Mitigation of human-elephant conflict in the Kavango-Zambezi Transfrontier Conservation Area through Community Based Problem Animal Control, with particular reference to the use of chilli peppers.

Final Report: December 2006

Prepared for Conservation International by John Hanks

Table of Contents

Acknowledgements

It was encouraging to find interest and support for this initiative from a wide range of people involved in human-elephant conflict issues and Community Based Problem Animal Control projects throughout the KAZA TFCA and in organizations and institutions outside of the region. In particular, I would like to thank the following for granting me time to discuss concepts and / or sharing with me reports and unpublished information on HEC related activities: Nad Brain, Leo Braack, Michael Chase, Richard Diggle, Nina Gibson, Anja Held, Tom Heineken, Roy Kanga, Malvern Karidoza, Luscious Mafwila, Charles Matengu, Tammie Matson, Sibangani Mosojane, Beavan Munali, Nyikavanhu Munodawafa, Carol Murphy, Mike Musgrave, James Mwanza, Patrick Myirende, Loki Osborn, Garth Owen-Smith, Ron Phillips, Alessandro Ricoveri, Nesbert Samu, Roger Short, Alfred Sibonga, Jonathan Smith, Lovemore Sola, Joss Swennenhuis, Chris Weaver and Graeme Wilson.

I would also like to thank Kellie Landon for her permission to use her photographs for the cover and for Plate 1, Graeme Wilson for his permission to use his photographs in Plates 6 - 8, and 10 & 11, and IRDNC for permission to reproduce the poster in Annex 5.

Executive Summary

This initial analysis has confirmed that human-elephant conflict (HEC) is escalating in Botswana, Namibia, Zambia and Zimbabwe and is likely to be further accentuated as the Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA) is developed. With the increasing movement of elephants into south-eastern Angola, HEC incidents seem inevitable there too. Although good systems have been developed for monitoring and evaluating HEC, there is little or no consistency on methodology within and between the five KAZA TFCA countries. The highly variable nature of recording HEC data within the KAZA TFCA makes it very difficult to compile quality national and regional assessments of the scale of the problem. However, it is possible at this stage of our knowledge to identify national HEC "hotspots", but further work is required to put these in an order of priority at a national level, and even more work is required to rank these "hotspots" at a regional level because of the differences between countries in recording HEC.

The recommendations from the KAZA TFCA Pre-feasibility Study, which have been discussed and agreed by the five Member Countries, called attention to the urgent necessity of introducing programs in the HEC "hotspots" to mitigate against the impacts of human-wildlife conflict (HWC) in general and HEC in particular as a matter of priority, especially in areas where HWC is severely impacting on the livelihoods of communities. In places, HEC is so serious that it could jeopardize the future of the TFCA. Most of the mitigation methods have focused on short-term deterrence at the conflict site, a "band-aid approach" which has usually been applied in an *ad hoc*, uncoordinated manner, and has subsequently achieved little long-term success at alleviating the problem for more than a few farmers. Furthermore, several of the mitigation methods have simply displaced elephants from one small area of arable land to another one nearby.

Although the recent increase in HEC in many African countries has stimulated some new work on managing and reducing the impact of these conflicts, there is a growing awareness after years of trying various methods in numerous sites that there is unlikely to be one simple, cost-effective option or solution that can be applied throughout the region. In any one area, *several different methods should ideally be employed simultaneously*, with the interventions put in place in good time ahead of the period when serious problems are expected. It is unrealistic to expect complete

solutions to all HEC problems. Where elephants and people live in proximity to one another, the management objective should not necessarily be to eliminate the problem but to reduce it. Ideally, responsibility for action should be initiated by the affected people, but with the assistance of the wildlife authorities where it is needed. Linked to this is the acknowledgement that if national conservation authorities want elephants to extend beyond the formally protected areas, which is certainly the case with the KAZA TFCA, it will be necessary to balance ecological interests with community incentives, *making elephants an asset rather than a liability to communities.*

In this report, methods to reduce HEC are evaluated in terms of their advantages and disadvantages based on literature cited and on discussions with field workers in the KAZA TFCA area listed in the acknowledgements. Methods evaluated are grouped as follows: (i) traditional deterrents; (ii) disturbing elephants when close to areas of potential conflict; (iii) killing problem elephants; (iv) translocation of problem elephants; (v) physical barriers; (vi) olfactory repellents; (vii) relocating agricultural activities and changing cropping regimes; (viii) creating secure routes or "corridors" for elephants; (ix) repositioning boundaries of protected areas; (x) African bees; and (xi) chemical deterrents. Compensation for HEC is also evaluated. The major problems and deficiencies associated with traditional compensation payments are summarized and contrasted with the successes achieved with self-insurance schemes, which not only successfully dealt with payments for crop losses, but also introduced a greatly improved monitoring system. All of the methods outlined in this report have had at least some success, and at this point, not one of them should be dismissed as an unacceptable approach. What has become clear is that each case of HEC merits individual attention, and that the attitudes of effected communities and their willingness to try new methods of mitigation, coupled with the present and likely future patterns of human settlement in relation to elephant movements, are of particular importance in any objective assessments.

The various uses of chilli peppers are reviewed in detail together with an outline of the activities of the Elephant Pepper Development Trust. From information gathered to date, chilli peppers clearly have an excellent potential as one of the most promising HEC mitigation options that can be applied at low cost at the community level, with the added advantage of producing extra income from the sale of chillies. However, with the evaluations of conflict mitigation methods varying in their level of scientific rigour and taking place in the absence of controls and

data on background changes which impact on elephant movements and their feeding requirements, there is an obvious need for rigorously designed field trials on mitigation methods running over several seasons before recommendations can be made with confidence on how to reduce HEC in the KAZA TFCA.

The report concludes by outlining a project entitled: *Mitigation of Human-Elephant Conflict in the KAZA TFCA through Community Based Problem Animal Control.* The project will be based on comprehensive HEC mitigation coverage for *all farmers in "hotspot" areas* linked to the introduction of a combination of methods using chilli peppers, which in turn will be linked to a suite of additional low-cost mitigation techniques that are suitable for use in community based projects. Particular emphasis will be placed on the development of model systems for HEC management, focussing on the sustainability of the methods introduced, and on an exit strategy to enable the project team to complete work in the selected areas after a period of three years before moving on to new geographical areas of HEC concern.

List of Acronyms

AfESG	IUCN/SSC African Elephant Specialist Group
AWF	African Wildlife Foundation
CAMPFIRE	Communal Areas Management Program for Indigenous Resources
CARACAL	Center for Conservation of African Resources: Communities, Animals, Lands
CBNRM	Community Based Natural Resource Management
CBPAC	Community Based Problem Animal Control
CI	Conservation International
CITES	Convention on International Trade in Endangered Species of Wild Fauna & Flora
CR	Community Ranger
DNPWM	Department of National Parks and Wildlife Management (Zimbabwe)
DWNP	Department of Wildlife & National Parks (Botswana)
EBS	Event Book System
EPDT	Elephant Pepper Development Trust
GIS	Geographic Information System
GMA	Game Management Area
HACCIS	Human-animal conflict compensation scheme
HEC	Human-elephant conflict
HWC	Human-wildlife conflict
HWCC	Human-wildlife conflict collaboration
IRDNC	Integrated Rural Development & Nature Conservation (NGO in Namibia)

KAZA TFCA	Kavango-Zambezi Transfrontier Conservation Area
LIFE	Living In a Finite Environment
MET	Ministry of Environment & Tourism (Namibia)
MoU	Memorandum of Understanding
NACSO	Namibian Association of CBNRM Support Organisations
NGO	Non Government Organization
NRP	Natural Resources & People
P & W	People & Wildlife Initiative
PAC	Problem Animal Control Unit (Botswana)
RDC	Rural District Council
SADC	Southern African Development Community
TCC	Transfrontier Conservation Consortium Consultancy
TFCA	Transfrontier Conservation Area
WILD	Wildlife Integration for Livelihood Diversification (Namibia)
WWF-SARPO	WWF-Southern Africa Regional Program Office
ZAWA	Zambia Wildlife Authority

1. Introduction

The main purpose of this study is to collate information and experience to date regarding human-elephant conflict and the use of chilli pepper and other measures to mitigate elephant impact, with the geographic area of the study being restricted to the Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA). The Terms of Reference and Key Deliverables are set out in Annex 1.

1.1 Kavango-Zambezi TFCA

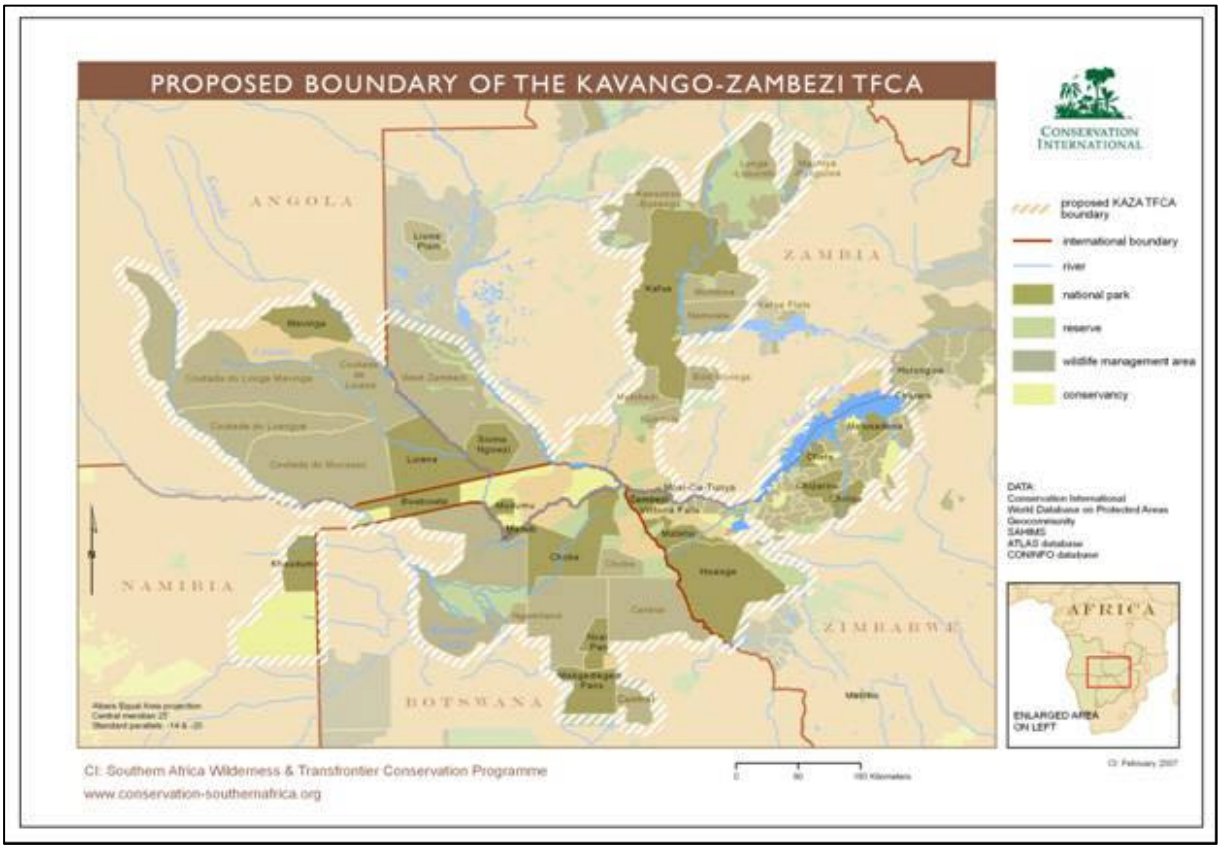
Africa's political leaders, local communities, governments, conservation and tourism organizations, bilateral and multilateral aid agencies, the private sector and NGOs are increasingly embracing Transfrontier Conservation Areas (TFCAs) in recognition of their role in conserving biodiversity, socioeconomic development and promoting a culture of peace and regional cooperation, and in southern Africa this new paradigm for conservation was greatly facilitated by the promulgation of the Southern African Development Community (SADC) Protocol on Wildlife Conservation and Law Enforcement in 1999.

On 29 May 2003 the Ministers responsible for tourism in Angola, Botswana, Namibia, Zambia and Zimbabwe agreed in principle to establish a major new TFCA (with emphasis on conservation and tourism development) in the Okavango and Upper Zambezi River Basins encompassing 278,000km^2 of savanna, woodlands, rivers and wetlands in a contiguous area of the five countries, and it was named the *Kavango-Zambezi Transfrontier Conservation Area* (KAZA TFCA). To encourage ownership by the five countries, and to reflect the priorities determined by these countries, the meeting clearly articulated a vision for the KAZA TFCA, namely: *To establish a world-class transfrontier conservation area and tourism destination in the Okavango and Zambezi river basin regions of Angola, Botswana, Namibia, Zambia and Zimbabwe within the context of sustainable development.*

In 2005 the five partner countries commissioned a Pre-feasibility Study for the KAZA TFCA, which was completed in October 2006 (TCC, 2006). The Study established that there is widespread and enthusiastic support for the initiative. Stakeholders see it as a long-term regional program that all five countries are pursuing together. The initiative focuses specifically on the coordinated development and management of their wildlife and tourism assets in the Kavango

and Zambezi river basins. The target beneficiaries of the KAZA TFCA are local communities, and public and private stakeholders in the wildlife and tourism sectors. From this joint venture the partner countries want to achieve sustainable improvements in the livelihoods of local communities, better protection of the region's biological diversity, establishment of a premier African tourism destination, and the building of sufficient capacity for the ongoing management of the region's wildlife and tourism resources.

Ministers from Angola, Botswana, Namibia, Zambia and Zimbabwe met on 7 December 2006 in Victoria Falls to sign a Memorandum of Understanding (MoU) to jointly work towards the establishment of the TFCA. The next step in the roll-out of the KAZA TFCA is the Feasibility Phase where key projects identified will commence and various detailed studies will be undertaken and implementation recommendations formulated. Institutional arrangements must be put in place at this stage to facilitate internal and external consultative processes, regardless of the current level of the various components of the trans-boundary negotiations.



Map 1. Recommended revised boundaries of the KAZA TFCA.

1.2 Introduction to human-wildlife conflict and human-elephant conflict

People and animals are increasingly coming into conflict over living space and food as human populations continue expanding and natural habitats shrink. The impacts are often huge, with crop and livestock losses, and even cases of people losing their lives. The animals, many of which are already threatened or endangered, are sometimes killed in retaliation or to 'prevent' future conflicts. Human-wildlife conflict (HWC) is one of the main threats to the continued survival of several species, and is also a significant threat to local human populations. There is a growing awareness of the social, economic and biological importance of HWC. For example:

(i) WWF and its partners have a number of projects around the world to reduce HWC and improve the livelihoods of the people affected (WWF, 2006).

(ii) The Wildlife Conservation Research Unit at the University of Oxford and the Born Free Foundation have launched a People & Wildlife (P & W) initiative, recognizing that resolving HWC is a challenge that conservation biology cannot afford to shun (P & W, 2006).

(iii) The need for a new partnership initiative to work on HWC was identified by a workshop of HWC practitioners at the 5th IUCN World Parks Congress in 2003, in Durban, South Africa, and recognized in the Congress's formal recommendations (Appendix II). This stimulated the launch of the Human-Wildlife Conflict Collaboration (HWCC)[1]. Its mission is to prevent and mitigate HWC through a global network and partnership that facilitates collaborative learning, innovation, scientific analysis and the development and improvement of best practices and policies, through promoting adoption of best practices for HWC prevention and mitigation by conservation, development and planning professionals and institutions.

(iv) The Consortium for Wildlife Friendly Enterprise is a global initiative to link farmers, livestock producers and harvesters balancing economic activities with conservation of wildlife and habitats[2].

[1] For more information, contact: Francine Madden, Executive Director, HWCC. *Phone +1.202.986-0067;* fmmadden@comcast.net

[2] The Consortium will launch via a Spring (northern hemisphere) 2007 Summit. For further information contact summit@coex-wildlife.org

A specific component of HWC and the focus of this report is human-elephant conflict (HEC). Such events are common across most of the distributional range of the African elephant (Barnes, 1996; Chiyo *et al.*, 2005; Hoare & Du Toit, 1999; Kiiru, 1995; O'Connell-Rodwell *et al.*, 2000; Osborn & Hill, 2005; Parker, 2003; Sitati & Walpole, 2006; Taylor, 1999), and are also becoming more common within the range of the Asiatic elephant. For example, in India's northeastern state of Assam, HEC has reached alarming proportions with the elephants straying into towns and cities looking for food. Since 2001, elephants have killed 239 people in Assam alone, while 265 elephants have died during the period, many of them victims of retaliation by angry humans (P & W, 2006).

HEC is a growing concern within the KAZA TFCA (Gadd, 2005: Mosojane, 2004; Cumming & Jones, 2005; NRP, 2006), where elephants are making more frequent forays into areas of human settlement from the major protected areas (all of which are unfenced) and are destroying crops, raiding food-stores and damaging water sources, occasionally killing or injuring people in the process. With some 80% of the potential elephant range in southern Africa being outside of protected areas (Cumming & Jones, 2005), HEC is likely to remain a serious concern in the KAZA TFCA for many years to come.

Human-elephant conflict

The broad definition of human-elephant conflict (HEC) adopted by the IUCN/SSC African Elephant Specialist Group (AfESG) is "Any human-elephant interaction which results in negative effects on human social, economic or cultural life, on elephant conservation or on the environment" (Hoare, 2001). The AfESG has had an HEC Working Group since 1996, with a well-established network in Africa and Asia (see www.iucn.org/afesg).

In parts of the continent, farmers sometimes lose an entire years harvest to elephants in one night, and often risk their lives in defense of their crops (Kangwana, 1995; Hoare, 1999a; NRP, 2006). Elephants will start to raid crops when the quality of their preferred food item, grass, begins to decline in their natural habitats, a point at which it becomes worth the risks associated with raiding crops and coming into conflict with people (Osborn, 2004). The economic impact

of these interactions can be significant to people living in, or close to, a state of absolute poverty. For example, in Kibale, Uganda, farmers were losing on average US$60 per year to elephant crop damage (some lost much more). In Kaélé, Cameroon, elephants destroyed 5,093 ha of farmland in one year with the estimated cost of more than US$200,000. The annual average crop loss per farmer in Kaélé is about half the local annual per capita income estimated at US$200 (IUCN, 2005). In southern Ghana, farmers living close to Kakum National Park were losing on average 50% of their crops (Barnes *et al.*, 1995). Of 173 crops and fields damaged by elephants in one part of the Okavango Delta, in more than one third of the cases elephants destroyed the whole crop. Of the households surveyed in the same area in the 2004/2005 growing season, 93% had no surplus crops to sell as a result of elephant damage (NRP, 2006).

The social impact of HEC can also be devastating, with the price-tag of the conflict going beyond the loss of food, which is bad enough on its own. It must be extended to include *indirect costs* such as absenteeism from school as children stay home to guard crops, impacting on their education and a passport to employment. Adults can suffer from psychological stress from anticipating nocturnal raiders, and this cost should not be under-estimated. Stress can promote exaggerated hostility towards the perceived source of the threat, not the elephants themselves, but the conservation authorities who are the custodians of wildlife, resulting in widespread negative attitudes towards the very existence of protected areas. Stress is then exacerbated when frustrated communities take matters into their own hands by attempting to kill the raiding elephants, all too frequently without suitable means of problem animal control, and then finding that raids continue as other elephants move in (Gadd, 2005; IUCN, 2005; WWF SARPO, 2005). A recent review of hundreds of press reports disseminated since early 2003 by the *Save the Elephants News Service* (http://www.savetheelephants.org) suggests that HEC situations killed more elephants in the last two years than ivory poachers.

There is now widespread agreement in conservation and management circles about the need to mitigate the negative effects of this conflict on both humans and elephants, and various initiatives are underway to introduce new ways of reducing this conflict (see Section 3 of this report). Most rural communities must defend their farms themselves, ideally by using inexpensive, low-tech, non-fatal mitigation methods (Sitati & Walpole, 2006). Pastoralists are more tolerant of elephants than agriculturists. They find elephants to be problematic but are

willing to tolerate the inconveniences. Agriculturists have more animosity towards elephants than towards any other species. When people attempt to cultivate adjacent to or in the midst of elephant populations, conflict with elephants is inevitable.

Despite extensive monitoring of HWC incidents over the past decade, the implementation of several management systems, and the recognized significance of the problem, HWC is still generally poorly understood by conservation agencies in the KAZA TFCA region and in several parts of the TFCA is increasing annually. Stander (2005) believes that there is an urgent need to evaluate the status and levels of HWC in Namibia, and to implement a national policy framework for HWC management. There is no doubt that guidelines are needed in Namibia and throughout the KAZA TFCA to ensure objective monitoring and sensible measures to mitigate the conflict and increase the benefits of living alongside wildlife.

1.3 The African elephant within the KAZA TFCA

The elephant is widely recognized as one of the continent's most important flagship species and a potential flagship species for the TFCA itself. The species is of considerable economic and ecological importance to the region. The KAZA TFCA embraces the largest contiguous population of elephants in the continent, with the overall biomass of elephants in southern Africa being higher than that of any other large mammal in the region (Cumming & Jones, 2005). Estimates in northern Botswana alone are in excess of 150,000 elephants growing at 5% per year, with an additional 50,000 in north-western Zimbabwe and 16,000 in north-eastern Namibia (Martin, 2005; Chase & Griffin, 2005). However, Junker *et al.* (2007) have recently suggested that "it appears that elephant numbers in northern Botswana have begun to stabilize despite the high growth rate noted previously".

The two countries holding the largest part of this elephant population (Botswana and Zimbabwe) have not announced their intentions regarding elephant management (Martin, 2005), a situation that is complicated by the considerable movement of the species between northwestern Zimbabwe, the Caprivi Strip of northern Namibia, southwestern Zambia and southern Angola. In addition, rapidly growing human populations, veterinary fences in parts of northern Botswana and a protracted period of civil unrest in Angola have contributed to these high concentrations by posing restrictions to normal patterns of dispersal, resulting in a complex

series of effects on the natural environment (Hanks, 2001; Osborn, 2002). Increasing human populations and activities, particularly subsistence farming, have amplified HEC. As elephant populations become more and more constrained so the need for 'safe corridors' between protected areas becomes even more important (Osborn & Parker, 2003; Hoare, 2004).

Throughout their range, elephants have a major impact on the vegetation, primarily through their feeding habits, but they also make paths, dig to open up water sources, consume large volumes of water and affect nutrient cycling by depositing large quantities of urine and dung.

Plate 1. Elephants in the Linyanti area of northern Botswana are having a major impact on the mopane woodlands and riverine vegetation.

Elephants eat both grass and woody plants but tend to obtain the bulk of their food in the dry season from woody plants. As most grazing is done in the wet or growing season, and grasses can quickly replace foliage removed, the impact of elephants on grasses is generally assumed to be low. However, as elephant numbers increase in south-central Africa and in the absence of any population reduction by culling or poaching, there will be a decrease in woodlands and an increase in the extent of shrubland and wooded and bushed grassland (Conybeare, 2004).

In Botswana, the Department of Wildlife and National Parks (DWNP) is becoming increasingly concerned about the effects that this build-up of elephants is having on a priority area of conservation concern, the riverine vegetation, particularly in Chobe National Park. Furthermore, several local communities adjacent to Chobe are also expressing concern about the

escalating HEC, which has included crop-raiding (even the total destruction of crops), damage to wild fruits and wild trees, impeded human movements, and the depletion of water during the dry season. All of this is resulting in a growing demand and pressure to reduce the number of elephants, and a major culling program has been mooted.

As part of a program to address these concerns, Conservation International (CI) has been working in collaboration with the Botswana conservation agencies to determine the abundance, distribution, population structure, habitat needs, and movements of elephants in northern Botswana, and on the transboundary movements of the species within the KAZA TFCA. What has emerged from this important study is that there is considerable potential for elephants from Botswana to move north into Zambia and Angola once new corridors have been established, which should reduce the environmental and social pressures of their over-abundance in Botswana and Caprivi (Chase & Griffin, 2005). There is now unanimous agreement that availability of surface water is one of the prime factors regulating the distribution of elephants and restricting their movements throughout their existing and potential range within the KAZA TFCA, particularly towards the end of the dry season (Hoare, 2004).

A management plan has been drafted for the elephants of Namibia, and it includes addressing the challenges and opportunities presented by the move of elephants into Caprivi from Botswana, noting that the economic contribution which elephants could make to the wildlife industry and to land use values in northern Namibia is very high indeed. The vision statement for the plan expresses Namibia's desire to work with neighbouring countries and the international community to enhance the status of elephants. It also clarifies Namibia's position on elephants and draws attention to the fact that a policy of total protection for elephants will result in their available range being reduced to State protected areas and a decrease in their numbers. In contrast, a policy of sustainable use, as enshrined in the Namibian constitution, will result in an expansion of the range available to elephant and an increase in their numbers. The draft plan also noted that there are strong grounds for forming an alliance between the five KAZA TFCA countries specifically aimed at more effective performance in the forum of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), based on the fundamental premise that all wildlife products should have value and that legal trade is beneficial for conservation (Martin, 2005).

1.4 Recommendations from the KAZA TFCA Pre-feasibility Study on HEC

The recommendations from the Pre-feasibility Study, which have been discussed and agreed by the five Member Countries, called attention to the urgent necessity of introducing programs in the HEC "hotspots" to mitigate against the impacts of HWC in general and HEC in particular as a matter of priority, especially in areas where HWC is severely impacting on the livelihoods of communities. Although further work is still required on optimum methods, sufficient information is already available to select suitable techniques *and introduce them with immediate effect in communities where HWC is so serious that it could jeopardize the future of the TFCA.* The Study also noted that with HEC issues increasingly being exacerbated by animals crossing from one country to another, the need for a trans-boundary strategy for managing HEC should also receive attention. With elephants and other large mammals moving beyond formally protected areas, it will be necessary to balance conservation interests with community incentives, making these species assets rather than threats and liabilities to communities, an initiative which should be coupled with the development of innovative techniques to reduce HWC (TCC, 2006).

1.5 Approach used in this study

This study is based on interviews and field inspections where applicable with stakeholders listed in the acknowledgements in Namibia (Windhoek, Katima Mulilo, and Conservancies in Caprivi), Zambia (Livingstone and communities in adjacent rural areas, Kafue National Park, Namwala Game Management Area), Botswana (Kasane and Maun) and Zimbabwe (Victoria Falls area). In addition, extensive use has been made of additional interviews, material and literature on HEC collected during the KAZA TFCA Pre-feasibility Study.

2. Extent of Human-elephant conflict within the KAZA TFCA

2.1 Introduction

One of the major frustrations voiced by people working on HEC is the lack of a complete record (reports proportional to the true number of incidents) and vagueness of localities in existing records (Hoare, 2001). Ground-truthing ongoing conflict events is essential to create an accurate measure of contemporary events and to correct for the discrepancies between reality and the information gathered by the variety of HWC and HEC data sheets in use, and the information voluntarily reported in interviews or public meetings (Gadd, 2002). Furthermore, an accurate assessment of the financial implications of HEC and a reliable measure of the frequency, extent and locality of the various conflicts is an essential prerequisite for taking appropriate action to reduce conflict situations and to prepare project proposal and budgets for field implementation of mitigation measures. In addition, with the introduction of one or more methods to reduce HEC, reliable monitoring systems must be put in place to assess the effectiveness of the various options and to see if any maintenance of the option might be required. This study has identified a growing number of recommendations and methods for collecting information on HWC in general and HEC in particular. These include:

- A detailed evaluation and description of the fundamental requirements for a standardized monitoring system for HWC has been produced by IUCN's African Elephant Specialist Group (http://iucn.org/afesg/hec).
- WWF's *Human Wildlife Conflict Manual* (WWF SARPO, 2005), which lists basic facts which should be collected on HWC.
- Elephant Pepper Development Trust's *Community-based Problem Animal Control. Training Manual* (EPDT, 2006) which has a comprehensive section on Monitoring and Evaluation (see Annex 3).
- *Human Wildlife Conflict Incident Report Form* developed in 2006 by Namibia's Ministry of Environment & Tourism (see Annex 4).
- Animal Conservancy Self-Insurance Scheme (HACSIS) at selected Conservancies in the Kunene and Caprivi Regions (Esterhuizen, 2004; Stewart & Diggle, 2004).

Although good systems have been developed for monitoring and evaluating HEC, there is little or no consistency on methodology within and between the five KAZA TFCA countries. The highly variable nature of recording HWC data within the KAZA TFCA makes is very difficult to compile quality national and regional assessments of the scale of the problem. Problems identified were as follows:

- Most current monitoring systems are not adequately supervised nor sufficiently focused or robust to capture data on HEC which can be used for comparative statistical analyses or for accurate planning purposes, although some good efforts are underway to improve the systems in use, as outlined above.
- Low numeracy skills of field staff leading to incorrect reporting in monthly and annual summaries and statistics.
- Underestimation of the actual extent of HEC in any one area, as not all events are recorded, and often there is no information on the number of elephants involved and their age and sex.
- Reporting structures and methods are too complicated and detailed for use by relatively poorly-educated field staff.
- General lack of reliable quantifiable information on the extent of crop damage, including difficulties in separating crop damage from poor production during droughts
- A tendency for farmers to exaggerate the extent of the damage or loss related to the opportunity given to them to express anger and frustration about the problems caused by elephants and their limited capacity to deal with these problems.

The need to improve on HEC monitoring throughout the KAZA TFCA and move towards national consistency is discussed further in Section 7 of this report. Preliminary data are presented here on the extent of HEC and the possible location of HEC "hotspots" in Botswana, Namibia, Zambia and Zimbabwe. No data were available from Angola.

2.2 HEC in Botswana

Although general information on HEC and HWC has been collected in various parts of Botswana by the Problem Animal Control (PAC) Unit of the DWNP over the last 10 years and is still being collected, it was not possible to access most of this information as the data are still being analysed. The DWNP in Maun was prepared to release spread sheets on HEC from Ngamiland for the period February to November 2005, and these have been summarised in Figure 1. Just over 30% of the HWC cases reported were elephant related.

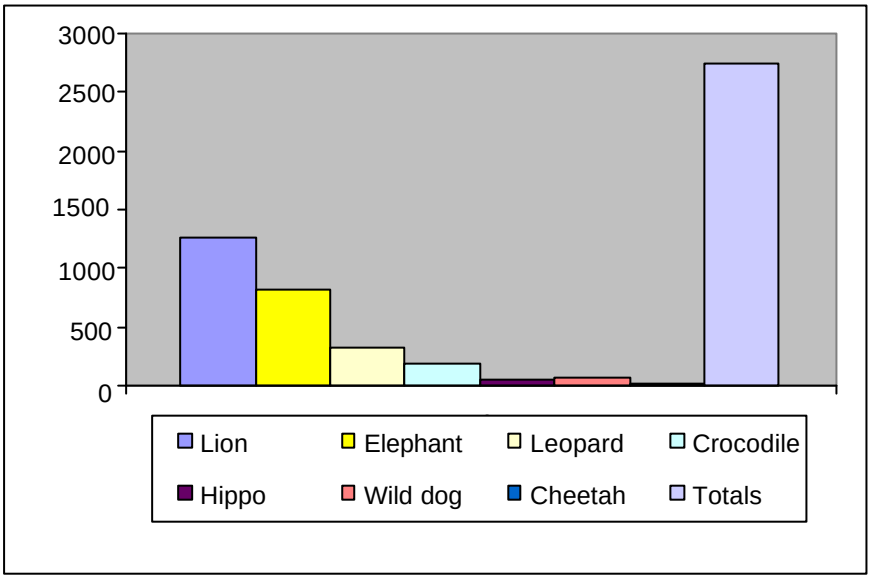


Figure 1. Summary of the 2,738 cases of HWC in Ngamiland District from February to November, 2005 (from the PAC Unit, DWNP, Maun).

However, independent detailed studies on HEC have taken place in the Okavango Delta (NRP, 2006) and in and around the Okavango Panhandle. In the latter, where the communities are located in NG11 and NG12, land is designated as pastoral/arable/residential zones. Envik (2000), Gadd (2001 & 2002) and Mosojane (2004) have all called attention to the economic and social impact of crop-raiding by elephants, noting that HEC in these areas is seasonal and occurs mainly during the harvesting period (March - May). Mosojane (2004) observed that not all fields are raided, but the impact is significant, with elephants destroying as much of 40% of the potential annual harvests of subsistence farmers. Bulls are principally involved in raiding and most raids take place during the night. Elephants avoid densely inhabited locations and areas that have been intensely transformed for farming. Local people spend sleepless nights guarding

their crops from being raided by elephants. The raiding animals did not destroy all crops, and farmers along the Okavango Panhandle managed to harvest some of the crops that they had planted. The fraction of fields damaged decreased sharply with increasing area of the cultivated patches, with most of the fields raided by elephants being located in or in the proximity of segments frequently crossed by elephants. More bull groups than breeding herds were involved in crop raiding. Agricultural patches are relatively small and typically extend over less than 5 hectares. Mosojane (2004) concluded that the fraction of a field damaged by elephants declines with increasing size of the field., which he ascribed to an edge effect generated by the small patches of arable land being surrounded by natural vegetation. Larger patches appear less vulnerable, as elephants typically only raid crops close to the edge. He concluded that the larger patches may therefore reduce the extent of damage experienced by farmers. The same effect may be obtained by grouping fields to form relative large patches as opposed to the present situation where fields are isolated and surrounded by natural vegetation. He concluded that incidents of HEC are bound to increase if appropriate land use practices are not initiated (Mosojane, 2004).

In the Ramsar site associated with the Okavango Delta, HEC is widespread, peaking in March and early April. NRP (2006) noted that many of the people are cultivating illegally, regularly cultivating within 150 m of the water, which contravenes the Environmental Conservation Act. The Okavango Delta management planning process is using GIS and digital mapping to develop a problem animal control decision support system with emphasis on the collation of data on HEC, with a spatial and temporal display of HEC stratified by conflict type. Data analyzed at the time of the July 2006 Progress Report had not identified unique "hotspots" but rather a consistent patters on HEC around the delta (NRP, 2006).

A more recent report on HWC in the Okavango Delta (CARACAL, 2006) focusing on leopard and cheetah, noted that the local communities identified elephant and predator conflict as a major problem, significantly impacting on livelihood strategies. In the Seronga area of the delta, the elephant was regarded as the primary problem animal.

2.3 HEC in Namibia

Within the KAZA TFCA, Namibia has taken the lead in setting the highest standards of monitoring programs. The structured monitoring of HWC in Namibia is a relatively recent

development. There are two national sources of data on HWC, namely the Event Book System (EBS)[3] and the HWC database maintained by the Ministry of Environment and Tourism (MET)[4], and several smaller monitoring systems that are species or regional specific. Stander (2005) has evaluated these systems for data quality and consistency, analyzing the data to assess the status and magnitude of HWC in Namibia. Even the two national monitoring systems produced varied results, although some of the findings were similar or complimentary. The EBS is based on data collected by the Communal Conservancies from 2001 onwards, and recorded many more incidents of HWC than did the MET HWC Database. A major problem with the MET HWC Database is an apparent inconsistency in recording HWC incidents, particularly in the Caprivi, where HWC incidents were either not recorded systematically, or not recorded at all. The Event Book System was found to be more robust and systematic, although it is worth noting some of the limitations of data collected by the Community Rangers for the Event Books as reviewed by Mulonga *et al.* (2003).

Stander (2005) has produced a comprehensive situation analysis of HWC in the whole of Namibia. He noted that HWC is particularly common on the communal lands in northern Namibia, where elephants, for example, destroy crops and damage water installations, and large carnivores regularly prey on domestic livestock. These conflicts result in financial losses and disrupt the lives of the local people. In Caprivi, Community Rangers (CR) resident in both conservancies and areas outside have been collecting information on HWC since the inauguration of the community game guard work in 1991. The CR's recording procedure was customized in the EBS in 1999/2000 by the CRs with facilitation from Integrated Rural Development & Nature Conservation (IRDNC) and the Natural Resources Working Group of the Namibia Association of Conservancy support Organization (previously known as the WWF-LIFE Natural Resources Team). Since 2001, all conservancies in Caprivi (see Map 2) have used the EBS. Community Based Natural Resource Management (CBNRM) in Namibia and the emergence of communal conservancies especially in Caprivi have contributed to growing wildlife populations. Although local communities on communal land and owners of freehold

[3] The Event Book System is a comprehensive database that forms part of the Communal Conservancy Program and is coordinated by the Namibian Association of CBNRM Support Organizations (NACSO).

[4] MET maintains a national database on all HWC (dating back to 1997) for most of the northern Regions of Namibia.

land benefit from wildlife, the increasing numbers of many wildlife populations lead to high levels of HWC.

The elephant is one of a number of species where there is a marked seasonal pattern of conflict, with HEC in Caprivi being more pronounced during the late wet season, when crops mature. Between 1996 and 2001 elephants destroyed 677 hectares of crops and gardens, amounting to total losses of N$235,700. In a study conducted as part of the Wildlife Integration for Livelihood Diversification (WILD) Project for MET, the combined damage to crops and livestock in 2001 in the Caprivi region was estimated at N$300,000 (N$240,000 for livestock and N$60,000 for crops). From 1996 to 2001, elephants were responsible for approximately 75% of the reported incidence of crop damage and 86% of the damage inflicted on fields. On average, each time an incident involving elephants was reported, the damage covered just over two hectares of fields. Buffalo inflicted relatively minor damage to crops, but the damage was severe in areas where it occurred. There was also a high incidence of damage to crops by cattle. Stander (2005) noted however that due to the difficulty of reporting HWC incidents in remote rural areas, these data should be regarded as minimum estimates. With the increased combination of human tolerance towards elephants in Caprivi and the environmental pressure of elephants in northern Botswana, it will only be a matter of time before elephants reach unsustainable numbers in Caprivi. This will become apparent, as more elephants move into the communal areas of Caprivi, destroying crops and killing people. Already Caprivi has the highest incidence of conflicts between human beings and elephants in Namibia. Most of these incidents occur along the Kwando and Chobe Rivers, with the incidents of crop damage from elephants increasing from 52 in 2001 to 985 in 2003 and 1,081 in 2005 (Diggle *et al.*, 2006). In East Caprivi, elephants dominated PAC reports, with the Kwando Conservancy having the highest number of HEC reports (Table 1) and reports of crop damage (Table 2). In two meetings with community members in the Kasika Conservancy, frequent reference was made to HEC (JH record), and yet when comparing the reported incidents of HEC from the Event Books (Tables 1 & 3), Kasika is at the bottom of the list of HEC for the whole of Eastern Caprivi. Murphy[5] (personal communication) believes that this anomaly has come about because elephants are not in Kasika in the main growing season, but in the dry season when they are feeding on floodplain grasslands.

[5] Carol Murphy cmurphy@africaonline.com.na

Table 1. Problem Animals Incidents - East Caprivi, 2005. (Summarized from Event Book data).

Conservancy	Total Incidents	Elephants	Hippo	Antelope	Lion	Hyaena	Leopard	Crocodile	Pig	Baboon/ Monkey
Kwandu	596	183	78	69	1	5	14	12	206	27
Mayuni	79	18	8	11	0	2	2	13	19	6
Mashi	111	27	13	0	15	56	0	3	6	5
Wuparo	37	19	12	2	5	20	2	0	0	1
Malenga	66	22	0	0	12	32	0	0	0	0
Bbalelwa	139	44	6	3	23	51	0	6	0	6
Lusese	29	9	0	0	0	7	0	13	0	0
Nakabolelwa	55	25	8	0	2	2	0	18	0	0
Salambala	100	42	4	0	7	42	0	5	0	0
Impalila	99	31	10	22	0	0	1	35	0	1
Kasika	101	3	1	44	0	5	0	48	0	0
Mbara	89	39	0	4	8	25	1	4	0	8
TOTALS	**1,501**	**462**	**140**	**163**	**73**	**247**	**20**	**157**	**231**	**54**

Table 2. Incidents of Attacks/Damage - East Caprivi - 2005. (Summarized from Event Book data).

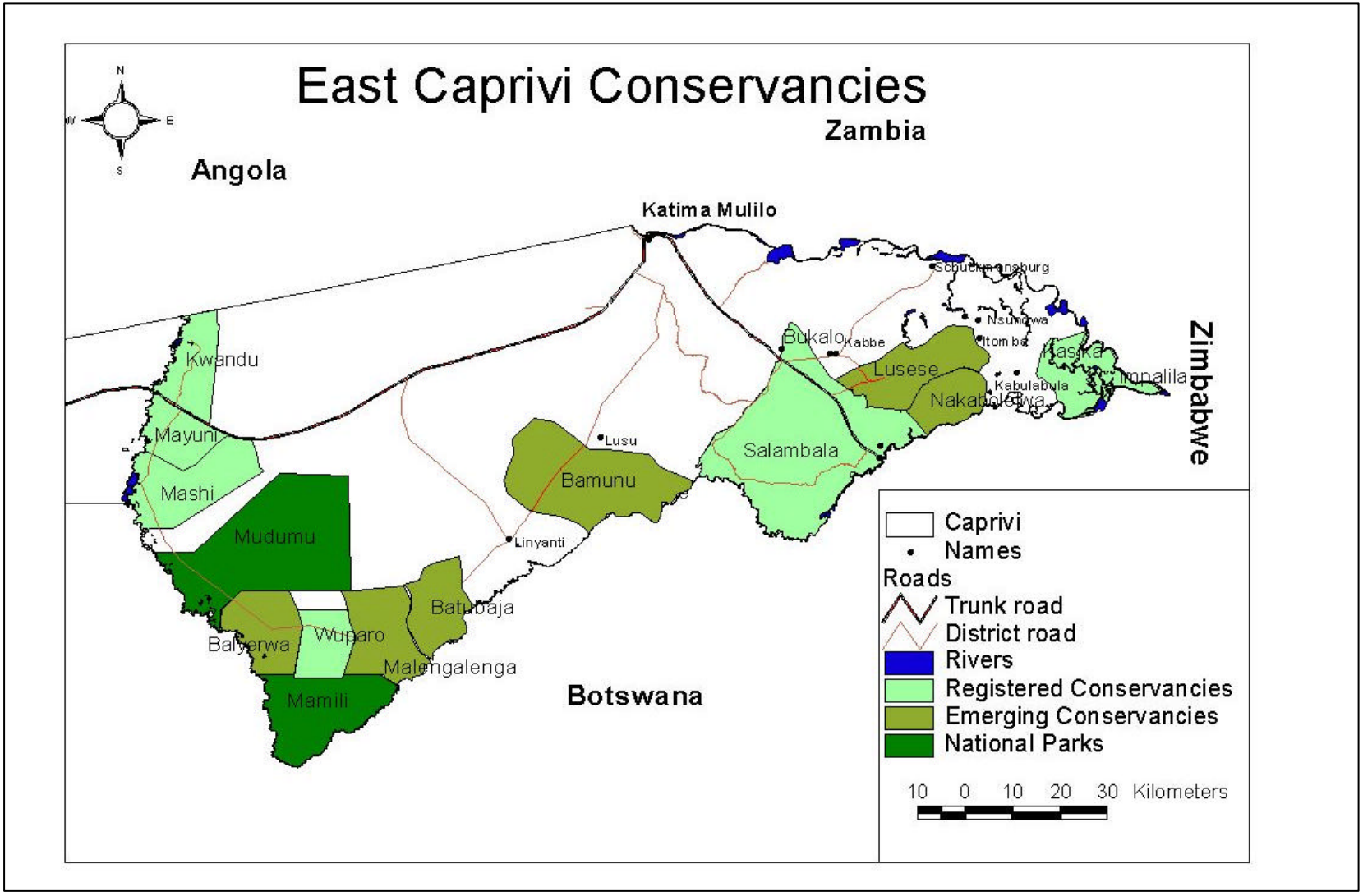
Conservancy	Humans	Livestock	Crops
Kwandu	2	33	586
Mayuni	0	17	78
Mashi	0	107	62
Wuparo	3	32	40
Malengalenga	4	57	34
Bbalelwa	1	143	32
Lusese	0	0	0
Nakabolelwa	2	22	36
Salambala	1	63	43
Impalila	1	33	51
Kasika	1	50	45
Mbala	1	44	54
TOTAL	**16**	**601**	**1,061**

Many HEC incidents that occur in Kasika, do not include crop damage (e.g. lack of safety for children walking to school; people terrified of elephants outside their courtyards at night; elephants destroying the few remaining woodland areas etc.), incidents that more often than not go unrecorded, as community members have given up making reports because of the difficulties of tracking down the community ranger. Kasika does however have a serious new problem of buffalo damaging crops and threatening safety (Table 4). Mulonga *et al.*, (2003) have joined others in noting that HWC has worsened in Caprivi since CBNRM started, a combination of CBNRM increasing wildlife numbers and elephants from Chobe moving into the area. More than half of people interviewed reported that HWC affected their livelihoods severely.

Matson (2005) has analyzed HEC in Nyae Nyae Conservancy and Khaudum National Park. A record of conflicts that have occurred with elephants in the last five years was provided by Dries Alberts, Area Warden, MET. Each conflict was categorized as low, medium or high, depending on the number of conflicts and the extent of damage caused in financial and human life terms. Preliminary analysis suggests that most conflicts with elephants in the five years occurred in the hot dry season (46%), although conflicts also occurred in the cold dry season (28%) and the wet season (26%), with most conflicts being caused by elephants in herds of five or less animals (55%), and mainly bulls. However, 18% of HEC were associated with large herds of more than 40 animals (mostly in Khaudum). The mean herd size of elephants involved in HEC incidents was 19.03 ($\pm$ 4.33) (Matson, 2005).

Namibia's MET has taken a leading role in the KAZA TFCA in promoting awareness at a national level of the importance of HWC management. In March 2006, the Ministry organized and hosted a workshop in Windhoek on HWC Management Policy (MET, 2006), and is also in the process of formulating a policy to deal with HEC management[6]. The four areas to be covered in the policy are the devolution of HEC management authorities, self-insurance schemes (see Section 4.2 of this report), alternative mitigation measures, and a standardized monitoring and reporting system. At the community level, IRDNC in cooperation with CI, has produced an informative poster on HEC which calls attention to the problem and highlights the HEC "hotspots" (see Annex 5). A similar initiative should be repeated in other parts of the TFCA where HEC is a problem.

[6] Keynote address by the Minister of Environment & Tourism W. Konjore, on the occasion of the official launching of the Kasika Conservancy on 30 November 2006.



Map 2. Registered and Emerging Conservancies in Caprivi.

Table 3: HEC incidents by Month: East Caprivi – 2005. (Summarized from Event Book data).

Conservancy	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Kwandu	3	24	31	53	62	7	0	0	2	0	1	0	183
Mayuni	1	0	0	1	12	4	0	0	0	0	0	0	18
Mashi	0	3	0	1	23	0	0	0	0	0	0	0	27
Wuparo	0	1	7	1	9	0	0	1	0	0	0	0	19
Malenga..	0	0	10	6	2	0	0	2	0	2	0	2	22
Bbalelwa	0	0	0	34	2	0	1	1	0	0	0	0	44
Lusese	0	4	13	0	0	0	0	0	0	4	3	0	25
Nakabolelwa	1	0	0	0	0	0	0	0	0	0	0	1	2
Salambala	2	14	18	6	0	1	0	0	0	0	2	0	9
Impalila	0	15	1	0	0	3	2	2	0	4	4	0	31
Kasika	0	0	0	0	0	0	0	0	3	0	0	0	3
Mbara	0	4	14	13	5	0	0	1	0	0	1	1	39
TOTALS	7	65	94	115	113	15	3	7	5	10	11	4	422

Table 4: HWC Incidents (antelope and buffalo) by Month: East Caprivi – 2005. (Summarized from Event Book data)

Conservancy	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Kwandu	2	13	21	30	3	0	0	0	0	0	0	0	69
Mayuni	1	3	5	2	0	0	0	0	0	0	0	0	11
Mashi	0	0	0	0	0	0	0	0	0	0	0	0	0
Wuparo	0	2	0	0	0	0	0	0	0	0	0	0	2
Malenga..	0	0	0	0	0	0	0	0	0	0	0	0	0
Bbalelwa	0	0	1	2	0	0	0	0	0	0	0	0	3
Lusese	0	0	0	0	0	0	0	0	0	0	0	0	0
Nakabolelwa	0	0	0	0	0	0	0	0	0	0	0	0	0
Salambala	0	0	0	0	0	0	0	0	0	0	0	0	0
Impalila	3	6	2	0	0	0	0	0	0	0	0	11	22
Kasika	4	3	0	0	0	0	0	1	2	3	13	19	45
Mbara	0	0	0	0	0	0	0	0	0	0	4	0	4
TOTALS	10	27	29	34	3	0	0	1	2	3	17	30	156

2.4 HEC in Zambia

Over 20% of all elephants in Zambia occur outside of the formally protected area, where the Zambian Wildlife Authority (ZAWA) is responsible for elephant control measures. HEC reports in the media are becoming more common each year, and the conflicts are a growing concern. For example, in February 2006, according to a local traditional ruler more than 60 elephants moved into a village in the lower Zambezi area and damaged maize and sorghum fields "leaving hundreds of families without food" (P & W, 2006).

Although ZAWA has been collecting records of the type and locality of HEC, attempts to access these data at a regional and national level were unsuccessful. ZAWA has a high staff turn-over, and in the absence of an efficient and well-maintained central filing system, it appears that valuable original data have either been lost or misplaced. The EPDT has recently been working with the ZAWA in the Livingstone area on the design of a database for HWC reported to ZAWA from 27 May 2004 to 6 March 2006 (Klebelsberg, 2006). Over that period, elephants dominated the reports of HWC (283 reported incidents), with the number of HEC reports being more than three times higher than all the other species combined. Klebelsberg (2006) is cautious in the interpretation of these results, suggesting that the high number of elephant reports could be a result of (i) elephants indeed being the greatest threat; or (ii) they were perceived by the community as the greatest threat because of limitations in the traditional ways of dealing with the threat; or (iii) HEC reports to ZAWA might result in a problem elephant being shot, with local people benefiting from the meat. The zones Livingstone East and Livingstone West had the most HEC reports, probably a consequence of the elephants coming in from Zimbabwe passing through these areas[7]. In Livingstone North no conflicts were recorded in the years 2003 and 2004 but there was an increase of conflicts in 2005 and 2006. This probably indicates a change of the migration pattern of the elephant or a change in their feeding grounds as a result of a rapidly expanding human population in Livingstone and associated urban encroachment. Klebelsberg (2006) has recommended that the HEC "hotspots" should be clearly identified and mapped and related to the elephant pepper project sites, patterns of human settlement and annual variations in rainfall, using these data to help with the possible identification of elephant

[7] Three elephants (two bulls and one cow) were fitted with satellite tracking collars early in August 2006 as part of an investigation by CI to identify potential and existing elephant corridors from the Livingstone area to the Kafue National Park. (M. Chase, personal communication - mchase@forwild.umass.edu)

"corridors" in the area. Assistance should also be given to ZAWA to improve their data collection and reporting system and to develop and maintain a new HWC data base.

A visit was made to the HQ of Kafue National Park at Ngoma for a meeting with research staff to discuss HEC in and around the central part of the park. No data on HEC were available, and no monitoring of HEC is anticipated in the adjacent Game Management Areas (GMAs), in spite of the fact that HEC is becoming an increasing problem as arable lands extend into the GMAs. For example, a meeting was held with Chief Kaingu in the Namwala GMA (see Map 1) where HEC has become a serious problem in recent years. The Chief reported that elephants were frequently crossing the Kafue River from the Park and raiding his crops. At his request, preliminary arrangements have been made for him to visit the EPDT in Livingstone, possibly funded with support from the private sector in Zambia.

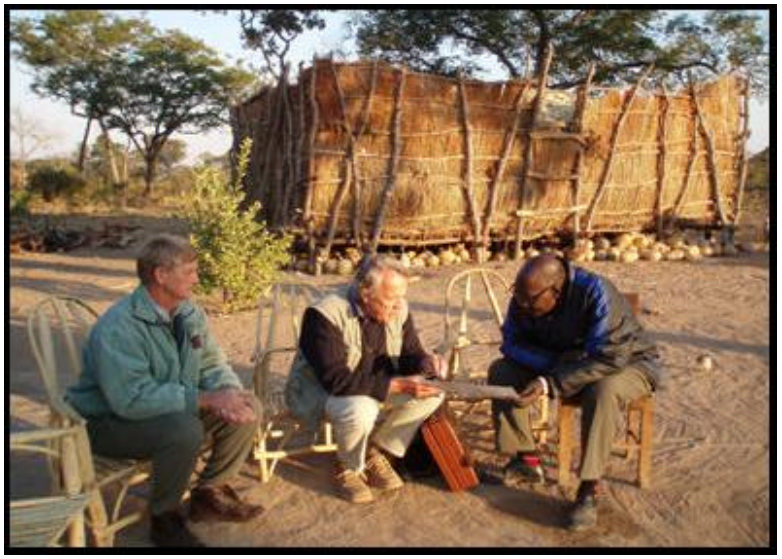


Plate 2. A meeting with Chief Kaingu in the Namwala GMA was arranged by the Manager of Kaingu Lodge (Tom Heineken – left) to discuss HEC mitigation. The Chief is a productive and successful farmer, but is experiencing increasing crop raiding by elephants.

2.5 HEC in Zimbabwe

HEC in Zimbabwe needs to be placed in the context of the devolution of authority for wildlife management to local communities. In 1988 the Department of National Parks and Wildlife Management (DNPWM) granted two Rural District Councils (RDCs) 'Appropriate Authority' status over the wildlife resources in the same manner the private ranch owners had been granted the authority status in 1975. In 1989 and 1990, 'Appropriate Authority' was granted to the twelve 'wildlife' districts, giving legal control of wildlife to RDCs but under the administrative condition that control was further devolved and Communal Areas Management Program for

Indigenous Resources (CAMPFIRE) committees were established at village, ward, district and national levels. In 1998, the program began to diversify away from hunting largely through micro-projects including ecotourism (Murphy *et al.*, 2004). CAMPFIRE revenue grew steadily, reaching approximately US$2 million by 2000. By the late 1990s, an estimated 90,000 households (630,000 people) were benefiting from CAMPFIRE revenue and positive changes were being recorded among the communities. It has led to the strengthening or increased capacity of institutions at the national level (CAMPFIRE Association), District level (District CAMPFIRE Committees), Ward level (Ward CAMPFIRE Committees) and the Village level (Village CAMPFIRE Committees). These are democratically elected committees who are accountable to the local electorate in terms of all development decisions regarding natural resources (Maveneke, 1998).

Malvern Karidozo from EPDT accessed CAMPFIRE HEC data in December 2006, and has provided a summary of HEC over a five year period from 2002 to 2006 in five RDC HEC "hotspots", namely Binga, Gokwe South, Hwange, Nyaminyami and Tsholotsho (Figure 2). The first four are all within the KAZA TFCA, with Tsholotsho being close to the southern border of Hwange National Park. In these five areas, 5,570 HEC incidents were recorded over the five

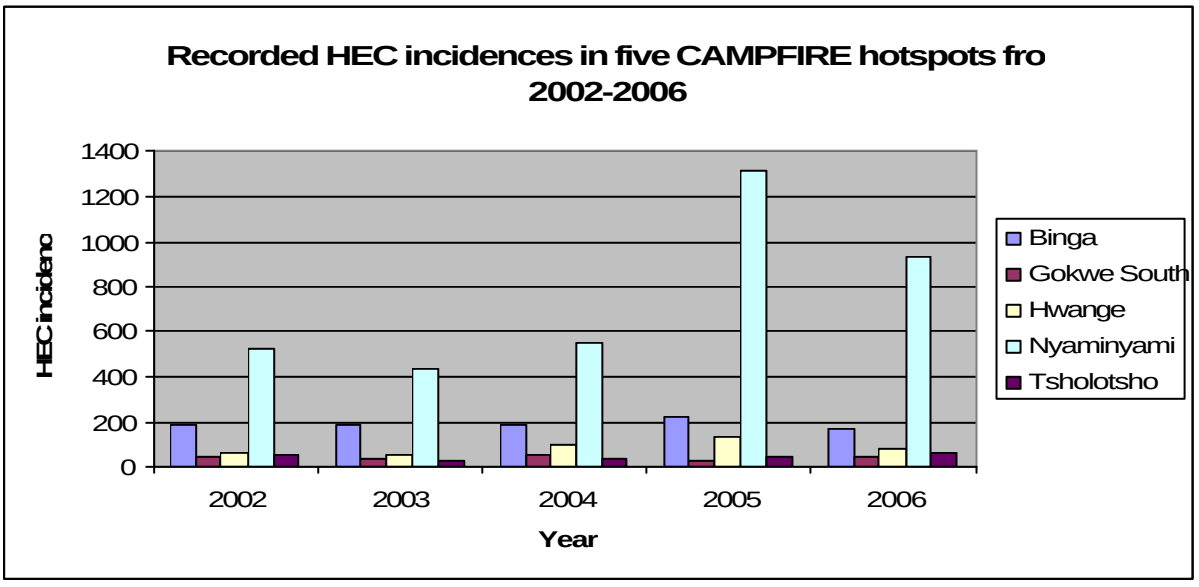


Figure 2. Number of HEC incidents recorded in five RCD "hotspots" from 2002 to 2006.

years, increasing from a total of 862 in 2002 to a peak of 1,754 in 2005. Seven people were killed by elephants in 2004, increasing to 12 in 2005. HEC in clearly a concern in the Zimbabwean part of the KAZA TFCA, and with elephant populations probably still increasing coupled with a continued move back into the communal lands by people displaced from the commercial farms in Zimbabwe, HEC is likely to intensify in 2007 and beyond.

2.6 Conclusion

This initial analysis has confirmed that HEC is increasing in Botswana, Namibia, Zambia and Zimbabwe and is likely to be further accentuated as the KAZA TFCA is developed. With the increasing movement of elephants into south-eastern Angola, HEC incidents seem inevitable there too. Although it is possible at this stage of our knowledge to identify national HEC "hotspots", further work is required to put these in an order of priority at a national level, and even more work is required to rank these "hotspots" at a regional level because of the differences between countries in recording HWC in general and HEC in particular.

3. Review of methods used to reduce and manage HEC

3.1 Introduction

Although the recent increase in HEC in many African countries has stimulated some new work on managing and reducing the impact of these conflicts, there has also come a growing awareness after years of trying various methods in numerous sites, that there is unlikely to be one simple, cost-effective option or solution that can be applied throughout the region. In any one area, *several different methods should ideally be employed simultaneously*, with the interventions put in place in good time ahead of the period when serious problems are expected. It is unrealistic to expect complete solutions to all HEC problems. Where elephants and people live in proximity to one another, the management objective should not necessarily be to eliminate the problem but to reduce it. Ideally, responsibility for action should be initiated by the affected people, but where it is needed, with the assistance of the wildlife authorities (Barnes, *et al.*, 1995; EPDT, 2005; Gadd, 2002; Hoare, 1995 & 1999b; 2001; IUCN, 2005; Nelson *et al.*, 2003; O'Connell-Rodwell *et al.*, 2000; Osborn,1998; Osborn & Hill, 2005; Osborn & Parker, 2002; Stander, 2005; Taylor, 1999; Thouless & Sakwa, 1995; WWF SARPO, 2005).

3.2 The importance of recognizing the commercial value of elephants to local communities as part of HEC mitigation

There is a growing acknowledgement that if national conservation authorities want elephants to extend beyond the formally protected areas, which is certainly the case with the KAZA TFCA, it will be necessary to balance ecological interests with community incentives, *making elephants an asset rather than a liability to communities* (Lindeque, 2005). This is particularly important when considering HEC mitigation. If elephants have a real value to local communities, individuals in the community will be much more tolerant of HEC.

The philosophy of the CBNRM approach assumes that local communities will conserve wildlife, and bear the associated costs of living with these wildlife populations when the benefits they derive from the wildlife outweigh the costs. However, it is important to consider that individuals generally have to absorb the direct costs of HWC, whilst the community as a whole receives the benefits (Stander, 2005). Quite clearly, if elephants do have a value to the

community there will be an incentive to tolerate their presence and conserve them. Most countries in southern Africa now have programs which allow community-based and community-managed wildlife utilization to return benefits to local people (Hoare, 2001). A prime example is the work of Zimbabwe's CAMPFIRE committees (Murphy *et al.,* 2004; Maveneke, 1998). In Caprivi, Diggle *et al.* (2006) have quantified the value of elephants to the communities through revenue earned from hunting and tourism. In 2005, 12 elephant trophies earned the communities N$738,000; six were shot in Kwandu - Linyanti Hunting Concession, and six in Salambala. The income accounted for 63% of the total guaranteed hunting payments earned for the 2005 hunting season. Payment from elephant hunts is set to increase in 2006 - 2007, pending the formal approval of Ministry of Finance to allow earnings from the newly established community hunting concession in Bwabwata National Park to be returned to the communities. The quota for elephants will then increase from 12 to 39, of which seven elephant have been allocated to traditional festivals in the region, and will contribute significant symbolic and meat values in terms of cultural benefits. The direct financial returns from the elephant quota should earn the community an estimated N$2.1 million for the 2006 hunting season, while total hunting returns and salaries (inclusive of all species) should generate returns of approximately N$4.5 million. The value of elephants in attracting tourists is more difficult to quantify. One joint venture partnership has currently been negotiated, from which the conservancy earned N$107,325 in 2005 from royalty fees with conservancy household earning approximately N$220,906, mainly as a result of salaries. Assuming that the existing negotiations between conservancies and 10 lodge operators are successfully concluded, potentially N$1.6 million in royalty fees can be earned by the Caprivi Conservancies for reinvestment in their conservation and development efforts. A further N$2.6 million should be earned in salaries by conservancy households (Diggle *et al.,* 2006)

Throughout the KAZA TFCA, there are clear opportunities for creating incentives for rural subsistence farmers to live with elephants and also opportunities to increase the benefits derived from elephants (both live and dead) to local communities. With the species having the potential to generate major financial returns to communal farmers, and with these returns being much higher than those from subsistence cropping, there are real incentives for communities to manage elephants sustainably on their lands and by so doing extend wild areas in the region (Cumming & Jones, 2005).

With the devolution of responsibility for managing elephants moving from central government to local communities, and with the benefits from the presence of these elephants in their communal areas going back to the villagers involved, there is a real incentive not only to tolerate the presence of elephants but to actively encourage their presence even if HEC increases. Benefits include revenue from hunting fees and from the sale of elephant products going back to local community funds, meat from elephants shot on control or from safari hunting being made available locally, and the sharing of income from community-based tourism initiatives. The challenge of these programs is that conflict problems are usually borne by individuals, whereas the benefits from the presence of elephants accrue to a wider community (Hoare, 2001).

3.3 Classification and summary of the methods used to reduce HEC

The literature on HEC mitigation includes a variety of recommendations on methods and their relative strengths and weaknesses (IUCN, 2005; Nelson *et al.*, 2003; WWF, 2005). There is no consistency in the grouping or classification of these methods. For the purposes of this report, the groupings used are similar to those used by IUCN/SSC African Elephant Specialist Group (IUCN, 2005), with the additional grouping of *(a) relocation of agricultural activities and changing the cropping regimes, (b) creation of secure routes or "corridors" for elephants, (c) repositioning boundaries of protected areas, (d) the use of bees and (e) chemical deterrents.*

(i) Traditional deterrents: Several traditional methods have a good short-term record, including positioning watchmen to be stationed at night in the fields[8], placing scarecrow figures in the fields, driving elephants away by shouting, cracking whips, and beating drums and/or tin cans, throwing stones, burning sticks and other objects at elephants, lighting fires and keeping them burning at night close to arable lands, burning bamboo causing it to 'explode', clearing areas of woodland around fields (to enable farmers to see elephants before they get too close), placing sharp objects on elephant pathways, erecting low cost barriers with cowbells[9] around the fields,

[8] An extension of a simple traditional over-night hut in arable lands is a network of watch-towers in communication with one another to warn of approaching problem animals. This is now being increasingly used in parts on Zambia and Zimbabwe (Stander, 2005; WWF SARPO, 2005).

[9] Any "alarm system" is a useful augmentation of control methods as it improves a farmer's ability to detect elephants, presenting the opportunity to deter them before they cause crop damage (Osborn & Parker, 2002).

planting thorny plants on the perimeter as 'live fencing', using dogs[10], and building pit traps. These methods are relatively cheap, can be applied by the local communities themselves, and usually not fatal to the elephants. However, elephants habituate quickly to most traditional deterrents and soon learn to ignore or avoid those (Osborn & Parker, 2002).

(ii) Disturbing elephants when in or close to areas of potential conflict: Methods include firing weapons near raiding or approaching elephants, shooting at elephants with bird-shot or rubber bullets, use of thunder flashes and flares (Sitati & Walpole, 2006), broadcasting elephant alarm calls[11] and various forms of trip wire alarms (O'Connell-Rodwell *et al*., 2000; Hoare, 1995). Some of these methods can be dangerous due to the proximity of elephants, require funds to purchase disposable material and in some cases capital equipment, and should ideally be applied by trained personnel. As with traditional methods, habituation often becomes a problem. In 1989, wildlife authorities in Kenya, working together with the Kenyan Army, used two helicopters to drive elephants out of human settlements adjacent to the Tsavo National Park (Ngure, 1995). This is an expensive option, which has limited applicability in most parts of the continent.

(iii) Killing problem elephants: It is generally accepted that this method is only to be used if the "problem animal" has injured or killed a person. It has the advantage of providing meat and skins to local populations. There is an option of offering the animal concerned to a professional hunter, but this is usually extremely difficult to organize in the short-term and to ensure that the correct animal is identified. Because problem elephant shooting has never resulted in complete elimination of the elephant problem it is likely that problem elephants are replaced by other

[10] In parts of Ethiopia, cattle herders have recently been observed chasing elephants using dogs during the day, and arable farmers also observed recently using dogs at night to chase elephants. Yirmed Demeke (personal communication - yirmed@yahoo.com) is following this up and sees three advantages, namely: (i) dogs help to awake people when elephants come too close; (ii) their barking clearly disturbs the elephants, and (iii) as the dogs are fast runners they are able to escape elephant attacks.

[11] Helena Harrington spent several months in the Bandipura Tiger Reserve in Southern India, recording the vocalizations of wild Asian elephants. Several of these recordings were taken to Howletts and Port Lymne Zoos in Kent, UK, where there are breeding herds of African and Asian elephants. The Asian elephants were engrossed by the voices, and would not leave the loudspeaker, but when the African elephants heard them, they were quite literally terrified, all getting temporal gland discharges. The cows formed a defensive cordon around the calves, and the bull eventually tried to attack the loudspeaker. Spinage (1994) describes how Ptolemy's African elephants in 300BC fled when they encountered Asian elephants because they could not stand the smell and the trumpeting of the Asian elephants. The playback of those Asian elephant sounds could well drive African elephants away from crops (R.V. Short, personal communication - r.short@unimelb.edu.au). This option is worth investigating further in areas of "high value" with ready access to high tech facilities, but has little or no application in communal lands.

elephants in causing problems. In other words, all elephants can be problematic, and it is not just rogue elephants that cause problems. Most conservation authorities within the KAZA TFCA have protocols for the killing of problem elephants, which limit the killing to extreme cases of HEC. These protocols inevitably result in long bureaucratic delays rather than immediate action, much to the frustration of the effected communities.

(iv) Translocation of problem elephants: Although translocation is widely advocated by animal rights groups, it is a very expensive option, requiring skilled personnel and specialized vehicles to move the animals. As with killing problem animals, it is difficult to ensure that the correct animal is identified for translocation, and to find a site for relocation that will accept the "problem animal". There is also the concern that the "problem animal" might continue with its unacceptable activities in its new location (Hoare, 1995). Furthermore, breaking up elephant family units by moving one or two individuals can be socially disruptive for the elephants remaining behind and cause more problems in the future. Ideally, whole family units should be immobilized and moved. A reported success was the four problem elephants immobilized in the Luwero District of Uganda and translocated and released in the Murchison Falls National Park, but at a total cost of just under US$100,000 (Wambwa *et al*., 2001).

(v) Physical barriers: These include various forms of fencing (cables, conventional and electrical), stone walls, placing sharp objects in elephant pathways (sharp stones or sharpened wooden stakes), moats and buffer crops[12]. If they are properly sited, maintained and regularly inspected, electric fences are extremely effective (Thouless & Sakwa, 1995; Hoare, 1995; WWF, 1997). Electric fences are usually high-voltage and incorporate a number of design features, including extra pole wires to protect them from elephant attacks. Elephants are notorious at seeking out the weak points of fences. Their high installation costs and demanding maintenance routine makes them unsuitable for use in communal areas, where there is often an additional problem of theft of the photovoltaic panels and vandalism (Hoare, 2001). Where fences have been donated, even the upkeep (clearing of vegetation and maintenance and repair of the wires) has failed in communal arrangements. Fencing projects are usually implemented by international aid organizations. In many cases the ownership and responsibilities for the fence

[12] Sisal has been suggested as a physical barrier, but the spines do not seem to deter elephants, and they even eat the plants (Hoare, 1992).

were not clarified by the organization and the erection of a fence cannot be justified economically because of the low return from the crops.

Plate 3. Electrical fences are expensive to install and maintain. Although undoubtedly effective in large scale commercial operations, the technology has limited application in community based projects.

Rarely is a cost-benefit analysis undertaken; if it is, the value of the lost crops is not found to justify the cost of the fence (Osborn & Parker, 2003). The strongest fences will be breached if elephants do not associate them with a direct and painful consequence (O'Connell-Rodwell *et al.*, 2000). Unfortunately, most "traditional" fences are not well maintained, and even livestock have no difficulties in breaking through (Gadd, 2002). Some very expensive fencing projects have failed because elephants when encountering a barrier will walk along it until they reach the end. A smaller fence which encircles a valuable resource, such as an irrigated field or a food storage facility has a much better chance of success in terms of reduced elephant damage and overall cost-effectiveness (Hoare, 2001).

Plate 4. Large, sharp rocks act as a very effective elephant barrier in parts of Namibia, but unfortunately such objects are not readily available in many parts of the KAZA TFCA which experience HEC.

HEC in the Nyae Nyae Conservancy and Khaudum National Park, Namibia were mainly related to damage to water installations (52.5%) and occurred in the hot dry season with the number of incidents increasing steadily between 2000 and 2003 and then declining in 2004 when concrete enclosures were built around water installations at particular villages (Matson & Putland, 2007).

(vi) Olfactory repellents: These include the use of chillies in various forms (covered in details in Section 5) and the burning of rubber and dung (Hoare, 2001). Although various sprays and smoke clearly act ask effective irritants and keep elephants away, the direction of the effect is wind-dependent, with the inherent danger of accidental exposure to people and other animals when the wind changes direction.

(vii) Relocation of agricultural activities and changing the cropping regimes: This option includes the growing of crops less palatable or not palatable to elephants in the more vulnerable areas, such as cultivars like coffee, tea and hot peppers, but is dependent upon farmer investment, climate and soil suitability and ability to market the crops (Osborn, 2002). In the last five years, farmers in the Mayuni Conservancy have moved their arable lands away from the river and towards the forest, and HEC had been reduced. It is only possible in a policy environment with some legitimate, enabled form of local participation in wildlife management (IUCN, 2005). Relocation of agricultural activities and changing cropping regimes are more likely to succeed if the farmer in particular or possibly the community in general derives significant benefits from the presence of elephants in the area. The level of financial benefits provided by the CBNRM programs is thus critical to influencing the decisions a farmer might make. In short, the benefits to be gained from elephants living close to communities must exceed the cost of daily or constant exposure to people and their arable lands (WWF SARPO, 2005).

Any attempt to relocate arable land should be encouraged, implemented, monitored and evaluated entirely at the local level through dialogue and consultation. With the present high rates of human population growth in most African countries, and with ongoing land transformation associated with crop production, solutions to HEC problems are becoming increasingly difficult. Crop raiding should not be seen as a perverse behaviour by elephants but rather an inevitable consequence of their isolation in a human-dominated landscape (Barnes, 2002).

(viii) Creation of secure routes or "corridors" for elephants: As elephant populations become more and more constrained so the need for 'safe corridors' between protected areas becomes even more important. There is considerable potential for elephants from Botswana to move north into Zambia and Angola once new "corridors" have been established, which should reduce the environmental and social pressures of their over-abundance in Botswana and Caprivi. Although new "corridors" could reduce HEC in parts of the TFCA, these movements could also result in an increase of HEC problems as elephants disperse to new areas. CI (2006) has identified the following "corridors" that need to be consolidated, strengthened or developed:

- Okavango Panhandle through western Bwabwata National Park and up along the Cuito River in Angola (Okavango-Cuito Corridor).
- Immediately west of the Kwando River reaching from northern Botswana through east Bwabwata National Park and in to the Luiana Partial Reserve in Angola (Kwando West Corridor).
- Immediately east of the Kwando River from the Savute region of northern Botswana through Mamili and Mudumo National Parks and then northwards via a series of Community Conservancies into Sioma Ngwezi National Park (Linyanti-Sioma Ngwezi Corridor).
- From central and eastern Chobe National Park up through the extreme eastern region of Caprivi (Kasika/Impalila) north-easterly across current farmland along the Zambezi River in Zambia (East Chobe–Kazungula-Kafue Corridor).

There is as yet no firm evidence of elephants from the Kafue National Park having contact with elephants from the Livingstone area of Zambia or with elephants in and around Sioma Ngwezi National Park (see Map 1). Based on a study of 10 elephants from the Ngoma area of the Kafue National Park (tracked with satellite-linked radio collars from 2003 to 2005), the southern Kafue "cluster" as described by Jackson & Erasmus (2005) does not appear to extend northwards beyond the southern shore of Lake Itezhi Tezhi towards the central or northern sectors of the Park. Movements to the south are restricted to the western part of the Nkala GMA, while the Nanzhila region of the Park was visited periodically, mainly in the wet season by males. To date, there is no evidence of elephants from this cluster using either the Sichifulo or Bilili Springs GMAs to the south and southeast of Kafue National Park (Jackson & Erasmus, 2005). At the southern end of this potential "corridor", Chase (personal communication) deployed eight

satellite-linked radio collars in the second half of 2006, and by the end of the year, none of these elephants had moved north into the Kafue National Park.

The KAZA TFCA Pre-feasibility Study has identified further work on these and other "corridors" as a priority for the next Phase of the development of the TFCA (TCC, 2006). In a review entitled *Megaparks for metapopulations: Addressing the causes of locally high elephant numbers in southern Africa* van Aarde & Jackson (2007) argue that although the application of the metapopulation metaphor is a powerful ecological platform from which to manage elephant numbers in southern Africa, this needs to be melded with social, political and economic realities in the region, which they note is being encouraged by the ongoing development of several TFCA programs.

(ix) Repositioning the boundaries of protected areas: This option should be regarded as a last resort as a way of reducing or eliminating particularly serious cases on HEC. A repositioning of boundaries does not necessarily mean a reduction in the size of a protected area as additional land could be incorporated away from areas of higher human population density as long as there is a minimum impact on the ecological integrity of the protected area. This could be an option for further consideration in the Angolan component of the KAZA TFCA.

(x) African bees: Ideally, any method to steer elephants away from fields should be selective and non-lethal, as well as being efficient and effective, immediate, cheap in capital outlay, and self-supporting once set up. In addition to the use of chilli peppers (see Section 5) the African bee (*Apis mellifera*) could also be an option, with elephants responding quickly to bee stings in

Plate 5. A traditional log-type beehive with African bees could be a useful additional method of keeping elephants away from crops at the same time as proving a source of food for communities.

sensitive areas such as the trunk and around the eyes. Bees can and will sting elephants in these sensitive places, and there are records of elephants being chased by bees for 3-5 km. There are no records of bees killing elephants, but there is a record in Foran (1958) of bees killing buffalo (*Syncerus caffer*). Vollrath & Douglas-Hamilton (2002) experimented with hives placed in fever trees (*Acacia xanthophloea*). Empty hives without bees provided limited protection to its tree. A hive full of bees provided full protection for the tree. Smell could be deterring elephants from harming a hive or approaching too closely too it. Elephants also have excellent hearing and the "buzz" from an active hive could also stimulate hive avoidance (O'Brien, 2002).

Karidozo & Osborn (2005) have tested whether mounting beehives around fields would deter elephants from raiding crops, but unfortunately their tests were too small to produce convincing results, and they recommended further tests, recognizing that bees alone would not stop crop raiding but could be a useful addition to a suite of other options. Where communities have a culture of keeping bees, and where the indigenous vegetation or crops being grown are suitable for keeping bees, this HEC mitigation option is certainly worth exploring further, although the record to date of donor-funded projects to introduce bee-keeping have not been that successful (Karidozo & Osborn, 2005).

(xi) **Chemical deterrents:** Stewart (2003) designed field trials to experiment with Revira granules[13] to keep elephants away from crops in a number of areas in Caprivi: West Caprivi, south of Mudumu National Park, Kasika, and Melengalenga. Preliminary results suggest that Revira appears to cause changes in behaviour in elephants. Initially, there were some promising signs, but only in regards to elephants and one case of hyenas. Other species, particularly hippos, seemed immune to Revira. For example: (i) In a field south of Mudumu National Park initial reports suggested that the elephants approached via their normal entrance/exit route but failed to cross a line of Revira granules, following the line until it ended at the junction with the gravel road, from where the elephants once again entered the field. (ii) A field surrounded by Revira lines was completely avoided by elephants. (iii) A line laid down some 100m away from an

[13] Revira granules are of the LECA type (Lightweight Expanded Clay Aggregate). The granules are "programmed" to suit specific species. However, they can be used for several species at the same time. It is both non-toxic and light enough to float on water, although it does not get damaged by it. Gloves are not needed to distribute the granules, which will not be contaminated by hands and will not harm skin. The product can be stored up to three years in an unbroken package and once spread on the ground. Some users in Europe have noticed effects for almost a full year. The manufacturer claims that Revira's power effectively increases over time, rather than declines as seen with many other deterrents.

Induna's crops appeared to stop elephants returning to raid his field, whilst his neighbours' fields were still attacked. A follow-up meeting provided less promising news. Four (of five) farmers, who had had their fields treated, claimed that Revira worked at first but only for up to a month, after which the elephants returned and destroyed the fields. There was an opinion that the Revira "expired" and hence no longer worked after a month. However, both the manufacturer and a supplier suggests that no evidence had ever been seen any evidence of Revira losing its effect before. The supplier claims that the product should remain effective more or less indefinitely, as the same formulae were used year after year with equal effect. The German Insurance business considers Revira to be 95 percent effective when used in connection with roads.

4. Payment of compensation for crop loss associated with HWC and the development of self-insurance schemes

4.1 Compensation payments

The payment of compensation to farmers for crop loss as a result of HWC is a controversial topic. Communities suffering financial losses from damage caused by a variety of wildlife species will often request compensation from the responsible wildlife authorities, particularly if the communities concerned did not benefit from wildlife and had no control over it. Although these schemes have been tried in several parts of the continent, such as the well documented Human-Animal Conflict Compensation Scheme (HACCS) (IRDNC, 2003), all have encountered serious problems (Gadd, 2002; Hoare, 2001; IRDNC, 2003; Mosojane, 2004; Stander, 2005; Stewart & Diggle, 2004; NRP, 2006). Problems and deficiencies encountered include the following:

- Compensation schemes are cumbersome, expensive to run and all too often have poor or inadequate administration (because of the need to train assessors, cover large areas, have stringent financial controls, etc.). For example, in Botswana the compensation paid by the Government for crop damage does not satisfy all farmers[14], with most considering the process as cumbersome and payments taking too long to be settled. Requests have been made to government to consider increasing the rates to the full market values of crops and livestock[15]. According to DWNP, the government does not intend to increase the compensation rates due to a shortage of funds. DWNP regards damage payouts as only "alleviating the impacts caused by the problem animals" - they are not intended to replace what has been lost. The word "compensation" (which means: replacement of the value) will be replaced by the term *"ex gratia"* (which means: out of kindness) (Sola, personal communication)[16].

[14] The rates of compensation in Botswana for property damaged by the listed problem animals are gazetted in the Government Notice No. 78 of 2005 of the Wildlife Conservation and National Parks Act Chapter 38:01. If a person is killed by an elephant in Botswana, no compensation is paid.

[15] As an example of compensation payments, from January to December 2005 a total of Pula 296,654 was paid to 509 farmers in the Maun District. 226 cases of stock loss from lion paid a total of Pula 209,060, 118 cases involving leopard paid Pula 42,630, and 111 cases of elephant damage paid Pula 17,494. Other successful claims paid out involved wild dog (43), cheetah (4), hippo (4) and crocodile (3). (US$1 = Pula 6.16)

[16] L. Sola - lmooreblues@yahoo.com

- The cause of the problem, namely the problem animals, is not being addressed (so schemes potentially have no end point).
- People are also not being compensated for the loss in quality of life when having to spend sleepless nights beating drums, and making fires and decoys around their cultivated fields to scare elephants away. Linked to this is the inability to compensate for indirect costs experienced in HWC situations.
- There is and has been considerable abuse or blatant corruption of compensation schemes through bogus or inflated claims.
- Compensation can result in a *reduction* in the incentive to protect arable lands, which in turn can even increase the scale of the problem.
- Food relief is often not sustainable and is reliant on government and/or external support.
- There are several records of an absence of sufficient funds to cover all claims, and when coupled with high administrative costs, this became a major reason for failure of compensation schemes in several places. With claims running far in excess of funds allocated, the suspicion was aroused that farmers had reduced their efforts to protect crops or that false claims were being submitted as an easy way to access cash.
- Unequal disbursements among community members that suffer losses, causing disputes or social problems.
- Problems in assessing the extent of the damage or loss[17].
- Problems with timing of the reporting of HEC and crop loss. As an example, for compensation to be paid out in Botswana, the farmer must report the incident to the authorities within seven days[18]. There are practical problems faced by farmers in remote areas where HEC is often the most pronounced, as there are no wildlife offices immediately accessible and no methods of submitting reports within the stipulated seven days. In cases where the relevant authorities are not able to assess the damage promptly, farmers are faced with the difficulty in proving the evidence as the tracks of the problem animal become faint.

[17] The government compensates farmers whose crops are damaged by Elephants at Pula 250 / hectare. However, in many places where HEC occurs, most fields are less than one hectare in size, and payments can be as little as Pula 10 (S. Mosojane, personal communication - smosojane@gov.bw).
[18] Wildlife Conservation and National Parks Act Chapter 38:01

Even in cases where monetary compensation has been replaced by compensation in staple foodstuffs (e.g. maize or millet) to the value of losses, many of the above deficiencies remain. Stander (2005) believes that "compensation", as a concept, is fundamentally flawed. Innovative programs, such as the Conservancies in Namibia, have changed past management regimes, granting local communities the rights to benefit from wildlife, to participate in management decisions, and most importantly have ownership over their wildlife resources. Stander (2005) further argues that compensation schemes may therefore be harmful, since they deprive people of the right and privilege of ownership and responsibility over their wildlife resources.

4.2 Self-insurance scheme for crop losses associated with HWC

An alternative and more realistic option for payment for crop losses is a system of "self-insurance" a concept which is being developed in Namibia and which is in line with the management philosophy of the Communal Conservancies. IRDNC has developed and implemented such an initiative through a Human Animal Conservancy Self-Insurance Scheme (HACSIS)[19] at selected Conservancies in the Kunene and Caprivi Regions (Esterhuizen, 2004; Stewart & Diggle, 2004). The pilot program not only successfully dealt with payments for crop losses, but also introduced a greatly improved monitoring system, with the HACSIS database producing similar or better results than the other monitoring systems (Event Book, MET database) (Stander, 2005). In short, the Conservancy Committees and their traditional authorities seek to balance the losses of individual Conservancy members against benefits from wildlife gained by the Conservancy. Farmers are paid fixed-rates for losses from certain wildlife species that have collective value to Conservancies, with payments only being made to registered members, in the event of such member's maize, sorghum or millet being destroyed. These payments will only be made within a framework of rules and conditions, which were developed with the Conservancy members, and are clearly set out. Claims that fail to meet any of such rules and conditions are not eligible for any form of compensation.

The title change (from "compensation" to "self-insurance") marks IRDNC's new approach to dealing with crop loss. The new scheme has three main aims:

[19] The same scheme as it evolved is also referred to as the Human-Animal Conflict Insurance Scheme (HACIS) (Stewart & Diggle, 2004).

(i) Its principal aim is to encourage better land management. *It does this by applying strict conditions that require farmers to put in specific and continuous input into better farming management as an essential prerequisite to any compensation claim being considered.* Where a farmer has abided by the conditions of the scheme (i.e. made all reasonable efforts to reduce his losses) but still has his crops damaged, he will be compensated for a proportion of the total value of the lost crops. By not paying the full market value, it reduces deliberate fraud of the scheme, as farmers will be well aware that they are likely to gain significantly greater income from managing and harvesting their crop that a value for compensation would provide. Deliberate fraud of the system would lead to the farmer being barred from the scheme for a stipulated period, as decided by the Conservancy Committees (Stewart & Diggle, 2004).

(ii) The second aim of the scheme is to increase the tolerance to the wildlife that comes into "conflict" with the farming and subsistence community. It has been well-documented that the perception of HWC is particularly acute when the farming community feel powerless to stop their crops and their livestock being plundered by animals that they believe they have little power to act against, especially elephants.

(iii) The third aim is to promote the equitable distribution of the benefits of keeping wildlife throughout the participating conservancies, which is a constitutional condition that needs to be met by the Conservancies. It takes into account the balance of individual losses versus collective gains, the philosophy of CBNRM being to direct returns to those that have either made a direct contribution to or suffered loss from living with wildlife (Stewart & Diggle, 2004).

The scheme makes no attempt to cover all losses for all types of crops or cover damage done by all problem animals, but works by balancing the losses that farmers experience against the overall value (directly or indirectly via consumptive (hunting) and non-consumptive (tourism) activities) of keeping particular species within that Conservancy. The Africa 2000 Trust and IRDNC have been recently been reviewing various aspects of HACSIS (Ricoveri, personal communication)[20] and agreement was reached on the following:

- *Crops to be covered*: Maize, millet and sorghum.

[20] A. Ricoveri - africa2000@iway.na

- *Animals to be covered:* Elephants were regarded as the most difficult animals to deal with, but also offer the greatest potential revenue earnings for the conservancy. Both hippopotamus and bushpig will also be covered as both cause extensive damage.
- *Age of crops to be considered:* All crops above 60cm height should be covered.
- *Additional support to the poorest:* The scheme should be open to everyone and implemented without taking into consideration the economic situation of claimants.
- *Putting a value on crop loss:* This topic was discussed at length before any real consensus could be reached. It was agreed that crop losses should be compensated in financial terms and not through payments in kind, that claim limits should range between N$120 (less then the value of one 50 kg sack of maize) to a maximum of N$480 for the worst cases of crop raiding and that the Traditional Authority in the area would play a leading role in deciding upon claim values with the support of Conservancy Committee representatives.
- *Minimum amount of damage:* It was agreed that the equivalent of at least one sack worth of damage would be needed for a community member to make a claim. Members of the Conservancy agreed with the principal of minimum amount of damage.
- *'No-claim' areas:* After some debate on how geographic limits could be set, it was agreed that no claims for crop loss would be considered from within the recognized 'tourism development zones'.
- *Seasonality of the scheme:* In an ideal situation, the scheme should run from January to June each year.

In summary, as with compensation schemes, HEC is not being addressed directly, as this can reduce incentives to protect crops. However, there are the following distinct advantages of self-insurance schemes:

- ✓ Actively encourages better land management.
- ✓ Schemes are owned by communities who decide on payment rates and schedules.
- ✓ Farmers are paid fixed-rates for losses from certain wildlife species that have collective value to Conservancies, with payments only being made to registered members.
- ✓ Schemes seek to balance the losses of individual Conservancy members against benefits from wildlife gained by the Conservancy.
- ✓ Promotes a more equitable distribution of benefits.

5. The use of chilli peppers in human-elephant conflict mitigation

5.1 Formation of the Elephant Pepper Development Trust

Recognizing that repellents based on atomized capsicum oleoresin resin from *Capsicum* species have been used to alter animal behaviour for a variety of species, including bears, ungulates, dogs and humans, Osborn (2002) was prompted to explore its possible use as an elephant repellent in the Hwange National Park in Zimbabwe. He found that elephants were repelled from fields significantly faster by the capsicum oleoresin spray than by traditional methods. From this initial work came the development of the use of *Capsicum* species grown in fields in Africa for use as an elephant deterrent and a cash crop, and the formation of the Elephant Pepper Development Trust (EPDT), which moved from Zimbabwe to Livingstone in Zambia in 2004, and has taken the lead in promoting and encouraging the use of chilli peppers in Community-Based Problem Animal Control and HEC mitigation.

ELEPHANT PEPPER DEVELOPMENT TRUST

Mission: The Elephant Pepper Development Trust aims to promote the livelihood of farmers living in elephant range through training, the deployment of appropriate conflict mitigation methods and development of agricultural techniques which promote elephant conservation.

Trustees: Loki Osborn, Michael Gravina, Lucy Welford, Guy Parker

Management: Nina Gibson, Anja Held, Ignatius Masarirevu, Catherine Chandenda, James Mwanza.

Partners: Wildlife Conservation Society, United States Fish and Wildlife Service, DED, World Bank, Agricultural Support Program, Zambia. USAID- Market Access Trade and Enabling Policies (MATEP) and AGOA -Southern Africa Global Competitiveness Hub, have supported the US launch initiative of Elephant Pepper through trade fair attendance and export advisors.

Contact address: Elephant Pepper Development Trust, P.O. Box 60301, Livingstone, Zambia. www.elephantpepper.org

5.2 The origin, use and active ingredients of the chilli pepper

The chilli[21] pepper is the fruit of the plant *Capsicum* from the nightshade family, *Solanaceae*, and it was one of the first cultivated crops in the Americas to be used as a part of the human diet since they were domesticated there between 5200 and 3400 BC. Christopher Columbus was one

[21] Also spelt "chili" and "chile".

of the first Europeans to encounter them, and called them "peppers" because of their similarity in taste (though not in appearance) with the Old World peppers of the *Piper* genus. The most common species of chilli peppers are *Capsicum annuum*, *C. frutescens*, *C. chinense*, *C. pubescens* and *C. baccatum*. The substances that give chilli peppers their heat is capsaicin (8-methyl-*N*-vanillyl-6-nonenamide) and several related chemicals, collectively called *capsaicinoids*. Capsaicin is the primary ingredient in pepper spray. The "heat" of chilli peppers is measured in Scoville units. The fruit is eaten cooked or raw for its fiery hot flavor which is concentrated along the top of the pod. The stem end of the pod has glands which produce the capsaicin, which then flows down through the pod. Removing the seeds and inner membranes is thus effective at reducing the heat of a pod. Chilli peppers are rich in vitamin C and are believed to have many beneficial effects on health. The pain caused by capsaicin stimulates the brain to produce endorphins, which act as analgesics. Birds do not have the same sensitivity to capsaicin as mammals, as capsaicin acts on a specific nerve receptor in mammals, and avian nervous

Plate 6. Ripe red fruit of the chilli pepper, which is eaten cooked or raw for its fiery hot flavor concentrated along the top of the pod.

systems are rather different. Chilli peppers are in fact a favorite food of many birds living in the chilli peppers' natural range. The flesh of the peppers provides the birds with a nutritious meal rich in vitamin C. In return, the seeds of the peppers are distributed by the birds, as they drop the seeds while eating the pods or the seeds pass through the digestive tract unharmed (Wikimedia, 2006).

5.3 Summary of chilli pepper use for HEC mitigation

(a) Burning of "chilli bricks": Elephant dung is mixed with ground chillies with the concentration of one buddle of a human's hand with two of elephant dung, compacted into a mould, and then dried in the sun.

Plate 7. There is considerable variation in the mixture of elephant dung and chilli peppers used to make each "chilli brick". In this case the ratio was 1:1.

Chilli peppers can cause a severe allergic reaction when coming into regular contact with unexposed skin. EPDT recommends that gloves are worn when mixing dung and peppers to make the chilli bricks. Cattle dung has been tried in place of elephant dung but it is much more difficult to mix into a mould and make an effective brick.

Plates 8 & 9. Although EPDT suggest that the ideal chilli brick should be the size and shape of a large elephant dropping (above left), great variation was noted at sites visited.

Plate 10. A hot coal is placed in the chilli brick. Depending on its size and shape, each brick burns slowly for 2 – 8 hours, producing noxious smoke which drives elephants away and which last for 3 – 4 hours, depending on wind strength.

The chilli bricks should be placed 5 – 8 meters apart, but several factors can influence the optimum placing including the number of elephants, their direction of movement and wind direction. A field of approximately 10 hectares of maize near Livingstone belonging to a Mr. Lubinda was successfully protected with a chilli fence and chilli bricks placed 20 meters apart.

(b) Application of chilli grease to fences: Engine grease or old engine oil is mixed with chillies, and smeared on strings placed around the fields which should be between 1.5 and 2.0 meters above the ground. The strips of mutton cloth impregnated with chilli grease are placed on

Plates 11. Chilli peppers are mixed with grease or old engine oil and rubbed into mutton cloth before hanging on the fences.

these fence strings about 8 meters apart. The fences with chilli pepper grease are not physical barriers and can be made of no more than string strong enough to carry the impregnated chilli strips.

Plate 12. James Mwanza from the EPDT in Livingstone demonstrates a chilli pepper fence at the Nsongwe Women's Group garden. Since the fence was installed and chilli bricks used, there have been no problems with elephants. In this case he recommends that the strips are renewed every three weeks.

Plate 13. A small demonstration plot with a chilli pepper fence was set up by the EPDT at the remote village of Jafta near Livingstone. At the time of the visit (July 2006) no crop losses had occurred.

The cost of the cloth, chilli peppers and grease for the fence around the 10 hectare maize field of Mr Lubinda was approximately US$180. Sitati & Walpole (2006) reported that a farm encircled by chilli rope in the Lolgorien elephant corridor in Kenya survived for two years without elephant crop raiding, despite nine attempts by elephants to enter the farm. A nearby farm without chilli rope was raided seven times during this period and was subsequently abandoned.

(c) Planting of chilli peppers as a buffer crop: Chillies can be planted on the periphery of other crops as the first plants elephants will encounter as they move towards arable land. Although other mammals will eat chillies, they are avoided by elephants (Parker & Osborn, 2006).

Plate 14. A simple chilli pepper fence at the Livingstone demonstration plot, with chillies planted as a buffer crop, and bells attached to the fence to warn the farmer if large animals move the fence.

(d) Chilli darts: Harvested chillies from Namushasha in Namibia have been processed into a potent distillate that can be delivered via a drop-out dart system to deter small elephant herds and elephant bulls that are destroying fields and homesteads. Preliminary tests have shown these chili darts to be highly effective in deterring single elephant bulls with the drop out dart system perfected by Brain (2006). Although there are risks and technical concerns associated with this option, it should be explored in more detail with costing related to its use in extension services.

5.4 Activities of the EPDT

By producing high quality and uniquely African chilli products[22] (see info@elephantpepper.com and www.elephantpepper.org) the EPDT seeks to create new economic opportunities for rural Africans and support efforts to safely reduce the conflict between elephants and humans in Africa, at the same time as bringing sustainable financial, social, and environmental benefit to its stakeholders by linking African farmers to a global marketplace and raising awareness around successful approaches to elephant conservation (EPDT, 2006). EDPT has launched an intensive **training course** which not only teaches

[22] Elephant Pepper chilli sauces are sold on-line at www.elephantpepper.com. Products are also available in stores throughout South Africa and Zambia.

farmers how to grow and market the crop, but also how to prepare the chillies for HEC mitigation. The advantages of chillies as a commercial cash crop and an elephant deterrent are listed by EDPT (2006) as follows:

1. An elephant's sense of taste and smell is over 100 times more powerful than that of humans, and so the pain experienced by elephants is much greater.
2. They can be grown easily, as chillies like hot, dry conditions.
3. They can be used in problem animal control. The procedure for making chilli bricks and string fences is simple and farmers can copy and teach others the methods easily.
4. Chillies can be sold locally in the market, or internationally through a trade link. Chillies currently command a good price and so any harvest can be sold to generate income.
5. Chillies cause no long-term injury to elephants, and also cause no damage to the environment.

The EPDT Training Course introduces Community-Based Problem Animal Control (CBPAC), and provides both theory and practical training in the technique. In addition, the course explores HWC, conflict mitigation and monitoring and evaluation methodology. It is conducted through a combination of lectures, discussion points and practical demonstrations. The system has been exclusively developed by the EPDT and is funded by the Wildlife Conservation Society and the US Fish and Wildlife Service. The complete training manual accompanies this Interim Report as Annex 3. The EPDT also provides *in situ* training through extension officers on growing chillies and using them for HEC mitigation. The EPDT (2006) makes use of demonstration sites as a crucial means of introducing the crop protection methods to the farmers, noting that the sites should be maintained for up to six months to allow sufficient time for the farmers in surrounding communities to visit them, and to maximize the chances of elephant encounters. The selection of a site should consider the following points:

1. *Level of risk:* The site needs to have a high potential for being raided by elephants so that the methods will be fully tested.
2. *Vulnerable crop:* The site should have food crops such as maize or cassava which are attractive to elephants and are therefore at greater risk.
3. *Season:* The demonstration plot must be established during the cropping season, when food crops are maturing.

4. *Accessibility*: The site must be accessible to a large number of people so that the methods can be displayed to as many communities as possible.
5. *Commitment of the farmer:* The farmer whose field is being used must have an interest in the project, so that he not only maintains the demonstration site and actively defends his field, but also passes on the information to other farmers in the area.

Plate 15. Preparation of holes with compost for planting chilli peppers at the Livingstone demonstration farm.

Plate 16. Shade drying of chillies at the David Livingstone College of Education, where all students (future teachers) are taught the value of chilli peppers in HEC mitigation. The College has also installed a chilli fence to stop crop raiding by elephants.

The EPDT demonstration site at Livingstone was visited during the course of this study. It is situated at the old Livingstone Show-grounds site in the peri-urban area of Livingstone next to the Zambezi River and the Mosi-o-Tunya National Park. There are today about 350 people living there, most of them dedicated to small-scale agricultural activities. HEC incidents started increasing in 2002, and in 2003 and in the following two years the farmers lost almost their entire harvest to elephants, with a peak being reached in June 2005, when one of the farmers, Roy Kaanga, reported the case to ZAWA. He was eventually referred to the EPDT's office in Livingstone, who organised a PAC and chilli-growing workshop for fifteen people from the Show-grounds in October 2005. According to an unpublished internal report at EPDT: "Immediately after the workshop, Kaanga and the others installed a chilli fence and a buffer strip of chilli plants around the community garden. Kaanga finished the fence around his own field about one month later and started chilli growing as a cash crop in December. After that elephants only once came back to Kaanga´s field "but they smelled the chillies that were burned immediately and ran away". After having started using the PAC methods the elephants did not raid his crops anymore."

In April 2006, the first chillies were sold commercially by rural farmers in Salambala Conservancy in Caprivi to the Conservation Farming project of the USAID funded LIFE Plus Program. Nineteen farmers from Masikili Village and six farmers from Maritzburg Village sold their chillies for N$ 9 per kg of dried chilli. The total amount of chillies bought was 300 kg valued at N$ 2,700. In early June, N$ 3,779 was paid out to a total of 50 farmers in Masikili, Ngoma, Isuswa and Maritzburg (about 420 kg), with the highest amount paid to one farmer being N$ 270 (30 kg) to John Likezo from Masikili Village. In these cases the farmers were either relatively close to a marketing outlet or received assistance from the LIFE program to get their chillies to such an outlet. In the Livingstone area, most farmers are able to get their chillies to the office of EPDT. However, where farmers do not have these opportunities, the sale of chillies will remain a problem. Further work is required to develop an efficient and cost-effective marketing structure if this initiative is to move towards self-sufficiency.

From information gathered to date, chilli peppers appear to have an excellent potential as one of the most promising HEC mitigation options that can be applied at low cost at the community level, with the added advantage of producing extra income from the sale of chillies.

6. The advantages and disadvantages of HEC mitigation methods described in this report.

6.1 Comparison of mitigation methods

There is clearly an urgent need to make a significant reduction in HEC within the HEC "hotspots" in the KAZA TFCA (TCC, 2006). Most of the mitigation methods used to date have focused on short-term deterrence at the conflict site, a "band-aid approach" which has usually been applied in an *ad hoc,* uncoordinated manner, and has subsequently achieved little long-term success at alleviating the problem for more than a few farmers. Furthermore, several of the mitigation methods have simply displaced elephants from one small area of arable land to another one near by. While this in itself is undoubtedly welcomed by those farmers who benefit from crop protection, objective evaluations of HEC mitigation methods are almost impossible in the absence of near-by or adjacent untreated controls. Nevertheless, it is possible at this stage of our knowledge to summarize the *advantages and disadvantages* of the various mitigation methods based on the literature cited elsewhere in this report, and on discussions with field workers in the KAZA TFCA area listed in the acknowledgements (see Table 5).

All of the methods outlined in his report have had at least some success, and at this point, not one of them should be dismissed as an unacceptable approach. What has become clear is that each case of HEC merits individual attention, and that the attitudes of effected communities and their willingness to try new methods of mitigation, coupled with the present and likely future patterns of human settlement in relation to elephant movements, are of particular importance in any objective assessments.

More recently, Sitati & Walpole (2006) tested a range of a range of simple, cost effective, traditional and novel mitigation methods that are accessible to rural communities without major external support. The study was conducted in Kenya, where the rural communities received little support from the national wildlife authorities. *In contrast to the majority of other reports on HEC mitigation, an experimental research design was attempted by selecting a sub-sample of farms for testing mitigation methods, leaving others nearby as untreated controls.* The study concluded that the sustained implementation of traditional and novel farm-based methods is effective in reducing HEC, based on a combination of early warning, guarding and chilli grease deterrents to guard front-line farms, with the farmers themselves being responsible for implementing mitigation methods. This significance of this approach and the conclusions are discussed further in the next section of this report.

Table 5. Summary of the advantages and disadvantages of the methods proposed to reduce HEC.

Method used to reduce HEC	Advantages	Disadvantages
Traditional deterrents	1. Easily applied by community farmers. 2. Low cost and easy to use. 3. Good short-term results, with watchtowers proving early warnings. enabling farmers to respond before elephants enter farms. 4. Not fatal to elephants.	1. Elephants quickly habituate. 2. Should be used in combination with other methods. 3. Some options pose danger to human life, particularly when elephants are injured or stressed.
Disturbing elephants when close to settlements or arable land	1. Good short-term results. 2. Thunder flashes particularly effective when combined with early warning systems. 3. Not fatal to elephants.	1. Elephants quickly habituate, and will return to the area even if disturbance is followed up by chasing elephants. 2. Most methods are dangerous to apply. 3. Some options expensive (e.g. thunder flashes & equipment for playing back recorded elephant "alarm calls").
Killing problem elephants	1. An effective solution in the short term. 2. Meat and skins made available for communities. 3. Communities see this as retribution for problems caused. 4. Relatively cheap and easy to apply.	1. Trained personnel required. 2. Difficulties in identifying problem elephant from others. 3. Problem elephants often replaced by other elephants, with little overall reduction in HEC. 4. Criticism from animal rights groups.
Translocation of problem elephants	1. Not usually fatal to elephants, although deaths have been recorded during capture and translocation. 2. Immediately effective if the correct animals are moved.	1. High cost of trained personnel and equipment. 2. Difficult to ensure correct animal is translocated. 3. Shortage of suitable release sites for translocated problem elephants. 4. Breaking up family units is disruptive often causing future problems .

Electric fences	1. Very effective if correctly positioned and maintained. 2. Useful in clearly demarcating important and sensitive areas. 3. Not fatal to elephants.	1. Very expensive to install, and consequently unlikely to be applied in communal situations. 2. Regular maintenance and inspection essential, with vandalism and theft of components a major concern. 3. Elephants that are "habitual fence-breakers" are unlikely to be deterred. 4. Must encircle whole field – elephants will walk around partial fences.
Other physical barriers (Traditional fences, rocks, moats & buffer crops)	1. Large sharp rocks and stone walls can be very effective. 2. Useful in clearly demarcating important and sensitive areas. 3. Not fatal to elephants (with possible exception of some moats and ditches).	1. Rocks not available in most HEC "hotspots" in KAZA TFCA. 2. Most traditional fences not well-maintained and elephants are not deterred. 3. Moats and ditches expensive to construct and vulnerable to soil erosion.
Chilli peppers (various uses)	1. Not fatal to elephants and no long-term harmful effects. 2. Produced on-site and at low cost 3. Chilli grease overcomes the problems of accidental exposure through air-borne delivery. Fences locally produced and cheap. 4. Farmers have an additional cash crop from the chillies, and thus their use readily accepted by most farmers.	1. Expensive if chillies are not grown locally. 2. Accidental exposure to people and other animals with chilli bricks when wind changes direction. 3. Chilli grease fences must encircle whole field – elephants will walk around partial fences.
Other olfactory repellents	1. Not fatal to elephants. 2. No known long-term harmful effects.	1. Accidental exposure to people and other animals when wind changes direction. 2. Difficult to evaluate.

Relocation of agricultural activities and change of cropping regimes	1. Very effective when arable lands relocated away from main areas of elephant movements. 2. Potential as a long-term solution to HEC, especially if it discourages further human encroachment into elephant range. 3. A long-term strategy which can also improve conservation of other wildlife species, and help to create space for elephants and people to live together. 4. Not fatal to elephants.	1. Only possible with new investments by farmers on availability of areas with suitable climate and soils for new crops, and market for crops. 2. Unlikely to succeed if effected communities do not get commercial benefits from the presence of elephants. 3. Requires a long-term commitment and results are often not immediately evident. 4. Government support may be required coupled with enabling legislation.
Creation of secure routes or elephant corridors	1. Great potential for development within the KAZA TFCA. 2. A long-term strategy which can also improve conservation of other wildlife species, and help to create space for elephants and people to live together. 3. Not fatal to elephants	1. Could result in increase in HEC in other areas as elephants disperse. 2. Corridors require a big investment in community consultations and agreements. 3. Unlikely to bring any immediate short-term changes.
Repositioning of protected area boundaries	1. A long-term strategy which can also improve conservation of other wildlife species, and help to create space for elephants and people to live together. 2 . Not fatal to elephants	1. Should be seen as a last resort requiring considerable work locally and nationally. 2. Unlikely to bring any immediate short-term changes.
Chemical deterrents (Revira)	1. Potential encouraging – elephants avoid Revira "lines". 2. Effective, non-lethal and easy to use. 3. Elephants respond quickly 4. Useful addition to a suite of other options.	1. Revira produced outside of KAZA TFCA, with relatively high import and distribution costs. 2. Difficult to assess.

African Bees	1. Bees can be integrated into livelihood strategies of communities living in elephant range, with honey being harvested for additional income and food. 2. Not fatal to elephants.	1. Duration of effectiveness uncertain, and difficult to assess. 2. Communities must have a culture of bee-keeping or be willing to undergo training on managing bee hives to avoid risks of being stung. 3. Elephants respond quickly to bee stings in sensitive areas (trunk and around the eyes). 4. Bees are inactive at night / cold weather.

6.2 Conclusions

The Terms of Reference for this study noted that "While it is critically important to understand the whole range of mitigation measures adopted by people, emphasis should be placed on the extent and nature of use of chilli peppers." With most of the more serious crop-raiding taking place from January to May, it has not been possible to conduct first-hand inspections of the success of chillies in mitigating HEC. *Nevertheless, initial assessments on the use of chillies are extremely favourable.* However, before confident proposals can be made on the promotion of the use of chillies (as outlined in Section 5) as one of the major HEC mitigation options through community-based organizations with initial support from government / NGO extension services[23] within the KAZA TFCA, it is recommended that rigorously designed field trials on mitigation methods running over several seasons should be implemented (see Section 7), with the design of the trials incorporating the following principles and conclusions.

- Each case of HEC merits individual attention. *It is highly unlikely that there will ever be one simple blueprint for mitigation that will have universal application throughout the KAZA TFCA.*
- HEC will never be totally eliminated, but it can be reduced significantly with the right counter measures. In short, one type of intervention on its own, although having some effective, will never be as effective as a carefully

[23] The term "extension services" refers to training, capacity building and mentorship activities by government departments or NGOs to enable farmers and others experiencing HEC problems to implement mitigating activities.

selected number of other options appropriate to each specific area. In any one area, several different methods should ideally be employed simultaneously, with the interventions put in place in good time ahead of the period when serious problems are expected.

- It is unrealistic to expect complete solutions to all HEC problems. Where elephants and people live in proximity to one another, the management objective should not necessarily be to eliminate the problem but to reduce it.
- Community Based Problem Animal Control (CBPAC) implies a sense of ownership by the communities. Thus the attitudes of effected communities and their willingness to try new methods of mitigation must be determined.
- For HEC mitigation to succeed, there must be a high level of cooperation within communities and ideally between neighbouring communities.
- To ensure long-term effectiveness, new deterrent methods should be introduced regularly or existing methods available rotated, to avoid eventual habituation by the elephants.
- HEC mitigation methods developed must be readily available and acceptable to the people using them, particularly those living in remote areas, and ideally should be based on the premise that farmers must take responsibility for their own crop protection and not rely on external assistance.
- HEC mitigation needs to be addressed at all levels, from the underlying causes of the conflict through to all aspects of the human dimension.
- Present and likely future patterns of human settlement in relation to elephant movements, are of particular importance in any objective assessments.
- The overall support of the responsible conservation management authorities in the KAZA TFCA is essential.

7. Proposal for a new project in the KAZA TFCA linked to the use of chilli peppers in HEC mitigation

7.1 Introduction

Comprehensive HEC mitigation coverage for *all farmers in "hotspot" areas* is long overdue. The project will be based on the introduction of a combination of methods using chilli peppers, which in turn will be linked to a suite of additional low-cost mitigation techniques that are suitable for use in CBPAC. Particular emphasis will be placed on the development of model systems for HEC management, focussing on the sustainability of the methods introduced, and linked to an exit strategy to enable the project team to complete work in the selected areas after a period of three years before moving on to new geographical areas of HEC concern.

7.2 Proposed project activities

Based on the track record and experience of the EPDT, the project should be based in Livingstone, Zambia, at the offices of the EPDT. It will be linked closely to the KAZA TFCA Secretariat to ensure optimum regional coordination[24] and will undertake the following activities during the first three years:

- Establish and appoint the project team to develop and run the project entitled *Mitigation of Human-Elephant Conflict in the KAZA TFCA through Community Based Problem Animal Control*.
- Identify HEC "hotspots" in Botswana, Namibia, Zambia and Zimbabwe, and develop an agreed KAZA TFCA HEC strategy for the region which is be supported by clear policies and legal frameworks at the local, district and national levels, based on a standardised and accepted HEC monitoring systems for the whole TFCA.
- Select communities and arable areas for HEC mitigation. For HEC management to be effective at the site level, local communities will be given the appropriate level of authority to decide how elephants should be managed while developing strategies to improve local livelihoods.

[24] Every effort should be made to avoid overlap and duplication of activities. As an example, close links must be established in Botswana to the one year study on HEC data capture and mitigation trials linked to the Okavango Delta Management Plan (NRP, 2006).

- Establish regional or local committees as appropriate, comprised of affected communities and where relevant CBOs, NGOs, wildlife authorities and private sector, etc. who share responsibility for dealing with HEC[25]. For HEC mitigation to succeed, there must be a high level of cooperation within communities and ideally between neighbouring communities.
- Set up demonstration plots in the "hotspot" areas. The selection of a site should consider the following points:
    - ✓ *Level of risk:* The site needs to have a high potential for being raided by elephants so that the methods will be fully tested.
    - ✓ *Vulnerable crop:* The site should have food crops such as maize or cassava which are attractive to elephants and are therefore at greater risk.
    - ✓ *Season:* The demonstration plot must be established during the cropping season, when food crops are maturing.
    - ✓ *Accessibility*: The site must be accessible to a large number of people so that the methods can be displayed to as many communities as possible.
    - ✓ *Commitment of the farmer:* The farmer whose field is being used must have an interest in the project, so that he not only maintains the demonstration site and actively defends his field, but also passes on the information to other farmers in the area.
- Provide training and regular extension services to all farmers in selected areas based on the EPDT *in situ* training courses in CBPAC.
- Establish and run standardised monitoring programs of the effectiveness of mitigation in each HEC "hotspot", with these programs being applied throughout the KAZA TFCA. Monthly monitoring should take place of all HEC related incidents, together with data on elephant movements and any changes in the location of arable land and changes in crops planted.

[25] Partner organizations must be clearly identified and their respective roles unambiguously articulated..

- Encourage the standardization of national legislation to deal with problem animal control in general and HEC in particular.
- Establish trials on the effectiveness of various combinations of HEC mitigation methods, giving priority to chillies, to evaluate and test various combinations of some of the options listed in Section 3. These should be conducted in relation to cost, effectiveness and realities of use throughout the area, paying particular attention to the use of unprotected controls and the monitoring of the movements of elephants in and around the "hotspot" areas, with reference to rainfall patterns and declines in food production for elephants from natural vegetation which might trigger crop raiding. The trails should also include a detailed study of the relative effectiveness of various chilli/dung ratios in making chilli bricks, the size and shape of the bricks and the optimum distribution of these bricks in relation to field size, wind direction and other variables, and a study of the size and spacing of chilli cloths on fences and the frequency of the renewal of the chilli grease under different climatic conditions.
- Preliminary results of the self-insurance schemes are most encouraging, but further evaluation is needed. A limitation on their extension to other parts of the KAZA TFCA is the capacity of local communities to administer the financial aspects. A comprehensive and long-term training program would be required for the scheme to succeed. At the same time it would be worth examining the possibility of payments being initially "topped-up" by an international insurance fund.
- When sufficient chillies have been grown for HEC mitigation, the project Extension Officers will encourage and foster links between farmers and a commercial buyer of fair trade chili, based on the establishment of an efficient and sustainable marketing structure.

7.3 Project outputs

It is now widely accepted that HEC will not be eliminated from most of the communal "hotspot" areas, but that it can be reduced to generally acceptable levels. At the end of three years, in addition to the establishment of demonstration plots and the training of farmers in mitigation techniques, the project should have achieved the following outputs:

- ✓ Establishment of a comprehensive HEC mitigation coverage for *all farmers in the selected "hotspot" areas*, based on the introduction of a combination of methods using

chilli peppers, linked to a suite of additional low-cost mitigation techniques that are suitable for use in CBPAC.

- ✓ HEC reduced to acceptable levels linked to improved livelihood security.
- ✓ Models systems in place for HEC management which can be transferred to others parts of the KAZA TFCA. These model systems with focus on the sustainability of the methods introduced, and will be linked to an exit strategy to enable the project team to complete work in the selected areas after a period of three years.
- ✓ A KAZA TFCA HEC strategy in place for the region, supported by clear policies and legal frameworks at the local, district and national levels, will be in place.
- ✓ A common HEC monitoring and evaluation program in place for the whole of the KAZA TFCA. The Pre-feasibility Study has identified the need for harmonization in HEC monitoring techniques and the development an efficient system acceptable to all five countries. This is an essential prerequisite for an objective assessment of HEC "hotspots" within the KAZA TFCA, and is absolutely essential in the evaluation of the effectiveness of mitigating methods.
- ✓ Initial trials on HEC mitigation techniques completed, and reports submitted for peer review.
- ✓ Links established between farmers and a commercial buyer of fair trade chili, based an efficient and sustainable marketing structure.

References[26]

Barnes, R.F.W. 1996. The conflict between humans and elephants in the central African forests. *Mammal Rev.* 26(2/3): 67-80.

Barnes, R.F.W. 2002. Treating crop-raising elephants with asprin. *Pachyderm* 33: 96-99.

Barnes, R.F.W., Azika, S. & Asamoah-Boateng, B. 1995. Timber, cocoa, and crop-raiding elephants: a preliminary study from southern Ghana. *Pachyderm* 19: 33–38.

Brain, C. 2006. *Namushasha elephant deterrent project.* Proposal prepared for The Green Trust.

CARACAL. 2006. *ODMP Wildlife Management Component. Leopard and cheetah baseline inventory in the Okavango Delta particularly in relation to areas of Human Wildlife Conflict. Final Report.* Centre for Conservation of African Resources: Animals, Communities, and Land Use, Kasane, Botswana.

Chase, M. & Griffin, M. 2005. *Ecology, population structure and movement of elephant populations in northern Botswana.* Final Year End Report submitted to the Shikar Safari Club.

Chiyo, P.I., Cochrane, E.P. Naughton, L. Basuta, G.I. 2005. Temporal patterns of crop raiding by elephants: a response to changes in forage quality or crop availability? *African Journal of Ecology* 43: 48

Conservation International. 2006. *Towards Rationalizing Transboundary Elephant Management and Human Needs in the Kavango/mid-Zambezi Region.* Proceedings of the workshop held in Gaborone, Botswana, on 23 and 24 May 2006. Conservation, International, Cape Town.

[26] Includes reports on HEC in areas outside of the KAZA TFCA (including Asia) which were not referred to in the text of this report but include useful material for future reference.

Conybeare, A.M. 2004. Elephant Impacts on vegetation and biodiversity in the Four Corners Area. In: *Biodiversity of the Four Corners Area: Technical Reviews Volume Two.* (Chapters 5-15). Timberlake, J.R. & Childes, S.L. (Eds.) Occasional Publications in Biodiversity No 15,Biodiversity Foundation for Africa, Bulawayo/Zambezi Society, Harare.

Cumming, D, & Jones, B. 2005. *Elephants in southern Africa: management issues and options.* WWF-Sarpo Occasional Paper Number 11, Harare.

De Boer, W.F. & Baquete, D.S. 1998. Natural resource use, crop damage and attitudes of rural people in the vicinity of the Maputo Elephant Reserve, Mozambique. *Environmental Conservation* 25:208–218.

De Boer, F. & Ntumi, C. 2001. Elephant crop damage and electric fence construction in the Maputo Elephant Reserve, Mozambique. *Pachyderm* **30**: 57–64.

Diggle, R., Munali, B. & Owen-Smith, G. 2006. *Community benefits from Elephants: Examples from Caprivi.* Paper presented at a workshop: 'Towards Rationalizing Transboundary Elephant Management and Human Needs in the Kavango / mid- Zambezi Region'. May 2006, Gaborone, Botswana.

EPDT. 2006. *Community-based Problem Animal Control: livelihood security for people living in elephant range. A Training Manual Version, 4.1, March 2006.* Elephant Pepper Development Trust, Livingstone, Zambia.

Envik, K. L. 2000. *Living with Elephants: a non-governmental organization based strategy for Botswana.* Master of Environmental Science. University of Calgary, Calgary.

Esterhuizen, A. 2004. *A perspective of problem causing animals in the Kunene Region, Namibia with regard to strategies implemented to reduce conflict between local communities and problem causing animals.* IRDNC, Windhoek.

Foran, W.R. (1958). *A breath of the wild*. Robert Hale, London.

Gadd, M. 2001. *Final report to Botswana Department of Wildlife and National Parks: 2000-2001 Eastern Botswana Elephant Project.* DWNP, Gaborone.

Gadd, M. 2002. *Report on the November 2002 Field Trip for the CI Botswana Human Elephant Conflict Project*. Conservation International, Cape Town.

Gadd, M. 2005. Conservation outside of parks: attitudes of local people in Laikipia, Kenya. *Environmental Conservation* 32 (1): 1–14.

Hanks, J. 2001. Conservatio n strategies for Africa's large mammals. *Reproduction, Fertility & Development* 13(7,8):459-468.

Hill, C.M. 1997. Crop-raiding by wild vertebrates: The farmer's perspective in an agricultural community in western Uganda. *International Journal of Pest Management* 43: 77–84.

Hill, C.M. 1998. Conflicting attitudes towards elephants around the Budongo Forest Reserve, Uganda. *Environmental Conservation* 25: 244–250.

Hoare, R.E. 1992. The present and future use of fencing in the management of larger African mammals. *Environmental Conservation* 19(2): 160-164.

Hoare, R.E. 1995. Options for the control of elephants in conflict with people. *Pachyderm*. 19: 54–63.

Hoare, R. 1999a. *Data collection and analysis protocol for human-elephant conflict situations in Africa*. African Elephant Specialist Group, Species Survival Commission, IUCN - The World Conservation Union, Nairobi, Kenya.

Hoare, R.E. 1999b. Determinants of human-elephant conflict in a land-use mosaic. *J. Appl. Ecol.* 36: 689-700.

Hoare, R.E. 2001. *A decision support system for managing human-elephant conflict situations in Africa.* The African Elephant Specialist Group, Nairobi. Also www.iucn.org/afesg

Hoare, R. 2002. Update on the study and management of human-elephant conflict in Africa. *Pachyderm* 33: 91-92.

Hoare, R.E. 2004. Elephant movement and conservation in the four corners transboundary area. In: *Biodiversity of the Four Corners Area: Technical Reviews Volume Two.* (Chapters 5-15). Timberlake, J.R. & Childes, S.L. (Eds.) Occasional Publications in Biodiversity No 15,Biodiversity Foundation for Africa, Bulawayo/Zambezi Society, Harare.

Hoare, R.E. & Du Toit, J.T. 1999. Coexistence between people and elephants in African Savannas. *Conservation. Biology* 13: 633-639.

IRDNC. 2003. *A quick guide to the Human-Animal Conflict Compensation Scheme (HACCS) for Kwandu and Mayumi Conservancies.* IRDNC, Windhoek

IUCN. 2005. *Human-Elephant Conflict: causes, effects and options for mitigation.* Human-Elephant Conflict Working Group, African Elephant Specialist Group, Nairobi, Kenya.

Jackson, T. & Erasmus, D.G. 2005. *Assessment of seasonal home-range use by elephants across southern Africa's seven elephant clusters.* Progress Report to Peace Parks Foundation. CERU, University of Pretoria.

Junker, J, van Aarde, R.J. & Ferreira, S.M. 2007. An appraisal of temporal trends in elephant numbers and densities in northern Botswana. *Oryx (in press).*

Kangwana, K. 1995. Human-elephant conflict: The challenge ahead. *Pachyderm* 19**:** 11-14.

Kangwana, K. 1996. Assessing the impact of human-elephant interactions. In: *Studying Elephants, AWF Technical Handbook Series*, ed. K. Kangwana, pp. 138–147. Nairobi, Kenya: African Wildlife Foundation.

Karidozo, M. & Osborn, F.V. 2005. Can bees deter elephants from raiding crops? An experiment in the communal lands of Zimbabwe. *Pachyderm* 39: 26-32.

Kiiru, W. 1995. The current status of human-elephant conflict in Kenya. *Pachyderm* 19: 15–19.

Klebelsberg, E. 2006. *Situation assessment on human elephant conflicts within the area around Livingstone/Zambia.* EPDT, Livingstone.

Lindeque, P. 2005. Human and elephant conflict - a major difficulty in conservation. *Conservation and the Environment in Namibia.* 2005/6:6-7.

Low, B. 2000. *Investigating the role of elephant migration routes in determining human-elephant conflict spatial patterns in Taita Taveta District, Kenya*. M.Sc. Thesis, University of Kent, Canterbury. .

Martin, R.B. 2005. *Elephants. Transboundary Species Project, Background Study.* Transboundary Mammals Project of MET, Namibia, facilitated by NNF, Windhoek.

Matson, T. 2005. *Human-elephant conflict research project. Nyae Nyae Conservancy & Khaudum National Park.* Project report update. MET / NNF, Windhoek.

Matson, T.K. & Putland, D. 2007. Factors affecting human-elephant conflicts in Nyae Nyae Conservancy and Khaudum National Park, Namibia. *Pachyderm* (in press).

Maveneke, T.N. 1998. *Local participation as an instrument for natural resource management under the communal areas management programme for indigenous resources (CAMPFIRE) in Zimbabwe.* Paper presented at the International CBNRM Workshop. May, 1998. Washington, D.C.

MET. 2006. *Human Wildlife Conflict Management (HWCM) Policy Workshop.* Kalahari Sands Hotel, Windhoek. 15 March 2006. Ministry of Environment & Tourism, Windhoek.

Mosojane, S. 2004. *Human-elephant conflict along the Okavango Panhandle in northern Botswana*. MSc Thesis (Conservation Ecology and Planning), University of Pretoria.

Mulonga, S., Suich, H. & Murphy, C. (2003). *The conflict continues: Human wildlife conflict and livelihoods in Caprivi.* DEA Research Discussion Paper, No. 59. Directorate of Environmental Affairs, MET, Windhoek, Namibia.

Murphy, C., Suich, H., Slater-Jones, S. & Diggle, R. 2004. *Big can be beautiful – Ensuring regional transboundary conservation supports local community resource management in the proposed Okavango/Upper Zambezi TFCA, southern Africa.* Paper presented at the 2004 International Association of the Study of Common Property conference, Mexico, 9–13 August, 2004.

Naughton-Treves, L. 1997. Farming the forest edge: vulnerable places and people around Kibale National Park, Uganda. *The Geographical Review* 87: 27–47.

Naughton-Treves, L. 1998. Predicting patterns of crop damage by wildlife around Kibale National Park, Uganda. *Conservation Biology* 12: 156–168.

Nelson, A. Bidwell, P. & Sillero-Zubiri, C. 2003. *A review of humane elephant conflict management strategies.* People and Wildlife Initiative. Wildlife Conservation Research Unit, Oxford University.
www.peopleandwildlife.org.uk/crmanuals/HumanElephantConflictP&WManual

Ngure, N. 1995. People-elephant conflict management in Tsavo, Kenya. *Pachyderm* 19: 20–25.

NRP. 2006. *Okavango Delta Management Plan. Component 6: Wildlife Management – Human Elephant Conflict.* Progress Report No. 2. Natural Resources & People, Gaborone, Botswana.

Nyhus, P.J., & Tilson, R. & Sumianto. 2000. Crop-raiding elephants and conservation implications at Way Kambas National Park, Sumatra, Indonesia. *Oryx* 34: 262–274.

Osborn, F.V. 1998. *The Ecology of Crop-raiding Elephants in Zimbabwe*, PhD thesis, University of Cambridge, Cambridge.

Osborn, F.V. 2002. Capsicum oleoresin as an elephant repellent: Field trials in the communal lands of Zimbabwe. *Journal of Wildlife Management* 66: 674–677.

Osborn, F.V.2002. Elephant-induced changes in woody vegetation and its impact on elephant movements out of a protected area in Zimbabwe. *Pachyderm* 33:50-57.

Osborn, F.V. 2004. Seasonal variation of feeding patterns and food selection by crop-raiding elephants in Zimbabwe. *African Journal of Ecology* 42: 322–327.

Osborn, F.V. & Hill, C.M. 2005. Techniques to reduce crop loss: human and technical dimensions in Africa. In: *People and Wildlife: Conflict or Coexistence?* (Woodroffe, R., Thirgood, S. & Rabinowitz, R. eds.), Cambridge University Press.

Osborn, F.V. & Parker, G.E. 2002. Community-based methods to reduce crop loss to elephants: experiments in the communal lands of Zimbabwe. *Pachyderm* 33: 32–38.

Osborn, F.V. & Parker G.E. 2003. Linking two elephant refuges with a corridor in the communal lands of Zimbabwe. *African Journal of Ecology* 41: 68-74.

Osborn, F.V. & Parker G.E. 2003. Towards an integrated approach for reducing the conflict between elephants and people: a review of current research. *Oryx* 37(1): 1-5.

O'Brien, C. 2002. Bees buzz elephants. *New Scientist* 176, 8.

O'Connell-Rodwell, C.E., Rodwell, T., Rice, M. & Hart, L.A. 2000. Living with the modern conservation paradigm: Can agricultural communities co-exist with elephant? A five-year case study in East Caprivi, Namibia. *Biological Conservation* 93: 381-391.

Parker, G.E. 2003. *Ensuring farmer's livelihoods and food security around Kakum Conservation Area, Ghana.* EPDT, Harare, Zimbabwe.

Parker, G. & Osborn, F.V. 2006. Investigating the potential for chilli *Capsicum* spp. to reduce human-wildlife conflict in Zimbabwe. *Oryx* 40(3):

P & W. 2006. *People and Wildlife. Creating conservation solutions for living together.* www.peopleandwildlife.org.uk

Rasmussen, L.E.L., Riddle, H.S. & Krishnamurthy, V. (2002). Melliferous matures to Malodorous in musth. *Nature* 415:975-976.

Sitati, N.W., Walpole, M.J., Smith, R.J. & Leader-Williams, N. 2003. Predicting spatial aspects of human-elephant conflict. *Journal of Applied Ecology* 40: 667–677.

Sitati, N.W. & Walpole, M.J. 2006. Assessing farm-based measures for mitigating human-elephant conflict in Transmara District, Kenya. *Oryx 40(3):279-286.*

Smith, R.J. & Kasiki, S.M. 2002. *African Elephant Specialist Group Report: A spatial analysis of human-elephant conflict in the Tsavo ecosystem.* African Elephant Specialist Group, (SSC/ IUCN), WWF, Nairobi.

Spinage, C.A. 1994. *Elephants.* Princeton University Press.

Stander, P. 2005. *Situation analysis of Human Wildlife Conflict in Namibia.* MET, Windhoek.

Stewart, A. 2003. *Guidelines on how to use Revira. Field Manual.* Unpublished m.s.

Stewart, A. 2004. *Trials of Revira in the Caprivi Region of Namibia.* Report to the Namibia Nature Foundation, Windhoek.

Stewart, A. & Diggle, R.W. 2004. *Operating Procedure for HACIS (Human Animal Conflict Insurance Scheme). Part 2 for loss of crops.* IRDNC, Windhoek

Sutton, W. 1998. The costs of living with elephants in Namibia. In: *Proceedings from the Workshop on Cooperative Regional Wildlife Management in Southern Africa*, pp. 57–71. Davis, CA, USA: University of California.

Taylor, R.D. 1999. *A Review of Problem Elephant Policies and Management Options in southern Africa.* Report prepared for the Human Elephant Conflict Task Force, IUCN/SSC Africa Elephant Specialist Group.

TCC (2006). *Final Report. Pre-feasibility Study of the proposed Kavango-Zambezi Transfrontier Conservation Area. Volumes 1 – 3.* Transfrontier Conservation Consortium, Cape Town

Tchamba, M.N. 1996. History and present status of the human/elephant conflict in the Waza-Logone region, Cameroon, West Africa. *Biological Conservation* 75: 35–41.

Thouless, C.R. 1994. Conflict between humans and elephants on private land in northern Kenya. *Oryx* 28: 119–127.

Thouless, C. R. & Sakwa, J. 1995. Shocking elephants: fences and crop raiders in Laikipia District, Kenya. *Biological Conservation* 72(1): 99-107

van Aarde, R.J. & Jackson, T.P. 2007. Megaparks for metapopulations: Addressing the causes of locally high elephant numbers in southern Africa. *Biological Conservation* 134: 289-297.

Vollrath, F. & Douglas-Hamilton, I. 2002. African bees to control African elephants. *Naturwissenschaften DOI 10.1007/s00114-002-0375-2.* fritz.vollrath@zoo.ox.ac.uk

Waithaka, J. 1999. Monitoring human-elephant conflict through remotely located stations. *Pachyderm* 27: 66–68.

Wambwa, E., Manyibe, T., Litoroh, M., Gakuya, F. & Kanyingi, J. 2001. Resolving human-elephant conflict in Luwero District, Uganda, through elephant translocation. *Pachyderm* 31: 58-62.

Western, D. & Waithaka, J. 2005. Policies for reducing human-wildlife conflict: a Kenya case study. In: *People and Wildlife: Coexistence or Conflict*, ed. R. Woodroffe, S.J. Thirgood & A. Rabinowitz (in press). Cambridge University Press.

Wikimedia (2006) *Chili Pepper*. http://en.wikipedia.org/wiki/Chile_pepper

WWF. 1997. *Electric Fencing Projects*. Wildlife Management Series, WWF-Southern African Regional Program Office, Harare.

WWF. 2006. *World Wildlife Fund. Human-wildlife conflict.* www.worldwildlife.org/conflict/hwc.cfm

WWF SARPO. 2005. *Human Wildlife Conflict Manual*. Wildlife Management Series, WWF-Southern African Regional Program Office, Harare.

Young, T.P., Palmer, T.M. & Gadd, M.E. 2005. Competition and compensation among cattle, zebras, and elephants in a semi-arid savanna in Laikipia, Kenya. *Biological Conservation* 122: 251–259.