; Wright et al., 2022).

2.4.4. S4: Increased cost of domestic meat

In this scenario, based on the current BAU trend in which market prices for domestic meat (e.g., beef, chicken, and pork) are observed to be increasing, respondents were presented with a situation in which the costs of domestic meat increased substantially, by 40 % (i.e., 1 kg of beef from $6 to $8.4 USD per kg) and became equivalent to and even slightly more expensive than the currently most consumed bushmeat species, like brushed-tailed porcupine and blue duiker (which currently sell at around $8 USD per kg). Unlike the other scenarios, this scenario reflects an existing trend rather than a proposed policy intervention and examines the potential implications if this trend continues.

2.4.5. S5: Livelihood or enterprise training is offered

In this scenario, respondents would be given the opportunity to leave the bushmeat trade by receiving training in an activity of their choice for a period of six months. The training would be tailored to the locality and could include skills, e.g., poultry farming or pig farming. However, if respondents were still found to be selling bushmeat, they would be removed from the scheme.

2.5. Analysis

We coded responses to the fairness indicator with a two-point scale "fair" or "not fair". For selling protected species and whether they would switch to a different activity or not under a given scenario, we equally used a two-point scale "sell protected species" or "not sell protected species" and "switch activity" or "continue as BAU" to coded responses. As fairness of interventions, selling protected species, and switching to a different activity were binomial in nature, we used generalised logit models to predict their outcome in the R package "Mass" version 7.3–60.0.1 (Venables and Ripley, 2002). We built full models containing all predictor variables (4 scenarios and socio-demographic variables such as age, gender, number of dependents, experience, and level of education) and then used backward elimination of the most non-significant *P* value predictor to finally obtain a minimum adequate model (MAM) with the lowest AIC (Akaike's Information Criterion) value.

To assess how different scenarios would affect profit made from selling bushmeat relative to BAU, we subtracted the profit made in each scenario from that of BAU to obtain the relative profit and then used a linear mixed effects model in the R package "lme4" version 1.1–35.3 (Bates et al., 2015) with respondent ID and market ID as nested grouping factors. We used the same fixed predictors as in the logit models. We did not find any significant random effects either at the respondent level or market level in either country, so used a generalised linear model implemented in the R package "Mass". We followed the same process to find the MAM model with the lowest AIC (Akaike's Information Criterion) value. We show full model results in the supplementary material.

3. Results

3.1. Perceived fairness of interventions and trends

Most respondents in both countries (95.5 % in CMR and 88 % in DRC) perceived their current situation as fair because they felt it enabled market vendors with no formal employment to have a reliable source of income, feed their families, and send their kids to school even as it put them at odds with law enforcement. In both countries, a successful demand reduction campaign (S3), and increased enforcement (S1) were perceived to be less fair than BAU (Table 2) because market vendors saw these scenarios as reducing profitability and affecting their livelihoods.

No effect was found for selling only resilient species (S2). An increase in the cost of domestic meat (S4) was perceived as fairer than BAU and welcomed because market vendors believed that consumers would be more likely to buy bushmeat than domestic meat under this scenario, especially since bushmeat is perceived to be a fresher and healthier option than most domestic meats.

In DRC, the scenario in which vendors were trained in an alternative income source (S5) was on average perceived to be less fair than BAU because vendors felt that switching from a reliable activity to an unknown one was too risky. In Cameroon, the proportion of respondents who thought this scenario was fair was higher, because vendors saw it as an opportunity to leave an activity that has a high risk of being arrested and losing all investment. One market vendor we interviewed in Yaoundé said:

"*I would be happy to switch to selling dry and salted fish if I could be offered a capital base, even though it's not as lucrative as bushmeat, at least it's not illegal and I would face no risk of being arrested*" Interview n^{o} 25, November 2022.

Table 2
Predicted differences in probability of a scenario being perceived as fair, leading to change in sales of protected species, and switching away from bushmeat selling relative to BAU. The table includes business-as-usual (BAU) and the different hypothetical scenarios for market vendors in Yaoundé (CMR) and Kinshasa (DRC). Probabilities are calculated from a generalised logit model. The BAU value is the baseline probability (i.e. there is a 61 % probability of BAU being perceived as fair in Cameroon and 86 % in DRC, 91 % of selling protected species in Cameroon and 98 % in DRC, and 8 % of switching away from bushmeat in Cameroon and 3 % in DRC). The scenario values are the estimated change in probability (positive = an increase, negative = a decrease relative to BAU).

	Scenario	Perception of fairness	Sell protected species	Switch activity
Yaoundé	*Business-as-usual*	*0.61***	*0.91****	*0.08*
	1- Increased enforcement	−0.38*	−0.82***	0.87***
	2 - Authorising the trade of resilient species without a sales permit	−0.02	0	0
	3 - Successful demand-reduction campaign	−0.34	−0.14	0.11
	4 - Increased costs of domestic meat	0.27*	0	0.01
	5 - Livelihood and enterprise training	0.37*	−0.64**	0.68*
Kinshasa	*Business-as-usual*	*0.86****	*0.98****	*0.03*
	1 - Increased enforcement	−0.73***	−0.94***	0.09
	2 - Authorising the trade of resilient species without a sales permit	−0.07	−0.02	0
	3 - Successful demand-reduction campaign	−0.83***	−0.25*	0.18*
	4 - Increased costs of domestic meat	0.05	0	0
	5 - Livelihood and enterprise training	−0.17*	−0.95***	0.55**

Significance: very significant $P = 0.00001$ '***', significant $P < 0.001 > 0.00001$'**', weakly significant $P < 0.5 > 0.001$'*'.

3.2. Selling protected species

The probability of market vendors selling protected species under S2 (authorising the trade of resilient species (Class C/Appendix III) without a sales permit) and S4 (increased costs of domestic meat) were no different from BAU in either country. Respondents said that this was because law enforcement officials already turned a blind eye to the sale of resilient species on market stalls.

Conversely, the probability of selling protected species under the scenarios of increased enforcement (S1) and enterprise training (S5) was significantly lower than BAU in both countries, and the scenario of a

successful demand-reduction campaign (S3) also reduced the probability of selling protected species in Kinshasa but not in Yaoundé. Respondents said the first scenario would cause supply to drop as intermediaries would find it difficult to supply urban vendors while enterprise training would be an opportunity to stop working in an illegal sector. In Yaoundé, respondents said frequent market raids by enforcement agents made selling bushmeat riskier, especially selling protected species, so they would rather focus on common species for which the risk of arrest and facing a jail term or paying a high penalty was much lower. In Kinshasa, vendors also believed the first scenario would make selling protected species very difficult. A market vendor interviewed in Kinshasa said:

"*Increasing law enforcement for the bushmeat sector is a rhetoric we have been hearing but are still to see any signs of it. However, if this unfortunate situation should happen, then it would be practically impossible to sell any protected species. I would sell only common species like cane rats and brushed-tailed porcupines to stay out of trouble*". Interview n° 44, January 2023.

3.3. Leaving the bushmeat trade

The probability of market vendors leaving the bushmeat trade altogether was higher than BAU for the increased enforcement (S1) and enterprise training (S5) scenarios in CMR. In DRC, respondents were more likely to leave the bushmeat trade if demand for bushmeat dropped (S3) or they were offered enterprise training (S5).

The main reason given by respondents in Cameroon was that selling bushmeat on market stalls was already very stressful because it put them at odds with law enforcement agents, who occasionally undertake surprise raids to confiscate all bushmeat and destroy stalls, causing a heavy loss to already impoverished market vendors.

In DRC, respondents reported that they would be more likely to temporarily switch activities if there was a successful demand-reduction campaign, because their incomes from bushmeat would drop so they would focus on other commodities like salted fish, etc., while hoping for demand to increase quickly so they could reinvest in bushmeat. This scenario of a successful demand-reduction campaign would therefore likely lead to only a temporary switch of activity. In both countries, the main reason given by respondents as to why they would leave the bushmeat trade if provided with enterprise training was that an alternative activity would guarantee a more stable and legal source of income.

3.4. Impacts on profits from selling bushmeat

In both countries, the scenarios that were likely to reduce the profit respondents made from selling bushmeat relative to the BAU were a successful demand-reduction campaign, increased enforcement, and enterprise training (Fig. 1).

The only scenario under which market vendors in DRC and Cameroon felt that profits would increase relative to BAU was an increase in the cost of domestic meat (S4). Market vendors felt that customers who generally buy domestic meat would switch to purchasing bushmeat species if the prices were similar (Table 3). Market vendors reported that the profits from selling resilient species without a sales permit (S2) would be similar to BAU in both DRC and Cameroon. Market vendors in DRC reported that they already traded without permits without severe repercussions, and so did not expect this scenario to affect them in any way. Market vendors in both countries felt that scenarios 1, 3 and 5 would all reduce profits. They suggested that a successful demand-reduction campaign (S3) would reduce demand and hence profits. Under increased enforcement (S1), the difficulty of supplying urban markets would reduce sales and hence profit, while livelihood and enterprise training (S5) would encourage many market vendors to focus on other activities and either reduce time spent trading or leave the trade.

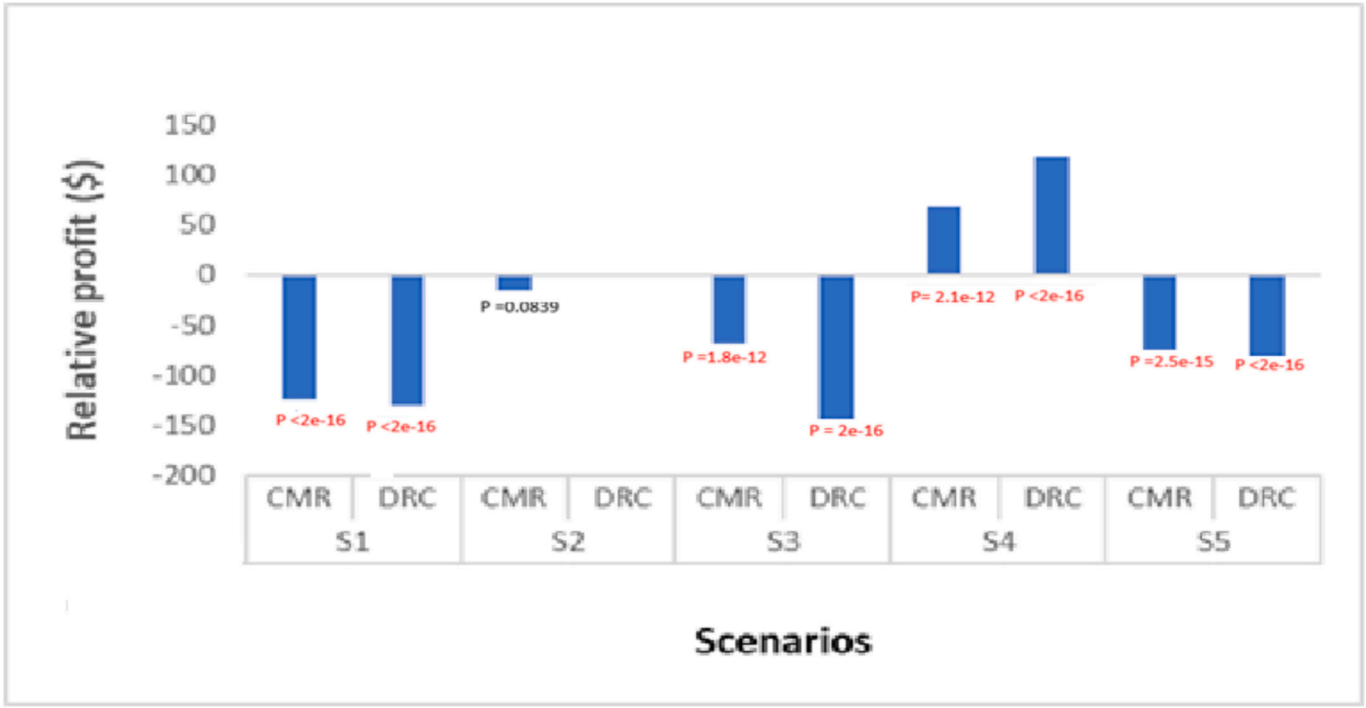

Fig. 1. Change in profit made from selling bushmeat over 30 days relative to the business-as-usual situation under different scenarios, calculated using a linear mixed effects model. S1 = Increased enforcement along trade routes resulting in reduced supply of bushmeat; S2 = Authorising the trade of resilient species (Class C/Appendix III) without a sales permit; S3 = Successful demand-reduction campaign; S4 = Increased cost of domestic meat; S5 = Livelihood and enterprise training is offered.

Table 3
Number of respondents who regarded each scenario to be fair/unfair, how they believed their profits to be affected whether they would change their behaviour in terms of their anticipated reactions, with a selection of reasons provided by respondent. Total sample size was 213.

Variable	Level	Scenario									
		1. Reduced demand		2. No permit		3. Increased Enforcement		4. Increased cost of domestic meat		5. Alternative activity	
		N	Examples of reasons given	N	Examples of reasons given	N	Examples of reasons given	N	Examples of reasons given	N	Examples of reasons given
a) Fairness	Fair	07	"Main clients are high-profile consumers who will continue wanting bushmeat". "Few remaining clients would buy more protected species enabling me to make more money as these are more expensive". "That won't be a problem for me because I also supply high profile consumers at their homes".	174	"Good thing but won't increase sales". "Good for traders but won't increase sales". "Will protect traders from unscrupulous law enforcement agents".	23	"Would reduce unfair competition for vendors who comply with the law". "Would regulate the sector and make it profitable in the long run". "I have no problem with getting permits. My income will drop for a start but after some time buyers will get used to what they find and sales will rise again".	194	"Bushmeat sales would increase". "This would be excellent as I'll sell even more bushmeat". "Same people would continue to buy. Nothing would change for me".	155	"Would be happy to switch activity". "Good, I'll stop selling bushmeat". "It's fair but I'm more comfortable with bushmeat that I know and can't start a new trade at my age".
	Not fair	206	"Reduced sales would cause a drop in income". "I'll invest more into other commodities until demand is high again". "I'll be discouraged to invest more into bushmeat".	39	"Would encourage unfair competition because other traders who sell other commodities would join". "I'll not be able to sell tortoises, pangolins, buffalo. My income will drop by about 50 %". "For a retailer like me this would reduce my profit as I would have to focus on resilient species".	190	"Would force most vendors to switch activity" "This would be the worst thing gov't could ever do. Would be a disaster for us". "This would force me to switch to something else. Maybe tailoring which I have done in the past".	19	"Would encourage non bushmeat vendors to join the trade". "Won't increase sales because city dwellers eat bushmeat occasionally and may eat even lesser".	58	"Reliability of activity in the long run not certain". "Difficult to find anything as reliable as selling bushmeat for an under educated person like me". "I won't accept that. I am comfortable selling what I already know quite well".
b) Sell protected species	Yes	172	"Due to their higher prices, selling more protected species would compensate reduced demand". "The prices of protected species on the market would increase and I'll make more money". "I will still be able to sell to my regular high-profile clients who prefer mostly protected species".	207	"Demand for protected species would increase if common species are sold freely". "Won't change anything because I'll still be able to sell through my regular channels".	05	"Would still be able to sell to the same high-profile consumers through direct supply chains". "The same people who enforce the law are also our best clients. Do you think they would stop eating bushmeat?" "Enforcement agents who work with us will help us get round these controls".	206	"Demand would increase". "More people would prefer protected species because they are sweeter in the mouth". "I don't think anything would change. It will be business as usual".	93	"Not ready to start a new activity at an old age". "I'll leave bushmeat trade to a family member so as win on both sides". "It would depend on if it can last for long. I'll simply continue selling as usual".
	No	41	"Would rather switch activity until demand is high again". "I will reduce the quantity I buy as during the Ebola crisis and wait for better days. I'll focus on my other commodities".	06	"Would reduce conflicts with law enforcement". "I'll face less harassment by law enforcement agents". "This will just reduce abuse by enforcement agents but won't increase or decrease my income	208	"Would become too risky". "I'll prefer to comply with the law and stay out of trouble". "I'll invest more into clothing concurrently with resilient species".	04	"Sales would overall increase so needless to take further risks". "I don't sell protected species because I don't fully depend on bushmeat". "All bushmeat will become	118	"Would switch activity". "I'll be happy to switch activity provided that alternative is sustainable". "It's risky but I'll happily switch to it".

(*continued on next page*)

Table 3 (*continued*)

Variable	Level	Scenario									
		1. Reduced demand		2. No permit		3. Increased Enforcement		4. Increased cost of domestic meat		5. Alternative activity	
		N	Examples of reasons given	N	Examples of reasons given	N	Examples of reasons given	N	Examples of reasons given	N	Examples of reasons given
					from bushmeat because I don't sell any protected species".				lucrative so there will be no need to take more risks".		
c) Switch activity or not	Yes	40	"Drop in income would affect livelihood". "It would make no sense to continue with an activity that is not profitable anymore".	0	–	64	"Risk of arrest would be higher". "This would be a disaster for me. I'll have to switch activity again". "This will be bad for bushmeat traders. I'll switch to another commodity. Maybe I'll sell only smoked fish".	01	"Would encourage unfair competition because other traders who sell other commodities would join". "Bushmeat is already expensive and only few city dwellers can afford it. If domestic meat should also increase, then most people won't even afford meat".	129	"More stable and legal source of income". "I'll simply take what gives me more money. In this case the alternative". "Yes, but I prefer not to say".
	No	167	"Selling side commodities would compensate reduced demand until it rises again". "I can't accept to switch to any alternative because none can give me the kind of money I make". "I have been selling bushmeat for two decades and have gone through all challenges".	213	"Business-as-usual". "Why prevent hunters to kill certain animals. These animals die by themselves in the forests and are abundant. Authorising the sale of only a fraction won't be fair".	149	"Selling bushmeat would still be possible even as supply would decrease".	212	"Demand for bushmeat would increase". "That would be a big booster to the trade and I'll increase quantities I buy and sell". "This would increase my income because I'll be able to sell even to those who don't want to consume bushmeat now".	84	"Not ready to start a new activity at an old age". "I won't accept such a scenario because I'm only skilled in selling bushmeat. At my age I′ not prepared to start anything new". "I make enough money by selling bushmeat and master this trade. Why would I want to change? I will never switch".
d) Relative Profit from bushmeat	Increase	0	–	04	"Would be less risky to invest more into bushmeat".	0	–	156	"Demand for bushmeat will increase". "Sales would increase and income"	0	–
	Decrease	199	"Sales would drop and profit from selling bushmeat". "Wouldn't make much sense to continue losing money".	18	"Would encourage other vendors not selling bushmeat to join the trade". "That won't be good. The state should just leave us continue with the trade without interfering".	207	"Bushmeat supply to markets would drop". "I'll lose money because supply will be disrupted". "I'll put more money into other commodities".	0	–	127	"Will switch to selling other commodities like salted and smoked fish". "I would switch to fresh food stuff which can also be lucrative".
	Same	14	"We sell only few species to high-profile consumers who will still buy". "I'll continue to sell bushmeat because some consumers will always buy whatever the scenario".	191	"Similar to Business as usual" "We are already in a similar situation".	06	"Won't make any difference for vendors who comply with the law". "I'll be able to buy from suppliers in the black market".	57	"Don't expect sales to increase".	85	"Will send a relative to sell bushmeat in the market". "Hard to get an alternative activity that will give me the same income as bushmeat".

4. Discussion

Choosing interventions that could achieve behaviour change among key actors in the bushmeat supply chain (market vendors), while not damaging their incomes or causing unfairness, is not an easy task for decision-makers and conservation practitioners because resources are limited and evidence on which to base decisions is often lacking (Saterson et al., 2004; van Velden et al., 2018; Christie et al., 2020). Our findings suggest that interventions that would increase the risk of involvement in an illegal activity or significantly reduce the level of profit made from selling bushmeat would lead to the greatest change in behaviour.

Understanding the perceptions of key actors involved in an illegal activity in conservation can inform the right course of action and improve decision-making (Bennett, 2016; Marshall et al., 2020). Our findings reveal that the perceptions of fairness by market vendors towards different interventions and trends was influenced by how the scenarios would affect their current situation. When a scenario was perceived as having a negative impact on their ability to sell bushmeat and would expose them to higher risks, e.g., the risk of being arrested (S1) or losing money (S3), these were not perceived to be fair. By contrast, scenarios that could lead to a positive outcome compared to their current situation, e.g., an opportunity to make more money (S4) or to have a legal source of income (S5), were more likely to be perceived as fair. The perceptions of key actors regarding an intervention can directly impact their motivation to comply with the associated rules (Bennett, 2016; Bennett et al., 2019). Perceptions of key actors also depend on the value of the intervention and the overall legitimacy of the implementers (Oyanedel et al., 2020). Our findings show a positive association between interventions that could impose behaviour change because vendors would lose out, and those that are perceived as unfair and with negative effects on income. This matches the findings of Jones et al. (2019) from Liberia in West Africa, who found that the main motivation for the majority of bushmeat traders to reduce the volume of bushmeat sold was the financial risks from meat confiscation. For example, in March 2024 (after these interviews took place), the government department in charge of wildlife in Cameroon published a press release to announce destruction of all market stalls and seizure of all species sold as bushmeat in one of the main bushmeat markets in Yaoundé. While seen as a conservation success, such actions could lead to longer term unintended consequences if it fosters resentment and distrust among vulnerable people for the loss of income.

Our results also show that when law enforcement is carried out imperfectly, e.g., tolerating market vendors selling bushmeat in urban markets without a permit, vendors get bolder, as they see no need to comply with the laws. The scenario to allow the sale of non-protected species without a permit therefore showed no significant change in either the selling of protected species or vendors leaving the trade. This finding aligns with a recent study by Moloney et al. (2023), which found that bushmeat traders in Central Africa are selling more bushmeat online, including totally protected and vulnerable species as they see no need to hide their activities. This suggests that decision-makers who are considering the option of authorising market vendors to sell non-threatened species without a permit as a means of enhancing their livelihoods and further protecting the threatened ones, should treat this option with caution, because it may simply lead to business-as-usual unless additional measures are implemented (e.g. more effective enforcement against selling protected species).

Conversely, stepping up law enforcement to render the supply of protected species to urban markets more difficult, reaching out to consumers against consuming protected species, or providing the opportunity for vendors to move out of the illegal sector could make a significant difference. Our findings show that the probability of selling protected species under the scenarios of a successful demand-reduction campaign (S3), increased enforcement along trade routes resulting in reduced supply of bushmeat (S1), and livelihood or enterprise training offered (S5) would significantly reduce the sale of protected species compared to the current situation. This finding agrees with a previous study in the Central Africa region which found that arresting bushmeat vendors who sell protected species is a strong deterrence for other vendors not to sell similar species (Latour and Stiles, 2011). Also, making alternative, reliable and legal sources of income available to bushmeat vendors is a strong incentive that may encourage vendors to stop trading bushmeat, which is not the most desirable occupation for many vendors as it includes high risks (SCBD, 2011).

Leaving the bushmeat trade altogether is not an option right now for many bushmeat vendors as they consider selling bushmeat to be culturally important, a family legacy, or the most profitable economic activity available to them (Nana et al., 2025. Unpubl.). However, our findings suggest that certain factors can encourage market vendors to leave the trade, either due to the increased likelihood of losing all investment, being arrested, or reduced absolute or relative profit. Such factors include increased law enforcement, livelihood support in other sectors, and declining demand that would reduce profitability below the level individual traders are willing to tolerate. This supports the findings of other studies which found that bushmeat vendors will leave the trade even for a less lucrative but legal activity because of the risks involved (SCBD, 2011). In Cameroon, where law enforcement agents occasionally undertake market raids, bushmeat vendors would prefer to switch to a legal activity if law enforcement increases further because they are familiar with arrests and losing their whole investment. This may explain why fewer vendors have resumed the trade in the market raided in Yaoundé, probably because most incurred heavy losses and have had to switch to a different activity or maybe moved to a different location. In DRC, where enforcement is relatively weak, vendors are not familiar with the same level of risk and so did not consider leaving the trade as a realistic option even if enforcement was increased.

Our results show that in DRC a successful demand-reduction campaign would make market vendors consider bushmeat sales a liability. Vendors reported that during the Ebola crisis in 2014 and the peak of COVID-19 in 2020 they faced a huge drop in bushmeat demand and had to switch to selling alternative commodities like salted and smoked fish. However, they resumed the trade as demand rose again to its previous level. Little information exists on the impact of demand-reduction campaigns on market vendors because the evaluation of such campaigns usually focuses initially on changes to consumer behaviour, but the impacts of successful campaigns on market vendors should also be monitored. Gauging the opinions of bushmeat market vendors towards demand reduction campaigns and engaging them as potential allies warrants further attention.

While three out of the five scenarios (S1, S3, S5) predicted a negative impact on profit from selling bushmeat, and a corresponding reduction in bushmeat trading in urban markets, the scenario of an increase in the price of domestic meat (S4) instead predicted a rise in bushmeat sales. Studies on bushmeat and alternative sources of protein have focused on exploring the outcomes of increasing the cost of bushmeat to discourage bushmeat consumption (Rentsch and Damon, 2013; McNamara et al., 2019; Walelign et al., 2019). Monitoring of bushmeat and domestic meat prices would provide valuable information to decision-makers by raising the alarm when rapid changes are observed and when particular sources of protein could become considered as alternatives (van Vliet et al., 2012). In rural areas, prices are more equivalent, and demand is driven by taste preferences and availability (Chausson et al., 2019). For example, in rural areas of Central Africa, bushmeat is more available and cheaper than domestic meat (beef, chicken, and goat) and so rural consumers prefer to eat bushmeat (van Vliet et al., 2012). The outcome of relative price changes is uncertain in urban areas, but the preference of urban consumers would likely be for bushmeat, as vendors reported for scenario S4 (Chausson et al., 2019). Changes in demand for bushmeat should be monitored closely if bushmeat and domestic meat prices become competitive.

5. Conclusion and recommendations

Our results suggest that a combination of interventions that would tighten control of bushmeat supply to urban markets via improved enforcement, reduce the profitability of bushmeat for market vendors via demand reduction or reducing the price of domestic meat, and promote livelihood and enterprise training are most likely to have the greatest impact on the behaviour of bushmeat vendors. Although our study only looked at individual scenarios in isolation, combining them could produce enhanced impact, and should be investigated.

In both Cameroon and DRC, we recommend the following combination of interventions to achieve behaviour change while ensuring the wellbeing of bushmeat vendors: providing livelihood and enterprise training, as vendors saw it as an opportunity to leave an activity that has a high risk of arrest and loss of investment, improving enforcement, and undertaking demand reduction campaigns. Care must however be taken to first ensure that vendors are provided with genuine legal opportunities that would lead to a long-term switch, and livelihood and enterprise training programs should be sensitive to factors associated with livelihood vulnerability (e.g., gender) and be perceived as fair. This would be helped via equitable and transparent approaches to their design and implementation. These recommended approaches should be investigated further in relation to sustainability to see if they can support progress towards a more sustainable urban bushmeat trade.

CRediT authorship contribution statement

Eric Djomo Nana: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Lauren Coad:** Writing – review & editing, Writing – original draft, Resources, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Henry Travers:** Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Juliet Wright:** Writing – original draft, Methodology, Formal analysis, Conceptualization. **E.J. Milner-Gulland:** Writing – original draft, Supervision, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare no competing interests.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.biocon.2025.111276.

Data availability

The raw data used in this study will be made available by the authors, without undue reservation.

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