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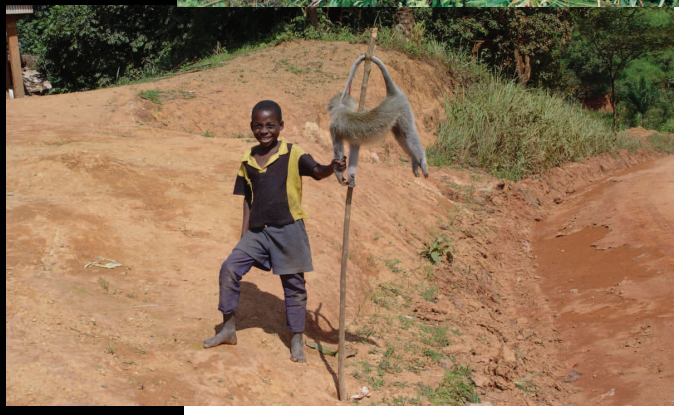
CONSERVATION AND USE OF WILDLIFE-BASED RESOURCES: THE BUSHMEAT CRISIS



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Acronyms

CBD Convention on Biological Diversity
CIFOR Center for International Forestry Research
CITES Convention on International Trade in Endangered Species of Wild Fauna and Flora
DRC Democratic Republic of Congo
ICDPs Integrated Conservation and Development Projects
IUCN IUCN - The World Conservation Union
NBSAPs National Biodiversity Strategies and Action Plans
NGOs Non-Governmental Organizations
NTFPs Non-Timber Forest Products
ODI Overseas Development Institute
PRSPs Poverty Reduction Strategy Papers
PSIAs Poverty and Social Impact Analysis
SCBD Secretariat of the Convention on Biological Diversity
SBSTTA Subsidiary Body on Scientific, Technical and Technological Advice
WCS Wildlife Conservation Society
WHO World Health Organization

Foreword


Photo courtesy of CBD

Wildlife in tropical forests is a main source of livelihoods, and the 'empty forest syndrome' can have direct negative impacts on the health and well-being of forest dependent communities. The bushmeat crisis therefore reminds us of humankind's dependence on biodiversity: the disappearance of wildlife from our forests is also a serious threat to the cultural and spiritual identity of many indigenous and local communities and other forest dependent communities.


Photo courtesy of CIFOR

Addressing the bushmeat crisis will be an important step towards the 2010 target to significantly reduce the loss of biodiversity, as well as to the achievement of the Millennium Development Goals. This Technical Series publication synthesizes existing knowledge on this topic, and suggests some policy options to make the use of wild fauna more sustainably. Interactions with other sectors, in particular forestry, agriculture, and fisheries, are demonstrated.

We are grateful to our partner organizations, in particular the Overseas Development Institute (ODI) and the Wildlife Conservation Society (WCS), for their contributions to this report. We hope that it will provide impulses for a coordinated and response to the increasingly urgent challenge of addressing the bushmeat crisis – at international, national, and local level.

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on Biological Diversity

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Director General,
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1. Introduction

1.1. Focus of the paper

This document addresses the hunting of tropical forest wildlife for food (known as "bushmeat", "wildmeat", and/or "game meat"; see 1.2 for the definition). It was prepared for the Secretariat of the Convention on Biological Diversity (CBD) under the coordination of CIFOR and in collaboration with the Liaison Group on Non-timber Forest Resources, convened in response to paragraph 42 of decision VI/22 of the Conference of the Parties to the CBD and its annex, the expanded programme of work on forest biological diversity, on the basis of goal 4, objective 2, activity (a) of programme element 1[1] .

Hunting for food in tropical forests is an issue of concern for primarily three reasons:

- There is strong evidence illustrating that the scale of hunting, occurring in these regions, poses a real threat to many tropical forest species;

- The depletion of wildlife is intimately linked to the food security and livelihood of numerous tropical forest-region inhabitants as many of these forest-dwelling or forest-dependent people have few alternative sources of protein and income;

- The so-called "bushmeat crisis" is the focus of many conservation organizations and of a number of development programmes throughout the tropics. However many of the ways in which hunting and wildlife trade operate, as well as their links to livelihood or ecosystem function, are either poorly understood or not properly taken into account.

1.2. Definitions

Bushmeat is defined in this paper as any non-domesticated terrestrial mammals, birds, reptiles and amphibians harvested for food. Insects, crustaceans, grubs, molluscs and fish are excluded from this definition and will not be addressed in depth. While invertebrates can be locally important dietary items, it is the larger vertebrates which constitute the majority of the terrestrial wild animal biomass consumed by humans. However the links between bushmeat, fish and invertebrate harvesting will be explored.

Hunting is defined as the extraction of any wildlife, from the wild, by whatever means and for whatever purpose. Wildlife is hunted for food, trophies (most often skins, teeth, antlers and horns), medicines and other traditional uses (most hard and soft body parts), and as pets (especially primates, birds and reptiles). Therefore individuals hunt tropical forest wildlife primarily to eat and/or sell it.

Garden hunting[2] (or farm-bush hunting) occurs when wild animals enter swiddens[3] and fallows because of the relative abundance of food sources. As a result several game species thrive in this habitat mosaic of swiddens and forest (Linares 1976; Peterson 1981; Posey 1985). These animals are usually viewed as pests by farmers and are generally hunted. In the idealized scenario, crop losses resulting from the presence of these species are balanced with protein gains.

Commercial wildlife trade is characterized by the transport and sale of wildlife in a manner which often requires capital investment, generally operates over long distances (greater than a hunter would walk in a day), and involves middlemen or re-sellers who are not hunters themselves.

[1] Establish a liaison group with an associated workshop to facilitate development of a joint work plan with relevant members of the Collaborative Partnership on Forests to bring harvesting of non-timber forest products (NTFP)s, with a particular focus on bushmeat, to sustainable levels. This group should have a proportionate regional representation, giving special consideration to regions where bushmeat is a major issue and representation of relevant organizations such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora. The mandate of this group is to:

i. Consult in a participatory manner with key stakeholders to identify and prioritize major issues pertaining the unsustainable harvesting of non-timber forest products, particularly of bushmeat and related products;
ii. Provide advice on the development of policies, enabling legislation and strategies that promote sustainable use of, and trade in, non-timber forest products, particularly bushmeat and related products;
iii. Provide advice on appropriate alternative sustainable livelihood technologies and practices for the affected communities;
iv. Provide advice on appropriate monitoring tools.

[2] Garden hunting is based on the tendency of many game animals to be attracted to garden sites where they are killed by humans. In some cases they are attracted to crop plants, in others to the weeds that flourish under increased light in open areas (see also www.fao.org/docrep/v7795e/V7795e02.htm).

[3] Swiddens are (usually small) areas of shifting cultivation, often using "slash and burn" techniques, referring to the temporary cutting and burning of forests or woodlands to create fields for agriculture or pasture for livstock, or for a variety of other purposes.

However a significant proportion of game meat is also sold locally amongst villagers.

Article 2 of the Convention on Biological Diversity defines sustainable use as: *The use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.*

In practical terms, a sustainable use is one which is perpetuated over the long term. Often local interest in the resource is an important factor in maintaining its quality. Obviously as one cannot sustainably use a resource that has vanished, the statement that sustainable use is a form of conservation has some merit. It should be clear that all uses, consumptive or non-consumptive, will impact on ecology in some way and that these impacts will translate into more or less dramatic effects on the local environment depending on what is used and how. Ultimately, for hunting to be sustainable, it must be so from social, ecological and economic viewpoints.

Ecological sustainability: Populations of animal species usually fluctuate naturally over time, depending on many environmental factors. However habitat quality and predation (including hunting) are two of the most important factors in determining population densities. The combination of increased hunting pressure and the loss of habitat quality triggered the decline of many wildlife species, especially larger species with specific habitat requirements and low reproduction rates. Sustainable harvests should not be greater than production, and harvested populations should not be reduced to densities whereby they can no longer fulfil their ecological role, e.g. as pollinators, seed dispersers, predators and browsers. However, in practice, it can be very difficult to properly assess population densities and annual production, especially in closed forest ecosystems. Similarly establishing the specific ecological role of all species is an equally difficult task. One should therefore be cautious about assuming ecological roles as our understanding of this complex web of interactions is far from exhaustive (see discussion in section 2).

Economic sustainability: Harvested populations should not be reduced to densities whereby they cease to fulfil their economic role of ensuring sustained livelihoods for dependent populations.

Social sustainability: The benefits of wildlife for local communities are wide-ranging and diverse. They play an important role in addressing many social demands. Anthropogenic disturbances of wildlife (from industrial to local hunting activities) as well as policy decisions should be managed in a way that sustains or increase these benefits.

In all the above it is essential:

- To note that in each case (ecological, economic or social sustainability), the optimal population density may be different;
- To consider the time factor. As no one can be sure that a particular use will be sustained indefinitely, there can only ever be a probability of a use being sustainable. These probabilities are based on current knowledge and commitments or on a qualification of the estimated sustainability by its estimated duration;
- With the availability of different data sets and models and the great uncertainty of their validity, the precautionary principle has to be taken into account in developing policies based on the current imperfect knowledge.

Bushmeat vendor in Cameroon

Text Box 1. Lessons learned from North America

Management of hunting in tropical forests is a recent phenomenon, with most active programs only being initiated in the past 50 years or considerably less. In North America, the ecology and productivity of the ecosystems are totally different to those of tropical forests, but none the less some lessons can be learned from North America's long history of wildlife management.

The first humans to enter the Americas about 11,000 years ago were the Clovis peoples. Evidence indicated that their hunting for food probably caused the extinction of many large vertebrate species.

As a reaction against regulations in Europe which restricted hunting for the benefit of the ruling classes, during the initial European colonization of North America, wildlife was deemed to belong to the people. For almost 200 years, the freedom to hunt, including for commercial sale, was largely unregulated. The effect on local wildlife populations was obvious. In the early 1600s in Massachusetts, USA, it only took ten years for the local deer population to be depleted by colonist hunters. The American bison once roamed in the millions throughout the western United States, but uncontrolled hunting drove it to the edge of extinction in the mid-1800s. Over a 60 year period, herds estimated to number around 60 million were reduced to a mere 25 animals.

In the mid- to late-19th century, commercial hunters on the Chesapeake bay used sink boxes (shallow draft barges) and punt guns to slaughter huge numbers of Canada geese, canvasback ducks, redhead ducks and other water fowl, that were shipped on the railroads to markets in eastern cities. One shot fired from these 50 kg cannons could kill up to 30 ducks and 10 geese at once, generating the equivalent of an average worker's monthly salary for the hunter.

By the turn of the nineteenth century, over-hunting combined with the destruction of the eastern hardwood and old growth forests meant that the future for wildlife in North America was bleak. Perhaps never before in human history had so many animals of so many species been killed in such a short time. Species extinctions within the United States included: Stellar's sea cow (*Hydrodamalis gigas*) (1768) ; Labrador duck (*Camptorhynchus labradorius*) (1878); Eastern subspecies of elk (*Cervus canadensis canadensis*) (1880); sea mink (*Mustela macrodon*) (1894); Merriam's elk (*Cervus canadensis merriami*) (1906); Audubon's bighorn sheep (*Ovis canadensis auduboni*) (1910); Carolina parakeet (*Conuropsis carolinensis carolinensis*) (1914 in the wild; 1918 in captivity); and heath hen (*Tympanuchus cupido cupido*) (1932).

Perhaps the most infamous of the North American extinctions around this time was the passenger pigeon. Although it was the most abundant bird that had ever existed, its numbers went from five billion to zero in 70 years. It was extinct in the wild by 1900 and in captivity by 1914. Nest trees were cut and the young collected. Live birds were tied to stools to attract and allow the slaughter of huge flocks of birds seeking to roost – this was the origin of the term stool-pigeon. In 1869, 21 million birds were shipped out of Hartford, Michigan in only 40 days.

The realization that America's once magnificent wildlife was disappearing rapidly led to some major legislative changes. In 1896, the Connecticut State Court prevented one citizen from shipping game birds out of the State; this was a fundamental turning point declaring that wildlife belonged not only to individuals, but to society as a whole. This was followed in 1900 by President William McKinley signing the first federal wildlife conservation law, the Lacey Act. This was a sweeping piece of legislation that made it illegal to transport birds across state boundaries if they had been taken in violation of any other law in the nation. Today, after numerous amendments, the Lacey Act makes it unlawful to import, export, transport, sell, buy, or possess fish, wildlife, or plants taken, possessed, transported, or sold in violation of any federal, state, foreign, or Native American tribal law, treaty, or regulation.

2. The ecological importance of wildlife

Human extractive activities in tropical forests (including but not restricted to hunting) are disruptive processes and can trigger numerous, yet not completely understood, mechanisms (compensatory or predation rate changes) or effects (trophic cascade or keystone effects) which will in turn alter, in a more or less significant way, the overall function, structure and composition of the ecosystem. Although every organism contributes to ecosystem processes, the nature and magnitude of individual species contributions vary considerably. Most ecosystem processes are driven by the combined activities of many species. Plant regeneration (loss of pollinators, seed dispersers and seed predators), food webs (loss of top predators or of their prey), and plant diversity (change in herbivory patterns, increased pests) are amongst the various processes dependent upon the presence of fauna. Therefore activities, such as hunting, have the potential to not only impact targeted species but the ecosystem more broadly.

Different species, performing similar roles in ecosystem processes and having similar trophic status or life-history constitute what have been termed functional groups. Species within these groups such as grazing mammals, large predators, perennial grasses, or nitrogen-fixing microbes are functionally similar despite their uniqueness in genes, life history, and other traits. It is therefore often difficult to determine the relative contributions of a given species to ecosystem processes as several species may contribute in similar ways.

However some species or functional groups matter more than others. This becomes especially clear in the case of "keystone species" which are also referred to as "ecosystem engineers" or organisms with high "community importance values." All these terms refer to species whose loss has a disproportionate impact on the community when compared to the loss of other species. Conventional wisdom therefore predicts that as hunters prefer large animals that are often keystone species, the reduction or extirpation of these animals will result in dramatic changes to the ecosystems (See Text Box 3 and 4). Some of these predicted changes have been empirically demonstrated while others have yet to be demonstrated or have so far proved to be inexact (see Bennett & Robinson 2000 for a review and Wright 2003 for a thorough discussion on this issue). Some examples of keystone species whose removal induced change in ecosystem features are:

- Top predators (e.g. large cats): their extirpation triggers an uncontrolled growth of the prey population which in turn dramatically increases browsing or grazing intensity to the point where forest regeneration can be totally prevented. However, it is also possible that the loss of a predator will be compensated by hunting pressure in which case changes might not be as dramatic as expected.

- Elephants have a tremendous role in modifying vegetation structure and composition through their feeding habits (differential herbivory, seed dispersal) and movements in the forest (killing a large number of small trees). Two similar forests, one with elephants the other without, show different succession and regeneration patterns as shown by the long term studies in Budongo (no elephants) and Rabongo (large population of elephants) forests (Sheil & Salim, 2004).

Papuan hunter with wild pig

- Wild pigs (*Sus* spp., *Potamochoerus* sp, etc.) and some antelopes are among the most active seed predators. A significant change in their population densities will have a major effect on seedling survival and forest regeneration.

On the other hand, there are some examples where additions or losses of possible keystone species have had, for various reasons, little obvious effect on ecosystem processes, e.g. when another species takes over the ecological niche of a keystone species.

Text Box 2. Examples of successful programs to reduce hunting to more sustainable levels

Programs to manage wildlife trade can be instituted at one or more points along the axis from source populations (in protected areas, logging concessions, community forests or other lands), through to the point of sale and consumption (in subsistence hunter communities, to local markets, to long-distance and even overseas markets).

The best way to maintain source populations varies greatly between sites, depending on the legal status and ecological conditions, the distribution, size, socioeconomics and cultures of local human populations and the wider socioeconomic and political context in which the site is embedded. Under different conditions, some programmes have succeeded in reducing hunting by protecting source populations through management programmes mediated by government authorities, logging companies or local communities. Often international or local NGOs are involved in providing technical advice for such programs.

Controlling hunting in a national park

Nagarahole National Park in south-west India covers 644 km2, and is home to many species of spectacular large mammals, including tigers, elephant, gaur, dhole, sambar and axis deer. It is accessible by road on many sides, and is surrounded by extremely high human population densities: over 100,000 people live within 10 km of its boundaries. Hence, potential hunting pressure is extremely high for direct consumption and local trade, and for commercial products (e.g., tiger bones, ivory). A multi-faceted program led by the Indian Government involves intensive protection of the area by a large, legally-empowered forest service. About 250 government staff are engaged in the Park, equivalent to one person per 2.6 km2. Management comprises intensive enforcement (with wildlife population densities being highest where enforcement efforts are most focused), local education programmes, voluntary resettlement of enclaved communities, and a detailed ongoing monitoring programme. As a result, over the last 30 years the National Park has become one of the best places for viewing wildlife in tropical Asia, with guarantees of spectacular views of large mammals, even in the midst of such pressure.

Wildlife management in a community reserve

By contrast, the Reserva Comunal Tamshiyacu-Tahuayo in the Peruvian Amazon comprises some 3,225 km2. The diversity of mammals in the reserve is greater than in any other protected area in the Amazon, and possibly globally, e.g., at least 14 species of primates occur here. Local human population density is extremely low; only nine villages consider themselves close enough to the reserve to be involved in management.

The closest city, Iquitos, has 300,000 residents but is more than 100 km away, with no road access linking the two. Management of the reserve legally lies with the local communities. Hunting pressure is limited to local subsistence consumption, some sales of dried meat to Iquitos, and peccary pelts for sale to overseas markets. There is almost no hunting within the reserve by outsiders. Wildlife management involves a combination of community-based and co-management strategies, involving local communities, government agencies, NGO extension workers and researchers. Decisions on resource use and management are voted upon during community meetings, and are informed by NGO extension workers, based on detailed research and monitoring by researchers. This allows communities to experiment with different types of management, and to find management systems which are compatible with their culture. Communities are not too large for effective communication, and can easily define their boundaries and membership. The area is divided into strictly protected and buffer zones. Data shows that harvests of all species except tapir are apparently sustainable, and ways are being sought to ensure that tapir hunting is also reduced to sustainable levels. Hence, different ecological and socio-economic conditions mean that an entirely different system of management from that used in Nagarahole is ensuring that wildlife populations are being conserved successfully.

Private sector co-management of hunting

In most tropical forests, logging concessions are important sources of hunted animals, with logging being correlated with rapidly escalating and unsustainable levels of hunting. In logging concessions surrounding Nouabalé Ndoki National Park, northern Republic of Congo, a successful collaboration has been established between the Government, an NGO (Wildlife Conservation Society, WCS), the private sector (Congolaise Industrielle des Bois, CIB), and local communities. The aim of the project is to design, implement, and monitor wildlife management systems with the timber company and local communities, in the forestry concessions adjacent to the National Park. The project components include: conservation education for logging company managers, employees and their families, and local communities; wildlife regulations in company policy; a strict system of wildlife law enforcement carried out by locally recruited and highly trained ecoguards; development of alternative protein supplies and activities including fish farms and the importing of affordable beef; and an intensive program of socio-economic and ecological monitoring. The presence of abundant populations of large mammals throughout the concession, including gorillas, chimpanzees, forest elephants and bongo, is testimony to the success of the project. The private sector benefits from the increased vigilance and law enforcement through a decrease in theft of company property in the concession, improved corporate image, and improved opportunities for timber certification. The local communities benefit because the management programme supports their traditional land tenure system. They also have employment opportunities as jobs in the project are targeted specifically at local communities, and they have increased food and cultural security. Wildlife conservation benefits by a reduction in threats facing the National Park, by some of the management costs being borne by the private sector, and by wildlife being protected outside the Park over an extremely large area. A mutually beneficial system of management is therefore created.

Regulating demand for wild meat

One programme that has been successful at the demand end of the spectrum has been implemented by the Malaysian state of Sarawak. In this region wildlife populations had been severely depleted in the past 50 years due in large part to hunting. For example, the banteng and Sumatran rhinoceros had become extinct; hornbills had become rare due to hunting for their feathers and meat; the ranges and numbers of both proboscis monkeys and orangutans had shrunk dramatically.
Many rural people still depended on hunting for their subsistence, so the Government, with technical support from WCS, prepared and implemented a wildlife master plan. This comprehensive policy document covered all steps needed by all sectors to conserve wildlife in the State, and balancing this with development needs. A core focus was reducing hunting to sustainable levels, while still allowing rural people to hunt for their own subsistence. This resulted in passing of the Wild Life Protection Ordinance in 1998, which banned all commercial sales of wildlife taken from the wild. This meant that rural people who still needed to hunt for their food could do so, but the unsustainable commercial trade in wildlife would be stopped. It was widely supported by rural community leaders as it protected their own resources from being lost to outside hunters and to external trade.

The Ordinance was put into effect by the Government through major publicity and education programmes in towns and rural areas. In towns, government workers explained the law to traders and consumers – focusing on the reasons why the law was needed, and the penalties for breaking the law. In rural areas, the programme explained the benefits of maintaining wildlife populations in the forest so that they can provide a continuing food supply for future generations. The law was also vigorously enforced in markets, art and craft shops, pet shops and restaurants throughout the State. Further measures included controlling firearms and ammunition, and implementing regulations to ensure that logging roads are not used for hunting and transporting wild meat from forests to towns. These combined measures increasingly limited hunting only to those who depend on it for subsistence, thereby reducing it to more sustainable levels, and conserving the wildlife resource both for its own sake, and also for the people who depend on it.

For almost 20 years after kangaroo rats were experimentally removed from a Chihuahuan desert ecosystem in the United States, other rodent species were unable to compensate and use the available resources. This changed abruptly in 1995, when an alien species of pocket mouse colonized the ecosystem, used most of the available resources, and compensated almost completely for the missing kangaroo rats (Morgan Ernest & Brown 2001).

The answer to the question "What are the environmental, social and economic implications of sustainable use?" in this context is largely dependent on what one means by "sustainability". If sustainability means ensuring that the ecological system can provide only a limited number of benefits in the long term, then in many cases this can be achieved despite eradicating a specific species. If it means that the full range of environmental benefits are to be maintained, the level of use should be adapted to allow for this continued level of environmental services. However, this does not mean that the status quo of wildlife resources should be kept in all its aspects, e.g. that no change to the age or size structure, sex ratio, distribution or abundance should occur. If it means regulating the impacts of a use, such that the ecosystem can continue to produce the target species, then dramatic impacts can occur, perhaps to the benefit of the target population, but not necessarily to other ecosystem components or their users (Webb 1994). Environmental sustainability however is not necessarily restricted to ensuring continuity of certain ecosystem functions. Avoiding irreversible loss of biodiversity, and related cultural and future or present economic losses, however should be a critical part of the equation.

Text Box 3. The impact of hunting on the biological community

Hunters focus initially on large animals, and continue to hunt them even when their numbers become low (Text Box 4). Such species comprise the majority of the mammalian biomass in undisturbed forests, and play keystone ecological roles. Reduction or loss of such species will have wider impacts on the forest community, through:

- Loss of pollinators. Large fruit bats in particular are extremely important pollinators of many tropical forest trees;
- Loss of seed predators (e.g., pigs, peccaries, agoutis, large squirrels). With reduced seed predation, trees with large seeds are at a competitive advantage over trees with smaller seeds. In one study in Panama, such trees dominated forest patches after less than 75 years following the depletion of seed-eating animals;
- Loss of seed dispersers (e.g., primates, frugivorous bats, frugivorous birds, forest ungulates). Many large animals play a primary role in seed dispersal; seeds of up to 75% of plant species in African rain forests are dispersed by animals. Hunting can deplete complete guilds of seed dispersers by removing primates, large birds and bats. The exact balance between animal dispersed plants and vegetative propagation of rain forest plants is still unknown, but the loss of seed dispersers will undoubtedly affect forest composition, in ways that are difficult to predict;
- Loss of predators (e.g., large cats, raptors). This can cause unusual and uneven densities of different prey species. In turn, proliferation of certain prey species can lead to declines or local extinctions of their animal or plant food species, which changes forest composition and decreases overall biodiversity. In Barro Colorado Island, Panama, the absence of large predators led to an increase in meso-predators (coatis). The increased predation by the meso-predators on birds' eggs and fledglings caused declines and local extinctions of many low-nesting birds;
- Loss of food for predators. Hunting of ungulates and primates can reduce the populations of predators that depend on them for prey. In India, hunting can result in reductions of 90% of the prey eaten by tigers. This reduces tiger densities, and also results in their hunting smaller prey, thereby causing further detrimental effects on the biological community.

The loss of animals from forest ecosystems and the resultant disruption of ecological and ultimately evolutionary processes, changes in species composition and probable reduction in biological diversity are collectively known as the "empty forest syndrome".

3. Wildlife and sustainable livelihoods

3.1. The values of wildlife

The use of wildlife has important livelihood aspects and serves multiple roles. Wildlife products are often major items of consumption or display and have high medicinal and spiritual values in many human cultures (Scoones et al., 1992). Bushmeat, in particular, offers a number of benefits to forest-dwelling populations. It is an easily traded resource as it is transportable, has a high value/weight ratio and is easily preserved at low cost. It often represents both the primary source of animal protein and the main cash-earning commodity for the inhabitants of the humid forest regions of the tropics. Throughout tropical forest countries, many people benefit from wild meat: from those who eat it as part of a forest-dependent subsistence life-style, to those who trade and transport it at all points along different supply chains, to those who consume it in restaurants and homes, often far from the forest.

3.1.1. Economic values

Rural people, moving from a subsistence lifestyle to a cash economy, have relatively few options for generating income. They can sell agricultural or pastoral produce, work for a cash wage in agriculture or industry, or sell retail goods in local or regional marketplaces. However for rural people, without access to capital, land or livestock, the harvest of wildlife resources may offer the best return for labour input.

Cash income from the sale of wildlife products can be highly variable, even when the same resource category is considered. While those products destined for international markets fetch much higher prices (a breeding pair of Lear's Macaw is worth around $100,000 on the black market; Panda pelts sell for $10,000 on the black market in Hong Kong and dealers and collectors in Asia pay $40,000 for panda skins[4]) than locally consumed goods and the unit value of wild meat is low, the returns from hunting are generally higher than average local wages (Gally et Jeanmart 1996, Ntiamoa-Baidu 1997, Bennett & Robinson 2000, etc.).

Since the 1950s, a growing demand from urban areas combined with larger populations more generally has catalyzed the trade in wildlife resources, with resources increasingly being drawn from forested areas (including agriculture/ secondary forest mosaics) into towns and cities as favoured or inexpensive sources of animal protein. From first harvest to final sale, the trade in bushmeat for local, national or regional trade now forms an important part of the informal sector's "hidden economy" and although access to markets is a key factor in realizing economic values of wild products, the determination of people to access markets if there is sufficient economic incentive to do so should not be underestimated (Neumann and Hirsch, 2000). If prices and profits are high enough, local traders will make remarkable use of any transport networks to get perishable goods to market. As a result hunting and the bushmeat trade, although largely ignored in official trade and national statistics, play a crucial role in the economies of numerous tropical forested countries, but they are usually not tapped as a source of government revenues.

An inventory in 1995-96 of the four main markets in the Cameroon capital, Yaoundé, indicates sales of 70–90 tons of bushmeat monthly (Bahuchet & Ioveva 1999). A similar situation exists in Gabon where the overall annual bushmeat trade has been valued at about $25 million (Wilson & Wilson quoted in Colchester 1994: 48-9). Estimates of the national value of the bushmeat trade range from US$42-205 million across countries in West and Central Africa (Davies 2002). Similar examples can be found in the tropical forests of South America. For example in Tahuayo (Peru), 22 tons of wild meat is extracted annually from a 500 km^2 area, with 86% of it being sold for more than US$ 17,000 (Bodmer et al. 1994). For the whole of the Amazon basin, the value of wild meat harvested exceeds US$ 175 million per year (TCA 1995).

For many tropical forest peoples, the distinction between subsistence and commercial use is blurred, with meat from the forest supplementing both diets and incomes. Several studies group self-consumption and local sales under the category of "locally consumed" (table 1). Recent studies (Takforyan 2001, De Mérode et al. 2003) show that most people in tropical forests hunt and that meat sales within the village can be significant (30% in Cameroon, up to 90% in the Democratic Republic of Congo) somewhat contradicting the conventional wisdom that banning external market sales of bushmeat, and restricting consumption to local subsistence use, offers a 'win-win' strategy to the benefit of both conservation and the poor (De Mérode et al. 2003).

[4] http://www.arkive.org/species/GES/birds/Anodorhynchus_leari/more_info.html, http://www.american.edu/ted/PANDA.HTM

Table 1: Wild meat use in various communities

Country	Lost	Gifts	Locally consumed		Externally sold	Reference
			Self-consumed	Locally sold		
Cameroon	26%		34%		40%	Delvingt 1997
Cameroon	4%		58%		38%	Delvingt et al. 2001
Cameroon	6%	7%	63%		15%	Takforyan* 2001
Cameroon	3%	3%	59%		28%	Takforyan* 2001
Cameroon		18%	34%	34%	14%	Dounias 1999
Congo	4%		28%		68%	Delvingt 1997
Congo	4%		42%		54%	Delvingt 1997
CAR	20%		45%		35%	Delvingt 1997
DRC			6%	94%	0%	De Merode et al. *in press*
Eq. Guinea	9%		23%	34%	34%	Fa & Garcia Yuste 2001
Peru			14%		86%	Bodmer et al. 1994

* Total is less than 100% as there is a percentage of "undetermined" use

3.1.2. Nutritional values

Bushmeat represents an important protein source in the tropics while gathered plant foods are important dietary supplements to the starchy staple diet. In at least 62 countries world-wide, wildlife and fish constitute a minimum of 20% of the animal protein in rural diets. Wildlife provides significant calories to rural communities, as well as essential protein and fats (for a comprehensive review of the importance and role of wildlife in nutrition see Hladik et al. 1989, 1996 and Froment et al. 1996). Even where there has been a change from a hunter-gatherer lifestyle to pastoralism or agriculture, hunting and gathering remain important to a high proportion of rural households in tropical forests. Hunting provides between 30 to 80% of the overall protein intake of rural households in Central Africa (Koppert et al. 1996) and nearly 100% of animal proteins. What is known of the nutritional composition of bushmeat species suggests that these provide an equivalent or even greater quality of food than domestic meats with less fat and more protein. The average protein value of wild meat is estimated at around 30g of protein per 100g of meat (Ntiamoa-Baidu 1997). These proteins cannot be substituted by available protein of vegetal origin, such as cassava or gnetum leaves, as they are poorer in amino-acids (Pagezy 1996). They could be replaced by other vegetal sources, dairy products, and/or meat from domesticated animals (cf. also chapters 6 and 7.2.2.1).

Bushmeat stew

Though some recent studies (De Mérode et al. 2003) show that wild meat does not necessarily play a major role in the nutrition of poor forest households, they also demonstrate clearly that it plays an important food security role during the lean season. A study (Fa et al. 2002) shows that if bushmeat harvests were reduced to a sustainable level, all Central African countries except Gabon would be dramatically affected by the loss of wild protein supply. The

Table 2: Average daily wild meat consumption (kg/day) in various communities

Area	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 & Ioveva 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. *in press*
Odzala	Congo		0.116-0.164			Delvingt 1997
Dja	Cameroon		0.075-0.164			Delvingt et al. 2001
Dja	Cameroon		0.171			Bahuchet & Ioveva 1999
Ngotto	CAR		0.090			Delvingt 1997
Mbanjock	Cameroon			0.005		Bahuchet & Ioveva 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
-	Côte d'Ivoire				0.020	Chardonnet 1995
	Côte d'Ivoire				0.022	Caspary 1999
-	CAR				0.032	Chardonnet 1995
-	South Saharan Africa	0.104	0.043	0.003		Chardonnet et al.1995
Schrader range	PNG	0.370				Jenkins & Milton 1996
-	Sarawak				0.033	L. Kaskija 2002

dependence on bushmeat protein is emphasized by the fact that four out of the five countries studied do not produce sufficient quantities of non-bushmeat protein to feed their populations. These findings imply that a significant number of forest mammals could become extinct relatively soon, and that protein malnutrition is likely to increase dramatically if food security in the region is not promptly resolved.

A precise evaluation of the quantity of wild meat consumed per capita is not easy to derive from the published information for various practical and methodological reasons. It is clear however that consumption depends of the type and residence of consumers (table 2), with hunter-gatherers eating 100 to 400 g of meat daily, while rural (farmers, logging company employees) and urban populations consume 40 to 160 g and 3 to 94 g, respectively.

It is not known how the diet of people might change as a result of extinctions and diminishing wildlife resources. It might lead to shifting practices, relying more on domesticated animals supplemented with products from garden farming. It is possible that people are able to substitute to a large extent the protein that is provided by bushmeat, once the resource becomes less available and, therefore more expensive, but this would have to be studied and documented.

3.1.3. Social and cultural values

Wildlife and hunting are intimately linked to many cultures throughout the world's tropical forests even if in some cases the meat is only of minor nutritional importance. Important social and cultural values are linked to foods and medicines derived from wild resources. Therefore while hunting provides meat and income it also remains an important social and cultural tradition for many peoples (both in developed and in developing countries). Acquisition of animal parts as cultural artefacts, for personal adornment or for hunting trophies is still a widespread practice throughout tropical forest regions and the rest of the world. In many cultures to be a hunter is essential in gaining respect, achieving manhood or winning a bride. As a result, peoples hunt, even when they have alternative sources of nutrition or income (Young, 1970, Posewtz 1994, Bennet & Robinson 2000). These links between hunting, wildlife, religion, mythology, and sociology of forest-dwelling peoples have to be considered in conjunction with sound conservation and management plans (Bradley 2002).

In several cases, meat sharing among members of the community does not seem to play a large role

Penan with Blowpipe – Sarawak, Borneo

(less than 20% of the game in African cases) in meat distribution within the community (Dounias 1999, Takforyan 2001, De Mérode et al. 2003). Rather, sale within the village or the community appears as a new market, creating monetary networks of exchange between villagers. Such a sale could well represent a new social obligation, as it did in the past with the sharing or gifting of wild meat. The trend is therefore of an increased commercialization of bushmeat with all the associated consequences (see section 5.4)

3.2. Impacts on livelihoods

Conventional wisdom tells us that the people who, in theory, will suffer the most from declining wildlife resources are the millions of people across Latin America, Africa and Asia living in and from the forests. These people (hunter-gatherers, swidden cultivators, urban poor) are often the poorest and most marginalized people in their country. They typically lack the education and skills to easily find alternative employment. They lack capital or access to agricultural markets and cannot switch to alternative livelihoods or food sources.

Many of the assumptions which have been made about the role of bushmeat in local livelihoods are not borne out by research however. Evidence is growing (Takforyan, 2001, de Mérode et al. 2003) and is beginning to show that the poor are likely to be more dependent than the rich on sales of meat

as they cannot afford to withhold the meat from consumption because it is a high value and tradable commodity, as discussed elsewhere. This contradicts the conventional view that the poor primarily have subsistence needs, while the wealthy trade wild meat.

In reality, many people do not depend on wildlife resources as a full-time source of food or income, but 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). The fact that few individuals solely or primarily depend on wildlife resources for their main income (and these are rarely the poorest) should not be taken to indicate that the prohibition of meat sales would not seriously affect them. Rural livelihoods are often made up of complex mosaics of enterprise, and components which may appear minor may none the less be integral to family welfare, and an important dimension of risk reduction and social safety nets.

Increased trade in wildlife products is clearly a serious sustainability issue that also has very important livelihood implications. There is the need to separate out the commercial interests of entrepreneurs seeking to make money from what they know to be an illicit activity with high commercial value (i.e. trade in medicinal products like rhinoceros horns, pangolin scales or tiger bones) to the day-to-day means of survival of poor populations (i.e. the great majority of the bushmeat trade in Central Africa). De Mérode et al. (2003) show that wild meat and wild fish form a moderately important component of household diets but a very important component of household sales, particularly for the poor. More generally wildlife sales are often the main source of income for poor and marginalised populations. Lack of sustainability, increased controls or blanket criminalization of the trade is likely to seriously impact the livelihood of these poorest of the poor.

Studies show that the number of commercial wildlife trade middlemen and re-sellers is small compared to the number of hunters. Traders generally buy and sell wildlife because it is profitable at the time. Yet, they also usually sell other goods on the same or other occasions, so few depend on selling wildlife as their sole source of income. There is also evidence that the vertical integration of the bushmeat trade has important gender aspects, and provides important benefits to women and children, often from activities requiring widely available skills and offering low financial risk (e.g. cooked meal sales).

4. The bushmeat crisis

Wildlife species are and have been harvested almost everywhere, from the deepest seas to the highest mountains, and from both marine and freshwater systems. Numerous species, from invertebrates, fish, and amphibians to reptiles, birds and mammals, have and are continuing to be used to enhance human welfare. However this wildlife harvest has not been without impact. Historically hunting pressure has contributed to the extinction and near-extinction of several animal species, especially where species were exploited for either food, medicine or ornamental purposes (e.g. passenger pigeon, right whales, great auk, Eskimo curlew, red kite, European wolf). Several studies illustrate the potential impact that wildlife harvesting may have on a species and an ecosystem more broadly. For example:

- Historical records (Murray 2003) tell us that numerous species are extinct or have been locally extirpated at least partly because of unregulated hunting, often in synergy with habitat alteration (tertiary mammal megafauna, pacific islands large fauna, passenger pigeon, American bison, and North-African elephants for example).

Text Box 4. Why large-bodied animals are prone to local extinction due to hunting

Large animals tend to be the those that hunters favour most as killing one animal supplies a large amount of meat, and larger animals tend to be the ones that have the most valuable horns, antlers, tusks, furs, skins, feathers or other artefacts. Thus, the value returned per unit of time and cost expended by hunters is greatest for large animals. Large species are rare compared to smaller ones and reproduce slowly; thus, they are especially vulnerable to overhunting and have limited capacity to recover from population declines. Primates breed more slowly than their size alone would suggest, so they are vulnerable to hunting in ways which are more like those of much larger animals.

• Most studies show that large game species are the first to disappear, leaving behind only the most resilient, small or unhunted species. For example in Kilum Ijim, Cameroon, many species of large mammals, including elephants, gorillas and other primate species, have become locally extinct in the past 50 years due to hunting and land use change (Maisels et al. 2001). In the Tangkoko Duasudara Nature Reserve in Sulawesi, Indonesia, between 1978 and 1993, the population of crested black macaques declined by 75%, while anoa and maleo bird populations declined by 90%, and bear cuscus numbers fell by 95% (O'Brien and Kinnaird 2000). Similar situations have been reported inside national parks of northern Thailand (Doi Inthanon and Doi Suthep), where all elephants, wild cattle and tigers have been hunted out. Similarly in Viet Nam, 12 species of large vertebrates are either extinct or on their way to extinction as a result of hunting, demographic pressure and land use changes. These extinct species include Eld's deer, wild water buffalo, batagur turtle and Siamese crocodile, while the tiger, elephant and banteng are close to extinction (Bennett & Rao 2002).

The harvest of wildlife need not necessarily be as severe as the above examples indicate, as situations exist where the hunting of preferred species was strictly regulated (e.g. deer, *Cervus elaphus*, and beaver, *Castor canadensis*), and where viable populations survived despite intense land use changes. One has to be careful however with these examples, as most do not deal with tropical forest ecosystem which are far more complex and in many cases more sensitive than temperate forests and tropical savannas. Looking at some of the most commonly hunted species in African tropical forests, such as duikers (*Cephalophus spp.*), it appears that the situation may not be as dire as sometimes assumed:

• In a report from IUCN (Eves & Ruggiero 2002), it was estimated that the number of all duikers, blue duikers (C. monticola) and bay duikers (C. dorsalis) are 13.24, 7.00 and 0.73 million respectively. The same document estimates the harvest rates of blue and bay duikers at 18 and 0.25 million respectively, based on the assumption that 50% of the forest area is hunted and by using the latest estimates of dense forest areas in Central Africa (Mayaux et al. 2004). At such harvest intensities, these species should presently be extinct, yet the rate of offtake remains more or less unabated.

Orphan Gorilla

• Between 1925 and 1950 up to 800,000 duikers pelts were annually exported from French Equatorial Africa. Yet the areas from which these animals were extracted (e.g. the Lobaye province in Central African Republic) are still rather heavily hunted and remain a source of the same duikers species (Fargeot 2003).

The example of duikers would therefore suggest that the outlook is not necessarily as bleak as sometimes reported, and a differentiated approach is needed for different cases and species. However it is obvious that an overall lack of sustainability and a resource depletion problem exist in many regions. This situation is often aggravated by changes in land use, for example opening up of forest areas for mining or logging. The empirical evidence supporting this statement is both voluminous and varied (see Text Box 5 and 6).

5. This term describes the local extinction of the most vulnerable species due to unsustainable hunting pressure, often immediately following changes in land-use.

Table 3: Sustainability of hunting

Country	Reason for hunting	Estimated sustainability[a]	Reference
Bolivia	Subsistence	50 (10)	Townsend, 2000
Cameroon	Subsistence / trade	100 (2)	Fimbel et al., 2000
Cameroon	Subsistence / trade	No	Infield 1998
Cameroon	Subsistence / trade	50-100 (6)	Delvingt et al. 2001
C. A. R.	Subsistence / trade	100 (4)	Noss, 2000
Côte d'Ivoire	Trade / subsistence	100 (2)	Hofmann et al. 1999
DRC	Subsistence	Yes	Hart 2000
DRC	Subsistence / trade	Yes	De Merode et al. 2003
Ecuador	Subsistence	30 (10)	Mena et al, 2000
Eq. Guinea Bioko	Subsistence / trade	30.7 (16)	Fa, 2000
Eq. Guinea (Rio Muni)	Trade	36 (14)	Fa & Garcia Yuste 2001
Eq. Guinea (Rio Muni)	Trade	12 (17)	Fa et al. 1995
Ghana	Trade / subsistence	0 (2)	Hofmann et al. 1999
Ghana	Trade	47(15)	Cowlishaw et al. 2004
Indonesia (Sulawesi)	Subsistence / trade	66.7 (6)	O'Brien and Kinnaird, 2000
Indonesia (Sulawesi)	Subsistence / trade	75 (4)	Lee, 2000
Kenya	Subsistence / some trade	42.9 (7)	FitzGibbon et al., 2000
Paraguay	Subsistence	0 (7)	Hill and Padwe, 2000
Peru	Subsistence / trade	Yes	Bodmer et al. 1994
Peru	Subsistence / trade	No	Bodmer et al. 1994
Peru	Subsistence	0 (2)	Hurtado-Gonzales and Bodmer 2004

Modified from Bennett & Robinson (2000)
[a] Estimated sustainability: % of species unsustainably hunted (number of species studied); Yes /No when the above information was not available in the reference

4.1. Bushmeat crisis, the empirical evidence

A review of the literature addressing the sustainability of hunting in tropical forests was compiled by comparing estimated productivity and off-take rates. From table 3 it can be seen, that in general hunting appears to be unsustainable.

- The percentage of unsustainably hunted species is greater than 50% in a limited number of cases for which the number of species studied is low (6 at the maximum)
- It is difficult to draw any firm conclusions or recommendations as to the overall sustainability (or not) of a use when 40% of the species are over-harvested. These species might well be locally extirpated or reduced to levels where they do not appear anymore in trade but the overall use (i.e. hunting or harvesting) can still keep going and the ecosystem can still function. In such cases, there is clearly a conservation problem for the over-harvested species and action is needed but one cannot draw any simple conclusion about the overall sustainability of the activity and issue a blanket interdiction.
- Most of the cases considered sustainable are either in very remote locations, sparsely populated or beyond the influence of any external markets (for example the Aché in Paraguay, who live largely outside a market economy, exclude others from their hunting areas and occur at extremely low densities – Hill & Padwe 2000). Contrarily locations with 'mature' markets can also be sustainable as they generally have gone through "extinction filters"[5]. For example the Takoradi market in Ghana shows that large urban centres can be sustainably supplied in bushmeat by robust species from an agricultural landscape (Cowlishaw et al. 2004).

Aside from examining the relationship between estimated productivity and offtakes, a further method of assessing sustainability, also found in the literature, is to monitor the population density fluctuations of target species (table 4).

Table 4: Decrease of population densities in hunted areas compared to unhunted areas

Location	Country	% by which mammal densities decrease in moderately and heavily hunted forest	Reference
23 Amazonian sites	Brazil	80.8	Peres 2000
Quehueiri-ono	Ecuador	35.3	Mena et al. 2000
Mbaracayu	Paraguay	53.0	Hill and Padwe 2000
Ituri I	D.R. of Congo	42.1	Hart 2000
Ituri II	D.R. of Congo	12.9	Hart 2000
Mossapoula	C. African Republic	43.9	Noss 2000
7 sites in Sarawak and Sabah	Malaysia	62.4	E.L.Bennett, unpublished data
Nagarahole	India	75.0	Mahusudan and Karanth 2000
Makokou	Gabon	43.0 to 100	Lahm 2001
Mbaracayu	Paraguay	0 to 40	Hill et al. 2003
Mata de Planalto	Brazil	27 to 69	Cullen et al. 2000

Modified from Bennett & Robinson (2000)

Here again, empirical studies show generally that population densities are lower in hunted areas, implying a potential decline in stocks and an unsustainable use. This should be further qualified as not all species are equal vis-à-vis hunting pressure. Some appear very vulnerable while others appear unaffected. However some data suggests that a few species can be locally advantaged by hunting practices (Bodmer et al. 1997, Cullen et al. 2000, Salas & Kim 2002, Cowlishaw et al. 2004, Hurtado-Gonzales & Bodmer 2004).

- Species with low intrinsic rates of population increase, long generation time and long-lived individuals like primates, carnivores, lowland tapir, African forest buffalo, giant hog and yellow-backed duikers are less resilient to hunting than species with high intrinsic rates of population increase, shorter generation times and shorter-lived individuals such as rodents, small to medium-sized duikers, brocket deer, and peccaries.
- Species whose mating, nesting, predator avoidance or social behaviour allows easy harvest are potentially more at risk. This includes group-living species (most primates, some pigs), since they are often noisy and travel in large groups so several animals can be bagged at one time as well as animals which breed communally in accessible areas (e.g., turtles, maleo birds), or with spectacular displays and loud calls (e.g., birds of paradise, hornbills, some primates).
- Slow-moving species (e.g. tortoises, pangolins or bear cuscus) are easy to catch by hand once detected and so are generally more vulnerable than fast-moving ones (yet the tree pangolin Manis tricuspis is often also found in areas of heavy hunting pressure).

Papuan and soft-shell turtle

4.2. Some methodological caveats in assessing sustainability of hunting

While the amount of information relating to the sustainable harvest of species is ever growing, it is far from complete. Most tropical hunting studies have the primary goal of determining whether hunting is sustainable in forested areas. However many of these studies fail to adequately address the question of what actually constitutes sustainable hunting practices for the following main reasons:

1. Many of the studies are only capable of demonstrating a localized depletion caused by hunting. However this is a generally expected biological outcome whenever predator activities are concentrated in areas smaller than the entire catchment. The great majority of the studies trying to assess the sustainability of hunting have neglected the importance of the presence or absence of game "sources" (protected or unhunted areas) and game "sinks" (hunted areas) in the calculation of sustainable harvest rates. The few studies that consider sources/sinks interactions (Novaro et al. 2000, Salas & Kim 2002) demonstrate that ignoring the presence of sources results in an underestimation of the sustainable harvest rate. This effect is, of course, likely to be more pronounced for mobile species with sizeable home ranges, who are able to move through the landscape and re-colonize sinks than it is for sedentary or localized species.

2. Spatial and temporal analyses of density data on animals show that most populations experience local fluctuations of density over time (e.g. Brown et al. 2001). These temporal fluctuations are spatially complex, consisting of moving, localized density peaks. These fluctuations can be caused by many different sources. Therefore segregating abundance fluctuations into those caused by hunting and those caused by other factors is quite complicated. Any study that monitors a large number of species across only two time periods or two geographic regions will almost always find some species that are lower in density in one region or time-period. As many researchers have looked at only two zones (hunted or unhunted) or only two time periods, recorded density fluctuations attributed to hunting may well have their causes (or part of it) rooted in other factors For example Hill et al. 2003 recorded a 10% drop of encounter rates for coatis over the 7-year period of their study despite the fact that 1% of the stock population was harvested each year and that coati encounter rates in heavily hunted areas were no lower than in unhunted areas. Therefore other factors must be affecting the coatis' population level. This potential problem is further illustrated by the current Ebola virus outbreak near the Congolese-Gabonese border which is devastating gorilla populations. We are directly witnessing this drama but assuming that we had only two points in the time series "before" and "after" (and had we not known that there was such an epidemic), we would probably have concluded that gorillas were being decimated by poachers (Walsh et al. 2003, Leroy et al. 2004).

3. Sustainability estimates in many studies are based on a formula modified by Robinson & Redford (1991, 1994) that assumes a maximum sustainable harvest rate determined primarily by the density-independent rate of increase of the studied species following a logistical curve (Robinson 2000). Although based on a sound theoretical basis, this model makes numerous and often poorly founded assumptions. For example the assumption that demographic traits will be stable in unhunted populations may prove to be untrue under several conditions. As a result, populations thought to be harvested at sustainable levels might, in fact, be under- or over-harvested (Slade et al. 1998, Struhsaker 2001, Milner-Gulland & Resit Akçakaya 2001). Therefore even when the annual harvest rate is well below the calculated maximum sustainable level the presence of many erratic and poorly understood population processes can lead to extirpation. Lastly many species in a bounded ecosystem can go extinct, in relatively short time periods, through completely natural processes (e.g. Brown et al. 2001), a situation that further confounds the issue of sustainable harvest calculations.

4. Assessing the sustainability of hunting in tropical forest requires biological data (rates of population increase, densities, spatial interaction) that are difficult to obtain and generally unavailable for most populations. Estimates therefore have to be considered with caution. A good example of this fact is presented by the biomass estimates of duikers in Central Africa. Several studies have been conducted on this issue and have come to substantially different conclusions, with estimates for duiker biomass ranging from 86 to 1497 kg/km^2. While some of these differences are partially attributable to variations in site conditions, results obtained

from the same area but using different census methods varied as well and are quite striking:

- In the Ituri region (DRC), Koster & Hart (1988) estimated a duiker biomass of 174 kg/km2 using visual counting while Wilkie & Finn (1990) estimated 1,497 kg/km2 counting dung.
- Cruising the same transects twice in the hunting area of Ekom (Cameroon), Dethier (1995) found a duiker biomass of 184 kg/km2 using simple visual counting and of 1,326 kg/km2 using the same method while emitting the distress call of the blue duiker.

Similar variations between census methodologies also exist when large regions, as opposed to specific species, are considered. For example Robinson and Bennett (2000) estimate the sustainable potential harvest from the undisturbed Manu forest (Peru) at 152 kg/km^2/yr and by comparing this value to other published harvest data, they conclude that sustainable harvest rarely exceed 200 kg/km^2/yr and is likely to be around 150kg/km^2/yr in most tropical forests. However Fa et al. (2002) reach rather different results and find a productivity of 1,111 kg/km^2/yr for the Congo Basin and of 488 kg/km^2/yr for the Amazon Basin. Estimates of sustainable harvest based on 150 kg/km2/yr or on 1,100 kg/km^2/yr productivity are likely to give very different values. This demonstrates that we do not know which estimate is the right one. More likely they are either wrong or only locally useable and extreme caution should be exercised when using such estimates in quota setting or policy decisions. From a conservation perspective the precautionary principle should apply and the lowest productivity should be considered but for livelihood issues it might be the contrary.

5. Much of the interest relating to conservation is focused on animal stocks in mature and only slightly disturbed forest ecosystems. However in several countries much of the hunting takes place in the more productive forest-agriculture mosaic. Even highly disturbed agricultural or swidden landscapes are not completely empty of wildlife. For example 385,000 tons of bushmeat is harvested yearly in Ghana (Ntiamoa-Baidu 1998 in Cowlishaw et al. 2004) and 118,000 tons in Côte d'Ivoire (Caspary 1999). These farm-bush-forest mosaics are in fact inhabited by a suite of adaptable, fast-reproducing species able to withstand human activity (e.g., common and blue duikers, brush-tailed porcupine, cane and giant rat in Africa; agoutis, armadillos, red brocket deer in the Americas). The status of such species may not be of immediate conservation concern, and will not attract tourists but they have both economic and ecological value and deserve to be taken into account in management decisions (Naughton-Treves et al. 2003). Note however that many of the original species inhabiting these areas are now locally extinct.

6. As demonstrated by most studies, not all species are equally affected by hunting. Some species are more vulnerable than others and for the most vulnerable species hunting is likely to be unsustainable at any given rate. On the other hand, some species seem able to withstand considerable of hunting pressure and for these species hunting might be managed sustainably provided that adequate regulation and monitoring are in place.

7. Most of the market analyses of hunting do not differentiate between game originating from garden hunting or from commercial hunting in undisturbed forest. Garden hunting prey are typically the fast-reproducing species which thrive in the forest-agriculture mosaics and that are of little concern for conservation but of great importance to local livelihoods. Bahuchet and Ioveva (1999) show that brush-tailed porcupines and cane rats would be the preferred meat of urban residents in Yaoundé but hunters do not sell these animals (they are generally eaten locally) and instead sell potentially threatened duikers (see Text Box 7). Knowing which parts of the meat entering a market come from garden hunting activities is another important parameter to assess the sustainability of the use.

Antelope and Grasscutter in Ghana

Text Box 5. Theoretically sustainable offtake levels, and their application and limitations when applied to management

Many models have been proposed to calculate biologically sustainable offtake rates for individual species. Most depend in some way on calculating maximum theoretical rates of population increase for the species concerned, and the proportion of that production which can be harvested without detrimental effects on the population. These models are continually being refined, and are an extremely useful guide to upper limits of offtake which are likely to be sustainable. Such limits vary greatly among tropical forest species, with insectivores and rodents tending to have maximum sustainable offtake rates ranging from less than 20% to more than 70% of the standing population per year, to primates for which sustainable offtakes are invariably 4% or less of the standing population per year.

Such models, when combined with monitoring of hunting offtakes and populations of hunted wildlife species, have proved to be extremely useful tools for defining broad management strategies. They can suggest whether current hunting pressures appear to be sustainable and can be maintained, or whether the hunting is unsustainable and should be reduced. Some models are now refined enough to determine precise sustainable offtake rates for particular species, if sufficient knowledge of the biology of the species is available (e.g., population density, demography, reproductive rates, social behaviour, feeding ecology).

Applying models to active management on the ground is at present possible at very few tropical sites. Insufficient data exist on the biology of most tropical forest species and, in addition, population densities can vary greatly between sites due to the heterogeneity of tropical forest vegetation. Moreover, capacity for wildlife management remains extremely low in most of the tropical forest world. Hence, the ability to harness the power of models for species-specific adaptive management of hunting exists only for a very few sites. Attempts to generalize from these sites to other areas are fraught with danger. For example, sustainable hunting levels of rates for certain fast-breeding species in degraded and edge habitats might be high. Allowing such species into commercial trade could indeed be biologically sustainable, but it might undermine the ability to enforce the stricter regulations essential for biodiversity conservation in nearby protected areas.

Models are invaluable in estimating whether or not present offtake rates are or are not sustainable. They can also be extremely important in supporting political arguments for particular management recommendations. In areas where detailed knowledge of the biology of the hunted animals is known, and where management capacity, including for ongoing monitoring, is high, models can help set offtake rates. Such conditions are extremely rare; in most tropical forest areas they do not exist. Thus, in areas where maintenance of healthy wildlife populations is an agreed goal, the precautionary principle should guide offtake levels, and monitoring is crucial to ensure that hunting is sustainable.

4.3. Factors leading to unsustainable hunting

While there are numerous factors which can lead to the unsustainable harvest of bushmeat, they can be grouped into one of six different categories:

1. *Ecological factors*: the number of tropical forest animals that can be harvested sustainably is limited in the first place by their biological supply (production). Hunting in tropical forests with low animal production (e.g., monodominant forests, upland Amazonian *terra firme* forests) is less likely to be sustainable than more productive landscapes (e.g. forest-savanna mosaics or fruit rich forests). Although biophysical variation between tropical forested sites is large and more data is needed, current best estimates suggest that on average, they produce about 150 kg of vertebrate biomass per year. Yet annual hunting rates can be substantially higher than productivity in these same forests, with values ranging from 200 kg/km^2 up to 700 kg/km^2 across several locations. This unavoidably generates declines in wildlife populations in both the medium and long term. Species with low intrinsic rates of population growth are more vulnerable to over-harvesting as are species with particular mating, nesting, predator avoidance strategies or social behaviour

that allows for their easy location (e.g., group-living species that travel in large groups, and species that breed communally in open areas). Lastly a decrease in forest area, through deforestation, unsustainable logging and land use change for examples, contribute to a loss of habitat for typical forest species. However the mixed agricultural/forest landscapes that is created through such activities usually favours a number of other wildlife species. Some vertebrate species that thrive in fallow vegetation and/or agricultural mosaics are known to be resilient to hunting pressure and are favoured game. Ecological factors can therefore have a variety of impacts on the sustainable harvest of bushmeat.

2. *Demographic factors*: Increases in human population density generally lead to increased pressure on bushmeat resources. It is estimated that for people depending solely on bushmeat, human population densities should not exceed one person per km^2 (see Robinson & Bennett 2000 but remember that this is strongly dependent on the actual reliability of production estimates). Actual human densities in tropical forests where hunting is considered sustainable are much lower. Furthermore, these people live largely outside a market economy, and tend to exclude others from their hunting areas (e.g., Aché, in Paraguay). An important pressure on wildlife in 'frontier forests' comes from local communities (including new settlements and increased sedentarism of indigenous forest dwellers), with usually a high proportion of the population hardly involved in the traditional economy.

3. *Technological factors:* Changes in traditional hunting practices through the use of improved hunting technology (e.g. shotguns, flashlights, outboard motors) generally decrease the probability that hunting will be sustainable since both the range of species taken, the area hunted and fatal injury rates increase. In addition the use of steel wire snares, for any species, also increase rates of indiscriminate harvest.

4. *Cultural factors:* Hunting, eating of bushmeat and the use of wildlife artefacts are integral parts of cultural heritage, and are closely linked to social status, or believed to provide special or "magic" forces. These are strong factors in maintaining the demand for various types of wildlife products. Loss of traditional lifestyle usually means that traditional territories and hunting methods are abandoned, leading to a loss of the sense of ownership of land and wildlife. It might be useful here to distinguish cultural practices and in particular food habits from cultural heritage. It is true that the consumption of bushmeat is a cultural practice and a food habit in most tropical forest areas. However, it is also known that these cultural habits can and will change rapidly in the case of changes in the availability of resources. Similarly there are numerous examples of individuals changing their habits to adapt to changing economic realities. While it is true that hunting can be rooted in cultural heritage (where hunting is part of certain rituals, or certain products are necessary for rituals), it seems to be a marginal part of the bushmeat problem.

5. *Economic factors:* Most of the remaining, relatively undisturbed forest areas can be considered as "frontier zones", with usually a low forest land value and more or less open access. This situation leads to the degradation of the forests and the wildlife found within them. Roads, railways, and other transport infrastructure help to open up new frontier areas; they contribute to habitat loss and to the fragmentation of habitat as well as promote increased immigration and settlement in new, formerly undisturbed areas. This improved access increases the hunting pressure and facilitates the transport of bushmeat to markets. Declines in world prices for some agricultural crops have driven many farmers to seek alternative sources of income, and many have become part-time or full-time hunters. However, the factors that determine whether a household farms or hunts are complex. For example, bushmeat hunting is likely to be more profitable than farming in enclave areas without easy access to roads, as the price to weight ratio of bushmeat is typically higher than for any agricultural crop, and only small quantities of goods can be transported on foot to markets. In the short term, hunting is likely to be preferred to farming in recently

opened forested areas because wildlife is abundant, communities might not yet have a tradition of commercial farming, and tree crops may take several years to harvest. However in the long term, farming is likely to be preferred to hunting in communities that have been residing in a given forest area for a long time because bushmeat levels are already likely to be depleted.

6. *Institutional and governance factors*: Lack of adequate attention to the role of bushmeat as an important contributor of local livelihoods by development agencies, non-governmental and inter-governmental organizations, and national governments contributes to the unsustainable hunting of bushmeat in tropical forests. Even when present at the national level, policy and legal frameworks to promote sustainable use of natural resources are seldom adequate in remote rural areas. Financial, material, and training resources are insufficient to allow law enforcement personnel to adequately address the illegal commercial trade in bushmeat and this deficiency decreases the capacity for control of illegal activities. Loss of both traditional hunting territories (e.g., those belonging to certain traditional groups) and methods (e.g. hunting zone rotations) allow open access to the resource and concentration of hunting, thereby resulting in a loss of sustainability.

As we have shown, estimating both existing hunting yields and maximum sustainable harvest rates presents considerable difficulties because of the various methodological problems highlighted above. Nevertheless, we are witnessing massive and completely unmanaged harvesting, in conditions of ever-increasing public access, improvements in destructive technologies, wide availability of arms, ammunition and growing penetration by high spending and strategically-positioned "elites". While doomsday thinking must be treated sceptically, sustainability for many species does appear threatened under present conditions. In section 5, we will analyse in more detail the synergistic factors affecting the sustainability of hunting.

5. Synergistic factors affecting the sustainability of hunting

5.1. Nature of the wildlife resource

The very nature of the resource, a low unit value, a common resource freely accessible and difficult to assess, is one of the main reasons for its unsustainable use and encourages free-rider behaviour. Those who exploit the resource have little ability or incentive to manage it sustainably. Some of the characteristics of wildlife resources are (modified from Inamdar et al. 1999):

- *Low ownership*. In most countries, wildlife is either without any owner or is state property and alienated from the local communities.
- *Non-recognition of user rights*. Recognizing the rights of traditional users in relation to mobile resources like wildlife poses particular intellectual and managerial challenges. All too often, the discourse of biodiversity conservation equates low densities of sedentary human populations and 'true' owners with an absence of legitimate user rights, a confusion which can easily serve to justify transfers of rights away from the poor and marginal.
- *Criminalization of use.* Activities associated with the use of wildlife tend to be criminalised and wildlife exploitation is often subject to numerous negative sanctions.
- *Difficulty of monitoring the resource.* Despite many years of effort, the quest for practical and affordable techniques to census forest animals (especially in dense tropical forests) accurately has so far eluded ecologists, even for large animals like elephants and the great apes.
- *Low economic barriers to entry in the exploitation of the resource*. The low cost and wide availability of hunting technology lowers the barriers to entry into hunting, and its frequent blanket criminalization only discourages regulation.

5.2. Inappropriate policies and governance

In almost all Amazonian countries, hunting is prohibited except for sport hunting (see Richard-Hansen & Hansen 1998). Still, the activity is carried out at a large scale and legislation is either ignored by educated, wealthy game hunters or is, in most remote areas, not taking into account the basic needs for the very survival of poor local people.

In Central Africa (see Yadji Bello 2003 for a critical review), the various hunting rules and regulations (often part of the forestry laws) authorize hunting by licence holders ("permis spéciaux" in the Congolese legislation, "permis de chasse" in the Gabonese forestry code). Hunting is therefore not an illegal

Text Box 6. Sustainability of wildlife harvests in different tropical ecosystems

The probability that hunting can be sustainable depends in part on ecological conditions that affect the 'supply' of and 'demand' for wildlife resources. This in turn has implications for management planning, since hunting is more likely to be sustainable in certain ecosystems than in others.

Supply can be defined as the biomass of wildlife which can be harvested sustainably. Demand can be defined as the total amount of wildlife hunted in reality. Supply varies across relatively undisturbed ecosystems, broadly in relation to annual rainfall. Supply is potentially highest in dry forests and wetter savanna grasslands, and decreases in moist forests and more xeric grasslands. Because of their very low productivity for wildlife, demand tends to exceed supply in moist forests and xeric grasslands. The balance between supply and demand in the more productive ecosystems depends on local conditions, including human population densities, degree of access to forests and potential market pressures, but in theory supply can match or exceed demand in such systems, and the potential exists for sustainable use management.

Analogous to this ecological variation along the rainfall gradient is the gradient created by the conversion of tropical forests by humans. In some cases, wild meat supply might be greater in secondary forests and forest-farm-fallow mosaics than in undisturbed forests, again allowing for potentially higher offtake rates and a wider range of management options in the former.

The core factors influencing these differences in supply are the productivity and location of food available to large mammals in the different ecosystems, and also the taxonomic groups of animals predominating in each. Mammal communities in moist forests tend to be dominated by primates, which generally occur at relatively low population densities, and have low reproductive rates. Mammal communities in savanna grasslands and in forest-farm-fallow mosaics tend to be dominated more by ungulates and rodents, which have higher reproductive rates, and for which sustainable offtake rates are higher (see Text Box 5). Thus, the probability that hunting will be sustainable varies with ecosystem type and degree of human disturbance.

Within the humid tropics, not only are anthropogenic landscapes more likely to be able to withstand a higher degree of hunting than undisturbed forests, but also the species present in anthropogenic landscapes are likely to be ones which are more tolerant of human presence as opposed to the more endangered species which tend to be restricted more to undisturbed areas. In addition, humans are generally intolerant of most large-bodied wildlife entering agricultural lands. Thus, anthropogenic landscapes can, in theory, be areas where the supply of wildlife can match demand, through the harvesting of relatively common, generally faster-breeding, smaller species.

Management choices should take these ecological differences into account, by planning wildlife use regimes in areas most likely to be able to sustain such harvesting, and a higher degree of protection in areas less able to.

activity per se. If you hold one of these licences and providing that you do not hunt protected species or in protected areas, you can hunt and even, provided that you hold the right official paper, commercialize the catch. Furthermore, the laws recognize user rights for the local populations and allow for traditional hunting and fishing. However, at the same time most laws forbid, among others, hunting during the night, the use of metallic snares or traps, of nets, of fire, etc. All this makes illegal most of the hunting practised by the local communities (villagers or pygmies do not hold licences, steel wire is the preferred material for snares, some species are only hunted at night).

Hunting rules and regulations exist almost everywhere but they are rarely enforced. There is clearly an ownership and management problem. The State is the owner of the resource and issues rules and regulation to manage it but the State is unable to enforce its decisions. A law that is not enforced undermines the authority of the government, and a law that can only be enforced at great cost and difficulty might need to be revised. There is much work to be done in order to tackle this issue in most tropical countries. The range States[6] and their donors need to take a radical look at all types of natural resource policies with the clear aim of enhancing the rights and sustainable livelihoods of rural dwellers.
In Asia, the example of Sarawak (Malaysia) gives some cause for optimism. A Master Plan for Wildlife in Sarawak has been developed based on long-term research and has resulted in the passing and strict enforcement of a new law banning all trade in wild animals and their parts, strict control of shotgun cartridge availability and hunting in logging concessions, broad education programmes and involvement of local communities in the management of protected areas. The 1998 "Wild Life Protection Ordinance" bans the sales of all wildlife and wildlife products taken from the wild. It has been put into effect by intensive programmes of education and enforcement, and has received strong support from rural community leaders who see it as conserving the resources on which their rural constituents depend (Bennett & Madhu Rao 2002). This was however possible because in Sarawak (and throughout much of Asia), the commercial wildlife trade is mainly supplying a luxury, urban market, both for meat and traditional medicines. A major part of the problem in Asia, then, can be solved by strictly controlling or banning the commercial wildlife trade without causing nutritional hardship as people in towns do not depend on wild meat for protein. It seems that in this context the twin strategy of banning the trade of bushmeat and setting up a comprehensive network of well-managed protected areas offers a potential solution to the issue. It remains however to be implemented in other regions.

Snare used for trapping

5.3. Demography

What would be the maximum acceptable human population density in areas where people depend almost exclusively on wildlife for protein?

According to Robinson & Bennett (2000), studies worldwide show that population densities for sustainable hunting cannot be more than one person per km^2. This estimate is based on an average sustainable production of 150kg/km^2/yr of which 65% is edible and a daily need of 0.28kg of meat per capita. However Fa et al. (2002) found much higher productivity estimates (1.111 kg/km^2/yr in the Congo basin and 588 kg/km^2/yr in Amazonia). Using the same hypotheses about the percentage of edible meat and the daily per capita need, the Congo Basin forests could therefore sustain the local consumption of 7 persons/km^2 while Amazonian forests could sustain 3 to 4 persons/km^2. These values are significantly higher than the current population densities found in the forested areas of both regions, except urban populations.

Based on the WHO recommended daily allowance (0.75g of protein/day/kg of body weight), the daily protein need of a 70 kg man would be a total of 52,5g of protein or approximately 170g of meat/ day, assuming that this protein comes from meat

6. States in which use of bushmeat is common practice. For the purpose of this study, this includes States in Africa (except Northern Africa), Central America, South America, and Central and Eastern Asia.

sources alone. A value slightly below the one used in the previous paragraph but quite consistent with the values from the literature. Detailed estimates of average protein intake of African people can be found in Koppert et al. (1996) and range from 31 to 69g/day which is roughly equivalent to 0.10-0.25 kg of meat/day. If we also consider that the percentage of these proteins coming from animal origin (fish and meat) varies from 4% (Nigeria) to 88% (Cameroon), our estimates of the carrying capacity of the forests in Central Africa would be between 2 adult persons/ km^2 (productivity 150 kg/km^2/yr) and 12 adult persons/km2/yr (productivity 1111 kg/km^2/yr). This carrying capacity might even be underestimated as the average individual does not weigh 70 kg but more likely weighs between 40 and 50 kg.

This variation in carrying-capacity figures illustrates the need to be very cautious in using such numbers in policy-related documents. This observation is also reinforced by the fact that population is unequally distributed; with cities and coastal areas being more densely populated than the vast expenses of land in the interior. Urban people have, in general, access to a large range of protein sources (including of course bushmeat) and their consumption of wild meat is much lower than that of the rural population. While people living near the coast have access to fish resources from the sea and rely less than interior people on bushmeat. A fact clearly demonstrated by Koppert et al. (1996) in their examination of three ethnic groups in south-west Cameroon. Therefore it would appear that the consumption of bushmeat varies with geographic location as well as population densities.

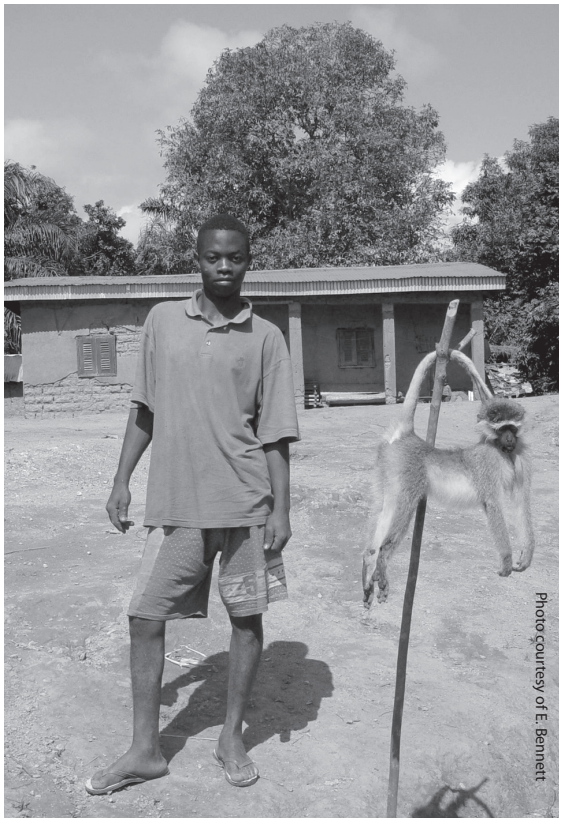
Nevertheless, the conventional wisdom and available literature on the use of renewable natural resources tells us that demand and harvest increase with the number of people (see Text Box 1). High population densities are therefore generally linked to unsustainable use of wild resources and of intensification of land uses. We have however shown that it is very difficult to estimate how many people can obtain their daily needs of protein from the forest. There are probable thresholds of human population density above which hunting becomes unsustainable but these are likely to be much higher than the ones claimed by several organizations. High local population densities in remote forest areas are generally the result of three phenomena: internal population increase, sedentarism and immigration. Places like large camps or small towns established by extractive industries increase the size of the sedentary population (migrant or imported workers) and attract a large amount of immigrants as the living conditions are generally much better than those in the surrounding villages or towns. One of the best examples is probably Pokola in North-Congo where what was a once a small fishing village with a population of 200 people in the 1970s, is now a town of 14,000 people, with infrastructure that rivals that located in the official regional capital Ouesso (Nsosso 2003).

The sustainability of hunting activities will also likely vary with the age of the settlement being considered. If settlements are recent, forest fauna is still rich and diverse and hunters easily find large prey such as tapir, buffalo, large antelopes, apes, and wild pigs. However these densely populated pockets are places were hunting becomes quickly unsustainable. These areas should therefore be the focus of intensive conservation and management actions (Auzel & Wilkie 2000, Auzel 2001). However if settlements are long-established they have generally gone through an extinction filter (most of the vulnerable species have already been extirpated) and the fauna is reduced to the most resilient species (Cowlishaw et al. 2004). Hunters bag rodents, small antelopes, and small primates. Provided that the population remains relatively stable, these types of markets are probably sustainable and do not need attention and funding for conservation efforts.

5.4. Increased commercialization of the wildlife harvest

As we have seen in table 1, the commercialization of bushmeat seems to be prevalent, even in societies where hunting is considered primarily as a subsistence activity, with a significant part of the harvest being sold within the communities themselves.

We will not dwell on the trade of wild fauna products in this document but it is important to remember that the overall international trade in animal products is estimated at US$ 3,851 million (Broad 2001). A large part of this trade involves the harvest of protected animals (tigers, bears and tortoises). In principle, this international trade can be regulated through various existing mechanisms and monitored by relevant organizations (CITES, TRAFFIC) but in practice the value of some products is so high (tiger bones, rhinoceros horn, some rare live animals for the pet trade) or considered so vital (some Chinese medicine components like pangolin scales) that it is likely to continue until the species in question are close to extinction. At this point their densities become so low that harvest or hunting is not economically viable. However hunting might continue even if not



Bushmeat seller and vervet – Cameroon

economically viable to do so and this may eventually lead to species extirpation. This situation can occur in cases where two [or more] species are hunted simultaneously. While one species might be too scarce to be actively hunted, it would none the less be worth the kill if it was found during the course of hunting for another species. One example of this type of opportunistic hunting can be seen in the interactions between the rhinoceros and elephant hunts. While rhinos were too rare to be economically hunted by poachers, their presence was a bonus as it allowed them to opportunistically kill one while actively hunting elephants (Bulte 2003).

The bushmeat trade is different from the trade of wildlife fauna products in the sense that its international component is still very limited. However, there is evidence of the emergence of a growing trade for expatriate African or Asian communities. There is also a growing regional market among range states. The recognition of this situation has triggered the creation of a CITES Bushmeat Working Group. While it is clear that bushmeat is a trade issue, the international aspect is only the tip of the iceberg. It may however have an importance greater than its relative volume would suggest. This is for at least two reasons:

- The international trade tends to attract considerable media attention
- Partly as a consequence of this attention, action at the international level may provide a lever for action at the national level within the range States

The nature of the trade is such that sole reliance on a CITES listing and permit approach is unlikely to make much headway in managing the cross-border element. International trade can really only be influenced by dealing with the trade at the national level.

The bulk of the commercial trade is indeed within country borders, generally directed towards the supply of urban centers or extractive industry camps in the forest. Like other non-timber forest products (NTFPs), the patterns of bushmeat trade reveal some distinctive features:

- It is often linked to other commodities.
- It only becomes economical on a large scale when existing infrastructure lowers costs significantly (i.e. logging roads).
- Though evidence is uncertain, it seems that large-scale commerce may often be dominated by 'polyvalent' entrepreneurs with multiple commercial interests, and who are able to operate over long distances.
- It seems that political patronage may be a key factor in the trade.

It is likely that a successful attempt to manage the trade will disadvantage this category of polyvalent entrepreneurs. Great care is needed, however, because these individuals are often well-connected, and have the means to resist marginalization.

Care is also needed in evaluating the assumption that these entrepreneurs exploit rural producers, and that, if they were excluded from the trade, producers would experience increased prices, without increased risk.

5.5. Logging and other resource extraction activities

Wildlife is adversely affected by the industrial extractive sector (logging, mining, and oil-drilling, for examples) because in the course of their activities, companies a) directly destroy critical habitat, disturb movement patterns and alter behaviour, and b) indirectly facilitate hunting by building roads and/or providing hunters transportation. Salaried employees and their extended families that live in company camps within or bordering concessions constitute

a significant local source of demand for proteins (and therefore bushmeat). The establishment of camps with better living standards than surrounding villages creates an immigration flux and locally increases population density. The presence of a large cash-rich population generates a cascade of changes within local communities that further exacerbate the impact on wildlife and increase the volume of the harvest. Increased income allows hunters to take advantage of new hunting technologies (such as cartridges, guns, snare wires, outboard motors, and headlamps), which in turn allows for more efficient harvests. As industrial activities stimulate the local economy, the increased level of income generally raises the demand for wild meat. For example, per capita harvest rates in local communities adjacent to logging or oil-drilling infrastructures are three to six times higher than in communities remote from such roads (Robinson et al. 1999, Bolivia; Auzel & Wilkie 2000 –Congo; Auzel 2001, Cameroon; Thibault & Blaney 2003, Gabon). As a result of these changes local forest communities are increasingly drawn into a market economy involving wildlife.

A great deal of attention is presently being given to attempts to control the wild meat trade by putting pressure on companies not only to control the activities of their own employees (banning them from hunting; preventing them from purchasing wild meat from forest villagers and transporting it to urban markets), but also to control the activities of forest villagers themselves (blocking off their channels for trade). This approach has evident value and may help protect the resource. However, there must be some concern that it is adding to the repressive nature of public-decision making on wildlife management and that this process risks becoming a substitute for effective policy. In general, there is a need for a more sophisticated analysis of the issues and the purposes that these repressive activities are intended to serve. There may be a conflict between biodiversity and development interests, which can be addressed by accepting some negotiated trade-offs between conservation and human welfare. The arrival of natural-resource-based industries clearly increase the off take of wildlife based resources but at the same time, offers the opportunity for poor rural villagers to increase their welfare by selling wildlife products - either for local consumption or for sale in urban centres. If the welfare of such poor people can be increased without eroding the resource stock, then this should be encouraged, both for its welfare benefits and its wider governance effects. While increased control of the companies operating in these areas of concern is justified, the solution does not necessarily lie in the outright ban of all sales on

Logging truck, North Congo

wildlife (or setting up fictive markets in which local and indigenous communities are allowed to sell products from production reserves only to company employees or other villagers). A more complex response is needed, one which both optimizes the benefits to local people and fosters their support for the control measures, without providing an unnecessary subsidy to a lucrative industry. This will require a management strategy which goes beyond a simple interpretation of conservation priorities, and seeks to build real local buy-in and ownership.

Some promising examples of collaborations with the industrial sector to curb illegal hunting and reduce the amount of wildlife-based resource trade have been documented (see Aviram et al. 2003 for a review of such initiatives).

5.6. Fragmentation and land-use changes

Forest fragmentation could aggravate the effects of hunting by, among others:

- Isolating populations averse to the surrounding habitat matrix (Gascon et al. 1999);
- Reducing or precluding re-colonisation of sink areas from adjacent source areas (Robinson 1996);
- Increasing the amount of forest habitat accessible to hunters (Peres 2001)
- Reducing the area of suitable habitat for species averse to forest edges (Laurance et al. 2000)

It remains unclear whether any level of game harvest could be defined as sustainable in highly fragmented landscapes, as few studies have quantified large vertebrate abundance within forest fragments differentially affected by a history of hunting (see Chiarello 1999 or Cullen et al. 2000 for examples of such studies in Brazil). Extirpations of normally hunted resilient species at heavily hunted sites in fragmented forests suggest that in forest remnants, hunting exacerbates the effects of fragmentation, such as genetics and demographics, and is an important factor in emptying these forests of large species over the short term. Some species appear however resilient to both hunting and fragmentation. Collared peccaries, for example, are hunted throughout the highly fragmented Mata de Planalto region, yet there is no evidence of decreased abundances between slightly hunted and heavily hunted sites (Cullen et al. 2000). Such species (that are also those remaining after extinction filters) are primary candidates for active management and sustainable use.

5.7. Agricultural sector

Most farmers derive income or sustain their livelihoods from a variety of sources among which NTFP extraction and hunting play a significant role. Economic crisis and declines in world prices for several agricultural crops has driven many unemployed urban inhabitants back to the countryside as well as forced many rural farmers to seek alternative sources of income. Many have become part-time or full-time hunters. The factors that determine whether a household farms, hunts or undertakes a combination of the two are complex:

- Hunting is likely to be more profitable than farming in enclave areas without easy access to roads as the price to weight ratio of wild meat is typically higher than for any agricultural crop, and only small quantities of goods can be transported on foot to markets;
- Hunting is likely to be more profitable in the short term than farming in isolated areas of forest that only recently have been opened up with roads, as wildlife is abundant, communities may not have a tradition of commercial farming, tree crops may take several years to produce, and transportation costs for agricultural crops will be higher in isolated areas than those closer to markets;
- Farming is likely to be more profitable than hunting in communities that are adjacent to roads and that have been inhabited for a long period time. Though agricultural crops have a lower unit value than wildlife, they can be produced in significantly greater quantities than bushmeat and the presence of roads makes transporting them to markets relatively easy.

Analyses of the temporal distribution of rural activities illustrates that for most rural households hunting and fishing activities increase when farming activities are completed (Pasquet & Koppert 1996, Wilkie et al. 1998, Takforyan 2001). However garden hunting is generally practiced year round to protect crops from animal damages. In Central Africa, the bulk of this game from the bush-farm matrix is made of "pests": rodents, small ungulates and primates (Dounias 1993, De Wachter 2001). In a recent study Naughton-Treves et al. (2002) showed the same trend in an area of Amazonia close to a reserve, and concluded that:

- The number of commercial hunters in the surrounding communities had a stronger impact than did the individual field owner's hunting intensity.
- Large-bodied species appeared only in remote farms neighbouring uninhabited areas in the reserve, indicating that undisturbed forests act as sources for wildlife dispersing into agricultural regions. Farmers in these remote areas experience greater crop and livestock losses to wildlife, but by hunting large game they are able to offset losses with bushmeat gains (the basic tenet of garden hunting theory).
- In more disturbed areas, crop losses exceeded bushmeat gains, although both occurred at negligible levels.
- Even highly disturbed forest-agriculture mosaics are not empty of wildlife, but are inhabited by a suite of adaptable, fast-reproducing species able

Small ungulates – one day catch – Congo

to withstand human activity.

6. Linkages between bushmeat harvest and other available protein sources

6.1. Protein from other types of harvested wildlife (fish, invertebrates)

The two other main sources of wild animal protein in tropical forest regions are wild fish and invertebrates. The importance of fish is well-known as both salt and fresh water species constitute major sources of protein for tropical forest inhabitants. For example, in Central African countries, fish resources represent approximately 25% to 50% of the total food supply (Watson & Brashares 2004). Animals such as snails and caterpillars play an important role either as safety nets for people in years of environmental stress or as regular source of food and income (Vantomme et al., 2004). However while the importance of these animals is generally well-documented their importance is often ignored in the regulatory framework and in development assistance.

The consumption of fish and/or bushmeat seems to be closely linked to both its availability and/or the price of substitutes. For example:

- In Pokola town, northern Congo, consumption of wild fish and wild meat are inversely correlated. During the dry season when river fish are easily available, their price drops below that of wild meat, and wild meat consumption decreases. During the wet season, the opposite occurs.
- In the Campo area coastal ethnic groups (Yassa) eat more fish than bushmeat (176g/day vs. 18 g/day) whereas interior groups (Bakola) do the contrary (18 vs. 201 g/day). Similar observations have been made within the same ethnic group as well. For example coastal residents belonging to the Mvae group consume 94 g/.day of fish and 83 g/day of meat while interior populations eat 37 g/day of fish and 164 g/day of meat (Koppert et al. 1996).
- Brashares et al. in Watson & Brashares (2004) examined the link between fish supply and bushmeat species biomass at a national scale. They illustrated that years of poor fish supply, caused or aggravated by industrial fishing activities of subsidized fishing fleets, were correlated with relatively large declines in abundance of bushmeat species. This potential link at the national level is not fully explained as most of the fish caught are demersal species and are directed to export markets. However, the researchers also found that at local scales, bushmeat and fish availability was closely related in 14 local markets. In each of the markets surveyed, bushmeat volume and sales were greatest in months when the availability of pelagic fish was poor.

Overall, people who depend on wild protein will substitute wild fish and wild meat for one another, depending on the price and availability of each. This means that a decline in one wild resource tends to drive up unsustainable exploitation of the other. However there are incidences were fish is considered as either an inferior or superior good compared to bushmeat. This further complicates the situation by blurring the potential feedback loop between fish and meat catches. Without good management, declines in consumption of wild meat, whether due to management controls or declining wildlife populations, may lead to unsustainable fishing, and *vice versa*. Therefore, for this reason, hunting and fishing should be managed together both at local and national levels.

Estimates suggest that in tropical areas worldwide, probably more than 1,000 terrestrial species of invertebrates are used as food (De Foliart 1992, Marconi et al. 2002, Vantomme et al. 2004). In Amazonia for example, Marconi et al. (2002) show that the consumption of 100 g of any of these invertebrates contributed 1.2–9.4% of the daily fat requirement and 26–144% of the daily protein requirements for an adult male. They concluded that the consumption of invertebrates by tropical human populations represents not only an important traditional habit but also, considering their nutritional composition, a substantial contribution to the human diet. There is also an important livelihood component as invertebrates are often traded.

Invertebrates also play a significant role in Africa. Vantomme et al. (2004) observe that when supplies of bushmeat and fish decline in the rainy season, it does seem that people rely more on caterpillars and other available insects. The linkage is not very clear as both insects and bushmeat are goods with widely fluctuating prices and availability. This shows however the actual importance of invertebrates as human food and in the livelihoods of local people, a point generally overlooked in most of the studies about bushmeat consumption.

6.2. Protein from farming, ranching of wildlife or from domestic animals

Governments and NGOs are already experimenting with options for reducing the reliance on wild meat by rearing wild species in captivity (such as ostriches, crocodiles and cassowaries). However, many forest species are difficult to rear in captivity and the captive breeding of only a handful of species has been mastered. Furthermore wild species are

almost always less productive than domesticated ones (Eltringham 1984, Feer 1993). In addition, at least initially, the capture of wild species for "farming" is a drain on wild populations. Since it is generally impossible for law enforcers to distinguish captive bred animals from hunted wild ones, captive facilities could easily become a conduit for illegal wildlife trade, divert funds, manpower and attention away from the management of wild animals, and most importantly, a vector for disease that could potentially lead to the infection of wild populations.

While the view of farming of domestic livestock as "the most realistic approach to supply people's protein needs in the immediate future" (Bennett & Robinson 2000) may lead to useful solutions to the problem of excessive hunting pressure, there is a need to proceed with caution in this area, given the concerns outlined above.

In particular the following issues must be considered (Bowen-Jones et al. 2002):

- There is rarely any direct link between the proposed substitution activity and the hunting activity to be foregone. Indeed, in some instances, the target population differs for the two activities. Hunting appeals to young self-employed male peasant farmers without significant capital, while ranching appeals to more wealthy people, able to draw on the pool of wage labour (especially in the case of cattle ranching). Thus, there is no guarantee that success in producing substitute protein sources will reduce hunting pressure.
- While the banning of hunting by peasant farmers and the migration into agricultural day labour may have benefits for the conservation of wild fauna, such a move may well have negative social effects (decreased standards of living, population concentration in urban settlements leading to rising levels of disease, and increased propensity for social unrest).
- The fact that small numbers of domestic livestock thrive in free-range conditions in forest villages tends to be extrapolated by advocates of protein substitution. Free-range animals usually survive quite well in what are essentially domestic foraging conditions around forest villages, but two constraints may inhibit the scaling-up of production: i) Lack of sufficient food waste from the domestic household as villagers produce much less waste food than typical industrial families; ii) Lack of enclosures or fencing. Except where human population densities build up to high levels (rarely the case in hunting areas), it may be excessively costly to fence off either animals or crops. Thus, domesticated animals living in free-range conditions can only be kept in small numbers around forest settlements.
- Economically captive rearing is problematic, particularly where hunted wild animals exist as a virtually free good.
- The concentration of small stock in intensive farms is costly, and increases the risk of disease. It is only feasible close to major urban settlements with large consumer populations that have significant purchasing power. Generally, where such schemes have potential, they have already been developed. Increasing the potential would require not only that the policy and market failures associated with hunting are addressed but also that the wealth of the nations increases so as to overcome the purchasing power constraint for the poor.

A recent bio-economic study (Damania & Bulte 2006) shows that results of supplying alternative protein by captive breeding schemes are not as straightforward or as clear-cut as expected in terms of conservation. By generating supplies from captive-bred animals, wildlife commodity prices are expected to fall, thereby lowering the incentive to poach species in the wild. Supply-side policies, however, often neglect the institutional framework within which the wildlife trade takes place, and ignore the potential strategic responses of economic agents. Adopting a model that captures imperfect competition between traders and farmers, the authors analyse the effect of supply-side policies and conclude that under some circumstances these policies may contribute to further devastation of wild stocks.

Finally, a major concern is the risk that alternative options, valid though they may be, will divert attention away from the more pressing issue of bringing hunting under effective management.

7. Lessons learned and recommendations

7.1. Lessons learned

The harvesting of wildlife, especially for food, is a complex problem, one in which biological issues and conservation concerns should play an important role alongside livelihood issues. Such a problem has no simple solution and actions will have to be taken at all levels from the international policy dialogue to the field-project level. If attention is focused solely on field-level initiatives, such as protected-area management, then the underlying forces driving unsustainable and unregulated harvest will continue. Both governance and field issues need to be addressed concurrently, albeit at different levels. Hunting or harvesting wildlife is a territorial activity with three interacting dimensions: space-rules-institutions (i.e. nation-no hunting of protected species-government agencies; swidden-garden hunting for pest control-farmer household) that must be considered concomitantly.

At the policy or governance level, many of the underlying causes of the unsustainable use of wildlife are the same as those underlying poverty. For example weak local governance, war, famine and unfavorable terms of trade impact both poverty and the use of wildlife. This would seem to suggest that there is room for conservation and development agencies to work together (albeit in different ways and through different agencies) as the underlying causes of poverty and biodiversity loss are often related (Davies 2002).

The so-called bushmeat crisis is first and foremost a problem resulting from an unmanaged common resource being unsustainably harvested because of inadequate governance and policy frameworks. The problem arises out of the way in which the State monopolizes control over high value timber and mineral resources in the forest, without necessarily having the capacity to manage those resources for real public benefit. As such it should be considered as a facet of the "tragedy of the commons" and be dealt with in the broader framework of renewable resource management (like timber or fuelwood). Ideally, one would start by putting in place sound governance regimes for the management of all resources, not just bushmeat. Sound governance regimes for the management of all resources are an important element in the development of the sustainable use of renewable natural resources. Recent political developments suggest that decentralization and devolution of government could contribute to the more effective and efficient management of local natural resources. However several examples suggest that decentralization ends up in privileging a short-term resource exploitation approach rather than a long-term sustainability approach because of high local discount rates or short-term political concerns and interests. For decentralization to work it has to go hand in hand with empowerment of the resource's users and education on what is sustainable.

Text Box 7. The role of taste in determining the demand for wild meat

The role of taste and cultural preference in driving the demand for wild meat is unclear. It is commonly believed that people in tropical forest countries often prefer the taste of wild meat over that of domestic animals, and that wild meat consumption is a deeply-rooted tradition that is highly resistant to change. These views are supported by the continuing demand for wild meat from formerly rural people now living in middle-class urban or even overseas environments, from Jakarta, Libreville and Brazzaville to London and New York. In these cases, wild meat is consumed as a luxury item to maintain a link to a departed lifestyle and is not a staple source of animal protein.

Scientific data to determine how important a role taste and culture play in the overall demand for wild meat is scarce. Most studies of preference have often simply documented that consumers noted "meat hunger" when their diet is composed primarily of starches, or have focused solely on which species of wildlife consumers prefer. They have not established that consumers have clear taste preferences for wild meat relative to the meat of domesticated animals. In a recent study in Gabon, consumers were asked to select which of two plates of meat they preferred. Only poor rural people showed a measurable preference for bushmeat. And, of the 42 subjects who stated a preference for domestic poultry, 78% avoided bushmeat when given the choice of porcupine or chicken. Overall, results suggest that taste is not the primary determinant of consumer demand for wild meat.

Schenck, M., E. N. Effa, M. Starkey, D. Wilkie, K. Abernethy, P. Telfer, R. Godoy, A. Treves 2006. Why People Eat Bushmeat: Results From Two-Choice, Taste Tests in Gabon, Central Africa. *Human Ecology* 34(3):433 – 445

Such governance frameworks could be helpful at addressing land-use issues relevant to the sustainable harvesting of wildlife (e.g. agriculture, establishment of protected areas, regulating hunting practices) at the most appropriate level. In many cases this would also require a radical re-examination of the tenurial and resource-rights situations in their rural areas, including (but not limited to) the bushmeat-producer areas.

However, that is not where we are starting from, for a variety of historical reasons (not all of them located in the range States themselves). To the extent that it can be addressed on its own terms, the resolution of the problem can only be the product of strategies that seek to reinforce human rights and to promote species conservation. This will best be achieved by fostering individual and group rights and security, while overall criminalization of the sector is unhelpful. While some actors on the conservation constituency have tended to see the solution to the problem as an application of the law in relation to protected-area management, the view from the periphery is often rather different. In contexts where almost all economic activity by villagers can be deemed 'illegal' in one way or another, there may be an entirely understandable reluctance to treat protected areas as worthy of exceptional treatment. Thus, there is a need to place wildlife management in a wider framework of social justice and equity. The aim will be to provide an acceptable framework for economic and social activity that is supportive of local cultures, and which leaves decision-making in the hands of local people without any moral opprobrium. This will include decisions about what species to conserve, where to conserve, for whom to conserve as well as who is going to pay and who is going to benefit from the conservation initiative. It should be an approach which empowers local institutions, yet does not diminish local authority.

Local empowerment of resource users appears to be a potential key strategy to achieve long-term sustainability. However the transfer of rights has to be coupled with the transfer of responsibility for the conservation of the resource, in balance with the resources characteristics (e.g. biodiversity) as a national and global good. At the same time, one cannot credibly transfer the rights to bushmeat resources to local communities without addressing the rights to other resources such as timber and mining products.

One of the major challenges confronting local empowerment is that while the obvious solution seems to empower the poorer rural dwellers to manage the resource, the formal tenurial rights of this category of the population are often minimal to non-existent, and their ability to resist pressures from powerful political and economic interests is low. Where rural social structure is complex (for example in countries like Ghana and Côte d'Ivoire where there are a large number of migrants in the forest with weak rights), it will be doubly difficult to remedy the situation. Another risk or challenge is that, in seeking to make progress on one front, one could well take numerous steps backwards on others. For example, the control over such fugitive resources is inherently decentralized. While this has many negative features (not least of which are opportunities for 'rent-seeking behavior' by officials), it does mean that the poor derive some residual benefits from the operation of the market chain, however limited these are. There is a need to ensure that any solutions which are offered should not remove these benefits, and preferably, further enhance them.

The case for international assistance to support the development of a well regulated bushmeat industry must be based in the first instance on recognition of its important livelihood benefits, and in the second, on its potential to contribute positively to the growth of good governance of the broader forest resource at the country level. An essential prerequisite for the latter must be to bring the bushmeat trade into the open and clearly identify the possibilities for legal and legitimate trade. The very first step should probably be the recognition of wild-meat harvest and consumption in national statistics (Asibey & Child 1991). What has been lacking to date is an understanding of the centrality of social interests to conservation goals. As others have noted, sustainability is not, at the end of the day, an issue of purely biological concern (Hutton and Dickson 2002). To argue that social and livelihood issues are more pressing is merely to acknowledge that the decisions regarding what resources to retain and what to consume will ultimately be made by those whose lives are directly affected by their day-to-day contact with the wildlife resource, while it is in their best interest to achieve a sustainable management of the resource (Brown & Williams 2003).

It is likely that management of the bushmeat sector could learn a lot by using examples (both successes and failures) from other renewable natural resource sectors. The natural candidate could be the fishery sector because of the commonalities in the nature of the resource (see Bowen-Jones et al. 2002 and Cochrane 2000 for a comparison of the principles

of effective fisheries and their potential relevance to bushmeat management). The use of rights-based management systems (e.g. individual transferable quotas) and productivity monitoring tools based on catch data (and not on count data or on models based on dubious and unproven assumptions) could offer some promise for wild meat management (Inamdar et al. 1999). Optimism must however be tempered as failures in the fisheries sector have nevertheless occurred despite massive investments in management on a national and international scale. Another sector that could offer some solutions or ideas is fuelwood. Studies of local markets for fuelwood in the Sahel show clearly that the transfer of rights and sector management to local people could be at least as good for the environment as when national governments were in charge and certainly much better in terms of improved local livelihoods (Mahamane et al. 1995, Mahamane & Montagne 1997).

7.2. Some recommendations towards a more sustainable use of wildlife resources

7.2.1. Preamble

1. It needs to be recognized at the outset that the bushmeat problem (to the extent that it can be spoken of in this generalized way) is a problem of sovereign States. Nationals of these States are often under-represented in the current international debate, and it would follow, as a consequence, that the national interests of the range states are also likely to be under-represented. One immediate caveat here is that governments in many cases do not adequately represent the interest of local stakeholders. The example of the management of timber and mining resources demonstrates this. So there is a need to go beyond the government level and involve civil society.

2. This is an immense and intractable problem. It has hitherto tended to be treated in terms of the need to achieve short-term sustainability, an approach which tends to require urgent imposition of heavy control measures. For a variety of reasons, these have often not been very effective. A more realistic starting point might be to treat the problem as one of 'helping range states to better manage a resource in unpropitious circumstances' – not of seeking to impose idealistic and externally-defined conservation aims as a short-term strategy.

3. Renewed efforts are needed to build up national ownership of conservation issues and interests. This will require a much greater willingness to accommodate the realities of a multi-million dollar trade, and of cultural practices which favour consumptive use of wildlife.

4. However short-term sustainability measures can be useful to gain time while a more broad policy process is engaged. There is no need to provide another list of the possible short term field-based measures as comprehensive reviews and lists of such recommendations can be found in the literature (Bailey 2000, Bennet & Robinson 2000, Bowen-Jones et al. 2002, IIED & TRAFFIC 2002, Mainka & Trivedi 2002, etc.). It is however crucial to stress that these recommendations are by nature very much site and condition specific and that indiscriminate blanket decisions made based on such recommendations are to be, at best ineffective and, at worst, counter-productive.

5. Proper wildlife management techniques, including developing databases of existing information, census of indicators to populations, monitoring of results, modelling of populations, and planning wildlife management in the context of forest management may provide assistance in instances where funds are available to help manage key wildlife populations.

6. Parties need to assess local and transboundary priorities for conservation among the species harvested for bushmeat. For example, species that are endangered, species with restricted ranges, species in declining habitats etc. These species require priority action by and among governments.

7.2.2. Recommendations

7.2.2.1. National level – in the bushmeat range States

1. *National policy linkages:* There is an urgent need to 'lift the policy debate onto a higher plane'. This involves giving greater attention to governance issues at appropriate levels (policy and legislation, links to development assistance priorities through Poverty Reduction Strategy Papers (PRSPs), etc.),

and treating the high-value bushmeat trade as an aspect of the national economy as well as an international animal welfare concern.

The bushmeat economy is largely non-visible. Acknowledging the role of bushmeat and other animal products in the local economy will be a first essential step in sustainable management of this resource. Inclusion of information on bushmeat and animal products in national, official statistics may be a next step in order to better understand its role in the country's economy, and as a contributor to local livelihoods and food security. Hunting for bushmeat and other animal products usually occurs in remote areas ('frontier development zones'), where national institutions have limited power and where law enforcement usually is less intense – if even existent at all. To some extent, decentralization (devolution) can help to involve local groups in policy development, planning and management of local resources; non-governmental organization and development programmes can play a positive role, but solving the often conflicting interests of all local stakeholders remains a great challenge. Forest exploitation has an impact on bushmeat hunting in several ways: it provides increased access to hunters, attracts more temporary or permanent settlements and, last but not least, it affects wildlife habitat. Therefore wildlife management should be an integral part of (mandatory) forest management plans.

2. *Enhancing ownership and links to tenurial and rights reform:* Initiatives should be promoted to transfer ownership to the people so as to stimulate an interest in sustainable land use and hunting practices, and guarantee local people the benefits of these activities (related to institutional arrangements).

   In significant measure the bushmeat problem is often a problem of rights. Rural dwellers lack rights to the resources they need to secure their livelihoods, wildlife included, and hence their unwillingness to invest in wildlife management is only to be expected. Wildlife is one of a range of assets (land and trees are two others) which need to be brought within a secure rights regime. Measures to reform the tenurial systems pertaining to all of these resources are urgently needed, if the problem of high discount rates is to be overcome. Opportunities exist within the 'Poverty Reduction Strategy' process to progress the rights and tenurial changes needed to ensure sound management of rural resources, bushmeat included.

   The aim should be to increase the incentives to local populations to manage local resources in their own - and the national - interest (Text Box 2 provides some example of successful programs to reduce hunting to sustainable levels). This is likely to involve giving local users the right of exclusivity over the legitimate use of the resource – i.e. the right to exclude external hunters and agents from the legal harvest.

3. *Legitimizing the bushmeat debate:* Policy is unlikely to be advanced as long as bushmeat is stigmatized in public discourse. There is an urgent need to remove the stigma surrounding this lucrative trade. The aura of illegality which surrounds all aspects of the trade is unhelpful to the policy process, and is preventing a sound assessment of management requirements. This legitimization would involve:
   a. Increasing the visibility of the existing trade, as a necessary precursor to getting its management onto a sounder footing.
   b. Bringing levels of existing wild meat consumption into national statistics, as a means of valuing the resource and giving it appropriate weight in public policy and planning.
   c. Bringing in a realistic and open assessment of wildlife consumption and its role in livelihoods into the major policy documents – particularly PRSPs, but also PSIAs and other national resource assessments.
   d. Taking account of the wild meat trade and hunting activities in national planning.

Inter alia, this would encourage an approach in which the various public institutions (different ministries and services of government, for example) could be brought together to deliberate on effective solutions.

Moves to legalize a portion of the trade would also increase the reliability of information on the organization of the bushmeat commodity chain. As matters stand, little is known about the potential for a legal chain, or for adding value to the commodity chain in a way that is sound in terms both of biodiversity (conservation effects) and development (poverty reduction).

4. *Legislative review:* National legislation on wildlife and hunting often suffers from incoherence and impracticality. Well-established and widely accepted practices may be *de jure* illegal (increasing the opportunities for rent-seeking by officials) and the steps required to achieve legality may be so impractical as to encourage illegality on the part of otherwise law-abiding citizens.

   Range States are therefore encouraged to review their existing legislation for:
   a. Policy coherence and incoherence;
   b. Practicality and feasibility;
   c. Potential for positive discrimination in the trade – rationalizing and legalizing the lower risk elements (for example production from disturbed environments and farm bush, off take of highly reproductive vermin species) and offering trade-offs which allow for greater discrimination and protection of at-risk species;
   d. A more realistic approach to enforcement, in which control measures are brought more into line with capacity, and trade-offs are accepted with actual realities;
   e. Rationalization of the law to reflect actual practice, without surrendering key conservation concerns. This would often involve diminishing the emphasis on a dubious distinction between 'subsistence use' and 'commercial trade';
   f. Cross-sectoral linkages with poverty-reduction strategies, forest management policies, NBSAPs, etc.

5. *Protected areas:* Protected areas are an essential component of any strategy for sustainable use of wildlife at the landscape level and large protected areas will be essential if we want to conserve the larger animals. However, a rational approach to protection policy is required, giving greater attention to the identification and quantification of the priority hot-spots and conservation areas, with due regard to all aspects of sustainability, and harmonizing protected-area policy with the limitations of actual capacities (human resource and financial). The fact that biodiversity hot-spots are often associated with human settlement and impact renders this a challenging issue.

   Over-reliance on exclusion areas, without adequate regard to existing patterns of resource use, is unlikely, on the face of it, to offer the best path to effective conservation. In such circumstances, it could be argued that, by concentrating game species in a defined area, the strict protection perversely acts to increase the incentives to harvest the resource, and sows the seeds of its own demise. A radical re-think may be needed. Where feasible (i.e. for non-territorial species), protected area management should be allied with wider land-use practices – for example, on the 'sources and sinks' and/or fisheries 'no-take area' within productive areas models.

6. *Management interventions:* Range State governments should seek means to ally control of the bushmeat trade with other aspects of natural resource management, benefiting from the economies to scale of joint enterprise. There are clear linkages between this and the tenurial and legislative reforms outlined above.

   Bushmeat hunting can be very profitable, especially when extraction rates are unsustainable. One of the key problems is

to find a balance between the short term benefits and sustainable development without complete depletion of the natural resources. The values of wildlife both in the national economy and in the informal economy should be recognized at a more local scale.

7. *The role of science in wildlife policy:* Heavy investments have been made in bushmeat range states in relation to the scientific study of wildlife populations and the impacts of their use. The value of this research has been limited by its frequent close association with advocacy for animal welfare interests, usually representing the interests of external groups and constituencies. Much greater attempts are needed to separate out the science from the advocacy, and to clarify the bases on which science is made available to policy makers. Support is needed to increase the information base of national policy makers (government and non-government) and to reduce their dependence on advocacy-based organizations with external constituencies and mandates.

8. *Engaging the private sector:* Approaches to conservation in production forests have tended to focus on restricting the impact of timber concessionaires and their personnel. While these efforts are in many ways to be commended, there have, to date, been rather limited efforts to consider the implications for the livelihoods and welfare of locally-resident populations. Policy development needs to go beyond the interests of the reputable loggers and the external organizations, and to embrace public participation of the citizenry at a higher level.

9. *Public planning:* Greater attempts may be needed to bring conservation issues within the frame of development planning, so that pressures on the wildlife resource are mitigated by the opening up of wider opportunities for the populations which have hitherto depended on hunting and the bushmeat trade. Income-generating opportunities need to be offered in ways which absorbs labour which might otherwise be rationally deployed in hunting and the bushmeat trade. Policies aimed at poverty reduction can be as important as developing a legislative framework for hunting. Such policies could (should) include the establishment of clear land tenure and land-use rights, development of alternative sources of proteins, and involvement of indigenous and local communities in land use planning and natural resource management. Small-scale animal husbandry (investment, secure land tenure arrangements, food and fodder crops). But the land needed for such development would inevitably create another pressure on tropical forest. Farming wildlife appears quite difficult but encouraging examples exist in savanna ungulate ranches, crocodile farms, butterfly farms, etc.

10. *Learning processes:* Greater attempts are needed to investigate and build on the experience of other sectors for ideas and models which might help to improve the management of the bushmeat trade. Relevant sectors might include sea fisheries [the experience of North Atlantic cod fisheries, etc.], the pharmaceutical industry, herbal medicines, etc.

11. *Substitution and other palliative measures:* A shift in thinking is needed, away from palliative measures intended to mitigate the effects of wildlife harvest with minimum implications for the status quo (e.g. captive breeding of game species; livestock breeding schemes intended to replace existing sources of animal protein; ICDPs) towards more radical measures to improve management and governance. As matters stand, the purchasing power constraint severely restricts the positive impact of schemes intended to divert local populations away from consumptive uses of wildlife.

7.2.2.2. International level:

1. *The need for national ownership:* The international community is called on to give much greater support to range states to bring the bushmeat problem under effective national ownership in ways which provide broad national benefits. One area where this process is underway is with the CITES Great Ape Enforcement Task Force Country

Profiles which may help develop this sense of ownership by assisting countries in determining or identifying some of the key issues associated with the bushmeat trade.

2. *Democratic process:* Host governments need to be supported to open up the national debate on wildlife management, and to bring this within the democratic process.

3. *Policy processes:* International partners should seek to ensure that wildlife issues are, wherever relevant, adequately covered within internationally supported policy processes, such as poverty reduction strategies.

4. *Trade relations:* More consideration needs to be given to the issue of the conservation implications of unfavorable terms of trade between wealthy and developing nations. A case in point may be international fisheries policy and fisheries licensing agreements, where there is some evidence of possible linkages with bushmeat consumption levels. To the extent that this evidence is confirmed, the manipulation of international trade patterns relating to marine fisheries could well provide a surrogate means of influencing the bushmeat trade in positive directions.

5. *International trade in wildlife:* An area of particular international interest is the potential for the high-value export arm of a segmented trade in wild meat to act as a force for the rationalization of the trade, and as a means of adding greater value to the lower levels of the bushmeat commodity chain. As matters stand, legitimate channels for export of wild meat simply do not exist in most of the major range States, and this may serve as an incentive to illegality.

   Control of hunting of bushmeat and other animal products always will remain a difficult task, even when plenty of money, trained staff, and equipment are available. One of the basic requirements for control of hunting is full support of local communities that have a vested interest in protecting their resources. Control of trade, at both national and international levels can be a feasible instrument to reduce hunting pressure on wildlife species. International control is fairly successfully controlled by CITES, and in some cases trade in (certified) animals or animal products has contributed to sustainable development of indigenous and local communities. Trade at local and national level is less subject of regulations, but might provide opportunities, e.g. by providing tax revenues. In some cases unfortunately, it is only a source of income for a few powerful persons.

   Control of demand for bushmeat and other animal products is also a complex issue. Demand is only partly price-driven (high price/low demand, and shift to other products). Other aspects of the demand are based on tradition, status, or the alleged secret powers derived from bushmeat and other animal parts. Generally a shift in the demand of bushmeat can be stimulated when sufficient alternatives are available at low cost (e.g. replacing bushmeat with farmed animals or fish). To what extent such replacements are feasible for non-price driven consumption based on belief in super-natural powers derived from bushmeat and other animal products is not clear (e.g. Viagra pills instead of gorilla meat and rhino horns). Nevertheless, education of people in the areas of the world that hold these beliefs may be a key to reducing the demand for animal parts, especially when species are threatened.

6. *International policy environment:* In general terms, international policy might be well advised to give less emphasis to restrictive and repressive measures in the bushmeat range States, and to give greater attention to the positive incentives which may be required to better manage the wildlife resource.

No universal solutions exist to solve the problem of unsustainable bushmeat hunting in tropical forests. Approaches must be nation, site and context-specific, be based on a detailed knowledge of hunting patterns and the ecology of the hunted species and be tailored to local cultural, socio-economic and political conditions. However, overall management actions may include a monitoring and feedback mechanism, an iterative process to ensure that management is achieving its goal of ensuring sustainability of harvest, and sustainable livelihoods of local communities. Some principles

need to be taken into account in order to achieve the sustainability of bushmeat hunting. The following are some ideas for such principles:

- Ensure that research is linked to the practices
- Mitigate against the potential for tension between livelihood and conservation objectives
- Analyse the livelihood implications of a given intervention on all stakeholders
- Search alternative models from other sectors
- Identify the most appropriate entry points
- Employ multi-pronged approaches to a complex problem by involving different stakeholders
- Recognize the limited relative significance of the international dimensions of the bushmeat trade.

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