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INTERACTIONS BETWEEN ELEPHANTS AND PEOPLE

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INTRODUCTION

MOST PRESENT-DAY interactions between elephants and people in South Africa occur within conservation areas, and are predominantly positive. However, human–elephant interactions in Africa have received increasing attention in the scientific literature in the last decade because of a perceived rise in levels of conflict between the two (Hough, 1988; Thouless & Sakwa, 1995; Tchamba, 1996; Naughton *et al.*, 1999; O'Connell-Rodwell *et al.*, 2000; Dublin & Hoare, 2004). Important advances have been made in researching, responding to, and reducing conflict between elephants and people across the continent (Hoare, 2000; Dublin & Hoare, 2004; Sitati, 2007), and are discussed later in this chapter. However, the 'conflict paradigm' (Lee & Graham, 2006) has presented an unbalanced perspective on the way elephants and humans interact by overlooking positive interactions. This chapter seeks to redress this oversight by additionally assessing a range of positive types of interactions, such as between tourists and elephants.

Because human–elephant conflict (HEC) is a highly emotive and politicised issue, it is reviewed in this chapter in detail. The attention it receives is not meant to reflect the current scale of the problem in South Africa. Rather, it provides a comprehensive assessment to aid formulation of policy in the current context, while recognising that HEC could become an increasingly important political issue in South Africa with the expansion of conservation areas, growing elephant populations, a burgeoning tourism industry, and greater participation by rural communities in resource management.

Elephants and people have interacted in Africa for thousands of years. Humans have preyed on elephants since the Stone Age, as evidenced by rock art depicting elephant hunts (Carrington, 1958). However, the advent of cultivation probably changed the relationship between the two species from one of 'a mild predator/prey interaction' to one that was 'fundamentally competitive' (Parker & Graham, 1989). Humans and elephants have the same habitat preferences, and this would have given rise to localised competition between the two for

space, probably resulting in elephants raiding people's crops from time to time (Parker & Graham, 1989). It has been speculated that wide stone walls constructed around ancient villages may have been to deter crop-raiding elephants (Clutton-Brock, 2000). However, some indirect interactions between elephants and people in pre-colonial times were also positive. Localised bush encroachment caused by overgrazing by livestock may have favoured elephants (Parker & Graham, 1989). Conversely, elephants could have caused the local disappearance of tsetse fly, which is a vector for sleeping sickness, by opening up thickets and woodlands (Ford, 1966), and thus creating new areas suitable for human habitation (Parker & Graham, 1989). Various African societies have totems and folklore about elephants which are indicative of respect (Mutwa, 1997).

Human–elephant interactions during the colonial period were characterised by the decimation of elephant populations by sport and ivory hunters (see Chapter 1). However, since the late colonial period, and into the post-colonial era, interactions between people and elephants have intensified and diversified with the growth of human populations, expansion of conservation areas, and localised increases in elephant populations (Tchamba, 1996; Hoare & Du Toit, 1999; Smith & Kasiki, 2000; O'Connell-Rodwell *et al.*, 2000; Sitati, 2007). This is particularly relevant to South Africa, where elephant conservation and the unprecedented expansion of both state and private protected areas has resulted in a dramatic recovery of elephant populations since the 1960s (Hall-Martin, 1992), drawing in a greater range of role players and creating new types of human–elephant interactions.

SOCIETAL VALUES AND ATTITUDES TO ELEPHANTS

Many controversies over wildlife management become acrimonious because they are either conducted at cross-purposes or reflect fundamental differences in values and attitudes that cannot be changed through argument (Bell, 1983; see also *Conservation and Society* 4(3) 2006 on evictions from national parks). Also, there is a tendency to find short-term solutions to issues that derive from distal or long-term causes. Conflict arises when management decisions do not suit all stakeholders and when unpopular decisions are taken (Caughley & Sinclair, 1994). For example, Leakey (2001) cites the conflict that can arise over nature conservation when wealthy tourist demands are contrasted with those of the poor and hungry. In many instances there are no clear 'right' or 'wrong' answers to the difficult questions arising from the complex socio-economic dimensions of wildlife management. Rather than discussing these further, this

chapter describes how elephants are perceived and lists the values that tend to shape attitudes and perceptions.

People view elephants variously as beautiful and charismatic icons of conservation, dangerous and destructive pests, a valuable and exploitable resource, and as keystone species in ecosystems (Hoare, 2000; Dublin & Hoare, 2004). These different attitudes reflect different societal values, which are defined as 'conception[s] of what is good' (Rokeach, 1973). People's values are socially constructed and are shaped by factors such as personal experience, ethnicity, culture, gender, age, socio-economic context, and political orientation (Steel *et al.*, 1994; Manfredo & Zinn, 1996; Vaske & Donnelly, 1999; Dougherty *et al.*, 2003; Lockwood 2006). A range of different types of societal values of wildlife have been recognised (Giles, 1978; Rolston, 1988; Gilbert & Dodds, 2001; Conover & Conover, 2003), and key categories relevant to human–elephant interactions are summarised in table 1. These form the basis of the components of total economic value of elephants discussed in Chapter 10.

According to the cognitive hierarchy model of human behaviour, values held by individuals underpin their attitudes (Rokeach, 1973; Fulton *et al.*, 1996; Tarrant *et al.*, 1997; Vaske & Donnelly, 1999; Tarrant & Cordell, 2002). Specific patterns of values held by a person create 'value orientations' or basic belief patterns, which shape the way the individual interprets and understands the world. This influences the attitudes and opinions held by the person on particular objects or issues. Attitudes, in turn, influence people's behavioural intentions, and ultimately, their behaviour (Fulton *et al.*, 1996; Vaske & Donnelly, 1999).

Sociologists recognise a continuum of environmental value orientations in society (Vaske & Donnelly, 1999). Glaser (2006) suggests that this variation can be represented by human-nature mind-maps. At the one end is the *anthropocentric* value orientation, based on a definition of nature through a 'social lens' (Glaser, 2006), focusing on human uses and benefits from nature (Vaske & Donnelly, 1999). Society and nature are conceived of as two separate systems. At the other end is the *biocentric* or *ecocentric* value orientation which considers society as part of nature (Glaser, 2006), and places greater emphasis on the non-use values of biodiversity (Vaske & Donnelly, 1999). Mental models in this value orientation include the traditional African world-view (Mutwa, 1997), as well as western notions of 'pristine nature' impacted by society, and absolute biocentrism typified by the 'deep ecology' model, which regards humans and their needs as no more important than those of any other species (Glaser, 2006).

Value	Definition	Relevance to elephants
Aesthetic	Appreciation through the senses	People enjoy observing elephants because of their size and power
Commercial	Importance for generating income	Non-consumptive use, such as tourism, and consumptive use, such as trophy hunting, use of meat, hides and ivory
Cultural	Importance as cultural symbols	Associated with power and royalty, and used as clan totems and names
Ecological	Role in contributing to ecosystem composition, structure and function	Valued for their role as ecosystem engineers or keystone species
Empathetic	Satisfaction from being able to emotionally relate to another species	General public empathise with elephants as intelligent, social and long-lived creatures
Existence	Sense of wellbeing from knowledge of their existence	Most South Africans have not seen an elephant in the wild but many still care what happens to them
Historical	Symbols of a past era	Nostalgic appreciation of elephants as symbols of 'wild Africa'. 'Big Five' status harks back to the days of the great game hunters and explorers
Recreational	Enjoyment of experience from recreational activities	Tourists enjoy the thrill of finding and observing elephants in the wild and experiences such as elephant-back safaris
Scientific	Importance for the advancement of knowledge and understanding	Great scientific interest in the complex challenge of solving the 'elephant problem'
Subsistence	Used for purposes of non-commercial consumption	Consumption of elephant meat or use of dung for medicinal purposes

Table 1: Key ways in which society values wildlife, with examples specific to elephants

The anthropocentric-biocentric continuum is similar to the utilisation-protection or benefits-existence continua in the wildlife management literature (Fulton *et al.*, 1996; Vaske & Donnelly, 1999). In reality, these value orientations are not mutually exclusive, and individuals or societies may exhibit a combination of values. In fact, Glaser (2006) proposes that 'interdisciplinary' and 'complex systems' mind-maps of human-nature interactions have emerged in the scientific community as a result of dissatisfaction with the reductionism inherent in both anthropocentric and biocentric mind-maps.

The environmental value orientation of an individual will influence his or her attitude to elephants and opinions on issues relating to their management. This helps to explain why two people who are equally passionate about elephants can have diametrically opposing beliefs, attitudes and opinions

on controversial topics such as culling. The biocentric orientation is broad, and underpins both the perspective of animal rights groups who place great importance on the existence value and rights of individual elephants, as well as the perspective of people who believe that the control of elephant populations may be necessary for the greater good of ecosystems and other species. The anthropocentric orientation underlies the perspectives of those who support sustainable utilisation of elephants as a valuable consumptive resource. The deep moral issues associated with these differences in orientations are dealt with in Chapter 9. The perspective of conservation authorities in South Africa today probably reflects a combination of value orientations, simultaneously valuing elephants for their existence value, their ecological role, and their economic importance for tourism. Similarly, tourists may also value elephants for their intrinsic beauty as well as the enjoyment they get from recreation associated with them.

People's values, value orientations and attitudes strongly influence the way they interact with elephants and issues relating to them. For example, people may choose to visit a game reserve to see elephants or pay to hunt them for recreation, become passionately involved in the 'elephant debate' or totally ignore it. Apathy towards issues such as culling may not necessarily be indicative of an uncaring society, but may rather reflect the fact that many people do not consider them of particular concern to society, especially if they are not directly affected materially by what happens to elephants. It is important to note that in addition to being shaped by values, interactions between people and elephants may also themselves shape values. For example, a person who has suffered loss due to elephants, such as through crop damage, may value elephants less for their existence or aesthetic value than somebody who has only had meaningful positive interactions with them.

HUMAN–ELEPHANT INTERACTIONS IN PROTECTED AREAS

Effectively all wild elephant populations in South Africa are confined to fenced national parks, game reserves and privately owned ranches. Particular types of interactions thus occur between elephants and a range of human role-players within clearly defined land use types, or spatial domains. We use this concept as an organising framework to assess human–elephant interactions in South Africa (figure 1).
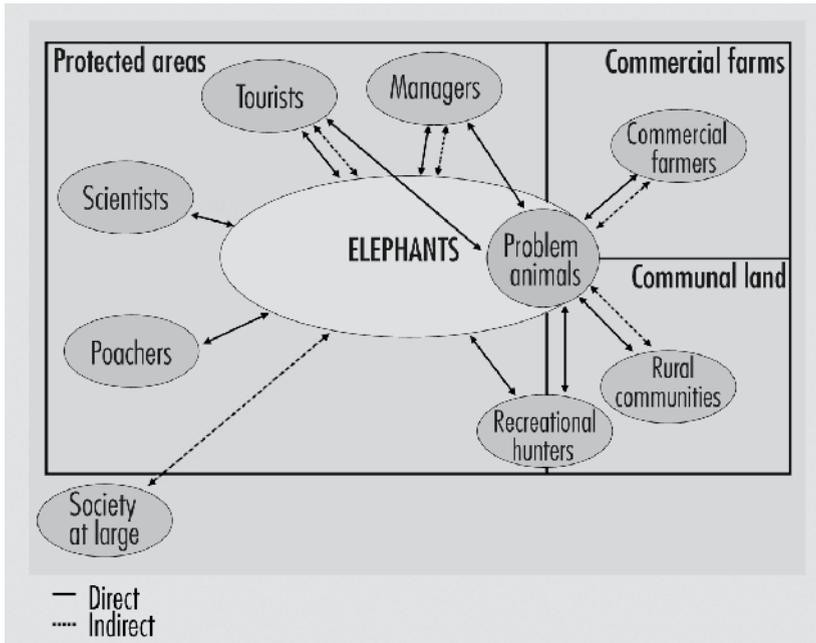
Figure 1: Key human–elephant interactions in different land-use settings

Elephants occur in both privately-owned and state-owned protected areas in South Africa. The primary objective of most private reserves is to generate profits through ecotourism or recreational hunting. Elephants, as one of the 'Big Five', are a huge marketing tool in this regard. Although state-owned reserves also generate revenue, this is to subsidise their primary activity of conserving biodiversity.

Protected areas containing elephants fall into two management categories: 'small' reserves covering less than 1 000 km^2 (i.e. smaller than the typical elephant home range size), and 'large' reserves greater than 1 000 km^2 in extent (Owen-Smith *et al.*, 2006). Wider elephant movement is limited within small reserves, and they are therefore usually characterised by higher elephant densities and levels of impact across the landscape and throughout the year (Owen-Smith *et al.*, 2006). This implies that the intensity of encounters between people and elephants, and levels of management interventions needed, are usually higher in smaller protected areas. Exceptions include large reserves with high elephant densities due to an abundance of artificial water points.

There is little readily available literature on human–elephant interactions in protected areas. Even in books or documents ostensibly dedicated to addressing

the management of mammals in conservation areas (see Jewell & Holt, 1981; Ferrar, 1983; Owen-Smith, 1983) there is no mention of interactions between humans and elephants or other large mammals. We therefore have to infer these from existing data. We assess interactions between humans and elephants within protected areas according to various categories of people involved.

Tourists

Large charismatic wildlife, such as elephants, plays an important role as 'flagship' species which attract tourists to protected areas (Walpole & Leader-Williams, 2002; Lindsey *et al.*, 2007a). South African game reserves attract large numbers of foreign and domestic tourists. For example, overnight visitors to the Kruger National Park (Kruger) increased from 1 million per year in 2002 (Freitag-Ronaldson & Foxcroft, 2003) to 1.3 million per year in 2006 (SANParks, 2007).

Most visitors to parks such as the Kruger are strongly motivated by wildlife experiences (Saayman & Slabbert, 2004), but it is often difficult to tease out the specific contribution of elephants as a motivating factor. However, Kerley *et al.* (2003) found that 77 per cent of tourists visiting Addo Elephant National Park came mainly to see elephants, and most were satisfied if they were successful in that goal, even if they saw little else. Addo would probably enjoy little mainstream tourist attention were it not for the presence of elephants, due to the dense thicket vegetation which makes game viewing difficult. In their assessment of viewing preferences of tourists in four South African savanna game reserves (Kruger National Park, Pilanesberg National Park, Djuma Game Reserve and Ngala Game Reserve), Lindsey *et al.* (2007a) found that elephants were among the most popular species, especially among first-time and overseas visitors. Regardless of the primary motivation for visiting a protected area, positive interactions between tourists and elephants generate public support and goodwill for elephants and conservation in general. Such experiences may galvanise popular opinion on issues relating to elephant management.

Although the overwhelming majority of interactions between tourists and elephants in protected areas are positive, negative interactions also do occur. Elephants may become stressed under conditions of high tourist activity (Pretorius, 2004) or if tourists get too close (Pretorius, 2004; Burke, 2005). Burke (2005) proposed the '50 m rule' based on her observation in Pilanesberg National Park that stress in elephants due to the presence of tourists was substantially reduced at distances greater than 50 m. This needs further investigation in other

settings. In rare instances, elephants injure or even kill tourists. This is discussed in more detail in the next section which deals with human–elephant conflict.

Managers

Interactions between managers and elephants are both direct and indirect, and are covered in detail in Chapters 5–8 and 12. The important point here is that tensions exist between (1) conservation management objectives, which include but also extend beyond elephants (e.g. conserving biodiversity at various scales), (2) the expectations of tourists (either to see more elephants or to see less destruction of vegetation by elephants), and (3) the sentiment of the general public.

Scientists

Elephants generate much interest in the scientific community because of their advanced social behaviour and the substantial impacts they have on the vegetation and other species in the ecosystem. South African scientists have authored or co-authored roughly 150 scientific journal articles dealing with elephant physiology, anatomy, social behaviour, ecology, impacts, and management. Interactions between scientists and elephants are both direct, such as observation of social behaviour, and indirect, such as measurement of elephant damage.

Recreational hunters

Elephants are prized as targets by recreational hunters. Their status as one of the 'Big Five' game species in the contemporary tourism industry originates from their reputation as one of the five most dangerous but highly desirable species during the era of sport hunting in the nineteenth century. Big game trophies, such as elephants, are highly sought after by foreign hunters, particularly from North America and Europe (Taylor, 1993). In South Africa, approximately 30 elephants are hunted annually, mainly on private land (Lindsey *et al.*, 2007b). Taylor (1993) suggests that professional and sports hunters have a potential role to play in the control of problem elephants and in providing an opportunity for rural communities to generate money from elephants on their land. This is discussed further under HEC mitigation strategies. Negative impacts of elephant hunting, other than on the individual killed, include stress in the rest of the proximate population (Burke, 2005, Bradshaw & Schore, 2007),

and genetic shifts in extreme cases of selective hunting (Nyakaana *et al.*, 2001). Attitudes to trophy hunting in South Africa are polarised between those who find it morally reprehensible, and those who support it for the contribution it makes to conservation by generating revenue (Lindsey *et al.*, 2007b).

Poachers

Although it remains a factor in elephant management, poaching has significantly diminished as a concern in South Africa. For example, poaching of elephants in the Kruger National Park has dropped substantially since the early 1980s, when over 100 elephants were poached in 1981, and has been consistently five or less per year over the last decade (Freitag-Ronaldson & Foxcroft, 2003). The general decline in elephant poaching in South Africa is largely attributed to effective anti-poaching enforcement (Lee & Graham, 2006). The contribution of the CITES ban on ivory trade appears to be minor in comparison to effective management in southern Africa (Stiles, 2004). Most elephant poaching in South Africa, whether by locals or cross-border raids, is commercial rather than subsistence, targeting ivory rather than meat.

Rural communities

Most positive interactions between rural communities and elephants in protected areas are indirect, and include cultural values and economic benefits. Elephants are prominent in African folklore and have particular significance for clans for whom they are a totem, such as the Batloung and Ndlovu clans (Mutwa, 1997). Rural communities thus value elephants in protected areas as part of their cultural heritage. However, although communities living adjacent to South African protected areas allude to the cultural value of elephants and the historical relationships between them and people (see SANParks, 2005), little has been published or is known about the details of these. This needs further research.

Conservation, tourism and recreational hunting create secondary benefits from elephants for local rural communities, such as employment and training. This, in turn, has a positive influence on local attitudes towards protected areas (Anthony, 2007). However, since parks employ a relatively small proportion of the neighbouring population, rural communities have expectations of greater access to other economic benefits from parks. Parks like Pilanesberg and Madikwe in North-West Province outsource management activities such as fence maintenance to contractors in adjacent communities. In the context

of elephant management, community representatives at the Great Elephant Indaba (Berg-en-Dal, 19–21 October 2004) expressed their desire to benefit economically from elephant culling operations in Kruger (SANParks, 2005). This included outsourcing of functions such as processing, marketing and selling elephant by-products like meat and hides (Mabunda, 2005). Community expectations of benefits from culling add another layer of complexity to the culling debate, and therefore need to be investigated further.

Land restitution and the emergence of community-based natural resource management (CBNRM) initiatives provide opportunities for communities to benefit from revenues and employment from tourism and recreational hunting on their own conserved communal land which has been restored to them (see Chapter 10). However, as exemplified by the case of the Makuluke land claim, commercial hunting of elephants in restored communal land within national parks can be politically complex and controversial (Steenkamp & Grossman, 2001). The possibility exists for communal land adjacent to protected areas to serve as 'sink' areas for elephants to disperse from high density areas, within a metapopulation management approach (Van Aarde & Jackson, 2007). This would provide tangible benefits for communities, such as meat and revenue from controlled sports hunting on their land.

Positive direct interactions between rural communities and elephants are limited. Communities get access to meat when problem animals are destroyed, and some local residents visit neighbouring parks as tourists. Anthony & Bellinger (2007) found that rural residents adjacent to the Kruger value elephants for meat and recreation, as well as for ornaments (ivory) and religious purposes. Negative interactions with elephants are discussed under human–elephant conflict.

Society at large

Most people will never see elephants in the wild, but they interact indirectly with images of elephants through the media. The media play a powerful role in shaping public opinion, both domestically and overseas, on controversial issues such as hunting of elephants in contractual parks (Steenkamp & Grossman, 2001). In a modern democracy like South Africa, society at large will ultimately decide on the objectives and desired course of action in the management of the nation's elephants (Owen-Smith *et al.*, 2006).

HUMAN–ELEPHANT CONFLICT IN COMMUNAL LANDS, COMMERCIAL FARMS AND PROTECTED AREAS

Defining HEC and 'problem elephants'

The negative impacts of elephants on humans have replaced the concern over poaching (since the 1970s and 1980s) as the main source of conflict between elephants and humans (Kangwana, 1995; Sitati, 2007). Although some would consider the issue of culling to be a prominent HEC, it is not covered in this chapter, as it is dealt with in Chapters 8 and 9. Current consideration of HEC in the literature typically refers to those interactions between people and elephants which threaten human lives and livelihoods (Hillman Smith *et al.*, 1995; Smith & Kasiki, 2000; Dublin & Hoare, 2004; Thirgood *et al.*, 2005). Such conflicts emerge where human and elephant ranges coincide, either in unprotected landscapes or in land-use mosaics of protected areas and human settlement (Hoare, 1999; 2000). Elephants come into conflict with humans, particularly subsistence farmers, because they are large, strong, social, intelligent, long-lived, require large amounts of food and water, are destructive feeders, can move silently, and move over large home ranges (Smith, 1989; Lee & Graham, 2006).

HEC takes the form of direct and indirect impacts or costs to those affected. Direct costs to humans include destroyed crops, raided food stores, damaged infrastructure and water sources, disturbed or killed livestock, injury, and loss of human life (Thouless, 1994; Tchamba, 1996; Hoare, 1999; Naughton *et al.*, 1999; Hoare, 2000; Dublin & Hoare, 2004; Gadd, 2005; Lee & Graham, 2006). Indirect or social costs include disturbance of normal human activities, such as interference with school attendance (Kangwana, 1995; Kiiru, 1995; Malima *et al.*, 2005), disruption of household chores like collecting water and firewood (Lee & Graham, 2006), loss of time due to guarding fields (Lee & Graham, 2006), and loss of productivity due to sleepless nights guarding fields (Kangwana, 1995; Kiiru, 1995). Injury or death due to retribution by humans are direct costs to elephants, while indirect costs include disturbance and denial of habitat.

In the prevailing context of HEC in Africa, the term 'problem elephants' is typically applied to those individuals or groups which temporarily extend their range into human settlements and engage in activities which negatively impact on humans (Hoare, 1999; 2000). However, in a more general sense, the term also includes elephants which exhibit deviant behaviour that frustrates management activities or objectives *within* protected areas. Examples of these include elephants which habitually damage infrastructure, threaten the lives of staff (Whitehouse & Kerley, 2002) and tourists (Nel, 2004), or kill other

wildlife (Slotow *et al.*, 2000; 2001). These are largely atypical behaviours that are considered unprecedented. It has been suggested that such deviant behaviour is a result of stressors such as culling, hunting, poaching, translocation, habitat fragmentation, and high tourist pressure, which disrupt social processes (Slotow *et al.*, 2000; Nel, 2004; Bradshaw *et al.*, 2005; Bradshaw & Schore, 2007). It could thus be argued that 'problem elephant' behaviour reflects changes in human behaviour.

Hoare (2001) observed that removing individual problem animals frequently does not solve the problem, and he proposed the idea of a 'problem component' within elephant populations. The implication of this untested hypothesis is that as problem animals are removed, others take their place. However, the notion of a 'problem component' may be inappropriate in contexts where human behaviour causing the problem persists, such as cultivating highly desirable foods like maize in unprotected fields close to reserve boundaries. In such cases, the unprotected temptation could be regarded as the problem, not the elephants.

HEC in Africa has received increasing attention in the scientific literature in the last decade (e.g. Kangwana, 1995; Thouless & Sakwa, 1995; Tchamba, 1996; Naughton-Treves, 1998; Hoare, 1999; Hoare & Du Toit, 1999; Naughton et al., 1999; Hoare, 2000; Smith & Kasiki, 2000; De Boer & Ntumi, 2001; Sitati et al., 2003; Dublin & Hoare, 2004; Barnes et al., 2005; Gadd, 2005; Lee & Graham, 2006; Sitati, 2007). Naughton et al. (1999) attribute the perceived intensification of conflicts to a combination of changes in (1) land use, (2) elephant behaviour and socio-ecology due to human intervention, and (3) socio-economic changes in rural communities which bring elephants and humans into closer contact and reduce human tolerance of elephants. However, Lee and Graham (2006) challenge the assertion of intensification of HEC on the basis that it has not been adequately substantiated. Other authors note that reports of HEC may be sensationalised or inflated by the media (Kangwana, 1995; Lee & Graham, 2006).

How much of a problem is HEC?

Direct conflicts between elephants and rural populations in southern Africa are comparatively few (Sitati, 2007). This is perhaps because of the hard-boundary effect created by fencing of protected areas in the region. Although no fence is totally elephant proof (Thouless & Sakwa, 1995), there is strong evidence that electric fences dramatically curb the incidence of elephants leaving protected areas, and they thus substantially reduce the levels of conflict between

elephants and adjacent human populations (Taylor, 1993; O'Connell-Rodwell et al., 2000; Omondi et al., 2004; Kioko et al., 2006). Nevertheless, localised problems with elephants escaping protected areas and causing damage do occur in South Africa. In one of the very few studies quantifying this in South Africa, Anthony (2007) found that 12.1 per cent of households ($n = 240$) in 38 rural communities along the western boundary of the Kruger claimed to have experienced damage from wildlife in the last two years (mid-2002 to mid-2004). Of the 386 reported incidents concerning damage-causing animals between October 1998 and October 2004, 14.5 per cent involved elephants, all of which came from the park.

Damage to crops

Crop-raiding is by far the most common source of HEC in Africa (Newmark *et al.*, 1994; Osborn & Parker, 2003; Sitati *et al.*, 2003; Malima *et al.*, 2005). While impacts of crop-raiding may be catastrophic for individual households, these forays by problem elephants are generally uncommon, localised, and seasonal (Thouless, 1994; Lahm, 1996; Naughton-Treves, 1998; Naughton *et al.*, 1999; Hoare, 2000; De Boer & Ntumi, 2001; Dublin & Hoare, 2004; Sitati *et al.*, 2003; Adjewodah *et al.*, 2005). Although some farmers may experience near-total destruction of their crops, this is exceptional, and damage is usually medium- to low-level (Naughton *et al.*, 1999; Adjewodah *et al.*, 2005; Malima *et al.*, 2005). Caution should be exercised when interpreting data on levels of crop damage in the literature because some studies disproportionately sample areas hard-hit by elephants, making the data difficult to extrapolate (Naughton *et al.*, 1999).

Crop damage by elephants is often less than that caused by livestock (Naughton-Treves, 1998) or other wildlife pests such as insects, birds, rodents, primates, antelope, and bushpigs (Newmark *et al.*, 1994; Lahm, 1996; De Boer & Baquete, 1998; Naughton-Treves, 1998; Naughton *et al.*, 1999; Omondi *et al.*, 2004). In a review of 25 studies of wildlife pests in Africa (South Africa excluded), Naughton *et al.* (1999) found that across all studies, elephants accounted for less than 10 per cent of total crop damage. They concluded that elephants may be a significant pest locally, but not nationally.

Despite their relatively modest impact, elephants are less tolerated than most other wildlife pest species because of their size, which makes them more obvious, and the danger they pose (Naughton *et al.*, 1999; Sitati *et al.*, 2003). It is also widely reported that complaints of crop damage by elephants are usually disproportionate to the actual damage (De Boer & Baquete, 1998; Hoare, 2000; Dublin & Hoare, 2004; Lee & Graham, 2006). Farmers may inflate estimates

of crop damage by up to 30–40 per cent (Tchamba, 1996) in anticipation of compensation (Tchamba, 1995, 1996) or meat from shot problem elephants (Taylor, 1993). Regardless of the level of impact, crop-raiding has a significant negative impact on local people's attitude towards conservation (De Boer & Baquete, 1998; Naughton *et al.*, 1999; O'Connell-Rodwell *et al.*, 2000; Dublin & Hoare, 2004; Gadd, 2005; Sitati *et al.*, 2005) and provides a convenient avenue for them to vent other grievances about neighbouring conservation areas (Naughton *et al.*, 1999; Lee & Graham, 2006).

Our assessment of the South African situation is that crop-raiding is relatively rare, primarily because protected areas are fenced. Nevertheless, elephants do break out and damage crops from time to time (Anthony, 2007). These events are likely to be in localised 'hot-spots' associated with very particular situations, such as where fences are not maintained (Anthony, 2007) or where erecting fences may be difficult, such as along or across rivers (see Chapter 7).

Most of the elephant populations in reserves in Limpopo, Mpumalanga, North-West and KwaZulu-Natal provinces are adjacent to densely populated communal lands. By contrast, the elephant populations in the Eastern Cape (and Welgevonden Private Game Reserve in Limpopo Province) mainly abut privately-owned commercial farms. The human density in communal lands adjacent to protected areas such as the Kruger can be as high as 300 people. km^{-2} (Pollard *et al.*, 2003). This is a legacy of the forced removals during the apartheid era. Black people were displaced from land earmarked for white-owned agriculture or conservation areas, and were crammed into 'homelands'. This resulted in 74 per cent of the population being allocated a mere 13 per cent of the land surface of the country (Anderson *et al.*, 2002). Such human densities greatly exceed the threshold density of around 16 people.km^{-2} beyond which elephants rapidly disappear from savanna landscapes due to insufficient habitat (Hoare & Du Toit, 1999). Human density in the communal lands of the former homelands thus acts as an effective barrier to elephants, and elephant incursions into rural communities are therefore likely to be of short duration and distance.

Even rare, brief crop-raiding incursions by elephants can wreak havoc locally and have a substantial impact on community perception of conservation areas. This is illustrated by a South African study in the lowveld in which 49–80 per cent of respondents in villages bordering protected areas felt that benefits from tourism were not enough to make up for problems with wildlife, including crop-raiding by baboons and elephants, and stock losses to predators (Spenceley, 2005). The bitter association between conservation and displacement, loss of land and exclusion has bred hostility among rural populations towards

protected areas (Fabricius *et al.*, 2001), which is also likely to taint local attitudes to elephants and isolated fence-breaking incidents. Slow response by authorities when elephants break out of protected areas and lack of compensation for damage caused by problem elephants are contentious issues which contribute further to these negative attitudes (Anthony, 2007).

Direct livelihood impacts of crop damage by elephants are likely to be very modest in the communal lands of South Africa, although very poor and vulnerable households will be disproportionately affected. In the rest of Africa, the livelihoods of *subsistence* farmers are the hardest hit by crop-raiding (Smith & Kasiki, 2000; Osborn & Parker, 2002; Dublin & Hoare, 2004). Direct livelihood impacts of crop damage include loss of food sources and income (Osborn & Parker, 2003). However, in South Africa, the subsistence farming peasantry had been virtually eliminated by the end of the 1950s (Seekings, 2000). Small-scale agriculture thus contributes less than a third of total household income in the former homelands (Seekings, 2000; Leroy *et al.*, 2001; Crookes, 2003), and nearly two thirds of rural African households earn nothing at all from agriculture (Seekings, 2000). Rural livelihoods in South Africa are primarily cash-based, with a high reliance on income from migrant labour (May 1990) and government social grants (Carter & May, 1999). Agriculture in communal areas of South Africa therefore plays a safety-net function, rather than being the mainstay of rural livelihoods (Shackleton *et al.*, 2001). However, in relative terms, agriculture makes a greater contribution to the livelihoods of the poorest and most marginalised households in these rural communities (Carter & May, 1999).

Crop-raiding on commercial farms is rare, the damage is probably very localised, and the levels of damage are medium to low. Direct impacts on the livelihoods of commercial farmers are thus likely to be negligible, although they may negatively impact on the attitudes of farmers to elephants and conservation areas. Crop-raiding on commercial farms was largely eliminated around the Addo Elephant National Park with the construction of the elephant-proof Armstrong fence in the 1950s (Woodd, 1999). However, raiding of neighbouring citrus farms may become a problem in the future as the elephant population expands into new sections of the park fenced with more conventional game fencing. In the lowveld, elephants used to make frequent forays into commercial sugar cane farms south of the Kruger in the dry season. This was a major reason for electrifying the southern boundary of the park (Bigalke, 2000).

Conflicts with livestock

Few studies have quantified the impacts of elephants on livestock in Africa. Elephants may chase or even occasionally kill livestock (Gadd, 2005; Thouless, 1994), and in situations where elephants live outside of parks, they may also compete with livestock for food (Gadd, 2005; Young *et al.*, 2005) and water (Kuriyan, 2002; Gadd, 2005). However, the scant evidence which exists suggests that conflict with livestock is a minor issue, especially when compared to crop-raiding and the social impacts of HEC (Gadd, 2005; Malima *et al.*, 2005).

We found no documented evidence of disturbance of livestock by elephants in South Africa in recent times. Given that the minority of rural households in the former homelands own cattle (Shackleton *et al.*, 2001), the implications for rural livelihoods of any isolated incidents which might occur are negligible. Similarly, direct impacts on commercial cattle farmers are inconsequential. Implications of fence-breaking for livestock are dealt with under *indirect impacts.*

Damage to property and infrastructure

Property and infrastructure damaged by elephants around human settlements typically includes fences, food stores, and water sources (Kangwana, 1995; Kiiru, 1995; Hoare, 1999; Gadd, 2005; Malima *et al.*, 2005). As in the case of livestock, few studies have quantified this. Destruction of fences is usually collateral damage associated with crop-raiding, while damage to other property or infrastructure appears to be occasional and localised. It is therefore an unimportant issue outside of protected areas at the national level in South Africa. Although the literature focuses on elephants breaking out of protected areas, it should be noted that illegal immigrants and poachers also sometimes cut fences, allowing elephants to leave these areas freely. There is anecdotal evidence that within protected areas, elephants sometimes cause substantial damage to infrastructure, particularly water pipes.

Human injury and loss of life

An objective assessment of the relative impact of injury or loss of human life due to elephants is hard to achieve. Human life should not be lumped together with the value of crops damaged and property destroyed, nor weighed up against the life of an elephant. It could justifiably be argued that one human death is one too many, and the same could be said for an elephant killed. However, human injury and death caused by elephants are very rare events (Tchamba, 1995;

Sitati et al., 2003; Malima et al., 2005), possibly accounting for less than 0.5 per cent of all HEC incidents (Tchamba, 1996; Malima et al., 2005). Incidents resulting in human injury or death are usually 'unfortunate spatial coincidences' when the paths of elephants and people cross (Sitati et al., 2003).

The risk of being killed by an elephant is very low, especially compared to other causes of mortality, such as malaria or motor vehicle accidents (Kuriyan, 2002). Thus, although every injury or death due to elephants is a regrettable tragedy, devastating at the household level, it is not a significant problem at the national level. However, even isolated incidents fuel the pervasive fear of elephants in rural communities, even at some distance from protected areas (Kaltenborn *et al.*, 2006), and sour local perceptions of wildlife and conservation (Thirgood *et al.*, 2005).

Year	Protected areas	Communal land	Enterprises using tame elephants	Total
2002	2	1	0	3
2003	3	2	0	5
2004	2	0	0	2
2005	4	0	1	5
2006	2	0	1	3
2007	0	1	0	1
Total number	13	4	2	19
Per cent	60%	21%	11%	

Table 2: Annual numbers of human deaths caused by elephants in protected areas, communal lands, and enterprises using tame elephants (e.g. elephant theme parks and elephant-back safari operations) in South Africa (from media reports)

In South Africa, based on information gleaned from the media, no more than five people were killed by elephants in any given year over the last five years (table 2). This includes animal handlers killed in enterprises involving tame elephants, such as elephant theme parks and elephant-back safari operations. An important observation is that 72 per cent of all recorded fatalities since 2002 occurred in protected areas, compared with 17 per cent in communal lands and 11 per cent in elephant-based enterprises. It is possible that there may be some minor under-reporting of incidents in remote rural locations outside of protected areas, but it is unlikely that this dramatically alters the picture. These data suggest that staff, tourists, scientists, hunters, and poachers in protected areas are more at risk than neighbouring communities from attack by elephants. The threat particularly to staff and tourists may be increasing due to growing densities of elephant (see Chapter 8) or tourists (Nel, 2004) in many parks.

Indirect costs

The indirect costs of HEC, such as disturbance of normal human activities, are significant and may even outweigh the direct costs in people's experience of conflict with elephants (Hoare, 2000; Dublin & Hoare, 2004; Sitati *et al.*, 2005). Because indirect costs are difficult to quantify, it is not possible to assess their relative impact compared to direct costs. HEC colours rural communities' sentiments towards elephants and conservation in general (Naughton *et al.*, 1999; O'Connell-Rodwell *et al.*, 2000; Dublin & Hoare, 2004; Gadd, 2005), which is a serious indirect cost borne by governments and conservation authorities (De Boer & Baquete, 1998; Naughton *et al.*, 1999; O'Conell-Rodwell *et al.*, 2000; Dublin & Hoare, 2004; Thirgood *et al.*, 2005).

Indirect costs of HEC have not been investigated in South Africa, but based on the relatively low incidence of elephants leaving protected areas, these are likely to be very low for affected communities. An issue not mentioned in studies elsewhere in Africa is the costs associated with other wildlife leaving protected areas when fences are damaged by elephants. This provides opportunities for predators to kill livestock and for the transmission of disease such as foot and mouth disease and corridor disease between wildlife and cattle (see Chapter 7). This has not been quantified, but may be more significant than other social costs to those impacted by sporadic incidents of elephants escaping from reserves. However, the animosity HEC creates towards conservation among rural communities is the most serious indirect cost in South Africa.

Factors determining risk and intensity of conflict

Studies from across Africa reveal a range of spatial, temporal and other factors which influence risk and intensity of HEC. Risk is not evenly distributed and appears to be less predictable in space than in time (Sitati *et al.*, 2003).

Spatial factors

One of the clearest spatial risk factors is distance from the boundary of the protected area. A growing number of studies show that incidence of HEC increases sharply with proximity to protected areas (Barnes *et al.*, 1995; Naughton-Treves, 1998; Naughton *et al.*, 1999; O'Connell-Rodwell *et al.*, 2000; De Boer & Ntumi, 2001; Parker & Osborn, 2001; Barnes *et al.*, 2005; Sam *et al.*, 2005). Exceptions to this pattern are rare (e.g. Hoare, 1999; Smith & Kasiki, 2000; Sitati *et al.*, 2003). Households most affected by damage-causing animals,

including elephants, in the communal lands next to the Kruger were within 3 km of the park boundary (Anthony, 2007).

Proximity to rivers in the dry season is another possible distance predicator of risk. Parker & Osborn (2001) showed that lower frequency but higher intensity crop-raiding occurred close (<5 km) to rivers in the dry season. Communities close to a park boundary defined by a river may thus be at significantly greater risk of crop-raiding, particularly in the dry season. This is intuitive, but needs to be validated with more data. Risk of elephant-induced injury or death may be positively correlated with proximity to roads because of the higher probability of human–elephant encounters along transport routes (Sitati *et al.*, 2003), despite elephant densities possibly increasing with distance from roads (Blom *et al.*, 2004).

Some studies have shown that risk of crop-raiding generally increases with field size (Barnes *et al.*, 2005; Sitati *et al.*, 2005). Others have found that total area of land cultivated in a region, rather than area of an individual field, increases the risk of a field being raided (Sam *et al.*, 2005; Sitati *et al.*, 2005). Yet other studies have shown that total area of land cultivated around a settlement is a weak predictor of risk, and that smaller, more isolated farms are more vulnerable (Malima *et al.*, 2005; Lee & Graham, 2006). We conclude that no consistently predictable relationship exists between risk of crop-raiding and area of cultivation. This may be because of confounding factors such as type and number of crops grown. For example, maize, which is the staple food crop in much of the continent including South Africa, is favoured by elephants (Taylor, 1993; Kiiru, 1995; Smith & Kasiki, 2000; De Boer & Ntumi, 2001; Barnes *et al.*, 2005). Crop-raiding may also increase with increasing number of crops grown (Barnes *et al.*, 2005; Sam *et al.*, 2005). These results imply that rural communities growing maize, along with a mix of other crops, in communal lands may be at greater risk than commercial mono-crop farms. However, a lack of comparative studies precludes affirmation of this possibility.

Neither human nor elephant densities appear to be good predictors of the *amount* of direct conflict between people and elephants (Naughton-Treves, 1998; Hoare, 1999; Hoare, 2000; Dublin & Hoare, 2004). However, Nel (2004) observed a correlation between the increasing number of 'serious elephant incidents' and the rising number of tourist beds (an indication of the number of game drives) in Madikwe Game Reserve from 1992 to 2004. As he pointed out, this apparent relationship needs to be explored further.

Temporal factors

The large majority of crop-raiding incidents and elephant attacks on people in communal lands occur at night (Hillman Smith *et al.*, 1995; Hoare, 1999; Smith & Kasiki, 2000; Osborn & Parker 2003; Sitati *et al.*, 2003; Sitati *et al.*, 2005; Kioko *et al.*, 2006). Elephants are most likely to raid crops after dark in order to minimise the risk of being detected. This would account for crop-raiding being lowest during full moon (Barnes *et al.*, 2007). By contrast, almost all elephant attacks on people in protected areas in South Africa occur during the day, when humans are most active in elephant habitat.

Elephant crop-raiding is strongly seasonal, with highest frequency of raids occurring when crops are mature and ready for harvesting (Hillman Smith *et al.*, 1995; Kiiru, 1995; Hoare, 1999; Parker & Osborn, 2001; Adjewodah *et al.*, 2005; Malima *et al.*, 2005; Sam *et al.*, 2005). This has also been noted in communal lands of South Africa (Spenceley, 2005), and is particularly frustrating for farmers.

Behavioural factors

Risk of HEC incidents is also influenced by the behaviour of both elephants and humans. Crop-raiding usually involves female-led mixed groups (Smith & Kasiki, 2000; Sitati *et al.*, 2003; Malima *et al.*, 2005), although lone bulls or small male groups may be the dominant crop-raiders in particular areas (Hoare, 1999; Chiyo & Cochrane, 2005; Kioko *et al.*, 2006). Habitual fence-breakers or crop-raiders are often bulls (Thouless & Sakwa, 1995; Hoare, 1999). Most crop-raiding groups are relatively small, consisting of 10 or fewer individuals (Smith & Kasiki, 2000; Sitati *et al.*, 2003; Malima *et al.*, 2005; Kioko *et al.*, 2006).

Bulls are more risk-tolerant than females and are therefore more likely to be problem animals in risky situations, such as close to towns and roads (Hoare, 1999; Sitati *et al.*, 2003). The physiological state of individual bulls influences risk of life-threatening encounters with them. Males can be extraordinarily aggressive when in musth, a period of heightened testosterone levels indicated by copious secretion from the temporal glands (Poole & Moss, 1981). However, bulls in this state are less likely to engage in crop-raiding as their priorities change from feeding to fighting and breeding (Hall-Martin, 1987; Poole, 1989). Human behaviour is also a key factor, and attacks on people by elephants are usually associated with situations where people get too close to elephants which are traumatised, sick, injured, harassed, bulls in musth, or females with young calves (Leggat *et al.*, 2001). Bradshaw *et al.* (2005) and Bradshaw

& Schore (2007) argue that stress caused by social disruptions associated with culling, translocation and habitat loss underlie such aggressive behaviour.

Mitigation of HEC

Over a decade of research on HEC has yielded insights on mitigation strategies which show potential for reducing conflict between people and elephants, and increasing tolerance of affected communities towards elephants. These lessons are useful for informing policy and national mitigation strategies to address both current and future HEC scenarios. The IUCN African Elephant Specialist Group (AfESG) uses the term 'mitigation' rather than 'prevention', based on the belief that HEC can never be totally eliminated, but should be reduced to local tolerance levels (Dublin & Hoare, 2004). Nelson *et al.* (2003) provide a detailed review of strategies for managing HEC. Options for mitigating HEC are briefly discussed below, and methods for changing elephant behaviour are discussed in more detail in Chapter 7.

Strategies used by rural communities

Traditional methods still used by rural communities include guarding fields, making loud noises, making fires, clearing field boundaries, erecting simple barriers, planting decoy foods or unpalatable crops, and using traps, spikes and home-made weapons (Nelson *et al.*, 2003). These are largely ineffective, especially in the long term (Osborn & Parker, 2002; 2003; Nelson *et al.*, 2003). Elephants often become habituated to some of these methods (Thouless, 1994). Little is known about indigenous knowledge relevant to mitigating elephant impacts in pre-colonial times.

Strategies currently used by conservation authorities

Electric fences are the most effective barrier to elephants (O'Connell-Rodwell et al., 2000; Osborn & Parker, 2003) and are the most important and effective proactive HEC mitigation strategy employed in South Africa. However, although they can substantially reduce incidents of HEC, they are not impregnable to elephants (see Chapter 7) and their effectiveness is highly dependent on regular maintenance (Nelson *et al.*, 2003). Rural communities who experienced damage from elephants escaping from the Kruger blamed the park authorities for not maintaining the boundary fence (Anthony, 2007). Fences may be most effective when combined with punishing offenders (O'Conell-Rodwell

et al., 2000). Refer to Chapter 7 for a discussion of the effects of fences on elephant movement.

Reactive strategies currently used by South African conservation authorities are *disturbance methods* (firing weapons to scare off elephants and driving stray elephants back into parks with helicopters, vehicles or people) and *problem animal control* (killing problem elephants). Although firing weapons to scare elephants usually provides initial relief, it is seldom effective in the long term (Nelson *et al.*, 2003), and elephants can become habituated to such techniques (Kangwana, 1995). Stress associated with some of these techniques may exacerbate the problem (Bradshaw & Schore, 2007).

Killing problem animals is a quick-fix solution with high public relations value because authorities are seen to be doing something and communities usually get the meat. Although often regarded as one of the most effective means of controlling problem elephants, limitations of this approach include: (1) it is dangerous and needs to be conducted by well-trained personnel, (2) it is often difficult to identify culprits since elephant forays out of protected areas usually occur at night, and the culprit may rejoin herds once back in the park, (3) it is a poor deterrent to other elephants, and other individuals may move in to replace the culprit as problem elephants, (4) it may cause stress in other elephants, (5) response by centralised authorities is often slow, and (6) it raises difficult ethical questions (Kangwana, 1995; Hoare 2001; Osborn & Parker, 2003; Nelson *et al.*, 2003; Burke, 2005; Bradshaw & Schore, 2007). Refer to Chapter 8 for further discussion of lethal methods of controlling problem elephants.

In the context of South African legislation (*res nullius* principle – see Chapter 11), the authority responsible for destroying a problem animal is usually not the authority managing the protected area from which the elephant escaped. This may result in further delays and cause confusion among affected communities as to who is responsible (SANParks, 2005). Currently, South African communities receive meat from shot animals, but do not get any direct economic benefit from them.

Other strategies for consideration

One of the first responses of rural communities to damage caused by wildlife is to demand *compensation*, especially if the animals are viewed as property of the state (Nelson *et al.*, 2003; Nyhus *et al.*, 2005). A number of African states experiencing HEC, including Kenya, Botswana, Malawi and Zimbabwe, have implemented or experimented with compensation schemes, and most have abandoned them. Major problems with compensation schemes include

(1) high administration costs, (2) lack of funds, (3) challenge of accurately and promptly verifying damage, (4) lodging of fraudulent claims, (5) disincentives for guarding fields, (6) subsidising uneconomical agriculture, and (7) no discernable improvement in relations between communities and conservation authorities (Bell, 1984; Thouless, 1994; Taylor, 1993; Taylor, 1999; Bulte & Rondeau, 2005; Nyhus *et al.*, 2005). Like many of the other strategies, compensation addresses the effects of HEC, not the cause (Hoare, 1995), and should therefore complement proactive measures to reduce HEC incidents (Nyhus *et al.*, 2005). This highly emotive issue needs to be considered as a policy option with caution.

Experimentation with *repellents* has shown that chilli (*Capsicum*) products, such as aerosol sprays, grease or smoke are effective in repelling elephants (Osborn & Rasmussen, 1995; Osborn, 2002; Nelson *et al.*, 2003). However, these are expensive (Osborn, 2002), and therefore not viable on a large scale or in poor rural communities if not subsidised or locally produced using simple technology. Most other repellent techniques, such as auditory repellents (e.g. elephant distress calls) (O'Connell-Rodwell *et al.*, 2000) and bees (Karidozo & Osborn, 2005), are ineffective.

Since rural communities incur costs from elephant damage and mitigation, they should also receive greater benefits, which would increase community tolerance of elephants (Leader-Williams & Hutton, 2005; Walpole *et al.*, 2006). Options for *community beneficiation* range from 'outreach programmes' in which revenues from protected areas are shared with neighbouring communities, to Community Based Natural Resource Management (CBNRM) projects where communities are empowered to manage their natural resources and earn income from elephants on their own land, through tourism or commercial hunting concessions (Nelson *et al.*, 2003). Some of this income could be used to insure households against damages caused by elephants. Ironically, the *res nullius* law (see Chapter 11) which creates ambiguity around managing HEC in South Africa, also provides an opportunity for communities to benefit economically from elephants that wander onto communal land. CBNRM holds much promise for enabling communities to better respond to HEC and realise benefits from elephants (Omondi *et al.*, 2004). A positive spin-off is increased community tolerance of elephants (Taylor, 1993). However, CBNRM is difficult to apply for many reasons, many of which have to do with the complex nature of communities (Nelson *et al.*, 2003; Koch, 2004). CBNRM is in its infancy in South Africa, and the role of elephants in revenue generation in the flagship Makuluke project remains to be seen. For further discussion of the economic benefits of CBNRM for rural communities, see Chapter 10.

One option for generating revenue for communities and conservation is to integrate *commercial hunting* safaris into problem animal control strategies (Leader-Williams & Hutton, 2005). This has been employed in CAMPFIRE projects in Zimbabwe where income from commercial hunts has been shared with local communities as an incentive to conserve wildlife on communal land (Taylor, 1993). However, challenges include: (1) quotas can be manipulated, (2) problem elephants are not always desirable trophy animals, (3) problem elephants are often difficult to identify, and 4) professional hunters seldom have clients ready and waiting to quickly respond to a HEC incident (Taylor, 1993; Nelson *et al.*, 2003). Members of rural communities adjacent to Kruger have expressed interest in being trained as professional hunters (SANParks, 2005), which may improve the efficiency of problem animal control while creating local employment and revenue. Thus, although hunting problem elephants is unlikely to be an effective method for reducing the incidence of elephant break-outs from reserves, it has potential of contributing to poverty mitigation and increasing local tolerance of HEC.

Land-use planning has been identified as being fundamental to managing HEC (Hoare, 2000; Omondi *et al.*, 2004). This can occur at a national level, such as in Namibia, where the entire country was classified into different elephant use zones (Kangwana, 1995), and at local level, such as the Nyaminyami CAMPFIRE project in Zimbabwe, where communal land was zoned into settlements and fields, elephant sanctuary, and safari hunting areas (Taylor, 1993). Buffer zones – areas with low human and elephant density and minimal agriculture – between protected areas and settlements could lessen the incidence of conflict between humans and elephants (Taylor, 1982). However, large areas of high human density and transformed commercial agricultural land abut protected areas in South Africa. These contexts produce hard edges and an inflexible land-use template, which pose a challenge to land-use planning for mitigating HEC. Nevertheless, this needs to be explored further.

HEC policy

Lack of adequate HEC policy leads to crisis management which focuses on the effects instead of the causes of the problem (Kangwana, 1995). The negative political impacts of HEC are usually also disproportionate to the actual impacts on people and their livelihoods. Clear policy on dealing with problem elephants is thus vital for government credibility (Dublin & Hoare, 2004), especially given the emotive nature of the issue. Policy should clearly state who holds responsibility for problem elephants and define appropriate responses for

particular situations (Kangwana, 1995). Greater attention needs to be given to involving and empowering local communities in HEC mitigation, including mechanisms for communities to gain more economic benefits from elephants. It is clear that no single strategy on its own will be sufficient and policy will thus need to integrate different approaches to addressing HEC proactively (Omondi *et al.*, 2004; Walpole *et al.*, 2006).

For South Africa, HEC policy is also important within the regional context, given the emergence of transfrontier conservation areas (TFCAs) with neighbouring countries such as Mozambique, Swaziland, Zimbabwe and Botswana. Three existing or potential TFCAs, namely the Great Limpopo Transfrontier Park (GLTP), Lubombo Transfrontier Conservation Area (LTCA), and Limpopo-Shashe Transfrontier Conservation Area (LSTCA), contain populations of elephants. Indeed, providing more habitat for elephants, reconnecting isolated populations, and relieving population pressure in areas with high elephant densities has been an important conservation motivation for creating TFCAs (Hanks, 2000; 2003). A potential policy consideration is South Africa's position in situations where neighbouring states experience high levels of HEC in TFCAs sharing elephant populations with South Africa.

CONCLUSION

Elephants and people interact with each other both directly and indirectly, and positively and negatively. Our Assessment has shown that most of these interactions occur within conservation areas, and are predominantly positive. Further, levels of direct conflict between humans and elephants outside of protected areas are generally low. However, the impact of sporadic conflict incidents outside of protected areas has a negative effect on local attitudes towards elephants and conservation, often disproportionate to the actual damage caused. An important observation is that human–elephant interactions ending in human injury and death are very rare and occur mainly in protected areas. Phenomena such as the expansion of conserved land, growing elephant populations, intensification of ecotourism, and increasing inclusion of rural communities in resource management are expected to intensify interactions between humans and elephants in South Africa. This will necessitate adequate policy and management strategies for mitigating and responding to conflict between humans and elephants. At the same time, efforts need to be made to address some of the misconceptions about human–elephant conflicts.

Key information gaps identified by the authors, particularly for the South African context, include:

- The historical relationship between indigenous human populations and elephants, including indigenous knowledge and cultural beliefs, practices and values.
- Contemporary societal value systems underpinning opinions that give rise to conflicts over elephant management, and the factors shaping these value systems.
- Size, characteristics, and opinions of different elephant stakeholder groups.
- Comprehensive and consistent records of elephant break-outs from protected areas, analysis of factors determining the probability of break-outs, and quantification of direct and indirect impacts on humans.
- The incidence and determinants of human–elephant conflict within protected areas, including attacks on humans, destruction of infrastructure, and tourist pressure on elephants.
- Locally appropriate models for beneficiation of rural communities from elephant conservation and management.

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