

# Human Elephant Conflict in the Waza-Logone Region of Northern Cameroon: An Assessment of Management Effectiveness

M.N. Tchamba<sup>1</sup> & D. Foguekem<sup>2\*</sup>

Keywords: Waza Logone- Elephant- Crop raiding- Villages- Management- Cameroon

## Summary

*An investigation into the current level of human-elephant conflicts in the Waza Logone region was carried out during the 2005 rainy season to assess the effectiveness of conflict management. This was done by talking mainly to wildlife authorities, the local agricultural service, the local communities and consulting sequential reports from the nearest enumerators. The number of villages affected was declining in the dry season compared to the rainy season crop raiding. However, general pattern indicates a decline in the number of villages impacted by elephants since the 1992 to 1993 surveys, but comparatively more damaging as shown by the estimated costs. Therefore, the improve in ecological management of the Waza National Park and its elephant population has had a positive impact in the number of villages crop raided but has not definitely resolved the conflicts between man and elephant. Other approaches are needed to buttress the effort been undertaken in the region to date.*

## Résumé

### Conflit homme éléphant dans la région de Waza Logone du nord Cameroun: évaluation de l'efficacité de gestion

*Une enquête sur le niveau actuel des conflits homme-éléphant dans la région de Waza Logone a été réalisée au cours de la saison des pluies 2005 pour évaluer l'efficacité de gestion de ces conflits. Cela a été fait en parlant principalement aux autorités de la faune, les services agricoles locaux, les collectivités locales et la consultation des rapports séquentielle des agents recenseurs la plus proche. Le nombre de villages touchés par la déprédation des cultures était en baisse pendant la saison sèche comparativement à la saison des pluies. Toutefois, la tendance générale indique une baisse du nombre de villages touchés par les éléphants depuis les enquêtes réalisées en 1992 et 1993, mais relativement plus dommageable comme le montre l'estimation des coûts. Par conséquent, l'amélioration de la gestion écologique du parc national de Waza et de sa population d'éléphants a eu un impact positif sur le nombre de villages où les cultures sont attaquées, mais n'a pas définitivement résolu les conflits entre l'homme et l'éléphant. D'autres approches sont nécessaires pour appuyer les efforts ayant été entrepris dans la région à ce jour.*

## Introduction

Human elephant conflict has become one of the biggest issues facing elephant conservationists today (19) and the costs of dealing with "problem animals" are increasing (15).

Human elephant conflict can take many forms (9) including the direct killing of elephants by people. However, the destruction of crops by elephants is the major concern. The issue of human elephant conflict has differentiated temporal and spatial patterns in many places, but some general trends include it is often seasonal, and conflict is often highest in areas close to migration route and dispersal areas as well as protected areas that act as elephant refuges (6, 9, 16). Farmers' livelihoods can be seriously impacted by crop damage where subsistence cultivation occurs. Many

crop varieties are fed on or damaged by elephants (3, 8, 12). Males elephants have generally been associated with taking higher risks in foraging and for being involved in most crop raiding, but in many sites family groups are also involved (8). The Waza Logone Region is an example of area where human elephant conflict can be complex and logistically challenging problem requiring long-term undertaking. The human elephant conflict in this region has resulted from increase in the human population expansion and combined with the increase in elephant's number. Human population growth remain high in northern Cameroon and growing economic forces want Cameroon to concede more government-owned land around Waza to agricultural interests, especially cotton farming (14). Agricultural

<sup>1</sup>Department of Forestry, University of Dschang, P.O. Box 222, Dschang, Cameroon.

<sup>2</sup>World Wide Fund for Nature, Cameroon Country Programme Office. Po. Box 6776, Yaoundé, Cameroon.

Email: d\_fogke@yahoo.fr Phone: (237) 74179235 Fax: (237) 22 21 42 40

\*Corresponding author

Received on 02.02.11 and accepted for publication on 06.03.12.

activities mostly fall within the range of elephants and generate human-elephant conflicts. Human population density (49 persons per km sq) in the Waza Logone regions is one of the highest found in Cameroon. The annual population growth rate 3.7% is higher than the national average of 2.9% (13).

Rural farmers and elephants are increasingly coming into conflict, as elephant habitat is converted to farmland (25). Several years of monitoring of elephant movement in this region (6, 10, 21, 22, 23), have improved our understanding into the insights of human elephant conflict. It appears that the migration of elephant outside Waza National Park to feed and the resultant human/elephant clashes due to frequent raids on local crops was a function of land-use changes near the park in 1980. And, especially an ill-fated and partially remediate dam project, which altered the hydrology and vegetation and elephant migration (4, 5, 17). The resultant human elephant interaction has led to retaliatory poaching and has required government officials to kill some nuisance-causing elephants. Rural communities suffer chronic depredations and were unable to overcome the problem (25). An attempt to improve on the management of the region's ecosystem function for the benefit of local people and wildlife has led to the Waza Logone Project of 1991 (11). Therefore, from 1994 to 1997 some of the original feeding areas of elephants in the part of the park have been restored and this has brought major changes in the region ecosystem (11, 18). It has been suggested that as a result of increased water availability and improved vegetation quality from improved ecological management of the Waza National Park, there will be a shift in the elephant movement and consequently, in the level of elephant impact on local agriculture (10). The main reason for assessing the trends of human elephant conflict has been to find out whether elephant damages to croplands have changed as predicted, and to what extent?

Waza elephants were the focus of this study because of considerable damages they inflicted to the local agriculture. A fundamental premise of their conservation is that they should remain viable to conserve their ecological, economical and cultural values. About 2000 of Cameroon's remaining 20,000 elephants is believed to live in northern Cameroon (24) and more than 250 of these animals reside or migrate through Waza National Park (7). Although these elephants were accounting for only 10% of Cameroon's total elephant, the ecological health of the park depends greatly on the viability of this elephant population, and its 170,000 ha is also an important migratory route and site for elephants within the Lake Chad Basin.

Despite their ecological value, recognition of the scale of problems facing Waza elephants has led, ending 2003, to a reassessment of their management and recognition of the need for better knowledge about their status and habitat; and the effectiveness of

their management. Managers in many Cameroon's protected areas lack the information needed to make an informed assessment of the present situation of their elephant's status and management effectiveness. WWF Cameroon Country Programme Office has been working for about 15 years ago with the government of Cameroon to develop a database for assessing elephants' status, main threats and management effectiveness in protected areas. The major question in the current assessment was then: what is the present situation of human elephant conflict in the Waza Logone region? More specifically, how effective the restoration of the ecosystem in the region has reduced human-elephant clashes? These and other issues are at the centre of this investigation.

Therefore, this study was concentrated on three main specific objectives: (i) To carry out a survey on human-elephant conflicts around the WNP region; (ii) To carry out statistic evaluation from stakeholders data (especially from the gov't—Ministry of Agriculture, Ministry of Forestry and Wildlife and the Ministry of Environment and Protection) for three years period (2003, 2004, 2005) on human-elephants conflicts in the Waza region and; (iii) To compare and analyze data collected from the gov't services to the baseline data from previous author with regards to changes and progress.

### Study area and methods

The Waza-Logone region is situated in the extreme north of Cameroon and is defined here as the region extending from the divisions of Mayo Kani (Kaele) and Mayo-Danai (Yagoua) in the south to the Lake Chad in the north. It covers an area of approximately 29,800 km<sup>2</sup> and lies between 10°25' and 12°50' north, and 14°05' and 15°15' east. Vegetation is under the Sudan type. The climate of the region is characterized by the dry and wet seasons (11), which are however, variable in duration from year to year. This is a common phenomenon in the entire Northern region of Cameroon. These seasons are caused by the two winds (South-West Monsoons which brings moisture and the North-East Trade or harmattan winds which brings dry air) that influence the climate of the entire country. The dry season starts from November, reaching its peak in January (the driest month) and ends in March, while the rainy season starts in April, reaching its peak in August (the wettest month) and ends in October. The rainfall in the area is generally scanty, with an annual mean of 745.6 mm. The mean maxima daily temperature ranges from 30 °C in August to 39.7 °C in April, thus indicating that the hottest months occur during March and April, while the mean minima daily temperature ranges from 17.3 °C in December to 28.1 °C in April, giving December and January (heavy harmattan months) as the coldest months.

The investigation was carried out during the 2005 rainy season by talking mainly to wildlife authorities

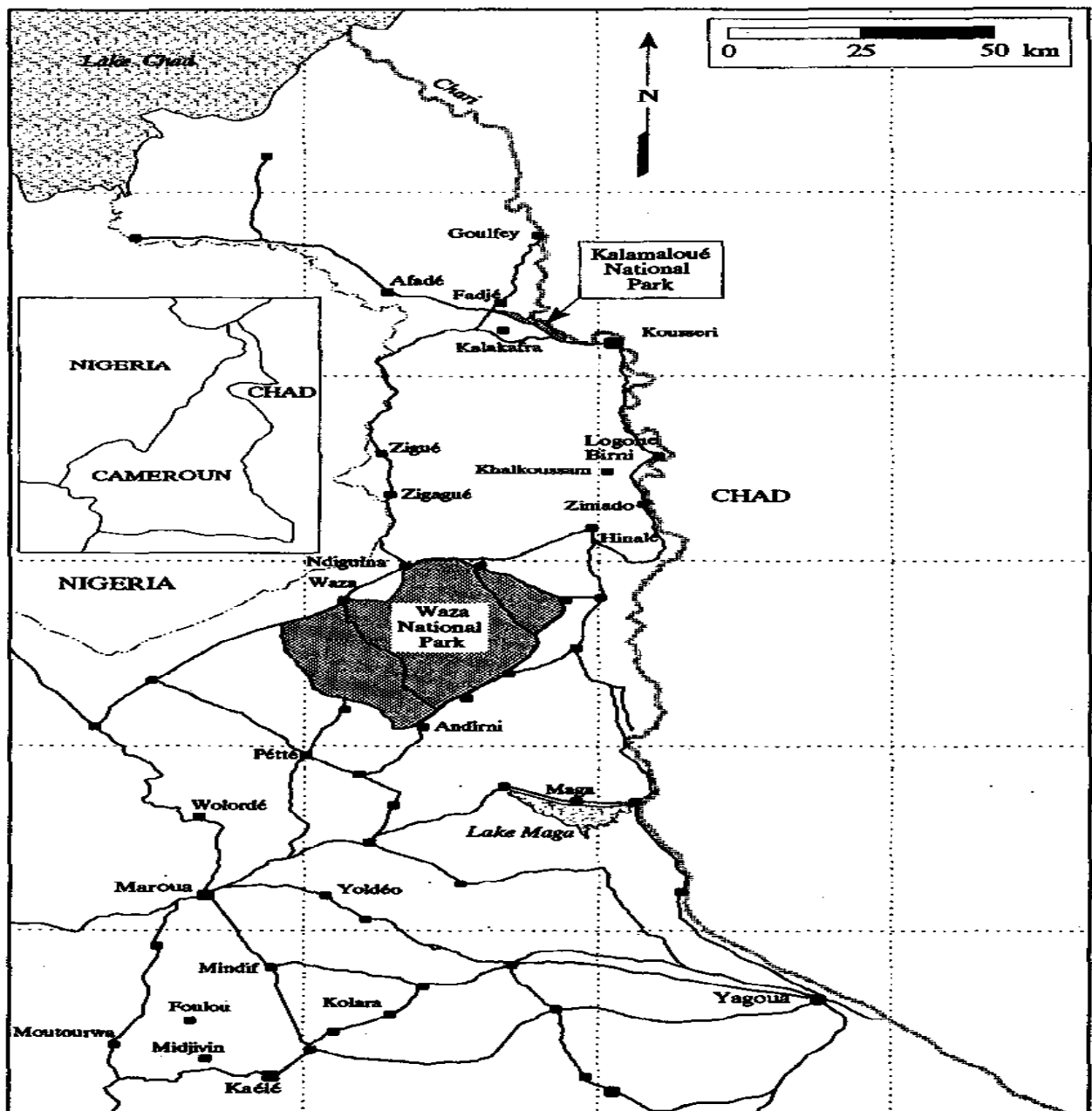


Figure 1: Waza National Park and some of the sampled villages.

and the local agricultural service. Meetings were held in 13 villages with reported elephant damages. The villages Goulfey, Fadje and Afade are located between Lake Chad and Kalamaloué National Park; Kalakafra, Ndiguina, Zigué and Khalkoussam between Kalamaloué National Park and Waza National Park; Pette, Wolorde, Yoldeo, Kolara, Midjivin and Foulou are situated south of Waza National Park (Figure 1). Population density is around 17 hts/km<sup>2</sup>. A maximum of 2000 peoples live in these villages. The main ethnics groups found are the nomadic pastoral group Fulbe or Fulani. The Shuwa Arabs are of origin nomadic pastoralists, but many of them are now settled agro pastoralists. The Musgum and Kotoko are of origin also pastoralists but they have turned to farming quite some time ago.

These villages were purposefully sampled as they are considered as representative of the economic, ecological, geographical, and cultural diversity of the study area (Table 1). The chief of the villages, the farmers and the nearest enumerators attended these meetings. During these meetings, field visits to discuss current conflict situation with community sections, other relevant people and community representatives were carried out. Basic information on the development of elephant problems' for the past three years (2003, 2004 and 2005) were collected by talking mainly to local administrators and residents, and consulting sequential reports from the local agricultural services. Staff of these services goes in each location to record all crop raids systematically during conflict situation. Semi-structure interviews

**Table 1**  
**Elephant impacts in the villages in 2003, 2004, 2005**

Villages	Distance from Waza (Km)	Elephant incident/visits in the villages								
		Yes/No			Period			Crop type		
		2003	2004	2005	2003	2004	2005	2003	2004	2005
Goulfey	100 north	yes	no	no	Dry season	0	0	All crops	0	0
Fadjé	80 north	yes	yes	yes	Rainy season	Rainy season	Rainy season	All crops	All crops	All crops
Afadé	80 north	no	no	no	0	0	0	0	0	0
Kalakafra	70 north	yes	yes	no	Dry season	Dry season	0	Sorghum	0	0
Ndiguina	0	yes	yes	yes	Rainy season	Rainy season	Rainy season	All crops	All crops	All crops
Zigué	30 north	yes	yes	yes	Dry season	Dry season	Dry season	Millet	Millet	Millet
Khalkoussam	30 north	yes	yes	yes	Dry season	Dry season	Dry season	All crops	All crops	All crops
Pétté	18 south	yes	yes	yes	Rainy season	Rainy season	Rainy season	All crops	All crops	All crops
Wolordé	50 south	no	no	no	0	0	0	0	0	0
Yoldéo	54 south	yes	yes	yes	Rainy season	Rainy season	Rainy season	Millet	Millet	Millet
Kolara	85 south	yes	yes	yes	Rainy season	Rainy season	Rainy season	All crops	All crops	All crops
Midjivin	100 south	no	no	no	0	0	0	0	0	0
Foulou	93 south	no	no	no	0	0	0	0	0	0

were conducted with village resource person to freely express his opinion on: types of crops grown.

Elephant impact in the village for the last three years 2003 Yes/No; 2004 Yes/No; 2005 Yes/No. If yes, period: 2003 Dry season/Rainy season; 2004 Dry season/Rainy season; 2005 Dry season/Rainy season; Types of crops destroyed: 2003, 2004, 2005; Villages and cropping areas affected 2003, 2004, 2005; Estimate costs.

Data collected from consulting sequential report of the local agricultural service consist of: date, size of the farm, type of damage, size of farmland damaged, estimated number of plants damaged, history of damage in the farm.

### Data analysis

The data analysis consists mainly of data tabulation and graphic presentation. A correlation coefficient was also computed to illustrate the trends in elephant incidences in the villages over time.

### Results

Statistic evaluation of elephant incidences in the villages

Table 2 gives a statistic evaluation of elephant incidences in the villages in 2003, 2004 and 2005. Trends observed indicate a reduction in the number and the percentage of villages affected by elephant from year 2003 through year 2005. However, the

**Table 2**  
**Percentage of villages affected/not affected by elephants per season and per years (2003, 2004 and 2005)**

Years	Number of villages affected per season (N= 13)		Villages affected per year (N = 13)	Villages not affected per year (N=13)
	Dry season (number of villages)	Rainy season (number of villages)		
2003	30.7% (4)	38.46% (5)	69.23% (9)	30,77% (4)
2004	23% (3)	38.46% (5)	61.54% (8)	38,46%(5)
2005	15.4% (2)	38.46% (5)	53.85% (7)	46,15% (6)

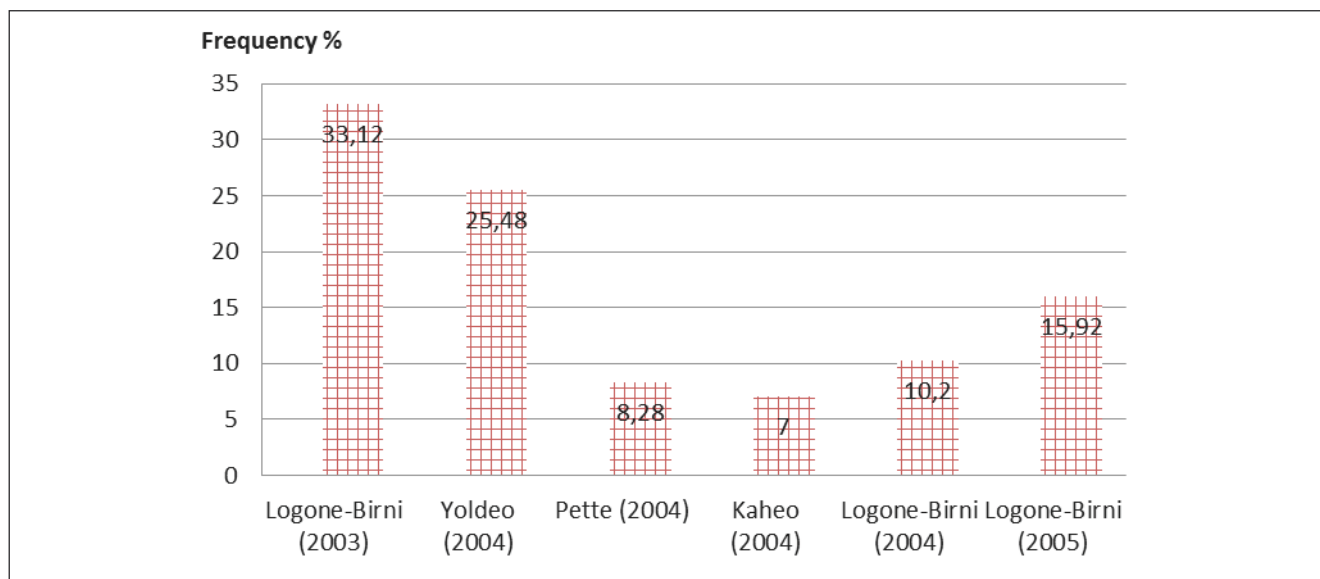


Figure 2: Areas of direct human-elephant conflict.

seasonal pattern of crop raiding shows that the number of villages affected during the wet season is stable. Five out of a sample of 13 villages making up 38.46% are affected each year in the rainy season, while the number of villages impacted by elephants tends to be decreasing in the dry season. It is important to note that many villages including Afade, Wolorde, Midjivin, and Foulou with reported elephants visit did not recorded any damage to crops over time.

#### Areas of human elephant conflict assessed

Reports on elephant damage to local agricultural crops were obtained and assessed for four (4) villages (Figure 2). Based on the reports frequency, Logone-Birni was the top village that has delivers crop raiding by elephants more intensively during the three years examined and this has occurred in 2003 (35% of reports), followed by Yoldeo in 2004 (25% of reports) and Logone-Birni in 2005 (15% of reports). Comparatively, Logone-Birni, Pette and Kaheo were the village less affected with less than 10% of reports in 2004. The results of the survey indicate that the cash crops of greater concern for crop raiding in the region were sorghum, beans, millet, maize, cotton, ognon, mango, tomato, groundnuts, cassava, tomato, guayava, gombo, lemon, aubergin.

Crop types and level of elephant impact per year per village surveyed

The cropping areas damaged were decreasing from 34.2 ha in 2003 to 9 ha in 2004 and to 7.65 ha in 2005 in Logone-Birni (Figure 3). In this village cropland of greatest concern for elephant impact was sorghum field in 2003 & 2004 as did ognon field in 2005. Other villages surveyed received important elephant impact mainly in year 2004 (Figure 3). Cotton fields were the centre of elephant impact at Pette in 2004; while beans, maize and cotton fields were the most important crops damaged by elephants at Yoldeo in

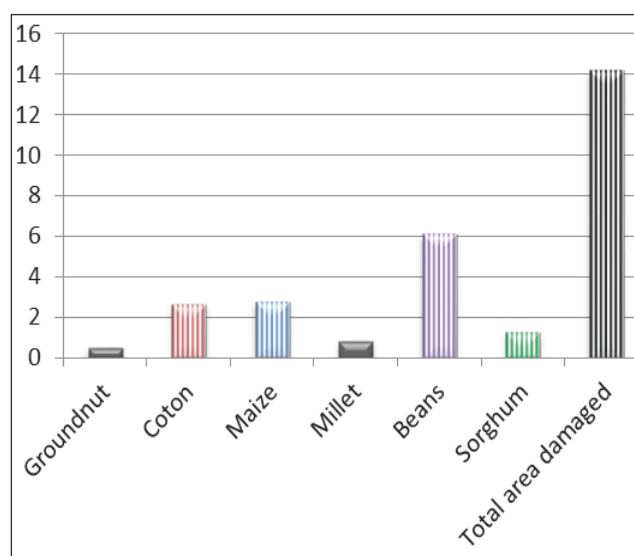
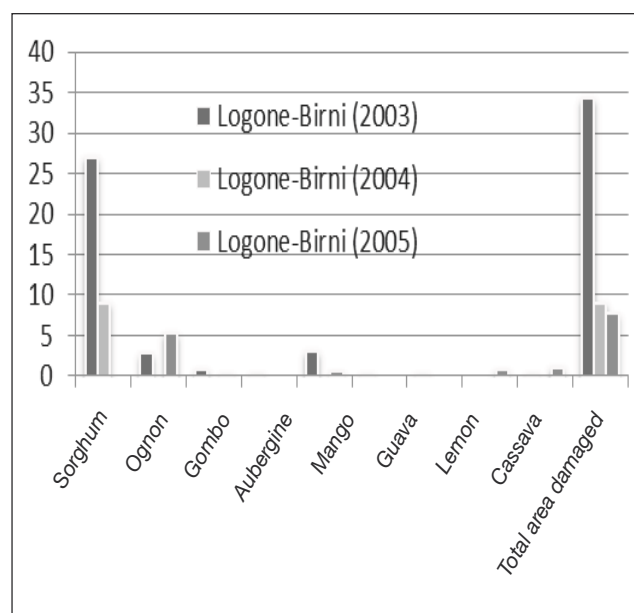


Figure 3: Cropping areas damaged in the villages.

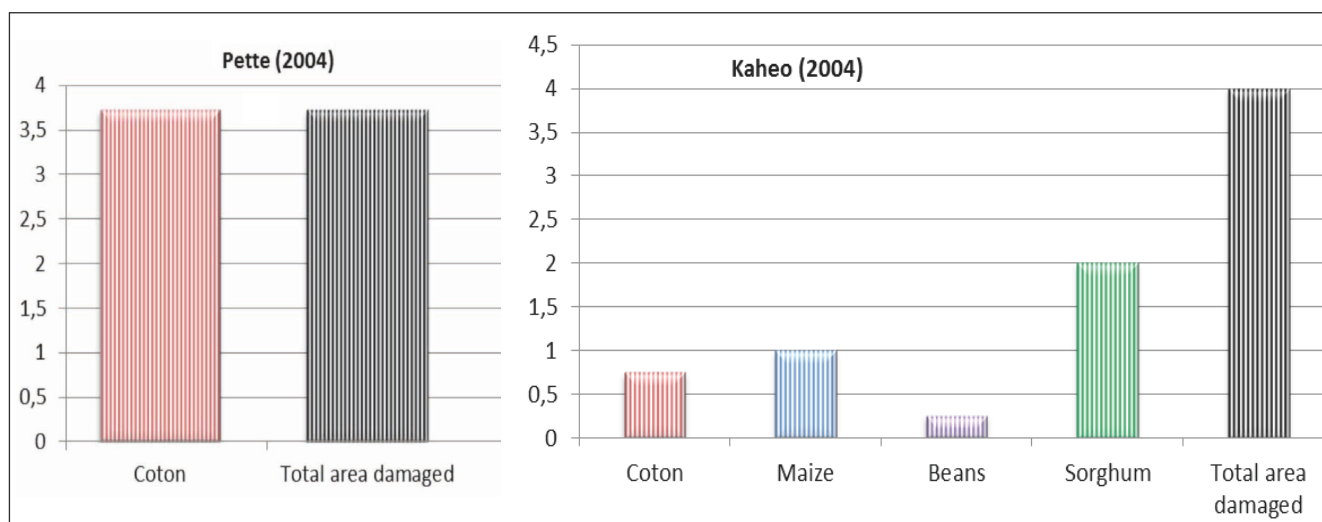


Figure 3: Cropping areas damaged in the villages.

2004 as also did sorghum, maize and cotton fields at Kaheo in 2004.

The total estimated crop loss to elephant at Logone-Birni decreased from \$ 108266.34 in 2003 to \$ 1077.67 in 2004 before increasing to \$ 168 390.74 in 2005. In 2004, crop loss at Yoldeo was high estimated at \$3271.29 and comparatively low at Pette (\$ 989.5) and even more at Kaheo (\$ 551.53).

The total annual crop loss per farmer was estimated at \$ 751.85 in 2003, \$ 40.9 in 2004 and \$ 1169.4 in 2005 in the village surveyed and the total estimated crop loss was \$ 108266.34 in 2003, \$ 5889.99 in 2004 and \$ 168390.7 in 2005 (Table 3).

The disruption of social activities to stay guarding the fields during day and night was indirect impacts difficult to measure. School days were loss by children to assist their parents guarding the farms or scaring the elephants and this is worthy of special note.

Based on reports frequency for the years and villages examined, the most damaged crop was sorghum followed by beans, onions, cotton and mango. Other crops are damaged with minor frequency (less than 5% of reports) including millet and maize.

#### Current status of human elephant conflict

Figures 4 A & B compare actual number of village affected by elephants in the Waza Logone region with the baseline data from 1992 through 1993 (17). They also provide general trends in the evolution of human

elephant conflicts in the region.

Except for the rainy season, which exhibited increase/stable number of villages affected by elephants each year, the dry season crop raiding is reducing along with the number of villages affected year round. The trends observed followed a linear distribution with highly significant relationship for wet season ( $r^2= 0.99$ ,  $P< 0.05$ ); the year round crop raiding ( $r^2= 0.99$ ,  $P< 0.05$ ) and weak but significant relationship in the dry season ( $r^2= 0.48$ ,  $P< 0.05$ ). There was also significant relationship between the number of villages not affected over time ( $r^2= 0.95$ ,  $P< 0.05$ ).

#### Discussion

We found the increase in the number of village affected during the rainy season compared to the dry season. This might be due to seasonal pattern of crop raiding. Crop raiding is seasonal, occurring mainly in the harvest season and, is a man-made problem (1). It is foreseen that the harvesting period of the rainy season is more prone to elephant crop raiding because the fields have the most crops at this time same as in our study area. Crop damage is at its height during the wet season when the majority of crops are grown (16). In the Waza Logone region this is supported with the observations made by previous authors who monitored elephant movement and postulates that, the distribution of location cycle inside and outside

Table 3  
Damaged fields and estimated crop loss per year

Villages	Total area destroyed (ha)			Estimated costs (USD)		
	2003	2004	2005	2003	2004	2005
Logone-birni	34,2	9	7,65	108266,34	1077,67	168390,7
Yoldeo	0	14,2025	0	0	3271,29	0
Pette	0	3,725	0	0	989,5	0
Kaheo	0	4	0	0	551,53	0
Total	34,2	30,93	7,65	108266,34	5889,99	168390,7

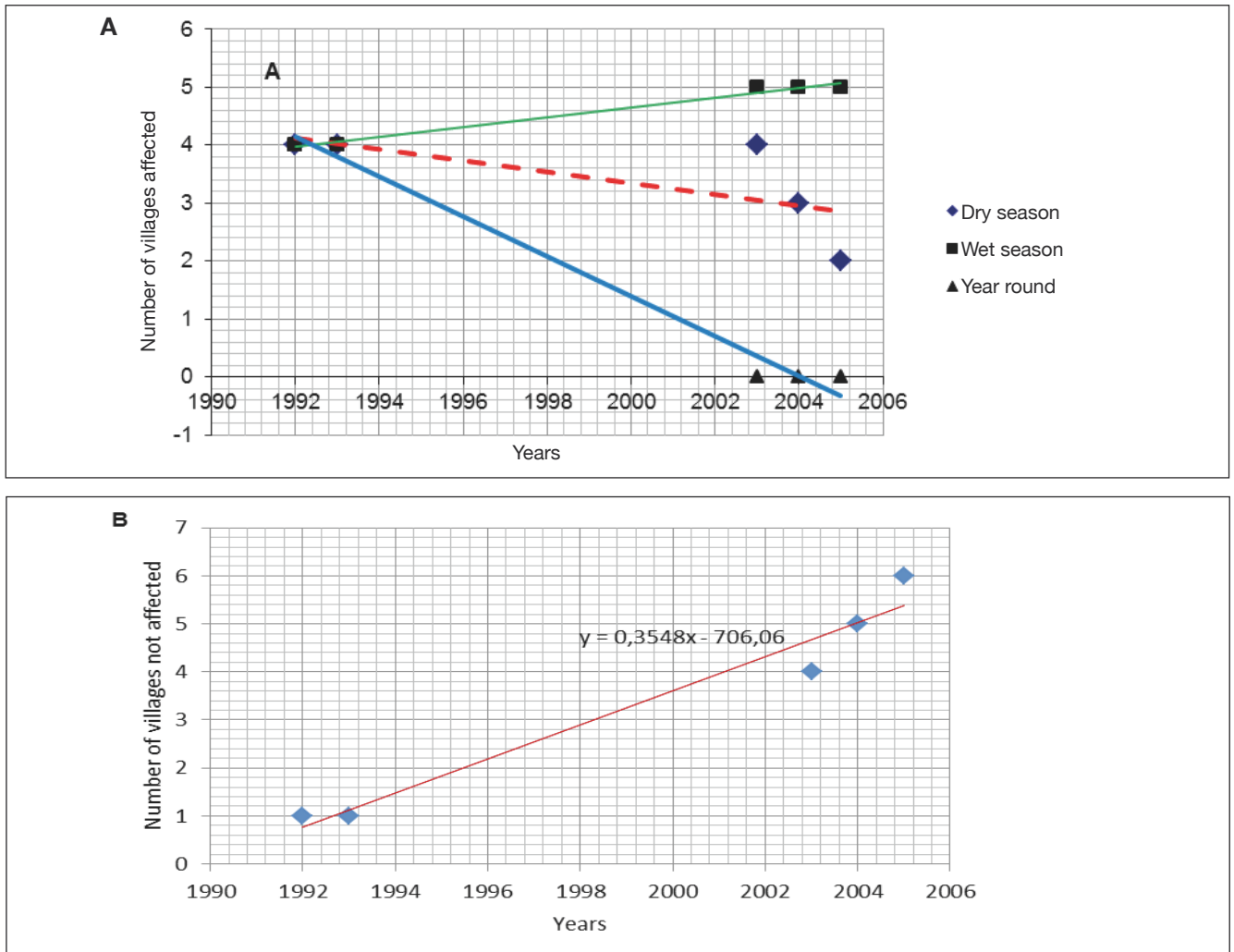


Figure 4: Relationship between time (years) and number of villages affected (A) or not affected (B) by elephants.

the Waza National Park does not indicate a decrease after the re-flooding of the south bound wet season migration routes to areas far south of the park where the elephants cause serious damage to agricultural crops (10). Although there have been changes in the movement pattern (6), as the villages presently affected by elephants in the rainy season are not the same with those affected in 1992-1993 survey. The decrease in the number of village affected during the dry season might be consistent with an adjustment in elephant movement route north of Waza National Park. However, general pattern of crop raiding by elephants in the region indicates a reduction in the total number of villages affected by elephants as a result of a shift in dry season habitat use by elephants inside the park and a longer residence time in the park during the period of migration (10). The conclusion that the total number of villages with reported elephant crop raiding in the region is declining, is consistent with our expectations. This may be viewed as a testimony of the effectiveness of past management of the ecosystem of the region (11). Conversely, this reduction can be viewed also as a decline in the elephant population number (7) because an increase in elephant population

as do human population must have led to increase in competition over the scarce land resources. This hypothesis of elephant population decrease is very likely and should be taken into consideration as recent reliable elephant population estimates inside Waza National Park in 2007 lead to the conclusion of a rapidly declining population number (7). Farmers in the region are largely dependent on small-scale subsistence farming and cash crop production. The crops damaged forms the main component of the staple diet of people in the region. And, the variety of crops associated with crop raiding is conforming to findings of other authors (3, 8, 12). Crops commonly fed on or damaged by elephants include maize, millet, bananas, sweet potatoes, sorghum, beans, cassava, cotton, groundnuts, mangos, melons, etc. It has been suggested that elephants often search out ripe crops, even when wild forage is available (3). However above all the crops found in this study, elephants raid predominantly on sorghum fields. This is in line with the past observations (25) which indicate that in the Waza Logone region elephants are more attracted by the nutritious sorghum fields and they accounted for much of the crop raiding incidences in the rainy

season. But the crop damage assessment indicates an increase in financial loss compare to previous estimates of more than 1000 ha of cropland annually destroyed and the annual cost of crop damage estimated at more than US\$ 200 000 (25). While the current distribution shows that 34.2 ha; 30.93 ha and 7.65 ha were annually destroyed and the annual cost of crop damage evaluated at US\$ 108266,34; US\$ 5889,99 US\$ 168390,7 respectively. This can be attributed to the localized patterns of crop raiding by elephant (20). According to this author, an elephant can eat more than 200 kg of food a day, and even a small herd can wipe out a farmer's annual crop in one night's foraging. Therefore, the localized pattern of crop raiding can be more destructive and costly in a relatively small area. However, we can inferred in the local context that as there is always much discussion and publicity about the damage and an increased expectation by complaint regarding compensation, the local agricultural service (also in charge of allocating compensation when available) and the farmers tend to overestimate the damage (25).

Although the ecological management of the Waza National Park and its elephant populations has brought some hope in the mitigation of human elephant conflict in the Waza Logone region, the problem is not definitely resolved. Resolving a very complex problem such as human-elephant conflict at a minor level might be quite impossible in the context of Waza Logone region unless if this can combine strategies such as translocation, fencing, animal problem control activities and sanctuaries creation. To further enhance human-elephant conflict management effectiveness, we recommend (a) the creation of community-based elephant sanctuaries delineated outside Waza National Park to increase available elephant range, thus mitigating conflict. The corridor under consideration in the Waza-Logone region is the habitat connecting Waza and Kalamaloue National Park. Because Kalamaloue National Park is too small to support large number of elephants even for a short period of time, it is anticipated that the creation of a corridor would secure additional areas for use by elephants. The corridor is 100 km long and 15 km wide. While no effort is underway to establish or to provide a status to conservation corridor in the region, elephants are using the vegetation corridor to move between Waza and Kalamaloue National Park. However, the present quality of the corridor under consideration was evaluated on the basis of available information including topographic maps, and 1987 SPOT imagery data, aerial photos of elephant trails, ground observations of elephant sign (tracks and droppings) and kernel home range of tracked elephant herd using satellite telemetry devices (6). (b) Protecting humans and their properties from elephant menace should be one of the priorities for wildlife service in the region of Waza. Animal problem control

activities should be implemented to help reduce conflict. This can help reduced the costs induce by crop raiding elephants and increased the benefits to rural farmers (2). In this case local communities in the Waza Logone region have never received direct assistance in mitigating crop damage for instance, through capacity building in problem animal issues, basic elephant ecology and problem animal control strategies. This intervention has proved to have had a positive impact on Dande community's interactions with problem elephants (Foguekem, pers comm.). (c) The importance of Waza National Park for wildlife tourism cannot be overemphasized. We suggested that part of the park revenue generated through tourism goes to local community as a form of compensation for crop loss due to elephant. Failing to do so, human elephant conflict problem in the area will increasingly favor poaching if people don't receive any return from wildlife.

#### **Current methods to mitigate human elephant conflict in northern Cameroon**

HEC has been increasing in northern Cameroon and was for quite some time a major focus of national and international attention. The methods used for its mitigation are simple, traditional methods used by villagers. Expensive technologies have never been implemented by state agencies. A brief overview of the various traditional methods is given below.

1. Collective prayers and magical practices. These have prove to be ineffective as they do not affect elephant behavior.
2. Beating drums or empty barrels to scare elephants. This only has the effect of moving the problem to other areas.
3. Sheep dung has been burnt in the fields. People believe that elephants dislike its smell, but is ineffective.
4. Light fires piles around croplands or sleep in the crop fields to guard them from elephants (vigilance methods to alert farmers to approaching elephants and increase the chance of driving them away).
5. Sticks and stones are thrown at elephants. This sometimes ends in fatal incidents
6. Wound elephants by shooting them with light shotguns.
7. Disturbance or control shooting has been applied by wildlife staff to kill some nuisance causing elephant. Quantitative evaluation of control shooting has not been carried out so far and there is no evidence that it reduces the magnitude of the damage.
8. Limited wet season safari hunting is opened in high conflict sites. In addition to generating revenue for the state coffers (\$ 4000 US and \$ 2000 US for the female and male elephants respectively), the launching of safari hunting helps regulating wildlife population of the park. The remote consequence



of this measure is the regain of confidence by local farmers on the part of government authorities in charge of wildlife. The killing of some elephants (be they problem ones or not) every year by licensed tourists (within the quotas fixed by CITES and national regulation in force) for their trophies is in one way or other beneficial to the local populations. They benefit from the meat and have the moral satisfaction of "seeing justice take its course"

The methods used for its human elephant conflict mitigation and their effectiveness in elephant range in northern Cameroon are available (25). However, gaps in knowledge do exist, and require studies to document the quantitative effects of human elephant conflict and to determine the most appropriate combination of methods that can mitigate human elephant conflict under the specific conditions. To

improve on this study in the future the percentage of farms that is raided along with the proportion of farm per crop grown need to be calculated. This will help to properly assess the intensity of the problem and design appropriate measure.

### Acknowledgement

We wish to thank the World Wide Fund for Nature (WWF), Cameroon Country Programme Office for financing this study. We also acknowledge the logistic support of WWF Northern Sudan Savanna and especially Dr. P. Donfack for logistic support. Our thanks also go to Mr S. Tyawoum and T.S. Tekem for their assistances in the field. We are thankful to the Conservator of Waza National Park, Adam Sale for providing some facilities. Our special thanks go to Dr H. Njiforti for reading through the script.

### Literature

- Barnes R.F.W., 1996a, Facing the storm: five year of research in and around Kakum National Park, Ghana. Proceedings of a course in elephant biology and management: Ghana Wildlife Dept, Conservation International and University of Cape Coast.
- Barnes R.F.W., 1996b, The conflict between humans and elephants in the central African forests. *Mammal review*, **26**, 2/3, 67-80.
- 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? *Afr. J. of Ecol.* **43**, 48-55.
- DDA, 1981, Rapport annuel d'activités. Délégation départementale d'agriculture du Diamaré, Maroua, Cameroun.
- Eijs A.W.M. & Ekobo A., 1987, Les éléphants du Parc National de Waza et les interactions avec l'agriculture dans la région. Série Environnement et Développement au Nord du Cameroun. Université de Leiden, Pays-Bas.
- Foguekem D., Tchamba M.N., Le Breton M., Ngassam P. & Loomis M., 2009, Changes in elephant movement and home ranges in the Waza region, Cameroon. *Scientific Research and Essay*, **4**, 12, 1423-1431.
- Foguekem D., Tchamba M.N. & Omondi P., 2010, Aerial survey of elephants (*Loxodonta africana africana*), other large mammals and human activities in Waza National Park, Cameroon; *Afr. J. Envir. Sc. & Tech.* **4**, 6, 401-411.
- Hoare R.E., 1999a, Determinants of human-elephant conflict in a land-use mosaic. *J. of Appl. Ecol.* **36**, 689-700.
- Hoare R.E., 2000, African elephants and humans in conflict: the outlook for coexistence. *Oryx*. **34**, 34-38.
- longh H. de, Tchamba N.M., Tamis W., Zelfde V.M., Prins H., Haes H.U. de., Bauer H. & Tyawoun S., 1999, Results of four years' satellite tracking of elephant in northern Cameroon. *Pachyderm*, **27**, 62-65.
- Loth P., 2004, The return of the water: restoring the Waza Logone Floodplain in Cameroon. IUCN, Gland, Switzerland and Cambridge, UK. Xvi + 156 pp.
- Malima C., Hoare R. & Blanc J., 2004, Systematic recording of human-elephant conflict: a case study in south-eastern Tanzania. *Pachyderm*, **38**, 29-38.
- MINEF, 1993, Gestion de l'espace et utilisation des ressources dans la région soudano-sahélienne. projet pnud/unso, no cmr/89/x0<sub>2</sub> ministère de l'environnement et des forêts, Yaoundé, Cameroun.
- Mope J.A.S, 1997, Case study of population involvement in the management of protected areas in Cameroon: Korup and Waza National parks. Consultancy report, WWF. Yaoundé, Cameroun.
- Omondi P., Bitok E. & Kagiri J., 2004, Managing human-elephant conflicts: the Kenyan experience. *Pachyderm*, **36**, 80-86.
- Parker G.E. & Osborne F.V., 2001, Dual season crop damage by elephants in eastern Zambezi Valley, Zimbabwe. *Pachyderm*, **30**, 49-56.
- Steehouwer G. & Kouahou E., 1988, Olifanten, milieuveranderingen gebiedsinrichting. Serie environnement et développement au Nord Cameroun. Université d'Etat de Leyde, Pays-Bas.
- Scholte P., Kort S., Weed M.V., 2000, Flood plain rehabilitation in far north Cameroon: expected impact on birdlife. *Ostrich*. **7**, 1, 112-117.
- Stephenson P.J., 2004, The future for elephants in Africa. In: N. Burgess, J. D'Amico Hales, E. Underwood, E. Dinerstein, D. Olson, I. Itoua, J. Schipper, T. Ricketts, and K. Newman (eds.), *Terrestrial Ecoregions of Africa and Madagascar: A Conservation Assessment*. Island Press, Washington DC, USA. Pp. 133-136.
- Stephenson P.J., 2006, WWF species action programme, African elephants 2006-2011. World Wide Fund for Nature, CH-1196, Gland, Switzerland.
- Tchamba N.M., 1993, Numbers and movement patterns of savanna elephants (*Loxodonta africana africana*) in northern Cameroon. *Pachyderm*, **16**, 66-71.
- Tchamba M.N., Bauer H., Hunia A., De longh H.H. & Planton H., 1994, some observations on the movements and home range of elephants in Waza national park, Cameroon. *Mammalia*, **58**, 527-533.
- Tchamba M.N., Bauer H. & longh H.H., 1995, Application of radio and satellite telemetry on elephants in the extreme north province of Cameroon. *Afr. J. Ecol.* **33**, 335-346.
- Tchamba M.N. & Elkan P., 1995, Status and trends of some large mammals and ostriches in Waza National Park, Cameroon. *Afr. J. Ecol.* **33**, 366-376.
- Tchamba M.N., 1996, History and present status of the human/elephant conflict in the Waza-Logone region, Cameroon, West Africa. *Biol. Cons.* **75**, 35-41.

M.N. Tchamba, Cameroonian, Ph.D, Associate Professor, University of Dschang, Head of the Forestry Department.

D. Foguekem, Cameroonian, Ph.D, World Wide Fund for Nature, Biodiversity Officer.