

Bushmeat consumption and environmental awareness in rural households: a case study around Taï National Park, Côte d'Ivoire

JOSEPH A. K. KOUASSI, EMMANUELLE NORMAND
INZA KONÉ and CHRISTOPHE BOESCH

Abstract Consumption of bushmeat, a staple food of people living in the vicinity of protected areas, is a challenge for the conservation of wildlife. The underlying factors driving this consumption are, however, relatively understudied, particularly among rural households, and improved understanding would facilitate the development of conservation strategies. We therefore aimed to identify the factors that influence bushmeat consumption in rural households to the west of Taï National Park, in Côte d'Ivoire. We carried out enquiries in a total of 144 rural households in 20 localities during July–December 2012. Bushmeat, the majority of which comprised rodents and bovinds, accounted for 13% of the animal protein consumed in these households. This consumption was significantly higher in households in which poverty was more acute (low annual income and more dependent children). We found that repeated awareness campaigns involving theatre performances and/or film screenings (multimedia campaigns) contributed to a decrease in bushmeat consumption. This decrease exceeded 62% after exposure to four multimedia campaigns. We highlight the importance of awareness campaigns for reducing consumption of wild animals, and demonstrate the importance of recurring multimedia campaigns to maximize the impact of such conservation activities in rural communities.

Keywords Bushmeat, conservation, consumption, Côte d'Ivoire, public awareness campaigns, Taï National Park, West Africa

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JOSEPH A. K. KOUASSI* (Corresponding author) and INZA KONÉ† Unité de Formation et Recherches de Biosciences, Université Félix Houphouët-Boigny, Abidjan, Côte d'Ivoire. E-mail joseph.ano@wildchimps.org

EMMANUELLE NORMAND and CHRISTOPHE BOESCH‡ Wild Chimpanzee Foundation, Abidjan, Côte d'Ivoire

*Also at: Wild Chimpanzee Foundation, Abidjan, Côte d'Ivoire

†Also at: Centre Suisse de Recherches Scientifiques en Côte d'Ivoire, Abidjan, Côte d'Ivoire

‡Also at: Department of Primatology, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany

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Introduction

Bushmeat consumption is a major driver of overexploitation of wild animals as it is a source of protein for many people and provides income for hunters, transporters and vendors (Fa et al., 1995; de Merode et al., 2004; Albrechtsen et al., 2005). Impoverished households are often nutritionally dependent on wild sources of protein (Scoones et al., 1992; Albrechtsen et al., 2005; East et al., 2005). Wild animals are also killed for their symbolic cultural value (Ntiemoa-Baidu, 1997). Increasing extraction of natural resources is having a severe impact on wildlife and habitats (Kormos et al., 2003). For exploited species it is vital that the harvest rate does not exceed the reproduction rate because overexploitation leads to depletion. However, hunting demand often exceeds availability of wildlife, threatening the survival of some target species (Fa et al., 1995; Newing, 2001; Refisch & Koné, 2005). Incidental hunting of non-targeted species also occurs because most hunters use unselective hunting methods such as wire snares (Hofer et al., 1993; Newing, 2001).

Uncontrolled use of natural resources is linked to limited conservation knowledge and a lack of local environmental awareness-raising (Harcourt et al., 1986; Infield, 1988; Borchers et al., 2014). Other studies have indicated that wildlife population declines as a result of hunting are determined by social and economic drivers, such as poverty (Loibooki et al., 2002), cultural values and other traditional belief systems (Kaltenborn et al., 2005), and lack of access to alternative incomes (Johannesen, 2005). Wildlife declines are also caused by a lack of control measures, frequent ranger patrols (Hilborn et al., 2006) and respect for laws protecting fauna, and poor law enforcement (Newmark et al., 1993; Blom et al., 2004).

Taï National Park, in south-west Côte d'Ivoire, has suffered from intense hunting pressure, which is the greatest threat to wildlife in the Park (Köndgen et al., 2008; Campbell et al., 2011; N'Goran et al., 2012, WCF, 2012). Previous studies have reported that duikers and primates are the most affected taxa in the Taï region, where subsistence and commercial hunting are common (Casparly et al., 2001; Hoppe-Dominik et al., 2011). An estimated 895 tons of wild meat were extracted from the Park and surrounding forests in 1999, including > 68 tons of protected species (Casparly et al., 2001; Refisch & Koné, 2005).

As a response to hunting pressure in the Park several conservation projects have been established, with a permanent presence of researchers (Campbell et al., 2011), ecotourism, ranger patrols (N'Goran et al., 2012), community development projects and awareness activities (Boesch et al., 2008a; Borchers et al., 2014). However, the impact of research stations is limited to the geographical area in which the research takes place (Refisch & Koné, 2005; Köndgen et al., 2008). The assumption that ecotourism and ranger patrols have a positive effect on wildlife populations has been supported at research sites within the Park (Köndgen et al., 2008; N'Goran et al., 2012). Education and development projects have been shown to be the best way to raise conservation awareness and provide livelihood alternatives around the Park (Borchers et al., 2014). However, prior to 2002, awareness activities involved meetings with local people, which did not demonstrate positive effects on behavioural change (Goh, 2005). Moreover, no previous study has investigated the impacts of awareness activities on biodiversity conservation in Taï National Park.

To achieve this goal, the Wild Chimpanzee Foundation diversified educational activities through theatrical performances and film screenings around the Park between 2002 and 2012 (Boesch et al., 2008a). We analysed the impact of those environmental awareness activities in countering bushmeat consumption, and investigated economic and social constraints that determine bushmeat consumption in rural households. In this context, we examined whether environmental education can decrease bushmeat consumption in households. We also estimated the level of participation in environmental education needed to obtain a significant decrease in bushmeat consumption. The outcomes of this study are important for the park managers, to help them determine the best management strategy for long-term wildlife conservation in the Park.

Study area

The study was conducted in 20 villages west of Taï National Park, a primary rainforest and UNESCO World Heritage Biosphere Reserve (Allport et al., 1994) in south-west Côte d'Ivoire (Fig. 1). The Park and surrounding forests act as a reservoir for endemic species in the Guinean forest region (Mittermeier et al., 2004). Study villages were located in two regions: Taï and Djouroutou. Details of the study villages are provided in Table 1. Human populations in the vicinity of the Park include the Guéré, Oubi and Kroumen peoples, immigrants (from several ethnic communities in Côte d'Ivoire) and foreigners (from neighbouring countries); the major religions are Christianity, Islam and Animism. The economy of the region is dominated by subsistence agriculture, with intensive cash-crop farming, hunting, fishing and extraction of non-timber forest products as sources of additional income.

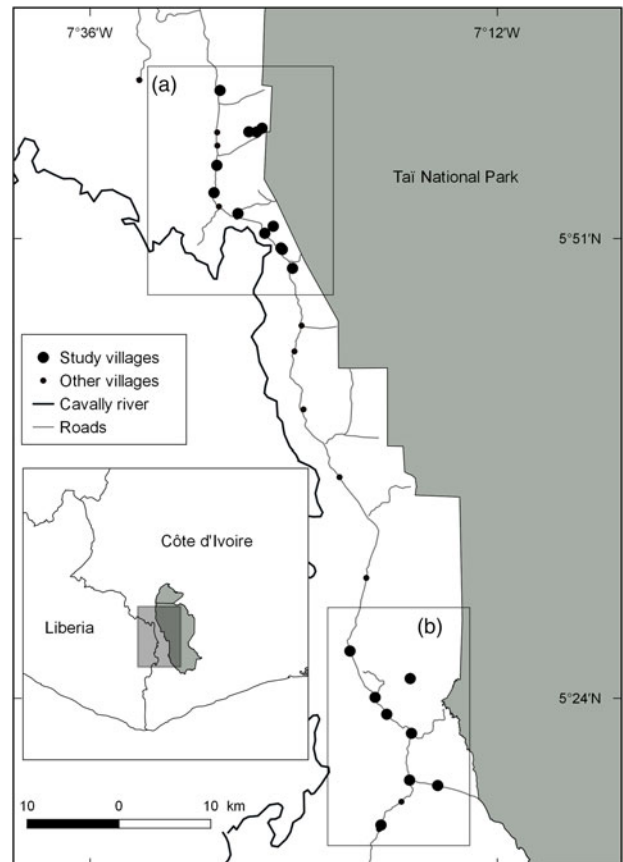


FIG. 1 Locations of the study villages in the (a) Taï and (b) Djouroutou areas west of Taï National Park, Côte d'Ivoire.

Methods

Data collection

We conducted questionnaire surveys (Supplementary Material 1) with 144 household heads (with signed consent) during July–December 2012 (Fig. 1), using purposive sampling to select households (Ardilly, 1994). The questionnaire comprised 22 multiple choice questions and was divided into three sections: (1) socio-economic aspects of interviewees, (2) their food consumption habits, and (3) their participation in various theatrical performances or film screenings conducted between 2002 and 2012 by the Wild Chimpanzee Foundation. During interviews the annual income of each household was estimated on the basis of existing financial resources and goods (Mbete et al., 2011); i.e. wages, estimated plantation revenue and other goods declared.

Before or after each interview we weighed the meat and/or fish to be consumed that day, with weighing performed not only on survey days but also for 4 days at 1-week intervals for 1 month. This period is representative of market dynamics, as the availability and price of fish and meat (fresh and smoked) are relatively constant throughout the year, independent of season (Mbete et al., 2011). We used a record

TABLE 1 Details of the study villages in the Taï and Djouroutou areas west of Taï National Park, Côte d'Ivoire (Fig. 1), with presence of schools, population, number of households, number of households surveyed, and number of awareness-raising activities.

Villages visited during the study ¹	Presence of schools	Estimated human population in 2012 ²	Estimated no. of households in 2012 ³	Surveyed households	No. of awareness-raising activities ⁴
Taï area					
<i>Keibly</i>	Yes	4,259	835	10	7
Atchokro	No			3	0
Yaokro	No			5	0
Kouassikro	No			6	1
<i>Ponan</i>	Yes	3,353	657	7	4
Gbegbekro	No			3	0
<i>Taï</i>	Yes	5,060	992	10	4
Kouadiokro	No			5	3
Sangbekro	No			3	0
<i>Gouleako2</i>	Yes	867	170	7	4
Gouleako1	No			4	1
<i>Paule oula</i>	Yes	3,353	657	10	1
Djouroutou area					
<i>Béoué</i>	Yes	2,749	539	13	3
Alokokro	No			6	0
<i>Djawédi</i>	No	175	34	4	0
<i>Djouroutou</i>	Yes	4,958	972	13	9
Carrefour	No			8	1
Konankro	No			2	0
<i>Karié</i>	Yes	6,727	1,319	13	3
<i>Youkou</i>	Yes	1,416	278	12	3

¹The main villages are in italics.

²We multiplied the human population size in the study area in 1998 by the mean rate of population increase in Côte d'Ivoire during 1998–2012, which was c. 28.6% (estimated July 2012; CIA, 2012).

³We divided the estimated population size in the study area in 2012 by the mean no. of people per household nationally, which was c. 5.1 (INS & ICF International, 2012).

⁴Theatrical performances and/or film screenings (multimedia) conducted during 2002–2011 by the Wild Chimpanzee Foundation. Neighbouring communities were also invited to participate in these awareness campaigns.

sheet to record the state (fresh, smoked), weight and purchase price of meat and fish, the probable number of days on which meat and/or fish were consumed, the number of people who consumed various species, and the provenance of the meat/fish.

Data analysis

To determine the factors influencing bushmeat consumption in rural households, we used a binary logistic regression (Dobson, 2002) in R v. 2.14.1 (R Development Core Team, 2012). Bushmeat consumption was the dependent variable, Y , with a value of zero for no and 1 for yes, with a logistic regression model as follows: $E(Y) = \exp(Y)/(1 + \exp(Y))$. Independent variables that potentially affected a household's dependency on bushmeat included religion, area of study, education, number of multimedia campaigns in which a household participated, household annual income and number of dependent children going to school. We included an interaction between income and number of dependent children. In our analysis the interaction involves two

independent quantitative variables with a regression equation as follows:

$$Y = \beta_0 + \beta_1 \times \text{income} + \beta_2 \times \text{number of dependent children} \\ + \beta_3 \times \text{income} \times \text{number of dependent children} \\ + \beta_4 \times \text{number of awareness campaigns} \\ + \beta_5 \times \text{religion} + \beta_6 \times \text{education} + \beta_7 \times \text{area of study}$$

where β_0 is the intercept term, and $\beta_1, \beta_2, \beta_3, \dots, \beta_7$ are the coefficients associated with each independent variable. All statistical tests were two-tailed, with statistical significance at $P < 0.05$.

Results

Wild animals consumed

Respondents reported consuming 18 wild animal species in total (Supplementary Table S1). Of these, three are categorized as Vulnerable (*Phataginus tricuspidis*, *Smutsia gigantea*, *Ceratogymna elata*) and one as Endangered (*Procolobus*

TABLE 2 Factors affecting bushmeat consumption in rural households west of Tai National Park, Côte d'Ivoire (Fig. 1), with summary statistics from general linear modelling in which bushmeat consumption was the dependent variable.

Independent variables	Estimate	SE	z value	P (> z)
Intercept	0.885	0.822	1.077	0.282
Number of awareness campaigns	-0.353	0.168	-2.097	0.036*
Religion: Christianity	0.267	0.535	0.499	0.618
Religion: Islam	0.389	0.788	0.493	0.622
Area (Tai vs Djouroutou)	-1.475	0.530	-2.781	0.005**
Number of dependent children	-0.011	0.131		
Annual income	-4.69E-07	1.92E-07		
Education	-0.639	0.486	-1.314	0.189
Annual income : number of dependent children	6.430E-08	3.196E-08	2.012	0.044*

*P < 0.05; **P < 0.01

badius) on the IUCN Red List (IUCN, 2014). Overall, *Cricetomys* sp., *Tragelaphus scriptus*, *Cephalophus maxwelli* and *Thryonomys swinderianus* were the most frequently consumed species (20, 18, 13 and 12% of species, respectively).

Determinants of consumption

The location of households was the strongest factor explaining bushmeat consumption, which was less in the Tai region than in Djouroutou (Table 1). We did not find a factor that explained this difference.

Independently, the probability of bushmeat consumption decreased with increasing participation in awareness campaigns (Table 2; Fig. 2). The more rural households participated in multimedia campaigns, the less they consumed bushmeat. Bushmeat consumption decreased by > 62% after participating in four theatre performances and/or film screenings. On average, bushmeat consumption in households decreased by c. 15% after each participation in a theatrical performance and/or film screening.

We found one significant interaction: bushmeat consumption decreased in households with larger annual incomes and fewer dependent school children. The more dependent children, the smaller the effect. When poverty increased (low annual income and more dependent children) the probability of consuming bushmeat was significantly higher (Table 1; Fig. 3). The consumption of bushmeat did not appear to be influenced by religion or level of education (Table 1).

Discussion

Our findings show that greater participation of rural households in awareness raising activities lead to a significant decrease in bushmeat consumption. Among the potential drivers of bushmeat consumption by rural households, only the interaction between a household's yearly income and the number of dependent school children had an effect, not religion or level of education.

To interpret these results it is important to understand the evaluation mechanisms for environmental awareness campaigns, and their effects on the food behaviours of the local population. The few previous studies that empirically tested a relationship between awareness campaigns for environmental conservation and an increase in positive attitudes towards nature partly confirm our results (e.g. Harcourt et al., 1986; Boesch et al., 2008a,b; Borchers et al., 2014). However, these studies reported people's attitudes but not their behaviour towards nature, and concluded there is no association between attitudes and poaching activity. In fact, poaching activity takes place despite local people expressing considerable concern for the targeted species (e.g. Newhouse, 1990; Schultz, 2011; Heberlein, 2012). An additional factor that may have led to such mixed results is that previous studies tested only for the impact of presence/absence of education campaigns (e.g. Infield & Namara, 2001) and not for the number of instances of participation in awareness campaigns on bushmeat consumption. This more longitudinal dimension of our study revealed the positive effect of multiple education campaigns on reducing bushmeat consumption. It is with increased number of instances of participation that the effect becomes significant and detectable. This is supported by results from surveys carried out in Rwanda to investigate farmers' attitudes, which found a marked improvement in attitudes after the fifth year of conservation awareness raising (Weber, 1981, 1989). Knowledge improvement is thus a prerequisite for behaviour change and reduced bushmeat consumption. These results indicate that education and awareness raising require a long-term commitment to counter natural resource extraction in Tai National Park.

Our results also indicate that low-income rural households with more dependent children attending school consume more bushmeat. This could be explained by one of the following hypotheses, confirmed by various studies. (1) Bushmeat can be divided and sold in small pieces, which can be acquired at an affordable price for the majority of households. This is supported by the study of Albrechtsen

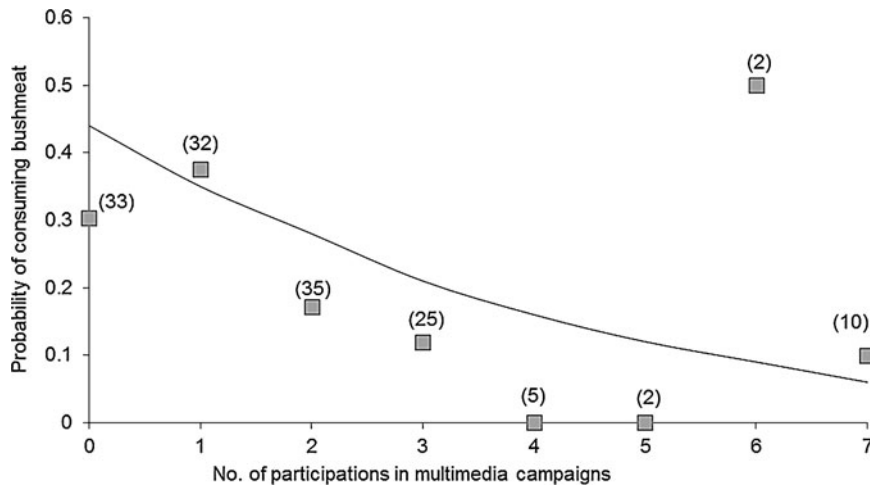


FIG. 2 Probability of bushmeat consumption by households in the study villages west of Taï National Park (Fig. 1) as a function of the number of times they participated in multimedia campaigns. The line represents the model line. The numbers in parentheses indicate the number of people who participated in multimedia campaigns.

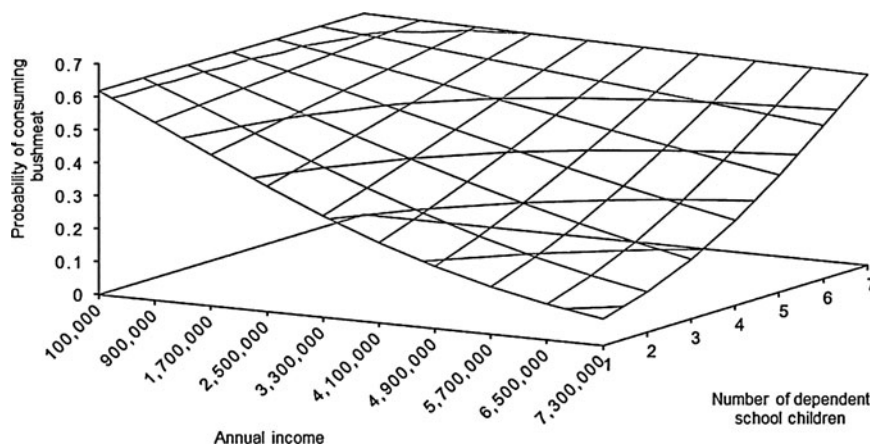


FIG. 3 Interaction between annual income, number of dependent school children, and consumption of bushmeat by rural households west of Taï National Park (Fig. 1).

et al. (2005), which found that lower income households may rely more on bushmeat as their main source of protein because of lower prices. (2) Bushmeat may be exchanged as a gift between low-income households, increasing their level of consumption. (3) Some wild animals migrate into plantations from Taï National Park and are caught in traps for personal consumption, with no monetary transaction (e.g. Noss, 2000; de Merode et al., 2004; Albrechtsen et al., 2005). This subsistence hunting is practised throughout rural Côte d'Ivoire (Caspary et al., 2001). A lack of financial resources combined with high expenses for school children results in poor rural households relying on bushmeat to meet their nutritional needs (Kümpel, 2006), as they are unable to acquire the more expensive domestic meat available (Loibooki et al., 2002; Johannesen, 2005).

Poor rural households depend on wildlife as a source of food. Our surveys indicate that a long-term environmental awareness programme can result in behavioural change and reduce bushmeat consumption. Our results have encouraged the Wild Chimpanzee Foundation and other organizations to increase the number of awareness campaigns and run them across a number of years, as has been done in

the villages around the Proposed Grebo-Krahn National Park in Liberia (WCF, 2014, 2015). There is accumulating evidence that constant human presence (tourists and researchers; Campbell et al., 2011; N'Goran et al., 2012), increased law enforcement (N'Goran et al., 2012) and education campaigns (Borchers et al., 2014) together provide an effective approach to protect threatened wildlife in tropical areas.

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Author contributions

JK led the project, collected, analysed and interpreted the data, and wrote the article. EN contributed to analysis and interpretation of results. IK contributed to the writing and revision of the article. CB played a central role in determining assumptions, and contributed to the writing and revision of the article.

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Biographical sketches

JOSEPH KOUASSI's research focuses on biodiversity conservation and the sustainable management of ecosystems. EMMANUELLE NORMAND is a conservation biology and cognitive science specialist and Director of the Wild Chimpanzee Foundation West African office. INZA KONÉ is a primate biologist and conservation biologist with interests in biodiversity and food security. CHRISTOPHE BOESCH is a conservation biology specialist and President of the Wild Chimpanzee Foundation.