

The role of wildlife for food security in Central Africa: a threat to biodiversity?

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1. Introduction

Meat from wild terrestrial or semi-terrestrial animals, termed ‘bushmeat’, is a significant source of animal protein in Central African countries, and a crucial component of food security and livelihoods in rural areas. Estimates of bushmeat consumption across the Congo Basin range between 1 million tonnes (Wilkie and Carpenter 1999) and 5 million tonnes (Fa et al. 2003) and harvest rates are estimated to range from 23 to 897 kg/km²/year (Nasi et al. 2008). Many sustainability assessments focusing on tropical forest wildlife in the region have warned about the increasing unsustainability of hunting and associated ecological impacts (e.g. examples within Bennett and Robinson, 2000).

Although humans have been hunting in the forests of Central Africa for millennia, there are several reasons why hunting is not sustainable in every place and for all species: (1) increasing consumer demand, from growing human populations and a lack of acceptable alternative sources of protein, (2) greater efficiency of hunting and trade, due to easier access to wildlife source areas and markets and more efficient gear types and (3) increasing hunter supply, resulting from rural poverty and a lack of alternative rural livelihoods reducing hunters’ opportunity costs (Kümpel, 2006). In addition, civil conflict or insecurity, poor governance, lack of respect for government law and order and inadequate law enforcement are all contributing factors. The growth of extractive industries such as logging and mining, particularly where operating without proper management or impact mitigation plans, has multiple impacts on wildlife hunting and trade. In the course of unregulated activities, companies (1) directly destroy critical habitat, disturb movement patterns and alter behaviour of wildlife, and (2) indirectly facilitate hunting in remote areas, often not governed by village traditions, by building roads and camps, thus providing or facilitating transportation for hunters and market trade as well as increasing local demand (e.g. Thibault and Blaney 2003, Poulsen et al. 2009). The loss of both traditional hunting territories and methods (e.g. hunting zone rotations) allows open access to the resource and concentration of hunting, with negative implications for hunting sustainability (Kümpel et al. 2010a).

Overhunting for bushmeat in tropical forests is an issue of concern for three main reasons:

- **Food security and livelihoods:** The depletion of wildlife is intimately linked to the food and livelihood security of numerous inhabitants of the Congo Basin, as many forest-dwelling or forest-dependent people have few alternative sources of protein and income.
- **Ecological impacts:** There is strong evidence illustrating that the scale of hunting poses a real threat to many Central African forest species. **Local extirpations of hunted species are widespread**, with West and Central Africa being particularly hard hit. The loss of keystone species through hunting reduces the resilience of the forest as a whole by disrupting ecological and evolutionary processes.
- **Health and zoonotic diseases:** Bushmeat is a known reservoir of zoonotic pathogens, including HIV (which originated from SIV or simian immunodeficiency virus) and Ebola virus in Central Africa, but we still understand relatively little about the transfer dynamics of such infections. Parasitic and bacterial infection risks from wild meat consumption are also likely to be significant due to the inappropriate sanitary conditions under which transportation and storage occurs.

Despite the increasing international attention to the bushmeat issue, the available information on bushmeat harvest and trade is still fragmented and understanding of the complex interactions between the ecological, socio-economic and cultural dimensions is limited. Field studies are usually site or country-specific without follow-up or co-ordination among sites and disseminated either in unpublished reports or peer-reviewed articles that are not easily accessible to certain audiences. As a result, governments and other stakeholders do not have objective data generated at national and regional levels to support their management decisions. A number of international and regional framework agreements and policy fora now call for action. Since CoP 11 from the CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) in 2000, three Central African countries have developed or drafted National CITES Bushmeat Action Plans, namely Cameroon, Gabon and the Republic of Congo. From 2001 to 2005, FAO (Forest and Agriculture Organization), supported the development of national bushmeat strategies. The Decision IX/5 at CoP 9 from the CBD (Convention on Biological Diversity) in 2008 on Forest Biodiversity, urged Parties to address as a matter of priority major human-induced threats to forest biodiversity, including unregulated and unsustainable use of wildlife. Since 2008, the Observatory for the Forests of Central Africa (OFAC), with technical support from TRAFFIC, is working to include wildlife and bushmeat issues more explicitly in their database through the development of a bushmeat monitoring system for Central Africa (SYsteme de suivi de la filiere Viande de Brousse en Afrique Centrale-SYVBAC). **The current issue of the State of the Forest is the first to include a chapter specifically on bushmeat. As an introduction to the bushmeat issue, this chapter aims at synthesising the most relevant information available for the Congo Basin since the early 1980s.** We will start by describing the species commonly hunted and traded as bushmeat. Second, we will focus on the role of bushmeat for food and income. Third, we will analyse the reasons behind bushmeat hunting, trade and consumption, especially in urban areas where other sources of protein are available. Finally, we will describe the impacts of hunting on wildlife populations and the broader forest ecosystem.

2. Species commonly hunted and traded

In Gabon alone, 114 recognised species have been recorded in hunter catches, household consumption and markets. This figure is very high compared to West African markets, where

wildlife is already dramatically impacted. Mammals make up the majority of the harvest (46% of species recorded) in comparison to birds (3%) and reptiles (6%). Different mammal species are not hunted equally frequently (Abernethy & Ndong Obiang, 2010). Rodents and ungulates usually represent more than two thirds of the carcasses sold in urban markets or recorded from hunter offtakes in Central Africa (Table 1). The most frequently hunted species are those between 2 and 22 kg, with brush-tailed porcupine (*Atherurus africanus*), blue duiker (*Cephalophus monticola*) and red duikers (other *Cephalophus spp.*) forming the majority of the catch in most forest areas. Blue duiker alone can account for about a third of the catch (van Vliet, 2008; Kümpel, 2006). The presence of other species depends on local circumstances as well as hunting techniques.

Country	Location	Source	Ungulates	Primates	Rodents	Other
DRC	Ituri forest	Hart, 2000	60-95	5-40	1	1
Gabon	Makokou	Lahm, 1994	58	19	14	9
	Dibouka, Baniati	Starkey, 2004	51.3	10.6	31	
	Dibouka, Kouagna	Coad, 2007	27	8.3	48.7	
	Ntsiete	Van Vliet, 2008	65	23.5	9	
Congo	Diba, Congo	Delvingt, 1997	70	17	9	4
	Oleme, Congo	Gally and Jeanmart, 1996	62	38		
	Ndoki and Ngatongo	Auzel and Wilkie, 2000	81-87	11-16	2-3	
CAR	Dzanga-Sangha	Noss, 1995	77-86	0	11-12	2-12
Equatorial Guinea	Bioko and Rio Muni	Fa et al., 1995	36-43	23-25	31-37	2-4
	Sendje	Fa and Yuste, 2001	30	18	32	
	Sendje	Kumpel, 2006	35	16	43	
Cameroon	Dja	Dethier, 1995	88	3	5	4
	Ekim	Delvingt, 1997	85	4	6	5
	Ekom	Ngnegueu and Fotso, 1996	87	1	6	6

Table 1: Percentage of carcasses from ungulates, primates, rodents and other species in different hunting sites of Central Africa

Most mammal species (70%) hunted for bushmeat in the Congo Basin are not listed as threatened on the IUCN Red List of Threatened Species. Average extraction rates calculated for African forest mammals within each Red List category indicate that unthreatened species have the highest extraction rates. In Gabon, 23 of the partially protected species and 24 of the totally protected species were found to be used as bushmeat. However, rare and vulnerable species (e.g. great apes, elephants, okapi) usually represent a very small proportion (often less than 5%) of the total catch (Abernethy and Ndong Obiang, 2010; van Vliet et al, 2010).

The nature of the offtake also varies depending on hunting technique, distance from the hunting centre and vegetation type. In north-east Gabon, secondary forests provided the greatest diversity of species (15 regularly hunted species, mainly blue duiker, rodents and small monkeys) compared to other vegetation types (van Vliet and Nasi, 2008). Rivers and riverine forests provided prey such as reptiles and ungulates (mainly water chevrotain *Hyemoschus aquaticus* and sitatunga *Tragelaphus spekei*). Mature forest provided mainly medium sized ungulates such as red duikers and red river hog, as well as small monkeys. Rodents and small ungulates (mainly blue duiker) predominated in agricultural areas and small carnivores and birds around roads. Differing hunting methods target different species, with guns being used for larger animals and arboreal species (Kumpel 2006, Coad 2007, van Vliet 2008), and snares for relatively smaller and terrestrial prey, often used to protect farming plots. Strong positive relationships have been found between the distance from a village and both prey species body size (Coad, 2007; van Vliet, 2008) and catch per unit effort (Kümpel et al., 2010a), suggesting impacts of hunting on wildlife around settlements.

3. The role of bushmeat in the diets and income of people in the Congo Basin

In many rural areas of Central Africa, bushmeat is the main source of animal protein available (although fish is usually also available), and is cheaper than any source of domesticated meat. Even where it is more expensive than alternatives, bushmeat is essentially a ‘free’ source of protein as it can be captured rather than purchased (Kümpel 2006). As such, bushmeat plays an essential role in people’s diets. In rural communities, wildlife provides significant calories, as well as essential protein and fat. Even where bushmeat is used to satisfy basic subsistence requirements, many families also use hunting to supplement short term cash needs (Table 2). For hunters, the distinction between subsistence and commercial use is often blurred, with meat from the forest supplementing both diets and incomes (Kümpel et al. 2010b). It is important to understand to what extent rural people depend on bushmeat, rather than simply use it, and would therefore suffer if the resource diminished. Many people depend on wildlife resources as a buffer to see them through times of hardship (e.g. unemployment, illness of relatives, crop failure), or to gain additional income for special needs (e.g. school fees, festivals, funerals) (Fa & Brown, 2009), and this ‘safety net’ is often more important for the more vulnerable members of a community (Allebone-Webb, 2008; de Merode et al., 2004). Barriers to access mean that in some cases it is the middle income or wealthier households in a community that benefit most from hunting, although the relative importance of this to development is negligible where all members of a community may be poor (e.g. de Merode et al., 2004, DRC). However, how bushmeat income is spent is important in judging its potential for poverty alleviation; studies in Gabon, Equatorial Guinea and Cameroon have found that hunter income tends not to be reinvested back into the household but spent on non-necessities (Coad et al., 2010, Kümpel et al., 2010b and Solly, 2004).

By choosing a specific hunting technique and a specific hunting area, hunters target particular species with a view to whether they will be consumed or sold (Coad et al, 2010, van Vliet & Nasi, 2008). Hunters often choose to sell larger species (Abernethy & Ndong Obiang, 2010; Coad, 2007; Okouyi, 2006; Fa & Brown, 2009) or those preferred for their taste (van Vliet, 2008) and consume those carcasses that have little commercial value (including those which are rotten or taboo; Kümpel, 2006), leading to potentially significant biases in the characteristics of the market compared to local offtakes. Fishing, where possible, is also an important source of protein and income. Fishing often has higher entry costs than hunting, where nets or a boat may be required, but can replace hunting as a primary activity in coastal or riverine areas (Blaney, 2008; Abernethy & Ndong Obiang, 2010).

Country	Locally consumed	Sold	Source
DRC	10%	90%	de Merode et al (2003)
CAR	27%	73%	Noss (1995)
	65%	35%	Delvingt (1997)
Equatorial Guinea	57%	34%	Fa & Yuste (2001)
	10%	90%	Kumpel, 2006
Gabon	41%	59%	Starkey (2004)
	60%	40%	Van Vliet (2008)
	56%	44%	Carpaneto et al. (2007)
Cameroon	36%	64%	Wright & Priston (2010)
	44%	56%	Solly (2004)
	34%	40%	Delvingt (1997)

	63%	15%	Takforyan (2001)
	59%	28%	Takforyan (2001)
	68%	14%	Dounias (1999)
Congo	28%	68%	Delvingt (1997)
	42%	54%	Delvingt (1997)
	45%	35%	Delvingt (1997)

* Total can be less than 100% as there is a percentage of “loss” and “undetermined” use

Table 2: Wild meat use in various communities

Hunting for the commercial trade is probably the primary driver of the increasing levels of bushmeat offtake in Central Africa (Bennett et al. 2007; Davies 2002). In some of the highly urbanised nations such as Gabon, aggregate urban bushmeat consumption can be higher than aggregate rural consumption due to the higher population density of urban areas (Starkey, 2004), although per capita rural consumption across the region is on average ten times greater than that of urban individuals (Chardonnet 1995; Wilkie & Carpenter 1999). A precise evaluation of the quantity of wild meat consumed per capita is not easy to compare between sites from the published information for various practical and methodological reasons. It is clear however that consumption depends on the type, wealth and residence of consumers, with hunter-gatherers eating 100 to 400 g of meat daily, while general rural (e.g. farmers or logging company employees) and urban populations consume 40 to 160 g and 3 to 94 g, respectively (Nasi et al. 2008; Table 3).

Site	Country	Hunter-gatherers	Rural	Urban	Average	Reference
Ituri	DRC	0.160				Bailey & Peacock 1988
Mossapoula	C.A.R.	0.050				Noss 1995
Campo	Cameroon	0.216	0.185			Bahuchet & loveva 1999
Campo	Cameroon	0.201	0.018-0.164			Koppert et al. 1996
Ituri	DRC		0.120			Aunger 1992
Kiliwa	DRC		0.040			De Merode et al. 2004
Odzala	Congo		0.116-0.164			Delvingt 1997
Dja	Cameroon		0.075-0.164			Delvingt et al. 2001
Dja	Cameroon		0.171			Bahuchet & loveva 1999
Ngotto	CAR		0.090			Delvingt 1997
Mbanjock	Cameroon			0.005		Bahuchet & loveva 1999
Bangui	CAR			0.039		Fargeot & Diéval 2000
Libreville	Gabon			0.003		Thibault & Blaney 2003
Port-Gentil	Gabon			0.008		Thibault & Blaney 2003
Oyem	Gabon			0.024		Thibault & Blaney 2003
Makokou	Gabon			0.039		Thibault & Blaney 2003
Gamba	Gabon			0.094		Thibault & Blaney 2003
Libreville	Gabon		0.05-0.26	0.02-0.12	0.08	Wilkie et al. 2005

Modified from Nasi et al. 2008

Table 3: Average daily wild meat consumption (kg/day) in various communities

4. Reasons for bushmeat consumption in urban areas

Urban consumers usually have the choice of several sources of protein but opt for bushmeat for a variety of reasons (e.g. cost, taste or preference) that vary between regions. In Kisangani, Democratic Republic of Congo (DRC) and Bangui, Central African Republic (CAR), consumers typically buy bushmeat as it is the cheapest or most available form of meat although not necessarily

the most preferred (van Vliet et al. 2010; Fargeot 2010). In CAR, the poorest urban families often buy smoked bushmeat as the most available and cheaper source of protein, often from the less expensive species, and consume it in very small quantities per day (Fargeot, 2010). In urban Equatorial Guinea, the situation is quite different: the top three most preferred foods are all fresh fish or bushmeat species, red snapper (*Lutjanus campechanus*), porcupine and blue duiker, whereas the top three most consumed foods are frozen mackerel, frozen chicken and frozen pork due to their lower cost (Kümpel et al. 2007). The price of bushmeat in comparison to other sources of protein affects bushmeat consumption. Wilkie et al. (2005) showed that changes in the price of fish affect bushmeat consumption where fish and bushmeat are substitutes. For the wealthiest families in Libreville or Yaoundé, the incentives for bushmeat consumption do not only depend on availability and prices. In urban Gabonese towns, the wealthiest households consume less bushmeat per person per day than poorer households, but are less sensitive to prices and often choose fresh wild meat (rather than smoked) and the more expensive species (porcupine, red river hog *Potamochoerus porcus* or python) (Knights 2008). Schenk et al. (2006) analysed taste choices in Gabon, reporting that consumers differentiate amongst bushmeat species and that wildlife cannot be treated as a generic food source.

Besides the economic factors that drive demand for bushmeat, cultural factors also explain bushmeat consumption patterns. East et al. (2005) used a study of consumption and preferences in Bata, Equatorial Guinea, to indicate that besides income, ethnicity and nationality are key determinants of consumption of bushmeat. In Bata (Equatorial Guinea) and in Bangui (CAR), purchasers of fresh domestic meat are more likely to be Muslims originating from neighbouring countries whereas bushmeat consumers are most likely to be from local ethnic groups (East et al. 2005; Fargeot, 2010). The Equatoguinean consumers preferred fresh meat or fish (not just bushmeat) over frozen meat and fish types, often citing health reasons. Some authors have also shown that a cultural preference for bushmeat encourages consumers to pay high prices for bushmeat (Bahuchet & Ioveva 1999, Trefon & de Maret 1999). For example, King (1994) suggests that in urban areas of western Cameroon the rate of consumption seems predominantly dictated by preference or taste rather than a lack of alternatives. Chicken, beef, pork and fish are commonly available in urban restaurants and from street corner 'chop stalls' at cheaper prices than bushmeat. In Gabon, familiarity with the taste of bushmeat due to childhood experience is clearly a major factor in determining preference (Starkey 2004). In Gabon, bushmeat is associated with the village, with rituals and with ceremonies, such as men's circumcision ceremonies (Angoué et al. 2000; van Vliet & Nasi 2008). The traditional role of bushmeat has also been shown in Equatorial Guinea, where some species are considered to have magical or medicinal properties that increase their value and others are taboo (Kümpel 2006). Taboos on certain foods are widespread in parts of Central Africa (Okouyi, 2006; van Vliet & Mbazza *in press*). Taboos can be specific to a tribe, clan, family or individual, and can relate to hunting as well as consumption. Taboos do not necessarily reduce the level of hunting of a species (especially when non-specific hunting methods are used) but do reduce their trade value. Yellow-backed duikers (*Cephalophus sylvicultor*) can be accidentally hunted in villages near Makokou, but the meat is never consumed by the young people in the village and never sold in the bushmeat market of Makokou (Okouyi 2006; van Vliet 2008). However, local taboos can break down where trade to other regions or to other tribes is possible (e.g. the trade in apes in Equatorial Guinea; Kümpel 2006).

5. Long term ecological impacts of hunting

Impacts on wildlife populations

Data from African sites indicate significant drops in mammal densities between un hunted and hunted sites; 13–42% in DRC (Hart, 2000), 44% in CAR (Noss, 2000) and 43–100% in Gabon (Lahm, 1994; van Vliet, 2008). As hunting pressure becomes heavier, primate numbers may drop almost tenfold (Oates, 1996) and carnivores are significantly affected (Henschel, 2009). Hunting is also a major cause of a reported 50% decline in apes in Gabon within two decades (Walsh et al, 2003). Interpretation of these data is however difficult since information on the influence of habitat type and past hunting pressures is not often available. Thus, major drops in mammal densities are more likely to occur in previously un hunted, highly productive habitats, than in those that have been exploited before or include habitats that are known to have low standing mammalian biomass. The rapid decline of fauna after intensive periods of hunting has also been suggested by market studies in Bioko, Equatorial Guinea (Fa et al., 2005). Overall numbers of carcasses decreased by 23% since 1991, while revenue increased by 35% and the proportion of carcasses of smaller species, such as rodents and the blue duiker, also increased (Fa et al., 2005). This suggests a dramatic reduction in presence of the larger species: Ogilby's duiker (*Cephalophus ogilbyi*) and diurnal primates.

Species are impacted by hunting pressure to different extents. Indeed, some appear very vulnerable while others appear relatively unaffected. Larger-bodied, longer-lived species with low intrinsic rates of population increase, such as large primates, large carnivores, elephant (*Loxodonta africana*) and yellow-backed duiker are less resilient to hunting than species with high intrinsic rates of population increase such as rodents and small- to medium-sized duikers. The black colobus (*Colobus satanas*) was found to be more vulnerable to over-hunting in Equatorial Guinea (Kümpel et al. 2008) perhaps because it is an easy target owing to its relative inactivity and large body size (Brugiere, 1998). In areas where larger species have been significantly depressed, abundance of small and medium-sized species can remain unaffected or even increase. For example, the small-sized blue duiker is significantly less abundant in remote forests inside the Ivindo National Park than in hunted areas close to Makokou with similar vegetation cover, while the larger red duikers (Peter duiker *Cephalophus callipygus* and bay duiker *Cephalophus dorsalis*) are less abundant or even depleted in those same hunted areas (van Vliet 2008, van Vliet et al., 2007). The explanation may be that abundance of resilient species may rise if their competitors are harvested, known as density compensation (or under-compensation) (Peres & Dolman, 2000). Suggestions of density compensation have been made in Korup forest monkey communities with relation to increases in putty-nosed guenons (*Cercopithecus nictitans*) in heavily hunted sites (Linder, 2008).

Population age structures and demographics of hunted vs. non-hunted sites are rarely available but studies in Gabon in the late 1980s (Dubost, 1980) concluded that hunting and trapping most severely affect young adult chevrotains and duikers, the age class with the greatest reproductive potential. Hart (2000) found that duiker dispersal rates in DRC were higher in a hunted than un hunted area, and concluded that dispersal was potentially important in maintaining small ungulate populations under exploitation; high rates of dispersal may also have been a factor in maintaining the elevated and localised hunting offtakes observed in a rotational hunting system in Equatorial Guinea, as expected under source-sink theory (Kümpel et al. 2010a). Recent results from Congo, however, showed that animals' dispersal rates do not appear to be greatly increased by hunting pressure (Mockrin 2009). Building a fuller understanding of animal population demography under hunting, including dispersal, is essential for management efforts.

Long term impacts of hunting on ecosystems

The loss of animals from forest ecosystems results in the disruption of ecological and evolutionary processes, as a result of changes in species composition and probable reduction in biological diversity (Emmons 1989; Redford 1992). Most of the evidence for this comes from case studies in the Neotropics, with a paucity of relevant studies conducted in the Congo Basin. Predicting the long-term influences of hunting on the ecosystem remains a tremendous challenge, but the Neotropical studies already show that reduced mammal densities can result in severe ecosystem changes and cascading effects on the entire food web. Although every organism contributes to ecosystem processes, the nature and magnitude of individual species' contribution varies considerably. Most ecosystem processes are driven by the combined activities of many species. Plant regeneration (affected by the loss of pollinators, seed dispersers and seed predators), food webs (affected by the loss of top predators or of their prey), and plant diversity (affected by a change in herbivory patterns or an increase in pests) are amongst the various processes dependent upon the presence of fauna. Therefore activities such as hunting have the potential to impact not only targeted species but the ecosystem more broadly.

'Keystone species', 'ecosystem engineers', or organisms with high community importance value are species or groups whose loss is expected to have a disproportionate impact on the ecosystem compared to the loss of other species. As hunters preferentially select large animals, which are often keystone species, the local extinction of these animals results in dramatic changes to ecosystems. Top predators (e.g. large cats, raptors, crocodiles) impact biodiversity by facilitating resources that would otherwise be scarcely available to other species (e.g. carrion, safe breeding sites) or by initiating a trophic cascade (Terborgh, 2010). Local extinction of these predators can trigger large changes in prey populations, which in turn dramatically alters browsing or grazing to the point where large regime shifts or ecosystem collapse happen. Elephants and other mega-herbivores can play a major role in modifying vegetation structure and composition through their feeding habits (including differential herbivory and seed dispersal) and movements in the forest (killing a large number of small trees). Their impact has in some cases appeared to be positive (Goheen et al. 2004), in others negative (Guldemand and Van Aarte 2008), but they do have a strong impact on vegetation dynamics. Ungulates such as wild pigs and duikers are among the most active seed dispersers or predators; thus a significant change in their population densities will have a major effect on seedling survival and forest regeneration.

Human extractive activities in tropical forests (including but not restricted to hunting) are therefore disruptive processes and can trigger numerous, yet not fully understood, effects, which will in turn alter, in a more or less significant way, the overall function, structure and composition of the ecosystem. As forest resilience is dependent upon all these processes and functions, it is very likely to be impacted by the loss of biodiversity linked to the direct and indirect impacts of defaunation (Thompson et al. 2009).

6. Conclusions

Increased hunting pressure has tangible effects on wildlife and is likely to have long term impacts on forest ecosystems. As it is expected in hunted areas, the abundance and composition of mammal assemblages differ from un-hunted areas. However, the abundance of several hunted species can decline without necessarily indicating un-sustainability. The most resilient species are often able to adapt to hunting pressure, either by modifying their biological parameters and their ecology or by taking the niche left empty by the most vulnerable species. Despite long and continuous sustained heavy harvesting, some bushmeat species continue to thrive in natural and modified habitats. Multiple studies suggest that the brush-tailed porcupine and the blue duiker are highly resilient to hunting. Thus, high harvesting pressure should not always be equated with local extinction. On the other hand, many vulnerable species such as elephants and great apes, although not representing high percentages in the hunter's catch, have declined or become locally depleted due to hunting. In addition, very little is still known for the majority of other Central African hunted species that are partially or totally protected. The effects of hunting on those species need further investigation, with a particular focus on the impacts of hunting at varying spatial and temporal scales and under different hunting techniques, to provide objective information for sustainable wildlife management.

Bushmeat plays a crucial role in the diets and livelihoods of rural and urban people in Central Africa. Bushmeat serves multiple roles at the hunter level and remains a major source of protein and income in most rural areas. The distinction between subsistence and commercial hunting is blurred, particularly where rural areas are well integrated in the cash economy, but also because often bushmeat is the most valuable tradable commodity for remote communities. However, there remains a lack of detailed empirical evidence concerning the role of bushmeat within the rural household economy, and in maintaining the food and livelihood security of different components of different forest-dependent communities. Such an understanding is needed to formulate an appropriate policy response to the bushmeat issue for the benefit of both local livelihoods and forest ecosystems.

The increasing trade from rural to urban areas is the main driver of unsustainable levels of bushmeat hunting in Central Africa. Even where urban consumers have access to domesticated sources of meat, bushmeat remains an important item of their diet. Indeed, bushmeat serves multiple functions over and above the purely consumptive. There are cultural, spiritual and taste preferences that override predictions and patterns of behaviour captured in economic models. Moreover, in some urban towns, bushmeat remains the cheapest source of protein. As such, with Central African nations becoming increasingly urbanised, there is no guarantee that demand for bushmeat will decline. However, preferences are relatively elastic, and there is generally no particular demand for protected and vulnerable species, with the more common species (such as brush-tailed porcupine or giant pouched rat) often the most highly valued for their taste or their cultural value. There is thus hope for the sustainability of the trade if it can be restricted to the more resilient species, supplemented by the production and marketing of acceptable alternatives (such as fresh meat and fish) at an appropriate scale.

The reasons behind bushmeat consumption are complex and integrate economic, cultural and social factors that should not be disregarded in efforts to promote the sustainable levels of bushmeat hunting. More particularly, a clear understanding of consumer preferences for both wildlife and alternatives is needed before any efforts to develop alternative protein sources are started. As

demand from the increasing urban population in Central Africa increases, the target for awareness-raising campaigns should shift from rural to urban settings with innovative messages and approaches that take into account Central African perceptions of wildlife. The Convention on Biological Diversity (CBD) and the report of its Liaison Group on Bushmeat recognises that existing policies and legal frameworks related to hunting are unpractical or unfeasible, provide unrealistic approaches for enforcement, and ignore the economic and nutritional value of bushmeat (CBD, 2009). As such, multidisciplinary approaches are needed to combine a better knowledge of the use and trade of bushmeat, the strengthening of legal frameworks, the provision of food and livelihood alternatives and the sustainable use of wildlife. None of these alone appear to be able to solve the so-called “bushmeat crisis”, but combined and incorporated into solid national and regional bushmeat strategies, there is potential to achieve a more sustainable use of wildlife for food in Central Africa.

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