Crop damage done by elephants in Malebo Region, Democratic Republic of Congo

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Abstract

Data on crop damage and crop raiding were collected from Malebo Region to document patterns of human–elephant conflict. Using interviews, field visits and market surveys, we found that raided fields had a mean size of 320 m^2 (75–600 m^2), 16.6% of which were intersected by permanent elephant trails leading to permanent water points. The most damaged plant species was manioc (damage index $I = 60.1\%$). The mean number of monthly crop raiding incidents ranged between 0 (March and October) and 3 (July and August). Tree species eaten by elephants represented 23% of all trees surrounding fields. Mean annual financial loss caused by crop raiding in individual fields was USD 400 (USD 97–1,005). We argue that a broad community conservation scheme is essential. It must redraw the agricultural map of the region to account for habitat needs of elephants and other wildlife species to solve the human–elephant conflict. A condition for the success of such a programme is that communities are shown that elephants are part of their natural resources.

Additional key words: human–elephant conflict, key plant species, economic loss, community conservation

Résumé

Les données sur les dégâts et la maraude des cultures ont été recueillies dans la région de Malebo pour documenter des modèles du conflit homme–éléphant. Grâce à des interviews, des visites de terrain et des études de marché, il est apparu que les champs maraudés avaient une taille moyenne de 320 m^2 (75–600 m^2): 16,6 % des champs ont été recoupés par des pistes permanentes d'éléphants menant à des points d'eau permanents. L'espèce la plus endommagée était le manioc ($I = 60{,}1$ %). Les incidents mensuels de maraude des cultures variaient entre 0 (mars et octobre) et 3 (juillet et août). Les espèces d'arbres consommées par les éléphants représentaient 23% de tous les arbres des champs environnants. La perte financière annuelle causée par la maraude des cultures dans les différents champs était évaluée à 400 USD (97 à 1.005 USD). Nous affirmons qu'un programme plus large de conservation communautaire est essentiel et qu'il doit redessiner la carte agricole de la région pour tenir compte des besoins de l'habitat des éléphants et d'autres espèces sauvages pour résoudre le conflit homme-éléphant. Une condition pour le succès d'un tel programme est qu'on montre aux communautés que les éléphants font partie de leurs ressources naturelles.

Mots clés supplémentaires: conflit homme–éléphant, espèces de plante clés, perte économique, conservation communautaire

Introduction

Few data have been collected on human–elephant conflict (HEC) in the western Democratic Republic of Congo (DRC), although it is one of the most vexing problems in working to conserve elephants across their range (Dublin 1996; Kangwana 1995; Ekobo 1995; Parker and Osborn 2001). Existing records across elephant ranges hypothesize several HEC determinants. First, elephants are hypothesized to raid crops seasonally and tend to do so more frequently on farms with stands of trees with fruits that both elephants and people eat (Parker and Osborn 2001; Kinzonzi 2004). Second, it is hypothesized that human expansion pushes people to use marginal habitats inside intact forest blocks, thereby encroaching on elephant habitat. Indeed, cultivation inside protected areas harbouring elephants increases the risk of crop-raiding events (Hoare 1999). Third, elephants are thought to be attracted by both the quantities and the taste of cultivated staples (Wasilwa 2003). Finally, other studies indicate that habitat fragmentation may lead to HEC as humans often place their fields along elephant migratory routes (Hoare 1998, 2000).

None of these hypotheses has been tested in the western part of the DRC, particularly in the Lake Tumba Region. However, local communities indicate that HEC is a common problem; it is the reason why local farmers have resented conservation efforts over the last two decades. Reasons for this lack of information are numerous, the most prominent being that elephants had been thought to be extinct locally; no field surveys documented their abundant presence in this region (Inogwabini et al. 2011). HEC became a topic of concern for elephant conservation in many places across Africa in the 1980s and 1990s because HEC has immediate negative effects on both people and elephants; it frequently preceded a decline in African elephant numbers (Kangwana 1995). Lack of information meant that elephant populations in the Lake Tumba Region were in conflict with villagers, but this conflict is undocumented. It raised poaching levels, there was little effort in conservation, and the international conservation community was uninformed. This paper addresses this gap in knowledge. It has been designed with the objective of preliminarily documenting HEC patterns in the Malebo Region, Lake Tumba landscape. The study also provides the first indications of the economic cost of HEC to local communities.

Materials and methods

Study site

The Malebo Region (S: 02°00′00″–2°45′00″; E: 16°10′00″–17°12′00″; Figure 1) is in the Lake Tumba landscape, which straddles the provinces of Bandundu and Equateur, western DRC (Inogwabini et al. 2007a,b). At its southern edge, the region is located on the Bateke plateau and descends toward the Congo central basin, known as the Cuvette Centrale (Inogwabini et al.

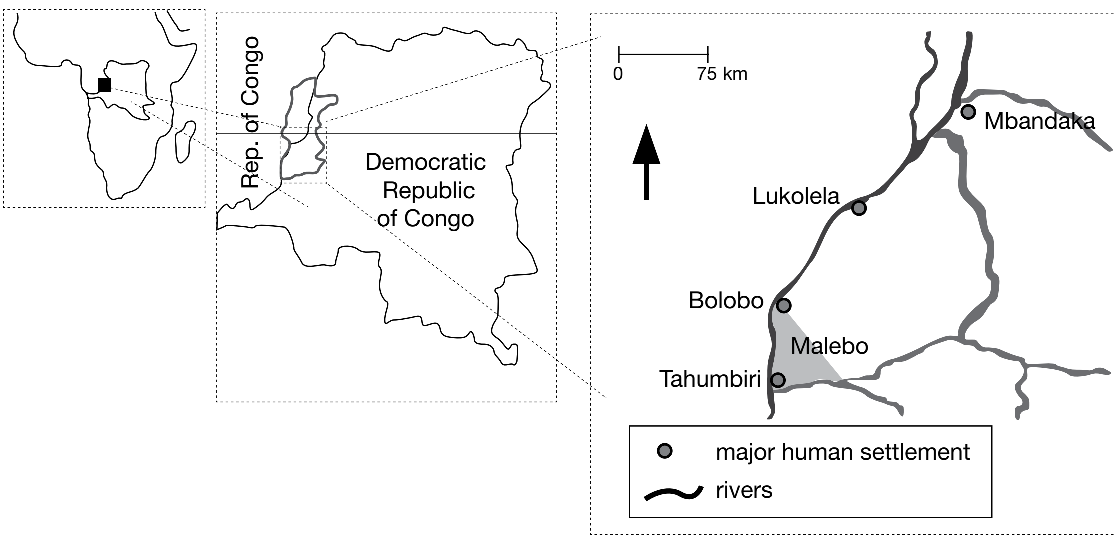

Figure 1. Malebo Region, Democratic Republic of Congo.

2006). Malebo is a forest–savanna mosaic ecosystem dividing the northern swampy forests and the southern savannas. Swampy forests in most of the territory of Lukolela are essentially composed of mixed mature forest with open understorey whose main emergent trees are *Uapaca guineensis*, *U. heudelotii* and *Gubortia demeusii* (Inogwabini et al. 2006). The region is also characterized by flood episodes during which water covers ca. 65% of the forest. Some portions of this region are within the Tumba–Lediima Natural Reserve. Forest galleries in the forest–savanna mosaic comprise a terra firma mixed mature forest with species such as *Gilbertiodendron dewevrei* and *Entandrophragma* sp., and 45–50% understorey of Marantaceae species such as *Haumania liebrechtsiana* and *Megaphrynium macrostachii*. Some of these galleries have been logged in the past 25–30 years to extract wenge (*Millettia laurentii*), a highly priced hard blackwood. The savannas are woody, dominated by *Hymenocardia acida* and *Annona senegalensis*. The southern limit of the region for this study is ca. 45 km from the southern limit of the Tumba–Lediima Natural Reserve. Due to increased poverty and poor law enforcement that began in the early 1990s, the two million people residing in the Lake Tumba landscape depend on hunting, including elephants, as a permanent commercial activity (Colom et al. 2006). Modern weapons and ammunition are now prevalent all over the region and they fuel hunting activities.

Data collection and analysis

Data collection consisted of 1) interviews with local populations on the occurrence of field raiding by elephants in the vicinities of their villages, and 2) visits to fields to collect evidence of elephants raiding crops. Interviews consisted of a questionnaire on the species of crops grown in the villages, how often elephants visited fields, and which crop species elephants raided most frequently. Interviews were conducted in a stepwise approach. First, a list of villages was drawn up randomly and the questionnaire administered. A second list of 12 fields was established based on the analysis of the first list. It consisted of randomly selected villages that had reported HEC, regardless of its intensity. Twelve fields in these selected villages were randomly chosen for visits. Field sizes were measured using a 50-m tape measure. Elephant signs encountered within and near the field and damages were recorded. Crop-damage data consisted of species eaten or trampled on, counts of plants eaten or trampled and parts eaten.

We documented the environment immediately adjacent to the field by cutting four short 20-m line transects from the field's edge. This was done for six randomly pre-selected fields. We counted key fruit plant species along the transects. Key fruit plant species were defined as those that elephants of Malebo Region ate most frequently (Inogwabini et al. 2011). Along these transects, all trees having a diameter at breast height (dbh) of ≥ 10 cm were counted within a strip of 20 m. To evaluate the economic cost of elephant crop raiding, we conducted a local market study and recorded individual prices of each item consumed.

We calculated the mean monthly crop-raiding incidents. A consumption or damage index was calculated as the ratio $I = \Sigma S_i/12\Sigma f$, where S_i represents the count of each item eaten or trampled on in all fields, 12 represents the 12 months of the calendar year, and f the number of randomly selected and monitored fields (n = 12). A distribution index of key plant species was calculated as the percentage of how many of these species were recorded out of the total number of trees counted from 24 random transects laid around six random fields. The economic cost of crop raiding or crop damage by elephants presumed that all the production had a market value even though some portions would not end up at the market. This cost equalled the sum of all staple plants in the field multiplied by the market price. For staples sold in subsets, as are manioc roots, which are sold in 50-kg bags, we calculated the price based on how many 50-kg bags are ideally produced from one 100-m^2 field.

Results

The mean size of fields raided by elephants was 710 m^2 (range = 75–5,000 m^2). However, if we take out the outlier of 5,000 m^2, a typical field in the region had a mean size of 320 m^2 (range 75–600 m^2). Of the total randomly selected fields, 16.6% were intersected by permanent elephant trails: all trails led to permanent water points. Elephants raided nine food crops (Figures 2 and 3): the most damaged was manioc (I = 60.1%; Figure 2); next was bananas (I = 11.4%; Figure 2). Mean monthly crop raiding or crop damaging ranged between 0 and 3 events. The highest means were in July and August (Figure 3). Of the 27 tree species (dbh ≥ 10 cm) recorded along transects, 6 were key plant species (Figure 4). These trees represented a distribution index of 0.23, indicating that 23 out of 100 trees in the forest immediately adjacent to fields were key plant species. Mean cumulated annual financial loss that local communities incurred was estimated at USD 744.65 per field (range = USD 97–5,200). When the outlier of USD 5,200 is eliminated from the range, the mean decreases to USD 339.61 (range = USD 97–1,005).

Discussion

The nine food crops elephants raided (Figures 2 and 3) were the most important agricultural produce of the region. Manioc (I = 60.1%), the most important food item, constitutes > 65% of the commercialized products of the region. The elephants did not eat manioc but trampled it. Bananas (I = 11.4%), an equally important commercial product, have more economic value than manioc and other products. The elephants ate bananas and damaged the manioc in their search for bananas.

The highest mean monthly crop-raiding incidents were observed in July and August (Figure 3); this high coincides with the long dry season. Parker and Osborn (2001) also reported higher frequencies of crop damage in dry seasons in Zimbabwe. Dry seasons coincide with a period when vegetables and maize mature in Zimbabwe; this was not the case in Malebo. The first potential explanation for this pattern in Malebo is that during the dry season, water retreats in most rivers and permanent water points in the region. That the most damaged fields were located along permanent elephant trails leading to permanent water points implies that elephants searching for water come across fields with staples and damage them. Permanent water points determined elephant movements in different ecological conditions across Africa (Vanleeuwe and Gautier-Hion 1998; Tchamba 1998; Wasilwa 2003). Parker and Osborn (2001) also found that most crop-raiding incidents occurred along major rivers, meaning that elephants move to zones with sufficient water sources in the dry season. The second possible explanation is that fruits are relatively scarce in July and August in the Malebo forests (Inogwabini and Matungila 2009; Inogwabini 2010). Elephants might be forced to search for alternative sources of food.

The distribution index of key plant species was not high. The low index reflects the rarity of these trees in the region, which leads elephants to search for them during fruiting seasons. Among key plant species, *Annodium manii* and *Irvingia* sp. were of particular

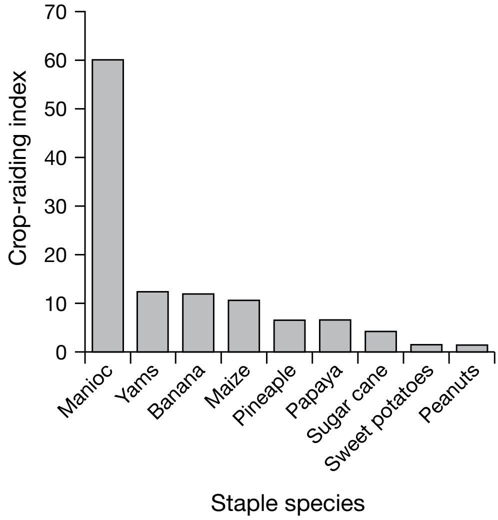

Figure 2. Raided staple species and crop-raiding index in Malebo Region.

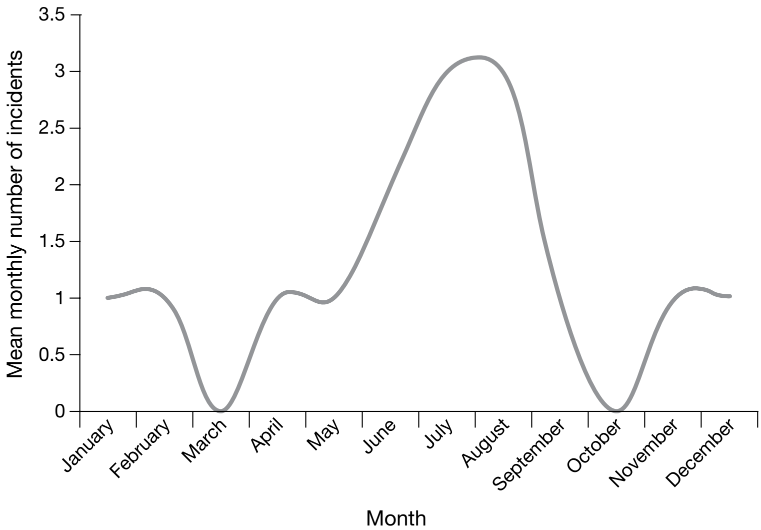

Figure 3. Mean monthly crop-raiding or crop-damaging incidents in Malebo Region.

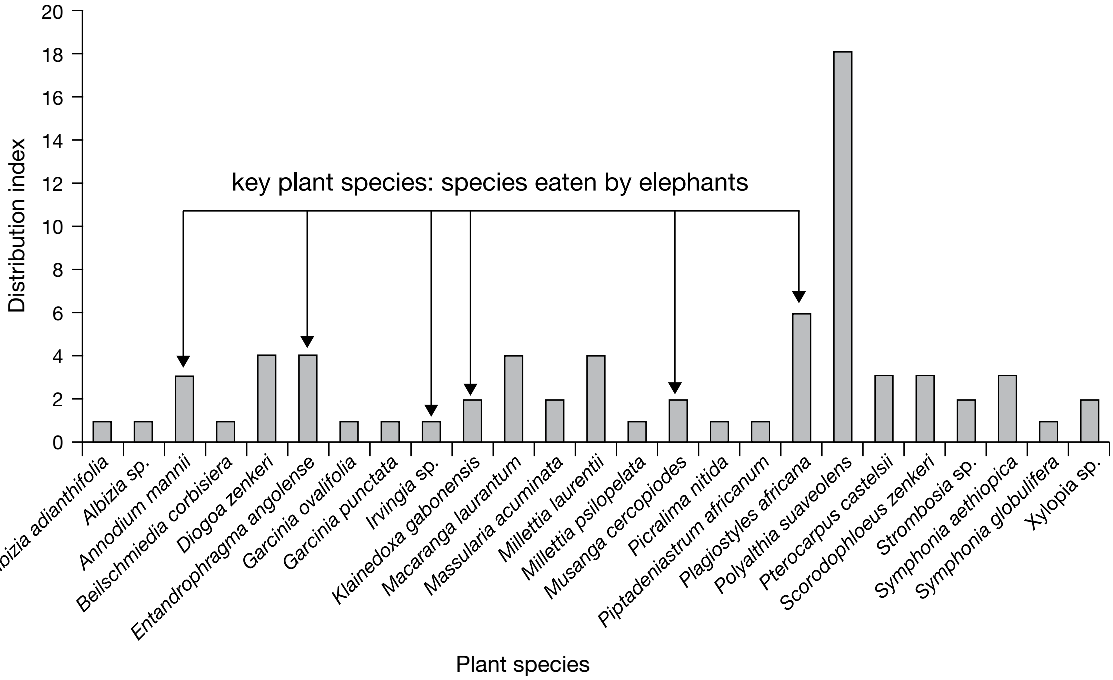

Figure 4. Tree species present around fields and key plant species that elephants consume.

interest. Both species grow naturally and, as in other forest sites across Central Africa (Dowsett-Lemaire 1995a,b; Maisels 1996; Blake 2002), both humans and elephants eat their fruits. The presence of elephant signs around fields with these species indicates that elephants were searching for them. Elephants raided more frequently farms with stands of the same tree species in other sites in Odzala-Kokoua National Park (Kinzonzi 2004). Key plant species such as *Ziziphus mauritiana* and *Sacoglottis gabonensis* also drove seasonal crop raiding in Zimbabwe (Parker and Osborn 2001) and Gabon (White 1994; Lahm 1996).

The estimated mean financial cost that farmers incur is significant. Crop raiding in communal semi-industrial and commercial fields increased the mean financial loss. Even when the increase introduced by the outlier was taken out, losing ca. USD 100 still had a significant impact in a country where the mean GDP is USD 130 per person per year (Eba'a Ayi et al. 2008). Extrapolated over the entire area of Malebo where 1,500 fields were recorded and ~15% of these fields had been raided by elephants, mean income loss equaled ca. USD 76,500 annually. This is an enormous loss for local communities. Similar findings were reported from other sites across Africa (Tchamba 1995, 1996; Kotchikpa 1997; N'sosso 1997; Bhima 1998; Sam and Barnes 1998).

Elephant conservation schemes in the region should factor the local economics in their planning and incorporate community conservation aspects in their programmes. Through such a programme, people would be brought to understand the ecological, cultural and material benefits elephants provide to local communities. Such a programme should include knowledge of how to avoid crop-raiding incidents, improve agricultural practices and relocate fields to areas where there are fewer signs of elephants.

Barnes (1999) warned that in their range HEC was second only to ivory trade as a problem in working to conserve elephants. Therefore, conservation schemes have to put in place mechanisms to convince local communities to save their remaining elephant populations. The community conservation we argue for here should focus on root causes of crop raiding across communities. It would be prudent to include redesigning the agricultural map of the region, and improving local livelihoods and the overall sustainable development. This whole process will work only if local communities become better organized, democratic and an integral part of the decision-making process (Inogwabini 2007). The proposition echoes the idea that conservation of elephants in this region, as in other parts of Africa, will work only when people are convinced that elephants are part of their natural resources, not the sole property of conservation organizations.

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