8 · *Closing the Gap*

8.1 Introduction

As already highlighted in a number of global documents on the topic of sustainable use of wild meat in tropical and subtropical environments (e.g. Coad *et al.* 2019; Nasi *et al.* 2008), achieving this goal is challenging. Much data and many examples have emerged from research over more than four decades. From this information the overall recommendation is that with the right enabling environment and political will, and well-designed and multi-sectoral participation, it is possible to sustainably manage wild meat supply. There is no doubt that this is complex, but it is certain that under these conditions demand can be reduced to justifiable levels, at least for several species in some environments. Our intention in this book has been to primarily undertake a state-of-the-art review of the existing knowledge on the use of wild meat in a variety of tropical and subtropical environments. We present evidence on what species are consumed and how they are hunted; we explore the characteristics of the environments in which wildlife is exploited, and then discuss how sustainable hunting can be measured. In Chapters 6 and 7, we examined what is known about zoonotic diseases that are linked to wild meat use, an important topic considering the COVID-19 crisis and we then tackle how much we know about current hunting levels and the impact of overexploitation to set the scene for this final chapter. Here, we deliberate on ways we can 'close the gap' between knowledge and action, by a better understanding of sustainable wildlife use issues. We first concentrate on providing a comprehensive overview of what factors need to be considered to guarantee sustainable wild meat use, using the topics covered in previous chapters. We then end by providing guidelines on how we can improve wild meat governance and management worldwide. Our eventual purpose is to secure wildlife and food security for the benefit of biodiversity and humans.

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8.2 Achieving Sustainable Wild Meat Use

In the following sections, we concentrate on a number of pivotal elements which we illustrate in Fig. 8.1. By understanding these major issues in an integrated manner, we can move closer to ensuring the long-term use of wild meat as a resource. We first expand on the need to determine the ecological determinants of wild animal numbers in the different habitats, learn about the reproductive biology and ecology of prey species, and then move towards understanding the demand side of the equation. The latter relates to how we can recognize who needs wild meat, and therefore puts pressure on wildlife and which factors enable this process. We present these different elements in a simple list within which we present the available information.

8.2.1 Improving the Sustainability of Local Wild Meat Supply

8.2.1.1 Knowing the Production Potential of Different Habitats

Overall productivity of hunted species (particularly mammals) in different habitats across the world is correlated primarily with rainfall (Chapters 2 and 6). Production of huntable species even within the same habitat type such as tropical forests can differ due to ecological parameters such as vegetation composition. Monodominant upland Amazonian *terra firme* forests or *Gilbertodendron* forests in the Congo Basin are less productive. Differences between sites in prey species richness and biomass, can also occur because of biophysical variation between areas, even within the arguably more uniform and productive landscapes, such as forest-savanna mosaics or fruit-rich forests. Some authors like Robinson and Bennett (1999b) have argued that only about 150 kg of vertebrate biomass per year are available for extraction per kilometre square but this amount will differ according to habitat type, as indicated above. Reported annual hunting rates are known to be substantially higher than these figures thus provoking declines in wildlife populations in both the medium and long term (Chapter 6). Further understanding what ecological factors explain the vertebrate species biomass in different habitats is essential to determine the natural capacity an environment has to supply wild meat. Although in the past some studies have attempted to measure animal numbers and their biomass in a variety of habitats (see Chapter 2), emphasis on these sorts of investigations has become less popular since John Eisenberg's seminal work in the 1970s (Wemmer & Sunquist 2005). As highlighted in Eisenberg and Thorington (1973),

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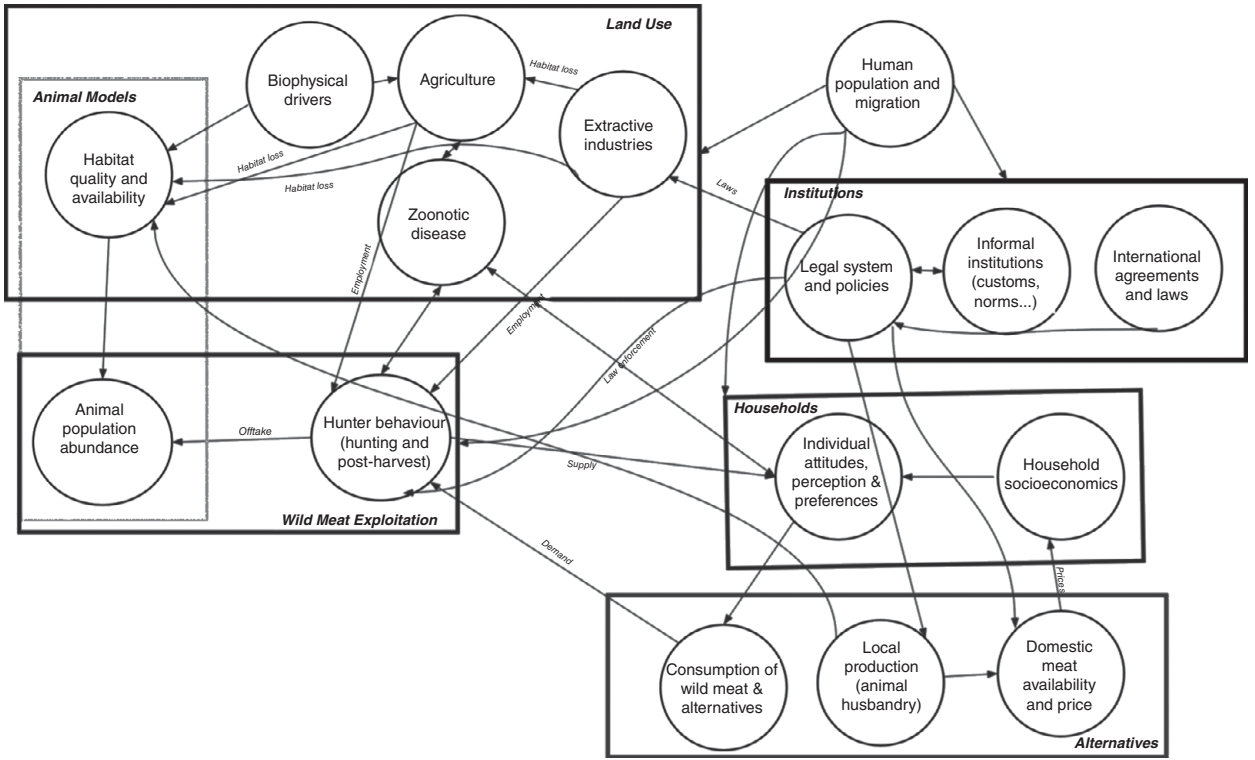

Figure 8.1 A simple conceptual diagram of some of the processes driving the direct use value of wild meat. The hunting decision is made at the small scale by individual hunters, but this decision is influenced by village and market-level factors; for example, consumer preferences and availability of substitutes influence consumer demand. Hunter offtake is a function of animal abundance, which is affected at a range of scales by habitat quality and availability. Modelling approaches to this system vary by scale and process type; for example, small-scale harvest models, market models, habitat models and village livelihoods models. These different components of the wild meat system have been modelled separately but not in an integrated manner.

assessing the numbers and biomass of different mammalian species (applicable to any other group of organisms) can shed light on the role these have in the functioning of an ecosystem. By determining the biomass present per taxon it is possible to establish the ecological dominance (and success) of different species and orders of mammals within a particular ecological context, compared to the more conventional use of number of species or genera per higher taxon in each geographic area. More importantly, comparisons of the biomass and numbers of the species found in different habitats and geographic areas, can be useful to highlight the ecological and anthropogenic factors involved in these environments.

8.2.1.2 Comprehending the Basic Ecology of Hunted Species

Although the existing variation at a macroecological level is important to understand the limits of exploitation possible in specific environments, information directly linked to a species' likelihood of being overharvested can allow researchers and conservation managers to better calculate sustainable exploitation levels. Generally, the intrinsic rate of population increase of a species, denoted as r_m (Caughley & Birch 1971) or r_{max} (see Skalski *et al.* 2005) or λ_{max}, which is the exponential of r_{max} (e.g. Robinson & Bodmer 1999) is very simply the number of births minus the number of deaths per generation time – the reproduction rate less the death rate. This index has been used as a useful measure of a species' vulnerability to overharvesting. A related general rule, Fenchel's law (Fenchel 1974), proposes that species with larger body sizes tend to have lower rates of population growth and these are more vulnerable to overharvesting. Sustainability of harvests therefore hinges on methods for estimating life-history parameters (Robinson & Redford 1986) alongside measurement of prey abundance (Chapter 5). Fundamental for assessing hunting sustainability using models such as the Robinson and Redford (1986) production model (Section 5.4.2), which has become a standard model in sustainability analyses, is the estimation of r_{max}. This parameter has often been calculated using Cole's (1954) equation. For populations not limited by food, space, resource competition, or predation and parasites, r_{max} is the maximum possible increase in number (Caughley 1977; Robinson & Redford 1986). Therefore, r_{max} can be used to predict how particular prey species will respond to different levels of harvesting (Greene *et al.* 1998), and it is used in models to determine the sustainability of hunting

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(see Chapter 5), such as the production model with survival probabilities (Slade *et al.* 1998), source-sink models (Joshi & Gadgil 1991) and spatial models (Levi *et al.* 2011b).

The key value used to estimate r_{max} is the annual birth rate of female offspring, which is also used in a range of hunting models such as Bodmer's (1994b), Robinson and Bodmer's (1999) and Robinson and Redford's (1991a) (Chapter 5). Annual birth rate is also used in population viability analyses (Section 5.3.2; Akçakaya & Sjögren-Gulve 2000) and calculations of minimum viable population size for several species, the results of which are used to determine International Union for Conservation of Nature threat status (IUCN 2020a). Nevertheless, inaccurate reproductive estimates can strongly influence sustainability calculations: basic biological data often does not exist for many species, so researchers cannot make accurate calculations (Milner-Gulland & Akçakaya 2001). The reality is that few reproductive life histories have been estimated in the field (Duncan *et al.* 2007) with Conde *et al.* (2019) showing that only 1.3% of 32,144 extant described mammals, birds, reptiles and amphibians have comprehensive information on birth and death rates. These authors suggest that data from zoos and aquariums in the Species360 network (Species 360 2020) can significantly improve knowledge for an almost eightfold gain.

Reproductive parameters used in the Robinson and Redford (1991a) production model or other algorithms to estimate r_{max} are in most cases based on data from captive populations. These are normally kept in low-density, high-resource settings (Fa *et al.* 2011) that may produce reproductive variations due to multiple factors, such as the stress of captivity, availability of resources, mates, territories and the composition of social groups. Furthermore, seasonal variations in food availability in the original habitats are often circumvented in captive populations and likely have strong impacts on reproduction (Goodman *et al.* 1999; Mayor *et al.* 2011). Because captive conditions may differ substantially from the wild, reproductive estimates obtained from captive systems may be appropriate for estimating maximum reproductive parameters (e.g. longevity), but even wild populations not limited by food, space and resource competition may not achieve these estimates. Furthermore, data on captive reproduction are unavailable for many, often endangered species, mainly because they do not reproduce well in captivity (Bowler *et al.* 2014). As a result of using reproductive values generated from captive populations,

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there is evidence that production estimates are consistently inflated and values of sustainable exploitation exaggerated (Milner-Gulland & Akçakaya 2001; Van Vliet & Nasi 2008b). In a sensitivity analysis with 33 comparisons, the production model failed to detect unsustainability, whereas unsustainability was detected by other methods, which do not use r_{max} estimates in 58% (n = 19) of the cases (Weinbaum *et al.* 2013). Thus, if models based on r_{max} are to be used to determine the sustainability of game harvests, reproduction parameters of game species should be derived from field studies or, at least, uncertainty should be modelled. Barychka *et al.* (2020b) used an approach that allows the integration of parameter uncertainty (Section 5.4.5).

When reproductive performance is studied in the wild, it is usually by directly examining animals after capture and restraint, or from direct field observations of births (e.g. Zhang *et al.* 2007). This is a difficult task to cover all hunted species since studies of their life histories (and especially long-lived ones) are beset by logistical, methodological and financial constraints. Because the application of researcher-led methods is challenging, especially for tropical forest animals (Fragoso *et al.* 2016), citizen science is becoming more widely applied to gather large amounts of biological and ecological data in the field (Dickinson *et al.* 2010). There are now numerous examples of non-professionals participating in obtaining vital information on a variety of subjects (Bonney *et al.* 2014; Steger *et al.* 2017). In the tropics, Indigenous and rural people have been involved in citizen-science projects, providing information on animal populations and trends, just as accurately as trained scientists (e.g. Danielsen *et al.* 2014). Since local communities in tropical forests have extensive knowledge of the environment and are the main direct users of natural resources, their participation in scientific monitoring is central (Pocock *et al.* 2015). Mayor *et al.* (2017) have demonstrated the effectiveness of citizen science through a community-based collection of organs of Amazonian forest mammals to determine reproductive parameters. In this study, local hunters collected and voluntarily donated complete viscera of hunted specimens over an uninterrupted 15-year period. Using this material, Mayor *et al.* (2017) were able to estimate annual birth rates of female offspring. These estimates differed significantly from those obtained in sustainability assessments that often use data from captive populations. Mayor *et al.* (2017) have shown that it is possible to collect accurate reproductive parameters of some hunted species over the long-term through

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the examination of biological materials brought back to researchers. This is possible for small-bodied animals but not for large species since their viscera are often not brought back from the forest due to their greater weight (see Mayor *et al.* 2017). El Bizri *et al.* (2020a) overcame this setback by training hunters to determine the reproductive status of the larger-bodied species in the field. By engaging local people in sample collection survey costs are lessened and involve locals in data processing and analysis, arguably allowing the collected data to be used directly in decision-making. Beyond providing more precise estimates of reproductive rates, larger sample sizes are also possible to better understand hunting impacts, for example by determining how variation in reproductive rates over time relates to density-dependent responses of populations to hunting. Local communities who depend on subsistence hunting for food could become active samplers of valuable biological material that is usually discarded. Alongside this, the involvement of hunters with scientists will also facilitate a better understanding between these often-disparate groups and create the much-needed trust and understanding that can lead to hunting sustainability. Importantly, results should be fed back to the people who provide the data.

8.2.1.3 Counting Animals

The management of wild populations for sport and subsistence harvest requires knowledge of both animal abundance and harvest success. Knowing the population size of harvested animals is crucial not just to monitor baseline populations but to follow the impact of hunting over time. Wildlife population size has been estimated using many models that require information on various population parameters such as carrying capacity (for logistic growth models), age structure, age-specific survival and reproduction rates (for age structure models), demographic and environmental stochasticities (for logistic growth models and age structure models), catch per unit effort (CPUE) and catch effort (for Poisson catchability models) (Skalski *et al.* 2005). Obtaining or estimating these population parameters, especially for species in tropical forests, is complicated, sometimes even impossible, due to the lack of direct observability of the study animals and the difficulties of undertaking mark–recapture studies.

Visual surveys are possible for animals in open habitats and such surveying is the most widely used non-tagging method to estimate and monitor wildlife abundance. Visual count surveys provide a relatively

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inexpensive and unintrusive approach to population surveys. Line-transect methods have seen a rapid development in statistical theory (Buckland *et al.* 2015). Detection functions estimated from right-angle distance data can be used to both test the assumptions of homogeneous detection probabilities and convert counts to absolute abundance and/or density. Extensive examples of the use of line transects in determining the impact of hunting of animals are available from the work of Peres and colleagues in the Amazon (e.g. Parry *et al.* 2009).

Methods that involve the collaboration of hunters to record the species hunted by them are more practical. Harvest data are relatively easy to collect, and at the same time, they avoid the high costs associated with more direct hands-on survey methods. Accompanying age-structure estimates can also provide crucial information on survival, productivity and age composition at relatively low cost. Data on the animals hunted over time can be used in CPUE estimates to monitor both hunter satisfaction and population trends. When carefully structured, CPUE data (Section 5.2.2) can also be used to estimate absolute abundance. Harvest counts can be employed in conjunction with change-in-ratio (CIR) methods and index-removal methods to estimate total abundance (Skalski *et al.* 2005). All of these methods rely on the impact of harvest removals on population responses which in turn can be linked to changes in animal abundance. The CIR and index-removal methods use auxiliary observations to relate harvest numbers to animal abundance. The CPUE methods use changes in success rate with known removals to estimate abundance. Alongside information of where hunting takes place harvest data can be used to assess sustainable harvests and denote hunting territories.

Long-term management of mammal populations, as for example emphasized by Newing (2001) for Central African populations, are likely to be more effective if the effects of different hunting management scenarios are monitored, and where solutions rely on trial-and-error models rather than scientific methods, the basis of which is still a matter of debate. Hunting management models that incorporate spatio-temporal rotation of hunting areas, as proposed by Vermeulen *et al.* (2009) in logging concessions, where non-hunted areas act as 'wildlife reserves', able to re-stock the hunted zones (see McCullough 1996), are a more realistic way forward. Alongside awareness programmes, the control of poaching, supply of alternative protein sources where needed and recognition of the rights of the local populations must be acknowledged if realistic hunting models are going to succeed. Monitoring by the actors

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of hunting offtake and the areas used is fundamental if an effective way forward is to succeed after its implementation.

8.2.2 Understanding the Drivers at a Landscape Level

8.2.2.1 Keeping an Eye on Human Population Increases

Extraction and use of wild meat resources is directly related to human population densities, both, where hunting takes place and where meat is being consumed. A higher human population will exert a proportionately greater pressure on wild animals hunted for wild meat and other natural resources. Understanding of the potential that habitats have to support human beings has been the concern of some researchers seeking to determine the carrying capacity, especially in tropical forests (Robinson & Bennett 1999b). Forest dwelling peoples have persisted in tropical forests for as many as 40,000 years in Asia (Hutterer 1988), 90,000 years in Africa (Bahuchet 1993; Verdu *et al.* 2009) and more recently in the Americas. These peoples would have depended significantly on animals for their protein needs (Chapters 1 and 3), and most hunted species may have persisted because hunter numbers were low, thus enabling sustainable human hunting. However, human harvest of wild species will depend on the harvestable biomass related to the overall standing biomass of the species, which in turn is linked to the available primary productivity of the different habitats (Chapter 2). Given these relationships, the maximum number of people solely depending on wild meat (i.e., with little or no dependence on agriculture and domestic animals) who can live in tropical forests has been calculated by Robinson and Bennett (1999b). According to these authors, if the maximum sustainable production of wild meat in tropical forests is around 150 kg/km^2 in most forests, the carrying capacity of humans in tropical forests should not exceed 1 person/km^2. This result is based on the per capita protein needs of 0.8 g of protein/day/kg (US recommended daily amount) or a daily protein need of a 70 kg man of 56 g of protein or approximately 180 g of meat/day, assuming that this protein comes from meat sources alone (Fa *et al.* 2003). Comparison of actual human population densities in tropical forests indicate that rural population densities in Central Africa are orders of magnitude higher than 1 person/km^2 (see Fa *et al.* 2003), almost equivalent to this figure for the Amazon (Fa & Peres 2001) but much higher in Asian forests (Corlett 2007). Trends of protein supply in all tropical forests are therefore highly pessimistic especially considering that human population densities are increasing (Chapter 2). Fa *et al.* (2003) in fact suggest that wild meat

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extraction in the Congo Basin is unsustainable and not only catastrophic for wildlife but also for the people who rely on it.

8.2.2.2 Containing Logging and Other Resource Extraction Activities

A major source of disruption of wildlife habitat is linked to the industrial exploitation of renewable resources as is the case of timber or non-renewable resources, such as minerals and oil. Extractive companies may directly destroy critical habitat, disturb movement patterns and alter behaviour of wildlife, but also indirectly facilitate hunting by opening forests to hunters and creating markets for wild meat. Once roads provide access to markets, wild meat becomes a market commodity, transforming hunting from a solely subsistence activity to a joint subsistence and commercial activity (Robinson *et al.* 1999; Wilkie *et al.* 2000). The extensive networks of roads created by logging companies open up remote forest areas – estimates suggest that 50,000–59,000 km^2 are opened every year (Grieser Johns 1997). The greater access to untouched forest areas accelerated by the large-scale operations of extractive industries can 'ring the death knell' for many hunted species.

The demand for natural resources is, in part, fuelled by emerging nations, such as China, India and Brazil, but also by many others which are propelling their economies by expanding their exploitation of natural resources (e.g. mining in Brazil in 2020; Vallejos & Veit 2020; Villén-Pérez *et al.* 2020). In particular, the accompanying rise in prices has led to the expansion of operations of extractive industries causing an increase in pressure on wildlife but also on Indigenous Peoples throughout the tropics (Butler & Laurance 2008). Logging concessions in Central Africa, the most extensive extractive industry in the region, occupy 30–45% of all tropical forests and over 70% of forests in some countries (Global Forest Watch 2002; Laporte *et al.* 2007). As a result, road construction for logging has intensified dramatically in the last decade, opening an additional 29% of Central African forests to increased hunting pressure (Laporte *et al.* 2007). Logging companies also attract large numbers of workers (and their family members) into formerly sparsely populated forest areas (Wilkie & Carpenter 1999). Since most logging companies do not provide their workers with animal protein, many have to survive on wild meat hunted by themselves and bought from others (Poulsen *et al.* 2009). Moreover, the better salaries offered in logging companies allow hunters to acquire more sophisticated hunting technologies (such as cartridges, guns, snare wires, outboard motors and headlamps), which in turn allows for

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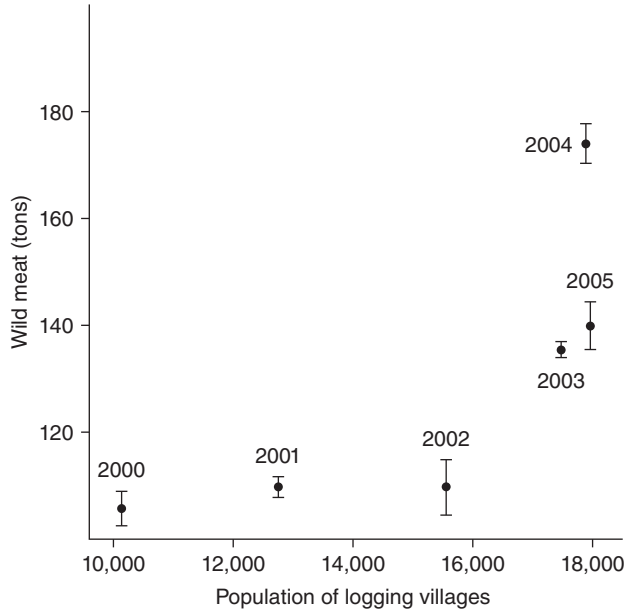

Figure 8.2 Annual biomass of wild meat entering logging towns in relation to the combined populations of the towns. Bars are bootstrapped 95% confidence intervals. (From Poulsen *et al.* 2009; adapted with permission from John Wiley & Sons.)

more efficient harvests. As a consequence, the per capita harvest rates in local communities within logging or oil-drilling infrastructures can be three to six times higher than other villages (Auzel *et al.* 2001: Cameroon; Auzel & Wilkie 2000: Congo; Robinson *et al.* 1999: Bolivia; Thibault & Blaney 2003: Gabon). In five logging towns in the northern Republic of Congo, Poulsen *et al.* (2009) found that industrial logging operations led to a 69% increase in population and a 64% increase in wild meat supply. Wild meat biomass entering logging towns was highly correlated with population increases of these settlements, around 10 kg per person per year (Fig. 8.2). Importantly, immigrants hunted 72% of all wild meat, suggesting that the short-term benefits of hunting accrue disproportionately to 'outsiders' and not to rural communities and Indigenous Peoples who have prior, legitimate claims to wildlife resources in the area.

Attempts to control the wild meat trade within lands occupied by logging concessions (but not for other extractive industries) have primarily focussed on coercing companies to ban their employees from hunting and prevent them from purchasing wild meat from forest villagers and transporting it to urban markets. To a lesser extent, logging companies

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have been encouraged to regulate the activities of forest villagers themselves such as by blocking off their channels for trade. Although the take up is still patchy, there are some promising examples of collaborations between conservation organizations and logging companies to curb illegal hunting and reduce the amount of wild meat trade (see Aviram *et al.* 2002; Butler & Laurance 2008; Elkan *et al.* 2006; Poulsen *et al.* 2007).

By promoting biodiversity conservation and human livelihoods, extractive companies can foster sustainable practices that explicitly consider the direct and indirect effects of their activities on wildlife (Milner-Gulland & Bennett 2003; Robinson *et al.* 1999). One way of achieving this, as Poulsen and Clark (2010) argue, is for forest certification granted to companies if they are able to raise management standards and improve practices in support of biodiversity conservation. A good example is the unprecedented partnership between the Wildlife Conservation Society, Congolese Industrielle des Bois (CIB), and the Congolese Ministry of Ministry of Sustainable Development, Forest Economy and the Environment (MDDEFE) in northern Republic of Congo. The result was the accreditation by the Forest Stewardship Council (FSC) of two timber concessions (750,000 ha) resulting in the largest tract of contiguous certified tropical forest in the world (Poulsen & Clark 2010). Aside from reducing the impact of logging practices, these concessions are managed for wildlife and biodiversity. Wildlife has increased in these concessions, comparable to adjacent Nouabalé-Ndoki National Park (Clark *et al.* 2009), and there has been a consistency in wild meat supply over time partially resulting from the conservation measures taken by the logging companies (Poulsen *et al.* 2009). These measures include: (1) companies guaranteeing the importation or development of protein sources for their workers and their families, keeping prices competitive with wild meat and fish; (2) companies should contribute to wildlife law enforcement (e.g. salaries of ecoguards who control transport of hunters and wild meat along logging roads); (3) companies should ensure that their workers hunt legally (with proper licences and permits) and impose penalties or fire workers who break the law; (4) traditional systems of resource management (e.g. hunting territories) should be formalized in land-use planning (e.g. management plans for logging concessions) and access to resources for indigenous people should be prioritized; (5) access to forest roads should be restricted to company vehicles, and roads should be closed when not actively used for logging. Poulsen *et al.* (2009) also suggest that urbanization should be avoided in logging concessions. If possible, sawmills and wood-finishing factories should be built and

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operated in or close to existing cities to avoid the growth of urban centres in the forest. Such a multi-pronged approach can address biodiversity and development interests, but acceptance by all extractive companies is still the major challenge. Of course, these measures only function for legal forestry and mining, but do not address the multitude of illegal wood extraction and mining that is widespread throughout the tropics and subtropics (e.g. Andrews 2015; Lawson 2014; Plummer 2014; Vallejos & Veit 2020; Villén-Pérez *et al.* 2020).

8.3 Governance and Legal Control of Wild Meat Use

8.3.1 International Conventions

A main channel for national governments to get involved in wildlife issues, including wild meat, is via international conventions and declarations. Such mechanisms, notably the CBD, Convention on Trade in Endangered Species (CITES) and Convention on Migratory Species (CMS), and the UN Declaration on the Rights of Indigenous Peoples (Table 8.1), but also other formally recognized international organizations that support or help implement the Decisions adopted by the Parties (i.e., Interpol, TRAFFIC, IUCN), attempt to control or regulate the international wildlife trade, including wild meat. Such agreements, which are between national parties have most authority over transboundary issues, but also promote food security and conservation through the sustainable use of wild fauna within national boundaries. Conventions are important platforms for intergovernmental policy outcomes, particularly relating to curbing the illegal wildlife trade. For those governments that ratify these global conventions, they are legally binding. However, Parties are not legally bound by the decisions of the Conference of Parties, known as COP, the decision-making body responsible for monitoring and reviewing the implementation of United Nations conventions, but should work toward implementing them.

In most cases, conventions have concentrated on species for which rapid or critical declines have been recorded, usually as recognized by the IUCN Red List framework. The illegal wildlife trade for products other than meat, ivory or rhino horn, as examples, is of major concern for many governments and international/regional institutions, as it generates large sums of untraceable money, often used to fund other international crime (UNODC 2016) and can also drive wildlife to extirpation very rapidly. The expansion of pangolin scales in the international trade

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Table 8.1 *Description of the main international conventions relating to wildlife and use of wild meat (taken from Coad et al. 2019)*

International convention	Description
UN Convention on Biological Diversity (CBD)	The CBD does not regulate trade in wildlife but is interested in the sustainable use of biodiversity and its components, including wild meat. In 2010, the COP to the CBD adopted the Strategic Plan of the Convention on Biological Diversity at their 10th meeting. The Strategic Plan is a 10-year framework for action by all countries and stakeholders to save biodiversity and enhance its benefits for people. It comprises a shared vision, a mission, strategic goals and 20 ambitious yet achievable targets, collectively known as the Aichi Biodiversity Targets. Specifically, Target 4 states that: 'By 2020, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits'. After publishing a CBD Technical Series report (Nasi *et al.* 2008) on conservation and use of wildlife resources, the CBD established a Liaison Group on Bushmeat. The Liaison Group provided recommendations for the sustainable use of wild meat which were adopted by the CBD COP 11 in 2012 (Decision XI/25), with further recommendations adopted by the CBD COP 12 in 2014 (Decision XII/18). The work of the Liaison Group culminated in support for the creation of the Collaborative Partnership on Sustainable Wildlife Management (CPW) in 2013, a voluntary partnership of international organizations with substantive mandates and programmes for the sustainable use and conservation of wildlife resources. In addition, the CBD Action Plan on Customary Sustainable Use (UNEP/CBD/COP/DEC/XII/12, B, Annex) was adopted in 2014. It aimed to promote, within the framework of the Convention, a just implementation of Article 10(c)4 at local, national, regional and international levels and to ensure the full and effective participation of indigenous and local communities at all stages and levels of implementation. Article 10(c) of the CBD states that Parties shall: 'protect and encourage customary use of biological resources in accordance

(*cont.*)

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Table 8.1 (*cont.*)

International convention	Description
	with traditional cultural practices that are compatible with conservation or sustainable use requirements.'
Convention on Trade in Endangered Species (CITES or Washington Convention)	CITES monitors and authorizes the international trade among its parties of all species listed in its appendices. The wild meat trade impacts several of these species, such as sharks, rays and pangolins, which are killed for both trade in wildlife parts (teeth, gill rakes and scales) and their meat. The current CITES position on wild meat is explained in Resolution Conf. 13. 11 (Rev. CoP 17) and encourages Parties to implement CBD Decisions XI/25 and XII/18 where appropriate and take advantage of the guidance and other materials provided by the CPW in relation to the sustainable management and use of wildlife. CITES is also part of the CPW, which is dedicated to developing improved policies and practices for sustainable wildlife management (see below and Section 1.3). Transport channels, such as seaports or airports, provide focused control points for CITES enforcement of international trade between distant countries; this is less the case for trade between neighbouring countries with porous borders (UNODC 2016). More consideration should be given to how trade across such borders could be effectively regulated. In 2016, the COP adopted Resolution Conf. 16.6 (Rev. CoP17) on 'CITES and livelihoods', recognizing that the implementation of CITES is better achieved when the national governments of the parties seek the engagement of rural communities, especially those traditionally dependent on CITES-listed species for their livelihoods. In 2000, CITES supported the creation of a Central Africa Wild Meat Working Group (CBWG). The group held two meetings including a joint meeting with the CBD Liaison Group on Bushmeat in 2011. However, the CBWG is no longer active after the 2012 decision (CoP15 Doc.61) that no further action was required on the subject.
Convention on Migratory Species (CMS)	The CMS lists threatened migratory species in two appendices, very much like the three CITES appendices, and seeks protection of these listed species against their 'taking' (with some exceptions). Appendix 1 lists endangered species and Appendix

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Table 8.1 (*cont.*)

International convention	Description
	2 lists other species of unfavourable conservation status and the need for international agreements to protect them during migrations. Wild meat hunting of species listed on either appendix is not prohibited if it accommodates the needs of traditional subsistence users. The COP 12 document on unsustainable use of terrestrial vertebrates and birds gives the most relevant CMS position on wild meat use, and in 2016 their Scientific Council championed the concept of aquatic wild meat, which requested some action by the CMS on the issue of overexploitation of fisheries. The CMS is a member of the CPW.
UN Declaration on the Rights of Indigenous Peoples (UNDRIP)	The UNDRIP, passed in 2007, elaborates on existing human rights standards and fundamental freedoms as they apply to the specific situation of Indigenous Peoples. It sets minimum standards that should be adhered to by nation-states and broader society to ensure the survival, dignity and well-being of the Indigenous Peoples of the world. Articles particularly relevant to wild meat management are Article 8 on preventing dispossession from territories, Article 18 on the right to participate in decision making, Article 19 relating to free, prior and informed consent (FPIC), and Article 26 on the right to own, use, develop and control traditional territories. Further policy principles and commitments relevant to the rights of IPLCs in managing wildlife are provided in Table 1 of Wildlife, Wild Livelihoods, published by the UN Environment Programme (UNEP; Cooney *et al.* 2018).

exemplifies how hunting of these species for their meat has also resulted in the illegal flow of a more lucrative secondary product resulting in even greater pressures on these species (Heinrich *et al.* 2016; Ingram *et al.* 2019; Mambeya *et al.* 2018).

Another international channel concerned with regulating the use of wildlife resources involves the regional cooperation bodies such as the European Union (EU), African Union (AU), Association of Southeast Asian Nations (ASEAN), Union of South American Nations (USAN),

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and the Commission for Environmental Cooperation of North America (CECNA) and associated specialized wildlife bodies, such as the Inter-ministerial Commission on Forests of Central Africa (COMIFAC) or the South Asian Wildlife Enforcement Network (SAWEN). Within these intergovernmental conventions, there is a tacit acceptance that wildlife should be sustainably used. Some regional intergovernmental bodies have also translated this mandate into policies promoting sustainable use within their own regions. This move indicates a clear shift toward wildlife as a resource that can be managed by and for humans, with the right enabling environment and resources and a step away from 'fortress conservation' policies. Yet, despite the clear positioning expressed by all these bodies that sustainable use must govern access to wildlife and other natural resources, policies resulting from these are often not adequately implemented on the ground. Moreover, in the case of conventions, their secretariats have not yet adopted technical standards for measuring sustainability in wildlife harvests, nor methods for moving toward improved sustainability should this be needed. As sustainability of a wildlife population can only be assessed over relatively long timeframes, there is also a need for standards in monitoring and measuring change over time. Such lack of international standards leaves national governments reliant on their own technical expertise, or that proffered by their NGO community. De facto, this leaves poorer nations with fewer technical resources to develop new approaches and revise governance structures.

8.3.2 Regional Governance Related to the Wild Meat Sector

8.3.2.1 Africa

Unsustainable hunting has been generally understood to be a threat to wildlife and livelihoods in most African countries. More explicit policies have been developed in Central and Southern African countries to manage subsistence hunting and to control illegal poaching of wildlife for meat. The AU adopted the Convention on the Conservation of Nature in 2003, and an 'African Strategy on Combating Illegal Exploitation and Illegal Trade in Wild Fauna and Flora in Africa' was drafted in May 2015. Revised and adopted in 2017, it became the Convention on the Conservation of Nature and Natural Resources, expanding on elements related to sustainable development. Through sustainable management tools their position calls for wildlife conservation and protection of traditional access to wildlife.

In Central Africa, COMIFAC has united six central African countries under a Convergence Plan for environmental management. The plan's

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objectives include conservation and sustainable use of biodiversity and socioeconomic development through multi-actor strategies. COMIFAC has supported several national and regional initiatives to improve the sustainability of wild meat and non-timber forest product harvests, as well as regulation of their trade. Together the COMIFAC and the Central African Forests Observatory have produced a State of the Forests report every 2–3 years, including an overview of hunting impacts and policy guidelines. Similarly, the Southern African Development Community, (SADC) developed and signed a Protocol on Wildlife Conservation and Management in 1999. This agreement promotes community-based management of wildlife and sustainable use for local consumption focussing on regulating use of wildlife for tourism, including trophy hunting, to improve local livelihoods. In conjunction with the Government of the Republic of Botswana the SADC Secretariat hosted a Ministerial Workshop on Illegal Trade in Wildlife, in Gaborone, Botswana, on 8 July 2016. In West Africa, the Economic Community of West African States (ECOWAS) and the West African Economic and Monetary Union have agriculture and environment sectors, but projects and expertise are heavily weighted toward agricultural crop production. Neither organization has formulated a clear position on wild meat management or use. The East African Community identifies three sectors potentially influencing the governance of wildlife and fisheries: agriculture and food security, tourism and wildlife management, and environment and natural resources. Under the environment and natural resources sector, member states agree to adhere to sustainable use policies, including for forests and wildlife, and to promote regional cooperation for cross-border management.

8.3.2.2 Latin America

South American regional policies unanimously recognize the need for sustainable use of all wild resources though the reality is that implementation of these rules is often ineffective. In Brazil alone, June 2019 saw an 88% rise in Amazon deforestation over the same month in 2018. In the first half of July 2019, deforestation was 68% above that for the entire month of July 2018, according to INPE, Brazil's federal monitoring agency. In the case of hunting, or rather overhunting, and its potential threat to biodiversity, regulations are rarely available. In particular, there is a need to fully integrate and manage subsistence hunting as part of regional environmental governance. The Amazon Cooperation Treaty Organization (ACTO)

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coordinates the policies and practices undertaken in respect of the Treaty for Amazonian Cooperation (TCA), and streamlines the execution of its decisions through its Permanent Secretariat. The Program for Sustainable Use and Conservation of Forests and Biodiversity in the Amazon Region, called the Amazon Regional Program (PRA), was born out of a joint cooperation between ACTO, the Directorate-General for International Cooperation (DGI), of the Netherlands, the German Federal Ministry of Economic Cooperation and Development (BMZ) and the German Development Cooperation (GIZ). It promotes the sustainable use of forest resources but refers to hunting only within projects to protect the rights of Indigenous Peoples. The Guiana Shield Facility (GSF) is a multi-donor funding facility for the long-term financing of national and regional activities to conserve ecosystems, protect biodiversity and sustain human livelihoods within the Guiana Shield ecoregion. The GSF priority setting workshop did not identify hunting as a major threat to biodiversity conservation in the region.

In 1993, Mexico, Canada and the USA signed the North American Agreement on Environmental Cooperation to address environmental issues of common concern, prevent environmental conflicts arising from the commercial relationships and promote the effective application of environmental legislation in the three countries. The agreement complements the North American Free Trade Agreement (NAFTA) and promotes sustainable development based on cooperation and mutually supportive environmental and economic policies. This applies to wild meat hunting; however, most hunting in this region is for sport rather than subsistence.

The Central American Commission for the Environment and Development (CCAD) is the organ responsible for the environmental agenda in Central America. Its main objectives are to contribute to the sustainable development of the region and strengthen cooperation and integration for the management of environmental resources. Although CCAD encourages the participation of indigenous communities and local farmers in activities compatible with conservation and sustainability, it does not express a specific policy on hunting, citing only water, ecosystem services, timber and non-timber plant resources as the objectives of sustainable management.

The Southern Common Market (Mercado Común del Sur, or Mercosur) is a regional integration process, established by Argentina, Brazil, Paraguay and Uruguay, and then more recently joined by Venezuela by the Treaty of Asunción in 1991 and Protocol of Ouro

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Preto in 1994. Associate countries are Bolivia, Chile, Colombia, Ecuador, Guyana, Peru and Suriname. The stated objective of Mercosur is to promote a common space that generates business and investment opportunities through the competitive integration of national economies into the international market. The parties signed a specific agreement on environmental issues within Mercosur, reaffirming their commitment to the principles enunciated in the Rio de Janeiro Declaration on Environment and Development. The agreement aims to promote sustainable development and the protection of the environment through the articulation of economic, social and environmental dimensions, and to improve the quality of the environment and provide better lives for the population. This would clearly require sustainability to be part of any regulated hunting for trade, but Mercosur has not published specific wild meat policies.

8.3.2.3 Southeast Asia

Southeast Asian countries recognize an urgent need for improved hunting governance, and this is expressed as a priority at national and regional levels. However, hunting to supply the commercial trade in wildlife trophies and traditional medicines is at the forefront of policies. ASEAN is a regional intergovernmental organization comprising ten Southeast Asian countries. It promotes intergovernmental cooperation and facilitates economic, political, security, military, educational and sociocultural integration among its members. Members include Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam. ASEAN's overarching objectives and policies are detailed in three blueprint documents for community policies in economics, sociocultural affairs and politics–security. The socio-cultural blueprint for policies until 2025 includes environmental cooperation. It identifies several priority areas of regional importance, including sustainable use of terrestrial, marine and coastal ecosystems, and a halt to biodiversity loss and land degradation.

ASEAN member states have recognized the importance of action on wildlife crime, with ASEAN ministers adding wildlife and timber trafficking to the list of priority transnational crimes, mandating follow-up through the ASEAN Senior Officials Meeting on Trans-National Crime. Following this decision, the ASEAN National Police Network, (ASEANAPOL), is also seeking to work more closely with the International Consortium on Combating Wildlife Crime's (ICCWC) ASEAN-Wildlife Enforcement Network (ASEAN-WEN).

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8.3.3 The Challenge of Legislating for Subsistence Hunting and Limited Sale

In numerous countries, there are still inconsistencies in national laws with regards to rural and Indigenous communities' rights to hunt wildlife for self-consumption, and to sell some of the meat (Van Vliet *et al.* 2019). Although hunting is often to satisfy the need for food for most families, hunters may sell some of the animals killed as a source of income. The proportion and volumes of meat sold varies depending on the cultural and socioeconomic contexts of the hunters thus making it difficult to establish simple categories. A practical definition of subsistence hunting could include selling (mostly locally) part of the game hunted for consumption to purchase other subsistence goods (e.g. soap, gasoline, oil). However, in legal terms, the concept of subsistence hunting is defined differently and refers to often contrasting realities. As shown by the diversity of terms used in legal frameworks in examples from Latin America (Mexico, Brazil, Colombia, Guyana) and Africa (Republic of Congo, Gabon, Democratic Republic of Congo) Van Vliet *et al.* (2019) attest to the difficulty of developing a unified concept of subsistence hunting (Table 8.2). These authors argue that formal regulations are ill adapted to the contexts in which they should be applied and are characterized by gaps and contradiction that maintain hunting for meat and the sale of its surplus in an equivocal legal space, a limbo according to Van Vliet *et al.* (2019).

Though most legal instruments allow Indigenous or rural peoples to hunt wildlife for food, the sale of surplus meat is not permitted. Differences exist across countries, but a common denominator is the lack of clarity concerning the right to sell wild meat hunted by local communities. Currently, the sale of surplus meat is either under-regulated, or over-regulated to a point where enforcement becomes nearly impossible. For example, in Brazil, it is forbidden to transport, sell or acquire eggs, larvae or specimens of fauna and by-products from hunting and harvesting or from unauthorized breeding sites (Antunes *et al.* 2019; Pezzuti *et al.* 2019) but within indigenous territories Amerindians have rights over aboveground natural resources and there are no commercial legal restrictions. An interesting contrast is the case of Gabon, which is the only country that, following a forest law reform in 2008, has introduced the concept of 'economic user rights' (Sartoretto *et al.* 2017). These are rights, recognized by the State, to market locally and without intermediaries, part of the collection of products derived from their customary use rights. Customary hunters selling game products outside their community must apply for a hunting permit and a commercial capture license.

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Table 8.2 *Comparison of national regulations regarding the use and trade of wild meat in Colombia, Brazil, Guyana, Mexico, Republic of Congo, Gabon, and Democratic Republic of Congo (taken from Van Vliet et al. 2019).*

Country	Hunting rights	Wild meat trade rights	Relevant legal code
Colombia	Subsistence hunting allowed for any resident except for protected species in protected areas (unless specified by a management plan in the case of overlap with indigenous reserves).	Trade allowed in theory for species listed by the Ministry of Environment (no list has been issued to date) provided permit being issued by the regional environmental agency after submission of an Environmental Assessment Study (EIS).	Decree-Law 2811 of 1974-National Code on Natural Renewable Resources Environment Protection. Decree 1076 pf 2015-Regulatory Decree of the Environment Sustainable Development Sector. Law 17 of 1981-Approves the CITES Convention, Resolution 705 of 2015-Establishes safety requirements for commercial hunting. Decree 1272 of 2016-Establishes regulation on wildlife hunting compensatory fees.
Brazil	Only explicitly allow for Indigenous people (Amerindians) within titled land. Generally tolerated for other ethnic groups and rural populations if intended 'to quench the hunger' in remote regions.	Trade is forbidden in the entire Brazilian territory, except inside titled Indigenous lands where Amerindians have management rights over aboveground natural resources and there are no legal restrictions on internal commercialisation of meat surplus. Commercial extensive management can be permitted	Law 5197/03 January 1967-Wildlife Protection Act. Law 6001/19 December 1973-Indian Statute. Law 9605/12 February 1998-Law of Environmental Crimes. Law 9985/18 July 2000-National System of Conservation Units (SNUC). Law 10826/22 December 2003-Disarmamen Statute. Decree 5051/19 April 2004-Promulgation of ILO Convention 169. Law 11346/15 September 2006-National

(*cont.*)

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Table 8.2 (*cont.*)

Country	Hunting rights	Wild meat trade rights	Relevant legal code
		in exceptional circumstances upon the existence of management plans and governmental licenses.	System of Food and Nutritional Security (SISAN). Decree 6040/08 February 2007-National Policy for the Sustainable Development of Traditional Peoples and Communities.
Guyana	Only allowed in Amerindian titled land. Outside Amerindian titled lands, hunters are required to request a permit delivered by the Guyana Wildlife Conservation and Management Commission.	Allowed for any citizen, pending the obtention of a commercial license.	Kaieteur National Park Act of 1930. Fisheries (Aquatic Wildlife Control) Regulations of 1966. Amerindian Act of 2006. Animal Health Act of 2011. Protected Areas Act of 2011. Wildlife Management and Conservation Regulations of 2013. Wildlife Conservation and Management Act of 2016.
Mexico	There is lack of clarity whether hunting can be practiced as part of the legally recognized 'subsistence uses' or if it is subjected to previous authorization by the Ministry in charge.	Trade is legal only if the meat comes from intensive or extensive breeding authorised centres (called Wildlife Management Units – UMA) and is sold in established and official markets.	General Law for Wildlife (Ley General de Vida Silvestre, LGVS) (SEMARNAT, 2016/2000). LGVS Regulations (SEMARNAT, 2014/2006). National Strategy foer Wildlife 1995–2000 (INE, 2000). Program of Wildlife Conservation and Productive Diversification in the Rural Sector 1997–2000 (SEMARNAP, 1997).

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Republic of Congo	Hunting for the satisfaction of personal and community needs is allowed under customary rights.	No commercial trade is allowed under any circumstances.	Loi 37-2008 du 28 novembre 2008 sur la faune et les aires protégées. Loi 16-2000 portant code forestier. Loi 5-2011 du 25 février 2011 portant promotion et protection des droits de populations autochtones. Arrêté 3772 de 12 aout 1972 fixant les périodes d'ouverture et de fermeture de la chasse sportive en République du Congo. Arrêté 5053/MEF/CAB du 19 juin 2007 définissant les directives nationales d'aménagement durable des concessions forestières.
Gabon	Hunting for the satisfaction of personal and community needs is allowed under customary rights.	Trade within the community is allowed without restrictions following the economic user rights. For trade beyond the community boundaries, the trader should obtain a certificate of origin, a zoo-sanitary certificate and a certificate of harvest.	Loi 16-2001 portant code forestier. Décret 161/2001, fixant les conditions de délivrance des permis et licences de chasse et de capture. Décret 163/2011, fixant les conditions de détention, de transport, de commercialisation des espèces animaux sauvages, des trophées et produits de chasse.
Democratic Republic of Congo	Hunting, including by local communities, is subordinated to the acquisition of a collective hunting license, which authorises hunting 'within the strict limits of their food needs'.	Trade is allowed under a specific license or a 'commercial catch' permit, pending the obtention of a 'hunting ability test' and a hunting license.	Loi 82-002 portant règlementation de la chasse. Arrêté 014/CAB/MIN/ENV/2004.

In addition, the Gabonese legislation provides that the possession and transport of the remains of species requires a certificate of origin, a zoo-sanitary certificate and a certificate of harvest (Sartoretto *et al.* 2017): requirements that are far beyond the capacities of contemporary Gabonese hunters. Van Vliet *et al.* (2019) suggest that there is the need for much greater clarity on how the rights to sell surplus of meat and sustainable use of wildlife is defined in law that accounts for the realities and needs of communities from different cultural backgrounds. Without the revision of current inconsistencies, overlaps and gaps, there is little hope that investments in law enforcement will achieve tangible outputs for wildlife conservation and the livelihoods of marginalized groups.

8.4 Reducing the Demand for Wild Meat

8.4.1 Stemming Increased Commercialization of the Wildlife Harvest

Wild animals hunted may be consumed, sold locally or transported to urban markets where they fetch higher prices. Factors which determine which species are sold or consumed include the size of the animal, cultural inhibitions as well as personal or public appeal and demand. Hunters might sell a proportion of the wild meat extracted. However, the proportion of wild meat sold varies depending on the hunters' needs, access to market and even the individual's desire to monetize the resource if this is not cultural. For example, differences between the proportion of hunted game sold by Indigenous groups (Pygmies) and Bantu farmers in the Congo Basin indicate that whilst on average only 35% (range 0–90%) of the hunted game in Pygmy settlements was sold, significantly more prey (65.4%, range 11–95.3%) was commercialized in non-Pygmy settlements (Fa *et al.* 2016). Often, small-sized prey is more likely to be consumed locally while the more appealing and profitable species are sold in town and city markets.

As discussed in the previous chapters in this book, wild meat hunting is a major component of the livelihoods and food security of myriad rural and Indigenous Peoples. In some areas, unsustainable hunting is a major cause of wildlife declines even affecting many protected areas (see Tranquilli *et al.* 2014). These declines can have significant knock-on effects on ecological systems, impacting ecosystem services such as nutrient cycling and carbon capture (Chapters 2 and 6) and also affect human survival. Hunting in more remote rural areas is likely to be sustainable, primarily because human population densities (and thus hunter numbers)

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are low (see Ávila Martin *et al.* 2020) and source areas are likely to be larger. In high human density areas or where the focus of hunters is to supply urban markets, vulnerable species may be extirpated leading to larger numbers of smaller species making the bulk of the wild meat sold in these markets (Cowlishaw *et al.* 2005).

Generally, the demand for wild meat in fast-growing urban centres is considered by many researchers to be the main drive for unsustainable harvesting rates (Coad *et al.* 2019). Because many urban dwellers consume wild meat as a luxury item rather than as a nutritional staple in many cases, they pay higher prices than rural consumers do for the same animal. This encourages hunters in rural villages to hunt more animals for sale, to gain higher incomes resulting in a classic, unregulated Tragedy of the Commons problem. Likewise, this same urban demand drives the proliferation of purely commercial hunters, some forming parts of highly organized groups engaged in the illegal trade of wildlife products at the domestic or even international level. More income from wild meat will also allow these hunters to buy better and more powerful firearms, thus increasing the pressure on wild meat populations even more. The consensus is that this uncontrolled wild meat trade, together with the loss of intact habitat, threatens wildlife in all tropical and subtropical regions in all continents. In the Amazon, an area presumed by some in the past to have been exempt from the huge demand for wild meat by cities or town (Rushton *et al.* 2005), El Bizri *et al.* (2019) have shown that there has been a considerable switch from hunting wild meat for home consumption to supplying more lucrative city markets. Emerging evidence for large cities in Central Africa, for example, Kinshasa and Brazzaville (together representing more than 15 million people), suggests that if each inhabitant ate a minimum of 1–2 kg of wild meat per year (data for urban consumers from Wilkie & Carpenter 1999) between 15–30 million kilograms are likely to be consumed annually (Fa *et al.* 2019). Given that urbanization is growing in all tropical regions with large, even megacities emerging, the demand for wild meat is increasing rapidly (see Fig. 2.10, Chapter 2). Although most data on the flow of wild meat from rural to urban areas are from Africa (Chausson *et al.* 2019; Fa *et al.* 2019; Fargeot *et al.* 2017; Mbete *et al.* 2011) and increasingly from Latin America (El Bizri *et al.* 2019; Van Vliet *et al.* 2014, 2015a), increasing urban wild meat consumption in Asian cities also poses a major threat to faunal biodiversity (see Sandalj *et al.* 2016 for Vietnam). The reduction or even elimination of wild meat in cities and towns, if possible, is unlikely to affect access to other forms of animal protein. As

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shown in Fa *et al.* (2019) for Kinshasa and Brazzaville, and by Wilkie *et al.* (2005) for the Congo Basin, domestically produced and imported animal source foods (primarily chicken and fish) provide city dwellers with almost all their dietary protein, and that wild meat is sold irregularly by only a small percentage of vendors, and is not likely to be a dietary necessity. Research in poor neighbourhoods in sub-Saharan African cities shows high levels of household food insecurity and emphasizes the important role of informal food traders in meeting the needs of poor urban household (Crush & Riley 2019; Ingram 2020).

Tackling the problem of wild meat consumption in urban settlements is an urgent priority requiring a greater focus on social science research to compliment long-term ecological monitoring (Redman *et al.* 2004). Understanding better why different people in metropolitan areas consume wild meat is essential if we are to eliminate obstacles to creating policies that remove the need for these resources and promote the potential for other more abundant (and more affordable) animal protein sources to be available. Because food systems are complex entities, consisting of many different actors, their activities and interactions – the driving forces shaping these activities and the outcomes produced at the individual and system level – food systems research must move towards an integrated approach for analysis and new ways to communicate this complexity outside the research domain. Moving towards sustainable management requires interconnected interventions to target the management of rural supply but primarily the reduction of urban demand. This calls for work along the entire value chain, including local hunting communities, urban consumers and wider society.

8.4.2 Substituting with Other Meat Alternatives

Farming of wildlife species for their meat was proposed as a solution to reduce demand as early as the 1950s (e.g. Asibey 1974; de Vos 1977; Ntiamoa-Baidu 1997). Though there are known zoonotic risks linked to rearing of animals in restricted spaces, whether domestic animals or wild species (Chapter 7), the main assumption is that by providing people with farmed wild animal meat, pressure would be lessened on wildlife populations. Concerns about the viability of such farming, its cost effectiveness and its impact on wildlife populations has been much debated (Mockrin *et al.* 2005). Wildlife farming proponents envision fully controlled production systems, independent of wild populations for source animals, operating in urban, peri-urban and rural settings to

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supplement human protein intake without large investment costs. A wide array of vertebrate species has been investigated for farming to obtain meat (see Appendix 1 in Mockrin *et al.* 2005), either because they are preferred food species (Smythe & Brown de Guanti 1995), others because they command a high price in markets (Jori *et al.* 1995). However, raising wild species for food does not necessarily comprise domestication of the species – a long and intensive process whereby humans selectively control the animals' reproduction, with resulting genetic changes. Yet, notwithstanding the somewhat consistent emphasis on wildlife farming of a variety of tropical forest species (e.g. mini-livestock, see Hardouin 1995) in the past three decades, examples of successful wildlife farming are uncommon. Few wild vertebrate species native to the humid tropics are commonly farmed with perhaps the exception of large rodents such as grasscutters in West and Central Africa (Adu *et al.* 2013; Jori *et al.* 1995; Mensah 2000).

The possibility and eventual success in raising wild species in captivity depends on the species' biology (reproduction, productivity and vulnerability to disease) and the cost-effectiveness of farming it. The demands on source populations for new blood, genetic mixing with wild populations and potential introductions of invasive alien species are concerns that have to be taken into account. Aside from these issues, the reception of this production method by actors unfamiliar with farming wild animals will also influence the likely success of such efforts. Cultural norms and individual motivations will influence which community members participate in an activity, and throughout much of Central Africa mini-livestock rearing (e.g. chickens, cane rats) is often a women's activity (Hardouin *et al.* 2003; Thornton *et al.* 2002). Furthermore, even the lack of preference of the produced farmed over wild meats can impede progress. For example, a study of consumer preferences in Ghana showed that wild grasscutter meat was favoured over farmed animals because it was perceived to have better flavour, be more tender and had less fat content (Teye *et al.* 2020).

Wildlife farming is therefore a complex enterprise, involving aspects of rural development, agricultural production and conservation. However, the production of wild meat farming, even if economically viable, is unlikely to produce sufficient meat to satisfy the needs of consumers and ensure their food security. Wildlife farming also poses major conservation threats to existing wildlife populations. This is because of the need to acquire breeding stock from wild populations, increased risks of disease and genetic contamination of wild populations

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of the same or other species, as well as the risks of the spread of invasive alien species including diseases. Wildlife farms are also known to be a front for illegal trade of wild-caught animals (e.g. Livingstone & Shepherd 2016). Moreover, until wildlife numbers in the wild become so low that it is no longer worthwhile hunting them, wildlife farming is unlikely to reduce hunting, due to the high costs of farming compared to hunting, lack of appropriate technical skills and funds, and cultural constraints. However, as suggested by Tensen (2016), wildlife farming can benefit species conservation only if the following criteria are met: (1) the legal products will form a substitute, and consumers show no preference for wild-caught animals; (2) a substantial part of the demand is met, and the demand does not increase due to the legalized market; (3) the legal products will be more cost-efficient, in order to combat the black market prices; (4) wildlife farming does not rely on wild populations for re-stocking; (5) laundering of illegal products into the commercial trade is absent. Until these conditions are met, more efforts should be placed to create hardier breeds that are less susceptible to disease and choose appropriate locations and socio-economic strategies to expand domestic livestock farming as part of planning for a sustainable landscape (Robinson 1993). Any improvement of known domestic breeds must ensure that production is not extensive and thus does not encourage deforestation and soil erosion, for example. However, in certain economic and cultural conditions, wildlife farming should be conducted but strict guidelines are needed to ensure that the operations succeed as viable farming enterprises and do not harm wildlife populations.

Although the regulation of hunting practices in rural areas is likely to ensure a sustainable supply of wild meat to the local consumers, in some cases wildlife farms may be appropriate if domestic animal farming is not a viable option. Wildlife farming in peri-urban areas to satisfy the demand for wild meat could reduce the pressure on wildlife. The higher prices paid by some urban consumers will, in some cases, make this economically viable. Under these circumstances, the farms are not a food security solution since urban dwellers who can afford the higher-priced farmed wild meat inevitably have alternative, cheaper, sources of protein, usually fish or domestic meat. Such farms are also not a solution to a conservation problem, since they would not reduce hunting by rural peoples, or supply cheap meat to poorer urban dwellers. The farms might, however, be viable commercial concerns, and be supported politically.

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8.5 Balancing Conservation and Needs of Rural and Indigenous Peoples

Reducing the rates of global deforestation and forest degradation would yield substantial gains for climate change mitigation and biodiversity conservation. However, forest loss caused by the rising and urbanizing non-forest human population will dramatically increase competition for natural resources with forest-living peoples. The exploitation of sub-surface commodities, namely mining, oil and gas resources, poses one of the greatest of the many threats facing Indigenous Peoples and the lands, territories and the resources that they depend on. As the global economy expands, pressure on indigenous lands to yield up these resources is intensifying. In the eyes of more socially minded conservationists, however, local people (and the improvement of their social, physical and economic well-being) are understood to be the focal point of holistic conservation efforts. Recent reviews suggest that this is a promising path to explore: evidence shows that local traditional and Indigenous Peoples are better custodians of forests and biodiversity than governments (Fa *et al.* 2020; O'Bryan *et al.* 2020; Stevens 2014), and a global survey of tropical forests found that government-protected forests were cut down four times faster than community-managed ones (Porter-Bolland *et al.* 2012).

There are at least 370 million people who define themselves as Indigenous (The World Bank 2020), are descended from populations who inhabited a country before the time of conquest or colonization, and who retain at least some of their own social, economic, cultural and political institutions (International Labour Organisation 1989). Irrespective of their global diversity, Indigenous Peoples often express deep spiritual and cultural ties to their land and contend that local ecosystems reflect millennia of their stewardship, with Indigenous Peoples' lands representing one of the oldest forms of conservation units (Garnett *et al.* 2018). Moreover, they assert that Indigenous rights do not require state-sanctioned approval to exist. While Indigenous Peoples' land rights are acknowledged and implemented to varying degrees across time and geography, even when refused or ignored, Indigenous Peoples frequently retain de facto influence over their ancestral lands. Using publicly available geospatial resources, Garnett *et al.* (2018) have shown that Indigenous Peoples manage or have tenure rights over at least approx. 38 million km^2 in 87 countries or politically distinct areas on all inhabited continents. This represents over a quarter of the world's land

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surface and intersects about 40% of all terrestrial protected areas and ecologically intact landscapes (Fa *et al.* 2020). These results add to growing evidence that recognizing Indigenous Peoples' rights to land, benefit sharing and institutions is essential to meeting local and global conservation goals. Alongside training, capacity and awareness building etc., we have the same problem as it is not being Indigenous *per se* which achieves conservation goals but population density (as opposite to the 'noble savage hypothesis'; Section 3.6).

International solutions to achieving the conservation of tropical forest biodiversity have historically followed three general approaches: (1) establishing parks and other protected areas (PAs) to safeguard wild species and natural systems, and (2) enforcing/promoting restraint in the harvest and (3) prohibiting consumption of wild species and their products. All three approaches affect rural and Indigenous People's access to natural resources, either by denying them the opportunity to use certain areas (as in PAs), or by reducing their harvest levels. In so doing, conservation actions can conflict with other ethical obligations, by curtailing, for instance, the ability of some people to make a living, an obligation and a core right recognized in the Universal Declaration of Human Rights (United Nations 1948): 'Everyone has the right to a standard of living adequate for [their] health and wellbeing'. If conservation activities have a negative impact on the autonomy and rights of Indigenous Peoples, then it might conflict with other ethical obligations such as the right of all peoples to self-determination enshrined in UN International Covenant on Economic, Social and Cultural Rights (1976) that 'recognizes the right of peoples to dispose freely of their wealth and natural resources to satisfy their needs' or, as identified in the UN Declaration on the Rights of Indigenous People (United Nations 2007), which states that Indigenous People have rights 'to the lands, territories and resources which they have traditionally owned, occupied, or otherwise used or acquired'. Other relevant international conventions include the Convention on Biological Diversity (article 8j); International Covenant on Civil and Political Rights (Article 1); the Charter of the United Nations (Article 1, 55 and 56); Rio Declaration on Environment and Development (Principles 1, 10, 22 and 23), and other international ethical standards such as the Principles of the Forest Stewardship Council or the International Labour Organisation Convention 169 (Articles 6, 7 and 15.2).

Indigenous Peoples lands are demarcated territories officially recognized as belonging to and managed by the first-comers. These

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Indigenous Peoples are traditional groups who closely identify with their land and with a distinctive culture but who are marginalized by dominant society. Despite the potential spectrum of solutions available for balancing the needs of people with those of nature, it is the 'parks *versus* people' debate that has created the greatest tensions between and within the conservation and development communities (see e.g. Adams & Hutton 2007; Brockington 2002; Roe & Elliott 2004; Sanderson & Redford 2004; Schwartzman *et al.* 2000; Terborgh 1999, 2000). Such debate has, more often than not, concentrated on the value and efficacy of PAs or the alternative, Integrated Conservation and Development Projects (ICDPs), in protecting biodiversity – and promoting (or negatively impacting) human livelihoods (e.g. Terborgh *et al.* 2002; Wells & McShane 2004). For those within the 'strict preservation' camp, PAs are the most important means to achieve the primary task of conservation, that is, the protection of global biodiversity. Among conservation interventions in tropical forests, the establishment of PAs has been the most prominent and best funded (Chomitz *et al.* 2007). The Global Environment Facility reports that its investments in PAs included $1.6 billion of its own resources and $4.2 billion in co-financing; much of this has been implemented through the World Bank. Protected areas, mostly in the marine realm, have expanded rapidly in recent years (Coad *et al.* 2008) and now cover around 27.1% of the tropical forest estate, contributing to the reduction of tropical deforestation. As already mentioned, there is emerging evidence that forest reserves that allow for sustainable use by local people were even more effective, on average, than strictly protected areas focused exclusively on conservation. The most effectively protected areas of all were those within indigenous lands, which were estimated to reduce deforestation by about 16% more than all other conservation approaches between 2000 and 2008 (Nelson & Chomitz 2011). These findings are relevant in the context of ongoing global efforts to reward countries for reducing greenhouse gas emissions from deforestation pointing to the fact that the most effective forest conservation incorporates local livelihoods and recognizes indigenous land and resource rights. Collaborative partnerships involving conservation practitioners, rural and Indigenous Peoples and governments would yield significant benefits for conservation of ecologically valuable landscapes, ecosystems and genes for future generations. It is through these new alliances, where long-resident human populations who have a right to their lands and resources manage and protect biodiversity areas, including PAs, that protection and supply of human needs will be possible in the future.

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8.6 Concluding Remarks

A clear understanding of the numerous factors which can lead to the unsustainable harvest of wild meat is needed to resolve the issue. From an applied perspective, we need to differentiate between commercial *versus* non-commercial hunting, the species we are dealing with, the zoonotic risk and the results of monitoring to devise management strategies (Fig. 8.3). Fundamental is the interpretation of the issues affecting the supply side, that is, the environment and the ecology of the hunted species, but also how the present and future demand by rural and urban populations puts pressure on the animal populations themselves. We use a simple conceptual diagram (see Fig. 8.1) of the key processes driving the direct use value of wild meat ranging from the decisions made at the small scale by individual hunters, the influence of village and market-level factors, for example, consumer preferences and availability of meat substitutes and how these in turn affect consumer demand. At the ecological level, hunter offtake is a function of animal abundance, which is affected at a range of scales by habitat quality and food resource availability. The productivity of these habitats is influenced by land use patterns at a local scale but also by global changes at a macro level. Although researchers may concentrate on approaches that vary by scale and process type, for example, small-scale harvest models, market models, habitat models and village livelihoods models, these different components of the wild meat system progress can only be made if we consider all these variables jointly.

This book concentrates on the science on wild meat use so we focus less on the regulatory aspects of how communities manage the resource although we mention issues of national governance of wild meat in Section 8.3. This is a key to the successful management of natural resources at the country level. A first step forward in regulating the use of wild meat in any country is to ensure the consultation with all stakeholders so national hunting laws and land tenure governance systems are adequate (see Van Vliet *et al.* 2019 and above). However, hunting regulations in many tropical and subtropical countries are based on legislation originally written for seasonal hunting in temperate regions and are not focused on subsistence needs (e.g. for laws with colonial legacy, see Morgera & Cirelli 2010). They are often ambiguous, as they do not fit well within the local context, making it difficult for local communities to act within the law, or use the law to support hunter adherence to sustainable practices (Van Vliet *et al.* 2019). Failure to

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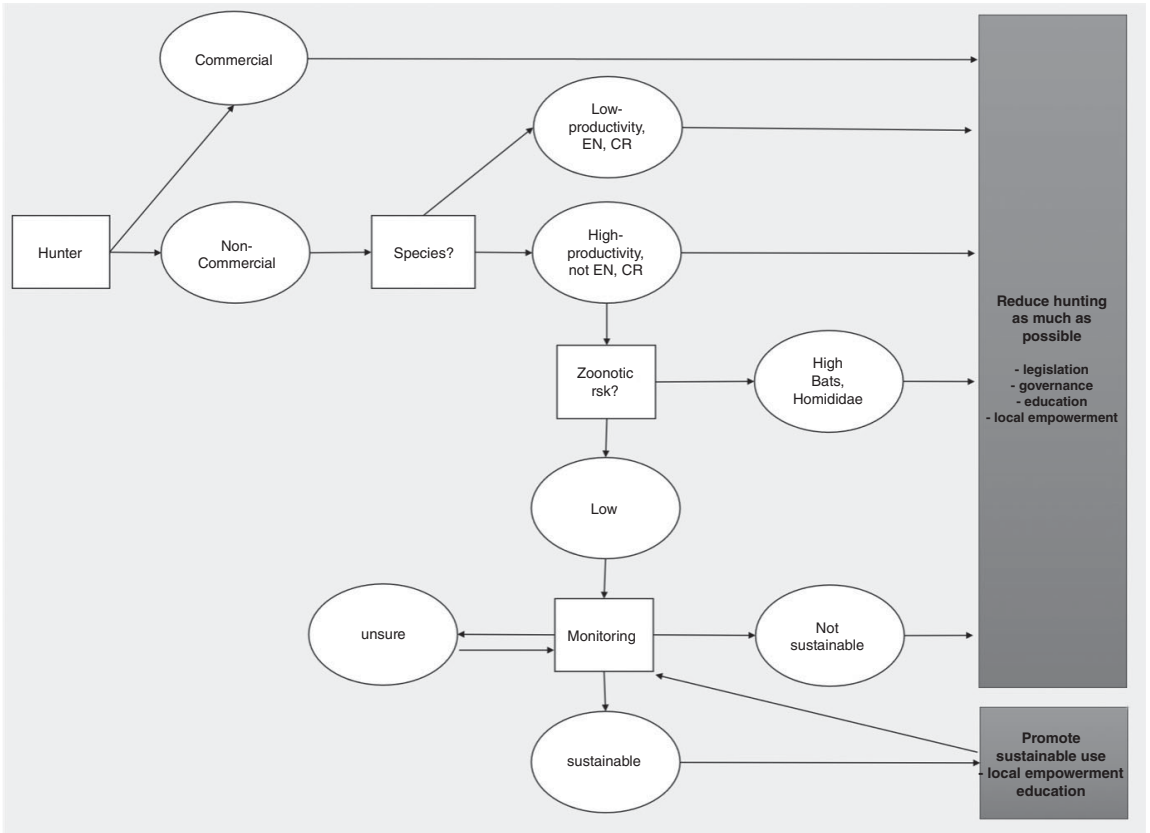

Figure 8.3 Simplified decision diagram to decide how wild meat hunting is managed. Non-commercial subsistence hunters might sell part of their hunted game; we consider this as 'non-commercial' as long as trade is local and does not involve intermediate buyer/sellers.

devolve land tenure and support Indigenous management, for example, how to enable them to restrict outside commercial hunters has also prevented many of these populations from acting as stewards of their landscapes, especially in Africa.

Political support for sustainable wild meat management is more likely if the circumstances for legitimate consumptive use of wildlife are recognized and formalized (Coad *et al.* 2019). Ensuring sustainability is genuinely achieved over the long term will require regional- and national-level monitoring and surveillance frameworks that respond to indicators of unsustainable use. Understanding what works and what does not in a specific context will allow the refinement of policies and measures over time, providing a pathway to ensure true sustainability for the future. Bringing together a series of actions that can ensure better governance towards a sustainable wild meat sector has been proposed by Nasi and Fa (2015), as shown in Box 8.1.

In this last chapter we have highlighted the ecological and socio-economic variables that are involved in the study and understanding of wild meat use and over-exploitation. Designing effective policies on sustainable wild meat use will require robust data on the indicators of overexploitation of wildlife – and the impacts of exploitation on ecosystems, human health and livelihoods – so that a legitimate case for sustainable use can be made. Such data should be commonly available to managers and decision makers. Thus, whilst we acknowledge that the sustainable management of the tropical wild meat sector is complex, we argue that with the right enabling environment and political will, well-designed and participatory multi-sectoral approaches that are based on solid science, we can effectively enable wild meat supply and reduce demand to sustainable levels. We are nonetheless realistic in acknowledging that this may be possible only for some species in some places.

Emphasized throughout the book is the fact that sustainable wildlife exploitation has to happen against a complex and changing backdrop because of human population growth. Talk of human population numbers in the tropics and subtropics, and its concomitant decline in space for wildlife from habitat loss, is the ever-present 'elephant in the room'. Thus, ultimately, and quite categorically, governments and development agencies must recognize that wild meat use must be reserved for those people and communities closest to the resource (and more dependent on it). Every effort should be made by them to reduce or even eliminate the demand for wild meat in urban areas as well as be given the support or power to stop others taking away their resources. Protected

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Box 8.1 *A comprehensive roadmap for better governance towards a sustainable wild meat sector requires (Nasi & Fa 2015).*

- **Working with the upstream actors to improve the sustainability of supply**
  - Hunters: negotiate hunting rules and quotas allowing harvesting resilient species and banning vulnerable ones; design and agree on simple participatory monitoring tools
  - Extractive industries: enforce codes of conducts and include wildlife concerns in companies' standard operating procedures; forbid transportation on company's vehicles; establish adequately staffed checkpoints; provide alternative sources of protein at cost; organize, support community hunting schemes; adopt certification.
- **Reducing the demand**
  - Rural consumers: develop alternative sources of protein at a cost similar to wild meat; improve economic opportunities in productive sectors; use local media (e.g. radio) to deliver environmental education and raise awareness
  - Retailers, urban consumers: strictly enforce ban on protected/endangered species sales and consumption, confiscating and publicly incinerating carcasses; taxing sales of authorized species of international consumers: institute very heavy fines for transport (eventually targeting airline companies), possession or trade of wild meat (whatever the status or provenance of the species); raise awareness of the issue in airports or seaports; train custom personnel
- **Create an enabling environment for a controlled, sustainable wild meat sector**
  - Local institutions: negotiate full support of communities that have a vested interest in protecting the resource; increase capacity to setup and manage sustainable wild meat markets.
  - National level: enhance ownership, linked to tenurial and rights reform; legitimize the wild meat debate; make an economic assessment of the sector and include in national statistics; acknowledge contribution of wild meat to food security in national strategies; develop a framework to 'formalize' parts of the trade; review national legislation for coherence, practicality and to reflect actual practices (without surrendering key conservation concerns); include wild meat/wildlife modules in curricula.
  - International level: strictly enforce CITES with more consideration on regional trade; ensure wildlife issues are covered within

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internationally supported policy processes; link international trade with increased emerging disease risks; impose tough fines and shame irresponsible behaviour.

- **Develop more targeted research**
  - Create a shift away from descriptive studies of wildlife exploitation to more incisive investigations on the roles which wild meat might play in poverty eradication in balance with the sustainable use of the resource.
  - Develop cost-effective systems for examining the importance of wild meat to human populations in different ecological and socio-economic settings. In particular, examine the further application of existing global mechanisms for data gathering on nutrition, such as FAO's Food Balance Sheets.
  - Determine causal links between alternative protein sources (e.g. marine and freshwater fish supply) and wildlife populations, and the ecological footprints of increasing accessibility to domestic meats (e.g. livestock, poultry).
  - Elaborate effective systems for monitoring the status of hunted wildlife that can be operated by local communities and managers.
  - In combination with the conservation sector, instigate original research on the role of source–sink dynamics of hunted wildlife, including the role of protected areas.
  - Understand the relationships and trade-offs between wild meat and other meat/protein sources for human populations inhabiting distinct faunal areas, such as those identified by Fa *et al.* (2015b) for Central Africa.

areas are no doubt refuges for wildlife and sources of wild meat for adjacent communities but envisaging these areas as fortress conservation spaces may work against the future of wildlife and of long-time resident peoples. Also, it is possible to facilitate sustainable hunting of species that reproduce quickly (such as small ungulates and large rodent species), and where necessary supplementing this with domestic meats at the same time as protecting threatened animals.

Sustainable management of wildlife resources will not happen if interconnected interventions are not deployed to target the management of rural supply of wild meat and most definitely achieve the reduction of

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urban demand. This needs to be achieved by involving local hunting communities, urban consumers and the wider society. Of vital importance is the involvement and stewardship of Indigenous Peoples and local communities who inhabit more than half of the world's land area. Despite these populations being the custodians of existing natural resources, including wildlife, they rarely have formal legal ownership. This lack of land tenure rights makes it hard for communities to protect their lands legally, especially against external commercial hunters and extractive industries (see Pemunta 2019 for Baka in Cameroon). A key prerequisite for ensuring sustainable management of wildlife resources has to be the devolution of land management and tenure rights to local communities. Additionally, government authorities must have the structures, capacities and budgets to support local communities in their management of wildlife, as well as enforce local and national hunting rules. A number of different community-based approaches for managing wildlife that are appropriate in different contexts are already in force including community- or co-managed protected areas, wildlife ranching and community conservancies, Payment for Ecosystem Services (PES) schemes and certification mechanisms (see Coad *et al.* 2019 for examples). Alongside these initiatives, extractive industries as well as extensive agriculture, which now affect a significant proportion of tropical and subtropical habitats should provide food alternatives (such as domestic meat) for staff working in concessions, help to enforce equitable hunting regulations in collaboration with local communities to ensure sustainable local use. Ultimately, they should also prevent the use of concession roads and vehicles by external commercial hunters aiming to supply urban demand.

As stressed by Van Vliet (2018) in all aspects of biodiversity use and protection, it is fundamental to carefully consider the value orientations toward wildlife, bringing often segmented perspectives away from hegemony, and closer to an overall vision for conservation that is broadly inclusive of a full range of wildlife values (Manfredo *et al.* 2016). Taking into account both hegemonic and marginalized ideas about wildlife will reduce the likelihood for conservation abuses in postcolonial contexts (McGregor 2005) and provide a unique opportunity to shift the paradigms in tropical wildlife management. The human stakeholders with the most to lose often have no voice in decision-making. Disturbingly, some conservation practitioners suggest that promoting cultural change regarding wildlife use amongst traditional users is legitimate based on evidence-based scientific knowledge about the 'bushmeat crisis'

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(Dickman *et al.* 2015; Jepson & Canney 2003). Acknowledging the disparities in power relationships, providing the necessary grounds for a fair debate and supporting free decision-making by the legitimate constituency are all necessary steps to avoid 'cultural imperialism' in conservation practice. Failing to do so might increase the potential for social conflict over wild meat management issues. Embracing the richness and complexity of cross-cultural plurality will allow us to take disparate value orientations seriously without privileging anyone (Hovorka 2017). In a period of unparalleled social-ecological change, bringing together the differences in wildlife value orientations between local/international, rural/urban, traditional/western visions is a necessary step in radically reconstructing a new paradigm for a sustainable and culturally respectful wild meat sector.

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