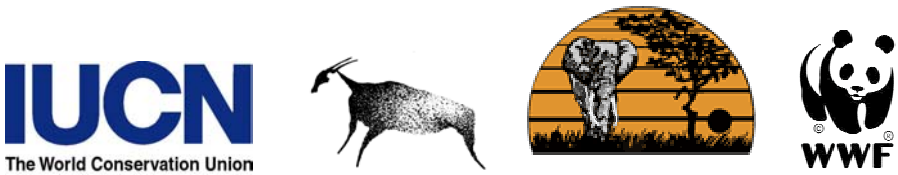
DATA COLLECTION AND ANALYSIS PROTOCOL FOR HUMAN-ELEPHANT CONFLICT SITUATIONS IN AFRICA

A DOCUMENT PREPARED FOR THE IUCN AFRICAN ELEPHANT SPECIALIST GROUP'S HUMAN-ELEPHANT CONFLICT WORKING GROUP



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Funded by: WWF International

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CHAPTER 1: BACKGROUND

1.1 Justification

The AfESG, which has 70 members from 37 countries making up the elephant 'range states', has identified five issues having equal priority that need attention regarding the African elephant (AfESG, 1997; WWF, 1997). These are (i) law enforcement, poaching and the ivory trade; (ii) habitat loss; (iii) local overpopulation of elephants; (iv) improved elephant surveys, and (v) human–elephant conflict. Negative interactions between humans and elephants have become known as 'human-elephant conflict'. This conflict takes many forms but in some form occurs over most of the large interface between elephant range and human settlement in Africa, both in the forest component of the elephant range (mainly central and west Africa) as well as in the savanna component (mainly eastern and southern Africa).

In recent years, as the issue of human-elephant interaction and conflict has become more important, researchers and wildlife managers have begun to investigate the subject. To date studies on elephant damage have been conducted in 14 African countries. Literature amounting to some 70 titles from these countries has been published which contains various types of actual data on human-elephant conflict (see bibliographic list). The literature has revealed that the problem of human-elephant conflict is very widespread in Africa.

At present only 20% of the species range has any form of protection but conflict occurs at almost any interface, whether the elephant populations involved are protected or not. Greater democracy and better communications have allowed the issue of elephant problems to become increasingly politicized locally, even if actual incidents are sporadic or of limited impact. Nevertheless, much conflict goes unreported. Because of the size of the species range and the relative newness of this topic, there has as yet been very little co-ordination of the investigations into human-elephant conflict or synthesis of the results from them.

Studies and evaluations of human-elephant conflict have been independently set up, conducted by different methods and the results presented in various ways. A reasonably standardized system is now required will allow valid comparisons to be made about levels of human - elephant conflict both within and across different bio-geographical regions of Africa. It is important to summarize what has emerged from previous studies in order to achieve the objective of the present initiative: i.e. a standardized data collection and analysis protocol for human - elephant conflict situations.

1.2 Assessing losses due to elephants to date (general terms)

Elephant problems in any area are thought of as the net result of a number of individual damage incidents occurring over a given period of time (e.g. a season, a year, a period of years). In general terms, known characteristics of elephant damage resulting from a number of well conducted studies of elephant problems in Africa are:

- elephants are never the most frequent crop raiding species.

- elephant damage is more localized but more severe per raid than that of smaller pest species. Typically a few farms are seriously affected by elephants while many others are often only lightly affected.

- elephants are only one of a spectrum of agricultural pests which afflict African farmers. Primates, suids, rodents, birds or insects are often the more important taxa of agricultural pests. It is suspected that the level of complaint about elephant damage is often in disproportion (i.e. far greater) to its relative contribution to farming problems.

- subsistence agriculture is the sector most prone to conflict with elephants. Many agricultural zones where farmers suffer damage by elephants, especially those in semi-arid and arid savanna areas and parts of the rain forest region, are climatically and edaphically unsuitable for subsistence agriculture, even in the absence of pests.

- socio-economic 'opportunity costs' are borne by rural people living in proximity to elephants. These are important but are difficult to quantify. They may outweigh the direct costs of agricultural damage and be a major component of the perceived conflict (WWF, 1997). Examples of such opportunity costs are restriction on people's movement (especially at night), competiton for water sources, loss of sleep or reduced school attendance while guarding crops or property, employment opportunities being prejudiced. These factors definitely contribute towards people's negative attitude to elephants.

1.3 Assessing losses due to elephants to date (quantitative terms)

In quantitative terms, most people think of evaluating elephant induced damage to humans and their property on an economic basis. Assessing economic effects of crop damage, the largest category of elephant incidents, is problematic because:

- crop yields are site specific
- crop values and prices vary within and between countries
- data collection of damage often relies on assessments by different enumerators

Comparing elephant damage between well-conducted studies is made difficult by the use of different sampling strategies. Three types of sampling approaches have emerged where damage incidents have been quantified on the basis of :

METHOD 1: number of "damage events" or elephant incidents reported to an authority.
METHOD 2: actual losses to crops due to elephants (measured and quantified by an enumerator).
METHOD 3: perceived losses due to elephants (derived from interviews with farmers).

In Method 1 the recording of damage events is sometimes a 'passive' process as far as the investigator is concerned (e.g. affected people report incidents which are recorded in an 'occurrence book' in some districts of Kenya). Where method 1 has been actively carried out by a researcher, this logically leads to the descriptive summary sometimes called a "raid frequency index". Raid frequency indicies (RFI) incorporate spatial and temporal dimensions e.g. :

- elephant raids per village per month (Sukumar 1991, southern India)
- elephant raids per growing season (Deodatus & Lipiya 1991; Simons & Chirambo 1991, Malawi)
- elephant raids per household per month (Kiiru 1995, Kenya)
- elephant raids per km^2 of human settlement per year (Hoare 1999, Zimbabwe)

It is desirable if possible not just to record an elephant damage incident but to quantify what was damaged (Method 2) Very few studies record what proportion of farms or fields in a given area are affected by elephant damage. For a rigorous analysis this information is needed since presenting an overall level of elephant damage which is applicable only to the affected farms is somewhat misleading. The overall level of damage in the whole farming area is what really needs to be quantified. This relies on

what can be termed “the proportional availability of different crops”. Proportional availability needs to be assessed so that (i) the total amount of damage in the area can be objectively quantified and an economic loss estimate worked out and (ii) elephant preferences for different crops can be critically evaluated. The compiling of data on proportional availability is a demanding and very time-consuming job which can only be done by a full-time researcher in a relatively small site. A number of well quantified (“actual loss”) studies assessing damage to farms in relatively small study areas have revealed the following levels of crop damage (Table 1) :

Table 1 Actual crop losses from elephants in studies of high conflict areas

Country of study (site)	Year of study	% of total crop loss to elephants	Source
Gabon (Gamba)	1996	0.75%	Languy 1996
Gabon (Gamba)	1998	0.3 - 6.2%	Blaney et al 1999
Ghana (Red Volta)	1996	8.6%	Sam et al 1997
Malawi (Kasungu)	1981	6.3%	Bell 1984
Malawi (Liwonde)	1997	8.8%	Bhima 1998
Mozambique (Maputo)	1996	10.2%	De Boer & Ntumi 1999
Uganda (Kibale)	1996	21.0%	Naughton-Treves 1998
Zimbabwe (Binga)	1994	11.7%	Wunder 1997
Zimbabwe (Sengwa)	1994	5.4%	Osborn 1998

Method 3: Perceived losses are those obtained from interviews with farmers who supply details of damage events and estimate their own losses. These types of study can reveal with some accuracy the species mix of animal pests affecting farms and the distribution of damage. They are also the method of choice if the research is orientated towards a ‘sociological’ approach.

Examples of the Method 3 type of study are:

Interviews in 218 villages across seven provinces of Gabon (Lahm 1994)
Interviews in five villages around Shimba Hills National Reserve, Kenya (Kiiru 1995)
Interviews with 1396 people living adjacent to seven protected areas in Tanzania (Newmark *et al*. 1994)

1.4 Summary of the application of the methods

METHOD 1 Gives a good general idea of problem elephant activity and thus allows comparisons to be made about the intensity of such activity between areas. There is, however, little distinction between 'visits'and 'raids' by problem elephants, so there may be an inherent bias. Visits (Osborn 1998) are cases where elephants traverse the field and do little damage; what damage there is may be from trampling only, whereas raids are cases where crops are fed upon. By a simple RFI the pitfalls of assessing economic damage (e.g. varying crop quality; different assessors) and the statistical problems of comparing different farms (e.g. different acerages; different crop combinations) are avoided.

METHOD 2 This is the ideal method for assessing the real impact of elephants. Unfortunately it is logistically difficult over the large areas affected by elephants. It has tended to be applied by researchers working in small areas of relatively high elephant challenge.

METHOD 3 This is good for investigations where it is particularly important to asses either (1) a range of pest species or (2) attitudes of affected people. With this method, the frequency and severity of damage is less accurately evaluated because of the loss of detail in peoples' memory over time and the tendency to exaggerate losses from damage incidents to any outside interviewer.

CHAPTER 2: PROPOSED DATA PROTOCOL

2.1 Primary data

The present study proposes using a combination of the three sampling methods above to obtain the primary data from fairly large areas of conflict. This involves reporting of the incident to a trained and paid enumerator who then visits the site of the incident and interviews the affected person as soon as possible after the occurrence of the problem. The enumerator makes his own assessment of the incident but asks the affected person (complainant) to provide him with retrospective extra details about the incident.

This approach yields good distribution and frequency information, allows adequate severity assessment and also provides for some of the 'social dimension' of elephant problems to be included. The practical advantages of this approach is that involves local people, provides employment and does not rely only on the complainant. It has the disadvantage that enumerators have to be trained and engaged in paid employment, something, which requires some administration of finance and personnel. For the returns, however, it is a relatively inexpensive scheme to set up and run.

2.2 Secondary data and analysis

A hierarchy of data collection and analysis is involved in this protocol. The second level involves a research person who trains enumerators (according to a recommended format - see attached training package) and condenses data from their reports into an annual summary for the conflict zone in which they were deployed. Annual reports are designed to show the distribution, frequency and severity of elephant damage and consist of

(i) spreadsheet summaries of incidents (to act as a permanent record)
(ii) graphical illustrations of these spreadsheet summaries (to make large amounts of numerical data easy to understand)
(iii) scoring of damage incidents and ranking of problems according to area (to assist in making management decisions)

Annual reports are sufficient for local level management decisions (e.g. where to deploy scouts to scare elephants, how to distribute revenue on the basis of the level of problems, where to plan fencing projects)

2.3 Tertiary data and analysis

This level involves the input of additional "site characteristics" data by the researcher. Some of these are drawn from a wider area around the conflict zone referred to as the "conflict area". The reason for this is so that incident data can be linked to environmental variables in the conflict area and used in research-orientated analyses at a third level, the Geographic Information System (GIS) level. A specialized level of spatial analyses in a larger sample of compared sites should be able to synthesize the findings into more meaningful management recommendations at a national level.

A flow chart depicting the proposed data collection and analysis protocol is illustrated in **Fig. 1**. The following are explanatory notes on interpreting this diagram:

INFORMATION LEVEL

COLLECTION 1: An incident form entitled "Elephant Damage Report Form" (**Form 1**) is used by the enumerator to collect the primary data.

ANALYSIS 1: An annual incident summary (**Table 2**) for a small area is shown with an example of actual data (one ward of one district in Zimbabwe). Notice the following from these data:

- Damage is localized - the same villages have repeated incidents
- A range of crops are damaged
- Most cases involve low levels of damage. Mature crop damage can be serious
- Small groups of elephants are involved. In this area bulls are always involved, cows infrequently involved

These incidents are then scored for damage severity using a very simple formula (**Table 3**). This separates incidents for the year in question into categories of seriousness and enables the ward to accumulate a combined "damage score" from all its incidents.

An example of an area report for a whole district follows (**Chapter 3**). This contains graphical and tabular format of data from a total of 10 Wards situated in the same district as the one ward in Table 2. Wards are ranked according to three criteria of

problem elephant activity (**Table 3**):

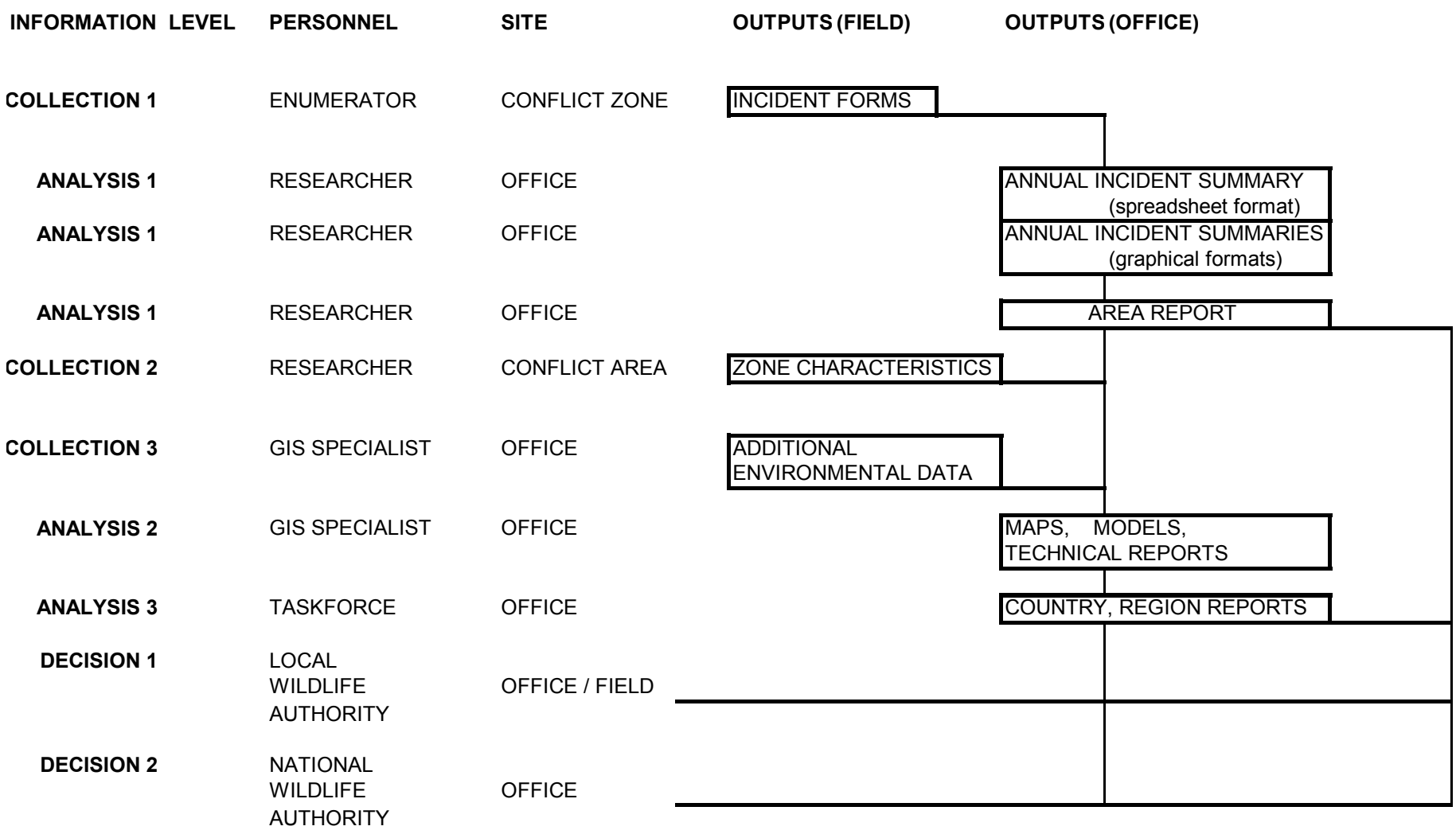
- rank by total number of incidents
- rank by number of serious incidents
- rank by overall damage score of incidents.
- a mean of these three ranks is given

The language in the report is very simple so that it can be understood by a wide range of rural people who inhabit the affected district.

COLLECTION 2: This consists of three tables (**Chapter 4**) in which certain environmental and elephant population characteristics of the conflict area are captured. The third table asks for the annual incident summary and can be used in places where the enumerator and area reporting scheme (above) is not in place.

COLLECTION 3 ONWARDS: The GIS section of the data protocol is beyond the scope of this report. Issues related to the use of GIS in human-elephant conflict data are explored in a separate report by S. M. Kasiki entitled " A spatial analysis of human-elephant conflict in the Tsavo ecosystem, Kenya".

FIGURE 1 SCHEMATIC OF PROPOSED HUMAN ELEPHANT CONFLICT DATA COLLECTION AND ANALYSIS PROTOCOL



FORM 1. ELEPHANT DAMAGE REPORT FORM

REGION …….. …….. …….. …….. **FORM No.** …….. ……..
DISTRICT …….. …….. …….. ……..
SUBDIVISION …….. …….. …….. ……..
VILLAGE …….. …….. **MAP GRID REFERENCE…** …….. …….. ……..
ENUMERATOR NAME …….. …….. …….. **DATE OF INCIDENT** …….. ……..
COMPLAINANT(S) NAME(S) …….. …….. …….. …….. …….. …….. ……..
…….. …….. …….. …….. …….. …….. ……..
DATE OF COMPLAINT …….. ……..

CROP	**DAMAGE**	**QUALITY** (Tick one category)	**BEFORE**	**DAMAGE**	**AGE** (Tick one category)	**OF**	**CROP**
CROP	TYPE	GOOD	MEDIUM	POOR	SEEDLING	INTERM.	MATURE
CROP 1	……..	……..	……..	……..	……..	……..	……..
CROP 2	……..	……..	……..	……..	……..	……..	……..
CROP 3	……..	……..	……..	……..	……..	……..	……..
CROP 4	……..	……..	……..	……..	……..	……..	……..
CROP 5	……..	……..	……..	……..	……..	……..	……..

DIMENSIONS (Paces) OF **TOTAL FIELD** WHERE DAMAGE OCCURRED
LENGTH …….. PACES
WIDTH …….. PACES

DIMENSIONS (Paces) OF **ACTUAL DAMAGED PORTION** OF FIELD
LENGTH …….. PACES
WIDTH …….. PACES

OTHER	**DAMAGE**	TICK	AND	SPECIFY	DETAIL		
FOOD STORE		……..	……..	……..	……..	……..	……..
WATER SUPPLY		……..	……..	……..	……..	……..	……..
THREAT TO LIFE		……..	……..	……..	……..	……..	……..
HUMAN INJURY		……..	……..	……..	……..	……..	……..
HUMAN DEATH		……..	……..	……..	……..	……..	……..
OTHER SPECIFY		……..	……..	……..	……..	……..	……..

ELEPHANTS INVOLVED	NUMBER	VISUAL ID (Tick)	TRACK ID
GROUP SIZE (TOTAL)	……..	……..	……..
Adult Male	……..	……..	……..
Adult Female	……..	……..	……..
Subadult / Calf	……..	……..	……..

YOUR COMMENTS: …….. …….. …….. …….. …….. …….. ……..
…….. …….. …….. …….. …….. …….. …….. …….. ……..
…….. …….. …….. …….. …….. …….. …….. …….. ……..
Was This Report Forwarded?
To Whom? …….. …….. Where? …….. …….. …….. ……..
When? …….. …….. How? …….. …….. …….. ……..

Table 2 EXAMPLE OF ANNUAL SUMMARY OF PROBLEM ELEPHANT INCIDENTS IN SPREADSHEET FORMAT WITH DAMAGE SCORES CALCULATED FOR EACH INCIDENT AND SUMMED FOR THE AREA

KEYS

CROP TYPE	CROP AGE	CROP QUALITY	DAMAGE CATEGORY	DAMAGE SCORE	ELEPHANTS INVOLVED	GROUP TYPE
1=MAIZE						
2=COTT			1=<5%			
3=GNUTS			2=6-10%			
4=MILLET			3=11-20%			M=BULL
5=VEG	1=SEEDL	1=POOR	4=21-50%	<5 = LOW		MM=BULLS
6=MASAU	2=INTER	2=MED	5=51-80%	6 - 8 = MED		CC=COWS
7=OTHER	3=MATURE	3=GOOD	6=>80%	>9 = HIGH		MH=MIXED

AGE + QUALITY + DAMAGE = SCORE

DATA EXAMPLE

DATE OF INCIDENT	VILLAGE NAME	MAP REFERENCE	CROP TYPE	CROP AGE	CROP QUALITY	DAMAGE CATEGORY	DAMAGE SCORE	NUMBER ELEPHANT	GROUP TYPE
31-Jan-98	Mufudzi	878064	2	2	2	1	5/L	2	MM
31-Jan-98	Mufudzi	878064	1	2	2	1	5/L	2	MM
31-Jan-98	Mufudzi	878064	1	3	1	1	5/L	3	MM
06-Feb-98	Budzinike	872048	7	3	2	1	6/M	2	MM
06-Feb-98	Budzinike	872048	1	2	3	1	6/M	2	MM
06-Feb-98	Budzinike	872048	1	2	1	1	4/L	2	MM
06-Feb-98	Budzinike	872048	1	3	1	1	5/L	2	MM
06-Feb-98	Budzinike	872048	3	2	2	1	5/L	2	MM
07-Feb-98	Budzinike	875045	2	2	3	1	6/M	2	MM
04-Mar-98	Budzinike	875045	1	3	1	1	5/L	1	M
04-Mar-98	Budzinike	879049	1	3	1	1	5/L	1	M
04-Mar-98	Budzinike	875045	2	3	2	1	6/M	1	M
31-Mar-98	Kayongo	844016	2	3	1	1	5/L	1	M
31-Mar-98	Kayongo	844016	1	3	1	1	5/L	1	M
18-Jun-98	Gamanya		1	2	1	3	6/M	2	MM
18-Jun-98	Gamanya		1	2	1	3	6/M	11	MH
23-Jun-98	Gamanya		1	3	1	4	8/M	6	MH
23-Jun-98	Gamanya		1	3	1	4	8/M	6	MH
23-Aug-98	Kayongo	836012	5	3	1	1	5/L	4	MM
24-Aug-98	Budzinike	883039	5	3	1	1	5/L	6	MM
26-Aug-98	Kayongo	834012	5	3	2	3	8/M	3	MM
26-Aug-98	Kapenyongo	833012	5	3	2	3	8/M	4	MM
26-Aug-98	Kayongo	834012	5	3	2	5	10/H	3	MH
26-Aug-98	Kayongo	833012	5	3	1	3	7/M	2	MM

SCORES

SCORE TOTALS FOR WARD

LOW = 14
MED = 9
HIGH = 1

DAMAGE POINTS FOR 1998 IN THIS WARD 144

CHAPTER 3: EXAMPLE OF AN AREA ANNUAL REPORT ON HUMAN - ELEPHANT CONFLICT (Muzarabani District, Zimbabwe, 1998)

Conflict between elephants and humans has become an important issue within some communal lands in Zimbabwe as elephants frequently cause damage to crops and property. The Muzarabani Rural District Council (RDC) has an obligation, under its Appropriate Authority status accorded by the natural resource management programme CAMPFIRE, to address this problem.

3.1 Human - elephant conflict : *what we need to know*

- Which areas of the district are affected?
- What time of year is the problem worst?
- Which crops are being damaged?
- How bad is the damage to crops and property other than crops?
- Which elephants are causing these problems?
- Where do problem elephants have a refuge?

3.2 Human - elephant conflict : *what activites were undertaken*

A problem elephant reporting scheme was established to provide detailed information about problem elephants within the district. As ten *resource monitors* were already employed in each of the ten wards of the district, the RDC suggested they be trained to carry out the additional reporting duties (i.e. to report every incident of elephant damage within their respective wards).

The scheme started with the training of resource monitors before the crop planting season. Two day-long workshops covered the following topics:

- rationale for the work
- interview technique
- map reading to accuracy of a six figure grid reference (UTM grid system)
- identification of elephants by age and sex (if possible)
- elephant spoor counting
- crop damage assessment
- forwarding of reports

Each reporter was provided with a 1 in 50 000 scale map of their ward, a notebook and reporting forms. On hearing of crop damage via community members, the resource monitor went to the scene of the incident and filled in a standardized report form **(Form 1)** which contained the following information:

Date of incident;
Location of incident (a six figure grid reference and the name of the village);
Crop type and age;
Size of field;
Size of damaged area;
Number and sex of elephants involved.

Monthly meetings were held at the RDC offices to collect results and discuss any problems. In addition regular field visits were made to each reporter to overcome specific problems and assist the data collection. Each reporter received a monthly allowance for doing this extra work, paid by the Muzarabani Elephant Project, a private organisation.

3.3 Human - elephant conflict ; *what happened in 1998*

There were 155 problem elephant incidents recorded during 1998. Eleven (7%) involved property while 144 (93%) involved crops. The results of the reporting scheme are separated into sections based on the questions posed above:

(a) Which areas are worst affected?

The map **(Figure 2)** shows the location of each report of a problem elephant incident. At this scale one dot may represent a number of incidents. Crop damage appeared to be more common in the western wards of the district where there is more farming and the incidents occurred in clusters around areas of settlement. During the wet season crop damage occurred mainly around villages and some distance from the rivers. Dry season damage normally occurred along the major rivers, and was focused along the Musengezi between Muzarabani Business Centre and Dambakurima Business Centre. Some damage was also reported along the Hoya river at the confluence of the Nzou-Mvunda. Very little damage is reported in the escarpment wards at the dry time of year.

In the wet season elephants damage maize and cotton crops which are grown in fields surrounding the villages. Elephants can roam widely at this time of year because water is easily available and there is a lot of thick vegetation for cover. During the dry season elephants are attracted to the major rivers where they can still find water, and to the fruiting Masau trees (*Ziziphus mauritiana*), which grow along riverbanks. Many thickets also occur along the riverbanks, particularly in the Musengezi, and these make ideal hiding places during the day. When they come to water at night the elephants damage gardens growing vegetables and maize.

Muzarabani Map

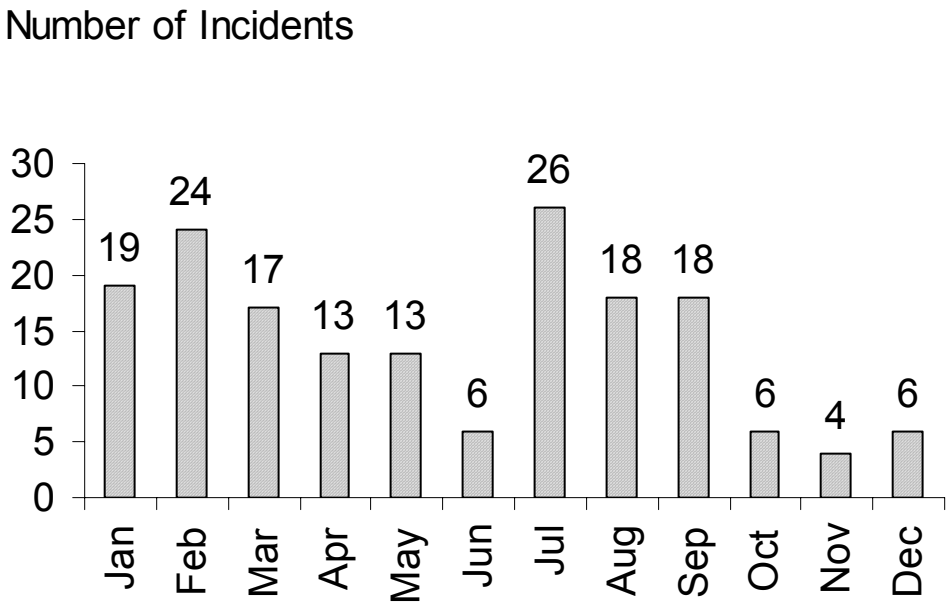
(b) What time of year is the problem worst?

The number of crop damage reports per month for the whole of 1998 **(Figure 3)**, shows there were two distinct peaks of crop raiding cases : the first occurred in the wet season (January-March) and the second in the dry season (July-September). During the wet season most of the reports were from elephants damaging maize and cotton crops. In the dry season period most of the damage was to vegetables. In the period from October to December very little crop damage occurred.

These patterns of crop damage reflect the farming practices. During the rains farmers grew maize and cotton crops in fields surrounding their villages. These crops matured in the period February - March and this is why a great deal of crop damage occurred at this time.

At the end of the rains farmers abandoned their larger fields and cultivated small gardens along the beds of major rivers. Here the water table is high enough for bucket irrigation and vegetables and green maize were grown. By October most gardens had finished producing and this is why little elephant damage occurred after this time.

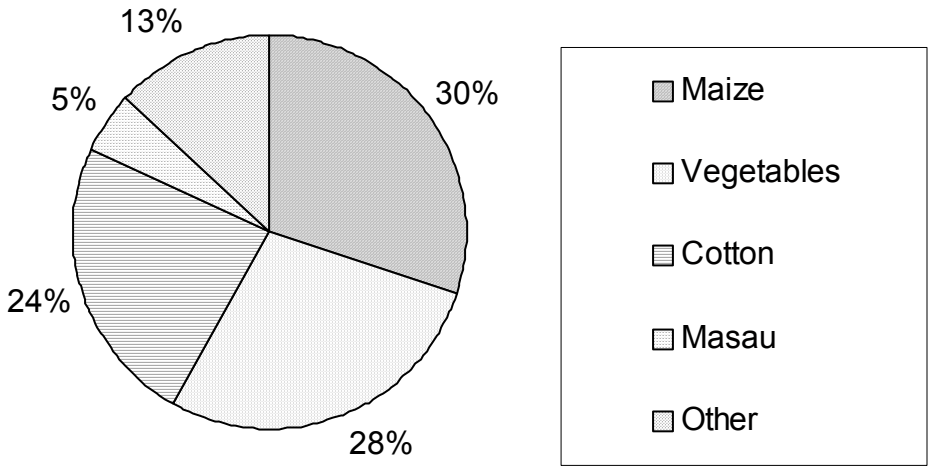
Figure 3 Elephant damage incidents per month in Muzarabani District 1998



(c) Which crops are affected?

The percentage of incidents for each crop type damaged **(Figure 4)** shows how problem elephants select crops in Muzarabani. Maize is the crop worst affected, followed by vegetables and then cotton. 'Other' crops include millet, groundnuts and Sugarcane, which are affected to a lesser extent.

Figure 4 Selection of crops by elephants in Muzarabani District 1998



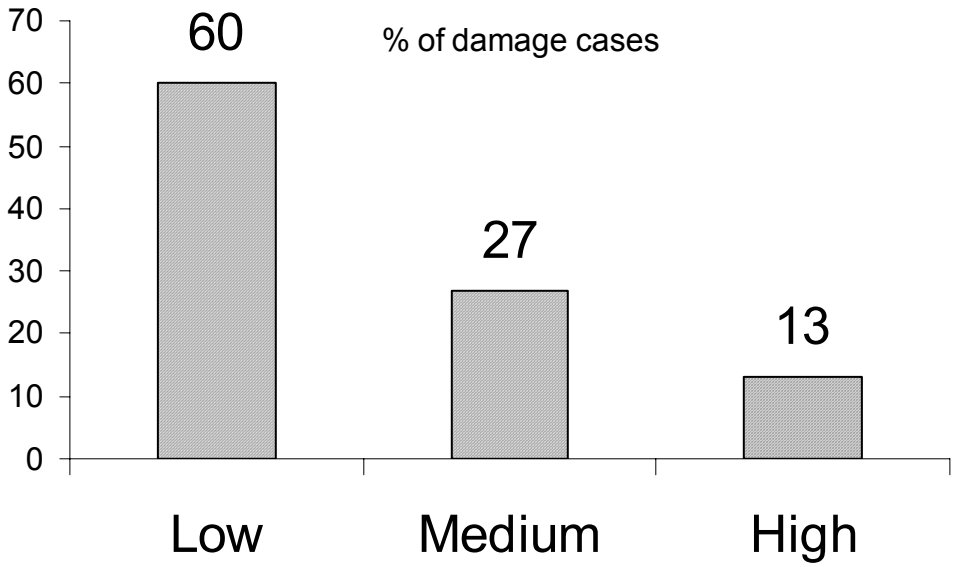
The majority of the damage (76%) is done to food crops and only 24% of the damage is to the cash crop cotton. This is because food crops are more nutritious than cotton, which does not produce edible fruits. In most of the reports of damage to cotton, elephants caused minor damage to the crop as they walked through the field. Damage to food crops tended to be more severe as elephants ate the crop as well as trampling it.

(d) How bad is the crop damage?

Crop damage by elephants was assessed in three categories: low, medium and high. The seriousness of each damage incident was assessed by the researcher who scored the age and quality of the crop and the amount of damage reported by the enumerator on each incident form. Higher scores mean more damage. Over the whole district in 1998, most incidents (60%) were not serious, about one third were in the medium category (27%) and in a small percentage of cases (13%), farmers suffered heavy losses **(Figure 5)**. This shows that while elephants are a nuisance in many places in the district, the actual economic damage they cause is serious only in a minority of cases. These results illustrate the value of a scheme where there is independent

assessment of damage by trained people. If this reporting scheme was not in place the RDC would be besieged with complaints and would have no way of knowing who plaints were genuine and serious.

Figure 5 Levels of elephant damage to crops in Muzararbani District 1998



(e) Which elephants are damaging crops?

Most of the crop damage was caused by small groups of elephants. On average the group size of crop raiders was six. 80% of all the crop damage incidents were caused by groups of 8 or less elephants.

Occasionally bigger groups were involved and sometimes these groups could be as large as 30 elephants. Most of these groups were mixed herds of elephants: bulls and cows together. In other areas of Zimbabwe bulls commonly cause crop damage, so this result is unusual, but probably reflects the structure of the Muzarabani elephant population as a whole.

(f) Where do problem elephants come from?

We know that in Zimbabwe, crop damage by problem elephants takes place almost entirely during the night. The distribution of incidents in Muzarabani **(Figure 2)** and the comments on report forms suggest that problem elephants live mostly in the protected area refuge, the Mavuradona Wilderness Area (MWA) and in neigbouring Guruve District. This agrees with observations on the ground during this project. In order to manage the problem we need ways to compare problem elephant activity in parts of the district. There is more than one way to determine which areas suffer most (**Table 3**).

Table 3 Ranking of wards in Muzarabani District in 1998 according to various criteria of problem elephant activity: (i) total number of incidents (ii) number of serious incidents (iii) overall damage score of incidents. A mean of the three ranks is given. Management decisions can be prioritized according to the desired rank

WARD	Total Incidents (No.)	Serious Incidents (No.)	Damage Score POINTS	Total Incident RANK	Serious Incident RANK	Damage Score RANK	MEAN RANK
Kapembere*	24	3	144	1	3	1	1
Muringazowa	23	1	103	2	4	2	2
Gutsa	18	4	78	3	2	6	4
Dambakurima	17	1	88	4	4	5	5
Chadereka	15	5	90	5	1	4	3
Chiweshe	14	0	95	6	5	3	6
Hoya	12	0	51	7	5	8	8
Chawarura	12	1	63	7	4	7	7
Hwata	9	1	48	8	4	9	9
Machaya	1	0	5	9	5	10	10
TOTALS	145	16	765				

* for a breakdown of incidents in this ward, see Chapter 2, Table 2

3.4 Summary of problem elephant reporting, Muzarabani District 1998:

- Crop damage is concentrated in the western wards of the district.
- Maize, vegetables and cotton are the three crops worst affected by elephants.
- Crop damage in the wet season affects maize and cotton and is widespread in the district.
- Crop damage in the dry season centres on the larger rivers, mainly affecting vegetables, green maize and masau fruit.
- Damage to food crops is greater than damage to cash crops.
- Only a small number of crop damage cases cause serious losses.
- Crop raiding is mainly caused by small, mixed-sex groups of elephants.
- Property damage was rare and involved grain storage facilities in all cases.
- No human injuries or deaths from elephants were recorded in 1998.

3.5 Recommendation

The fairest way to say which areas are worst affected overall by elephants may be to rank the wards according to the three criteria (i) total number of incidents (ii) number of serious incidents (iii) overall damage score of incidents and take a mean (average) of these ranks to rank the ward.

(END OF ANNUAL REPORT)

CHAPTER 4: SITE CHARACTERISTICS OF CONFLICT ZONES

This section (see Fig 1, Collection 2) is in a memorandum format, which will be sent out to researchers working in human-elephant conflict areas. The idea is that the data supplied in this section provides attributes and characteristics of the conflict zone that can be used by the GIS level.

MEMO

From : IUCN African Elephant Specialist Group (AfESG)
Re: HUMAN - ELEPHANT CONFLICT STUDY SITES
Date: 1999

Dear Researcher

The AfESG is one of the most active of the 100 or so voluntary specialist groups in the IUCN's Species Survival Commission (SSC). A special AfESG taskforce, the Human - Elephant Conflict Task Force (HETF) has been formed to study and make recommendations on the increasingly important issue of human - elephant conflict in Africa. A standardized data collection system or protocol is needed so that meaningful comparisons can be made between different sites. The data collection system is designed to enable input of data into the African elephant database (AED), a Geographic Information System, which maintains and updates information on elephant numbers and distribution throughout Africa. The AED is situated at the AfESG secretariat in Nairobi, Kenya and has a full-time database manager. The AfESG also has a full-time programme officer who administers many aspects of its work.

The HETF has divided the collection of data on human-elephant conflict into the following:

- on site description of individual conflict incidents by an enumerator. Enumerators are people resident in the conflict zone who are trained by a researcher such as yourself. A recommended training package has been developed for enumerators and is available separately.
- characteristics of conflict zones (both environmental and regarding elephant populations involved in the conflict). These data are supplied by a researcher such as yourself.

Table 4 is used to describe the zone in which human - elephant conflict occurs and the surrounding area.

Table 5 is used to describe the elephant population(s) involved and summarizes the

conflict incidents caused by those elephants. Table 5A requests information which may already be in the AED but will benefit from additional or updated information that you may be able to provide. Table 5B summarizes the annual conflict incidents by year. It may not be possible to be very accurate here if a reporting scheme using enumerators has not been employed. However, any data you can give may be helpful and you can indicate its limitations in the comments section.

Please fill in whatever you can and return copies to the taskforce chairman. It would be particularly appreciated if you could also forward your suggestions and comments on this initiative so that improvements to the data protocol can be made.

Contact persons are :-

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Table 4: Characteristics of Human - Elephant Conflict Zones

ENVIRONMENTAL CHARACTERISTICS			
Attribute	**Units**	**Description / Coding**	**Data**
Zone name	Text	Country District/Province Name of conflict zone	
Location	Lat/long coordinates	Geographic location of conflict Zone preferably to be drawn on a Geo-referenced topographic map.	
Year of survey	Year	Year(s) for which data are Applicable	
Conflict Duration	Years	Provide years of conflict duration Or leave blank if unknown	
Population Density	No. / km2	Human population density	
Human Population Trend	Code	Current population trend 1 = Increasing 2 = Decreasing 3 = Constant	
Land tenure System	Code	Main land tenure system Within the conflict zone 1 = Communal 2 = Leasehold 3 = Freehold 4 = State owned 5 = If other, specify	
Agricultural Landuse	Code	Main agricultural land use Within the conflict zone 1 = Irrigated cropping 2 = Rainfed cropping 3 = Livestock 4 = Mixed farming 5 = If other, specify	
Other Commercial Activities	Code	Major human activities e.g. 1 = Logging 2 = Mining 3 = If other, specify	
Habitat	Code	Dominant habitat type Within conflict zone 1 = Dense forest 2 = Patched forest 3 = Savanna woodland 4 = Shrubland 5 = Grassland 6 = Semi-desert 7 = Desert	

ENVIRONMENTAL CHARACTERISTICS			
Attribute	**Units**	**Description / Coding**	**Data**
Water Availability and Annual Rainfall	Code And Mm / year	Availability of water resources 1 = Perennial (no shortage) 2 = Intermittent (temporary shortage) 3 = Scarce (general shortage)	mm / yr
Interface Type	Code	Type of interface between Human settlements & Elephants 1 = 'Hard edge' (e.g. park) 2 = Isolated settlement 3 = Mosaic 4 = Shifting 5 = If other, specify	
Interface Length	Km	Total length of interface (1 or 2 above only)	
Incursion Distance (average)	Km	Average distance of elephant raids From a permanent refuge for Elephants	
Incursion Distance (maximum)	Km	Maximum distance of elephant raids from a permanent refuge for Elephants	
Conflict Season	Code Mark Months	Peak of conflict season 1 = Dry season 2 = Wet season 3 = Wet & Dry season	J F M A M J J A S O N D
Interventions Human*	Text, Code	Provide max 3 data pairs Describing type of human Interventions and their Effectiveness on a scale of 1 (high)-3 (low) Examples given:-	Noise/Alarms Fire Watchmen Missiles Compensation Land zonation Other specify
Interventions elephant*	Text, Code	Provide max 3 data pairs Describing type of elephant Interventions and their Effectiveness on a scale of 1 (high)-3 (low) Examples given:-	Disturbance shooting Wounding Kill by shooting, residents Kill by shooting, authorities Poisoning attempts Irritant sprays Infrasound calls Translocation Other specify

ENVIRONMENTAL CHARACTERISTICS			
Attribute	**Units**	**Description / Coding**	**Data**
Interventions environment*	Text, Code	Provide max 3 data pairs Describing type of environmental Interventions and their Effectiveness on a scale of 1 (high)-3 (low) Examples given:-	Home made barriers Stone wall Ditch/Moat Wire fence, home made Wire fence, conventional Wire fence, electrified Vegetation barrier Other specify
Other pest Species	Text, Code	Rank elephant with other Pest species in descending order of ***perceived importance***. Provide max 5 data pairs On a scale of 1 (high)-5 (low), e.g. (baboon, 1), (elephant, 2) (rodents, 5) Examples given:-	Primates Suids Rodents Birds Insects Carnivores Other specify

* For a classification of interventions see the AfESG journal : Pachyderm 19 (1995) pp. 67-70.

List any relevant literature references to human - elephant conflict in the area:

Please add any comments and observations you may have on human-elephant conflict in your area as well as suggestions on how to improve the collection of relevant data.

Table 5: Elephant populations involved in human - elephant conflict

TABLE 5A	ELEPHANT POPULATION CHARACTERISTICS		
Attribute	**Units**	**Description / Coding**	**Data**
Elephant Population	Code (AED 1995)	Input zone code for Elephant population	
Population Estimate	Number	Estimate for elephant Population	
Area	Km2	Range area of elephant Population	
Density	No. / km2	Provide mean elephant density Or leave blank if unknown	
Conservation Status	Code	Conservation status Of elephant population 1 = Protected 2 = Unprotected 3 = Both 4 = Unknown	
Unnatural Mortality of Elephants	Code with Estimated Annual no. of deaths from each source	1 = Problem Animal Control 2 = Poaching 3 = Safari hunting 4 = None 5 = Unknown	

TABLE 5B	ELEPHANT DAMAGE INCIDENTS		
Total elephant raids	Number/ Year	Approx annual number of Elephant damage incidents	
Mean raiding Group size	Number	Average size of Raiding elephant group	
Raiding group type	Code. Quantify each Annual total if known	Rank group code in descending order (i.e. commonest to rarest) 1 = Single bull 2 = Male group 3 = Cow -calf group 4 = Mixed group (i.e. 2+3) 5 = Aggregate group (>50 ele.)	
Foodcrop Damage	Text. Nos.	Rank food crops damaged in descending order (i.e. commonest to rarest). Quantify each annual total of incidents if known	
Cashcrop Damage	Text. Nos.	Rank cash crops damaged in descending order (i.e. commonest to rarest). Quantify each annual total of incidents if known	
Foodstore Damage	Text Nos.	Rate damage to foodstore Structures (e.g. granaries) by type and number of incidents per year	
Water Supply Damage	Text. Nos.	Rate damage to water supply Structures by type and number of incidents per year	
Human Injuries	Number Per year	Annual number of Human injuries	
Human Deaths	Number Per year	Annual number of Human deaths	

CHAPTER 5: DEVELOPMENT, USE AND TESTING OF THE PROTOCOL

The original data collection protocol was produced at the inaugural meeting of the HETF in 1997. It was a prototype of the 'site characteristics' section of the present protocol. At that time, when the group's investigations into human-elephant conflict were just beginning, research initiatives into the topic involved a simple inventorying of conflict sites, compilation of a bibliography and identification of priority topics for investigation. One of these topics was the subject of the present study: producing a standardized data collection system.

5.1 Need for primary level data

Through the author's continuing involvement in human-elephant conflict work, it became increasingly clear that the ecological basis of the interactive relationship between rural people and elephants is predominantly spatial (Hoare & du Toit 1999). Both relative abundance of people and elephants and the direct conflict between them is poorly described by numeric means. Therefore the data to assess conflict should be geo-referenced via the enumerator approach, enabling computerization for spatial analyses via GIS. Also with a site summary, there is insufficient detail of incidents to produce accurate measures of severity of incidents. Although employment of enumerators involves personnel management and some expense, the practicalities of doing this are not very complicated. Creation of such a scheme offers some badly needed rural employment and allows greater local participation in the management of wildlife, something which is a global trend. An enumeration scheme should yield data which is consistently collected and standardized in format. It is thus hard data, not guesswork. Therefore, even if the scheme can only be run over a restricted area of the conflict zone or for a limited period (e.g. one season) aspects of the resulting data sample can probably be extrapolated with some confidence.

5.2 Discontinuity of levels of activity

With this protocol, no data is ever wasted if there is discontinuty either in time or in the progression to the next phase. The process can be stopped and started at different times and levels. Common problems and solutions encountered might be:

- If for example data there is no further analytical capability, the process can stop at the incident summary level. Even here there is sufficient information to make simple local management decisions that may alleviate some conflict.

- if for example only a years incident forms are available, they can be analysed some time later. The area report level can even be excluded and the data used instead at the specialist GIS level.

- if for example no enumerators can be employed, a researcher can visit the area once (e.g. at the end of the crop season) and make an adequate summary with the zone characteristics section. This can still be used by the GIS level in comparisons with other conflict sites.

5.3 Use of the method at enumerator level

The author has been involved with enumerator training in eight districts in Zimbabwe over the last seven years. Three districts (Binga, Kariba, Gokwe) yielded data from an enumerator scheme that formed the basis of a paper in an international ecological journal (Hoare 1999). In another two districts (Muzarabani and Guruve) successful workshops which yielded management action have been held using similarly collected and processed data contained in the area report example (Chapter 3).

In the Central African Republic, elephant conflict data was collected by a single enumerator using this format in each of two forest sites. These form the basis of a report in the present series of HETF investigations.

Problems encountered with the enumerator scheme have been the following:

(a) Employment problems

The supervision and encouragement of enumerators by a researcher is a 'must'. Enumerators sometimes do not have an easy task e.g. working long hours under uncomfortable conditions in the field or having to justify to angry farmers why the scheme is only to collect information and not to award compensation.. As their pay is modest, they can become disinterested without support from the workplace. The researcher can keep up an interest level among enumerators by frequent field visits and monthly meetings. Monthly meetings must deal with morale, attention to reporting detail and work discipline. An end-of-season discussion meeting on the results of the enumerators efforts and their suggestions and further employment conditions is essential. An annual refresher training exercise is a good idea.

(b) Mistakes in the enumerators' data

- Map reading mistakes are quite frequently encountered. It is very easy to make mistakes with these figures; transposing the co-ordinates is a common error. A map may be a foreign concept to some rural people in Africa and this section of the training often needs careful explanation and repetition (see training package document). Accurate geo-referencing is important for later GIS input.

- Sexing elephants is very difficult, particularly as most raiders are never seen in the daytime. Not too much emphasis should be placed on this. A small sample of sexed groups is sufficient for analysis.

- Some enumerators have a tendency to be biased in their damage assessments of crops. It is very difficult to distinguish % categories of damage, especially the lower categories which tend to be more common. With close supervision the researcher will get to know whether the bias of an individual is to increase or to decrease the figures. Small errors and some bias are unavoidable and are not too important, since the analysis uses pooled data in which over- and underestimates will largely cancel out

These problems are relatively minor and can all be easily overcome. They are far outweighed by the advantages of running the enumerator scheme.

5.4 Use of the method at researcher level

The researcher is the key element around which the whole data protocol functions. He/she does not have to be highly qualified but certainly needs to be numerate and also computer literate if possible. In some cases the researcher may even be an enumerator and/or the GIS specialist as well. Almost always he should be the initial trainer and field supervisor of enumerators.

Summarizing the enumerators' data is simple. Data entry into a spreadsheet format is not difficult and can be done by a third party or even tabulated manually if the researcher has no computer. Scoring of incidents, summing of scores in any area and ranking of areas in a table is elementary and can even be done manually. Computerization merely facilitates storage, analysis and transfer of data.

The zone characteristics are descriptive and likewise straightforward to collect. Many of the data fields are in 'multiple choice' format where possible answers are listed. Answers are numeric where possible to enable easier input and analysis in a GIS. The zone characteristics were filled in for many sites during the course of this project. Countries contributing were those where there are researchers actively working on human-elephant conflict: Zimbabwe, Botswana, Namibia, Mozambique, Malawi, Zambia, Kenya, Uganda, Cameroon, Central African Republic and Ghana.

The main difficulties encountered with the zone characteristics are those pertaining to quantifying actual details of elephant raids (numbers of raids, types of elephant groups involved, incursion distances from a refuge, what was damaged etc). This is why the initial protocol was considerably expanded and the enumerator level recommended as a vital component to the whole data collection process.

5.5 Use of the data beyond researcher level

As the protocol flow chart (Fig. 1) illustrates, primary and secondary data can be used

by GIS specialist researchers, the AfESG taskforce or local or national wildlife authorities. There are a variety of pathways through which the data may be processed and a number of different levels it may subsequently reach. If the primary data are geo-referenced and these are supplemented by a number of secondary spatial, temporal and numeric attributes, the logical destination for it where it will be most rigorously analysed, is in a GIS. What are most urgently required at this point in human-elephant conflict research are:

(a) measures of severity
(b) predictors.

Extensive discussions were held with the GIS project in this series of investigations (S.M. Kasiki & R.J. Smith) to explore potentially relevant types of analyses and ensure that data such as those coming from conflict sites using the above protocol were suitable.

Examples of the types of analyses being considered are relating yearly figures for

(1) total elephant incidents
(2) serious problem incidents
(3) crop damage score

to :

- defined grid square of human settlement (e.g. 10km^2 5 km^2 2.5 km^2 1 km^2)
- unit of human population (e.g. per 1000 people)
- distance (e.g.per km) from elephant refuge
- unit (e.g.per 10km) of refuge boundary
- defined unit of rainfall (e.g. per 200mm/year)
- hectarage of cultivated crops (e.g. per 5ha)
- biomass/hectare unit of crops
- type of natural vegetation
- type of land ownership
- unit of surface water availability
- category of refuge – settlement interface (e.g. linear, nucleated, mosaic).

The poor quality and 'outdatedness' of maps in African countries is a problem. A potentially useful suggestion on the production of maps for enumerators to use came from a commercial GIS institute in Zimbabwe. This was that the AfESG's own AED facility could purchase satellite imagery and produce paper maps from it for specific human-elephant conflict zones. This is a good idea as a central mapping facility, sending maps to field sites, would further standardize the data collection process. Some prior ground truthing of co-ordinates and indications of the scale and extent of the maps are apparently required if this method is to be used. This suggests prior liaison between

a field researcher and the AED is necessary.

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ACKNOWLEDGEMENTS

I am indebted to researchers of the Mid Zambezi Elephant Project in Zimbabwe for the data contained in Chapter 3. Guy Parker, Kinos Mariba and Ignatius Masarirevhu diligently trained and supervised enumerators, verified their data in the field and summarized their findings. Loki Osborn digitized the crop damage information and produced Figure 2.