

Crop damage by African elephants assessment in kaftasheraro national park, Ethiopia

Dawit Mamo^{1*}, Hans Bouer² and Yaynshet Tesfay³

¹Department of Animal Science and Eco-tourism, College of Agriculture, Aksum University, PO. Box:314 Shire endasslasse, Aksum, Ethiopia,

²Wildlife Conservation Research Unit, Department of Zoology, University of Oxford, Tubney House, Tubney, OX13 5L, U.K. and ³Department of Animal, Rangeland & Wildlife Science, College of Agriculture, Mekelle University, Mekelle, Ethiopia

Abstract

This study was conducted in Kafta-Sheraro wereda in Northwest Tigray region of Ethiopia to assess community take on crop damage by the African Elephant, to identify visiting time of Elephants to agricultural plots and identify any other animals causing crop damage. A total of 240 households were selected from twelve villages using a stratified random sampling procedure. Half of the villages represented samples closer to the park and the other half, represented samples farther away. Whether the farmer owned or rented plots on which crops were grown as well as the distance to the park from the plots were the primary factors significantly ($P < 0.05$) influencing crop damage by elephants in the area. Time of the elephants visiting the agricultural plots was significantly ($P < 0.05$) higher at night. In a ranking exercise, among seven species considered, Elephants were ranked second in importance after Warthogs for crop destruction in villages close to the park but last in villages farther away. In the latter area, the most problematic animal was the Warthog followed by the Crested Porcupine. In the former areas where elephants' damage to crops was more frequent, farmers ranked fire as the most effective way of controlling the invasion. The study concludes that bringing the community to the discussion on elephant crop damage, increasing the time of keeping vigil during the night; improving the extension services and training in awareness creation and additional research's should be undertaken to evaluate in monetary terms the value of crop damage.

Key words: agriculture plot, community perception, crop damage, problem animal, village distance

Résumé

Cette étude a été réalisée dans la commune de Kafta-Sheraro, au Tigré, au nord-ouest de l'Éthiopie, pour évaluer comment la communauté fait face aux dommages causés aux cultures par les éléphants, pour déterminer quand les éléphants pénètrent dans les parcelles cultivées et identifier tous les autres animaux qui causeraient des dégâts aux cultures. Au total, 240 foyers furent sélectionnés dans 12 villages par un processus d'échantillonnage aléatoire stratifié. La moitié des villages représentaient des échantillons proches du parc et ceux de l'autre moitié étaient plus éloignés. Les premiers facteurs influençant significativement ($P < 0.05$) les dommages causés par les éléphants étaient le fait que les exploitants possèdent ou louent les parcelles sur lesquelles poussaient les cultures ainsi que la distance par rapport au parc. Les éléphants pénétraient dans les parcelles significativement ($P < 0.05$) plus souvent pendant la nuit. Dans un classement impliquant sept espèces, les éléphants étaient deuxièmes en importance après les phacochères, suivis par les porcs-épics. Dans d'autres zones où les dommages des éléphants étaient plus fréquents auparavant, les cultivateurs citaient les feux comme le moyen le plus efficace de contrôler leurs invasions. Cette étude conclut qu'il faudrait réunir la communauté pour des discussions sur les dégâts des éléphants, augmenter le temps passé à surveiller les cultures, améliorer les services de sensibilisation et former à la conscientisation, mais aussi faire des recherches supplémentaires pour pouvoir évaluer en termes financiers les dommages causés aux cultures.

Introduction

Ethiopia has diverse wildlife populations which are comparable, species wise to that of other countries of East

*Correspondence: E-mail: davelephant60@yahoo.com

Africa. The inventory of the wildlife potential of the country indicates that there are 260 species and subspecies of mammals, 845 species of birds, 78 species of snakes, 54 species of amphibians and 101 species of fish (EWCO (Ethiopian Wildlife Conservation Organization), 1988). Among these; 28 species of mammals, 28 species of birds, three species of snakes, 30 species of amphibian and four species of fish are endemic to the country (Ibid).

Kafta Sheraro National Park (KSNP) is a newly established park in Ethiopia found in the Tigray region which has great wildlife resources. Preliminary wildlife inventory of the park indicates that there are 318 African elephants (*Loxodonta africana*), 500 Greater kudu (*Tragelaphus stoeperis*), 50 Red Fronted gazelles (*Gazella rufifrons*), 60 Orbis (*Ourebia ourebia*), 1000 Anubis Baboons (*Papio anubis*), 180 Common Bushbucks (*Tragelaphus imberbis*), 40 Warthog (*Phacochoerus africanus*), 500 Grey duiker (*Sylvicapra grimmia*), 141 Soemmerings (*Gazella soemmeringi*) and 50 Ground squirrel (*Xerus rutilus*) (KSNPCL, 2008).

During the past few decades, the number of elephants in Ethiopia was decimated to an endangered level. At present, the total number of elephants all over the country is approximately 1000 and they have been affected to seek sanctuary in pockets of peripheral areas (Yirmed & Afework, 2000). Currently, nine separate elephant populations are established in Ethiopia (Yirmed, 1997, 2004; Yirmed *et al.*, 2006), one of which is that of the Kafta-Sheraro National Park which seasonally migrates between Ethiopia and Eritrea (Shoshani *et al.*, 2004; Agnew, Hagey & Shoshani, 2005). The number of this elephant is less compared to the other elephant population established in the country (Shoshani & Yirmed, 2008).

Crop damage is perhaps the most prevalent form of conflict across the African continent. When elephants damage food and cash crops, they affect a rural farmer's livelihoods (Dublin, 2007). Elephants in large groups can destroy large areas of crops in a single night. While elephants target staple food crops such as maize (Yirmed, 2008), they also damage cash crops such as cotton and cocoa. Crop damage not only affects a farmer's ability to feed his or her family, but it also reduces cash income and has repercussions for health, nutrition, education and ultimately, development (Dublin, 2007). According to the report of Poole *et al.* (1992); Ngure (1992); Mwangi *et al.* (1993) and Thouless (1994) high incidences of crop-raiding by elephants were reported by farmers living in the fertile agricultural areas which border forests, and

national parks such as Mount Kenya and the Aberdare forest complex.

Now days due to expansion of encroachments on forest land and migration corridors, elephants 'come into conflict with people by destroying the peoples crops and property. Since the time of elephant's to damage is not clearly identified. The aim of the study will is to collect data by various methods in order to report where human and elephant conflicts and to recommend the right measures to protect and minimise the crop damage from elephants.

Objectives:

- 1 To assess community perception on crop damage.
- 2 To identify the exact time when Elephants visit agricultural plots in the area.
- 3 To identify which other wild animal species are involved in damaging crops on farmer's fields.

Materials and methods

Description of the study area

Kafta-Sheraro National Park (KSNP), which was recognized as a Park in 2007 (Letter, No: 13/37/82/611) is situated in the North West Ethiopia between 13°50' and 14°23'N and 36°31' and 37° 29'E. It is bordered by Eritrea in the North and it is presumed to have an estimated total area of 6000 km². KSNP is located 600 km North West of Mekelle and is one of a few areas in the region which are scarcely populated and with relatively better natural vegetation cover compared to other part of the region. It stretches from Ruwassa River in the South to Tekeze River in the North from Welkait wereda in the East. The Park is home to many ungulates, predators and other wild animal species. The presence of some mega wild animals such as the African elephant, Roan antelope and the Cranes (which use the area as a wintering site) and other migratory birds make the Park and its environs a significant conservation site. Other mammals such as Greater kudus and Bohor reedbucks were relatively common to the area. The common crops grown in the area are Sesame, Sorghum and Maize but the most dominant one is Sesame.

Data collection procedure and analysis

In order to get the time, elephant's damage crops and community perception on elephant damage crop; both structured and semi-structured questionnaires were designed. The questions were prepared in such away that

farmers could provide information that was most recent and easy to recall. For this survey a stratified random sampling technique was used. From the study area twelve villages were selected based on the distances from the park. Six villages located near the park and frequently visited by elephants were selected. The other six villages were relatively far from the park. Twenty farmers were picked randomly from each village, giving a total sample size of 240 respondents.

Results from the survey and relevant secondary data was organized, summarized and analysed based on six independent variables such as villages, sex, distance to the park, land type, number of years resided and level of education having different levels on each. Non parametric Chi-square test was used for analysing the relationship and level of significance of the different data categories. The data was presented using tables, and graphs.

Rank analysis

Problem animals and strategies used to scare elephants were ranked using preference ranking methods. In the preference ranking method, index was computed with the principle of weighted average and indexes were ranked using auto ranking with MS Excel 2003. The following formula was used to compute index as employed by Musa, Peters & Ahmed (2006):

$$\text{Index} = \frac{R_n * C_1 + R_{n-1} * C_2 \dots + R_1 * C_n}{\sum R_n * C_1 + R_{n-1} * C_2 \dots + R_1 * C_n}$$

where, R_n = Value given for the least ranked level (example if the least rank is 5th, then $R_n = 5$, $R_{n-1} = 4$, $R_1 = 1$).

C_n = Counts of the least ranked level (in the above example, the count of the 5th rank = C_n , and the count of the 1st rank = C_1).

Results and discussions

Community perceptions on crop damage by elephants

With relation to crop damage by elephants, the respondents were divided in two categories; these whose crop were damaged and these whose crop were not damaged. The degree of crop damage complain differed significantly ($P < 0.0001$) among the twelve sample villages. The greatest complain was perceived from Adebay 90%,

followed by Edris, Wuhdet, Adiaser 25% and Adigoshu 5% (Fig. 1). Aditsetser, Rawyan, Giyts, Mykeyh, Mytemen, Tekeze and Mykuhli had no complained on crop damage. The higher percentage of crop damage is probably due to high presence of forest and water sources that can serve for wild animals compared to the other sample villages.

The number of complainant on crop damage was significantly influenced ($P < 0.0001$) by distance of the villages from the park (Table 1). About 43.7% ($n = 52$) of the respondents from those villages located closer to the park complained the most. This is probably due to the frequent movement of elephants between the park and adjacent villages. Dublin (2007) farming communities which have settled near the boundaries of national parks, for example Tsavo and Amboseli, also experience severe crop-raiding.

The highest percentage (56.7%, $n = 68$) of the respondents closer to the park and 100% ($n = 120$) of respondents far from the park were reported no crop damage in their agricultural fields (Table 1), which might be due to selection of the elephants on natural green forages than crops and the location of agricultural field may be out of elephants reach. This finding is in agreement with Sukumar (1990) who reported that elephants eat crops when there is a decline in the quality or nutritive value of natural forage.

Crop damage was significantly influenced by land type ($P = 0.0187$). About 29.7% the respondents who were landless complained about crop damage, and only 16.8% of the land owners complained about crop damage (Table 1). The high proportion of landless respondents

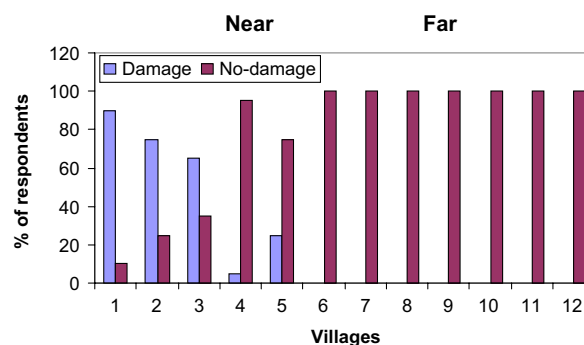


Fig 1 Crop damage complain perceived from Closer and Far villages to the park

Note = 1–6 villages are closer to the park whereas 7–12 are relatively far from the park. (1 = Adebay, 2 = Edris, 3 = Wuhdet, 4 = Adigoshu, 5 = Adiaser, 6 = Aditsetser, 7 = Rawyan, 8 = Giyts, 9 = Mytemen, 10 = Mykeyh, 11 = Tekeze, 12 = Mykuhli)

Table 1 Crop damage complains based on different parameters

Parameters	Level	Damage N (%)	No damage N (%)	Test		
				DF	X ²	P-value
Sex	Male	28 (20)	112 (80)	1	0.54	0.45
	Female	24 (24)	76 (76)			
Land type	Owner	25 (16.8)	124 (83.2)	1	5.4	0.018
	Landless	27 (29.8)	64 (70.3)			
Distance	Near	53 (44)	67 (56)	2	126.8	<.0001
	Far	0 (0)	120 (100)			
Length of stay	0–5	24 (20.9)	91 (79.1)	3	4.74	0.188
	6–10	22 (28.6)	55 (71.4)			
	11–15	5 (12.8)	34 (87.2)			
	>15	1 (11.1)	8 (88.9)			
Level of education	A	9 (19.1)	38 (80.9)	6	6.87	0.3325
	B	27 (20.9)	102 (79.1)			
	C	11 (26.8)	30 (73.2)			
	D	5 (21.7)	18 (78.26)			

Note = A = Illiterate, B = Basic education, C = Primary school D = High school.

complaining about crop damage is probably due to the fact that they pay a higher land rent, and to reduce such rent they seek to rent land located adjacent to the park, which is frequented by elephants.

The time elephants damage crop

The time when elephants visited the arable cropland varied among the villages ($\chi^2 = 2341.18$, $df = 44$, $P < 0.0001$). The highest number 63.3% ($n = 152$) of respondents detected elephant damage during the night time (Fig. 2).

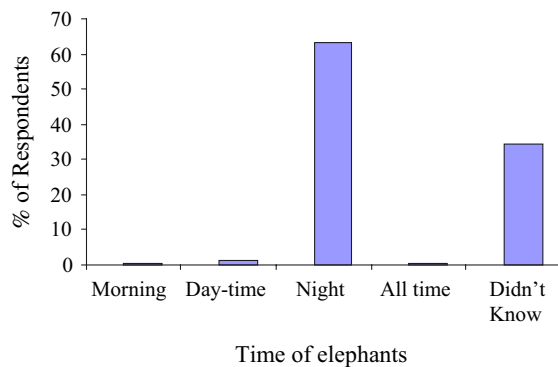


Fig 2 : Time elephants inside agricultural plots as perceived by the respondents

Note: Morning = from 6:00 AM to 10:00 AM, Day-time = 10:00 AM to 5:00 PM, Night = from 6:00 PM to 5:00 AM

When elephants utilise these feeding areas (i.e. farm-lands), they tend to do it only at night (Douglas-Hamilton *et al.* 2001). Elephants can destroy large areas of crops in a single night (Yirmed, 2008). In exceptional cases, damage by elephants during the midday was reported by only a few respondents ($n = 3$, 1.25%). Similarly, Yirmed (2008) observed in Babbile a group of elephants damaging maize field during the midday. About 34.6% ($n = 83$) of the respondents were unable to identify the actual time of damage by elephants to their agricultural fields. This is due to the distance of their village and their information on elephant was low.

Over all, elephants come to the cultivated land only after sunset and left before sunrise (Barnes *et al.*, 2007). This study confirmed that most of crop damage occurred at night. 63.3% of the respondents confirmed that (Fig. 2). From the total 28 incidents (71.4%) happened at night time. Yirmed (2008) observed that 57.4% of maize field raiding took place at night.

Problem pest animals

Respondents from near and far villages claimed that seven wild animal species were the most problematic (Table 2). Elephants, warthogs, porcupines, baboons, monkey, greater kudu and duikers were reported to destroy crops. According to the respondents, the most problematic animals were ranked based on the distance from the KSNP.

Table 2 Problem animals for crop damage ranked by individual respondents in near and far off villages from KSNP

Problem animals	Near		Far	
	N (index)	Rank	N (index)	Rank
Elephants	24 (0.204)	2	9 (0.077)	7
Warthog	25 (0.207)	1	25 (0.211)	1
Baboon	18 (0.147)	4	20 (0.168)	3
Monkey	16 (0.137)	5	18 (0.147)	4
Crested porcupine	12 (0.101)	6	24 (0.198)	2
Greater kudu	25 (0.210)	1	11 (0.091)	6
Duiker	21 (0.181)	3	13 (0.105)	5

Warthogs, greater kudus, elephants, duikers, Anubis baboons, vervet monkeys, and porcupines were claimed to be crop raiders. The first species was referred to as a typical pests in near and far off villages (Table 2). Greater kudu was also ranked first in near villages, whereas the porcupine was ranked second in far off villages. The second ranked pest animal in near villages and seventh rank from far off villages were elephants. This indicated the level of damage in elephants is lower compared to warthog and greater kudus.

Strategies used to scare elephants

The people living near and far from KSNP used a variety of methods to protect their crops and to discourage elephants from entering their fields. These included, patrolling around their plots and chasing out interfering animals. However, protecting against elephants was much tougher than protecting against other wild animals. Mostly, young and adult males do the protection in the area.

Farmers sometimes work collaboratively to chase away remains from their neighbours' fields. This is a system of

Table 3 Traditional elephant avoidance and crop protection methods ranked by respondents in near and Far villages to KSNP

Traditional method	Near		Far	
	N (index)	Rank	N (index)	Rank
Fire ('chibo')	31 (0.259)	1	24 (0.202)	3
Rooster sound	26 (0.215)	3	16 (0.133)	4
Bullet sound	21 (0.176)	4	12 (0.103)	5
Banging noisy (tin can)	29 (0.238)	2	36 (0.299)	1
Throwing stones	13 (0.109)	5	32 (0.261)	2

(Rank 1 = the most used method, 7 = Least used).

minimizing the fear of elephants. During the night, most farmers guarded their crops from watchtowers, constructed in tall trees either at the edge of or inside their farms. They are equipped with powerful torches, roosters, and noisy tins. It was very common for farmers to light fires and keep them burning late into the night at the entrances of farms, specifically at the entrances for elephants. A method used by near and far off villages as ranked in Table 3. Of the methods used in villages near KSNP, (n = 31, 0.259 index) of the respondents ranked Fire/'Chibo' as the most effective method. Banging noisy tine was the second preferred method (n = 29, 0.238 index) and was preferred first by the respondents from far off villages (Table 3). Throwing stones was not very helpful in scaring the elephants easily, though this was the best for other crop pests and was the second preferred method by respondents of far off villages from KSNP.

Conclusion and recommendation

Conclusion

Crop damage has been noted to occur at night. Elephants only rank second among other pests in areas near to KSNP, but farther away their effect is negligible. It is the warthog that tops the list both near and far away from the park. Complaints are mostly registered by farmers having near the park especially the landless ones who have rented land next to the forests. Traditional methods of crop protection are common among the peoples a task they perform collaboratively.

Recommendation

Development intervention. The study concludes that bringing the community to the discussion on elephant crop damage, increasing the time of keeping vigil during the night; improving the extension services and training in awareness creation.

Research intervention. Basic and applied research is very instrumental in ensuring proper conservation and sustainable use of biological resources in the country.

Further studies on loss in financial values should undertake to know the annual average lost and help to measure the degree of resentments of the local people who have the damage.

References

- AGNEW, D.W., HAGEY, L. & SHOSHANI, J. (2005) The elephants of Zoba Gash Barka, Eritrea: Part 4. Cholelithiasis in a Wild African Elephant (*Loxodontaafricana*). *J. Zoo Wildl. Med.* **36**, 677–683.
- BARNES, R.F.W., DUBIURE, U.F., DANQUAH, E., BOAFO, Y., NANDJUI, A., HEMA, E.M. & MANFORD, M. (2007) Crop-raiding elephants and the moon. *Afr. J. Ecol.* **45**, 112–115.
- DOUGLAS-HAMILTON, I., BARNES, R.F.W., SHOSHANI, H., WILLIAMS, A.C. & JOHNSINGH, A.J.T. (2001) *The New Encyclopedia of Mammals (Elephants)*, Oxford University, Oxford, pp. 436–447.
- DUBLIN, H.T. (2007) African Elephant Specialist Group report/ Rapport du Groupe Specialiste des Elephants d'Afrique [Chair/ President]. *Pachyderm*, (42), p1–12. Location: <http://www.african-elephant.org/pachy/pachy42.html>.
- EWCO (Ethiopian Wildlife Conservation Organization). (1988) Ethiopian Conservation Plan. Addis Abeba, Ethiopia.
- KSNPCL. (2008) Censuses of Wildlife in Kafta-Sheraro National Park. Office of Humera Agriculture, Humera, Tigray. Unpublished.
- MUSA L.M.-A., PETERS K.J. & AHMED M.-K.A. (2006) On farm characterization of Butana and Kenana cattle breed production systems in Sudan. *Livestock Res. Rural Dev.* **18**, 56–61.
- MWANGI, E., OMONDO, P., KIRU, W. & LOTOROH, M. (1993) A survey of the Loroko Forest Reserve elephant population. Unpublished report to the Kenya Wildlife Service.
- NGURE, N. (1992) History and present status of human-elephant conflict in the Mwatate-Bura area, Kenya. Unpublished MSc. Thesis, University of Nairobi.
- POOLE, J.H., AGGARWAL, N., SINANGE, R., NGANGA, S., BROTEN, M. & DOUGLAS-HAMILTON, I. (1992) The status of Kenya's elephants. KWS/DRSRS Report:KWS Elephant Programme.
- SHOSHANI, J. & DEMEKE, Y. (2008) Report on the Kafta-Sheraro National Park. In memorial to Professor Jeheskel Shoshani. Tigray Region, Ethiopia.
- SHOSHANI, J., HAGOS Y., YACOB Y., GHEBREHIWET M. & KEBROM E. (2004) The elephants (*Loxodontaafricana*) of Zoba Gash Barka, Eritrea: Part 2. Numbers and distribution, ecology and behaviour, and fauna and flora in their ecosystem. *Pachyderm* **36**, 52–68.
- SUKUMAR, R. (1990) Ecology of the Asian elephant in southern India. II. FEEDING habits and crop raiding patterns. *J. Trop. Ecol.* **6**, 33–53.
- THOULESS, C. (1994) Conflict between humans and elephants on private land in northern Kenya. *Oryx* **28**, 119–127.
- YIRMED, D. (1997) The status of the African elephant (*Loxodontaafricana*) in Ethiopia. *Walia* **18**, 15–27.
- YIRMED, D. (2004) Elephants in Ethiopia (Amharic Version). Berhanena Selam Printing Enterprise, Addis Ababa, pp. 75.
- YIRMED, D. (2008) The Ecology and Conservation of the Relic Elephant Population in the Horn of Africa. Four years report. Addis Abeba.
- YIRMED, D. & AFEWORK, B. (2000) Study on the elephants of Mago National Park, Ethiopia. *Pachyderm*, **28**, 32–43.
- YIRMED, D., RENFREE, M.B., SHORT, R. & BARNES, R.F.W. (2006) The undisclosed facts about the relic elephant population in the horn of Africa. Proceeding: Biological Society of Ethiopia, 16th annual conference and workshop. pp. 13.

(Manuscript accepted 28 May 2013)

doi: 10.1111/aje.12094