Assessment of the human wildlife conflict mitigation measures being implemented by the Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA) Partner Countries

Final Report

to the

KAZA TFCA Secretariat

(BMZ NO.: 2009 66 788 AND BMZ NO.: 2006 65 646)

September 2016 **Ver 6.5**

CONNECTED CONSERVATION
758 Aerodrome P.O. Box 37,
Victoria Falls, Zimbabwe
Tel. +263 13 46672
www.connectedconservation.com

CONNECTED CONSERVATION

Cite as:
Karidozo, M, La Grange, M & Osborn, F.V. (2016) Assessment of the human wildlife conflict mitigation measures being implemented by the Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA) partner countries. Report to the KAZA TFCA Secretariat (BMZ No.: 2009 66 788 and BMZ No.: 2006 65 646), Kasane, Botswana.

EXECUTIVE SUMMARY

Human wildlife conflict (HWC) is arguably one of the most pressing conservation issues across the Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA) where a significant number of people live in areas that abut wildlife range. If KAZA TFCA is to be successful, accepted and adopted by stakeholders, particularly communities throughout the TFCA, finding ways to reduce HWC and promote human-wildlife coexistence is a prerequisite. Managers and or communities attempting to reduce crop and livestock damage by wildlife encounter a range of complex technical and social issues. This draft report to the KAZA TFCA Secretariat details an assessment of the HWC mitigation tools in use across the KAZA TFCA.

The objective of this consultancy was to review and recommend the most effective, efficient and sustainable HWC mitigation measures for adoption within the KAZA TFCA by the partner countries. We suggest partner countries focus HWC efforts in and around the five-wildlife dispersal areas (WDAs) that the secretariat are considering giving protection and resources toward. While some hotspots will fall outside these areas, they will nevertheless be useful for countries to prioritise efforts in the context of KAZA. This review also included the partner countries' HWC policies, which need standardising for effective and sustainable HWC mitigation within the KAZA TFCA.

Methodological approaches used include interviews with several local and traditional authorities, the KAZA Liaison Officers (KLOs) as well as other stakeholders. The consultants explored these at community, district, provincial and national levels to determine the methods in use and their effectiveness in key HWC hotspots. Furthermore, this enabled an understanding of constraints and concerns at the various levels concerning implementation of the methods. Expert review of the available HWC literature and related reports from various practitioners in the region and beyond was a vital tool in coming up with the current thinking in HWC management. The consultants also reviewed conflict hot spots, possible movement corridors of wildlife and investigated the spatial patterns of conflict using Geographic Information System (GIS) techniques and most importantly by reviewing available literature on these aspects. Using ranking and scoring techniques, the consultants evaluated the effectiveness of the conflict mitigation methods and the rate of adoption or uptake of current methods giving an indication of the sustainability of some of these measures. However, in the absence of a consolidated HWC database in an electronic format across the partner countries, we relied on a more subjective identification of hot spots through consultation with management authorities and stakeholders operating on the ground. The consultants verified these hotspots using available Problem Animal Control (PAC) data at local, national or regional offices using triangulation and cross validation methods.

We assessed the self-reliance scheme for loss of property (crops and livestock) due to wildlife depredation such as the Human Wildlife Self-Reliance Scheme (HWSRS) in Namibia by evaluating the system through a Strengths Weaknesses Opportunities Threats (SWOT) analysis. We evaluated all the frameworks and processes of the system to provide recommendations for replication or adaptation of the scheme to other partner countries. An evaluation of Botswana's compensation scheme using the same methodological approach completed the task.

Findings

- HWC is increasing in all the partner countries.
- Most common types of conflict across the KAZA landscape are ranked as crop and property damage by wildlife, and human and wildlife death, or injury.

- Traditional[1] methods of deterring wildlife are the most common ways of mitigating conflict.
- Lack of capacity (knowledge and resources) to mitigate all the conflict that is prevalent across all the partner countries.
- Most problematic wildlife identified and ranked were elephant, lion and hyena followed by crocodile and hippo.
- Most current mitigation methods are not sustainable, have less efficacy and are not cost effective
- The HWCSRS is an effective insurance scheme model that needs adoption elsewhere as a strategy to help address HWC.
- It is not easy to replicate the HWCSRS in other partner countries unless several fundamental conditions, principles and policies are prevailing in these countries.
- In most of the partner countries, monitoring and evaluation systems of HWC do not exist and where they are available, they need robust upgrading.
- There is no absolute or single solution to HWC. Reducing the intensity of this conflict is vital-, i.e. the aim should be mitigation and management not elimination. A holistic approach that addresses root causes over the long term as well as short-term mitigation.
- Controls directed against animals (e.g. disturbance, killing, translocation, species culls and long game-proof fences) are far less successful than more positive measures directed at people (e.g. Community Based Natural Resources Management (CBNRM) programmes, land use planning and zoning, and promoting community awareness).

Recommendations

- Aim to reduce HWC and not solving it completely through a number of suggested tools specific for each problem animal species and directed at positive incentives for people.
- Compliment current mitigation tools by adapting some of the suggested measures.
- Need to capacitate communities and resource persons who work directly on mitigating the conflict.
- Improve the efficacy, sustainability and cost effectiveness of mitigation tools by constant improvement, innovation and changing of the tools to discourage habituation by wildlife and adapt them to suit local conditions.
- Partner countries should implement both short and long-term management strategies that address the causes of HWC in order to ameliorate conflict.
- Partner countries should improve the collection; collation and reporting of conflict data by implementing a standardized reporting format (see suggested synthesis of various methods currently in use).
- Policy harmonization is vital particularly where shared natural resources are in use.
- Need to develop a KAZA region HWC mitigation strategy that aims at reducing conflict and improving people's livelihoods.
- Communities facing crop and livestock damage from wildlife need alternative ways to cushion themselves from the vagaries of HWC.

We believe that this report will be useful to the governments of the five partner countries and particularly wildlife departments and hope it will help them to develop a regional HWC mitigation strategy. This is critical for long-term success in the conservation and management of wildlife, natural resources and uplifting the livelihoods of people living side by side with wildlife in this region.

[1]'Traditional' deterrents are those that have been devised and carried out by rural communities living alongside wildlife. They generally utilise low-tech materials that are widely available.

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ACKNOWLEDGEMENTS

The compilation of this report stems from the initiatives of the five partner countries that form the Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA). The authors would like to thank the partner countries, KAZA TFCA Secretariat and the German Development Bank for funding and supporting this initiative. We would also want to extend our thanks to Peace Parks Foundation who are the contracting party and for providing many of the maps used in this document. Many thanks to the participants of the many meetings, tele-conferences, e-mails and workshops whose efforts provided a framework for this document. In addition, we thank the many experts, practitioners and communities within the KAZA TFCA network and beyond, who have contributed vital information and insight in the production of this report.

ACRONYMS

ACE	Ambush Chilli Educator
AfESG	African Elephant Specialist Group
BAM	Butorphenol, Azaperone and Medetomidine
BOCOBONET	Botswana Community Based Organisations Network
CAMPFIRE	Communal Areas Management Programme for Indigenous Resources
CARACAL	Centre for Conservation of African Resources
CBCM	Community Based Conflict Mitigation
CBC	Community Based Conservation
CBD	Convention on Biological Diversity
CBNRM	Community Based Natural Resources Management
CBO	Community Based Organization
CCTV	Closed Circuit TV
CDC	Constituency Development Committee
CHA	Controlled Hunting Area
CTA	Conditioned Taste Aversion
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DDC	District Development Committee
DWNP	Department of Wildlife and National Parks
EPDT	Elephant Pepper Development Trust
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environmental Fund
GIS	Geographic Information System
GLTP	Great Limpopo Transfrontier Park
GMTFCA	Greater Mapungubwe Transfrontier Conservation Area
GPS	Global Positioning System
HACSIS	Human Animal Conflict Self Insurance Scheme
HWSRS	Human Wildlife Self Reliance Scheme
HCC	Human Crocodile Conflict
HEC	Human Elephant Conflict
HWC	Human Wildlife Conflict
HWCSRS	Human Wildlife Conflict Self-Reliance Scheme
IRBM	Okavango Integrated River Basin Management Project
ISPAAD	Integrated Support Programme for Arable Agricultural Development
IUCN/SSC	The World Conservation Union/Species Survival Commission
IWRM	Integrated Water Resources Management
KAZA TFCA	Kavango-Zambezi Transfrontier Conservation Area
KfW	Kreditanstalt für Wiederaufbau
KLO	KAZA Liaison Officer
LED	Light Emitting Diode
LUCIS	Land Use Conflict Identification Strategy
MET	Ministry of Environment and Tourism
MOU	Memorandum of Understanding
NAP	National Action Plan
NGO	Non-Governmental Organization

NBHWC	Northern Botswana Human Wildlife Coexistence (Project)
ODMP	Okavango Delta Management Plan
OERP	Okavango Elephant Research Project
ORI	Okavango Research Institute
PA	Protected Area
PAC	Problem Animal Control
PPF	Peace Parks Foundation
SADC	Southern African Development Community
SAREP	Southern African Regional Environmental Project
SMS	Short Message Service
SWOT	Strengths Weaknesses Opportunities Threats
USD	United States Dollar
TFCA	Transfrontier Conservation Area
TNA	Training Needs Assessment
VDC	Village Development Committee
WCP	Wildlife Conservation Policy
WDA	Wildlife Dispersal Area
WMA	Wildlife Management Area
ZAWA	Zambia Wildlife Authority

1. INTRODUCTION

The governments of Angola, Botswana, Namibia, Zambia and Zimbabwe agreed to establish a Transfrontier Conservation Area (TFCA) known as the Kavango-Zambezi TFCA, also known as the KAZA TFCA. The KAZA TFCA is a development project of the Southern African Development Community (SADC), the Governments of five partner countries and co-financed by the Federal Republic of Germany through Kreditanstalt für Wiederaufbau (KfW). In December 2006, the governments of the five countries signed a Memorandum of Understanding (MOU) regarding the establishment of the KAZA TFCA, with the formal establishment on 18 August 2011, when the governments of the partner countries signed a treaty in Luanda, Angola. The TFCA covers about 520,000 square kilometres of land spanning across the international boundaries of Angola, Botswana, Namibia, Zambia, and Zimbabwe, linking conservation areas that constitute protected national parks, wildlife management areas, forest reserves, communal lands and settled areas (Figure 1). The landscape is host to the largest contiguous population of the African elephant, about 250,000, and about one quarter of the African wild dog population as well as 3 iconic world heritage sites.

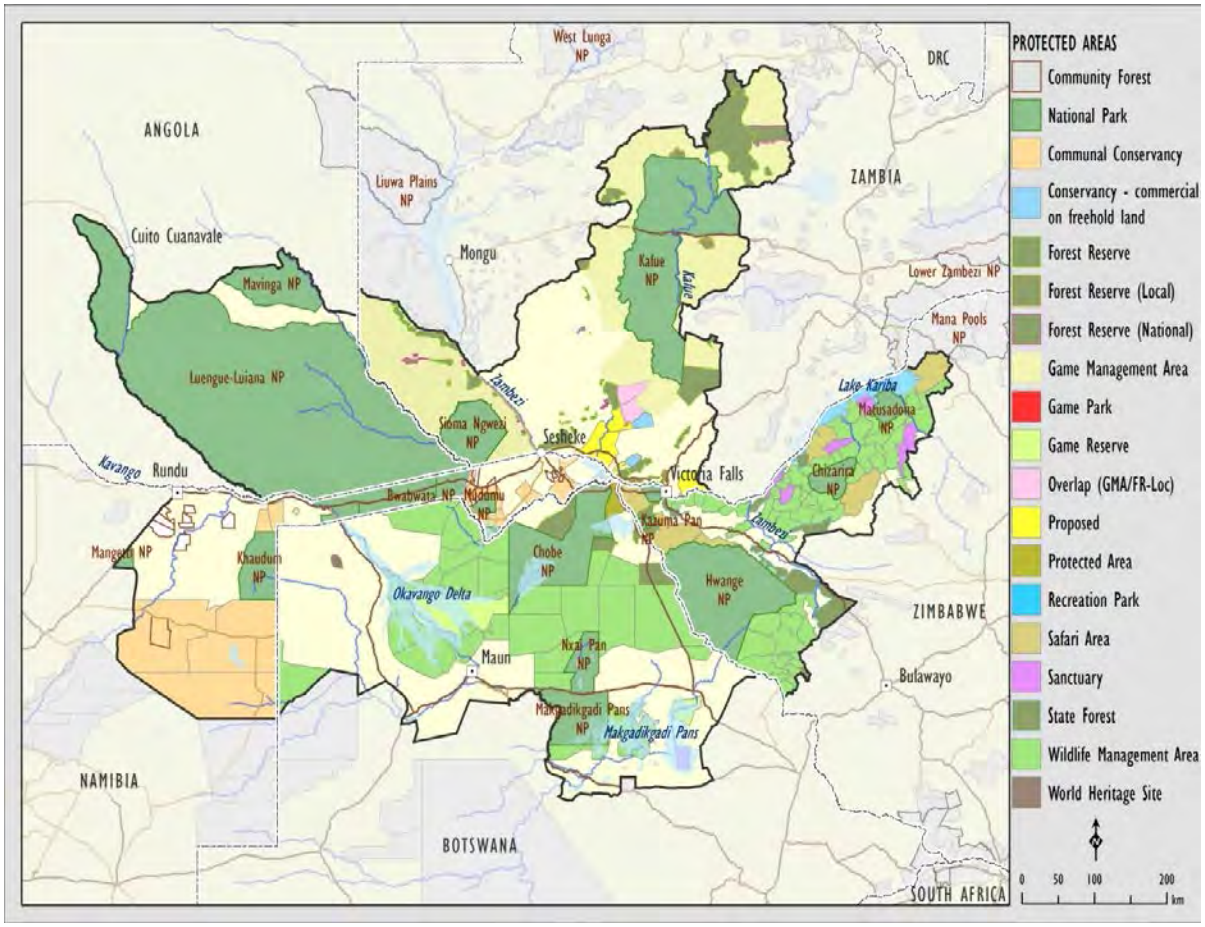


Figure 1: Map of study area (Source: KAZA Secretariat website www.kavangozambezi.org)

The vision of the KAZA TFCA is "To establish a world-class transfrontier conservation and tourism destination area in the Okavango and Zambezi river basins, supporting sustainable development in this region by 2030". The mission is "To sustainably manage the Kavango-Zambezi ecosystems, and its heritage and cultural resources based on best conservation and tourism models for the socio-economic well-being of the communities and other stakeholders in and around the KAZA region through harmonization of policies, strategies and practices."

Two categories form the KAZA TFCA objectives, namely: (a) ecological and (b) socio-economic. The former focus on protection of internationally shared ecosystems; increasing the area available for wildlife and plant populations; and re-establishment of transboundary seasonal wildlife dispersal routes; and the latter is concerned among others, with increasing economic opportunities for the local communities who often bear the opportunity cost of living with wildlife. The KAZA Treaty commits the governments, among other ideals, to:

a) "ensure co-operation at the national level among governmental authorities, communities, non-governmental organisations and the private sector;

b) co-operate to develop common approaches to natural resources management and tourism development and;

c) collaborate to achieve the objectives of relevant international agreements to which they are party and:

d) Develop and implement programmes that shall enhance the sustainable use of natural and cultural heritage resources to improve the livelihoods of local communities within and around the KAZA TFCA and thus contribute towards poverty reduction".

This document focuses mostly on those measures people living with wildlife in the KAZA landscape are currently using in managing conflict between people and wildlife, current policy options available and recommendations on cost effective and sustainable methods that people affected by this conflict can and may use to reduce the conflict.[2]

1.1. Background to the Consultancy

It is now widely recognized that humans have profoundly affected wildlife and the environment in many ways. This has manifested through habitat loss, pollution, introduction and spread of exotic and invasive species, overexploitation, and climate change. Human wildlife conflict (HWC) is a worldwide phenomenon and is a manifestation of the detrimental impact humans are having on the earth. While this conflict has existed since time immemorial, its intensity has increased in recent years. The driving forces behind this problem are many. Some of them include growth in the human population; increase in land usage to harness the land and its resources for economic activities and loss of the wildlife habitat. Migration of people because of shocks such as floods, droughts and civil unrest, direct persecution of wildlife due to perceived economic losses resulting from livestock predation or crop raiding; and an increase in wildlife populations (Graham, Berckerman and Thirgood, 2004).

According to the Food and Agriculture Organisation (FAO 2009), the impact of HWC is more serious in the tropics of the developing world than in the developed world because of these countries' greater dependence on livestock as a livelihood strategy and source of income. In the KAZA, there are at least four aspects of HWC, namely: (1) space conflict; (2) crop raiding; (3) death of humans; and (4) predation of livestock. In addition, conflict also occurs when there is general destruction of property by wild animals.

In the KAZA, where many rural people live in close proximity to wildlife, even one incident of property, crop or livestock loss can impose severe economic and livelihood hardship on individuals and families. It can also produce psychological and social costs that are unquantifiable or compensated. Such unquantifiable costs include the opportunity costs or the fear arising from potential attacks against oneself and one's property. In retaliation, humans

[2] **Source**: Terms of reference

usually shoot, poison, capture, injure or kill the animals. Such human induced mortality affects not only the population viability of some of the most endangered species, but also has broader environmental impacts on the ecosystem equilibrium and biodiversity preservation (Distefano, 2005).

Reconciling the need for re-establishing seasonal wildlife movements with the socioeconomic development aspirations of local residents is challenged by HWC, which is one of the most profound wildlife management problems facing the KAZA TFCA, inflicting damage to property (infrastructure, crops and livestock), and in some instances, loss of human life. HWC impacts species conservation, jeopardizes human livelihood and safety, and requires increased resources to mitigate.

A number of HWC mitigation measures are in use in the KAZA TFCA partner countries. Many of these are targeting single and multiple species, including implementation of innovative approaches to compensate/offset losses inflicted by wildlife, as in the case of the Human Wildlife Self-Reliance Scheme (HWSRS) in Namibia as well as using holistic management approaches that address the root causes of conflict alongside the immediate needs of farmers.

Irrespective of these efforts, stakeholders within the KAZA TFCA do not commonly understand the efficacy, cost-effectiveness and sustainability of these HWC mitigation measures. In view of this, the KAZA TFCA engaged the consultants to review the HWC mitigation strategies currently in use in the KAZA TFCA, including policies that provide frameworks for effectively and efficiently addressing HWCs and promoting harmony between biodiversity conservation and human development.

As multiple strategies are in use in the KAZA TFCA to mitigate HWCs and compensate losses inflicted by wildlife, the consultants had to objectively evaluate, rank and recommend an integrated approach to HWC mitigation. The task included reviewing mechanisms for compensating/off-setting losses, where applicable due to wildlife depredation, for adoption within the KAZA TFCA based on their efficacy, cost-effectiveness and sustainability (in terms of self-financing by the affected communities).

The consultants would also tap into experiences from other SADC countries (and possibly further afield, if there are relevant examples), and distil elements that would enhance strategies for sustainable HWC mitigation in the KAZA TFCA.

In the KAZA region, HWC varies according to geography, land use patterns, human behaviour, livelihoods, and traditions, and the habitat and behaviour of wildlife. There is a need for better understanding and awareness of the nature and complexity of factors contributing to HWCs in the five partner countries, including climatic factors, land use, agricultural practices and wildlife management initiatives as well as mitigation measures in use.

In the KAZA TFCA landscape, several factors and practices in recent decades have created favourable environmental conditions for most wildlife populations (particularly elephants) to stabilize with other reports indicating an increase in elephant numbers (Blanc *et al*., 2007) in countries such as Botswana and Namibia. In most of the landscape, there are currently underway enhanced government and private partner efforts to conserve and protect wildlife and their habitats. In support of “sustainable development”, there is recognition of the importance of the natural environment in the lives of communities living side by side with wildlife. However, these efforts may have incidental consequences of increasing human-wildlife interface and interactions, which need proper management to maintain a healthy balance between the need for socio-economic development and protection of the natural environment.

The partner countries (through the KAZA TFCA Secretariat) have long realized the growing urgency to address the problem of HWCs in all the respective countries. Through a number of initiatives (including the socio-economic survey conducted to date) they have also recognized that a comprehensive plan, based on available knowledge, must be designed if this conflict is to be reduced, human livelihoods enhanced and conservation succeed in the long run. Accordingly, the partner countries (through the Secretariat) have taken the initiative to engage the consultants to draft such a document to guide them in addressing HWC. This has culminated in the compilation of this working document that forms a guide on finding a long-term solution to this problem.

As such, prior, during and after the Project Inception meeting in September 2015 in Kasane, Botswana, the Consultants solicited information from various stakeholders to develop this report. Research identified the need to address urgently the growing severity of conflicts involving different wildlife species. These formal and informal meetings, consultations and literature review formed the basis of the several key findings and outputs. These outputs and the consultancy's terms of reference form the foundations of this report.

This document identifies several key considerations for the mitigation of HWC across the KAZA landscape and presents clear short and long-term mitigation and management measures and activities that improves the mitigation of HWC in the region. We humbly suggest and urge the responsible authorities should take on board the key highlights contained in the report, and provide required leadership by exploring and implementing appropriate and site-specific proposed strategies to help ameliorate HWC and improve local livelihoods. This is based on the three levels of addressing HWC, namely legal, institutional (wildlife authority, agriculture, land boards, etc.) and site level (technologies used to mitigate conflict).

1.2. A Global Historical Overview of Human - Wildlife Relations

The relationship between wildlife and rural people has, been historically antagonistic (Crosby, 1986). Either people engaged in subsistence hunting for food or the animals ate peoples' crops, killing livestock, or occasionally the people themselves. There are a few exceptions where a 'neutral' relationship exists, usually for religious or cultural reasons (Osborn, 1998). There are also a few examples where wildlife and humans living in close proximity co-exist, without conflict (Inamdar, 1996).

It is important to note, however, that not all interaction between people and elephants is negative (Graham, 2006). Many animals are valued as a source of protein and some large mammals are revered as religious symbols (Crosby, 1986). From old texts, it appears as if almost all wild animals are potential threats or competitors to people. It is apparent that birds of prey eat chickens and ducks, other birds eat grains, there is a general fear of most reptiles and most mammals will feed on either livestock or crops (Osborn, 1998). A variety of animals have been documented as in conflict with farmers, including birds, rodents, primates, antelopes, hippopotamus, bush pigs, predators and elephants (Bell, 1984). Eltringham (1980) aptly put it across when stating that '…wild animals that directly compete with humans for resources such as water or food quickly become a "problem animal…"

Fossil records show that the first hominids fell prey to the animals with which they shared their habitats and shelters. Forensic evidence has recently demonstrated that the "Taung skull", perhaps the most famous hominid fossil, which was discovered in South Africa in 1924, belonged to a child who was killed by an eagle two million years ago (Berger, 2006). San people rock art across Africa frequently portrays people fleeing from predators or other large animals and early nineteenth century historians describe areas in Africa and other parts of the

world where elephants invaded human cultivations, causing food shortages and leading to the displacement of settlements (Barnes, 1996).

While humans seem to have been the only ones on the receiving end of wildlife depredations, wildlife has also suffered human induced "persecution". Graham (2006) noted that the accounts of early European travellers and explorers in Africa indicated a conspicuous absence of elephants and other large mammals in some apparently suitable areas suggesting that hunting by indigenous Africans had contributed to localised extirpations (e.g. Neumann, 1898; Selous, 1881; Thomson, 1885). He further hypothesizes that the historical demand for ivory among the early civilisations of Rome, Egypt, China and India might have contributed to the extinction of elephants from Syria around the 4th Century A.D. and from the rest of North Africa by the 7th Century, citing Spinage (1994).

1.3. Domestication of Food the Genesis and Basis of Conflict

It appears as if ever since there has been agriculture, humans have lost crops and livestock to wild animals. Various authorities agree that Oldfather (1979) finds the earliest records of crop damage by elephants in ancient Egypt as the Greek historian Diodorous Siculus wrote around 80-20 BC and translated. The Sumerian farmers of antiquity prayed to Ninkilim, 'goddess of field mice and vermin in general' lest they harm the growing grain (Kramer, 1936, cited by Naughton-Treves, 1996). Sukumar (1989) wrote of Sanskrit texts from the 6th century BC that chronicled the devastation of the Anga Kingdom by wild elephants and other animals. Studies of dwelling sites of Neolithic man suggest that in addition to hunting, early humans ate a wide range of wild plants (Osborn, 1998).

These early humans presumably selected plants for their pleasant taste and 'sensory' value (i.e. plants low in deleterious chemicals and high in sugars). The first recorded cultivation of plants occurred in Iraq in approximately 7000 BC, the first crops domesticated being wheat and barley (Purseglove, 1972). Past studies do indicate that human selection of wild species for favourable traits to cultivate and breed has meant that many naturally occurring defence chemicals in plant tissue have disappeared or have been reduced in quantity through selective breeding (Parker *et al*., 2007). The changes that have resulted through the domestication of wild plants include the loss of adaptations such as spines or thorns, reduction in the development of fibrous tissues and improvement of palatability (Purseglove, 1972). As humans adopted a pastoralist way of life and began to cultivate, the relationship with wildlife changed as both these lifestyles altered the structure of the ecosystem in which they were conducted (Parker, 1984; Osborn, 1998). The presence of high densities of wildlife in pre-colonial Africa is one of the reasons that may have presented a major constraint to cultivation and livestock rearing (Barnes, 1996; Hoare, 1999; Parker & Graham, 1989; Graham, 2006).

The pre-colonial African landscape is often characterized as small, scattered human settlements existing in a 'sea of wildlife' (Parker & Graham, 1989; Graham, 2006). However, the arrival of Europeans and the establishment of colonial administration in Africa marked the beginning of a new phase in human-wildlife interaction (Graham, 2006). The coming of the early European settlers heightened hunting of wildlife and altered the spatial distribution of large mammals such as elephants. Graham (2006) argues that this is likely to have resulted in major transitions in the spatial occurrence of HWC as wildlife shifted their range beyond the intense hunting spheres of the European big game market. The creation of game laws and game departments effectively transferred responsibility for crop pest management from the local people living with large mammal pests such as elephants, buffalos and hippos, to the colonial authority (Graham, 2006). This complicated the management of HWC as the local people relinquished their former responsibility to the colonial establishment (now replaced by institutions such as the parks authorities), a situation prevailing to this day.

There are several definitions of HWC. Earlier the World Wide Fund for Nature (WWF, 2005) defined HWC as "any interaction between humans and wildlife that results in negative impacts on human social, economic or cultural life, on the conservation of wildlife populations, or on the environment." The 'Creating Co-existence' workshop at the fifth Annual World Parks Congress defined HWC in the context of human goals and animal needs as “HWC 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" (Madden, 2004). A review by the United States Geological Survey defines HWC in two contexts; firstly, actions by wildlife conflict with human goals, i.e. life, livelihood and life-style, and, secondly, human activities threaten the safety and survival of wildlife (Cline, *et al*., 2007). Messmer (2000) points out that the phrase human–wildlife conflicts describe situations that involve any negative interactions between humans and wildlife.

1.4. General Drivers of HWC across the KAZA-TFCA

(i) Increased settlement in wildlife range

Demographic and social changes place more people in direct contact with wildlife: as human populations grow, settlements expand into and around protected areas (IUCN, World Park Congress) as well as in urban and sub-urban areas. As the transformation of forests, savannah and other ecosystems into agrarian areas or urban agglomerates is a consequence of the increasing demand for land, food production, energy and raw materials. In Botswana, land transformation particularly into crop fields or cattle posts is another major driver of this conflict. Land apportionment seems to be problematic as is sometimes given in areas known to be conflict “hot spots”.

(ii) Habitat loss, degradation and fragmentation

Habitat destruction poses one of the greatest threats to wildlife survival outside protected areas (Smith & Kasiki, 2000) and consequently leads to conflict with people. Some wildlife (elephants) can tolerate relatively high densities of humans, and the two can coexist at many different densities (Hill, 1997). However, habitat conversion appears to be the critical factor. Previous research has indicated that when habitat destruction reaches a certain threshold, wildlife can no longer survive.

One of the underlying causes of HWC is habitat loss (Desai, 2002). Elephants and lions tend to have large home ranges with traditional migration routes. In the KAZA, their feeding grounds and migration routes are increasingly decreasing in size and quality by development and human settlements. The conversion of natural forests to farmlands has contributed to the loss of wildlife habitat and the lack of integrated land-use planning which leads to forest fragmentation aggravates the situation. This fragmentation of wildlife habitat results in pocketed herds/prides/packs, which may have to depend on crop raiding and or livestock destruction for survival. If, as often happens, forest fragmentation continues in an area, resident wildlife particularly elephants become squeezed into an ever decreasing forest patch, thereby increasing their density beyond the carrying capacity and placing a strain on the available resources. Ferguson & Hanks (2010) outline the roll fencing has had in habitat fragmentation and the continuing role fences have in driving conflict across the region.

(iii) Land use transformation

Land use planning and agricultural field allocation seems to be problematic as people are often given land in areas known to be conflict “hot spots,” such as in the eastern Okavango Panhandle (Songhurst 2012; Songhurst, McCulloch, and Coulson 2015). Zimbabwe’s land reform programme at the beginning of the millennium involved some people allocated land in formerly wildlife dominated landscapes making conflict with wildlife inevitable. In Zambia’s southern province, the proliferation of huge commercial farms in the early to mid-2000s along

the Zambezi River front transformed formerly wildlife habitat diverting traditional wildlife dispersal routes into human settlements increasing the propensity of conflict.

(vi) Increasing elephant population as a result of conservation programmes

Botswana is the country with the largest elephant population across all the African elephant range states and this population which stands at approximately 155,000 (Blanc *et al*., 2007) is known to be increasing. Namibia and Zimbabwe have seen their elephant populations marginally increasing as well over the years. Much of this increase in population is due to pro-conservation programmes implemented and supported by the Government, NGOs, and community-based organisations among other factors[3]. However, the major drawback has been the increase in conflict incidences.

(v) Climatic factors

Although not often mentioned, perhaps because people cannot control them, climatic trends are an important cause of HWC. Studies have shown that seasonal changes in rainfall correlates directly with HEC intensity in Kenya as well as Zimbabwe. The same trend is also noted in Botswana where a significant increase in conflict incidences during drought years particularly in the Chobe and Okavango Delta (D.G. Ecological Services 2003).

Stochastic (sporadic) events such as fire events are difficult to forecast and prevent, yet also have an impact on HWCs. For example, recent flooding of the Okavango River and subsequently the delta and the Makgadikgadi plains has led to a shift or alteration in the movement patterns of elephants thereby triggering conflict in some areas such as Boteti and Rakops in the Central District of Botswana.

Other causes of conflict include poor planning that includes; scattered lands, living adjacent to Protected Area (PA) boundaries, herding livestock within or too close to PA boundaries and a poor understanding of animal behaviour such as how animals approach or avoid human settlement, crops and livestock.

(vi) Ban on hunting and greater control over PAC (lethal control)

In the past hunting wildlife for sport or meat helped to keep conflict with problem animals under control. Hunting concessions used to maintain large areas of otherwise valueless bush through the provision of water points and management of PAC with human populations in these ranges. For example, due to the hunting ban in Botswana, waterholes maintenance has stopped in the hunting areas and wildlife has moved to communal lands with a massive increase in HWC. [4]

There is no doubt that the KAZA TFCA faces great challenges in the management of HWC. One important part of the solution to this problem is the development of environmental laws, particularly land use and wildlife laws, which are effective in preventing, deterring and mitigating HWC. To understand the shortfalls in HWC management for the KAZA TFCA countries, it is important to assess the policies dealing with this topic. Legislation and policy at global, regional and national levels provides the framework within which HWC management strategies are developed.

For example, the Ecoexist Project in the Okavango district of Botswana designed a schematic web that depicts the many facets and connectivity of the drivers of HWC with a major focus on HEC. It shows how several factors manifest in driving HEC from a local to international level and how the connectivity of such factors complicates the management of this conflict. While

[3] Such as immigration from neighboring countries

[4] http://www.nytimes.com/2015/09/13/world/a-hunting-ban-saps-a-villages-livelihood.html?_r=0 .

this illustration describes HEC in the eastern Panhandle, it can apply across the KAZA TFCA. Below is their illustration.

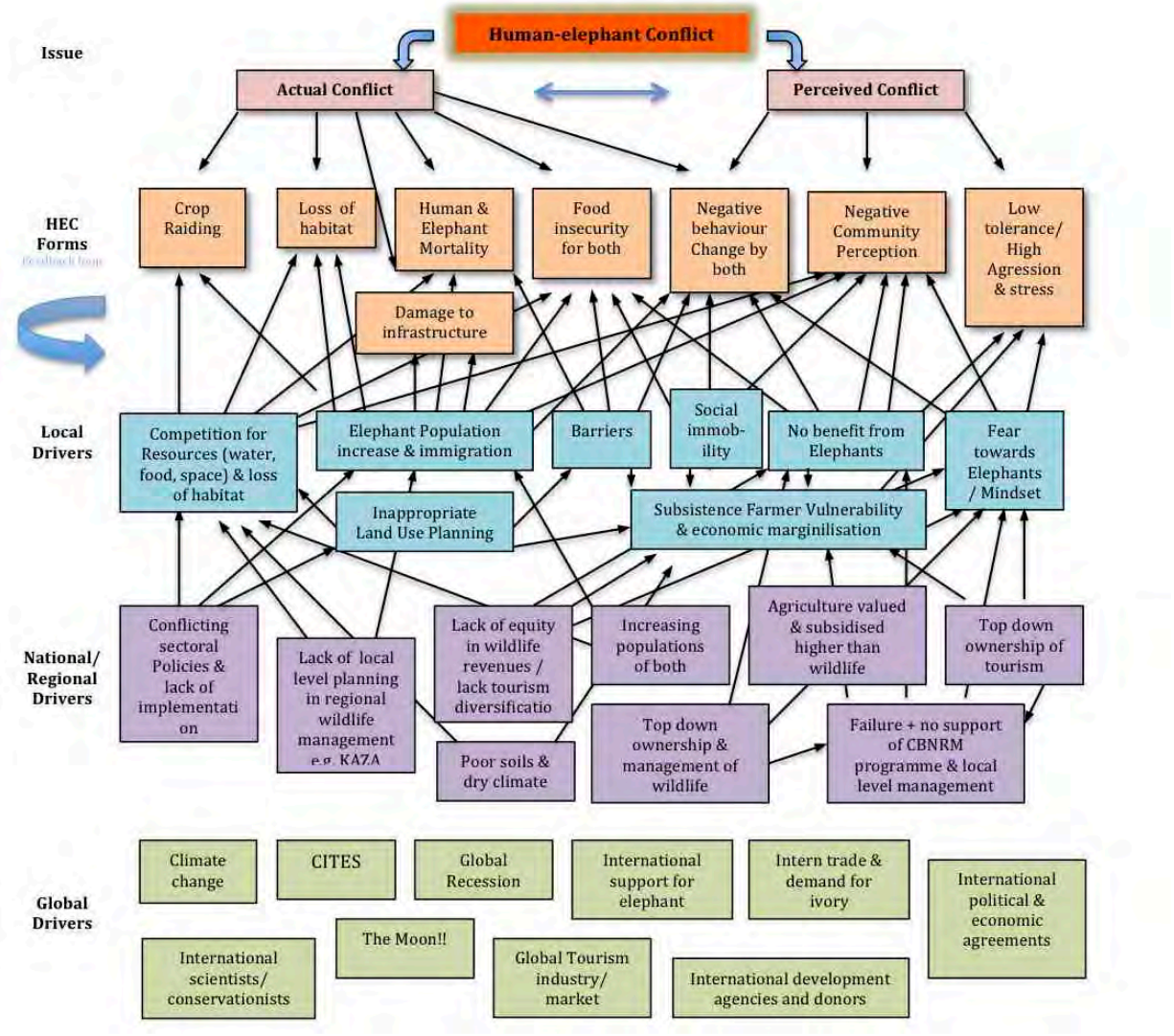


Figure 2. Types of HEC in the eastern panhandle and their drivers, identified at local, national and international levels. Driver intra (driver-driver) and inter-relationships (driver-HEC type) are illustrated using arrows. With permission: www.ecoexist.com.

1.5. Overview of human wildlife management policies in the KAZA TFCA

1.5.1. Global Level

Protection and use of wildlife's regulation at global level is through multilateral agreements such as the Convention on Biological Diversity. The three objectives of the CBD include conservation, sustainable use of biodiversity components (including wildlife) and fair, equitable sharing of benefits arising from the utilization of genetic resources (Article 1). Sustainable use is using biodiversity components in such a way and at a rate that does not lead to the long-term decline of the biological diversity thereby meeting the needs and aspirations of present and future generations (Article 2). The CBD obliges parties to cooperate with each other through relevant international agreements such as KAZA Treaty in matters of mutual interest like the management of HWC and in areas beyond national jurisdiction for the conservation and sustainable use of biological diversity.

1.5.2. Regional Level

The objectives of the CBD have found expression in regional protocols and treaties focusing on the conservation and sustainable use of biological resources such as the SADC Protocol on Wildlife Conservation and Law Enforcement of 1999, the KAZA Treaty, (Great Limpopo Transfrontier Park (GLTP) Treaty and the Greater Mapungubwe Transfrontier Conservation Area (GMTFCA). The SADC Protocol on Wildlife Conservation and Law Enforcement seeks, among other things, to promote the sustainable use of wildlife and facilitate community based natural resources management (CBNRM) which is a key strategy being implemented across all five KAZA TFCA countries to manage HWC.

1.5.3. National Level

The translation into action of regional protocols on wildlife in Angola, Botswana, Namibia, Zambia and Zimbabwe has in general sought to address wider governance issue of growing national economies. The local communities are involved in tourism ventures and the enfranchisement and empowerment of historically excluded poor rural communities living in or near wildlife sanctuaries where HWC is endemic. A section in the situational analysis of each partner country explains the national policies with a bearing on HWC.

2. METHODOLOGY USED IN THIS CONSULTANCY

In reviewing and analysing the HWCs in the KAZA TFCA, we used several methods. These include literature review and consultation with stakeholders. A number of field surveys were also undertaken. The field surveys were not extensive due to limited time as we interviewed field staff, local leadership, KAZA Liaison Officers (KLOs), Non-Governmental Organizations (NGOs) who are active practitioners in HWC mitigation projects and some experts in different fields related to HWC to explain status of conflict in different areas. The information gathering exercise employed a multi-sectoral approach of data collection. Both primary and secondary sources of data were in use while collecting the data from the relevant sources and stakeholders including interviews with respective government wildlife authorities, field reports, unpublished reports, published papers, books and other relevant reports. Where applicable, Geographic Information System (GIS) tools completed the identification of conflict hotspots in the region.

3. SITUATIONAL ANALYSIS

We explored the status of HWC in the partner countries and a brief illustration of the situational analysis findings are tabulated in Table 2 below. Appendix 3 details in full the HWC situational analysis of each partner country where the nature and type of conflict, the causes of conflict, past and current mitigation measures are described and explained in detail.

Table 1: HWC status in each partner country.

Country	Causes of conflict	Types and nature of conflict	Past conflict mitigation measures	Current conflict mitigation measures	Applicable policy
Angola	Elephants moving into Angola from neighbouring countries i.e. Zambia, Namibia as well as Botswana. Human encroachment. Subsistence agriculture along the main river. Lack of defence of crops and livestock by farmers. Lack of proper land tenure and planning. Human population rising at an annual rate of close to 4%. A limited recent experience of 'living with wildlife' and possibly a growing elephant density in the area	Crop damage Attack on livestock (cattle), Human deaths and injuries Damage of food stores	Traditional methods	Traditional methods e.g. fire, noise making	Angolan Constitutional Law (No. 23/92 of September 1992) Environmental Framework Act (No. 5/98 of 19 June 1999.
Botswana	Human population growth Land-use transformation Habitat loss, degradation and fragmentation Growing elephant population	Crop raiding Livestock depredations Spreading of foot and mouth disease from buffalo to cattle	Traditional methods Lethal control by PAC units	Securing key and sensitive wildlife areas such as corridors Guarding Land-use planning scale	Wildlife Conservation Policy Wildlife Conservation and National Parks Act and Associated Regulations

	Growing interest in ecotourism Increasing livestock populations Climatic factors and stochastic (e.g. flooding) events	Wildlife and human injuries and deaths		Provision of alternative water points for both communities/livestock Fences Repellence options such as chilli peppers Beehives	
Namibia	Settlement of wildlife corridors Scattered agricultural lands that are impractical to defend, Living in and adjacent to PA boundaries Herding livestock within or too close to PA Commuting between villages, Poor understanding of animal behaviour by local people Fishing and wild products harvesting Access to water by animals/ wild and domestic, *Molapo* farming (ploughing along a river flood plain).	Crop damage Livestock predation Damage to property e.g. fences Direct and perceived attacks on persons Conflict at water points and riverbanks	Predominantly lethal control using legal and illegal means. Toxicants. Steel leg hold traps. Direct hunting by MET or commercial operators. Other traditional methods	Land-use planning. Implementation of an integrated national policy on wildlife. Development of conservancies that help to offset the costs of living alongside PAs. Securing key and sensitive wildlife areas. Set up of defendable clusters of fields. Training of communities of new mitigation methods. Providing alternative water points for both communities/livestock.	Human wildlife conflict policy

				Exclusion fences Chemical repellent options[5]. Chilli growing, chilli grease, burning chilli bricks. Guarding Good crop minding. Translocation Limited lethal control. PAC/trophy hunting practiced	
Zambia	Occupation of corridors, Scattered agricultural lands, Living in WMAs and adjacent to PA boundaries, Herding livestock too close to WMAs, corridor and PA boundaries, Commuting between villages at night, Poor understanding of animal behaviour, Understanding how animals approach or avoid human settlement, crops and livestock, both during the day and at night, Desire for game meat.	Crop damage. Livestock killing and maiming. Damage to property both rural and urban. Direct and perceived attacks on persons. Challenges on game fences surrounding some wildlife enterprises	Predominantly lethal control that includes: Old firearms Toxicants Steel leg hold traps Traditional methods	Effective planning in some areas. Implementation of an integrated national policy on wildlife (on going). Securing key and sensitive wildlife areas such as corridors and core habitats. No direct compensation offered however, communities living in hot spots living in and against Setting up of individual defendable clusters of fields Training of communities, and trialling of plots with	Ostrich Export Prohibition, Chapter 115 of the Laws came into force on 16 March 1912 Plumage Birds Protection, Chapter 117 of the Laws came into force on 27 November 1915 National Parks and Wildlife Act Chapter 316

[5] Tests have been conducted with HATE 4-C and Capsicum oleo-resin

				low-tech mitigation methods Exclusion fences. Independent electrical poly wire with reflective streamers Niteguard™ LED lighting system. Chilli growing Chilli grease Burning chilli bricks Dogs to warn of intended challenges Explosive bangers and sound horns Destruction of specific dangerous animals	
Zimbabwe	Poor implementation of land-use plans Occupation of corridors, scattered lands, Living in and adjacent to PA boundaries Herding livestock within or too close to PA boundaries Commuting between villages at night Poor understanding of animal behaviour by	Crop damage Livestock killing and maiming Damage to property both rural and urban Direct and perceived attacks on persons	Most problem animals were removed when they came into conflict with people Traditional methods Predominantly lethal control used included:	Exclusion fences Fences traditional and commercial Electric offsets/hotwire Repellence options Lion minding Limited lethal control	Parks and Wildlife Act (Chapter 20:14); Draft Wildlife-Based Land Reform Policy of 2004 Environmental Management Act (Chapter 20:27); Rural District

	some local residents Feeding of animals in areas where there are many tourists Change in management in Botswana (Closing of elephant hunting)		Toxicants Steel leg hold traps Direct hunting or lethal removal.	Baboon toxicant control PAC hunting Destruction of specific dangerous animals	Councils Act (Chapter 29:13);

4. MITIGATION MEASURES COMMONLY USED ACROSS THE PARTNER COUNTRIES

4.1. Introduction

This assessment is of the various combinations of mitigation measures currently used in one or more countries in the KAZA TFCA and their success depends on a number of environmental factors as well as social and economic variables. HWC mitigation measures across KAZA partner Countries can be categorised into two categories, which are traditional deterrents and modern deterrents.

4.2. Traditional deterrents

'Traditional' deterrents are those that generally utilise low-tech materials that are widely available. Rural communities living alongside wildlife devised most of these techniques.

a) Noise

The most common way that farmers attempt to chase wildlife out of fields and human settlement is by shouting and banging metal objects to make loud noises. Farmers use a range of noisemakers, such as beating drums and tins, 'cracking' whips and yelling and whistling. However, crop raiding and livestock depredating animals tend to habituate very quickly to this deterrent.

b) Missiles

Farmers may throw rocks, burning sticks and occasionally, spears at crop-raiding animals and livestock depredating carnivores. This usually involves getting close to the animals, and therefore the level of danger to the farmer is high and usually the effect is short lived.

c) Fire

Farmers may burn plastic and rubber to create a noxious smoke on field boundaries and will often leave fires burning all night even if they are not present in the fields. In some cases, they carry the fire in the form of burning sticks around fields or livestock enclosures. While widely utilized, this method often cause widespread increased deforestation in many areas.

d) Simple fences

Simple fences are made of any material that famers might have on hand. They include branches, rough-cut poles, wire strands and mesh. These have historically provided some protection from raiding animals, but generally, they provide little protection against such animal attacks.

e) Visual deterrents

Brightly coloured cloths, sun reflecting silver metal sheets and plastic hanging on simple fences at the edges of fields or livestock enclosures. Such visual deterrents may have an initial 'scaring' value, but this method does not provide any reliable protection. Traditional deterrents tend to become ineffective over time, as lions, elephants and baboons habituate to these 'empty threats' once they are repeatedly exposed to them (Osborn & Parker, 2003). Usually a community will rely upon just a few methods, and these tend to be in use repeatedly with little variation.

f) Disturbance Shooting

Disturbance shooting is the firing of gunshots over the heads of crop raiding or livestock depredating animals. Mainly Government Agencies (centralised units) use this method and it

is in use across the continent. Disturbance shooting has been a long-standing deterrent. However, it is at best considered a temporary respite from problem animals particularly lions, baboons and elephants. There is a large body of anecdotal evidence to suggest that elephants habituate to gunshots if exposed to them for a prolonged period. Transport and logistical problems are the major drawbacks.

g) Shooting problem wildlife

Wildlife managers consider the killing of problem wildlife a last resort. The practice has been in use across Africa for the past 100 years. All countries engage in some lethal control of animals identified and deemed problematic.

Shooting a problem animal such as an elephant while it is crop raiding has been considered the best way to 'teach' the other elephants to stay away from crops. To appease the local people and to compensate for their crop losses, there is distribution of meat from the killed problem animal among that community. Most wildlife managers feel that this method is generally of little long-term effect and is a waste of valuable resources. In many situations, the animal responsible for the majority of the damage is not identifiable, and the PAC units end up killing a token animal. Besides being a waste of a valuable resource, this type of solution does little to deter other crop-raiders (Osborn, 1998). Often the reaction of the targeted problem animal is merely to change areas of raiding rather than to stop crop-raiding altogether.

4.3. Modern deterrents

Vigilance and co-operation by farmers

Farmers who sleep at their fields lose fewer crops than those who do not because they can react when an animal approaches (Smith and Kasiki, 2000). For example, Lahm (1996) found that 36% of farmers in Gabon experiencing crop destruction by elephants did nothing to deter them. Osborn (1998) found that 85% of damage incidents occurred in undefended fields. Currently, guarding of fields and livestock is taking different forms such as the lion guardians in Kenya and long shields lion guardians (run by Hwange lion research) in Zimbabwe defending people and livestock from predators.

If farmers can co-operate by a system of rotating 'guard duty' whereby only a few farmers patrol during the night and when wildlife is sighted; other farmers are woken up to chase the animals away. Watchtowers that provide good vantage points, built around fields of crops or near livestock kraals, increase the farmers' chances of their being alerted to the presence of potentially harmful wildlife before damage has occurred. Simple alarm systems, using string and cowbells or tins, can also be effective and avoid the farmer having to be alert all night long.

Alarm Systems

Alarm systems are acoustic devices that are set at the boundary of the farms or kraals and triggered off by a tripwire. Their primary goal is to alert farmers to the presence of wildlife, but they also have some deterrent effect.

a) Bells

In Zimbabwe, cowbells strung along a simple string fence at the edge of vulnerable fields or kraals work as an alarm system. As wildlife, particularly elephants and antelopes attempt to enter a field, they disturb a string thus making the bells ring both alerting farmers to the elephant's presence and scaring a crop-raiding animal.

b) Electric sirens

In Namibia, researchers tested a system that triggers a siren when elephants made contact with the trip wire. They reported some success (O'Connell-Rodwell 2000). In Sri Lanka, researchers have found similar success with such methods. However, the limitations are that in high rainfall conditions, it is difficult to maintain electrical systems and they are vulnerable to theft.

Alarms can play a critical role in crop protection as they offer security to the farmers. In Zimbabwe (Museruka village in Mbire District), farmers found them to be critical to field guarding as: a) they always knew when the elephants were approaching; and, b) the bells sometimes drove the elephants away. Many farmers complained that it was exhausting guarding the fields all night and it was impossible to maintain constant vigilance. Alarm systems were highly regarded in some communities in Zimbabwe because they allowed farmers to sleep whilst maintaining a level of vigilance.

Barrier Systems

Barriers work on the principle of excluding wildlife from crops and livestock. A wide range of potential methods exists.

a) Bamboo spikes

Short lengths of bamboo with sharpened ends laid into the ground so that the spike protrudes vertically from the soil. Spikes must be positioned close together and in a wide band so that the raiding animal can neither step between the spikes, nor step over the entire barrier. Elephants and in some cases buffalo will not tread on the spikes, as they require a large surface area to distribute their weight. In areas where bamboo is readily available this method would be cost-effective, but the limitations would be the labour and time involved in the construction and maintenance.

b) Sharp stones

A barrier of sharp stones laid out in a broad band in the same manner as the bamboo spikes (above). The method is time-consuming and labour intensive, but ultimately cheap and low maintenance. It would require access to a large number of suitable stones.

c) Other barriers

Across Africa and Asia, farmers attempt to construct barriers around their fields and homesteads to deter elephants, hyenas and lions. One of the most common barrier materials is thorn branches. Piling logs and sticks around the edges of fields or kraals is common in the KAZA area. In some areas, farmers may simply run bark ropes from tree to tree and hang pieces of white cloth from the line. None of these barriers can stop a determined elephant or lion but any boundary creates a psychological barrier that can have some impact. The most important aspect is the availability of the materials to build the barriers. In deterring predators from livestock, fortified enclosures that do not allow wildlife from seeing the livestock have proven to be effective, as wild animals do not attack what they cannot see.

BARRIER VEGETATION

a) Unpalatable cash crops

One can reduce the attractiveness of cultivated areas by planting unpalatable crops in vulnerable areas, e.g. on farms at the edges of protected areas. Crops may include chilli, tea, ginger or oilseed. These unpalatable crops may not deter some animals, but they can reduce the threat to a farmer's livelihood security by providing a valuable crop that the animals will not eat.

b) Buffer zones

The 'hard edge' boundaries of dense human settlements abutting a protected area tend to be areas of high conflict between wild animals and people. Numerous park planners have

suggested the creation of a buffer zone around protected areas where human influence is limited, thus relieving the pressure on both the protected area and the surrounding human population.

Concerning elephants, the purpose of a buffer is to create a zone of reduced attractiveness between the protected area and the surrounding crops (Thouless 1994). This involves clearing secondary forest on the boundary and creating some physical distance between the boundary and cultivation. There is, however, no evidence that such boundaries make a difference to elephant movements as the elephants can just pass through them to the cultivation.

FENCING OPTIONS

Non-Electric Fencing

Strong, non-electrified fences are in use (some successfully) to restrict wildlife movements in many parts of Africa and Asia. These fences, built with wooden or steel poles driven vertically into the ground some with heavy gauge wire or cable strung between the poles and drawn tight, are showing various levels of effectiveness. While these fences have met with some success, they can be expensive to erect and maintain.

Electric Fencing

Electric fences come in a variety of designs and used to protect small farms, enclose entire wildlife reserves, or deflect animals away from specific areas. Elephant fences are usually high-voltage and may incorporate a number of design features, such as extra pole wires, to protect them from elephant attacks. Elephants are notorious at seeking out the weak points of fences. Thouless and Sakwa (1995) concluded that elephants could overcome most modifications in time, meaning that a fence's effectiveness does not depend on entirely on design, construction and voltage alone.

The materials, installation and maintenance costs can usually make electric fencing impractical for applications in poorer developing countries unless funded by international aid agencies. However, there has been an enormous improvement in fence designs with a marked reduction in cost such that some of these methods are appropriate in the so-called poorer communities. In addition, equipment such as solar panels, energisers, batteries and wire are all desirable materials accessed at relatively low prices although there might be a high risk of theft. In Muzarabani District, Zimbabwe, a game fence along the edge of Mavuradona Wilderness Area had solar panels and batteries stolen no less than 3 times in 2 years rendering the project ineffective.

A key factor determining the success of a fence is ownership. A fence that is constructed and maintained by a government agency such as the Wildlife Division may invoke a perception that it is a government fence. The community is likely to leave maintenance to the government and the community will take little or no responsibility. Rarely does a government agency have the resources to maintain a fence year after year, and inevitably, the fence deteriorates. However, if the community builds a fence (with the cost of materials subsidised by a donor agency), and the community is responsible for its upkeep, then success will be more likely, because local people have a stake in its success.

Fences around parks or reserves tend to give poor results. It is better to fence in grazing lands, fields and or kraals. However, fencing projects may fail because of repeated damage from elephants.

Single-Strand Fencing
Electric fencing can be adapted to rural conditions by cutting down on building costs and materials. For example, it is possible to construct a fence with just a single live strand and hang it from bush poles instead of metal stanchions. This cuts costs considerably, but there is still a need for insulators, solar panels and batteries, all of which are high value items at risk from theft.

The limitation of barriers is that they are generally expensive to construct, is labour intensive and has high levels of maintenance. In addition, much anecdotal evidence suggests that elephants will overcome even the most sophisticated barriers over time. In addition, permanent barriers may not be popular with farmers as they can restrict agricultural expansion.

5. COST BENEFIT ANALYSIS OF MITIGATION MEASURES USED ACROSS KAZA TFCA.

We divided our review of mitigation measures into five parts. First is *Efficacy* that is the ability to produce a desired or intended result. Second is *Efficiency* the state or quality of being efficient. S*ustainability* is a measure of the chances for methods to continue after introduction. *Adaptability* between locations and species of each method and *Replicability* or the ability to have the same system or method copied to another location.

5.1. Low-tech traditional tools mitigation measures

In the section below, we compare low-technology tools, such as noisemakers and vigilance, to high-tech fencing and surveillance. In many cases, the success of any combination of methods is due to an interaction between two techniques, such as good crop minding by a farmer and use quick use of loud noisemakers. In addition, many of the animals a farmer may need to repel may respond to one mitigation technique and not another making it difficult to generalise with any precision.

Mitigation measure: low-tech traditional tools that includes banging of tins, stock whips, shouting and good surveillance (sleeping in fields) by farmers or livestock minders.

- *Efficacy:* the ability of traditional methods to produce the desired result is low and is the source of much of the frustration by rural people in the KAZA.
- *Efficiency:* medium to low depending on effort placed crop minding– good when combined with other tools demonstrating motivation and inventiveness.
- *Sustainability:* dependent on farmer effort, improved considerably by training, in particular by understanding animal behaviour.
- *Adaptability*: quickly adapted for each household and situation.
- *Replicability:* easy to replicate.

Mitigation measure: low-tech traditional tools of which 'good crop minding' provides the corner stone to effectively mitigate HWC in crops.

- *Efficacy:* possibly the most important aspect of crop or livestock protection. The most abused, misunderstood mitigation principle practised, although widely known by all member countries fundamental to effectively mitigation. Upon it, every other approach and tool is built-on.

- *Efficiency:* excellent to none depending solely on effort and individual/community motivation and dwelling in the cropped land – very good when combined with other tools demonstrating inventiveness and improved strategy.
- *Sustainability:* dependant on farmer effort, improved considerably by training in particular by understanding animal behaviour.
- *Adaptability*: quickly adapted for any crop situation.
- *Replicability:* cheap very easy to replicate.

Mitigation measure: low-tech <u>traditional tools</u> that includes traditional fencing.

- *Efficacy:* widespread use in KAZA TFCA fundamental as a base line approach to provide the first line of defence to protect crops.
- *Efficiency*: wide ranging, medium to high, depending on effort undertaken and structure of the fence provided.
- *Sustainability:* is dependent on farmer siting the fence well and maintenance effort. Improved considerably by training in particular by understanding animal behaviour.
- *Adaptability*: easily built from any material i.e. the cheapest and most available to hand. Improved barrier enabling the attachment of an electrical offset or other sophisticated alerting and or repellence tools.
- *Replicability*: easy to replicate for all crops.

Mitigation measure: low-tech <u>traditional tools</u> – use of fire.

- *Efficacy:* widespread use in KAZA TFCA fundamental as a base line approach.
- *Efficiency:* variable depending on farmer effort and level of crop minding – very good when combined with other tools demonstrating motivation and inventiveness.
- *Sustainability:* dependent on farmer effort, improved considerably by training in particular understanding animal behaviour.
- *Adaptability:* quickly adapted for each household and situation. Innovative improvements recorded include burning embers in tins tossed toward elephant and predators.
- *Replicability*: cheap easy to replicate.

Mitigation measure: low-tech <u>traditional tools</u> – use of surveillance measures (famers guarding fields or kraals).

- *Efficacy:* widespread use in all partner countries fundamental as a base line approach.

- *Efficiency:* extremely variable depending on individual farmer effort and good crop minding dwelling the land – very good, when combined with other means of surveillance and tools demonstrating motivation and inventiveness.
- *Sustainability:* dependent on farmer effort improved considerably by training in particular understanding animal behaviour and individual farmer motivation.
- *Adaptability:* quickly adapted for cropped lands and kraal situations.
- *Replicability*: cheap easy to replicate.

Mitigation measure: low-tech <u>traditional tools</u> – strategic placement of watchtowers.
In Zimbabwe and Zambia, either farmers build watchtowers that are in a tree or freestanding from which they can observe their fields at night and be safe.

- *Efficacy:* not as widespread everywhere in all member countries but is effective when properly implemented.

- *Efficiency:* extremely variable depending on farmer effort and good crop minding dwelling the land – very good when fully occupied during vulnerable periods combined with other means of surveillance and tools demonstrating motivation and inventiveness.
- *Sustainability:* dependent on farmer effort improved considerably by training in particular understanding animal behaviour and individual farmer motivation.
- *Adaptability:* quickly adapted for cropped lands and kraal situations.
- *Replicability*: cheap easy to replicate by farmers.

Mitigation measure: low-tech traditional tools that includes homemade bangers, firecrackers, carbide bangers, chilli exploders, other explosive canisters and shooting in the air (see full list of traditional repellence tools).

- *Efficacy:* widespread use in all member countries as value adding tools to boost the traditional fence.
- *Efficiency:* high depending on effort placed and good crop minding dwelling the land – very good when combined with other tools demonstrating motivation and inventiveness.
- *Sustainability:* dependent on farmer effort improved considerably by training in particular understanding animal behaviour.
- *Adaptability*: quickly adapted for cropped lands and kraal situations.
- *Replicability:* easy to replicate with training.

Mitigation measure: low-tech traditional tools that includes various types of lanterns and torches.

- *Efficacy:* widespread use in all member countries fundamental to mitigate HWC. Light emitting diode (LED) torches are brighter, last longer and are much more user friendly and durable compared the older generation torches.
- *Efficiency:* medium to low depending on effort placed and good crop minding dwelling the land – very good when combined with other tools demonstrating motivation and inventiveness.
- *Sustainability:* dependant on farmer effort improved considerably by training in particular understanding animal behaviour.
- *Adaptability*: quickly adapted for cropped lands and kraal situations.
    - *Replicability:* easy to replicate improved with training.

Mitigation measure: low-tech traditional tools that includes good kraal structure and applying good kraaling techniques.

- *Efficacy:* widespread use in all member countries fundamental as a base line approach to provide the first line of defence to protect livestock.
- *Efficiency*: Wide-ranging medium to high depending on effort undertaken and stature of the fence provided.
- *Sustainability:* dependent on farmer maintenance effort improved considerably by training in particular understanding animal behaviour and the kraal standard required.
- *Adaptability*: can be built from any material, the cheapest and most available to hand, enabling the attachment of an electrical offset or other sophisticated alerting and or repellence tools.
- *Replicability*: easy to replicate for all livestock.

Mitigation measure: low-tech traditional tools of which 'good livestock minding' provides the cornerstone for mitigation of livestock HWC.

- *Efficacy:* possibly the most important tool of the toolkit. The most abused, misunderstood mitigation principle practised, although widely known by all member countries fundamental for effective mitigation. Every other approach may revolve around it.
- *Efficiency:* variable depending solely on effort and individual/community motivation remaining vigilant at all times, proper herding using well-constructed kraals – very good, when combined with other tools demonstrating inventiveness and improved strategy.
- *Sustainability:* dependant on farmer effort. Improved considerably by training, in particular with an understanding of carnivore behaviour.
- *Adaptability*: quickly adapted for any livestock situation.
- *Replicability:* cheap and very easy to replicate.

5.2. Medium tech, semi-sophisticated tools Mitigation measures

Mitigation measure: medium tech semi-sophisticated tools that includes various types of noise and sight tools used in combination with other tools that includes *vuvuzelas*[6]*,* football whistles, bear bangers, flares and commercial Taser units.

Mitigation measure: medium tech semi-sophisticated specialist tool to provide green laser therapy specifically for baboon and directing animals away from specific places.

- *Efficacy*: new technique still under experimentation in Zimbabwe.
- *Efficiency:* effective with little training to repel baboons from their night roosts and growing in use by the hunting fraternity to redirect individual animals.
- *Sustainability:* dependant on farmer effort improved considerably by training in particular understanding animal behaviour.
- *Adaptability*: quickly adapted for cropped lands and kraal situations.
- *Replicability:* easy to replicate improved with training.

Mitigation measure: medium tech traditional tools that includes various types of offset or polywire electric wires.

- *Efficacy*: less widespread but used in all member countries where it is more effective when added to a fence (traditional or commercial) rather than on its own.
- *Efficiency:* extremely efficient provided it is well maintained depending on effort placed and good crop minding dwelling the land – very good when combined with other tools demonstrating motivation and inventiveness.
- *Sustainability:* ranging from relatively cheap (polywire to cover 5km ≤ USD 1000 complete with solar charger and battery) to very expensive depending on configuration. Requires vigilance and high maintenance to reduce theft of components and ensure voltage is maintained requiring farmer effort, improved considerably by training in particular by understanding animal behaviour.
- *Adaptability*: quickly adapted for cropped lands, kraal situations and small-defended areas such as parked vehicles defended from attacks by hyenas.
- *Replicability:* easy to replicate improved with training.

Mitigation measure: moderate tech solutions and tools – mitigating the chilli option – ***passive*** applications (see main tools for details) to repel animals from crops and livestock kraals.

[6] Plastic horns popular with football fans

- *Efficacy:* Well known throughout the KAZA region (although not used everywhere in all the member countries) that is effective when properly implemented around the edges of lands against the traditional fence. Its effectiveness enhanced when used as a package alongside the different chilli guns.
- *Efficiency:* extremely variable depending on farmer effort and good crop minding dwelling the land – requires diligent application during vulnerable periods combining well with other surveillance and repellence tools demonstrating motivation and inventiveness.
- *Sustainability:* dependent on farmer effort improved considerably by training in particular understanding animal behaviour and the chilli strategies required. Easily replicable once respective communities gain the knowledge and without much cost.
- Adaptability: It adds value to tool effectiveness:
  - fortifies traditional fencing and/or barriers;
  - prevents traditional approaches becoming stale by offering something different to break the routine;
  - provides for the traditional approaches to become more effective – by increasing the animal's suspicion of the tools implemented;
  - provides for the disciplining of the animal and reminding the animal of the deterrence;
  - provides for the establishment and enforcement of a crop or livestock boundary interface – by establishing a memory fence [7];
  - warding off early scouts – in situations where new lands or crops are for some reason presently unknown to them;

Particularly effective as a secondary option to lethal control warding off new would be offenders, and is easily adapted for cropped lands and kraal situations.

- *Replicability*: cheap and easy to replicate by farmers.

Mitigation measure: <u>Moderate tech solutions and tools</u> – mitigating the chilli option – ***active*** applications that include the different types of chilli guns to repel animals from crops and livestock kraals.

- *Efficacy:* relatively new concept that has taken time for acceptance but that has indicated promising results in Chirundu and Victoria Falls in Zimbabwe, South Luangwa Zambia and in Niassa, Mozambique. The system requires diligent and persistent doggedness to effect lasting results. It is very effective on cow groups and new problematic bulls often only requiring a single treatment to them but strongly habituated bulls require a lot more effort. With persistence however even these individuals are effectively repelled from lands and do not return. The *Mhiripiribomba* chilli gun is the only active tool apart from lethal control that will finally stop persistent habituated bulls. Although a freestanding tool works well in combination with other tools defending a traditional or commercial fence or barrier, its effectiveness greatly enhanced when used as a package alongside other mitigating tools. The Ambush Chilli Educator (ACE) is still under trial, defending approach paths to crops.
- *Efficiency:* variable depending on farmer effort and good crop minding dwelling the land – requires diligent application during vulnerable periods combining well with other surveillance and repellence tools.
- *Sustainability:* requires specific training of designated community scouts, persons familiar and confident to approach elephant with an understanding of animal behaviour and the chilli strategies. The guns cost USD 170 and the chilli oil is easy to produce.

[7] 'Memory fences', more correctly known as 'virtual fences', are unseen but established boundaries precisely geo-located that animals respect as non-negotiable. These are established through conflict of some kind resulting in fear brought about by the interaction of other animals for example territorial disputes or man induced through HWC/wildlife management.

- *Adaptability:* With proper training, all communities can become proficient using this technique.
- *Replicability*: cheap and easy to replicate by farmers.

Mitigation measure: <u>medium tech sophisticated tools to combine</u> that includes the *Niteguard* and *PREDeter* LED deterrents

- *Efficacy:* relatively new concept used presently only in Namibia, Zimbabwe and Zambia.
- *Efficiency*: set at the appropriate carnivore height at 7 metres intervals has proven extremely effective.
- *Sustainability:* increased effectiveness dependent on kraal design and construction preventing the carnivores from seeing what is inside the kraal. Improved considerably by on-going training in particular understanding animal behaviour and the kraal standard required.
- *Adaptability*: is relatively expensive and less effective set on crop fencing but worth the while set on kraal walls combining well with other tools such as the attachment of an electrical offset or other sophisticated alerting and/ or repellence tool options.
- *Replicability*: easy to replicate for all livestock kraals.

Mitigation measure: <u>medium tech wire crocodile fencing</u>

- *Efficacy:* relatively new concept used presently mainly in Namibia.
- *Efficiency*: effectively set it cuts off any possible access by crocodiles and efficiently reduces crocodile attacks.
- *Sustainability:* reliant upon the water level remaining reasonably constant. Requires rearranging where water levels fluctuate enough to submerge the leading edges needing meaningful community participation to ensure its proper function.
- *Adaptability*: is relatively inexpensive and can be adapted to most large river, pool, lake or dam situations.
- *Replicability*: easy to replicate provided sufficient instruction.

Mitigation measure: <u>medium to hi tech bee fencing.</u>

- *Efficacy:* concept hugely attractive to various conservation groups and well funded by development NGOs that seek to find a biological way of mitigating conflict and provide a win-win situation for both conservation and communities. Still under trials to test its efficacy in the KAZA.
- *Efficiency*: still need further trials to prove its effectiveness and cost effectiveness.
- *Sustainability:* tried in all KAZA countries except possibly Angola, the main problem being occupation of the respective hives particularly in hot dry areas. Where conditions for beekeeping are ideal, the method is highly sustainable.
- *Adaptability:* With proper training and or a tradition of bee, keeping it may easily be adapted.
- *Replicability*: highly replicable in places with proper bee keeping conditions and might be worth trying.

Mitigation measure: <u>Moderate tech solutions and tools</u> – mitigating the chilli option – ***active*** applications employing the Mhiripiribomba in the Chirundu border town in Zimbabwe.

- *Efficacy:* relatively new concept that has taken time for acceptance but that has indicated promising and effective results in Chirundu. The Chirundu Elephant Management Program comprising of Zimbabwe Parks and Wildlife Authority, Jeche Fishing Camp and the Chirundu District Council provided diligent and persistent doggedness to effect lasting results. It is very effective on cow groups and new

problematic bulls often only requiring a single treatment to them but strongly habituated bulls required a lot more effort. With persistence however even, these individuals were effectively repelled from the town boundary and have not returned. The program has been running now for a year, with chilli balls fired some 770 times through two chilli guns before requiring refurbishment.

- *Efficiency:* the efficiency of the Chirundu example is arguable due to the tireless effort undertaken by the project manager reacting daily to phone in requests to chase the elephants beyond the town edge and the *virtual fence established*[8]*,* demonstrating good crop/town mindedness that has proved to be the secret for success. Perhaps the most remarkable achievement in Chirundu was the change in attitude by local inhabitants of the uncontrolled rubbish thrown out previously attracting elephants and habituating them.
- *Sustainability:* in Chirundu, the chilli guns are in use as stand-alone tools that would be even more effective combined with other tools. The program providing specific training of Zimbabwe Park Rangers, persons familiar and confident to approach elephant with an understanding of animal behaviour and the chilli strategies.
- *Adaptability:* with proper training all communities can become proficient using this technique
- *Replicability*: cheap and easy to replicate anywhere provided there are persons that would be willing to implement it over time

Mitigation measure: <u>medium to hi tech lethal control option</u> considering the hunting of individual animals

- *Efficacy:* is target specific and extremely effective when correctly administered. Used extensively in all five KAZA TFCA countries, as the only effective way of dealing with a specific rampaging or wounded animal. It effectively promotes the boundary dynamic or *virtual fence* where identification and killing of the culprit animal occurs in the field or at the boundary. In the early years, hunting of problem animals was common across the region targeting all species including antelope and crocodile. Much more recently just before the turn of the century, this practice became unacceptable and newer more conservation friendly options that included translocation and repellence replaced this tool. Nevertheless, this option still provides an important tool as a backup for extreme situations. Interestingly the Mhiripiribomba closely mimics a rifle in many ways, effectively replacing its function without destroying the offending animal.
- *Efficiency*: used sparingly only when necessary hunting is a very efficient tool.
- *Sustainability:* widely practiced and unsustainable.
- *Adaptability:* effective in any situation provided administered by a qualified expert.
- *Replicability*: Parks officials can easily replicate this method augmenting the technique by repellence methods to instil discipline through memory.

5.3. High tech mitigation measures

Mitigation measure: high tech <u>commercial fencing</u> commonly used for game parks and large wildlife areas.

- *Efficacy:* immediately effectively repelling all animals when working well. However it is extremely expensive so exclusively used for high value commercial enterprises found in all member countries except perhaps Angola for containing and/or excluding wildlife. Of all systems, properly enforced it dramatically implements the memory dynamic

[8] The concept of the Virtual Fence/Memory Fence definition on page 33

providing an effective virtual fence thereafter even within wildlife corridors but takes more time. For this reason, fences of this stature require careful forethought, wildlife movement knowledge and planning before implementation, considering long-term ramifications to wildlife movement and wellbeing. Historically these fences mostly were ill planned and occasionally politically motivated, adversely effecting wildlife movement patterns. Completely enclosing an area provides a closed ecosystem that will require careful monitoring by ecologists and timely management to sustain it. Provided it is properly maintained and enforced, effectively minimising challenges that will occur, a virtual fence provided outside an active corridor will be established within 2-5 years whereupon even if the fence is removed the boundary will remain established. For example, the electric fence along the boundary of the Malilangwe Private Game Reserve in Zimbabwe is a 52km enclosed fence. Unfortunately, this fence does cut through an active elephant corridor thus making it more difficult to maintain as elephants are constantly challenging it at great expense to the owners. It is interesting that countries to the north in Central Africa, except possibly Kenya, discourage large scale fencing projects preferring to work around corridors finding a workable compromise with communities. Namibia seems to have struck a workable balance for fenced areas that considers both wildlife and communities. See Ferguson & Hanks (2010).

- *Efficiency:* completely dependent upon finance and individual farmer/community effort. Despite the Malilangwe standard, cutting down the yearly elephant breakouts and break-ins from 300 to 30 a year, (interestingly mostly the same individuals) elephant still breaks it probably driven by the fact it does close off a major corridor accessing Gonerezhou National Park, requiring other options as reinforcement.
- *Costing:* considering costing USD 16 000/km the Malilangwe fence costs a further USD 432/km to maintain it including twice spraying with herbicide during the wet season to prevent vegetation growth shorting out the system.
- *Sustainability:* to sustain this standard of fencing requires high care management each day, each scout patrolling 7-8km of fence testing voltage output, ensuring that it remains above 5000 volts preferably around 7000, maintenance crews reacting immediately it drops. Using the Malilangwe model even less ambitious fences still depend on farmer effort and sufficient funding to police and maintain it.
- *Adaptability*: politically many communities see this scale of fencing as a direct challenge to their rite of passage and benefits accrued from living adjacent to PAs requiring innovative benefit sharing to improve their perception.
- *Replicability:* Not easy to replicate for communities even with training requiring innovative individual and community benefit programs to convince them

Mitigation measure: <u>high tech specialist tools to capture and translocate problem animals</u> that includes both physical and chemical capture methods.

- *Efficacy:* advanced technology developed enabling the safe capture and movement of all wildlife species. Capture takes place in all member countries including Angola, with the use of contracting qualified teams from Zimbabwe and South Africa. Zambia and Botswana largely provide their own teams except for major operations. Capture and translocation require a high level of knowledge, skill and equipment determining capture success that may range from complete disaster to total success with less than 2% loss.
- *Efficiency*: largely dependent upon the capture unit reputation, with experienced teams providing total capture and translocation success.
- *Sustainability:* the more reputable units although expensive, they consistently produce the desired results.
- *Adaptability*: most reputable units are able to operate anywhere under all conditions throughout the KAZA sub region.

- *Replicability*: requires specific training and years of working alongside experienced operators to gain sufficient experience to cope independently.

Mitigation measure: high tech capture and translocation employing various cage and camp traps.

- *Efficacy:* traps largely employed for the capture, translocation and destruction of specific problem animals rather than general capture discussed above. Successful strategies and traps specifically designed and developed 'in house' to solve a specific problem drawn from considerable field experience now replicated throughout KAZA, but more often practiced in Namibia, Botswana and Zimbabwe.
- *Efficiency*: dependent on personal knowledge, experience, usually gained through hands-on training requiring innovativeness, motivation and extreme patience.
- *Sustainability:* employed by qualified persons provides sustainable results. Best to contract in experienced individuals to teach correct strategy to new staff.
- *Adaptability*: can be adapted to most situations by experienced persons.
- *Replicability*: easy to replicate provided sufficient instruction in the field.

Translocation: Not recommended particularly in respect to habituated animals

Mitigation measure: <u>hi tech lethal control option</u> lethal control using toxicants (MOSTLY BABOONS)

- *Efficacy:* In the last ten years, *Papiol* was the only toxicant still administered for the control of baboon populations in Zimbabwe. (*Mike Le Grange Pers. comm*.) Although target specific and very effective in reducing baboon populations quickly, subsequent management failed to be implemented to remove the drivers that caused the population increase in the first instance resulting in the stalled populations slowly reverting. This inability highlights the principle: *culling of wild animals is ineffective as a method for addressing HWC.*
- *Efficiency*: lethal control whether by hunting or toxicants is the only method to remove habituated individuals from a population that occurs with respect to urban baboon populations. For example, urban baboon troops have crossed the human/wildlife barrier that for the future will result in significant disease cross over and the baboon becoming extremely unpleasant to live with. The adverse knowledge urban baboon retain cannot be reversed by re-educating them but by removing all the baboons involved along with the knowledge invested that toxicant control can quickly achieve. Thereafter significant changes in human behaviour that in anyway encourages them needs to be actively discouraged (see control of baboon in particular the point dealing with this) With respect to baboon problems occurring in communities most often baboon problems are efficiently solved by community action driving them repeatedly from conflict areas.
- *Sustainability:* community action/guarding improves the sustainability of this technique throughout the KAZA TFCA.
- *Adaptability: e*ffective in any situation provided administered by a qualified expert under an appropriate permit.
- *Replicability*: mostly no longer accepted requiring other mass control measures such as the baboon mass cage trap technique.

5.4. Species-specific mitigation measures-livestock depredation

Mitigation measure: Specialist measures principally designed to protect specific target carnivores, mostly NGO driven, that help to reduce conflict to communities.

1. Cheetah

- *Efficacy*: almost exclusive to Namibia but also tried in Botswana largely involving the larger conservancies that provides for innovative planning using holistic solutions to reduce conflict from cheetah. These include the use of specialist dogs, donkeys and wildebeest (consult full list provided).
- *Efficiency:* effective with training and sufficient motivation. The way to go forward for the future capitalising on behavioural traits that provide a workable compromise for both animal and community. This will allow cheetah passage through PAs.
- *Sustainability:* dependant on farmer effort, improved considerably by training, in particular understanding carnivore behaviour.
- *Adaptability*: perhaps more difficult depending on each situation on the ground provided there is sufficient motivation, adequate extension workers/cheetah minders, community buy-in and funding.
- *Replicability:* easy replicated provided communities are properly sensitised and fully support the concept.

2. Lion

- *Efficacy*: mostly administered by various lion NGOs protection groups such as the Lion Guardian Project and the Hwange Lion Project operating in communities surrounding PAs, providing innovative planning using holistic solutions to reduce conflict from lion generally. These include the use of conditioned taste aversion (CTA), radio telemetry fitted with geo PA boundaries to forewarn concerned communities of imminent approach and using a Global Positioning System (GPS) to quickly locate and remove carcasses outside PAs before they can be consumed.
- *Efficiency:* effective with training and sufficient motivation. The way to go forward for the future capitalising on behavioural traits that provide a workable compromise for both animal and community such as cheetah passage through PAs.
- *Sustainability:* dependant on farmer effort, improved considerably by training in particular understanding carnivore behaviour.
- *Adaptability*: perhaps more difficult depending on each situation on the ground provided there is sufficient motivation, adequate extension workers/minders, community buy-in and funding.
- *Replicability:* not at all sustainable by communities on their own, requiring continual NGO support and funding. Easily replicated provided communities are properly sensitised and fully support the concept.

3. Wild Dog (Painted hunting dog)

- *Efficacy*: practised where wild dog occur in conservancies and respective PAs providing for innovative planning using holistic solutions to reduce conflict generally. These mostly include training awareness programs and pack monitoring directly and through GPS telemetry.
- *Efficiency:* effective with training and sufficient motivation, the way to go forward for the future capitalising on behavioural traits that provide a workable compromise for both animal and community.
- *Sustainability:* dependant on community sensitising improved considerably by training in particular understanding carnivore behaviour. May have to consider translocation of groups establishing territories outside PAs and wildlife conservancies in livestock ranches.

- *Adaptability*: perhaps more difficult depending on each situation on the ground provided there is sufficient motivation, adequate extension workers/wild dog minders, community buy in and funding.
- *Replicability:* easy replicated provided communities are properly sensitised and fully support the concept.

5.5. Mitigation measures developed and used outside of the KAZA TFCA.

Mitigation measure: <u>Moderate tech solutions and tools</u> – mitigating the chilli option – ***active*** applications employing the Tanzanian motorised approach (see further details under chapter dealing with HWC tools)

- *Efficacy:* relatively new concept that has taken time for acceptance but that has indicated promising and effective results in Tanzania in the Kwakuchinja Corridor alongside the Tarangire National Park. The Honeyguide Elephant Management Program comprising of Tanzanian State Parks and Burungwe WMA, financially assisted by Honeyguide provides diligent and persistent doggedness to effect lasting results. It is particularly effective on cow groups that occurred within the corridor. However strongly habituated bulls require considerably more effort. With persistence, even these individuals were effectively repelled from the corridor and moved back to the Park boundary.
- *Efficiency:* the efficiency of this example as indicated in the Chirundu initiative is arguable due to the tireless effort undertaken by Honeyguide staff reacting nightly to phone in reports, chasing the elephant out beyond the corridor edge and *virtual fence* established demonstrating good crop mindedness that has proved to be the secret for success.
- *Sustainability:* In the Kwakuchinja Corridor, the chilli guns are in use combined with other tools. Furthermore, the program provides specific training of Burungwe scouts, persons familiar and confident to approach elephant with an understanding of animal behaviour, the chilli strategies and using the tools outlined to defend individual crops.
- *Adaptability:* With proper training, all communities can become proficient using this technique.
- *Replicability*: cheap and easy to replicate anywhere provided there are persons that would be willing to take responsibility to implement it over time.

6. RECOMMENDED HWC MITIGATION TOOLS

6.1. Mitigation against Crop raiding

a) Diligent crop and livestock minding which includes:

- Implementation of a planned strategy
- Incorporating many different tools and constantly trying different combinations
- Synchronising cattle calving down to minimise vulnerable period
- Living in the cropped lands
- Provision of 24/7 crop guards during the vulnerable period
- The implementation of early warning systems that include use of dogs tied up near respective guard posts
- Tins or cow bells interconnected that provide warning when disturbed
- Well placed and manned vantage points to detect early entry and to provide warning to others in the village of possible intrusion from which to provide repellence action
- Providing some sort of cleared area forcing the animals to pass though on approach to crops

- Commercial fencing including electrification
- Offset electrical wires permanently installed
- Temporary and movable 'polywire' hotwire arrangement or simple 2-strand polywire 'electronic string' solar electric fencing

b) Traditional fencing

- Pole/bamboo fencing with pole or wire fill in
- Scrub/bush fencing
- Weaved wall fencing
- Hedges of grown plants
- Stone walls

c) Low tech direct community repellence (people acting on their own initiative) that includes:

- Shouting, singing and hand clapping (even talking aloud)
- Scarecrows
- Use of tins and drums in various formats
- Tins and or cowbells suspended on outrigger fence
- Positioning of a drum in the land middle and banging with a club
- Banging portable bits of tin or pots to actively ward off intruders
- Reflective plastic bottles with inverted chip packets to reflect starlight and directed torch beams
- Poly tapes and reflective streamers
- Catapults
- Community rallying to help one another
- Stock whips
- Various homemade 'pipe' bangers including the filling of old cartridge cases with match heads, mouth crimped over and thrown into a fire
- Improved bangers (firing live rounds over the top, carbide bangers (western Africa) and crackers)
- Homemade explosive bangers (fertilizer and black powder)
- Chilli bombs manufactured from chilli contaminated gravel chips surrounding a pyrotechnic cracker set in a condom thrown at approaching elephant
  Torches **–** mostly now LED branding, fundamental equipment to commute around the lands and investigate sources of disturbances, actively ward off detractors and communicate intruder position to nearby villagers and motorised units to help chase them off where applicable. Torches are also useful to reflect light from reflective bottles strategically placed in and around cropped lands
- The OLIGHT 96 industrial torch producing 4000 lumens is particularly effective brightly illuminating a large area providing direct deterrence particularly in the strobe mode
- Fires
- Burning logs/stumps (In Mozambique the favoured species involved appears to be *Julbenardia paniculata* that provides for showers of sparks)
- Fire embers on the ground or thrown up
- Vuvuzelas
- Various chilli applications that include:
    - Growing chill plants
    - Chilli fences
    - Burning of Chilli dung in its various forms
    - Chilli string
    - Chilli spray onto fences
    - Chilli bombs Tanzanian style (see bangers for more details)

    - Tennis ball thrower to fling these
- Bear bangers, use of flares and commercial Taser units
- Green laser therapy[9] for baboons
- High-tech game and predator-proof *Bonnox*[10] fencing sporting several electrical offsets

Advanced options

Use and management of these is by experienced operators specifically licensed and trained to do so

- Digging trenches- best lined (*teak railway sleepers work well)* to prevent refilling of trench. If done properly trenches can be extremely effective for elephant and hippo but is expensive requiring regular maintenance. Most often employed for smaller high profile projects.
- Loose rocks piled around specific objects to protect them (good for elephants and hippos).
- Bee fences (see King, L. 2010 & 2012)

Chilli dispensers

- *Mega-fogger* chilli gun
- Aerosol mortar launcher
- The 'Mhiripiribomba'
- The Ambush Chilli Educator (ACE ambushchillibomba)
- The ACE ambushchillixploda
- Adaption of pyrotechnics rocket launcher
- The chilli bombers (suggest training of community scouts be employed)

6.2. Mitigation against livestock depredation

- Good livestock minding
- Accounting for all stock into the pens each evening
- Staying away from designated wildlife areas (PAs, WMAs and corridors)
- Properly herded each day
- Herded earlier rather than later each day when they are at less risk from predators
- Kraals well placed in respect to security of the village
- Exposed as much as possible to discourage attack and observe possible approach
- Early warning systems fitted
- A fence within a fence approach following *living fences* approach in East Africa
- Well-built and strong walled *kraal*
- Ensuring animals can neither see in or out – use of some sort of screening
- Chilli twine
- The provision of a 'hot wire' on top
- Fortified with either Niteguard or PREDeter repellence LED light systems
- The provision of 24/7 livestock guards and dogs where the threat is eminent
- Crocodile fencing

Innovative approaches (mostly NGO driven)

- Anatolian sheep dog, donkey and wildebeest minding
- Cheetah passage corridor - opening up game fences
- Conditioned taste aversion (CTA)
- Removing carcasses of livestock killed by predators before they get a chance to consume them
- Bio fence - GPS boundary fencing
- Virtual fencing implementing the boundary dynamic approach

[9] This is the use of a powerful green laser at night that to produce a very bright and "blinding" light aimed at the roosts of sleeping baboons producing a brilliant, shinning and blinding light.

[10] http://www.bonnox.co.za/

- Memory management - removing knowledge, preventing habituation
- Lion minders using radio telemetry.
  Lion guardian project Namibia – warning communities of eminent

6.3. Physical trapping options

A Variety of traps for certain problems animals such as;

- Crocodile traps
- Spring leaf trap
- Box trap
- On land trap
- floating traps
- Bush pig camp trap
- Baboon camp trap
- Individual carnivore cage traps
- Specialised capture release/translocation cable leg hold traps
- Mass capture and darting translocation – specialised licenced capture units

6.4. Chemical capture and translocation

- Darting systems and drugs used
- Plastic boma mass capture method
- Net boma and Net gun method for capture
- Drop boma capture technique

6.5. The use of sophisticated surveillance systems:

- Camera traps (CTs) that send pictures while alerting using Short Message Service (SMS) platforms
- Closed-circuit television (CCTV) covert surveillance systems
- Motorised repellence Honey guide Tanzania 'minder' approach – employing a vehicle, personnel and tools to physically chase wildlife back over the *virtual boundary* of PAs. These tools include rocket propelled pyrotechnic rocket fired through especially adapted electrical launchers that explode over the elephant/baboon in an array of bright colours or from a drone; the chilli dispensers comprising of coated gravel chips set around a fire cracker encased using a condom; football horns (Vuvuzelas) and the Olight 96 torch. Armed with this equipment, operators would respond to SMS telephone directions and guided by standard LED torches onto the elephant. A coded two flashes mean they have arrived. Employing the vehicle, they then would charge toward the elephant using these mentioned tools, often driving them back several kilometres to the Park boundary, thereby enforcing *the virtual fence principle.*

6.6. Urban mitigation approaches

Increasingly conflict between wildlife and people in towns and cities is a major source of both injury and has negative economic impacts. Methods need to be developed that are innovative and adaptable to this unique landscape. Some ideas include:

- Identifying habituation behaviour and the coping strategy indicated by animals under stress in urban environments
- Identifying and management of the key attractants drivers
- Community buy-in issues
- Lethal control (the quickest most efficient technique for wounded or incapacitated animal

7. RECOMMENDED SPECIES-SPECIFIC HWC MITIGATION MEASURES

Several wildlife species are involved in HWC situations across the KAZA TFCA. Below we illustrate in the form of a table the animals received the most ranking scores when communities living with wildlife mentioned the animals involved in most of the HWC situations. We briefly recommend the possible planning strategies and tools available for mitigation in table 3 below. The animals are not listed in any particular order and the full description of the behavioural aspects of these animals in HWC situations is detailed in Appendix 2.

Table 2: Most problematic animals and suggested species-specific mitigation measures.

Problem Animal	Strategy/Approach to mitigation	Tools
Elephant *(loxodonta Africana)*	• Elephant corridors and paths • An understanding of how, why and when elephants use paths and corridors is essential in the application of mitigating measures. • Agricultural Lands need to be planted in defendable clusters • The first line defence from corridor or • Establish a physical boundary • Consider a 'motorised' or chase-to-boundary by a response team to enforce boundaries • Cluster defence • Individual land defence	• Electric fencing where possible (see AfESG 2000) • Traditional fence with electric wire off-set • Fence fitted with noise makers such as cow bells • Plastic bottle with inverted chip packets insert acts as a visual barrier • Effective crop guarding • Manned watch towers for farmers to guard fields at night (see photographs) • All the traditional tools • An alert fence and passive chilli applications • All the chilli options, both passive and active, used in conjunction to provide both discipline and reminder the include the *ACE* and *Mhiripiribomb*a options • Translocation • Biological Technologies i.e. • Contraception • Manipulating male reproduction and aggression

Hippo *(Hippopotamus amphibius)*	• Provide and maintain passageways • Lands planned in clusters that are properly fenced • Any development should be a minimum of 100 metres away from the river or dam waterline • Cluster defence - A strong solid barrier/fence or trench is essential • Apply individual crop/land minding in severely compromised fields • If these conditions cannot be met, seriously consider translocation them elsewhere as the technology to achieve this has been established	• Electric fence, if applicable • Traditional fence with electric off set • Traditional fence • Defensive barrier fitted with a taut steel cable some 500mm above ground passing *through* large solid poles at 7metre intervals that they are unable to step over • *Offset early warning fence* (4-5 metres from barrier string set 2,2 m up) • Fence can be fitted with cow bells • Plastic bottle with inverted chip packets insert acts as a visual deterrent • Effective on the spot crop guarding • Manned watch tower recommended • All the traditional tools discussed earlier • Barriers of any sort help to frustrate hippos • Alert fence and passive chilli applications • All the chilli options both passive and active used in conjunction to provide both discipline and reminder the include the chilli dispenser options • Torches and bear-bangers • Translocation options
Baboon *(Papio cynocephalus ursinus)*	• Remove all the infected baboon by lethal control • Discourage new incursions around towns, villages or homes • Diligently remove and incinerate all rubbish • Encourage community buy in to enforce local bi-laws and ensure clean living	• Dedicated guarding diligently watching over crops at all times • Traditional methods that include: • Banging tins • Poly tapes and streamers • catapults • Community rallying to help one another • Stock whips • Various homemade ‘pipe’ bangers • Improved bangers (firing live rounds over the top, carbide bangers and crackers) • Scarecrows - incorporating moving positions and hiding tactics to mimic real life situations • Manned watch tower recommended to deal with chronic incursions • Use of guard dogs

		• Community rally to provide organised drives to chase them out from the area to the PA's • Capture, paint and release of dominant males through cage traps • For extreme cases the removal of entire troops using large camp traps • Watch towers • Community participation • ACE ambushchillixploders • Cage traps • Large camp traps • Green laser
Bush pig *(Potamochoerus porcus)*	• Understand the conditions under which bushpig thrive • Reduce conditions for population increase in particular waste wet area management • Open out approach areas to crops • Exploit bushpig extraordinary sense of smell to repel them • Actively exploit the dry season to reduce numbers • Open up boundaries • Regular scout patrols to determine movement and lie up places • Low close wire fencing ≤ 500mm height with strong poles 7metres apart across vulnerable approaches • Set up and constantly change smell deterrents • Regular night patrols in the cropped lands	• Diligence • Bush pig camp trap • Good crop minding practices
Antelope – *species of plains game*	• Repellence techniques work well for antelope • Consider moving problem species to a collective wildlife use area • Exploit value added opportunities it provides • Good crop minding • Fencing is the best option	• Streamers on fences work well • Try scent options like spraying on rendered down lion/leopard scats
Crocodile *(Crocodylus niloticus)*	• Provide a minimum of 100 metres away from the river or dam waterline for houses and farming activities • Discourage passage and gathering of people close to the waters' edge • Plan water for consumptive purposes away from natural water bodies • Specific crocodiles known as problem individuals should be destroyed • Crocodile fence off a number of protected spots opposite dwellings	• Diamond mesh crocodile protection fence • Dedicated watch person diligently watching over activities within the protected area • Protected area should be in shallow water exposed, totally free of vegetation rocks or debris build up • Crocodile fences and the proper management of them.

	and night kraals, safe positions to access water • Where possible try to manage fishing along the rivers to try and improve fish harvesting in a sustainable manner • Good livestock minding – herding cattle and goats maintaining a watchful eye over them particularly when grazing close to water and kraaling them at night.	• Kraals • Trapping and translocation
Lion (*Panthera leo*)	• Must not be able to see in or out of night kraals • Kraals built providing solid walls • Exposed as much as possible • Livestock properly herded at all times • Away from protected areas • Dedicated guarding diligently watching over the livestock at all times • Implement some sort of flashing LED light system on the kraal walls • Strive to let the animals out earlier to graze and bring them back before sundown	• Diligence • Well-built kraals • Good livestock minding • LED lights • lethal control options • PAC hunting • Trapping and translocation
Hyena *(Crocuta crocuta*	• Proper kraaling essential • Must not be able to see in or out of night kraals • Kraals built providing solid walls • Exposed as much as possible • Livestock properly herded at all times • Away from protected areas • Dedicated guarding diligently watching over the livestock at all times • Implement some sort of flashing LED light system on the kraal walls • Strive to let the animals out earlier to graze and bring them back before sundown • Resist intimidating tactics that hyena may employ to gain access	• Diligence • Well-built kraals • Good livestock minding • LED lights • Trapping and translocation
Leopard *(Panthera pardus*	• Maintain passage ways through 'cheetah window' through protected area • Minimise access to livestock • Incorporate human and animal minders • Keep them out – proper herding • Incorporate an animal minder imprinted on each herd to chase away cheetah • Night kraals should still be used to ward off attacks by other animals • Livestock properly herded at all times • Away from protected areas • Dedicated guarding diligently watching over the livestock at all times	• Diligence • Well-built kraals • Good livestock minding • LED lights • Problem leopard - management of habituated individuals • lethal control options • PAC hunting • Culling • Trapping and translocation

Wild dog or Painted Dog *(Lycaon pictus*	• Daily patrolling by qualified tracker scouts is essential to accurately monitor game, livestock and carnivore movement and activity • Vigilance is essential to quickly discover the arrival of the dogs to the area and their general movement patterns • Mobilise minders to limit Lycaon access to livestock • Consider temporary fencing a smaller more manageable area until the dogs move on • Keep them out – proper herding • Night kraals should still be used to ward off attacks by other animals • Livestock properly herded at all times • Dedicated guarding diligently watching over the livestock at all times	• Diligence • Well-built kraals • Good livestock minding
Black-backed jackal *(Canis mesomelas)*	• Keep all domestic dogs vaccinated against rabies. • Place all lame, incapacitated animals and cows having difficulty in calving under direct protection. • Discourage unusual jackal build up. • Consider the use of toxicants only if necessary.	• Apply jackal proof fencing • Guard dogs • Separate and kraal infirm animals
Quelea *(Quelea quelea lathemii)*	• Active destruction of nests and fledglings during breeding • Good bird minding that includes active chasing away of birds alighting onto the crop using a variety of improvised tools • Small scale trapping of Quelea has been successfully carried out using standard box traps covered with ½ inch bird mesh of 1mx1m square 300mm high providing several tapered funnels of ± 250mm length around the edge leading in, adopting the 'fish trap' principle so that birds wandering in do not find their way out • Various designs of catapult traps	• String fences and streamers around the edge and within lands • Scare crows • Wind effected plastic sheeting and bags • Bangers and other noise providers such as whips • Active Human presence • Tools • Catapults • Traps

8. SCHEMES TO COMPENSATE PEOPLE FOR LOSS TO WILDLIFE

8.1. Compensation in perspective

Compensation and insurance schemes promote the mitigation of the effects of wildlife conflict once people incur damages by making payments to cover losses from predation. These measures have both *ex ante (*based on forecasts rather than actual results) as well as *ex post (*based on actual results rather than forecasts) benefits (FAO, 2009). HWC compensation schemes aim to spread the costs of wildlife conservation more fairly within society. Specifically, they aim to reimburse costs of lost property or life. Compensation programs may also aim to increase tolerance for wildlife and conservation policies, thereby reducing illegal killing of wildlife and resistance to conservation management actions (Muruthi, 2005). However, these approaches and programs are rarely successful unless people affected by conflicts view them as their own and are willing to invest in their success.

Although considered a key component of a human wildlife conflict strategy, the use of compensation mechanisms as a mitigation tool for human wildlife conflict has had mixed results (Lamarque et al., 2008; FAO, 2009). A number of schemes formulated and implemented in a wide variety of environments and governance contexts have taken a variety of forms.

In Africa, HWC compensation schemes are scarce and have rarely been effective (Lamarque et al., 2008; FAO, 2009). A few government-run schemes have been initiated (Botswana, Kenya, Zimbabwe, Mozambique) but these have generally not lasted long and the ones that remain (Botswana) have not placated farmers due to low compensation rates, procedural barriers to many rural poor, and administrative delays (Muruthi, 2005, Lamarque et al., 2008; FAO, 2009).

In their most common form, compensation schemes target reimbursement of individuals or their families who have experienced wildlife depredation. This is mainly in the form of damage to crops, livestock, property, or people injured or killed by wildlife. People experiencing wildlife damage may receive compensation in the form of cash or in-kind assistance. Compensation can range from more than fair market value to just a fraction of the value of the lost property.

Compensation programs typically target single species or small groups of species. Payment for damage by large or predatory protected species is common. In most schemes, there is a narrow definition of what or who is eligible for compensation. For example, compensation for damage by specific large predators may be limited to livestock owners following specified animal husbandry guidelines. Some programs may target single species damaging specific crops; others may pay for any damage resulting from any protected species or from any species if the damage occurs in a prescribed area (Cozza *et al.*, 1996, de Klemm, 1996).

According to Nyhus et. al., (2003), a major benefit attributed to compensation programs is that they may increase tolerance of wildlife and promote more positive attitudes and support for conservation among people who live closest to endangered and dangerous animals (Wagner *et al.* 1997). When carried out effectively, compensation programs raise awareness about community concerns and shift economic responsibility to a broader public depending on where the funds come from. Compensation may result in a landowner giving a wild animal additional chances or result in discussions of how to prevent conflict in the first place. Conservation education and moral persuasion may be more effective in the presence of compensation. In the absence of effective compensation programs, revenge killing or poaching may be more likely. For example, Zambia has an arrangement of assisting affected people when a person loses life to wildlife through the Disaster Management Policy.

8.2. Botswana's Compensation Scheme

Botswana is the only member of the SADC and consequently of the KAZA TFCA to employ a state funded compensation system. Compensation systems involve paying reparations to property owners for losses incurred to wildlife. The underlying tenet of all compensation schemes is that payments encourage tolerance for losses by minimizing the economic impact of these losses (Nyhus et al., 2005). In essence, compensation is a method for increasing tolerance for a problem and not a method of preventing the problem from occurring.

People suffering losses from wildlife are able to claim for compensation from damages to livestock, crops and other properties. Payments are not for the replacement value of the losses but generally, for no more than 80% of the value (DWNP, 1998). On filing a claim, the DWNP are required to validate it by investigating the evidence submitted and identifying the animal responsible and whether the species is on the list eligible for compensation.

As noted by Kgathi, et al. (2012), the compensation rates for damage by predators in Botswana are about 35% of the market value of the livestock, but households expect higher payments (higher percentage of the market value). While the old compensation system in Botswana paid farmers regardless of the animal husbandry practices adopted, the current system reimburses farmers only if there is evidence that efforts to reduce the risk of predation were in place by adopting good animal husbandry practices. However, indications are that the compensation is now at 100%. This will likely reduce the incentive for most farmers to protect their crops and livestock, as they can receive a payment after any conflict incident.

8.3. Common Challenges of Compensation Schemes[11]

- They are susceptible to corruption when managers/payers misappropriate funds.
- They are susceptible to fraud when recipients exaggerate, conceal, or fabricate evidence in support of claims.
- Scientific verification and separation of authority between verifiers, recipients and payers can reduce the risk of fraud.
- They are susceptible to waste when financial transactions, claims, or verifications are cumbersome, costly, or time-consuming.
- They are susceptible to moral hazard. In other words, when the full value for a lost good is paid and/or protection is more costly (or less preferable) to seeking compensation, it may be easier to allow a loss than to protect one's property, which may result in negligent ownership.
- They are difficult to reduce or phase out once begun. As wildlife populations' recover or spread, the costs may increase.
- If special interest politics and lobbying prevails in swaying payment rules, costs are likely to increase.
- Trade-offs are often invisible (high opportunity costs). Namely, the funds used for compensation could be devoted to other conservation activities or other wildlife.
- Recipients tend to view compensation as inadequate – even if generous financially – because of wasted time, lost investments, stress, frustration, or fear.
- Payments do not appear to raise the tolerance for the damaging wildlife among recipients – although beforehand- after assessments of the same individuals are lacking.
- Compensation programs appear to create political space for multi-stakeholder discussions of wildlife policy – although systematic studies of this conjecture are lacking.

[11] Excerpt FAO, 2009

- Political clashes between donors, payers, and recipients are likely, especially during formulation or renegotiation of rules.
- Donor disaffection or defection from the program is likely if rules change, wildlife are reclassified, or if lethal control of wildlife is paired with compensation payments. This is especially true where donors have short-term funding horizons and sustainability lies further into the future.

All compensation schemes, whether community-run or operated by some other entity, require clear rules to lower the risk of corruption. Such guidelines relate to the management (e.g., transparent accounting and monitoring) and separation of powers between verifiers of claims, payers of claims, and managers of funds. Putting in place monitoring structures that use scientific verification and separation of authority between verifiers, recipients and payers, or through systems of community peer pressure minimise the risk of fraud.

8.4. Namibia's Self Reliance System

The Namibian government developed the Human Wildlife Self Reliance Scheme (HWSRS) specifically to provide the means to offset the losses of communities and individual farmers caused to livestock and crops. The intention was also to promote the equitable distribution of benefits derived from wildlife so that individuals who suffer losses can benefit from wildlife income (Jones, et al 2014). The strategic approach under the HWSRS is that payments are made to cover livestock losses at rates that do not cover the full value of the animal concerned but aim to partially offset the loss to the farmer. In the case of damages to crops, a payment at a determined rate is also made to cover for damages as approved by the review panel.

However, in administering the scheme, MET works with NGOs and with the regional councils. Funds budgeted for the scheme are transferred by the MET to the conservancies for localised management although in some conservancies the MET continues to carry the functions of the allocation of the matching funds as well as the assessment and investigations of damages. In gazetted conservancies, the review panels consist of the representatives of MET, support NGO, the conservancy committee and traditional authority while in non-conservancy areas, MET appoint a Ministerial review panel of not less than three staff members to assess the application from payments and make recommendations for approval.

In order for the scheme to be self-sustaining, the HWC policy has a provision that when the government is issuing quotas for trophy hunting in conservancies, the quota allows for funds to pay for the livestock and crop damages to members of such conservancies. For non-conservancies claims, contributions also come from the Game Product Trust Fund. In addition, donors approved by the government can contribute to the scheme.

Five livestock species namely cattle, goat, sheep, donkey and horse are covered in the scheme in both conservancy and non-conservancy areas on state land and resettlement farms. There are five conditions outlined in the scheme for claims to be valid when there is death of any of the specified livestock species because of wildlife attacks. The national policy on HWC states that:

i. payments are only made for livestock killed in the multiple use zones of zoned national parks and not for livestock killed in a national park or conservancy exclusive wildlife zone;
ii. livestock death must be reported within 24 hours of the incident occurring, unless a valid reason for not doing so as stipulated is provided and the evidence thereof is still visible;

iii. the cause of death must be verified by a MET staff member or a community game guard where structures exists;
iv. no payment is made if the livestock was killed without reasonable precautions being put in place;
v. MET staff members together conservancy staff (if inside the conservancy) and traditional leaders inspect livestock enclosures and advise where strengthening is required.

As for crops (specifically maize, millet, sorghum and vegetables damages), payments are only made for those caused by elephants and hippopotamus as such damages are believed to be beyond farmers' control. No payments are made for damages caused by other animals because of two reasons; (a) such damages are difficult to verify and (b) it is possible (according to the policy) for farmers to take precautionary measures to control other animals.

Some conservancies do not generate any revenue but still get the matching funds. The N$60,000 each conservancy gets annually is not dependent on the level of conflict or value of loss caused by wildlife.

The key component for why the previous scheme worked was this tenant of *matching payments*. This means far less likelihood for fraud and the system will be *self-policing.* This is similar the basic ideas behind game theory. Implementing agencies noted that the amount of claims dropped and there was less fraud if local communities were matching the payments.

There are the pricing issues around the value of livestock or crops damaged. How much is a cow worth and how much should be paid out has to be weighed against what a conservancy can afford or what they want to or what was the animal worth. For example, where a Conservancy can only afford say N$800 but the market value may be N$3000 so a compromise of is reached. When a wild animal kills someone, a funeral contribution of N$5000 is paid out without any questions and quickly helps with perception issues.

8.4.1. Analysis of Namibian Human Wildlife Self Reliance Scheme (SWOT Analysis)

Table 3: HWSRS SWOT analysis.

Strengths	**Weaknesses**
• Has put in place a mechanism to compensate for loss of life, crops and other damages because of increased wildlife after improved conservation. • Devolving management of funds at the lowest level empowered local communities. • Low level of bureaucracy • Compensation targets individuals who incurred costs. • Payments made to those who have taken measures to protect their livestock/crops from damage. • Internalisation of both the costs and benefit of living with wildlife. This is different from other cases that are donor dependency. • Economic benefits derived from wildlife under this scheme are greater than those incurred from wildlife related damages are. This gives strong motivation for	• Back-up insurance scheme payments by removal of predators is not a sustainable strategy (if the goals include wildlife conservation). • There seem to be weak/no-legal framework to support this system to ensure its financial sustainability. • There is a gap in terms of ensuring appropriate skills at community level for development of specific management interventions. • The scheme does not account for the different impacts of human wildlife conflicts or damages according to the status of individual households. The damage to the crops of poor small producers will have higher impact than similar damage to the crops of more wealthy family with larger croplands. • The scheme is a not clear about those

communities to live with wildlife despite the problems caused by it. • For the scheme to work it should not be in isolation from the ability of communities to generate other economic benefits	living close to wildlife habitat but not in conservancies who have high chances of facing damage problems. Agricultural enterprises (both crops and livestock) located close to wildlife habitat/corridors may suffer many times problems resulting in a significant drop of their incomes. This does not give much motivation to these people, as the scheme does not cater for them entirely. • It is difficult to place a value on the most significant and catastrophic impact of HWC - human injury or loss of life.
Opportunities • Improve policy dialogue at local and national levels. • Network building based on the insurance scheme model at national and regional levels. • Potential for improved knowledge in dealing with HWC issues and compensation schemes • Improved governance, increased empowerment, increased skills and capacity. • Diversified livelihoods and increased income.	**Threats** • Potential for increasing human population attracted to income generated from wildlife. They will likely lead to increased human wildlife conflict. • Risk of elite capture in paying out compensation. • In the event of many communities affected (whose crops, livestock destroyed), more funds than available may be required for compensations. • Valuing impact of damage might cause new conflicts or disputes especially if there are misunderstandings among people.

8.4.2. Namibia's HWSRS: Is replication possible in Other Partner Countries?

Design

The conservancies established the precursor to the HWSRS in 2003 for application within the borders of their conservancies. This system has its own management structures and a conservation mandate to generate and distribute wildlife-derived income equitably. The main purpose of HWSRS is to provide a mechanism that paid out for loss of life, livestock and crops[12].

HWSRS is not a typical insurance scheme where premiums are paid in advance, hence the term self-insurance. It is more of a condition-based payment where registered conservancy members have to take mutually agreed proactive measures to protect themselves, their crops and cattle. Communities are willing to pay out after an incident occurred as opposed to advance payments like in most commercial insurance systems.

What makes it work?

Collective income from tourism and wildlife is successfully used to compensate registered members who incur losses. Management of this system is devolved to the lowest level, and there is generally no abuse of the system. In addition, claim conditions are strict and this encourages responsibility among the communities. In most cases, the actual loss incurred

[12] http://www.nacso.org.na/dwnlds/training_manuals/3.06%20HWC.pdf

would be far less than anticipated which make this relatively affordable. Both financial and technical support from NGOs partners is critical in driving this system.

Replication in other countries

For replication in other countries, understanding policy context and influencing it towards this is essential. The model should be well recognised by the national policies. National governments should be prepared to devolve power to the lowest level as done in Namibia for this to be successful. Ways of ensuring transparency and accountability as well as local management all backed by favourable policies should be in place. The idea of building networks and partnerships to support the scheme is important for this system to work. Capacity building including local administration of the scheme should be at the forefront to help build strong foundation for the system. Partner countries also need to put in place mechanisms to diversify their sources of income for the communities to benefit fully. In Namibia, much of the revenue comes from the hunting industry. In countries where hunting has been banned such Botswana and Angola, it would be essential that lucrative alternative revenue streams be established for this to be applicable.

8.4.3. Core elements for a successful adoption of the HWSRS in partner countries

1. Quick, accurate verification of damage

This requires training, adequate tools to properly identify losses, and a mechanism to establish trust among all participants to ensure that the process is fair and honest.

2. Prompt and fair payment

Timely payment can temper the anger of wildlife damage victims and reduce retaliation against animals or conservation authorities. The compensation process needs to be transparent, protected against abuse, account for unverifiable losses (i.e., when it is difficult to determine how or how many livestock were killed), and be capable of evaluating differences in the value of different livestock or crops.

3. Sufficient and sustainable funds

An inadequately funded scheme may cause more problems than no scheme at all. Wildlife damage may vary considerably from year to year, or wildlife may make multiple kills creating large losses at a single point in time. Managers need to plan for contingencies, for long-term sustainability, and/or for an exit strategy. Solid baseline information is necessary to accurately predict future compensation claims and to determine if compensation makes sense in a local context.

4. Site specificity

Although there are some general guidelines that can aid wildlife managers in implementing effective self-insurance/compensation schemes, it is important to be sensitive to site, species, and culture-specific issues. A sense of shared program ownership between local people and institutions running the schemes can reduce the potential for conflict and abuse.

5. Clear rules and guideline

Successful programs tend to have strong institutional support and clear guidelines. Self-insurance schemes linkages to sound management practices becomes critical. Efforts cannot be ad hoc.

6. Measures of success

Is a compensation scheme having its intended impact? For example, are more people supportive of wildlife and conservation? The first purpose of the scheme is always to ensure

that those who have a loss from wildlife receive payment. Ultimately, are fewer animals of conservation interest being killed than would have been without the program? If one wants to have a scheme that positively affects improved stewardship, then it could twin the scheme with a conservation performance payment, i.e. payment incentives for good management, and not just wait for a loss before making payments.

Despite the apparent potential implementation characteristics of the HWSRS in the partner countries, the fact is that there is no experience of testing of this approach in a different setting apart from Namibia. This would suggest that, before the extensive promotion and adoption of this approach, undertaking some pilot studies and model testing is vital to understand the viability and applicability of this scheme in all the partner countries. In the case of Angola, establishment of CBNRM is important where awareness and training programs takes centre stage.

Key determinants of success for compensation schemes typically include the accurate and rapid verification of damage, prompt and fair payment embedded in a transparent process. A long-term source of funding capable of responding to variations in damage over time, clear rules and guidelines that link payment to sound management practices, an appreciation of the cultural and socioeconomic context, and an ability to actively monitor the wildlife population of interest.

9. CAPACITY NEEDS ASSESSMENT FOR COMMUNITIES

9.1. Training in mitigation strategies

The main objective of the Training Needs Assessment assignment was to assess the partner countries' training needs and recommend training modules to respond to the identified needs. The whole assignment ran from the post inception-meeting period (September 2015) until the report validation meeting. Twenty-one stakeholders representing 17 institutions derived from all the partner countries participated in the exercise.

The main approach used in the whole exercise was participatory systematic stakeholder consultation. Formal and informal interviews formed the basis of primary communication with most stakeholders with invitations to validate the identified training needs and training modules. It is recommended that the partner countries should promote a CBNRM based HWC mitigation concept that seeks to achieve structural transformation, which will sustain community empowerment by making the communities affected by HWC more tolerant, responsible and resilient in managing conflict situations. See appendix 3 for a detailed species (elephant) based training module that can be adapted to suit other wildlife species.

9.1.1. Defining capacity needs and strategies

Major tasks for the training needs assessment were as follows:

- Examine the structure and operations of a selected number of organizations including but not limited to the partner countries' national parks and wildlife authorities and communities living with wildlife.
- Interview KLOs from all the partner countries to examine areas of training gaps and actual training requirements.
- Through probing, clearly define the expected impact according to the organization e.g. organizations operating in the KAZA TFCA and involved in HWC mitigation in terms of conflict mitigation protocols.
- By interviewing the traditional local authorities in some of the partner countries exploring the traditional knowledge in-house training skills available in the affected communities and their ease of access.
- Where possible, visit the targeted areas (i.e. area of potential training beneficiaries) to identify local experience available, which can be called on for demonstration as realistic examples in the area of training.

- Examine the past and current training materials/programs of the concerned area in the organizations and identify their strengths and weaknesses relative to the identified needs. This involved traveling to some of sites in the partner countries.
- By reviewing and comparing the material content with the common concerns of the rural people affected by wildlife depredations, assess the applicability of those materials to specific situations, and how locally available materials usage in technical demonstrations is a requirement.
- Build the corresponding training modules per group of needs/institutions.
- Incorporate the findings of the training needs into the training modules

9.2. Data Collection

Data collection methods used in the exercise included the following:

- Secondary records: this included reading the literature provided by the partner countries as well as other sourced from partners.
- Semi-Structured Interviews (SSI) used throughout the TNA exercise.
- 3Ls Survey: (Look, Listen and Learn) method was used during visits to the operating project sites.
- Focus group discussions (FGD) were conducted with CBOs

9.3. Training needs findings

Knowledge and practice of training concepts and process. Under HWC mitigation training, it was noted that there is need to have communities affected by conflict understand the following questions;

- What is Human Wildlife Conflict (HWC)?
- Where does it occur in your community (spatial aspect)
- Who is responsible for solving HWC?
- When does it occur (temporal aspect)?
- Is the conflict increasing or decreasing?
- How does it occur?
- What causes it?
- Which animals affect you?
- Which animals are the most problematic?
- When did you first experience the problem?
- Where does these animals come from?
- How many come at once?
- How often /frequent do they come?
- What are the current mitigation measures in your community?
- Are the mitigation measures working? (Explain)
- Which mitigation measures would you propose?

Above all, they need to know the general behaviour of problem animal species particularly in conflict situations. Most respondents wanted to identify how training processes particularly those aimed at HWC mitigation need linkages with CBNRM. Some partners define CBNRM in terms of geographical location of management functions. Consequently, most CBNRM capacity building efforts seek to create structures, which can respond effectively to the demands of a natural resources project management functions. For example, in a number of CBNRM activities, the formation of CBOs and training in leadership skills and functions forms the basic requirement. Development workers prescribe job descriptions to the committees. In this case, the consultants emphasized the need for co-management of HWC between parks officials and affected communities, sharing responsibility. Most partners while clear about the

meaning were not sure on how to initiate community-based conflict mitigation (CBCM). The concept of co-management begs a number of questions such as why co-management? Is it co-ownership? Co-decision making? Co-evaluation? Co-accountability? Co-responsibility? Co-benefiting? Is it a partnership? Alternatively, is it a transitional strategy towards autonomous community based conflict mitigation and natural resources management? These were some of the questioned raised by most respondents.

As in CBNRM, the main issue in a CBCM approach is structural: powerlessness. This means that communities, at some historical time, lost ownership, control, influence and/or responsibility over the means (natural resources) as well as the initiative to try to reduce conflict that is critical to their own development. In this case, a CBCM approach becomes an empowerment process to regain lost power, ownership, decision-making and control of the conflict mitigation process. Community-Based-Mitigation is a participatory educational/learning and action process, in which the communities are the subjects and proponents of the process. The process revolves around the knowledge, skills, decisions, institutions, organic leadership, technology, culture, felt needs, aspirations, and other capacities of the beneficiary community in mobilizing and implementing HEC reduction techniques. In addition, the community does the functions of management, such as, planning, implementation, maintenance, monitoring, evaluation, benefiting and re-planning of the techniques.

Feedback showed that the most dominant training approach most of the training participants experienced prior the interview is teacher/facilitator-centred. The training is based on pedagogical principles. The development worker or parks officer knows it all, and the community knows nothing approach. Messages are already accepted as true, so a community is expected to accept. The main impact of the teacher-centred approach is that it turns most adults into children. CBCM aims to change this approach where communities become perpetually dependent on extension workers or parks authorities to solve their wildlife related problems. Intellectual self-reliance, creativity and self-management are retarded whereas CBCM enhance these. Instead of education fulfilling its humanizing process, which all humans are capable of, the approach dehumanizes. Communities do not have to wait for outsiders to tell them how to survive in their habitats.

9.4. *Training needs assessment conclusion*

- Most organizations in the partner countries have structures and operations that have adequate capacity to contribute to sustainable CBNRM and consequently CBCM. That however, needs to be re-aligned and coordinated better.
- CBNRM Training has so far focused on giving messages and some skills in a teacher-pupil relationship. Technical training in CBNRM is still required in several areas of capacity building particularly process training and continuous follow-ups that remain the weakest. This was noticed in most HWC mitigation demonstration sites whose conditions were not up to a level expected of a demo site. It was however attributed to a lack of proper and extensive training and also the seasonality of the conflict.
- There is little documentation on local CBNRM examples or models. Most of what is documented is based on donor projects. Natural resources management and subsequently CBCM is not just a project, and cannot be waiting for donors. In fact, natural resources management, particularly CBCM requires less of school education but sound ecological management practices are a product of culture, which is a mechanism for adaptation and hence survival.
- Skills set required in the majority of the KAZA landscape related to HWC include;
- Conservation farming
- Sustainable natural resources extraction and utilization (include fishing, water harvesting, etc)
- Recording and monitoring of HWC incidences
- Identification of problem animal species particularly where livestock has been killed

- Identification of alternative sources of income and livelihood coping strategies

10. RECOMMENDED INSTITUTIONAL ARRANGEMENTS, PRINCIPLES AND GOVERNING POLICIES

We have outlined what we believe are many of the fundamental constraints and complexities associated with HWC. There are many levels that HWC need to be understood and managed including the most difficult, political. In our specific breakdowns we will outline methods that vary from country-to-country, region-to-region; but most of the interventions, institutional arrangements and principles we are advising to be adopted are universally applicable to all conflict situations.

The practical solution to the problem of wildlife damage lies not in blaming the people or the animals but in establishing appropriate legal and institutional arrangements on wildlife damage, while at the same time adopting benign alleviation measures. This should work hand in hand with a conservation strategy and laws that take into account core human welfare concerns, values because while humans have responsibility for wildlife welfare, human welfare is paramount hence prioritised. Admittedly, the HWC cannot be fully resolved thus, management of people's attitudes and perceptions is critical. There is need therefore for the five partner countries to have effective legal and institutional arrangements on wildlife damage and maintain sustainable wildlife management systems that do not undermine human rights, human welfare and livelihoods.

In this section, we review the importance of regular monitoring and its role in *adaptive management*[13]. This approach creates a logical feedback system for managers in a system like the KAZA TFCA that plugs data from regular monitoring into a decision tree. It is an effective way to manage a large heterogeneous and volatile system. Partner countries need to apply an adaptive management approach in addressing HWC problems, modifying mitigation tools and methods through continuous learning and feedback. We also stress the need to combine monitoring and evaluation with an intervention to improve the current situation.

Admittedly, HWC cannot be fully resolved but the rage the people have towards the animals. There is need therefore for the five partner countries to have effective legal and institutional arrangements on wildlife damage and maintain sustainable wildlife management systems that do not undermine human rights, human welfare and livelihoods. To achieve this, we recommends the following reforms:

10.1. Need for constitutional provisions on wildlife

While most of the partner countries have legislative provisions on wildlife, all the countries lack constitutional provisions on wildlife or even natural resources. A national Constitution is a basic charter for a country representing the goals as well as the primary obligations and mandate of state and governmental authorities. It should therefore recognize a country's major resources and sectors of which wildlife is a major resource in all the partner countries. Such a provision could preferably be in the form of a statement of public policy, for instance, stating that wildlife is a national heritage vested in the state on behalf of, and for the benefit of, the present and future generations. Such provisioning would not only be a guideline for governmental action in matters of wildlife, but would also have given direction on issues of wildlife ownership, control, use, as well as benefits, and costs.

[13] **Adaptive management** (AM), also known as **adaptive resource management** (ARM), is a structured, iterative process of robust decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring. https://en.wikipedia.org/wiki/**Adaptive_management**

10.2. Establishing a Compensation Fund for Wildlife Damage

Under the wildlife damage compensation and or self-reliance schemes in both Botswana and Namibia, compensation/offset payments are from budgetary allocations voted by Parliament from the Consolidated Fund according to expenditure items that Parliament consider a priority at the time. Such priorities usually vary according to circumstances and political exigencies and there is no guarantee that wildlife damage will always remain a top priority item, hence there is usually not enough allocation for wildlife damage compensation. If all the partner countries are going to adapt a self-reliance or compensation scheme, there is need therefore to set up a fund specifically designated for paying victims of wildlife damage. Monies from this fund should then be used only for compensating damage caused by wildlife. Such monies may be derived from revenue from tourism and wildlife related activities, or through the traditional methods of raising government revenue, for instance, taxation.

A policy of sharing of benefits and revenue will ensure that the local communities benefit positively and directly from wildlife revenue as well as benefits such as boosting cottage industries and improving communal infrastructure such as schools and hospitals. Other benefits could include: allowing some grazing of domestic animals within designated sections of protected areas during drought periods; allowing local people to cut thatching grass for personal use on a regulated basis; allowing people to access water sources in the protected areas; providing transit through protected areas without permit requirements.

10.3. Data collection and mitigation

The HWC problem is so acute in most regions of the KAZA that there is no time to do 'proper science' and we recommend that an aggressive mitigation program be set. In many areas, communities are experiencing *interview fatigue.* They are now cynical about any benefits new projects might bring them. Using the lessons learned from a range of recent interventions across the KAZA and beyond famers can easily withdraw their support for well-intended interventions. Once a project suggests an idea to communities, it needs following through in a reasonable amount of time or people become disaffected.

Technological solutions involving data collection often fail in rural Africa for a range of reasons and no technology will outpace the simplicity of pen and paper but a combination of the two is highly beneficial as technology has the extraordinary power in communicating messages. While not part of the ToR's for this consultancy, we support the idea of the data collection system developed by PPF for KAZA TFCA and believe it should be implemented and expanded. This idea of a 'live platform' where data can be entered into a smart phone and accessed on the web instantly is something that PPF has been working on for some time. This system, which uses ArcGIS mobile platform ArcCollector,[14] allows any content recording, visualisation of content via graphs and charts and spatial data reporting via maps.

[14] https://www.esri.com/products/collector-for-arcgis

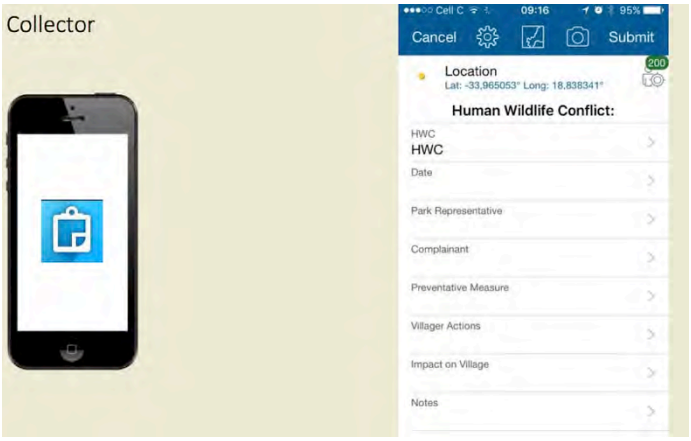


Figure 3: HWC ArcGIS mobile platform developed by PPF for Existing and Developing Spatial Knowledge & Integrated Planning Resources in KAZA. Source: Beech, (2015)

A similar system set up in India articulates the advantages of this system: "This initiative seeks to document and map the various instances of human wildlife conflict across the Asia, in the hope of improving our understanding of the issue. Such a platform will strive to include features allowing anyone interested to provide relevant information, and add to the diverse range of instances. http://www.wildlifeconflict.org"

It is also important to try to have funding in place for a multiyear program as all interventions take a few seasons to institute. Importantly, many conflict situations are highly seasonal and farmer, community and institutional memories can be short.

10.4. Specific Interventions

We suggest a multiple phased approach toward addressing HWC in the KAZA region:
The vision we have involves a three-tiered approach that follows a Vertical Integration Model VIM). This approach attempts to harmonize policies as the causes and effects of HWC occur at multiple scales and across multiple sectors. VIM is a process, which attempts to integrate governance activities at the local, national, and international levels to effectively face the challenge of wildlife conflict (Anstey 2010).

10.4.1. Record and 'off set'

It is crucial that there is local support for monitoring and data collection that can better inform decision-making through calculation and quantifying wildlife damage as economic data, quantifying farming areas 'at risk' in each HWC zone, producing HWC maps at different scales suitable as well as comparing relative levels of pest species damage. Farmers need to feel that informing wildlife authorities about an incident has some value and in some way, their participation in the process will work toward improving the situation.

This should not be in the form of *compensation* but a *modified self-assurance scheme* that is transparent, administered locally and has farmer support. This goes a considerable way toward improving the relationship with stakeholders who are suffering losses. Community participation in the damage assessment is important for the transparency of the system. Earnings from consumptive use of wildlife and ecotourism income serve as a long-term source of revenue to compensate farmers suffering from crop damage and livestock loss by contributing to the self-insurance scheme capital.

As noted above it is crucial to *mitigate* conflict and this can be achieved through the methods we have outlined in the species-specific section attached as appendix 2. It is important to highlight that to keep farmers engaged with the mitigation process they need to believe that it is beneficial to adopt the methods suggested.

An important question that we have been confronted with is: How do we motivate farmers to a) collect data and b) to mitigate? In this case we suggest the establishment and reenergizing of HWC committees, as appropriate, involving interested stakeholders from a variety of sectors to advise management authorities. This is crucial for moving any mitigation initiative forward.

One of the things we have observed across the region is a disproportional amount of effort put into recording PAC. Many of the people responsible to collect these data are poorly paid, unmotivated and constrained by lack of transport and access to airtime.

10.4.2. Promote Conservation agriculture

Conservation Agriculture (CA) has tremendous potential for achieving sustainable yield increases by improving the growth conditions for crops and the efficiency of input (www.fao.org/ag/ca). CA is a zero-tillage-based cropping system for farmers in low and erratic rainfall areas, with poor soils that offers an array of practices, but at its core are three interlinked principles that can be applied in a variety of combinations to meet the needs of resource-poor farmers and enable them to grow more crops in a smaller area: continuous minimal mechanical soil disturbance; permanent organic soil cover; and, diversified crop rotations of annual crops and plant associations of perennial crops. CA, therefore, offers the potential to significantly improve food security among rural subsistence farmers. By increasing yield in a smaller area, farmers can secure enough food for their families and protect the smaller area of cultivated land more effectively and efficiently with HEC mitigation techniques like chilli deterrents.

CA also provides potential to address HWC by reducing the amount of land required for agriculture and therefore reducing HEC levels at the landscape scale (Songhurst 2012). One of the main drivers of HEC is land use change and resulting increased competition for space and barriers to elephant movement corridors.

In addition, a major challenge to unsustainable land use is the traditional ‘slash and burn’ agricultural practice, whereby naturally low existing soil fertility is greatly reduced by continual same crop production and drives farmers to abandon their fields after 5 to 10 years and seek new land elsewhere. CA, therefore, reduces the size of agricultural land required by farmers and also makes existing fields sustainably productive, thereby, curbing the ‘slash and burn’ farming practice.

Farmers fields in most of the KAZA are also often situated far from the village to avoid livestock raiding, however, this then makes fields more susceptible to elephant crop-raiding (Songhurst 2012). If people can plough sufficient food in a smaller area through CA practices then this will potentially enable them to protect their fields from livestock and reduce the need to plough far away from the village.

Over the long-term, CA also has the potential to significantly improve livelihoods beyond a reliance on subsistence agriculture. FAO has recognized that CA has the potential to bring higher prices in emerging niche and “green” markets because of the quality and safety of its production and the environmental services generated by its production processes. Establishing organic certification processes or setting up carbon sequestration compensation mechanisms encourages farmers to shift to CA and other sustainable agriculture practices. A long-term strategy that includes pursuing these avenues of market generation and an enriched local economy will also contribute significantly to nurturing empowerment and reduced vulnerability among farmers in the KAZA TFCA.

One particularly good example of the successfull link between innovative farming practices, markets and conservation has been the COMACO project[15] in the Luangwa Valley of Zambia. Rates of illegal hunting have declined over the years thanks to the alternitive livilihoods provided by this private company.

10.4.3. Long-term interventions to address HWC

Land-use planning

The main factor attributed to causing many conflicts between humans and wildlife is land use change. Wildlife habitats can become reduced and fragmented when more and more is converted to agricultural land or human settlements, which in turn lead to more frequent interactions between people and elephants wildlife. One long term mitigation strategy to reduce HWC is to reduce the size of agricultural land required by farmers (Songhurst 2012), allow free movement of wildlife along identified corridors (Chase & Griffin 2009) and develop more effective micro-level land use planning (Hoare 1995). A clear understanding of spatial use of both people and wildlife in an area is required to assist with such detailed land use planning, current and future movement routes, favoured habitats and resource locations. It is also important to understand the population dynamics of both human and wildlife populations, in order to predict future land use requirements. Partner countries should build on current knowledge and collect data on wildlife and human spatial use in the respective countries in order to find ways to accommodate the needs of both species in future land use plans through zoning different land uses. Other long-term interventions intertwined with land use planning to address the conflict should consider:

- Incentives provided for landowners not to convert land from bush to fields.
- Increase and harmonize research related to wildlife and communities to inform decisions.
- Consolidate farms by forming cultivation zones away from wildlife corridors and critical ranges.
- Harmonise land-use planning approaches across all sectors by Government department policies on land use need to be harmonised).
- Develop, as appropriate, long-term plans to manage locally overabundant wildlife populations in harmony with national wildlife policies.
- Enforce anti-poaching to minimize illegal killing of wildlife that sometimes drives wildlife close to human settlement from thick forests.
- Ensure the flow of community benefits from wildlife-related activities to improve services such as boarding schools and clinics.
- Investment in monitoring wildlife numbers, population trends and to understand wildlife movements, particularly across international borders and between protected areas and community conserved areas
- Strengthening and improving CBNRM in KAZA through capacity building of CBOs and promoting good governance
- Investment in a highly focused and targeted public relations campaign to inform national decision-makers, international conservation organisations and the international general public and decision-makers of the issues concerning HWC and wildlife management
- Lobby to have issues pertaining to HWC to be included in the education curriculum of schools for communities to learn formally about such issues from a young age. This is possible through the existing structures in the wildlife departments such as the

[15] http://www.itswild.org

Environmental Education and Extension Program as well as the Community Extension and Outreach Division or through NGOs operating in the region.

10.4.4. Policy harmonization

The policies relating to HWC that we have outlined in the previous sections need reviewing by a KAZA TFCA committee and harmonized over time. Policy harmonization should be done at national and then at KAZA level to manage resource utilization particularly where resources are shared by countries. The policy review also meant to identifying the constraints of the frameworks, in relation to cross-sectoral inconsistencies, information gaps and impediments to implementation contained therein, and highlighting opportunities to engage with and contribute to future policy implementation and decision-making.

Several policies in each country are relevant in terms of their contribution as drivers of HWC, while others guide the current strategies that address HWC. Policy related drivers of HWC arise, primarily, from the current multiplicity of sectoral policies, programmes, legislations and regulations that guide the use of land and natural resources, which are often inconsistent and conflicting. For example, in Botswana, agricultural policy encourages the clearing of land for cultivation, providing incentives through the Integrated Support Programme for Arable Agricultural Development (*ISPAAD*). This is a Government grant scheme to plough, fence and cultivate, while a number of natural resource management and sustainable use policies provide for the promotion of wildlife and its sustainable use in the eastern panhandle WMAs and the protection of important wildlife areas, like corridors.

A lack of appropriate land use planning (zoning of land uses) in the eastern panhandle and elsewhere in Botswana means, however, that these opposing policies create frequent overlap of land uses and conflict arises as a result. Other challenges arise from conflicts between national policy on wildlife ownership and inconsistencies with regards to local devolution of wildlife management and benefit potential among local communities living with wildlife.

These policy inconsistencies and conflicts are exacerbated by poor cross-sectoral communication and implementation coordination, both at the national and district levels. Responsibility for the implementation of these policies, regulations and programmes is spread across a broad spectrum of institutions leading to fragmented understanding and a lack of implementation (Ecoexist, 2013).

10.4.5. Abolishment of Compensation Schemes

We propose a gradual removal of the scheme i.e. reducing the amount paid out on an annual basis for any crops lost, and introduction of self-insurance schemes. This contrasts fully the current situation whereby the amount paid out in the past 5 years has been increasing and communities still feel that the compensation is even lower than they expect.

This gradual removal of the scheme can be introduced with the temporary adoption of **Conditional payment of compensation**. This implies that those farmers engaged in mitigation will have a percentage of their lost property being compensated for. For example, if one is not kraaling his cattle he will not be paid anything, the same applies to those not protecting their crops or leaving near their crops shall not be compensated for any loss they incur. Those settling illegally in elephant corridors should have the same fate as well.

The process would then culminate in the establishment of a **Community self-insurance schemes**. The concept is currently in place in Namibia and has been touted to be one of the most realistic alternatives to the present compensation scheme. The system will deal with issues of conflict resolution as well as payments for crop losses but is not centralized. The Conflict Resolution Committees (CRCs), which is the community leadership of traditional

authorities, seeks to balance the losses of individual community members against benefits from wildlife/elephants gained by the communities. Farmers will then be paid fixed-rates for losses from elephants or any other wildlife species that have a collective value to communities, with payments only being made to registered members, in the event of such member's field being predated upon. However, such payments will only be made within a specific laid down framework of rules and conditions (some kind of constitution), which need be developed by the community members themselves. Claims that fail to meet specifications in the constitution will be deemed ineligible for payment.

10.4.6. Support to data collection and Monitoring Program

Landscape level monitoring and the analysis and evaluation of HWC is important in order to develop land use planning and predictive mitigation (early warning). All five KAZA countries have undertaken some form of monitoring, but none have been as comprehensive and well thought out as event book used in the Zambezi region, Namibia, and later was adopted with varying degrees of success in Botswana and Zambia. However, as this consultancy has identified, the data collected are often hard to access for logistical and possibly political reasons. International press exerts great pressure on Government Departments. Support for monitoring and data collection that can better inform decision-making through:

- calculation and quantifying wildlife damage as economic data,
- quantifying farming area 'at risk' in each HWC zone,
- producing HWC maps at different scales suitable as well as
- comparing pest species damage to have comparative analysis.

Support for in-service training of mid-level managers (particularly on issues related to wildlife management and HWC in particular). Support for CBNRM, particularly on institutional and governance issues so that communities can be empowered to conserve wildlife and manage human wildlife conflicts in a manner that achieves a win-win outcome. Investment in a highly focused and targeted public relations campaign to inform national decision-makers and the general public of the issues concerning wildlife management in all the partner countries is needed.

For example, it would be interesting to see if data on HWC are given back to the communities, and discussions held to understand the dynamics of the conflict in a following period and the effectiveness of certain measures. This may help in getting communities more engaged in the management of the situation, as it is essential to communicate.

10.4.7. Publicity and Advocacy

Using various mediums of communication (e.g. theatre) to address rural villagers about HWC is complicated and often politically charged. If a Government agency, with multiple responsibilities is given the mandate to roll out a new idea, misinterpretation by suspicious community members is common. It is important to explain any new initiative and we recommend using a mobile platform such as a purpose outfitted overland truck to take a road show to the communities one wants to influence. By outfitting, a truck with a team of young educators and materials, it is an effective way of spreading the conservation message. Getting people discussing a new initiative may contribute to achievement of the many KAZA educational goals[16].

[16] This has been undertaken successfully by Resource Africa in the communal lands around the Kruger Park, South Africa.

10.4.8. Coordination of HWC within the KAZA TFCA

Establish a specific multi-sectorial group that is able to deal with HWC issues in a way that is most efficient and effective, and is able to coordinate well the various activities, consolidating the data from the different sectors, and as such maximizing the resulting interventions.
Improve the dialogue and communication with communities on issues of HWC.

10.4.9. Training

Continue with the various programs of training, to improve the technical capacity of the various stakeholders that are responsible to respond to HWC (Government scouts, as well as communities and others), the understanding on animal behaviour and wildlife management, as well as the general awareness programs. This will also include reviewing the time-frame for the training programme, tailoring them according to area specific requirements.

10.4.10. Other interventions

- Ecotourism development: earnings from tourism particularly in areas within the wildlife range to serve as a long-term source of revenue to compensate farmers suffering from crop damage and livestock loss by contributing to the self-insurance scheme capital. In addition, trying compensation in terms of kind or food supply's impact need to be determined.
- Increase and harmonize research that is related to wildlife and communities to inform decisions
- Partner countries need to apply an adaptive management approach in addressing HWC problems, modifying mitigation tools and methods through continuous learning and feedback
- Compile, promote and disseminate existing information on HWC interventions to all levels from communities to national level decision makers
- Develop or strengthen policy guidelines for reducing HWC at all levels
- Provision of incentives not to convert land.
- Livestock and wildlife promotion as alternative land uses to cultivation.
- Where possible, develop incentive mechanisms for people to increase benefits from wildlife, while reducing costs
- Establish HWC committees, as appropriate, involving interested stakeholders from a variety of sectors to advise management authorities
- Harmonise land-use planning approaches across all sectors
- Develop, as appropriate, long-term plans to manage locally overabundant elephant populations in harmony with national elephant policies
- Enforce anti-poaching to minimize illegal killing of wildlife which sometimes drives wildlife close to human settlement from thick forests
- Planting and harvesting seasons should be synchronised to limit individual risk of crop raiding.
- Farms should be consolidated in cultivation zones away from elephant corridors and critical ranges
- Alternative, community-based tourism activities should be developed in the project area (such as elephant-back safaris; in Zambia's Livingstone District, one CBO under chief Mukuni is currently involved in elephant back safari and lion encounters/walking with lions, etc), bird watching and walking and horseback safaris.
- The flow of community benefits from such wildlife-related activities should be ensured, to improve services such as boarding schools and clinics.
- Investment in monitoring wildlife numbers, population trends and to understand wildlife movements, particularly across international borders and between protected areas and community conserved areas
- Strengthening and improving CBNRM in KAZA TFCA through capacity building of CBOs and promoting good governance

- Investment in a highly focused and targeted public relations campaign to inform national decision-makers, international conservation organisations and the international general public and decision-makers of the issues concerning HWC and wildlife management
- Support for monitoring and data collection that can better inform decision-making through: Calculation and quantifying wildlife damage as economic data, quantifying farming area 'at risk' in each HWC zone, producing HWC maps at different scales suitable as well as comparing pest species damage to have comparative analysis
- Lobby to have issues pertaining to HWC be included in the education curriculum of schools for communities to learn about such issues. This can be done through the existing structures in the wildlife departments such as the Environmental Education and Extension Program as well as the Community Extension and Outreach Division or through NGOs operating in the region.
- Need to have other mid-high tech methods of reducing HWC in place e.g. where resources permit electric fences could be used. However, a feasibility study is required; one that takes into account a thorough Cost Benefit Analysis. Where fencing might be extensive, an Environmental Impact Assessment (EIA) may be necessary.

Interventions

- The above interventions need to be constant, and not just occasional campaigns;
- There needs to be greater active participation in the Strategy activities by the various responsible parties;
- Introduce other, innovative mechanisms and approaches on dealing with HWC;
- Work with fishermen on fishing techniques that may reduce conflicts;
- Management committees should have better logistics capacity;
- Increase the number of scouts where there is need;
- Introduce trained hunters in certain areas to resolve dangerous problematic animals (not applicable to Botswana);
- Produce and implement strategy documents on the management of HWC

Equipment

- Equip ground teams with appropriate weapons, ammunition, uniforms and other logistics, to scare away animals;
- Continue with the program of placing signs on areas of conflict;
- Provide means of transportation (e.g. bikes, boats and vehicles);

Procedures

- Simplify procedures for licensing game farms, and harvesting crocodile eggs (especially in Zimbabwe);
- Infrastructure improvement
- Continue with the program of placing fences where appropriate and removal where inappropriate;
- Continue with the program of construction of water sources and river pools;

Funding

- Increase the funding sources, by having not only further donor partners, but also a set budget from the Government allocated and designated for this category.

10.4.11. Forming partnerships for implementation of HWC

This selection of partners for the KAZA TFCA to work with and ultimately fund, is complicated. We interviewed representatives from many organisations doing useful research and implementation. To suggest working with one elephant group, for example, over another or one predator group over another, is not productive. We simply reviewed the organisations that responded to our requests for an interview.

Criteria used in sampling partners in the Training Needs Assessment (TNA) exercise included the following:

- Project demonstration sites especially those currently working on HWC mitigation and offering some trainings
- CBOs that are part of the KAZA TFCA landscape.
- NGOs that have trained communities before as well as currently training communities to consolidate what has been done e.g. Ecoexist Project in Botswana, Angola's Acadir, Namibia's IRDNC, Zambia's Green Rural African Development and Zimbabwe's Lion Project.
- NGOs that are facilitating CBNRM activities at community level such as Zimbabwe's Campfire Association
- Government Departments that are directly facilitating community initiatives in the partner countries e.g. Agriculture and Forestry departments.
- NGO's (mostly in Botswana) that are directly involved with elephant and people issues such as the Ecoexist Project, Elephants for Africa, Living with Elephants and Elephants without Borders.

11. MONITORING AND EVALUATION FRAMEWORK

11.1. Current monitoring and evaluation

Discussions with several stakeholders showed that there are currently no robust real time reporting structures of HWC incidents across the KAZA. Where available, the data are not easily accessible and are not up to date or are not simplified into statistics defining the magnitude of the damage caused by wildlife. There is a need to develop and maintain an updated database containing the broadest array of records documenting the type and location of the incidents. Such a database would provide a detailed overview of the impact on local populations; better identify which geographical zones are more vulnerable to HWC and which species are commonly involved in the conflict.

As a result, it would ensure adequate use of resources, help identify high-risk areas and allow effective responses to these. The categorisation and quantification of the level of incidence is generally carried out through common indicators such as the number of people maimed by wildlife, or livestock kills in a year or the annual economic loss. However, the use of this kind of information is constructive only if it is taken in the context of the specific social, economic and ecological dimensions of the study area; for example the number of livestock killed over a period of time is an inconsistent figure and it would be more informative if it were related to the total family livestock holding or total village units. The quantification of the economic losses should also be related to annual household income or the economic value of the family holdings (cattle, agricultural fields). Information gathered should include: dimension of the focal area (village, ward, district), number of people injured or killed over a fixed period of time, wild animal mortality induced by humans as well as species responsible or suspected to be involved in the conflict.

Appropriate research should also take into account a family's land tenure, crops grown and yields, damage calculated as percentage of crop loss per hectare or percentage of crop loss per annual production; livestock ownership and percentage of domestic animals killed and their current market price. With the aim of providing a complete scenario, it should be specified which protection measures were adopted, the time and money spent on defending the property, any additional damage to it (pipelines, fences, etc.) and any suggested measures to reduce the losses.

In the KAZA TFCA, many ecological variables influence HWC. It becomes prudent to make each case very specific, for instance wildlife density, water, natural prey and forage availability

and quality (abundance and distribution), competition with other species and these need to prioritisation.

11.2. Understand, Monitor and Evaluate the Problem

It is essential to have accurate spatial and temporal geo-referenced information about when and where the conflict is occurring. This understanding, concurrent with implementation of appropriate measures, should lead to a better focus on target areas and the most relevant species. Simple monitoring and evaluation schemes exist across the KAZA which need to be standardized and then be adapted to local circumstances and information gathered can be used to draw up a strategy to combat the problem. The monitoring framework proposed aims to answer a number of questions, should be having both the impact (quantitative) and progress (qualitative) monitoring indicators.

Generic questions to be answered by the framework include:

- Are we working in the right location?
- How severe is HWC?
- Is our work making a difference?
- Are we doing the right things in the right place?
- Is HWC increasing, stable or decreasing over time?
- When has an intervention succeeded? When can it be called it is a success or failure?
- Is a new technique /tool/ procedure, working?
- What technique/tool/procedure works under what circumstances (ecological, socio-cultural, economic, and political)?

12. RECOMMENDATIONS FOR SUSTAINABLE FINANCING OF HWC

12.1. Establishment of KAZA TFCA HWC Mitigation Fund

One of the key constraints is the lack of a clear and sustainable source of funding for HWC. Because the problem is both technical and social, overlaid with conflicting policies, there are many barriers to effective implementation. Once funding is availed for a once-off project, the challenge then becomes the maintaining funding for HWC mitigation. We suggest establishment of a fund for the provision of financial sustainability of financing HWC mitigation measures and affected communities. Funds can take at least three fundamentally distinct forms in the short or long term: Cash Fund (from donors, governments or through business ventures), Endowment Fund, and Revolving Fund. According to the Global Environment Fund (GEF) funding protocols, such funding mechanisms allow massive contribution towards a human wildlife conflict mitigation program.

12.1.1. Cash Fund or Sinking Fund

This form is the simplest one. The Cash Fund receives money from donors, fines, royalties or any other source, either in one instalment or in several tranches, and spends it according to the availability of money and approval of projects. All spending is on a grant basis. Project monitoring is encouraged by the Fund administration. When Funds are exhausted, either the Fund is replenished or, if it was designed as a Sinking Fund, it ends its operations. This is often the case with debt counterpart Funds.

12.1.2. Endowment Fund

The Endowment Funds invest the Funds received in an interest-bearing form such as bonds, private bank accounts, real estate, etc. and spend only interest earned on those investments. This form trades cash availability, which of course is considerably smaller than in the case of the Cash Fund, against the establishment of a long-term financial investment for environmental conservation. Moreover, the establishment of administrative bodies is also a

more long-term affair. However, this kind of Fund requires a minimal financial critical mass to be worthwhile. If the capital invested is too small, the interest earned will be insignificant and not worth the trouble.

12.1.3. Revolving Funds

The Revolving Fund disburses the cash in the same way as the Cash Fund but it does so on a loan basis. A long-term financial mechanism is therefore established in the same way as the Endowment Fund. Here again, there is a trade-off, this time between investment security and immediate outreach to target groups. Assuming that loans made in the context of the Fund's environmental aims are not as secure an investment as government bonds or real estate, the Funds trade greater availability of cash for its projects against a higher degree of insecurity.

12.2. Recommended type of Fund

None of these alternatives is better or superior to the other (Mikitin, 1995). Each one fits a particular situation that should be carefully analysed. Among these deciding factors, one can note the following: the immediate financial absorption capacity of the NGOs, government agencies, and communities; the amount of funds available; the experience NGOs or state agencies have with Revolving Funds; the relationship between the NGO community and the government; the situation of the local financial market, etc.

Important factors for establishing a Human Wildlife Conflict Mitigation Fund

- The HWC issue to be addressed is significant, and appropriate actions to respond are long term and can be met with the resource flows an HWC Mitigation fund could produce.
- There is active and broad-based government support for creating a mixed, public-private sector mechanism that will function beyond direct government control.
- There is a critical mass of people from diverse sectors – government, NGOs, academic and private sectors, donor agencies – who can work together despite different approaches to nature conservation and sustainable development.
- There is a basic fabric of legal and financial practices and supporting institutions (including banking, auditing and contracting) in which the majority of people have confidence.
- There is a legal framework that permits establishing the Fund, and tax laws that allow it to be exempt from taxes.
- There are mechanisms to involve a broad set of stakeholders in the design process, and willingness by these stakeholders to use them.
- One or more mentors (e.g., another more experienced fund or an experienced international NGO) are available to provide technical support to the new Fund.
- There are realistic prospects for attracting a level of capital sufficient for the Fund to support a significant programme while keeping operating costs to a reasonable percentage.
- There is an effective demand for the fund's products, i.e. a client community interested in and capable of carrying out the mitigation activities on the scale envisaged.
- If one of the first four conditions is missing, it is suggested to investigate other possible financial mechanisms. Some of the other conditions might not be met but if so, efforts should be made to remedy the situation as soon as possible.

12.3. Using wildlife as a marketing tool

12.3.1. Wildlife branded products

The concept of wildlife branded products has been around for many years and projects across the continent are taking advantage of the expose and income it can produce. For example, the "Elephant Pepper" range of chilli products showed how innovative eco-marketing strategies based on the argument that "these products are special because they help to conserve threatened wildlife species" enable increasing of sales. To achieve the desired conservation impacts it is further necessary to translate that appeal into premium prices, and to ensure that producers know they are getting a premium because they put up with elephants.

It is also important to find ways of targeting specific consumer groups who may be swayed by such arguments, which would suggest going after people with an interest in elephants and introducing them to the products, rather than the reverse (i.e. pushing the products and using "elephant-friendly" as additional value). A certain percentage of funds coming from such enterprise would then be channelled towards the mitigation of conflict or is distributed amongst the communities bearing the costs of living with wildlife. Another example is the initiative called Wildlife Friendly http://wildlifefriendly.org that certifies products as supporting conservation.

12.3.2. Direct payments for maintaining wildlife habitat

In essence, this would involve calculating the "carrying costs" of having wildlife in a farming area and soliciting direct payments from (Western) wildlife lovers to keep the population above the minimum required for mere reproduction of the species. Ideally such a system would have several hundreds of thousands of donations or levies from tourists signing monthly stop-orders for small amounts with some of the money used to contribute to the proposed self-insurance cover to individual farmers who suffer wildlife damage to crops or infrastructure, and the rest to support an on-going programme of work aimed at reducing HWC. Setting up such a scheme would probably involve spending a considerable amount on recruiting donors. On the other hand, it would have the added benefit of creating a large network of potential clients for the branding strategy outlined above.

END MAIN SECTION

Appendix 1 Ver 6.3

SITUATIONAL ANALYSIS OF MEMBER COUNTRIES

ANGOLA

Introduction and Background

Angola lacks reliable and up-to-date information on the status of most of its wildlife population as well as the extent of HWC (Ron & Golan 2010). In 2006, the elephant population in Angola was estimated at 2,384 (Chase & Griffin, 2005; Blanc *et al*., 2007) and this could now be close to 7,500 in 2010 (Chase pers. comm.) mainly within southeastern Angola. The Kuando Kubango province has the largest block of protected forest areas i.e. Luenge National Park and Mavengue National Park that were formerly two nature reserves and four game reserves in southern Angola and shares international boundaries with Namibia and Zambia as illustrated in figure 2. The KAZA TFCA area of the Angolan component incorporates Mucusso Game Reserve (formerly Coutada) that is approximately 21,300km² of land and adjoins the Kubango (Kavango) River and Namibia to the south, and the Cuito River to the west. People also inhabit the Mucusso Reserve. The largest human settlements occur in two areas of the reserve: in the south, where a series of small villages line the banks of the Kubango and Cuito Rivers, and in the north, where the Likua settlement aligns the Lumuna River. Most agricultural activity occurs along the Kubango and Cuito Rivers. Other human settlements appear to be small in scale. The reserve overlaps with two municipalities, Dirico and Rivungu, and five communas Xamavera, Dirico, Mucusso, Luiana and Galangue. Only the Mucusso communa is wholly within the boundaries of the Mucusso Reserve. After the civil war, both people and wildlife (particularly elephants) started re-colonizing these areas (Conservation International, 2010).

The end of the civil war has probably provided the requisite security for elephants and other wildlife to return to southeast Angola despite the heavy presence of landmines in the region. However, such surveys are yet to be conducted on other wildlife species although plans are underway. Cross border movement of elephants to Angola from Botswana, Namibia and Zambia have now been confirmed (Chase, Curtice & Griffin 2009) and from the course of these movements, conflict manifests. Wildlife poaching is prevalent in the Angolan section of KAZA. This is mainly due to inadequate law enforcement. Due to insecurity, wildlife, particularly elephants tend to move away from insecure deep parts of the forest to human settlements and cause conflict in the process.

Mucusso, Dirico and Menongue residents expressed concern about HWC with respect to three animals: elephants, crocodiles and hippos. Crocodiles and hippos make use of the river dangerous. Residents of these areas say that the crocodile population grew during the years of war. Prior to independence, the Government allowed selective culling of crocodiles to limit crocodile numbers in the river. Mucusso residents fear these animals when crossing the river by boat, and when collecting river water. Elephant intrusion into cropland is a major problem for the local people. Elephants access the river along the Mucusso border at three primary locations. In two of these locations, elephants pass through cropland to reach the river.[17] Elephants migrate to the Kavango River in Mucusso from the forests to the North, and from Namibia. Elephants most likely enter Angola to access the river because Angola sites are conducive to river access.

[17] The three locations where elephants access the river include the main village of Mucusso, the village that lies directly west of the Luiana road, which is the seat of the Mbukushu King, and at the village that lies parallel to the former Coutada office. Elephant access at the main village of Mucusso poses less of a problem, because residents there do not rely upon agriculture as a means of survival. In the other two locations, communities experience significant problems with elephant intrusion into cropland.

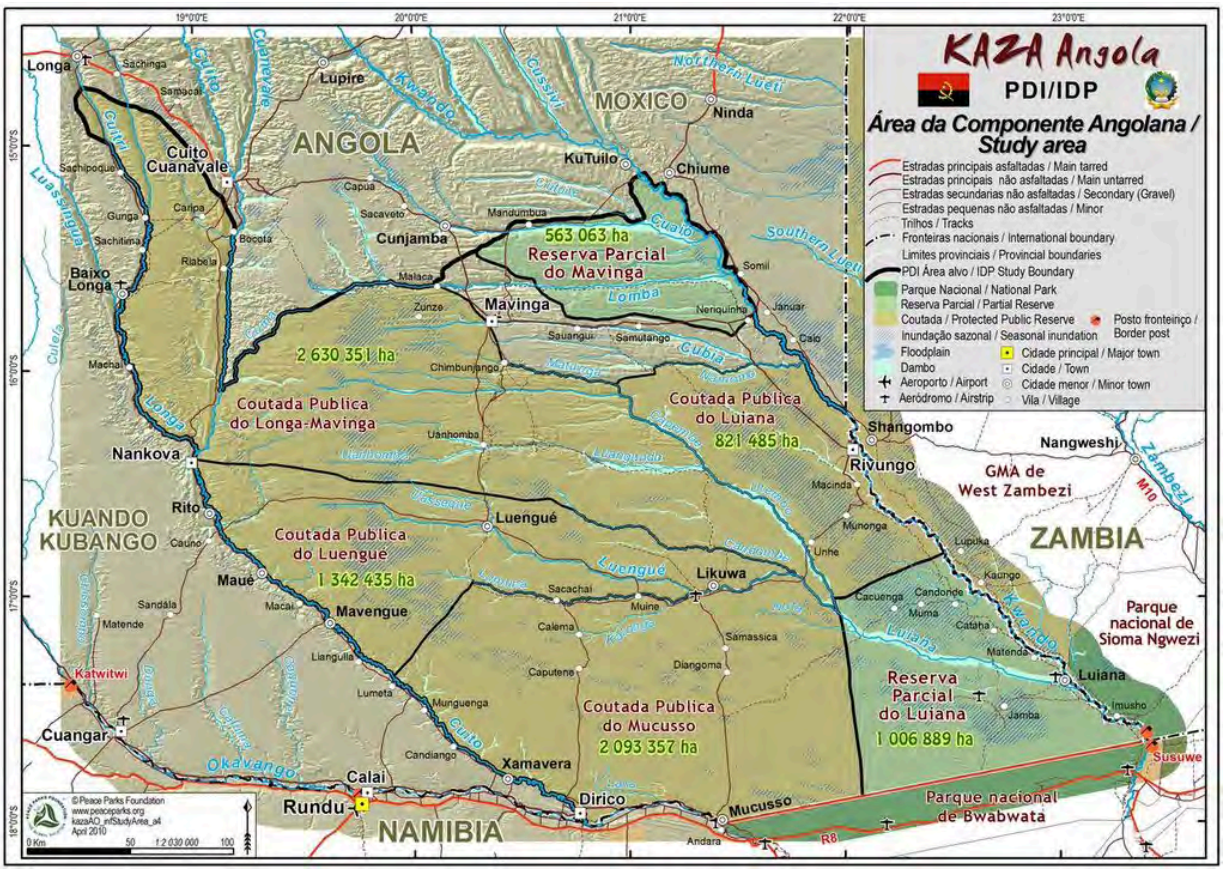


Figure 1: Map showing the extent of the KAZA TFCA component in Angola

Causes of Conflict in Angola

- Elephants moving into Angola from neighbouring countries i.e. Zambia, Namibia as well as Botswana.
- Human encroachment returning as refugees into sparsely settled areas adjacent to Mucusso Reserve and the Luiana ecosystem.
- Subsistence agriculture along the main river leading to elephant, crocodile and hippo attacks.
- Lack of defence of crops and livestock by farmers.
- Lack of proper land tenure and planning.
- Human population rising at an annual rate of close to 4%.
- A limited recent experience of 'living with wildlife' and possibly a growing elephant density in the area.

Types and nature of human wildlife conflicts

Angola experiences mainly four types of HWCs that include crop damage, attack on livestock (cattle), human deaths and injuries and damage of food stores. In the Mucusso Coutada (hunting reserve) that is one of seven areas designated for protection in the province of Kuando Kubango, over 600 conflict incidences were recorded between 2008 and 2012 from various wildlife (Antonio Chipita, pers. comm). In this Savannah ecosystem, the main crops damaged include millet, maize, groundnuts, sorghum and sweet potatoes. However, hippos and crocodiles are the most problematic animals alongside elephants. Hippos raid crops, injure and or kill fishermen as well as people harnessing water from the river. Crocodiles ambush livestock grazing and drinking from the river as well.

Spatial and temporal patterns of human wildlife conflicts and conflict hotspots

The documentation of the intensity of HWC in Angola is an ongoing concern, as there are no formal reports. Anecdotal information summarises the intensity as shown in Table 1 where crop damage is very high. There are no official records about the number of people or wildlife injured or killed every year because of conflict. Some attacks on people occur on the farms when farmers are guarding their crops at night. However, most attacks are accidental with unsuspecting people falling victim mostly whenever elephants stray out of their range. The conflict hotspots are mainly along the rivers where most subsistence farmers grow their crops and fish as shown in figure 3 below.

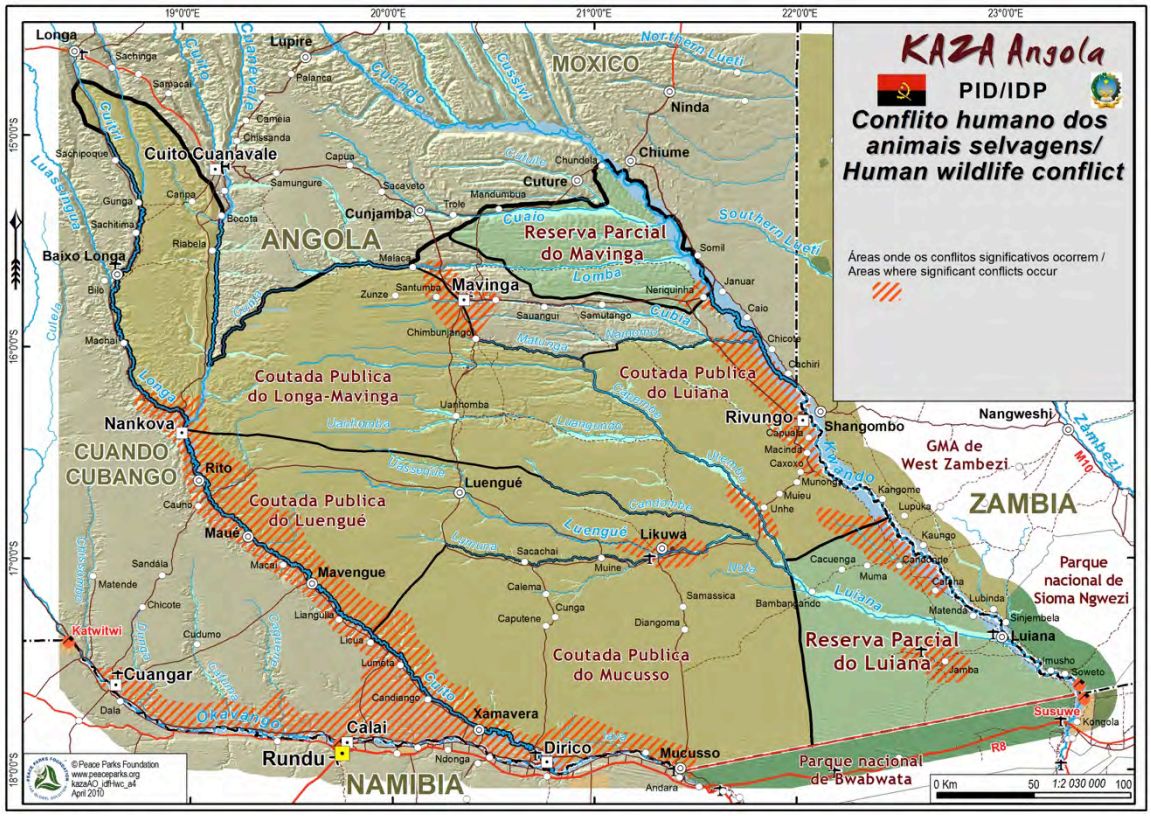


Figure 2: Map showing conflict hotspots in Angola.

Table 1. Types and intensity of human wildlife conflicts experienced in Angola.

Type of conflict	Low	High	Very high
Crop damage			√
Livestock attack		√	
Food store damage	√		
Killing and injuring of people and wildlife		√	

The type and intensity of conflict varies between the areas such as Mucusso, Kalai, Dirico, Menongue and Temangue and there is a slight variation in habitat types. People living closer to rivers reported crocodile attacks on livestock. High incidences of elephant attacks on people came from Mucusso area as people live in the former Coutada now a National Park. Also due to limited food availability for the elephants in the savannah ecosystem, elephants are more likely to pull down food stores than in the forest where food is plenty and readily available.

HWC is prevalent across most of the wildlife range forming the Angolan KAZA TFCA component but with varying intensity and exhibiting both spatial and temporal variations. The

areas around Mucusso in the Mucusso ecosystem appear to experience high conflict incidences and thus forms part of the conflict hot spots. The ecosystem has all three-problem wildlife species (elephant, hippo and crocodile). Hippo and crocodile conflict is throughout the year whereas conflict with elephants appears to be seasonal. Elephants in this area disperse further into the hinterland during the wet season as they can find water almost everywhere. In the dry season, conflict is severe as they come down to the river from the forest on a daily basis in need of water. Given that most human settlements are along the river, elephants have to negotiate this "hard edge" on a regular basis making conflict inevitable.

Past conflict mitigation measures
In Angola, traditional ways of mitigating conflict are the most common and this includes the use of fire to scare away elephants and hippos, banging tins and drums and in some cases the use of trenches around fields.

Current mitigation measures
Not much has changed in the manner conflict mitigation is being practised from the traditional setup. Current methods include use of fire, banging of tins and drums, the use of torches. Community based conflict mitigation (CBCM) methods were introduced in some parts of Mucusso around 2008 but without further support, the methods seem to have died out. These included among other things the use of chilli-based deterrents to reduce HEC (Karidozo, 2008).

Applicable policy
Angola inherited a great deal of environmental legislation (acts and decrees) and decisions, or orders (e.g. on the establishment of protected areas) from the colonial era (Jones, 2004). The environmental legislative tools influenced the interaction of humans and natural resources especially wild animals. Despite attaining independence in 1975, Angola's legislation remained out-dated. The new thinking in environmental legislation is developing and adoption and enforcement is improving since the mid-1990s. A number of decrees and acts that take into consideration the effects of HWC. However, addressing HWC is not dealt with explicitly by any policy document. These include Angolan Constitutional Law (No. 23/92 of September 1992) and Environmental Framework Act (No. 5/98 of 19 June 1999. However, some of the colonial statutes are still in place while others are under review, amended, revoked or repealed.

BOTSWANA

The Botswana component of the KAZA TFCA hosts numerous natural and cultural resources that are of critical importance to regional tourism and economic growth, as well as the creation of sustainable benefits to the region and its people (www.kavangozambezi.org/botswana). These include the Okavango Delta which is a Ramsar Site, the largest in-land Delta in the world; the Makgadikgadi Pans, the largest salt pans in the world; various Wildlife Management Areas and the world renowned Chobe National Park as shown in figure 4 below.

Introduction and background
In Botswana HWC varies according to geography, land-use patterns, human behaviour, the habitat and behaviour of animals. There is a need for better understanding and awareness of the nature and complexity of factors contributing to HWC in Botswana, including climatic factors, land-use, agricultural practices and wildlife management initiatives as well as mitigation measures in use.

There is considerable government commitment to conserve and protect wildlife and their habitats. In support of "sustainable development", there is recognition of the importance of the

natural environment in the lives of Batswana [18]. Recent increased numbers and range combined with increased development, human footprint and population, for example, may have incidental consequences of increasing human-elephant interface and interactions, which need to be managed to maintain a healthy balance between the need for socio-economic development and protection of the natural environment.

The Department of Wildlife and National Parks (DWNP) has long realized the growing urgency of HWCs in Botswana particularly HEC. In fact, the DWNP has implemented many individual programs to mitigate specific HWC challenges. However, the DWNP also recognized that a comprehensive plan based on available knowledge had to be designed if this conflict is to be reduced, human livelihoods enhanced and conservation is to succeed in the end. The Government of Botswana through the Northern Botswana Human Wildlife Coexistence (NBHWC) Project saw this as a significant issue and directed the DWNP to design a set of concrete, project level strategies. In addition, there are a number of NGOs (e.g. the Ecoexist Project) working in partnership with DWNP to understand and address the root causes of conflicts and attempting to find collaborative solutions between communities, Government departments and other stakeholders to reduce the problems.

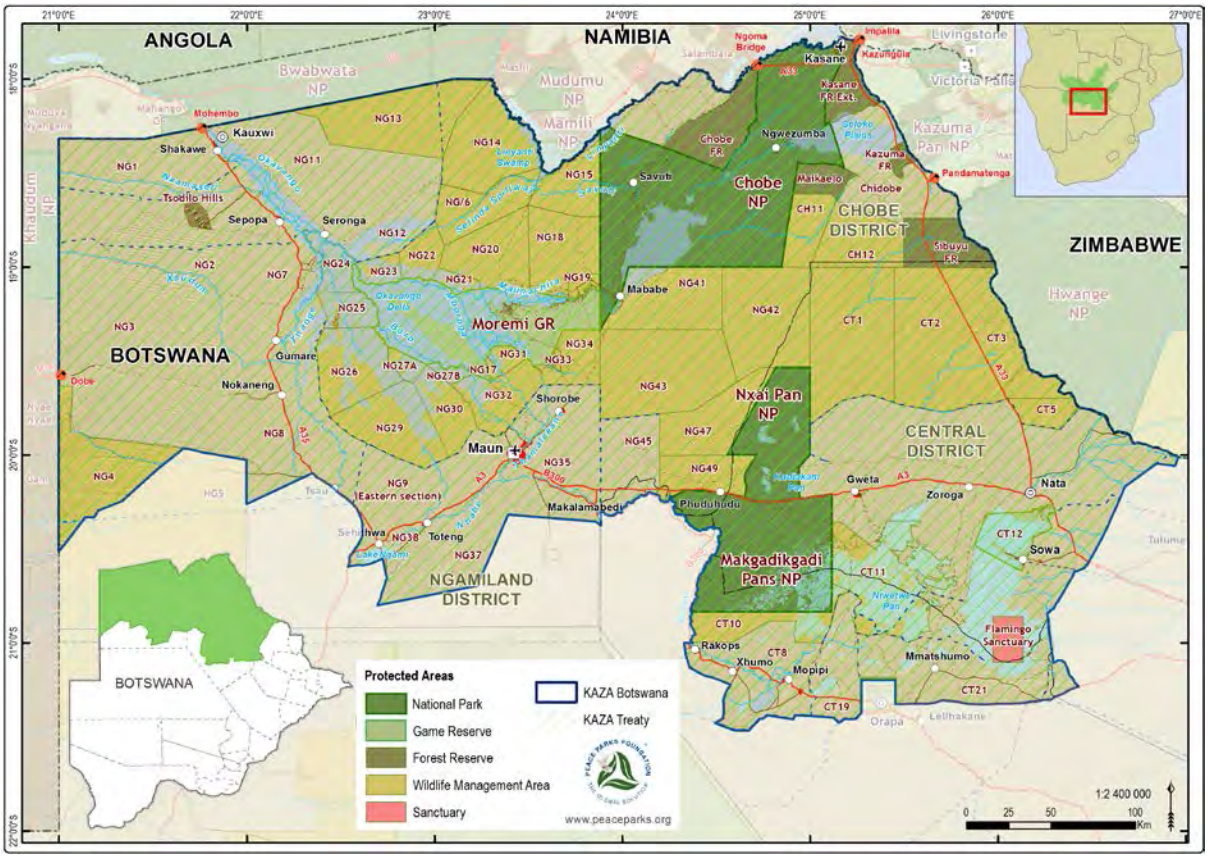


Figure 3: Map showing the extent of the KAZA TFCA in Botswana

Causes of Conflict in Botswana

A set of continental trends has contributed to the escalation of HWC across the KAZA TFCA component of Botswana. These can be grouped into human population growth, land-use transformation, habitat loss, degradation and fragmentation and growing elephant population as well as growing interest in ecotourism and increasing access to nature reserves, increasing livestock populations, climatic factors and stochastic (e.g. flooding) events.

[18] An interesting reference here is http://voicesofafrica.co.za/botswanan-batswana-its-complicated/

Although human population growth in Botswana is marginal compared to neighbouring states, information from Chobe and Tawana land boards shows a significant increase in people settling in the Chobe enclave and along the Okavango delta as well as establishing several new fields and cattle posts in well-known wildlife corridors leading to encroachment into wildlife habitats. This is particularly common in Northern Botswana where 99% of Botswana's elephants reside. Between Kasane and Kazungula along the Chobe and Zambezi River fronts, there is increasing settlement that has impeded access for elephants to the river and leads to conflict with local residents.

Types and nature of human wildlife conflicts

The main type of conflict in Botswana is crop raiding and livestock depredations. The main crops destroyed by elephants include maize, sorghum, millet and groundnuts. Livestock killing is widespread and this has a huge toll on the country's economy, as the beef industry is a critical economic sector. The spreading of foot and mouth disease from buffalo to cattle is also another form of HWC prevalent in Botswana. Human injuries and deaths occur but are relatively rare.

There is sufficient evidence to show that the elephant population in northern Botswana is part of a larger population linked to Zimbabwe, Namibia, Angola and Zambia (Chase, 2006). Cooperation is vital between all of these countries particularly if the approach of developing wildlife dispersal corridors is followed and if adequate measures are to be taken regarding the mitigation of HWC.

Spatial and temporal patterns of HWCs and conflict hotspots

In northern Botswana, as has been identified elsewhere in Africa, crop damage is seasonal, exhibiting a peak of activity when the crops approach maturity as they are more palatable and nutritious at this stage. However, in Botswana's Chobe enclave and the Okavango where *Molopo* (flood plain) agriculture is widespread, dry season crop raiding is also common as elephants and other wildlife raid these fields when they go into the delta to drink water (Songhurst et al 2015). Livestock depredations are usually throughout the year although during the dry seasons conflict is heightened. All areas in proximity to national parks and forestry areas where there are animals are considered as conflict hotspots. Figure 5 below illustrates some of the known conflict hotspots.

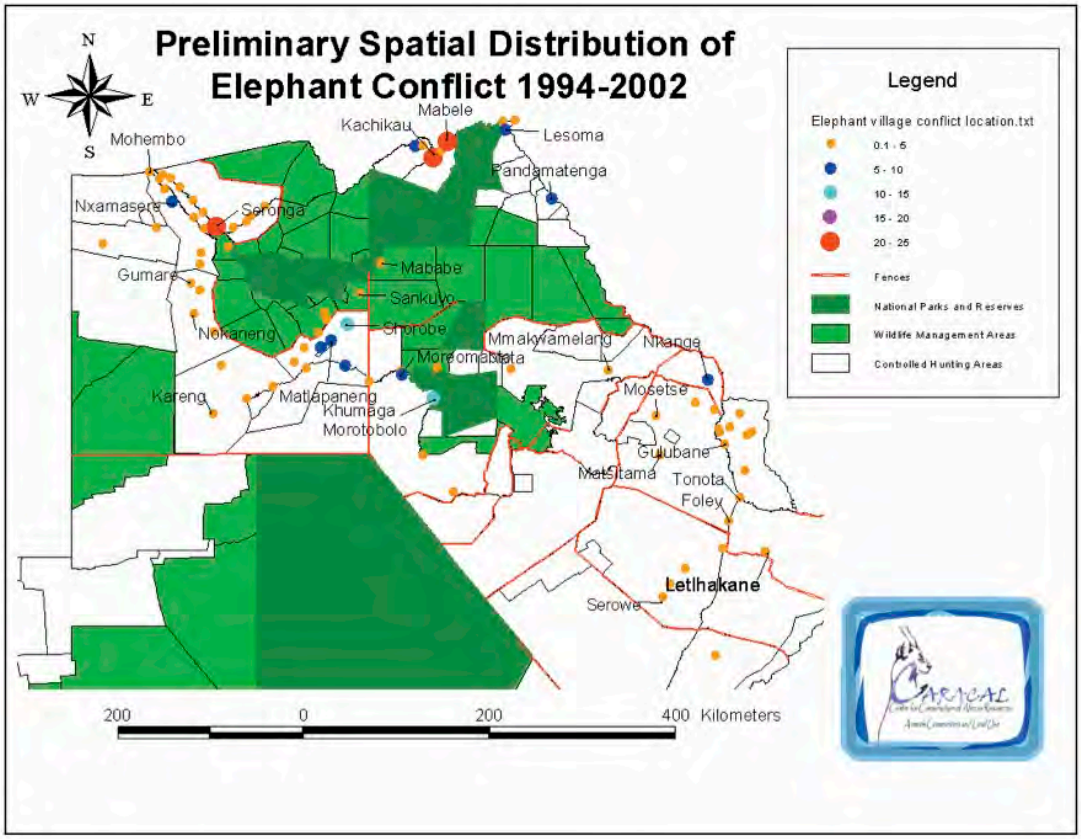


Figure 4: Spatial patterns of human-elephant conflict in Botswana 1994-2002 (Braack, & Smuts 2006)

Past conflict mitigation measures

In the past, the predominant measures of conflict mitigation were more or less the same as the surrounding countries. Famers are mostly left up to their own devices that include the range of traditional 'drive-them-away' techniques including fire and banging on drums or barrels to scare raiding wildlife away. Furthermore, lethal control was and is still used occasionally but the practice has been on the decline over the past number of years.

Current mitigation measures

Effective planning that includes an elaborately designed and implemented integrated national policy on wildlife. There has been an increased awareness in securing key and sensitive wildlife areas such as corridors and core habitats both at the national/regional scale e.g. KAZA TFCA and at a finer micro-level land-use planning scale e.g. LUCIS (collaboration between Tawana Land Board, Ecoexist Project and SAREP). Encouraging setting up of individual defendable clusters as well as training of communities on several mitigation measures as shown during the Northern Botswana Human Wildlife Coexistence project (NBHWC) implemented by the DWNP. Synchronising cattle calving down to minimise vulnerability to attack in hotspots has been mentioned in the Central District of Botswana and the provision of alternative water points for both communities/livestock separated from wildlife has been mooted as a method of conflict mitigation in the drier arid areas. Compensation forms the backbone of the mitigation methods in use in Botswana. Exclusion fences including the buffalo/veterinary fences and traditional as well as commercial are used extensively to separate communities, crops and livestock (Ferguson & Hanks, 2010).

Some of the fences are fitted with early warning devices, both simple and sophisticated, including electric offsets/hotwire, fenced off cattle grazing schemes and predator proof fences.

The DWNP occasionally employs helicopters to herd buffalo and elephant back into PAs. Crocodile fences are also common in places where the Okavango River passes through.
A number of repellence options such as chilli growing, chilli fencing, burning chilli bricks are currently in use in Chobe District, Okavango Panhandle and many other parts of Botswana. As part of the NBHWC project, beehive fences (King 2010, 2012) were trailed as a deterrent for crop-raiding elephants but the initiative was abandoned due to poor colonisation of the hives.

Other standard traditional tools include:

- Using torches.
- Dogs to warn of pending intrusion.
- Donkeys used to alert people of approaching cheetah and brown hyena
- Disturbance shooting i.e. firing of firearms over problem animals
- Good livestock and crop minding has been observed where livestock owners mandated to accompany livestock during the day and kraal or animals at night. Lions and in some cases elephants have been trans-located.
- Limited lethal control i.e. destruction of specific dangerous animals is also practiced.

Applicable policy
In Botswana, the emphasis on responsibility to mitigate against problem animals rests on government empowering Problem Animal Control (PAC) units in which communities are expected to play their part in mitigating the conflict. CBNRM programs are in general stalled with an unwillingness to devolve control to local people and of late total compensation packages are offered by government provided good livestock husbandry and crop mindedness are demonstrated.

Several policies and legislative instruments are relevant to HWC issues and the strategies that can be used to prevent it. In this section, we provide a brief review of the relevant legal and policy framework related to HWC and its associated sectors that Botswana is currently working within and is guided by.

This policy review is, therefore, also meant to identify these constraints in the policy and legislative framework, in relation to cross sectorial conflicts, information gaps and impediments to implementation, and to highlight opportunities to inform future policy decision making.

Wildlife Conservation Policy of 1986 (*Department of Wildlife and National Parks*)

This Wildlife Conservation Policy (WCP) deals with the utilization of wildlife resources in areas outside PAs and the proper management and utilization of wildlife resources. It aims at continued harvesting of wildlife resources and a fair distribution of benefits. Special attention is given to the needs of rural people, promoting the principle of ‘wildlife management with sustained utilization’, encouraging the development of a commercial wildlife industry.

However, its incentive or disincentive to implement is that it makes provision for the zoning and protection of wildlife and migration corridors in land-use planning in order to protect wildlife, and aims at distributing the benefits fairly with special attention to the needs of rural people. Land-use planning is in place for PAs for wildlife preservation, and for conservation and utilization of wildlife in Wildlife Management Areas (WMAs) around PA and wildlife corridors and licensed hunting in Controlled Hunting Areas (CHAs). This planning gives effect to CITES and other international conventions for the protection of fauna and flora.

Constraints and / or opportunities that it has to take into account are that land-use planning must accord wildlife resources a position that reflects its considerable economic significance.

It also makes provision for benefit through wildlife utilisation from areas where HWC exists, in order to offset impact. However, no hunting licenses are allocated in Botswana anymore. A review of the Wildlife Conservation Policy, the Wildlife Conservation and National Parks Act and Associated Regulations in 2008 concluded that there was a need to reduce HWC through a number of approaches. The following HWC relevant options were explored: separation of wildlife from human activities through fencing out of wildlife in agricultural areas; creation of buffer zones between PAs and communal areas like WMAs and game ranches; problem animal handling, including elephant management; effective integrated land-use planning; and innovative community based approaches/strategies, like chilli plants for elephant control. It was also recognised that there is also potential for introduction of community-based compensation in the form of insurance schemes, paid for in part by wildlife revenue. Other relevant policies are explained in full in Appendix 1.

NAMIBIA

Introduction and background

Conflict between wildlife and the Namibian people is a significant and well-documented problem. HWC is particularly common on the communal lands in northern Namibia, where elephants, for example, destroy crops and damage water installations, and large carnivores regularly prey on domestic livestock. These conflicts result in financial losses and disrupt the lives of the local people. CBNRM programmes in Namibia and the emergence of communal conservancies have contributed to growing wildlife populations. Although local communities on communal land and owners of freehold land benefit from wildlife, the increasing numbers of many wildlife populations lead to high levels of HWC. The individual farmers and pastoralists that live on the land are the ones that bear the actual costs of living with wildlife, but they seldom share equally in the benefits from wildlife.

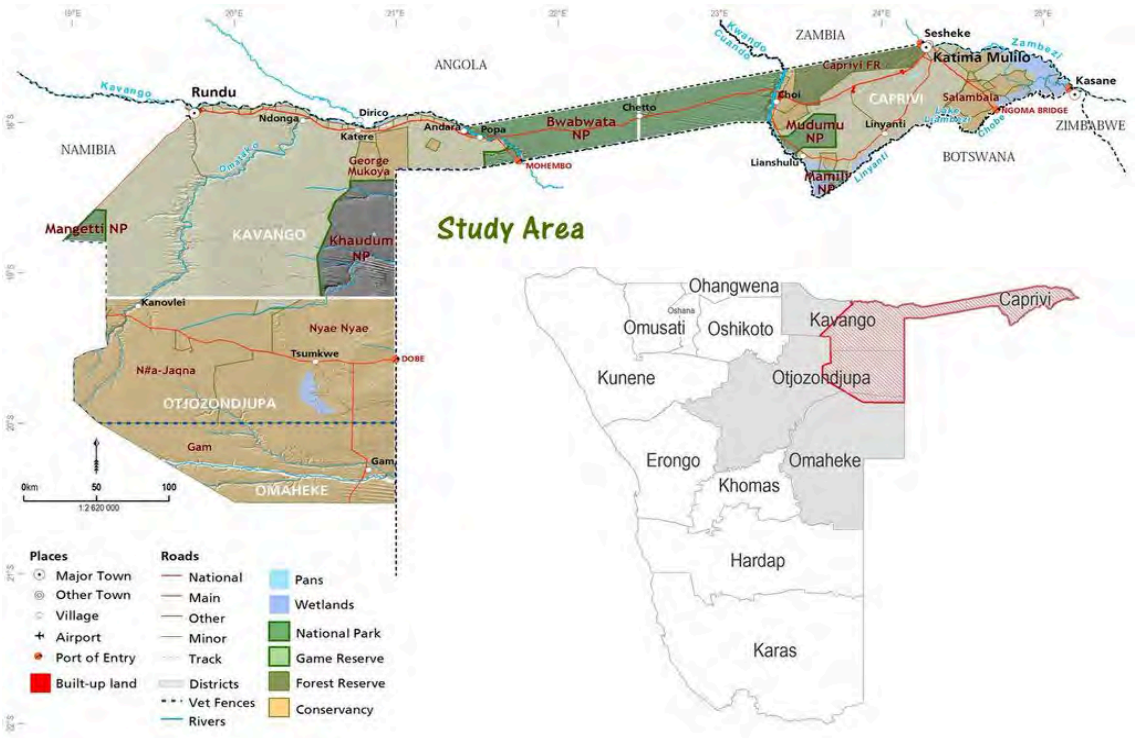


Figure 5: Map showing the extent of KAZA TFCA in Namibia.

Causes of Conflict in Namibia

Namibia, particularly the Caprivi Strip, cuts through the middle of the KAZA TFCA and is where most of the important wildlife corridors are found. Its long boundary makes it particularly susceptible to HWC. Commercial hunting of wildlife has been extremely important in the development of the conservancies (Naidoo et al 2016). Conflict is particularly severe along the river systems that flow through the Caprivi (now Zambezi region) and the high densities of wildlife and unplanned human settlement makes conflict particularly severe in the eastern Caprivi. Land-use planning is at the root of much of the conflict in Namibia. Issues that have an impact on levels of HWC include:

- settlement of wildlife corridors,
- scattered agricultural lands that creates a mosaic that is impractical to defend,
- living in and adjacent to PA boundaries,
- herding livestock within or too close to PA boundaries,
- commuting between villages,
- poor understanding of animal behaviour by local people (e.g. how problem animals approach or avoid human settlement, crops, water points and livestock both during the day and at night),
- fishing and wild harvesting,
- access to water by animals/ wild and domestic,
- *molapo* farming (ploughing along a river flood plain).

Types and nature of human wildlife conflicts

- Crop damage
- Livestock predation
- Damage to property e.g. structures, water points, fences (both rural and urban)
- Direct and perceived attacks on persons
- Challenges on game fences surrounding wildlife enterprises
- All standing crops including vegetable gardens damage occurring from direct feeding and trampling ranging from slight to total destruction
- Conflict at waterpoints and riverbanks

Spatial and temporal patterns of human wildlife conflicts and conflict hotspots

Conflict between wildlife and people is most pronounced in northern Namibia. The review of the dynamics of HWC will therefore focus on the Caprivi, Kavango and parts of Otjozondjupa. In Namibia the characteristics of HWC is highly variable, because of contrasting ecological, socio-economic, and land-use conditions. This variation complicates the use of one standardised mitigation system. Available reports state that the frequency of HWC appears to be higher in the Caprivi Region than elsewhere in Namibia. Livestock losses remained the most important impact of HWC on the local communities. Damages to crops occurred more frequently in the Caprivi and attacks on humans, primarily by crocodiles and hippopotamuses, occurred mostly in the Kavango and Caprivi Regions. When all records for Namibia were assessed, elephants, spotted hyenas, lions, and leopards were responsible for the majority of HWCs.

Past conflict mitigation measures

As in the other KAZA countries, rural people have had to resort to traditional drive-them-away methods. This also includes efforts by the MET, Game Guards and local councils to repel animals from fields.

- Predominantly lethal control using legal and illegal means.
- Toxicants.
- Steel leg hold traps.

- Direct hunting by MET or commercial operators.

Current mitigation measures

Namibia has been the most proactive of the KAZA countries on addressing HWC. The self-assurance scheme (discussed later), strong community involvement in mitigation and practical monitoring has enabled the people to benefit from living with wildlife. Namibia has done this through:

- Effective land-use planning.
- Design and implementation of an integrated national policy on wildlife.
- Development of conservancies that help to offset the costs of living alongside PAs.
- Securing key and sensitive wildlife areas such as corridors and core habitats.
- Encouraging farmers to set up defendable clusters of fields.
- Training of communities and trialling plots of new mitigation methods.
- Synchronising cattle calving down to minimise vulnerability to attack.
- Providing alternative water points for both communities/livestock separated from wildlife.
- Financial assistance to new developing wildlife ventures that alleviate HWC and improve community perception.
- Exclusion fences- traditional and commercial; some fitted with early- warning devices/ both simple and sophisticated, including electric offsets/hotwire.
- Crocodile and Hippo fences.
- Chemical repellent options[19].
- Passive options such as chilli growing, chilli grease, burning chilli bricks.
- Active options such as dogs in particular the Anatolian breed, and donkeys.
- Explosive bangers made from fertilizer.
- Good crop minding.
- Relocation options for lion and leopard largely failed as the individual returned to their capture site.
- Limited lethal control.
- PAC/trophy hunting practiced.

Applicable policy

Namibia's attainment of independence from South African rule in 1990 opened space for legislative and policy reforms typified by, *inter alia,* the introduction of innovative ideas on an inclusive CBNRM approach which resonated with the new government's policies seeking to remove discrimination and empower rural communities through the decentralisation of control over wildlife and related natural resources and in the process also alleviate rural poverty (Jones, 1999). In Namibia, the reform of policy and legislation was informed by global ideas on common property resources management, practical experience from the implementation of earlier pilot projects and lessons derived from Zimbabwe's Communal Areas Management Programme for Indigenous Resources (CAMPFIRE).

- In private conservancies, animals are privately owned and managed.
- Human Wildlife Self Reliance Scheme (HWSRS) and CBNRM programs are functional.

Namibia's conservancies have an overall beneficial effect on household welfare and are a significant promotional tool for Namibia as a country and a tourism destination. While cash benefits are limited, communities enjoy many important intangible (non-cash) benefits such as meat, community infrastructure etc. Equally important gains include the strengthening of local institutions and governance, women's empowerment and great community cohesion. This

[19] Tests have been conducted with HATE 4-C and Capsicum oleo-resin

programme is among the most successful efforts by developing nations to decentralise natural resource management and simultaneously combat poverty. There is considerable opportunity for conservancies to become an engine for economic growth in the northern rural areas of Namibia. However, tourism-based growth potentials within the conservancies are limited.

ZAMBIA

Introduction and background

Zambia is a nation blessed with extraordinary bounty in terms of wildlife. Its people have benefitted but also suffered from conflict. A wave of unchecked poaching in the 1980s saw huge numbers of elephants and rhinos being wiped out across the country.

Elephant populations throughout Zambia were severely depleted by a wave of illegal hunting which began in the late 1970s. Between 1981 and 1985, Zambia may have lost 100,000 elephants (Martin, 1986). Despite a hunting ban in 1981 and the listing of the Zambian elephant population on Appendix I of CITES, elephants continued to decline in most parts of Zambia. AfESG (1998) estimated the population as 15,873 animals ('definite' estimate). The south-west corner of Zambia was not exempt from this holocaust.

Chase (2004) carried out a survey of Sioma Ngwezi National Park and its immediate environs and estimated 1,212 elephants, of which the majority were in the national park (1,099). The authors remark that the population does not appear to have increased since the last survey, which estimated 1,187 elephants in 1991 (Tembo, 1995). They attribute the status quo to high levels of illegal hunting; human settlement along the Kwando River that is preventing Botswana's dispersing elephants from reaching Sioma Ngwezi and to veterinary fences also constraining movements.

DG (2004) shows a discontinuous elephant range in south-western Zambia with no links between Sioma Ngwezi and the nearby Kafue National Park. Recently large numbers of elephant are being seen along the Zambezi from Livingstone westwards to the point where the borders of Botswana, Namibia, Zambia and Zimbabwe meet.

In response, projects like ADMADE[20] in the 1980s and later COMOCO[21], have pioneered CBNRM in southern Africa and the system of Wildlife Management Areas, similar to Namibia's conservancy program, has benefitted many Zambians and helped reduce illegal hunting.

Causes of Conflict in Zambia

In the areas of Zambia that have wildlife, it is super-abundant and often human settlement has grown unchecked around some of Zambia's most iconic wildlife areas. For example, lack of urban land-use planning and implementation has made Livingstone one of the hotspots for conflict with all species. Central Government directives are often ignored in the remote areas surrounding wildlife areas and settlement often does not take the needs of wildlife into consideration. Poor planning and implementation includes:

- Occupation of corridors,
- Scattered agricultural lands,
- Living in WMAs and adjacent to PA boundaries,

[20] USAID/Zambia works with the Zambia Ministry of Tourism to promote community-based natural resources management in Game Management Areas surrounding Zambia's national parks through the Administrative Design for Management (ADMADE) project.

[21] COMACO Community Markets for Conservation http://itswild.org

- Herding livestock too close to WMAs, corridor and PA boundaries,
- Commuting between villages at night,
- Poor understanding of animal behaviour,
- Understanding how animals approach or avoid human settlement, crops and livestock, both during the day and at night,
- Desire for game meat,

Types and nature of human wildlife conflicts

- Crop damage.
- Livestock killing and maiming.
- Damage to property both rural and urban.
- Direct and perceived attacks on persons.
- Challenges on game fences surrounding some wildlife enterprises.

Spatial and temporal patterns of human wildlife conflicts and conflict hotspots

The conflict hotspots in general terms are around densely settled areas such as Livingstone and Sesheke and most of this is conflict with elephants coming to the river courses to drink or hippos leaving to forage at night in agricultural lands. Conflict with crocodiles is of course along rivers, particularly the Zambezi where people get their water, fish and water their livestock. Reports suggest that lions and other predators are the cause of conflict reports in the areas between the Zambezi and the Kafue National Park (Lines, 2015). The area around Sioma Ngwezi National Park has been the focus of investigations into movement and mitigation of crop raiding elephants to the high levels of conflict there. (von Gerhardt *et al*.,. 2013; Murphy, 2009)

Community questionnaires indicated a sharp gradient away from the edge of PAs and interconnecting corridors of HWC damage, with crops nearest the PAs being the most challenged and effectively protecting others further away as shown in figure 7 and 8 below.

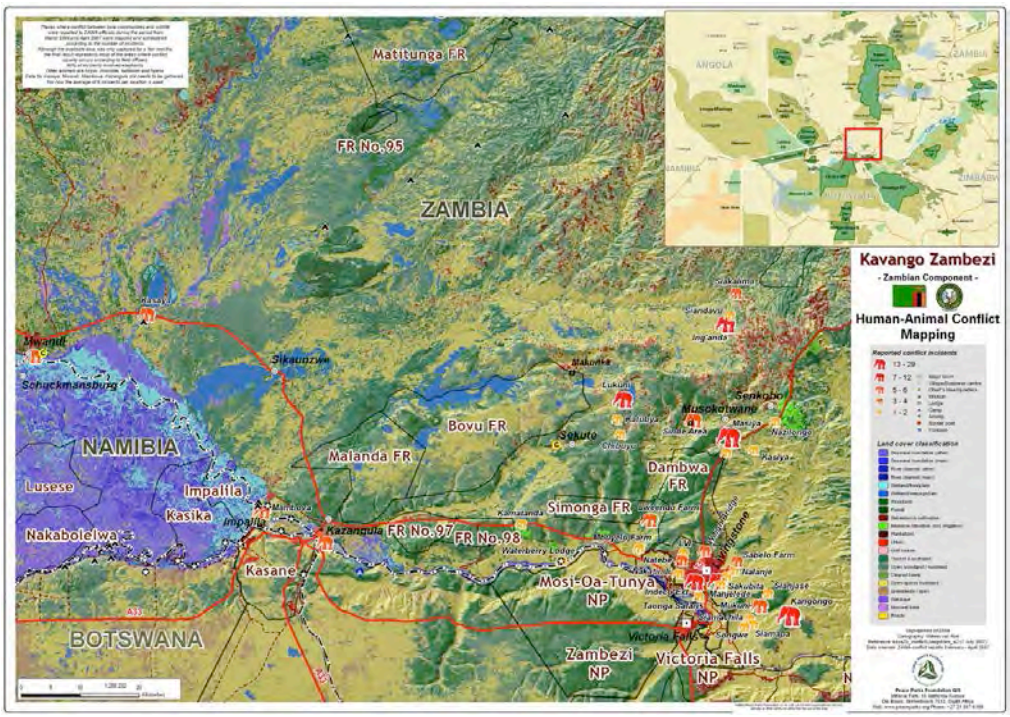


Figure 6: Map illustrating the conflict hotspots in Zambia.

Past conflict mitigation measures

Like the other countries, particularly Zimbabwe, famers use traditional methods to deter wildlife. Many Zambians also have weapons and use them to defend themselves, and to hunt. Predominantly lethal control includes:

- Old firarms
- Toxicants
- Steel leg hold traps

Current mitigation measures

- Effective planning in some areas.
- Design and implementation of an integrated national policy on wildlife (on going).
- Including WMA to offset costs from wildlife alongside PAs.
- Securing key and sensitive wildlife areas such as corridors and core habitats.
- No direct compensation offered however, communities living in hot spots living in and against WMAs and PAs are benefited from trophy hunting in a CAMFIRE style of arrangement until recently.
- NGOs have been encouraging setting up of individual defendable clusters of fields, training of communities, and trialling of plots with low-tech mitigation methods in Livingstone and other towns on the Zambezi. (http://www.gradinternational.org)
- Providing alternative water points for both communities/livestock separated from wildlife.
- Financial assistance to new developing wildlife ventures that alleviate HWC and improve community perception
- Exclusion fences.
- Independent electrical poly wire with reflective streamers used in Livingstone adding the Niteguard™ LED system.
- Repellence options currently being used
- Chilli growing
- Chilli grease
- Burning chilli bricks
- Dogs to warn of intended challenges
- Explosive bangers and sound horns
- Destruction of specific dangerous animals

Applicable policy

In Zambia, the earliest recorded piece of legislation relating to wildlife conservation impacting on HWC was enacted more than 100 years ago when the Ostrich Export Prohibition, Chapter 115 of the Laws came into force on 16 March 1912 (Northern Rhodesia Government (NRG), 1948). Later on, the Plumage Birds Protection, Chapter 117 of the Laws came into force on 27 November 1915. In 1941, Ordinance number 41 was enacted but the Game Ordinance Chapter 106 of the Laws later replaced this on 1 January 1943 (NRG, 1948). Afterwards, there was a series of repeals, revisions and replacements of laws. The Fauna Conservation Ordinance Number 43 of 1954 which was replaced by the National Parks and Wildlife Act Number 57 of 1968 was amended in 1971 into National Parks and Wildlife Act Chapter 316 (Chomba, Mwenya and Nyirenda, 2011).

Since the mid 1990s, Zambia undertook an extensive review and revision of environmental policy and legislation, which led to the development of new laws. The new legislation updated laws in terms of new thinking in conservation and in particular approaches to community involvement in conservation, which ultimately impacts the interaction of humans and wildlife.

ZIMBABWE

Introduction and background

Zimbabwe has a long history of dealing with HWC and many of the most innovative responses to it have had their genesis in the Government wildlife department or the CAMPFIRE project. As the CBNRM projects mentioned in the Zambia and Namibia sections, CAMPFIRE linked benefits from wildlife as a way to offset the costs of living with wild animals. Much of the infrastructure needed to make the CAMPFIRE project function is now not in place in much of Zimbabwe.

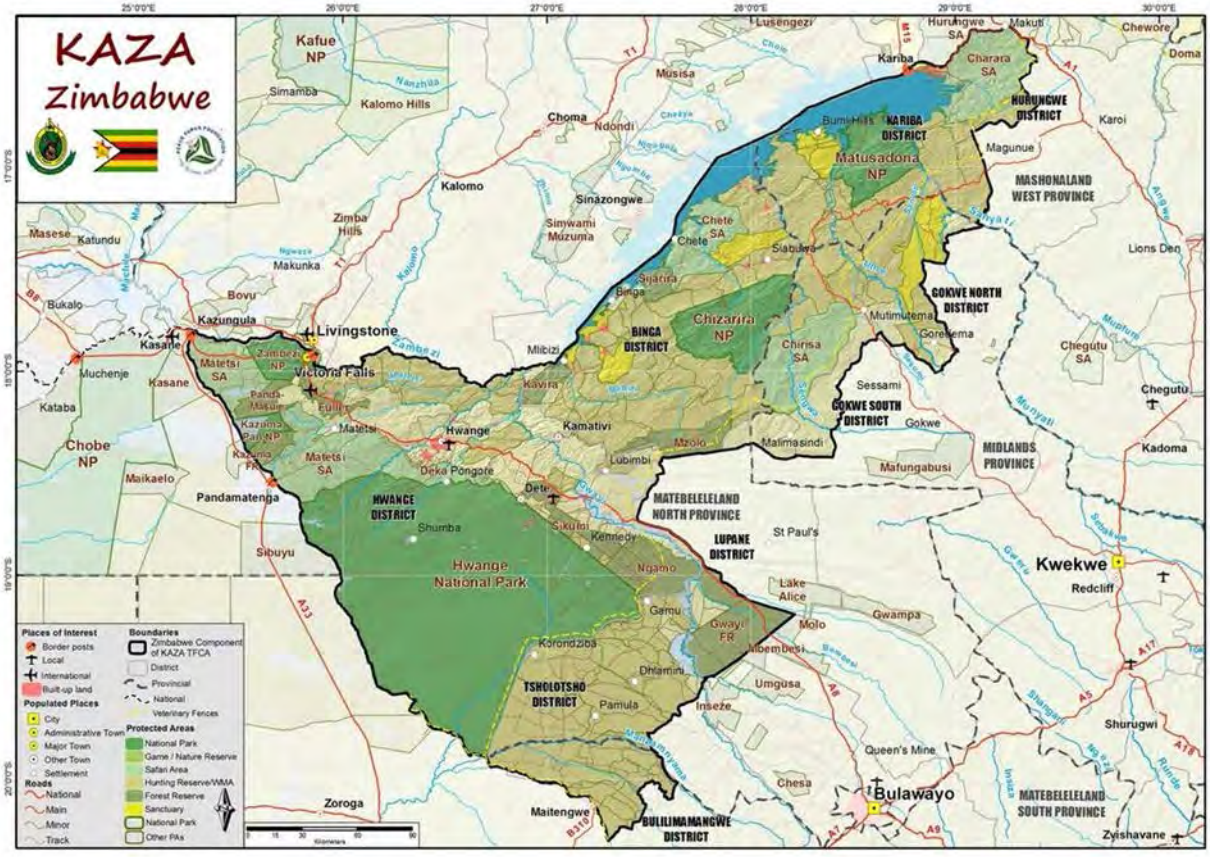


Figure 7: Map showing the extent of KAZA in Zimbabwe

Causes of conflict in Zimbabwe

- Poor implementation of land-use plans which includes occupation of corridors, scattered lands, living in and adjacent to PA boundaries
- Herding livestock within or too close to PA boundaries
- Commuting between villages at night
- Poor understanding of animal behaviour by some local residents
- Poor understanding how they approach or avoid human settlement, crops and livestock, both during the day and at night.
- Feeding of animals in areas where there are many tourists
- Change in management in Botswana (Closing of elephant hunting)

During the pre-ban days, hunted animals were watered on the Botswana side by pumps and bore-holes maintaining by those who had the hunting concessions but the stopping of hunting resulted in large number of animals moving into Zimbabwe to seek water in the dry season.

Types and nature of human wildlife conflicts

- Crop damage
- Livestock killing and maiming
- Damage to property both rural and urban
- Direct and perceived attacks on persons
- All standing crops including vegetable gardens damage occurring from direct feeding and trampling ranging from slight to total destruction

Spatial and temporal patterns of human wildlife conflicts and conflict hotspots

Community questionnaires have indicated a sharp gradient away from the edge of PAs and interconnecting corridors of HWC damage, crops nearest the PAs being the most challenged and effectively protecting others further away.

Past conflict mitigation measures

The farmers and livestock herders in Zimbabwe are very used to high densities of wildlife due to multiple generations of concerted wildlife conservation. It could be argued that rural people here have developed the most advanced and diversified of the countries using 'traditional' methods. In the 1990s however, Zimbabwe was at the forefront of PAC thinking with the use of community-owned small-scale electric fencing and commercial wet season PAC hunts for foreign clients. However, in general most problem animals were removed when they came into conflict with people, and then were killed directly or through snaring.

Predominantly lethal control used included:

- Toxicants
- Steel leg hold traps
- Direct hunting or lethal removal.

Current mitigation measures

The mitigation methods being employed in Zimbabwe have been greatly affected by the economic and social upheavals in the country. These have negatively impacted progress made to devolve control of wildlife back to communities where animals reside under the CAMPFIRE program. Currently much of the land-use planning and the implementation of by-laws have been ignored and many plots have been cleared in former wildlife areas. Mitigation across most of the country has been left to the farmers themselves, much to the detriment of the wildlife.

- Exclusion fences
- Fences traditional and commercial
- Electric offsets/hotwire
- Repellence options
- Passive
- Active
- Lion minding
- Limited lethal control
- Baboon toxicant control
- PAC hunting
- Destruction of specific dangerous animals

Applicable policy

The domestication of multilateral agreements and regional protocols which have a bearing on HWC in Zimbabwe is mediated by national legislative and policy instruments including the:

- Parks and Wildlife Act (Chapter 20:14);
- Draft Wildlife-Based Land Reform Policy of 2004
- Tourism Act (Chapter 14:20);

- Draft National Tourism Policy 2011-2015;
- Communal Land Forest Produce Act of 1987;
- Environmental Management Act (Chapter 20:27);
- Rural District Councils Act (Chapter 29:13);
- Regional Town and Country Planning Act (Chapter 29:12);
- Traditional Leaders Act (Chapter 29:17); and
- Indigenization and Economic Empowerment Act (Chapter 14:33)

Institutional, policy and legislative framework for the management of HWC

The Parks and Wildlife Authority that manages wildlife on behalf of the government has a policy on tackling problem wildlife. The most common method used to control problem animals is lethal killing and disturbance shooting. According to the government policy, a professional hunter may be engaged to hunt the problem wildlife species deemed by the area manager after complaints by villagers. However, the bureaucratic process of getting to the level of killing a problem animal is long, as it involves first assessment by the wildlife authority and making a decision on whether problem warrants killing the animal. A hunter is then allowed to look for the animal. However, because of the length of time taken during the process of decision-making, the wrong animal may end up being killed. The meat is shared between the hunter and the villagers but in the case of an elephant, the tusks are kept by the hunter after paying a substantial amount of money through the Rural District Councils.

Appendix 2 Ver 6.4

13. RECOMMENDED SPECIES-SPECIFIC HWC MITIGATION MEASURES

13.1. Elephant (*Loxodonta africana*)

As mentioned in the introduction it is essential to address HWC in a holistic way. Short-term solutions are urgently needed when the conflict is intense, but difficult long-term strategies also need to be implemented. This section focuses mainly on short to medium term solutions but longer approaches need to be implemented and supported by Government and the private sector.[22]

Addressing conflict with elephants is a particular challenge. First, it is important to plan and implement as many of the suggestions outlined as possible. The intelligence of elephants requires that a constant rotation of methods will always work better than reliance on a single method.

a) Applicable elephant behavioural traits

- Elephants are wary of any change that must be exploited
- Extremely sensitive to chilli pepper
- Effective on newcomers but once strongly habituated are difficult to deter requiring persistence and determination to break the habit
- Threats by elephant mainly adjacent to PAs and corridors that declines sharply the further away crops are grown, frontline crops literally protecting the others further back
- Cow herds largely not risk takers preferring to keep out of cropped lands unless the lands are poorly placed within a corridor
- Bulls on the other hand are efficient risk takers going to great lengths to obtain a tasty morsel
- Which they will intimidate and threaten for, even move in temporally where they can be extremely cunning
- They mostly commute along paths to and from the lands where they may be ambushed with chilli pepper
- Tools need to be rotated so as to not allow habituation to occur

b) Planning and strategy

- Elephant corridors and paths
- An understanding of how, why and when elephants use paths and corridors is essential in the application of mitigating measures. At night and early each morning elephants spread out to take advantage of scattered food while foraging, moving away from paths. Later as it becomes warmer they tend to clump and rest before moving to a new site or to water, following defined paths that link a myriad of connecting conduits, mini-corridors that the elephant choose to use rather than 'cutting through the bush' forming a new one. Several elephants may use the same paths though heading to different destinations travelling along these linked 'mini corridors'. Any new path occurs only when connecting a new point of provision or to avoid a blocked pathway or possibly where there is persistent conflict. These mini-corridors coalesce into larger pathways following drainage lines up and over higher ground to access

[22] To this end Ecoexist, for example is working together with people living in elephant range in the panhandle of Botswana and trying to find a way to coexist through land-use planning and building sustainable corridors and business around elephants in their area.

other drainage lines beyond such as the Nata system crossing over at Boli to the Dete/Gwayi drainage system in Hwange National Park. When sandwiched through more developed areas or changing land use patterns, they become major highways with a lot of movement observed seemingly going both somewhere and nowhere, linking short distance destinations. Bulls hold the key to the wider knowledge of the greater movement options, being forced from their natal herds at puberty, joining and separating other bulls as they mature. Bulls will also suddenly undertake long distance sojourns often over several months through-out the KAZA TFCA (Von Gerhardt, et. al. 2013).

c) Possible application

Importantly, elephants and other animals choose to move along established paths that connect them to the resources they require. It follows that any interference with these paths would be treated with suspicion and avoided- even circumnavigated. In a strategy to challenge elephants, a system that is constantly rearranged to take advantage of the natural wariness of elephant and the need to access the paths could prove to be a useful first line tool to prevent problem elephant approaching cultivated areas.

What exactly what constitutes a corridor?

Examining how elephants move over long distances considering mounting research data that consistently reinforces the establishment of smaller defined home ranges within protected areas and in-between rather than large movement patterns connecting protected areas, masking the true significance of the well-developed paths observed and used by elephants (Songhurst 2010, Chase 2013). There is controversy (e.g. van Ardde 2006) around corridors and how they are defined that many regrettably take to mean bulk movement of elephant in and out of protected areas whereas home range studies clearly refute this, although that said, bulls do on occasion move considerable distances. This understanding, seriously challenging the concept of *source and sink dynamics* popularised as the answer for dealing with the large elephant populations found in the KAZA region (Bennett 2003).

General Approach toward mitigation of conflict with elephants

Without question, planning land-use in areas where elephants and people coexist is critical. Without cooperation between stakeholders most mitigation methods will not work. Below are listed a number of ideas to consider when planning a 'mitigation intervention'.

- Agricultural Lands need to be planted in defendable clusters
- The first line defence from corridor or PA's (**see note above listing HWC approaches)**
- Establish a physical boundary
- Consider a 'motorised' or chase-to-boundary by a response team to enforce boundaries
- Cluster defence
- Individual land defence

d) Keep them out

- Electric fencing where possible (see AfESG 2000)
- Traditional fence with electric wire off-set
- Fence fitted with noise makers such as cow bells
- Plastic bottle with inverted chip packets insert acts as a visual barrier
- Effective crop guarding
- Manned watch towers for farmers to guard fields at night (see photographs)

e) Other Tools

- All the traditional tools
- An alert fence and passive chilli applications
- All the chilli options, both passive and active, used in conjunction to provide both discipline and reminder the include the *ACE* and *Mhiripiribomb*a options

f) Translocation

Translocation is an option using sophisticated equipment both entire herds and individuals. However, important questions are where to move them and justifying sufficient funding. In southern Africa generally there are too many elephant placing pressure rather on repellence effort. Much has been written on this technique popular in other parts of Africa[23], but it is not seen as a viable option in the KAZA TFCA at this time.

g) Biological Technologies

Biological methods that hold promise for mitigating HEC include physiological, pharmacological and immunological methods for modifying the reproduction and/or behaviour of elephants. These could have applications in situations where elephant populations need to be reduced or maintained without further increase, or for controlling aggressive behaviour and *musth* in adult males.

i). Contraception

Contraception as a means of slowing elephant population growth has been developed in South Africa and two experimental immuno-contraception trials on small, enclosed, populations were conducted and some experiments to investigate the possibility of sterilizing males (Fayrer-Hosken 2008) were also carried out. The results to date of immuno-contraception trials indicate that it is feasible, at least for small populations, and few side effects on elephant welfare and behaviour have been detected.

Its main application is likely to be in containing population growth in the many small, largely unviable populations in South Africa. Its potential use in Kruger National Park and Addo Elephant National Park is still being debated. The method is expensive and is not seen as a useful approach by stakeholders elsewhere in the region; many of those consulted considered it “unnatural”, if not morally wrong, to spend vast sums containing the productive growth of elephants that could be harvested to alleviate poverty.

Induction of temporary infertility (i.e. reversible contraception) in cycling females can be achieved by immuno-contraception, involving immunization against cellular components or hormones that are essential for reproduction. Trials in Africa have shown that three doses administered at intervals of three weeks using drop-out darts prevented pregnancies in elephant cows for up to one year (Delsink *et al*. 2003).

Studies in many domestic species and a few wild species (e.g. deer, bison) have shown that 2-3 doses of the vaccine are effective in achieving contraception for 1-2 years with no adverse side-effects (Fayrer-Hosken 2008). Studies are currently underway in South Africa and Sri Lanka to test the efficacy of this procedure in elephants.

Another approach is treatment with long acting preparations of oestradiol 17-β, which causes negative feedback on the hypothalamus and pituitary, resulting in inhibition of ovulation. Trials in African elephants using sub-coetaneous implants which are commercially available for

[23] Guidelines for the in situ translocation of the African elephant for conservation purposes http://www.iucn.org/about/work/programmes/species/who_we_are/ssc_specialist_groups_and_red_list_authorities_directory/mammals/african_elephant/tools_studies/translocation_guidelines/?uPubsID=2869

livestock have shown that pregnancies can be prevented for over 12 months (Hildebrandt *et al.* 2006).

j) Manipulating male reproduction and aggression

Immunization against GnRH in male domestic animals causes two reversible effects in the testes: reduction in testosterone production from the Leydig cells (resulting in reduced libido); and disruption of spermatogenesis in the seminiferous tubules (resulting in infertility). African bull elephants vaccinated with three doses had lower faecal epiandrosterone concentrations, indicating a reduction in testosterone production from the testes, and showed a marked reduction in aggression for periods of 6-9 months (Stout *et al*. 2007). After further re-vaccination of bulls that were in musth, a cessation of aggressive behaviour within 7-10 days of the first booster vaccination was noted.

13.2. Hippo *(Hippopotamus amphibius)*

The hippo is one of the most feared of all African animals do to their aggressive behaviour around bodies of water. Most conflict occurs within a few hundred metres of a body of water and is usually when a person is collecting water or tending a garden.

a) Applicable hippo behavioural traits

- Live in large bodies of water both flowing and stagnant
- Largely nocturnal resting during the day feeding at night
- Will readily exit water and graze during the day when hungry or when unmolested
- Must have clear access to grazing areas and to where they establish and maintain a routine, usually clearly demarcated by midden splash and paths
- Strongly territorial living in family pods largely at peace with communities unless disturbed
- Hippo move along distinct paths to and from their pools often on separate entry and exit paths. They exit the water up a shallow incline where they expose themselves gradually compared to entry back into water with steeper sides enabling them to crash back in if disturbed
- Hippo are able to move considerable distance, several kilometres, from the water at night returning before dawn
- As the pools evaporate, territories become smaller resulting fights between dominant males often leading to eviction of the loser with nowhere to go. The ousted males often take refuge nearby, often under a shady bush, where they can be extremely dangerous if approached
- Mostly hippo rest on the bottom lying or crouched head either permanently out or dipping their heads under resurfacing every 5-10 minutes when disturbed
- If very disturbed hippos seek water with overhanging vegetation- they often stay underwater only exposing their nostrils to breathe at 5-7 minute intervals
- Hippo are not strong swimmers, and in deep water will rather walk/run along set routes rather than to swim surfacing briefly to breathe and look around
- Tethered in deep water which occasionally occurs during capture they are easily held
- Where the pod rests fish congregate to feed off the dung and often river fisherman on their Mokoros venture too close and are attacked
- The physiology of hippo being an aquatic species, is more similar to whales and dolphins rather than animals so that surface blood vessels are deeper seated and more constricted consequently drug absorption is considerably slower that needs to be borne in mind when considering darting

- Hippo are very sensitive to the opioid group of drugs rendering chemical capture difficult in the past. Recently a combination of drugs has been found BAM mixture (Butorphenol, Azaperone and Medetomidine) that immobilizes hippo without losing its ability to surface to breathe regularly so do not drown. This in combination with additional ketamine and some mechanical innovations to existing capture equipment allows for the selective capture and translocation of them to safer refuges
- Hippo are unable to cross a vertical sided gully too wide to step across nor are they able to step over solid obstacles
- They also dislike strong light
- They have sensitive skins
- Given the opportunity they will brazenly enter built up areas to graze

b) Planning and strategy

- Provide and maintain passageways
- Lands planned in clusters that are properly fenced
- Any development should be a minimum of 100 metres away from the river or dam waterline
- Cluster defence - A strong solid barrier/fence or trench is essential
- Apply individual crop/land minding in severely compromised fields
- If these conditions cannot be met, seriously consider translocation them elsewhere as the technology to achieve this has been established

c) Keep them out – some sort of barrier is essential

- Electric fence, if applicable
- Traditional fence with electric off set
- Traditional fence
- Defensive barrier fitted with a taut steel cable some 500mm above ground passing *through* large solid poles at 7metre intervals that they are unable to step over
- *Offset early warning fence* (4-5 metres from barrier string set 2,2 m up)
- Fence can be fitted with cow bells
- Plastic bottle with inverted chip packets insert acts as a visual deterrent
- Effective on the spot crop guarding
- Manned watch tower recommended

d) Tools

- All the traditional tools discussed earlier
- Barriers of any sort help to frustrate hippos
- Alert fence and passive chilli applications
- All the chilli options both passive and active used in conjunction to provide both discipline and reminder the include the chilli dispenser options
- Torches and bear-bangers

e) Translocation options

Now a definite option using the BAM drug combinations and sophisticated equipment enabling the capture and translocation of a number of individual animals. Currently there is a market for a number of particularly sub-adult and younger adults into the commercial sector.

13.3. Baboon (*Papio cynocephalus ursinus*)

a) Applicable baboon behavioural traits to provide effective mitigation

- Baboon cause great devastation to cereal crops that include maize, pine plantations, sugar cane and sometimes wheat which they chew like sugar cane spitting out the pith.

- They sleep in a well-defined roost usually in tall trees in a wooded gully or at the base of a hill or in thick dense riverine vegetation. These roosts can often be recognised from the air as clearly defined paths may be seen emerging from them in a pattern similar to the spokes of a bicycle wheel.
- The troop may have several other temporary roosts nearer the crop, which they will use for convenience, depending on where their preferred food source is at any one time.
- Roosts are recognised by the pungent smell emanating from them, as well as the ground beneath being devoid of vegetation (depending on the level of occupation). Small trees in the vicinity, used as play gyms by the younger animals, are often bent over and clear of leaves lower down.
- Interestingly there is increasing observations that indicate an association with bush pig that forage beneath the roost feeding on baboon faeces particularly when enriched during crop raiding forays
- Baboons have a well-developed and disciplined social structure governing their behavior. During foraging the dominant males remain fairly well hidden relying on the sub-adults to detect danger however when commuting it is the dominant troop males that determine direction and lead the troop though not often from the front, more by audial grunts
- They move in predictable patterns along established paths or roads while foraging but also establishing their own paths particularly in broken country along the side of steep slopes mostly inaccessible to other animals that become more conspicuous the closer these paths occur to their night roosts. Baboons have well developed eyesight, which they primarily rely upon to detect danger.
- Their eyesight, apparently the most developed amongst the mammal's species, is particularly attuned to movement, which they are able to detect quickly even at long ranges. It is practically impossible to approach a troop unnoticed, for the simple fact that if you can see them they can definitely spot you well before approaching too close.
- Where they detect even minute changes to routine and obstacles they are not familiar with, they will first avoid it, an observation that must be exploited to provide good repellence. It appears that major changes in land use for example are at first avoided for a season but then through chance encounter or a mechanism of *passed on experience*, never deduction, the food potential is realised where they thereafter connive to obtain it having now become habituated. The mechanism involved has yet to be fully understood but seems to be a process of an 'information transfer' in some way, where this information is passed onto the troop probably through immigrant dispersal male acceptance that is then added to their knowledge base and subsequent behaviour thereafter.
- All the sensory organs play a role in this, but Baboon principally rely more on sight than smell or hearing. Baboons are observant and quickly recognize weak points in the various preventative measures placed against them. Baboon however quickly learn to avoid each of them and rather enter elsewhere where there are less changes. Current repellence options in the form of scarecrows or carbide guns, are seldom effective in the long term because they are static and routine in practice. Even the routine movement of a crop guard is quickly summed up, which they will then work around.
- Recent satellite telemetry on Thetford Estates near Harare has indicated that while daily foraging and grooming takes up most of their daily routine, time is also spent knowing and conversing with neighbouring troops, constantly reminding one another, it would seem, of their respective home range boundaries. It would appear that while boundaries remain intact in relation to one another the exact position changes frequently up to ½ a kilometre depending on subtle troop strength and dominance changes between the respective troops probably influenced by seasonal food variations and perceived human threat as seasonal operations vary to grow crops for example. The study in question suggests strongly that on Thetford Estates that there

was a clear difference between 'during the week' and 'weekend' activities where during the week the baboon tended to less frequent areas used by people probably because of active harassed from the lands during cropping (Le-Bel & La Grange 2012).

- Research trials manipulating male dominance by removing the alpha male from one troops reflected an immediate change to the home range boundary of the other each time giving ground to the adjacent troop home range, but importantly the relative position of all the troops remained intact throughout the program removing other males
- When not persecuted, baboons appear to live in distinct seldom overlapping home ranges in which they forage, occasionally frequenting the common boundary between them where they vocally announce their respective positions to enforce their boundaries. Mostly these disputes are settled by vocal exchanges at the boundary interface seldom resulting in physical contact but it does seem they need to view one another.
- Where they are attracted outside their home ranges to 'bait stations' for control purposes, their behaviour changes dramatically often resorting to physical fighting until common agreement in troop ranking is achieved when they then try to stay clear of one another, the dominant troops given preference so that they satellite around round one another as the weaker troop make way for the stronger in a 'battle of words' while the attraction of the provisioned food dominates proceedings. Observations indicate that while several troops may be attracted to the pre-bait site, particularly when established for some time, not all would be feeding at the same time. It would appear that the troops rather remain close by waiting to feed in turn possibly in some sort of 'peck' order arrangement as discussed determined by troop strength all the while still bickering and fighting. Observations also indicate that the dominance ranking achieved is not dependent on numbers but the strength of the male coalition involved that we successfully managed by removing all the dominant males to achieve consistent feeding at each bait station
- During this time of frenzied activity, tensions remain high resulting in much anxiety by the respective troops waiting often resulting is some displacement behaviour ranging from leaf stripping to serious bark stripping that also occurs in the wild, depending on the time period anxiety continuous. This is particularly noticeable amongst the troops waiting longer periods to feed fuelled by boredom it would appear. Where this condition is temporary this behaviour ceases as soon as the situation returns back to normality but over time, it is suspected that the disorder becomes chronic becoming a longer term learned adaptive behavioural trait that is then passed on! This condition frequently occurs on large intensively managed exotic plantations that become extremely difficult to control.
- In afforested plantations it is suspected that mal-adaption to the constantly changing environment, brought on by constant 'rapid' silvicultural operations may be the driver of the problem, constantly changing landscape suspending the baboons' ability to geo locate necessary in the maintenance of home ranges.
- Effectively these plantations follow repetitive cycles of thickening up, followed by thinning out by continuous pruning back clearing all substrate vegetation beneath to promote growth but inadvertently completely changing the nature of the landscape. All the trees rapidly growing in height, changing both the profile of individual trees and the landscape as a whole effectively rendering the baboons lost, unable to define respective home range boundaries leading to frustration, most often at these interfaces, as the individual troops 'argue' to establish recognizable boundaries. While plantations don't occur in the immediate KAZA TFCA it does so in the Zimbabwe Eastern Highlands underscoring a principle that ultimately the successful control of baboon in conflict with agriculture, in particular plantations, for the long term must include re planning of the respective enterprises to reduce this driver for anxiety in combination with other exclusion and repellence options Baldwin & La Grange, 2013)

- There is evidence to suggest that Leopard do play a large role in maintaining baboon numbers, although it has been shown through a study in Matopos National Park in Zimbabwe, that baboons may not necessarily form their principle diet.
- Baboons are not considered dangerous, however, where little resistance is put up whilst crop raiding, they have learned to intimidate particularly women working in lands in the communal areas in order to raid the crop. Occasionally baboons can be a problem predating on livestock, particularly lambs. They are also able to inflict serious damage to inexperienced dogs, upon which they will quickly turn once they feel secure,
- In the Gokwe communal land adjacent to Sengwa Research Station FAO reported that between 1993 and 1996, 241 livestock were taken of which the principle predators were 52% by baboon, 34% by lion and 12% by leopard. To have such a high percentage attributed to baboon is extremely unusual, undoubtedly not replicated elsewhere, but it does reflect baboon ability to discover new opportunities and adapt to them. Observing them while bark stripping in the Eastern Highlands of Zimbabwe (Baldwin & La Grange 2013) indicates that baboon hierarchy within each troop, limits individuals doing something different or exploiting something new disciplining junior members that try to do so providing the reason why tree stripping for example is carried out by some troops but not others even immediately adjacent to one another, they simply do not copy others that have different movement and strategy patterns. How then are ideas exchanged and are adopted? Shirley Sturm in her book *Almost Human* (Strurm 1987) relates to an incident of a dispersal male that had learned the art of killing Thomson Gazelle fawns that only after final acceptance to the troop did the others adopt the idea and successfully harvested 100 fawns the next year. The inference being that animals do not readily adopt new ideas even habituation to new opportunity. Procedures developed for the control of baboons over many years, habituating them to a new site is an art that takes time, but once developed it becomes a habit difficult to break
- Increasing urban baboon challenges underscores the problem habituation brings: Baboons unlike most species adapt well to human provisioning quickly adopting information gleaned, changing their behaviour habits to accommodate the new challenge. Reports of child kidnapping and aggression toward humans is on the increase in urban areas that seldom occurs in natural populations, unnatural behaviour not ever seen in the wild. In the larger urban centres in the partner countries, baboons are not a problem and troops on the edge of town don't try to enter as they seemingly seem to be unaware of potential food within. This proves the hypothesis that *where they don't know, they don't go,* achieved in the past (personal observation) by rigorous lethal control that successfully removed all the baboon including dispersal males that knew of it, effectively removing all information of its existence in the baboon knowledge bank. For the smaller more recent settlements particularly border towns that developed much later, this did not occur baboon allowed even encouraged to live and roam town crossing over human wildlife fear barrier complicated by indiscriminate public rubbish waste dispersal and opinion change not to undertake lethal control. Consequently, baboon have thrived on these newly found provisions and have learned to successfully intimidate humans rendering disease transfer between baboons and humans more probable as both populations increase and strive for the same commodities in the future. Habituated baboon, in fact any animal, is extremely difficult if impossible to control eventually resorting to lethal control that for baboon would mean the total removal of all troops in town and surrounding area until the knowledge is broken. Trials have indicated that provided detection of improvised food is prevented, they never establish the enterprise as a food source no matter how attractive it may look enforcing the cliché' that *where they don't know they don't go*! This may be accomplished in two ways, by preventing other troop males or bachelor males from venturing too close and preventing all access to improvised food sources in particular waste products

- Experience on two occasions, one involving a commercial farm near Harare and the other under rural chieftainship near Victoria Falls has conclusively shown that prompt action following lethal control to physically chase away new incursions was successful to prevent baboons re-establishing themselves in the area again.

b) Recommendations for totally habituated baboon:

- Remove all the infected baboon by lethal control
- Discourage new incursions around towns, villages or homes
- Diligently remove and incinerate all rubbish
- Encourage community buy in to enforce local bi-laws and ensure clean living

c) Keep them out – preventing habituation at all costs

- Dedicated guarding diligently watching over crops at all times
- Traditional methods that include:
- Banging tins
- Poly tapes and streamers
- catapults
- Community rallying to help one another
- Stock whips
- Various homemade 'pipe' bangers
- Improved bangers (firing live rounds over the top, carbide bangers and crackers)
- Scarecrows - incorporating moving positions and hiding tactics to mimic real life situations
- Manned watch tower recommended to deal with chronic incursions
- Use of guard dogs
- Community rally to provide organised drives to chase them out from the area to the PA's
- Green laser therapy: Recently discovered is the effective eviction of baboon from their night roosts (see strategies and tools used for details) and to a lesser degree from places where they have become a nuisance provided that they are not too habituated
- Capture, paint and release of dominant males through cage traps
- For extreme cases the removal of entire troops using large camp traps

d) Tools:

- Traditional tools
- Watch towers
- Community participation
- ACE ambushchillixploders
- Cage traps
- Large camp traps
- Green laser

13.4. Bush pig (*Potamochoerus porcus*)

a) Applicable behavioural traits

- Bushpig are nocturnal omnivores that move in sounders comprising of 7-9 pigs up to 15 where they are not persecuted, evidence of their passage more noted by ground sign (spoor and rooting up) than being seen
- Being omnivores bushpig eat anything from offal to grain and are particularly partial to fermented maize which they detect from afar and home in on
- They lie up in the densest undergrowth or reeds around during the day only vacating at the last moment when approached from which they charge out to seek new refuge
- Although well equipped to defend themselves they would rather attempt to run off rather than attack unless cornered

- Bushpig occur throughout sub region, but are more numerous in the Highveld, probably because of the better rainfall found there.
- Observations indicate that they are more numerous in wetter areas and broken country favouring marshy ground to root and dig in. They particularly thrive in commercial areas where there is wasted water flooding large areas such as found below large irrigation schemes such as Hippo Valley Estates
- As a result of this evidence suggests that predators are not the main controlling factor to limit their numbers, but rather the amount of ground water affecting soil moisture conditions during the dry season. It has been found that bushpig root in the ground for food even if the food is placed on the surface. Once food becomes scarce with the onset of the dry season, they are unable to root over wide ranging areas, rather becoming confined to vlei heads and along riverine vegetation, where the soil is moist enough to continue rooting providing significant opportunity to trap them. On Hippo Valley Estates (HVE) problems of drainage and the growth of sugarcane has provided ideally, improved habitat for bushpig resulting in a significant increase in bushpig numbers. It is probable that naturally, they would come under nutritional stress during the dry months and experience difficulty in obtaining food at this time, the principle factor that limits their numbers in the dry lowveld area of Zimbabwe.
- As discussed for baboon, bushpig appear to thrive on baboon excrement located beneath baboon roosting places and from nearby villages defecating in the surrounding bush
- Bushpig have a well-developed sense of smell and hearing which they exercise at all times. While depredating agricultural crops individuals of a sounder communicate with one another by uttering low, but audible grunts. When danger threatens one grunt will send the entire sounder scuttling for safety.
- Bush pig are acutely aware of any changes to the environment, particularly smell, and will avoid these changes even to the point of denying themselves food. Experiments attempting to attract them to bait through a set gun have failed because of this! They approached the trap but refused to enter, probably because of human scent remaining. With respect to bait stations, this problem is alleviated as the smell of humans already has been accepted along with the bait right from the onset.
- Where they crop raid, this well-developed cautionary behaviour can be used to advantage by continually placing ‘smell’ obstacles in their path, particularly plastic fencing, cotton soaked in creosote and placed in tins, or strong perfume odours that effectively prevents them accessing the crop.
- Bush pig dislike using established paths or roads, preferring to make their own. They avoid open areas and prefer to move through the denser bush to which they are ideally adapted. Their body shape slopes naturally forward forcing the vegetation over them as they pass beneath.
- Their suspicious nocturnal nature makes them difficult to control, but methods have been devised to overcome this. Mechanical trap systems are largely ineffective as they easily detect odours associated with humans. Old school trappers eliminate these by boiling the trap in hot water with a small concentration of caustic soda, rinsing them well and then dunking them back in more hot water upon which a layer of melted bees wax floats so that as the traps are pulled out it leaves a thin coating to both lubricate and camouflage any scent remaining. This problem is also overcome by habituating them to the trap beforehand where they learn to accept the food along with human scent before capture is contemplated
- Where bushpig become a problem to standing crops, hunting is still the most effective method employed, success being dependent upon the hunter’s skill to approach the feeding animal in the crop under full darkness downwind without a torch and alerting the pigs. Success of this approach is improved by opening walkways through the lands at regular intervals to access the crop without making a noise. By opening up the approach area bordering the crops forces the pigs to expose themselves which they

dislike but will undertake to crop raid improving the opportunity to hunt them as they cross by using sophisticated night goggles and laser sights.

- Alternatively, bushpig may be hunted during the day where they roost in nearby thickets by ambushing them as they run from beaters beating through in an extended line through the thicket employing 12-gauge shotguns or machetes as they attempt to escape. Success obviously being dependent upon choosing where the pigs will run out, quick accurate shooting and a lot of luck! Bushpig in the absence of suitable thickets harvest grass and set up a dome of piled grass in which they both nest and nurture piglets from which they sleep in during the day from which they 'explode' out from if disturbed providing an element of surprise to avoid predators including man hunting them requiring foreknowledge and a steady composure to exploit the occasion!
- This would be an effective community action approach combined with using dogs
- Regrettably macro farming operations in general and in particularly large irrigation enterprises provide ideal habitat for bushpig the whole year round so that natural control is minimised, there being excessive run off providing ideal habitat in which they move, roost and forage providing more wet/damp soil to root in that boosts reproduction success significantly.
- Reducing bushpig populations under these circumstances is more effective during the dry season of the year when natural food is scarce where they take more readily to fermented maize offered overcoming their natural suspicion of humans rendering them more vulnerable
- Bushpig even under these circumstance are still cunning requiring foresight and planning to design and carry out a well thought through strategy.
- Habituation to exploit this opportunity is critical but once feeding regularly they can be removed using a portable pig boma/camp trap or sounder eliminator system. Recent trialling of this technique in sugar cane in Hippo Valley Estates has indicated that there is an optimum area the camp trap should be. The estimation is at ± 5metres diameter, set upon currently used bushpig paths preferably near but not on a road where they are also accustomed to human traffic. The camp trap should be well camouflaged in the standing cane and once baited left alone for the pigs to discover and over a couple of days, enter.

b) Repellence technology

- During the rains bushpig crop raiding is more effectively controlled by physically preventing their access to the crops using preventative fencing (see my suggestions for improved traditional fencing) and by using scent repellents to advantage to capitalise on their natural suspicious nature that has proved effective
- The use of toxicants is not considered appropriate or effective as bushpig seem to succumb considerable distances from the bait site although there are systems to apply the toxicant that is considered target specific. This is achieved by burying the bait in a shallow trench with a lead in of uncontaminated bait which they root out and ingest.

c) Planning and strategy

- Understand the conditions under which bushpig thrive
- Reduce conditions for population increase in particular waste wet area management
- Open out approach areas to crops
- Exploit bushpig extraordinary sense of smell to repel them
- Actively exploit the dry season to reduce numbers

d) Keep them out – proper management

- Open up boundaries
- Regular scout patrols to determine movement and lie up places
- Low close wire fencing ≤ 500mm height with strong poles 7metres apart across vulnerable approaches
- Set up and constantly change smell deterrents
- Regular night patrols in the cropped lands

e) Tools

- Diligence
- Bush pig camp trap (La Grange, 2016)
- Good crop minding practices

13.5. Antelope – or a variety of species of plains game.

a) Applicable behavioural traits

- Occasionally, antelope such as Kudu, damage crops, for example cotton or tobacco, but losses usually do not warrant lethal control measures, and they are better deterred by fencing or captured and translocated, rather than to destroy.
- Some species, for example Sable inflict little damage to crops and do very well on the edges of lands where there is less competition by other species.
- The wildlife industry in Southern Africa provides lucrative business options, so where a problem persists the offender can be captured and translocated, or set up as a safari hunt from which a return may be derived to the communities.
- When large numbers of antelope are involved, consideration should be given to the creation of a community wildlife area buffer zone and these animals moved and managed through providing community buy in while minimising the hard interface between communities and protected areas
- The development of the wildlife industry has enabled the capture of entire herds of animals including hippo and elephant
- Wildlife that includes antelope, provides for huge valuable income generating opportunities, possibly much more than any other community project because of the multiplicity of value adding possibilities that may be exploited
- In years of severe drought, particularly in the Lowveld regions of Zimbabwe, wildlife resorted to large scale irrigated crops that saved them providing an upside to macro agriculture. Mass die off was prevented by providing outside fodder for them in the bush and through mass capture placing them into protected fences enabling the temporary feeding of them, providing fodder from other areas further afield, less affected by the drought.
- Antelope are sensitive to people activities so preventive techniques work well and should be explored, only considering translocation or lethal options when this is not possible.
- Where animals are to be directly hunted to protect crops, the shooting should be carried out by a competent person with a rifle calibre in the range of a .223 to 30-06 Springfield, using low power, good quality rifle scopes particularly if shot at night. Larger weapons in the range .338 Winchester Magnum to .375H&H would be better for Eland and Giraffe. Care should be taken to ensure that correct weapons are used in terms of the respective countries Law.
- In the South-Eastern Lowveld, Impala were deterred effectively from entering sugar cane during the drought of 1983 by hunting them at night along the edge where they usually entered to enforce a memory dynamic.
- Kudu and eland can extensively damage tobacco and cotton where this habit has been allowed to develop
- Hunting opportunities particularly for local residents are rapidly disappearing providing a lucrative opportunity for community wildlife programs such as campfire that may be exploited
- Weapons in the range of .270 Win to 30–06 Springfield calibres are suggested for the hunting of the smaller range of antelope, using well-constructed soft nose bullets, combinations falling within the so called ‘green band’ range while heavier cartridges of .338 Win to 375 H&H be used for eland. Most farmers are conversant with hunting

plains game, but the novice is advised to study the booklet "Ballistics in Perspective" (LA Grange 1990).
- Considering translocation options refered to the relevant sections on capture from books in the reference list.
- Capture is an expensive operation so rural areas dealing with smaller numbers of problem antelope are encouraged to consider the authors patented 'Drop Boma System' managed by AWMC in Harare.

b) Planning and strategy
- Repellence techniques work well for antelope
- Consider moving problem species to a collective wildlife use area
- Exploit value added opportunities it provides
- Good crop minding

c) Keep them out
- Fencing is the best option

d) Tools
- Streamers on fences work well
- Try scent options like spraying on rendered down lion/leopard scats

13.6. Crocodile *(Crocodylus niloticus)*

As with the hippo, the crocodile lurks in the life giving water so important to farmers and herders. Some crocs specialize in eating livestock and even people and management of human behaviour is essential for mitigation methods to be effective. Murphy, C. (2007) in the Caprivi and conflict around Lake Kariba (McGregor 2004). (Thomas 2006) Crocodile/human conflict in the Okavango Delta, Botswana. (Bourquin & Shacks 2015) threats to the croc in the Okavango and Angola[24] using attack data to look for trends (Pooley 2015).

a) Applicable crocodile behavioural traits
- Crocodiles are a threat to livestock along most of the larger rivers in particular those adjacent to the communal areas where the waters are heavily fished
- During the summer months when the crocodiles feed and are most active, they regularly take livestock, and occasionally humans
- Crocodiles are able to remain beneath the water for up to one and a half hours, and in small water bodies, usually detect human presence well before they themselves are seen, submerging and remaining in ambush.
- Small pools, particularly along large rivers, are deceptive and often harbour large crocodiles. They should be approached with caution.
- Although crocodiles are opportunists, taking whatever food is available; their preferred food is ground feeding fish for example barbel. In well-stocked dams and rivers therefore they are less likely to be a threat to livestock
- Confirmed man-eaters, however, will continue to take humans even when relocated to dams better stocked with fish. The removal of these individuals should be considered immediately
- Crocodiles have a well-developed sense of hearing, smell and sight, and may be attracted by barking dogs or the bleating of a goat, and lured into a trap or a 'shootable' position
- Responding to their keenly developed senses of smell and sight, meat placed in a trap upwind is easily detected as they patrol the water's edge at night.

[24] http://www.okavango-croc.com

- Females seldom exceed 3,5m while the males can grow to 4.5, with the largest caught in Zimbabwe being 6m in length
- Crocodile are easily spotted at night using a torch, characteristically showing one red eye. For hunting purposes, undisturbed crocodile populations can easily be approached in this manner using a boat
- There are many methods of capturing crocodile including cage traps both static and floating, various steel noose traps, harpoon and the use of partly submerged cable snare lines to capture them
- Generally unknown is that crocodile do stress easily during capture and man-handling but are quickly calmed down by binding their mouths closed using tape, blindfolding them and placing them in a darkened well aerated cool crate or reservoir away from disturbance where they can be transported or held for several days.
- Communities in communal areas are able to fence out portions of the river or dam with diamond mesh providing crocodile free river/dam frontage for livestock to drink and to gather water safely
- Aptly demonstrated in Namibia are well placed and managed crocodile fences that separate the main water body from a selected protected area free of crocodile

b) Planning and strategy

- Provide a minimum of 100 metres away from the river or dam waterline for houses and farming activities
- Discourage passage and gathering of people close to the waters' edge
- Plan water for consumptive purposes away from natural water bodies
- Specific crocodiles known as problem individuals should be destroyed
- Crocodile fence off a number of protected spots opposite dwellings and night kraals, safe positions to access water
- Where possible try to manage fishing along the rivers to try and improve fish harvesting in a sustainable manner as is being explored along the river in Niassa Reserve in Mozambique
- Good livestock minding – herding cattle and goats maintaining a watchful eye over them particularly when grazing close to water and kraaling them at night.

c) Keep them out – some sort of barrier is essential

- Diamond mesh crocodile protection fence
- Dedicated watch person diligently watching over activities within the protected area
- Protected area should be in shallow water exposed, totally free of vegetation rocks or debris build up

d) Tools

- Crocodile fences and the proper management of them.
- kraals

e) Trapping and translocation

There are several methods by which crocodiles are caught and managed. These include:

- the spring steel rope noose trap for individual large crocodiles
- floating partly submerged and on land box traps
- physical capture from a boat for smaller individuals
- harpooning larger ones tethered to a marker float with which they are retrieved once they tire out
- partly submerged cable snare lines to capture them around the upper jaw but all these require to be used under licence granted to an experienced operators requiring to capture them for research or commercial purposes
- The mass capture of crocodile also possible by surrounding a large bait carcase (buffalo) in a shallow dug out water filled depression near a crocodile infested water body. The pond is encircled with nets and approached via trenches dug in from the

main water body each guarded by a drop gate. Once the crocodile moves in through these into the pond, the gates are manually tripped capturing all the crocodiles within that are systematically processed
- Shock immobilisation in comparison to using of drugs
- Traditionally the drug of choice in the past has been Plaxadil a paralysing drug that while paralysed the crocodile remains awake that is now questioned
- The more humane method is to shock stun crocodile at the back of the neck immediately behind the head that renders it unconscious to allow jaw taping and blindfolding. This has the desired calming effect Generally unknown is that crocodile do stress easily during capture and man handling but are quickly calmed down by binding their mouths closed using tape, blindfolding them and placing them in a darkened well aerated cool crate or reservoir away from disturbance where they can be transported or held for several days. Care needs to be exercised to ensure their snouts remain clear to breathe freely The back legs may be tied back loosely together over the back (not too tight to reduce blood circulation) that effectively restricts them, periodically hosing them down with water in exceptionally dry hot weather conditions

13.7. Lion (*Panthera leo*)

Next to the elephant, the lion has caused more conflict incidence than any other animal.
Work on these predators has produced a number of innovative studies of conflict between lions, cattle and people in the Kalahari (Hermann, 2002) and in the Caprivi (Hanssen, *et al* 2014) and Stander (2000) for example and the conservation of lions and other large carnivores in the Kunene region, Namibia (Potgieter, 2014).

a) Applicable lion behavioural traits
- lions are a threat to livestock alongside most of the larger PAs that are adjacent to the communal areas particularly where there are no buffer zones
- lion attacks on livestock multiply significantly where livestock is grazed or watered within the park boundary attracting them directly to the night kraals
- livestock that are not night kraaled are at particular risk
- individual animals that lag behind on return to the kraals that end up sleeping outside are extremely vulnerable
- good livestock minding includes staying away from the PA boundaries, daily herding and night kraaling remaining consistently vigilant essential first line of defence components to prevent lion attacks
- lion behaviour particularly towards humans changes dramatically at night where they become much bolder and take on more risks to obtain prey
- Regrettably their boldness at night also renders them more vulnerable to poisoning practices that is of huge concern
- Observations over time are that mostly animals kraaled are let out too late in the day and brought back in the evening after dark when lions are most active; mostly a logistic issue of young boys having to attend school. Letting them out and bringing them back earlier would be a better option
- the practice of not kraaling donkeys for part of the year also needs to be addressed that is attractive to all carnivores particularly if they are fitted with a bell
- recently it has been established that cow bells fitted to indicate where wandering animals are, strongly attract lion and hyena to them
- moving kraals to provide some form of rotational grazing as was practised many years ago implementing the Lagisa grazing scheme in Tsholotsho is the way to go combining conservation agriculture with good livestock minding
- young males and ousted pride males tend to wander from natal home ranges outside and adjacent to protected areas often remaining close by but occasionally collared

data has indicated long distance movement covering several hundred kilometres of individuals or a small group presumably searching for food and reproductive opportunities elsewhere turning up in some amazing places possibly following an old corridor route

- lion like most animals attacking, require to see their prey targeting a specific individual before committing to an attack rather than blindly leaping in
- research universally has demonstrated that to prevent this opportunity, kraal design should primarily prevent them from seeing in and secondarily prevent access
- kraals may be built from several materials including living fences (diamond mesh either side of *Commiphora* species thickets), woven matting, close set poles and even steel panels so long as they are substantial
- early alert systems that include dogs are strongly advised
- attacking lions generally approach from cover downwind so the kraal should be exposed in open ground as much as possible to discourage undetected approach
- with this in mind it is important to always respond to signals indicating lion approach to prevent an attack before it occurs
- lions are suspicious of flashing LED lights that are properly placed at regular intervals 7-10 metres set at approach height
- both Niteguard and the PREDeter versions are recommended
- burning fires and manned guard positions may also be necessary to deal with chronic situations
- most of the prides found in the KAZA TFCA have been collared for research purposes that are geo monitored enabling reaction to chase lion back to the protected areas.
- In Namibia the *Lion Guardian* approach is firstly to warn neighbouring communities of intended approach and then to identify kills by monitoring periods of very localised pride movement during peak hunting periods outside the park which they react to and remove the carcase before the lion benefit, increasing kill effort for little return
- In Zimbabwe the *Hwange Lion Research Unit* [25] similarly warn communities but then to react to these incursions and chase and disturb them back to the Park using vuvuzelas
- Modern IT technology has enabled the electronic recording of data on line and while it is understood that many communities do not have cell towers at present communications for rural communities is expanding fast. There are many options including SMS Frontline, KoBoCollect that maybe considered that automatically inform responsible persons and register on the main data bank
- Translocation concerns: there are concerns translocating problem lion to other areas, that each situation be thoroughly investigated to prevent mal adjustment of the lion in already inhabited situations or the transfer of the undesirable behavioural trait. Research in Namibia has indicated that many of these lion later returned to the site of capture

b) Keep them out – proper kraaling in well-constructed kraals is essential

- Must not be able to see in or out of night kraals
- Kraals built providing solid walls
- Exposed as much as possible
- Livestock properly herded at all times
- Away from protected areas
- Dedicated guarding diligently watching over the livestock at all times
- Implement some sort of flashing LED light system on the kraal walls
- Strive to let the animals out earlier to graze and bring them back before sundown

c) Tools

- Diligence

[25] https://www.wildcru.org/research/tkpp-mitigating-conflict/

- Well-built kraals
- Good livestock minding
- LED lights

d) Problem lion management of habituated individuals

- lethal control options
- PAC hunting

e) Trapping and translocation

- Trapping of individual lion using box traps with falling doors
- Darting and chemical capture of entire prides: At night lions are easily lured into bait amplifying recordings of animals in distress which they quickly react to and investigate if heard. Their bold nature particularly when not persecuted completely ignores human and equipment presence even while the darting operation is underway allowing for the darting of the entire group. There are a number of drug combinations presently used most operators favouring a zolitol medetomidine cocktail.

13.8. Hyena (*Crocuta crocuta*)

a) Applicable hyena behavioural traits

- Hyena are a threat to livestock alongside most of the larger Protected areas that are adjacent to the communal areas particularly where there are no buffer zones however because of increased numbers, penetrate more deeply into the communal areas
- Hyena attacks on livestock multiply significantly where livestock is grazed or watered within the park boundary attracting them directly to the night kraals
- livestock that are not night kraaled are at particular risk
- individual animals that lag behind on return to the kraals that end up sleeping outside are extremely vulnerable
- good livestock minding includes staying away from the protected area boundaries, daily herding and night kraaling remaining consistently vigilant are essential first line defence components to prevent hyena attacks
- Hyena mostly dislike direct confrontation with humans rather seeking opportunity around them while all is quiet however recently I observed hyena threatening the camp growling like a dog a noise I didn't directly associate with hyena making short rushes at us reacting to meat it smelt in camp. It never followed through and I believe it was trying to intimidate us to leave. Following up the incident with hyena researches, it would appear that hyena have learned to successfully intimidate the occupants of donkey carts where the occupants run off leaving the donkeys to the hyena
- Our observations are that mostly animals kraaled are let out too late in the day and brought back in the evening after dark when hyena are most active; mostly a logistic issue of young boys having to attend school. Letting them out and bringing them back earlier would be a better option
- the practice of not kraaling donkeys for part of the year also needs to be addressed that is attractive to all carnivores particularly if they are fitted with a bell
- recently it has been established that cow bells fitted to indicate where wandering animals are, strongly attract lion and hyena to them
- moving kraals to provide some form of rotational grazing as was practised many years ago, implementing the Lagisa grazing scheme in Tsholotsho, is probably the way to go combining conservation agriculture with good livestock minding
- Hyena as is the case with most predators require to see their prey targeting a specific individual before committing to an attack rather than blindly leaping in
- research universally has demonstrated that to prevent this opportunity kraals design should primarily prevent them from seeing in and secondarily to prevent access

- kraals may be built from several materials including living fences (diamond mesh either side of commiphora species thickets), woven matting, close set poles and even steel panels so long as they are substantial
- early alert systems that include dogs are strongly advised
- attacking hyena generally approach from cover downwind so the kraal should be exposed in open ground as much as possible to discourage undetected approach
- with this in mind it is important to always respond to any signal indicating carnivore approach to prevent an attack before it occurs
- hyenas like most carnivores are suspicious of flashing LED lights that are properly placed at regular intervals 7-10 metres set at approach height
- both Niteguard and the PREDeter versions are recommended
- burning fires and manned guard positions may also be necessary to deal with chronic situations
- Modern IT technology has enabled the electronic recording of data on line and while it is understood that many communities do not have cell towers at present communications for rural communities is expanding fast. There are many options including SMS Frontline, KoBoCollect that maybe considered that automatically inform responsible persons and register on the main data bank
- Apart from Lion, Hyenas are probably the most destructive carnivore to the livestock industry in the KAZA TFCA.
- Hyenas have a highly developed sense of smell, sensing even buried foreign objects. For this reason, mechanical devices such as gin-traps (no longer used) are generally not effective as they are with Lion and Leopard without a laborious cleansing process beforehand. Tame Hyenas have even been used to detect landmines underground!
- Hyenas tend to move in predictable patterns, and when these have been finally realised have they been successfully controlled.
- Their sense of smell and patience once they become suspicious is truly remarkable, but with care this evasive ability can be overcome with the decontamination of equipment, using suitable lures and careful camouflage of the trap.
- Hyenas quickly become educated and will not return to a carcass in the area they have been persecuted, but appear to be less cautious away from it. Observations are that they associate the *area* with the problem rather than the tool or strategy used but if presented in a new area where they have not been persecuted they are less wary of bait presented.
- Like Jackal, Hyena, being canidae, tend to prefer following established paths to and from places of refuge. It is useful to locate these paths before control is attempted, to determine where they come from and to ascertain their ‘modus operandi’.
- Hyenas usually occupy defined lairs in caves or holes in rocky outcrops or in disused anthills, but where neither occurs they will lie up in thickets or tall grass.
- Hyena respond to clear, amplified tape reproductions of other Hyena feeding, and so with careful planning and execution may be called into a ‘shootable’ position. Usually they come running in, requiring quick action to accurately shoot them. Where this fails however, they are less likely to be caught in a similar manner again. Static ambush hides are not considered effective favouring hunting from a movable concealed provided by a vehicle covered with a camouflage net, constantly changing position every 20-30 minutes. This is achieved by moving 3-5km distances, calling for 2min, listening for 10, repeating this sequence a second time and if there is no response, either a response call or they come running in, drive on and try another 3-5km further covering the district this way throughout the night. Hyena dislike spotlights so preferably they should be hunted without the aid of one; where this is not possible, turn it on (using a second person) the second they run in. The use of sophisticated night vision equipment is helpful to improve results.
- Around camp sites or to protect valuable equipment, Hyena may be deterred by electrically charged fencing or polywire around the camp or object.

b) Keep them out – proper kraaling in well-constructed kraals is essential

- Must not be able to see in or out of night kraals
- Kraals built providing solid walls
- Exposed as much as possible
- Livestock properly herded at all times
- Away from protected areas
- Dedicated guarding diligently watching over the livestock at all times
- Implement some sort of flashing LED light system on the kraal walls
- Strive to let the animals out earlier to graze and bring them back before sundown
- Resist intimidating tactics that hyena may employ to gain access

c) Tools

- Diligence
- Well-built kraals
- Good livestock minding
- LED lights

d) Trapping and translocation

- trapping of individual lion using box traps with falling doors
- darting and chemical capture of entire packs: not really an option for hyena apart for research purposes

13.9. Leopard (*Panthera pardus*)

a) Applicable leopard behavioural traits

- Leopards are without doubt the masters of stealth of all carnivores, able to operate largely unnoticed even in urban areas
- They are largely solitary except for females accompanied by their young and during temporary mating rituals
- They are almost exclusively nocturnal only venturing out late afternoon or early morning out where they feel secure
- Their secretive nature and successful hunting techniques allow them to survive even in the most unlikely of places, and are much more widespread than is imagined
- Leopard are not thought to move great distances as do Lion rather occupying smaller territories preying on smaller animals that are found in greater numbers. Their predominant prey depends largely on the species most common to the area they occupy.
- Leopards lie up during the day in a wide variety of habitat that best enables them to retreat and operate from. Broken country, rocky hillocks and granite outcrops are favoured refuge spots that are more inhospitable to move through while enabling them to see longer distances but they will readily occupy stands of denser trees in open savannah or riverine vegetation in fact some surprising locations because they are so secretive
- livestock not night kraaled are at particular risk
- individual animals that lag behind on return to the kraals that end up sleeping outside are extremely vulnerable
- good livestock minding including daily herding and night kraaling, being consistently vigilant are essential first line defence components to prevent leopard attacks
- Leopard problems most often occur when small livestock are placed in the immediate vicinity of an occupied den. By simply by repositioning the livestock stockade further away often serves to alleviate the problem. Young livestock are particularly vulnerable so should be kraaled away from known Leopard habitat providing the best long term option

- Leopard play a large role in reducing baboon and bush pig numbers down to a tolerable level in a farming or communal land environment so their presence should be rather encouraged and the farming activities planned around them to reduce conflict.
- often when leopard attack livestock in a confined space where livestock are unable to escape, they will kill indiscriminately until all struggling ceases fuelled by the enclosure preventing the non-targeted animals to escape
- leopard like most animals attacking require to see their prey, targeting a specific individual before committing to an attack rather than blindly leaping in
- research universally has demonstrated that to prevent this opportunity, kraal design should primarily prevent them from seeing in and secondarily prevent access
- for leopard, standard cattle design kraals are not advised, rather opting for much smaller replicas but with the roof closed in to prevent access from the top
- kraals may be built from several materials including living fences (diamond mesh either side of commiphora species thickets), woven matting, close set poles and even steel panels so long as they are substantial
- early alert systems that include dogs are strongly advised
- attacking leopard generally approach from cover downwind so the kraal should be exposed in open ground as much as possible to discourage undetected approach from this direction
- with this in mind it is important to always respond to any disturbance indicating carnivore approach to prevent an attack before it occurs
- leopards are suspicious of flashing LED lights that are properly placed at regular intervals 7-10 metres set at approach height
- both Niteguard and the PREDeter versions are recommended
- burning fires and manned guard positions may also be necessary to deal with chronic reoccurring situations
- Modern IT technology has enabled the electronic recording of data on line and while it is understood that many communities do not have cell towers at present, communication towers for rural communities are expanding fast. There are many options including SMS Frontline, KoBoCollect that maybe considered that automatically inform responsible persons and register on the main data bank

b) Trapping and chemical capture:

Where Leopard have not been previously hunted they can be trapped reasonably easily however where they have been “educated” they become extremely cunning. Leopard invariably have a preferred species of prey they mostly attack, so where live bait is employed to attract them, it is important to use the species they prefer to prey upon, which may differ considerably depending on locality.

They are however particularly fond of dogs, and will go to great lengths to obtain them, even to enter occupied houses to obtain them that may be used. Patience is essential when attempting to trap Leopard, as they quickly become suspicious and often will not return for several days. By patiently waiting, even for several weeks, one is usually rewarded. Leopards have traditionally been trapped using cage traps but more recently the humane leg hold cable snare has proved a better option resulting in less injury to the captured cat and more hits for effort and time spent trying to trap them. This system however is definitely not recommended by the novice as it requires considerable experience and know how to properly position and set the trap to prevent injury to persons and the leopard while improving the chances of success.

Chemical capture without trapping is generally not considered an option as they are not as easy to dart in the same way as Lions are, so preference should be given to trapping first, followed by an immobilising drug administering either Zoletil/medetomidine or Ketamine/medetomidine combinations, before they are handled (Botma & Dutoit 2010).

c) Translocation concerns

There are concerns trans-locating problem leopard to other areas, that each situation need a thorough investigation to prevent mal adjustment of the animal in already inhabited situations. As new founder populations in uninhabited territory, this would be a good option however, in Namibia collared leopard all returned to their places of capture.

Hunting:

Leopards are extremely valuable to the hunting industry, and where destruction of one becomes necessary it is profitable to sell it through the safari industry. Currently the most effective method to hunt leopard is from a well prepared hide overlooking a bait site, usually in a tree using rheostat controlled lighting facilities to reduce the risk of spooking the Leopard before shooting. Again it is essential that this is carried out by persons experienced in hunting leopard.

Trained dogs are extremely effective for the control of problem Leopards. Experienced dogs provide security for the hunting of problem leopard particularly while following up on a wounded animal, distracting and baying the Leopard until it can be despatched. This approach may be used for the darting of problem Leopard to relocate them as the bayed leopard concentrates upon the dogs rather than persons firing the radio-tracking dart.

d) Keep them out – proper kraaling in well-constructed kraals is essential

- Must not be able to see in or out of night kraals
- Smaller kraals suggested built providing solid walls
- Providing a roof at the top
- Exposed as much as possible
- Livestock properly herded at all times
- Away from protected areas
- Dedicated guarding diligently watching over the livestock at all times
- Suggest dogs used to warn of eminent attack
- Implement some sort of flashing LED light system on the kraal walls
- Strive to let the animals out earlier to graze and bring them back before sundown

e) Tools

- Diligence
- Well-built kraals
- Good livestock minding
- LED lights

f) Problem leopard - management of habituated individuals

- lethal control options
- PAC hunting
- culling

g) Trapping and translocation

- Trapping of individual lion using box traps with falling doors
- Darting and chemical capture of leopard: There are a number of drug combinations presently used most operators favouring a Zoletil Medetomidine cocktail (Kock & Burrows 2013).

13.10. Cheetah (*Acinonyx jubatus*)

a) Applicable behavioural traits

- Cheetah as with most carnivores, are opportunists, so ranching cattle, particularly breeding stock with calves and small stock, risk being targeted. The problem is

exasperated where livestock increases to the detriment of naturally occurring wildlife even although cheetahs prefer to take wildlife rather than livestock.

- Cheetah have many enemies, including Hyena and Lion, which often drive them off their kills. On commercial ranches however, these are largely absent and so Cheetah provide greater impact.
- Cheetahs devour as much as possible after a successful kill, quickly moving on to escape other predators, and consequently do not return to their kills.
- Cheetahs generally do not scavenge, but kill anew each time. Their mode of attack is to panic and chase down their quarry, tripping it before pouncing on it then strangling by the throat. Stationary quarry or a 'face off' situation is largely avoided but are executed by the cat striking down on its back and side with the developed dewclaw, collapsing it to permit repositioning to finally strangle it.
- Cheetah are not aggressive in the sense that both Lion and Leopard are, rather they avoid confrontation, killing only when they dictate the situation so that they respond less to being attracted to bait, dead or alive and so must be attracted some other way when trapping them.
- Their lack of aggression is the reason livestock can be effectively protected by using minders in the form of people, dogs, donkeys and other animals to aggressively repel and chase them off rather than opting for translocation or lethal control
- Although Cheetah are true cats, part of the Felidae family of animals, in terms of behaviour, they behaviourally seem neither to fall into the cat nor dog family but rather somewhere in between, displaying traits of both. More like canines, they respond positively to scent left by other Cheetah, *calling stations that* all passing cheetah investigate, where they may be lured.
- Cheetah hunt almost exclusively during the day approaching quarry stealthily using anthills and bushes to approach close enough to facilitate the final rush no more than 100 metres away. Chases over 300 metres are rare often terminated by the cheetah itself
- The effort is exhausting so is calculated to ensure success within this distance an approximately 40% success rate recorded in Namibia with fawns providing much better success nearer100%
- Cheetah as do all carnivores target an individual, but do not seek animals that lag behind or are sick, but rather one deemed to be the most vulnerable for the surprise attack. Often in terrain that is more open they may approach until detected and then rush toward the group, not fully committed until they lock onto an individual and accelerate towards it. Where cover is available they rather stalk approaching to provide a more opportune final attack distance (Estes 1991).
- Their remarkable flexible design structure, oxygen and heat management achieves rush speeds in access of 100km/hour but the effort exhausts the carnivore requiring at least 30 minutes to recuperate before trying again
- Cheetah occur both singularly and small groups comprising either a female with offspring or sibling males remaining together as a coalition enabling them to hunt bigger prey, females separating at 2 years of age
- Both male and female Cheetah are strongly territorial defending their respective home ranges however these constantly change particularly for the males to maximise advantage of prey migration
- Unlike lion while there is a formal greeting, social bonds are not fostered so that individuals of coalitions refrain from rubbing up against one another or even being in too close in proximity
- During the heat of the day Cheetah, depending on the level of exhaustion, can quite often be approached closely with a vehicle moving in slowly at an angle, provided no one is on the outside and the noise kept down to a minimum.
- *Capture and translocation* success in Namibia has been achieved, by identifying urination spots often characterised by 'marking trees', placing open ended cage traps

around them, with thorn bushes in between the traps to ensure the only access is through the traps. Two cage traps are adjoined with open doors set at each end to provide a tunnel, which are tripped simultaneously by a false floor 'base plate' in the middle as the Cheetah runs through capturing it in between.

- Fences in occupied areas may serve to funnel cheetah into traps as they often pass by alongside fences so placing a circular boma against the fence may encourage them to enter inadvertently through some sort of gate or non-return system that may be added.
- Cheetah in the past have been successfully captured using the plastic boma technique when on a few occasions Cheetah happened to be spotted close by during routine capture operations
- Cheetah running at full speed quickly tire and bay up after a couple hundred metres, discussed above, providing opportunity for quick and deft physical capture. When cornered, they often will climb into the branches of a low tree providing opportunity for experienced handlers to grab and restrain them while administering a narcotic drug directly intravenously.
- Research in Namibia has indicated that passageways may be provided through fences to allow cheetah to enter and exit wildlife preserves providing connected long distance corridors reducing density effectively enabling the hunting of natural prey over a wider area rather than stock raiding in the surrounding communities.
- Various techniques are employed to protect livestock on commercial ranches and in some communities employing some very novel ideas to repel them using the Anatolian Sheppard Dog and donkeys, even wildebeest that remain with the specific sheep or goat herd adopting them as their own family.
- Communities are also encouraged to synchronise cattle births to lessen the vulnerable time that they are susceptible to attack and the transmitted cattle disease malignant catarrhal by wildebeest.
- Urine and faeces from foreign Cheetah has been used successfully to attract problem Cheetah. Urine from a neutered female is also reported to be successful in this regard: Bill Mcbride pers. comms. Captured cheetah may be used in this role.
- As Cheetahs are protected animals lethal control is not acceptable.

b) Planning and strategy

- Maintain passage ways through 'cheetah window' through protected area
- Minimise access to livestock
- Incorporate human and animal minders

c) Keep them out – proper herding

- Incorporate an animal minder imprinted on each herd to chase away cheetah
- Night kraals should still be used to ward off attacks by other animals
- Livestock properly herded at all times
- Away from protected areas
- Dedicated guarding diligently watching over the livestock at all times

d) Tools

- Diligence
- Well-built kraals
- Good livestock minding
- Specially designed box traps with falling doors

13.11. Wild dog or Painted Dog (*Lycaon pictus)*

The name change from the Wild dog to Painted hunting dog was a rebranding effort to help move *pictus* off vermane status.

a) Applicable behavioural traits

- Painted Dog like cheetah are largely diurnal in habit often restricting their activities to the early mornings, late afternoons and on into the evenings on hot days.
- Observations in Southern Africa indicate that often the dogs are not resident in one area for any length of time, moving in large circles of approximately 100km in diameter, seldom returning to the same area twice a year. Where possible therefore, a policy of protecting the livestock at the vulnerable time until the pack moves on would be more appropriate.
- Observations are that painted dog prefer to keep away from communities preferring wildlife areas and mixed game/livestock wild areas
- Estes asserts that painted dog are the most successful of predators rarely failing to effectively hunt even several times a day, capable of changing home ranges and pack formations frequently surviving major calamities, quickly responding by rapid population increase
- Painted dog are extremely prone to all the canine diseases including distemper and rabies quickly wiping out entire packs but even disease is not thought to be the most effective control influence on populations
- *Livestock predation:* Information gathered during the incursion in the Doma district in Zimbabwe, suggests that most stock were taken early in the morning before 10am. The pack remains at the carcass until it is completely consumed, and if disturbed they will not return.
- Protection can be achieved by kraaling the cattle close to the homestead at night and by providing a livestock guard/minder with the cattle during the day until the dogs have moved on.
- *Capture and translocation:* The capture of the entire pack is now possible, based upon work started in Kruger National Park and independently in Zimbabwe. But there are major hurdles which have to be thought through and logistical considerations before the translocation should be attempted. Most importantly, the entire pack has to be moved together as if individuals are removed, the pack unity, which they rely upon to hunt successfully, is broken up. To achieve this, the alpha female must initially be radio collared to monitor the pack's movement, to positively locate the active den used to enable the proper positioning of the capture boma, while ensuring the dogs remain in the vicinity when the operation is planned. In Zimbabwe, painted dog have been caught using the plastic boma technique with drop nets set up inside at the end of the boma to ensnare the individuals. It is my conviction that better results would be achieved using the standard net boma being easier to camouflage and more quickly set up.
- Once the pack runs into the boma, they become ensnared in drop lines where they are physically restrained and immobilised using Zoletil at a rate of 2-3mg/kg (a total dose of 50mg), or Ketamine/Xylazine combination at 5mg Ketamine and 0,5mg Xylazine per kg. More recently 0,5mg Zoletil/kg and0,03-0,05 mg Medetomidine/kg is recommended, the average mass being 25-30kg for adults
- Under capture conditions, painted dog are not as aggressive as one would imagine, being totally overwhelmed by the activities around them.
- An alternative capture system, the den may be surrounded with a camp trap or the whelps removed and placed into a separate cage to act as bait, and the cage traps to capture the others then placed so that they can only approach the whelps through the cage trap door.

b) The painted dog broadening boundary knowledge hypothesis

Providing for a wider *memory dynamic* view for prey species. This hypothesis contends that boundary knowledge for the different prey herds in an area is largely either forced or brought in by dispersal males, never deduced. Herd dominance generally confines a particular herd preventing redistribution or recolonization so it is possible that major disturbance catalysis's such as brought on by painted dog may be the force that

effectively achieves this. Even when the herds return they have the knowledge of the wider field to venture to in hard times or in productive times to expand

c) Planning and strategy

Daily patrolling by qualified tracker scouts is essential to accurately monitor game, livestock and carnivore movement and activity
Vigilance is essential to quickly discover the arrival of the dogs to the area and their general movement patterns
Mobilise minders to limit Lycaon access to livestock
Consider temporary fencing a smaller more manageable area until the dogs move on

d) Keep them out – proper herding

Night kraals should still be used to ward off attacks by other animals
Livestock properly herded at all times
Dedicated guarding diligently watching over the livestock at all times

e) Tools

Diligence
Well-built kraals
Good livestock minding

13.12. Black-backed jackal (Canis *mesomel*as*)*

a) Applicable behavioural traits

- The primary species of Jackal posing a threat to farmers is the black-backed jackal, not the side-striped jackal (*Canis adustus*).
- Although omnivorous feeding on plants, insects and rodents they also scavenge and kill birds and small livestock.
- They often are victims of secondary poisoning not primarily feeding on the carcasses but from feeding on the dung, taking up in undigested grain still contaminated during lethal baboon control exercises using toxicants.
- Given the opportunity, they will raid poultry, sheep and goats as well as cattle when found in an extreme weakened state.
- They are susceptible to canine diseases particularly rabies and distemper which they do transmit before succumbing themselves.
- Major fluctuations in jackal population densities are often the result of other primary environmental imbalances. These are often associated with macro farming and livestock activities, while reducing prey species, more than compensates with the provision of improvised opportunities such as cattle dung, offal and waste vegetable matter in an environment. This is particularly true where most predators are largely absent from large-scale commercial farms.
- In the communal areas it is usually reoccurring rabies outbreaks that sweep through the population significantly reducing numbers as they quickly build up.
- Jackals are most active from sunset through the night to sunrise but maybe seen during the day sunning themselves when undisturbed.
- They occur singly (predominately non-territorial wanderers), territorial pairs, or in family groups comprising of parents and their most recent offspring.
- The food source becomes concentrated during the calving season and packs of black-backed jackal can wreak havoc amongst small livestock, killing and maiming many animals. They can also inflict severe damage to fully-grown cattle, sometimes attacking weakened cows in the process of calving down. They attack and feed on the placenta and new-born calves during the calving process where cows are unable to defend themselves; they will often eat into the cow through the vulva for example. These situations, although not common, are almost impossible to reverse, requiring

the control of the entire problem pack while improving on surveillance and the management of livestock to eliminate this practice.

- In the advent of a rabies outbreak, it has been found that the control of all jackals near the outbreak is probably fruitless as the jackal themselves quickly succumb to the disease. Observations when outbreaks occur are generally associated with increased Jackal population density so it is considered better to reduce the populations immediately outside the area of the rabies outbreak in an attempt to reduce animal to animal contact, effectively minimising contact between animals effectively limiting spread
- There is scientific evidence (C. Foggin, pers. comm.) suggesting that rabies is not held in the jackal population, but rather in the population of domestic dogs in the area that remain unvaccinated that then spreads into and is sustained in the jackal population. It is suggested that an outbreak reaches a tipping point when the disease crosses into the jackal population. Logic dictating that if it were possible to vaccinate the entire dog population, rabies would die out completely (D. Cummings pers. comm.). Farmers allowing dogs into their staff dwellings should be aware of this, and ensure that all dogs on their property are adequately vaccinated.
- Jackals, as is the case with hyena, mostly commute along well-defined paths rendering them vulnerable to most lethal control techniques. Coyote getters provide the most successful means of control. However, if poisoning is required to control populations over large areas, treating tallow baits with "Compound 1080" toxicant is considered an extremely effective alternative, with baiting done near stock kraals or along the paths that they most frequently use (the canidae family are particularly susceptible to sodium monofluoracetate (compound 1080) so that it is possible to reduce toxicant levels to sub lethal to other forms of wildlife but remain lethal to the dog family)
- Jackals are curious by nature so are easily attracted to visual cues such as a tuft of feathers blowing in the wind or scent lures that enable the trapping of them in drop door single cage designs or camp traps
- The effectiveness of general jackal control (large-scale killing) is questionable and consensus is rather use barriers that exclude them.
- Jackal proof fencing it seems is the most effective means of protecting livestock provided it is well managed and maintained

b) Planning and strategy[26]

- Keep all domestic dogs vaccinated against rabies.
- Place all lame, incapacitated animals and cows having difficulty in calving under direct protection.
- Discourage unusual jackal build up.
- Consider the use of toxicants only if necessary.

c) Keep them out – vigilance and active repellence action

- Apply jackal proof fencing
- Guard dogs
- Separate and kraal infirm animals

[26] See: http://www.farmersweekly.co.za/article.aspx?id=10803&h=Getting-to-know-the-black-backed-jackal a http://www.capenature.co.za/wp-content/uploads/2014/02/Literature-Review-of-the-Ecology-and-Control-of-black-backed-jackal-and-caracal-Bothma-2012.pdf

13.13. Quelea *(Quelea quelea lathemii)*

a) Applicable behavioural traits

- Quelea are extremely gregarious birds, congregating wherever possible depending upon food availability and distribution.
- They are closely related to other species of the Weaver family, but are unique in their behavioural pattern, capable of moving considerable distances each year during the breeding season to take advantage of seasonal timing of rains in the sub region, with 1100 km recorded on one occasion.
- The escalation of numbers into vast locust like proportions provides a further downside to macro farming activities that reduces natural constraints on their numbers providing for a rapid population increase.
- In Zimbabwe under the land redistribution program where some large-scale commercial agricultural land has been parcelled out to subsistence farmers, a reduction in large tracts of land under one crop has also effectively reduced the intensity of the Quelea problem. This observation along with other macro forms of agriculture clearly indicates responsibility that commercial farming has to take cognisance of, situations where they have effectively reversed mechanisms to naturally limit population levels
- For Quelea to reproduce in large numbers each year, they require specific conditions found in the semi-arid areas south and north of the central watershed below the 1200-meter contour line. These areas provide sufficient food through annual grasses, timely insect flush to provide food for their young and Acacia type thickets in which to build their nests.
- Quelea move to these low lying areas with the onset of the rains in November, when the natural grass seeds have begun to germinate no longer available in the Highveld at this time.
- It is probable that late rainfall in the breeding areas, after the Quelea have begun their move down, has a strong controlling influence upon population numbers.
- Research has indicated that there is a strong correlation between rainfall received affecting food production in these areas, and Quelea build up the following season, that is not at all related to the number of birds controlled in any one season.
- Quelea breed successfully up to three times in any one season where perfect breeding conditions continue to prevail owing to breeding synchronisation and short nesting/fledgling/dispersal time.
- Following breeding from November through to March, they spread out in smaller flocks to take advantage of the more widely spread food sources.
- When the grass seed begins to fall off in amongst rank grass, Quelea are effectively unable to reach it at the same time commercial wheat crops mature to the ‘soft dough’ stage providing them with an alternative food source, *at the right moment*.
- Quelea respond by concentrating around this improvised food source, forming large swarms to take advantage of the timely concentration of the food source. Interestingly research indicates that even so Quelea still prefer natural food growing within and around the wheat; Samples taken of birds feeding within the wheat, indicate that only ±30% of the birds fed upon the crop itself but those that did fully engorged themselves.
- At the same time because of the localised food source Quelea occupy large night roosts nearby from which they forage from and return to each day
- Quelea usually reoccupy a roost used the previous season enabling easy monitoring of their build up. Roosts are generally less numerous, but larger as the season progresses, suggesting that as more of the birds begin to be attracted to the crop they abandon the smaller roosts for the larger ones, even if these may be situated further away. Should early heavy rains, lasting several days occur early in the season before the wheat is harvested, Quelea build-up thereafter is often greater inflicting more

damage, possibly, because any natural food left begins to germinate and is no longer available to the birds.

- Quelea flying back to a roost behave in a characteristic manner, as they begin to congregate in the late evening along set routes, usually along vlei/river lines or field edges as they dislike moving over open ground, where they are more vulnerable. They generally tend to move directly to a water source first before the roost site at sunset. As they move along defined *corridors,* they can easily be followed to the roost from the ground, even if it takes several days to do so, commencing each evening where following was abandoned the previous evening until the roost is located.
- Quelea usually arrive at the roost some 10 minutes before sunset, and continue arriving for 20–25 minutes thereafter. An estimate of roost size is best assessed at this time determining the pattern and flock sizes entering the roost over this period.
- During observations of a roost, confusion may occur when the birds seemingly occupy a vast area, flying up and down the entire reed bed. This is particularly noticeable where they have been continuously disturbed, however at last light will usually establish their final true roosting position when they all will have concentrated together, usually in an area confirmed by clearly demarcated areas of excreta... the amount of excrement of course, dependent on the duration of occupation
- Traditionally during the breeding phase, Quelea birds are harvested by any manner of means including direct picking of nestlings and capture of adults using nets. In the roosting stage, the avicide Queletox is sprayed on using a number of aerial and ground spraying rigs which is effective to control even the largest roost. Control by avicide is the responsibility of the PWMA Department's Quelea Bird Unit in Zimbabwe to whom all roosts must be reported by law.
- Quelea harvesting for human consumption not only solves a HWC problem but also provides a valuable source of protein to communities that may develop the potential further to harvest them commercially. Obviously this will require the development of alternate mechanical techniques not involving toxicants compliant with stringent health laws and there has been some progress to develop some doable ideas in this regard
- Control of early scouts: - Birds it seems, like animals are unable to deduce the whereabouts of food from mere observation but have either to stumble upon it directly or be taken to it following another bird that has previous knowledge. Trials observing other flocking species of birds has indicated that individual birds that know where food is reliably found generally leave the night roosts first each morning which then the others that do not follow the majority lead. The successful removal or controlled taste conditioning *cta* of early scouts locating new opportunities effectively prevents the birds ever discovering its location. This has been demonstrated using specific bird repellents such as Mesurol™ or low concentrations of toxicant Azodrin™ in the past spraying the edges of lands that generally develop quicker

b) Planning and strategy

- Active destruction of nests and fledglings during breeding
- Good bird minding that includes active chasing away of birds alighting onto the crop using a variety of improvised tools
- Small scale trapping of Quelea has been successfully carried out using standard box traps covered with ½ inch bird mesh of 1mx1m square 300mm high providing several tapered funnels of ± 250mm length around the edge leading in, adopting the 'fish trap' principle so that birds wandering in do not find their way out. Several traps are placed around the lands and especially at the corners and seed placed both around the trap and within to attract them. Results indicate better results when a few birds are left in after the removal of the majority to attract others
- Various designs of catapult traps are devised among communities where birds are attracted to seed bait on the ground that is then triggered maiming and killing the feeding birds for food. Most of these employ inner tube rubber set 2 metres apart

pulled back on a manual trigger arrangement deployed manually when many birds are feeding

c) Keep them out – vigilance and active repellence action

- String fences and streamers around the edge and within lands
- Scare crows
- Wind effected plastic sheeting and bags
- Bangers and other noise providers such as whips
- Active Human presence

d) Tools

- Catapults
- Traps

END APPENDIX 2

Appendix 3 Ver 6.3

MECHANISMS FOR THE EXCHANGE OF EXPERIENCES

Exchange visits aim at benefiting all participants through an open exchange of ideas, knowledge, and sound practices. The host organization should expect to gain as much from the experience as the visitors. In HWC, exchange of resources, technology, and knowledge between individuals (such as KLOs), government officials, farmers and others develops crucial capacity and relationships between actors, fostering cooperation in the KAZA. The purpose of these exchange visits is to allow managers and other stakeholders to benefit from lessons learnt from successful experiences to build operational responses tailored to their own needs.

Key principles

- Exchange visits provide valuable and often unique experiences for all people to be involved to experience other cultures, develop new ideas, friendships and thus broaden their horizons and knowledge.
- Staying with a host organization/family/community may give the visitors a first-hand opportunity to use their learned HWC mitigation skills in a real context.
- By following national best practice and standard guidelines, it will be possible to establish, manage and maintain safe and productive exchange visits.

Summary of guidance

Expectations and assurances should be established for all parties involved (farmers affected by conflict, KLOs, community leaders, representatives from HWC mitigation practicing organizations and/or establishments) and these must be fair and reciprocal as far as is reasonably practicable. Provision of specific guidance for host partners about the visitors' expectations is critical so is the provision of guidance for visitors on what entails covering personal safety. Exchange visits differ from other visits in that, there is no direct supervision of the visitors by teachers or workers etc. whilst they are with the host parties; exchanges thus require thorough and carefully planned risk management. Careful matching of exchange partners is central to successful visits.

13.14. Preparation and planning

Research prior to the visit in this respect will pay dividends whilst in the host country. A consideration of what constitutes good manners will help with acceptance in host communities.

In addition to assessing risks inherent in any external visit, there are additional risks relating to exchange visits that will require extra consideration. In order to reduce the possibility of harm it will be necessary to consider additional control measures, some of which may be Are the visitors and hosts carefully matched with due regard to gender, diet, religious belief, special needs etc.?

- Does the organizer know the visitors?
- Is there a hosting agreement form that includes a question regarding criminal convictions or other contra-indicators?
- Has the safety and wellbeing of the visitors during travel considered?
- Does this include appropriate drivers and transport whilst with the host organization?
- Does work experience feature as part of the exchange and does it require an assessment by an appropriate person about any significant hazards the work environment may present?
- Is there a contingency plan in place that considers unforeseen events, such as emergencies, severe weather or the requirement to find alternative accommodation if it becomes necessary to move the visitors from their host organization/country or community? Useful to check the rules and regulations governing the country.

- Exchange visits could be also at higher level for learning experience in the management of natural resources.

13.15. *Pre-visits*
If it is a first time visit, or involving a significant number of new staff, a preliminary visit is necessary as it may reassure all parties and provide details and photographs for a presentation to all parties concerned. This will serve as a control measure in itself as well as being an opportunity to consider a specific risk assessment first hand. The issues raised in 'Risk Management' (see above) should be considered during a preliminary visit and discussed with colleagues on both sides of exchange.

13.16. *Language capability*
The majority of the exchange visits involving parks authorities/government representatives etc. are language based and thus normally include language staff as group leaders. It is important that there is someone who can act in the interests of the group who is available 24 hours and able to communicate fluently. Visit leaders should ensure this is in place prior to the visit.

13.17. *Personal safety*
Staff should also be aware of issues relating to personal safety and professional protection, especially in order to avoid situations that could lead to accusations of improper conduct.

13.18. Additional considerations
The recommended additional procedures and advice are as follows: An advanced planning visit is essential. As part of the risk assessment process, it should be considered whether an appropriately trained person be part of the staff team. Check whether travel insurance covers pre-existing health conditions. If not, insure with a company that specialises in policies for these young people. Availability of interpreter and leader trained if required in the appropriate communication medium i.e. sign language. A suitable social area should be available for group meetings etc.

END

REFERENCES

African Elephant Specialist Group (1998) *Report of the African Elephant Specialist Group*, IUCN, Species Survival Commission

African Elephant Specialist Group (2000) *Fencing and other barriers against problem elephants.* AfESG Technical Brief Series. IUCN African Elephant Specialist Group, Human Elephant Conflict Working Group. Available at: http://www.africanelephant .org/hec/pdfs/hecfencen.pdf

African Elephant Specialist Group (2002) *Review of compensation schemes for agricultural and other damage caused by elephants*. Technical brief, Human- Elephant Conflict Working Group, African Elephant Specialist Group, IUCN, Gland, Switzerland.

Allaway, J. D. (1979) *Elephants and their interaction with people in the Tana River region of Kenya*, Unpublished PhD Thesis, Cornell University, Ithaca, New York.

Anstey, S. (2010) HEC Vertical integration model, Mozambique and Tanzania. IUCN AfESG, Nairobi.

Anon, M. (2000) Report of the Central Unit Anti-Poaching Unit, Guruve RDC, Mushumbi Pools. 12 PGs typescript.

Anderson, J.L and Pariela, F., (2005) Strategies to mitigate human-wildlife conflicts in Mozambique, Food and Agriculture Organization of the United Nations Rome, Italy.

Arntzen, J. W., D.L. Molokomme, E. M. Terry, N. Moleele, O. Tshosa and D. Mazambani. (2003) *Final Report of the Review of Community-Based Natural Resource Management in Botswana*. Report prepared by the Centre for Applied Research for the National CBNRM forum. Gaborone.

Baldwin G. & La Grange M, (2013) Chemical Control of the Chacma Baboon (*Papio ursinus*) on Hippo Valley and Triangle Sugar Estates Chiredzi - Internal report.

Barnes, R. F. W. (1996) The conflict between humans and elephants in the central African forests. *Mammal Review*, 26(2/3): 67-80.

Barnes, R. F. W. (2002) Treating crop raiding elephants with aspirin. *Pachyderm*, **33,** 96-99.

Bell, R. H. V. (1984) The man-animal interface: an assessment of crop damage and wildlife control in *Conservation and Wildlife Management in Africa*: Bell, R. H.V. and Mcshane-Caluzi (Eds.) US Peace Corps Seminar, Malawi.

Bennett, A. F. (2003*) Linkages in the landscape: The role of corridors and connectivity in wildlife conservation*. IUCN, Gland, Switzerland.

Bendsen, H. and T. Meyer (2003) The Dynamics of the Land Use Systems in Ngamiland: Changing Livelihood Options and Strategies. Harry Oppenheimer Okavango Research Centre and German Development Service – DED, Maun, Botswana

Bennett, A.F., (2003*). Linkages in the Landscape: The Role of Corridors and Connectivity in Wildlife Conservation*. IUCN Gland, Switzerland and Cambridge, UK.

Berger, L.R. (2006) Predatory Bird Damage to the Taung Type-Skull of *Australopithecus africanus* (Dart 1925). *American Journal of Physical Anthropology*, 131:166–168.

Binot, A, Blomley T, Coad, L, Nelson F, Roe, D, and Sandbrook, C, (2009) Community Involvement in natural resources management in Africa: Regional overviews, in Roe, D, Nelson, F, and SandBrook, C (eds) *Community management of natural resources in Africa: impacts, experience and future directions* IIED, London, UK.

Blanc, J.J., Barnes, R.F.W. Craig, G.C. Dublin, H.T. Thouless, C.R. Douglas-Hamilton, I. and Hart, J.A. (2007) *African Elephant Status Report 2007: An Update from the African Elephant Database*. IUCN, Gland

B. M. A. Oswin Perera (2009). The Human-Elephant Conflict: A Review of Current Status and Mitigation Methods, *Gajaha,* 30; 41-52.

Bourquin S.L, & Shacks V.A. (2015) *Okavango Crocodile Monitoring Programme: Past, Present and Future*. Botswana Symposium on Wetlands and Wildlife, Natural resource research: Implications for management and conservation. Okavango Research Institute, University of Botswana, Maun, Botswana.

Boudreaux, K. C. (2010) *Community Conservation in Namibia: Devolution as a Tool for the Legal Empowerment of the Poor*. Working Paper, No. 10-64.

Boudreaux, K. (2005) *The role of Property Rights as an Institution: Implications for Development Policy*, *Mercatus Policy Series no. 2*, Mercatus Centre at George Mason University, Airlington, VA.

Bowen-Jones, E. (2012) *Financial mechanisms for addressing Human Wildlife Conflict; with particular reference to institutional aspects therein*. IIED Case Study Summaries.

Bulte, E.H. & Rondeau, D. (2005): Why compensating wildlife damages may be bad for conservation. *Journal of Wildlife Manag*ement 69 (1): 14-19.

Braack, L.E.O., and Smuts, R. (Eds.) 2006. *Towards rationalizing transboundary elephant management and human needs in the Kavango/mid-Zambezi region*. Unpublished proceedings of a workshop presented in Gaborone, Botswana, by Conservation International (Southern Africa Wilderness and Transfrontier Conservation Programme), Cape Town, South Africa.

Campbell AC, (1990) History of Elephants in Botswana, in: *The Future of Botswana's Elephants,* Workshop of the Kalahari Conservation Society and the Department of Wildlife and National Parks. 5-15. Cited in DG Ecological Consulting. Undated Review of the 1991 Elephant Conservation and Management Plan: Issues, Options and Recommendations for Elephant management in Botswana.

Carrington, R. (1958) *Elephants*. Chatto and Wndus, London.

Chase, M. and C. R. Griffin. (2005) *Ecology, population structure and movements of elephant populations in northern Botswana.* Conservation International. Maun, Botswana.

Chase, M. (2006) *The Population Status, Ecology and Transboundary Movements of Elephants in the Okavango Upper Zambezi Transfrontier Conservation Area.* OUZTFCA Elephant Project Report. Conservation International. Maun, Botswana.

Chase, M, & Curtice R. Griffin (2009) Elephants caught in the middle: impacts of war, fences and people on elephant distribution and abundance in the Caprivi Strip, Namibia *African Journal of Ecology,* 47, 223–233.

Chiyo, P., Cochrane, E.P., Naughton, L. and Basuta, G.I. (2005) Temporal patterns of crop raiding by elephants: a response to forage quality or crop availability. *African Journal of Ecology* 43: 48-55.

Chomba C, Senzota R, Chabwela H, Mwitwa J, & Nyirenda V (2011) Pattern of human-wildlife conflicts in Zambia: causes, consequences and management responses. *Journal of Ecology and the Natural Environment.* 4(12):303-313.

Churchill, C. 2006. *Protecting the Poor: A Micro Insurance Compendium*. ILO, Geneva, Switzerland.

Cline, R.; Sexton, N. & Stewart, S.C. (2007): A human-dimensions review of human-wildlife disturbance: a literature review of impacts, frameworks, and management solutions (Report) U.S. Geological Survey. p. 2. Open-File Report 2007-1111.

Clutton-Brock, J. (1998) *Cattle, sheep and goats south of the Sahara: an archaezoological perspective*. In The origins and development of African livestock: archaeology, genetics, linguistics and ethnography, ed. R.M. Blench and D.W. Macdonald. London: University College London Press.

Conover, M. (2002) Resolving human-wildlife conflicts: the science of wildlife damage management. Lewis Publishers, New York.

Cozza, K., Fico, R., Battistini, M.L., & Rogers, E. (1996) The damage -conservation interface illustrated by predation on domestic livestock in central Italy*. Journal of Biological Conservation*. 78, 329-336.

Crosby, A. W. (1986) *Ecological Imperialism: the Biological Expansion of Europe, 900-1900.* Cambridge University Press, Cambridge.

Cunliffe, R (2008) *An Assessment of Ngongo, Ngcusha and Shamamputu villages with in the Mucosso Reserve.* Consultants report prepared for Okavango Integrated River Basin Management Project (IRBM) Gaborone, Botswana

Davies, C. (1999) Aerial census of the Zambezi Valley. WWF Harare, Zimbabwe.

De Klemm, C. (1996) *Compensation for Damage Caused by Wild Animals*. Nature and Environment # 84. Council of Europe Publishing. Strasbourg, France.

Delsink, A., Bertschinger, H.J., Kirkpatrick, J.F., DeNys, H., Grobler, D., van Altena, J.J. & Turkstra, J. (2003) Contraception of African elephant cows in two private conservancies using porcine *Zona pellucida* vaccine and the control of aggressive behaviour in elephant bulls with GnRH vaccine. In: *Control of Wild Elephant Populations*. Utrecht University, The Netherlands. pp 43-45.

Desai, A. A. (2002) *Design of Human-Elephant Conflict Mitigation Strategy for the Proposed Tesso Nilo Protected Area, and Possible Expansion of Such Strategy into the Tesso Nilo Conservation Landscape, and the Province of Riau*. WWF Indonesia, Jakarta.

De Silva, M. & De Silva, P.K. (2007) The Sri Lankan Elephant: Its Evolution, Ecology and Conservation. WHT Publications, Colombo, Sri Lanka.

DG Ecological Consulting (2013) Review of the 1991 Elephant Conservation and Management Plan: Issues, Options and Recommendations for Elephant Management in Botswana. (DG Ecological Consulting) Windhoek, Namibia.

DWNP (2006) *Draft national policy for the conservation and management of elephants in Botswana*. Department of Wildlife and National Parks. Gaborone, Botswana.

DWNP (1998) *Guidelines for Compensation*. Department of Wildlife and National Parks, Gaborone, Botswana.

Desai, A. A. (2002) *Design of Human-Elephant Conflict Mitigation Strategy for the Proposed Tesso Nilo Protected Area, and Possible Expansion of Such Strategy into the Tesso Nilo Conservation Landscape, and the Province of Riau*. WWF Indonesia, Jakarta.

de Klemm, C. (1996) *Compensation for Damage Caused by Wild Animals*. Strasbourg, France: Council of Europe.

Du Plessis, P. (2009) Potential new methods and approaches to support Problem Animal Control in rural communities in Southern Province of Zambia, Unpublished report to the Elephant Pepper Development Trust and EC in the project: *Protecting the environment through trade in high value chilli peppers.*

Distefano, E. (2005) Human-Wildlife Conflict worldwide: collection of case studies, analysis of management strategies and good practices. FAO. Rome

Elliot, W., Kube R, and Montanye, D. (2008) Common Ground; Solutions for reducing the human, economic and conservation costs of human wildlife conflict. WWF Report, Gland, Switzerland.

Eltringham, S. K. (1980) *The Ecology and Conservation of Large African Mammals*. The Macmillan Press, London, UK.

Food and Agriculture Organization of the United Nations. (2009) *Human-wildlife conflict in Africa; Causes, consequences and management strategies*, Rome, Italy.

Fayrer-Hosken, R. (2008) Controlling animal populations using anti-fertility vaccines. *Reproduction in Domestic Animals* 43 (Suppl. 2): 179-185.

Fergusson, R. A. (2008) *Techniques for Mitigation of Crocodile Attacks on Rural Communities in Africa*. FAO of the UN, Rome, Italy.

Ferguson, K. & Hanks, J. eds. (2010) *Fencing Impacts: A review of the environmental, social and economic impacts of game and veterinary fencing in Africa with particular reference to the Great Limpopo and Kavango-Zambezi Transfrontier Conservation Areas.* Pretoria: Mammal Research Institute. www.wcsahead.org/gltfca_grants/pdfs/ferguson_final_2010.pdf

Fisher, M. (2016) Whose conflict is it anyway? Mobilizing research to save lives. *Oryx* 50(3) 377-378.

Gadd, M. (2002) Report on the November Field Trip for the Conservation International-Botswana, Human Elephant Conflict Project. Gaborone, Botswana.

Gibson, C.C. and Marks, S.A. (1995) Transforming rural hunters into conservationists: an assessment of community-based wildlife management programs in Africa. *World Development* 23: 941-957.

Graham, M.D (2006) Coexistence in a land use mosaic? Land use, risk and elephant ecology in Laikipia District, Kenya, PhD Thesis, *University of Cambridge, UK*

Hermann, E. (2002). The conflict between lions and cattle in the southern Kalahari. In Lion Conservation Research: Workshop 2: Modelling Conflict (eds. A.J. Loveridge, T. Lynam & D.W. Macdonald), Vol. 2. WildCRU, Oxford, UK.

Hanks, J. (2006) Mitigation of human-elephant conflict in the Kavango-Zambezi Transfrontier Conservation Area, with particular reference to the use of chilli peppers. http://www.conservation-southernafrica.org

Hanks, J. & Cronwright, R. (2006) Kavango-Zambezi Transfrontier Conservation Area, Prefeasibility study of the proposed Final Report Volume 1 Prepared by the Transfrontier Conservation Consortium for the Peace Parks Foundation (PPF) on behalf of the Governments of Angola, Botswana, Namibia, Zambia and Zimbabwe.

Hanks, J. and W. Myburgh (2007) The evolution and progression of Transfrontier Conservation Areas in the Southern African Development Community Chapter 9. in The status of Transfrontier Conservation Areas in Southern Africa

Hanks, J (2013) Hunting: The Great Debate. Africa Geographic, Nov. 33-37 www.africageographic.com.

Hanks, J. and W. Myburgh (2013) The Status of Transfrontier Conservation Areas in Southern Africa. Biodiversity and Protected Areas. Environment 16. 26pp.

Hanssen, L, Funston, P, Fwelimbi, P and Siyanga, O. (2014) Human-Lion Conflict in the Mudumu South Complex, Zambezi Region, Namibia Kwando Carnivore Project.

Hildebrandt, T.B., Göritz, F., Hermes, R., Reid, C., Dehnhard, M. and Brown, J.L. (2006) Aspects of the reproductive biology and breeding management of Asian and African elephants *Elephas maximus* and *Loxodonta africana*. International Zoo Yearbook **40:** 20-40.

Hill, C.M. (1997). Crop raiding by wild animals: the farmers' perspective in an agricultural community in western Uganda. *International Journal of Pest Management* 43(1): 77-84.

Hill, C. M, Osborn, F. V, and Plumptre, A. J (2002) Human-Wildlife Conflict. People, Crops and wildlife. Conflict of Interests: Identifying the problem and possible solutions. Albertine Rift Technical Report Series volume. Wildlife Conservation Society, New York, USA.

Hoare, R.E. (1999) A Standardized Data Collection and Analysis Protocol for Human-Elephant Confl ict Situation in Africa. IUCN/SSC African Elephant Specialist Group, Nairobi, Kenya.

Hoare, R.E. (2000). African elephants and humans in conflict: the outlook for coexistence. *Oryx* 34(1): 34-38.

Hoare, R. (2012) Lessons from 15 years of human–elephant conflict mitigation: Management considerations involving biological, physical and governance issues in Africa. *Pachyderm*, 51, 60-74

Inamdar, A. (1996) The ecological consequences of elephant depletion. Unpublished PhD Thesis, University of Cambridge.

Jones, B.T.B. (2004) Synthesis of the current status of CBNRM Policy and Legislation in Botswana, Malawi, Mozambique, Namibia, Zambia and Zimbabwe.

Jones, B.T.B and Barnes, J. I. (2006) Human Wildlife Conflict Study. Namibian Case Study.

Kangwana, K.F. (1993) Elephants and Maasai: Conflict and conservation in Amboseli, Kenya. *PhD Thesis*. Cambridge University.

Kenya Wildlife Service. 1996. Wildlife-human conflicts, sources, solutions and issues. Available at: www.safariweb.com/kwild/wildlife.htm

Kgathi, D. L, Mmopelwa, G, Mashabe B & Mosepele, K (2012) Livestock predation, household adaptation and compensation policy: a case study of Shorobe Village in northern Botswana, Agrekon: *Agricultural Economics Research, Policy and Practice in Southern Africa*, 51:2, 22-37

Karidozo, M. (2008) *Community Based Human-Elephant Conflict Mitigation Training and Establishment of Demonstration Sites Report*. Consultants report EPDT Divundu,Namibia and Muccuso, Angola.

Karidozo, M. and Osborn, F. V. (2005) Can Bees deter elephants from raiding crops? An experiment in the communal lands of Zimbabwe, *Pachyderm* 39, 26-32. Visit web:
KAZA (2012) Secretariat website www.kavangozambezi.orghttp://www.fao.org/3/a-au241e.pdf

King, L.E. (2010) The interaction between the African elephant (*Loxodonta africana africana*) and the African honey bee (*Apis mellifera scutellata*) and its potential application as an elephant deterrent. DPhil thesis. University of Oxford, UK.

King, L.E. (2012) *Beehive Fence Construction Manual,* The Elephants and Bees Project, Save the Elephants Nairobi, Kenya.

Kline, R. (2013) PATHWAYS for People & Predators; The Annual Report of Cheetah Conservation Botswana April 2012 - March 2013 http://www.cheetahconservationbotswana.org/uploads/6/4/3/3/64330039/ccb_annual_report_apr12-mar13_pdf.pdf

Kramer PJ. (1936) Effects of variation in length of day on growth and dormancy of trees. Plant Physiology 11, 127–137

Kock M.D. and Burroughs R. (2012) *Chemical and Physical Restraint of Wild Animals*, 2nd edition, IWVS (Africa) PO Box 106 Greyton 7723 South Africa

Kwando Carnivore Project (2016) Human-Lion Conflict in the Mudumu South Complex, Zambezi Region, Namibia. http://www.facebook.com/kwandocarnivoreproject

Le Bel, S. Taylor R. & *La Grange M.* (2010) An easy-to-use capsicum delivery system for crop raiding elephant in Zimbabwe: *Pachyderm* Issue No 47.

Lahm, S. (1996) A nation-wide survey of crops raiding by elephants and other species in Gabon. *Pachyderm*, 21, 69-77

Lamarque, F., J. Anderson, P. Chardonnet, R. Fergusson, M. Lagrange, Y. Osei-Owusu, L. Bakker, U. Belemsobgo, B. Beytell, H. Boulet, B. Soto and P. Tabi Tako-Eta. (2008) *Human-wildlife conflict in Africa: An overview of causes, consequences and management strategies*. WORKING PAPER, Rome.

Langbauer, W., Payne, K. B., Chairf, C., Rapaport, L. and Osborn, F. (1991) African elephants respond to distant playbacks of low frequency nonspecific calls. *Journal of Experimental Biology*, 157, 35-46.

Lines, Robin (2015) *Landscape Connectivity at the Kafue-KAZA* Interface Midterm Report, August 2015.

Loewe, M. (2006) Downscaling, upgrading or linking? Ways to realize micro-insurance. *International Social Security Review*. Vol. 59.

McGregor, J. (2004) Crocodile crimes: people versus wildlife and the politics of postcolonial conservation on Lake Kariba, Zimbabwe. *Geoforum,* 36(3):353-369.

Madden, F. (2004) Creating Coexistence between Humans and Wildlife: Global Perspectives on Local Efforts to Address Human–Wildlife Conflict. *Human Dimensions of Wildlife* 9: 247–257. doi: 10.1080/10871200490505675. ISSN 1087-1209

Madhusudan, M.D. (2003) Living amidst large wildlife: livestock and crop depredation by large mammals in the interior villages of Bhadra Tiger Reserve, South India. *Environmental Management* 31: 466–475.

Medlicott, A. P. (1990) Product specifications and post-harvest handling for fruits and vegetables from the Caribbean. Caricom Export Development Project.

Mentzel, C. & Niskanen (eds) (2014) Evaluation of the Human-Wildlife Conflict Strategy and Action Plan for Mozambique. Experts Review, Questionnaire Evaluation of Implementation and Recommendations. IUCN Eastern and Southern African Regional Office, Nairobi, Kenya.

Messmer, T. A. (2000): Emergence of human–wildlife conflict management: turning challenges into opportunities. *International Biodeterioration* 45:97–100.

Mishra, C., P. Allen, T. McCarthy, M.D. Madhusudan, A. Bayarjargal and H.H.T. Prins (2003) The role of incentive programs in conserving snow leopard. *Conservation Biology* 17: 1512–1520.

Morrison, K., Victurine, R. and Mishra, C. (2009) *Lessons Learned, Opportunities and Innovations in Human Wildlife Conflict Compensation and Insurance Schemes*, Wildlife Conservation Society, New York, USA.

Mosojane, S. (2004) *Human-elephant conflict along the Okavango Panhandle in northern Botswana* MSc. (Conservation Ecology and Planning) University of Pretoria.

Murphy, C. (2007*) Community based crocodile management*. Travel News Namibia.

Murphy, C. (2009) *Imusho Ward, Sioma Ngweze National Park, Western Province Zambia: A Participatory Assessment by farmers of the success of use of chilli as an elephant deterrent*. Consultants Report to IRDNC, Kitima Milimo, Namibia.

Muruthi, P. (2005) *Human Wildlife Conflict: Lessons Learned from AWF's Africa Heartlands*. African Wildlife Foundation Working Papers.

Naidoo, R. L., Weaver, C., Diggle, R. W., Matongo, G., Stuart-Hill, G & Thouless, C. (2016) Importance of local values to successful conservation: response to Jacquet and Delon, *Conservation Biology*, 30, 4, 912.

Namibia Nature Foundation (2104) *Protecting Livestock to Reduce Human-Wildlife Conflict in the Southern Kunene Conservancies*. Final Report- Conservancy Development Support Grant Fund, Windhoek, Namibia.

Naughton-Treves, L. (1998) Predicting patterns of crop damage by wildlife around Kibale National Park, Uganda. *Conservation Biology* 12(1): 156-168.

Naughton-Treves, L. (1996). *Uneasy Neighbours: wildlife and farmers around Kibale National Park, Uganda*. Ph.D. Thesis, University of Florida.

Naughton, L., Rose, R. and Treves, A. (1999) *The social dimensions of human-elephant conflict in Africa: A literature review and case studies from Uganda and Cameroon. A report to the African Elephant Specialist Group, Human-Elephant Conflict Task Force of IUCN*, Glands, Switzerland.

Nelson, A. Bidwell, P. & Sillero-Zubiri, C. (2003) *A Review of Human Elephant Conflict Management Strategies. People and Wildlife Initiative*, Wildlife Conservation Research Unit, Oxford University, United Kingdom.

Neumann, A.H. (1898) *Elephant Hunting in East Equatorial Africa*. London: Rowland Ward Ltd.

Nyhus, P.J., S.A. Osofsky, P. Ferraro, F. Madden and H. Fischer. (2003) Bearing the costs of human-wildlife conflict: the challenges of compensation schemes. (R. Woodroffe, S. Thirgood, A. Rabinowitz, (eds.). Pp. 107-121 in *People and Wildlife, Conflict or Coexistence?* Cambridge University Press, Cambridge.

Nyhus, P.J., H. Fischer, F. Madden and S. Osofsky. (2003) Taking the bite out of wildlife damage: the challenges of wildlife compensation schemes. *Conservation in Practice* 4: 37–40.

O'Connell-Rodwell, C. E., Rodwell, T., Rice, M. and 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 (3), 381-391.

Oldfather, C. H. (trans.) (1979). Diodorus Siculus, Vol. 2. Loeb Classical Library. Harvard University Press, Cambridge.

Oliver, R.C.D. (1978) *On the ecology of the Asian elephant*. PhD thesis, University of Cambridge.

Osborn, F.V. & Anstey, S. (2007) Elephant/ Human Conflict and Community Development around the Niassa Reserve, Mozambique. WWF Southern African Regional Programme. www.Elephantpepper.org/downloads/

Osborn, F. V. and Welford, L. A. (1997) Living With Elephants: a manual for wildlife managers in the SADC region. SADC/NRMP, Malawi.

Osborn, F. V. (1998) *The ecology of crop-raiding elephants in Zimbabwe*. Unpublished PhD Thesis, University of Cambridge, Cambridge, UK.

Osborn, F. V. (2004) Seasonal variation of feeding patterns and food selection by crop-raiding elephants in Zimbabwe. *African Journal of Ecology* 42: 322-327.

Osborn, F.V. & Parker, G. (2003a). Linking two elephant refuges with a corridor in the communal lands of Zimbabwe. *African Journal of Ecology* 41: 68-74.

Osborn, F.V. & Parker G.E. (2003b) Towards an integrated approach for reducing the conflict between elephants and people: a review of current research. *Oryx* Vol. 37 (1): 80-84.

Parker, I.S.C. and Graham, A.D. (1983) Rainfall, geology, elephants and men. In Symposium on the extinction alternative, (ed). P.J. Mundy. Johannesburg: Endangered Wildlife Trust.

Parker, I. S. C. (1984) The nature and interaction between humans and wildlife. In: *Conservation in Africa*. Bell, R. H .V, and McShane-Causely, E. (eds.), US Peace Corps, Malawi.

Parker, I.S.C. and Graham, A.D. (1989) Man, Elephants & Competition. *Symposium of the Zoological Society of London*, 61:241-252.

Parker, G.E. (2006) The Costs and Benefits of Elephants: Communities and the CAMPFIRE Programme in Zimbabwe, Unpublished PhD Thesis, University of Kent, UK.

Parker, G.E., Osborn, F.V., Hoare R.E. and Niskanen, L.S. (eds.) (2007) *Human-Elephant Conflict Mitigation: A Training Course for Community-Based Approaches in Africa*. Participant's Manual. Elephant Pepper Development Trust, Livingstone, Zambia and IUCN/SSC AfESG, Nairobi, Kenya.

Parker, G. (2004) *Ensuring Farmer's Livelihoods and Food Security Around Kakum Conservation Area*. Proceedings of the 'Training of Trainers' workshop. UN/FAO Regional Office for Africa, Accra Ghana

Parker, I. (2004) *What I tell you three times is true: conservation, ivory, history and politics*. Librario Publishing, Moray, Scotland.

Pittiglio, C. Skidmore, AK, Hein, AM van Gils, McCall, M.K.& Prins (2013) Smallholder farms as stepping stone corridors for crop-raiding elephant in northern Tanzania: Integration of Bayesian Expert System and Network Simulator. *Ambio*, 10.1007/s13280-0130-0437-z.

Pooley, S. (2015) Using predator attack data to save lives, human and crocodilian *Oryx*, 49(4), 581–583

Potgieter, G. (2014) Protecting Livestock to Reduce Human-Wildlife Conflict in the Southern Kunene Conservancies. (CDSGF) Grant, Namibia Nature Foundation.

Purseglove, J. W. (1972) *Tropical Corps*. Vol. 2, Longman Group Ltd., London.

Rasmussen, G.S.A.(1999) Livestock predation by the painted hunting dog *Lycaon pictus* in a cattle ranching region of Zimbabwe: a case study. 133±139 *Biological Conservation* 88.

Rasmussen, L. E. L., Hess, D. L. and Hall-Martin, A. (1996) Chemical profiles of African bull elephants (*Loxodonta africana*); Physiological and ecological implications. *Journal of Mammalogy,* 77, 422-439.

Ron, T. and T. Golan. (2010) *Angolan Rendezvous: Man and Nature in the Shadow of War*. 30 Degrees South, SA. 243 pp. (2006, in Hebrew, Am Oved Publishers Ltd, Tel-Aviv; 2007, in Portuguese, Cha de Caxinde and Prefacio, Luanda and Lisbon).

Seidensticker, J. (1984) *Managing Elephant Depredation in Agricultural and Forestry Projects*. The World Bank, Washington, D. C.

Selous, F.C. (1881) *A Hunter's Wanderings in Africa*. London: Richard Bentley & Son, London.

Sitati, N. (2001) Human-Elephant Conflict in Transmara District, Kenya. In: *Wildlife and People: Conflict and Conservation in Maasai Mara, Kenya*, eds. M.J. Walpole, G.G. Karanja, N.S. Wasilwa & N. Leader-Williams. Masai Mara National Reserve and adjacent districts: Durrell Institute of Conservation and Ecology, University of Kent.

Sitati, N.W., Walpole, M.J., Smith, R.J. and Leader-Williams, N. (2003) Predicting spatial aspects of human-elephant conflict. *Journal of Applied Ecology* 40: 667- 677.

Sitati, N.W., Walpole, M.J. and Leader-Williams, N. (2005) Factors affecting susceptibility of farms to crop-raiding by African elephants: using a predictive model to mitigate conflict, *Journal of Applied Ecology* 42: 1175-1182.

Skarpe, C. & 21 authors (2004) The return of the giants: ecological effects of an increasing elephant population. *Ambio*, **33**, 276-282.

Smith, R.J. & Kasiki, S. (2000) A spatial analysis of human-elephant conflict in the Tsavo ecosystem, Kenya. *AfESG Human-Elephant conflict Task Force report.* IUCN SSC African Elephant Specialist Group, Gland, Switzerland.

Songhurst, A., M. Chase, and T. Coulson. 2015a. Using simulations of past and present elephant (Loxodonta africana) population numbers in the Okavango Delta Panhandle, Botswana to improve future population estimates. *Wetlands Ecology and Management* **23**:1-20.

Songhurst, A. McCulloch, G. and Coulson, T. (2015b) Finding pathways to human–elephant coexistence: a risky business. *Oryx*, available on CJO2015. doi:10.1017/S0030605315000344.

Songhurst, A. (in press). Measuring Human-Wildlife Conflict - comparing insights from a government approach with an IUCN data collection protocol. *Wildlife Society Bulletin*

Spinage, C.A. (1994) *Elephants*. London: T & A D Poyser Ltd.

Steinhart, E.I. (1989) Hunters, poachers and gamekeepers: towards a social history of hunting in colonial Kenya. *Journal of African History* 30: 247-264.

Stiles, D. (2004) The ivory trade and elephant conservation. *Environmental Conservation,* 31 (4): 309–321.

Stout, T.A.E., Bertschinger. H. J. & Colenbrander, B. (2007) The use of GnRH vaccines for reproductive suppression in horses and elephants. In: EU-Asia Link Project Symposium "Managing the Health and Reproduction of Elephant Populations in Asia". Kasetsart University, Bangkok, Thailand. pp 114-116.

Stander, P.E. (1990) A suggested management strategy for stock-raiding lions in Namibia. *South African Journal of Wildlife Research*, 20: 37–43.

Stander, P.E. (2000) Conservation of lions and other large carnivores in the Kunene region, Namibia. African Lion News, 2: 8 - 9

Sukumar, R. (1990) Ecology of the Asian Elephant in Southern India II: feeding habits and crop-raiding patterns. *Journal of Tropical Ecology* 6: 33-53.

Sukumar, R. (1989) *The Asian elephant: ecology and management*. Cambridge University Press, Cambridge, UK.

Taylor, R.D. (1993a) Elephant management in Nyami-Nyami District: Turning a liability into an asset. *Pachyderm* 17:19-29.

Taylor, R.D. (1993b) *Wildlife management and utilization in a Zimbabwean communal land: a preliminary evaluation in Nyami-Nyami District, Kariba*. WWF MAPS Project Paper No. 32. Harare, Zimbabwe, WWF Southern Africa Regional Office.

Taylor, R.D. (1999*) A review of problem elephant policies and management options in Southern Africa*. HEC Task Force, IUCN AfESG, Nairobi.

Tchamba, M. (1996) History and present status of the human/elephant conflict in the Waza-Logone region, Cameroon, West Africa. *Biological Conservation* 75: 35-41.

Tembo, A. (1995) A survey of large mammals in Sioma-Ngwezi National Park. *African Journal of Ecology* **33**(2): 173-174.

Thomson, J. (1885) *Through Masai Land*. Boston: Houghton Mifflin.

Thouless, C. (1994) Conflict between humans and elephants on private land in northern Kenya. *Oryx* 28(2): 119-127.

Thouless, C. R. and Sakwa, J. (1995) Shocking elephants: fences and crop raiders in Laikipia District, Kenya. *Biological Conservation*, 72, 99-107.

Thomas, G. (2006) *Crocodile/human conflict in the Okavango Delta*, MSc, Botswana.

von Gerhardt, K., Van Niekerk, A., Kidd, M., Samways, M. & Hanks, J. (2013) Long-range movements of three savannah elephants within a Transfrontier Conservation Area (TFCA): implications for management. *Oryx*: 1-9.doi:10.1017/S003060531200138X

van Aarde, R (2006) Delineating Ecological linkages between key components of the Kavango-Zambezi Transfrontier conservation areas. PPF/P/3-80.

Wagner, K. K., R. H. Schmidt & M. R. Conover (1997) Compensation programs for wildlife damage in North America. *Wildlife Society Bulletin*, 25, 312-319

Whyte, I. (1993) The movement patterns of elephant in the Kruger National park in response to culling and environmental stimuli. *Pachyderm*, 16, 72-79.

Williams, A.C. Johnsingh, A.J.T. & Krausman, P.R. (2001) Elephant-human conflicts in Rajaji National Park, north-western India. *Wildlife Society Bulletin* 29 (4): 1097-1104.

WWF (2000). Problem animal reporting, Wildlife Management Series, World Wide Fund for Nature, SARPO, Harare, Zimbabwe.

WWF (1997) Conserving Africa's elephants: current issues and priorities for action. Dublin, H.T., McShane, T.O. & J. Newby, (eds) World Wide Fund for Nature International Report, Gland, Switzerland.

WWF SARPO, (2005) Human Wildlife Conflict Manual. Harare: World Wide Fund for Nature Southern African Regional Programme Office (SARPO) Harare, Zimbabwe.

Young, T.P., Palmer, T.M. and Gadd, M.E. (2005) Competition and compensation among cattle, zebras and elephants in a semi-arid savannah in Laikipia, Kenya. Biological Conservation 122: 351-359.

Appendix 4

Photos of Human-Wildlife Conflict in Africa. Please note that we have not been able to identify all the photographers and if anyone can identify and claim, it would be appreciated.

Elephant crossing an electrified fence in Sengwa, Zimbabwe. *L Osborn*

Problem elephant captured and translocated after entering commercial farmlands in Zimbabwe. *L Osborn*

Capture and translocation: *M. La Grange*

Elephants crossing the road in northern Botswana *Ecoexist (A. Stronza)*

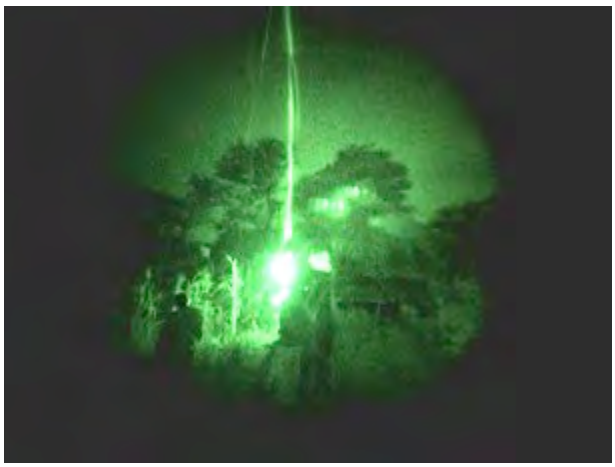
Photographers unknown

Woman constructing a string fence in Zimbabwe *L Osborn*

Watch tower at night in Zimbabwe *L Osborn*

Guard post/watch tower. *M La Grange*

Silver Foil in plastic bottles around fields help deter animals *M La Grange*



Homemade flash bangs in Zimbabwe *L Osborn*

Elephants drinking out of pool at high end game private houses in South Africa *Nick and Helen Pickard*

Bull elephant attacking tourist vehicle in Kruger National Park (off the internet)

Destroyed grain bin in the Zambezi Valley, *L Osborn*

SEKA Theatre Group in Luangwa Valley, Zambia *L Osborn*

Chilli Demonstration plots and young farmers in Livingstone, Zambia *L Osborn*

Hippo being butchered on the banks of the Kavango River in Angola (*copy from Parks office Mucassa, Angola) Other Pictures Photographers unknown*

Injuries sustained in an attack by a hippo. *Photographer unknown*

Potential for human/croc conflict. *L Osborn*

Six-meter crocodile shot after eating a man in Zimbabwe (*photographer unknown*)

Photograph of fencing against crocodiles ("croc-proof pools") - allowing people access to water on a river bank. These structures are most successful in slow flowing river sections without massive water level fluctuation. Mentzel, C. & Niskanen, 2014)

Elephant killed on Problem Animal Control *(A. Songhurst)*

Removing tusks from an elephant killed on Problem Animal Control (*L Osborn)*

Elephants killed on Problem Animal Control *(A. Songhurst)*

Problem Animal Control meat distribution *(A. Songhurst)*

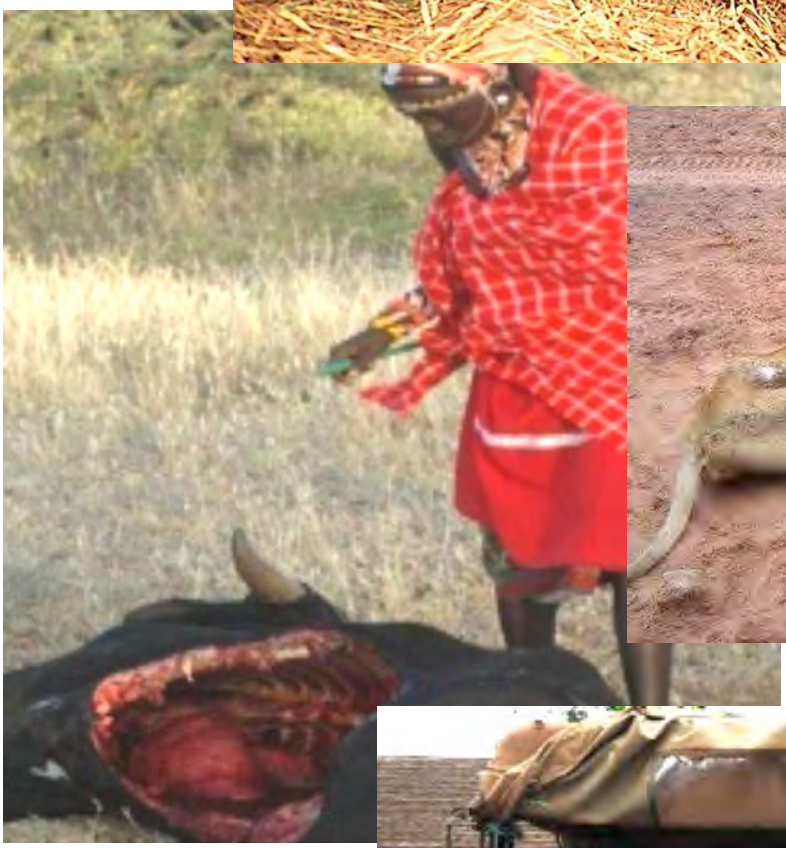
Bee-hive fence in the Okavango. *L Osborn*

Log-hive at the water hole in the mid Zambezi valley, Zimbabwe. *M. Karidozo*

Light system employed for Predators in Zimbabwe (*L Osborn*)

Fire (*Julbernadia pinaculata and Acacia nigresens* stumps used in fields). *M. La Grange*

Conflict with lions- *L Osborn and unknown photographers*



Different types of fences

Traditional fencing: *M La Grange*

Game proof electric fencing. *M La Grange*

Commiphora africana used as hedge fence. *M La Grange*

Fence of *Euphobia pinicalli M. La Grange*

Fence of *Jatropha curcas M. La Grange*

Visual barrier of reeds- (particularly important with predators *M. La Grange*

Wood and reeds *M. La Grange*

Stone Fence *M. La Grange*

Noise makers: *M La Grange*

Crackers dispensed by crossbow *M La Grange*

Paint gun pistol. *M La Grange*

Decoy Raptors in wheat fields. *M La Grange*

Elephant speared, Kenya *Photographer unknown*

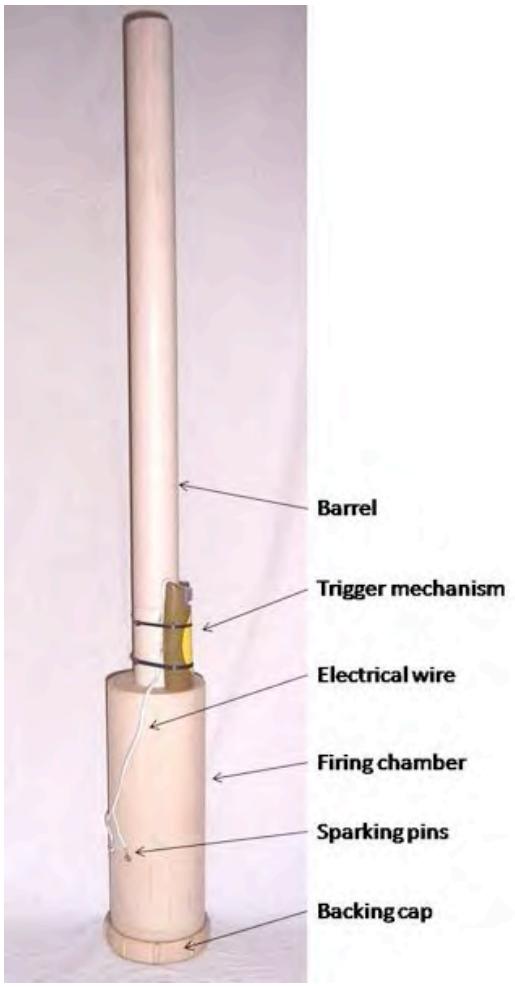
Snared elephant. *Rachel McRob*

Applying chilli grease to a fence in Namibia, *L Osborn*

Elephant pulling down cable fence *Photographer unknown*

Chilli Gas Grenade, launcher and chilli gas sprayer *L Osborn*

Ambush chilli educator *M La Grange*



Miripiri bomber *M La Grange*

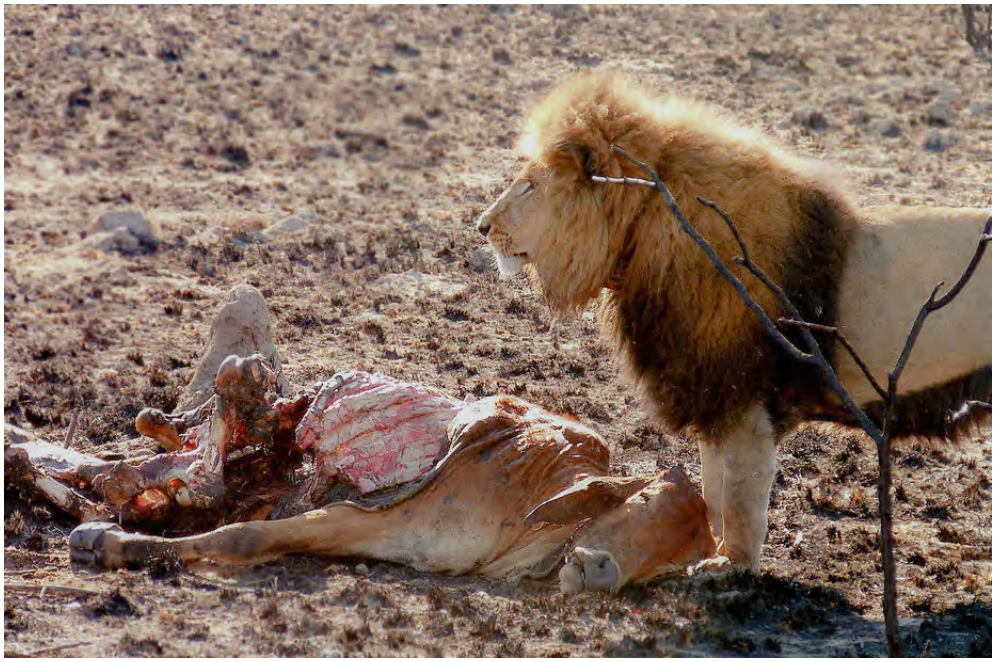
Bulls on the boundary of Kruger National Park (National Geographic Magazine)

Chilli gun pepper strike. *M La Grange*

Chilli-Dung Briquettes *L Osborn*

Crop and property damage by elephants *L Osborn*

Trenches. Uganda. *Photographer unknown*



Niki Rust
http://theconversation.com/how-lions-leopards-and-livestock-are-affected-by-racism-on-namibias-farms-57167

https://tosco.org/2014/01/23/success-of-lion-officer-pilot-project/

https://goondwan.com/animals/elephant/elephant-pix-8/elephant-and-quelia/

Farmers using firecrackers to scare elephants from their farm in Nova Madiera bloc Chipanje Chetu, Mozambique *James Morgan.*
http://www.jamesmorgan.co.uk/features/wildlife-management/#jamesmorgan-1/11/MG_5751.jpg

Elephant and people competing for water in Namibia. http://www.desertelephant.org

Innovative high voltage electric fences in Livingstone, Zambia *M Karidozo*

Problem Baboons in southern Africa

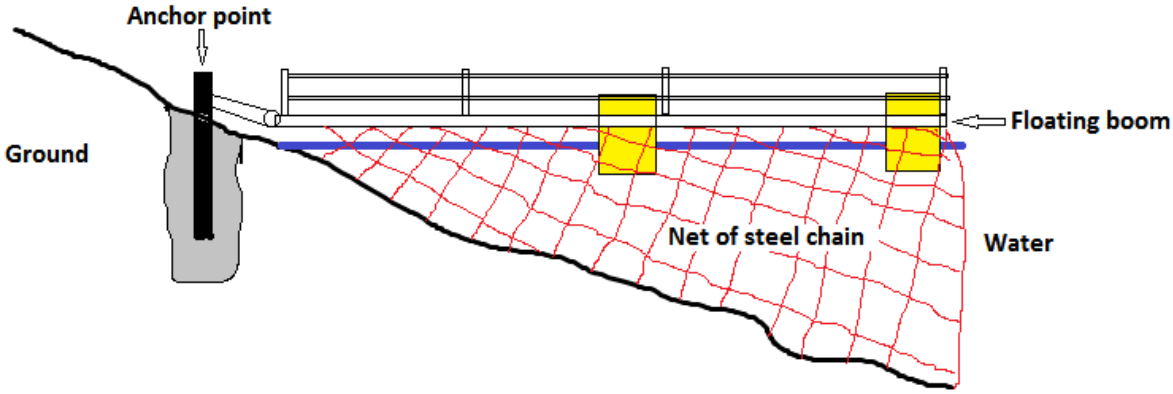
http://baobabhunting.co.za/?p=196#

http://www.amusingplanet.com/2011/01/africas-first-elephant-underpass.html

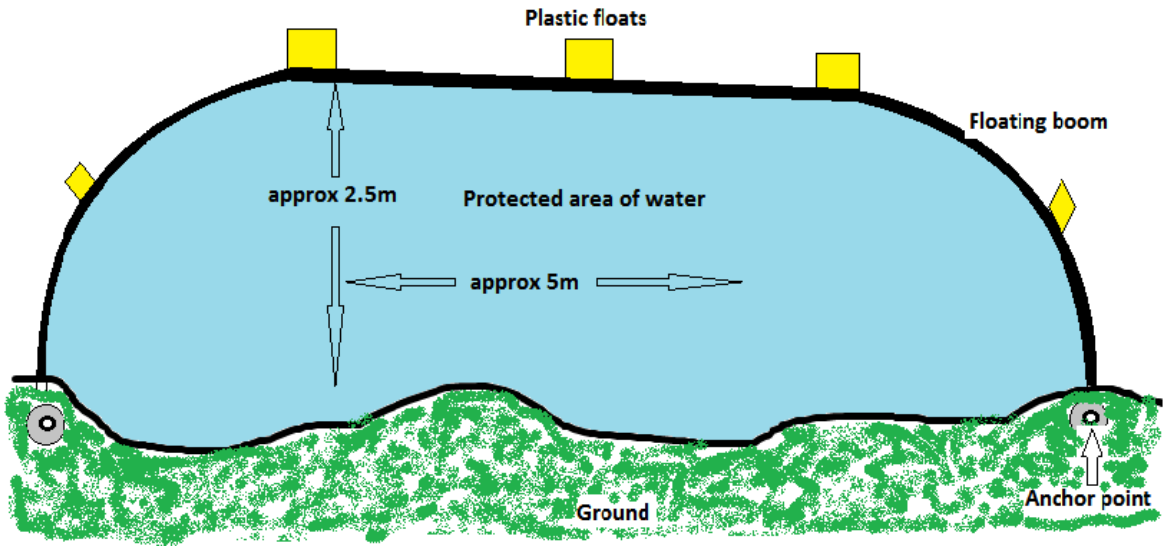
Water Access point barriers – construction guide (From Mentzel, C. & Niskanen, 2014)

Construction of a barrier for protection against crocodiles

The revised version of the proposed barrier is as follows;
The barrier comprises a curved floating boom and a curtain of steel chain which hangs from the boom to the bed of the river. The boom is anchored at both ends at the shore.
We believe that a large number of these smaller type barriers will work better than a small number of large enclosures. Communities will use these more readily than one large enclosure that many people use.
The proposed structure is best described in pictures – see below;

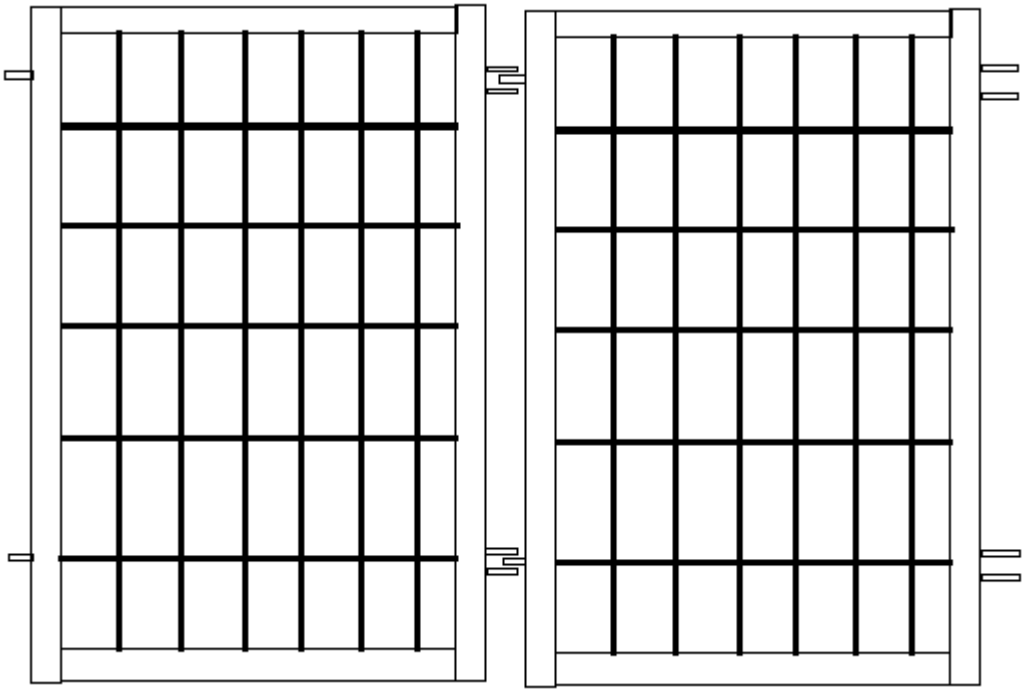


Seen from above the structure will extend out from the river bank into the river – see below;



Hanging from the floating boom will be a "curtain" of steel chain welded into a net. This chain will reach the bed of the river and will rest on the river bed. In fast flowing water it may be necessary to anchor the chain curtain to river bed by attaching it to rocks.

Above the floating boom that supports the chain curtain, there will be 0.5m of vertical wall in steel to prevent crocodiles from coming over the barrier into the protected pool.
The shallow sides near the anchor points and the landward side of the protected pool can be secured with modular sections of steel fence as previously proposed (see below), if a complete circle of barrier is required, as suggested by communities and fiscails at recent meetings.



The advantage of this design is that the uneven and irregular shape of the river bed can be completely covered by the chain curtain. This prevents gaps at the base where crocodiles could get into the protected pool.
The second advantage of this design is that these units are small enough to be moved up and down the bank with changes in water level. The difficulty of a large fixed barrier is that it is at risk of being swept away by flood water.
This design will also be easier to install and use in places where there is deep or fast running water, so is less restricted in the places it can be used.
For protection of places that have still water and a shallow slope into the water (such as sites in lakes and dams), the initial design using modular panels (see above) can be used.
This barrier can be produced as a pilot project for installation at the agreed site in Tete at a cost of US$5538 per 2.5 x 5m barrier.
This price does not include the modular fencing to 1m high on the land side – this is an optional extra that can be produced for US$80 per panel of 1.4m width.
If the pilot project is successful using these barriers and agreement is reached to extend this project to a national programme, it is suggested that an additional service to install the

END>>>>