
2. Human-wildlife conflict: the issues

TYPOLOGY OF HUMAN-WILDLIFE CONFLICT

Human deaths and injuries

Human deaths and injuries, although less common than crop damage, are the most severe manifestations of human-wildlife conflict.

The hippopotamus was long considered to be responsible for more deaths than any other large animal in Africa. Nowadays, however, the crocodile seems to have superseded the hippopotamus (Box 1). Crocodile attacks are common for the following reasons.

- The numbers of large crocodiles are high, and their distribution range is wide. In addition, crocodile populations can recover relatively rapidly when afforded protection.
- Crocodiles can live in close proximity to people without being detected, while lions or elephants cannot.

In addition, the number of attacks is certainly much underestimated, for the following reasons.

- In some cases there is no evidence of a person having been taken by a crocodile, especially if that person was alone at the time of the attack.
- Many deaths due to crocodile attacks go unrecorded because human births and deaths are often not registered. In addition, attacks on humans by crocodiles are often ascribed to witchcraft (Musambachime, 1987). This may be because crocodiles often seem to be wary of humans, yet will attack without warning from an invisible position. There is a widely held belief that crocodiles that attack humans are not real crocodiles, but either creatures constructed by witches, so-called “human crocodiles”, or crocodiles controlled by a spirit as a result of a curse.

Large mammalian carnivores are responsible for numerous fatal attacks on humans, and large herbivores, such as elephants, are also involved in human deaths every year, albeit more rarely. Elephants and hippopotamuses will rarely deliberately attack humans; in most cases deaths occur while people are protecting their crops against raiding animals (usually at night); when people accidentally come into close contact with the animals, especially on paths near water at night; or when people encounter injured animals whose normal sense of caution is impaired.

Baboons are seldom, if ever, dangerous to humans, though they are capable of inflicting serious wounds to dogs. But they will intimidate humans – especially women – in urban areas, when scavenging for food.

BOX 1

Fatal wildlife attacks in Africa: some figures**Crocodiles**

Unpublished documents from Zambia (Zambia Wildlife Authority records) and Mozambique (Magane, 2003) show that, although data collection is sparse, crocodiles are the animals causing the greatest number of deaths. In Mozambique, many deaths go unreported, simply because of the difficulty for many people of getting to a government office. A rough estimate would be around 300 people killed by crocodiles per year nationwide (FAO, 2005).

In the United Republic of Tanzania from 1999 to 2004, crocodiles killed at least 28 people and injured 57 others in the Jukumu Wildlife Management Area, an area of about 500 km² comprising 22 villages located in the northern buffer zone of the Selous Game Reserve. In one village alone 11 people were killed in a single year (Baldus, 2005).

In Namibia, 157 crocodile attacks on humans and cattle were recorded in 2005 by community rangers in registered conservancies in the Caprivi region (Murphy, 2007).

Large felines

In Mozambique, lions killed 70 people in Cabo Delgado province over a period of 18 months between 2001 and 2002. Most of these people were out at night protecting their crops from elephants (FAO, 2005).

In the United Republic of Tanzania, home to the world's largest lion population, lion attacks are widespread. Between 1990 and 2004, lions killed at least 563 people and injured more than 308. The problem has increased dramatically over the past 15 years, with the majority of cases occurring in the southern part of the country (Packer *et al.*, 2005). A few lions are known to eat humans, such as the notorious Osama which killed at least 34 people along the Rufiji River (Baldus, 2008).

In South Africa, between 1996 and 1997, at least 11 (possibly more) illegal immigrants making their way on foot from Mozambique across the Kruger National Park were reportedly killed by lions. This tragic situation may have occurred many times over the years (Frump, 2006). Information gathered from the Ugandan Game Department archives (1923–1994) reveals that leopards and lions have preyed on hundreds of humans in Uganda over the past several decades. Analyses show that lion attacks were more dangerous than leopard attacks (Treves and Naughton-Treves, 1999).

Elephants

More than 200 people were killed in Kenya over the last seven years by elephants alone (WWF, 2007a). In Ghana, ten people were killed by elephants in the last five years, in the Kakum conservation area. In the densely populated Caprivi region of Namibia, a population of 5 000 elephants – one of the largest free-ranging population of elephants – was responsible for twice as many aggressions as lions in the 1990s, and attacked over a larger area (O'Connell-Rodwell *et al.*, 2000).



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The crocodile is the animal responsible for the most human deaths in Africa



D. CORNELIS

Some lions are known to prey on humans regularly

Finally, road accidents caused by wildlife can result in human death and injury. This phenomenon, well known in Europe and the United States (Mouron *et al.*, 1998; Scanlon, 1998) is also a serious problem in Namibia where vehicle collisions with greater kudus are responsible for more human deaths than attacks by both crocodiles and elephants.

Destruction of crops

Crop damage is the most prevalent form of human-wildlife conflict across the African continent. The occurrence and frequency of crop-raiding is dependent upon a multitude of conditions such as the availability, variability and type of food sources in the area, the level of human activity on a farm, and the type and maturation time of crops as compared to natural food sources.

A wide variety of vertebrates conflict with farming activities in Africa. These include birds, rodents, primates, antelopes, buffalos, hippopotamuses, bush pigs and elephants. While it is widely recognized that in most cases elephants do not inflict the most damage to subsistence agriculture, they are generally identified as the greatest threat to African farmers (Parker *et al.*, 2007). Elephants can destroy a field in a single night raid. Most peasant farmers are unable to deal with the problem of elephant damage themselves and governments rarely offer any compensation (see Box 2).

In most cases the adult male elephants carry out crop-raiding, while the female herds prefer to keep away from areas inhabited by humans. It is worth noting that during dry seasons elephants can also break into storage bins and steal grain. When they do so the consequences for food security are even more serious.

Hippopotamuses can cause substantial damage to fields while feeding at night. Cultivations at risk are those close to rivers or lakes such as rice, vegetables and other crops grown on river banks during a drop in the water level, or crops grown directly in the water such as bourgou (*Echinochloa stagnina*), which is cultivated in the Niger river.

Primates cause widespread damage to plantations of exotic trees by stripping away bark (Box 3). Baboons and vervet monkeys are also highly skilled at raiding



J. ANDERSON

Elephants can destroy a field in a single night

BOX 2

Elephant crop-raiding in Africa

Within the Zimbabwean portion of the AWF Zambezi Heartland, elephants are estimated to be responsible for up to three-quarters of all crop damage caused by wildlife (Muruthi, 2005). In the area around the Kakum National Park in Ghana, approximately 80 to 90 percent of crop-raiding is attributed to elephants (Osborn and Parker, 2002). Every year the 500 households living close to the Kakum Conservation Area lose about 70 percent of their food crops to elephant raids alone (Barnes *et al.*, 2003).

In the Djona hunting zone in North Benin, 34 percent of surface crops were destroyed by elephants during the agricultural season from 2001 to 2002. A survey carried out in the area revealed that 80 percent of those interrogated had lost crops to elephant raids every year over the previous four years (Alfa Gambari Imorou *et al.*, 2004). Table 2 shows the actual agricultural losses caused by elephants to crops in selected regions.

TABLE 2
Percentage of total agricultural output reported lost as a result of elephant crop-raiding in some African countries

Country	Zone	Year of study	% lost
Gabon	Gamba	1996	0.75
		1998	0.3–6.2
Ghana	Red Volta	1996	8.6
Malawi	Kasungu	1981	6.3
	Liwonde	1997	8.8
Mozambique	Maputo	1996	10.2
Uganda	Kibale	1996	21
Zimbabwe	Binga	1994	11.7
	Sengwa		5.4

Source: after Hoare, 1999.

food crops. They will even chew on young tobacco or wheat stems to extract the juice and then spit out the fibre, in the same way that humans chew on sugar cane.

Finally, this study assesses the competition between humans and crocodile over fish. This competition can take various forms: the theft of live fish from fishing nets and associated damage to fishing gear; and crocodiles encroaching on and diminishing fish catches. Two species are particularly implicated: the Nile crocodile (*Crocodylus niloticus*) and the African slender-snouted crocodile (*Crocodylus cataphractus*), a smaller species of fish-eater with limited distribution, which is also capable of taking fish from nets and destroying fishing gear. The third African species of crocodile (*Osteolaemus tetraspis*), is small, docile, and not in any way a threat to humans.



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Storage bins damaged by elephants

BOX 3

Bark stripping and its consequences

In southern and eastern Africa three species of baboon are responsible for stripping bark from trees: the chacma baboon, the yellow baboon and the olive baboon. In the same region, at least three species of monkey are also known to be bark strippers: samango monkey (*Cercopithecus mitis labiatus*), blue monkey (*Cercopithecus mitis*) and Syke's monkey (*Cercopithecus mitis albogularis*).

These animals raid timber plantations for the inner bark of several species in the genera *Pinus*, *Eucalyptus*, *Acacia* and *Cupressus*. The areas most affected by the problem are in South Africa and Zimbabwe. Between 2002 and 2006, baboons damaged 5 percent of the total area of pine plantations in South Africa, and 8 percent of the total pine plantation area in Zimbabwe. Initially the animals targeted young pine trees, selecting species that were lower in tannin. However, over the following five years they went on to strip all the species of pine grown, as well as eucalyptus, and to some extent even wattle. Eventually they targeted all the trees in the plantations, including the mature pine trees. Damage in all cases was similar; the baboons bite into the bark, lifting and pulling it from the tree. Then they use their front teeth to scrape off and eat the soft inner layer of cambium. If the pine tree is not killed by ring barking, fungal and borer damage make the attacked parts unmarketable. More importantly, stripping of the bark forces the tree to coppice, and it no longer produces the straight grain timber for which it was selected. The baboons attacked the base of gum trees, in a similar way to porcupines. They also pulled newly planted wattle seedlings from the ground. The motivation for this behaviour is unknown and a range of hypotheses have been raised. Bark stripping may simply be a bad habit, or else the fulfilment of some dietary or medical requirement, or other non-food stimuli.

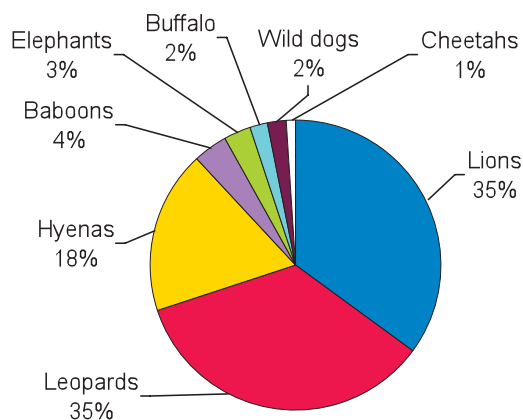
Attacks on domestic animals

Another adverse effect of the human-wildlife conflict is the killing of domestic animals by predators. The number and type of domestic animals killed by wildlife varies according to the species, the time of year, and the availability of natural prey. In the savannah and grasslands where pastoralism remains the main source of livelihood for many people, attacks on livestock are an issue. On a national level the losses are hardly significant, but for the individual stock owner, they can be catastrophic. For a small-scale herder, losses to wildlife can mean the difference between economic independence and dire poverty.

Large carnivores are the principal culprits. Patterson *et al.* (2004), for example, analysed 312 attacks claiming 433 heads of livestock over a four-year period on two neighbouring arid-land ranches adjoining Tsavo East National Park in Kenya. Lions were responsible for 86 percent of the attacks while the rest were carried out by hyenas and cheetahs. Lions and hyenas attacked mainly cattle and at night, whereas cheetahs nearly always took smaller sheep and goats. Some other smaller carnivores are also responsible for attacks on livestock. In Bénoué National Park in Cameroon, the civet is the main predator, causing losses to livestock income of about 18 percent (Weladji and Tchamba, 2003). Nevertheless, mammalian carnivores are not the only group involved (Figure 1).

On the Gokwe communal land, situated next to the Sengwa Wildlife Research Area in Zimbabwe, 241 livestock were killed by baboons, lions and leopards between January 1993 and June 1996 over a study area of 33 km², which contributed respectively to 52, 34 and 12 percent of their kill. Their predation techniques are different; baboons attack by day and usually kill small stock such as goats and sheep, while lions and leopards attack at night, and lions kill larger prey such as cattle and donkeys (Butler, 2000).

FIGURE 1
Domestic animals killed by wild predators in the African Wildlife Foundation (AWF) Samburu Heartland, Kenya (% of reported deaths)



Source: Ogada and Ogada (2004).

Of the three species of crocodiles in sub-Saharan Africa, the Nile crocodile is the most common, and the main culprit in attacks on livestock. This large species (with a mass of up to 1 000 kg) lives off aquatic and terrestrial prey species. In the Jukumu Wildlife Management Area in the United Republic of Tanzania, for example, 53 cows were killed and 41 injured by crocodiles in a single year (Baldus, 2005).

Transmission of diseases to livestock and/or humans

Serious diseases are known to be transmitted by wildlife to domestic livestock and possibly also to humans (i.e. rabies). Scavengers and predators, such as spotted hyenas, jackals, lions and vultures, also play a role in disseminating pathogens by opening up, dismembering and dispersing parts of infected carcasses. For example, predators ingest anthrax spores together with carcass tissue; the spores are then widely disseminated in the predators' faeces (Hugh-Jones and de Vos, 2002).

The key role played by the African buffalo as maintenance host of foot-and-mouth disease was identified in the late 1960s. The important role played by wildebeest in the maintenance and seasonal shedding of alcelaphine herpesvirus-1 has also been established (Bengis, Kock and Fischer, 2002).

It is now generally accepted that the parasite *Theileria parva parva* is a cattle-adapted variant of *Theileria parva lawrenci* borne by buffalo. Infection with this organism, which is generally silent in buffalo, causes high mortality rates in cattle (Bengis, Kock and Fischer, 2002). Cattle farming is therefore risky where buffalo and a suitable vector are present. In the Gaza Province of Mozambique, 228 cows – of which 76 were pedigree Brahmans – died from theileriosis as a result of contracting the disease from buffalo (FAO, 2005).



D. EDDERA

Wildlife can transmit diseases to domestic livestock when they share the same grazing areas

In lowland areas of Africa, where the winters are mild, African horse sickness is endemic in zebra populations, which are ideal maintenance hosts.

Sylvatic rabies has been diagnosed in 33 carnivorous species and 23 herbivorous species (Bengis, Kock and Fischer, 2002). Endemic rabies has been identified in certain communal burrow-dwelling wildlife species, such as yellow mongoose, bat-eared fox and jackal.

Brucellosis, caused mainly by *Brucella abortus* biotype 1, has been observed to infect predominantly hippopotamuses and waterbuck in several free-range ecosystems (Bengis, Kock and Fischer, 2002).

Adverse interaction with other species (endangered or highly valuable)

Attacks on other wildlife species are only viewed as forms of conflict in countries – such as Botswana, Namibia and South Africa and to a lesser extent Zambia and Zimbabwe – where game ranching and game conservancies have developed populations of high value ungulates, such as sable and roan antelopes, which are managed for trophy hunting or live sale. In most cases, the landowners are wealthy and can generally resolve conflict problems themselves.

Competition between wild species occurs when habitats become degraded, especially by elephants (see Box 4).

BOX 4

Impact of elephants on habitat and sympatric wildlife

In southern Africa, where savannah animal communities tend to be dominated by a few large species such as hippopotamuses, buffalo, zebras, wildebeest and especially elephants Cumming (1982), Craig (1992) and Martin (1992) have calculated that elephant densities need to be kept below about 0.5 animals per km² in order to maintain existing woodland canopy cover intact. This level is far lower than the densities currently occurring in many of the national parks and safari areas, which were estimated to range from 0.25 to 2.12 animals per km² in 1991 (Cunliffe, 1996).

The destruction of habitats by elephants can even jeopardize the survival of sympatric wildlife species. In Waza National Park in Cameroon, the destruction of *Acacia seyal* by elephants near the ponds where they gather at the end of the dry season endangers the survival of the giraffes that feed off this tree. In Chobe National Park in Botswana, there has been concern over the survival of the indigenous Chobe bushbuck as a result of elephants altering vegetation patterns along the Chobe River (Ben-Shahar, 1999). In the Caprivi region of Namibia, the damage caused by large numbers of elephants to habitats is likely to be detrimental to the development of populations of roan, sable and tsessebe after rainfall. The same phenomenon was also observed in the Sebungwe region in Zimbabwe where all three species have been in decline for a number of years. This coincided with a period in which the elephant population has continued to grow and has brought major structural changes to habitats (Martin, 2005).

Overgrazing by wildlife occurs sporadically. Leaving aside the question of enclosed areas, unfenced natural habitats may be subject to overgrazing if natural cycles are left unmanaged or if external intrusions such as human disturbances are allowed. The decline in populations of elephants and other herbivores in Tsavo National Park, Kenya, was a result of discrepancies between the park's carrying capacity, which was lowered by severe drought, and the overabundance of wildlife due to mismanagement practices (Waithaka, 1997).

Other manifestations of human-wildlife conflict

Baboons raid gardens and food in lodges and camping areas and can cause an immense nuisance in small urban settlements if left unchecked. On the Zimbabwean side of the Zambezi valley, baboons are a major menace in bush camps and small towns such as Chirundu and Victoria Falls, and in wildlife camps and lodges where they are not actively controlled. They pull thatch from thatched-roof buildings and will even intimidate wide-eyed tourists in order to steal food directly from the tables they occupy (Gaynor, 2000; Kansky, 2002).

In the Gourma region, located in sub-Saharan Mali, livestock and humans compete for water with a herd of about 500 elephants. Aside from the fatal accidents which could occur due to the close and often dangerous encounters with the elephants at the ponds, this competition can lead to loss of cattle, particularly at the end of the dry season or in times of drought.

Finally, elephants can damage infrastructures such as ponds or tracks in national parks (Alfa Gambari Imorou *et al.*, 2004) and elsewhere. In Namibia, for example, the main problem caused by elephants in the arid northwest is damage to water installations whereas, in the rest of the country, it is damage to crops (Government of Namibia, 2007).

CAUSES OF HUMAN-WILDLIFE CONFLICT

A set of global trends relating to human populations, habitat evolution and animal distribution and behaviour has contributed to the escalation of human-wildlife conflict worldwide.

Human factors

The following factors are among the main causes of human-wildlife conflict in Africa.

The requirements of human development. The main cause of human-wildlife conflict worldwide is the competition between growing human populations and wildlife for the same declining living spaces and resources. The transformation of forests, savannah and other ecosystems into agrarian areas or urban agglomerates as a consequence of the increasing demand for land, food production, energy and raw materials, has led to a dramatic decrease in wildlife habitats.

This is particularly true in Africa where the human population came close to tripling in the four decades from 1960 and where, in consequence, settled

agriculture has spread to more marginal rangelands leading to encroachment into wildlife habitats. Under these conditions, conflict between wildlife and local communities has inevitably increased (Siex and Struhsaker, 1999; Muruthi, 2005; Tjaronda, 2007). This is perfectly illustrated by the conflict between humans and elephants. It is estimated that about 80 percent of elephant range lies outside protected areas. This habitat is rapidly being eliminated and fragmented by intensified agriculture, and is resulting in one of the most serious human-wildlife conflicts.

Another consequence of the opening of new lands and villages into areas that were once private wildlife refuges is the creation of new bush paths between these settlements. This generates a greater traffic of pedestrians, increasing the risk of contact with wild animals. Other activities organized around the new settlements such as the daily collection of wild fruit, berries and fuelwood, fishing, and poaching further expose the inhabitants to encounters with wildlife.

Access to water is another essential human requirement. Permanent settlements are developed close to a source of water, but this prevents access to wildlife. Despite efforts to develop alternative water supplies, in rural Africa water is still most frequently drawn from natural or man-made surface waters, i.e. rivers, lakes and dams. People are dependent on access to these water bodies for their daily needs: collection of water for domestic use, washing clothes and utensils and bathing. Many of these water bodies are habitats for crocodiles and with growing human populations needing to make use of water “the scene is set for increasing human-crocodile conflict” (Fergusson, 2002).

Migration of peoples for reasons of security or food safety. Drought, floods, civil unrest, natural disasters or war disrupt the normal production and distribution of food, resulting in famines. This phenomenon is on the increase; the number of food emergencies in Africa each year has almost tripled since the 1980s. Across sub-Saharan Africa, one in three people are undernourished (McCarthy, 2006). These factors spur the continuing migration of rural people into areas where resources could be obtained, and which are frequently occupied by wildlife. The resultant occupation of the habitat of wild animals by humans leads to conflict.

War and civil unrest force people to seek shelter in protected areas where they exert a strong pressure on natural resources and enter into competition with wildlife. For example, it is estimated that more than 120 000 people displaced by civil war are currently living in protected areas in Mozambique (Government of Mozambique, 2006). Political upheaval can have indirect repercussions on the human-wildlife conflict situation. Funding for the Campfire organization in Zimbabwe, which acts as custodian for wildlife in communal areas, has been seriously depleted as a result of the current crisis in the country. Rural populations are forced to take matters into their own hands. They resort to the illegal hunting of problem species with incorrect calibre weapons, with the result that they often wound the animals. They use agricultural pesticides to control lions, leopards and to some extent also baboons.

The human population surrounding the Kakum Conservation Area in Ghana has increased dramatically during the past 30 years. During the 1970s farmers migrated in large numbers from other regions of the country to take advantage of the ideal cocoa-growing conditions at the edge of the forest. This has contributed directly to the increase in levels of conflict between humans and elephants.

In Africa waterside communities have grown in recent years at a rate of about 3 percent per annum (Bryant, 2005), partly as a result of migration of peoples displaced by drought conditions and by political upheavals (McGregor, 2004; Bourdillon, Cheater and Murphree, 1985). In Zimbabwe, the human population occupying fishing camps along the shore of Lake Kariba doubled during the 1991–1992 drought and subsequently increased again as people were displaced by land reforms and economic collapse. More people are exposed to the risk of attacks by crocodiles now that the numbers of residents drawing water directly from the lake, and the numbers of people informally engaged in subsistence and commercial fishing in the area, have increased.

Successive droughts and the subsequent desertification of the land have led to the substantial migration of northern populations southwards. These migrants often settle near the last pockets of natural resources within protected areas where they are particularly exposed to human-wildlife conflict. Conflict is most acute in zones in which a wide range of species coexists with high-density human populations (Ogada *et al.*, 2003). A good example is the Tsavo National Park buffer zone (about 20 000 km²) in Kenya, which supports almost 250 000 people (Patterson *et al.*, 2004).

Attitudes and perceptions. In general rural Africans have little sympathy for wildlife and see animals purely in terms of their meat value. This is illustrated by the fact that, in several Bantu idioms, the word *nyama* used for wildlife also means “meat”. Rural communities consider wildlife, particularly large mammals, as threats to their safety and food security. This adverse perception is particularly strong near protected areas where the presence of wildlife populations inflicts daily costs on local communities, which can erode local support and tolerance. In turn, local people can develop a negative attitude towards reserves and wildlife, exacerbating conflict and undermining conservation efforts.

Landowners, traditional land-users and even wildlife managers still sometimes deliberately kill species they consider a threat –from elephants to birds such as *Quelea* sp. – with a view to reducing the population or even exterminating species within the locality.

The continued negative attitude of communities towards wildlife emanates from losses (including human life, property, crops and even agricultural land set aside for conservation purposes) incurred by wildlife. The association of wildlife with damage is now so integrated in the minds of local populations that they will even blame beneficial species. In Zanzibar, for example, Siex and Struhsaker (1999) found that red colobus monkeys, which villagers in agricultural areas adjacent to the Jozani Forest Reserve blamed for serious losses of coconut crops,

actually increased final tree yields. By pruning away small, immature coconuts, they accounted for a 3 percent increase in the potential harvest. Primates are also a source of income in that they attract tourism.

Elephants seem to crystallize the hatred of rural communities. Field reports from across Africa describe local antipathy to elephants beyond that expressed for any other wildlife. People living in central African forests “fear and detest” elephants (Barnes, 1996). Farmers in Zimbabwe display “ingrained hostility” to elephants, which are the “focus of all local animosity toward wildlife” (Wunder, 1997). Rural Ugandans complain bitterly about elephants, except where they have been eradicated (Hill, 1998).

In the minds of most rural communities in Africa, lions are considered a pest that should be eliminated. In a study conducted in and around Queen Elizabeth National Park, Uganda, 37 percent of 156 respondents thought that the best way to deal with stray lions entering the village was to kill them; 35 percent said a fence should be erected around the protected area, and only 28 percent felt people should be taught how to avoid lions (Driciru, 1999). In Cameroon, of 236 herders questioned from 10 different villages along the borders of Waza National Park, 50 percent had a negative perception of lions (Bauer, 2003b). In the Niger, 81.5 percent of 154 people questioned between 2000 and 2006 in 87 villages in the peripheral zone of the W transboundary Park had a negative attitude towards predators, and 14 percent confirmed that they would kill predators (Hamissou and di Silvestre, 2008).

In some instances, the eradication of large carnivores has been linked to sports hunting and in others to systematic widespread elimination by trained agents (Treves and Naughton-Treves, 1999). Well known examples are the professional hunters who frequently kill wild dogs because they regard them as excessively cruel and efficient as predators. National veterinary services and herders will poison lions and hyenas in order to protect livestock development.

The tolerance level for human-wildlife conflict varies according to the species or the location. For example, African people have a complex but generally negative perception of crocodiles (McGregor, 2004). There seems to be almost no indigenous knowledge remaining about the role of crocodiles in the natural ecosystem, in contrast to the perceptions held by older generations concerning the roles of many terrestrial wildlife species (Musambachime, 1987). Consequently, people simply see crocodiles as a threat and as a source of hardship because they attack livestock and compete for fish. However, there are a few exceptions, mostly linked to ancestral and totemic respect. These include the sacred crocodiles at Lakes Bazoulé and Sabou in Burkina Faso and other parts of French-speaking West Africa (Kpera, Mensah and Sinsin, 2007). In these localities a human death or injury is better tolerated if it is caused by a crocodile rather than an elephant or a lion. In the first case people consider that it was the human who encroached on the habitat of the crocodile while, in the second case, the animal intruded into the human environment.

Local beliefs have an impact on the occurrence of some conflicts. As previously cited, attacks on human victims by crocodiles are often ascribed to witchcraft

(Musambachime, 1987). The fatalism associated with witchcraft may, to some extent, explain the apparent lack of concern shown by communities in their daily exposure to crocodiles. Described as “carelessness” by Sichali (2000), this lack of any attempt to take even rudimentary precautions against attack, together with the repeated and frequent exposure to risk in the face of known and often recently demonstrated risk is difficult to understand. Wanjau (2002) refers to the same phenomenon in Kenya.

In rare cases, some local populations have a favourable perception of wildlife. Rural villagers who live close to the Waza National Park in Cameroon appreciate nature’s intrinsic value and agree with the need to protect forests and their wildlife inhabitants for future generations. Their positive attitude towards conservation arises from their use of natural resources, such as regulated harvesting of non-timber forest products, the use of waterholes and fishing (Bauer, 2003a). In the United Republic of Tanzania, several villagers in the Rufiji district (which has experienced 92 lion attacks on humans since 1990) reported a high tolerance for lions because the lions helped to control the bush pig population (Packer *et al.*, 2006).

Specific activities. Some activities particularly expose local populations to human-wildlife conflict. Box 5 shows an obvious gender bias in this respect.

Growing interest in ecotourism and the increasing presence of humans in protected areas are exacerbating conflict between humans and wildlife. The local capacity to manage and regulate public access and large-scale use of protected areas is weak. Equally, tourists are unaware of the dangers of wild animals. Each year, tourists are killed or injured by elephants, crocodiles, lions or other wildlife species in protected areas. In 2004 an American tourist was killed by a crocodile while in a canoe at Mana Pools National Park (Zimbabwe) on the Zambezi River (United States Department of State, 2007). Two British tourists were killed and another seriously injured by a rampaging elephant in Zimbabwe’s Hwange National Park on 24 March 2007 (Vasagar, 2007).

Habitat factors

The gradual loss of habitat has led to increasing conflict between humans and wildlife. As wildlife range becomes more and more fragmented and wildlife is confined into smaller pockets of suitable habitat, humans and wildlife are increasingly coming into contact and in conflict with each other. In the Kakum Conservation Area in Ghana, the forest area available to elephants has decreased by about half since the 1970s. This explains why the density of elephants (about 0.6/km²) is now higher than in most other West African forests, thereby resulting in increased crop-raiding activities (Barnes *et al.*, 2003).

Nowadays, the last suitable habitats generally survive inside protected areas. This explains why conflicts are particularly common in reserve buffer zones where healthy wildlife populations stray from the protected area into adjacent cultivated fields or grazing areas.

BOX 5

Gender and human-wildlife conflict

Most of the people killed by large mammals are men, and many of these incidents occur at night. In Kenya, alcohol was found to be a key factor in one third of the deaths; victims were drunk and returning home from the bar. Others died protecting their crops, herding cattle, walking at night between neighbouring villages or even taking the prey of large felines. Information gathered from the Ugandan Game Department archives (1923–1994) reveals that twentieth century agropastoralists regularly tried to scavenge from leopard and lion kills (Treves and Naughton-Treves, 1999). This hazardous behaviour led to many human deaths.

An analysis of conflict with lions in the United Republic of Tanzania showed that, above ten years of age, men are at much greater risk of being attacked by a lion than women. This is because men are more likely to tend cattle or forage for bushmeat, and they are more likely to walk around alone at night. Men are also attacked when trying to retaliate against man-eating lions, often relying solely on nets and spears. Although men are more at risk overall than women, both men and women are almost equally at risk when working in fields or near their homes (Packer *et al.*, 2006). Attacks on men however were often less lethal than attacks on women and children.

On the other hand, the gender roles prevalent within traditional African society and the fact that children and adolescents perform many household tasks expose more women and children to crocodile attacks. Attacks on women and children are more frequently fatal than attacks on adult males.

A study on human-wildlife conflict carried out by AWF in the Chobe-Capri corridor between Botswana and Namibia has also revealed a gender disparity relating to how people are affected by wildlife conflict, which is linked in turn to the ownership of resources. Men tend to view the lion as the most problematic animal because men mostly own livestock, which are prime targets for lions. In Botswana the highest compensation rates are paid for livestock losses. On the other hand, women, who generally tend crops, rank the elephant as the most problematic animal because of its tendency to raid crops. Households headed by women are most affected by wildlife conflict, with over 85 percent reporting damage to crops and 95 percent reporting attacks on livestock. This is because in most cases these households are relatively poor and unable to invest in mitigation measures such as building strong fences and animal enclosures (Muruthi, 2005).

In this respect, border zones of protected areas may be considered population sinks; critical zones in which conflict is one of the major problems (Woodroffe and Ginsberg, 1998).

Several factors can contribute to the modification of the quantity or quality of wildlife habitats. The two most important factors are the following.

- ***Impact of human activities.*** Human activities such as husbandry, agriculture, fishing, the development of infrastructure or even of tourism or wildlife protection itself, can dramatically modify wildlife habitats either directly or indirectly (Box 6).

BOX 6

Human activities and wildlife habitat

In Kenya, the fencing of farms to keep wild animals away has created physical barriers for migratory species. Conflicts can arise when migratory species such as zebras and wildebeest, which had previously migrated without any hindrance, destroy fences and crops in a bid to reclaim their traditional routes from dispersal areas to the parks. The subdivision of state and trust ranches, sold as smallholdings and cultivated with commercial horticultural crops, also creates a source of conflict. Land-use fragmentation resulting from the development of small-scale farming has intensified the human-wildlife conflict in many areas where wildlife is abundant, such as Samburu, Trans-Mara, Taita and Kwale in Kenya (Kenya Wildlife Service, 1996).

The San people of the communal Na Jaqna conservancy are critical of the small-scale farming project currently implemented in Namibia for the same reason (Damm, 2008).

The eradication of the tsetse fly (*Glossina* sp.) and the development of anti-trypanosomiasis treatments have opened up abundant new grazing territories for cattle herders in areas that were once inhabited uniquely by wildlife. The concomitant eradication of *Simulium* sp., vector of *Onchocerca volvulus*, responsible for onchocerciasis (river-blindness), has allowed farmers to settle in new areas. With the geographical extension of human activities, especially husbandry, it is increasingly common for livestock and wild ungulates to share the same grazing fields. This is an obvious risk for the transmission of pathogens. The single most important factor contributing to the outbreak of diseases associated with wildlife is probably the direct or indirect (vector) contact of infected wild hosts or populations with susceptible domestic animals at the interface of their ranges, i.e. where mixing has occurred on common rangeland, or where other resources such as water are shared (Bengis, Kock and Fischer, 2002).

Baboons have been eradicated from some areas of South Africa and Zimbabwe, particularly where they interfered with commercial agriculture, to the extent that the current distribution range of baboons is largely restricted to areas that are not used for commercial cropping and horticulture. Baboons are now concentrated instead in areas where subsistence agriculture is practised, where they can raid crops grown by subsistence farmers.

Subsistence and commercial fishing are common in most African waters. Fishing was formerly concentrated in places where the rewards in terms of fish catch were highest and where crocodiles – being naturally wary of the presence of humans – were scarce. As a result crocodiles tended to inhabit areas that were less heavily fished, where they were less likely to be disturbed. But the growing demand for fish has meant that these areas have also become subjected to fishing pressure. The chances of contact and conflict between humans and crocodiles have increased as a result.

The surge in dam construction from the 1940s to the 1980s undoubtedly benefited wild crocodile populations inhabiting the rivers prior to closure. Damming a river

vastly increases the extent of shoreline where water is relatively shallow (hence warmer), eutrophic and stable in depth. Dams create ideal habitats for the survival of juvenile crocodiles. The construction of dams also attracts human inhabitants, thus favouring potential human-wildlife conflict.

In recent years, the successful recovery of declining or near extinct species, through wildlife management and protection from poaching and overexploitation, has created new conflicts. Effective protection and habitat management within the Kakum National Park in Ghana, for example, has increased the population of the forest elephant and resulted in many elephants straying out of the reserve into local villages. Similarly, elephant conflict in Zimbabwe has largely been brought about by the overpopulation of elephants, which have totally swamped the state wildlife land provided for them, and overflowed into the adjacent communal lands. It is here that most of the elephant damage is reported; elephants compete for water and take advantage of easy food found there. As regards crocodiles, the small individuals that survived the hunting pressures of the 1950s and 60s are now large breeding animals in the size class, which feed on large mammalian prey including livestock and even humans (Fergusson, 2002).

- **Natural factors.** Droughts, bush fires, climatic changes and other unpredictable natural hazards can contribute to a decrease in suitable wildlife habitat and therefore affect the occurrence and extent of human-wildlife conflicts (Box 7). Similarly, the seasonal modification of habitats due to rainfall can also have an impact on human-wildlife conflict (see Box 8).

One of the main consequences of the loss of habitats is the decrease in natural resources available for wildlife. The destruction of natural vegetation around protected areas and in some cases the total disappearance of buffer zones force herbivore species to feed in cultivated fields. This phenomenon is on the increase because the growth rate of cultivated areas is high at the periphery of protected areas. The W-Arly-Pendjari (WAP) ecological complex (Benin, Burkina Faso, the Niger) in West Africa lost 14 percent of its natural savannah vegetation within 30 km of protected area boundaries (Clerici, Hugh and Grégoire, 2005). Likewise, species with a more diversified regime such as primates will encroach on cultivated areas when the availability of natural food diminishes, as demonstrated in the case of baboons stripping bark from trees (Box 9).

The decline in numbers of natural prey is one of the major reasons why carnivores shift their diets to livestock, which are easier to capture and have limited possibilities of escape (Mishra *et al.*, 2003; Patterson *et al.*, 2004). Indeed many authors recognize that when native prey is abundant, wild predators consume it in preference to livestock. Possible causes and consequences of the impoverishment of prey populations are given in Box 10.

BOX 7

Natural hazards, habitat and human-wildlife conflict

The severe drought that struck Zimbabwe and South Africa from 1982 to 1983 caused baboons to raid exotic timber plantations. Over the last 30 to 40 years baboons had only been known to cause damage to timber plantations in a few localized sites in the mountainous regions of these two countries. The drought forced the baboons to search out alternative marginal foods, and caused the bark-stripping problem to surface in "hot spots" several kilometres apart. Thereafter over the following 10 to 12 years the problem seemed to spread relatively slowly from these hot spots into other adjacent forest areas until the next major drought hit in 1993 and 1994, and the problem escalated again.

The rise in lion attacks observed in the United Republic of Tanzania in 1999 was largely attributed to the El Niño floods of 1997 and 1998, which caused wildlife in many parts of the country to seek higher ground. As the floods receded in 1999, the wild ungulates returned to their normal ranges, leaving the lions with insufficient prey (Packer *et al.*, 2006).

In 1983, prolonged drought in Ghana caused severe bush fires. The fires reduced the quality of most wildlife habitats and forced some animals to seek refuge in adjacent habitats and farms. In Kakum, many wild animals were spotted in cocoa farms close to the park boundary; the resultant damage, especially to cocoa pods, forced the government to take immediate action by sending the military to the communities to force wildlife back to the park.

BOX 8

The seasons, habitat and human-wildlife conflict

Seasonal changes in rainfall are directly linked to the intensity of predation. Patterson *et al.* (2004) have demonstrated that in Tsavo National Parks in Kenya, lions are more likely to attack livestock during seasonal rains. The same tendency was found in Cameroon around Waza National Park (Bauer, 2003b) and in the Niger in the peripheral zone of the W transboundary Park (Hamissou and di Silvestre, 2008). During dry seasons, ungulates are easily found and killed close to the limited number of water sources; when rain fills seasonal pools, ungulates disperse, driving lions to prey on easier targets.

Near Sengwa Wildlife Research Area in Zimbabwe, in contrast, wild predators were found to be more likely to attack domestic animals in the dry season (Butler, 2000).

Lion attacks on humans in the United Republic of Tanzania also appeared to be highly seasonal, with most cases occurring in the harvest season of March, April and May. During this period, most people were attacked while sleeping in makeshift huts to protect their crops from nocturnal crop-raiding pests such as bush pigs (Packer *et al.*, 2006).

In Kakum, Ghana (Barnes *et al.*, 2003), the Democratic Republic of the Congo (Mubalama, 2000) and the Caprivi region of Namibia (Hanks, 2006), wildlife – particularly elephants – were observed to raid crops most frequently during the major rainy season between May and June, when the crops began to mature.

Nile crocodiles are poikilothermic reptiles, and are most active when temperatures are highest; this often coincides with the time of year when water levels are lowest and population densities of the crocodiles and their aquatic prey sources are thus highest. Fisherfolk who prefer to fish at periods of low water because the catches are greater are thus more exposed to contact with crocodiles during the warm season. This is confirmed by the more numerous crocodile attacks observed in the warmest months.

BOX 9

The link between monospecific tree plantations and bark-stripping baboons

In Zimbabwe, the elimination of natural vegetation to plant large tracts of monoculture vegetation such as pine, eucalyptus and wattle (*Acacia* sp.) was instrumental in fuelling the baboon problem. Aside from wild granadillas (*Passiflora* sp.) and a few indigenous plants and insects, natural food is scarce in these afforested areas, and therefore the baboons are more likely to eat the cambium layer beneath the tree bark. Extensive single species plantations also make it difficult for the baboons to move in search of alternative foods, even though the food value in the cambium is minimal, in fact insufficient to sustain a baboon in the long term. The link between these monocultures and bark stripping by baboons is now confirmed by the fact that troops whose territory lies adjacent to indigenous forest or commercial farming land did not cause the same kind of damage, whereas those adjacent to other afforested areas did. The same phenomenon was observed in South Africa where the isolated plantations were largely unaffected and conversely those adjacent to one another suffered the most damage.

BOX 10

Possible causes and consequences of the decrease in natural prey hunted by wild carnivores

Poaching, hunting and fishing

The dramatic rise in lion attacks in the United Republic of Tanzania since 1990 is most likely due to the human population increase in the country (from 23.1 million in 1988 to 34.6 million in 2002) and an associated increase in illegal bushmeat hunting that has eradicated much of the lions' prey from outside the protected areas. This in turn

Continues

Box 10 continued

has forced the lions to enter villages and feed on livestock (Barnett, 2000; Nowell and Jackson, 1996).

Similarly, in the Kakum Forest Reserve in Ghana, wildlife was frequently killed as a result of intensive logging and hunting before the area was officially gazetted as a national park in 1989. This adversely affected the number of prey, thereby forcing predators to look for food outside the reserve.

The human-crocodile conflict is sometimes attributed to the overfishing of the crocodile's primary food source, which led crocodiles to hunt other prey, including humans (FAO, 2005). However this argument oversimplifies a more complex relationship between predator and prey; fish constitute only 33 percent of the diet of adult crocodiles.

Agriculture and husbandry

The decline or local extinction of wild herbivore populations is partly linked to growing densities of livestock populations, the competition for forage and consequent overgrazing (Butler, 2000).

Diseases can cause a huge decline in the numbers of prey. In the 1890s, an outbreak of rinderpest killed millions of zebras, gazelles and other African wildlife. As a result lions had to look elsewhere for food, and attacks on humans increased across Kenya.

Natural characteristics of wildlife

The intrinsic characteristics of wildlife, such as food preferences, migration patterns, wariness or predation behaviour, can influence human-wildlife conflict.

Some particularly palatable food items can attract wildlife over rather long distances. This is the case for some crops. For instance, according to Barnes *et al.* (2003), of the crops planted outside the Kakum National Park in Ghana, maize and cassava particularly attract elephants. Maize is also the crop most frequently raided in the area around the Djona hunting zone in North Benin. It is raided twice as often as cotton, and far more often than groundnut and millet (Alfa Gambari Imorou *et al.*, 2004).

In Benin, elephants raiding maize and groundnuts were found to be attracted by mature wild fruits such as shea nuts (*Vitellaria paradoxa*) and *Parkia biglobosa* pods growing in the crop fields (Kidjo, 1992; Mama, 2000). Likewise elephants are attracted by wild fruits growing alongside cultivated fruits such as mangoes (*Mangifera* sp.) or guavas (*Psidium* sp.) in central Burkina Faso (E. Compaoré, personal communication).

The species as well as the availability of wild prey can have an impact on potential human-wildlife conflict. A study in the United Republic of Tanzania (Packer *et al.*, 2005) showed that the number of humans attacked by lions in each district was closely linked to two factors: the abundance of medium-sized prey (zebras, hartebeest, dikdik or impala) and the abundance of bush pigs. Lion attacks

were most common in areas where normal prey was scarcer and bush pigs were abundant (Packer *et al.*, 2006).

Species that migrate seasonally on a regular basis, such as elephants, are known to use the same traditional routes. Establishing cultivations along these routes exposes them to being raided. This has been observed for instance in Mali and Togo where the most serious damage occurred in villages located along the elephants' habitual paths (Maïga, 1999; Okoumassou *et al.*, 2004).

The wariness of wild species can explain why some fields are more prone to raiding than others. For example, baboons and monkeys tend to raid smaller fields surrounded by large trees and rocky hillocks, which provide cover for them. These vantage points provide them with easy escape routes and make it difficult for guards to follow them. On the other hand, when, for various reasons, wild species lose their fear of humans, this can also cause conflict. Elephant numbers have increased within many parks and reserves. Some individuals have grown accustomed to harmless contact with tourists, have lost their fear of people and will visit communities and destroy life and property. Crocodiles are naturally wary of humans, especially in places where they are frequently hunted, but they can learn that people pose no threat. Food is a strong stimulus and a reward for learning; it is certainly possible for animals to acquire the habit of eating humans.

A particular aspect of lion behaviour known as "surplus killing" certainly exacerbates human hostility towards lions and enhances conflict. Like any other large felid species, once a lion breaks into a fenced enclosure it is often tempted to kill more –sometimes many more – domestic animals than it can eat (Nowell and Jackson, 1996). In addition, some lions become specialized and are chronic livestock killers (Frank, 2006).

Behaviourally, the Nile crocodile is an opportunist ambush predator which has evolved many physical attributes to optimize its success in this role. Adult crocodiles will feed on any animal they can capture or find animals that are freshly dead ranging in size from fingerling fish to a hippopotamus. Humans are less powerful and slower in water than any similar-sized wild mammal and are therefore easy prey.

The physiological (e.g. rutting) or health (e.g. injuries, diseases and parasitism) status of a wildlife species may affect its normal behaviour and subsequently create conflict with humans (Box 11).

CONSEQUENCES FOR HUMANS

The consequences of the human-wildlife conflict are more serious in the tropics and in developing countries where livestock holdings and agriculture are an important part of rural people's livelihoods and incomes. In these regions, local people with a low standard of living are particularly at risk, as are agropastoralists who depend exclusively on production and income from their land.

Safety issues

Injuries to people mostly occur as a result of chance encounters with elephants, buffalo, hippopotamuses and lions, usually along paths between dwellings and

BOX 11

The impact of pathology and physiology on human-wildlife conflict

Behavioural modifications can be generated by different phases of reproduction. In the male elephant, during the rutting or "musth" period, plasma testosterone levels increase, characterized by the enlargement of, and copious secretions from, the temporal gland, persistent dribbling urine, and also increased aggression towards other elephants and objects (Poole and Moss, 1981). Male aggressiveness during the rutting period has also been observed in lions. In the same way, females become aggressive in the presence of youngsters – particularly elephants and lions – and may even attack humans.

Numerous authors have invoked the infirmity theory (injured, sick or old lions) to explain instances of human-eating and marauding by lions (Kruuk, 1980). Patterson and Neiburger (2000) examined evidence for this hypothesis in the skulls and mandibles of the Tsavo and Mfuwe human-eaters: all the cats had sustained serious and chronic injuries to the teeth and jaws. However, although the infirmity theory used to explain human-killing is widespread, this explanation may be too simple. In Uganda only 14 percent of 275 lion attacks documented in the archives were attributed to wounded animals, suggesting that a majority of healthy animals were involved in attacks on humans.

Wounded buffalos are known to be particularly dangerous. This is not the case for crocodiles; there is no evidence to suggest that attacks by crocodiles on humans are carried out only by old, sick or otherwise challenged individuals.

Wild animals may become irritated as a result of disease or parasites. In Mozambique, lions affected by TB after a contamination from buffalos, were noted to be more prone to prey on livestock than healthy individuals. Observers report that buffaloes parasitized with *Oestrus* sp. larvae will attack humans for no apparent reason. Encephalitis and parasitic diseases affecting the brain will significantly alter the behaviour of the sick animal; the exacerbation of aggressiveness and loss of fear of humans due to rabies is a well-known example.

a water source. Contact with crocodiles when bathing or collecting water more frequently result in death than in permanent injuries, nevertheless many of these permanent injuries cause significant disability. The amputation of limbs is quite frequent, as are attacks that result in major scarring, often on the trunk.

The dramatic consequences of these attacks go well beyond the unfortunate victim, for they have a repercussion on the whole community. At national level, the loss of a human life due to human-wildlife conflict has little consequence, but at the family and village level, it can be catastrophic. The death of a family member caused by a wild animal is a traumatic experience. For a poor peasant family in a developing country, the death or injury of the bread-winner can mean the difference between a secure life for all and one of destitution where simple day-to-



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Wildlife can be a safety concern for people in rural areas

day survival becomes a priority. If a mother is killed, the child has to take her place in carrying out family chores and has lost the opportunity to receive an education. In time, this will have consequences for her children and their future.

The danger of wildlife attacks restricts some activities considered “at risk” such as walking at night, guarding crops, bathing, etc. Security measures are then taken at the community level. In certain areas of Kenya, for example, such as Taita Taveta District that borders Tsavo National Park, curfews have been imposed on villagers to protect them from the uncontrollable movement of wildlife through villages and farms (Kimega, 2003).

Food security

In most of rural Africa, food security is precarious, relying intimately on the results of a single cropping season or on the sale of livestock.

Although on a national scale, the loss of two hectares of maize to elephants in a single night means nothing, to the family concerned, it can mean the loss of their food supply for the year, and the difference between self sufficiency and destitution. This consequence is particularly acute where governments do not have the capacity to pay compensation for losses. The capacity of smallholder subsistence farmers to cope with these losses can vary even within the same region. The owners of large farms situated on the edge of Kibale National Park in Uganda can employ guards or create a crop buffer zone to separate vulnerable yields from the forest edge, by cultivating less palatable plant species or using the land for pasture. These options are not available to subsistence farmers, who have less choice in their land use and cannot afford to pay for guards (Naughton-Treves, 1997).

The elephant is one of the wild species that can jeopardize the livelihoods of entire families by causing substantial damage to crops (see Box 12). The impact of elephant raids can be dramatic, but other species cause more insidious losses. In areas where subsistence agriculture is practised, baboon raids on grain crops

BOX 12

Elephants as a threat to food security

In some semi-arid rural farming areas of Zimbabwe and Kenya, elephant damage to food crops accounts for 75 to 90 percent of all damage caused by large mammals (Hoare and Mackie, 1993). In the area around the Kakum National Park in Ghana, about two-thirds of all farms that are susceptible to crop-raiding are devastated each year. It is estimated that about 300 households lose up to 60 percent of their food crops annually to elephants alone. The main crops damaged are maize, cassava, cocoyam, plantain and yam (Barnes *et al.*, 2003). At the periphery of the Djona hunting zone in North Benin, in 2002, elephants destroyed 50 ha (of an estimated total of 152 ha), representing an overall loss of 61 tonnes of crops for the villages. A survey showed that 80 percent of people questioned has registered damages each year over the last four years (Alfa Gambari Imorou *et al.*, 2004).

It has been estimated that the annual cost of elephant raids to crops ranges from US\$60 (Uganda) to US\$510 (Cameroon) per affected farmer (Naughton, Rose and Treves, 1999). In the Caprivi region of Namibia between 1991 and 1995, elephant crop damage amounted to a total economic loss of US\$39 200 (O'Connell-Rodwell *et al.*, 2000). At Kakum in Ghana, crop loss caused by elephants is estimated at US\$450 per farmer.

In Mali, the average area of crops destroyed by elephants is estimated at 1 000 hectares per year, i.e. a financial loss of about US\$195 230. In some areas, these damages forced the families affected to abandon their traditionally cultivated fields (Maïga, 1999; Marchand, 1999). In Togo, around Fazao Malfakassa National Park, the area raided between 1994 and 1999 was estimated at 204 ha, and represented a loss of 252 tonnes of yam, maize, rice, sorghum and cassava, with a gross value of US\$77 730 (Alfa Gambari Imorou *et al.*, 2004). In the area around the Bénoué National Park in Cameroon, communities lost an estimated 31 percent of their annual crop income and 18 percent of their annual livestock income per household (Weladji and Tchamba, 2003).

Elephants can also damage food stores during the dryer months following the main harvest. The loss of this stored food is considered far more disruptive to farmers than the raiding of crops while they are still growing in the fields, because so much damage can be done to a concentrated food source in a short space of time. Damage to field crops can be repaired by planting replacements if the damage occurs early in the season, but food stores cannot be replaced until the following growing season.

such as maize, sorghum and millet, as well as fruits and some vegetable crops can reduce the yield by a significant percentage. Around the Bénoué National Park in Cameroon, the species inflicting most of the crop losses are elephants, baboons, green parrots and warthogs (Weladji and Tchamba, 2003).

Likewise, the loss of a family's small herd of cattle to lions can effectively destroy that family's wealth and way of life. For rural populations, domestic animals are not only their main resource through production of manure, milk, meat, and live sales, but are also their only source of wealth (means of saving, source of income, social role). Predators such as lions often kill numerous domestic animals such as cattle in one raid, and can devastate a household's food security. In the Kanamub area of the Namibian Sesfontein Conservancy, farmers lose as many as three to four animals a month to lions, leopards, hyenas and cheetahs (Tjaronda, 2007).

The evidence relating to the direct competition for fish between crocodiles and humans is limited (Games, 1990). Crocodiles consume about 0.5 percent of annual fish production or from 6 to 10 percent of the amount caught by artisanal fisheries. Most (about 67 percent) of these fish are scaleless non-commercial fish species avoided by subsistence and artisan fishers.

On the other hand, crocodiles threaten food security by causing damage to fishing nets, particularly the thin monofilament gill nets with small to medium mesh size frequently used by artisanal fishermen. McGregor (2004) reports that at Lake Kariba in Zimbabwe, over 80 percent of a sample of fishermen's nets was damaged by crocodiles. The holes torn in the nets are often extensive – up to several metres in diameter. This reduces the fish offtake for the fishermen, and repairing or replacing the damaged sections requires significant amounts of time, effort and resources.

Economic and social costs

Agriculture. As illustrated in Box 12, crop damage not only affects farmers' ability to feed their families, it also reduces cash income and has repercussions for health, nutrition, education and ultimately development. When crop damage occurs finances are diverted from these areas to cover the cost of staple foods.

Forestry. Baboons stripping bark from exotic timber plantations may also have economic consequences such as:

- a decrease in the mean annual increment;
- a loss of overall productivity in the affected area which ranges from 25 to 32 percent (Van der Lingen, 2001; S. Valintine, personal communication);
- losses due to subsequent infestation by other pests (*Sirex* wood wasp in South Africa, and fungus such as *Lasiodiplodia* sp. responsible for "blued" timber which is more difficult to market because of its abnormal colour);
- increased cost of harvesting and log-making;
- an increase in replanting and protection/management costs;
- an increase in handling time and effort, and in the wastage off the saw;
- expenses linked to the cost of controlling the problem.

Although the loss of wood volume and value has been minor in economic terms, in Zimbabwe baboons have also damaged and raided non-timber forest products such as granadillas (passion fruit) or mushrooms which are interplanted with the pine trees and provide a significant additional income.

BOX 13

Livestock depredation – some figures

In Zimbabwe many areas of traditional agropastoralism bordering protected areas are exposed to livestock depredation. In the Gokwe communal land, neighbouring the Sengwa Wildlife Research area, the average annual loss per household, between January 1993 and June 1996, amounted to 12 percent of the total family's income. Although baboons killed more animals, lions caused the greatest economic loss because of the high value of cattle (Butler, 2000).

In the Caprivi region of Namibia, lion depredation between 1991 and 1994, totalled US\$70 570 (O'Connell-Rodwell *et al.*, 2000). In Cameroon, around Waza National Park, as many losses are due to predators as to disease (respectively US\$220 000 per year and US\$225 000 per year). Lions alone are responsible for losses of US\$130 000, primarily to cattle herds, that is approximately US\$370 per stockbreeder (Bauer *et al.*, 2001).

In the Niger, the economic losses for all those interviewed between 2000 and 2006 in the peripheral zone of the W transboundary Park are estimated at approximately US\$149 530. This loss equals an annual average of US\$138 per year per person (Hamissou and di Silvestre, 2008).

Depredation by carnivores does not only affect vulnerable rural communities, but also commercial cattle ranches. In Kenya, two commercial ranches adjoining Tsavo East National Park lost an average of 2.4 percent of the total herd per annum over a four-year study period, to lions, spotted hyenas and cheetahs. This represented 2.6 percent of the herd's economic value and amounted to losses of US\$8 749 (Patterson *et al.*, 2004).

There is little documentation of the number, type and value of domestic animals killed by crocodiles, but these indicators are significant. Small stock, such as goats and sheep, are much more frequently killed than cattle but the economic loss associated with the loss of a cow is considerable. At Kibwezi, Kenya, 478 goats, 48 sheep and 50 cows were killed by crocodiles over five years representing an economic value of US\$16 958 (Wanjau, 2000). Ducks and dogs are also frequent victims although their value is difficult to quantify. In addition, the cost of replacing fishing gear damaged by crocodiles is significant for a subsistence fisher.

Husbandry. Mammalian carnivores and crocodiles are responsible for the loss of a high proportion of livestock throughout Africa (see Box 13). However the number of livestock killed over a period of time is an inconsistent indicator in appraising the real impact on the livelihood of the rural population, and it would be more informative if it were related to the total family livestock holdings or total village units. The quantification of economic losses should also be related to annual household incomes or the economic value of family holdings (such as cattle or agricultural fields) (Sekhar, 1998).

The possibility of disease transmission from wildlife to livestock jeopardizes international trade. Cattle and/or meat can only be exported if they come from areas that are certified free of foot-and-mouth disease. This can only be done if the areas are free of buffalo.

Infrastructure. The economic cost of the damage caused by elephants to infrastructure in the Pama National Reserve in Burkina Faso would amount to about US\$587/pond/year and US\$23/track kilometre/year (Alfa Gambari Imorou *et al.*, 2004).

Sports hunting. The Department of Wildlife and National Parks in Botswana placed a new ban on lion hunting for the 2008 season, because of its concern over the number of lions killed in defence of livestock in certain areas of the country. As a precautionary measure, the Department has taken the decision not to issue any lion hunting quotas until further notice. The Department wishes to assure the public that appropriate measures are being put in place to reverse the current trends (Damm, 2007). This hunting ban represents an important economic loss for the state and the hunting operators. In 2007, the trophy fee for a lion in Botswana was US\$5 000 and the costs of a lion safari ranged from US\$60 000 to US\$92 000, depending on the duration of the safari.

Health and employment. Nuisance encounters with small animals, exposure to zoonotic diseases, physical injury or even death caused by attacks by large animals have high financial costs for individuals and society in the form of medical treatments. Nocturnal surveillance of fields results in a higher exposure to malaria (WWF SARPO, 2005).

Human-wildlife conflict can have repercussions on employment. In Zimbabwe, for example, approximately 9 400 permanent staff and regular contractors are employed in forest plantations and sawmills (Timber Producers Federation, 2006) and a further 3 770 employees are engaged in urban primary processing of forest products. Any threat to their employment arising from baboon damage can adversely affect the financial viability of the companies concerned and is keenly felt in the economy of the recruiting area. In South Africa, the number of people directly employed in the plantation sector would range from 67 469 to 164 800, although not all of these people work in geographical areas currently subject to baboon damage.

Other economic costs of human-wildlife conflict include the time spent and cost of guarding crops from elephants and bush pigs at night, and from baboons and granivorous birds by day. The task of guarding crops at night generally falls to men; by day this is frequently the responsibility of children. Time that might have been spent on production is instead spent on farm patrols to ward off rampaging wildlife. Human-wildlife conflict thus has a wide-ranging negative social impact, which includes missed school and work, additional labour costs, loss of sleep, fear, and also restriction of travel or loss of pets (Hoare, 1992). The costs of altering human behaviour patterns is also significant and is suspected to have contributed

to the apparent difficulty of persuading communities to reduce their exposure to crocodile risk.

In view of the socio-economic impact of human-wildlife conflict on communities living adjacent to parks, it is no wonder that most of the zones close to protected areas in Africa remain poor. Communities bear a disproportionately high cost in maintaining wildlife.

Politics and media

Human-wildlife conflict frequently has a political dimension. Incidents occurring in rural areas, particularly when the outcome is fatal and no official response is made or action taken, often lead to parliamentary questions and debate. In Mozambique and Burkina Faso, human-wildlife conflict is one of the most frequently raised issues when the president goes to the field to meet the rural population. As a result human-wildlife conflict has become an issue that receives national government attention.

Crocodile attacks on humans elicit an emotional response in the immediate family of the victim but also in the public at large, albeit from different perspectives and with different intensity. This is possibly the psychological root of the fascination that such incidents seem to hold for print, visual and electronic media, particularly when the victim is of European or American origin. For example, the fatal attack by a crocodile on an 18-year old British student in Kenya led to pages of headline coverage in the European press, while a summary of eight recent deaths of Kenyan citizens received only one paragraph on an inside page of a local newspaper.

CONSEQUENCES FOR WILDLIFE CONSERVATION

Short-term: conservation of individuals

The killing of wild animals in retaliation for incidents of human-wildlife conflict is a common reaction, even though the identification of the real culprit is seldom possible. This is particularly true for predators, but also for other species (Box 14).

Mid-term: conservation of species

Several species of large carnivores such as lions or hyenas have been eliminated from a large part of their former home ranges in response to human-wildlife conflict. In Mali, lion-cattle conflicts are one of the main reasons for the drastic reduction in the number of lions. Similarly, in national parks of northern Central African Republic, the decrease in lion numbers is largely due to systematic shooting by pastoralists who enter the parks with their herds during the dry season (Chardonnet, 2002). Today, illegal persecution of predators, including poisoning, shooting and trapping, is still one of the greatest threats to these species (Muruthi, 2005).

The situation for the crocodile is different. When a crocodile kills or injures a human, the human response is to kill or remove not just the individual crocodile

BOX 14

Killing wildlife in retaliation

In Northern Kenya, the number of predators killed by farmers has been reported to be equal to the number of livestock killed by lions, hyenas and leopards (Ogada *et al.*, 2003). Kenyan pastoralists poisoned all the lions in Amboseli Reserve in 1990 and speared 27 out of 40 lions in Nairobi National Park in 2003. Pastoralists in Chad and in several districts of the United Republic of Tanzania also poison lions (Packer *et al.*, 2006). In Namibia, an average of about 60 lions were killed each year outside Etosha National Park over a 20-year period, almost always by communal or commercial farmers (Government of Namibia, 2007).

Crocodiles attack from the water and retreat underwater with the victim immediately after the attack. For this reason it is unlikely that a particular individual is ever identified as being responsible for attacks. In general more crocodiles are killed in retaliation than the number of people attacked (Wanjau, 2002; M. Foloma, personal communication). Smaller crocodiles are sometimes trapped by nets if they are unable to tear away the netting which holds them beneath the water surface, and will eventually drown. Alternatively, fishermen who find live crocodiles trapped in their nets will typically dispatch the animal with a blow to the head.

Elephants are often killed in retaliation for human deaths. Kenyan Wildlife authorities shoot between 50 to 120 problem elephants each year (WWF, 2007a).

In the surroundings of Virunga National Park (Democratic Republic of the Congo), habitat destruction and human population growth mean that the mountain gorilla and other forest animals, such as elephants and buffalo, are increasingly coming into contact and conflict with people. For mountain gorillas, interactions with local people are a source of stress, can result in the transmission of human diseases, and can lead to direct physical attacks, disabilities such as loss of limbs from snares, and even death: 18 mountain gorillas were killed between 1996 and 2003 in Virunga and Bwindi (MacFie, 2003; Woodford, Butynski, and Karesh, 2002).

responsible, but the whole local population. The Nile crocodile is not endangered on a continental scale by the existence of conflict, given that significant populations are conserved in protected areas where by definition, conflict cannot occur. On the other hand, in countries such as Mozambique and Madagascar where none of the major crocodile habitats are conserved within protected areas, conflict with the human population places the crocodile populations at risk, in addition to the potential risks of habitat degradation and disturbance.

Additionally, in some countries such as Uganda, deliberate campaigns have been launched aimed at eradicating crocodiles in the belief that this would benefit the fishing industry (Graham, 1973).

Human-wildlife conflict also has several indirect consequences. The transmission of diseases from domestic animals to wildlife, competition over grazing land,

BOX 15

Adverse effects of human-wildlife conflict on wildlife conservation

The rinderpest pandemic of 1889–1905 in sub-Saharan Africa, reputed to have been introduced into Eritrea from India by the Italian army in 1887–1888, or by a German military expedition that brought infected cattle from Aden and Bombay to the East African coast, caused the death of countless wild artiodactyls. Buffalo, tragelaphs, wild suids and wildebeest were most severely affected and in some areas only relic populations survived. Bovine tuberculosis, probably introduced in Africa with imported dairy and beef cattle during the colonial era, has become endemic in several buffalo populations in South Africa and Uganda, as well as in a Kafue lechwe population in Zambia.

Buffalos and lechwes have become true sylvatic maintenance hosts of this mycobacterial disease, and sporadic spill-over of the infection has been documented in greater kudu, common duikers, chacmas and olive baboons, lions, cheetah, leopards, warthogs, bush pigs, spotted hyenas and common genets. The long-term effects of this chronic progressive disease on African wildlife host populations at sustained high prevalence rates is unknown, but preliminary evidence suggests that it may negatively affect population dynamics or structure in buffalos and lions.

Canine distemper virus is said to have been introduced into the African continent by domestic dogs. In the past decade, this disease has apparently crossed the species barrier in the Serengeti ecosystem, causing significant mortalities in lions. It is estimated that 30 percent of lions in the Serengeti died in this outbreak. The major population decline of the wild dog in this ecosystem may also be attributed in part to canine distemper (Bengis, Kock and Fischer, 2002).

The competition between growing human populations and declining wildlife populations for the same living space and resources has been demonstrated as being the underlying cause of the decline in the continent's elephant populations (Parker and Graham, 1989).

Veterinary fences erected to control the spread of livestock diseases in order to protect the European Union beef market have been responsible for the decline of wildlife populations either by blocking the movements of some species such as buffalos, roans, wildebeests, zebras and tsessebes, or by direct (collision, entanglements in the fence) or indirect (poaching) mortalities. This was particularly observed in Namibia (Martin, 2005) and in Botswana, especially in the Okavango delta (Mbaiwa and Mbaiwa, 2006).

Pollutants including silt can limit the distribution of crocodiles. Rivers that previously provided a habitat for crocodile populations, but which are now heavily affected by informal alluvial gold panning which releases toxic pollutants and massive amounts of silt, have resulted in the almost complete loss of habitat for crocodiles.

habitat fragmentation or pollution; all pose threats to the survival of wildlife populations or even the species as a whole (Box 15).

Long-term: conservation of wildlife outside protected areas

Human-induced wildlife mortality not only affects the population viability of some of the most endangered species, but also has a broader environmental impact on ecosystem equilibrium and biodiversity preservation.

Conflict between people and wildlife today undoubtedly ranks among the main threats to conservation in Africa – alongside habitat destruction and commercially motivated hunting of wildlife to satisfy the demand for bushmeat – and represents a real challenge to local, national and regional governments, wildlife managers, conservation and development agencies, and local communities (Kangwana, 1993; Conover, 2002; Treves and Karanth, 2003).

Conservation of wildlife outside protected areas cannot be achieved merely by protecting animals and avoiding the issues of people's needs and rights and their conflict with wildlife. Human-wildlife conflict, rural poverty and hunger, the prohibitive costs of wildlife law-enforcement arising from land use practices; all severely limit wildlife conservation outside Africa's national parks. The following example perfectly illustrates a situation that is common today. In Cameroon, in the area around Bénoué National Park, wildlife is causing major damage to crops and livestock, especially staple food crops. As a result people are attempting to



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Veterinary fences have been responsible for the decline in populations of some species of wildlife

secure their livelihoods through illegal encroachment of farms and poaching, to the extent that bushmeat now constitutes about 24 percent of their animal protein intake (Weladji and Tchamba, 2003).

Developing conservation approaches in response to these challenges, which are both culturally acceptable and financially and ecologically sustainable, could help solve the problem of maintaining viable large-mammal populations in Africa.