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# BUSHMEAT, WILDLIFE-BASED ECONOMIES, FOOD SECURITY AND CONSERVATION

INSIGHTS INTO THE ECOLOGICAL AND SOCIAL IMPACTS OF  
THE BUSHMEAT TRADE IN AFRICAN SAVANNAHS





Cover photograph courtesy of Ed Sayer

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Lindsey, P., Taylor, W.A., Nyirenda, V., Barnes, J.

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS  
Zimbabwe 2015

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## FOREWORD

This technical publication, titled *Bushmeat, wildlife-based economies, food security and conservation: Insights into the ecological and social impacts of the bushmeat trade in African savannahs*, is the second in an open series of FAO publications on illegal hunting and the bushmeat trade. The publication provides insights into the ecological and social aspects of the bushmeat trade in Africa, as requested by FAO member countries at the 16th and 17th Sessions of the African Forestry and Wildlife Commission (AFWC)\*.

Decision-makers need to know the magnitude of illegal hunting and the bushmeat trade, and the long-term economic and food security benefits. The study responds to this need.



This publication is the result of fruitful collaboration by FAO and Panthera, the Sustainable Use and Livelihoods Specialist Group (SULi) of the International Union for Conservation of Nature (IUCN) and the Zoological Society of London.

It is important to realize that while illegal hunting and the bushmeat trade pose a considerable threat to wildlife conservation, the legal sustainable production of wild meat has the potential to provide long-term benefits for rural livelihoods and contribute to food security in wildlife-rich regions through wildlife-based land uses such as ecotourism, trophy hunting and community-based wildlife farming and ranching.

Success stories exist in some African countries, such as Namibia, where wildlife resources are managed for the benefit of local and national economies. It is important to share these best practices with other countries. It is equally important to document challenges faced by other countries in the areas of illegal hunting and the bushmeat trade in order for the decision-makers and wildlife practitioners to use wildlife effectively as a renewable natural resource, for the benefit of local and global communities.

### **Dr Chimimba David Phiri**

FAO Subregional Coordinator for Southern Africa

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\* The African Forestry and Wildlife Commission (AFWC) is one of the six regional forestry commissions of the Food and Agriculture Organization (FAO). The AFWC provides a policy and technical forum for the countries of the African region to discuss and address forest and wildlife issues and priorities on a regional basis.

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# ACRONYMS

<b>AFWC</b>	Africa Forestry and Wildlife Commission
<b>DWNP</b>	Department of Wildlife and National Parks
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>GDP</b>	gross domestic product
<b>IUCN</b>	International Union for Conservation of Nature
<b>KWS</b>	Kenya Wildlife Service
<b>NGO</b>	non-governmental organization
<b>PA</b>	protected area
<b>SADC</b>	Southern African Development Community
<b>SULi</b>	Sustainable Use and Livelihoods Specialist Group
<b>UNDP</b>	United Nations Development Programme
<b>UNEP</b>	United Nations Environment Programme
<b>UNEP-WCMC</b>	United Nations Environment Programme’s World Conservation Monitoring Centre
<b>WDPA</b>	World Database on Protected Areas
<b>WWF</b>	World Wide Fund for Nature
<b>ZAWA</b>	Zambia Wildlife Authority

## EXECUTIVE SUMMARY

The bushmeat trade is a serious but underappreciated conservation threat in African savannahs. While bushmeat hunting has been practiced by humans for subsistence for millennia, increases in human populations mean that harvests are often no longer sustainable. Furthermore, hunting for bushmeat is increasingly conducted on a commercial basis to obtain meat for sale. Illegal hunting for bushmeat constitutes one of the primary threats to wildlife conservation in Africa today. Many wildlife areas are now suffering from the dual threat of illegal hunting for bushmeat and illegal hunting for non-meat trophies such as ivory and rhino horn, with catastrophic consequences for the ecology of those areas, and for the potential for deriving long-term economic and livelihood benefits from wildlife.

With funding from FAO, Panthera, the Zoological Society of London, the Howard G. Buffet Foundation and the IUCN CEESP/SSC Sustainable Use and Livelihoods Specialist Group, a study was conducted to assess the ecological impacts of the bushmeat trade in Southern and East Africa, to assess the economic and social impacts of the phenomenon, to identify key challenges associated with addressing the issue and to suggest solutions. Methods included surveys of experts associated with protected areas, literature reviews and in-depth case studies involving two Southern African Development Community (SADC) countries. The identity of those two countries was kept anonymous because the issues highlighted are widespread and so as not to imply that they are the only countries facing such challenges. The two countries are referred to as 'Country A' and 'Country B'.

### Ecological, social and economic impacts

#### Ecological impacts

- In spite of the massive spike in illegal hunting of elephants and rhinos that has been experienced in several countries in recent years, illegal hunting for bushmeat was identified as the single most serious threat to wildlife in protected areas in several countries during a survey of experts affiliated with those areas (n=133).
- For example, experts affiliated with protected areas indicated that they considered illegal hunting for bushmeat to be the most serious threat to wildlife in protected areas in Botswana, Malawi, Mozambique, in several West African countries (which, on account

of small sample sizes, were lumped together) and Zambia, and the second most serious threat to wildlife in Tanzania, Zimbabwe and Central African countries (after poaching for non-meat wildlife products such as ivory).

- There are increasing indications from the literature that illegal hunting for bushmeat is a major contributor to wildlife population declines, including in several countries in Southern and East Africa traditionally perceived to be strongholds for wildlife.
- Case studies of two SADC countries highlighted that wildlife populations in national parks are depressed to an average of <20 percent of potential carrying capacity.
- The analysis indicates that these declines cannot simply be attributed to illegal hunting of elephants and rhinos and that many other wildlife species have been affected by illegal hunting.
- While there has been massive global and regional attention on the issue of elephant and rhino poaching and an inflow of resources to address those issues, the bushmeat problem has received little focus despite arguably being of similar severity.

*There are increasing indications from the literature that illegal hunting for bushmeat is a major contributor to wildlife population declines, including in several countries in Southern and East Africa traditionally perceived to be strongholds for wildlife.*

#### Economic impacts

- Illegal hunting for bushmeat and ivory is having a serious impact on tourism-based revenues from wildlife and undermining scope for wildlife-based land uses outside of protected areas.
- For Country A, overall income from trophy hunting and ecotourism is just 5.6 percent and 13 percent of potential income if wildlife populations were allowed to recover and used for those land uses in hunting blocks and national parks respectively, resulting in the loss of hundreds of millions of dollars per year.
- For Country B, overall income from trophy hunting and ecotourism is just 25.4 percent and

*By suppressing wildlife populations below levels where significant harvests are possible, illegal hunting greatly undermines potential for generating sustainable, legal harvests of wild meat.*

18 percent of potential income if wildlife populations were allowed to recover and used for those land uses in hunting blocks and national parks respectively, resulting in the loss of tens of millions of dollars per year.

- These reductions in revenue result in a concomitant reduction in income for communities (see ‘Social impacts’)
- As a word of caution, these estimates do not take into account reduction in potential income from wildlife that arises in some cases owing to human encroachment and habitat loss in protected areas, or potential limits to the demand for ecotourism and hunting tourism.
- Nonetheless, they do stress the point that very significant foregone revenues result from the depression of wildlife populations on account of illegal hunting.

#### **Social impacts**

- The case studies highlighted that the bushmeat trade does create livelihoods for many impoverished people but these benefits are modest, largely unsustainable and come at a high price.
- Illegal hunting for bushmeat and trophies currently makes logical sense for communities in many areas because of lack of opportunities to derive benefits from wildlife legally.
- For example, in Countries A and B many local communities are likely able to derive more income from illegal hunting than they do from either legal trophy hunting or ecotourism.
- However, in both countries, the potential benefits to communities from legal wildlife uses such as ecotourism and trophy hunting could be considerably higher than through illegal hunting if wildlife populations were allowed to recover, utilized legally and systems put in place to allow communities an equitable share in the benefits.
- In Country A and Country B, communities forego tens of millions of dollars and several million dollars

of potential income respectively, from ecotourism in national parks and trophy hunting in hunting blocks.

- These figures were calculated if one compares communities’ current earnings from tourism, trophy hunting and illegal hunting versus what could be earned if wildlife populations were allowed to recover to their carrying capacities and communities given a more equitable share of the benefits.
- Similarly, by suppressing wildlife populations below levels where significant harvests are possible, illegal hunting also greatly undermines potential for generating sustainable, legal harvests of wild meat.
- For example, in Country A and Country B, the total volume and value of meat extracted from the nation’s hunting blocks under current conditions (including both legal and illegal offtakes) is just 14.0 percent and 41.8 percent respectively of what could be extracted if those areas were comprehensively protected from illegal hunting and wildlife populations were allowed to recover and harvested legally and sustainably.
- This results in the loss of 13.7 million kg of meat and tens of millions of dollars per year in Country A.
- This results in a loss of 1.57 million kg of meat and millions of dollars per year in Country B.
- Illegal hunting for bushmeat almost certainly confers net negative livelihood and food security impacts because it results in the net loss of revenue, jobs and meat for communities and for nations as a whole.

#### **Challenges that make the bushmeat issue so difficult to address**

##### ***There is so much land and wildlife to protect***

- Several African countries have set aside a higher proportion of land for conservation than the international average.
- In addition, the average size of protected areas in Africa is larger than the international average.
- The burden of protected areas relative to national wealth (area relative to GDP per capita) is higher in many African countries than in the world as a whole.



- In addition, many African countries retain significant wildlife populations outside of protected areas.
- Unsurprisingly therefore, many African countries struggle to fund conservation efforts sufficiently, leaving wildlife vulnerable to illegal hunting and other human threats.

### ***Inadequate legal frameworks and implementation of the law***

- A key challenge to addressing the bushmeat trade is that penal codes pertaining to the illegal hunting of wildlife for meat are often inadequate or inconsistently applied.
- An additional problem is legal frameworks that pose barriers to wildlife-based land uses, and which exclude communities from the benefits of legal use of wildlife.
- Combined, these issues create a situation where it often makes logical sense for communities to engage in illegal hunting.

### ***Inherent developmental issues related to the bushmeat trade***

- The bushmeat trade is inherently tied to developmental challenges such as human population growth, unemployment, poverty and food insecurity.
- The relationship between household wealth and participation in illegal hunting and bushmeat consumption is complicated and variable.
- However, in some instances, improving wealth results in increasing demand for bushmeat, so while poverty alleviation, the provision of employment and alternative supplies of protein can be useful approaches in some cases, they are not enough in isolation to address the bushmeat issue.

### ***Increasing demand for bushmeat and lack of legal supplies***

- With increasing human populations and increasing affluence (particularly in urban areas), the demand for bushmeat is growing, causing an increasing commercialization of the bushmeat trade.
- In most African countries there is a lack of legal supplies of bushmeat, which forces people to rely on that sourced from illegal hunting, which is an inefficient and wasteful use of wildlife resources.

### ***The challenge associated with incorporating communities into conservation***

- Incorporating communities into conservation can be challenging for a variety of reasons, including the reluctance of state wildlife authorities to devolve user-rights to communities in some countries.
- This reluctance arises, in some cases, because state wildlife authorities receive little or no funding from central government and are thus dependent on income extracted from wildlife to cover operational costs.
- This situation forces state wildlife authorities to exclude communities from the benefits of legal wildlife use, which creates a cycle which marginalizes communities and encourages illegal hunting, which results in declining revenues to the authorities and thus a waning ability to protect the resource.
- Other challenges associated with engaging communities in conservation include communal land tenure systems and lack of exclusive rights over land and natural resources, and the challenge associated with allocating sufficient benefits to individuals within communities to offset potential benefits from illegal hunting.

*With increasing human populations and increasing affluence (particularly in urban areas), the demand for bushmeat is growing, causing an increasing commercialization of the bushmeat trade.*

### ***Expansion of human populations and lack of land-use planning***

- In some places, human incursion into formerly wild lands (including protected areas) is exacerbating the threat from illegal hunting and the bushmeat trade and making wildlife more difficult to protect.
- This incursion takes the form of expansion of human settlements and agricultural lands and the pushing of livestock into protected areas, all of which create conditions where wildlife is more susceptible to illegal hunting.
- There is often a lack of land-use planning associated with the expansion of human populations, which results in interspersed human settlements and wildlife and open-access systems which are often conducive to human-wildlife conflict and illegal hunting, and not conducive to creating incentives for communities to conserve wildlife.

### ***The growing opposition to sustainable use of wildlife***

- The growing popular backlash (particularly in the Western world) against sustainable use approaches in conservation in Africa poses a risk to efforts to control illegal hunting in the absence of alternative funding streams.
- If legal means for communities to derive benefits from wildlife are closed off through steps such as trade restrictions on hunting trophies or hunting bans imposed on a national level, then the options for local people to derive benefits from wildlife other than through illegal hunting are narrowed.

### **Solutions to address the bushmeat trade**

#### ***Greater effort from African governments and the international community***

- African governments and the international community are urged to make as significant a commitment as possible to address the bushmeat problem, in light of the severe associated ecological, economic and social issues that arise from it.

*African governments and the international community are urged to make as significant a commitment as possible to address the bushmeat problem.*

- The issue represents a crisis from both a development and conservation perspective and is deserving of attention from donors from both spheres.
- Providing support to address the bushmeat issue is congruent with the obligations of signatory nations to multilateral agreements such as the Millennium Development Goals, the CBD Aichi targets and the UN Sustainable Development Goals.

A range of interventions are needed, and the most important ones are considered to include:

#### ***The case for elevated local and international funding for conservation***

- Providing elevated funding and technical support for the management of protected areas is essential to allow for effective anti-poaching and anti-trafficking of bushmeat and other wildlife products.

#### ***The need for alternative funding streams for conservation***

- There is a limit to the potential of traditional forms of wildlife use, such as ecotourism and trophy hunting, to generate incentives for conservation.
- Consequently, there is an urgent need to find alternative funding streams for African conservation.
- Possibilities include payments to communities, landowners and governments for provision of environmental services or carbon sequestration, or 'debt for nature' schemes where countries are given debt relief in exchange for setting aside land for wildlife or protecting wildlife from overuse.
- However, such measures will almost certainly require elevated support for African conservation from the international community.

### *The need for legislative reforms*

There is a need for:

- Revision of laws to allow tighter control of illegal hunting and trade in bushmeat so that the penalties provide an adequate deterrent and exceed the value of the resource.
- Investing in the training of law enforcement officers and the judiciary.
- Revision of laws to empower communities to benefit legally from wildlife.
- Revision of laws to promote wildlife-based land uses on state, private and communal lands.
- Legal frameworks that encourage the legal and sustainable production of wild meat in a manner that involves and benefits communities, so that consumers do not have to source the product from illegal hunters.

### *The need for community engagement in conservation*

- Provide scope for communities to benefit from wildlife in as many different contexts as possible. Possible examples include:
  - Allocating ownership of tourism or hunting concessions in protected areas (or semi-protected areas) to communities.
  - Encouraging the creation of community conservancies/wildlife management areas on communal or state lands where communities can retain the benefits from wildlife use.
  - Encouraging partnerships between communities and the private sector in areas where communities live near private wildlife ranches.
- To allow communities to benefit adequately from wildlife, there is a need to reduce reliance of state wildlife authorities on revenues generated from protected areas through hunting and tourism, by providing central government funding for the functioning of those agencies.
- By 'letting go' of some of the revenues from wildlife (and all of the income where wildlife occurs on community lands), African governments will help to stimulate wildlife-based land uses and the tourism industry, create incentives for conservation, create employment, help generate economic growth and alleviate poverty among communities.

- There is a need for the international donor community and African governments to invest funding and technical support for the development of community-based wildlife initiatives.
- Law enforcement efforts should enlist communities as key allies by working with them and creating frameworks that make protecting wildlife in their interest.
- Ensure that wildlife and wildlife areas are as valuable as possible to communities, land owners and the state through as many legal means as possible.
- Invest in tourism-related infrastructure to enhance the legal benefits that accrue to communities through living near or with wildlife.
- Invest in educational programmes so that the general public understand the importance of wildlife to economies through tourism, and understand the negative impacts associated with illegal hunting and consuming meat sourced from illegal hunting.

### *The need for land-use planning*

- Land-use planning can be a key strategy for maximizing the efficiency with which land is used, and for reducing both human-wildlife conflict and illegal hunting.
- Land-use planning can ensure the retention of wild areas on community lands and thus retain scope for communities to benefit legally from wildlife conservation.
- Land-use planning on community lands can help ensure that communities retain exclusive access to their land and wildlife resources, thus preventing the 'tragedy of the commons' that often arises on community lands and which contributes to the bushmeat crisis.
- In protected areas, land-use planning can help to minimize encroachment by humans and livestock and make it easier to protect wildlife from illegal hunting.

The above steps represent ways that international donors and African governments could help to achieve sustainable rural development and poverty reduction in rural areas, while helping to address the crisis posed by illegal hunting and the bushmeat trade.



## INTRODUCTION

Africa has a vast protected area network and the continent hosts some of the highest diversities and densities of large mammals in the world. However, human populations on the continent are growing rapidly, placing increasing pressure on natural resources. African governments are struggling to allocate adequate funding to conservation efforts, partly because of the vast size of many of their protected area networks and partly on account of being faced with a slew of competing priorities (James *et al.*, 1999; Mansourian and Dudley, 2008).

Consequently, wildlife populations in Africa face a growing array of anthropogenic threats, such as human encroachment of land, habitat destruction and poaching of wildlife for high-value trophies such as rhino horn and ivory (Watson *et al.*, 2014; Wittemeyer *et al.*, 2014). An additional problem and a key driver of biodiversity loss is the illegal hunting of wildlife for bushmeat (Barnett, 2002; Lindsey *et al.*, 2013).

The bushmeat trade has long been recognized as being a serious problem in the forest biomes of Africa (Wilkie *et al.*, 1999; Fa *et al.*, 2003). More recently, the issue has also been recognized as having serious impacts in savannah

biomes (Lindsey *et al.*, 2013). Illegal hunting is typically conducted by young men using one or a combination of snares, traps, various types of firearms, dogs and fire to obtain meat for consumption or sale (Noss, 1998; Lindsey *et al.*, 2011; Becker *et al.*, 2013). The involvement of women in the bushmeat trade tends to be in the context of butchering and marketing bushmeat and in some cases, encouraging men to hunt (Le Breton *et al.*, 2006; Lowassa *et al.*, 2012). Illegal hunting is conducted on a continuum from that done merely to generate meat for subsistence, to that done for subsistence and for local trade, that done for trade to urban centres, and in some cases for trade to international cities (Chaber *et al.*, 2010; Lindsey *et al.*, 2013).

Bushmeat harvests are becoming increasingly commercial in nature, placing growing pressure on wildlife populations (Barnett, 2000; Andimile and Eves, 2009; Stiles, 2011). As populations of wildlife outside protected areas wane, the focus of bushmeat poachers is increasingly upon protected areas (Andimile *et al.*, 2012). Consequently, in addition to imparting severe ecological impacts such as reductions in the diversity and density of wildlife, illegal hunting and the bushmeat trade have potential to affect local and national economies negatively by destroying the resource on which tourism industries depend.

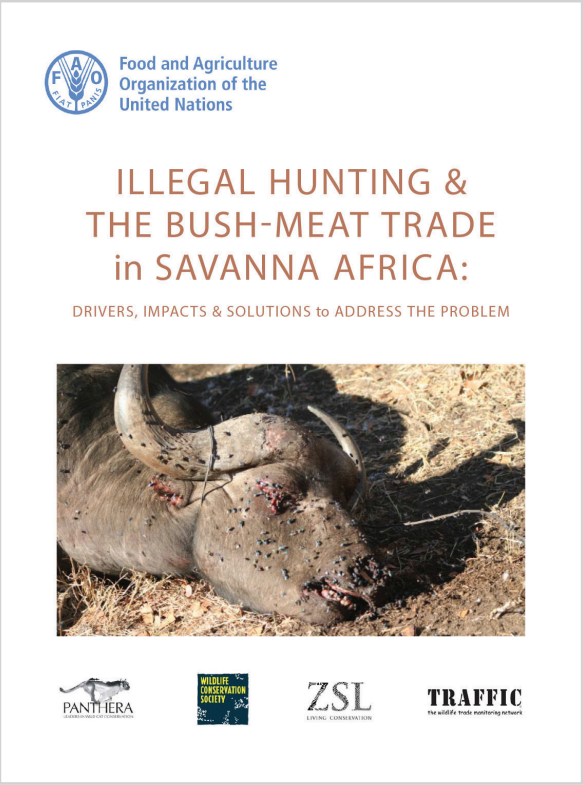


Large-scale commercial harvesting of bushmeat poses a growing threat to wildlife in Africa. (Photo: Ed Sayer)

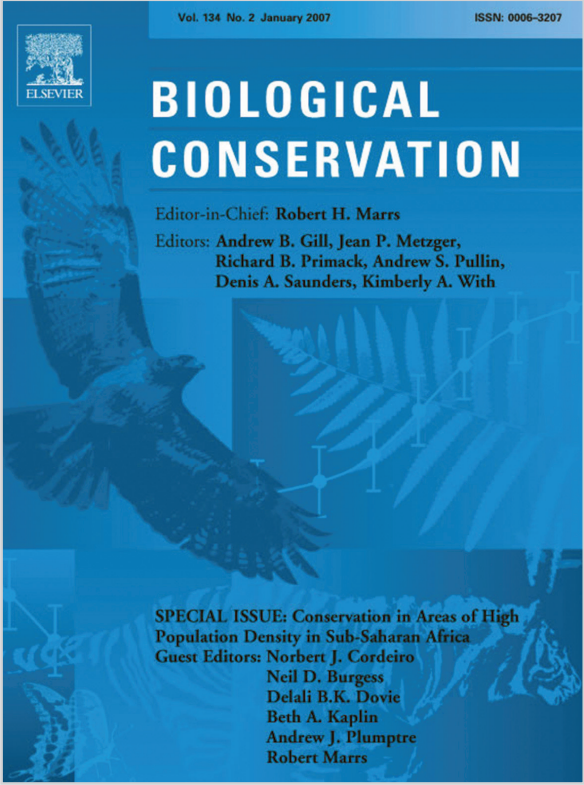
INTRODUCTION

In recent years there has been increasing research focus into the bushmeat trade in African savannahs. In most cases, research has involved case studies which have assessed the social and economic drivers for and impacts of the bushmeat trade on local scales (e.g. Lindsey *et al.*, 2011; Nielsen *et al.*, 2011, Rentsch *et al.*, 2013). However, there has been little effort to quantify the ecological, social and economic impacts on larger scales, which makes it difficult for policy-makers to appreciate the severity of the problem. To address that informational shortage, a brainstorming workshop was organized by Panthera, the Zoological Society of London and the Wildlife Conservation Society in Johannesburg, South Africa in May 2012. The participants presented available data and came to a consensus on steps necessary to address the problem (Lindsey *et al.*, 2013).

Later that year, those findings were disseminated and discussed at a second meeting supported by FAO through its technical cooperation programme involving the SADC secretariat, top officials from SADC member state wildlife agencies and representatives from conservation NGOs. Arising from that meeting were a set of guiding principles on how to address the challenge of illegal hunting and the bushmeat trade (see the annexures in Lindsey *et al.*, 2012). Government attendees at the second meeting requested more evidence of the impacts of illegal hunting for bushmeat to demonstrate the severity of the issue to their superiors. This study arose from that request, and the ecological, economic and social impacts of the bushmeat trade are assessed and the severity of the problem documented. In addition, several of the challenges that make the bushmeat trade such a complex problem to address are reviewed and some solutions necessary to address the issue suggested.



This report compiled available knowledge on the bushmeat trade in African savannahs following the May 2012 meeting



The report was subsequently published in the international journal, *Biological Conservation*



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## METHODS IN A NUTSHELL

Several methods were used to identify the impacts of the bushmeat trade, understand the key challenges associated with addressing the problem and to suggest solutions necessary to address the issue (readers are referred to the detailed methodology presented in Appendix 1, which will assist with interpretation of the results presented).

Firstly, in mid-2015 a questionnaire survey of protected area managers or experts (researchers, NGO staff, tourism industry representatives) associated with protected areas (n=133) in various African countries was conducted via telephone or email (in cases where respondents were located in areas with poor communications), in which respondents were asked to assess how serious the bushmeat issue is relative to other threats. Note that owing to small sample sizes, West African (Benin, Burkina Faso, Senegal, Niger) and Central African countries (Cameroon, Central African Republic, Chad) were lumped into two regional categories.

Secondly, available literature on the bushmeat trade and the associated challenges was reviewed to provide insights into the ecological, economic and social impacts.

Thirdly, detailed case studies of the ecological, economic and social impacts of the bushmeat trade were conducted from two SADC nations that were kind enough to provide the required data. These case studies involved:

- Comparing the biomass of wildlife as determined from aerial surveys with the estimated biomass that those areas could support based on soil and rainfall.

- Comparing the total current earnings in hunting blocks and national parks/reserves from illegal hunting (inferred maximum potential offtakes), ecotourism and trophy hunting with total potential earnings if wildlife populations were allowed to recover and used legally for hunting and ecotourism.
- Comparing the current earnings derived by communities from wildlife through illegal hunting, ecotourism and trophy hunting with potential community earnings if wildlife populations were allowed to recover and harvested sustainably and if communities were granted a more equitable share of the earnings.

The identity of the nations used for the case studies is kept anonymous so as not to imply that the challenges being faced are particular to those nations; on the contrary, they are common to most other countries in the region. Consequently, those nations are referred to as Country A and Country B.

Fourthly, the scale of Africa's protected area network relative to other parts of the world was quantified as a means of quantifying and contextualizing the scale of the challenge associated with protecting wildlife on the continent.

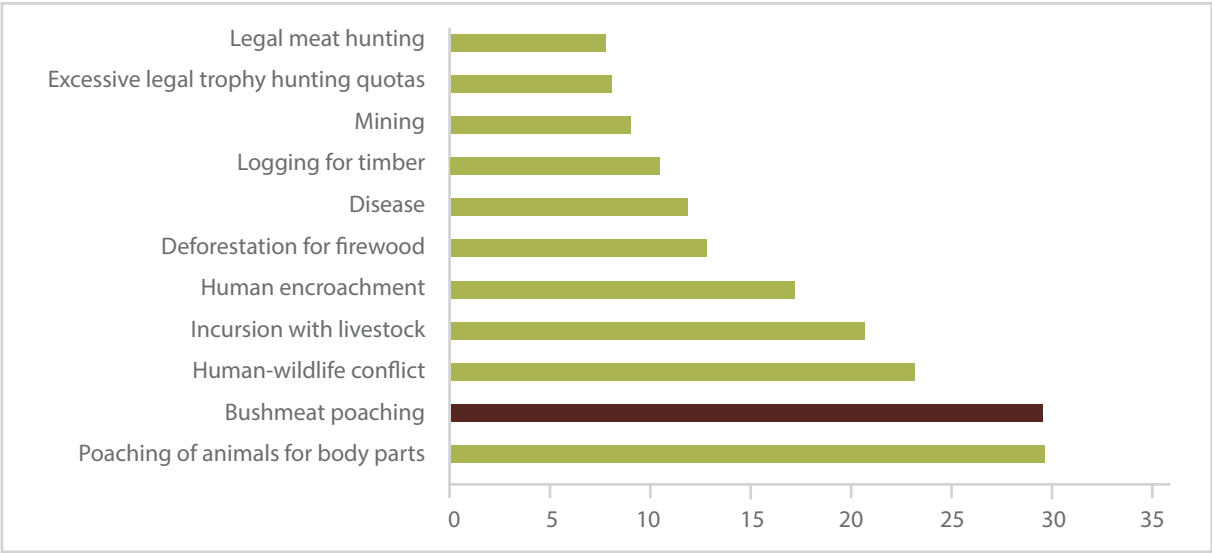
Lastly, the literature was reviewed to identify key challenges associated with addressing the bushmeat trade and key solutions necessary to address the issue.

# RESULTS AND DISCUSSION

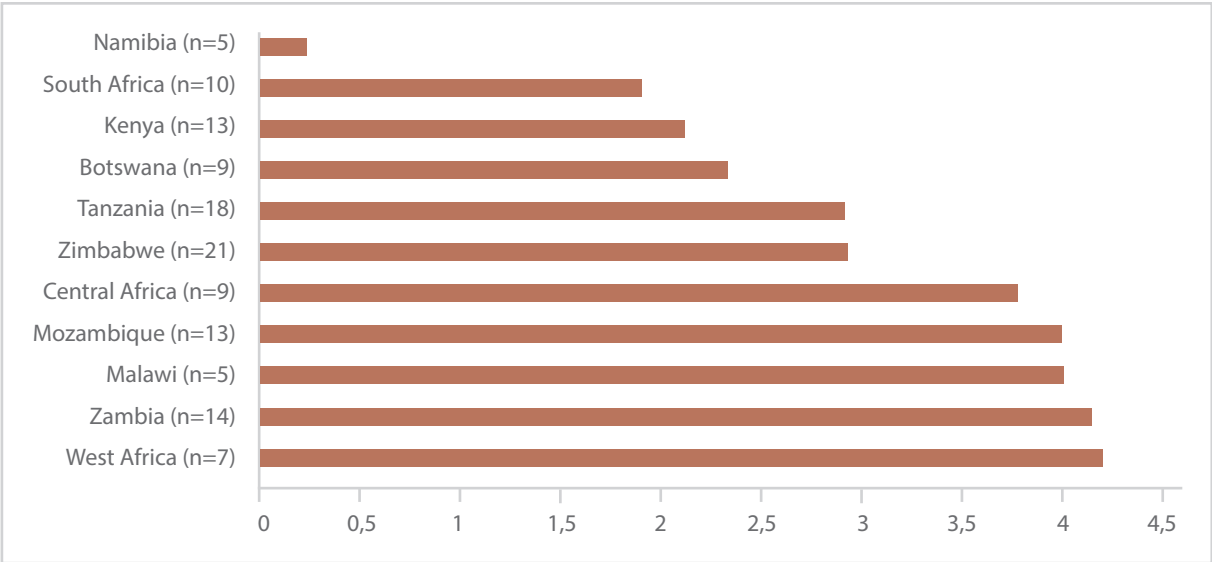
## The ecological impacts of the bushmeat trade

### Insights from questionnaire surveys

Illegal hunting for bushmeat and illegal hunting for non-meat body parts were identified by survey respondents as being the most severe threats to wildlife in protected areas (n=133) (Figure 1). Illegal hunting was considered to be most serious in West African protected areas, followed by those in Zambia, Malawi, Mozambique and Central Africa (Figure 2).

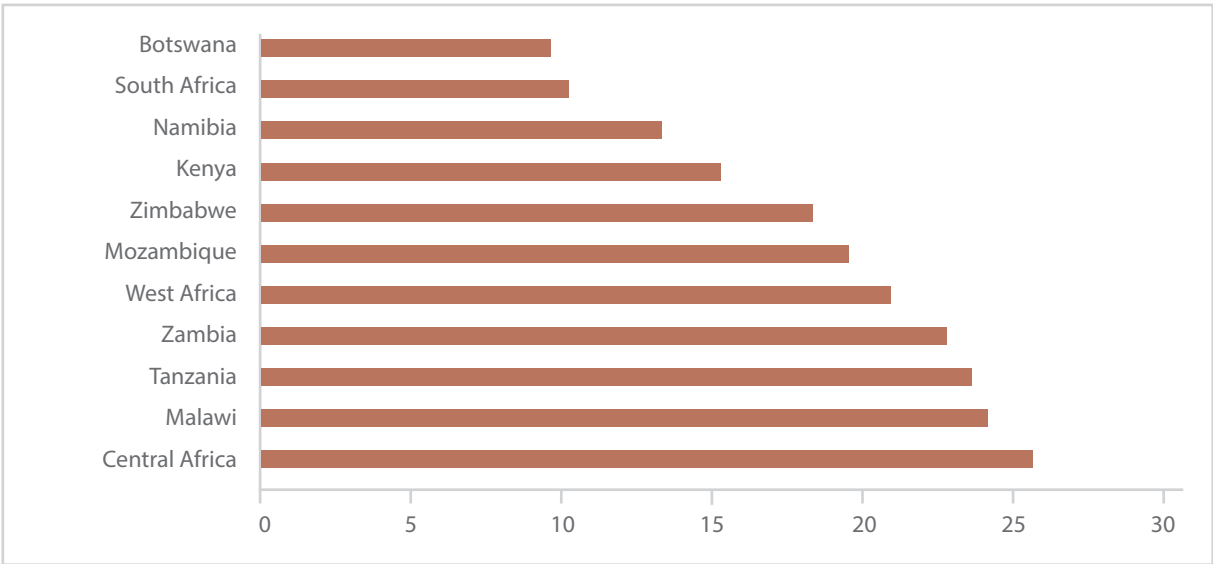


**Figure 1.** The relative severity of various threats to wildlife in protected areas across all countries (n=11 countries/regions [West and Central African countries were lumped into regions due to small sample sizes for individual countries within those regions], n=133 protected areas). Respondents were asked to indicate the severity of each threat to wildlife in the protected area on a scale of 0-5 (where 5 is very serious, and 0 not an issue at all). The scores were averaged for each country and those average scores added up to provide a total score for each threat.



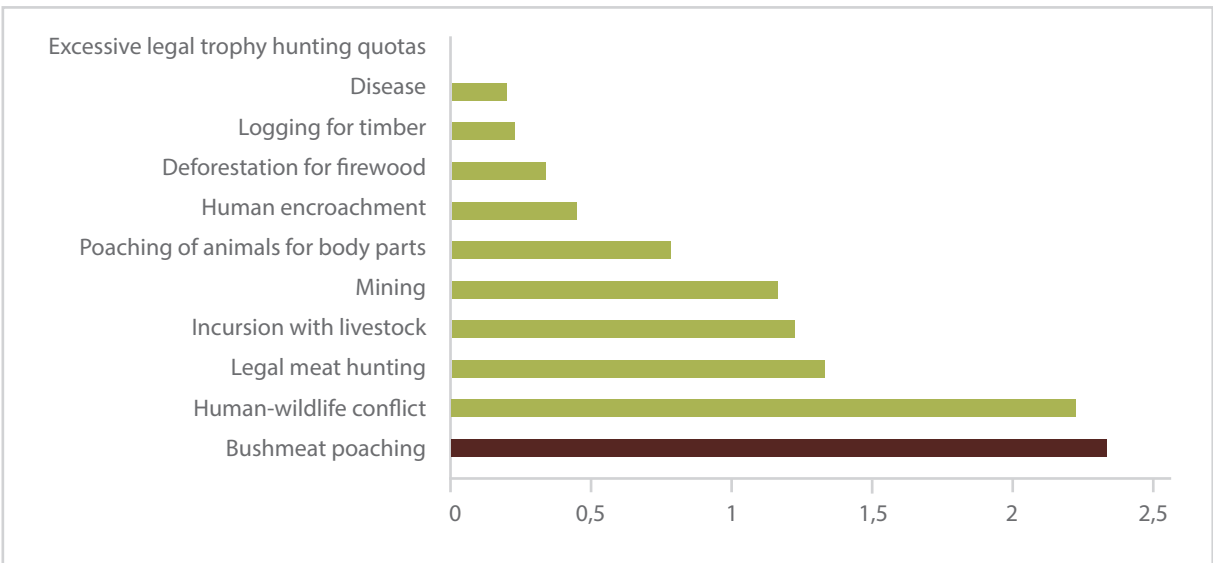
**Figure 2.** Mean scores given to illegal bushmeat hunting as a threat to wildlife in protected areas during a survey of experts affiliated with each protected area (n=133). Respondents were asked to indicate the severity of each threat to wildlife in the protected area on a scale of 0-5 (where 5 is very serious, and 0 not an issue at all)

Wildlife in protected areas was considered to be most under threat in Central African countries, in Malawi, Tanzania and Zambia, and least under threat in Botswana, South Africa, Namibia and Kenya (Figure 3).

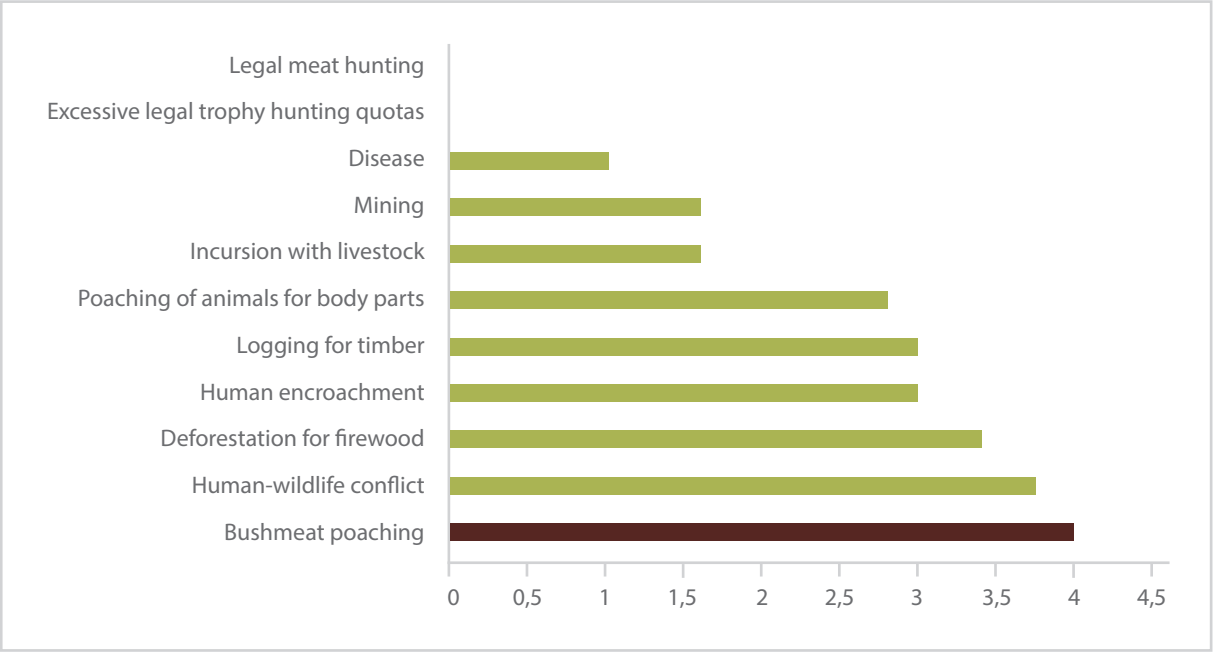


**Figure 3.** Experts affiliated with protected areas were asked to provide a score of 0-5 to each of a number of threats to wildlife in those areas (where 0 is no threat and 5 is a very serious threat) (n=133 protected areas). The scores for each threat were averaged across protected areas in each country and the averages for each threat in each country added up to provide a total ‘threat score’ for each country. The threat score provides insights into the scale of overall threats to protected areas among countries.

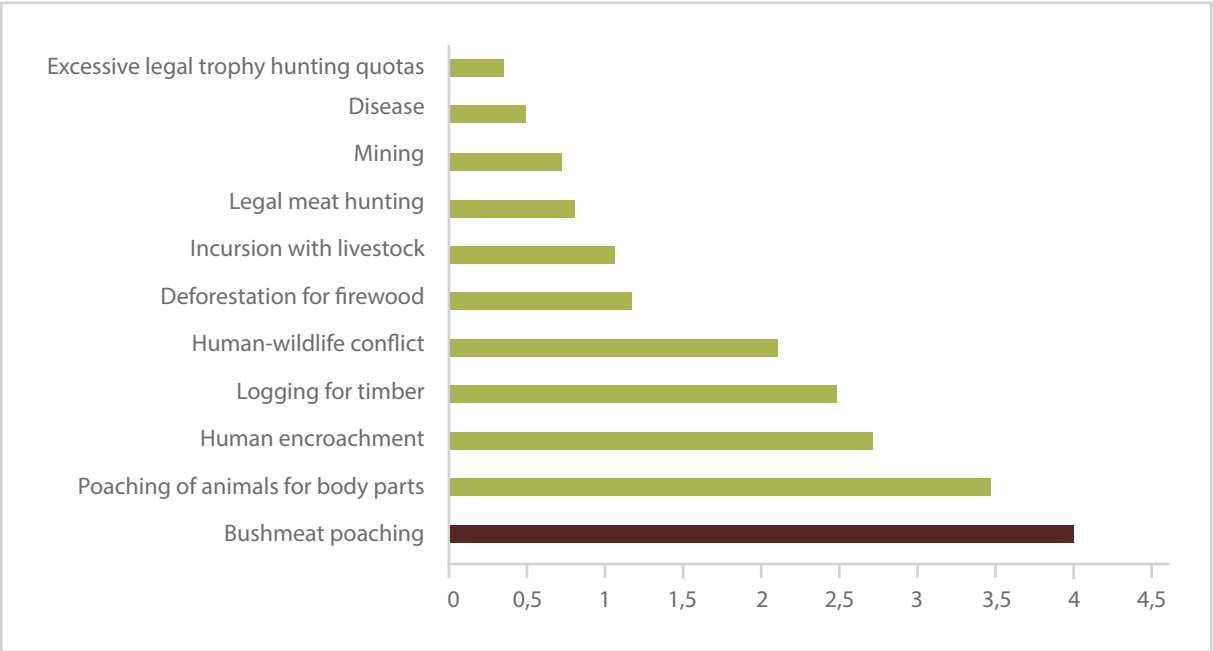
When one considers the results specific to each country or region, illegal hunting for bushmeat was considered to be the most serious threat facing wildlife in protected areas in Botswana, Malawi, Mozambique, Zambia and West Africa (Figures 4-7); the second most serious issue in Tanzania, Zimbabwe and Central Africa; and a less serious issue in South Africa, Kenya and Namibia (Figures 8-13).



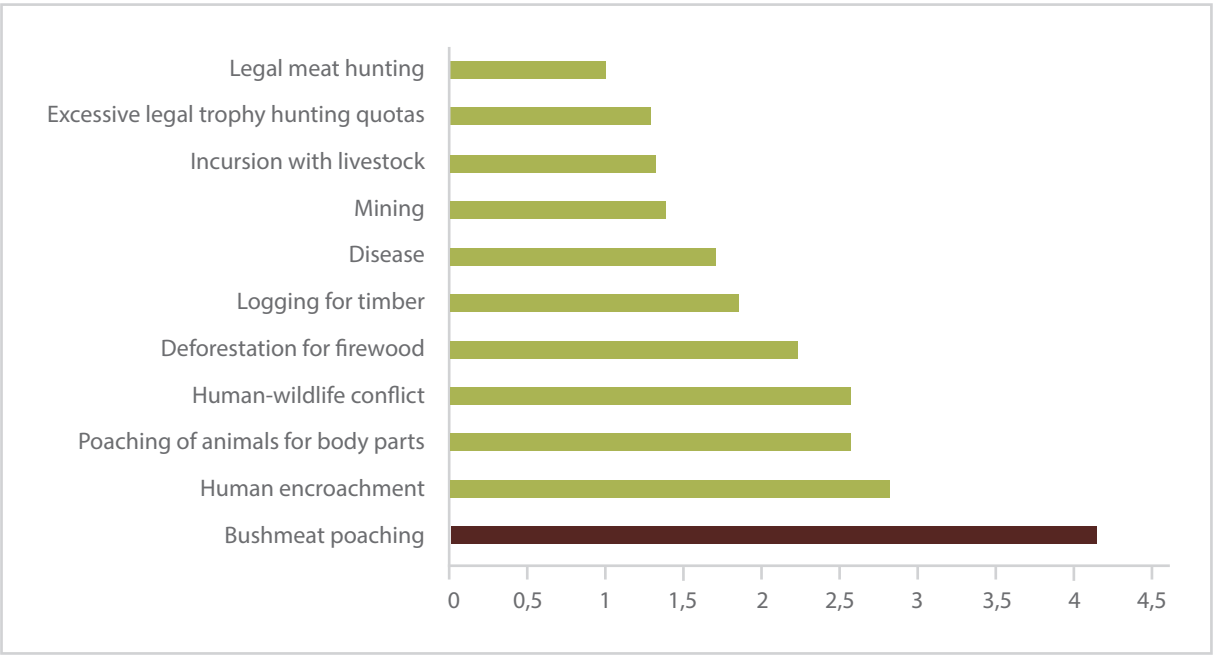
**Figure 4.** The average scores given to each threat facing wildlife in protected areas in **Botswana**, where data were derived from questionnaire surveys involving experts affiliated with protected areas (n=9). Respondents were asked to indicate the severity of each threat to wildlife in the protected area on a scale of 0-5 (where 5 is very serious, and 0 not an issue at all)



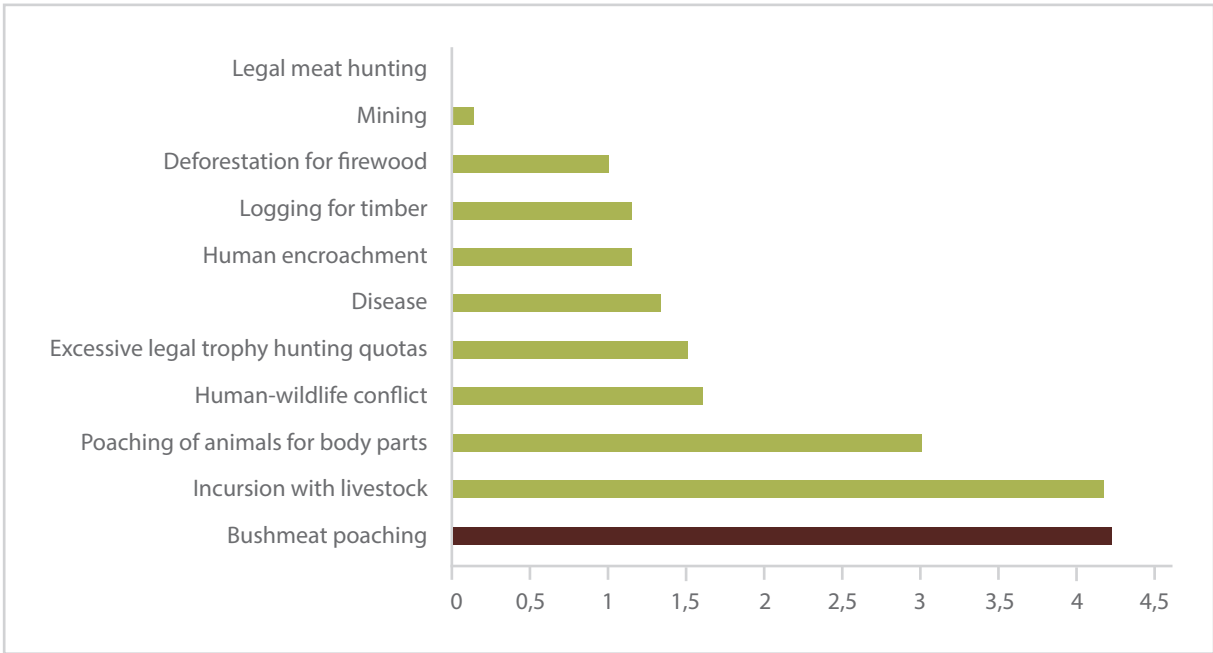
**Figure 5.** The average scores given to each threat facing wildlife in protected areas in **Malawi**, where data were derived from questionnaire surveys involving experts affiliated with protected areas (n=5). Respondents were asked to indicate the severity of each threat to wildlife in the protected area on a scale of 0-5 (where 5 is very serious, and 0 not an issue at all)



**Figure 6.** The average scores given to each threat facing wildlife in protected areas in **Mozambique**, where data were derived from questionnaire surveys involving experts affiliated with protected areas (n=14). Respondents were asked to indicate the severity of each threat to wildlife in the protected area on a scale of 0-5 (where 5 is very serious, and 0 not an issue at all)



**Figure 7.** The average scores given to each threat facing wildlife in protected areas in **Zambia**, where data were derived from questionnaire surveys involving experts affiliated with protected areas (n=14). Respondents were asked to indicate the severity of each threat to wildlife in the protected area on a scale of 0-5 (where 5 is very serious, and 0 not an issue at all)



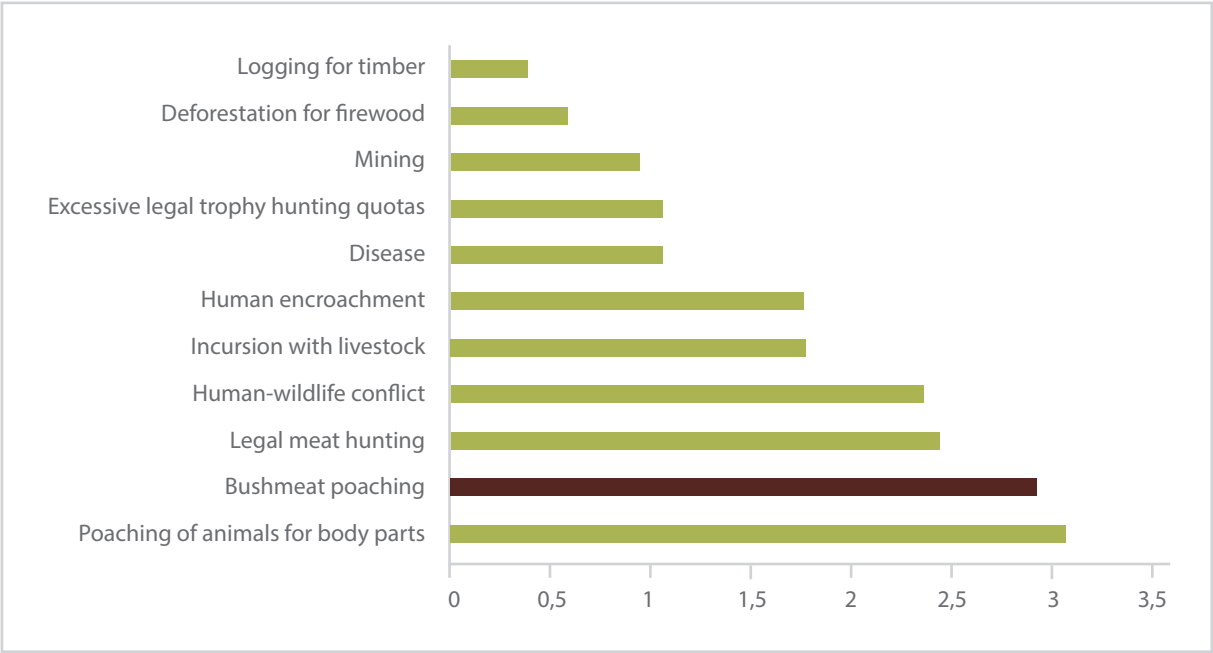
**Figure 8.** The average scores given to each threat facing wildlife in protected areas in **West Africa**, where data were derived from questionnaire surveys involving experts affiliated with protected areas (n=7). Respondents were asked to indicate the severity of each threat to wildlife in the protected area on a scale of 0-5 (where 5 is very serious, and 0 not an issue at all)



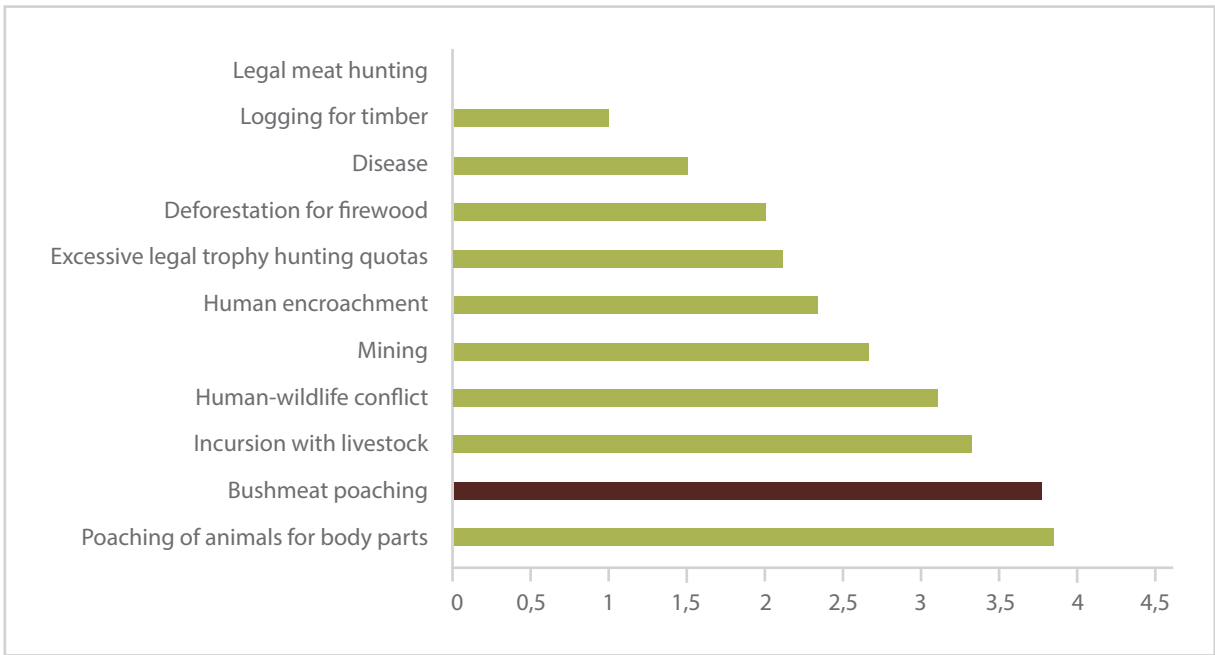
RESULTS AND DISCUSSION



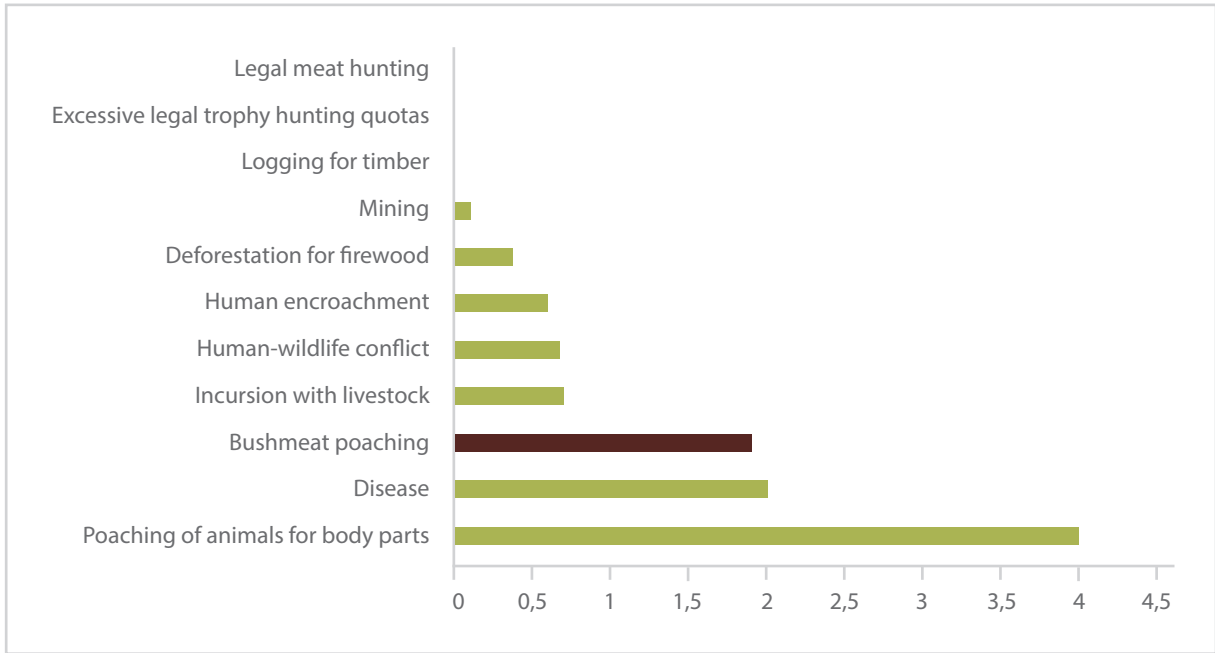
**Figure 9.** The average scores given to each threat facing wildlife in protected areas in **Tanzania**, where data were derived from questionnaire surveys involving experts affiliated with protected areas (n=18). Respondents were asked to indicate the severity of each threat to wildlife in the protected area on a scale of 0-5 (where 5 is very serious, and 0 not an issue at all)



**Figure 10.** The average scores given to each threat facing wildlife in protected areas in **Zimbabwe**, where data were derived from questionnaire surveys involving experts affiliated with protected areas (n=21). Respondents were asked to indicate the severity of each threat to wildlife in the protected area on a scale of 0-5 (where 5 is very serious, and 0 not an issue at all)



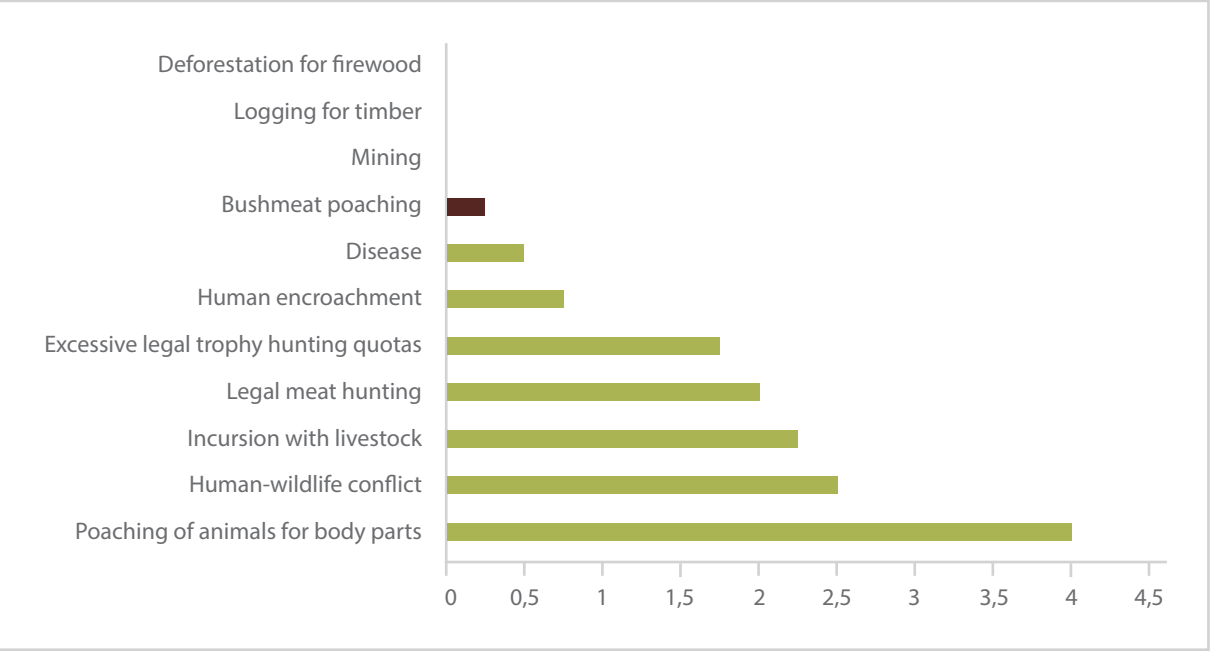
**Figure 11.** The average scores given to each threat facing wildlife in protected areas in **Central Africa**, where data were derived from questionnaire surveys involving experts affiliated with protected areas (n=9). Respondents were asked to indicate the severity of each threat to wildlife in the protected area on a scale of 0-5 (where 5 is very serious, and 0 not an issue at all)



**Figure 12.** The average scores given to each threat facing wildlife in protected areas in **South Africa**, where data were derived from questionnaire surveys involving experts affiliated with protected areas (n=10). Respondents were asked to indicate the severity of each threat to wildlife in the protected area on a scale of 0-5 (where 5 is very serious, and 0 not an issue at all)



**Figure 13.** The average scores given to each threat facing wildlife in protected areas in **Kenya**, where data were derived from questionnaire surveys involving experts affiliated with protected areas (n=13). Respondents were asked to indicate the severity of each threat to wildlife in the protected area on a scale of 0-5 (where 5 is very serious, and 0 not an issue at all)



**Figure 14.** The average scores given to each threat facing wildlife in protected areas in **Namibia**, where data were derived from questionnaire surveys involving experts affiliated with protected areas (n=5). Respondents were asked to indicate the severity of each threat to wildlife in the protected area on a scale of 0-5 (where 5 is very serious, and 0 not an issue at all)

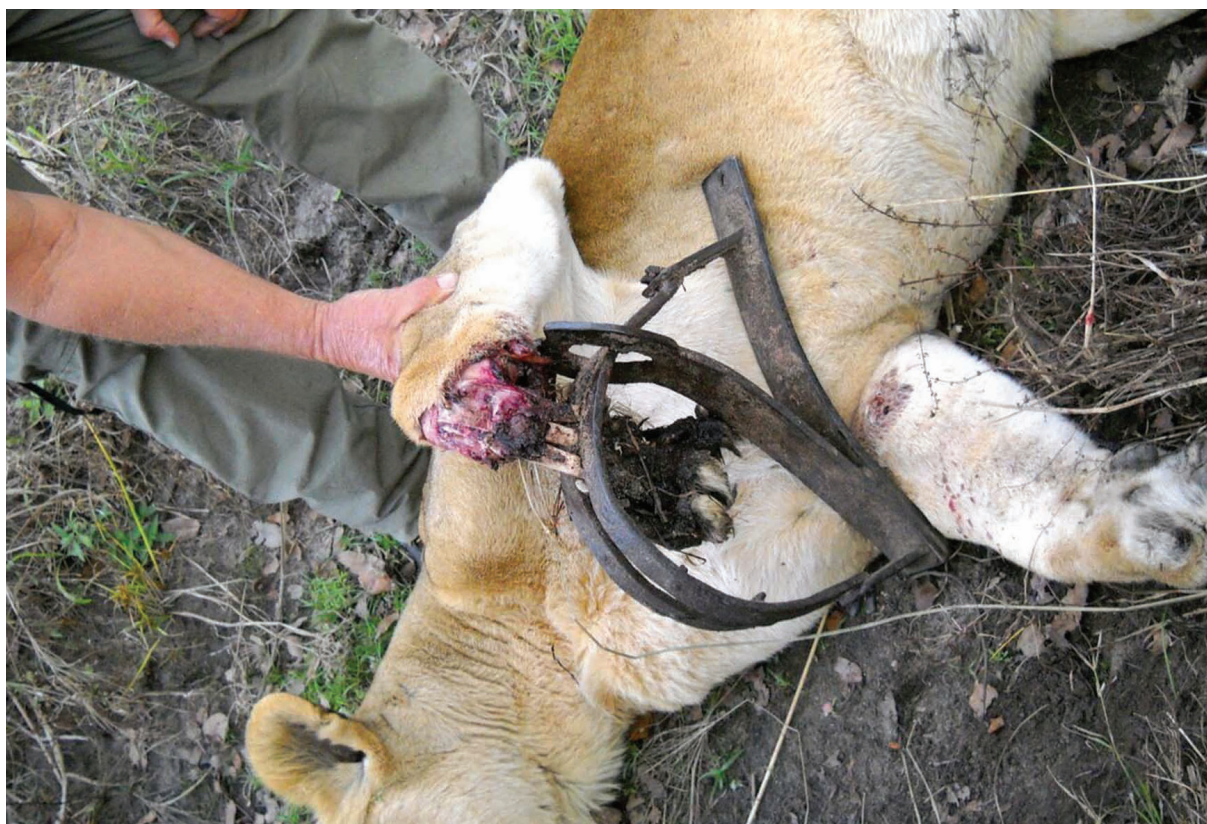
### *Insights from the literature*

Wildlife populations in African protected areas declined by 59 percent during 1970-2005 (Craigie, 2010; Lindsey *et al.*, 2014) and are severely depleted in many protected areas (Lindsey *et al.*, 2014). There are increasing indications from the literature that illegal hunting for bushmeat is a key contributing factor to wildlife declines in multiple countries, such as several in West and Central Africa, Botswana, Kenya, Malawi, Mozambique, Tanzania, Zambia and Zimbabwe (Hatton, 2000; Okello and Kiringe *et al.*, 2004; Fusari, 2006; Brown, 2007; Bouche *et al.*, 2010; Nielsen *et al.*, 2011; Renaud, 2011; Becker *et al.*, 2013; Henschel *et al.*, 2014; Lindsey *et al.*, 2014; Rogan *et al.*, 2015).

Some species appear to be particularly affected by illegal hunting for bushmeat. Large species are often targeted because of the high potential meat yield, and where illegal hunting is severe they often disappear (Nielsen *et al.*, 2006), resulting in the loss of associated ecological services (Ripple *et al.*, 2015). Predators are often particularly

affected because they tend to be attracted to the carcasses of other animals in snare lines and are thus susceptible to being caught, because they range widely and are of a similar height to some of the animals for which snares are set, and because they are also affected by reductions in the densities of their prey (Woodroffe *et al.*, 2007; Lindsey *et al.*, 2013; Everatt *et al.*, 2014).

More generally, illegal hunting affects wildlife populations via edge-effects around protected areas, reduced densities of wildlife and in cases where illegal hunting is allowed to proceed without control, complete collapse of wildlife populations (Fischer and Linsenmair, 2001; Bouche *et al.*, 2010; Renaud, 2011; Henschel *et al.*, 2014; Durant *et al.*, 2014). Collapse of wildlife populations has been widely observed in parts of West and Central Africa (Bouche *et al.*, 2010; Renaud, 2011), but is also increasingly observed in some protected areas in traditional strongholds for wildlife in Southern and East Africa (Hatton, 2001; Munthali, 2002; Jambiya *et al.*, 2007; Lindsey *et al.*, 2011; Lindsey *et al.*, 2014).

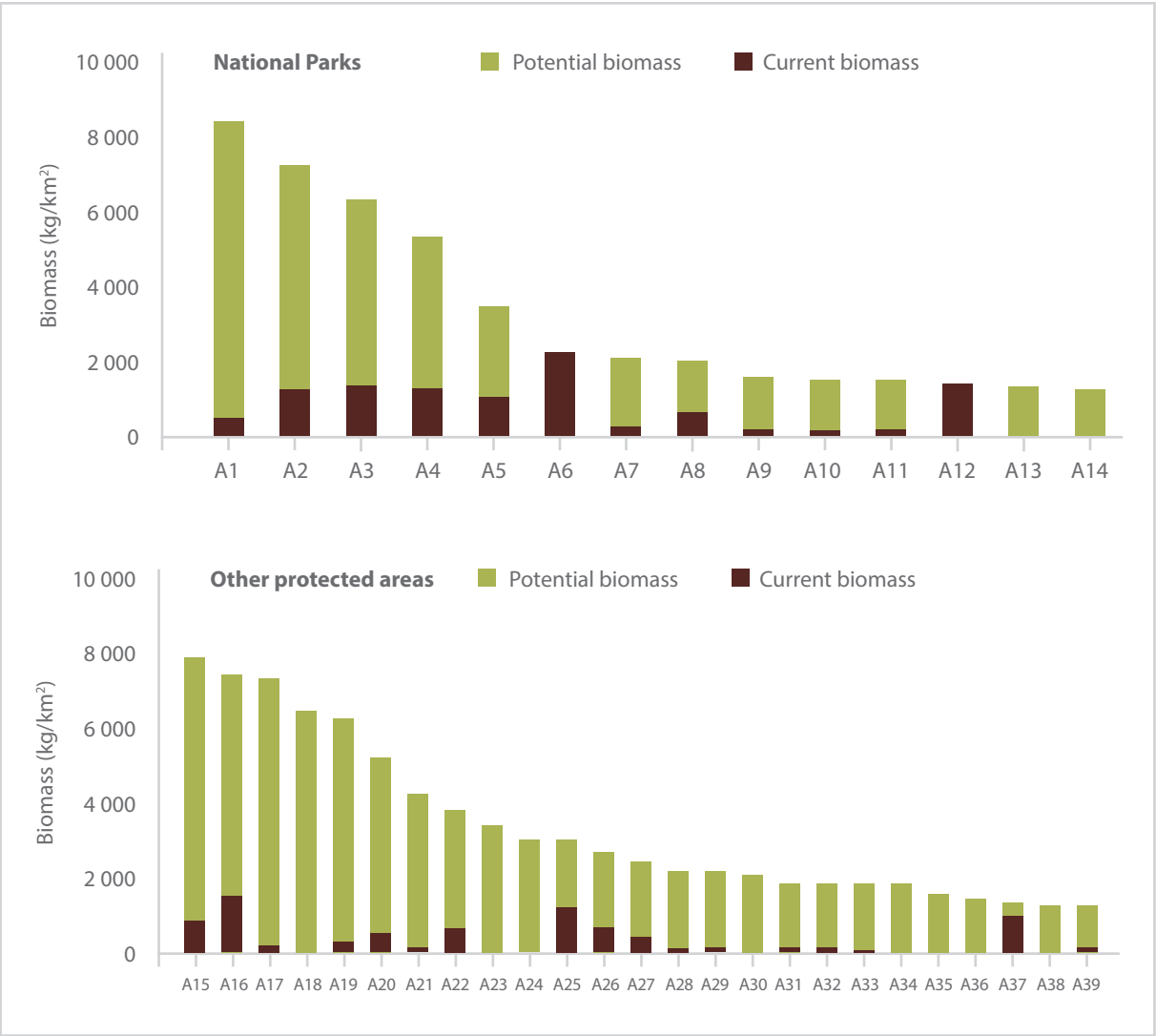


Predators are particularly susceptible to being caught in illegal hunters' snares (Photo: A. Pienaar)

Insights from the case studies

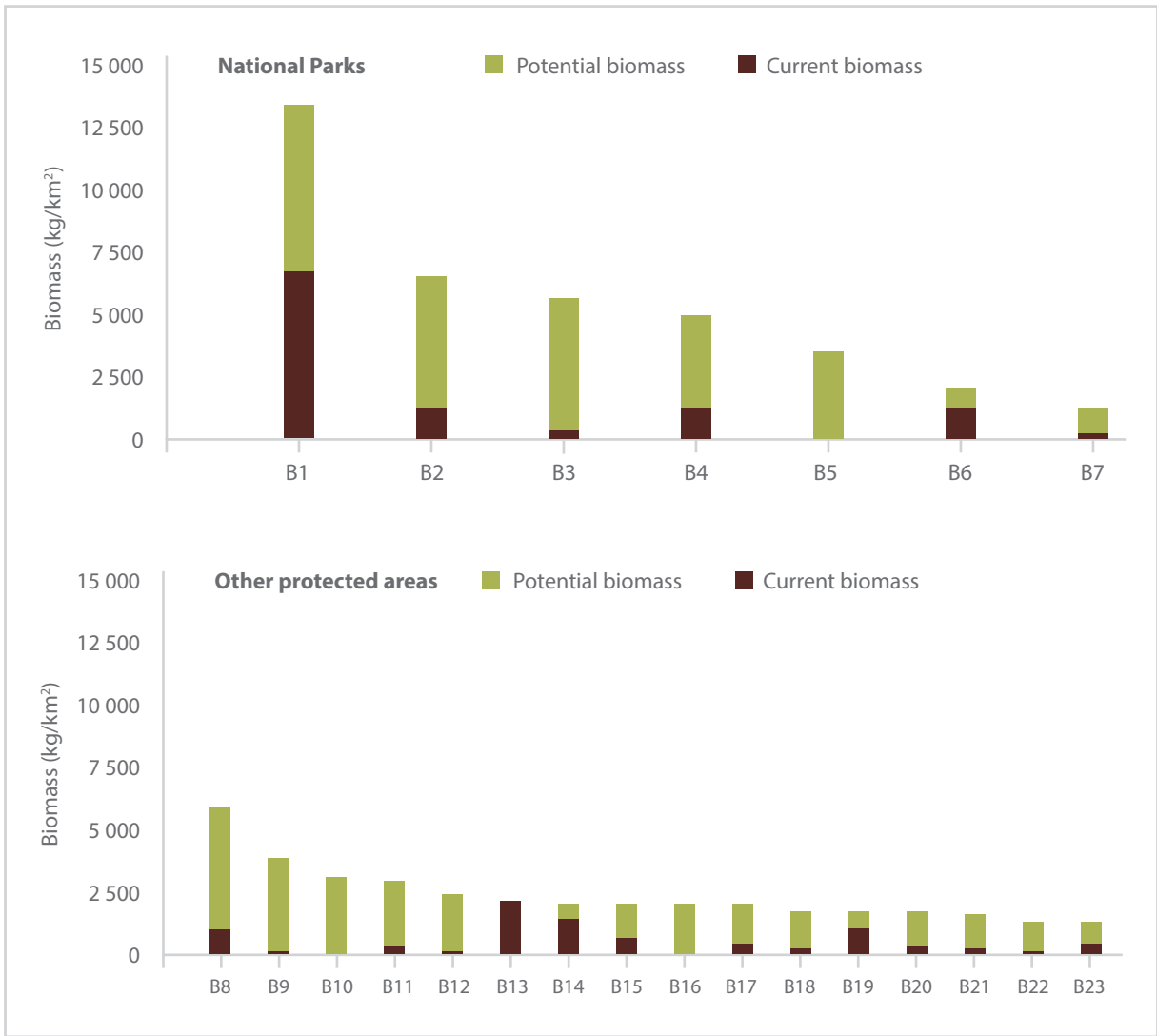
Herbivore populations in many protected areas in both Country A and Country B are depleted (Figures 15, 16; Table 1). In Country A, wild ungulates occurred at a median of 16 percent of predicted carrying capacity in national parks (n=13) and of just 2.4 percent (n=25) in hunting blocks. In Country B, wild ungulates occurred at just 19 percent of predicted carrying capacity in the national parks (n=7) and 15 percent in the hunting areas (n=16) (Figures 15, 16; Table 1).

An assessment was made to determine whether the depletion was merely caused by loss of elephants through illegal ivory hunting rather than loss of wildlife in general, but when the observed versus potential biomass was calculated excluding elephants from the equation, protected areas in both countries were still very depleted (Table 1). These data suggest that all herbivores are depleted and that elephant poaching for ivory alone cannot explain the depletion of wildlife biomass in protected areas.



**Figure 15.** Observed mammalian biomass versus the predicted carrying capacities in national parks and hunting areas in Country A





**Figure 16.** Observed mammalian biomass versus the predicted carrying capacities in national parks and hunting areas in Country B

**Table 1.** Wilcoxon matched-pairs results comparing current biomass with potential biomass in protected areas of Country A and Country B:

Country	Including elephants?	Median current biomass (kg/km²)	Median potential biomass (kg/km²)	Wilcoxon matched-pairs test
Country A	Including	113	2 126	W=772, P<0.001
	Excluding	79	691	W=684, P<0.001
Country B	Including	340	1 944	W=274, P<0.001
	Excluding	162	486	W=274, P<0.001

**The financial and economic impacts of the bushmeat trade**

*Insights from the literature*

Illegal hunting does not follow quotas, is often unselective, affects all age and sex categories and results in high levels of wastage (Hofer *et al.*, 1996; Noss, 1998; Lindsey *et al.*, 2011) if unregulated illegal hunting typically reduces wildlife populations to levels at which their productivity is low, and well below levels where significant, sustainable yields are possible.

Trophy hunting is financially unviable in a significant proportion of hunting blocks in Mozambique (92.3 percent), Namibia (66.6 percent), Zambia (66.6 percent), Zimbabwe (44.4 percent) and Tanzania (18.8 percent), and in most cases a key cause is likely to be illegal hunting (Lindsey *et al.*, 2012). In cases where there are benefit-sharing arrangements with communities, the community income from trophy hunting has declined accordingly (e.g. in Zambia, Lindsey *et al.*, 2014). In Savé Valley Conservancy in Zimbabwe, illegal hunting reduces trophy-hunting income by at least US\$1.1 million annually (Lindsey *et al.*, 2011). In Zambia, there was a significant contraction in the wildlife ranching industry

in 2013, primarily owing to disillusionment over the negative impacts of illegal hunting (Lindsey *et al.*, 2013). In Tanzania, illegal hunting by residents of refugee camps in the 1990s and early 2000s reduced trophy revenues in nearby game reserves by >70 percent (Jambiya *et al.*, 2007).

Photo-tourism operations are likely to be even more sensitive to illegal hunting because they depend on high densities of habituated large mammals (or spectacular scenery) (Okello, 2005; Lindsey *et al.*, 2006). In Zambia, for example, viable photo-tourism is limited to just five of 20 national parks, largely on account of suppression of wildlife populations (Hamilton, 2007). A major tourism company recently ceased operations in three Southern African countries owing to reduced wildlife densities, eradication of key species and reduced habituation of wildlife through illegal hunting (C. Roche, personal communication).

*Insights from the case studies*

**Impacts on earnings from trophy hunting and meat harvests**

In Country A, the current median gross income of USD92/km<sup>2</sup> generated from trophy hunting in the hunting blocks is a fraction of the estimated median potential



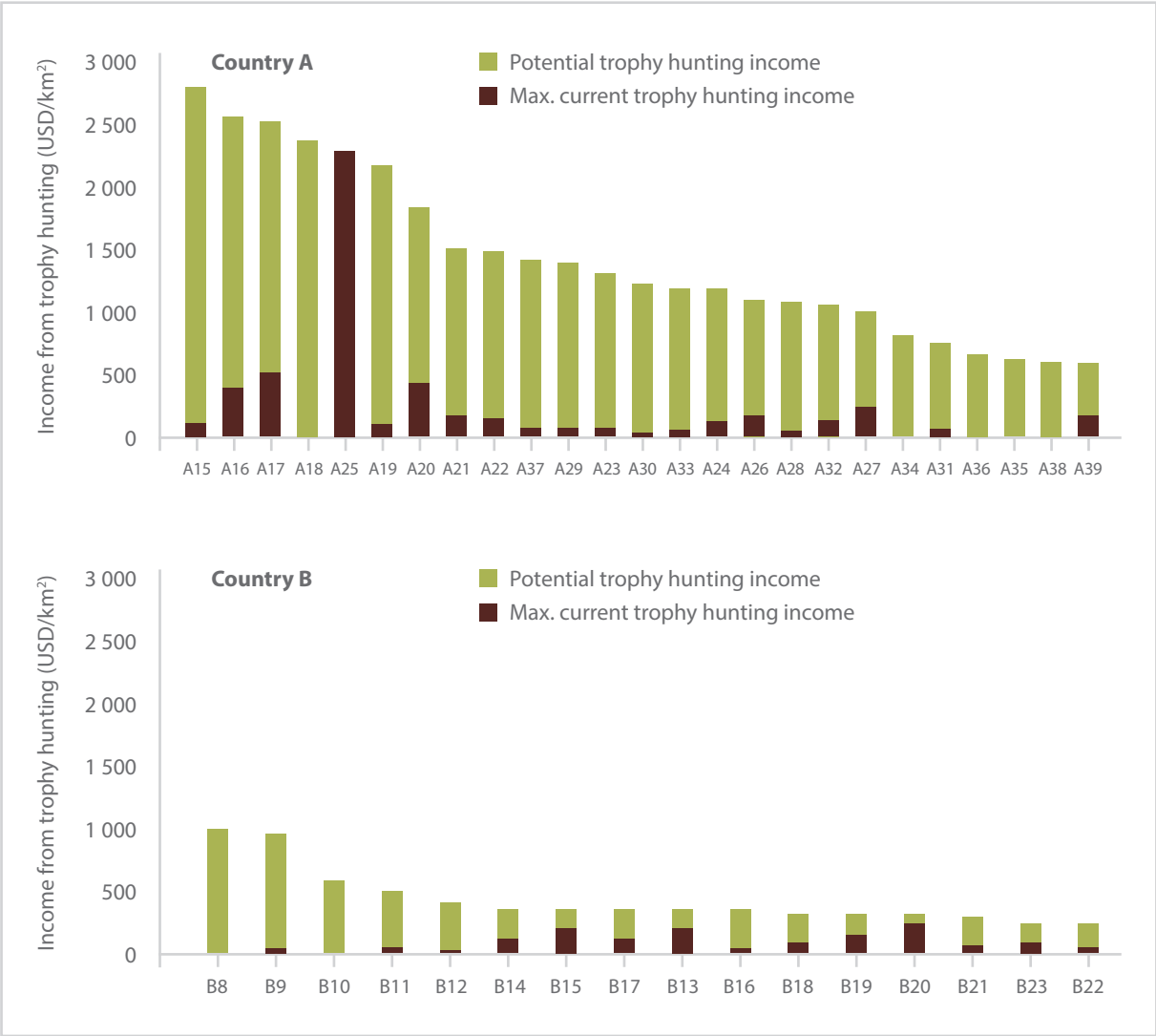
Photo-tourism is dependent on high densities of habituated wildlife and so is highly vulnerable to being affected by illegal hunting (Photo: P. Lindsey)

income of USD1,182/km<sup>2</sup> if wildlife populations were allowed to recover and harvested sustainably ( $W=303$ ,  $P<0.001$ ) (Figure 17). Similarly, in Country B, the median current gross income from trophy hunting (USD87/km<sup>2</sup>) was markedly less than the potential gross income of USD349/km<sup>2</sup> ( $W=136$ ,  $P<0.001$ ).

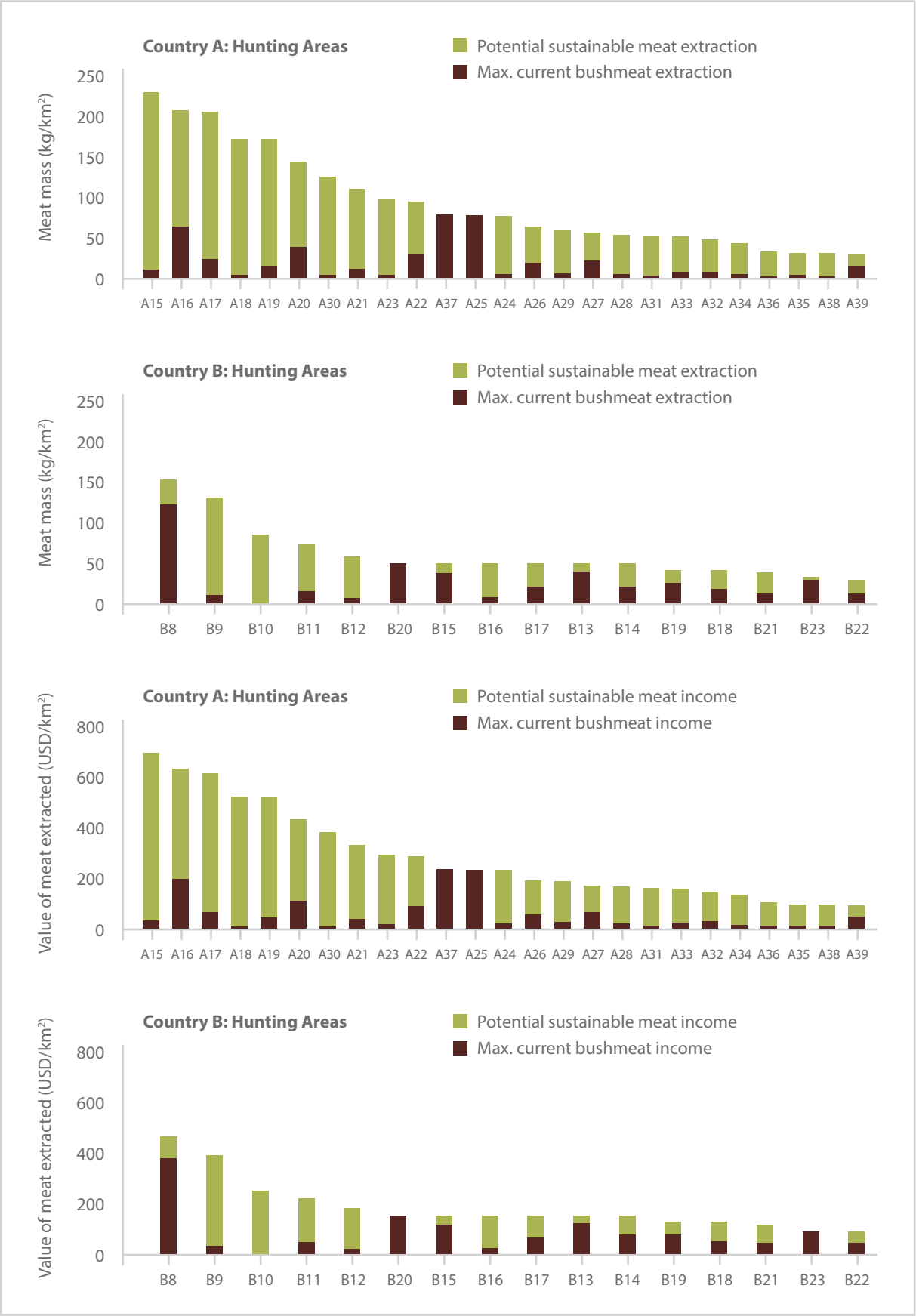
For Country A, total current income from trophy hunting in all 25 assessed hunting areas was 5.6 percent of potential income if wildlife populations recovered (Table 2), resulting in a projected loss of USD204.6 million/year. For Country B, total current income from trophy hunting was 25.4 percent of that obtainable if wildlife populations were allowed to recover, resulting in losses of USD14.6 million/year. This lost potential income moreover resulted in reduced income for communities (which is covered under ‘Social impacts’).

A word of caution: while these estimates do highlight the big difference between current and potential earnings from hunting, they do not take into account limits to potential earnings that may arise as a result of the impact of human encroachment of hunting blocks, or potential limits to the demand for hunting tourism.

An additional loss of USD41.1 million of potential income per year and USD4.71 million per year is incurred in Country A and Country B through foregone earnings from harvesting of wildlife for meat. (Foregone meat production is discussed below under ‘Social impacts’ - Figure 18).



**Figure 17.** Current income from trophy hunting in the hunting blocks of Country A and B and potential income if wildlife populations were allowed to recover to their estimated carrying capacities



**Figure 18.** Current meat extraction and income from hunting blocks in Country A and Country B and potential meat production and income from meat if wildlife populations were allowed to recover to their potential carrying capacities

**Table 2.** Current income, meat production, ecotourism values and livelihood equivalents from legal wildlife-based land uses and illegal bushmeat hunting in Country A and Country B, and potential values if wildlife populations were allowed to recover

Monetary values in USD/ mass of meat in kilograms	Country A parks	Country A hunting areas	Total Country A	Country B parks	Country B hunting areas	Total Country B
Current income from trophy hunting	0	12 200 000	12 200 000	0	4 980 000	4 980 000
Current value of meat from trophy hunting	0	840 000	840 000	0	1 020 000	1 020 000
Current revenues from ecotourism	58 900 000	0	58 900 000	15 600 000	0	15 600 000
Current revenues from illegal hunting	7 740 000	4 460 000	12 200 000	3 760 000	2 370 000	6 130 000
Quantity of meat from trophy hunting (kg)	0	790 000	790 000	0	340 000	340 000
Quantity of meat from illegal hunting (kg)	2 580 000	1 490 000	4 070 000	1 250 000	790 000	2 040 000
Total revenue	66 640 000	17 500 000	84 140 000	19 360 000	8 370 000	27 730 000
Total livelihood equivalents	74 044	19 444	93 489	18 980	8 206	27 186
Total meat produced	2 580 000	2 280 000	4 860 000	1 250 000	1 130 000	2 380 000
Potential income from trophy hunting	0	216 800 000	216 800 000	0	19 600 000	19 600 000
Potential value of meat from trophies	0	25 200 000	25 200 000	0	4 990 000	4 990 000
Potential revenues from ecotourism	471 500 000	0	471 500 000	86 900 000	0	86 900 000
Potential value of meat from cropping	0	22 900 000	22 900 000	0	3 110 000	3 110 000
Potential quantity of meat from trophies	0	8 410 000	8 410 000	0	1 660 000	1 660 000
Potential quantity of meat from cropping	0	7 620 000	7 620 000	0	1 040 000	1 040 000
Total potential revenue	471 500 000	264 900 000	736 400 000	86 900 000	27 700 000	114 600 000
Total potential livelihood equivalents	523 889	294 333	818 222	85 196	27 157	112 353
Total potential meat	0	16 030 000	16 030 000	0	2 700 000	2 700 000
Total foregone revenue	404 860 000	247 400 000	652 260 000	67 540 000	19 330 000	86 870 000
Total foregone livelihoods	449 844	274 889	724 733	66 216	18 951	85 167
Total foregone meat	-2 580 000	13 750 000	11 170 000	-1 250 000	1 570 000	320 000

Note that all of the values in this table exclude the use of species that are not accurately counted from the air, including hippos and mammals of bushbuck-size and smaller (see detailed methods). \* Note that these data are from a sample of the protected areas in each country and so in reality, the figures of foregone income, meat and jobs could be higher on a national level.

Impacts on income from ecotourism in parks

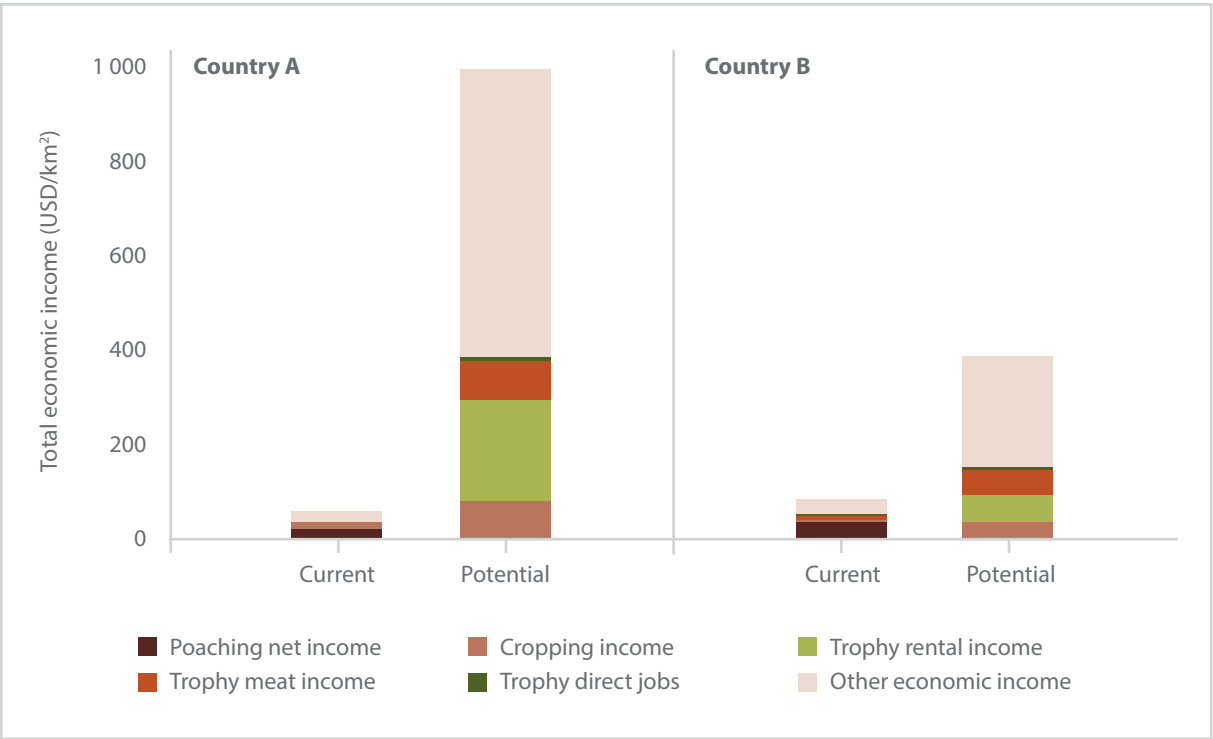
The current gross value of ecotourism in the 15 assessed parks in Country A is estimated to be USD58.9 million per year. If illegal hunting could be eliminated and wildlife populations were allowed to recover, estimated potential ecotourism income would increase to USD471.5 million. The current gross value of ecotourism in the seven assessed parks in Country B is estimated to be USD15.6 million. If illegal hunting could be eliminated, wildlife populations were allowed to recover and the potential for tourism was realized, the value could increase significantly to USD86.9 million.

National level economic impacts

In Country A, the current economic income from illegal hunting (USD20/km<sup>2</sup>) in hunting blocks is only 58 percent of the total economic income currently generated through trophy hunting (Figure 19) and only six percent of what could potentially be generated legally if wildlife populations recovered. In parks in Country A (Figure 20), the current economic income from illegal

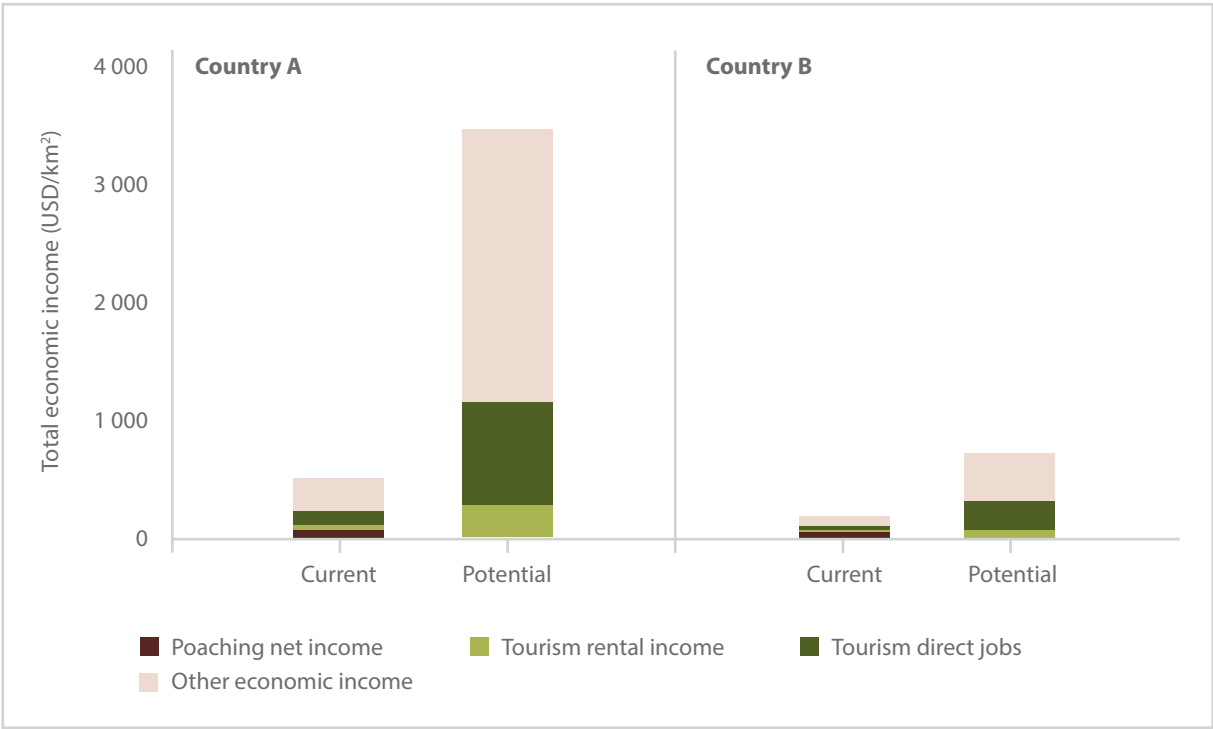
bushmeat hunting (USD85/km<sup>2</sup>) is only 20 percent of the total economic income generated through ecotourism, and only 59 percent of the livelihood income generated from ecotourism. The current total economic income contribution from all sources in parks is only 15 percent of what could potentially be generated through ecotourism if wildlife populations recovered.

In hunting areas in Country B (Figure 19), the current economic income from illegal hunting (USD32/km<sup>2</sup>) is only 67 percent of the total legal economic income generated through trophy hunting and only 21 percent of what could be generated legally if wildlife populations recovered. In parks in Country B (Figure 20), the current economic income from illegal hunting (USD65/km<sup>2</sup>) is <50 percent of the current economic contribution from ecotourism. In terms of livelihoods, current net income from illegal hunting exceeds current legal livelihoods income from ecotourism by 10 percent. Current total economic income from all sources in parks in Country B is 27 percent of what could be generated through expanded ecotourism if wildlife populations recovered.



**Figure 19.** Total current and potential economic value of meat and hunting, including net livelihood income generated by illegal hunting, meat cropping offtakes, trophy hunting, trophy meat offtakes and direct jobs, as well as other net economic incomes to investors, government and others. This figure depicts the current and potential *total economic contribution to national income* for the hunting blocks in countries A and B. Here, in addition to the livelihood net income from illegal hunting, meat cropping, trophy hunting rentals, trophy meat and trophy direct jobs accruing to communities, all the other net incomes generated in the hunting blocks by the hunting operators, capital lenders and government are included. These are referred to as “other economic income”.





**Figure 20.** Total current economic value (including illegally sourced bushmeat and wildlife viewing in parks) versus potential economic value (from wildlife viewing). These values include net livelihood income generated by illegal hunting (in the current scenario), wildlife-viewing ecotourism remit and direct jobs in ecotourism facilities, as well as other net economic incomes to investors, government and others. Both the current and potential total economic contribution to the national income are reflected. In addition to the net livelihood incomes from illegal hunting and legal ecotourism accruing to communities, all the other net incomes generated in parks by the ecotourism operators, capital lenders and government are included. These are referred to collectively as “other economic income”. Currently, illegal hunting net incomes as well as net economic incomes from legal ecotourism activities are generated. With park recovery, potential economic income would consist of that generated by expanded wildlife-viewing ecotourism.

The social impacts of the bushmeat trade

Insights from the literature

Hunting for meat is something that many African communities have engaged in for millennia (Murombedzi, 2003). In some cases, illegal hunting is conducted as a coping mechanism for poor people in contexts where limited alternative livelihood or protein options exist (Nyahongo *et al.*, 2005). However, the challenge is that because human populations have increased so much, and because harvests are increasingly commercial in nature, the benefits are often not sustainable and are likely to wane (with the exception of income derived from small, fast-reproducing species) (Fa *et al.*, 2003; Cowlishaw *et al.*, 2005). For example, bushmeat harvests in part of the Udzungwa Mountains in Tanzania have been so severe that sustainable protein derivation is no longer possible and bushmeat no longer plays a significant food security role (Nielsen *et al.*, 2006).



Commercialized illegal hunting for bushmeat can have severe impacts on wildlife populations if allowed to proceed unchecked (Photo: Ed Sayer)



In other cases, illegal hunting is conducted by people who are relatively well off and is simply done to generate additional income, for example in northern Botswana (Rogan *et al.*, 2015). When illegal hunting is conducted by people living far from the wildlife area, the activity strips communities who bear the expenses of living with wildlife from potential legal benefits (Brown, 2007). In addition, as demonstrated below from the case studies, the use of wildlife for illegal hunting and suppression of wildlife populations to low levels precludes the derivation by communities of much greater quantities of meat from legal harvesting, and the creation of greater livelihood benefits that would be possible if wildlife populations were allowed to recover and then utilized legally.

***Insights from case studies: foregone potential meat production***

Illegal hunting yields modest amounts of meat because it typically suppresses populations below levels where significant harvests are possible. In both Country A and Country B, the amount of meat currently extracted from hunting blocks (via both illegal hunting and trophy

hunting) and the associated value of that meat is much lower than that obtainable if herbivore populations were protected from illegal hunting, allowed recover to their carrying capacities for those areas and sustainably harvested (Wilcoxon matched-pairs test, Country A:  $W=313$ ,  $P<0.001$ ; Country B:  $W=132$ ,  $P<0.001$ ) (Figure 18).

In Country A, the volume and value of meat extracted from the hunting blocks under current conditions is 14.2 percent of what could be extracted if wildlife populations were allowed to recover, resulting in the net loss of 13.7 million kg of meat per year (Table 2). For Country B, the total volume and value of meat extracted from hunting areas is 41.8 percent of what could be extracted if these areas were allowed to recover, resulting in a net loss of 1.57 million kg of meat per year.

***Insights from case studies: impacts on community earnings from hunting blocks***

In both Country A and Country B, because of inadequate community benefit-sharing mechanisms, illegal



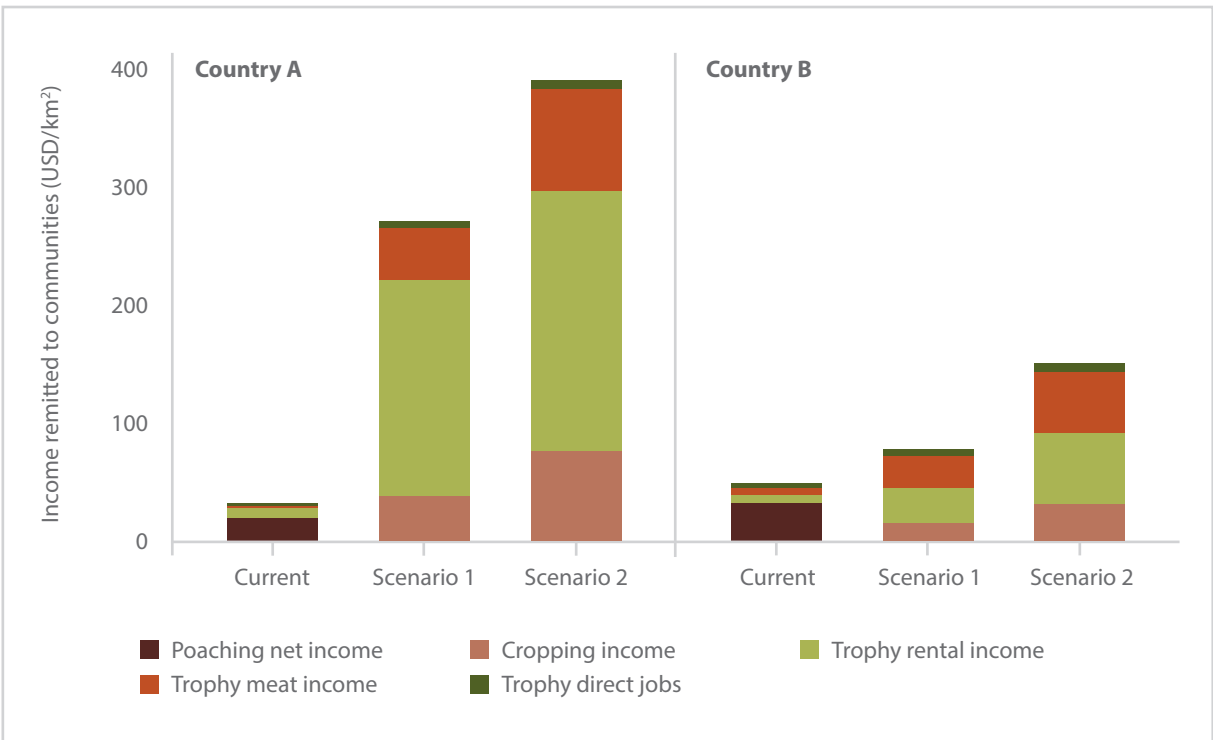
Illegal hunting is increasingly commercial in nature: these donkeys were found at a poacher camp in Serengeti National Park in Tanzania, and were being used to transport large quantities of bushmeat out of the protected area (Photo: Ed Sayer)

hunting probably currently generates more income for communities than they currently receive from trophy hunting (though benefits from illegal hunting are unlikely to be sustainable). In Country A, communities currently generate an estimated 70 percent more from illegal hunting than the combined value of income remitted to communities from trophy hunting, meat from trophy hunting and the monetary equivalent of the jobs created (Figure 21). In the hunting blocks of Country B, illegal hunting is currently estimated to generate 100 percent more than the combined value of income currently remitted to communities from trophy hunting and associated meat and jobs created (Figure 21).

The current income from trophy hunting that is remitted to communities by the governments of countries A and B is markedly lower than the potential income that could be remitted to these communities if wildlife populations recovered and a more equitable system of benefit sharing is put in place (Wilcoxon matched-pairs test, Country A:  $W=321, P<0.001$ ; Country B:  $W=136, P<0.001$ ) (Table 3, Figure 21).



Buffalo were virtually eradicated from Coutada 13 in Mozambique by illegal hunters, with the result that trophy hunting is marginal in the area and community income from hunting is limited



**Figure 21.** Current and potential net income (USD/km<sup>2</sup>) from illegal hunting, meat cropping offtakes, trophy hunting rentals, trophy meat offtakes and direct jobs going to communities in hunting blocks. Potential values under scenario 1 assume that the current systems for benefit sharing were in place. Potential values under scenario 2 assumed that 15 percent of hunting operator gross income went directly to communities (by-passing governments) and 50 percent of meat harvest went to communities.



## RESULTS AND DISCUSSION

**Table 3.** Current income (USD) and jobs accruing to communities via ecotourism and trophy hunting in Country A and Country B, versus potential income and jobs if illegal hunting was prevented, wildlife populations were allowed to recover and benefit-sharing regimes were reformed.

	Country A National Parks	Country A Hunting Areas	Country B National Parks	Country B Hunting Areas
<b>Current scenario</b>				
Illegal hunting income	5 263 200	3 030 624	2 559 180	1 611 233
Income from trophy hunting and meat	-	1 753 200	-	807 840
Income from ecotourism	10 879 435	-	4 052 279	-
Total community income	16 142 635	4 783 824	6 611 459	2 419 073
Total jobs	17 936	5 315	6 482	2 372
<b>Potential income*</b>				
Illegal hunting income	-	-	-	-
Income from trophy hunting	-	33 529 500	-	3 303 780
Income from meat	-	24 046 200	-	4 049 400
Income from ecotourism	87 035 480	-	16 443 249	-
Total community income	87 035 480	57 575 700	16 443 249	7 353 180
Total jobs	96 706	63 973	16 121	7 209
Total community income foregone	70 892 845	52 791 876	9 831 790	4 934 107
Total community jobs foregone	78 770	58 658	9 639	4 837

\* This scenario assumes that communities would get a fair cut of trophy hunting and ecotourism revenues equating to the maximum likely to be sustainable while retaining business viability (15% of turnover for hunting companies and 8% for ecotourism)

In total, as a result of wildlife populations being depleted, along with inadequate benefit-sharing schemes, communities in Countries A and B forego potential income of USD124 million and USD15 million sustainable consumptive use of wildlife, which translates into ~137 000 and ~15 000 and livelihood equivalents respectively (Table 3). However, while communities could unquestionably earn substantially more than they currently do if wildlife populations were allowed to recover and equitable benefit-sharing systems were put in place, these estimates do not take into account limitations to potential earnings arising from human encroachment of hunting blocks and potential limits to the demand for hunting tourism.

### *Insights from case studies: impacts on community earnings from parks*

In parks, foregone community income is in the form of the difference between a) current income and livelihoods from illegal hunting and employment from ecotourism and b) elevated levels of income and employment through ecotourism if wildlife populations were allowed to recover. In Country A and Country B, current income from all sources of wildlife in parks comprises just 20.6 percent and 37 percent respectively of what could accrue from ecotourism if wildlife populations recovered (Table 3).

# ISSUES THAT MAKE THE BUSHMEAT TRADE SUCH A CHALLENGING PROBLEM

## The scale of the wildlife estate and the cost and difficulty associated with protecting it

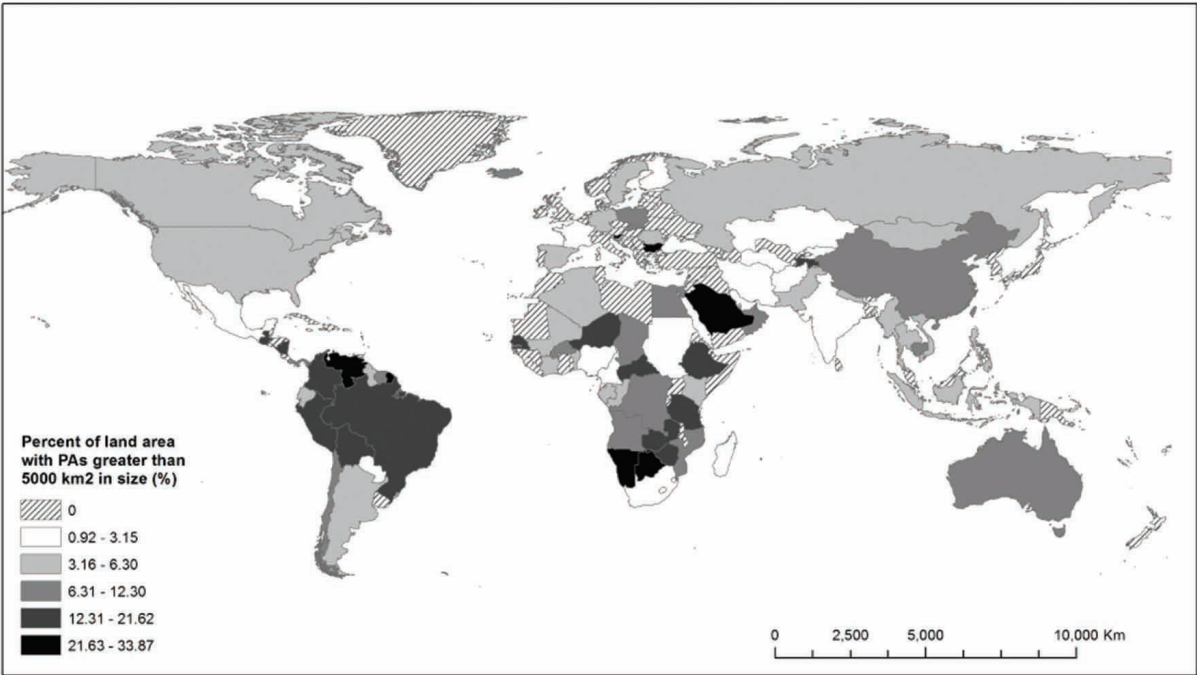
Many African countries, and particularly several in Southern and East Africa, have allocated generous portions of their land area for conservation. The proportion of land under any level of protected status (Table 4) and under strict protection status (IUCN PA categories 1-4, Figure 22) is higher in Southern and East Africa than in most other parts of the world. In addition, the average size of protected areas in Southern and East Africa is higher than in any other part of the world (Table 4) and these regions have an unusually high number of very large protected areas relative to other parts of the world (Figure 23). Furthermore, African nations carry a higher burden of protected land relative to national wealth (expressed as km<sup>2</sup> of protected land relative to dollars of GDP per capita, Figure 24). Consequently, African nations face a significant challenge associated with managing protected areas in the context of growing human populations, poverty and widespread reliance of rural populations on natural resources for survival. Furthermore, in addition to protected area networks, many African countries also retain significant wildlife populations on unprotected lands.

**Table 4.** Continental comparisons of the percentage of land under protection, under strict protection and the mean size of protected areas (PAs)

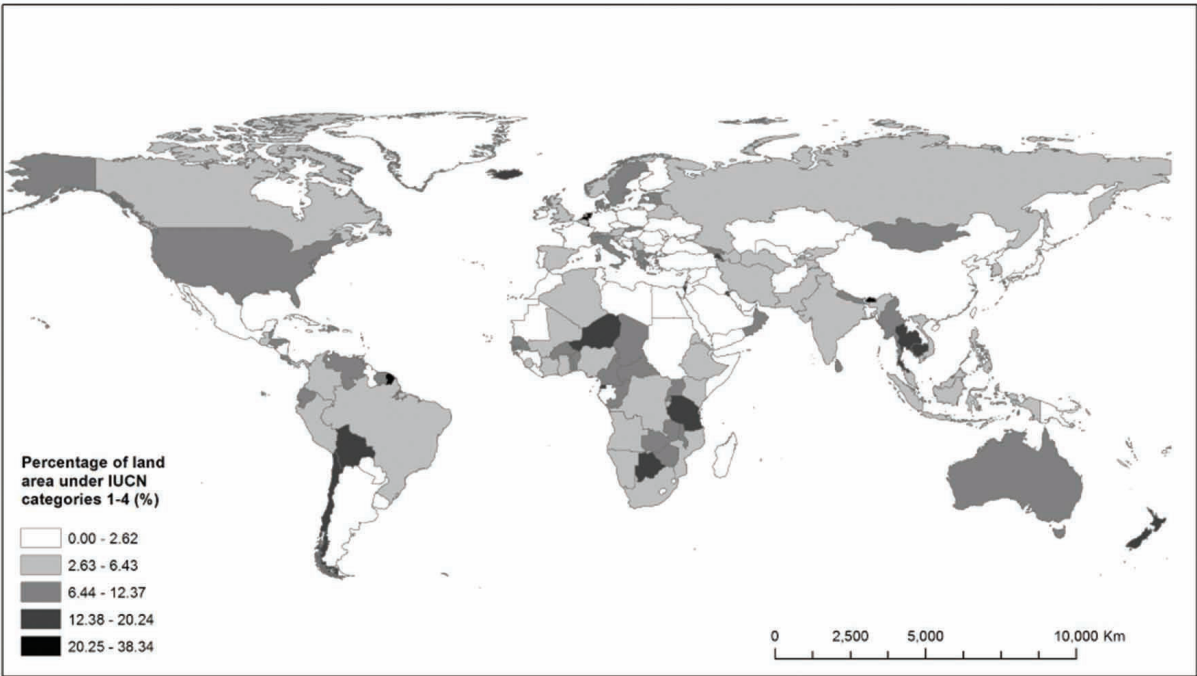
	% of land comprising PAs of all categories (±SD)	% of land under PA (IUCN categories IIV) (±SD)	Mean size of PAs (±SE)
Southern and East Africa*	22.2	7.85**	2 125
Europe	20.1	7.11	26.7
Central America	20.0	5.2	105.7
South America	19.1	7.8	1 165
North America	17.9	10.1	100
Africa	13.4	6.24	1 974
Asia	10.2	7.71	1 484

\* Data were presented for Angola, Botswana, Ethiopia, Kenya, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia and Zimbabwe

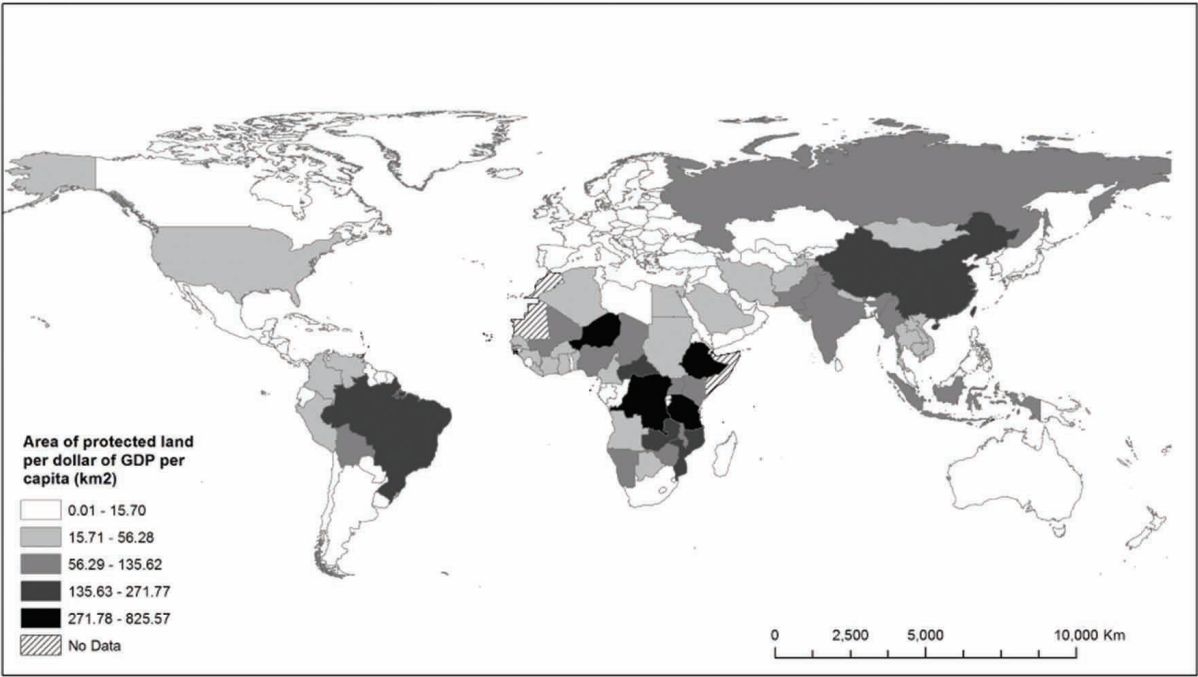
\*\* Excluding South Africa, for which many protected areas are uncategorized



**Figure 22.** The proportion of land encompassed by strictly protected areas (IUCN categories 1-4)



**Figure 23.** The proportion of land comprised of protected areas of a size >5 000 km²



**Figure 24.** The area of protected land per dollar of GDP per capita

Given the size of the protected area networks and competing developmental challenges, it is not surprising that there is a major deficit between the funds needed for effective conservation and those that are available (Brockington and Schofield, 2010). While recent data on funding for African protected areas are scarce, indications are that underfunding is widespread (Table 5).

**Table 5.** State funding for protected areas from selected African countries (values inflated to 2013 values based on the US inflation rate)

Country	USD/km <sup>2</sup>	Source of data
Mozambique	14	Nazerali, 2015
Zambia	41	Lindsey <i>et al.</i> , 2014 (Note that available funding is higher than this for some protected areas in Zambia, but lower for others)
Malawi	60	Cumming, 2004
Tanzania	62	Cumming, 2004
Ethiopia	80	H. Van Zyl, personal communication 2015
Botswana	116	DWNP, personal communication 2015
Namibia	200	Davies, unpublished information
Zimbabwe	416	Cumming, 2004
Kenya	1 861	KWS, 2014
South Africa	6 103	Davies, unpublished information (averaged across all provinces)

In many countries, operational budgets are declining (Cumming, 2004) and some have cut park management budgets in recent years (Saporiti, 2006). Estimates of the funding needed to manage protected areas effectively range from USD358-2,0000/km<sup>2</sup> (Bell, 1984; Cumming, 2008; Leader-Williams and Milner-Gulland, 1988; Packer *et al.*, 2013). By contrast, several African countries have park management budgets of <USD100/km<sup>2</sup> (Table 5). On average, African parks receive just 30 percent of the funding needed to manage them effectively (Drewniak *et al.*, 2012).

In some cases, donor funding augments protected area budgets. However, in 2010, just USD163 million was spent by conservation NGOs in Africa, and donor funding does not nearly make up for the annual budget deficits of USD430-650 million facing African protected areas (Brockington and Schofield, 2010). That only 14 percent of Africa's protected areas receive any donor funding and NGO support for conservation is geographically skewed (Brockington and Schofield, 2010). For example, South Africa, Kenya and Tanzania receive approximately USD14 million of conservation funding annually, Zimbabwe, Zambia and Mozambique each receive USD3.5-5 million and the whole of West Africa receives just ~USD5.5 million (Brockington and Schofield, 2010).

Funding shortages result in shortages of staff and equipment, poor salaries, low morale among staff and, ultimately, failure of park agencies to deal with illegal hunting (Cumming, 2008). Given the context of rapidly increasing threats from the bushmeat trade, elephant and rhino poaching and encroachment of protected areas (Lindsey *et al.*, 2014; Watson *et al.*, 2014), such funding shortages have serious implications for wildlife populations.



Underinvestment in park management renders wildlife areas susceptible to poaching for ivory and rhino horn, in addition to illegal hunting (Photo: Paul Funston, Panthera)

### The challenge of inadequate legal frameworks and implementation of the law

Bushmeat hunting is illegal in most savannah contexts owing to contravention of one or more restrictions on hunting in protected areas; hunting with prohibited methods, hunting protected species, prohibited age or sex classes; hunting out of season; and hunting without permits (Cirelli and Morgera, 2009). It is thus correctly termed 'poaching' or 'illegal hunting' in many instances. There appear to be several key challenges associated with legislation related to bushmeat:

- Weak legal deterrents for illegal hunting in several countries.
- Inconsistent application of existing laws.
- Flaws, and in some instances corruption, in the prosecution chain regarding bushmeat-related crimes.
- A shortage of prosecutors and police trained in wildlife crimes or crime scene management (Opyene, 2009).
- A lack of legal frameworks that allow communities to benefit adequately from wildlife management and centralized authority over wildlife resources (see below under 'Challenges associated with incorporating communities into conservation').
- Legal restrictions that limit the profitability of wildlife-based land uses relative to livestock production or agriculture and thus limit legal production of wild meat (Lindsey *et al.*, 2013).

In many cases, bushmeat poachers who are captured at great expense and risk to law enforcement officers are released without charge (Opyene, 2009) or issued fines lower than the value obtainable from selling meat from one animal (Barnett, 2000). In Mozambique, poachers are usually either released without charge or given fines that are rarely collected (Lindsey and Bento, 2012). For example, there has never been a conviction of a bushmeat poacher captured in Niassa National Reserve in northern Mozambique (A. Jorge, personal communication). In parts of Zambia, poachers are sometimes released without charge or granted nominal penalties even when they are caught in possession of automatic firearms and having shot at game scouts (Lindsey *et al.*, 2013). Similarly, in Botswana, bushmeat poachers are rarely convicted (Rogan *et al.*, 2015). In Uganda, weak laws and easy access to bushmeat markets are exacerbating the threat of illegal hunting (<http://www.theeastafrican.co.ke/news/Weak-laws--easy-markets-aiding-trade-in-bush-meat--/-/2558/2797978/-/lxi7sy/-/index.html>, accessed July 2015). Magistrates often fail to consider the criminal history of poachers, so first-time and repeat offenders receive





Penal codes related to illegal hunting should reflect the dangers posed to law enforcement officers during the apprehension of suspects. This AK47 assault rifle was confiscated from poachers in Zambia (Photo: P. Lindsey)

similarly weak punishments (V. Opyene, unpublished data). Illegal hunting typically attracts weaker penalties than theft of domestic stock, despite the higher value of wildlife, prejudicing the development of wildlife-based land uses (Lindsey *et al.*, 2011).

### **The inherent developmental issues related to the bushmeat trade**

The bushmeat trade is inherently tied to developmental challenges such as rapid human population growth, expansion of human populations into wild lands, poverty, food insecurity and unemployment (Davies, 2002; Lindsey *et al.*, 2013). The complexity of these issues makes the bushmeat trade particularly challenging to address. Savannahs and particularly drylands house some of the poorest and hungriest people in the world (UNDP, 2010). Ultimately addressing the bushmeat issue will require addressing these core development challenges.

However, in the meantime, illegal hunting should not be seen as a solution to a lack of alternative livelihoods and proteins because the associated food security benefits are generally not sustainable and, as seen from the case

studies, come at the cost of potentially much greater economic and livelihood benefits derivable from legal wildlife use and tourism. In addition, the relationships between wealth, food security and participation in bushmeat hunting and consumption are complex ones: demand for bushmeat can increase with increasing income (Rentsch *et al.*, 2013), and in some instances wealthier and more food-secure people are the most likely to participate in hunting (Mgawe *et al.*, 2012; Nielsen *et al.*, 2014; Rogan *et al.*, 2014). Consequently, approaches to alleviate poverty are not enough to address the bushmeat trade and must be combined with additional strategies (Nuno *et al.*, 2013).

### **Increasing demand for bushmeat and lack of legal supplies**

Demand for bushmeat is growing on account of expanding human populations as well as increasing affluence, particularly in urban areas where bushmeat is often considered to be a delicacy (Barnett, 2002). Increasing demand, coupled with waning supplies, is likely to stimulate price increases, further increasing the lure of illegal hunting (Conrad, 2012). In the North Luangwa ecosystem of Zambia for example, bushmeat harvests are believed to have increased twentyfold during the last 30 years (King, 2014), contributing to significant depletion of some protected areas (Lindsey *et al.*, 2014). Increasing demand, coupled with improving transport links, is contributing to making illegal hunting for bushmeat more commercial in nature (Barnett, 2000; Andimile *et al.*, 2009; Stiles, 2011). At present, there are very limited legal sustainable supplies of wild meat in most African countries with which to satisfy demand. Consequently, the only reliable source for bushmeat is from poachers, effectively creating a monopoly for the black market (Conrad, 2012).

### **The challenge associated with incorporating communities into conservation**

The case studies demonstrated that communities in the focal countries currently likely derive more income from illegal hunting than they do from legitimate wildlife-based land uses – either trophy hunting or ecotourism. A similar scenario likely prevails in many contexts in other countries in which communities coexist or live near wildlife. In most hunting blocks in Africa, few benefits accrue to communities from trophy hunting (Nelson *et al.*, 2013). Similarly, communities often benefit little from tourism in parks (other than through employment) and a great many parks lack tourism altogether. In such

cases, illegal hunting is often the only way communities can access benefits from wildlife. Earnings from illegal hunting may be higher than from remittances from legal wildlife use, even in some of the contexts where efforts have been made to extend benefits from hunting to communities. For example, in the Zambian game management areas, the Mozambican hunting blocks, the Zimbabwean CAMPFIRE areas, the Tanzanian Wildlife Management areas and formerly the Botswana Wildlife Management Areas, governments retain a large cut of the earnings from wildlife and have arguably not devolved user rights over wildlife far enough (Taylor, 2009; Nelson, 2013; Lindsey *et al.*, 2014).

In some countries, a key challenge which prevents or has dissuaded governments from devolving user rights over wildlife to communities has been the reliance of state wildlife authorities on hunting revenues or tourism income for their operations and a reluctance or inability to let go of that income (Nelson *et al.*, 2013; Lindsey *et al.*, 2014).

### **Limits to the scope for generating income from ecotourism and trophy hunting**

There is a limit to the markets for both ecotourism and trophy hunting. Consequently, in the absence of alternatives, creating incentives for conservation and alternatives to income from illegal hunting may be difficult

in some scenarios. Furthermore, income from trophy hunting is seriously threatened by growing international opposition to sustainable use approaches to conservation, particularly in the West. This opposition is manifesting in pressure on western governments to impose restrictions on the import of hunting trophies (Lindsey *et al.*, 2013c) and recently, on airlines to ban the transport of hunting trophies. Such steps taken in the absence of providing alternative funding streams for conservation, will limit scope for communities to benefit legally from wildlife, for wildlife to develop as a land use on communal or private land, or for state wildlife authorities to fund their operations (Nelson *et al.*, 2013).

### **The challenge associated with spatial expansion of human populations**

An increasing proportion of protected areas in Africa are suffering from human encroachment, either build up on the boundaries or incursion into land set aside for wildlife (Watson *et al.*, 2014). In some cases, immigration of people into or close to wildlife areas and the migration of refugees can place significant pressure on natural resources and result in an increase in illegal hunting (Jambiya *et al.*, 2007). Wildlife populations often fare better in areas with low densities of people and both participation in hunting and consumption of bushmeat tend to decline with distance from protected areas (Hofer *et al.*, 1996; Brashares *et al.*, 2011).



Human encroachment of protected areas is often associated with elevated levels of illegal hunting



## POTENTIAL SOLUTIONS TO ADDRESS THE BUSHMEAT ISSUE

### Greater effort from African governments and the international community

African governments and the international community are urged to make as significant a commitment as possible to address the bushmeat problem, in light of the severe ecological, economic and social issues that arise from it. Elevated effort to address the issue is congruent with the obligations of signatories to multi-lateral agreements such as the Convention on Biological Diversity Aichi targets, the Millennium Development Goals and the UN Sustainable Development Goals.

A range of interventions are needed, and some of the most important include:

### The case for elevated local and international funding for conservation

There is a need for elevated international and domestic expenditure to address the bushmeat issue. Examples of key funding needs include community conservation programmes and support for protected area management. The supply of funding and technical support has been a key component of the success of the Namibian and

Kenyan community conservation initiatives and played a key role in the early successes of the Zimbabwean CAMPFIRE programme (Jones and Weaver, 2008; Taylor, 2008; Pye-Smith, 2013). Similar support is needed for other countries. Similarly, adequate funding for protected areas, to allow for management such as anti-poaching and anti-trafficking, is of key importance (Hilborn *et al.*, 2006; Homern *et al.*, 2007). Expenditures on protected area management should be seen as investments in the tourism industry and rural development rather than as mere costs. Recent estimates suggest that for every one percent increase in tourism-related investment in the SADC region, a 0.3 percent increase in GDP per capita accrues (Makochekanwa, 2013). Consequently, there is a case for using development funding (as well as conservation money) to invest in protected areas. Tourist visitation and the contribution of tourism to GDP are greatly skewed among African nations (Christie *et al.*, 2014) and some countries could likely expand their tourist industries to a large extent if greater investment was made in protecting the wildlife product and in tourism infrastructure.

### The need for alternative incentives for conservation

There is a need to find additional means of generating incentives for conservation to reduce reliance on ecotourism and trophy hunting. In Kenya, incentives for conservation on community lands have been created



Anti-poaching has an important role in addressing illegal hunting

through aligning conservation objectives with steps to improve human welfare, such as through resolution of local tribal conflicts (Pye-Smith, 2013). Additional alternative incentives could be created through payments to communities, land owners or governments for carbon sequestration or for provision of environmental services (Dickman *et al.*, 2011). In Niassa in Mozambique, for example, conservationists are trialling an endowment scheme with communities whereby benefits are adjusted upwards or downwards in relation to the level of illegal hunting recorded (C. Begg, personal communication). Such approaches have significant potential but would require elevated international support. Some such support could potentially be generated through debt-for-nature schemes, whereby poor countries are granted debt relief in return for commitments to conservation (Phillips, 2000). African governments could potentially attract additional funding for protected areas by soliciting support from other countries, conservation NGOs, private companies and individual philanthropists for the co-management of wildlife areas (Spierenburg and Wels, 2010; Nyirenda and Nhakata, 2013).

### The need for legislative reforms

There is a need for legislation which strictly prohibits the hunting of wildlife for meat without the necessary permits

and which provides for penalties that greatly exceed the value of the resource. In addition, education and training programmes involving the judiciary are needed to raise awareness of the negative impacts of illegal hunting on wildlife populations, on national economies and on food security. In Zambia, the Zambia Wildlife Authority engaged in such an awareness-raising exercise with magistrates in the Kafue National Park area and achieved a 96 percent conviction rate for poachers in the following year (2013) (S. Beattie, personal communication).

In some places, governments appear to be starting to take illegal hunting more seriously. Zimbabwe now requires poachers to pay compensation (of USD500-120,000 depending on the species) in addition to facing criminal charges (Statutory Instrument 56 of 2012). In early 2014, both Mozambique and Kenya passed bills that allow for more stringent penalties against poachers (<http://allafrica.com/stories/201404100710.html>, [http://www.kws.org/export/sites/kws/info/publications/acts\\_policies/The\\_wildlife\\_conservation\\_and\\_management\\_bill\\_2013.pdf](http://www.kws.org/export/sites/kws/info/publications/acts_policies/The_wildlife_conservation_and_management_bill_2013.pdf) accessed April 2014), and Uganda is currently revising their Wildlife Act to allow for more stringent penalties for illegal hunting (<http://www.theeastafrican.co.ke/news/Weak-laws--easy-markets-aiding-trade-in-bush-meat--/-/2558/2797978/-/lxi7sy/-/index.html>, accessed July 2015).



Anti-trafficking interventions can help control the transport of illegally hunted bushmeat, such as this shipment seized in Zambia (Photo: J. Milanzi)





There is a need to replace illegally sourced bushmeat with legally and sustainably produced wild meat in a manner that involves and benefits communities (Photo: P. Lindsey)

When considering law enforcement efforts, there is a need to engage communities as committed conservation partners (Challender and MacMillan, 2014). Such partnerships are most likely to develop if communities are conferred benefits from coexisting with wildlife (either financial or other) and if they have good cooperative relationships with the state wildlife authorities and/or private tourism operators or land owners (Roe *et al.*, 2015). Correspondingly, there is a need for legislative reform that empowers communities to benefit legally from wildlife (see the next section).

Legislative reform should address constraints that currently limit potential for and the viability of wildlife-based land uses (Lindsey *et al.*, 2013 a, b, 2014). Legal frameworks should avoid bans on legal hunting of wildlife and ensure that wildlife is as valuable as possible in as many different ways as possible. Examples include high-end tourism, low-end tourism, trophy hunting, harvest of wildlife for meat and capture of live wildlife for sale. There is a need for policies which encourage the large-scale sustainable production of wild meat in a manner that incorporates and benefits communities (Challender and MacMillan, 2014). Wildlife ranches and community conservancies in Namibia, for example, produce millions of kilogrammes of meat per annum (Lindsey *et al.*, 2013).

## The need for engaging communities in conservation

The challenge for African governments is to develop legal frameworks that allow communities to access maximum benefits from wildlife conservation under as wide a range of scenarios as possible. A key change needed to

make such steps practically possible is to provide central government funding for state wildlife authorities so that they are able to 'let go' of some (or all) of the revenues generated from wildlife-use on community lands.

To achieve community participation in conservation, there is a need for innovative thinking and a range of models that apply to different scenarios. Examples include:

- Developing community conservancies (or 'wildlife management areas') on communal lands where user rights are devolved as far as possible to communities. Such a model has proven to be highly successful under Namibian conditions (Jones and Weaver, 2008).
- Allocating communities shareholdings or concessions in wildlife areas so that they benefit from conservation in those areas, as has been implemented in Namibia, for example (Thompson *et al.*, 2014).
- Providing communities with regulated access to non-wildlife products in protected areas, such as timber, thatching grass, honey, mushrooms and medicinal plants.
- Payments for environmental services approaches to encourage communities to conserve wildlife on their lands (Dickman *et al.*, 2011).

## The need for land-use planning

Land-use planning and allocating clearer land rights to communities are essential steps to address the open-access systems so conducive to over-use of natural resources. Providing communities with exclusive rights over land and the wildlife resources therein can create strong incentives for them to engage in conservation to access longer term sustainable benefits (Lindsey *et al.*, 2014). Land-use planning can also be a key strategy for maximizing the efficiency with which land is used, for ensuring that some wilderness areas are retained and for reducing human-wildlife conflict (Hoare, 2000).

In protected areas, land-use planning can help to minimize encroachment by humans and livestock, ensure the retention of buffer zones around parks and make it easier to protect wildlife from illegal hunting. In protected areas where human settlement is not permitted, enforcing such prohibitions is a key step to addressing the bushmeat trade. In protected areas where human settlement is permitted, limiting the inflow of people is paramount, as is land-use planning to ensure that some portions of the protected areas are remote from human settlement (Naughton-Treves *et al.*, 2005).



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## CONCLUSIONS

Illegal hunting and trade in bushmeat represents one of the most serious threats to wildlife in Africa today. From an African conservation perspective, the world's focus and attention is on the issue of elephant and rhino poaching. However, work undertaken suggests that a similar level of focus is needed to address the issue of illegal hunting for and trade in bushmeat. The bushmeat trade transcends both conservation and food security/development issues and is thus deserving of attention from both the conservation community and the wider development community.

Though illegal hunting for bushmeat does confer some livelihood benefits for the people involved, the benefits are generally not sustainable and will almost certainly wane as hunted populations of wildlife decline. The bushmeat trade has severe impacts on potential earnings from wildlife, the creation of jobs and the production of wildlife meat. Consequently, illegal hunting for bushmeat likely confers net negative food security impacts. The bushmeat issue is a complex problem that requires multi-pronged solutions and urgent attention.

## ACKNOWLEDGEMENTS

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*Rest in peace Jon Barnes. It was an absolute pleasure working with you and your passing is a tragic loss for conservation in the region.*



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## APPENDIX 1: DETAILED METHODS

### Questionnaire surveys

Questionnaire surveys were conducted as part of a wider study on lion conservation (Lindsey *et al.*, unpublished data). Sites were selected by identifying all of the protected areas that occur within lion range (which occupies 3.4 million km<sup>2</sup> of Africa's savannahs, Riggio *et al.*, 2013) and contacting as many managers/associated experts (e.g. researchers, NGO staff, tourism staff) as possible during a three-month period. A survey was then conducted via telephone or email (for those with poor telecommunications). Each respondent was asked to rate a series of challenges on a scale from 0-5 in terms of their current severity as a threat to wildlife in the reserve (where 0 is non-existent and where 1, 2, 3, 4 and 5 represent increasing severity of threat). The threats listed in the question included:

- Human encroachment of the protected area for agriculture or settlement
- Incursion of protected area with livestock (and associated competition with wild ungulates for grazing, and/or disease threats and/or increased human-predator conflict)
- Illegal hunting for bushmeat
- Illegal hunting of wildlife for non-meat body parts (e.g. ivory, rhino horn, pangolin scales)
- Human/wildlife conflict and any associated retributive killing
- Wildlife diseases
- Legal or illegal mining in the reserve
- Deforestation on account of logging for timber
- Deforestation on account of tree cutting for charcoal and firewood
- Excessive trophy quotas (either within the reserve or through animals in the reserve being affected by excessive quotas in adjacent areas)
- Excessive ration hunting/legal meat hunting
- Others (with respondents asked to specify)

### Estimating the size of protected area networks

To estimate the extent of protected areas in each country, a shapefile of terrestrial protected areas was created from the overlap of Natural Earth country boundaries with the protected areas from the World Database on Protected Areas (WDPA) (IUCN and UNEP-WCMC, 2015). The area encompassed by 'strictly' protected areas (i.e. IUCN

categories 1-4) was then identified following Jenkins *et al.*, 2013. Overlapping polygons in the WDPA shapefile were assigned to the category of stricter protection. Shapefiles of protected areas with Categories I-IV were merged and converted to a raster layer at 100-m resolution. This layer and the country boundaries shapefile were then used to calculate the percentage of each country composed of protected areas of strict protection. To estimate the burden of protected areas relative to wealth, data on GDP per capita were obtained from <http://data.worldbank.org>, accessed July 2015.

### Case studies of the ecological, economic and social impacts of the bushmeat trade

Using data from two SADC nations ('Country A' and 'Country B'), the impacts of illegal hunting and other human threats on wildlife populations were assessed. The food security benefits obtainable from illegal hunting were compared with benefits obtainable from legal wildlife-based land uses based on current populations, and whether wildlife populations were protected from illegal hunting and allowed to recover.

The two main types of protected area in Country A are national parks and hunting blocks. In parks, land use is restricted to ecotourism and no human settlement or agriculture is allowed. Hunting blocks generally occur adjacent to parks and are used for legal hunting and some ecotourism (Simasiku *et al.*, 2008) (the word 'ecotourism' is used to mean wildlife/photo-tourism).

Human habitation is permitted in hunting blocks, as are agriculture, forestry and mining. Protected areas in Country B include parks, reserves, hunting blocks, multiple-use areas and community-conservation areas. Parks are used for conservation and ecotourism purposes only, while the remainder are used for legal trophy hunting.

### Current large herbivore biomass in protected areas

Available data on wildlife abundance for protected areas in Country A and Country B were gathered from aerial census reports (Dunham, 2004, 2010; Matthew and Nemane, 2006; Simwanza, 2004; Simwanza, 2005; Simukonda, 2008, 2011; Craig, 2011; Stalmans, 2012, 2012; Frederick, 2011, 2013; Viljoen, 2011, 2013; ZAWA, 2013; Beilfuss *et al.*, 2013). Census data were available for 39 protected areas in Country A (14 parks comprising 61 812 km<sup>2</sup> and 25 hunting blocks comprising 152 122 km<sup>2</sup>) (92.6 percent of Country A's protected

areas) and 23 protected areas in Country B (seven parks/reserves comprising 39 394 km<sup>2</sup> and 16 hunting areas comprising 50 127 km<sup>2</sup>) (~71.2 percent of the total protected area network).

To reduce visibility bias associated with census data, species of bushbuck- (*Tragelaphus scriptus*) size and smaller, as well as suids, were excluded as they are difficult to count from the air. Hippopotamuses (*Hippopotamus amphibius*) were also excluded, as they are often excluded from census reports. Biomass estimates for each protected area were determined by multiplying the number of each species from the census data by their average body mass (Coe *et al.*, 1976), summing the biomasses of all species (excluding the above-mentioned) and multiplying the total by 1.1 as an approximation of the likely biomass of the small species excluded from the study.

**Potential biomass of large herbivores in protected areas protected from illegal hunting**

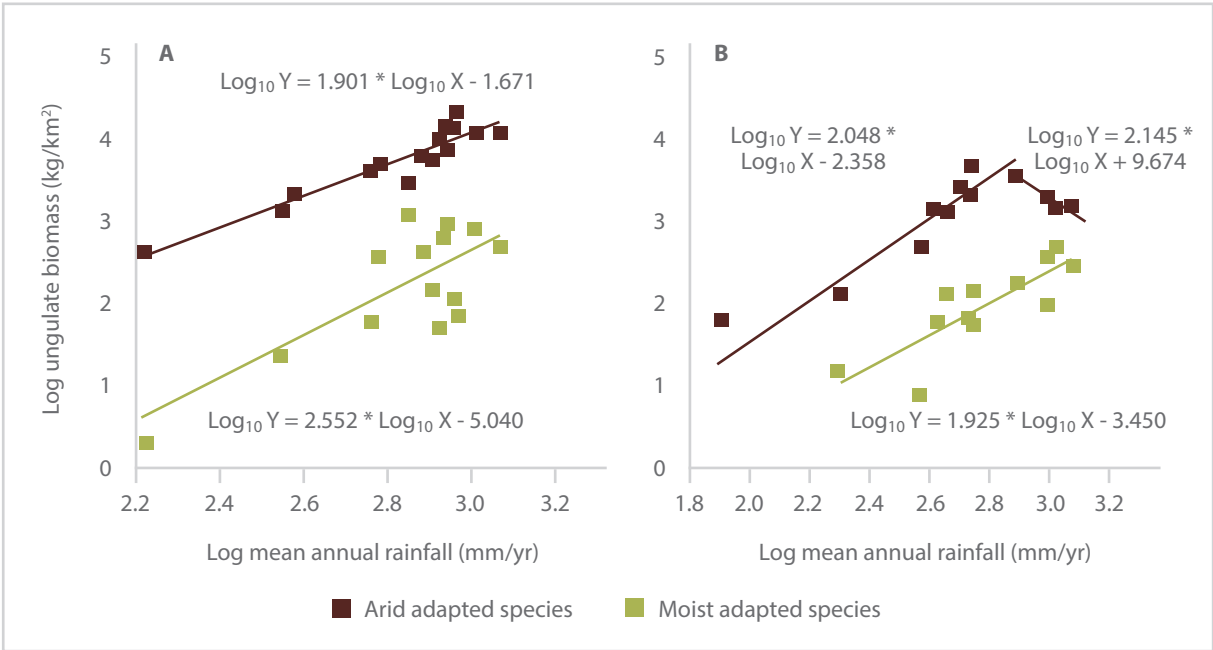
Total biomass of large herbivores can be predicted by the quality and quantity of plant biomass (Coe *et al.*, 1976; Bell, 1982; Bell, 1984; East, 1984; Fritz and Duncan, 1994). Bell (1982) showed that large herbivore biomass was positively related to annual rainfall <700 mm, but declined >900 mm. East (1984) showed a similar pattern, though noted that in areas of medium or high soil nutrients, herbivore biomass continues to increase beyond 1 000 mm

of annual rainfall. East (1984) categorized wildlife into species whose biomass peaked <820 mm and those whose biomass peaked >1 000 mm.

Rainfall, soil nutrient status and large herbivore biomass for 28 African savannah areas (East, 1984) were used to create five regression curves for predicting herbivore biomass (Figure 25):

- 1) medium soil-nutrient areas for moist-adapted species;
- 2) medium soil-nutrient areas for arid-adapted species;
- 3) low soil-nutrient areas for moist-adapted species;
- 4) low soil-nutrient areas for arid-adapted species with annual rainfall <700 mm;
- 5) low soil-nutrient areas for arid-adapted species with annual rainfall >700 mm.

In each case, herbivore biomass was plotted against rainfall using GraphPad Prism. These regression curves were used to predict potential herbivore biomasses (kg/km<sup>2</sup>) for protected areas where rainfall and soil nutrient data were available. Annual rainfall data were derived from literature and internet sources, while soil nutrient status was determined using soil and vegetation maps (Wild and Fernandez, 1967; Jones, 2013). In protected areas where there was more than one soil or vegetation type, the proportion of each type within the area was estimated and the average soil nutrient status calculated.



**Figure 25.** Regression of ungulate biomass against annual rainfall for: A) medium/high soil nutrient areas, B) low soil nutrient areas. Note that the noise around the line may affect accuracy of site-specific estimates though less so the overall 'average' picture. (Data from East, 1984)

Estimating depletion of protected areas

The extent of depletion of protected areas was estimated including and excluding elephants (*Loxodonta africana*). Elephants in savannahs are typically targeted by poachers primarily for ivory (rather than meat), enabling the authors to assess the extent to which biomass depletion was caused by factors other than illegal ivory hunting. Rhinoceros species were excluded as they are largely absent from the two countries.

Estimating species compositions in recovered protected areas

To estimate incomes from protected areas if wildlife populations were allowed to recover, the potential abundance of each species would be in each area, according to historical distributions and habitat preferences. Species compositions were assigned according to how biomass is commonly distributed between species across vegetation types (miombo woodland, mopane woodland and grasslands) (Cumming, 1982). Species geographic distributions were obtained from Skinner (2005), aerial census data and hunting quota data.

Current and potential meat extraction and income

Maximum likely harvests by poachers were inferred from persisting herbivore populations by assuming that they harvested wildlife at rates equivalent to the maximum intrinsic rate of increase for each species ( $R_m$ ) (Caughley, 1983).  $R_m$  is unlikely to be attained in well-stocked areas, so for protected areas with current standing biomass >50 percent of predicted carrying capacity, it was assumed that illegal hunting harvests occurred at half  $R_m$  for each species.

Current income from meat extraction was determined for each protected area by summing income from illegal hunting (equation 1) and income from meat derived from trophy hunting (equations 2a, 2b). Current income from the meat derived from illegal hunting for each species was estimated by multiplying the following factors: standing count for each species,  $R_m$ , mean live mass, dressing percentage and price. Current income from the meat derived from trophy hunting for each species was estimated by multiplying the following factors: for Country A – trophy hunting offtakes, mean mass of trophy animals, dressing percentage and price; for Country B – standing count for each species, trophy hunting quota offtake rate, mean mass of trophy animals, dressing percentage and price.

1										
Current meat income from illegal hunting for each species (USD)	=	Standing herbivore count	x	$r_m$	x	Mean live mass	x	Dressing %	x	Price (USD)

Where mean live mass equalled values in Coe *et al.*, 1976 and dressing percentages in Bothma and Du Toit, 2010. The price of illegal meat was set at USD3/kg (equating to estimates from various sources in the two countries [range USD2-5]).

2 (a)								
Current meat income from trophy hunting for each species (USD): Country A	=	2012 trophy hunting offtake numbers	x	Mean trophy hunted live mass	x	Dressing %	x	Price (USD)

2 (b)										
Current meat income from trophy hunting for each species (USD): Country B	=	Current standing count	x	Trophy hunting quota offtake rate	x	Mean trophy hunted live mass	x	Dressing %	x	Price (USD)



APPENDIX 1: DETAILED METHODS

Trophy offtake data for Country A were obtained from the wildlife authority. Trophy offtake data were not available for Country B; there offtakes were assumed to equal sustainable trophy harvest rates (WWF, 1987). Trophy animals were assumed to equal the mean male body mass (Bothma and Du Toit, 2010) and meat was assumed to be worth USD3/kg.

Potential income from meat extraction was determined for each protected area by summing the potential income from cropping (equation 3) and the potential meat income from trophy hunting (equation 4).

3							
Potential meat income from cropping for each species (USD)	=	Potential standing count	x	Cropping quota offtake rate	x	Mean cropped live mass	x Dressing % x Price (USD)

4							
Potential meat income from trophy hunting for each species (USD)	=	Potential standing count	x	Trophy hunting quota offtake rate	x	Mean trophy hunted live mass	x Dressing % x Price (USD)

Sustainable cropping quotas were obtained from WWF, 1987 and body masses for cropped animals were assumed to be intermediate between adult male and female weights (Bothma and Du Toit, 2010).

Current and potential earnings from trophy hunting and non-consumptive ecotourism

The value of trophy hunting was estimated following Lindsey *et al.*, 2012. Trophy hunting occurred in 20 of the hunting blocks in Country A in 2012 (the remainder are too depleted), and these were used to estimate current trophy hunting income for each species from equation 5.

5			
Current trophy hunting income for each species (USD): CountryA	=	2012 trophy hunting offtake numbers	x Trophy price (USD)

Current income from trophy hunting in Country B was calculated for hunting areas in which aerial census data were available, following equation 6.

6				
Current trophy hunting income for each species (USD): Country B	=	Current standing count	x Trophy hunting quota offtake rate	x Trophy price (USD)

Potential income from trophy hunting in hunting areas if wildlife populations were allowed to recover were calculated by summing the revenues from each species, which were obtained using equation 7:

7				
Potential trophy hunting income for each species (USD)	=	Potential standing count	x Trophy hunting quota offtake rate	x Trophy price (USD)



The current value of wildlife-viewing ecotourism in the parks of both Country A and Country B was calculated as follows:

8

Current wildlife-viewing income for each park (USD)	=	Number of ecotourism lodge/camp units	x	Average gross income for typical unit
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Gross income for a typical 20-bed lodge/camp unit was obtained from financial and economic wildlife-viewing ecotourism lodge enterprise models, following Barnes (1998) and Chemonics International (2011).

The development of ecotourism in parks of both countries is currently limited to places where sufficient wildlife and scenic attributes occur and where infrastructure is adequate. To derive the livelihood and economic values of current ecotourism in the parks of Country B, estimates provided by Barnes (2008) were used; and for Country A data assembled by Pope (2005, 2009) were extracted and used for imputation. Anticipated growth in potential and future ecotourism development was derived using estimates from Barnes (2009); PMTC (2008, 2010) and Pope (2009). The potential value of ecotourism in the parks of both countries was estimated by applying expected growth trends for ecotourism based on park development plans, overall ecotourism sector development plans and predictions for ecotourism demand.

*Social benefits: livelihoods created by meat extraction and trophy hunting*

There are both legal and illegal sources of livelihood support coming from protected areas. Trophy hunting operations create jobs and generate income that is returned to communities via government remittances. Additionally, illegal hunting generates income which contributes to poachers' livelihoods. The number of livelihoods generated from wildlife in hunting blocks in the two countries were calculated by summing the number of jobs created by trophy hunting, the number of 'employment equivalents' (equating to the minimum wage in each country [USD75/month in Country A, USD48/month in Country B]) arising from trophy fees and trophy meat sales remitted to communities, and the number of employment equivalents derived from the income earned from bushmeat sold by poachers (equation 9).

9

Total current livelihoods per hunting area	=	Number of jobs created by trophy hunting (10)	+	Employment equivalents from trophy rental and trophy meat income remitted to communities	+	Employment equivalents from poached meat income
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To estimate jobs created from current trophy-hunting enterprises (equation 10), it was assumed that a typical hunting camp would employ 10 staff members per camp plus three to accompany each professional hunter (Mokore Safaris, personal communication). Each camp would have a maximum of three professional hunters, the number depending on available quotas. It was assumed that each camp would require 1 000 km², 2 000 km², 3 000 km², 5 000 km² where high, medium, low or very low densities of wildlife persist: herbivore biomass estimates suggest that high soil nutrient areas have potential biomass values three times higher than low nutrient areas.

10

Number of jobs created by trophy hunting per hunting area	=	Number of hunting camps	x	Number of jobs per camp
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APPENDIX 1: DETAILED METHODS

To estimate potential employment equivalents if herbivore populations in protected areas were allowed to recover to potential carrying capacities, equation 9 was used, but with current jobs and employment equivalents substituted with potential values, and excluded income from illegal hunting. Employment equivalents were calculated using two scenarios: 1) assuming that current systems for benefit sharing were in place: in Country A, government remits 20 percent of concession fees plus 50 percent of animal trophy licence fees to communities; in Country B, government remits 20 percent of income from hunting to communities; 2) assuming that 15 percent of total gross income from trophy hunting operations was allocated as rental to communities instead of going through government departments (estimated to be the maximum percentage of gross income that a typical trophy-hunting operation could spare while retaining viability, following financial and economic models developed by FGU-Kronberg Consulting (1988) and Barnes (1998). It was assumed that land use in hunting blocks would be limited to trophy hunting and the sale of meat from trophy hunting and culling.

For local households and communities who live near (and in Country B, inside) parks, an alternative to illegal hunting is participation in ecotourism through employment and remittance of rentals from joint-venture ecotourism enterprises. Here, financial and economic enterprise wildlife-viewing lodge/camp models developed by FGU-Kronberg Consulting (1988) and Chemonics International (2011) were used to determine the employment benefits and the proportion of gross income that could be remitted as livelihoods. It was assumed that a typical 20-bed lodge would have 23 staff members, including four managers, eight semi-skilled and 13 unskilled workers. The estimated maximum percentage of gross income that a typical wildlife-viewing lodge operation could spare while retaining business viability was eight percent.

11

Number of jobs created by wildlife viewing per park	=	Number of lodges/camps	x	Number of jobs per camp
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Employment and employment units, as described for equation 9 above, were applied in the same way to estimate the total current livelihoods per park.

12

Total current livelihoods per park	=	Number of jobs created per park by wildlife viewing (11)	+	Employment equivalents from wildlife-viewing rental income remitted to communities	+	Employment equivalents from poached meat income
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Calculation of net incomes from wildlife

Estimates of net income from various forms of wildlife use were needed to allow more accurate comparisons of actual and potential incomes from legal and illegal wildlife use (Table 1). Empirical data on the structure of trophy hunting and ecotourism enterprises were available, but data on illegal hunting enterprises were not. Insights on the production costs associated with illegal hunting were derived from studies on legal small- and medium-scale wildlife use in Botswana (FGU-Kronberg Consulting, 1988; Barnes, 1989, 1989, 1991, 1998; Department of Wildlife and National Parks, 1987; Chemonics International, 2011). These data were deemed sufficient to act as proxies for illegal hunting in the focal areas where incomes, capital investments, labour, time and other operating costs are likely similar.

In addition to private livelihood values, economic values were also examined. These entailed the net overall direct impact of each activity on national economies, for which income accruing to the local households as livelihood was included, as were incomes to ecotourism investors, non-local employees, government and lenders of capital, among others. Thus the direct contributions to all components of the national income were estimated following Barnes (1998) and Chemonics International (2011).

### *Limitations of data from the case studies*

Herbivore biomasses in protected areas were estimated using aerial census data, which are affected by numerous biases (Jachmann, 2002). Furthermore, when estimating potential maximum herbivore biomasses, coarse data for rainfall, soil and vegetation were used, which do not allow for the fine-scale variation that occurs in large protected areas. Furthermore, those variables do not explain all the variability in ungulate biomass in protected areas (East, 1984; Fritz and Duncan, 1994) and the estimates in this report must be considered approximations.

Estimated potential herbivore biomasses represent maximum estimates that could only be achieved given

complete prevention of illegal hunting. Additionally, the use of the intrinsic rate of increase ( $r_m$ ) to estimate bushmeat extraction likely over-estimated harvests as some animals die for reasons other than illegal hunting, some methods of illegal hunting are wasteful and poachers do not utilize the meat from all animals killed. Lastly, the estimates do not take into account reductions in potential income that may occur on account of habitat loss caused by human encroachment, or potential limits to the demand for ecotourism and trophy hunting.

However, in spite of these shortcomings, the take-home message – that illegal bushmeat hunting captures a small fraction of the potential income, livelihoods or meat derivable from wildlife via legal use – is robust.



Snaring is extremely wasteful and tends to result in the death of large numbers of animals that are never recovered, such as this impala in Zimbabwe (Photo: R. Groom)



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