



# How Do Local Folks Value Wild Meat, and Why It Matters? A Study in the Democratic Republic of Congo

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## Abstract

We elucidate the value orientations (VOs) towards wild meat/wildlife in the Tshopo Province of the Democratic Republic of Congo, distinguishing between the provincial capital and rural areas. Based on stories prompted by four primary emotions, the most frequently encountered VOs were: concern for safety, nutrition and taste, and caring/respect. Rural people were more likely to express anthropocentric VOs. However, their stories did not necessarily associate negatively with caring/respect, suggesting that wildlife users may also be sensitive to biocentric values. Age, gender, and wealth were good predictors for biocentric VOs, with young women from the city more likely to express biocentric values. VOs and emotions related differently to specific wildlife species. Mutualism was not frequently elucidated in the stories. The associations we found provide crucial information to understand differences in value orientations across groups, identify barriers to change, and tailor behavior change campaigns to the local context.

**Keywords** Behavior change · Value orientations · Wildlife · Wild meat · Bushmeat · Kisangani Democratic Republic of Congo

## Introduction

Wild meat remains a critical part of people's diet (Nóbrega Alves & Van Vliet, 2018). In rural areas, aside from being a valuable source of food, hunting also provides income and medicine; it contributes to strengthening social bonds and identity and is practiced to reduce crop predation by animals considered pests (Coad *et al.*, 2019; El Bizri *et al.*, 2015; Fischer *et al.*, 2013; Nóbrega Alves & Van Vliet, 2018; van Vliet & Nasi, 2008; Van Vliet *et al.*, 2015). In urban areas, the consumption of wild meat has often evolved from a necessity to a delicacy (Wilkie *et al.*, 2016) to keep cultural links with the “village” in a context where increased availability of domestic sources of protein and the decreased availability of wild meat reduced the demand for wild meat daily (Van Vliet *et al.*, 2017).

As a response to the ecological impacts of over-hunting in tropical regions (Coad *et al.*, 2019), social marketing has been increasingly recommended to address the unsustainable use of wildlife (Drury, 2011; Challender & Macmillan, 2014; Thomas-Walters *et al.*, 2020), and evidence of its effectiveness to reduce wild meat consumption has recently been shown by Chaves *et al.* (2019) in the Amazon region. To develop such behavioral change strategies based on social marketing, understanding value orientations is essential to avoid imposing western conservation interests and risk social conflict over wild meat management issues (Rickenbach *et al.*, 2017; Van Vliet *et al.*, 2018). Value orientations of wildlife are a set of values, beliefs, attitudes, and norms that help to describe how people think about and act towards wildlife (Manfredo *et al.*, 2017). Incorporating value orientations towards wild meat in conservation strategies is essential to develop adequate wild meat policy and management responses and represent a shift away from the conventional vicious cycle of illegality, unsustainability and criminalization (Van Vliet, 2018).

Several studies from Sub-Saharan Africa have already provided an understanding of hunting and consumption patterns in both rural and urban contexts in terms of quantities consumed and hunted per species and the drivers associated with wild meat consumption (Luiselli *et al.*, 2018; Chausson *et al.*, 2019; McNamara *et al.*, 2019; Van Vliet *et al.*, 2017;

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Wilkie *et al.*, 2016; Nguyen *et al.*, 2021). These studies show that availability, price, and cultural attachment are among the main drivers of wild meat consumption. Generally, wild meat is perceived as healthy food and relates to childhood and village life (Nguyen *et al.*, 2021; van Vliet & Mbazza, 2011). However, within a given context, different segments of the population may relate differently to wild meat. This complexity is not captured in current studies, leaving a significant gap in understanding the value orientations that shape behaviors towards wildlife consumption and hunting in Sub-Saharan Africa.

In this study, we sought to elucidate the value orientations towards wild meat and wildlife in the Tshopo Province of the Democratic Republic of Congo in Central Africa, distinguishing between the provincial capital and rural areas. We investigated which socio-economic variables explain differences in the observed value orientations.

## Methodology

### Study Site

The study was carried out in the Tshopo Province, in the eastern Democratic Republic of Congo. Kisangani, the provincial capital of Tshopo, is the third-largest city in the country. The study covered the urban environment of Kisangani (its six communes, namely Makiso, Mangobo, Kabondo, Kisangani, Lubunga and Tshopo), and a rural environment of 16 villages distributed along the main access roads towards Yangambi, Bengamisa, Ubundu and Madula at about 100 km from Kisangani. Since 2003, at the end of a violent conflict, Kisangani started to slowly re-flourish as an influential trading center of agricultural products and imported merchandise between the DRC hinterland and neighboring Uganda (Takamura, 2015). During the last fifteen years, the urban population from Kisangani has exploded from 247 000 inhabitants in 2002 to 628 000 in 2009 and 1 600 000 in 2015 (Institut National de la Statistique, 2015).

The Tshopo province is marked by a long dry season from December to mid-March, followed by a short rainy season from April to May, a short dry season from June to July, and a long rainy season from August to November. The majority of the province is covered by dense semi-deciduous forests rich in commercial timber species like *Pericopsis elata* (Afromosia) or *Entandrophragma* spp. (redwoods) interspersed with mono-dominant *Gilbertiodendron dewevrei* forest, associated with a mosaic of secondary forests and agriculture. Wildlife largely contributes to food security and dietary diversity in the region, is consumed daily in rural areas, and is also sold in the urban market (van Vliet *et al.*, 2012; Kyamakya *et al.*, 2018; Van Vliet *et al.*, 2017). In

Kisangani alone, about 296 tons were sold between July 2015 to June 2016.

(Van Vliet *et al.*, 2017). Nonetheless, over the last ten years, chicken and pork prices have decreased compared to wild meat, linked to the post-conflict increase in the availability of those domestic meat sources (either imported from Ituri, Uganda, or locally produced) (Van Vliet *et al.*, 2017). This decreased per capita frequency of wild meat consumption, but considering urban population increase, that may not necessarily indicate an overall decrease in urban wild meat consumption.

Some large-sized and potentially vulnerable species such as okapi (*Okapia johnstoni*), orycterope (*Orycteropus afer*), giant pangolin (*Manis gigantea*), leopard (*Panthera pardus*), chimpanzee (*Pan troglodytes*), and elephant (*Loxodonta Africana*) are still present in the region, even if they may have been locally extirpated in some areas (Van Vliet *et al.*, 2018). The region is experiencing an irreversible post-depletion wildlife population process, with hunters increasingly entering relatively undisturbed areas to find larger prey and vulnerable wildlife species becoming extinct over larger proportions of the landscape (Van Vliet *et al.*, 2019).

### Data Collection

Before the interviews, permits were acquired from mayors and the heads of the neighborhoods and village chiefs. Nine hundred ninety-seven persons have been interviewed: 517 persons in Kisangani (about 90 in each of the six communes) and 480 persons in villages randomly chosen among those located less than 100 km from Kisangani situated along the primary access routes (about 30 persons per village). All interviewees were informed about the purpose of this research and were requested to give their consent to participate orally. In Kisangani, one household per street was chosen for an interview to spread the sample over a larger area and ensure a better representation. In villages, households were visited in their homes and selected based on convenience sampling. To ensure an equitable representation of gender, we interviewed the male head of the family in one interview and then the female head of the household in the following interview. Audio of the interview was recorded if the interviewee granted permission. The interviews were carried out either in Lingala or Swahili by two bilingual researchers (coauthors of this paper), depending on the origin of the household.

We adapted Dayer's methodology (2007) based on emotional prompts for personal stories to elucidate people's values regarding wild meat. As in Dayer *et al.* (2007), our method uses four fundamental emotions that have been identified as present in all cultures (Kemper, 1987): happiness, sadness, anger, and fear. Dayer *et al.* (2007) state that

emotions are considered universal and that people in many cultures categorize emotions in similar ways (Dayer *et al.*, 2007). The crosscultural nature of emotions reduces the possibility of conceptual confusion because all the respondents should recognize specific emotions. However, because the expression of emotion is culturally determined, each emotion may prompt very different stories related to wildlife from people in various cultures, depending on how the culture regards wildlife. The wildlife-related experiences that interviewees share through their personal stories are therefore expected to be very diverse. The word “Nyama” was used to refer to wildlife as it has the same meaning in Lingala and Swahili (and several other Bantu languages). The word “Nyama” indifferently means wild meat or wildlife. The interviewee was asked to tell a personal story (recent or in the past) about “Nyama.” Before telling the personal story, the interviewee was asked to pick up a colored ball which indicated whether the story was to be characterized by anger/happiness/fear or sadness depending on the color of the ball. This methodology always resulted in very friendly interviews, therefore overcoming the potential shyness of the interviewee or the dissimulation of the truth based on fears of stigma or lack of trust.

In addition, we asked the interviewees if they would be willing to respond to a short questionnaire on their socio-economic background, explaining the background of the research, the institutions involved, the type of questions that would be asked, and the potential use of the results. When the response was negative, we did not ask why to respect the free and informed decision of the interviewee. In total, 555 respondents agreed to participate to the second part of the interview. The socio-economic background was described by place of residence (rural/urban), gender, age (if age < 30 = young, if 30 < age < 50 = adult, if age > 60 = elder), ethnicity (Lokele, Mukusu, Nande, Mulengola, Mumanga, other), religion (catholique, église du reveil, protestant, musulman, other), profession/activity (hunter/fisherman, farmer, teacher, business owner, government employee, other), education (primary, secondary, none), wealth and nature relatedness. Wealth was a score based on the sum of the scores for type of house (concrete = 2, bricks = 1 or earth = 0), access to electricity (yes = 1; no = 0); access to tap water (yes = 1; no = 0); private transportation (car or moto = 1; bicycle or none = 0); and household size (< 5 = 3; between 5 and 10 = 2; > 10 = 1). Household size was included as a variable determining wealth category because household size shows that larger households are associated with poverty in African contexts (Meyer & Nishimwe-Niyimbanira, 2016). Wealth scores were categorized into three groups from 1 to 3 (if score < 3, wealth = 1; if 3 < score < 6, then wealth = 2; or score > 5 wealth = 3), with 3 representing the wealthiest group. Three variables described nature relatedness: Hunt (if the person hunted once a day or once a week = 1, or less

frequently = 0); Consume (if the persons consumed wild meat once a day or once a week = 1, or less frequently = 0); Forest (If the person went to the forest once a day or once a week = 1, or less frequently = 0).

## Analysis

The analysis of a subset of recordings (100 randomly chosen within the dataset) was used to adapt the list of value orientations (VOs) from Dayer *et al.* (2007) and create a new, better-adapted list of value orientations regarding wild meat. In particular, we added *Concern for health*, which relates to the concern of interacting with wildlife because of the possibility of contracting diseases (e.g., Ebola), and *Concern for crop/livestock destruction*, which relates to the fact that wild animals destroy crops, kill small livestock or destroy fishing nets. We also added *repugnance*, which relates to the non-consumption value of wild meat due to the lack of hygiene (primarily due to its bad preservation status: rotten, dirty, exposed to flies). A *regulation* value was added to accounts because people’s values about wild meat are dictated by what is legal and what is not. Last, we added *control over wildlife*, linked to the capacity of humans to dominate their fear and bravely take control over the wilderness. The following VOs described in Dayer *et al.* (2007) were not represented in our sample: “Scientific,” explained as the belief that humans can solve any environmental problems by using science and technology, and “Rational,” related to scientific explanations about the way the natural world works, and the way animals behave, as opposed to spiritual or religious explanations. Based on the newly created list of value orientations, the stories from the whole sample were categorized into VOs (Table 1). A single-story could relate to more than one VO. We categorized the VOs elucidated in our study area into two major categories: 1. *anthropocentric*, which considers humans as the central fact, or final aim of the universe emphasizing the utilitarian or instrumental value of nature (Vaske & Donnelly, 1999); 2. *biocentric*, which attributes an inherent worth and life to environmental objects other than humans, regardless of their usefulness to humans (McFarlane & Boxall, 2000).

To investigate significant associations between multiple and diverse qualitative variables, we conducted the statistical analyses with 547 interviews, having removed interviews with incomplete answers or with singular observations. All analyses were conducted in R 3.6.3 (R Core Team, 2020). We used Multiple correspondence analysis (MCA) to explore possible associations between all variables in the FactoMineR (Le *et al.*, 2008) and Factoextra (Kassambara & Mundt, 2020) packages. Differences in consumption of wild meat based on socio-demographic variables were evaluated with a G-test in the R-package DescTools (Andri *et al.*, 2021).

**Table 1** Anthropocentric Value Orientations and associations between VOs and specific wildlife species. Biocentric Value Orientations and associations between VOs and specific wildlife species

A. Anthropocentric Value Orientations		
VO name	Explanation	Species associated with this VO
Nutrition and taste (333 responses)	Relates the taste of wildmeat, its link to family sharing, its value as a source of food and nutrition	Common species such as red duikers, bush hog, pouched rat, brush tailed porcupine but also rarer species such as pangolin, elephant, aardvark
Income (37 responses)	Relates to the fact that people value wildlife as a means to cover for daily food needs, exceptional health or schooling expenses	Blue duiker, red duikers, Bush hog, brush tailed porcupine
Repugnance (28 responses)	Relates to the non-consumption value of wildmeat due to the lack of hygiene (mostly due to its bad preservation status: rotten, dirty, exposed to flies).	No particular species
Taboo or religion (24 responses)	Accounts for the non-consumption of specific wildlife species regulated either by religion or taboo.	Chimpanzee, tortoise, and yellow back duiker.
Control over wildlife (15 responses)	Linked to the capacity of humans to dominate their fear and bravely take control over wilderness	Elephant, buffalo
Concern for Safety (337 responses)	Linked to the fact that an animal can injure or kill humans	Leopard, snakes, chimpanzee
Concern for health (62 responses)	Relates to the concern of interacting with wildlife because of the possibility of contracting diseases (e.g., Ebola)	Small monkeys, bats
Concern for crop/Livestock destruction (72 responses)	Relates to the fact that wild animals destroy crops, kill small livestock or destroy fishing nets	Small monkeys, rodents, bush hogs, sitatunga, small carnivores, leopard, elephant and crocodile
B. Biocentric Value Orientations		
VO name	Explanation	Species associated with this VO
Mutualism (76 responses)	Translates the view that wildlife is part of an extended family and therefore deserves the same compassion.	Monkeys, chimpanzees
Identity (12 responses)	Relates to the fact that people identify wildlife (or certain wildlife species) as symbols of their identity	Okapi, elephant
Caring/respect (105 responses)	Translates the personal emotional attachment to animals, animals make humans feel better and likewise humans want to help animals and prevent them from suffering.	No particular species

**Quotes**

“When I eat wildmeat I am very happy, and I tell myself: here in Congo, we are really rich”

“I am happy when hunters bring me large monkeys, the red duikers or the river-hug because with those animals I can make a lot of money”

“When we buy bushmeat from the market with all the flies around and its bad smell, we eat it and then we have stomach pain and diarrhea. I am afraid to buy bushmeat.”

“My grand-mother ate yellow backed duiker and that is why she had bled a lot when she gave birth to my mother.”

“I am proud that I was able to control the small elephant by myself. We ate it in the forest.”

“If, by bad luck, a cub falls into a trap, the leopard stays there until the hunter comes by to check the trap, and directly kills the hunter right away”

“I learnt that the small monkeys carry Ebola, so we don’t eat it anymore. It makes me angry.”

“Monkeys destroy my corn field and bush hugs dig up my cassava. These animals make me angry because they harvest what we plant”

**Quotes**

“The chimpanzee does everything like humans, carry his baby and breastfeed, just like our mums, this is why I don’t eat it”

“The Okapi represents a richness for Congo and for Africa. I hate those who kill it.”

“I eat wildmeat, but I love observing animals in nature, that makes me happy. I don’t like it when animals are killed with cruelty”

Table 1 (continued)

**B. Biocentric Value Orientations**

VO name	Explanation	Species associated with this VO	Quotes
Regulations (9 responses)	Accounts for the fact that people's values about wildmeat are dictated by what is legal and what is not.	No particular species	"I love it that the government forbids hunting during the closed season. This allows to have plenty of animals for the next season."
Attraction/Interest (78 responses)	Interest in and a desire to know more about wildlife, curiosity to observe wildlife and discover interesting facts about their ecology and behavior	Small monkeys, rodents, okapi, leopard, bush hogs etc.	"Rodents spend a lot of time in their complex burrows. I often ask myself how they can breathe inside?"
Environmentalism (29 responses)	Relates to the general concern for protecting wildlife and the feeling that humans are impacting the environment in a negative way through their excessive hunting.	No particular species	"I like seeing that people eat wildlife, but not excessively. I am choked to imagine the forest empty in ten years."

Because respondents were asked to relate the story to the randomly chosen emotion, we tested for an association between emotions and the VOs with a Multiple Response Categorical Variables Analysis applying Bonferroni corrections in the MRCV package (Koziol & Bilder, 2014). Due to the significant relationship ( $P < 0.0001$ ), we next applied generalized linear mixed models (GLMM) to predict VOs based on socio-demographic variables. For the three most common VOs, generalized linear models with VO as the binary response variable, binomial distribution, and the emotion as a random effect were run in the package glmML (Brostrom, 2019). We selected the final most parsimonious model from a complete model based on the lowest AIC value.

**Results**

Less than 3% ( $N = 551$ ) of the respondents consumed wild meat daily. Others ate it weekly (38%), monthly (27%), infrequently (29%) or never ate it (4%). Determining the variables that explain wild meat consumption was beyond the scope of this study; however, we found that wild meat consumption differed according to place of residence (urban = 29%; rural = 59%;  $G = 43.642$ ,  $df = 1$ ,  $p < 0.0001$ ), ethnic background (Nande = 13%; Lokele = 45%, Mokuso = 39%, Mulengola = 48%, Mumanga = 69% and other = 31%;  $G = 44.248$ ,  $df = 5$ ,  $p < 0.0001$ ), and wealth category (1 = 52%; 2 = 39%; 3 = 25%;  $G = 22.177$ ,  $df = 2$ ,  $p < 0.0001$ ), but did not differ substantially according to gender ( $M = 40\%$ ;  $F = 40\%$ ;  $G = 0.0104$ ,  $df = 1$ ,  $p = 0.9189$ ), age (elder = 33%, adults = 45%, young = 37%;  $G = 4.3852$ ,  $df = 2$ ,  $p = 0.1116$ ), religion (Muslim = 29%; non-Muslim = 41%;  $G = 8.7785$ ,  $df = 4$ ,  $p = 0.0669$ ) or education (none = 40%; primary = 40% and secondary = 42%;  $G = 0.2170$ ,  $df = 2$ ,  $p = 0.8972$ ). Percentages indicate the percentage of respondents stating that they consume wild meat frequently (once a day or once a week).

**Value Orientations Towards Wildlife/Wild Meat**

The most frequent VOs encountered in our sample were Concern for safety (337 answers), Nutrition/taste (333 answers), and Caring/respect (105 answers). Some VOs related to "Nyama" in general, but others specifically related to certain species. Rodents and ungulates were mostly mentioned in VOs about Nutrition and Taste, Income and Concern for crop/livestock destruction, all promoting the consumptive use of those species. Small monkeys were mostly associated with Concern for health and Mutualism, both promoting the non-consumption of those species, for divergent reasons. Chimpanzees, elephants, and leopards, all vulnerable and emblematic

**Table 2** Results of the MRCV analysis showing positive (+) and negative (-) associations between the emotions of the stories and the VOs expressed, with statistical significance at the  $P < 0.001$  (\*\*\*) ,  $P < 0.01$  (\*\*) and  $P < 0.05$  (\*) level.

	Happiness	Anger	Fear	Sadness
Nutrition and Taste	***(+)	***(-)	***(-)	
Income				
Control over wildlife				
Taboo or religion				
Mutualism				*x(+)
Caring/respect			***(-)	***(+)
Identity				
Repugnance				
Attraction/interest	***(+)		***(-)	
Conflict	***(-)	***(+)		
Concern for Safety	***(-)		***(+)	***(-)
Concern for Health			**(+)	
Environmentalism			*(-)	***(+)
Regulations				

species, were mostly mentioned in VOs about Concern for safety. Chimpanzees were also present in VOs about mutualism. Elephants were present in concern for crop/livestock

**Table 3** Result of GLMM for the most common VOs with socioeconomic variables of gender, age, urban versus rural sites, ethnicity, religion, wealth, forest visit and wildmeat consumption. Only the model with the lowest AIC is presented here with the coefficient

	n	Nutrition and taste		Concern for Safety		Care/respect	
		Coef (SE)	P	Coef (SE)	P	Coef (SE)	P
Intercept						-2.521 (0.766)	<0.001
Gender (Female=ref)	n(F)=286, n(M)=264	-0.702 (0.248)	0.005			1.203 (0.328)	<0.001
Age	Mean=35 (18-85)	0.019 (0.008)	0.013			-0.0285 (0.011)	0.011
Urban (Rural=ref)	n(R)=210, n(U)=341			-0.592 (0.281)	0.035		
Ethnicity							
-Lokele	n=88						
-Mukusu	n=31						
-Mulengola	n=84						
-Mumanga	n=69						
-Nande	n=29	-2.061	0.011				
-Other (ref)	n=250	(0.815)					
Religion							
-Muslim	n=51						
-Protest	n=134						
-Reveille	n=135						
-Other (ref)	n=217						
Wealth:							
-Low	n=175						
-Med	n=270						
-High	n=106						
Forest	n(0)= 201, n(1)=350						
Consume	n(0)=221, n(1)=330			0.730 (0.280)	0.009		

destruction too. Okapi was mostly mentioned in Attraction/Interest and Identity.

### Association of VOs with emotions

The first two dimensions in the MCA with emotions and VOs explained 22.5% of the variation. Happiness, Fear, and Sadness, together with the VOs Nutrition and Taste, Concern for Safety, Caring/respect, Regulations and Environmentalism were sufficiently well-explained by the first two dimensions ( $\text{Cos}^2 > 0.2$ ). Only significant associations yielded by the MRCV (Table 2/) were considered for further interpretation. Significant negative associations between VOs and emotion mean that a given VO was not or rarely mentioned in stories prompted by that emotion. For example, Nutrition and taste were negatively associated with anger and fear, which means that this VO was not described in stories prompted by those two emotions but instead mentioned in stories prompted by other emotions.

Mutualism and Caring/Respect were positively associated with sad stories; Nutrition and taste were associated with happiness; Concern for crop/Livestock destruction, Concern for safety, and Concern for health were more associated with anger or fear. Detailed results are presented in Table 2.

(Coef), standard error (SE) and P-value (P). For categorical variables, the referent (ref) is indicated. Sample size (n) is provided for all categories.



## Determinants of Wildlife/Wild Meat Value Orientations

We tested the influence of place of residence, gender, age, ethnicity, religion, profession, education, wealth, and nature-relatedness on the VOs expressed by the interviewees. The multiple correspondence analysis explained 14.9% of the difference with the first two axes (F1 = 9.8% and F2 = 5.1%). The variables that contributed more to F1 were place of residence ( $v$ -value: rural = 20.4, urban = -20.4), forest ( $v$ -value: Forest-0 = -17.7; Forest-1 = 17.7) and wealth ( $v$ -value wealth-1 = 14.1; wealth-3 = -10.8). The variables that contributed most to F2 were gender ( $v$ -value: M = 13.6; F = -13.6) and hunt ( $v$ -value: hunt-0 = -10.9; hunt-1 = 10.9). Rural people, who use the forest frequently and belong to the least wealthy category, were concerned with Concern for crop/livestock destruction and Concern for safety, and Nutrition/taste.

In contrast, urban people from the wealthiest category were associated with Mutualism, Identity, Attraction for wildlife, Concern for health, and Repugnance for wild meat. The associations on F2 show that men were more likely to be associated with Income, Control over wildlife, Attraction/interest, Environmentalism, and Regulations. In contrast, women, who generally do not hunt, were associated with Nutrition and taste and with Taboos over wild meat. All other associations were non-significant on the two first axes.

Generalized linear mixed models, ran for the three most mentioned VOs, resulted in the following predictions (Table 3): Nutrition and taste can be predicted for non-Nande older women, no matter the place of residence (rural/urban). Safety concerns can be predicted for rural dwellers who are likely to consume wild meat frequently. Care/respect for wildlife can be predicted for young men.

## Discussion

In this study, we identified the main value orientations (VOs) found in our target audience and the socio-economic profile of the people that were more likely to express the most frequent VOs. Our results from DRC, together with those from Rickenbach *et al.* (2017) and Chausson *et al.* (2019) in Congo, are the only available studies that elucidate value orientations over wild meat/wildlife in Central Africa, based on a human dimensions' perspective. Our typology differentiated 14 VOs (as compared to 6 in Rickenbach *et al.*, 2017). The most frequent VOs encountered in our sample were Concern for safety, Nutrition/taste, and Caring/respect. Place of residence (rural/urban), gender, age, wealth, and frequency of forest use and wildlife consumption best explained differences in VOs.

As in Rickenbach *et al.* (2017) we found that rural people were more likely to express concern for crop/livestock destruction or materialism VOs. This is probably explained by the fact that rural families depend on wild meat for food security and are the most exposed to damage to crop or livestock destruction caused by wildlife (Rickenbach *et al.*, 2017). Therefore, our findings support Inglehart's thesis that people who are more dependent on natural resources for fulfilling their needs have a stronger materialistic value orientation (Inglehart, 1997). This conclusion, however, should be taken with nuance because the dichotomy between biocentric and anthropocentric values is overly simplistic to understand the complexity of values that shape people's attitudes and behaviors. Indeed, being rural and consuming wild meat does not necessarily associate negatively with caring/respect, suggesting that people who view wildlife through materialistic lenses may also be sensitive to biocentric values. Happiness was equally conveyed in stories related to Nutrition and taste and Attraction/interest. From a behavior change perspective, our results suggest that messages that acknowledge the fact that wildlife users also care about wildlife (e.g., "eating wildlife but conserving it too") may be more efficient than those who criminalize them. In fact, findings from Bonwitt *et al.* (2018) within communities from Sierra Leone showed that the criminalization of wild meat consumption fueled fears and rumors, entrenching distrust towards public policies, with negative effects on compliance with the wild meat consumption recommendations.

Biocentric VOs were well explained by age and gender in our study area, with young men more likely to express care/respect. As opposed to results from Brazzaville (Chausson *et al.*, 2019; Rickenbach *et al.*, 2017), education level was not found to be a good predictor for biocentric VOs, and the frequency of wild meat consumption did not differ between men and women.

Whereas in Western contexts, there is evidence of the increase of mutualistic values in urban areas (Manfredo *et al.*, 2017), mutualism does not dominate in Kisangani. If expressed, it is exclusively related to small monkeys or chimpanzees, species for which respondents also express anger due to concern for safety and concern for crop/livestock destruction. Management decisions and messaging in behavioral change campaigns should consider that concern for safety and concern for crop destruction are among the values that represent significant barriers to change behaviors towards the killing of wildlife, and those VOs are associated with anger and fear. Humanizing animals, a strategy often used to generate compassion or affinity, may generate a rejection response in our study site if it ignores why people fear wildlife. We would therefore caution about using compassion conservation or anthropomorphic attributions to wildlife in the context of our study region.

Although this was not the focus of our study, we also found that different wild meat species associated differently with different VOs. Our methods based on personal stories from the interviewees allowed relating specific wildlife species with different VOs and emotions. From a behavior change perspective, this may imply that different VOs need to be considered for species-specific conservation. Different species might be used in behavior change messages depending on the desired change.

As used in this study, we argue that the human dimensions approach provides crucial information to understand differences in value orientations across groups, identify barriers to change, and tailor behavior change campaigns to the local context. In particular, the type of associations shown in this study allows to clarify the target for behavior change campaigns and elucidate positive images, messages, and emotions that can be used to create empathy in social marketing campaigns. We do, however, acknowledge that demand reduction strategies cannot achieve tangible impacts on their own. Systems that encourage the participation of civil society, equal access to conservation benefits, rights to land and resources and access to funding and alternatives to diversify from the use of natural resources are required to develop efficient conservation strategies that account for the multiple motivators that fuel the wild meat sector and reduce the barriers to change for more sustainable practices (Thomas-Walters *et al.*, 2020).

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**Data availability** The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

**Disclosure statement** The authors have no conflicts of interest to declare that are relevant to the content of this article.

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