Chapter

# An Assessment of the Human-Wildlife Conflict across Africa

*Benjamin-Fink Nicole*

## Abstract

The coexistence between humans and mammals across Africa has led to Human Wildlife Conflict (HWC) due to the competition for limited natural resources. Over the past two decades, I have focused my research on conservation issues that either resulted from or induce human-wildlife conflict. Conflicts are intensified in regions where dense human populations live in close proximity to nature, and where livestock holdings and crop fields form a significant part of rural livelihoods. As a result, both people and wildlife suffer tangible consequences; therefore, creating the need for stakeholder's involvement and their willingness to adopt conservation-based behaviors, as key ingredients for feasible and effective conservation counter measures. This chapter provides a comprehensive review of the wide array of drivers and conservation implications of HWC incidences throughout Africa. An in-depth analysis is essential to understanding the problem and support future conservation prospects. Examples explore key case studies ranging from decreasing numbers of the charismatic forest dwelling elephant (*Loxodonta cyclotis*) in the DRC, to increasing numbers of waterbuck (*Kobus ellipsiprymnus*) in Mozambique, and varying numbers of lion populations bordering Kruger National Park in South Africa. Concluding with conflict resolution strategies employed across Africa and recommendations for the effective conservation of the world's most endangered mammals.

**Keywords:** Africa, biodiversity, carnivores, community based conservation, ecology, human-wildlife conflict, mammals, poaching, restoration, strategic planning, transfrontier parks

## 1. Introduction

Conflicts between people and mammals currently rank among the highest main threats to conservation in Africa. The World Conservation Union [1] defines Human-Wildlife Conflict (HWC) as a threat resulting directly from the competition between rural communities and wild animals over natural resources, entailing consequential tangible costs to both people and wildlife. Alarmingly, HWC primarily involves endangered species and embeds broader environmental impacts on ecosystem equilibrium and biodiversity preservation. The most common HWC incidences undermine human welfare, health and safety; which result in zoonotic diseases, physical injury, and loss of human lives. Sustainability is rooted in the continuous loss of economic revenue due to the damage to property and infrastructure (e.g. agricultural crops, water installation, etc.), livestock depredation, and the transmission of domestic animal diseases (**Figure 1**). In fact, the meat export

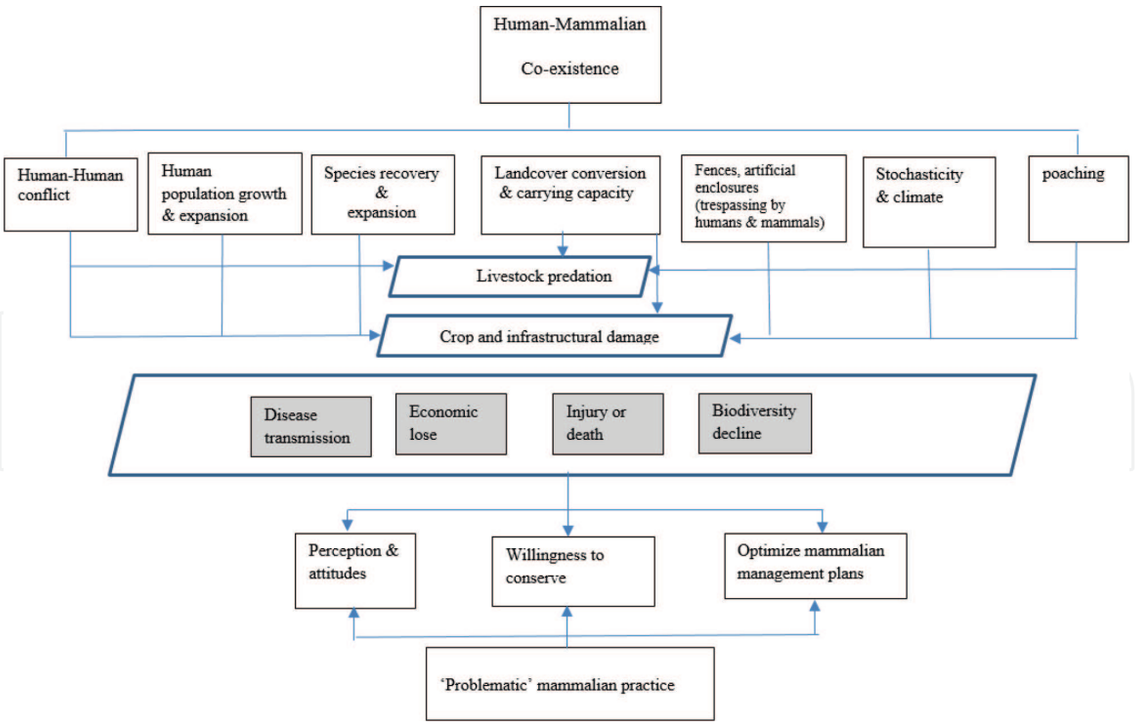


**Figure 1.**
*The connection between human-mammalian co-existence and its drivers for conflict. Casual interlinkages are illustrated by directional arrows. Consequential variables are highlighted with slanted frames and in gray boxes.*

market sector of South Africa came to a halt in 2008 due to concerns over a possible outbreak of Hand, Foot, and Mouth Disease (HFMD), known to be spread by ungulates such as wildebeest.

## 2. Overview of HWC drivers across Africa

Over the past two decades, I have focused my research on the implications of human-wildlife conflict interactions worldwide. In Africa, HWC primarily occurs in regions where rural communities live adjacent to protected areas. This chapter explores drivers for, and solutions to, regional case studies throughout Africa. Much of these drivers enable significant shifts in the dynamics of endangered mammalian species (i.e., abundance, composition, and distribution of prey and predator population). The conservation concern arises from the developed negative attitudes of the local people toward wildlife causing exacerbated and dejection of the conservations' efforts. In order to break this threatening cycle, there is a need to protect rural livelihoods, reduce their vulnerability, and counterbalance losses with benefits and foster community-willingness to participate in conservation.

### 2.1 Human population growth and land conversion

Human population growth inherently entails settlement expansion into and around protected areas [2]. Additionally, more often than not such expansion entails land cover conversion and shifts in wild herbivore and predator dynamics.

Human population growth entails settlement expansion which has resulted in the infringement into mammalian habitats, constriction of species into marginal habitat patches, and increased direct competition for coexistence. Human encroachment

into national reserves is documented to occur in Nigeria, Uganda, Ghana, Congo, Kenya, Tanzania, Zanzibar, and South Africa to name a few countries.

As human population grows and settlement expands, land cover conversion is driven by the need for economic profitability and livelihood sustainability. Research done in Samburu, Trans-Mara, Taita, and Kwale in Kenya illuminate the interlinkage between intensified conflict, land conversion and the development of small-scale farming [3]. Provide details!! Over the last 4 decades, state and trust ranches have been subdivided and sold as smallholdings and commercially cultivated horticultural areas. The unintended result is an artificially improved carrying capacity which alters mammalian ecology. These crops may serve as favorable feeding grounds for non- residential predators, thereby altering the natural distribution and ecology of predators and the dynamics of the prey population abundances. Need to add more details!!!

Growing densities in livestock populations can create an overlap of diets and forage competition with wild herbivores, resulting in overgrazing and decline or even local extinction in wild herbivore populations. As such, livestock becomes an important source of prey for predators. As a response, landowners often shoot and kill predators found on their land, or on the neighboring lands in order to avoid economic loss associated with livestock predation.

### 2.2 HWC results in monetary loss

Villagers living adjacent to Tasavo Conservation Area (TCA), Kenya, indicate the severity of the ongoing conflict; 64.8% of respondents indicated that their agriculture was destroyed, 28.8% reported livestock predation, 4% indicated damage to water structures, and 2.3% reported damage to fences (add reference).

A variety of mammals have been documented to cause crop damage, such as primates, rhino, elephant, deer, and wild pig. Crop loss includes mainly banana, cassava, maize, and sweet potatoes, millet, and cotton. In fact, the endangered African bush elephant (*Loxodonta africana*) accounted for 4–7% of annual crop loss in Kibale national Park, Uganda [2]. The park borders the communities, which is 54% of cultivated land within 1Km of Kibale's border. Landowners report a loss of maize, cassava, sweet potato, and banana due to elephants, bushpig (*Potamochoerus sp.*), olive baboons (*Papio cynocephalus*), and redtail monkey (*Cercopithecus ascanius*). Similarly, farmers consider most medium and large-size mammals as a threat to their crops in Jozani Forest Reserve located on Unguja, Zanzibar. In particular, loss of coconut harvest is attributed to one of the most endangered primates, the red colobus (*Procolobus kirkii*).

In Caprivi, Namibia, the largest free ranging population of elephants (5000) shares their habitat with local people. Elephants dispersing from the two Caprivi National Parks are documented to be responsible for a lot of crop damage although the financial losses are less than lion (*Panthera leo*) attacks on livestock (US$39,200, US$85,570, respectively) [4].

For many communities across Africa, the cost of coexisting with wildlife is the loss of valuable revenue due to livestock predation by the endangered Leopard (*Panthera pardus*), the vulnerable Lion and Cheetah (*Acinonyx jubatus*), or the Spotted hyenas (*Crocuta crocuta*).

Commercial cattle ranches supply meat to both national and international markets. Such ranches located adjacent to the Tsavo East National Park in Kenya suffer losses of large domestic animals (i.e., cows, bulls, and steers) due to predation by lions and spotted hyenas, in addition to losses of small domesticated animals (i.e., young cattle) following cheetah attacks [5]. In a 4 year study, ranchers lost

annually on average 2.4% of their herd, accounting for 2.6% of their economic revenue (US$8749).

Similarly, traditional agro-pastoralism is prone to livestock deprivation in Zimbabwe. During 1993–1996, 241 livestock were reported as killed by lions, leopards, and yellow baboons (*Papio anubis*), accounting for 34, 12, and 54% of the kills respectively [6]. These amounts account for an annual loss of 142% of total family's income per household. These mammals differ in their targeted prey and therefore, in the economic damage; while the large predators kill cattle and donkeys, baboons kill smaller livestock (e.g., sheep and goats). As a result, lions account for a large share of the economic loss.

### 2.3 Fencing and artificial enclosures

Across Africa, fences provide a spatial barrier around game reserves, conservancies, and homestead areas.

Populations are closed, finite and natural processes do not take place (e.g., dispersal, emigration, and colonization dynamics). This not clear!! Negative consequences may be in one of the following forms: hybridization and introgression, genetic bottlenecks, inbreeding or outbreeding depression, and shifts in local or regional ecological equilibrium. As a result of such artificial enclosures, game ranch owners are faced with the need to intensely manage populations on their land while weighting economic profitability with genetic concerns stemming from small and closed populations (e.g., inbreeding, outbreeding depression, and bottlenecks) [7]. As such, increasing risks posed to endangered mammals.

Conflicts over natural resources have increased as communities, particularly pastoralists, compete for diminishing water, pasture and food resources with wildlife. Tasavo Conservation Area (TCA) is located adjacent to traditional villages in Kenya where traditional pastoralism is practiced. Despite fences, people trespass with their livestock into the TCA so that they may access resources that are lacking (e.g., grazing). Similarly, Maasai herdsmen, a semi-nomadic pastoralist group, drive their animals into the Maasai Mara game in Kenya on an ongoing basis [8].

The effectiveness of natural or man-made fences depends on behavior of different mammalian species. For example, burrowing animals such as bushpig can breach such barriers and enable additional mammalian species to do so (such as lions utilizing their holes around Kruger National Park in South Africa). Similarly, baboons, lions and leopards have been documented to jump over fences and into livestock enclosures at the Wildlife Research Area in Zimbabwe [9]. In Laikipia District situated in Northern Kenya, pastoralists discovered that domestic animals experience a lower depredation rate when penned in corals overnight (when carnivore tend to hunt) [10].

### 2.4 Species' localized recovery

Conservation success is often synonymous with the successful recovery of declining endangered populations through effective management strategies. However, it is worth noting that the social organization, habitat and prey requirements, and home-range distributions of such recovered populations often serve as a renewed source for HWC. Examples include: lions straying out of the Kruger Park Reserve in South Africa and into adjacent villages, and bull elephants on musth acting aggressively and venturing into local communities across Kenya. Recent recovery programs have additionally contributed to the recolonization by cheetahs of their original home range including rural areas in Botswana; and in the process have increased the frequency of domestic livestock predation.

### 2.5 Climate factors and stochastic events

Climate is a determining factor in mammalian colonization (i.e., home range and distribution expansion, contraction, or shift). As climate chance becomes increasingly rapid, people can expect an increase in HWC incidences. Concurrently, seasonal changes in rainfall are directly correlated with lion predation intensity on livestock in Tsavo National Park in Kenya [5]. In fact, monthly rainfall predicts lion attacks on livestock during seasonal rains. Similarly, the intensity of livestock predation by predators increased in Sengwa Wildlife Research Area, Zimbabwe, during the dry season when vegetation cover is scarce [6].

### 2.6 Emerging markets

South Africa experienced an annual increase of 5.6% in land used for wildlife ranching during 1991–2000 [7]. Diminished economic profitability of livestock, coupled with an increase in stock theft, resulted in a shift from traditional agriculture and cattle farming to ungulate ranching within the private ranching industry. With an annual return on investment per hectare higher than any agriculturally based market (upwards of 80%), the game ranching industry generates annually R4.7 billion [11, 12].

More recently, the market for ungulate color variance has evolved in South Africa. Proactively breeding for morphological characteristics (i.e., coat color) is a relatively new avenue for economic revenue, yielding upwards of 1 billion Rand/year. This sector is emerging in its scope and has the capacity to produce 50–1000% ROIs in full. A primary example is the breeding of a bull golden wildebeest (*Connochaetes)* with a cow blue wildebeest (*Connochaetes taurinus*); the offspring is referred to as "Split Golden" and were sold in private auctions during 2014 for 513, 137 rand (a 541% increase in selling price compared to 80,000 rands in 2004) [7]. These Split Golden wildebeests are then mated with golden bulls (i.e., backcrossed) to facilitate the expression of the recessive allele for a golden color coat. Similarly, the price of offspring that result from breeding a blue wildebeest with split king wildebeest increased 10-fold during 2012–2014 (81,553–882,917 rands, respectively). The average price of a pure breed blue wildebeest in 2014 was 3626 rands. Breeding for color variance may also occur by selectively breeding blue wildebeest with split golden wildebeest or blue wildebeest with king wildebeest. The high ROIs dictate mammalian artificial overlap and stocking within the confinement of these reserves; thus, in turn, altering intra and interspecies dynamics, resulting in the potential of significant increases in HWC frequencies.

### 2.7 The illegal wildlife trade (IWT)

The illegal wildlife trade can be clustered into one of two categories: (1) the bushmeat trade, the illegal harvest of non-domesticated animals in tropical forests in order to meet local and regional consumption demand, and (2) the international trade in body parts of endangered animals to meet the international black-market demands [9, 10]. The first primarily consists of hunting ungulates and, the second entails the poaching of rhinos, elephant, and pangolins to name the most popular. It is important to note that often times, poaching entails the illegal harvest of ungulates which are not classified as endangered including Kudu (*Tragelaphus*) in Mozambique and waterbuck (*Kobus*) in Zimbabwe and Mozambique.

Bushmeat represents an important source of animal protein for humans in tropical Africa. In Bénoué National Park (BNP), Cameron, and Sam-Sam villages, Ghana, is the local diet, whereby bushmeat consists of up to 24% of animal

protein intake. Two primary negative impacts are associated with bushmeat consumption; the transfer of Zoonotic diseases and biodiversity loss. The Ebola outbreak crisis across West Africa in 2016 resulted in a decreased consumption rate in high-income households than in low-income households [16]. However, daily meal frequency decreased during the crisis, while the diversity of food items and preferences for bushmeat species remained constant. In Garamba National Park and neighboring Azande Hunting Reserve, Congo, bushmeat hunting of primates increased fivefold during political instability and armed conflict resulting from warfare.

The Illegal Wildlife Trade (IWT) refers to the trade in animal body parts among international borders. With an annual circulation of $17 billion annually, IWT is driven by the consumer belief system that consuming an animal or its body parts, then one resumes the animals' potency [14]. Africa is home to the most endangered mammalian population supplies. The most trafficked animal worldwide is the pangolin (*Manis*) for its scales, the white rhino (*Ceratotherium simum simum*) and the black rhino (*Diceros bicornis*) for their horn, and the elephant for its tusks. In 2011, South Africa was home to 83% of Africa's rhinos and nearly three-quarters of all wild rhinos worldwide. Alarmingly, on average, one rhino was poached every 8 hours during 2015. Specifically, three South African provinces (Limpopo, North West, and KwaZulu-Natal) are home to 90% of South Africa's rhino population, experiencing 75% of all poaching during 2012–2017.

### 2.8 Civil war and poaching

During the civil war and Human-Human Conflict (HHC) in South Sudan and The Democratic Republic of the Congo elephant populations significantly decreased. Their decreased numbers were attributed to increased poaching and dispersal. Studies conducted during political stable times indicate that elephant populations re-established their local home-ranges after HHC. Provide details!!!

## 3. Conservation strategies designed to address increasing HWC

Most HWC incidences may be considered *wicked* conservation problems; their multi-complexity is rooted in the interlinkage imbedded in social, economic, biological, and stochastic variables (**Figure 2**, [13]). They vary according to different taxonomic groups within the Mammalia class and sub-regions across the African continent. Their inherited uncertainty can be quantified by various technology and formulas, which can then be applied to assist local mammalian management [13]. Moving forward, conservation of mammals (and all other species) in Africa will only be affected if bottom-up and top-down approaches are implemented simultaneously. The following section offers an assessment of implemented strategies which mitigate and minimize HWC. These are subdivided into two: (1) ground level applications and (2) wide scale conceptual applications.

### 3.1 Ground level applications

The Maasai and Samburu local communities utilize homestead fencing whereby crop fields and livestock are fenced in corals and wildlife dispersal is enabled. Limited depredation is attributed to such established husbandry practices which utilize wire, acacia, wicker or solid enclosures (listed from the most effective to the least).

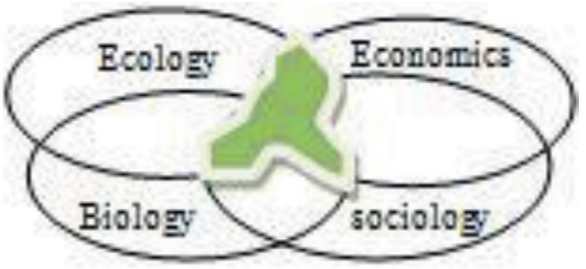


**Figure 2.**
*The multifaceted human mammalian interactions and conflict drivers are addressed within a wicked conservation contextual problem (illustrated in green). Effective strategies to decrease HWC are found within the interlinked area. Adapted from Benjamin-Fink and Reilly [13].*

In addition to these conventional fences, electric fencing such as those required in reserves that enclose the "BIG 5" (i.e., lion, buffalo (*Syncerus caffer*), leopard, elephant, and rhino), or constructing roofs on the fences, are viable alternatives for a more sophisticated solution. Electric fences have proven to be effective at creating a spatial separation between human settlements and mammals in Nyeri and Laikipia districts in Kenya encompass the Endarasha and Ol Moran villages. In fact, electric fences in the East Caprivi region of Namibia have successfully deterred elephants from destroying crops [4, 5]. Equally important, the return on investment in eletric fences ocurs within 5 years, which may then be reallocated to offset associated costs.

Crop damage and death incidences are primarily associated with male mammals, most of which are polygynous. This is due to their large body size and mass. As a result, culling a male elephant would have the equivalent crop economic result of removing a family of 20 elephants. The demography of a population is correlated to the female population size, age of first reproduction, litter size, interval between births, age of reproductive senescence, and mortality. In a polygynous species such as elephants, the male contributes sperm, providing no additional source of energy in the rearing of offspring. As such, a surplus of males is not uncommon. The critical adult sex ratio varies amongst mammalian species and is additionally correlated to spatial distribution, density, seasonality in breeding, duration and periodicity of oestrus in females, reproductive behavior, etc. With that in mind, poaching is primarily targeted toward male and female tuskers, which consequently skews the demography. As such, culling of problematic male elephants as a policy to reduce conflicts is not widely recommended.

The practice of translocation of "problematic" animals is a viable alternative to culling. However, when taken in an *ad hoc* fashion, this mammalian management practice may also have negative effects on the genetic pool; conservation programs should consider all aspects of ecological implications [7]. Ungulate translocations need to be considered as the possibility of inbreeding, outbreeding, and hybridization high risk implications may additionally be posed in the case of carnivores, particularly when territories are already occupied by individuals of the same species.

Herders are fearless when protecting their animals in East Africa. The task of deterring lions, hyenas, and cheetahs, is given to young boys or adult males. Undesired shooting and death of the animals themselves occurs frequently. The utilization of guard dogs as a safer tactic is employed across South Africa and Botswana, whereby the dog's bark is sufficient to scare predators away.

An intensified version of proactive protectors is anti-poaching units (APU) (see below).

### 3.2 Wide scale conceptual applications

A community based natural resource management scheme (CBNRMS) has been established in the Caprivi region of Namibia, where the eco-tourism industry and hunting concessions provide the lions a share of local economic revenue. The interlinkage of livelihoods with wildlife-based revenue (particularly large mammalian species and carnivores) is a scheme employed across Kenya and Namibia. An example of indirect economic income is the creation of employment opportunities via the tourist sector. Kibale National Park in Uganda foster positive attitudes toward the park by directly sharing a percent of generated revenues with local communities.

Moreover, Bénoué National Park (BNP), Cameroon, was established in 1968. Prior to which the land was owned by local villages. Concurrently, their revenue sources include crop, livestock, fishing, and hunting as such, the average loss per household is an estimated annual 31% of their economic revenue generated from crop and 18% of their economic revenue livestock generated from livestock due to elephants, baboons, and warthog (*Phacochoerus aethiopicus*) [15, 16]. The government currently subsidies their economic loss. In a nut shell, economic returns benefit rural communities and serve as incentives which motivate them to protect wildlife outside protected areas and to discourage poaching.

The role of anti-poaching units (APUs) is diverse. Their primary objective is to halt the poaching of charismatic mammals (e.g., pangolin, elephant, rhino, etc.`) and their activities range from aerial patrols conducted by satellites and helicopters, to ground patrols conducted by ground troops traveling by foot and/or in vehicles. Additionally, they serve as a vital peace-keeping governing body within local communities. At times, patrolling officers may extend themselves to assist surrounding villages in resolving common disputes surrounding criminal activities. Such processes and involvement facilitate a mutual trusting relationship and positive attitudes toward mammalian conservation.

Settlement of rights is a scheme by which the reimbursement for crop and livestock losses, or of loss of human life or injury, has a fixed quota of exploited commodities. It legitimizes the rights of local communities to resources within reserve zones. This, in turn, promotes positive attitudes and perceptions toward mammalian conservation and a higher tolerance for HWC incidences.

## 4. Recommendations and conclusions

This chapter highlights the importance of considering human-mammalian interactions when poising to understand the most critical conservation challenges facing biodiversity and formulating effective management strategies. It highlights common problems and solutions across biogeographical regions and demonstrates that conflicts have similar causes and effects, and that detailed information is the key to the development of appropriate strategies for resolving the problem and conserving different ecosystems and their inhabitants.

Many international organizations strive to implement mammalian conservation strategies that will decrease HWC incidences and bring back endangered species from the brink of extinction. Conservation beyond borders (CBB) provides an example of considering the most challenging conservation phenomenon within their complexity and formalizing comprehensive solutions.

The most sustainable approaches ensure the development of a local economy derived partially from wildlife (e.g., revenue from nature reserves), as well as a reduction in the vulnerability of rural communities to livestock

depredation and crop damage by various mammalian species. In order to optimize conservation efforts, management plans should be based on scientific knowledge, combined with indigenous knowledge, practical local knowledge, and collaboration.

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## Conflict of interest

There are no conflicts of interest the author wishes to point out or declare.

## Author details

Benjamin-Fink Nicole
Conservation Beyond Borders, Minnesota, USA

*Address all correspondence to: nicole@conservationbeyondborders.org

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