

*Full Length Research Paper*

# **Assessment of crop raiding situation by elephants (*Loxodonta africana cyclotis*) in farms around Kakum conservation area, Ghana**

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The study assessed the crop raiding situation around Kakum conservation area (KCA). This was done through analysis of data collected on elephant damage to crops from crop-raiding report forms completed for all raids, which occurred from January to December, 2007 at KCA. It was observed that cases of crop damage by elephants covered a total agricultural land area of about 2.3 ha and this involved 35 farms, which belonged to 30 farmers of seven communities around the Reserve. Cash crops like cocoa and orange and also subsistence food crops such as cassava, plantain and tomato were raided fiercely in both dry and rainy seasons. It appeared that the elephants engaged in spite raid in which situation the crop raided was not consumed. The study further revealed that the number of raids increased with the size of the farm and with the proximity to the park boundary and that the elephants mostly targeted mature crops. From the results of the study it was recommended that owners of farms around the reserve should be supported to use the available deterrent methods such as chili fences to prevent future damages. Also, farmers should be advised to plant trees that are undesirable to the elephants close to the boundary to act as buffer. A buffer zone of at least 100 m from the Park boundary should be considered.

**Key words:** Kakum conservation area, crop raiding, elephants, human-elephant conflict, cash crops, subsistence food crops, spite raid.

## **INTRODUCTION**

Human - wildlife conflict (HWC) is a term commonly used by conservationists to describe friction between wild animals and people. The conflict emerges when wildlife and human requirements overlap with consequential costs to humans and/or the wild animals (Osei-Owusu and Bakker, 2008). Although in extreme situations injuries and fatalities are caused to humans and livestock (Tchamba, 1995), the commonest type of HWC seems to be crop raiding by wild animals, especially large mammals and birds outside their refugia. This phenomenon is not new (Kagaro-Rugunda, 2004) and is one of the challenges being faced by one of Ghana's

successful protected areas attempts, that is, Kakum conservation area (KCA). Barnes et al. (2003, 2005), Danquah et al. (2006) and unpublished records available in the Park's Headquarters have reported many cases of sporadic raiding of farms by elephants, primates, duikers and birds from the Area.

Crop raids by elephants have been described by Whyte et al. (1998) as most thorny since elephants elicit drastically sometimes very wide different emotions. At one extreme elephants capture memorable and unflinching affection (Whyte et al., 1998) by those who view them for pleasure but at the other extreme they generate animosity, intimidation and fear. The latter may be true of some rural areas of Africa where food security and the very livelihood of poor fringe communities of protected areas may be threatened by elephants (Parker

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et al., 2007). Then, human - elephant conflict (HEC) becomes a primary threat to elephant survival (Hoare, 1995; Kangwana, 1995; Tchamba, 1995; Barnes, 1996; Western, 1997). To manage such situations, elephants may be put down by wildlife authorities or indigenes may react by killing elephants illegally (Kiiru, 1995; Omondi et al., 2004; Kioko et al., 2006). With the decrease in protected habitats available for elephants, crop raiding is anticipated to increase and play a significant role in the decline of elephant populations (Hoare, 1999).

Ensuring farmers livelihoods and food security through reduction of HWC is an internationally agreed goal (Parker et al., 2007) and conservation managers today are required to tackle this complex issue in collaboration with communities in order to achieve conservation objectives (Parker et al., 2007). If solutions to alleviate the negative impacts of elephants are not found, persistent raiding of crops may compromise elephant conservation (Chiyo and Cochrane, 2005). Combating HEC can prove to be a herculean task. Although in many societies traditional farmers self compensate for losses of HWC by hunting and consuming the animals, this approach could easily lead to abuses (Osei-Owusu and Bakker, 2008). It has been established that electric fences are expensive to install and maintain and most community fence projects in Africa are either sponsored by donor funds or by agencies (Kioko et al., 2008).

A long term solution to elephant crop raid can only be devised based on the outcome of proper investigations into the behavioral dynamics and pattern of raids by the elephants. Studies have already established that the frequency of crop raiding by elephants is affected by the ecological conditions within their forest refuge (Wyatt and Eltingram, 1974; Barnes, 1982; Ruggiero, 1992) but the farming landscape outside has not been completely unraveled (Oppong et al., 2008).

We report here about the raiding activities of *Loxodonta africana cyclotis* inhabiting the KCA. The trends observed are supposed to serve as guidelines for outlining strategies for successful management schemes that may eventually lead to the improvement of livelihoods for over 1200 households (Agyare, 1995).

## MATERIALS AND METHODS

### Study area

The Kakum conservation area (KCA) consists of Kakum National Park and Assin Attandanso Resource Reserve and forms a 360 km<sup>2</sup> block in the moist evergreen and semi-deciduous forest zones of the Central Region of Ghana. The KCA lies between longitude 1°30' W - 1°51' W and latitude 5°20' N - 5°40' N (Figure 1). Rainfall distribution shows a bimodal pattern with an annual average between 1500 - 1750 mm. The major rainy season extends from March to July with a peak in June whereas the minor season lasts from September to November. During the main dry season (that is, December to March), many water courses in the area dry up. Fifty-two communities border the KCA and it is estimated that there are at least about 36,620 people. The structure of the population shows

it is quite dependent with persons aged less than 15 years forming 45% and those aged 65+ forming 4.6% of the total population in KCA. There is a high degree of illiteracy among the adult population in the area. Three communities have no school at all and the majority have basic schools only up to six years but without trained teachers and none of the communities has senior high school. The population was estimated to double in 21 years from 1996 (WD, 1996). The main occupation of the inhabitants is subsistence farming. Therefore, KCA is surrounded by agricultural crops and the main crops cultivated are cocoa, maize, plantain and cassava.

### Survey methods

Data on elephant crop raid and destructive activities were gathered from January to December 2007 using the standard elephant damage report form developed by the IUCN's African Elephant Specialist Group (AFESG). A form was filled out each time a farm was raided to provide information such as date and time of the raid, types and parts of the raided crops, stage of maturity of raided crops, number of occurrence on the farm, description of the group or individuals of elephants by direct observation or identification of spoors like the dung and footprint. For each farm, the area raided was subdivided into measurable shapes that is, rectangular, triangular or squares and the area estimated by adding up the calculated areas of the various shapes. Readings of GPS were taken of each raided farm. The perpendicular distance of each raided farm to the nearest reserve boundary was estimated by plotting relative positions on the map of the KCA. The MINITAB (2003) was used for all computations of correlation.

## RESULTS

During the period under review 35 farms belonging to 20 farmers from seven villages, Aboabo, Antwikwaa, Brahabehome, Kruwa, Nyamebekyere, Pemsan and Ahomaho experienced a total of 50 raids by elephants from KCA.

The raids covered a total land area of about 24,925.8 m<sup>2</sup> (2.49 ha) (Table 1) at an average rate of 2.9 (1.05 S.E) farms per month and the maximum raids occurred in August, 2007 (Figure 2). About three sightings were made between 19.00 - 04.00 h with a peak at about 22.00 h. The raids took the form of consuming and destroying in the process; but there were some destruction without consumption. Destructions were mainly by trampling, uprooting and plucking of fruits (Table 2). Farming around the KCA occurred all year round and the raiding targeted both mature and immature crops including cassava, plantain, banana, orange and maize (Table 3.).

There was no correlation between the size of the raided farms and the proximity of farms to the Reserve's boundary ( $F = 1.22$ ;  $r^2 = 0.2409$ ;  $p > 0.05$ ) and the coefficient explained only 24.09% of the model (Figure 3). However, there was a correlation between the size of a raided farm and the extent of raid in the farm ( $F = 3.40$ ;  $r^2 = 0.5502$ ;  $p > 0.05$ ) (Figure 3).

In all cases inventoried the raids were found to be done by a group ranging between 2 - 15 elephants with a mode of 6.5 and 5, respectively (Table 4).



**Figure 1.** The map of Kakum conservation area showing the major communities.

**DISCUSSION**

Since the early 1990’s HWC has become a vigorous area of research (Balakrishnan and Ndhlovu, 1992; Naughton-Treves, 1998) but some pieces of information continue to add to the already accumulated for a better understanding. The case of HEC in particular merits an intense study due to the variability in terms of space and time.

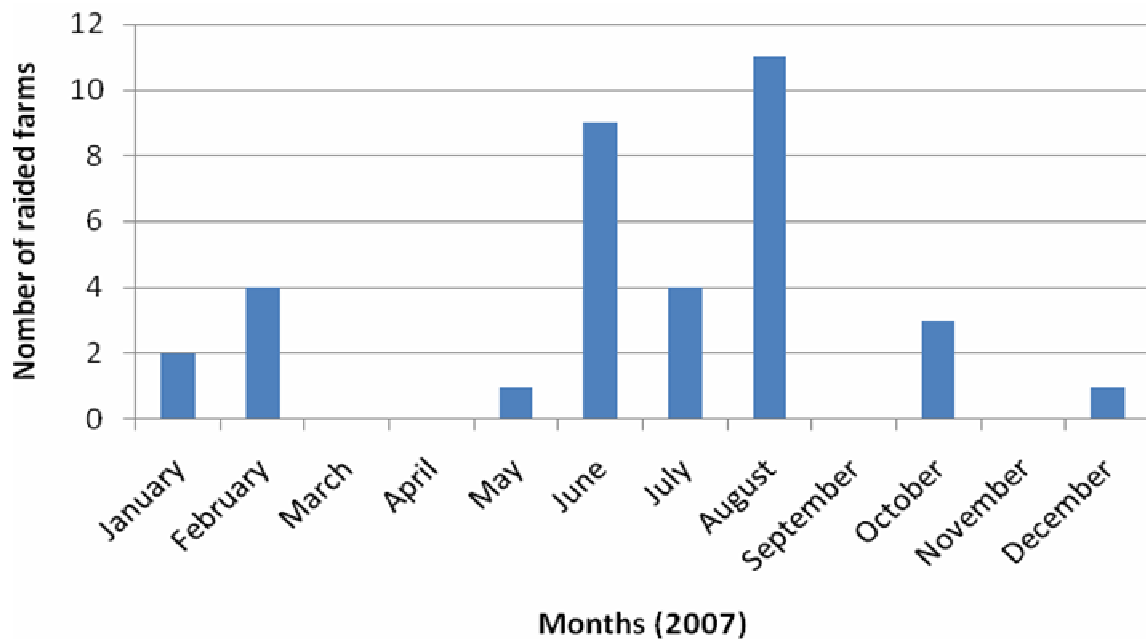
The spatiotemporal pattern that has emerged from this study is that elephants raid farms nearest the park border more and throughout the whole year. In fact no migration route or water course was found to be a trigger to the raid. Whereas crop raiding was restricted to the wet

season (Barnes et al., 2003; Danquah et al., 2006 ) the current study recorded crop damage during the dry season months as well, (that is, January, February and December) as shown in Figure 3. Many farms have been cultivated right to the boundary of KCA, which promotes conflict between elephants and humans that live there (Barnes et al., 2005). The Area has undoubtedly become a subsistence survival for the majority of people on a land that is increasingly overstretched. There are usually signs of abandoned farmlands right down to the edge of the area.

Elephants in KCA raided and caused more damage to larger farms, which are either closer or farther from the

**Table 1.** Number and size of farms raided by the elephants and distance of raided farms from the park's boundary in the various villages around the park.

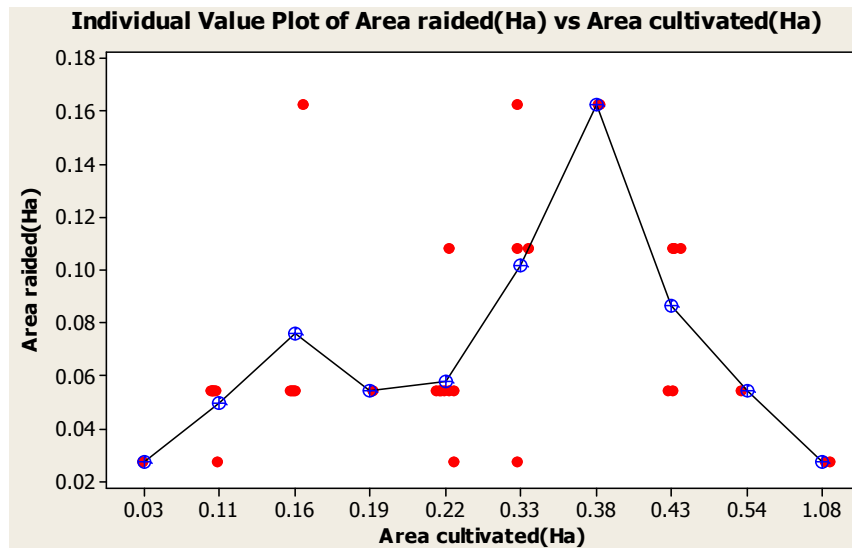
Name of village	No. of farms	Total area of farms raided/m <sup>2</sup>	Total area of farms/m <sup>2</sup>	Mean Distance of raid from Parks boundary (m)	Farthest distance of raid from Park's boundary (m)	No. of times of raid
Aboabo	1	1,625.6	1,625.6	150	150	1
Antwikwaa	5	4,334.92	9,482.64	430	500	5
Brahabebome	3	1,625.6	8,669.84	93	180	3
Kruwa	23	16,255.95	59,876.08	162	400	36
Nyamebekyere	1	541.87	0.216746	20	20	2
Pemsan	1	270.93	10,837.3	20	20	1
Ahomaho	1	270.93	10,837.3	10	10	2
Total	35	24,925.8	103,496.2			50

**Figure 2.** Number of farms raided by elephants in various months in 2007.**Table 2.** Nature of damage caused by elephants to crops raided.

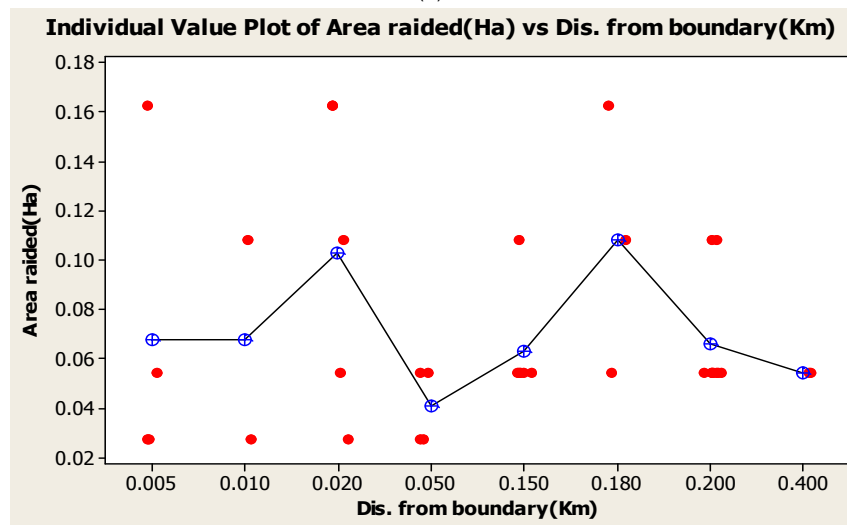
Type of crop	Nature of damage
Cassava	Consumption of leaves, uprooting and consumption of tubers
Plantain	Consumption of leaves and fruits
Maize	Trampling and consumption of immature cobs
Palm tree	Consumption of terminal bud and trampling of young plants and seedlings.
Banana	Consumption of leaves and fruits
Tomato	Trampling
Cocoyam	Trampling, uprooting and consumption of corm
Ginger	Trampling and uprooting, no consumption
Cocoa	Consumption of fresh and fermented beans
Orange	Plucking of fruits, no consumption

**Table 3.** Principal crops cultivated around Kakum conservation area that were found to have been raided by the elephants from Jan-Dec, 2007.

Name of crop	Category	Cultivated period	Harvest period
Maize	Food crop	March-April	August same year
Cassava	Food crop	March-April	October same year
Plantain	Food crop	March-April	Feb.-April following year
Banana	Food crop	March-April	Feb.-April following year
Yam	Food crop	February-April	Nov. same year
Cocoyam	Food crop	March-April	October same year
Tomatoes	Food crop	April-May	July-August
Orange	Cash crop	June	All year peak in Feb.-Mar.
Cocoa	Cash crop	June	All year peak in Oct.
Palm	Cash crop	July	All year but peak in Feb.



(a)



(b)

**Figure 3.** The relationship of the area raided and the proximity of the farms to the boundary (a) and the total area of the cultivated farm (b).

**Table 4.** Group details of elephants raiding the farms in the various villages around the park.

Name of village	Mean group size	Range of group size	Frequency of raid	Modal group size (frequency)
Aboabo	2		1	(1)
Antwikwaa	5		2	(1)
Brahabebome	2		3	(1)
Kruwa	8.4	2 - 15	16	5 (11)
Nyamebekyere	2		1	(1)
Pemsan	8		1	(1)
Ahomaho	2		1	(1)

park boundary. The reason for this may be due to the possibility of finding a wider variety of food crops in larger farms where they could easily meet their nutritional requirements compared with small farms with few crops as observed by Oppong et al. (2008). However, considering energy costs in foraging in general, it would be too expensive for the elephants to feed on large farms that are too far from the park boundary. Therefore establishing large farms very far away from the park boundary would be most ideal to prevent elephant raids. Applying deterrent methods on large farms is a more difficult task compared to small ones. Hence elephants may find it more convenient to enter ineffectively guarded farms that are farther than smaller guarded farms that are closer to the park boundary. Proximity of farms to the boundary line has been the strongest predictor of crop raiding in previous studies such as Sam et al. (2005) in Bia Conservation Area and Barnes et al. (2003, 2005) in KCA, Ghana and Naughton-Treves (1998) in Kibale Forest National Park, Uganda. There is high incidence of HEC in KCA and this can seriously undermine the long-term conservation of the elephant. The integration of conservation with other land uses is especially difficult in Africa and Asia (Sukumar, 1995). Human elephant conflict at some sites is a major obstacle to community support and the hostility of a vocal minority can undermine regional conservation initiatives (Gillingham and Lee, 1999).

So far as KCA is concerned, harmony between the governing institution and the indigenes has proved rather challenging by the complicated system of land tenureship in Ghana. The natives regard themselves as true owners of the land and as such their collective mandate and consent are important. The KCA falls within the jurisdiction of two local districts but the administrative transactions are done without the natives. National authority of the KCA has been fragmented across various ministries whose pre-occupation has been income generation at the expense of biodiversity conservation. However, majority of the people in the surrounding communities still depend on the natural resources of the forest and on their farm produce for their livelihood and therefore farm to the park's boundary.

The estimated number of elephants on raided farms (2 - 15 per incident) suggests that elephants browse in groups and not on individual basis; and the raiding effects of 15 elephants on a farm for example could be very devastating.

Elephants do not necessarily raid to consume food and confounding any reasonable explanation is the elephants' harvest of some crops such as orange and ginger, which they rather fail to consume. There is therefore some phenomenon of spite raid. A spite raid cannot be tied to seasons and hypotheses in temporal variation as suggested by Chiyo et al. (2005). A crop that is not necessarily consumed may therefore not deter elephants.

As the elephants evolve to adapt to feed on a variety of cultivated plants around the conservation area at any time where many people are migrating to farm, the issue of crop raiding is envisaged to escalate in future. The continuous destruction of crops such as cocoa, which hitherto was not consumed by elephants, could deal a big blow to the country's economy. Agricultural production is predominantly small scale and is concentrated on cocoa and staple food crops that include maize, cassava and yams which are mostly cultivated using traditional land use methods such as slash and burn.

Currently deterrent methods include pepper fencing and guarding farms in the night and scaring off threatening elephants with loud noise. Pepper fencing involves soaking sacks in a mixture of ground pepper and grease and hanging the sacks on fences around each farm. Current trends point to the fact that consolidation of the traditional methods of deterrence may ease the tension between the Park's staff and the locals. This can be combined with rapid response patrol team of wildlife employees and locals who may fire warning gun shots against attempting elephant raiders.

It is therefore, recommended that regular monitoring and evaluation must be done on the various deterrent measures used at present to keep many farms from elephants destruction.

## Conclusion

This study should form a base-line on which the dicey

issue of HEC conflict in KCA could be tackled. Any solution to the problem should be based on documentary evidence and not fragmentary information supplied by the aggrieved rural farmers. More studies are needed on prevention. There have been experiments on beehive and elephants (Vollrath and Douglas-Hamilton, 2002; King et al., 2009) and this issue may be investigated in the Ghanaian context. A legally acquired buffer zone planted with forest trees that are not palatable to the elephants must be grown closer to the forest boundary to serve as a safe haven to the farms. Also, finding effective farmer managed deterrents that are both socially and economically suitable should be pursued.

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