Managing the conflicts between people and lion: review and insights from the literature and field experience

Working Paper · January 2010

CITATIONS
14

READS
85

11 authors, including:

Philippe Chardonnet
IGF Foundation
47 PUBLICATIONS **335** CITATIONS
SEE PROFILE

Hervé Fritz
Claude Bernard University Lyon 1
222 PUBLICATIONS **5,420** CITATIONS
SEE PROFILE

Nolwenn Drouet-Hoguet
7 PUBLICATIONS **20** CITATIONS
SEE PROFILE

Maryline Pellerin
Office National de la Chasse et de la Faune Sauvage
47 PUBLICATIONS **233** CITATIONS
SEE PROFILE

Wildlife Management Working Paper 13

MANAGING THE CONFLICTS BETWEEN PEOPLE AND LION

Review and insights from the literature and field experience

fondation IGF

FAO FIAT PANIS

Wildlife Management Working Paper 13

MANAGING THE CONFLICTS BETWEEN PEOPLE AND LION

Review and insights from the literature and field experience

P. Chardonnet
International Foundation for the Conservation of Wildlife (IGF Foundation), France

B. Soto
Transfrontier Conservation Area Programme (TFCA), Mozambique

H. Fritz
French National Centre for Scientific Research (CNRS), France

W Crosmary
French National Centre for Scientific Research (CNRS), France

N. Drouet-Hoguet
Wildlife Consultant, France

P. Mesochina
International Foundation for the Conservation of Wildlife (IGF Foundation), France

M. Pellerin
Wildlife Consultant, France

D. Mallon
Manchester Metropolitan University (MMU), United Kingdom

L. Bakker
World Wide Fund for Nature (WWF) – The Netherlands
The Netherlands

H. Boulet
International Foundation for the Conservation of Wildlife (IGF Foundation), Mozambique

F. Lamarque
International Foundation for the Conservation of Wildlife (IGF Foundation), France

Food and Agriculture Organization of the United Nations
Rome, 2010

"When a lion emerges from the bushes in the red dawn and lets out a booming roar, then even in fifty years humans will stand in awe."

(Professor Bernhard Grzimek: *Serengeti Shall not Die*, 1959)

"The lion population continues to be fairly strong and well distributed but, because of the necessity to shoot cattle-killers and man-eaters, lion must be carefully looked after or else they will become rare."

(Ugandan Game Department Archives, 1962–1963)

Contents

Preface *5*

Foreword *6*

Acknowledgements *7*

Acronyms *8*

Introduction *9*

1 The Conflict 11

1. The nature of the conflict *11*
1.1. Predation on livestock 11
1.2. Attacks on humans 12
1.2.1. Provoked attacks 14
1.2.2. Unprovoked attacks 15
1.3. Predation on endangered species 15
1.4. Magnitude of the conflict 16
1.4.1. Attacks on humans 16
1.4.2. Predation on livestock 18

2. The roots of the conflict *19*
2.1. The human factor 19
2.1.1. Requirements of human development 19
2.1.2. The security risk 19
2.1.3. Attitudes and perceptions 21
2.2. The habitat factor 23
2.2.1. Natural factors 23
2.2.2. Agricultural influence 24
2.2.3. Pastoral influence 25
2.3. The lion factor 26
2.3.1. Behaviour 26
2.3.2. Diminished lions 26
2.4. The prey factor 27
2.4.1. Availability of prey 27
2.4.2. Competition for prey between man and lion 27
2.4.3. Pathology of prey 28

2 Human/Lion Conflict Management 29

1. Human management *29*
1.1. Community awareness 29
1.2. Compensation 30
1.2.1. Direct compensation: subsidies and insurance 31

2. Livestock management *35*
2.1. Intensifying human vigilance 35
2.2. Livestock guarding animals 36
2.3. Using enclosures 36
2.4. Grazing and herd management 37

3. Lion management *38*
3.1. Non-lethal control 38
3.1.1. Deterrent methods 38
3.1.2. Translocation of lions 39
3.1.3. Contraception 40

3.2. Lethal control 40
3.2.1. Offtake by administrations 40
3.2.2. Offtake by populations, farmers and breeders 41
3.2.3. Offtake by trophy hunters 42
4. Environmental management *43*
4.1. Increasing alternative prey 43
4.2. Land use planning 43
4.2.1. Planning and managing wildlife and village distribution 43
4.2.2. Zoning around protected areas 44
5. Conclusions and synthesis *45*
3 Decision framework 47
1. Phase 1: Investigation 47
2. Phase 2: Problem analysis 47
3. Phase 3: Choice and implementation of management option 48
Bibliography 51
Appendix 1. Some documented cases of lion predation on humans and livestock 58
Appendix 2. Some legal aspects of people's defence against wildlife damage 61

Preface

Not long ago, when large mammals harmed people we talked of accidents; when they damaged people's assets we referred to incidents. Nowadays, human/wildlife conflicts are regarded as common occurrences. It seems that what were once considered exceptional or abnormal events have become normal or usual. Whether this is a result of higher frequency and amplitude is not clear, because we do not have reliable statistics to make accurate comparisons.

Similarly, human-eating and livestock-raiding lions might be seen as normal lions expressing their carnivorous nature in particular circumstances. Contemporary lions are not wilder or crueller or more dangerous than before: it is just that these particular circumstances seem to be recorded more frequently. Also, communication is now instant and universal: news of a casualty in a remote wilderness can be reported at once on the internet, spreading the information worldwide. Furthermore, a problem lion seems to have a greater psychological impact than a problem crocodile: a crocodile victim disappears, but a lion victim is more likely to be noticed; also, according to B. Soto, a lion incident might be perceived as an intrusion into the human environment, whereas a crocodile incident might be viewed as a human intrusion into the crocodile environment. The result is that the lion might be regarded as more at fault than the crocodile, even though the consequences are the same.

In any case, the interface between humans and wildlife is increasing: growing human population and encroachment into lion habitat have simply augmented the incidence of contact between people and lions. Similarly, the harvesting of wildlife has increased, leaving less natural prey for lions. Obviously, the probability of clashes between people and lions now tends to be higher. Long-established traditional ways of deterring fierce, fully-grown lions might become partly ineffective, and lethal methods are not always acceptable by modern standards. Triggers for human eaters and cattle raiders are being investigated, and knowledge of behavioural factors is improving. New methods to protect people and livestock from lions are being tested in a number of risk situations; these methods are also designed to conserve the lion itself from eradication over its natural range. Conservation of the lion is now a topical concern because our ancestors, the hunted humans (Ehrenreich, 1999) of the past who were chased by predators have become hunting humans and predators themselves.

Interestingly, this study was undertaken during a period of rising general interest in conservation of the lion. Two regional strategies for the conservation of the African lion have been developed under the auspices of the Cat Specialist Group of the World Conservation Union/Species Survival Commission, one for West and Central Africa, the other for Eastern and Southern Africa.[1] And more and more lion-range states are developing national action plans. This provides evidence of the effort invested in tackling the diverse issues related to lion conservation. By focusing on the human/lion interactions, the present study is complementary to the work of the World Conservation Union. This study also echoes the dynamic forum facilitated by the African Lion Working Group.[2] We hope that this review will contribute to the challenge of long-term conservation of the African lion. Success will be attained when the lion changes from being perceived as vermin or a pest to being regarded as a wealth or an asset.

Philippe Chardonnet
Director
IGF Foundation

[1] http://www.catsg.org/catsgportal/20_catsg-website/home/index_en.htm
[2] http://www.african-lion.org

Foreword

Wildlife management and conservation efforts are rightly aimed at preserving the richness of biological diversity on this planet. Large mammals such as elephants or lions are important species, not only for the cultural value that can be attached to them, but also as large regulators in the natural environment.

Human-wildlife conflict stemming from overlap of human and animal habitats is a recognized threat to effective conservation of natural resources for future generations: people's entire livelihood can be lost in one night, which can lead to resentment towards wildlife. Besides the damage to crops or livestock directly affecting food availability, the consequences can be the damage to capital-intensive goods such as houses, or even injury or death of a family member resulting in serious psychological trauma and adverse effects on food security for a long period.

Humans occasionally react with retaliation killings, where no distinction is made between the animal that actually caused the damage and other non-culpable individuals. If the damaging behaviour occurred for a particular reason, the individual animal would probably display the behaviour repeatedly, augmenting the problem for other individuals of the species.

Solutions to agricultural pests such as plant diseases or insect plagues are numerous and well known, and often rely on the use of chemical compounds. In the case of large wild animal species, however, such lethal methods are considered unethical: more sophisticated means of dealing with the issue should therefore be sought. The Food and Agriculture Organization of the United Nations, which is concerned with food security and agricultural production, aims to help member states to find a solution to the threat that wildlife species pose to food production.

This report deals with lions. As top predators they are a threat to livestock and humans. Over-hunting of their natural prey and other ecological and ethological issues lead to casualties among livestock and humans, and occasionally to catastrophic circumstances in remote areas of Africa.

Traditional ways of removing fierce lions are not acceptable by modern standards. The pressure of lions on human production systems has made traditional protection methods for cattle and small livestock partly ineffective. Triggers for human eating and cattle killing by lions have been investigated, new information on behavioural factors have become known and management techniques relating to the problem have been tested; they are all explained in this document.

The Food and Agriculture Organization of the United Nations is pleased to support this work, which is based on years of research and experience, and which will serve as a comprehensive overview of potential solutions to deal with the issue of human/lion conflict.

Jose Antonio Prado
Director
Forest Management Division
FAO Forestry Department

Acknowledgements

E. Kaeslin, and R. Czudek managed and refined the publication in FAO. The publication was edited by M. Menhinick. O. Caillot and A. Lambert of the IGF Foundation provided editorial assistance.

Cover image: © Daniel Cornélis (lion), David Edderai (herdsmen with cattle)

Acronyms

CIRAD	*Centre de Coopération Internationale en Recherche Agronomique pour le Développement*
CLO	conservation liaison officer
ECOPAS	*Ecosystèmes Protégés en Afrique Soudano-Sahélienne*
FAO	Food and Agriculture Organization of the United Nations
HACSIS	Human Animal Conflict Self-Insurance Scheme
IGF	*Fondation Internationale pour la Sauvegarde de la Faune* (IGF Foundation)
IRDNC	Integrated Rural Development and Nature Conservation (Namibian NGO)
IUCN	International Union for Conservation of Nature
NGO	non-governmental organization
OIE	*Office International des Epizooties* (World Organization for Animal Health)
SSC	Species Survival Commission (IUCN)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WHO	World Health Organization
WRI	World Resources Institute
WWF	World Wide Fund for Nature (formerly World Wildlife Fund)

Introduction

Our generation is witnessing the greatest-ever increase in the human population and at the same time a major decrease in biodiversity. The linkage is obvious: humans have benefited from their over-use of biodiversity, and biodiversity has, to its cost, supported the surge in the human population. It looks as though humans and biodiversity have conflicting agendas: broadly speaking, humans seek to improve their livelihoods, while biodiversity is trying to survive. Development and conservation goals appear to be opposed – and conservation is losing the battle at this stage. Such warlike vocabulary demonstrates the highly fragile nature of the equilibrium between humans and biodiversity. Do we really live in a state of war? It is a fact that coexistence between humans and wildlife – wild flora and fauna – is becoming more and more problematic. The fact is that wildlife may suffer from humans, while humans may also suffer from wildlife. The response to suffering is to find the cure that will help to restore the soundness of the global system.

At the very top of the trophic chain are the large carnivores, the most charismatic emblems of the clash between people and nature. Among these are the jaguar (*Panthera onca*) in America, the tiger (*P. tigris*) in Asia and the lion (*P. leo*) in Africa and Asia; they seem nowadays rather odd sorts of living creatures. In our modern world, these strange "beasts" present an acute paradox: they are admired for their beauty and power and the fear they inspire, but they are hated and harassed because they kill domestic animals and occasionally humans and because they are perceived as cruel. Unfairly, large carnivores tend to crystallize the common oppositions between (i) urban dwellers and rural dwellers, the former advocating the beauty of the species and the latter defending their lives and goods, and (ii) countries of the North and countries of the South, the former claiming the right to enjoy tourism and to admire beautiful wildlife, the latter complaining about the costs of living in the vicinity of large predators. Indeed, conservation areas cannot contain carnivores without addressing the problems they cause in neighbouring farmland (Van der Meulen, 1977; Mills *et al*., 1978; Stander, 1990 and 1993), especially where the intensity of pastoralism increases (Van der Meulen, 1977; Anderson, 1981; Stander, 1990; Mésochina *et al.*, 2009; Pellerin *et al.*, 2009).

The goal of the present collective work is to contribute to maintaining a balance between human beings and lions in Africa. It supports the work of the Cat Specialist Group of the International Union for Conservation of Nature (IUCN) in developing a long-term conservation strategy for the African lion. In our work, the conflict between humans and the African lion is understood from both sides, in accordance with the recommendation of the 5th World Park Congress in 2004 in Durban: "Human-wildlife conflict occurs when the needs and behaviour of wildlife impact negatively on the goals of humans or when the goals of humans negatively impact the needs of wildlife. These conflicts may result when wildlife damage crops, injure or kill domestic animals or kill people" (IUCN World Conservation Union, 2004). Although we placed the emphasis on addressing the issue of lion attacks on livestock and humans, this does not mean that human aggression toward the lion is not also considered. Analysis of the roots of human/lion conflicts shows that human pressure – direct pressure in terms of people killing lions, and indirect pressure in terms of the destruction of the prey base and habitat – must be largely responsible for lion attacks on livestock and humans. The rapid encroachment of human activities on lion habitat – the reduction of wilderness as a whole – increases the interface between humans and lion, leading to the difficult coexistence of a large predator – lion – with a potential prey – human beings. To authors such as Madden (2004), human/wildlife conflict is increasing in frequency and severity and will probably continue to escalate. This hardly applies to the lion: it is more probable that the co-evolution of humans and lion was always difficult and might have been even more difficult in the past. Long before becoming major predators themselves, human

beings were the “hunted or chased”, as described by palaeontologists such as Ehrenreich (1999). And modern communications facilitate the reporting and recording of incidents, which introduces bias when comparing different periods.

Solutions to the problem of lion attacks on livestock and humans are studied here. In general, an animal becomes a problem when it competes at an unacceptable level for human food resources, becomes a nuisance or is a danger to human life (La Grange, 2005). That definition would no doubt be different for each type of land use and associated management. The issue is to define the degree of acceptance, which may differ from one area to another. A sound understanding of the problem is a step towards the cure: understanding the timing and distribution of attacks on rural communities will help to prevent them (Packer *et al.*, 2005). It can be difficult to establish the facts because the complaints of livestock herders tend be exaggerated, whereas the reactions of non-stakeholders tend to minimize the damage caused; the factual and emotional aspects of the problem must be analysed. A comprehensive review is proposed that will include all available mitigation methods for solving the problems. Finally, a decision-making process is submitted to the stakeholders in charge of managing the conflicts, based on reflections from specialists on African lions and experience of problem-solving frameworks related to other large predators such as the jaguar.

The conservation requirements for preserving the lion on a long-term basis must be recognized. Compared with many other mammal species, the resilience of the lion is high. The species is capable of rapid recovery, as demonstrated for instance after the distemper outbreak in the lion population of the Serengeti–Masaï Mara ecosystem (Cleaveland *et al*., 2007). But its resilience to any kind of shock or conflict becomes limited when the prey base disappears, when exotic diseases are introduced and when harassment is too systematic. Keeping wild lions in natural conditions requires large habitats with an adequate prey base and sustainable use of all natural resources.

The development constraints of the communities sharing space with lions – often reduced by desertification and agriculture encroachment – must be recognized, because these people are the ones who guarantee the long-term survival of the species. The people living with lions are some of the poorest on earth: imposing costly measures on them is not fair to them and does not help the lion. Conserving lions at the expense of people might produce “enemies of conservation” in protected areas, as identified by authors such as Dowie (2006). Understandably, the lion range countries have political priorities other than lion conservation, so to be effective the mitigation measures chosen must be pragmatic and acceptable.

1 The Conflict

The African lion, like other large carnivores, requires vast areas in which to roam. But human expansion and subsequent harassment by people increasingly restricts the lion to protected areas (Mills, 2000) such as national parks, wildlife reserves and hunting areas. In Africa, interactions between humans and large predators are increasing as human occupation of land expands. As might be expected, most such conflicts take place on the periphery of protected areas: cattle herders often penetrate them and new villages tend to be established on their borders, increasing the risk of lion attacks on livestock and people (Bourn and Blench, 1999).

To understand lion/human conflicts, therefore, it is necessary to classify the conflicts and assess the extent of damage, and to consider the local context because appropriate solutions will only be found through sound integration of local realities. The causes of conflict need to be analysed (i) to minimize negative man/lion interactions and (ii) to understand the circumstances where no solution exists but a decision has to be made as to which point of view – the human or the lion – should prevail.

1. The nature of the conflict

The impact of lion predation on domestic animals depends on the scale of the livestock husbandry system. It can be devastating for small traditional farmers who depend on a few livestock and can thus become a significant problem at the local level and induce drastic human retaliation. The problem is particularly acute in areas where regular predation on humans takes place. This chapter is based on extensive review of the literature (see Appendix 1), but only a few examples are used to illustrate the points made.

1.1. Predation on livestock

In Africa, pastoralists and their livestock have co-existed with wildlife for thousands of years, and it is likely that some of the tensions evident today existed in the past (Cumming, 1982; Bourn and Blench, 1999). But coexistence seems to have become more difficult in recent times: in the regions of Africa where lions occur, lion predation on livestock is reported to be the main form of conflict between predators and local people. The problem is particularly acute in the semi-arid rangelands of eastern and southern Africa, where human expansion and recent changes in land use have increased the competition between pastoralists, newly settled farmers who own livestock, and lions, especially around protected areas. This is a direct consequence of the 20th century practice in Africa of managing livestock and wildlife separately: on the one hand, national parks were set aside and livestock and people are excluded from much of them; on the other, wildlife was extensively hunted outside protected areas and pressure was exerted on predators because they impeded human development. Large predators have been decimated in most of the world because they prey on livestock, but the public have only recently become aware that populations of African lions have plummeted. Few parks are large enough to ensure their long-term survival, and because conflict with livestock is by far the most serious threat to large carnivores, it is critical that methods are found to integrate predator conservation with realistic livestock management (Frank, 2006).

In the last few decades, demographic pressure in parts of Africa has led to rural people progressively moving into wild lands where lions live. Pastoralists are gaining access to protected rangelands, and villagers are farming right up to the boundaries of parks containing large carnivores (Bourn and Blench, 1999), thereby increasing the potential for lion attacks

on livestock and people. In some cases, communities living within the boundaries of newly created parks have been displaced outside the borders, and they understandably object to lions coming from inside the parks to kill their livestock. Because of their resentment against the park system, these communities will not hesitate to intrude into the park to let their animals graze: people in Waza National Park in Cameroon and W National Park in Benin, for example, do not hide the fact that much of the lion predation on domestic animals occurs inside the park boundaries (Bauer and Kari, 2001; Hars, 2002). This of course multiplies the possibilities of lethal encounters between lions and people and their livestock. Worse, according to Bauer and Kari (2001), increasing lion predation on cattle outside and inside the parks could transform the entire lion population of such an area into stock raiders.

Movements of livestock and wildlife across protected area boundaries increase the risk of encounters because most of the protected areas with large lion populations are not fenced. In some regions, fences have been erected to prevent interactions between wild animals and the people and livestock living outside the boundaries, but fences are costly to maintain and are often damaged by erosion or by animals such as warthogs that dig holes through which lions might pass out of the parks to neighbouring farmland. In other cases, the surrounding communities destroy the fences. On the border with Kruger National Park in South Africa, for example, the people of Makoko village were found eating the roasted meat of four lions: the villagers claimed that lions from the park had killed eight of their cattle and, according to the *South Africa Sunday Times* of 23 March 1997, they had taken 500 metres of park fence to protect their houses and crops.

Lion attacks on livestock are a significant problem for rural populations, for whom domestic animals provide manure, milk and meat and are the basis of income generation, savings and social standing. The impact varies according to the size of domestic herds: it is considerable for those with only a few head of cattle. Losses can cause people to become hostile towards lions: in Mali, for example, lion predation on cattle is one of the main reasons for the drastic reduction in the number of lions. In the national parks of northern Central African Republic, the decrease in lion numbers is largely a result of systematic shooting by pastoralists during the dry season (Chardonnet, 2002). The timing and type of attacks varies: near Waza National Park in Cameroon, attacks occur mainly during the day because at night herds are kept in enclosures inside villages, where the lions generally do not dare to venture (Bauer, 2003). At the periphery of W National Park in Niger, lions typically kill cattle at night by approaching the *boma* (livestock enclosure) and causing the cattle to break out; in the same area 11 of 17 daytime attacks on herds were initiated by the predator approaching the herd rather than the herd stumbling upon a predator (Galhano Alves and Harouna, 2005). In Kenya, lions were found to attack grazing herds and herds in *boma*; in contrast to East Africa (Butler, 2000), attacks near Waza National Park occur mainly during the rainy season (Bauer, 2003).

1.2. Attacks on humans

The African lion occasionally preys on people (Skuja, 2002; Treves and Karanth, 2003; Quigley and Herrero, 2005). Even in the 21st century, lions eating humans is a serious problem in Ethiopia, Mozambique and Tanzania (Frank *et al.*, 2006), though the problem is not so severe in most other countries. Lions were third behind tigers and leopards (*Panthera pardus*) as human killers in a worldwide review of declared cases of large carnivores preying on humans in the 20th century (Löe and Röskaft, 2004). Among wildlife species, however, the lion does not appear to be the most responsible for human deaths: in the Niassa National Reserve in Mozambique, for example, Nile crocodiles (*Crocodylus niloticus*) have killed 57

people in the last 30 years; lions killed 34 and injured 37, spotted hyenas (*Crocuta crocuta*) killed 4, and leopards injured 9, though this is likely to be an underestimate (Begg *et al.*, 2007).

Lion attacks on humans often cause serious injuries or even death. In Uganda, between 1923 and 1994, 74.9 percent of lion attacks on humans were fatal; 25.1 percent caused injuries (Ugandan Game Department archives, 1923–1994). Near the W National Park in Niger, attacks on people are rare but they are often fatal (Galhano Alves and Harouna, 2005). In Tanzania, attacks on men are less often lethal than attacks on women and children (Packer *et al.* 2005). The word "human-eaters" should preferably be used for lions killing people on a repeated basis; otherwise the preferred expression is "attacks on humans".

Eastern and southern Africa are the regions where most lion attacks on humans occur. In Tanzania, according to Packer *et al.* (2005; 2006), lions killed 563 people between 1990 and 2006, and injured at least 308. Tanzania is home to the world's largest lion population and is the country where the largest number of people are attacked by lions – over 120 per year. Baldus (2004) estimates that 200 people are killed in Tanzania every year by wild animals, of which a third could be lions. A recent case study of true man-eaters in southern Tanzania (Baldus, 2004) found that at least 35 people had been killed in 20 months by one or more lions in a 350 km^2 area 150 km south-west of Dar es Salaam, between the Rufiji river and the Selous game reserve. According to Begg, Begg and Muemedi (*African Indaba*, 2007), a similar escalation in lion attacks was experienced in Cabo Delgado province in Mozambique, particularly on the Mueda plateau; recent reports suggest that 46 people were killed between 2002 and 2003 in Muidimbe district on the Makonde plateau; 70 people were killed between 2000 and 2001 by lions in Cabo Delgado. In Niassa National Reserve in Mozambique at least 11 people were killed by lions and 17 injured in the last six years; other attacks may remain unreported (Begg *et al.*, 2007). In Uganda, 275 people were attacked by lions between 1923 and 1994 (Ugandan Game Department archives, 1923–1994).

In west and central Africa, lion attacks on humans are perceived as occasional, but it is probable that some attacks are not recorded because events such as a nocturnal attack on a single person may not be reported. During the 1923 rainy season, 21 people were killed by a pair of lions near Po in Burkina Faso (Raynaud and Georgy, 1969), but attacks on people are not a thing of the past: in 2007, three villagers were severely injured by lions near to W Park in Niger (Samaïla Sahailou, pers. comm.). Near the Waza national park in Cameroon people do not fear lion attacks because they are rare: only three men were attacked in the area during one ten-year period (Bauer, 2003). In the Sahel, herders regularly encounter lions but are seldom attacked. Nomadic and migratory pastoralists are generally not afraid of lions because they know how to frighten lions away with sticks and shouts (Galhano Alves and Harouna, 2005); the same is true of camel and goat herders with cheetahs (*Acinonyx jubatus*) further north (Jérôme Tubiana, pers. comm.).

Lion attacks on people may occur inside or outside protected areas, usually in areas with high lion density. Between December 1996 and August 1997 in South Africa, 11 and possibly more illegal immigrants walking from Mozambique across the Kruger National Park were reported killed by lions, but such attacks may have been occurring for years (Frump, 2006). Not all reported conflicts occur along the borders of protected areas. In south-eastern Tanzania, for example, human population densities are low and so lion populations are widespread outside protected areas: the incidence of attacks on humans is therefore high, with up to 30 people killed each year (Vernon Booth, pers. comm.). Since 1990, some villages in Tanzania have suffered serious attacks by lions on people, probably as a result of human population growth (Packer *et al.*, 2005) leading to increased poaching and hence reduced

prey for lions. In Niassa National Reserve in Mozambique, 50 percent of attacks occur in villages with lions entering living areas: on four occasions people have been dragged from their huts. In the reserve, 34 percent of attacks occurred in fields; only 18 percent occurred in the bush (Begg, Begg and Muemedi, *African Indaba*, 2007).

Although man-eaters are not common (Macdonald, Sillero-Zubiri, 2002; Yamazaki and Bwalya 1999), the African lion has a tendency to attack humans opportunistically: easy targets include lone individuals, usually isolated hunters; 18 percent of 538 victims in Tanzania were children under 10 (Packer *et al.*, 2005). A notable exception was the man-eaters of Tsavo, which killed 140 workers building a railway bridge in Kenya in 1898 (Patterson, 1907; Kerbis-Petermans, 1999); a contributing factor may have been that workers who died of injury or disease were often poorly buried or not buried at all and scavenging lions might have started going after live humans.

In Niassa National Reserve in Mozambique, lion attacks in the 1980s may have been underestimated because some were believed to be the outcome of witchcraft. This situation changed in the 1990s with the death of a powerful traditional healer who lived in Mecula (Begg *et al.*, 2007). Also in Mozambique, in 2002 and 2003 a similar phenomenon in Cabo Delgado province led to a local rebellion (Israel, in prep.). In Tanzania, Baldus (2004) describes a local superstition about lions eating humans in which an invisible *simba-mtu* (human lion) kills for revenge. The same author reports opposite cases where people committed murder and disguised the events to look like the work of lions. In Malawi, spirit-lions called *walenga* are believed to be vengeful former chiefs (Carr, 1969).

It is generally acknowledged that lions avoid people because they are frightened of them. But in some circumstances lions might behave abnormally aggressively towards humans (see Section 2, Roots of the Conflict).

1.2.1. Provoked attacks

A provoked attack is defined as one in which a person approaches a lion too closely or tries to touch, injure or kill it, thus provoking an attack, or in which food or waste attracts the animal and brings it and a person into close proximity (Quigley and Herrero, 2005). Provoked attacks are rarely reported as such, except for rare trophy hunting accidents. Some provoked attacks might be described by the victims as unprovoked because their hunting is illegal. There are instances in which people claim to have been attacked by lions, whereas they were merely frightened. Provoked attacks might be associated with:

- Poaching: reports of man-eaters, for example in the Lower Lupande in Zambia, are often linked to the use of snares: snared or injured lions are unable to take natural prey and may resort to humans (International Conservation Services and Viljoen, 2006).
- Trophy hunting: although tourism hunting accidents with lions are rare, wounded lions are extremely dangerous.
- Kleptoparasitism: lion attacks on humans have been attributed to defence of kills (Treves and Naughton, 1999): information from the Ugandan Game Department archives (1923–1994), for example, shows that 20th century agro-pastoralists regularly scavenged from the kills of leopard and lion, which have preyed on hundreds of humans in Uganda in recent decades. Of every nine reports of humans scavenging from lion or leopard kills, three referred to the general practice rather than to specific incidents.

1.2.2. Unprovoked attacks

Unprovoked attacks are defined as cases when the victim cannot be held responsible for the encounter with a lion or its aggressive reaction. Unprovoked attacks may be classified as:

- Risks associated with the lions.
  - True predation on humans: it is said that once a lion has killed someone, its fear of man declines.
  - Weakened individuals: South African researcher Ian Whyte considers that old, sick or injured lions, or lions ejected from a pride – usually young males – are most likely to become man-eaters.
- Risks associated with humans and human activities.
  - Unusual circumstances: lions might attack when surprised, particularly at night, or when encountered with young cubs or driven off a kill (La Grange, 2006).
  - Protection of crops: in some regions, farmers stay in their fields to prevent animals from damaging standing crops. In southern Tanzania, 39 percent of lion attacks occurred during the harvest seasons; 27 percent occurred in fields. Lion attacks usually occur when people tending crops sleep in makeshift huts. Scarcity of prey accounts for 75 percent of lion attacks (Packer et al., 2005).
  - Walking at night and sleeping outside in lion country: lions are generally less fearful of people at night than during the day, so attacks occur more frequently at night (Mike La Grange, pers. comm.). In Tarangire National Park in Tanzania, 76 percent of human victims were taken at night (Skuja, 2002): this is consistent with lions' predatory behaviour in that ambush and escape are easier in the dark.
  - Where latrines are situated away from houses or where there are none, people are vulnerable at night in lion country (Packer *et al*., 2005).
  - Poaching pressure: intense poaching in rich wildlife areas reduces the availability of lions' prey; the risk is highest in tsetse-infested areas where livestock husbandry is prevented by trypanosomiasis and where people are one of the few alternative prey.

1.3. Predation on endangered species

One neglected aspect of conflict between lions and humans is lion predation on endangered species. Although this is part of the natural process, rare species caught in a "predator pit" need to be freed by wildlife managers to escape extinction.

In Kenya, for example, "… the Kenya Wildlife Service has, over several months, culled some 30 lions from the Aberdares National Park which is fenced, [where] the total number of lions is estimated to be between 145 – 180. The principal reason for the culling is their having been the main predators of the rare *bongo* (*Boocerus euryceros*) as well as inflicting serious depredation on the bushpig and giant forest hog (*Hylochoerus meinertzhageni*) within this particular habitat…" (Nehemiah Rotich, in litt. Anon., 2000).

In Kruger National Park in South Africa, lion predation has been suspected as a major cause of the decline of the roan antelope (*Hippotragus equinus*), though mismanagement is also suspected (Harrington *et al.*, 1999).

In Angola, lions were considered pests in 1940–1950 because of their threat to the giant sable (*Hippotragus niger variani)* in the Reserva do Luando. Subsequent studies showed that lions were rare in the area and that their impact on the giant sable was low (Silva, 1972).

The effect of the lion on endangered species is not restricted to herbivores. Lions may account for 80 percent of mortality among hunting dogs (*Lycaon pictus*) in Botswana, and

may be the main limit to hunting dog distribution (McNutt, 2001). In the Serengeti ecosystem in Tanzania, lions and spotted hyenas regularly kill young cheetahs, which have only a 5 percent chance of surviving to adulthood (Laurenson, 1994; *in* Jackson, 1997a,b). The extinction risk for cheetah is high when lion density is high (Kelly, 2001).

The lion is also known to prey on the chimpanzee (*Pan troglodytes*) in tropical forests (Inagoki and Tsukahara, 1993; Tsukahara, 1993).

1.4. Magnitude of the conflict

1.4.1. Attacks on humans

The extent of the human/wildlife conflict is difficult to measure. For example: "People in rural areas are very disturbed by the presence of lion, irrespective of the threat they might pose. It is common knowledge, for example, that if a goat is taken by a lion, it will often be recorded as a "threat to human life". In addition to this problem, it is abundantly clear that conflict events are not being routinely recorded, and when they are, only some of the data reach the database and are publicized" (International Conservation Services and Viljoen, 2006).

The impact of lions killing people is huge, whatever the scale. In terms of direct impact, the death of a single person is a major hardship for a family, but indirect impacts affect entire communities in terms of psychological stress and disorders, which are considerable but difficult to assess. Nevertheless, human casualties resulting from lion attacks must be ranked against other threats to rural communities such as climate hazards, animal disease outbreaks and food shortages.

Southern Tanzania and northern Mozambique are top of the list of African regions with the most human casualties from lion encounters.

One of the worst man-eating cases on record occurred in Njombe district in southern Tanzania (Baldus, 2004). Game rancher George Rushby (1965) reported that between 1932 and 1946 about 1,500 people were killed by lions in an area of not more than 2,000 km². According to Brian Nicholson, first warden of Selous game reserve, these man-eaters were after cattle and most people killed were not eaten. He confirmed that southern Tanzania was particularly affected by man-eating and gives a figure of 200 deaths per year, which Baldus (2004) considers higher than today. Between 2002 and 2004, a single lion killed 37 victims in a relatively small area south of the Rufiji river along the road to the Selous game reserve (Baldus, 2009).

In Mozambique, a national survey in 2008 (Chardonnet *et al.*, 2009) revealed that 18 of the 69 districts in the lion range experienced human/lion conflicts in the previous three years (see Figure 1). Cabo Delgado province had the most severe problem with man-eating lions: according to FAO (2005), 48 people were killed by lions between 1997 and 2004; according to Begg *et al.* (2007), 70 people were killed in 2000 and 2001; according to Israel (in prep.) 46 people were killed in Muidimbe district on the Makonde plateau in 2002 and 2003. In the Niassa National Reserve there have been at least 73 lion attacks, with at least 34 people killed and 37 injured since 1974 and at least 11 people killed and 17 injured since 2001 (Begg *et al.*, 2007).

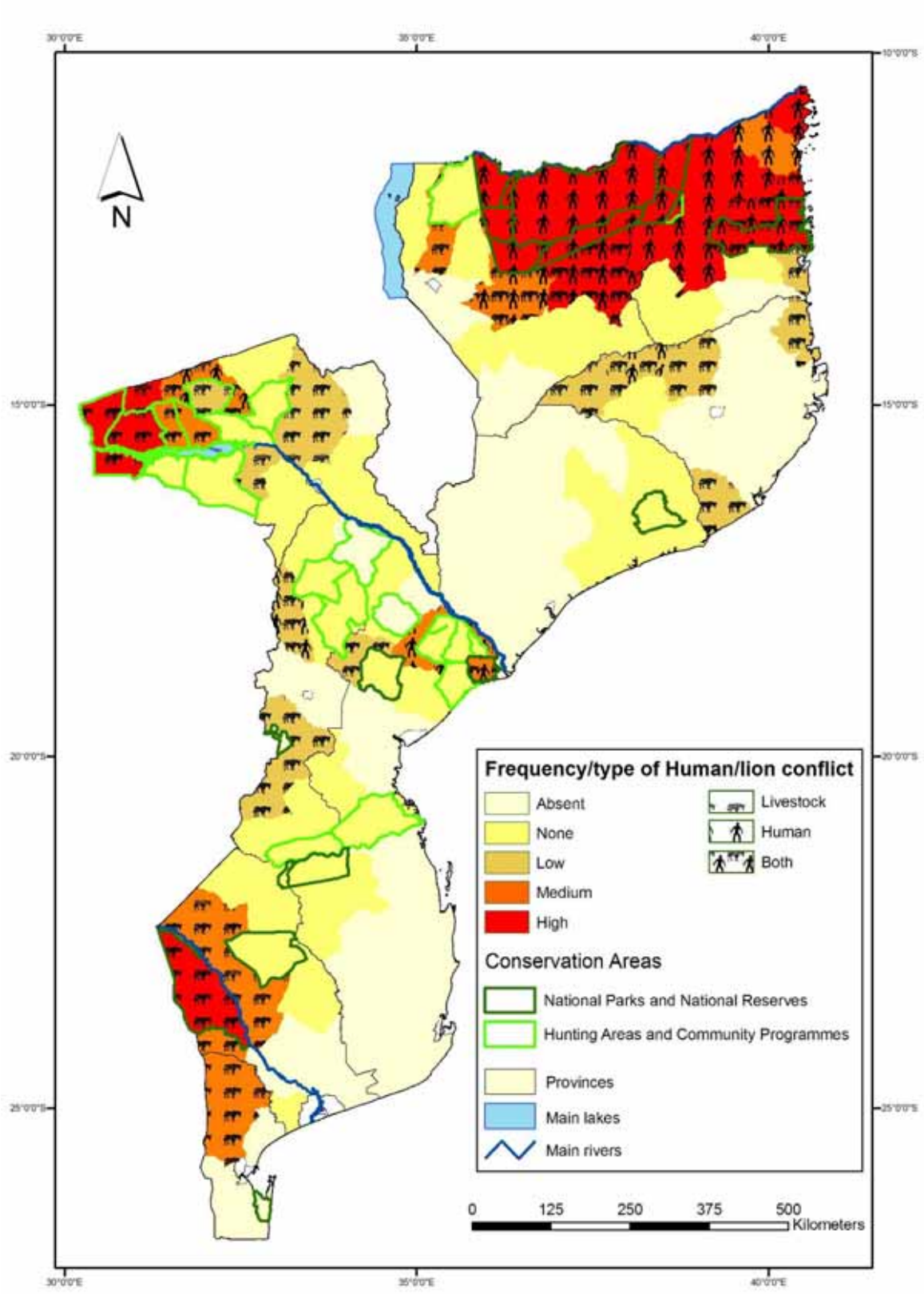


Figure 1. Frequency and type of human/lion conflict in Mozambique (December 2008). Absent: lion presence not recorded in the area. None: conflict presence not recorded in the area. Low: conflicts were reported once or twice and losses did not involve human death. Medium: conflicts were reported every year and/or involved at least one human death. High: conflicts were reported several times per year and involved human casualties and/or a high number of livestock losses (Source: Chardonnet *et al.*, 2009).

1.4.2. Predation on livestock

Lion predation on livestock is responsible for direct losses in animals killed and for indirect economic losses such as reduced breeding because of stress when herds are attacked. Although the proportion of stock killed may seem small, the economic impact is often severe, especially for poor communities. The rate of lion attacks on livestock depends on circumstances such as the type of domestic animal and the herd size in relation to the socio-economic situation of the owner.

In the late 1970s, east African pastoral tribes were losing between 2 percent and 10 percent of their livestock per year, mostly to lion, black-backed jackal (*Canis mesomelas*) and spotted hyena (see Appendix 1). In some countries the lion remains a serious predator of cattle in *bomas* at night and on grazing grounds during the day. Lion tend to kill more sheep and goats in *bomas* than spotted hyena, leopard and cheetah (Ogada *et al.,* 2003).

In Tsumkwe district near the Kaudom Game Reserve in Namibia, 40 percent of villages – mainly those of Namibian bushmen – suffered from livestock losses from lion predation valued at US$18.75 for each village involved (Stander, 1997). In the Caprivi region, the cost of cattle depredation by lions between 1991 and 1994 was US$70,570; in the Kwando area in eastern Caprivi, the total economic value of stock losses to lions between 1991 and 1993 was US$9,073 – higher than losses to crop-raiding elephants (O'Connell-Rodwell *et al.*, 2000).

In Gokwe communal land in Zimbabwe, the loss of livestock to predators averaged 12 percent of annual income per household between 1993 and 1996; more animals were killed by baboons, but lions were responsible for the greatest economic losses (Butler, 2000).

In Laikipia district in Kenya, an area of commercial ranching with tolerance for wildlife, the average ranch loses 0.8 percent of cattle per year to lions; it costs an estimated US$362 to maintain an individual lion on ranch land for one year (Frank, 1988. *In* Frank and Woodroffe, 2002). On ranches neighbouring Tsavo National Park, predation removes 2.6 percent of the estimated economic value of herds at an annual cost of US$8,749 per ranch; each lion in this region costs ranchers US$290 per year in depredations (Patterson *et al*., 2004).

In the area near Northern Queen Elizabeth National Park in Uganda, losses from lion predation on livestock between 1990 and 2000 were estimated at US$6,400 (Bauer and De Iongh, 2001).

Near Waza National Park in Cameroon, villagers estimate livestock losses to lions at 2.1 percent of cattle, 15 percent of sheep and 20 percent of goats (Bauer, 2003). Livestock losses from predation were higher than losses to disease and theft (de Iongh, Bauer, Funston and Hamling, 2008). The financial cost of livestock raiding was estimated at US$100,000 per year in six villages surveyed or US$37 to US$1,115 per livestock owner; the number of cattle lost to lions varied from 8 to 232 per village per year (Van Bommel *et al*., 2007.). Near Bénoué National Park – at least in villages with permanent farmers – livestock depredation by lions was less than that by "wild cats" such as feral cats (Croes, Buij, van Dalen and de Iongh, 2008).

In the area surrounding Zakouma National Park in Chad, three of the eleven villages and five of the six nomadic camps surveyed were regularly affected by lion predation; losses were generally below 5 percent and never more than 10 percent (Vanherle, 2008).

Farmers interviewed in the buffer zone of W Transfrontier Park in Niger lost US$149,530 because of lion predation on livestock between 2000 and 2006; the annual average cost per person was US$138 (Hamissou and Di Silvestre, 2006).

Near Pendjari National Park and Biosphere Reserve in Benin, the average annual loss to large carnivores such as lions was estimated at US$365 for each Fulani cattle herder and US$204 per small livestock farmer (Sogbohossou, 2004. *In* Sogbohossou, 2008).

2. The roots of the conflict

2.1. The human factor

2.1.1. Requirements of human development

The contribution of sub-Saharan Africa to world demographic growth has increased since 1990: in 1950, the population of sub-Saharan Africa accounted for 7 percent of the world population; in 2000 it reached 11 percent and will probably reach 14.5 percent in 2030 – approximately 1.2 billion people, almost as many as in the developed countries (United Nations Environment Programme [UNEP], 2002). Development is an essential requirement: failure to meet development needs would mean progressive impoverishment. In a context of increasing urbanization – the sub-Saharan Africa urban population multiplied by a factor of 12 between 1950 and 2000 – the rural population is facing challenges in terms of improving its own food situation and that of the urban population.

Since 1950, most of the increasing demand for food in the developed world has been met through intensified agriculture and husbandry rather than increased production areas. For developing countries, expansion of agricultural land between 1961 and 1999 accounted for only 29 percent of the increase in production; but in sub-Saharan Africa, expansion of agricultural areas contributed to two thirds of production increases (Millennium Ecosystem Assessment, 2005). So far, the increase in production in sub-Saharan Africa cannot be secured by greater productivity because technical progress does not match the rate of demographic increase. Continued expansion of agriculture and husbandry areas will have various impacts on habitats and biodiversity: at this stage, rural development in sub-Saharan Africa inevitably involves accelerated transformation of natural landscapes at the expense of wilderness that sustains biodiversity, particularly lions and their prey base.

2.1.2. The security risk

Political safety

In sub-Saharan Africa, alternating stability and instability imposes new constraints on the safety of people and goods, food security and environmental security. Whether it is the cause or the consequence of the conflicts, political instability impedes good governance. When security falls below minimum levels, wildlife officers tend to become disorganised, unmotivated, impoverished and even prone to corruption.

Deterioration and destruction of natural habitats and wildlife are among the most widespread and serious effects of wars; they also occur for strategic, commercial or subsistence reasons. More than 30 wars (Myers, 1996) and 200 *coups d'état* (Renner, 1999) have occurred in sub-Saharan Africa since the 1970s: as a consequence, 500 million light weapons are readily accessible (Smith, 2003). The proliferation of weapons helps to intensify poaching in several countries – those involved in the conflicts and those to which the weapons find their way (Shambaugh, Oglethorpe and Ham, 2001). Even when conflict is over, armed groups continue to exert devastating pressure on wild fauna for some time (Austin and Bruch, 2000). Allah-Demngar and Falmata (2003) showed that some villages on the edge of the Zakouma national park in Chad supply the cities nearby with bushmeat; this trade is facilitated by the proliferation of firearms in the area.

Another consequence of conflict – large-scale movement of populations – has environmental consequences that are not always fully evaluated. Large concentrations of refugees and displaced people exert strong pressures on their environment (Binder and Mwinyihali, 2001. *In* FAO, 2005). Refugee camps are often surrounded by degradation in the form of deforestation, erosion and reduced biodiversity. Exhaustion of resources and environmental pollution can precipitate a country or region into a vicious circle of increased impoverishment, growing political instability and intensification of environmental degradation (Shambaugh, Oglethorpe and Ham, 2001). Environmental safety is one of the main influences on lion conservation.

Food security

The number of under-nourished and malnourished people in sub-Saharan Africa, estimated at 100 million at the end of the 1960s, reached 200 million in 1995. A third of the population suffer from malnutrition and most live on less than US$1 per day (UNEP, 2002). Even today, the economic and social development of sub-Saharan Africa populations relies on exploitation of natural resources, fauna and flora. It seems that increasing exhaustion of natural resources inevitably accompanies the aggravation of poverty.

Desertification induced by natural and anthropogenic factors makes the food challenge even more difficult. If the degradation of cultivated land continues, the predictions are that harvest yields will be reduced by half in 40 years (UNEP, 2002). Whether accidental or seasonal, food shortages encourage poor populations to resort to wild resources, which often become over-exploited to the extent that the capacity to regenerate is endangered. The random character of the African inter-tropical climate, especially in the Sahel, contributes significantly to food insecurity. The numerous subsistence farming populations experience catastrophic climatic episodes that have a role in determining food choices, notably reducing the wild prey of lions with consequent increases in livestock losses. According to Burini and Ghisalberti (2001), anthropogenic pressure from the villages on the periphery of the W Transborder Park in Niger is one of the consequences of consecutive famines: people were probably attracted by the uncultivated land in and near the park and by the opportunities to take resources from the park to feed themselves.

Conservation of the lion must occur in a context influenced by the failure to satisfy the protein needs of the human population. In sub-Saharan Africa, consumption of red meat has decreased in the last 30 years (FAO, 2008) from 9.8 kg/pers/yr in 1970 to 7.3 kg/pers/yr in 2000 (Tacher, 2002), whereas it has increased in other developing countries over the same period. The ongoing increase in livestock numbers in sub-Saharan Africa does not match human population growth, but it exerts increasing pressure on natural habitats that support the prey base of the lion.

Animal protein may come from domestic animals or from wild animals, or bushmeat. The relative proportion of bushmeat in the diet compared with domestic meat and fish ranges from 6 percent in southern Africa to 55 percent in central Africa (Chardonnet *et al*., 2002). The production of bushmeat in sub-Saharan Africa exceeds 1 million mt a year, or 2 kg/pers/yr, but bushmeat consumption varies considerably with environmental or socio-cultural context (Chardonnet *et al*., 1995). For instance wild meat is consumed more in forest ecosystems than in savannas, but in the savannas people also eat more domestic meat. Hunter-gatherers consume larger quantities of bushmeat compared with agro-hunters. Wild fauna also contributes a significant share of the food of underprivileged rural social classes, whereas in cities where game meat is more expensive than domestic meat only wealthy people can afford to buy it. There is no doubt that the growing bushmeat industry has a

negative impact on lion conservation as a result of depletion of the lion prey base. Lions are outclassed as predators by humans when they seek the same prey.

Environmental risk

Even though it is rarely mentioned, the lion is threatened by the pesticides spread to control human diseases such as malaria, onchocercosis and trypanosomiasis and animal diseases borne by ticks and agricultural pests.

Lions may be poisoned by contaminated drinking water (Issa, 2004) in Benin, Burkina Faso and Niger where the pesticide content in water holes was found to be much higher than the levels recommended by the World Health Organization (WHO). And because the lion is at the top of the trophic chain, it may also be contaminated by pesticides accumulated in prey. Evidence of significant amounts of organochloride pesticides have been found in numerous lion kills in W Transfrontier Park (Issa, 2004).

2.1.3. Attitudes and perceptions

The lion is part of numerous cultures. In many tales, an animal society represents human society: in Chad, for example, the Teda-Daza and Bèri cattle-herders regard the lion as the king of the beasts, though he may be foolish as well as strong; the Bèri see the jackal as cunning; the Teda-Daza see the fennec (*Fennecus zerda*) in this light (Tubiana, 2006).

Experience with large carnivore recovery in Europe and North America shows that the social conflict element can be more important and harder to deal with than the material conflict (Kellert *et al.*, 1996; Bjerke and Kaltenborn, 1998; Linnell *et al.*, 2005). Interactions with large carnivores – primarily overlap of predator range and human distribution – will directly reduce people's perceived quality of life (Linnell *et al.,* 2005). The origins of the conflict go deeper than the economic level and may be seen as a land use conflict between nature and human society: a lion crawling through a fence is perceived as violating the barriers that people set up to keep wildlife separate. Even if there are no physical and economic consequences, there are always emotional consequences. Cattle predation affects people's livelihoods: their cattle symbolize their way of life and support whole communities. This creates the current sense of fear of *mbojo* (evil lion spirits) outside village boundaries (Skuja, 2002).

Negative perception by African rural communities

The perception of the "king of beasts" in rural African communities that live close to lions is often very different from those who do not live close to wildlife. The interface between people and large predators always carries a risk in terms of predation on livestock and human injuries or death. Lions are considered by many rural communities as pests to be eliminated. A study conducted in and around Queen Elizabeth National Park in Uganda – 156 questionnaires were returned and analysed – showed the following responses to questions about the best way to deal with lions that stray into villages: 37 percent of respondents said that the lions should be killed, 35 percent said a fence should be erected round the protected area, and 28 percent felt that people should be taught how to avoid lions (Dricuru, 2000). Of 236 people questioned in ten villages along the borders of Waza National Park in Cameroon, 50 percent had a negative perception of lions (Bauer, 2003). Tolerance for lions is often lower than for other predators: a study in the southern Kalahari by Hermann and Funston in 2001 showed that farmers responded lethally in 85 percent of cases of lion predation but only 55 percent of cases involving other large carnivores (Funston, 2008).

The psychological impact of lion damage to livestock often seems out of proportion to the economic damage. Even in countries where lion populations are small, the psychological impact of the lion remains strongly negative: Abdoulaye Kane (pers. comm.), representing IUCN in Senegal, notes that "... a strong pressure is exerted by the local populations on the authorities to organize eradication campaigns against lions in response to their livestock losses." Measures by conservation authorities to address the issues are not always appropriate, and compensation schemes for stock losses are often non-functional. A 1974–1975 study in the areas bordering the southern part of Nairobi National Park in Kenya showed that the Masai pastoralists who traditionally tolerate wildlife were less and less willing to suffer losses by predation without compensation. Rudnai (1983) explains: "... while these losses may be low in statistical terms, resentment engendered by even a few kills may be out of proportion with real damage suffered, since the individuals feel they do not benefit from game in general and predators in particular, yet have to bear the brunt of the damage inflicted by wild animals. Even though compensation payment for livestock killed by lions is on the books, in practice it is virtually unavailable because of a cumbersome administration". This leads to further persecution of lions.

Developing reasons for tolerance

The "social carrying capacity" – human tolerance of predators – is a major element in mitigating carnivore/human conflict. Acceptance of losses varies among cultures, but in general villagers and pastoralists view large carnivores as a nuisance and see little financial or aesthetic value in them. But positive cultural perceptions of the lion do exist: in spite of the pressure exerted by lions on their pastoral economy, some herder people preserve a balanced attitude towards lions and they do not poison, trap, spear or shoot them. Galhano Alves and Harouna (2005) note that in the Gourmantché area of Niger, in spite of attacks on livestock and sometimes people, "... in general, the opinions of the inhabitants are favourable to the conservation of the lion, because of the important symbolic value of the species in their representations [Fouali], and of its emblematic importance in the environment." Other than the cultural interest in lions among some African people, there is financial interest: the lion is perceived as a source "... of potential income in tourist terms for the area, more especially as certain villagers work seasonally as guides or employees in the Park" (Galhano Alves and Harouna, 2005). Cultural tolerance varies with social position and level of education: near Manyeleti game reserve, which is adjacent to Kruger National Park in South Africa, the most favourable of the various attitudes to lions were expressed by individuals with higher education (Lagendijk and Gusset, 2008).

When assessing a conflict situation, a holistic approach should be adopted that gives equal emphasis to the social and biological aspects in order to base mitigation mechanisms on a range of values that includes positive perceptions. This approach was chosen by the Kilimanjaro Lion Conservation Project with a view to understanding the recent loss of tolerance for lions among the Masai in southern Kenya and northern Tanzania. The project combines topics that include changing Masai attitudes towards predators and conservation, herding practices in Masai lands and in Laikipia and the assessment of community attitudes to the Predator Compensation Fund (Frank, 2006). Changing farmers' views of wildlife is challenging: forcing people to coexist with large carnivores often leads to illegal hunting (Eltringham, 1984; Martin, 1984; Martin and de Meulenaer, 1988) so promoting a positive attitude to wildlife is a vital step in conflict mitigation. This can be achieved by targeted environmental education and by upgrading wildlife as a natural resource for consumptive and non-consumptive use. If farmers derive direct and substantial benefits from wildlife they will be willing to accept the costs of living with wildlife (Table 1). Different measures for conflict mitigation are being devised and tested in sub-Saharan Africa. But the apparent mutual

exclusivity of lion cohabitation with people remains a major threat to lion conservation outside protected areas (Jackson, 1997a,b).

Table 1. Costs and benefits of lions living in communal areas in Zambia

Social costs	Social benefits
The death or injury of a person caused by lions results in trauma for families and communities.	Skins are important in ceremonies and are totems in some tribes.
Safety and freedom of movement are constrained in areas with lions.	The lion is used as an emblem.
Environmental costs	**Environmental benefits**
Lions kill livestock, with severe negative impacts on the households involved.	Where there is sufficient prey to sustain a viable population, lions are an attraction for trophy hunting.
The death of a person can have a severe impact on family welfare.	Lions kill bushpigs, which cause damage to agriculture.
Lions utilize a prey population that could be harvested by humans. This is not yet happening, but there is a law that allows harvesting rights.	Lions are valuable for tourism.
Political costs	**Political benefits**
Communities believe that because lions belong to the Government, the Government is responsible for resolving the conflict.	Not identified.

Source: International Conservation Services and Viljoen, 2006

2.2. The habitat factor

Competition for space and the resulting reduction in habitat may be an indirect, though powerful, factor threatening lions. Direct effects stem from the presence of humans as super-predators in lion habitats. If prey habitats are converted to agricultural or pastoral land, human/lion conflicts are bound to increase. A common consequence of human occupation of lion habitat is the development of negative perceptions of lions: an example is the case study in Queen Elizabeth National Park in Uganda in which communities expressed their negative attitude to lions (Dricuru, 2000) to the point where "... in Queen Elizabeth National Park, people are most concerned about the poisoning of wild carnivores and scavengers (lions, hyenas, vultures, etc), which is extremely destructive ecologically and economically ..." (Siefert, 2000).

Africa's vast rangelands are being gradually transformed, mostly by humans though some natural factors are significant. Humans appear to be the main cause of the modification of lion habitat, so we review the factors involved as a basis for analysing local contexts of conflict.

2.2.1. Natural factors

Desertification is the most significant factor affecting lion habitat: 33 percent of Africa is threatened, particularly the Sahel. Desertification contributes to the exclusion of lions from the northern parts of their sub-Saharan ranges. Not long ago, their range encompassed the Adrar of Ifhoras in Mali, the Aïr Ténéré in Niger, the Ennedi in Chad and other Saharan areas (Lhote, 1951), and also the Maghreb region north of the Sahara.

Even though lions are adapted to a semi-arid climate (de Waal *et al*., 2001), desertification affects them in terms of reduction of their prey base, reduction of water availability and increased vulnerability (Eloff, 1980). In the Sudanese savannah zone, desertification has a negative influence on lions through the reduction of some prey species associated with moist savannahs, especially Buffon's kob (*Kobus kob*) and defassa waterbuck (*K. ellipsiprymnus defassa*).

Lion predation on livestock increases during rainy seasons in Laikipia (Woodroffe and Frank, 2005), Tsavo region (Patterson *et al*., 2004), Makgalikgadi and Ngorongoro Conservation Area (Frank *et al*., 2008), near Waza National Park (de Iongh *et al*., 2008) and near W Transboundary Park in Niger (Hamissou *et al*., 2008). In 2003–2004 near Pendjari National Park in Benin, 74.5 percent of attacks by large carnivores occurred during the rainy season (Sogbohossou, 2008). Laurence Frank speculates that listless wild prey and ready availability of carcasses during dry periods provide easy meals, but that lions are likely to turn to livestock when abundant grass makes wildlife harder to catch.

Where the dry season drives nomadic or transhumant cattle herders to grazing close to protected areas, more attacks occur. Near Zakouma National Park in Chad, nomadic livestock in Ambaradje and Zan is more prone to lion predation during the dry season (Vanherle, 2008). Around Bénoué National Park in Cameroon, lions attack livestock more frequently during the dry season (Croes *et al*., 2008). Near W Transboundary Park in Benin, conflicts with wild carnivores are more likely to occur in any season (Sogbohossou, 2008).

2.2.2. Agricultural influence

Human expansion is probably the most influential factor affecting lion conservation in sub-Saharan Africa. The lion range maps of west and central Africa show a negative correlation between lion density and human density (Chardonnet *et al.*, 2002). Agricultural encroachment on lion ranges demonstrates the paramount importance of agriculture in sub-Saharan Africa for rural and urban populations: agriculture provides 40% of gross domestic product in sub-Saharan Africa and employs 60 percent of the labour force. In 2005, FAO estimated the area of forest exploited or converted to arable land in 1990–2000 to be 5.5 million ha, an annual rate of loss twice as high as that in South America (FAO, 2005). In 1990, the World Resources Institute (WRI) estimated that 80 percent of natural habitats had disappeared in Burkina Faso, 79 percent in Côte d'Ivoire and 45.3 percent in the Central African Republic (WRI, 1990). Between 1970 and 2000, the area devoted to agriculture in sub-Saharan Africa increased by 25 percent; the area of cultivated land increased by 0.65 percent per year in sub-Saharan Africa at the same time as it decreased in developed countries. Even so, in 2000 there was only 0.27 ha of arable land for each inhabitant of sub-Saharan Africa, whereas there was 0.49 ha for each inhabitant of developed countries (Tacher, 2002). The spread of cultivated areas near protected areas is also, unfortunately, rapid: the W-Arly-Pendjari complex in West Africa, for example, has lost 14.5 percent of its savannah vegetation within 30 km of the protected area boundaries (Clerici, Hugh and Grégoire, 2005).

In west and central Africa, the distribution of lions is convergent with the cotton-growing zone. But cotton cultivation has expanded significantly in sub-Saharan Africa, particularly in the savannah zone of West Africa. It was introduced at the end of the 1960s and became the main cash crop; it is almost the only crop for which African farmers can obtain loans from local banks (Burini and Ghisalberti, 2001). In several African countries, cotton is the main source of national income and a major tool for rural development. The environmental impact of cotton is difficult to establish because of the complex interactions between development and conservation. The crop also has harmful consequences for biodiversity, notably (i) the "race for space" in the expansion of cotton-growing areas into natural habitats, notably the savannah ecosystems where most of the protected areas in West Africa are located; (ii) the considerable increase in the use of plant pesticides and fertilizers; and (iii) competition with cattle-herders, who are tempted to penetrate into protected areas to find alternative grazing

land. Cotton cultivation is a reality that has to be taken into account: conservationists should make it an ally.

Like cotton, *berbéré* sorghum exerts increasing pressure near protected areas such as Zakouma National Park in Chad, which is the lion stronghold for the region. In an area traditionally dedicated to livestock breeding rather than agriculture (Jérôme Tubiana, pers. comm.), *berbéré* fields have expanded significantly. Formerly rare at the periphery of the park, *berbéré* now accounts for 97 percent of the crops there (David Edderai, pers. comm., 2005).

2.2.3. Pastoral influence

Pastoralism affects lion habitats mainly through the conversion of savannah into grazing range for livestock. In sub-Saharan Africa, the population of domestic herbivores – 450 million small ruminants and 200 million cattle – is increasing steadily; the grazing area expanded by 0.46 percent per year between 1970 and 2000. As a result of human demographic growth, the per capita area of grazing land fell from 2,650 ha per inhabitant in 1970 to 1,166 in 2000, reflecting the major economic and environmental modifications that the husbandry sector is undergoing today (Tacher, 2002).

As the need for grazing land becomes more acute, the expansion of livestock numbers may be sustained not only by arable lands but also by the network of protected areas, which are used seasonally by stockholders. Despite legal prohibition, protected areas are often regarded by stockholders as "free" or "unused" pastures, which demonstrates how important it is for cattle herders to access new grazing grounds. The cohabitation of cattle herders with lions is thus much more than a question of cattle predation: it comprises a range of stakeholders and stakeholder problems such as the establishment of sanctuaries where human activity is excluded.

Several authors identify transhumant livestock husbandry as the activity with the most detrimental impact on conservation for the W Transfrontier Park in Benin, Burkina Faso and Niger (Benoit and Macrae, 1993; Kagoné, 2002). The park lies in the area of transition between savannahs with annual grasses and savannahs with perennial grasses (Arbonnier *et al*., 2002). The attraction of the park for livestock herders depends on this preserved natural trait in a landscape that is intensively modified by people and agriculture. Immigration of transhumant pastoral societies into the area began in the 1970s with the increase in demographic growth (Benoit, 2000) and the degradation of climatic conditions (Santoir, 1999): about 130,000 people and 95,000 cattle now live in the immediate vicinity of protected areas. In terms of livestock movements in and around the W Transfrontier Park, sahelian countries such as Burkina Faso and Niger are emitting countries; Benin and Togo are receiving countries (Fournier and Toutain, 2007). The livestock carrying capacity in the receiving areas in the south is three to seven times higher than in the emitting areas in the north (Kagoné, 2004), which explains why transhumant herders plan their itineraries to approach protected areas regarded as rangelands. This is exacerbated by increasing agricultural encroachment in their area of origin and the degradation of their original grazing land (Kagone *et al*., 2002, Tamou 2002).

A similar situation prevails in the Central African Republic, where livestock husbandry began in the second half of the 20th century and was only really developed after the creation of protected areas. In Haut-Mbomou prefecture, for example, the most easterly region, 80 percent of land is now used by livestock herders who were absent 20 years ago. The prevalence of trypanosomiasis borne by tse-tse flies, which used to prevent cattle from

coming in, is no longer an obstacle to pastoralists with veterinary drugs. With desertification and civil unrest affecting neighbouring Chad and Sudan, the former seasonal movements of transhumant cattle herders are shifting to permanent livestock husbandry systems that conflict with local livelihoods and with protected areas, lion prey and lions (Mésochina, 2009a, b and c).

2.3. The lion factor

2.3.1. Behaviour

An adult female lion needs a minimum of 5 kg of meat per day to maintain basic metabolic requirements (Schaller, 1972). Lions also need more room than many other predators. Their behaviour, predatory and reproductive strategies show extensive regional variation reflecting their adaptability. Fundamental ecological and behavioural characteristics of carnivores such as density, grouping, range size and prey selection are influenced by habitat and by prey density, dispersion and richness (Stander, 1997).

Field observations indicate that lions are still found in areas used by people, even those with human settlements, because of favourable habitat and an adequate prey base in the form of domestic animals and wildlife with high tolerance of humans. Lions usually prefer to distance themselves from developed areas, but specific behaviour or habitat preference may increase the risk of conflict. Lions' preference for dense habitat, for example, may increase the likelihood of encounters with humans by increasing the opportunity for lions to ambush humans and livestock (Saberwal *et al*., 1994).

One aspect of lion behaviour is "surplus killing": a lion breaking into a fenced enclosure may kill more – sometimes many more – domestic animals than it can eat (Nowell and Jackson, 1996). This trait certainly exacerbates human hostility towards lions and exacerbates conflict.

Sub-adult males may be more likely to kill livestock, but all lions are potential livestock killers (Frank *et al*., 2008). Attacks on stock are usually carried out by individual animals of either sex or by small groups of young and inexperienced males, possibly animals expelled from prides that have moved out of their range. Culprits might also be mature lions forced out of prides that are no longer capable of killing wild animals as a result of old age or damage to paws or teeth (La Grange, 2005).

Some lions are chronic livestock killers (Frank, 2006). In Waza National Park, some lions are problem animals; others feed exclusively on wildlife. One collared male lion was a habitual problem animal who spent most of his time outside the park feeding primarily on livestock (de Iongh *et al*., 2008).

2.3.2. Diminished lions

Numerous authors invoke the infirmity theory that injured, sick or old lions are likely to attack humans and cattle (Kruuk, 1980). Patterson and Neiburger (2000) found that the skulls and mandibles of the Tsavo and Mfuwe man-eaters showed evidence of injuries to their teeth and jaws. If lions resort to prowling round dwellings and taking small stock such as chickens, they should be considered dangerous because this behaviour indicates that they are unable to catch wild prey and may kill humans and cattle (La Grange, 2005). According to Bartolomeu Soto (pers. com.), diminished lions infected with tuberculosis in Kruger National Park in South Africa have killed livestock in adjacent areas of Mozambique. In many parts of Africa rural people explain the disappearance of livestock by saying: "Ah, there is an old toothless

lion about. We must turn out and kill him, or he will soon begin eating us" (Fitzsimons 1919).

But the infirmity theory is not so simple. In Uganda, only 14 percent of 275 recorded lion attacks on humans were attributed to wounded animals. In the Namwera area of Malawi, two lions that killed 11 people in a fortnight were young and fit: Carr (1969) says that the lions started to kill humans because people had exterminated game in the area. Numerous other factors may lead carnivores to kill humans: a lion that has lost its fear of humans may not appear dangerous but may, for example, chase a running child as it would chase its normal prey (La Grange, 2005). This kind of behaviour might be enhanced in lions bred in captivity and released into the wild.

2.4. The prey factor

2.4.1. Availability of prey

The diversity, abundance, distribution, accessibility and size of prey has a direct effect on the density of lion populations (Schaller, 1972; Stander, 1997; Dublin and Ogutu, 1998). Change in the availability of lion prey is often the result of human development. Low prey densities result in low lion densities: in the Central African Republic, for example, the recent decline of lion populations may be partly ascribed to the decrease of the main prey species, which were subject to severe poaching pressure (José Tello, pers. comm.), and to systematic shooting nomadic cattle herders entering protected areas during the dry season (Bertrand Chardonnet, pers. comm.). There are, however, encouraging situations in west and central Africa where wild prey numbers are stable or increasing, especially in areas with large conservation programmes such as the *Ecosystèmes Protégés en Afrique Soudano-Sahélienne* (ECOPAS). Large national parks and some safari areas also create favourable situations for the conservation of the lion.

When the availability of wild prey is reduced, for example because of drought or expanding human settlements, lions are disposed to prey on domestic herds, particularly in farmlands adjacent to protected areas. Rudnai (1983) reports that a year of drought in 1974–1975 in Nairobi National Park in Kenya caused the death of large numbers of wild ungulates, which led to more lion incursions into surrounding areas. During the 1980s, fatal attacks by lions in southern Tanzania were attributed to widespread poaching of wild ungulates: as a result, lions turned to livestock and entered villages (Nowell and Jackson, 1996). At the end of the 19th century, when an outbreak of rinderpest killed millions of buffalo and antelopes, lion attacks on humans increased in several countries. Philippe Chardonnet suggests that attacks on humans are likely to be more frequent in tse-tse infested areas where domestic stock are few, for example in south-eastern Tanzania and north-eastern Mozambique.

2.4.2. Competition for prey between man and lion

As stated in section 2.1.2.2, human reliance on protein obtained from bushmeat can result in direct competition for prey between people and lions.

Commercial poaching is becoming a significant threat: there is growing urban demand for bushmeat, and modern weapons are widely available; in contrast, there is less and less traditional hunting in spite of its low impact on wildlife resources and its significant socio-cultural importance (Galhano Alves and Harouna, 2005). In the Central African Republic, the poaching situation changed radically in the early 1980s when traditional spears were replaced with automatic firearms (Eric Berman, *Small Arms Survey*, 2006).

This should not be perceived in a simplistic way. There is a real conservation dilemma: substituting wild meat with domestic meat, which theoretically benefits wild species, inevitably implies increased conversion of natural habitats into grazing land and crop fields. Careful attention must be given to this dilemma before policies promoting dietary changes and livestock husbandry are introduced. Cultural and social factors must be considered, for example in the lion ranges of the Congo basin and the Gulf of Guinea where people regard it as their right to harvest bushmeat as a staple food, and do not see the practice as poaching.

2.4.3. Pathology of prey

The fragmentation of natural habitats caused by human encroachment is accompanied by an increasing interface between lions and human activities. This promotes conflicts between people and lions and exacerbates disease interactions between domestic and wild animals, which has a direct effect on the lions and an indirect effect on the prey base.

Diseases transmitted by prey to lions (direct impact)

Bovine tuberculosis in buffalo and other herbivores is known to be transmitted to lions. The disease occurs in a number of protected areas such as the Kruger National Park in South Africa (Keet *et al.,* 1996, 1998, 2000), the Ruhaha ecosystem in Tanzania (Clifford *et al*., 2009) and in the Queen Elizabeth National Park (Mike Woodford, pers. comm.). The situation in central and west Africa has not been studied, though the risk of contagion exists.

Among numerous conclusive examples, bovine tuberculosis in buffalo and other herbivores is well-known to be transmitted to lions. Bovine tuberculosis occurs in a number of Protected Areas such as the Kruger National Park, South Africa (Keet *et al.,* 1996; Keet *et al.,* 1998; Keet *et al.,* 2000), the Ruhaha ecosystem, Tanzania (Clifford *et al*., 2009), the Queen Elizabeth National Park (Mike Woodford, pers. comm.). The situation in Central and West Africa has not been studied at all to our knowledge, although the risk of contagion exists.

Anthrax can also be transmitted to lions by prey, as seen in southern Africa, but it remains occasional notably because of greater resistance in carnivores than herbivores (Jager*,* Booker and Hubschle, 1990; Berry, 1993).

Domestic cats and dogs may transmit diseases such as rabies to lions; distemper can also affect lions. In the Serengeti-Masaï Mara ecosystem in 1996, up to a third of the lion population died in a canine distemper outbreak originating in shepherd dogs (Hofmann-Lehmann *et al.*, 1996; Kelly, 2001). In 2004, a serological inquiry by Rey-Herme (2004) in W Transfrontier Park in 386 dogs of a population of 8–10,000 and 83 cats of a population of 4–5,000 revealed a high prevalence of viruses potentially transmissible to lions. Average seroprevalence was 8.2 percent (0–13.3 percent) in feline leukaemia virus (FeLV), with mortality of 10 percent to 50 percent in domestic carnivores as a result of diseases, notably rabies (1.4–14.3 percent).

Diseases affecting the lion prey base (indirect impact)

Some diseases cause high mortality among lion prey, with resulting falls in availability. This occurs in two phases: (i) the disease infects (morbidity) and kills (mortality) a large number of individuals of the prey species: the sick and dead animals constitute an abundance of easily accessible food for carnivores, whose numbers increase; and (ii) the number of prey animals then declines below the original level: this reduction in the food supply impacts the lion population negatively; the health hazards disturb the equilibrium between prey and predators

and between herbivores and vegetation to the point where the whole ecosystem might be affected.

2 Human/Lion Conflict Management

The number of people and livestock killed by lions every year might not be large on the continental scale, but it is always a significant problem in the place where lion damage occurs. For communities with meagre resources, any loss to marauding lions is a real hardship and understandably creates hostility towards lions and increased apathy and antagonism towards wildlife conservation. Ultimately, the survival of wildlife – lions in particular – relies on acceptance by the people who share the habitat. But when the cost of cohabitation is high and compensation is low, there is little or no incentive for conservation. Stander (1997) explains: "... the future of large carnivores outside conservation areas in Africa depends on the views and aspirations of the local people. Only when the local inhabitants…have a particular interest in conserving large carnivores will their future be ensured." This is a common problem in parks and reserves in Africa. Communities bear the costs of the protected areas through loss of stock to lion predation and opportunity costs as a result of loss of grazing and arable land. With no tangible benefits to these communities, human/wildlife conflicts are intensifying and threatening the survival of large predators outside national parks (Lichtenfeld, 2001). Frank (2006) states: "If viable predator populations are to persist between protected areas, two conditions must be met: (i) pastoralists and ranchers need affordable and culturally acceptable methods of protecting their domestic animals from large carnivores; and (ii) they must realize significant financial gain from predators to offset the costs of living with them" (see also Breitenmoser *et al.*, 2005).

Human/wildlife conflicts are highly variable, and there is no single management option or solution that can resolve the problems. Solving the problem is hence not the purpose of the present study: we present some management options and methods to overcome local tensions, and long-term strategies for harmonious co-existence with large carnivores.

1. Human management

1.1. Community awareness

The first step is to raise people's awareness that they are in a wildlife area and of the potential consequences: living, working or travelling in areas with large carnivores calls for preparedness. Prevention consists of being alert, having sound knowledge of the environment and predator habits and using strategies to decrease the likelihood of being viewed as prey (Quigley and Herrero, 2005; Paris, 2006). It may seem trivial, but human activity in the vicinity of a wildlife area leads newcomers to settle and endure greater costs than the experienced local communities. Surprisingly, it is not uncommon that people living along park boundaries never visit the protected area and rarely see wild species.

Perhaps the single most important action to reduce the likelihood of attack is to eliminate food as an attractant near areas used by people by avoiding open-air butchery and not keeping pets or unfenced livestock. Preventive action is essential: once an animal has obtained food from a settled area, it may well develop the habit and possibly attack local people (Quigley and Herrero, 2005). Human activity can also act as a repellent to lions: attacks on cattle herds are fewer where a number of people are at a *boma*, for example; attacks are more likely where there is little human activity (Woodroffe *et al.*, 2006).

Reducing human vulnerability is another topic to be developed. Field workers should follow basic rules such as wearing bush-coloured clothes and checking wind direction when approaching a risky area. A backpack or heavy clothing may make a person more conspicuous. Movements at night should be avoided. If children are travelling with a group, they should kept off the ground (Quigley and Herrero, 2005). It is also crucial to maximize deterrents in areas of human occupation, for example by reducing cover near homes, especially when there are small children; lights may also reduce lion movements near human settlements. Latrines should not be built too far from houses, and should be used during daylight.

Environmental awareness should include ecosystems, carnivore behaviour, risk factors and managing activities to reduce human vulnerability. Education centres are important, especially for teaching children about wildlife, as for example at the Painted Dog Conservation Project on the periphery of Hwange National Park in Zimbabwe (http://www.painteddog.org/). In Kenya, a predator conservation video has been developed for pastoralists in Laikipia using the Masai language: it focuses on predator conservation and livestock husbandry using local settings and local narrators, and will be shown in schools and community meetings using the Laikipia Wildlife Forum's mobile video theatre.

Training is also important. The Demonstration Boma Project initiated by the African Wildlife Foundation is an example of empowering communities: in Laikipia and Samburu in Kenya the main human/wildlife conflict is nocturnal hyena predation on goats and sheep in *bomas*. Experiments were run to improve *bomas* at low cost, on the basis of which four demonstration *bomas* were built. The predator conservation officer, the local community liaison officer and the Kenya Wildlife Service community wildlife officer meet with communities to explain the reasons for conserving carnivores and low-cost ways of reducing losses to hyenas. Each community selects four residents who receive a demonstration *boma*, two of which have a solid gate – the critical improvement – and are surrounded by low-cost wire mesh; the other two have only the gate. A carpenter from each community helped with construction with a view to duplicating the design for others. In 2005, the project expanded into Samburu district, where people were copying the demonstration design they had seen in Laikipia. In total, 115 demonstration projects were developed, with gratifying results: the communities found that problems decreased dramatically, and people copied the design for themselves.

1.2. Compensation

Compensation schemes are intended to prevent people who bear the costs of living with wildlife from becoming enemies of conservation. The compensation mechanism must balance the costs of damage incurred by victims with benefits provided by income-generating activities or by state agencies or non-governmental organizations (NGOs). The mechanism might be (i) preventive in that it allows potential victims to benefit from wildlife activities through employment or income sharing, or (ii) compensatory in that it grants victims monetary or in-kind subsidies. Compensation is sometimes directed to households, but more often to communities. In uncontrolled remote areas where wildlife damage occurs, victims tend to seek compensation by themselves and to recover payment for losses by killing culprits and obtaining meat and cash from wildlife resources.

1.2.1. Direct compensation: subsidies and insurance

Compensation assessment

When establishing a compensation scheme, it is preferable to set up an independent wildlife damage control system to verify the causes of livestock deaths and determine livestock values (Linnell, Swenson and Anderson, 2001; Frank and Woodroffe, 2002; Ogutu, Bhola and Reid, 2005). Care must be taken to avoid bias and to prevent abuses, which could lead to failure in mitigating human/lion conflict. The success of compensation schemes in mitigating human and wildlife conflicts is controversial; they do not always achieve the desired effect.

Another issue is adequate and equitable distribution of compensation, whether in cash, employment or communal benefits. It is often pointed out that benefits are too small to offset costs, that they are not properly distributed, that distribution is late or partial or that compensation does not reach the actual victims.

Insurance and livestock compensation scheme

Financial compensation for losses from lion predation can be the final step and a way to encourage local people to tolerate lions. Compensation can be an effective tool when it is not abused (Nowell and Jackson, 1996; Breitenmoser *et al.,* 2005). It may be feasible to assess the level of livestock losses, but the values relating to the loss of a human life are difficult to establish. Generally speaking, lethal and non-lethal control options for resolving human/lion conflicts are costly. A system of compensation requires adequate financial resources for the wildlife authorities and the capacity to implement the scheme. Conflict resolution is seriously impeded in countries where conservation budgets are low. Baldus (2004) notes: "... realistically speaking there is no easy way that compensation could be paid for crop damage or livestock losses. The resulting sums would be huge and it is practically not possible to properly administer such a system and avoid gross misuse and embezzlement of funds. It would, however, be possible to envisage compensation for injury and loss of human life. The number of cases is less, evidence and organization of payment is easier and the case for compensation is stronger."

Compensation is essentially a negative payment: it does little to remove the conflict of interest between human development and the conservation of lions. A promising way forward is to make insurance a preventive tool: this is the philosophy behind the Human Animal Conflict Self-Insurance Scheme (HACSIS) in Namibia,[3] which encourages people to invest in protection and good husbandry as the condition for which compensation will be paid in case of predation, as shown in Box 1 (Ministry of Environment and Tourism, Namibia, 2006). This concept, which seems to perform well in the communal conservancies of Namibia, was introduced and financed for the first two years in Kunene and Caprivi by the Goldman Foundation. Some critical components are (Richard Diggle, pers. com.):

- The Communal Conservancy manages its own scheme, not the State;
- The Communal Conservancy must contribute financially to the scheme;
- Payments are linked to affordability not to value of claims and losses;
- Claims are paid only if mitigation actions were taken by farmers.

---

3 http://www.panda.org/about_wwf/where_we_work/africa/where/namibia/wwf_namibia_our_solutions/hwc_namibia/solutions/mitigation_measures/insurance_compensation/index.cfm

Box 1. Human/Animal Conflict Self-Insurance Scheme

Human/animal compensation schemes are by no means new, though many have been unsuccessful because of high costs, discontinued funding and corruption. Self-insurance has thus become an emotive term that arouses negative and unrealistic expectations

Mindful of the pitfalls, the Namibian NGO Integrated Rural Development and Nature Conservation (IRDNC) has shown that working at the community level makes it possible to initiate and operate a scheme that addresses the losses of individual farmers rather than enhancing the collective gains earned from hunting and tourism. Fair and equitable, but not necessarily equal, distribution of income to members is a core principle of community conservation in Namibia.

WHAT IS HACSIS?

HACSIS has three components currently being piloted in community conservation areas in Caprivi and Kunene in Namibia:

- Funeral benefit in the event of the death of a conservancy member or his/her child caused by any of the listed wildlife species.
- Conditional crop compensation for registered members; the scheme pays compensation only in the event of a member's maize, sorghum or millet being destroyed.
- Conditional stock compensation for registered members only; the scheme pays compensation only in the event of specified stock being destroyed.

The scheme focuses on claims related to species that are financially beneficial to the conservancies. It does not try to cover the value of the losses, which is contentious and unaffordable: instead it pays out what the members think is fair compensation for the loss incurred.

A principal aim of HACSIS is to promote equitable distribution of the benefits earned as a result of living with wildlife such as hunting and photographic tourism. This is a constitutional condition of the communal area conservancies: it takes into account individual losses as opposed to collective gains, which is part of the philosophy underlying community-based natural resource management. In other words, direct benefits go to people who have either made a direct contribution to or suffered loss from living with wildlife.

A second aim of HACSIS is to encourage better land management. It does this by requiring farmers to apply specific and continuous inputs for improved farm management as a prime requirement before any claim is considered. Where a farmer abides by the conditions of the scheme, making reasonable efforts to minimize losses, he or she will be eligible for compensation in the case of loss.

A major outcome of the scheme is to increase tolerance for wildlife that comes into conflict with farmers or their communities. Human/animal conflict is particularly acute when farmers feel powerless to protect their crops and livestock against predation: the main culprits are elephants and lions, which are feared more than other problem animals and hence receive a disproportionate level of blame.

MANAGEMENT AND FINANCE

The rules and conditions of HACSIS were developed with conservancy members and set out in a memorandum of understanding. Claims that fail to meet the conditions are not eligible for compensation.

The conservancies are responsible for management of the scheme in terms of investigating, processing and verifying claims and the distribution of payments. Any difficulties or complaints are handled by the conservancies themselves, although IRDNC and the Ministry of Environment and Tourism can provide guidance and assistance when needed. Two parallel mechanisms support the decision-making process:

- countersignature by the traditional authorities attesting that the particulars are true and that claimants have abided by the rules and regulations of the scheme; and
- processing of claims by the review panel, which is chaired by the Ministry of Environment and Tourism, with representatives from each conservancy: if there are concerns such as lack of documentation, claims are handed back to the conservancy. The decision of the review panel is final.

Subventions and local employment

By establishing good relationships with the relevant authorities, communities become eligible for financial benefits from wildlife. These have the effect of compensation and reduce people's problems by enabling them to invest in activities that help to reduce human/animal conflict.

In Zimbabwe, communities in Guruve and Gokwe districts have invested in the management of problem animals by employing community problem animal reporters and game guards (World Wide Fund for Nature [WWF], 2005).

In Kenya, the Lion Conservation Programme shows that financial benefits, particularly employment, are a strong incentive for conservation among the Masai. The Laikipia Predator Project[4] uses the Laikipia Wildlife Forum's conservation liaison officers (CLOs) in an outreach role to encourage predator-friendly livestock husbandry in their communities; it also

[4] http://www.wcs.org/international/Africa/kenya/laikipiapredatorproject

pays 25 percent of CLO salaries and transport costs. The CLOs are essential in planning and building the demonstration projects in teaching effective methods for protecting livestock.

In Tanzania, the Kilimanjaro Lion Conservation Project works with the privately funded Predator Compensation Fund, which uses a carrot-and-stick approach entailing rigorous verification of claims by a team of predator game scouts. Compensation is generous, but is reduced for losses resulting from poor husbandry and withheld if predators are killed in the area concerned within two months. Lion monitoring is essential for assessing the success of the Predator Compensation Fund (Frank, 2006). Hiring people to watch the herds in place of children is seen by the People and Predators Fund[5] as a way of enabling the children to attend school in greater numbers (Lichtenfeld, 2007).

Indirect compensation: valuing wildlife

The income generated by lions is poorly documented and publicized. Regardless of the distinction between consumptive and non-consumptive use, lions bring foreign currency through tourism and live sales; there are also benefits from the role of lions in the ecosystem and their spiritual and cultural value.

Conservation strategies involving communities have recently been introduced in some African regions to alleviate human/lion conflicts. The establishment of locally managed funds fed by money generated from live sales, trophy hunting and safaris may provide the basis for effective compensation schemes. Encouraging communities to regard large carnivores as a natural renewable resource and to understand their ecological value could be an incentive to them to tolerate large carnivores and could be a basis for mutually beneficial wildlife policies.

The best way to do this is to give farmers a high degree of control over wildlife and to let them have a substantial share of the benefits from wildlife management. Community-based natural resource management schemes assume that communities are willing to conserve, manage and live with wildlife when the benefits outweigh the costs. Lions may hence be an ecological and economic resource that can be sustainably managed. Most countries with a sport hunting industry have schemes that enable communities to benefit from trophy hunting and ecotourism; in some countries, communities can make contracts with hunting companies and lodges. Several pilot projects have shown that this is a major incentive for villagers to protect game on their land (Vernon Booth, pers. comm.). In the Central African Republic, communities in village hunting zones lease their land to hunting safari operators and receive a substantial share of the fees, employment and bushmeat. In Namibia, a system in the communal conservancies gives conditional rights over wildlife and returns the benefits to rural communities. Stander and Hanssen (2001) state: “Revenue gained through lion tourism is expected to exceed lion-related livestock losses, which will turn the large carnivores into a benefit for the communities in the Kunene region.”

Wildlife tourism

Tourism would increase people’s tolerance for some stock losses (Stander, 1993; Loveridge, 2002a; Woodroffe *et al.,* 2006). Large predators are central to all wildlife enterprises and may increase the ecotourism potential of an area: this is particularly true for the lion, an emblematic species associated with the image of the African savannah (Skuja, 2002). Viewing tourism takes place mainly in protected areas, but promising new ecotourism ventures are developing in communal areas. This is an option proposed by Hanssen and Stander (2000) for the Kunene Region in Namibia, where non-consumptive lion tourism could more than compensate for livestock losses to lions and would turn them into a

[5] http://www.people-predators.org

community benefit. In South Africa and Namibia, two large potential stock ranges are being operated as game reserves. Greater tolerance for predators is evident in commercial ranches in Laikipia district that are engaged in or are planning ecotourism.

Wildlife tourism is rarely compatible with intensive livestock husbandry, but it is a management practice that encourages the coexistence of lions and people. It can only be successful in areas with enough wildlife to support the activity and enough employment opportunities; in some of these areas, cattle ranchers and communities are realizing that there is more money to be made in keeping wildlife alive (Martin, 2001). Wildlife tourism and new approaches to make predators more accessible to tourists must therefore be encouraged (Frank and Woodroffe, 2002).

Tourism hunting

Game viewing is usually described as non-consumptive; other activities such as tourist hunting or live sales are described as consumptive. Low-intensity utilization of lions such as trophy hunting would provide benefits for communities, thus increasing their tolerance of a few stock losses (Stander, 1993), and may well be compatible with conservation (Creel and Creel, 1997). In some cases, tourism hunting could potentially be combined with control of problem animals: attitudes would change dramatically if stock-raiding lions became a source of income (see section 3.2.3.). In Namibia's Kunene and Caprivi regions, problem animals were offered to trophy hunters, with a substantial part of the trophy fee paid to the community; in Kunene, lions killed 8 cattle, 12 donkeys and 16 goats valued at US$1,400 over a three-year period during which two male lions were shot by trophy hunters and the community earned US$3,600 from the fees. Similar schemes have been tried in Zimbabwe and Zambia (WWF, 2005).

In Tanzania, according to Baldus (2004), "... tourist hunting currently generates approximately US$10 million for the Wildlife Division. Considering the [above representation of] fees by lions, approximately US$1 million is earned directly from lion trophy fees, but a total of US$2.4 million is generated through permit fees, daily fees, etc. A gross amount of US$27 million is generated by the hunting industry in Tanzania, which includes income to outfitters, auxiliary services taxation, Wildlife Division earnings etc. Lion hunting in Tanzania therefore generates a gross amount of US$6–7 million per annum for the hunting industry." According to Creel and Creel (1997), lion hunting in Tanzania generated 13 percent of the tax income from trophy hunting in the Selous game reserve alone: the figure for 1992 was US$1.28 million.

One outcome of tourism hunting is often overlooked: it encourages the setting aside of extensive areas for nature conservation; indeed, the protected areas gazetted as hunting areas are usually larger than national parks. Conserving about 2 percent of a small number of game species allows thousands of species of fauna and flora to thrive in a wilderness that is defended by tourism hunting operators. Lions take advantage of such a safe environment with a secure prey basis and less poaching pressure than elsewhere. Without this industry, the hunting areas – vast and rich in biodiversity – would be converted into agricultural and pastoral land with very little nature conservation. Most of the hunting areas are located around national parks and reserves, acting as buffer zones and wildlife corridors; they are all privately managed, with the owners assuming their share of responsibility for conserving natural resources and helping wildlife administrations to manage wildlife outside the parks. Tourism hunting contributes to the development of remote areas that do not attract investment from other industries, including wildlife viewing. To withdraw tourism hunting from wilderness lands gazetted as hunting areas would endanger the whole mechanism of nature conservation: the African lion would be among the first to disappear.

In 2001, the Executive Director of UNEP Dr Klaus Töpfer declared: "The sustainable utilization of wild animals through trophy hunting offers economic incentives to the local rural population, reduces poaching and offers incentives to conserve critical habitat." Tourism hunting is different from other forms of wildlife exploitation in that it affects a minute segment of the wildlife population (Bell and McShane-Caluzi, 1984). Tourist hunters never target females or juveniles, which helps to conserve the population. It is preferable to harvest a few adult male lions by trophy hunting, which generates revenues and encourages people to conserve lions, rather than use problem animal controls such as poisoning or trapping, which cost money and provides no revenue for rural communities.

Of the 32 countries in sub-Saharan Africa that are permanent lion range states, 13 operate lion tourist hunting. Game viewing and tourist hunting are often presented as mutually exclusive, but there are many examples where both activities are carried out side by side. In Tanzania, hunting and tourism are generally complementary forms of wildlife use (Baldus, 2004). In Botswana, Van der Merwe (2001) considers that a combination of photographic and hunting safaris ensures the economic viability of the wildlife management areas in a way that neither can achieve on their own.

2. Livestock management

Predation on livestock is to some extent preventable (Ogada *et al.*, 2003). Preventive measures include protection of livestock and measures to prevent predators from forming the habits of killing livestock (Frank and Woodroffe, 2002). Effective livestock husbandry can reduce predation and mitigate the impact of predators on human livelihoods (Ogada *et al.*, 2003; Breitenmoser *et al.,* 2005; Woodroffe *et al.,* 2006). For traditional societies, investment in protecting livestock is costly in terms of labour and resources (Kruuk, 2002). Improvements in livestock management developed by generations of traditional pastoralists are a promising approach to reducing human/lion conflict: on commercial ranches and community rangelands in East Africa, for example, traditional Masai livestock husbandry reduces predation: sound *boma* design, herding practices and deterrents can reduce predator attacks (Kruuk, 1980, Ogada *et al.*, 2003; Woodroffe *et al.*, 2006; Frank *et al.*, 2006). In the following sections, we review practices that may help to reduce livestock losses (Linnell *et al.*, 1996; Shivik, 2004).

2.1. Intensifying human vigilance

Livestock have always been guarded to protect them against predators, but social changes are affecting traditional stock management: in Namibia, for example, young boys used to protect herds at night, but after independence in 1991 and increased access to schools, herds tend to be left unattended at night and to wander into predator areas (O'Connell-Rodwell *et al.*, 2000). When herdsmen are present, the predation rate is lower than for free-ranging herds (Kaczensky, 1996; Ogada *et al.*, 2003; Breitenmoser *et al.,* 2005). Additional deterrents such as weapons and dogs can augment human guards. Firearms are usually used to scare predators away rather than to shoot them if they approach *bomas* too closely (Frank, 2000; Ogada *et al*., 2003). The Government of Tanzania is employing armed guards to protect villages near Tarangire National Park from lions.

Livestock herds that are herded by day and kept in *bomas* at night with guard dogs and a high level of human activity are less likely to be killed by predators (Ogada *et al.*, 2003). In Kenya, an analysis of herding practices in Masailand and Laikipia indicated that most livestock killed by predators had been left in the bush at night. This rarely occurs in Laikipia

and Samburu, so a study of herding was started to identify good practices with a view to helping herders to avoid losses to predators (Frank, 2006). Rewarding herders for good performance and organizing them under a headman in charge of several herds dramatically reduced predation in Laikipia (Frank and Woodroffe, 2002). Young children should not be employed for herding.

The use of watchtowers helps to alert farmers to the presence of wildlife. Farmers must cooperate in managing the watchtowers and setting up duty rosters, as they do in Mozambique, Zambia and Zimbabwe (WWF, 2005). A recent study of lion attacks on humans suggests that men were often taken from watchtowers while guarding fields against crop-raiding animals (Packer *et al.,* 2005).

2.2. Livestock guarding animals

Livestock guarding animals detect approaching predators and interrupt attacks (Smith *et al*., 2000). These animals, which live with the livestock (Coppinger *et al*., 1983), are either potential prey – herbivores – acting in self-defence, or carnivores that are potential competitors (Breitenmoser *et al*., 2005).

Dogs have been used since time immemorial to hunt down wild animals. Numerous breeds can be used to protect livestock: in a programme in Namibia, Anatolian sheep dogs were used (Marker, Dickman and Schumann, 2005; WWF, 2005). Having domestic dogs accompanying a herd reduces the risk of attack by 63 percent (Woodroffe *et al.*, 2006). The dogs are raised with sheep or cattle and live with the herd. They are not likely to chase lions, but they detect them and raise an alarm (Frank and Woodroffe, 2002). Schumann (ed., 2004) compares large dogs such Anatolians with smaller breeds: its loud bark gives the Anatolian an advantage in confronting large predators, especially cheetah and leopard, but they require attention and a large diet; some smaller breeds are better at coping with rough terrain and heat. Various training aids are available for dog handlers, including shock collars for obedience training, and global positioning system collars for finding lost animals (La Grange, 2006). The presence of dogs is associated with reduced rates of lion predation on cattle, but not on sheep and goats (Ogada *et al.*, 2003).

The use of donkeys to protect livestock, especially calving herds, reduced losses considerably as long as guidelines were followed (Breitenmoser *et al.*, 2005). According to Schumann (ed., 2004), one or two donkeys for each herd can guard against lions because they have a more developed instinct for defence than cattle; they are also more aware of predators and are not afraid of them: they chase them away, biting and kicking, and are formidable opponents; mares with foals are particularly protective. Foals should be raised with livestock, like Anatolian dogs. Stallions tend to break fences and become aggressive during breeding.

Dogs protect livestock against predators, whereas donkeys act as a deterrent. Dogs and donkeys have been used to accompany livestock in Namibia and Botswana with some success in reducing human conflict with cheetah and spotted hyena (WWF, 2005).

2.3. Using enclosures

Cattle breeders have a responsibility to protect their animals from lion predation. Simple measures such as erecting lion-proof shelters for the night can make a major difference (Mills, 2000). “Perhaps the best way to avoid conflict with lions is through lion-proof *bomas*. When I say “lion-proof”, I mean *bomas* which are sufficiently high and strong to prevent cattle from breaking out of them and lions from jumping in” (Skuja, 2002).

Bomas can be open, consisting of an area where livestock are bedded down with no barrier between them and the surroundings or they can be surrounded with branches, earth, rocks and ditches or made of bricks, wire and synthetic materials (Kruuk, 1980; Charudutt, 1997; Skuja, 2002; Frank and Woodroffe, 2002; Ogada, *et al.*, 2003; Breitenmoser *et al.*, 2005; WWF, 2005; Woodroffe *et al.*, 2006). Promising *bomas* with live thorn hedges have recently been tried: they seem to be more durable than *bomas* made of dead materials, which require more maintenance.

The design of bomas varies, for example in terms of the number of gates and the height and thickness of walls. Some – particularly those constructed with Acacia bush – consist of several areas separating herds and making it less likely that panicked livestock will escape (Ogada *et al.*, 2003). Where livestock are kept unguarded in *bomas*, they should be able to break out in the event of an attack in order to escape (La Grange, 2005).

Lion depredation on sheep and goats may be influenced by *boma* type, but there is no similar effect for cattle (Ogada *et al.*, 2003). The probability of attack is influenced by the transparency of the *boma* wall and the number of gates and deterrents (Woodroffe *et al.*, 2006); each gate increases the likelihood of attack by 40 percent. The risk of night attack was lowest for herds in enclosures with dense walls and few gates where men and dogs were present (Woodroffe *et al.*, 2006).

A herdsman should bring the animals into a single *boma* at night. Lion-proof *bomas*, provided they are practical and affordable, reduce the loss of strays and prevent stock from roaming at night. But such efficient husbandry has a perverse side-effect in terms of depredation away from the *boma*: lions are likely to take more than one sheep or goat when there are more herders (Ogada *et al.*, 2003).

If traditional *bomas* are not used, fences can be erected to deter large carnivores and allow livestock to graze freely. Where lions are not tolerated, fencing is often used to protect livestock in predator-proof grazing areas and even to exclude carnivores from entire regions. Fencing is used extensively in Namibia and parts of Botswana to control predation by lion, spotted hyena, wild dog and cheetah.

Wire fences are used to protect herds from carnivores such as the dingo (*Canis lupus dingo*) in Australia, where there are 5,300 km of dingo-proof fences. But in view of the jumping and climbing ability of felids, wire-mesh fences without additional impediments are limited in their effectiveness. The Laikipia case study shows that wire fences are less effective than brush fences at excluding lions (Ogada, *et al.*, 2003; Frank, Woodroffe and Ogada, 2005).

Yamazaki and Bwalya (1999) note that electric fences between conservation areas and villages or farmland can keep lions away from humans. Few studies address the efficiency of electric fences against felids, however (Linnell *et al.*, 1996), and methods that work in North America and Europe are relatively costly and may be inappropriate in areas with little infrastructure (Breitenmoser *et al.*, 2005). Fencing large areas is problematic because it fragments the habitat (Breitenmoser *et al.*, 2005); indigenous techniques are usually more suitable.

2.4. Grazing and herd management

Livestock management can be adapted in two ways to minimize the risk of lion predation: (i) through herd composition, or (ii) through pasture location and structure. The presence of cattle did not appear to influence predation rates on sheep and goats; the presence of sheep

and goats did not influence predation on cattle (Ogada *et al.*, 2003); only donkeys seemed to have any effect (see section 2.2). Animals can be protected through seasonal management of reproduction (WWF, 2005), especially in regions with seasonal transhumance, such that no calving or lambing occurs on the exposed summer pastures or during movements, when cows and calves are the most vulnerable (Breitenmoser *et al.*, 2005; WWF, 2005). Birth synchronisation can be achieved by managing the movements of bulls (WWF, 2005).

Creating buffer zones by clearing woodland along pasture boundaries makes it easier to detect approaching wildlife, and may act as a deterrent. A cleared area five metres wide can be made with machetes or axes (WWF, 2005). Some farmers in northern Namibia erect small fenced camps of 2–10 ha near their settlements where they keep vulnerable or valuable animals such as cows with calves. This has reduced predation on calves during the vulnerable stage of their growth (WWF, 2005). Having vulnerable animals in pasture with high visibility and close to villages is the best option.

3. Lion management

This chapter discusses options for managing lions and lion predation in the context of human/lion conflicts. Table 2 gives an overview of some commonly used methods, with observations on their advantages and disadvantages.

Table 2. Review of advantages and disadvantages of commonly used methods for lion control (adapted from La Grange, 2005)

Objective	Methods	Advantages	Disadvantages	Recommendations
Capture	Cage trap, or camp trap for multiple captures	Fairly selective, no full time attendance (not recommended)	Equipment, transport, costs of anaesthetics	Used when darting skills unavailable
	Gin trap	No attendance, cheap	Unselective, inhumane	Not recommended; to be banned
	Immobilization	Selective	Costs of drugs, requires skilled staff, time cost for e.g. ambush	Preferable; use carcass site if possible
Elimination	Poison (strychnine or compound 1080)	Low costs, no attendance	Unselective, numerous collateral effects	Avoid as much as possible
	Shooting	Selective	Requires skilled staff, time cost for e.g. ambush, tracking	Preferable; use carcass site if possible

3.1. Non-lethal control

3.1.1. Deterrent methods

As previously explained, traditional cattle herders use shouts and gestures to keep lions away. In a spectacular instance in Guinea, cattle herders organized a large drive with the help of hunters to chase lions away from grazing rangeland and back to the Haut-Niger national park (Oulare, 2008).

Many devices can be used to deter lion attacks: the two main types are those that frighten and those that cause aversion (Breitenmoser *et al.*, 2005). Lights or fires can be kept burning at night in areas where animals make regular raids. Human activity and settlements act as deterrents: lion attacks on livestock are negatively correlated with the number of people in

bomas (Ogada *et al.*, 2003). Scarecrows can have a deterrent effect, but they are less successful against lions than against leopards (Woodroffe *et al.,* 2006).

The most common deterrents are dogs and human guards with guns (Ogada *et al.*, 2003). On commercial ranches in Laikipia in Kenya, for example, people fire shotguns to scare off lions using cracker shells – 12-bore cartridges that launch a small charge that explodes near the predator with greater shock value than a gunshot from a *boma*. Other deterrent devices need to be developed to teach raiding lions that killing livestock has unpleasant consequences: options include the use of carcasses laced with lithium chloride, which induces nausea in the predators that eat them, or providing electric-shock collars for exposed calves; these have been tested in America and Europe, but they require too much labour and technology to be used on a wide scale. No single deterrent will be permanently effective, but using several of them in combination will reduce predation and prevent young animals from learning bad habits (Frank and Woodroffe, 2002).

3.1.2. Translocation of lions

Translocation of large carnivores is a sophisticated management practice with a relatively low success rate (Mills, 1991; Parker, 1995; Gault, 1997; Breitenmoser *et al.*, 2005; Lagrange, 2005), but it may be successful in specific cases (Stander, 1990). Before lions are moved, consideration must be given to the destination at which they are to be released: there would be repercussions if they were released in areas already inhabited by lion prides or utilized by livestock herds (Lagrange, 2005). Because they have territorial social systems, large carnivores should only be translocated when unoccupied habitat is available and predators are welcome (Frank and Woodroffe, 2002); otherwise competition with other carnivores, particularly resident lion prides, will have a negative impact on prey populations and ultimately reduce the lion population. Fights between lion prides may also occur, with probable fatalities.

Whenever translocation is carried out, follow-up monitoring to assess the outcome and subsequent long-term monitoring are essential (Stander, 1990; Mills, 1991). In the Etosha case study in Namibia, only long-term monitoring allowed differentiation between "occasional stock-raiding lions", predominantly animals from established prides, and "habitual problem animals". Translocation over a distance of less than 100 km was not sufficient to prevent lions from returning to their original pride territories: most of the 22 lions returned to the area where they were captured. Relocation is therefore not considered an effective strategy in addressing human/wildlife conflict except in unusual circumstances. The option is nonetheless relevant when species are endangered and worth the expense. In the Namibia experiment, non-habitual livestock killers did not kill livestock after they had returned to their former area (WWF, 2005). In South Africa and Botswana, the Kgalagadi Transfrontier Park study from 1997 to 2001 showed a similar trend: in 38 translocations of male lions, 14 were moved more than once; territorial males were translocated to areas about 50 km from their territory, but always returned.

Translocation is, therefore, rarely a suitable strategy. Except in the case of some highly endangered species or in special situations, it is more a public-relations exercise than an effective management tool (Linnell *et al.*, 1997; Woodroffe and Frank, 2005). Where attempts to relocate lion are unsuccessful, lions become extremely cunning and seldom show homing behaviour or return to kills (Lagrange, 2005; Breitenmoser *et al.*, 2005). For recurrent offenders, elimination is often the best solution (Frank and Woodroffe, 2002). According to the African Lion Working Group (2006), translocation of trapped problem predators is almost never justifiable because it usually leads to prolonged suffering and death. In the specific case

of lions, translocation is only viable when animals are moved into vacant habitat with no resident lions where humans will no longer kill them.[6]

3.1.3. Contraception

Contraception has been tried in male and female lions in response to over-population, particularly in small reserves in South Africa.

Surgical sterilization of males by vasectomy has mixed results. Some problems arose because vasectomized lions could not compete in the complex and brutal pride hierarchy. Other problems relate to the financial cost, logistical difficulties and the intrusive nature of the method; in any case, it is impractical to carry out surgical interventions in wild populations occupying vast areas.

Experiments with chemical sterilization were carried out in South Africa. Slow-release subcutaneous implants of Gonadotropin act on the ovaries in females and the testes in males. Because the drug must be placed under the skin, it cannot be given by dart and the expense of capture has to be incurred. More questionable consequences of this method are that reliable reversibility has not been demonstrated, and male secondary sexual characteristics may be suppressed (Munson, 2006): male lions, for example, may lose their manes.

All contraception methods are controversial for one reason or another. The population structure of lions is highly dynamic, and anything that interferes with it is likely to cause other problems.

Even though the Working Group on Wildlife Diseases of the *Office International des Epizooties* (OIE) favours the use of contraception techniques in exotic species and feral animals, it does not favour their use in wild animal species, particularly recombinant contraceptives that use a live vector that spreads automatically and without control among wildlife populations.[7]

3.2. Lethal control

Part III explains the circumstances in which lethal methods might be applied to control problem lions. Killers of humans are destroyed whenever possible; cattle raiders are also usually destroyed, especially in cases of "surplus killing" when a lion kills more cattle than it can eat. The African Lion Working Group states: "... in all cases where investigation shows that individual lions have attacked a person, the lions should be removed at the first opportunity no matter what circumstances of the attack. Investigation and removal should be followed by education to minimize future problems."[8]

3.2.1. Offtake by administrations

Reprisals are generally the responsibility of the wildlife authorities who carry out or authorize the control of problem animals. Problem lions may be shot, trapped or poisoned to prevent further damage. When a problem lion returns to a kill, it can be destroyed by poisoning the carcass or by shooting or trapping (Lagrange, 2005).

---

[6] http://www.african-lion.org/pac_fact_sheet.pdf
[7] http://www.oie.int/eng/press/a_960920.HTM
[8] http://www.african-lion.org/pac_fact_sheet.pdf

Near Etosha National Park in Namibia, 30 lions are killed every year under problem animal control (Stander, 2000). Over 30 years, between 1965 and 1994, 1,000 lions were destroyed on farmland, according to Etosha Ecological Institute records (Berry, 1996); the same source indicates that the number of animals killed may have been higher because farmers were not legally bound to report the killing of lions before 1994.

In Botswana in 1999–2000, an average of 25 lions per year were destroyed under problem animal control in the Okavango delta; an average of seven lions per year were destroyed in the Pan region (Vernon Booth, pers. comm.).

On Galana Ranch in Kenya between 1968 and 1988, persistent stock-raiders were shot at the rate of one lion for every ten cattle killed; 25 lions were shot per year out of a stable population of 150. Between 1988 and 1990, the Government prohibited the use of firearms, and numbers of livestock killed rose to 250–800 per year; 70 percent of the stock-raiding lions were young males. In 1990 the ranch was handed over to a parastatal company that was using poison to control stock-raiding lions (Adrian Radcliffe, pers. comm.).

In west and central Africa, the wildlife administration may request skilled and experienced people to destroy a lion in response to complaints. Annual poisoning campaigns with strychnine are organized: for example between 1970 and 1972 in Burkina Faso, 55 lions were poisoned with strychnine during cattle vaccination campaigns (Chardonnet *et al.*, 2005).

Agricultural or natural poisons are frequently used to kill stock-raiding lions. Strychnine and organophosphate cattle dips were widely used on east African ranches until the latter half of the 20th century (Denney, 1972; *in* Frank *et al.*, 2006). Until recently, the Kenya Wildlife Service and the Kenya Veterinary Department have poisoned hyenas, which affected other scavengers such as lions. In Botswana, despite the recent ban on lion killing, lion poisoning is recorded (Hemson, 2003; *in* Frank *et al.*, 2006). Farmers, particularly pastoralists, use poison to great effect (see section 3.2.2). But because poison is indiscriminate it may remove whole prides (Jenkins, 2001; *in* Frank *et al.*, 2006) and indiscriminately affect other carnivores, including birds. The African Lion Working Group (2006) states that "... poison should never be used under any circumstances."[9]

The use of carbofuran causes concern: it is a systemic neurotoxic insecticide with one of the most acute toxicities to birds and mammals, including humans. It is widely available and cheaper than strychnine. It is utilized in some pastoral areas of Kenya (Frank, unpub. data; *in* Frank *et al.*, 2006).

3.2.2. Offtake by populations, farmers and breeders

The initial reaction of most rural Africans in response to any lion conflict is to eliminate the lion, and often other lions, by shooting, trapping or poisoning to prevent further aggression. The offtake may be "preventive" or a "reprisal", particularly in the case of livestock owners, but this response is a major threat to lion populations (Frank *et al.,* 2006). Communities may also remove lions for other reasons such as seeking financial, social or cultural benefit from lions.

In most sub-Saharan countries, the law contains at least one article guaranteeing the defence of people and their goods against aggression by wild animals (see Appendix 2). In most cases self-defence is authorized and killers of humans and stock-raiding lions can be destroyed legally. The defence of people and cattle is often carried out by farmers and rarely

[9] http://www.african-lion.org/pac_fact_sheet.pdf

reported: the first response to human/lion conflict is usually the destruction of the offending lions.

In west Africa there is currently much less lion hunting, though pastoralists tend to shoot and poison lions to protect their stock. Little information is available on the effects of hunting in the region. The situation in central Africa is different in that there are more lions and hence more predation, but again few data are available. It is safe to assume, however, that a number of lions are killed each year in defence of stock (Bauer and Kari, 2001; Bauer, 2003), especially in situations where transient cattle herders enter protected areas.

In east Africa, traditional cultural practices include the spearing of lions. In Masai communities in Kenya and Tanzania, the mane is taken when a particularly large male lion is killed and used in ceremonies or hung on the warrior's flag pole. When a lion is killed, the tail is cut off and becomes the property of the warrior who put the first spear in; after the initial celebrations, the tail is discarded. Paws are also cut off and used in the celebrations and then discarded. If a lion is poisoned nothing is taken (Adrian Radcliffe, pers. comm.). Lions are not usually hunted in this region, but further studies are needed. Frank *et al.* (2006) cite Ogutu (2005), who reported that Masai *morans* (young warriors) have speared 90 lions since 1998 in Nairobi National Park and Kitengela Plains, presumably in response to cattle raiding. The same authors report studies by Richard Bonham that document 76 lions killed, poisoned or speared since 2001 on Mbirikani Group ranch in southeast Kenya. In the Tarangire-Manyara ecosystem in Tanzania, Bernard Kissui reported 125 lions killed between 2000 and 2005; in the Ngorongoro conservation area, Dennis Ikanda mentioned 35 kills of lions between 1998 and 2004.

In southern Africa, stakeholders such as farmers are controlling lions: for example, in the areas bordering the Kgalagadi Transfrontier Park farmers eliminated 93 lions in the four years up to 2001 in response to predation. The Kalahari lion population could sustain the off-take (Funston, 2001), but the numbers demonstrate the scale of the problem.

Lion off-take may also be accidental. Hunters or poachers kill animals that are not targeted, but trapping is the main indiscriminate method that results in lions being caught unintentionally. The villagers of Kacha-kacha near Zakouma National Park in Chad, for example, use a trap known as *am cadjaman* in which they capture hyenas and lions as well as buffaloes, korrigums and smaller antelopes (Allah-Demngar and Falmata, 2003).

Information on the scale of poaching is difficult to obtain (Scholte *et al.*, 1999a; *in* Bauer, 2003) and is too limited to measure the extent of off-take by communities (Schoemaker, 1999; *in* Bauer, 2003).

3.2.3. Offtake by trophy hunters

In countries with national hunting policies, legal trophy hunting helps to mitigate conflicts with problem lions: it helps to control recurrent stock-raiders or man-eaters and also provides victims and wildlife authorities with income to compensate for casualties.

Trophy hunting is difficult to manage, however, from identification of a culprit to the marketing of the operation. The African Lion Working Group questions tourism hunting as a method of controlling problem lions, even though it recognizes trophy hunting as a legitimate tool for lion conservation. The main issues are related to the difficulties of efficient problem animal control. Trophy hunters are interested in old males, so what should be done with problem lions that are young lionesses or young males expelled from breeding groups and in search of territories and prides? An immediate response is required when a problem lion has

killed a person, but how can a trophy hunter be found at the right time in the right place? How is it possible to ensure that only genuine problem lions are taken when the potential profits encourage people to class any potential trophy lion as a problem animal (International Conservation Services and Viljoen, 2006)?

The control of problem lions through tourism hunting is not yet developed, but it is an attractive option that deserves further exploration.

4. Environmental management

4.1. Increasing alternative prey

As explained in previous sections, increasing the availability of wild prey may reduce the number of livestock lost to predators. Each situation requires specific measures: effective conservation of habitats and control of poaching should maintain sufficient wildlife densities, but in areas where wild prey has been decimated, drastic protection measures are needed to build up numbers. If some of the prey species have become extinct, re-introduction should be considered if the expected benefits cover operational costs.

4.2. Land use planning

Land-use planning should aim to create space for people and wildlife to live together (WWF, 2005); this is a long-term method for preventing human/lion conflicts. Greater success is anticipated from modification of the ways in which the activities of humans and domestic animals intersect with those of carnivores (Treves, 2003). Ogutu, Bhola and Reid (2005) urge "... the development of an effective and participatory planning system for land use that restricts migration of people into the area and encourages compatible land uses, alternative livelihood options to reduce the level of dependence on livestock as the only source of income and incorporates soft edges." Establishing an institutional framework for dialogue is a crucial first step.

Research can help with landscape management by producing models for approaching such a complex and interactive system and by identifying potential danger points for human and wildlife interactions, as has been done in the case of elephants (Sitati *et al.*, 2003). Effects on the ecosystem should be investigated: for example concentrating large carnivores into an area, especially if several species are involved, may increase competition between game hunters and the carnivores (Linnell *et al.*, 2005). Areas that are important for cattle but not for wildlife should be devoted to animal husbandry; areas important for wildlife such as strongholds, corridors and economically viable wildlife areas should be dedicated to conservation.

4.2.1. Planning and managing wildlife and village distribution

Where there is a potential for planning, the land must be analysed to identify habitats, prey densities and travel corridors in which carnivores are likely to be present (Quigley and Herrero, 2005). In Gokwe North in Zimbabwe, for example, biological considerations are considered relevant when the objective is to reduce the attractiveness of an area or to create secure habitats such as routes or corridors that permit wildlife to move freely (WWF, 2005). The distribution of wildlife populations can be manipulated by changing the location of water points and providing salt licks at strategic sites (WWF, 2005). Any water supply – a river, pond or dam lake – is attractive to game and hence to predators, especially during dry seasons; fields are also attractive areas for prey, which in turn attract predators.

To reduce human/carnivore attacks and the long-term costs of carnivore management, new human settlements should avoid areas where lions are likely to be present (Quigley and Herrero, 2005). Human activities in lion ranges must be considered with care: livestock grazing land should be located well away from wildlife strongholds. Human encroachment into wildlife areas can be limited in several ways, for example by re-locating agricultural activities, re-positioning the boundaries of protected areas and creating buffer zones (WWF, 2005).

4.2.2. Zoning around protected areas

Zoning – geographically differentiated land management where different forms of potentially conflicting land use are given priority in different places – is widely used for biodiversity conservation in the creation of national parks, hunting areas and other protected areas. The basic concept is to reduce overlap between large carnivores and sources of conflict through complementary use of different management tools (Linnell *et al.*, 2005). If zoning is used, it is essential to scale management zones to the size of the biological process that they are designed to manage (Thiollay, 1989; Schwartz, 1999 in Linnell *et al*., 2005). Linnell *et al*. state: "... when we are thinking about carnivore zones, we must think in terms of bigger land areas than we are used to thinking about for any other terrestrial species group."

Zoning may be a means of preventing conflicts with lions (Loveridge, 2002b; Linnell *et al.*, 2005). Lions outside national parks may be managed according to land-use areas, ranging from areas where lions are completely protected to areas where they are tolerated under certain circumstances to areas where lions are not tolerated at all and are eradicated (Loveridge, 2002b). In the latter case, human settlements, pastoralism and agriculture should be encouraged in areas away from reserve boundaries (Ogutu, Bhola and Reid, 2005) to reduce the frequency of contact between people and carnivores. Resident lion prides only become a problem when livestock are introduced into wildlife areas or areas adjacent to them (La Grange, 2005). The creation of state or private wildlife management areas on park boundaries is a sound solution with the advantage that any human/lion conflict is displaced to these buffer zones (Loveridge, 2002b).

The are many advantages of zoning: (i) it concentrates the resources for conflict reduction and conservation measures into limited areas; (ii) it allows simplified management procedures to be initiated without time-consuming investigation; (iii) it enables people to make long-term plans and economic investments with knowledge of the extent to which large carnivores will be part of their future; and (iv) it can reduce fear of large carnivores as people become accustomed to their presence (Linnell *et al.*, 2005).

A disadvantage of zoning is that it may decrease tolerance for wildlife if people are excluded from area where carnivores are given preference. This could result in increased poaching and social conflict and might amplify fear because of the concentration of carnivores (Linnell *et al.*, 2005). This situation could be alleviated by introducing community-based natural resource management in the form of land-use planning and land-use change (WWF, 2005). Extended multiple-use landscapes are important for the survival of carnivores because few protected areas are large enough to host viable populations (Woodroffe and Ginsberg, 1998; *in* Breitenmoser *et al.*, 2005). Legal and institutional development will be necessary in creating such integrated landscapes; and agreement on land-use changes may take several years (WWF, 2005).

The concept of communal conservancies developed in Namibia is promising. Under a 1996 law, communities apply to have their land gazetted as a communal conservancy, a new

category of protected area where villagers are granted the authority to manage natural resources and to benefit from income-generating wildlife activities. About 50 communal conservancies have been created covering an area of 15 percent of Namibia: their rapid expansion and the dramatic increases in wildlife populations, including large predators, demonstrates the importance for conservation of sound zoning, wildlife ownership and expectation of benefits from wildlife enterprises.

5. Conclusions and synthesis

Every situation is different: it would be risky to extrapolate from one area to another. In all cases a combination of options is needed such as prevention of conflict, for example through land-use planning, protection against lions using *bomas* and mitigation of conflict, for example through control of problem lions. To be sustainable, the options should match the financial and technical capabilities of communities, individuals and the institutions responsible for implementation. The options available will be determined by regional, national and local policies (WWF, 2005). Interventions should therefore take local circumstances into account: management procedures, culture, trade and law enforcement will affect large carnivore extinctions (Linnell, Swenson and Anderson, 2001; Ogutu, Bhola and Reid, 2005). Methods that have been tested on other carnivores should be evaluated for application to the African lion (Frank and Woodroffe, 2002).

Non-lethal lion management is seldom efficient; it is ineffective against stock-raiders and human killers, when elimination is required. But for reasons of conservation, the killing of lions should be minimized. Table 3 shows options for human/lion conflict management and how they might be perceived by stakeholders. Some major points are:

- Prevention of conflict is the key to coexistence. Land-use planning to ensure that human activities are not carried out in wildlife protection areas helps to prevent human/lion conflict; there is also a need for community awareness about behaviour, triggers for lion conflict, animal husbandry and planning. Incentives are often needed: a promising approach is to establish innovative insurance schemes supporting best practices.
- Protection of people and livestock from lions, for example with *bomas* and wise use of pastoral rangeland is a second strategy. Livestock areas should be selected with regard to wild habitat, and buffer areas should be established between them and carnivore areas.
- Mitigation by ensuring that people perceive the lions more positively can be applied in cases where human/lion conflict is common. Interest in the benefits generated by lions will increase tolerance; in areas with little photographic tourism, trophy hunting could generating income and give people a sense that the lion population is being controlled.

TABLE 3. Synthesis of management options. Efficiency, costs and durability are graded from 1 to 4 by increasing value of each variable. Perception is graded as: P = poor, N = neutral, G = good, I = needs incentive, D = donor dependent, S = institutional/commercial support, C = requires community involvement, E = ethical or conservation issues.

Management option	Efficiency	Cost	Durability	Perception
HUMAN MANAGEMENT				
Community awareness	4	2	4	N/S,C
Compensation				
Direct compensation: subsidies and insurance	3	3	3	P,N/I,D,S
Indirect compensation: wildlife valuation	4	3	4	G/D,S,C
LIVESTOCK MANAGEMENT				
Intensifying human vigilance	3	1	2	P,N/I
Livestock guarding animals	4	2	3	N/I
Use of enclosures	4	2,3	3,4	N,G/I
Grazing and herd management	4	1	4	N,G/I
LION MANAGEMENT				
Non-lethal				
Deterrent methods	1,2	2,4	1	P,N/I,D
Translocation of lions	1,2	4	1	P/D,I
Contraception	1	4	1	P/D,E
Lethal				
Off-take by the administration	2	2,3	3,4	P,N/E
Off-take by populations, farmers and breeders	4	1,2	3,4	G/C,E
Off-take by trophy hunters	1	1	3	N,G/I,D,E
ENVIRONMENTAL MANAGEMENT				
Increase alternative prey	3	1	4	N,G
Land use planning				
Planning/manipulating wildlife and village distribution	2,3	3	2,3	P,N/I,O,S,C
Zoning round protected areas	4	3	3,4	N,G/I,S,C

3 Decision framework

1. Phase 1: Investigation

The first step in a case of predation is to investigate the identity of the killer and establish whether it is a lion. Various predator species co-exist in many areas, so more than one species may be involved. The fact that a carnivore feeds on a carcass does not necessarily mean that it killed the animal: it may be scavenging.

Once the species is identified, an accurate identification of the individual is needed: in some cases sub-adult male lions and adult females with cubs are more likely than others to kill livestock (Frank and Woodroffe, 2002).

A five-step investigation procedure is proposed by Bowland, Mills and Lawson (1994), a method developed for caracal (*Caracal caracal*), brown hyena (*Hyaena brunnea*), cheetah, leopard, black-backed jackal and domestic dog that could be adapted to the lion:

- Step 1: Determine whether the animal was killed by a predator or died from other causes. Lions may scavenge carcasses they have not killed.
- Step 2: Define the size of the prey. Only lion can prey on large species such as elephant, giraffe (*Giraffa camelopardalis*) and buffalo.
- Step 3: Examine the carcass carefully: both sides, head, neck, forelimbs, hind limbs and body.
- Step 4: Look for signs of predation such as claw marks and bites on the throat.
- Step 5: Search the area round the carcass for spoors, tracks, droppings, hair tufts caught in bushes or fencing and stomach contents.

A lion attack on a herd is characterized by signs of nervousness among the animals the next morning: they are usually found on open ground where they can observe any approaching predator. Evidence of a stampede is clear if the herd continues to crowd against fences, sometimes even breaking them, and if grass is flattened over a wide area (La Grange, 2005).

An efficient reporting system with a central database to identify hotspots and problem animals is essential for quick reaction and investigation. The long-term success of an information system will depend on the enumerators, who must be properly employed (WWF, 2005).

There may be no data on the situation before an attack. Regular monitoring will make it possible to measure success in managing human/wildlife conflict. An example of this approach is the “event book” system, widely used in southern Africa. It was originally developed by WWF and IRDNC in Namibia, then introduced and adapted in Botswana, Mozambique and Zambia with varying degrees of success (Richard Diggle, pers. com.). Communities decide what they want to monitor, and technicians from supporting organizations develop the structure accordingly: the entire process, including analysis, happens locally. The approach uses icons and visual displays that allow illiterate people to participate (WWF, 2005).

2. Phase 2: Problem analysis

A decision-making framework for cases of human/lion conflict is useful for authorities, managers and local populations in terms of utilizing the appropriate management strategy for the environmental and socio-economic conditions.

Jeremy Anderson of International Conservation Services and Viljoen (2006) propose decision-tree process to determine which actions to implement for mitigating human/lion conflicts (see Figure 2). The African Lion Working Group recently adopted a similar procedure, which is published in the Problem Lion Control Fact Sheet.[10]

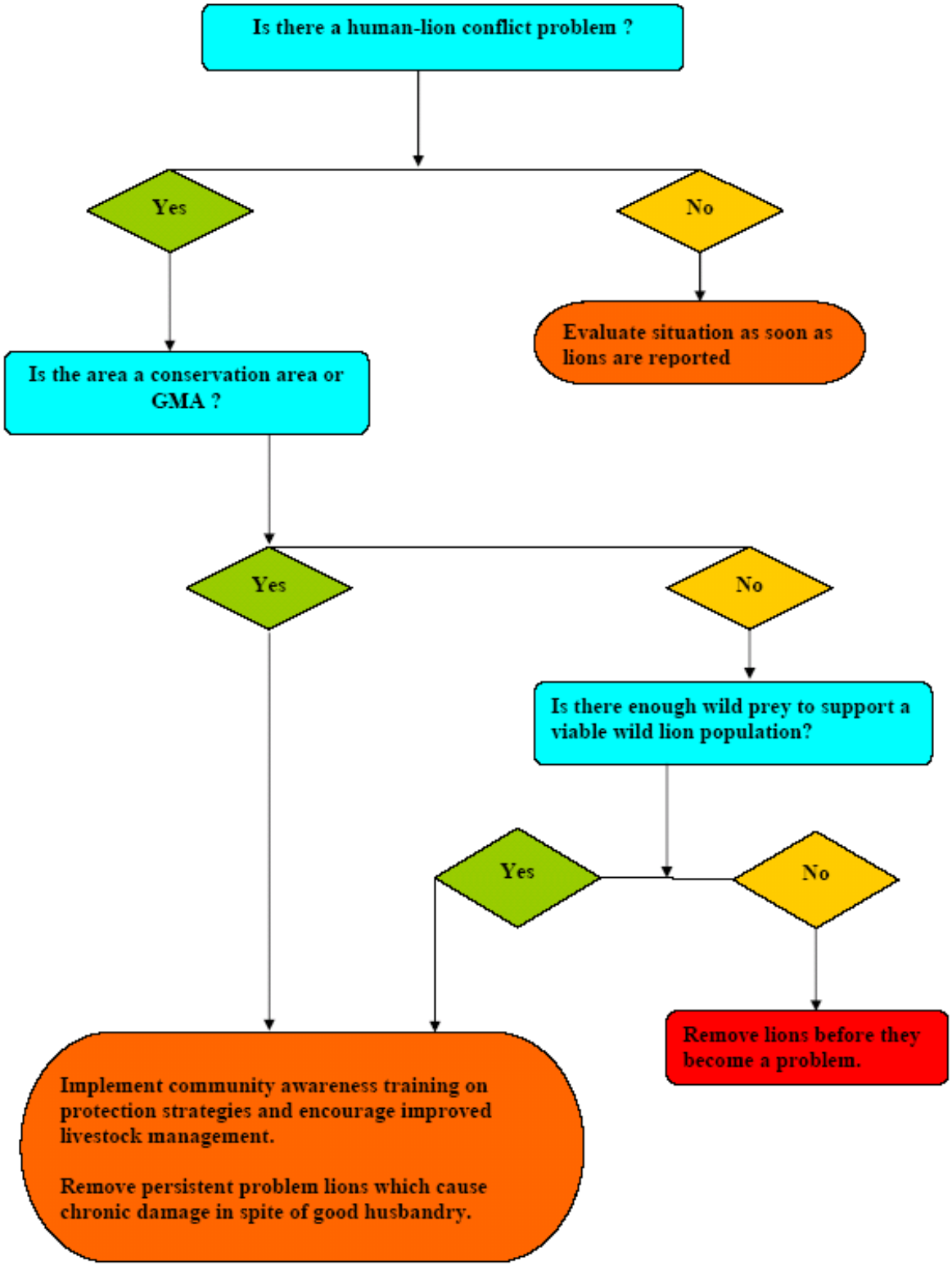
This decision-making process could be a guideline for wildlife authorities and stakeholders to resolve conflicts with lions. Problem animals and the appropriate management actions should be determined at the local level by all stakeholders together, under the authority of government representatives; they must also agree the mechanisms to be used for implementing actions and for reporting.

3. Phase 3: Choice and implementation of management option

When a lion has been proved to be responsible for an attack and the context has been defined, protection and mitigation methods can be selected and implemented. Cooperation among stock farmers and wildlife conservation authorities is crucial for promoting conservation practices in non-gazetted areas and the surroundings of protected areas (Stander, 1990; 1993; Mills, 1991). Table 4 summarizes the modes of intervention detailed in Part II, which are listed under objectives that depend on the type of operation stakeholders agree to implement. Table 4 forms the basis of a decision-making system for deciding the sequence of actions.

[10] http://www.african-lion.org

Figure 2. Decision-making process to determine management actions to resolve human/lion conflict.



GMA: game management area.
Source: International Conservation Services and Viljoen, 2005; courtesy of Jeremy Anderson.

Table 4. Management methods for carnivore/livestock conflicts

Type of intervention	Objectives of the intervention		Intervention modes		
HUMAN MANAGEMENT Tolerate predation on livestock	Increase the tolerance of breeders		Environmental education		
			Money compensation	Subventions	From State
					From NGO
	Positive breeder behaviour	Valuing lions	Viewing tourism		
			Capture tourism		
			Hunting tourism		
Limit predation on livestock	**LIVESTOCK MANAGEMENT** Intervention on livestock	Modify herding practices	Birth synchronization		
			Specific management of calves		
			Less extensive breeding		
			Intensified human vigilance		
	LION MANAGEMENT Intervention on lions	Dissuade lions	Livestock guarding animals		
			Electric enclosures		
			Exposed calves with electrical collars		
		Reduce lion populations	Extraction	Translocation	
				Controlled hunting	
			Others (poisoned collars, contraception, etc.)		
	ENVIRONMENTAL MANAGEMENT Intervention on the environment	Increase alternate prey	Domestic species		
			Feral species		
			Wild species		
		Landscape arrangement	Pasture away from lion habitats		
Eliminate predation on livestock	Separate livestock and lions	Exclude breeding	Integral protected areas		
			Protected areas of sustainable use		
		Exclude lions	Elimination of lions: lethal control method		
			Translocation of lions		

(Adapted from Chardonnet, Jori and Gaidet, 2000)

Bibliography

- **African Lion Working Group**. 2006. *Problem Lion Control Fact Sheet*. October 2006. 5 pp.
- **Allah-Demngar, A. & Falmata, A.** 2003. *Utilisation des ressources naturelles: "La consommation de la viande de brousse autour du Parc National de Zakouma au sud-est du Tchad" cas du village Kacha-kacha. Tchad*, Laboratoire de Recherches Vétérinaires et Zootechniques de Farcha.
- **Anderson, J.** 1981. The re-establishment and management of a lion (*Panthera leo*) population in Zululand, South Africa. *Biological Conservation* 19(2):107–117.
- **Anderson, J.** 2005. *Human/Wildlife Conflicts in Mozambique*. FAO. 80 pp.
- **Anon.** 2000. Kenya culls lions to protect rare bongo. *African Lion News*. Available at www.african-lion.org
- **Arbonnier, M., Barbier, N., De Wispelaere, G., Dulieu, D., Lejoly, J., Mahamane, A., Ouadba, J.M. & Saadou, M.** 2002. *Cartographie du couvert végétal du complexe du W*. ECOPAS report.
- **Austin, J.E. & Bruch, C.E.** 2000. *The Environmental Consequences of War*. Cambridge, UK, Cambridge University Press.
- **Baldus, R.** 2004. *Lion Conservation in Tanzania Leads to Serious Human-Lion Conflicts. With a Case Study of a Man-Eating Lion killing 35 People*. Tanzania Wildlife Discussions Paper No. 41. *Deutsche Gesellschaft für Technische Zusammenarbeit* (GTZ) Wildlife Programme in Tanzania, Wildlife Division, Dar Es Salaam.
- **Baldus, R.** 2009. *Wild Heart of Africa*. Rowland Ward Publications, Johannesburg.
- **Bauer, H.** 2003. *Lion Conservation in West and Central Africa. Integrating Social and Natural Science for Wildlife Conflict Resolution around Waza National Park, Cameroon.* University of Leiden, the Netherlands. (PhD thesis).
- **Bauer, H. & De Iongh, H.H.** 2001. Status and Needs for Conservation of Lions in West and Central Africa. *Proceedings Information Exchange Workshop*, Limbe, Cameroon, June 2001.
- **Bauer, H. & Kari, S.** 2001. Assessment of the people-predator conflict through thematic PRA in the surroundings of Waza National Park, Cameroon. *Participatory Learning and Action Notes* 41, 9–13.
- **Begg, C., Begg, K. & Muemedi, O.** 2007. Human-Carnivore Conflict in Niassa National Reserve. *African Indaba* 5(5).
- **Bell, R.H.V. & McShane-Caluzi, E.** (eds.) 1984. *Conservation and wildlife management in Africa*. Proceedings of a Workshop organized by the US Peace Corps at Kasungu National Park, Malawi, October 1984. 646 pp.
- **Benoit, M.** 2000a. *Statut et usage du sol en périphérie du parc national du W du Niger. Tome 5. Moli Haoussa et la zone tampon du Parc national du W du Niger. Le cas d'un village de savane en zone protégée (réserve totale de Tamou)*. Orleans, France, IRD. 105 pp.
- **Benoit, M.** 2000b. *Ways of life and the settlement of eastern Gourma in the 18th and 19th centuries*. Orleans, France, IRD. 17 pp.
- **Benoit, M. & Macrae, J.** 1993. *Programme régional d'aménagement des parcs nationaux (Pendjari et W) et des réserves avoisinantes au Bénin, Burkina Faso et Niger*. Ouagadougou, JM Consultants.
- **Berman, E.G.** 2006. *La République Centrafricaine: une étude de cas sur les armes légères et les conflits*. Small arms survey. Institut Universitaire des Hautes Etudes Internationales, Geneva.
- **Berry, H.** 1993. Surveillance and control of anthrax and rabies in wild herbivores and carnivores in Namibia. *Revue Scientifique et Technique de l'Office International des Epizooties* (1)12:137–46.
- **Berry, H.** 1996. Lions in Namibia. *Cat News* 24:13–14.
- **Bjerke, T. & Kaltenborn, B.P.** 1998. The Relationship of Ecocentric and Anthropocentric Motives to Attitudes towards Large Carnivores. *Journal of Environmental Psychology* 19:415–421.
- **Bourn, D. & Blench, R.** 1999. *Can Livestock and Wildlife Co-Exist? An Interdisciplinary Approach*. London, Overseas Development Institute. 251 pp.
- **Bowland, A.E., Mills, M.G.L. & Lawson, D.** 1994. *Predators and Farmer*s. Johannesburg, the Penrose Press, Endangered Wildlife Trust.
- **Breitenmoser, U., Angst, C., Landry, J.-M., Breitenmoser-Wursten, C., Linnell J.D.C. & Weber, J.-M.** 2005. Non-lethal techniques for reducing depredation. *In* R. Woodroffe, S. Thirgood & A.R. Rabinowitz. 2005. *People and wildlife: conflict or coexistence?* pp. 49–71. Cambridge, UK, Cambridge University Press.
- **Burini, F. & Ghisalberti, A.** 2001. *Rapport sur la recherche de terrain et sur la récolte de données concernant les aspects socio-territoriaux dans les Zones Périphériques du Parc W finalisé au repérage des critères pour le Zonage.* Report on the first phase of research on the ground. Bergamo, Italy, University of Bergamo.
- **Butler, J.R.A.** 2000. The economic costs of wildlife predation on livestock in Gokwe communal land, Zimbabwe. *African Journal of Ecology* 38(1):23–30.

- **Carr, N.** 1969. *The White Impala*. London, Collins.
- **Chardonnet P.** (ed.) 2002. *Conservation of the African Lion: Contribution to a Status Survey*. International Foundation for the Conservation of Wildlife, France, and Conservation Force, USA. 171 pp.
- **Chardonnet, P., Fritz, H., Zorzi, N. & Féron, E.** 1995. *Current Importance of Traditional Hunting and Major Contrasts in Wild Meat Consumption in Sub-Saharan Africa*. *In* J.A. Bissonette & P.R. Krausman (eds.) 1995. *Integrating People and Wildlife for a Sustainable Future*. Proceedings of the first International Wildlife Management Congress, pp. 304–307. Bethesda, MD, USA, the Wildlife Society.
- **Chardonnet, P., Jori, F. & Gaidet, N.** 2000. *Le conflit homme/jaguar au Pantanal brésilien*. CIRAD report no. 056-00.
- **Chardonnet, P., des Clers, B., Fisher, J., Gerhold, R., Jori, F. & Lamarque, F.** 2002. The Value of Wildlife. *In* Infectious Diseases of Wildlife: Detection, Diagnosis and Management. *Rev. Sci. Tech. OIE* 21(1):15–51.
- **Chardonnet, P., Belemsobgo, U., Crosmary, W., Koulagna, D. & Nowell, K.** 2005. *Influences directes et indirectes sur la conservation du lion en Afrique de l'Ouest et en Afrique Centrale*. *Atelier sur la Conservation du Lion d'Afrique de l'Ouest et d'Afrique Centrale*. Douala, Cameroon, 5–7 October.
- **Chardonnet, P., Mésochina, P., Renaud, P.C., Bento, C., Conjo, D., Fusari, A., Begg, C., Foloma, M. & Pariela, F.** 2009. Conservation Status of the Lion in Mozambique. National Directorate of Conservation Areas/Ministry of Tourism and National Directorate of Land and Forests/Ministry of Agriculture.
- **Charudutt, M.** 1997. Livestock Depredation by Large Carnivores in the Indian Trans-Himalaya: Conflict Perceptions and Conservation Prospects. *Environmental Conservation* 24:338–343.
- **Cleaveland, S., Mlengeya, T., Kaare, M., Haydon, D., Lembo, T., Laurenson, M.K. & Packer, C.** 2007. The Conservation Relevance of Epidemiological Research into Carnivore Viral Diseases in the Serengeti. *Conservation Biology* 21:612–622.
- **Clerici, N., Hugh, E. & Grégoire J.-M.** 2005. *Assessing Modifications in Burned Area Characteristics to Monitor Land-Use Changes and Landscape Fragmentation around the WAP Complex of protected areas (West Africa)*. Accepted for the conference on landscape ecology "Pattern and process: what is the present state of knowledge?" 14-16 November. Nice, France, IALE.
- **Clifford D.L., Sadiki, H., Mazet, J. & Kazwala, R.R.** 2009. *Tuberculosis Infection in Wildlife from the Ruhaha Ecosystem, Tanzania: Implications for Wildlife, Domestic Animals and Human Health*. 7th TAWIRI Scientific Conference, 2–4 December. Programme and abstracts, 69 pp. Arusha, United Republic of Tanzania.
- **Coppinger, R., Lorenz, J., Glendinning, J., Pinardi, P. & Range Manage, J.** 1983. Attentiveness of guarding dogs for reducing predation on domestic sheep. *Journal of Range Management* 36:275–279.
- **Creel, S. & Creel, N.M.** 1997. Lion Density and Population Structure in the Selous Game Reserve: Evaluation of Hunting Quotas and Off-Take. *African Journal of Ecology,* 35(2):83–93.
- **Croes, B., Buij, R., van Dalen, J. & de Iongh, H**. 2008. *Livestock-Carnivore Conflicts: Results of an Inventory around Bénoué National Park, Cameroon*. Proceedings of international seminar "Conservation of Large Carnivores in West and Central Africa", CML/Centre for Environment and Development Studies, 15–16 November 2006. Maroua, Cameroon.
- **Cumming, D.H.M.** 1982. The Influence of Large Herbivores on Savannah Structure in Africa. *In* B.J. Huntley & B.H. Walker (eds.) *Ecology of Tropical Savannas*. 1982. Berlin, Springer-Verlag. pp. 217–246.
- **De Waal, H.O., Avenant, P.L., Fouché, H.J. & van der Merwe, S.J.** 2001. A Comparison of the Seeds found in the Scat of a Kalahari Lion with the Seeds of two well-known *Cucurbitaceae* Families. *African Lion News* 3:21–22.
- **Dowie, M.** 2006. Enemies of Conservation. *Range Magazine* Summer 2006:24–27.
- **Dricuru, M.** 2000. *The Lions of Queen Elisabeth National Park, Uganda: their Demographic and Health Status and Relationship with People*. Institute of Environment and Natural Resources, Department of Wildlife and Animal Resource Management, Makerere University, Uganda.
- **Dublin, H.T. & Ogutu, J.O.** 1998. Demography of Lions in Relation to Prey Density and Habitat Factors in Masai Mara National Reserve, Kenya. *Advances in Ethology* 33(88). H. Hofer, P. Heribert, C. Pitra, R. Hofmann & R. Reinhold (eds.), contributions to the International Symposium on Physiology and Ethology of Wild and Zoo Animals, Berlin, 7–10 October.
- **Ehrenreich, B.** 1999. *Le Sacre de la Guerre.* Essais de Sociologie. Paris, Calmann-Levy.
- **Eloff, F.C.** 1980. Cub Mortality in the Kalahari Lion (*Panthera leo vernayi*). *Koedoe* 23:63–70.
- **Eltringham, S.K.** 1984. *Wildlife Resources and Economic Development.* New York, John Wiley and Sons.
- **FAO.** 2005. *Strategies to Mitigate Human/Wildlife Conflict in Mozambique*. Report for the National Directorate of Forests and Wildlife. Rome. 68 pp.
- **FAO.** 2008. *The Statistics Division*. Available at http://www.fao.org/statistics/index_en.asp

- **Fitzsimons, F.W.** 1919. *The Natural History of South Africa. Mammal*s. London, Longman, Green and Co.
- **Fournier, A. & Toutain, B.** 2007. *Suivi des activités en matière de pastoralisme et de transhumance dans la zone d'influence du parc régional du W du Niger*. Expert report for the ECOPAS Park Programme. Niamey. 73 pp.
- **Frank, L.** 1988. *Living with Lions: Carnivore Conservation and Livestock in Laikipia District, Kenya*. Washington DC, Development Alternatives Inc., for the United States Agency for International Development.
- **Frank, L.** 2000. *Ranchers Learn to Coexist with Predators in Kenya.* Laikipia Predator Project, the Wildlife Conservation Society. Available at www.wcs.org/home/wild/Africa/637/
- **Frank, L.** 2006. *Living with Lions*. Laikipia Predator Project. Kilimanjaro Lion Conservation Project, Wildlife Conservation Society, pp 1–15. Berkeley, CA, USA, University of California.
- **Frank, L. & Woodroffe, R.** 2002. *Managing Predators and Livestock on an East African Rangeland.* Lion conservation research workshop 2: "Modelling Conflict". Oxford, Wildlife Conservation Research.
- **Frank, L., Woodroffe, R. & Ogada, M.O.** 2005. People and Predators in Laikipia District, Kenya. *In* R. Woodroffe, S. Thirgood & A.R. Rabinowitz. 2006. *People and Wildlife: Conflict or Coexistence?* pp. 286–304. Cambridge, UK, Cambridge University Press.
- **Frank, L., Hemson, G., Kushir, H. & Packer, C.** 2006. *Lions, Conflict and Conservation in Eastern and Southern Africa*. Background paper for the Eastern and Southern African Lion Conservation Workshop, Johannesburg, 11–13 January.
- **Frank, L., Hemson, G., Kushir, H., Packer, C. & Maclennan, S.** 2008. *Lions, Conflict and Conservation*.. Proceedings of international seminar "Conservation of Large Carnivores in West and Central Africa" CML/CEDC, 15 and 16 November 2006, Maroua, Cameroon.
- **Frump, R.** 2006. *The Man-eaters of Eden: Life and Death in Kruger National Park*. Guilford, USA. The Lyons Press.
- **Funston, P.J.** 2001. *Kalahari Transfrontier Lion Project: Final Report*. Unpublished report submitted to the Endangered Wildlife Trust, Parkview, Johannesburg.
- **Funston, P.J.** 2008. *Conservation and management of lions in Southern Africa: Status, threats, utilization and the restoration option*. Proceedings of international seminar "Conservation of Large Carnivores in West and Central Africa", CML/Centre for Environment and Development Studies, 15–16 November 2006. Maroua, Cameroon.
- **Galhano Alves, J.P. & Harouna, A.** 2005. *Sociétés humaines, lions et biodiversité en Afrique Occidentale. Le cas de la région du Parc National du W du Niger (Gourma Oriental).* Post-doctoral research report. Lisbon, New University of Lisbon.
- **Gault, C.** 1997. *A Moving Story. Species and Community Translocation in the UK: a Review of Policy, Principle, Planning and Practice.* Godalming, UK, WWF.
- **Hamissou Malam Garba & Di Silvestre, I.** 2006. *Conflicts between Large Carnivores and Domestic Livestock in the Peripheral Zone of the W Transboundary Park in Niger*. Proceedings of international seminar "Conservation of Large Carnivores in West and Central Africa", CML/Centre for Environment and Development Studies, 15–16 November 2006. Maroua, Cameroon.
- **Hanssen, L. & Stander, F.** 2000. Desert Lions of Namibia. *Cat News* 33. IUCN/SSC Cat Specialist Group.
- **Harrington, R., Owen-Smith, N., Viljoen, P.C., Biggs, H.C., Mason, D.R. & Funston, P.** 1999. Establishing the Causes of the Roan Antelope Decline in the Kruger National Park, South Africa. *Biological Conservation* 90(1):69–78.
- **Hars, J.** 2002. *Projet d'épidémiosurveillance des maladies animales dans la zone des parcs W et Pendjari : étude des maladies transmissibles entre animaux domestiques et sauvages, en particulier chez les carnivores*. Douala.
- **Hofmann-Lehmann, R., Fehr D., Grob, M., Packer, C., Martenson, J.S., O'Brien, S.J. & Lutz, H.** 1996. Prevalence of Antibodies to Feline Parvovirus, Herpesvirus, Calici Virus, Coronavirus and Immunodeficiency Virus and of Feline Leukemia Virus Antigen and the Interrelationship of these Viral Infections in Free-Ranging Lions in East Africa. *Clinical Diagnostic Laboratory Immunology* 3:149.
- **Hosek, W.A.** 2006. *The Man-Eater of Mfuwe*. Available at: www.fieldmuseum.org/exhibits/exhibit_sites/mfuwe/maneaters.html
- **Inagoki, H. & Tsukahara, T.** 1993. A Method of Identifying Chimpanzee Hairs in Lion Faeces. *Primates* 34:109–112.
- **International Conservation Services CC & Viljoen, P.** 2007. *Lions and Lion Hunting in Zambia: Management Guidelines*. Lusaka, Zambia Wildlife Authority.
- **Israel, P.** The "War of the Lions": Lion Killings and Witch Hunts in Muidumbe, 2002–2003. In prep.

- **Issa, M.Y.** 2004. *Contribution à l'étude de l'impact de l'utilisation des pesticides sur la faune terrestre et aquatique : cas des grands mammifères et de quelques espèces de poissons dans les Réserves de Biosphère de la Pendjari et du W*. Rapport de maîtrise professionnelle. Benin, University of d'Abomey-Calavi.
- **IUCN.** 2004. Preventing and Mitigating Human-Wildlife Conflicts: World Parks Congress Recommendation. *Human Dimensions of Wildlife* 9 (4):259–260.
- **Jackson, P.** 1997a. Lions of the Kalahari. *Cat News* 26(11). IUCN/SSC Cat Specialist Group.
- **Jackson, P.** 1997b. The Status of Cats in the Wild. *International Zoo Yearbook* 35:17–27.
- **Jager, H.G., Booker, H.H. & Hubschle, O.J.B.** 1990. Anthrax in Cheetahs (*Acinonyx jubatus*) in Namibia. *Journal of Wildlife Diseases* 3(26):1372–85.
- **Kaczensky, P.** 1996. *Livestock-Carnivore Conflicts in Europe*. Munich, Germany, Munich Wildlife Society.
- **Keet, D.F., Kriek, N.P.J., Bengis, R.G., Grobler, D.G. & Michel, A.** 2000. The Rise and Fall of Tuberculosis in a Free-Ranging Chacma Baboon Troop in the Kruger National Park. *Onderstepoort J. Vet. Res.* 67(2):115–122.
- **Keet, D.F., Kriek, N.P.J., Penrith, M.L. & Michel, A.** 1998. *Tuberculosis in Free-Ranging Lions in the Kruger National Park.* Proceedings of ARC-Onderstepoort OIE international congress on anthrax, brucellosis, contagious bovine pleura-pneumonia, clostridial and mycobacterial diseases, with WHO co-sponsorship. Berg-en-Dal, Kruger National Park, South Africa.
- **Keet, D.F., Kriek, N.P.J., Penrith, M.L., Michel, A., Huchzermeyer, H.** 1996. Tuberculosis in Buffaloes *(Syncerus caffer)* in the Kruger National Park: Spread of the Disease to other Species. *Onderstepoort J. Vet. Res*. 63(3):239–244.
- **Kellert, S.R., Black, M., Rush, C.R. & Bath, A.J.** 1996. Human Culture and Large Carnivore Conservation in North America. *Conservation Biology* 10:977–990.
- **Kelly, M.** 2001. Serengeti Cheetah Viability and the Lion Factor. *Cat News* 34:28–29.
- **Kerbis-Peterhams, P.** 1999. The Science of Man-Eating among Lions (*Panthera leo*) with a Reconstruction of the Natural History of the "Man-eaters of Tsavo". *Journal of East African Wildlife Society* 90:1–40.
- **Kruuk, H.** 1980. *The Effects of Large Carnivores on Livestock and Animal Husbandry in Marsabit District, Kenya*. UNEP/Man and the Biosphere Programme. Nairobi, UNEP.
- **Kruuk, H.** 2002. *Hunter and Hunted: Relationship between Carnivores and People* Cambridge, UK, Cambridge University Press.
- **Lagendijk, D.D.G. & Gusset, M.** 2008. Human-Carnivore Coexistence on Communal Land Bordering the Greater Kruger Area, South Africa. *Environment Management* (42):971–976.
- **La Grange, M.** 2005. Problem Lion control. Methods and General Observations Related to the Control of Problem Lions, Harare. Report to IGF Foundation. *Wildlife Management*, volume II.
- **Lhote, H.** 1951. *La chasse chez les Touaregs*. Paris, Amiot-Dumont.
- **Lichtenfeld, L.L**. 2001. *Among Humans and Lions: Exploring Biological and Social Relationships to the Lion in Northern Tanzania.* 8th International Theriological Congress 2001. Sun City, South Africa.
- **Lichtenfeld, L.L.** 2007. Representing Local Communities in Lion Conservation. *African News* 7:44–46.
- **Linnell, J.D.C., Aanes, R., Swenson, J.E., Odden, J. & Smith, M.E.** 1997. Translocation of Carnivores as a Method for Managing Problem Animals: a Review. *Biodiversity and Conservation* 6:1245–1257.
- **Linnell, J.D.C., Nilsen, E.B., Lande, U.S., Herfindal, I., Odden, J., Skogen, K., Andersen, R. & Breitenmoser, U.** 2005. Zoning as a Means of Mitigating Conflicts with Large Carnivores: Principles and Reality. *In* R. Woodroffe, S. Thirgood & R. Rabinowitz. 2006. *People and Wildlife: Conflict or Coexistence?* pp. 162–175. Cambridge, UK, Cambridge University Press.
- **Linnell, J.D.C., Smith, M.E., Odden, J., Kaczensky, P. & Swenson, J.E.** 1996. Strategies for the Reduction of Carnivore-Livestock Conflicts: a Review. Carnivores and Sheep Farming and Norway 4. NINA Opdragsmelding 443:1–118.
- **Linnell, J.D.C., Swenson, J.E. & Anderson, R.** 2001. Predators and People: Conservation of Large Carnivores is Possible at High Human Densities if Management Policy is Favourable. *Animal Conservation* 4:345–349.
- **Löe, J. & Rösakaft, E.** 2004. Large Carnivores and Human Safety: a Review. *Ambio* 33:283–288.
- **Loveridge, A.J.** 2002a. *Hwange Lion Project*. Workshop on ecological research in Hwange NP, June. Oxford, UK, Wildlife Conservation Unit.
- **Loveridge, A.J.** 2002b. *Dimension of the Problem. 3. Synthesis.* Lion conservation research, workshop 2: Modelling Conflict. A. J. Loveridge, T. Lynam and D. W. Macdonald. Oxford, UK, Wildlife Conservation Research Unit.

- **Macdonald, D.W. & Sillero-Zubiri, C.** 2002. *Dimension of the Problem. 1) Large Carnivores and Conflict: Lion Conservation in Context.* Lion conservation research, workshop 2: Modelling Conflict. Oxford, UK, Wildlife Conservation Research Unit.
- **Madden, F.** 2004. Creating Coexistence between Humans and Wildlife: Global Perspectives on Local Efforts to Address Human-Wildlife Conflict. *Human Dimensions of Wildlife* 9(4):247–257.
- **Marker, L., Dickman, A. & Schumann, M.** 2005. Using Livestock-Guarding Dogs as a Conflict Resolution Strategy on Namibian Farms. *Carnivore Damage Prevention News*, January.
- **Martin, R.B & de Meulenaer, T.** 1988. *Survey of the Status of the Leopard (Panthera pardus) in Sub-Saharan Africa*. IUCN, Lausanne, Switzerland.
- **Martin, G.** 2001. In Peace With Predators: UC Biologists say People must Learn to Co-Exist with Africa's Carnivores if these Animals are to Survive. *African Lion News*, vol. 3.
- **McNutt, J.W.** 2001. *African Wild Dogs in Northern* Botswana: 1989-Present. National technical predator management and conservation workshop proceedings, October. Maun, Botswana.
- **Mésochina, P. & Yaguémé, M.** 2009. *Cartographie des activités humaines dans le Nord de la République Centrafricaine*. IGF Foundation, APFC and MDRA. PowerPoint presentation.
- **Mésochina, P. & Shehou, O.** 2009. *Cartographie participative des activités humaines dans le Haut-Mbomou*. IGF Foundation and FNEC. Bangui. 41pp.
- **Mésochina, P., Mamang-Kanga, J.B., Mandjo, Y., Yaguémé, M., Roulet, P.A. & Chardonnet, P.** *Statut de conservation du lion en République Centrafricaine*. MEFCP, MDRA and IGF Foundation. In press.
- **Ministry of Environment and Tourism, Namibia**. 2006. *Proceedings of the Human Wildlife Conflict Management (HWCM) Policy Workshop.* Windhoek.
- **Mills, M.G.L.** 1991. Conservation Management of Large Carnivores in Africa. *Koedoe* 34(1):81–90.
- **Mills, M.G.L.** 2000. *About Lions – Conservation Issues*. Available at www.african-lion.org
- **Mills, M.G.L., Wolf, P.E., Le Riche, A.N. & Meyer, I.J.** 1978. Some Population Characteristics of the Lion (*Panthera leo*) in the Kalahari Gemsbok National Park. *Koedoe* 21:163–171.
- **Munson, L.** 2006. Contraception in Felids. *Theriogenology* 66(1):126–134.
- **Myers, N.** 1996. *Ultimate Security: the Environmental Basis of Political Stability*. Washington DC, Island Press.
- **Nowell, K. & Jackson, P.** 1996. *Wild Cats: Status Survey and Conservation Action Plan*. Cambridge, UK, Burlington Press.
- **O'Connell-Rodwell, C., Rodwell, T., Rice, M. & Hart, L.A.** 2000. Living with the Modern Conservation Paradigm: Can Agricultural Communities Co-Exist with Elephants? A Five-Year Case Study in East Caprivi, Namibia. *Biological Conservation* 93:381–391.
- **Ogada, M.O., Woodroffe, R., Oguge, N. & Frank, L.** 2003. Limiting Depredation by African Carnivores: the Role of Livestock Husbandry. *Conservation Biology* 17(6):1521–1530.
- **Ogutu, J.O., Bhola, N. & Reid, R.** 2005. The Effects of Pastoralism and Protection on the Density and Distribution of Carnivores and their Prey in the Mara Ecosystem of Kenya. *J. Zool. Lond*. 265:281–293.
- **Oulare, A.** 2008. *Status, Trends and Threats for Lion Populations in the Republic of Guinea*. Proceedings of international seminar on conservation of large carnivores in west and central Africa, CML/CEDC, November 2006. Maroua, Cameroon.
- **Packer, C., Ikanda, D., Kissui, B. & Kushnir, H.** 2005. Lion Attacks on Humans in Tanzania. *Nature* 436:927–928.
- **Packer, C., Ikanda, D., Kissui, B. & Kushnir, H.** 2006. The Ecology of Man-Eating Lions in Tanzania. *Nature & Faune* 21(2). Accra, FAO.
- **Paris, R.** 2006. *Wilderness Awareness Training Course for CIRAD Hwange Programme*. Harare.
- **Parker, D. M.** 1995. *Habitat Creation – a Critical Guide.* Peterborough, UK, English Nature.
- **Patterson, B.D. & Neiburger, E.J.** 2000. *Morphological Corollaries of Man-Eating in African Lions: the Smoking Gun*. 81st Annual Meeting, American Society of Mammalogists. Durham, NH, USA.
- **Patterson, B.D., Kasiki, S.M., Selempo, E. & Kays, R.** 2004. Livestock Predation by Lions (*Panthera leo*) and other Carnivores on Ranches neighbouring Tsavo National Parks, Kenya. *Biological conservation* 119:507–516.
- **Patterson, J. H.** 1907. *The Man-Eaters of Tsavo and other East African Adventures*. London, Macmillan.
- **Pellerin, M., Kidjo, F., Téhou, A., Sogbohossou, E., Ayegnon, D. & Chardonnet, P.** 2009. *Statut de conservation du lion au Bénin*. IGF Foundation and Cenagref, Cotonou.
- **Quigley, H. & Herrero, S.** 2005. Characterization and Prevention of Attacks on Humans. *In* R. Woodroffe, S. Thirgood & R. Rabinowitz. 2006. *People and Wildlife: Conflict or Coexistence?* Cambridge, UK, Cambridge University Press.

- **Raynaud, J. & Georgy, G.** 1969. *Nature et chasse au Dahomey*. Paris, Secrétariat d'Etat aux Affaires Etrangères. 320 pp.
- **Renner, M.** 1999. *Ending Violent Conflict*. Washington DC, Worldwatch Institute.
- **Rey-Herme, P.** 2004. *Enquête épidémiologique en périphérie du Parc régional du W ECOPAS.* University of Lyon, France. Veterinary doctoral thesis.
- **Rudnai, J. A.** 1983. The Ecology of Lions in the Kitengela Conservation Unit, Kenya. *National Geographic Society Research Reports* 15:565–571.
- **Saberwal, V.K., Gibbs, J.O., Chellam, R. & Johnsingh, A.J.T.** 1994. Lion-Human Conflict in the Gir Forest, India. *Conservation Biology* 8:501–507.
- **Santoir, Ch.** 1999. *Du Sahel à la savanne. L'expansion peule au sud de la Sirba (Gurma burkinabé)*. Orleans, France, IRD. 64 pp.
- **Schaller, G.B.** 1972. *The Serengeti Lion. A Study of Predator-Prey Relations.* Chicago, USA, University of Chicago Press. 480 pp.
- **Schumann, M.** (ed.) 2004. *Integrated Livestock and Predator Management.* Otjiwarongo, Namibia, Cheetah Conservation Fund. 85pp.
- **Shambaugh, J., Oglethorpe, J. & Ham, R.** 2001. *L'herbe foulée. Atténuer l'impact des conflits armés sur l'environnement.* Washington, DC, Biodiversity Support Program. 127 pp.
- **Shivik, J.A.** 2004. Non-Lethal Alternatives for Predation Management. *Goat and Sheep Research Journal* 19:64–71.
- **Siefert, L. (ed.)** 2000. *Large Predators – Data, Protocols, Viability.* Uganda large predator and scavenger research and management project training workshop report, July/August, Mweya, Queen Elizabeth National Park, Uganda. Kampala, LPP/WARM Dept., Makerere University.
- **Silva, J.A.** 1972. *A palanca real.* Lisbon*,* Junta de investigaçoes do Ultramar, pp. 54–59.
- **Sitati, N.W., Walpole, M.J., Smith, R.J. & Leader-Williams, N.** 2003. Predicting Spatial Aspects of Human-Elephant Conflict. *Journal of Applied Ecology* 40:667–677.
- **Skuja, M. J.** 2002. *Human-Lion Conflict around Tarangire National Park, Tanzania.* Madison, WI, University of Wisconsin, Department of Geography.
- **Smith, S.** 2003. *Négrologie. Pourquoi l'Afrique meurt?* Calmann-Lévy, Paris.
- **Smith, M.E., Linnell, J.D.C., Odden, J. & Swenson, J.E.** 2000. Methods for Reducing Livestock Losses to Predators. B: Aversive Conditioning, Deterrents and Repellents. Acta Agriculturae Scandinavia, Section A. *Animal Science* 50:304–315.
- **Sogbohossou, E.** 2008. *Research on Lions in Benin: Review and Perspectives*. Conservation of large carnivores in west and central Africa. Proceedings of international seminar on conservation of large carnivores in west and central Africa, CML/CEDC, November 2006. Maroua, Cameroon.
- **Stander, P.E.** 1990. A Suggested Management Strategy for Stock-Raiding Lions in Namibia. *South African Journal of Wildlife Research* 20(2):37–43.
- **Stander, P.E. & Albon, S.D.** 1993. *Hunting Success of Lions in a Semi-Arid Environment*. Zoological Society of London. *Symposia* 65:127–143.
- **Stander, P.E.** 1997. *The Ecology of Lions and Conflict with People in North-Eastern Namibia*. Proceedings of a symposium on lions and leopards as game ranch animals. pp. 10–17. Onderstepoort, South Africa.
- **Stander, P.E.** 2000. Conservation of Lions and other Large Carnivores in the Kunene Region, Namibia. *African Lion News* 2 :8–9.
- **Stander, P.E. & Hanssen, L.** 2001. Desert Lions of Namibia. *Cat News* 33:15.
- **Tacher, G.** 2002. *Livre blanc de l'élevage en Afrique Sub-Saharienne*. Paris, MAE and CIRAD-EMVT.
- **Tamou, Ch.** 2002. *Carte de transhumance transfrontalière*. Cotonou, Laboratoire d'écologie appliquée.
- **Tehou, A.** 2006. *Projet pilote sur la mitigation des conflits homme/faune sauvage/animaux domestiques dans la zone périphérique de la réserve de biosphère de la Pendjari, Bénin.* Large Carnivore Seminar, November. Garoua, Cameroon.
- **Treves, A. & Karanth, K.U.** 2003. Human-Carnivore Conflicts and Perspectives on Carnivore Management Worldwide. *Conservation Biology* 17(6):1491–1499.
- **Treves, A. & Naughton-Treves, L.** 1999. Risk and Opportunity for Humans Coexisting with Large Carnivores. *Journal of Human Evolution* 36:275–282.
- **Tsukahara, T.** 1993. Lions Eat Chimpanzees: the First Evidence of Predation by Lions on Wild Chimpanzees. *American Journal of Primatology* 29:1–11.

- **Tubiana, J.** 2006. Représentation de l'animal sauvage chez les éleveurs Teda-Daza et Bèri du Nord-est du Tchad. *In* Rouaud, A. (ed.) 2006. *L'homme et l'animal dans l'Est de l'Afrique.* Bièvres, France, Les Ethiopisants Associés.
- **Ugandan Game Department Archives**. 1923–1994. Kampala.
- **Ugandan Game Department Archives**. 1962–1963. Kampala.
- **UNEP.** 2002. *Cadre du plan d'action pour l'initiative environnement du nouveau partenariat pour le développement en Afrique*. Dakar.
- **Van Bommel, L., Bij de Vaaste, M.D., De Boer, W.F. & De Iongh, H.H.** 2007. Factors Affecting Livestock Predation by Lions in Cameroon. *African Journal of Ecology* (45):490–498.
- **Van der Merwe, S.** 2001. Hunting Ban in Botswana. *African Lion News* 3:5–6. Available at www.african-lion.org
- **Van Der Meulen, J.H.** 1977. Note on the Capture and Translocation of Stock-Raiding Lions in North-Eastern and North-Western Rhodesia. *South African Journal of Wildlife Research* 7(1):15–17.
- **Vanherle, N.** 2008. *Report of the DAS/ROCAL Pilot Project in Zakouma National Park, Chad.* Conservation of large carnivores in West and Central Africa. Proceedings of international seminar on conservation of large carnivores in west and central Africa, CML/CEDC, November 2006. Maroua, Cameroon.
- **Woodroffe, R. & Frank, L.G.** 2005. Lethal Control of African lions (*Panthera leo*): Local and Regional Population Impacts. *Animal Conservation* 8:91–98.
- **Woodroffe, R., Frank, L.G., Lindsey, P., Ole Ranah, S. & Romanach, S.** 2006. Livestock Husbandry as a Tool for Carnivore Conservation in Africa's Community Rangelands: a Case-Control Study. *Biodiversity Conservation* DOI 10.1007/s10531–006–9124–8.
- **WRI.** 1990. *World Resources Report 1990*. Washington DC, UNDP, UNEP, World Bank, WRI.
- **WWF.** 2005. *Human Wildlife Conflict Manual*. Wildlife management series. Harare, Zimbabwe, World Wide Fund for Nature Southern African Regional Programme Office.
- **Yamazaki, K. & Bwalya, T.** 1999. Fatal Lion Attacks on Local People in the Luangwa Valley, Eastern Zambia. *South African Journal of Wildlife Research* 29(1):19–21.

Appendix 1. Some documented cases of lion predation on humans and livestock

Region	Lion range states	Sites	Predation on livestock	Attack on humans	References
WEST AFRICA	BENIN	Pendjari National Park	Average annual loss of US$365 per herder and US$204 per small livestock farmer		Sogbohossou, 2008; Tehou 2006
		W Transfrontier Park	Recently, >100 000 heads of livestock used to transit illegally in the park		Hars 2002
	BURKINA FASO	Near Po		21 people killed by a pair of lions in 1923	Raynaud & Georgy 1969
	GUINEA	Country-wide	Between 2001 and 2005, 98 livestock heads killed in 8 reported events		Lion range states inquiry, FAO 2007
		Haut-Niger National Park	7 lions killed 168 cattle between 1997 and 1998		Bauer 2003; Oulare, 2008
	NIGER	W Transfontier Park	Between 2000 and 2006, average of 125 lion attacks per year: 83 cattle, 37 small ruminants and others		Hamissou Malam Garba & Di Silvestre 2006
		Buffer zone of W Transfontier Park		3 persons severely wounded in 2007	Samaïla Samahilou com. pers. 2007
		Village of Moli-Haoussa/Gourma, Réserve de Tamou, Buffer zone of W Transfontier Park	Attacks by lion amount to 4% of the cattle population each year: 10 cows out of 250 during the period of investigation	Attacks on humans rare, but often mortal. Since the end of 1990, one child has been killed by a lion, and a shepherd was seriously wounded	Galhano Alves & Harouna 2005
	SENEGAL	ZIC Falémé	In 2001, 6 attacks on cattle declared, 28 heads killed. In 2005, 3 attacks on cattle declared, 7 head killed.	One person injured in 2004	Lion range states inquiry, FAO 2007
	TOGO	Countrywide	2 cases reported in 2006. 2 livestock heads killed		Lion range states inquiry, FAO 2007
CENTRAL AFRICA	CAMEROON	Waza National Park	Increasing lion predation: 700 cattle and 1,000 small ruminants per year. Losses of US$130,000 – primarily cattle; approximately US$370 per breeder; 5% to 7% of cattle reported to be lost annually per village and 20% to 30% of sheep and goats.	3 men attacked in the area during a 10 year period	Bauer & Kari 2001; Bauer & De Iongh 2001; Bauer 2003
			Livestock losses by lion predation higher than by disease and theft: 2.1% of cattle,15% sheep, 20% ofgoats. Financial loss: US$100,000 year/village.		De Iongh, Bauer, Funston & Hamling 2008
		Bénoué National Park	For resident farmers, livestock depredation by lion is much less than by wild and feral cats		Croes, Buij, van Dalen & de Iongh 2008
	CENTRAL AFRICAN REPUBLIC	Tiroungoulou, Northern CAR	2 cattle-raiding lions controlled as problem animals in 2006		DFC pers. comm. 2007
				1 person killed by a shot lion in 2006	CF pers. com. 2006
		Zemongo Faunal Reserve, eastern CAR		1 person wounded by a shot lioness in 2006	Roulet pers. comm. 2006
	CHAD	Zakouma National Park	In nomadic camps, cattle losses to large carnivores up to 5% (maximum 10%)		Vanherle 2008

REGION	LION RANGE STATES	SITES	PREDATION ON LIVESTOCK	ATTACK ON HUMANS	REFERENCES
EASTERN AFRICA	ETHIOPIA			Even in the 21st century, man-eating by lion is a real problem in Ethiopia	Frank *et al.* 2006
	KENYA	Galana Ranch	Over 20 years 1968–1988, lions killed about 1% of livestock per year: 250–300 head		A. Radcliffe, pers. comm.
		Laikipia Group Ranch	On commercial ranches, lions took 0.51% of cattle and 0.27% of sheep annually. In 1996, it cost US$300–400 to support a lion		Frank 1998
		Nairobi National Park & Kitengela Plains	58 head of livestock were killed during 1970–1975 from the Kitengela Conservation Unit. Masai warriors have killed 90 lions with spears since 1998 in response to attacks on livestock		Ogutu 2005
		Mbirikani Group Ranch	Since 2001, lions have taken 0.01% of cattle		Frank *et al*. 2006
		Tsavo National Park	On ranches near the park, predation accounted for 2.6% of the herd, estimated economic value and cost the ranch US$8,749 per annum. Each lion cost ranchers US$290 per year	1898: 140 workers killed	Patterson *et al*. 2004
	TANZANIA	Countrywide		Since 1990, lions have killed 563 Tanzanians and injured at least 308. 120 lion attacks a year	Packer *et al*. 2005
				200 people killed every year by dangerous animals, a third by lions	Baldus 2004
		Greater Tarangire-Manyara	Between 2000–2005, 125 lions killed apparently in response to predation on livestock		Frank *et al*. 2006
		Ngorongoro Conservation Area	Between 1998–2004, 35 lions killed apparently in response to predation on livestock		Dennis Ikanda *in* Frank *et al*. 2006
		Selous Game Reserve		15–30 people killed each year. On the edge of Selous Game Reserve, 29–50 people killed per year since 1990	V. Booth pers. comm., Strang, 2002
		Southern Tanzania		35 people killed by 1 or 2 lion over 20 months in area of 350 km² just 150 km south-west of Dar-es-Salaam	Baldus 2004
				High level of incidence of man-eaters in the region. During the 1930s, in Njombe district, lions killed 1,500 people in a 150 square mile area over 15 years. In 1999, 21 people killed by lions	V. Booth pers. comm., J.J. Jackson pers. comm.
	UGANDA	Queen Elizabeth National Park	Between 1990 and 2000, near the Park, losses caused by lion predation on livestock estimated at US$6,400	275 humans attacked by lions between 1923 and 1994; 74.9% fatal; 25.1% lead to injuries	Bauer & De Iongh, 2001

REGION	LION RANGE STATES	SITES	PREDATION ON LIVESTOCK	ATTACK ON HUMANS	REFERENCES
SOUTHERN AFRICA	BOTSWANA	Makgadikgadi	Livestock losses not spread homogenously. People living nearer the protected area lost more livestock than those further away		Hemson 2003
	MOZAMBIQUE	Niassa Province		1997–2004: 3 people killed	Anderson 2005
		Niassa National Reserve	Livestock depredation by large carnivores is not a major problem; few small ruminants and absence of cattle	Since 1974, at least 73 lion attacks with minimum of 34 people killed and 37 injured. In the last 6 years, 11 people killed and 17 injured	Begg, Begg & Muemedi 2007
				1987–2006: at least 9 people killed and 6 injured	Anderson 2005
		Cabo Delgado Province		1997–2004: 48 people killed	Anderson 2005
				Escalation in lion attacks, particularly on Mueda plateau; 70 people killed in 2000-2001; 46 people killed in 2002-2003 on Makonde plateau	Begg, Begg & Muemedi 2007
		Gaza province, around Limpopo National Park		1997–2004: 3 people killed	
		Maputo province	In December 2004, lions from Kruger National Park killed 18 head of Brahman cattle	1997–2004: 3 people killed	
		Nampula Province		1997–2004: 3 people killed	
		Sofala Province		1997–2004: 1 person killed	
	NAMIBIA	East Caprivi National Parks	Between 1991 and 1994, lion depredation around the park totalled US$70,570		O'Connell-Rodwell *et al.* 2000
		Etosha National Park	Along the borders of the park, 46 cattle, 13 goats, 8 donkeys and 3 horses were killed by lions between 1984 and 1988		Stander 1990
		Kwando Region in East Caprivi	The cost of stock raiding by lion between 1991 and 1993 totalled US$9,073		
		Tsumkwe District	Between January 1992 and December 1993, livestock were killed on 17 occasions; 20 cattle and 5 horses (12.2% of total) were killed; 40% of villages of the Tsumkwe district were affected		Stander 1997
	SOUTH AFRICA	Kruger National Park	8 cattle killed by lion between 1996 and 1997 in the village of Makoko		Cat News 1997
				Between December 1996 and August 1997, at least 11 illegal immigrants making their way from Mozambique were killed by lions	Cat News 1997
				In March 2002 another Mozambican immigrant was killed by a lion close to Phalaborwa	Wildnet Africa 2002
	ZAMBIA	Countrywide	3 cases from 2001 and 2005; 13 cattle killed	31 human/lion conflict complaints from 2001 to 2005; 3 people wounded and 10 killed; 13 lions removed as PAC and 1 killed by locals	Lion range states inquiry, FAO 2007
		Countrywide	1970-1985: 83 lions shot as probem animals. 2005–2007: 7 threats or livestock killing reports; 31 goats lost; 3 lions controlled.	2005–2006: 7 people killed, 5 injured and 11 threats; 12 lions controlled; 4 lions controlled for unspecified reasons	International Conservation Services & Viljoen 2006
		Luangwa Valley	Predation on livestock occurs countrywide	August 1991: three people killed by lion	Times of Zambia Nov. 2005
	ZIMBABWE	Countrywide	On communal lands, 1.2% of cattle and 3.4% of goats were taken by predators		Butler 2000
		District of Nyaminyami	1999, 2000 and 2001: 32 incidents reported, with observed losses of 50 goats, 13 donkeys and 1 lion destroyed per year. 10 incidents per lion destroyed		Chamoko Snodia pers. comm.
		Gokwe Communal Area	Between January 1993 and June 1996, 82 livestock, small and large, killed by lion		Butler 2000

Appendix 2. Some legal aspects of people's defence against wildlife damage

In most lion range countries, wildlife laws address the protection of people from wildlife damage, tacitly including lion attacks. Wildlife laws are quoted here from:

- Republic of Cameroon
- Central African Republic
- Republic of Côte d'Ivoire
- Republic of Mali
- Republic of Mozambique
- Republic of Niger
- Republic of Senegal
- United Republic of Tanzania
- Republic of Zambia
- Republic of Zimbabwe

The laws in respect of human/wildlife conflict are remarkably homogeneous. In all ten countries:

- there is at least one law article related to the defence of human life and property from wildlife attacks;
- the principle of self-defence is considered legitimate and legal, whatever category the culprit animal comes from and whether protected or non-protected;
- when a culprit animal is killed, the case must be reported to the wildlife authority with slight differences between countries in terms of delay to report: immediately in Niger; within three days in Cameroon; within 14 days in Zambia; and
- differences exist among the countries in terms of beneficiaries from the meat or trophies from the animals killed: in Cameroon and Senegal the victims benefit; in Niger and in Zambia the state is the beneficiary.

In many lion range countries, a cattle herder is legally allowed to kill a lion in defence of his life, the life of another person or of his livestock. The legal context may be seen from two perspectives:

> (i) Because communities are most exposed to lion damage, it is appropriate that the killing of a culprit animal by the offended stakeholder is not an offence. It is also relevant that communities are often the quickest stakeholders to react to lion attacks, usually with the best chance to target the culprit.
> (ii) Leaving a stakeholder to solve the problem by himself without any control, from assessing the damage to punishing the culprit, raises concerns about potential abuses such as biased evaluation of damage and over-reaction by killing non-culprit lions.

The question remains of control by non-involved parties with the ability to react quickly, accurately and efficiently. There is no single response to this question because of the huge diversity of situations; some of the largest differences in this respect lie between pastoral societies and non-herder communities.

Republic of Cameroon

Décret N° 95/466/PM du 20 juillet 1995 fixant les modalités d'application du régime de la faune

Titre II - De la protection de la faune et de la biodiversité

Chapitre I - De la conservation de la faune

Section III - De la protection des personnes et des biens

Article 13 -

(1) Conformément à l'article 83 de la Loi, nul ne peut être sanctionné pour fait d'acte de chasse d'un animal protégé, commis dans la nécessité immédiate de sa défense, de celle de son cheptel domestique et/ou de celle de ses cultures.

La preuve de la légitime défense doit être fournie dans un délai de soixante-douze (72) heures au responsable de l'Administration chargée de la faune le plus proche.

Titre III - De la gestion de la faune

Chapitre IV - Des produits de la faune

Section I - De la récolte et de l'exploitation des produits fauniques à des fins artisanales

Article 62 -

(1) La viande provenant des animaux abattus par suite de battues administratives ou pour nécessité de défense revient aux populations locales victimes et, en partie, aux chasseurs bénévoles.

Central African Republic

Code de protection de la faune sauvage

Ordonnance N° 84.045 – Portant protection de la faune sauvage et réglementant l'exercice de la chasse en République Centrafricaine

Titre II - De la Chasse

Chapitre V - Défense des biens et des personnes

Art. 95 : Les propriétaires ou usagers ont le droit de repousser de leurs terres les animaux qui feraient courir à leurs bétail et culture un danger immédiat.

Art. 97 : En toute hypothèse, les propriétaires ou usagers mentionnés à l'article 95 ci-dessus, ou bien l'autorité ayant ordonné une battue administrative adresseront au Ministre chargé de la faune, un rapport faisant apparaître les motifs de la battue, les noms des personnes, agents ou auxiliaires y ayant participé, le nombre exact, espèce par espèce, et les caractéristiques des animaux tués appartenant aux espèces intégralement ou partiellement protégées, la mention des autres animaux s'il y a lieu.

Titre IV - De la répression

Chapitre I - Des Peines

Art. 116 : Le fait d'abattre ou de blesser un animal de quelque espèce et quelque lieu ne peut constituer une infraction aux dispositions de la présente Ordonnance, dès lors que l'auteur de l'acte a agi pour la défense immédiate de sa propre personne ou d'autrui.

Republic of Côte d'Ivoire

Législation de la chasse et de la protection de la nature – Avril 1968

Loi N° 65-255 du 4 août 1965

Titre III – Chasse et capture

Chapitre VIII – Protection des personnes et des biens – Légitime défense

Art. 22 – Aucune infraction ne peut être relevée sauf provocation préalable des animaux contre quiconque a fait acte de chasse indûment, mais dans la nécessité immédiate de sa défense ou de celle d'autrui ou de la protection de son bétail domestique ou de sa propre récolte. En cas d'abattage d'un animal intégralement protégé, la preuve de la légitime défense doit être fournie dans les plus brefs délais, aux agents de l'Administration.

Republic of Mali

Loi N° 95-031 fixant les conditions de gestion de la faune sauvage et de son habitat

Titre III - Gestion du domaine faunique

Chapitre IV - Protection des personnes et des biens

Article 108 : Aucune infraction ne peut être retenue contre quiconque a fait acte de chasse dans la nécessité absolue de sa défense, de celle d'autrui ou de ses biens.

Republic of Mozambique

Lei N° 10/99 de 7 de Julho 1999 : Lei de Florestas e Fauna Bravia

Capitulo IV – Regimes de Exploração Sustentável dos Recursos Naturais

Artigo 25 : Caça em defesa de pessoas e bens

1. A caça fora das modalidades previstas na presente Lei só é permitida em defesa de pessoas e bens, contra ataques actuais ou iminentes de animais bravios quando não seja possível o afugentamento ou captura.

2. A caça referida no presente artigo é exercida prontamente, após o conhecimento dos factos, pelas brigadas especializadas do Estado ou pelo sector privado e pelas comunidades locais devidamente autorizadas.

Decreto n12/2002 Aprovando o Regulamento da Lei n° 10/99, de 7 de julho, Lei de Florestas e fauna Bravia

Capitulo IV – Exploração Sustentável da fauna bravia – Secção VI : Caça em defesa de pessoas e bens

Artigo 68 : Requisitos

1. São requisitos necessários ao exercício da caça em defesa de pessoas e bens, os seguintes:

A existência de um ataque actual ou iminente de animais bravios contra pessoas ou bens;

A impossibilidade de afugentamento.

2. Para efeitos do presente regulamento, considera-se que existe um ataque actual, quando um ou mais animais bravios estejam a perseguir ou a atacar pessoas ou bens; e considera-se que existe um ataque iminente, quando um ou mais animais bravios estejam a dirigir-se ou entrar em propriedade ou habitação, com fortes indícios de que estes poderão atacar pessoas ou os bens lá existentes.

3. Para os efeitos referidos no numero 1, considera-se impossibilidade de afugentamento, quando se trate de animais considerados perigosos, ou de outros que não sendo perigosos, não se afugentarem após a utilização dos meios considerados normalmente, como de afugentamento para aquela espécie.

4. Deve entender-se por bens, a vida humana, as culturas agrícolas, os animais domésticos, as habitações, os veículos e outros meios de valor económico ou social relevantes.

5. A caça referida neste artigo não está sujeita a períodos de defeso e bem assim, às limitações atinentes às restrições de exercício de actividades de caça.

Artigo 69 : Entidade competente

1. São competentes para o exercício da caça em defesa de pessoas e bens, as brigadas specializadas constituídas pelos fiscais e outros funcionários do sector, agentes comunitários, os fiscais ajuramentados, caçadores guias e os caçadores comunitários;

2. Para efeitos do número anterior, os fiscais ajuramentados, os caçadores guias e os caçadores comunitários, poderão junto dos Serviços Provinciais de Florestas e Fauna Bravia, requerer que lhes sejam autorizado a exercer caça em defesa de pessoas e bens.

3. O exercício da caça em defesa de pessoas e bens não é remunerado, devendo todos os intervenientes locais mobilizar meios para a sua efectivação, quando solicitados pelos serviços ou entidades competentes referidos no n.° 1 deste artigo.

Artigo 70 : Caça em defesa de vidas humanas

A modalidade de caça referida nos artigos antecedentes, quando em defesa de vidas humanas, poderá ser feita por qualquer indivíduo, com ou sem licença, contanto que se achem preenchidos, os requisitos previstos no artigo 60 deste Regulamento, devendo comunicar, posteriormente, tal facto aos Serviços ou Autoridade Administrativa mais próximos, num prazo não superior a 48 horas, salvo a ocorrência se registar em zonas remotas caso em que o prazo poderá ser justificadamente dilatado.

Artigo 71 : Abuso da caça em defesa de pessoas e bens

Todo aquele que não estando autorizado, ou que alegue caça em defesa de pessoas e bens sem que estejam reunidos os requisitos legais para o efeito, e por consequência capturar, abater ou ferir espécie de fauna bravia, será autuado por caça sem licença ou em desacordo com as condições legalmente estabelecidas.

Artigo 72 : Destino dos produtos

Os despojos resultantes dos animais bravios abatidos nos termos dos artigos antecedentes, quando considerados sanitariamente próprios para o consumo, serão distribuídos gratuitamente às comunidades locais respectivas, depois de retirada uma parte para o pessoal envolvido na caça.

Artigo 73 : Regulamentação

Compete aos Ministros da Agricultura e Desenvolvimento Rural e do Turismo estabelecer, por diploma ministerial conjunto, as demais normas de aplicação e exercício da caça em defesa de pessoas e bens, bem como as condições para os abates resultantes do maneio e desequilíbrio ecológico.

Republic of Niger

Document fixant réglementation de la chasse et de la protection de la faune – 29 avril 1998

Chapitre III – Protection des personnes et de leurs biens

Art. 29 : Aucune infraction ne pourra être retenue contre quiconque aura fait un acte de chasse dans la nécessité immédiate de sa défense ou de celle d'autrui.

Dans tous les cas, la preuve de la défense doit être immédiatement faite aux responsables de l'Administration chargée de la faune la plus proche qui récupère les dépouilles et trophées au profit de l'état.

Republic of Senegal

Loi N° 86-04 du 24 janvier 1986 portant Code de la chasse et de la protection de la faune (partie législative)

Titre premier - Principes généraux

Article L. 5 : Aucune infraction ne peut être relevée contre quiconque a fait acte de chasse indûment lorsqu'il se trouve dans la nécessité immédiate de sa défense, de celle d'autrui ou de celle de son propre cheptel domestique ou de ses cultures ou récoltes.

La preuve par tous les moyens du cas de légitime défense doit être fournie dans les plus brefs délais aux agents habilités de l'administration ou aux lieutenants de chasse.

Décret N° 86-844 du 14 juillet 1986 portant Code de la chasse et de la protection de la faune (partie réglementaire)

Titre II - De la protection de la faune

Chapitre 6 - Protection des personnes et des biens

Article D. 49 : Battues administratives…La viande des animaux abattus est laissée sur leur demande aux habitants des localités ayant subi les dommages.

Ordonnance N° 007/PRG/SGG/90 du 15 février 1990 portant Code de la protection de la faune sauvage et réglementation de la chasse

Titre quatrième - Réglementation de la chasse

Chapitre VI - Infractions et pénalités

Article 151 : Aucune infraction ne peut être relevée contre quiconque fait acte de chasse indûment lorsqu'il se sera trouvé dans la nécessité immédiate de sa défense, de celle d'autrui ou de celle de son propre cheptel domestique ou des ses cultures ou récoltes.

Clear policies on dealing with human/wildlife conflict set out the options that can be implemented by farmers and communities. To be effective, policies need to include a definition of the roles of the community and the authorities responsible for wildlife, and guidelines on human/wildlife conflict and the means of measuring its extent (WWF, 2005).

United Republic of Tanzania

Act to repeal and replace the Fauna Conservation Ordinance, to make provision for the protection, conservation, development, regulation and control of Fauna and Fauna products and for matters incidental thereto and connected therewith – 30th July, 1974

Part IV - Hunting, capturing and photographing of animals

(d) Miscellaneous provisions relating to hunting

Killing animal in defence of life or property allowed

50 – (1) Nothing in this Act shall make it an offence to kill any animal in defence of human life or property or for the owner or occupier of such property or any person dependent on or employed by such owner or occupier to drive or kill by any means what-so-ever any animal found causing damage to such property…

The Wildlife Policy of Tanzania – March, 1998

3.0 The Wildlife policy

3.3.12. Solving human-wildlife conflicts…..

Strategies for solving human-wildlife conflicts:

(ii) … devolving progressively the responsibility for problem animal control to rural communities operating CBC programmes and continuing to give assistance where rural communities have not developed this capability.

Alternatives strategies: In the long term, alternative strategies to reduce the conflict between people and wildlife will be explored. Possibilities include incorporating numbers of animals that are not shot under problem animal control into hunting quotas that can provide greater economic benefits to rural communities.

Republic of Zambia

The Zambia Wildlife Act, 1998

Part IX – Killing, wounding or molesting wild animals

Self-defence

78. (1) Notwithstanding anything to the contrary in this Act, a person may kill any wild animal in defence of himself or in defence of any other person if it is necessary.

Defence of property

79. … may kill any game animal, non-game animal, protected or non-protected animal which is identified as causing or has caused material damage to that land, building, crops or livestock, as the case may be and a report shall be made to the nearest proper officer, village scout or honorary wildlife police officer.

Game or protected animals killed through accident or error

80. (1) If any person kills any game animal or protected animal through accident or error, the person shall, within a period of fourteen days, make a report of the facts to the nearest proper officer, village scout or honorary wildlife police officer and shall hand over to the proper officer, honorary wildlife police officer or village scout the carcass, or any trophy or meat of the animal as the officer or village scout may direct.

Republic of Zimbabwe

Parks and Wild Life Act, Revised edition 1996

Part XII – Hunting, removal, viewing and sale of animals and animal products

61. Killing or injury of animals in self-defence

(1) Notwithstanding this Act, it shall be lawful for any person to kill or injure any animal on any land in defence of himself or any other person if immediately and absolutely necessary.

(2) The burden of proving that any animal has been killed or injured in accordance with subsection (1) shall lie on the person who killed or injured such animal.
