

Farmers' Perceptions and Attitudes towards Government-Constructed Electric Fences in Peninsular Malaysia

Vanitha Ponnusamy¹, Praveena Chackrapani^{2,3}, Teck Wyn Lim², Salman Saaban⁴ and Ahimsa Campos-Arceiz^{2,3*}

¹*Nottingham University Business School,*

The University of Nottingham Malaysia Campus, Kajang, Selangor, Malaysia

²*School of Environmental and Geographical Sciences, Faculty of Science,*

The University of Nottingham Malaysia Campus, Kajang, Selangor, Malaysia

³*Mindset Interdisciplinary Centre for Tropical Environmental Studies,*

The University of Nottingham Malaysia Campus, Kajang, Selangor, Malaysia

⁴*Department of Wildlife & National Parks Malaysia, Kuala Lumpur, Malaysia*

*Corresponding author's e-mail: ahimsa@camposarceiz.com

Abstract. In Peninsular Malaysia, the government has recently initiated a human-elephant conflict mitigation program based on electric fences. We conducted semi-structured interviews with 359 farmers living near eight fences to describe their perceptions and attitudes towards fences, elephants, and human-elephant conflict. Most of our respondents reported positive perceptions about the effectiveness of the fence and sharp reductions of human-elephant conflict-caused economic losses; on the other hand, we found low levels of tolerance and empathy towards elephants. Our study shows that the electric fence program has support from farmers and should be continued. Additionally, we recommend efforts to increase people's tolerance to elephant presence.

Introduction

The Asian elephant (*Elephas maximus*) plays important ecological and cultural roles but is endangered due to the rapid decline of populations across its range (Sukumar 1992; Barua *et al.* 2010; Campos-Arceiz & Blake 2011; Fernando & Pastorini 2011). It is widely accepted that the main threat for Asian elephant conservation is the combined effect of habitat loss and the human-elephant conflict (HEC) that subsequently arises (e.g. Leimgruber *et al.* 2003).

HEC can take several forms but the most common one is crop raiding by elephants (e.g. Fernando *et al.* 2005; Sukumar 2006; Campos-Arceiz *et al.* 2009). Farmers sharing landscapes with Asian elephants may suffer severe economic losses and other forms of distress due to HEC and often have low tolerance towards elephants (Fernando *et al.* 2005). Given the high degree of fragmentation of Asian elephant habitats (Leimgruber *et al.* 2003), the future survival of the species depends on our

ability to co-exist with them, which inevitably involves the effective mitigation of HEC.

HEC is an ancient phenomenon (Sukumar 2003) and many strategies exist to mitigate it (Fernando *et al.* 2008). Common HEC mitigation techniques include the removal of problem elephants (e.g. Fernando *et al.* 2012), crop guarding (e.g. Hedges & Gunaryadi 2010), economic compensation (e.g. Chen *et al.* 2013), and the use of physical and psychological barriers, such as electric fences (e.g. Hoare 2003; Graham *et al.* 2009). Electric fences are increasingly becoming a popular choice to mitigate HEC. They require very labour-intensive maintenance (Naughton *et al.* 2000; Chong & Dayang 2005; Cox 2012, Hoare 2012) and easily fail in the absence of good management. However, if effectively managed, electric fences allow people to share the landscape with elephants. Key aspects of electric fence success are the buy-in by local communities and the appropriate fence design and management.

Peninsular Malaysia is home to an endangered population of wild Asian elephants (Saaban *et al.* 2011). Due to the rapid transformation of Malaysia's landscapes, often involving the conversion of dipterocarp forest into oil palm and rubber plantations, elephant habitat is currently rather fragmented (Clements *et al.* 2010). Like elsewhere in the elephant range, HEC is a serious concern in Peninsular Malaysia, where rogue elephant translocation has been the most common strategy since 1974 (Daim 1995; Saaban *et al.* 2011).

Recent studies (e.g. Fernando *et al.* 2012) suggest that translocation is not sustainable as a long-term elephant conservation strategy. Accordingly, the Department of Wildlife and National Parks in Peninsular Malaysia has initiated a new electric-fence program to mitigate HEC in critical conflict hotspots. Since 2009, 20 fences have been constructed under this program in villages adjacent to elephant habitat. The use of electric fences, however, has been a common practice by Malaysian oil palm plantation companies since the 1940s (Monroe & England 1978).

Here we present a social study aiming to understand farmers' perceptions and attitudes towards the electric fences and elephants. Our specific objectives include: (a) assessing whether farmers perceive the electric fences as effective to mitigate HEC; (b) assessing the reported economic impact of these fences on farmers livelihood; and (c) assessing farmers tolerance towards elephants and HEC. In order to address these issues, we interviewed farmers living in the proximity of eight recently built electric fences.

Methods

Study area

This study took place in eight sites located in the states of Perak, Kelantan, Terengganu, Pahang, and Johor, in Peninsular Malaysia (Fig. 1). These eight sites have electric fences recently constructed by the Department of Wildlife and National Parks to mitigate HEC.

Data collection

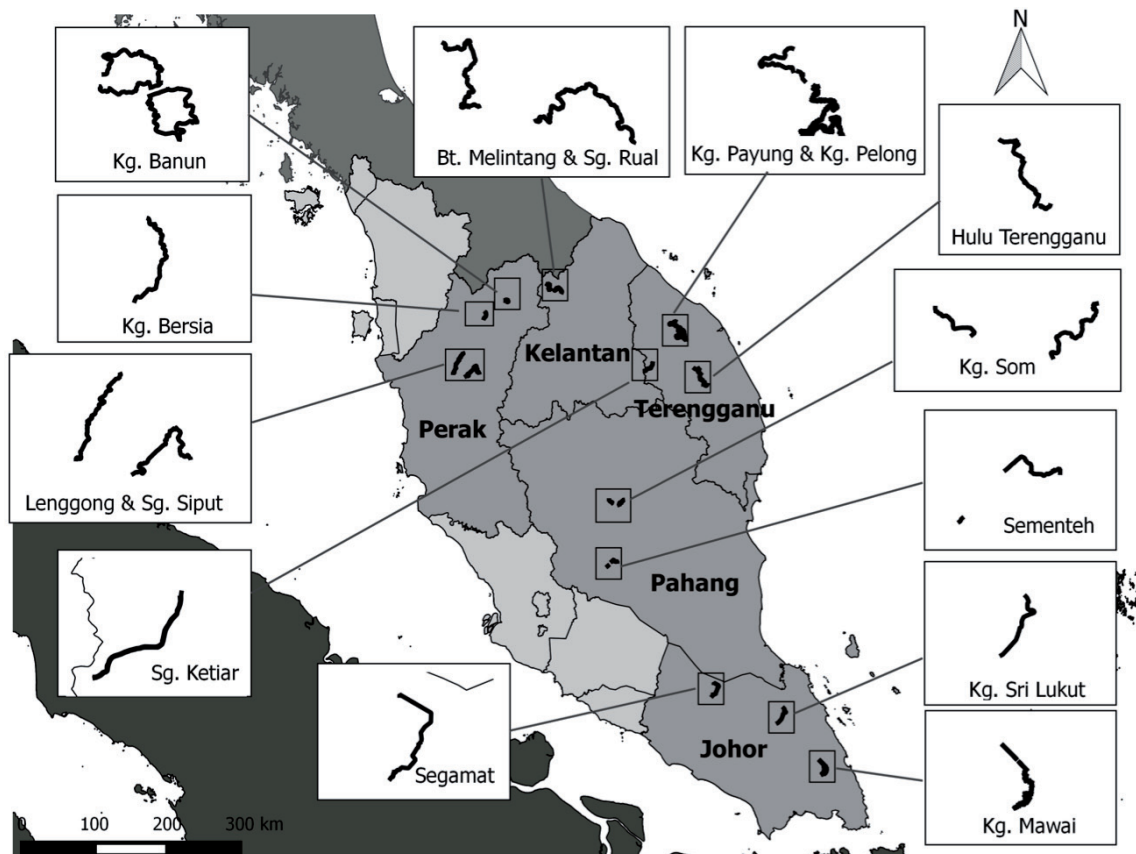


Figure 1. Map of Peninsular Malaysia showing the location of the electric fences built by the Malaysian government to mitigate HEC.

We used a semi-structured interview to gather data on the farmers' perceptions and attitudes towards the government-made electric fences. Data collection was carried out by the lead researcher (VP) assisted by field assistants to administer the questionnaires in the local language (Bahasa Melayu). We aimed to interview 50 respondents per site, which represented 20–25% of the households in six of the sites (the other two were smaller than 50 households). We did not randomize households, rather we conducted the sampling haphazardly from July 2014 till August 2015 (Table 1). In all cases, the respondents were farmers with plantations in the respective landscape.

Questionnaire design

Our questionnaire was divided in four general sections. First we recorded demographic information on the interviewee such as location of residence, gender, age, and highest level of formal education, and basic information on land ownership and agricultural activities. Second we collected information on the interviewees' perception on electric fences based on yes / no / I do not know questions such as 'is the fence effective to mitigate HEC?'. Third, we collected information on the HEC suffered by the interviewees before and after the construction of the fence. And finally, we asked yes / no / I don't know questions related to farmers' empathy and tolerance towards elephants, such as 'do you care about the habitat loss suffered by elephants when

we create new plantations?' or 'are you willing to tolerate some amount of damage by elephants?'.

Data analysis

The data was analyzed by means of simple descriptive statistics. All analyses and plots were conducted with R statistical environment (R Core Team 2016).

Results

Demographics

We interviewed a total of 359 farmers (49.6 ± 2.6 respondents per site; Table 1). Our respondents were predominantly male (55%). The mean (\pm SD) age of our respondents was 50 ± 16 (range = 14–86) years. In terms of education, 46% of the respondents had completed secondary school, 36% had completed primary school, 16% had no formal school education, and 3% had tertiary education.

These farmers were mainly smallholders; 88% of the respondents owned 0–3.6 hectares of land, 8% of them owned 4–7.6 hectares, and less than 5% had more than 8 hectares. The two most common cultivated crops were oil palm and rubber.

Perceptions and attitudes

Our respondents had a predominantly positive perception of the electric fences and their

Table 1. Description of the eight electric fences studied.

No.	Site	Length (km)	Completion date	State	Survey dates	No. of respondents
1	Sungai Rual	15	Aug 2009	Kelantan	Sep 2014	46
2	Lenggong	34	Nov 2010	Perak	Oct 2014	51
3	Batu Melintang	12	Dec 2013	Kelantan	Sep 2014	49
4	Mawai	18	Dec 2013	Johor	Aug 2014	54
5	Pelung	35	Dec 2013	Terengganu	Aug-Sep 2014	50
6	Mentolong	2	Oct 2014	Pahang	Jun 2015	13
7	Payong	8	Dec 2014 (Phase I) Dec 2015 (Phase II)	Terengganu	July 2015	50
8	Som	22	Nov 2014 (Phase I) Dec 2015 (Phase II)	Pahang	July 2015	46
Total		146				359

effectiveness (Fig. 2). In general, 74.7% of farmers felt that the fences bring economic benefits to them and 76.7% felt that they are effective (Fig. 2). When asked if fences are sufficient to mitigate HEC, 86.1% felt that the fences are sufficient (Fig. 2). Respondents had a high level of agreement, with 84.9% saying that the fence is needed and also 86.1% felt that more fences are needed to mitigate HEC in their village.

Farmers were also asked their perception of the fence maintenance, where 64.1% of people felt that it was well maintained. However 92.5% of the respondents were not involved in maintaining the fence (Fig. 3). 55.8% of the respondents felt that farmers should be involved in maintaining the fence and 37.7% of them were willing to contribute time to do so. There seemed to be a much stronger support for community involvement (69.7%) towards fence maintenance (Fig. 3).

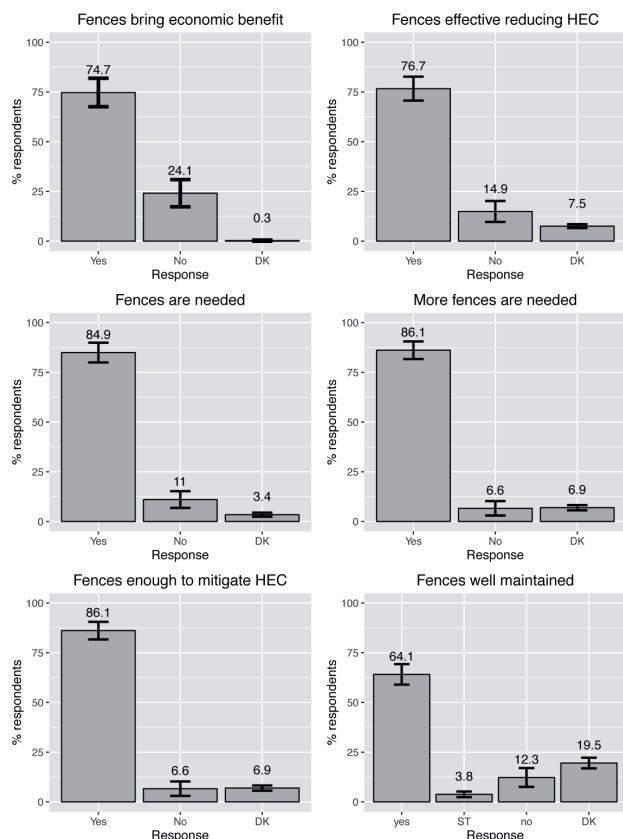


Figure 2. Farmers perceptions and attitudes towards electric fences as a measure to mitigate HEC in eight locations of Peninsular Malaysia. WTC = willingness to contribute. Numbers indicate mean percentage values. Error bars represent standard error values.

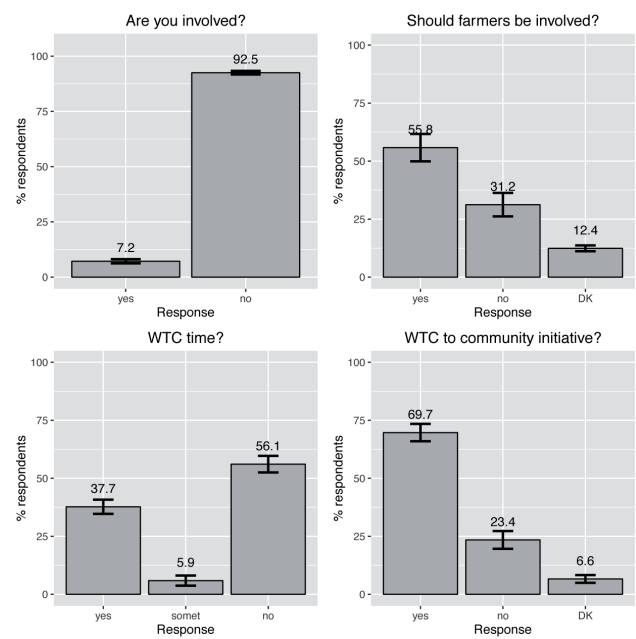


Figure 3. Farmers involvement and willingness to contribute to the management of electric fences to mitigate HEC.

Economic impact of the electric fence

The construction of the electric fences seemed to clearly reduce the economic losses suffered by farmers due to HEC (Fig. 4). Before their construction, 55% of respondents reported to have suffered economic costs; while 19% suffered losses after the construction (Fig. 4). One third of the respondents reported HEC costs of more than MYR 2500 per year (~USD 640 in April 2016) before the fence; while this number was reduced to 3% after the fence was built (Fig. 4).

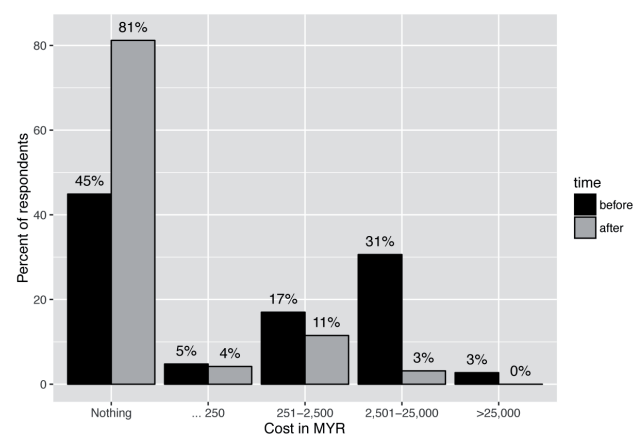


Figure 4. Reported annual losses due to HEC by farmers before and after the construction of electric fences in eight locations of Peninsular Malaysia.

Tolerance and empathy

Farmers were divided when we asked whether they thought that elephants ‘can be present in the area’: 54.8% of them said that elephants should not be there, while 40.6% said they can (Fig. 5). Most of the farmers (75.5%) said they cannot live with HEC and 74.8% were not willing to bear costs related to HEC (Fig. 5).

We found also mixed responses in terms of farmers’ empathy towards elephants. On the one hand, a strong majority of respondents (75.5%) thought that it is not acceptable to kill elephants to mitigate HEC. On the other, 74.8% of them did not care if elephants are affected by habitat loss (Fig. 5).

Discussion

We interviewed farmers in eight localities where the Malaysian government has recently built

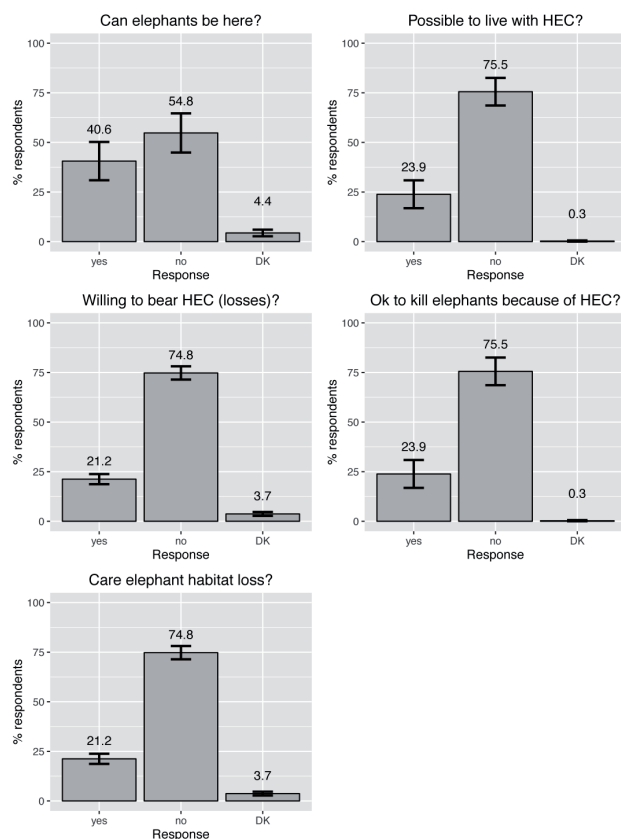


Figure 5. Farmers attitudes (tolerance and empathy) towards HEC and elephants in eight locations of Peninsular Malaysia. Numbers indicate mean percentage values. Error bars represent standard error values.

electric fences to mitigate HEC. Our results show some very promising patterns in terms of farmers’ acceptance of the fences and the positive impact of fences on livelihoods; but also some concerning ones regarding farmers’ tolerance towards elephants and HEC.

Overall, there was a general agreement among our respondents in that these electric fences (a) are effective in reducing HEC, (b) are actually needed and not a waste of resources, (c) are financially beneficial for the local communities, (d) are well maintained, and (e) are enough to mitigate HEC in these sites (Fig. 2). These results show local buy-in for the electric fence program initiated by the Malaysian government in 2009. Local buy-in is key for wildlife conservation, especially when it comes to conflictive and potentially dangerous species such as elephants. Farmer perceptions in Malaysia are similar to those described by Kioko *et al.* (2008) for farmers in Amboseli, Kenya, in that in both cases a large majority of farmers reported a decrease in crop raiding and a reduction of the economic burden of HEC after the construction of the fence.

Our respondents reported very clear economic benefits as a consequence of the building of the electric fences. Remarkably, the incidence of high economic losses (> RM 2500 per year) due to elephant crop raiding dropped from 34% to just 3% of the respondents (Fig. 4).

It is important to mention, however, that the high economic losses might be misrepresented in our sample because respondents had problems estimating the amount. Some respondents were unable to provide quantitative results other than ‘a lot’, ‘too much’, ‘so much that I had to quit my plantation’, and things alike, which we are not able to analyze quantitatively. On the other hand, some of the higher end estimations (e.g. RM 200,000 per year) are likely to be exaggerations. Indeed, farmers have a tendency to exaggerate the amount of damage caused by wildlife on their crops (e.g. Roper *et al.* 1995; Hoare 1999).

Another limitation of these results is that although the estimate of the costs was meant to be ‘annual’, many respondents might be pooling

economic losses of more than one year when talking about the past. In any case, our results suggest that the Malaysian government should continue this program.

It is important to stress that although electric fences can be effective, they are not silver bullets to mitigate HEC. For example, fences are considered relatively expensive and difficult to maintain, and some elephants are known to become ‘elephant breakers’ (Perera 2009). Factors such as the location and maintenance of the fence, the proximity to areas of high elephant concentrations, and the previous experiences of elephants with fences have been found to be determinant on the performance of electric fences (Thouless & Sakwa 1995; Kioko *et al.* 2008).

Although we found buy-in regarding the effectiveness and economic advantages of the fences, it is clear that the local communities are not involved in the maintenance of the fence; and most respondents had mixed feelings about contributing to such maintenance. While more than half of the farmers agreed that farmers should be involved in the maintenance and more than two thirds were willing to contribute through community initiatives, a solid 56% expressed not to be willing to contribute time to maintain the fence (Fig. 3).

This attitude pattern is concerning because the long-term success of electric fences programs in Malaysia will require a strong community involvement (e.g. Osborn & Parker 2003; Gunaratne & Premarathne 2005). Indeed, the current program, led by the Malaysian Department of Wildlife and National Parks should be seen as a pilot but not something that can be scaled-up to all conflict hotspots in the country. Only if farmers take ownership and responsibility in the development and maintenance of electric fences, this program will be feasible at a broader scale. Moreover, if this electric fencing program is scaled, it will be important to consider the ecological needs of elephants and potential disruptions of their movement patterns through the landscape. This problem could, to some extent, be mitigated with the design of elephant corridors within fenced landscapes.

The farmers in our study showed relatively low tolerance towards elephants and HEC. Three out of four respondents in our sample are not willing to bear any cost of HEC and think it is not possible to live with HEC (Fig. 5). Tolerance is important because Asian elephant conservation in the 21st century inevitably requires sharing landscapes, which means conflict between elephants and people. It is naïve to expect sharing landscapes without any conflict; hence conservation goals should focus on keeping conflict within tolerable levels for both people and elephants. At this point, it seems that farmers in Peninsular Malaysia are not inclined to bear any negative consequences of living next to elephants. More research is needed to understand how this tolerance can be enhanced.

In terms of empathy, we found mixed responses from the farmers. There is a general consensus that elephants should not be killed to mitigate HEC. We found surprising, however, that one out of four farmers considered killing as an acceptable option (Fig. 5). Most of farmers (75%) showed little concern about the loss of habitats for elephants. We predict that sympathy for elephants and other endangered wildlife precedes people’s care and willingness to compromise for their conservation.

This study provides important information to assess farmers’ buy-in towards Malaysia’s government efforts to mitigate HEC and conserve elephants. Our results show that people have very positive perception towards the effectiveness and value of the government-made electric fences but also that their tolerance towards elephants and the conflict associated to them is very low. A potential unforeseen risk of fences made and maintained by the government is that they may enhance farmers’ perception that elephants ‘belong to the government’ and hence HEC mitigation is also the government’s responsibility. In future studies we recommend to investigate perceptions relative to elephants ‘ownership’ and their implications. Based on our results, we encourage the Malaysian government to continue with this electric fencing program to mitigate HEC. Furthermore, we encourage future work to focus on (1) how to transfer ownership

and responsibility to the local communities and (2) how to enhance these communities' willingness to share landscapes with elephants, even if this involves bearing some costs. Importantly, we call for ways to share these costs with other stakeholders, such as other government agencies (e.g. agriculture and infrastructure agencies), the private sector (e.g. large plantations), and urban dwellers (who do not suffer HEC but care for elephant conservation).

Acknowledgements

This study is part of the Management & Ecology of Malaysian Elephants (MEME), a joint research project between the Department of Wildlife and National Parks (DWNP) Peninsular Malaysia and the University of Nottingham Malaysia Campus. We are very grateful to DWNP, and especially to its Director General Dato' Abdul Rasid Samsudin, for the permits to conduct this research and for the continuous support in the field. Field activities were generously financed by the Department of Wildlife and National Parks (grant NASB-0001) and Yayasan Sime Darby (grant M0005.54.04). We are particularly grateful to Mr Charles Keliang and wildlife officers from the Rompin, Mawai, Besut, Gerik, Jeli, and Temerloh districts for their help in the field; to Farah Najwa, Paveethirah Suppiah, and Fadhil Barsey for their contribution to the data collection; to Nurul Azuwa for the long hours typing the raw data; to Ange Tan for producing the map in Fig. 1 and useful feedback on the manuscript; and to other MEME members for the support at different stages of the project.

References

Barua M, Tamuly J & Ahmed RA (2010) Mutiny or clear sailing? Examining the role of the Asian elephant as a flagship species. *Human Dimensions of Wildlife* **15**: 145-160.

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 behavior of elephants. *Gajah* **31**: 5-14.

Campos-Arceiz A & Blake S (2011) Megagardeners of the forest – the role of elephants in seed dispersal. *Acta Oecologica* **37**: 542-553.

Chen S, Yi Z-F, Campos-Arceiz A, Chen M-Y & Webb EL (2013) Developing a spatially-explicit, sustainable and risk-based insurance scheme to mitigate human-wildlife conflict. *Biological Conservation* **168**: 31-39.

Chong DKF & Dayang Norwana AAB 2005. *Guidelines on the Better Management Practices for the Mitigation and Management of Human-Elephant Conflict in and around Oil-Palm Plantations in Indonesia and Malaysia, Version 1*. WWF-Malaysia, Petaling Jaya.

Clements R, Rayan MD, Zafir AAW, Venkataraman A, Alfred R, Payne J, Ambu LN & Sharma DSK (2010) Trio under threat: Can we secure the future of rhinos, elephants and tigers in Malaysia? *Biodiversity and Conservation* **19**: 1115-1136.

Cox B (2012) *An Overview of our Work from 2006-12*. Elephant Conserv. Network, Thailand.

Daim MS (1995) Elephant translocation: The Malaysian approach. *Gajah* **14**: 43-48.

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 & Conservation* **14**: 2465-2481.

Fernando P, Wickramanayake ED, Janaka HK, Jayasinghe LKA, Gunawardene M, Kotagama SW, Weerakoon D & Pastorini J (2008) Ranging behavior of the Asian elephant in Sri Lanka. *Mammalian Biology* **73**: 2-13.

Fernando P & Pastorini J (2011) Range-wide Status of Asian elephants. *Gajah* **35**: 1-6.

Fernando P, Leimgruber P, Prasad T & Pastorini J (2012) Problem-elephant translocation: Translocating the problem and the elephant? *PLoS ONE* **7**: e50917.

- Gunarathne LHP & Premarathne PK (2005) *The Effectiveness of Electric Fencing in Mitigating Human-Elephant Conflict in Sri Lanka*. A research report for economy and environment program for Southeast Asia.
- Graham MD, Gichohi N, Kamau F, Aike G, Craig B, Douglas-Hamilton I & Adams WM (2009) *The Use of Electrified Fences to Reduce Human Elephant Conflict: A Case Study of the Ol Pejeta Conservancy, Laikipia District, Kenya*. Working Paper 1, Laikipia Elephant Project, Nanyuki, Kenya.
- Hedges S & Gunaryadi D (2010) Reducing human–elephant conflict: Do chillies help deter elephants from entering crop fields? *Oryx* **44**: 139-146.
- Hoare RE (1999) *A Standardised Data Collection and Analysis Protocol for Human-Elephant Conflict Situations in Africa*. Report for IUCN African Elephant Specialist Group, Arusha, Tanzania.
- Hoare RE (2003) *Fencing and Other Barriers Against Problem Elephants*. <www.iucn.org/afesg> accessed Dec. 2013.
- Hoare RE (2012) Lessons from 15 years of human-elephant conflict mitigation: Management considerations involving biological, physical and governance issues in Africa. *Pachyderm* **50**: 60-74.
- Kioko J, Muruthi P, Omondi P & Chiyo PI (2008) The performance of electric fences as elephant barriers in Amboseli, Kenya. *South African Journal of Wildlife Research* **38**: 52-58.
- 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* **6**: 347-359.
- Monroe MW & England LD (1978) *Elephants and Agriculture in Malaysia*. Department of Wildlife and National Parks, Kuala Lumpur.
- Naughton L, Rose R & Treves A (2000) *The Social Dimensions of Human-Elephant Conflict in Africa: A literature Review and Case Studies from Uganda and Cameroon*. A report to IUCN/SSC AfESG, Gland, Switzerland.
- Osborn FV & Parker GE (2003) Towards an integrated approach for reducing the conflict between elephants and people: A review of current research. *Oryx* **37**: 80-84.
- Perera BMAO (2009) The human-elephant conflict: A review of current status and Mitigation methods . *Gajah* **30**: 41-52.
- R Core Team (2016) *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing, Vienna, Austria. <<https://www.R-project.org/>>.
- Roper TJ, Findlay SR, Lüps P & Shepherdson DJ (1995) Damage by badgers *Meles meles* to wheat *Triticum vulgare* and barley *Hordeum sativum* crops. *Journal of Applied Ecology* **32**: 720-726.
- Saaban S, Othman N, Yasak, Nor BM, Zafir A & Campos-Arceiz A (2011) Current status of Asian elephants in Peninsular Malaysia. *Gajah* **35**: 67-75.
- Sukumar R (1992) *The Asian Elephant: Ecology and Management*. Cambridge University Press, New York.
- Sukumar R (2003) *The Living Elephants: Evolutionary Ecology, Behavior, and Conservation*. Oxford University Press, New York.
- Sukumar R (2006) A brief review of the status, distribution and biology of wild Asian elephants *Elephas maximus*. *International Zoo Yearbook* **40**: 1-8.
- Thouless C & Sakwa J (1995) Shocking elephants: Fences and crop raiders in Laikipia District, Kenya. *Biological Conservation* **72**: 99-107.