

Trialling a new scent-based repellent to mitigate elephant crop-raiding around Murchison Falls National Park, Uganda

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Introduction

Crop raiding by African elephants (*Loxodonta africana*), like elsewhere in eastern and southern Africa, is a major challenge to communities bordering Murchison Falls Protected Area (MFPA). MFPA comprises Murchison Falls National Park and Bugungu and Karuma wildlife reserves. The Karuma–Arua national highway is the only boundary that separates the protected area's northern perimeter from the adjacent human community; there are no fences around MFPA. Internally displaced persons (IDPs), who fled during the civil war instigated by the Lord's Resistance Army (LRA), began to resettle the area following the defeat of the LRA in 2005. The returning settlers introduced agriculture into an area that had previously been sparsely cultivated and remained largely in its natural state until 2005. Communities of subsistence farmers now inhabit the land right up to the edge of the highway opposite the north side of MFPA. The presence of crops encourages the elephants to cross the busy Kampala–Arua highway. The accident count is increasing and there have been several collisions between vehicles and elephants on this stretch of road (New Monitor 2019). Before the de-gazetting of the Aswa-Lolim wildlife reserve in 1972 under the Idi Amin regime (Baker et al. 2013), elephants freely roamed this land, which in part formed an important migratory corridor up to what is now South Sudan. The landscape has become fragmented into smallholder farms, pine plantations, tracts of deforested grassland, and remnants of scrub bush, grassland and woodland, providing the perfect environment for crop raiding elephants.

As in most African elephant range states where human population is rapidly increasing and demand for land is rising, elephants are coming into daily conflict with humans. This is particularly the situation around the MFPA during

the crop harvesting seasons and when the *Borassus* palms have finished fruiting. With the patchwork landscape and numerous bushy “staging posts”, elephants are able to successfully crop raid usually at night and mostly unnoticed. As a consequence, tensions run high between elephants, the Uganda Wildlife Authority (UWA), and the community. The Acholi paramount chief, under whose chieftdom most residents fall, announced in December 2016 that any elephant straying into a community area should be killed (Daily Monitor 2016). Despite this, there is a strong desire from the community to coexist peacefully with their “ancestors”—the elephant is the totem, or tribal mascot, of the Acholi.

Developing a new elephant deterrent

As a case in point, the “smelly elephant repellent” was invented locally in 2013 by a group of students for an innovation competition, where they had been tasked with finding a solution to a local problem. The repellent was further refined by UWA, who added extra ingredients particularly disliked by elephants. The concoction included locally available and low-cost chilli, garlic, ginger, neem leaves, eggs, and cow or elephant dung. During the process, the fresh ingredients are pounded in a pestle and mortar and then boiled together, before adding raw eggs and cattle dung. The solution is sieved to remove the solids, stored in barrels, and fermented for a minimum of two-three weeks to produce a pungent-smelling semi-liquid. The longer the repellent ferments, the smellier it becomes, (Fig. 1; see colour plates: page vi). The liquid repellent can then be sprayed directly on crops, or hung around fields in perforated containers interspersed between on sisal ropes between posts, making a rudimentary fence line, (Fig. 2; see colour plates: page vi). The method can be deployed during

the weeks approaching harvest, or at any time when crop damage from elephants is a hazard. The solid residue can be made into chilli bricks and burnt, or used as an organic fertiliser.

At current prices (February 2019), if all items are bought from the market (i.e. not contributed by farmers for free) the cost of ingredients and production totals USD25 for 20 litres of repellent solution. By using the fence-line method of application, this quantity of repellent is sufficient to protect one acre (0.4 hectares). Spraying requires slightly more—approximately 40 litres per acre—and can require re-application of the repellent during the rainy season, similar to the chilli fence method. The cost of this new, novel technique of protecting crops is significantly cheaper than using a solely chilli mix, numerous beehives or electric fencing. It is also low maintenance, with one application per fence-line sufficient to protect crops for a whole season, providing that rain is prevented from diluting the mixture in the bottles.

Conducting trials

Initial trials using this scent-based repellent as a crop-raiding mitigation measure took place during crop ripening in late 2017, after community members suggested that it could provide a cheaper and more contextually appropriate method than chilli or beehive fencing. As far as the authors are aware, this was the first time that such a repellent was trialled on either wild or captive elephants. The first round of trials produced promising results, and positive anecdotal evidence, such as the following testimonies by farmers.

“Most of [the elephants] when they enter the community areas pass here. As soon as we (moved) here, we started planting crops like tomatoes, eggplant and others. At the start it was not easy, but when we began using the repellent, the elephants started going away. So I could say that the repellent is working. [...] the elephants can smell the repellent from a distance. As you can see we have put the gate there. The last time they came, almost seven of them, they just stood in a line, we didn't need to do anything, we didn't shout, we didn't make any noise, and they just turned away.”
- James, a farmer in Latoro village, Nwoya District.

“After I got the repellent [the elephants] came. You'll even see where they passed from [by their footprints] in a nearby rice field when they were here. So as they were coming I ran with the repellent in a jerry can and started spreading with a grass broomstick. Upon smelling the repellent I heard the sound that they made—they cried—and they started turning back. And they never returned to my fields. The next day I waited for them, but they have not yet come back.” - Okello, retired police officer and farmer in Latoro village.

In mid-2018, we set up a further round of trials, this time with the intention of collecting quantitative data to back up anecdotal evidence. Working with a sample of 30 smallholder farmers (eight female, 22 male) from Latoro village in Nwoya District, farms were GPS mapped, and base line data collected to assess demographics, socio-economic status, harvest yields, and attitudes towards elephants and conservation. Data on crop raiding incidents had been collected from 2016 onwards, and thus provided us with a base line from which to test impact. Ten camera traps were set up around some of the farms with the aim of capturing footage of how elephants behaved when exposed to the repellent. The repellent was brewed and applied across one acre of each farmer's crops, and crop-raiding data collected on an on-going basis (Fig. 3; see colour plates: page vi).

Preliminary findings

While our trials are still underway and data are being analysed, we have been able to draw some preliminary conclusions from the first season of trials. Overall, crop-raiding incidents appear to have increased in number in the area since 2016. No doubt this can be attributed in part to the increase in effort in recording incidents since we began working in the area, however, triangulation with UWA data from 2015, and from interviews with farmers, indicates that crop raiding has become more widespread over the last eight years, and has increased significantly again during the last two years. In our trial area in particular, all recently settled farmers experienced similar numbers of crop raids before the use of the repellent, and there were no areas in Latoro village that were unaffected by crop raiding. While little research exists identifying reasons for elephant crop raiding here, hypotheses include expansion of human settlements and widespread charcoal production around MFNP (Uganda

Correspondent 2012).

Following the application of the repellent, farmers who were using the repellent experienced fewer crop raids than those not utilising the repellent. In fact, no farmer from our test group who was utilising the repellent correctly—that is distributing it using a rudimentary but nevertheless effective fence or by spraying—experienced any further crop raid by elephants. People farming in the zone around the farmers using repellent also experienced fewer raids than previously, suggesting that elephants are staying away from the area because of their aversion to the repellent. Of our 30 trial farmers, only eight suffered no elephant damage to their crops in the season before application of the repellent. Following repellent use, 24 of our 30 trial farmers did not suffer crop damage by elephants. This was due to negligence in not using the repellent as demonstrated, or even forgetting to use it at all, for example leaving it stored in a jerry can inside a house when the elephants approached.

The “harvest” data shows that farmers who used the repellent increased their yields compared with the previous season, although this must be caveated by the fact that two different seasons—the early (July) and the late (December) harvest season—have been compared. Camera trap footage shows elephants turning away from farms where the repellent had been used, and farmer interviews corroborate this. The “attitudes” data shows significantly different attitudes towards conservation between farmers using the repellent with that of a control group.

Looking forward

Understanding the behaviour of elephants when they come into contact with the scent of the repellent would be useful in determining how elephants use their sense of smell in their decision-making process. Thus, this understanding will help guide the long-term sustainability of using this type of mitigation method; we encourage those interested in studying the way elephants use scent, to contact the authors. We are hoping that this appropriate technology will have wider application, and again further research is desirable.

Furthermore, once proof of concept is firmly

established, the intention is to place emphasis on the sustainability of the repellent value chain, with farmers producing all the ingredients themselves and manufacturing and marketing repellent without external support.

While initial findings are overwhelmingly positive, further trials are required in order to compare like with like in terms of harvest yields. Preparations are currently underway for a second season of trials in Latoro. Plans are also being developed for a second trial site in Uganda and another in Tsavo East, Kenya. By the end of the year we hope to have secured additional partners in other range states who are interested in using the repellent and contributing to the data.

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