

3. Human-wildlife conflict management

Human-wildlife conflict can be managed through a variety of approaches. Prevention strategies endeavour to avoid the conflict occurring in the first place and take action towards addressing its root causes. Protection strategies are implemented when the conflict is certain to happen or has already occurred. Mitigation strategies attempt to reduce the level of impact and lessen the problem. The main difference between the options is the moment at which the measure is implemented.

By definition management techniques are only cost-effective if the cost of implementing the technique is less than the value of the damage, taking into account the fact that a short period of active management may have a continued effect, by instating longer-term protection of crops or herds.

The various management possibilities are presented according to the characteristics of conflict (whether they relate to humans, production, animals and the environment), rather than according to their ability to prevent or mitigate damage.

HUMAN MANAGEMENT

Community awareness

Awareness raising can be carried out in the community at different levels, for instance in schools or in adult education arenas such as farmer field schools. Educating children, coupled with awareness raising among adults through the traditional authority of chiefs and headmen, would certainly be highly cost-effective means of managing conflict.

Education and training activities could be directed towards disseminating innovative techniques, building local capacity for conflict prevention and resolution, and increasing public understanding of human-wildlife conflict. Educating rural villagers in practical skills would help them deal with dangerous wild animal species and acquire and develop new tools for defending their crops and livestock. Over time, it would result in a change of behaviour among local populations and would contribute to reduced risks, improvements in local livelihoods and a reduction in their vulnerability. In an optimistic scenario, education and training would promote commitment towards conservation, raise awareness of the essential role of wildlife in ecosystem functioning and its ethical and economic value, as well as its recreational and aesthetic importance. Box 16 provides a few examples of issues which can be developed for awareness campaigns in order to reduce human-wildlife conflict.

BOX 16

Awareness raising: key points**Behavioural changes that reduce human vulnerability**

A few basic rules can be provided to decrease the risk of lion attacks such as:

- wearing bush-coloured clothes when carrying out activities in the field;
- checking the direction of the wind when approaching a risky area;
- wearing a backpack or heavy clothing to bulk out the silhouette and appear larger;
- avoiding activities at night;
- taking small children off the ground when travelling with them (Quigley and Herrero, 2005).

As regards crocodile attacks, adopting some simple behavioural habits, such as always entering the water in groups of several people together and keeping basic weapons (sticks, stones, axes and spears) close at hand, may not alter the likelihood of a crocodile attack occurring but reduces the chance of an attack being fatal. Not all attacks are immediately fatal, and it has been shown that resistance by the victim or bystanders can cut short an attack, even though this may still leave the victim injured.

Providing environmental and ecological training to villagers, fishermen and officials on the role of the crocodile and how the eradication of crocodiles as an apex predator would be likely to reduce rather than increase the volume and value of fish catch, would also be a useful means of alleviating the human-crocodile conflict. Finally, allowing community members to observe a captured animal would provide a new perspective on the risks they take on a daily basis. Rural Africans are largely unaware of the size and strength of adult crocodiles, possibly because these are normally seen with only their heads above the water and are not approachable in daylight.

Waste management

Every stage of waste handling should be addressed, from collection and transportation to disposal. Waste deposit systems that restrict wildlife access to garbage and good standards of waste management are important to avoid attracting wild animals to human settlements and to prevent wild populations from proliferating and becoming artificially sustained by the availability of human foods.

The following example shows that education and training can generate good results in mitigating human-wildlife conflict. In 2003, in the framework of a FAO pilot project, over 50 farmers drawn from ten communities around the Kakum National Park in Ghana, were trained as farmer trainers in deterrent techniques to prevent crop-raiding. These trainers were expected to help the majority of farmers in their respective communities to adopt the relevant techniques. After that it

was anticipated that the techniques introduced would spread through farmer-to-farmer training and by word of mouth. The success of the pilot project resulted in a reduction in crop losses around Kakum National Park of over 70 percent.

Practical manuals specifically targeting local communities such as the *Human wildlife conflict manual* edited by the Southern Africa Regional Programme Office of the World Wide Fund for Nature (WWF SARPO, 2005), a farmer's manual on protecting crops from damage by elephants prepared during the Kakum project (FAO, 2008a) or *Community-based problem animal control – livelihood security for people living in elephant range – training manual* realized by Elephant Pepper Development Trust (2006) are useful tools for raising awareness of human-wildlife conflict at local level.

Compensation

Direct compensation. The payment of compensation in the event of loss is usually confined to a specific category of loss, such as human death or livestock killed by predators or elephants. These schemes are often funded by a conservation organization, although government schemes also exist. All are designed to increase damage tolerance levels among the affected communities and prevent them taking direct action themselves, such as hunting down and killing the elephants, lions or other species involved (Muruthi, 2005).

In sub-Saharan Africa, some compensation schemes for losses caused by wildlife exist. However, as shown in the examples of Box 17, few are effective. Most African countries do not pay compensation for damage caused by wildlife, arguing that compensation schemes can do little to reduce the human-wildlife conflict and need to be modernized in order to become less bureaucratic, more reactive and transparent (Kenya Wildlife Service, 1996).

The IUCN African Elephant Specialist Group and Human-Elephant Conflict Task Force also advise against using compensation for elephant damage and argue that it can only at best address the symptoms and not the cause of the problem.

The failure of most compensation schemes is attributed to bureaucratic inadequacies, corruption, cheating, fraudulent claims, time and costs involved, moral hazards and the practical barriers that less literate farmers must overcome to submit a compensation claim. They are also difficult to manage, requiring among other things reliable and mobile personnel, able to verify and objectively quantify damage over wide areas (Muruthi, 2005). This often leads to delays in decision-making, low rates, irregular and inadequate payments or the rejection of compensation claims. All these factors discourage farmers from submitting complaints. A study of elephant damages carried out in the region of Boromo in Burkina Faso in 2001–2002, for example, revealed that 98 percent (100 out of 133) of the damages caused by elephants were not reported to the administration because the farmers knew there would not be any form of compensation (Marchand, 2002).

Furthermore, compensation programmes increase the return to agriculture and can therefore be viewed as a subsidy towards crop and livestock production. Such subsidies can trigger agricultural expansion and habitat conversion, an inflow of

BOX 17

Some examples of compensation schemes in sub-Saharan Africa

A compensation scheme was piloted by one district in Zimbabwe but abandoned when the number of claims quadrupled in the second year of operation (Taylor, 1993). In 2005, the Government of Mozambique paid compensation for elephant damages in the area adjacent to Maputo Special Reserve in the form of food products (e.g. maize and dried fish). However, crop raids continued in such a way that the government had difficulty obtaining enough food for compensation. It then decided to implement a definitive solution by erecting a fence preventing elephants from entering the villages. In Kenya, a compensation scheme was implemented with promising results, but it was suspended in 1989 because the system had become unworkable. This compensation scheme however neither replaced nor repaired any of the installations that were destroyed by wild animals (Thouless, 1993).

In Kenya, a compensation scheme for livestock killed by lions has also been introduced as well as a compensation scheme for loss of human life or injury, which pays about US\$400 to the family concerned (Wanjau, 2002). This is not even sufficient to cover funeral expenses or hospital bills (Obunde, Omiti and Sirengo, 2005). Nor does the scheme take into consideration the impact of such incidents on dependent children who are often taken out of school because of lack of funds to pay their fees. During the recent ban on lion hunting in Botswana, the government made public its intention to pay compensation for any livestock killed by lions. There is no information available to indicate how successful the scheme was.

In Namibia, the Ministry of Environment and Tourism allocates a subvention of approximately US\$710 for the funeral fees of people killed by elephants, crocodiles and hippopotamuses in cases where the affected person could not reasonably have been expected to defend him or herself or to avoid the incident, and where the family has to meet funeral costs (Government of Namibia, 2007). In Burkina Faso, the damage caused by wildlife is considered a natural hazard by law and as such is likely to be indemnified after analysis by a specific committee (Government of Burkina Faso, 1993). This procedure appears to be rarely operational due to the time lag between the complaint and the scarce indemnifications.

Non-monetary compensation schemes are preferred in some countries. In Ghana, where wildlife laws forbid the payment of compensation for crop damage by wildlife, the Wildlife Division and the Ministry of Food and Agriculture help victims of crop damages around Kakum to adopt mitigation and crop improvement techniques to enhance their livelihoods. In Burkina Faso, in 1991, the victims of elephant crop-raiding were preferentially contracted as workers to maintain infrastructure in the Deux Balé Reserve; this operation involved 127 farmers who received about US\$40 each, i.e. the equivalent of 3 50 kg bags of millet. This compensation scheme was much appreciated and helped to sensitize the villagers to conservation issues (Marchand *et al.*, 1993).

agricultural producers from outside the affected areas, and ultimately, intensification of agricultural production. This system is not sustainable as it depends heavily on the budget of the local governing bodies and/or non-governmental organization (NGO) support. Finally, it does not encourage villagers to protect their holdings and to coexist with wild animals, because there are no penalties for actions that exacerbate human-wildlife conflict. All of these consequences can be shown to have potentially adverse effects on the wildlife population that compensation intends to favour. In some circumstances, the net impact on wildlife stock could even be negative (Bulte and Rondeau, 2005).

Insurance schemes. The insurance scheme is an innovative compensation approach where farmers pay a premium for cover against a defined risk, such as livestock depredation. The premium can be set at the true market rate or be subject to subsidy provided by conservation organizations (Muruthi, 2005). The method also requires an accurate assessment of the cause of crop damage, livestock depredation, human injury or death, but because it operates on a more local scale, reports can be more easily verified. Although the insurance scheme can impose certain practices which need to be undertaken by participating farmers to avoid human-wildlife conflict, overall the method seems promising. An example is the Human Animal Conflict Self Insurance Scheme (HAC SIS) in Namibia (Box 18).

Indirect compensation. Alternative compensation systems rely on giving out licenses to exploit natural resources, through tourism, hunting or collecting fuelwood, timber, mushrooms, fodder, etc. This type of compensation scheme, also known as the “settlement of rights” to use natural resources, appears to be a more practical solution than monetary payment. Indeed, the benefits derived from the legitimate use of natural resources influence the attitudes and perceptions of rural residents (Sekhar, 1998).

In Zimbabwe for example, crocodile eggs are collected from the wild by communities and sold to private crocodile farms. When communities receive a financial incentive, this increases their tolerance of crocodiles in the wild (WWF SARPO, 2005).

Benefit-sharing can also be considered within this broader approach which provides tangible benefits to land owners in recognition of the role they play in hosting wildlife on their land and covering associated costs. In this way wildlife becomes a valuable resource rather than a liability. In Mozambique, for instance, the law stipulates that local communities living in areas where natural resources are exploited, should receive 20 percent of the income resulting from this exploitation, particularly through tourism in protected areas and hunting in *coutadas* (hunting blocks) (Government of Mozambique, 2005). This measure ensures that about US\$32 000 each year is distributed to the communities concerned.

Several modes of wildlife valorization can be used to provide income to compensate populations suffering human-wildlife conflict. The viewing tourism industry, for example, by creating additional job opportunities, compensates the

BOX 18

Human Animal Conflict Self Insurance Scheme, Namibia

The Human Animal Conflict Self Insurance Scheme (HACSIS) was developed in Namibia by the NGO Integrated Rural Development and Nature Conservation (IRDNC) with nine conservancies in Caprivi and Kunene regions, and is funded by the Global Environment Facility (GEF) Small Grants Programme.

HACSIS seeks to balance individual losses of conservancy members with benefits received by the conservancy, by offering payment for livestock mortalities to those members who have taken the required precautions to protect their livestock from wildlife (e.g. use of crocodile-proof fences at drinking points for cattle, careful herding during the day and kraaling cattle at night). Under this scheme, no payments are made for livestock killed in a protected area or conservancy exclusive wildlife zone, or if they are killed at night outside of a secure kraal or other enclosure duly inspected by conservancy staff and traditional leaders. Claims will not be accepted if members were warned that predators were in the area and they took no action to bring livestock to safety.

In the Kunene region, farmers are paid about US\$114 for cattle, US\$36 for goats, US\$21 for sheep and US\$43 for donkeys and horses. Sesfontein Conservancy paid out US\$3 290 in compensation in 2005, and US\$5 720 in 2006. No compensations were paid in 2007, because the conservancy management felt that livestock owners were not taking sufficient precautions to protect their animals. The Torra conservancy did the same. Meanwhile, in six conservancies in the Caprivi Region the scheme operated successfully. It covered human life, livestock deaths and crop damage. The conservancies pay between US\$17 and US\$114 for loss of cattle, horses, sheep, donkeys, goats and pigs, and for damage to maize, sorghum and millet (from US\$17 for a quarter to US\$69 for a whole field damaged by elephants). They also take into account injuries; a woman who lost her arm as a result of a crocodile attack, claimed US\$430 for her injuries through HACSIS. This amount may seem small in modern insurance terms for the loss of a limb, but it was a significant amount of money for the family and helped cover hospital visiting expenses (Murphy, 2007).

IRDNC pays half of the costs while the conservancies pay the other half. Over the past four-and-a-half years, the conservancies have paid out over US\$14 300 for 112 livestock and four human deaths and US\$1 012 for the crop insurance scheme, which started in March 2007. There were 43 claims for crop damage (Tjaronda, 2007). Payments per year would be capped at about US\$1 430 (N\$10 000). There is some indication that the scheme could become a drain on conservancy finances if total annual payments are not capped, or if conservancies are not able to increase their incomes. Some conservancies are considering establishing livestock herds which can be specifically used to replace animals lost to predators in lieu of making payments (WWF, 2007b).

cost of maintaining wildlife and helps alter local people's negative perceptions of conservation (Box 19). Where areas have little appeal for photographic tourism, safari hunting on communal land has been successful in generating a sustainable revenue stream for rural communities to be divided among participating villages within and adjacent to the hunting zones (Box 20). Community-Based Natural Resource Management (CBNRM) programmes involving local communities in several modes of wildlife valorization are a new and promising alternative to mitigating human-wildlife conflict (Box 21).

Although they are much appreciated by the communities concerned, the settlement of rights and the benefit-sharing approaches are expensive and require funds to be made available year after year in order to guarantee the sustainability of the system. Often, income is insufficient to finance the conservation activities required, let alone to share these revenues with neighbouring communities. Furthermore, the issues of ownership, participation and disbursement of income need to be universally agreed before any such venture is attempted. Other impediments are administrative arrangements; such as the formal acknowledgement of existence, setting up of a bank account and actual claiming of funds from the relevant authorities. Finally, it is worth stressing that, while the community as a whole receives the benefits,

BOX 19

Indirect compensation for human-wildlife conflict: viewing tourism

The managers of Kibale National Park in Uganda aim to foster positive attitudes towards the park and encourage local populations to support conservation by sharing revenues from tourism with them (Naughton-Treves, 1997). In Kakum in Ghana, the fringe communities benefit from revenues realized from conservation of the park. The community representatives serve on the board that oversee the day-to-day management of the park and therefore share the responsibility of protecting wildlife. In the Nyae Nyae Conservancy in Namibia, the sustainable use of leopards, through ecotourism, was evaluated as an option to balance the cost of living with these predators borne by the San community. A programme was developed whereby the San community linked up with ecotourism ventures to offer specialized leopard tours. Using their traditional tracking skills, the San led tourists on a four-day expedition following the tracks of leopards, reconstructing the movements and behaviour of these secretive animals and setting up hides at the sites of fresh leopard kills. These expeditions were tremendously successful, generating as much as US\$110 per adult per year, an amount which far exceeded the losses incurred by leopard raids on livestock (WWF SARPO, 2005). The development of crocodile ecotourism marketed as a "green" and eco-friendly adventure tourism sector, and relying partly on the fascination associated with the fact that crocodiles eat humans, has been considered in Zimbabwe as a means of compensating for the presence of crocodiles in Lake Kariba (McGregor, 2004).

BOX 20

Indirect compensation for human-wildlife conflict: safari hunting

This method is being carried out in a number of countries of southern Africa including Botswana, Namibia, Zimbabwe and Zambia where, in 2003, the Zambian Wildlife Authority distributed about US\$403 000 to 49 communities living beside or in game management areas (Damm, 2004). In eastern Africa, in the United Republic of Tanzania and Uganda for instance, some local communities receive a given percentage of sport hunting income. In some countries in western Africa such as Benin, Burkina Faso and the Niger, the European project *Ecosystèmes protégés en Afrique sahélienne* (ECOPAS) has set up community associations to benefit from wildlife hunting (Boulet *et al.*, 2004). Income from hunting is also redistributed in central Africa: in Cameroon, local communities living near hunting areas received US\$172 000 in 2002 (K. Denis, personal communication); in the Central African Republic, in 2001, the ten acting Village Hunting Zones received an income of about US\$135 000 from hunting activities (Boulet, Mbitikon and Ouamoudjou, 2003; Mbitikon, 2004). The communities also receive other benefits such as employment opportunities related to the sports hunt. Participating communities are often expected to conduct regular “watch and ward” patrols to ensure that target species are not being illegally hunted or poached, and undertake specific measures to enhance habitat so that target populations can be increased, especially with regard to the proportion of trophy-sized males.

Selling special hunting rights to sport hunters for particularly problematic animals (see “Regulation of problem animals through trophy hunting” in Chapter 3 for the limits of this system) is a slightly different method of generating greater goodwill among communities. In that case, the trophy fee and a share of the daily service fee are generally paid to the community.

The sale of the meat, skin, ivory etc. of the animals shot can bring an additional income to the communities.

In Namibia, where this method is commonly used and has been labelled “shoot and sell”, the government registered crocodiles as a protected species in 1975, but, as part of the conservancy’s right to benefit from their wildlife, two crocodiles per year have recently been acquired as part of the trophy-hunting quota from the Ministry of Environment and Tourism. For example, the Kasika Conservancy Committee has chosen, through a tendering process, a professional hunter who will bring his clients to their conservancy to hunt crocodile, as well as elephants, hippopotamuses and buffalos. In addition to paying a hunting fee to the conservancy, the hunter provides employment for a few local people and supplies meat from the trophy-hunted animals to the villages (Murphy, 2007).

compensation seldom reaches the individuals who have suffered losses and who generally continue bearing the direct costs of human-wildlife conflict (WWF SARPO, 2005; Muruthi, 2005; Government of Namibia, 2007).

BOX 21

Indirect compensation for human-wildlife conflict: Community-Based Natural Resource Management

In Namibia, CBNRM was established in 1998 through the conservancy programme in the Caprivi region where the ecotourism industry and hunting concessions are potentially valuable tools for developing a local economy based on wildlife related revenues. The aim was to establish a system of returning benefits to rural communities in order to motivate them to protect wildlife outside protected areas and to discourage poaching (O'Connell-Rodwell *et al.*, 2000). In 2007 the conservancy programme counted 50 conservancies. It encompassed 14 percent of the national territory and involved 60 communities, representing more than 200 000 people, i.e. 10 percent of the whole Namibian population and about 20 percent of the rural population. In 2004 alone, the conservancies earned more than US\$2 335 000 by valorizing wildlife through sport hunting, subsistence hunting, viewing tourism and the sale of game meat and live animals. As an example, in 2003, the Nyae-Nyae conservancy bordering the Khaudom National Park was already economically sustainable; its income from tourism and hunting covered its running costs and allowed it to pay dividends to community members of about US\$67 per person at the end of the year (Skyer, 2004).

In Benin, the ECOPAS project set up Community Associations for the Management of Wildlife Reserves (AVIGREF) in villages neighbouring national parks. The AVIGREF of the villages bordering the Djona hunting area are associated with the management of the Alfakoara elephant tourist zone and receive an income from the site exploitations as well as from the adjacent hunting zones. A part of this income is used to compensate the victims of elephant crop-raiding (Alfa Gambari Imorou *et al.*, 2004).

In conclusion, a number of key questions should be asked of the compensation schemes (Muruthi, 2005). Do they help wildlife species in conflict with humans? Are they based on concrete information to be applied effectively? Do they pay the appropriate amount of compensation? Do they target the right culprits? And are they fair, timely, transparent and sustainable?

Voluntary relocation

Where alternative land and incentives are available, the voluntary relocation of local communities to areas offering better access to natural resources and improved socio-economic opportunities can offer an adequate solution to managing human-wildlife conflict (Madhusudan, 2003). In fact, resettlement schemes aimed at preventing the overlap of wildlife and people can be successful in the long run if some essential assumptions are met: the villagers must gain substantial benefits, such as better access to resources; they should be relocated to an area where the



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Safari hunting is a means of providing indirect compensation for human-wildlife conflict



FONDATION IGF/H. BOULET

Community-Based Natural Resource Management programmes involving local communities in several modes of wildlife valorization are a new and promising alternative for mitigating human-wildlife conflict

risk of losing property is lower; and they should not face any political, social and cultural opposition (Treves and Karanth, 2003).

When socially acceptable, this option is expensive. For example, donors paid approximately US\$16 million to relocate the 6 000 people living inside the Limpopo National Park in Mozambique.

PRODUCTION MANAGEMENT

Different methods used to protect human production against the adverse effects of wildlife are presented below. However, given the inadequate resources of most subsistence farmers in Africa, effective protection of crops or livestock is often unaffordable, time consuming and risky.

Intensifying human vigilance

Vigilance is an important component of crop or livestock protection and human-wildlife conflict management. The fear of humans normally dissuades animals from committing damage. In Kibale National Park in Uganda, elephants waited at the forest edge until farmers left the fields before they would enter (Naughton-Treves, 1998), suggesting an aversion to the presence of humans. Elephants in the area around the Kakum Conservation Area in Ghana appear to avoid farms where people are present (Barnes *et al.*, 2003).

Guarding herds and taking steps to actively defend them are essential features of animal husbandry. Where herdsmen are present, the rate of depredation is generally lower than in free-ranging herds (Kaczensky, 1996; Ogada *et al.*, 2003; Breitenmoser *et al.*, 2005). In East Africa, where human herders are effective and fearless in warding off predators, herders are reported to challenge and scare away dangerous carnivores such as lions, hyenas and cheetahs with nothing more than simple weapons such as spears, knives or firearms (Patterson *et al.*, 2004).

On the other hand, some species such as baboons show less fear, and simple vigilance therefore gives less effective results. Determined troops of baboons can intimidate guardians, particularly women, who are often chased away. Baboons will adapt rapidly to measures taken against them and are remarkably quick to find weaknesses in the guarding of crops.

Watchtowers providing good vantage points, built around cultivated fields, can increase the farmers' chances of being alerted to the presence of potentially harmful wildlife before damage has occurred. Farmers need to cooperate among themselves to manage the watchtowers and set up duty rosters, as is widely practised in Zimbabwe, Mozambique and Zambia (WWF SARPO, 2005). Farmers can cooperate by means of a rotating system of guard duty whereby only a few of them patrol during the night. If an elephant is sighted, other farmers are woken to chase them away (Thouless, 1994). Simple alarm systems, using a network of cowbells or tins filled with stones connected along a length of twine, can also be effective and avoid the farmer having to stay alert all night long (Muruthi 2005).

Specifically constituted teams can act as guards. The FAO project in Kakum in Ghana set up a cadre of community scouts to provide vigilance and promote community-based problem animal control in an area of high human-elephant conflict. A total of 11 communities were grouped into a community scout cadre with an average membership of 5 scouts per community. Each group had a leader and a secretary who was responsible for the custody and updating of the patrol record book. This record book was available for inspection by other community members and stakeholders.

Guard animals

Guard animals provide an alternative to a herder monitoring a flock, which is labour-intensive, time-consuming and costly. To be successful, a guard animal must bond with the animals they are to guard. This bonding, combined with the guard animal's natural aggression toward predators, can make a guard animal an effective protector.

Dogs can be effective in protecting homesteads and livestock from attack by predators (see Box 22). The dogs are trained to alert people to the presence of predators, rather than chasing predators. These dogs are raised from puppyhood with sheep or cattle and live with the herd full-time. Several new training aids are now available to the dog handler including "shock collars" to provide stimuli to the animal in obedience training and are used in conjunction with whistles and global positioning system (GPS) collars in the event of animals becoming lost (La Grange, 2005).

Donkeys have also been used as guard animals in many parts of the world. In some areas of Kenya one or two donkeys per herd of cattle have been used to guard against lions. Donkeys appear to have a higher defence instinct than cattle and are naturally more alert and aware of predators. They make formidable opponents, they are not afraid and will find predators and chase them away, even by biting and kicking. Mares with foals are particularly protective. Foals should be raised with livestock. However, stallions tend to break fences and become aggressive during breeding (Schumann, 2004).

Both dogs and donkeys have recently been used in Namibia and Botswana to accompany livestock. This has been reasonably successful in reducing incidences of human-wildlife conflict, especially where cheetahs and spotted hyenas are concerned (WWF SARPO, 2005).

BOX 22

Effect of guard animals on predator attacks

In Northern Kenya, the presence of shepherds, dogs and humans has been linked with lower rates of livestock attacks by large predators. However, the presence of dogs was only linked with reduced rates of lion raids on cattle, but not on sheep and goats (Ogada *et al.*, 2003). Under a specific guard dog programme in Namibia, Anatolian sheep dogs were used to protect livestock (WWF SARPO, 2005). A study carried out between January 1994 and November 2001 of domestic dogs accompanying herds in 117 Namibian farms, showed that guard dogs were successful in terms of reducing livestock losses, with 73 percent of responding farmers reporting a significant decline in losses since they acquired a dog (Marker, Dickman and MacDonald, 2005).

Fencing

If they are properly designed, constructed and maintained, fences can be almost completely effective in preventing conflict between people and wild animals. Fences are used to protect crops and to protect people and livestock (Box 23). They are also used to insulate protected areas; communities seem increasingly to opt for separation rather than integration of culture and nature in the landscape, as a result of increasing human-wildlife conflict and scarce human involvement in or direct benefit from conservation. Fenced wildlife sanctuaries enable people to benefit, yet be separated, from wildlife, so that they can practise other land uses such as pastoralism and agriculture.

BOX 23

Examples of fences used against carnivore attacks

To prevent crocodile attacks, the Namibian Kasika conservancy used traditional thorn bushes placed in the river at cattle drinking points to offer protection from crocodiles. These were replaced with stronger materials such as wire fencing, with funds from GEF. Ten such crocodile-proof fences were constructed at village harbours for a cost of about US\$286 each (Murphy, 2007). The construction and maintenance of palisades or barriers need continued effort, and there is little evidence elsewhere of communities making that effort now to erect the kinds of protective barriers found in pre-colonial times (Musambachime, 1987), particularly at frequented spots such as watering points.

To protect their livestock, herders traditionally resort to several fencing devices. In the Laikipia District in northern Kenya, pastoralists use different traditional techniques, which are popular among Maasai and Samburu local communities. The enclosures can be made of: stone or wooden posts (solid); Acacia brush (acacia); branches woven around cedar poles (wicker) or 10 cm wire mesh (wire). A study was made of the effectiveness of different enclosure types in defending livestock from predator attacks; the depredation rate for domestic animals was lower when they were penned in corals over night, and the type of pen was a significant factor in accounting for a lower total loss of sheep and goats, whether they were kept in wire, acacia, wicker or solid enclosures (listed in order of effectiveness) (Ogada *et al.*, 2003).

Farmers can erect fencing that deters or keeps out large carnivores and allows livestock to graze freely. This technique is used extensively in Namibia and some parts of Botswana, to assist farmers in controlling raids on their livestock by lions, spotted hyenas, wild dogs and cheetahs. Farmers in northern Namibia sometimes erect smaller fenced camps (two to ten hectares) near their settlements, where they keep some animals, such as cows with small calves. This has been a successful option, which has reduced raids on calves during the vulnerable stage of their growth (WWF SARPO, 2005). However, these predator-proof barriers require more maintenance than normal livestock-proof ones.

Fences also help prevent the transmission of certain endemic contagious diseases such as foot-and-mouth disease, African swine fever and theileriosis. The establishment of control areas, game-proof fences, sanitary cordons and movement control to separate wildlife from domestic livestock has frequently given the best results. This method has generally been used in countries with an advanced land-use policy where nomadic pastoralism is not practised. It is less likely to succeed against endemic arthropod-borne infections such as trypanosomiasis, epizootic hemorrhagic disease, African horse sickness, and Rift Valley fever, where vaccination and vector control may be required to reduce transmission (Bengis, Kock and Fischer, 2002).

Although the introduction of fencing is a good way to manage human-wildlife conflict, it also brings a number of environmental and economic disadvantages and is never 100 percent efficient (Box 24).

Several types of fences are used throughout Africa for various purposes.



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If properly designed, constructed and maintained, fences can be almost completely effective in preventing conflict between people and wild animals

BOX 24

Some drawbacks of fencing

In Kenya, the fencing of farms has created physical barriers to migratory species such as zebras, topis and wildebeest, or species making seasonal displacements such as elephants. Fencing reserves may affect the dynamics of wildlife populations and hinder their natural migratory and dispersal behaviour, especially in the case of highly territorial species such as lions. It is also essential to take into consideration the different, unexpected effects that fencing may have on a wide range of non-target species (Hoare, 1992).

Physical barriers are not always an economical management practice. They frequently require additional labour from farmers and their family members and never ensure complete protection. The reason for this failure can be explained by the behaviour of different animal species. Burrowing animals for instance, will breach barriers and allow access to other species, as Hoare (1992) mentions; lions for example can use holes that have been dug by warthogs.

In Zimbabwe, in the areas neighbouring the Sengwa Wildlife Research Area, livestock are still attacked even though the reserve is fenced and livestock are penned in fortified enclosures at night. This is because baboons, lions and leopards can pass through the reserve fence and jump into the enclosures. Improving fences with the addition of a roof (chain link ceilings for instance) would substantially reduce economic losses (Butler, 2000).

Traditional barriers. Plant hedges of various spiny cacti (e.g. *Caesalpinia decapetala* and species of *Euphorbia*, *Opuntia* and *Agave*) have the advantage of being a low-cost solution, effective against both carnivores and ungulates. On the other hand, they are slow to establish, do not deter baboons and elephants, and are often made of exotic species which can spread uncontrollably. Although less permanent, fences made of dead thorny branches are erected as kraals for cattle but also against elephants. In the Malian Gourma they make up 32 percent of protective measures used, as against 28 percent for moats (Maïga, 1999). Trenches, either covered or uncovered, have been widely used in Africa to keep elephants from cultivated areas with considerable success. Stone walls have been used to exclude buffalo from invading cultivated areas in the AWF Virunga Heartland (Muruthi, 2005). Large, sharp rocks act as a effective elephant barrier in some parts of Namibia (Hanks, 2006).

In some areas, farmers simply run bark or sisal ropes from tree to tree or set up 3-metre long poles placed 30 metres apart and hang pieces of white cloth attached to twine at 5 metre intervals. This is done in conjunction with grease and hot pepper oil, which, when applied to the twine acts as a waterproofing media and causes irritation to any animal (such as elephants) making contact with the fence (see section on deterrents, p. 55) (WWF SARPO, 2005).

Artificial fences. Fences constructed using strong material such as galvanized steel wire protect crops successfully against many mammals. The major factor limiting the wider use of wildlife fences is their cost, which varies depending on many factors such as topography, type of fence and the species it is designed to contain. The high maintenance cost of fencing is another limiting factor, which explains why fences are effective when managed by commercial farmers for high-value crops such as sugar cane or citrus. This option is beyond the means of emerging farmers or subsistence growers. Moreover, for some species, such as baboons, standard wire fencing is ineffective.

Electric fencing. Electric fencing is a more sophisticated and efficient solution. It is more durable, due to the reduced physical pressure from animals; it deters a wider range of species; and it is more aesthetically appealing. However, the cost of installation and maintenance is higher than for simple fences (Hoare, 1992). The construction of a 3.3 m high electric fence around Aberdare National Park in Kenya cost an average of US\$20 000 per kilometre (Muruthi, 2005); in Namibia, the cost per kilometre of electric fence was US\$10 000 compared to US\$600 for a non-electric wildlife fence.

In Kenya, in Endarasha and Ol Moran villages in the Nyeri and Laikipia Districts, electric fencing is successfully used to separate wildlife from human settlements and agricultural areas (Kenya Wildlife Service, 1996). The electric fencing of the cultivated areas of Kimana and Namelok in the AWF Kilimanjaro Heartland has significantly reduced the levels of elephant crop damage; however, fence maintenance and the proximity of fences to areas with a high concentration of elephants appeared to be significant determinants in the long-term performance of electric fences in mitigating elephant crop-raiding (Kioko *et al.*, 2008). In Namibia, in the East Caprivi region, electric fencing is an effective strategy in reducing the human-elephant conflict on a large-scale. Electric fencing has proved to be the only long-term deterrent to elephants. Despite the high cost of maintenance and installation, electric fencing is demonstrably cost-effective to the community because it reduces elephant attacks, and thus allows crop increases and increased income for farmers. It is anticipated that it will take four years for a return on investment to be realized (O'Connell-Rodwell *et al.*, 2000).

Electric fencing can be adapted to rural conditions. For example, it is possible to construct a fence with just a single live strand at 1.5 metres above the ground in order to stop elephants, while allowing other species to pass through. This cuts costs considerably; in Mozambique, for instance, the cost per kilometre of a single strand of electric fence is US\$900 to \$1 000 compared to \$9 000 for a classic elephant-proof fence. Another means of cutting costs is to hang this single strand fence from bush poles instead of metal stanchions. Nevertheless, the theft of the solar panels, batteries and energizers used to power television sets, noted for instance in Botswana and Mozambique, means that electric fences can only be considered where the security to guard them is adequate.

CROP OR HERD MANAGEMENT

Human-wildlife conflict can be reduced, and in some cases totally prevented, by implementing changes to the resource or production that causes the conflict. This can be achieved by altering the resource itself, or the way it is managed or making changes to the surrounding landscape so that the problem-causing animal is more vulnerable, easier to spot by people and dogs, and generally less at ease in the area (Muruthi, 2005).

These possibilities can be applied to the different productions affected by human-wildlife conflict.

Agriculture

Little research exists on wildlife preferences for particular crops, but some crops are less palatable to wildlife. There are some crops that elephants appear not to eat. For this reason alternative crops such as ginger and chilli have been encouraged around Kakum National Park in Ghana. Several farmers who were considered to be in high-conflict areas have shifted from cultivating food crops to growing other crops such as cocoa and ginger to sell at the local market in Foso. It is possible to harvest 30 or so baskets of ginger from an acre of land. Each basket is worth a minimum of 60 000 cedis (¢); an acre of land can produce a total of ¢1 800 000 (US\$205). These prices can double towards the end of the season. Growing chilli peppers around the land has been encouraged in Namibia, in the Salambala Conservancy in Caprivi, where the first two sales of chillies in 2006 brought a total of US\$925 to about 50 farmers (Hanks, 2006), and in Zimbabwe where a programme to grow this crop for export was set up to raise income for farmers while also repelling elephants.

Other agricultural practices such as changing the time a crop is planted or harvested can also result in a decrease in crop-raiding. This can be done by using special varieties such as open pollinated maize varieties which can be harvested earlier than other food crops and consequently are less vulnerable to crop damage, which tends to occur late in the growing season. (WWF SARPO, 2005). By intensifying agriculture, increasing inputs and boosting yields, farmers are able to maximize their returns from smaller plots of land which are also much easier to defend against crop-raiding elephants. Intensification can be facilitated through the introduction of practical, environmentally sensitive practices such as mulching, and the use of organic fertilizers and liquid dung.

Small islands of crops scattered across a landscape inhabited by wildlife are more vulnerable to destruction than those that are clustered together. A landscape approach to reducing human-wildlife conflict might therefore involve growing crops in large communal fields with straight edges, fences or thorny or spiny hedges, and also removing nearby cover and habitat for wildlife (Muruthi, 2005). In that respect, a cleared margin of about 50 metres around crops does help as a preventive measure, since both baboons and bush pigs are wary of crossing these open areas (La Grange, 1984).

Forestry

The wealthy owners of commercial afforested areas are not greatly interested in management options to alleviate damage caused by baboons in the long term. However, several silvicultural methods could be employed to mitigate damage caused by baboons in timber plantations, such as:

- eliminating damaged trees by thinning;
- reducing pruning and weeding;
- limiting branches big enough to support baboons;
- planting other species;
- clearing and replanting;
- planting larger compartments;
- integrating natural vegetation.

All these methods can help alleviate the damage but can also have important disadvantages in terms of yield and productivity.

Husbandry

Livestock raids can be minimized through good husbandry practices, such as herding during the day, keeping livestock in a predator-proof enclosure at night or avoiding predators' home territory. Additionally, a livestock keeper can remove thick cover from near animal holding areas. Equally herders should systematically avoid taking livestock to water points which are known to be inhabited by large crocodiles. Good husbandry also requires vigilance and a willingness on the part of the owner to confront predators when the need arises. This is a daunting task when the farmer is not properly equipped for it, especially since confrontations usually occur at night.

Farmers can actively manage their herds to protect them against depredation by controlling breeding times. By directing the movement of the bull, the farmer can plan and synchronize calving. This helps protect cows and their calves against carnivores during the days and months in which they are most vulnerable to depredation, and means that animal protection can be seasonally managed (WWF SARPO, 2005).

With regard to diseases that threaten wildlife populations, such as bovine tuberculosis, rinderpest and canine distemper, containment and control is best effected by addressing the disease in the domestic compartment through test-and-slaughter methods and mass vaccination. Rinderpest control, for example, has been based on vaccination (Bengis, Kock and Fischer, 2002).

NON-LETHAL CONTROL

With diminishing wildlife populations and criticism in the media of the killing of species such as elephants, baboons and lions, non-lethal methods for managing problem animals are preferred provided they can solve or mitigate human-wildlife conflict problems and not simply shift them elsewhere; and provided they represent a permanent solution.

The non-lethal methods described below can be effective if rural people living around reserve areas are involved in their implementation and are also involved in the conservation and sustainable utilization of wildlife resources.

Deterrents

Deterrent methods are designed to repel animals from the targeted resource. They can be grouped into several categories according to the sense they target: hearing, sight, smell, taste and touch (see below).

Acoustic deterrents. Acoustic deterrents are those that shock wildlife away by emitting an unexpected loud noise or specific sounds known to scare wildlife.

Traditional acoustic methods are widely used by farmers throughout Africa, mainly against elephants: such as beating drums, tins and trees; using whips in addition to shouting, yelling and whistling; and setting off explosive devices such as “bamboo blasters” using calcium carbide or fertilizers, pipe bombs (in Zimbabwe), and homemade gunpowder (in Zambia).

Disturbance shooting (firing gunshot over the heads of crop-raiding elephants) has been a long-standing deterrent, but it needs the intervention of problem animal control units or administration representatives. People have used shotgun blasts to scare off lions in commercial ranches in Laikipia, Kenya. Cracker shells are 12 bore cartridges which launch a small charge that explodes near the predator, presumably providing greater shock value than gunshot coming from a boma (Frank and Woodroffe, 2002).

To scare baboons, the use of shots, cannon noise or predator sounds can be used. Sound aversion barriers generating a frequency that causes pain have also been considered but this technique is impractical for large areas, and has several other disadvantages: it is difficult to trigger; the signal generation is expensive; and it can potentially cause auditory damage to non-target species. Disturbance shooting at roost sites is a method easy to implement once all roost sites are known. However, baboons may return to their roost sites once the disturbance ends. The destruction of roosts is a more permanent solution, but as in the case of disturbance shooting, it may cause major changes to range use and transfer the problem to a new area.

Alarm systems established at the boundary of farms and set off by a tripwire (e.g. electric sirens in Namibia) or set up directly on fences (e.g. cowbells in Zimbabwe) alert farmers to the presence of elephants, but also have some deterrent effect.

Some more sophisticated techniques using tape recordings are currently being tested in Kenya, where play-back of Massai cattle noise to elephants in Amboseli National Park scared off elephants which are periodically hunted or injured by the local Massai tribesman. Researchers in Namibia have recorded elephant warning calls and played these back to elephants in order to scare them away.

Visual deterrents. Visual deterrents are a traditional method. Brightly coloured cloths and plastic may be hung from a simple fence at the edge of fields. Scarecrows

could have a potentially deterrent effect, but they are not as successful against lions as they are against leopards (Woodroffe *et al.*, 2007). The flames and smoke of fires lit on the boundaries of fields or burning sticks carried by farmers can deter wildlife. Burning tyres produce a lasting and noxious smoke which affects both visual and olfactory senses, and increases the deterrent effect.

Olfactory deterrents. Some chemical compounds deter elephants effectively either by generating an unpleasant or painful smell or by simulating a targeted compound such as a hormone that triggers fear.

In the first group, capsaicin resin extracted from chilli peppers (*Capsicum* sp.), which causes an extremely unpleasant irritation and burning, is the most effective and widespread. Repellents based on this resin have been used to alter behaviour in a variety of species, including bears, ungulates, dogs, and humans (Bullard, 1985).

Capsicum deterrent is employed under different forms.

- chilli-impregnated twine (grease and extract of hot chillies mixed together and applied to string);
- chilli-dung bricks (made of dried chilli mixed with elephant or cattle dung and compressed into bricks which are then sun-dried and burnt slowly at the edge of fields producing a strong smelling cloud of chilli smoke);
- pepper spray (capsaicin mixed with soybean oil and inserted into an aerosol can with a modified spray nozzle);
- chilli “bombs” which are shot at elephants and burst upon impact, delivering the capsaicin to the skin (this delivery system is under development in Zimbabwe).

Chilli-impregnated twine and burning balls of elephant dung containing chillies registered some success in Zimbabwe (Osborn and Parker, 2002, Parker and Osborn, 2006). In 2003, farms close to the eastern wing of Kakum National Park in Ghana, where elephant activities had been highest, harvested up to seven bags of maize per hectare after chilli-based deterrents were put in place to scare off wildlife – as compared with only 0.5 bags or less per hectare in 2001. The chilli-dung brick designed by the Kakum project is easy for farmers to make; the method is described in a farmer’s manual (FAO, 2008a).

The effectiveness of olfactory deterrents on primates is limited. Trial results suggest that chilli-based olfactory deterrents may have a short-term effect on baboons, but the delivery system has not yet been fully developed.

Tobacco is also efficient as a deterrent either in conjunction with chilli or alone. Trials funded by WWF in Mozambique and in Kenya’s Trans-Mara District have shown that a concoction of used vehicle oil, ground chilli and tobacco, smeared on ropes surrounding fields, barred elephants from raiding crops. Similar results have been observed in Zimbabwe. (Kiiru, Kioko, and Granli, 2006). In the United Republic of Tanzania, it was shown that when the supply of chillies, used as an olfactory deterrent for elephants, was insufficient, tobacco dust obtained from a local cigarette factory proved as effective (Hoare, 2007).

Field trials carried out in a number of areas in the Namibian Caprivi Region, have shown that granules of REVIRA®, a compound made of citronella and used



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Capsaicin resin extracted from chilli peppers, which causes an extremely unpleasant irritation and burning, is the most effective and widespread repellent for elephants

as a game repellent in Scandinavia, had a certain deterrent effect on elephants. Tests show that elephants failed to cross a line of REVIRA granules placed around a field. This chemical barrier could work for up to a month or more (Hanks, 2006).

Compounds from musth secretions seem to have some potential as an olfactory deterrent. In recent trials, elephants would not consume food items encircled by rings of dilute concentrations of one natural ketone in particular. This method may have great potential, but at present it is not applied in practice.

Some empirical methods based on olfaction have also been tested. Some experimentation was carried out for example in the eastern highlands of Zimbabwe in dealing with baboons, using a method developed by a traditional healer. This involved taking soil where baboons had urinated and then making up a solution (water mix) and spraying it along the edge of the field. On sniffing the ground the baboons retreated. This method has yet to be scientifically proven (WWF SARPO, 2005).

Taste deterrents. The existence of crops that are unpalatable to wildlife has already been mentioned. These crops, which include sisal, chilli, tea, ginger or oilseed, may not necessarily deter elephants. The experimental use of conditioned taste aversion on carnivores at Loisaba Ranch in Samburu Heartland (Kenya) failed to reduce livestock depredation (Muruthi, 2005). More research into chemical repellents effective against African carnivores is needed. Lithium chloride, for example, though effective against coyotes in the United States, has not proved to be effective in Africa (Forthman Quick, Gustavson and Rusiniak, 1985). Conditioned

taste aversion using lithium chloride or cyclophosphamide would be effective on baboons, given that they are physiologically close to humans. Repeated exposure or large initial doses would be needed to cause and maintain aversion. Compounds that are extremely bitter, such as Bitrex, or irritating such as chilli (see above), could also have a possible short-term deterrent effect on baboons.

Contact deterrents. Many traditional methods fall into in this category, which targets the sense of touch. Farmers throw rocks, burning sticks and, occasionally, spears at crop-raiding elephants. East-African herders challenge and scare away dangerous carnivores (see section on intensifying human vigilance). This usually involves getting close to the animals, and therefore the danger level is high. Experiments have been carried out in Kenya on the use of bees in problem-causing animal control. Beehives are placed on the edge of the fields and the bees are conditioned to react to approaching animals. This can be used not only for the big herbivores such as elephants which are scared of bees, but even for smaller problem animals (WWF SARPO, 2005).

Challenges to the use of deterrents. There are no known and proven deterrent methods for some species such as crocodiles. This is not because deterrence is impossible but simply because it has been simpler to remove the crocodile rather than to investigate possible methods. Crocodilians have acute senses and perceive sounds, smells and tastes in the water at low volumes or concentrations. They also sense and respond to pressure, electrical impulses and salinity using integumentary sense organs in the skin. In South Africa, electric fields have been used with some success to deter shark attacks (Dudley *et al.*, 2006) and the same principles could potentially be applied to crocodiles, although these species are behaviourally quite different.

While deterrent techniques are widely used, they are not effective in the long term. Animals soon learn that they pose no real threat and then ignore them. Both modern and traditional methods face this problem and become less effective over time (Muruthi, 2005). It is recommended that a combination of techniques be employed to minimize the risk of wildlife becoming used to any single method.

Finally, deterrent techniques present several disadvantages that could limit their successful application. They can generate adverse effects by displacing the problem to other areas. Some methods require close contact with the animal and expose the operator to danger. In many cases, government or NGO support is required to maintain the deterrent. Over most of the more remote areas where human-elephant conflict occurs, this support is difficult to provide. In northern Mozambique, for instance, in a region where chilli-pepper has been used, villagers rapidly lost confidence in its efficacy once NGO support ceased (FAO, 2005). External factors can lessen the efficiency of deterrents as shown by the following example: in Zimbabwe, wildlife is the natural resource that becomes targeted in an economic decline and as more and more people are unable to cultivate crops, they turn to wildlife, including the problem species, for bushmeat. Even projects to deter animals from crops using repellents then become jeopardized, because

people are more intent on obtaining meat from an elephant rather than scaring it off their crops.

Translocation

Translocation consists of moving a certain number of animals from a problematic zone to a new site. In spite of the risk of exporting the problem to another site, it may be a practical and politically correct approach in some cases, especially where suitable habitats with territorial vacancies are available.

In some situations, translocation can be a pre-emptive action before human-wildlife conflict occurs. For instance, the presence of a lion in a cattle ranching area or large crocodiles in water bodies close to human habitation can often be detected before the animals have caused a problem. These potential problem-causing animals can then be removed and translocated before they kill livestock or people. In addition, the sale of live animals to private reserves or crocodile farms can provide additional income.

This technique has been used more or less successfully with elephants, crocodiles and other carnivores (Box 25). Trapping and translocating baboons is feasible and can potentially provide an immediate solution to the bark-stripping problem within the troops range. However because baboons are abundant and widespread, there are few interested recipients. On the other hand, removing the problem troop potentially leaves an empty range that may be occupied by another bark-stripping troop.

Translocation is a controversial means of resolving human-wildlife conflict, as it can bring a number of problems, as shown by the examples in Box 25 (see also Conover, 2002).

- The animal causing the problem must be identified with certainty prior to capture; this is at best difficult and often impossible to achieve.
- Translocated animals commonly return to the site where they were originally captured.
- The problem is likely to persist, especially in the case of baboons. New animals are likely to immigrate to empty territories once translocation has taken place.
- The translocated animals can cause similar problems at their release site.
- Translocation is a risky procedure. Often a proportion of translocated animals dies, either because of the stress of capture or soon after release (see Omondi *et al.*, 2002).
- Translocated individuals can endanger a resident animal population by introducing disease or destabilizing that population through increased competition for territory (as in the case of carnivores) or food (in the case of elephants).
- In order for the strategy to work, species such as large carnivores and elephants need to be translocated to a large area, up to hundreds or thousands of square kilometres, lacking potential for conflict with humans (Stander, 1990).
- The cost-effectiveness of translocation is in question; it is extremely expensive and involves specialist equipment and skills.

BOX 25

Wildlife translocation**Elephants**

Elephant translocation methods used to be unsuccessful, but improved significantly at the beginning of the 1990s when it was shown that only family groups or solitary males should be moved (Coetsee, 1996). Since then, more than 1 000 elephants have been successfully translocated to 58 reserves in South Africa (up to 2004); and 141 individuals were translocated in Kenya between 1996 and 2002, with a mortality rate of 9 percent (Omondi *et al.*, 2002). However in some cases elephant translocations are still unsuccessful. Out of the first three family groups translocated in September 2001 from the northern parts of Kruger to the Limpopo National Park in Mozambique, each group was composed of seven animals and four bulls of different ages. Three of the four bulls returned to Kruger within four weeks to three months of being released in Mozambique. All three family groups remained in Mozambique for at least nine months, when one family group returned to Kruger. The other two groups remained for almost another year in Limpopo, and then both returned to Kruger in early 2003 (Hofmeyr, 2004).

Mammalian carnivores

The translocation of carnivores, although technically feasible, is generally unsuccessful. Only the translocation of leopards in South Africa has met with some success. Of over 38 translocations of male lions carried out between 1997 and 2001 in the Kgalagadi Transfrontier Park (South Africa and Botswana), 14 males were translocated more than once during the four-year period study. The territorial males were translocated to areas about 50 km away from their territory, but always returned to their original range (FAO, 2008b). In Namibia 16 leopards and 22 lions were relocated, marked with radio collars and then followed, in a study to test the success of relocations. All the leopards, and many of the lions, returned to the area where they were captured (WWF SARPO, 2005).

Furthermore, the translocation of carnivores can cause numerous problems, notably because most species are territorial. The following example illustrates the effects of territoriality: during a ban on lion hunting in Botswana, a cattle-killing male was captured and translocated seven times (I. Khama, personal communication) presumably because on each occasion it was being evicted from the area it had been moved to. Translocation into areas already occupied by individuals of the same species can lead to aggression and infanticide and a much higher death rate (Treves and Karanth, 2003).

Crocodiles

The capture of live wild adult crocodylians is possible using a variety of methods (boma traps, cage traps, rope traps, whip traps, nooses, harpoons, baited snares, etc.)

and is routinely carried out for research and commercial purposes, albeit with some difficulty and danger. Translocation of adult and juvenile Nile crocodiles from one wild population to another has been tested for academic and management purposes (Fergusson, 2000). This species has demonstrated that it is highly motivated and able to return to its original habitat. Given that wild crocodiles are relatively widespread, it is unlikely that any conservation benefit can be achieved from translocation; on the contrary, potentially significant damage could be done by introducing animals to a locally adapted gene pool in the wild. Translocation from the wild to captivity is a more potentially useful solution. Although captive crocodiles do little for the conservation of the species in the wild, this has the advantage of permanently removing crocodiles that are believed to be problem animals. In captivity adult female crocodiles, together with a smaller number of males are a biological asset and they continue to produce eggs which are one of the key inputs for the crocodile production industry. As such, crocodile producers are prepared to cover the costs of capture and removal of problem crocodiles

Contraception

The fertility of wild animals can, at least in theory, be controlled by using a variety of mechanical, surgical, endocrine-disruptive or immuno-contraceptive methods. One problem limiting many of these methods is the difficulty of administering drugs to, or capturing, free-ranging animals. Moreover, several health-related issues need to be resolved before fertility control becomes acceptable. The contraceptive used must not have harmful effects on the target animals, non-target wildlife, or on humans who might consume the meat.

The first attempts to use immuno-contraceptive methods in elephants were made in Kruger National Park in 1996 (Butler, 1998) using a contraceptive vaccine elaborated with antigens from pork zona pellucida. To date this vaccine has been largely unsuccessful. The procedure was difficult (requiring several repeat injections, as well as mandatory monitoring of the vaccinated females) and seemed to generate aggressive behaviour both in treated females and in rutting males, which were chased off by the females (Delsink *et al.*, 2003).

A second solution explored was that of chemical castration by selectively destroying the pituitary gland cells that produce gonadotrophin. This system would stop spermatogenesis in males and ovulation in females, and inhibit sexual behaviour. Chemical castration, which is still in the experimental phase, would require a single injection. Its side effects are unknown.

A third theoretical solution considered is that of surgical vasectomy in dominant males (Bokhout, Nabuurs and De Jong, 2005).

Controlling the fertility of wild crocodiles is technically possible but impractical in the wild. Essentially this is futile in a species that has evolved to survive the loss of more than 97 percent of its offspring before reaching reproductive age/size.

Contraception or surgical or chemical sterilization would theoretically be feasible for baboons, since it was successful in Brazil with capuchin monkeys engaged in bark stripping of commercial timber species (Rocha, 2000). However, there would be a lag period before damage to timber would be reduced, and the socio-ecological effects are unknown. The procedure would affect the whole population and not just individuals or troops.

Contraception as a wildlife management tool is still largely in the experimental stage and, to date, cannot be considered as an available option in managing human-wildlife conflict.

LETHAL CONTROL

Lethal control means killing the animals concerned. This strategy is still widely used in Africa, but rather with the purpose of maintaining social peace than resolving the human-wildlife conflict problem definitively.

In general, shooting a problem-causing animal is believed to be the best way of warning the others away. With lethal control it is obviously desirable to focus on those individuals actually causing the problem, or at least to target the group of animals whose home range includes the site where the problem is occurring. In reality, it is often difficult for wildlife managers to obtain permission to shoot an animal quickly, thus making killing the culprit virtually impossible. Any individual is then killed to satisfy the demand for action and revenge by the aggrieved community, especially in the case of loss of human life or the killing of livestock.

The killing of some animals often has only a short-term effect. This was noted in Ghana, where crop damage ceased for three to five years after raiding elephants were eliminated, but then recommenced. After 55 baboons, mainly immature animals, were shot dead in Malawi in 1977, and guards were employed to deter the baboons from entering the forest, the baboon damage returned by 1978.

The reduction of the wildlife population can have adverse effects on the species killed, on sympatric species or even on the environment. It often results in an increase in birth rate, a decrease in other causes of mortality and an increase in the immigration of naïve animals into the area. The possible consequences of eradicating certain species from a locality include upsetting ecosystem function and dramatic changes in the populations of other species. A phenomenon called “mesopredator release” can arise, for example, when small to medium-sized carnivores proliferate following the removal of large carnivores (Crooks, 2002). Similarly, profound changes to the local flora and landscape can occur as a result of the elimination of elephants.

Finally, this method is increasingly criticized by the public. For this reason, there has been no lethal control of baboon populations in South Africa since the voluntary moratorium in May 2006 which followed a public and media outcry against implementation of the “trap-and-shoot” protocol. Elephant culling has been abandoned in favour of non-lethal techniques. On the other hand, in Zimbabwe, discussions are under way between the Parks Management and Wildlife Authority, the Centre de coopération internationale en recherche

agronomique pour le développement (CIRAD) and private enterprise to introduce mini elephant cropping campaigns to the areas surrounding state-owned wildlife areas to reduce the conflict there and provide cheap meat for rural inhabitants.

In general, problem-causing animals are shot, but poisoning has been used with baboons (see Box 26). The diffusion of diseases or parasitic infestations could be used to eliminate problem-causing animals as in Australia, where an attempt was made to eliminate rabbits with myxomatosis. Although biological control using diseases and predators has been considered as an option for reducing elephant overpopulation in South Africa (Mabunda, 2005), it has never been carried out because of the danger of unintentional crossover to non-target species or even humans.

The killing of problem-causing animals can be carried out by three main groups of actors: public services, local populations and trophy hunters.

Lethal control of problem animals by public services

Generally, the department in charge of wildlife management is most involved in the killing of problem-causing animals. With some species such as crocodiles, wildlife departments can delegate implementation to private operators. Other government departments, namely animal husbandry, generally only use lethal control for predators.

On a few occasions, the national army has been required to kill problem-causing animals. For example, in Ghana in the early 1970s, it was a common practice for rampaging elephants to be killed by a team of military personnel, in order to reduce crop damage within the Kakum conservation area. The meat of these elephants was often shared among community members as a way of compensating them for their crop losses.

Wildlife departments. Killing is carried out directly by wildlife officers, specialist problem animal control (PAC) units or honorary conservation officers, experienced individuals who can assume responsibility for problem animal control when needed.

PAC units have all the required clearances and the necessary material available to solve human-wildlife conflict. They are supposed to be able to respond rapidly to reports of human-wildlife conflict occurrence. Unfortunately, their effective deployment is often jeopardized by a lack of material and capacity.

PAC units are particularly used for large carnivores such as lions. In Namibia, around Etosha National Park, more than 30 lions are killed every year by PAC units (Stander, 2000). In Botswana, in the period from 1999 to 2000, an average of 25 lions per year was eliminated by Problem Animal Control in the Okavango Delta, and an average of 7 lions per year in the Pan region (V. Booth, personal communication).

Culling has been used in South Africa to avoid damage to the biodiversity of national parks and problems associated with elephants wandering outside of the park to surrounding communities in search of food. Between 1967 and 1994 a

BOX 26

Regulation of bark-stripping baboons by poisoning

The sporadic control of bark-stripping baboons by poisoning was introduced in Zimbabwe from 1982 to 1983 using TMTelodrin (an organochlorine insecticide) and later TMPapiol (brodifacoum, a highly toxic anticoagulant).

A disciplined protocol was developed through trials and adhered to subsequently, concentrating on careful pre-baiting to habituate the baboon troops before applying the toxicant. In order to minimize the effect on non-target species, the toxicant was delivered in closed boxes which can only be opened by baboons. Approximately 5 000 baboon carcasses were recovered over the derogation period, and the problem was considerably reduced.

An important ethological study was made alongside the poisoning, to gain better understanding of troop behaviour. The study showed that some troops damaged trees, while others did not. It was also discovered that, due to the social organization of the troops, the success of the control operation is dependent not on capturing first the dominant troop males, nor the favoured females in oestrus, but rather concentrating on the less important individuals. Finally, the study concluded that in order to solve the problem, the whole bark-stripping troop and the groups of bachelors had to be removed. The conclusions of this study were used to control baboon populations further by trapping.

This system was carried out from 1997 to December 2004 when the derogation permit to use the toxicant granted by the Forest Stewardship Council (FSC) expired. Thereafter, its use was prohibited, and was replaced by other lethal mechanical devices, mainly trapping using baited cages. Since early 2007, one of the companies has employed a full time baboon control officer with responsibility for baiting and controlling baboons in selected areas of the plantations (S. Van der Lingen, personal communication).

In South Africa, the trap-and-shoot method has been employed with some success for several years. After considering previous attempts at poisoning, shooting and trapping in a detailed written protocol, this method was selected (R.A. Fergusson, personal communication) and was considered to be the most effective and humane way of reducing or eliminating entire troops of bark-stripping baboons.

total of 14 562 elephants were killed during culls in South Africa. A moratorium on culling was set up in 1994. In 2005, the Kruger National Park was thought to have a population of 12 467 elephants. Had the culling not taken place there would now be 80 000 elephants (SAPA, 2005).

The off-take of either individual crocodiles or larger numbers of adult crocodiles in a prescribed area can be carried out by officials from relevant government departments, but is more frequently contracted out to the private sector. Ideally

surveys of the population in the wild are first carried out to determine the number of crocodiles present and the age/size structure of the population. When delegated to private operators, the field implementation of the killing should be observed and controlled by wildlife officials. Without this, when the product is the skins, the incentive is to shoot many animals, but only recover or process those that will provide the best return.

Husbandry service. In Kenya, on Galana Ranch, between 1968 and 1988, roughly one lion was shot for every 10 cows killed, i.e. approximately 25 lions per year out of a stable population of 150. In West and Central Africa, not long ago, strychnine poisoning campaigns were organized annually by the administration in charge of livestock development. Between 1970 and 1972 in what was then known as Upper Volta (Burkina Faso), 55 lions were poisoned with strychnine (Chardonnet *et al.*, 2005). Poisoning is frequently used throughout Africa to kill lions that have been stock raiding. Until recently, the Kenya Wildlife Service and the Kenya Veterinary Department made widespread use of poisons to eliminate hyenas, which certainly affected other scavengers such as lions.

Lethal control of problem animals by local populations

Farmers and herders are regularly involved in the elimination of problem-causing animals. Sometimes local hunters may be involved. For instance, traditional hunters with dogs and/or traditional guns have been used to help reduce baboon populations in southern Africa.

Animal species killed or injured by local farmers or herders can be divided into two main groups; species that are killed or injured in protection of crops (this group includes African elephants, buffalo, hippopotamuses, bush pigs, yellow baboons, vervet monkeys, warthogs and rats); and species that are killed or injured in protection of domestic animals and human life. This latter group includes lions, leopards, crocodiles, and spotted hyenas. Some species fall into both categories, in that they cause crop damage and loss of human life.

These killings may be carried out legally. In most African countries wildlife laws address the issue of the protection of people from wildlife in at least one law article related to the defence of human life and property from wildlife attack. Generally, the principle of self defence is considered legitimate and legal, whatever category the animal belongs to, whether a protected or non-protected species.

However, in some countries it is illegal to kill protected species, even in self-defence. This is the case in Namibia for elephants, rhinoceroses and hippopotamuses, for example. On the other hand, every farmer is legally bound to control populations of baboons, hyraxes, black-backed jackals and caracals on his or her farm. If a farmer fails to control these pest animals he or she is liable to a fine of about US\$30 per animal. In addition, the Namibian government may, under certain conditions, delegate authority to specific conservancies to destroy problem-causing animals and use the products derived from the animals (Government of Namibia, 2007).

In any case, the law stipulates that when a culprit animal is killed it must be reported to the wildlife authority. Countries differ however concerning the time of report and who benefits from the killing of the animal. This is intended to avoid local populations revenging themselves by eliminating wildlife by poisoning (e.g. with soil insecticides that are cheaper than strychnine) or poaching.

In actual fact, illegal practices are common and widespread particularly when the human population affected knows perfectly well that, for various reasons, those officially entitled to kill the problem-causing animal will be unable to do so promptly, if at all.

This legal authorization, which is more relevant for predators than for elephants, may be seen from two perspectives. Firstly, given that local communities are the most exposed to damage caused by lions, it would seem appropriate to recognize that the killing of a culprit animal by the offending stakeholder is not an offence. Local communities are often the quickest stakeholders to react to lion attacks and frequently have the highest chance of targetting the culprit. Secondly, allowing the stakeholder to solve the problem autonomously raises concern over potential abuses such as biased evaluation of damage, or overreaction by killing non-culprit lions.

Finally, it must be stressed that wild animals are dangerous and many farmers in Botswana, Mozambique, Namibia and Zambia, who decided to take matters into their own hands, have been mauled and even killed by lions, leopards and crocodiles (WWF SARPO, 2005).

Regulation of problem animals through trophy hunting

Offering problem-causing animals to trophy hunters is a low-cost technique that has the potential to raise public tolerance towards wildlife, if sport hunting involves (or is managed by) local people (Muruthi, 2005). The money provided by the sale of licences or trophy fees can fund conservation activities and the protection of human settlements (Treves and Karanth, 2003) or bring direct income to communities.

In Namibia's Kunene and Caprivi regions, for example, a substantial part of the trophy fee is paid to the community and distributed through the Conservancy Committee to those who have suffered losses. In one area of the Kunene region, lions killed approximately 8 cows, 12 donkeys and 16 goats over a three-year period, causing losses estimated at about US\$1 700; during the same period two male lions were shot by trophy hunters and the community received about US\$4 200 from the fees paid. The same system is used in Zimbabwe and Zambia (WWF SARPO, 2005).

With valuable species such as crocodiles, the option of using trophy hunters to kill specific problem-causing animals could be relevant if permits to cull large numbers are issued by the administration to private-sector operators in order to make the hunting or capture economically viable. The existence of a market for the skins of wild crocodiles provides an incentive for harvesting wild crocodile populations in the short term. However, Nile crocodiles are listed in Appendix I

of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), with a derogation for eight ranching countries (Botswana, Ethiopia, Madagascar, Malawi, Mozambique, the United Republic of Tanzania, Zambia and Zimbabwe) which have effectively unlimited quotas for specimens produced through ranching and an additional quota for the control of problem-causing wildlife and for trophy hunting.

In practice, the culling of problem animals has several limits. It is often difficult to identify specific animals causing problems to be shot by sport hunters. Most incidents require a rapid response, and it takes some time for the sport hunter to reach the location. Trophy hunters will generally seek the largest animals, while the culprit in human-wildlife conflict incidents may not fit this description.

Furthermore, in order to be viewed as a legitimate management practice, hunting needs to be based on scientific monitoring to ensure sustainable harvests, and needs to be controlled by policies and regulations which address the timing, location and methods of hunting, as well as the distribution of benefits, including meat, to all stakeholders.

The regulated culling of animals through hunting is not always effective in reducing crop and livestock losses since the method does not ensure that the culprit is removed. It may even increase the risk of further losses, when dangerous carnivores are wounded instead of killed (Treves and Karanth, 2003).

Finally, many regrettable illegal off-takes of elephants, lions, hippopotamuses, crocodiles and buffalos have been carried out by emergent safari outfitters operating under the guise of PAC services with an apparently unlimited quota system bought from the respective authorities. To avoid creating incentives to hunt animals other than those that are causing problems, the Ministry of Environment and Tourism of Namibia is establishing a guideline price for the trophy hunting of problem-causing animals which makes provision for variation in the quality of trophies (Government of Namibia, 2007).

ENVIRONMENTAL MANAGEMENT

Increasing alternative crops, prey or water points

The use of diversionary tactics, i.e. providing an alternative source of food or water, in an attempt to lessen competition of wildlife with people for crops or water is a less commonly used management approach.

Diversionary fields have reportedly been used successfully to reduce crop damage in the United States (Conover, 2002) and in Europe (Granval, Arnauduc and Havet, 1999). This strategy does not seem pertinent to Africa, where a part of the population is undernourished. However the improvement of habitats in protected areas and their buffer zones could retain wildlife longer and thus decrease the intensity of crop-raiding. Similarly, providing food sources for baboons as a means of reducing damage to timber plantations could attract other troops, increase the number of baboons and by extension the damage they cause in the short or long term. In addition, the cost of this solution could be high depending on the food provided.

The most promising solutions appear therefore to be protecting the prey that wild carnivores depend on for food, and providing alternative water sources for both herbivores and carnivores, in order to reduce sources of conflict with people.

Protecting the prey of wild carnivores. Preventing poaching and the commercial harvest of natural prey would maintain adequate populations and restore the natural balance between predator and prey, thus preventing carnivores from relying on a diverse diet that includes domestic livestock (Polisar *et al.*, 2003). In the United Republic of Tanzania, the bush pig is the most likely maintenance diet for lions in highly disturbed agricultural areas. Farmers sleep in their fields to guard their crops from pigs, and this seems the most likely scenario in which lions learn to eat people. Strategies to control pig populations close to village farmlands could help prevent lions from being attracted to populated areas in the first place (Packer *et al.*, 2006).

As far as crocodiles are concerned, any environmental management that improves the availability of fish would have a beneficial effect on reducing human-wildlife conflict. Fishers would have less incentive to move into new areas that are less heavily exploited and thus inhabited by higher concentrations of crocodiles.

Alternative water sources for wildlife species. In Kilimanjaro Heartland, AWF rehabilitated the water supply at Imbaringoi in 2004 to serve the livestock and people living in the Kitirua Concession Area and prevent livestock from wandering into the Amboseli National Park in search of water. This has had the immediate effect of reducing encounters between livestock and wildlife in the park, and has consequently reduced the level of conflict in the area. In the same year, a water point was also rehabilitated in the Samburu Heartland to supply water to community areas, create separate drinking points for wildlife and livestock and help boost the tourism potential of the community areas (Muruthi, 2005).

The creation of new water points was also proposed by local populations of the Gourma region in Mali who wished to conserve local elephants while improving cohabitation with them (Alfa Gambari Imorou *et al.*, 2004). The provision of water points is also under consideration in Mozambique to encourage those living in Gorongosa National Park to move to the periphery, while making natural water available for wildlife in the park.

The development of alternative water supplies from boreholes and wells would also reduce the number of activities exposing people to hazardous encounters with crocodiles (e.g. while bathing, washing and collecting water) while reducing the risk of disease through the provision of drinking groundwater.

Finally, water management can be a good means of reducing wildlife populations when increasing numbers generate human-wildlife conflict. The closure of water points in protected areas on a temporary or permanent basis has been suggested as a possible means of decreasing the number of elephants by obliging the elephants to make longer journeys to feed and drink while increasing mortality in younger

BOX 27

The adverse effect of land-use planning on human-wildlife conflict

In Botswana, veterinary zoning regulations placed a ban on keeping cattle to the north of the Southern Buffalo Fence erected to separate buffalo and other wildlife from cattle herds to the south. This seriously affected the livelihoods of local populations; in an area where agriculture had been made difficult due to the threat of crop-raiding elephants, cattle-farming had become a major source of income (AWF, 2005).

In Namibia, the Green Scheme was established in 2002 under the Ministry of Agriculture, Water and Rural Development with the aim of enhancing socio-economic development for the country's rural communities, notably by supporting the development of a sustainable and competitive agricultural sector and facilitating the empowerment of small-scale irrigation farmers (Botschaft von Namibia, 2008). The resulting land-use plans were based on the analysis of the quality of the soils. Where the analysis results meet established standards, the area is devoted to agriculture, leading to potential conflict between wildlife and newly settled farmers.

individuals (Mabunda, 2005). Baboon populations could also be controlled by restricting their access to water.

Land-use planning

Land-use planning is a basic human-wildlife conflict management strategy which offers possibly the best chance of overall and long-term success. Unlike strategies of protection and mitigation, it tackles the root of the problem. It is therefore a preventive approach designed to alleviate human-wildlife conflict by creating landscapes in which people and wildlife can co-exist and have as little negative impact on each other as possible (Muruthi, 2005).

Land-use planning is typically a long-term process that requires government support, legislation and policy changes. It can be extremely expensive to implement, for this reason land-use plans are rarely implemented on a large scale in Africa. On the other hand, land-use plans designed to reduce wildlife losses can be usefully developed and implemented at local level (Muruthi, 2005).

National land-use planning should be designed through a coordinated approach involving all government departments, especially those dedicated to wildlife and national parks, and relevant development projects. Uncoordinated planning could only increase the human-wildlife conflict instead of mitigating it (Box 27).

The following are two possible options for using land-use planning to prevent and/or mitigate human-wildlife conflict.

Planning and manipulating the distribution of human activities. Where crop-raiding occurs, the underlying problem is that farmers are growing food crops close

to areas inhabited by wildlife. The most practical land-use planning techniques for managing human-wildlife conflicts with farming communities are therefore:

- relocating agricultural activity out of wildlife range;
- moving crop fields from the forest edge closer to dwellings;
- reducing human settlement encroachment into wildlife range, by repositioning the boundaries of protected areas or creating buffer zones (WWF SARPO, 2005).

Likewise, in order to avoid livestock raids and reduce carnivore-human conflict, carnivore attacks and the long-term costs of carnivore conflict and management, new human settlements should avoid those areas where lions are likely to be present (Quigley and Herrero, 2005).

Obviously, areas that are important for cattle or agriculture rather than wildlife should be devoted to animal husbandry or crops, while areas of particular wildlife importance such as strongholds, corridors, and economically viable wildlife-use areas, should be dedicated to wildlife conservation.

The clear designation of areas suitable for human activities and areas exclusively devoted to wildlife certainly helps mitigate human-wildlife conflicts while contributing towards resolving them in the long term. An example of such a policy is described in Box 28.

The creation of wildlife corridors linking wildlife areas, where human activities are forbidden and wildlife are free to move between human settlements, has been considered for elephants whose seasonal movements are a major cause of human-wildlife conflict (Alfa Gambari Imorou *et al.*, 2004; Mabunda, 2005; WWF SARPO, 2005), as well as for carnivores (Quigley and Herrero, 2005). This strategy can help alleviate human-wildlife conflict, but also carries major consequences for people living in and near these corridors where human-wildlife conflict is likely to escalate.

BOX 28

Establishing zones for wildlife and human activities

In Namibia, within the framework of the new policy on human-wildlife conflict management, the Ministry of Environment and Tourism will declare areas with chronic problems as human-wildlife conflict zones. Specific regulations will be developed for these zones, ensuring appropriate assessments are carried out and management plans are in place before new developments – such as new water points or agricultural schemes – are introduced. In addition, the Ministry of Environment and Tourism will advise and assist the Ministry of Land and Resettlement to ensure that land-use planning and the planning of resettlement schemes at local, regional and national levels take human-wildlife conflict into account. For example, land-use planning should consider agricultural schemes and the distribution of cultivations so as to leave corridors for the movement of wildlife (Government of Namibia, 2007).

Similarly, by zoning lakes and dams into areas designated for fishing and others closed to fishing to ensure successful spawning and recruitment of juvenile fish, as well as effectively policing and controlling gill net fisheries as a whole, it should be possible to reduce the frequency of conflict with crocodiles considerably. This however, requires skill and resources beyond the means of most African fisheries or wildlife authorities.

The development of improved transport options could also reduce the risk of fatal encounters with wildlife, such as those that currently take place when humans circulate on foot or on bicycles at night in areas frequented by dangerous animals such as lions, hippopotamuses or elephants, or when they cross rivers by wading or with dugout canoes. Similarly, in places inhabited by dangerous animals, toilets must be situated close to houses and should not be used at night.

Zoning around protected areas. Zoning has been widely used in biodiversity conservation and the creation of national parks, natural reserves and other protected areas (Box 29). It refers to any form of geographically differentiated land management where different forms of potentially conflicting land use are given priority in different areas. If a zoning approach is chosen, it is vital to scale management zones to the size of the biological process they are designed to manage. For instance, carnivores must be allotted bigger land areas than other terrestrial species groups (Linnell *et al.*, 2005).

BOX 29

Two examples of zoning around protected areas

In order to reduce conflict between humans and elephants in Ghana, a proposal to zone farming land has been put forward, whereby farmers with land within 1 km of a park boundary are discouraged from growing food crops over time, and are encouraged instead to cultivate crops that are unpalatable to elephants (Barnes *et al.*, 2003). This would make the land immediately adjacent to the park boundary less attractive to elephants. In the second zone, more than 2 km from the park boundary, farmers would be able to cultivate subsistence food crops.

The creation of hunting blocks or wildlife or game management areas at the boundaries of protected areas, on either state-owned or private land, is a form of zoning widely used in Africa. One advantage is that the interface of human-wildlife conflict is displaced from the park boundaries to the boundaries of the blocks which act as a buffer zone (Loveridge, 2002). Another advantage is that wildlife management in these zones whether for consumptive and, to a lesser extent, non-consumptive purposes, reduces human-wildlife conflict by controlling wildlife populations and generating income.

Zoning sets up areas with different:

- degrees of protection;
- thresholds for the initiation of control activities;
- hunting regimes;
- implementation of compensation;
- economic incentives to mitigate conflicts.

Zoning offers many advantages in terms of mitigating human-wildlife conflict. It focuses resources for costly conflict reduction and intensive conservation measures on limited areas. It simplifies management procedures which can be initiated without time-consuming investigation when responses depend on specific locations of conflict. Zoning allows for a degree of predictability, so that people can make long-term plans and economic investments knowing to what extent wildlife will be part of their future, and it may even allow people to become accustomed to the presence of wild animals, and thereby reduce levels of fear.

However, a number of sociological, political and ethical disadvantages to zoning must be considered (Linnell *et al.*, 2005). For instance, a disadvantage of zoning is that it may decrease people's tolerance of wildlife, especially for those living outside the area where wildlife damages are compensated. This situation could be alleviated by integrating these people/areas into CBNRM programmes (see Box 21) as a form of land-use planning (WWF SARPO, 2005).

Legal and institutional development is necessary in order to achieve an integrated landscape, and should be faced and tackled upfront, given that any agreement on land-use changes will take several years (WWF SARPO, 2005).

The design of a specific policy dealing with human-wildlife conflict management could be a useful tool in this respect. This has been demonstrated in Namibia, where the recently adopted policy considers the following priorities as part of its strategic approach to managing human-wildlife conflict: giving preference in allocating concessions to those living close to protected areas such as conservancies to help offset livestock and crop losses as a result of human-wildlife conflict, and promoting the adoption of compatible land uses such as wildlife and tourism on land adjoining protected areas in order to reduce human-wildlife conflict (Government of Namibia, 2007).