Can Bees Deter Elephants from Crop-Raiding in an Area of High Human-Elephant Conflict in Sri Lanka?

Kylie M. Butler [1]

The following provides a literary overview on the topical and contentious issue of human-elephant conflict, focusing primarily on the situation in Sri Lanka, and also provides a brief overview of the Elephants and Bees project in Sri Lanka, outlining what we hope will be a successful endeavour helping farmers and elephants co-exist more peacefully.

Human-elephant conflict (HEC) and mitigation

Conflict between humans and wildlife is one of the most important conservation issues worldwide, often resulting in substantial economic and social costs, and death or injury to both humans and wildlife (Harisch et al. 2013; Dickman 2010; Hill 2004; Sitati et al. 2003; Mishra 1997). Human-wildlife conflict (HWC) encompasses a wide range of species from rodents to large mammals (Graham et al. 2010) however species of larger size which present a higher level of perceived physical danger - or risk - to humans garner the most concern from communities. A prime example of such human-wildlife conflict is the crop-raiding behaviour of Asian (*Elephas maximus*) and African (*Loxodonta africana*) elephants, with such conflict recognised as a major elephant conservation challenge (Graham et al. 2010; Perera 2009; Sitati and Walpole 2006).

Human-elephant conflict (HEC) occurs when the actions of elephants negatively impact human wellbeing, or when the actions of humans are detrimental to the survival of elephants (Madden 2004). Primary drivers of HEC are habitat loss and fragmentation, and disruption of elephant movement corridors, mainly due to deforestation, agricultural expansion, and human encroachment into elephant inhabited areas (Haturusinghe and Weerakoon 2012; Fernando et al. 2011; Santiapillai and Read 2010; Campos-Arceiz et al. 2009). As human populations continue to rise, interactions between humans and elephants are inevitably increasing, which further exacerbates HEC (Fernando et al. 2011; 2005). Unsurprisingly, HEC fuels negative attitudes of people towards co-existing with elephants and hinders conservation efforts (Fernando et al. 2011; 2005; Campos-Arceiz et al. 2009).

In Sri Lanka, the damage caused by elephants in even a single crop-raiding event, coupled with the danger they present to humans, has resulted in a high focus on HEC and a low tolerance for co-existence with elephants (Fernando et al. 2011; Campos-Arceiz et al. 2009). With an estimated 5,879 elephants, Sri Lanka is home to the highest density of elephants in Asia (Fernando et al. 2011)

---

[1] University of Newcastle, Australia

and holds more than 10% of the global wild Asian elephant population (Perera 2009; Leimgruber et al. 2003). It is estimated that more than 200 elephant (Fernando et al. 2011) and 50 human (Campos-Arceiz et al. 2009; Perera 2009) deaths occur annually in Sri Lanka as a direct consequence of HEC, and HEC is recognised as the principal threat to the survival of Sri Lankan wild elephants (Fernando et al. 2005).

Methods commonly implemented at a government level to deter elephants from crop-raiding include confinement of elephants into protected areas through elephant drives, translocation of problem individuals, and large scale electric fencing. These methods are expensive and difficult to maintain and often do not take into account the behaviour and movement patterns of elephants (Fernando et al. 2010; Perera 2009). Common methods employed by farmers include creating 'elephant barriers' around an area to be protected, such as planting a buffer zone of unpalatable crops or digging a trench. Hanging tin cans from wire, guarding crops from a tree hut at night, making loud noises, shining bright flashlights, and throwing firecrackers or fire sticks (sticks with an oil soaked rag set alight at one end) in the direction of the elephants, are other methods commonly utilised (Haturusinghe and Weerakoon 2012; Fernando et al. 2011; Hedges and Gunaryadi 2009; Perera 2009). Over time elephants habituate to, or finds means of overcoming, most of these methods (Fernando et al. 2011; Osborn and Parker 2003). As HEC continues, farmers are using increasingly harmful methods to deter elephants. These include setting trap guns, live electric wires, putting poison in crops, and using shot guns or explosives to injure or kill elephants (Haturusinghe and Weerakoon 2012). As humans increase their aggressiveness towards elephants, elephants appear to be adjusting their behaviour by reacting more aggressively towards humans. Thus, a spiral of HEC escalation ensues (Fernando et al. 2011; Perera 2009).

In the last decade, a shift towards community-based mitigation encouraging farmers to use non-violent methods has emerged (Hedges and Guaryadi 2009; Graham and Ochieng 2008; Sitati and Walpole 2006). Ideally, community-based deterrents are relatively cheap, requiring little time to establish and maintain, and encourage ownership and responsibility by the farmer (King et al. 2011; 2009). Effectiveness of community-based deterrents depend not only the techniques ability to deter elephants but on how feasible it is for the farmers to implement and maintain, and their willingness to adopt the technique (King et al. 2011; 2009). Successful examples include planting orange trees around crops (Sri Lanka: SLWCS 2011), chilli fencing (India: Baishya et al. 2012; Sumatra: Hedges and Gunaryadi 2009), and beehive fencing (Kenya: King et al. 2011; 2009).

Beehive fencing as a human-elephant conflict mitigation tool

In Kenya, researchers discovered that African elephants avoid resting under trees containing bees (Vollrath and Douglas-Hamilton 2002), retreat from bee sounds and also respond with head-shaking and dusting, behaviours which may reduce the risk of bee stings (King et al. 2007). When retreating from the sounds of bees, elephants often produce rumble vocalisations which may alert nearby elephants to the perceived threat of bees (King et al. 2010). Based on the concept that crop-raiding could be reduced by capitalising on the elephant's bee-avoidance behaviour, the 'beehive fence' was designed (King et al. 2011; 2009). A beehive fence is a series of beehives hung from posts,

and connected to one another by wire linking one beehive to the next, with beehives approximately 8 m apart. Elephants attempting to enter the area inside the beehive fence, will hit the connecting wire between beehives, causing the attached beehives on either side to swing and, if occupied, disturb the bees causing them to exit the hive and swarm at the elephants (King et al. 2011).

fig.1 A beehive fence at Mr. Dharmadasa's house in
Central Sri Lanka (c) Kylie Butler.

Today in Africa, beehive fencing is an effective, relatively inexpensive, and low-maintenance elephant deterrent, from which farmers are deriving multiple benefits as money generated from honey and bee products can recoup initial set-up costs and provide an additional income source (King et al. 2011; 2010; 2009).

With the exception of two anecdotal newspaper articles from India reporting some success in using bees to deter elephants (Dutta 2013; Manoj 2012) beehive fencing has not been implemented in Asia, and it is not yet known how Asian elephants respond to bees.

Elephant crop raiding behaviour

At present, little is known about the demographic and behavioural determinants of crop-raiding (Graham et al. 2010). There is some evidence that the frequency of expression of crop-raiding behaviour differs between sexes (Haturusinghe and Weerakoon 2012; Campos-Arceiz et al. 2009; Sitati et al. 2003; Sukumar 1991) and varies both seasonally (Haturusinghe and Weerakoon 2012; Campos-Arceiz et al. 2009; Wikramanayake et al. 2004) and spatially (Ekanayaka et al. 2011) depending on available crops. In addition, crop-raiding has been found to be primarily nocturnal (Campos-Arceiz et al. 2009; Sitati et al. 2003; Sukumar 1991). Over and above this basic information, little is known about who crop raids within a population, to what extent crop raiding is consistently undertaken by the same individuals, and whether some aspect of the behaviour of these individuals, such as individual personality traits, predisposes them to crop raid. Also unknown are the social dynamics of crop raiding and in particular the association patterns of crop-raiding individuals and the genetic relatedness of individuals that crop raid.

At our study site in Central Sri Lanka, preliminary visits and anecdotal evidence, from personal discussions with local researchers at the Sri Lanka Wildlife Conservation Society (SLWCS)

and local farmers, indicate that the HEC situation shares common causes and consequences with many HEC situations worldwide. Elephants raid crops year-round with peaks in certain seasons, and most crop-raiding behaviour is nocturnal. Injuries and death to both humans and elephants have been reported. Thus, this location provides a strong model for building on the current knowledge base of HEC behaviour and mitigation. Data collected will contribute to global understanding of HEC patterns and influencing factors, while also highlighting the importance of in-depth site-specific investigations to properly implement a new community-based mitigation technique.

Beehive fencing in Sri Lanka

We have implemented a pilot beehive fence research site in a farming village near Wasgamuwa National Park, Sri Lanka and presently have 10 beehive fences surrounding the homes and small areas of crops in home gardens. This is a low-income area where farmers are commonly subjected to visits by elephants. Since mid 2014, more than 300 elephant sightings have been reported in the village, with almost half of these sightings within 50 m of the family home. Fields, home gardens or houses have incurred damage during around 75% of sightings reported with the extent of damage varying from a single banana tree to 2 acres of rice paddy to half a house knocked down. Farmers commonly use elephant crackers (large fire crackers issued by the Wildlife Department) to deter elephants, as well as making noise and shining torches with mixed success.

Following meetings with the community, we selected 10 of the worst affected households and over the past year constructed the beehive fences and began monitoring the level of crop-raiding and damage on beehive fenced (experimental) and non-beehive fenced (control) farms to try and understand if Asian elephants will, like their African cousins, be deterred by bees. We have been working with farmers on building and maintaining their fences, attracting and transferring bee colonies to the hanging hives, and harvesting small quantities of honey – the idea being that as beekeeping skills increase, farmers will be able to harvest enough honey to sell at local markets, thus providing an additional source of income.

fig 2 Building a beehive fence at Mr. Lelantha's farm (c) Kylie Butler.

fig 3 Mr. Lelantha inspects one of his occupied hives (c)

Kylie Butler.

We are also collecting data on the demographic characteristics and behaviour of elephants entering the village (using camera traps), in surrounding communal areas, and in Wasgamuwa National Park (using researcher observations) to generate a profile of the local elephant population, including personality assessments specifically for traits of boldness and aggressiveness.

Identifying differences in personality within a local population or species can help predict the behaviour of individuals, or groups of individuals, across time and contexts (Freeman et al. 2013; Bremner-Harrison et al. 2004; Capitanio 1999; Wielebnowski 1999), and provide information to guide wildlife management. I expect that identifying personality traits of individual wild elephants within a high HEC area might assist in predicting individual crop-raiding behaviour and likely responses to mitigation techniques.

fig 4 Elephants cross the road just outside of the village (c) Kylie Butler.

At present, it is too early to provide a profile of the local elephant population or to determine conclusively the deterrent effect of beehive fences as an Asian elephant mitigation tool. Behavioural data collection and monitoring of fences, crop raiding frequency and damage incurred is ongoing. Other factors, including farmer perceptions of beehive fencing and co-existing with elephants, fence upkeep, hive occupations and honey harvests will also be considered as we address the potential role of beehive fencing as an Asian elephant crop-raiding deterrent. We expect results to be available mid-2017.

A joint project by the University of Newcastle and Save the Elephants (supervised by Dr. Lucy E. King, Dr. Andrea Griffin & A/Prof Natalie Moltschaniwskyj), in collaboration with the Sri Lanka Wildlife Conservation Society

References

Baishya, HK, Dey, S, Sarmah, A, Sharma, A, Gogoi, S, Aziz, T, Ghose, D & Williams, AC 2012, 'Use of chilli fences to deter Asian elephants – a pilot study', *Gajah*, vol. 36, pp. 11 – 13.

Bremner-Harrison, S, Prodohl, PA & Elwood, RW 2004,'Behavioural trait assessment as a release criterion: boldness predicts early death in a reintroduction programme of captive-bred swift fox (*Vulpes velox*)', Animal Conservation, vol. 7, pp. 313 – 320.

Campos-Arceiz, A, Takatsuki, S, Ekanayaka SKK & Hasegawa, T 2009, 'The human-elephant conflict in Southeastern Sri Lanka: Type of damage, seasonal patterns, and sexual differences in the raiding behaviour of elephants', *Gajah*, vol. 31, pp. 5 – 14.

Capitanio, JP 1999, 'Personality dimensions in adult male rhesus macaques: Prediction of behaviours across time and situation', *American Journal of Primatology*, vol. 47, pp. 299 – 320.

Dickman, AJ 2010, 'Complexities of conflict: the importance of considering social factors for effectively resolving human-wildlife conflict', *Animal Conservation*, vol. 12, pp. 459 – 466.

Dutta, A 2013, 'Bees, acrid smoke from chillis keep elephants away and reduce conflict', *The Times of India*, June 24, 2013.

Ekanayaka, SKK, Campos-Arceiz, A, Rupasinghe, M, Pastorini, J & Fernando, P 2011, 'Patterns of crop raiding by Asian Elephants in a human-dominated landscape in Southeastern Sri Lanka', *Gajah*, vol. 34, pp. 20 – 25.

Fernando, P, Jayewardene, J, Prasad, T, Hendavitharana, W & Pastorini, J 2011, 'Current status of Asian Elephants in Sri Lanka', *Gajah*, vol. 25, pp. 93 – 103.

Fernando, P, Wikramanayake, E, Weerakoon, D, Jayasinghe, LKA, Gunawardene, M & Janaka HK 2005, 'Perceptions and patterns of human-elephant conflict in old and new settlements in Sri Lanka: insights for mitigation and management', *Biodiversity and Conservation*, vol. 14, pp. 2465 – 2481.

Freeman, HD, Brosnan, SF, Hopper, LM, Lambeth, SP, Schapiro, SJ & Gosling, SD 2013, 'Developing a comprehensive and comparative questionnaire for measuring personality in chimpanzees using a simultaneous top-down/bottom-up design', *American Journal of Primatology,* vol. 75, pp. 1042 – 1053.

Graham, MD & Ochieng, T 2008, 'Uptake and performance of farm-based measures for reducing crop-raiding by elephants *Loxodonta africana* among smallholder farms in Laikipia District, Kenya', *Oryx*, vol. 42, pp. 76 – 82.

Graham, MD, Notter, B, Adams, WM, Lee, PC & Ochieng, TN 2010, 'Patterns of crop-raiding by elephants, *Loxodonta Africana*, in Laikipia, Kenya, and the management of human-elephant conflict', *Systematics and Biodiversity*, vol. 8, no. 4, pp. 435 – 445.

Harisch, FK, Treydte, AC, Sauerborn, J & Owusu, EH 2013, 'People and wildlife: conflicts arising around the Bia Conservation Area in Ghana', *Journal for Nature Conservation*, vol. 21, no. 5, pp. 342 – 249.

Haturusinghe, HS & Weerakoon, DK 2012, 'Crop raiding behaviour of elephants in the Northwestern region of Sri Lanka', *Gajah*, vol. 36, pp. 26 – 31.

Hedges, S & Gunaryadi, C 2009, 'Reducing human-elephant conflict: do chillies help deter elephants from entering crop fields', *Oryx*, vol. 44, pp. 139 – 146.

Hill, CM 2004, 'Farmers perspectives of conflict at the wildlife-agriculture boundary: some lessons learned from African subsistence farmers', *Human Dimensions of Wildlife*, vol. 9, pp. 279 – 286.

King, LE, Douglas-Hamilton, I & Vollrath, F 2007, 'African elephants run from the sound of disturbed bees', *Current Biology*, vol. 17, pp. R832 – R833.

King, LE, Lawrence, A, Douglas-Hamilton, I & Vollrath, F 2009, 'Beehive fence deters crop-raiding elephants', *African Journal of Ecology*, vol. 47, pp. 131 – 137.

King, LE 2010, 'The interaction between the African elephant (*Loxodonta africana africana*) and the African honeybee (*Apis mellifera scutellata*) and its potential application as an elephant deterrent', *DPhil thesis*, University of Oxford, UK.

King, LE, Douglas-Hamilton, I & Vollrath, F 2011, 'Beehive fences as effective deterrents for crop-raiding elephants: field trials in northern Kenya', *African Journal of Ecology*, vol. 49, no. 4, pp. 431- 439.

Leimgruber, P, Gagnon, JB, Wemmer, C, Kelly, DS, Songer, MA & Selig, ER 2003, 'Fragmentation of Asia's remaining wildlands: implications for Asian elephant conservation', *Animal Conservation*, vol. 6, pp. 347 – 359.

Madden, F 2004, 'Creating co-existence between humans and wildlife: global perspectives on local efforts to address human-wildlife conflict', *Human Dimensions of Wildlife*, vol. 9, pp. 247 – 257.

Manoj, EM 2012, 'Jumbos get a sting of defeat', *The Hindu Newspaper*, February 25, 2012.

Mishra, C 1997, 'Livestock depredation by large carnivores in the Indian trans-Himalaya: conflict perceptions and conservation prospects', *Environmental Conservation*, vol. 24, pp. 338 – 343.

Perera, BMAO 2009, 'The Human-Elephant Conflict: A review of current status and mitigation methods', *Gajah*, vol. 30, pp. 41 – 52.

Santiapillai, C & Read, B 2010, 'Would masking the smell of ripening paddy-fields help mitigation human-elephant conflict in Sri Lanka?', *Oryx*, vol. 44, no. 4, pp. 509 – 511.

Sitati, NW, Walpole, MJ, Smith, RJ & Leader-Williams, N 2003, 'Predicting spatial aspects of human-elephant conflict', *Journal of Applied Ecology*, vol. 40, pp. 667 – 677.

Sitati, NW & Walpole, MJ 2006, 'Assessing farm-based measures for mitigation human-elephant conflict in Transmara District, Kenya', *Oryx*, vol. 40, no. 3, pp. 279 – 286.

Sri Lanka Wildlife Conservation Society (SLWCS) 2011, 'Project Orange Elephant (POE) 3rd phase expansion program, interim report', Sri Lanka Wildlife Conservation Society, Colombo, Sri Lanka.

Vollrath, F & Douglas-Hamilton I 2002, 'African bees to control African elephants', *Naturwissen*, vol. 89, pp. 508 – 511.

Wielebnowski, NC 1999, 'Behavioral differences as predictors of breeding status in captive cheetahs', *Zoo Biology*, vol. 18, pp. 335 – 349.