1. Introduction

According to the 2003 International Union for the Conservation of Nature (IUCN) World Parks Congress, human-wildlife conflict occurs when wildlife requirements encroach on those of human populations, with costs both to residents and wild animals (IUCN, 2005).

Human-wildlife conflict has been in existence for as long as humans and wild animals have shared the same landscapes and resources (see below).

Human-wildlife conflict does not occur only in Africa. Nowadays human-wildlife conflict exists in one form or another all over the world. Conflict between humans and crocodiles, for example, has been reported in 33 countries spanning the tropics and subtropics, and the problem probably exists in many more.

All continents and countries, whether developed or not, are affected by human-wildlife conflict. However there is an important distinction to be made between the level of vulnerability of agropastoralists in developing countries and that of well-off inhabitants of developed nations.

This review focuses on Africa, where human-wildlife conflict is particularly prevalent, even in countries with a higher average annual income. Crocodiles still kill people in the Lake Nasser area in Egypt and within towns in Mozambique; leopards still kill sheep within 100 km of Cape Town, South Africa, and lions kill cattle around the outskirts of Nairobi, Kenya.

In terms of the scale of their impact on humans, it is the smaller animals, occurring in vast numbers, that have the greatest impact. The red locust has been responsible for famines across vast swathes of Africa for centuries. Annual losses of cereals caused by the red-billed quelea have been estimated at US$22 million (Bruggers and Elliott, 1989). In Gabon, the number of overall complaints about grasscutters far surpasses those relating to any other animal species, including the elephant (Lahm, 1996).

However, the larger herbivores (elephants, buffalo and hippopotamus), large mammalian carnivores (lions, leopards, cheetahs, spotted hyenas and wild dogs), and crocodiles are traditionally seen as the animals representing the greatest threat to humans and responsible for the majority of human-wildlife conflicts. This may be due to the fact that local communities often regard the large wild animals as government property, as was the case under previous colonial legislation, and therefore feel prohibited from dealing with the problem themselves (WWF SARPO, 2005). The impact of the activities of large mammals on farmers and their livelihoods is enormous and even traumatic when people are killed. These incidents are often newsworthy, and generally attract the attention of political representatives who demand action from governments.

Baboons can cause significant damage to timber forest plantations and are also considered a pest, notably in Southern Africa.

For these reasons this survey deals with larger herbivores and carnivores, particularly animals that have been investigated in FAO studies, i.e. elephants, lions, baboons and crocodiles.

A BRIEF HISTORY OF HUMAN-WILDLIFE CONFLICT

Fossil records show that the first hominids fell prey to the animals with which they shared their habitats and shelters. Forensic evidence has recently demonstrated that the "Taung skull", perhaps the most famous hominid fossil, which was discovered in South Africa in 1924, belonged to a child who was killed by an eagle two million years ago (Berger and Clarke, 1995; Berger, 2006).

Crocodiles have an ancient lineage dating back to the Mesozoic era, and have remained functionally unchanged for longer than the human species has been in existence. It is likely that crocodiles have attacked and eaten humans and their predecessors in Africa over the last four million years. Egyptian historical records reveal that in 2000 BC, hippopotamuses in the Nile delta in Egypt fed on cultivated crops while crocodiles ate livestock and occasionally humans. It is no coincidence that the Egyptian god of evil was depicted as the crocodile-headed deity Sobek.

Human-elephant conflict is as old as agriculture in Africa (Treves and Naughton-Treves, 1999). San or Bushman rock art in Africa frequently portrays people fleeing from predators or other large animals. Pre-colonial and early nineteenth century historians describe areas in Africa and other parts of the world where elephants invaded human cultivations, causing food shortages and leading to the displacement of settlements (Barnes, 1996). Some authors blame colonialism for ruining traditionally harmonious relations between wildlife and local people (see for example, Adams and McShane, 1992). In actual fact, from the eighteenth

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Human-elephant conflict is as old as agriculture in Africa (a rural inhabitant tries to scare away elephants by throwing stones at them)

to the mid-twentieth centuries, the larger African mammals were regarded more as a resource to be exploited than a major threat. Ivory formed a cornerstone of the early trade with Europe and the Orient, while meat and hides were essential products both for the African people and colonialists alike. In the twentieth century, with the expansion and development of modern agriculture, exploitation diminished and interaction with large wildlife species came to be increasingly dominated by conflict.

HUMAN-WILDLIFE CONFLICT AROUND THE WORLD

North America

In the northern United States, bears raid dustbins in the national parks and even at the edge of towns, waking up residents and creating disorder in the streets. Deer collisions with automobiles in the United States injure an average of 29 000 people annually and cause more than US$1 billion in damages (USDA, 2006). In Alberta, Canada, over a period of 14 years (1982–1996) wolves killed 2 806 domestic animals, mainly cattle but also some dogs, horses, sheep, chickens, bison, goats, geese and turkeys. In Idaho, Montana and Wyoming in the United States, wolves killed 728 animals, mainly sheep and cattle, over a similar time period (1987–2001) (Musiani *et al.*, 2003).

Europe

Several wildlife species are responsible for causing substantial damage both to crops (wild boar, wild rabbit, hare, wood pigeon) and to regenerating forests (red deer, roe deer). For this reason, some of these species are labelled as "pests" and can be killed outside of the hunting season.

The monetary losses can be high (Table 1). In France in 2007, damage caused by wild boar and deer to agricultural crops amounted to €22 million to €23 million (E. Dion, personal communication). Large predators such as bears, wolves or lynx are regularly responsible for attacks on sheep or even cattle. In Slovenia, damage caused by large predators has increased since 1993. In the period 2000–2003, 1 440 claims were made for predation damage, mostly to livestock. The compensation for damage exceeded €706 000 (Adamič, Jerina and Jonozovič, 2004).

In the United Kingdom, badgers are known to spread bovine tuberculosis to dairy cattle (Wilkinson *et al.*, 2004).

TABLE 1
Cost of damage caused by bears and wolves in western Europe in 1997 (€)

	Bears		Wolves	
Country	**Total cost**	**Cost per bear**	**Total cost**	**Cost per wolf**
Austria	8 640	346	–	–
France	31 510	3 501	151 690	3 792
Greece	130 870	1 091	708 330	2 833
Italy	33 600	448	1 095 164	2 434
Portugal	–	–	407 010	1 163
Spain	70 562	882	173 970	1 160

Source: After Fourli, 1999.

Australia

The losses in productivity caused by wild rabbits eating forage are substantial: fewer livestock, lower wool clippings per sheep, lower lambing percentages, lower weight gain, lower wool quality and earlier stock deaths during periods of drought. At the end of the 1980s, the cost in production losses was estimated to be US$20 million per year for the pastoral districts of South Australia alone, and US$115 million per year for the wool industry over the whole of Australia (Williams *et al*., 1995).

Australian farmers have always regarded kangaroos as a pest, because they damage crops and compete with sheep for forage. Every year the federal government authorizes the culling of a certain number of kangaroos. Without taking into account the animals killed by farmers and poachers, a possible total of nine million kangaroos are eliminated each year (Therin, 2001).

Asia

Large feline predators (tigers, leopards, lions and snow leopards) and elephants are the principal sources of conflict in Asia. In India, in the state of Himachal Pradesh, near the Kibber Wildlife Sanctuary, wild carnivores – mainly snow leopards – killed 18 percent of the total livestock holdings in 1995 (Mishra, 1997). In the state of Gujarat, near the Gir National Park and Sanctuary, the Asian lion and leopard hunt prey such as buffalo, cattle, pigs and dogs (Vijayan and Pati, 2002). In the southern state of Karnatake, the overall annual damages caused by large tigers and leopards near the Bhadra Tiger Reserve, are reported to be approximately 12 percent of total family livestock holdings. In addition, elephant damage to crops accounted for an average loss of 14 percent of total annual production (Madhusudan, 2003). In China, the rural inhabitants of the mountain area of Simao, near the Xishuang Banna Nature Reserve, claimed that elephant damage reduced the community's annual income in 2000 by 28 to 48 percent, and that the total economic losses between 1996 and 1999 amounted to US$314 600 (Zang and Wang, 2003).