Human-elephant coexistence: Community involvement in conflict resolution in a land-use mosaic of the Anamalai Hills, Western Ghats, India

YEAR 2

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ELEPHANT FAMILY
Protecting Asian elephants and their habitat

HUMAN-ELEPHANT COEXISTENCE: COMMUNITY INVOLVEMENT IN CONFLICT RESOLUTION IN A LAND-USE MOSAIC OF THE ANAMALAI HILLS, WESTERN GHATS, INDIA

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SUMMARY

Wide ranging species such as Asian elephant (*Elephas maximus*) is faced by numerous anthropological threats in its range of habitats. Nearly 20% of global human population lives in the current geographical range of elephants which led to considerable amount of conflicts between people and elephants. Intense and wide spread conflicts resulted in loss of human and elephant lives besides property damage. This warrants extending conservation efforts beyond protected areas into human modified elephant landscapes. The present study investigates and compares results of elephant movement patterns, their conflicts with people over two years while assessing the efficacy of conflict mitigation measures and people involvement in managing human-elephant conflict for two years between April 2011 and March 2013. The study was carried out in a 220 km² plantation dominated landscape of the Valparai plateau in the Anamalai hills of Western Ghats in India. Elephant herd tracking, direct observations of herds, and field assessment of human-elephant conflicts were employed by Conflict Response Unit and through network of informants comprising of local people and forest department field staff. Elephants ranged all over the plateau but showed consistent movement patterns in both years with high concentration along major riverine systems which plays an important movement route for elephants across plantations. Human-elephant conflict is mainly due to damages to buildings which store food grains and lentils and few residential places. Incidence of elephant damages to property distributed across the plateau. However, no crop damage by elephants was noticed as tea is not palatable and occasional damage to coffee. However, percentage of damages in respective years indicated that damages to ration shops and residential places by elephants increased but decreased substantially to other places such as office buildings, muster rolls etc in the later year suggest prioritizing protection efforts to critical but sensitive places which would require adequate protection. Early warning messages about elephant presence and their movement to people alerted local people to safeguard their property and facilitated concerned authorities to take timely action which resulted in overall reduction in conflict incidents by elephants in the second year. Number of days of stay by elephant herds on the Valparai plateau had partial effect on occurrence of conflicts. Assessing circumstances of human deaths indicated that advance intimation about elephant presence and providing adequate safety at work and home would bring down a majority of fatal encounters with elephants. Loss of human life during the study period was mainly due to ignoring elephant messages, inebriation, and misjudgment of elephant movements. This necessitates sensitizing people about safety precautions while moving through elephant presence areas. Bulk SMS service has been effective and positively received by people due to its convenience than television message service. Community involvement in elephant alert indicators indicated that an average of 97% of light operations was carried out by local people during the past one year. False alarms and failed operations in operative alert indicators were less than one percent which indicates the progressive, consistent, and sustained efforts by the local communities in conveying advance intimation about elephant presence and their movement to residents in respective localities. The study clearly demonstrate that early warning systems and coordinated efforts by stakeholders help decrease incidence of conflicts, creates opportunity for better management of human-elephant conflict, and promoting human-elephant coexistence in fragmented elephant landscapes.

INTRODUCTION

Conservation of large mammals, particularly elephants, outside protected areas is increasingly becoming a challenge for scientific and conservation organizations, local communities, and park managers due to pressures associated with numerous anthropogenic threats and compel coexistence with humans (Sitati and Walpole 2006, Graham *et al* 2010, Fernando *et al* 2012, Gubbi, 2012). Continuous degradation and conversion of natural habitats, encroachment, and developmental activities posed a great threat to elephant survival in altered landscapes, leading to intense conflicts across Asia and Africa (Sukumar 1994, Sitati *et al* 2003, Chartier *et al* 2012). Effects of these threats, though not clearly documented, few studies (Ahlering *et al* 2011 & 2013, Burke *et al.* 2008) reported that human induced pressures increase stress levels in elephants and may affect their viability of population survival in human modified landscapes.

Asian elephant (*Elephas maximus*), recently recognized as National Heritage animal by the Indian Government, two third of its population lives in non-protected areas either close to or within human dominated landscapes giving opportunities into greater contact and conflict (Sukumar 1989, WWF 2000). Human-elephant conflict escalated with ever increasing human population coupled with hydro-electric projects, agriculture expansion, transportation networks and reservoirs within forested elephant habitats, resulted in fragmented populations (Leimgruber *et al* 2003) and pushed these pachyderms into neighboring human use areas(Desai 1991). Asian elephant worshiped as God, occupied cultural and religious prominence in human culture and societies, is rapidly eroding as result of human-elephant conflict. Thus, human-elephant conflict resolution is not only of scientific and conservation importance but a societal need to retain traditional values of tolerance towards elephants in human-elephant relationships.

There have been various techniques employed to deal with human-elephant conflicts in interspersing areas of elephants and humans. Multiple methods of deterring elephants from human-use areas or crop lands by deploying physical barriers such as electric fences, elephant proof trenches etc., traditional methods of using crackers, use of tobacco – chilly rope, elephant drives etc., have showed mixed results in their efficacy in dealing with human-elephant conflicts (Nath and Sukumar 1998, Parker and Osborn, 2006, Kioko *et al* 2008, Chelliah *et al* 2010). Recently, numerous experimental trials focusing on innovative measures have showed varying degrees of success to mitigate human-elephant conflicts in Asia and Africa (King *et al* 2011, Davies *et al* 2011).

Of the various kinds of conflict mitigation techniques, early warning systems proved to be effective in reducing incidence of conflicts (Venkatraman *et al* 2005, Hedges and Gunaryadi 2009, Davies *et al* 2011, Sugumar and Jayaparvathy 2013). However, there have been very few human-elephant conflict studies which addressed long term monitoring on efficacy of conflict mitigation techniques in terms of reduction in incidence of conflicts, adoptability of techniques by local communities, reduced stress levels in people, help increase levels of people tolerance towards elephants, and sustainability of conflict mitigation measures.

Here, we report, the movement of elephants and their conflict with people over a two-year period between 2011 -2013, while analyzing efficacy of early warning systems in promoting human-elephant coexistence on the Valparai plateau. The objectives are as follows:

1. Understanding movement patterns of elephants in the plantation dominated Valparai plateau
2. Spatial and temporal patterns of human-elephant conflict incidents
3. Efficacy and community involvement in sustainable human-elephant conflict mitigation mechanisms.

MATERIALS AND METHODS

A. Study area

The Valparai plateau in the Anamalai hills is a landscape of tea and coffee plantations interspersed with rainforest fragments and Eucalyptus plantations. The 220 km² Valparai plateau in amidst of protected areas which form an important landscape for Asian elephants in the Western Ghats of India. Nearly, around 40 rainforest fragments within monoculture plantations act as refuges for elephants to move across the plateau (Mudappa and Raman 2007, Kumar *et al* 2010, Figure 1). The plantation industry on the Valparai plateau owned by national and multinational companies support nearly 70,000 people working in tea and coffee plantations. The inevitable situation of using the plantation landscape by elephants and people dependency over tea and coffee plantations for survival led to interactions between elephants and people, leading to human-elephant conflict (Kumar *et al* 2004). The only way to resolve human-elephant conflict on the plateau is to make people vigilant of elephant presence and adopting better practices to promote coexistence between people and elephants.
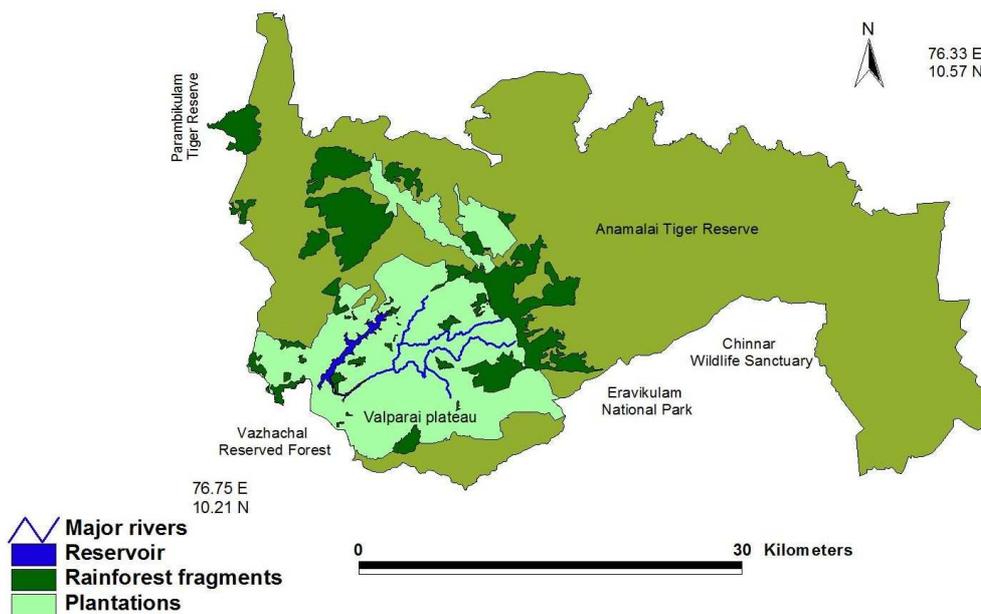
Figure 1. Map of Valparai plateau (light green) with rainforest fragments (dark green) and surrounding protected areas (dark green)

B. Methods

Methods adopted during the study were briefed below:

1. Establishing conflict response team (CRU) with a team of experienced tribal people who track elephants within plantation limits during the day and record information on date, time, identity of elephant herd, herd composition, incidence of conflicts, type of habitat, and movement with handheld GPS (Kumar *et al* 2004, 2010). The information from CRU was intimated to the elephant information centre on daily basis.

2. Elephant information network was established by initiating bulk SMS service and as a 'crawl' on local TV channel where information about elephant presence and their movement from CRU, local people, and field staff of Tamil Nadu Forest Department was communicated to people on their mobile phones residing within 2km form the place of elephants. A database which includes information about name of the person, place of residence, division, estate, about 2700 people who were willing to receive elephant messages on their mobile numbers has been maintained. Responses from people for Bulk SMS and TV initiatives have been systematically recorded, grouped, and analyzed for their efficacy. A detailed explanation on methods has been mentioned elsewhere (Kumar and Ganesh 2012).

3. Early warning remotely mobile operated elephant alert indicators with red LED flashing units have been installed in 25 locations which are visible from a distance

of 1 km from nearest bus stop. For each light, at least two people mobile phone numbers from local plantation workers community were registered. These people are authorized to operate alert indicators in case of elephant presence within 1km distance from the light. Information received in the form of SMS from alert indicators, when operated, was systematically recorded to understand involvement of people in alerting residents of respective localities about elephant presence. False alarms and failed operations were estimated based on elephant presence or absence within 1 km radius from each of the 25 lights installed on the Valparai plateau.

RESULTS

Elephant movements

During the last two years, movement by regular elephant herds has shown consistent patterns annually in areas of use inside plantations on the plateau (Figure 2). The Monica herd (red stars) mostly moved in north and north east parts whereas Stepear herd (blue squares) is confined to the south and south east part and Pig tail herd (red triangle) restricted mainly to western part of the Valparai plateau. Besides regular herds, peripheral herds used plantation area for a brief period time particularly in north and south – south eastern part of the Valparai plateau. High concentration of elephant locations along Nadu Ar – Sholyar river system which flows in the middle of the plateau forms an important critical habitat for elephants in plantations. The consistent movement patterns by regular herds over years would help predicts their frequent and intensive areas of use and identifies movement paths within plantations on the plateau.
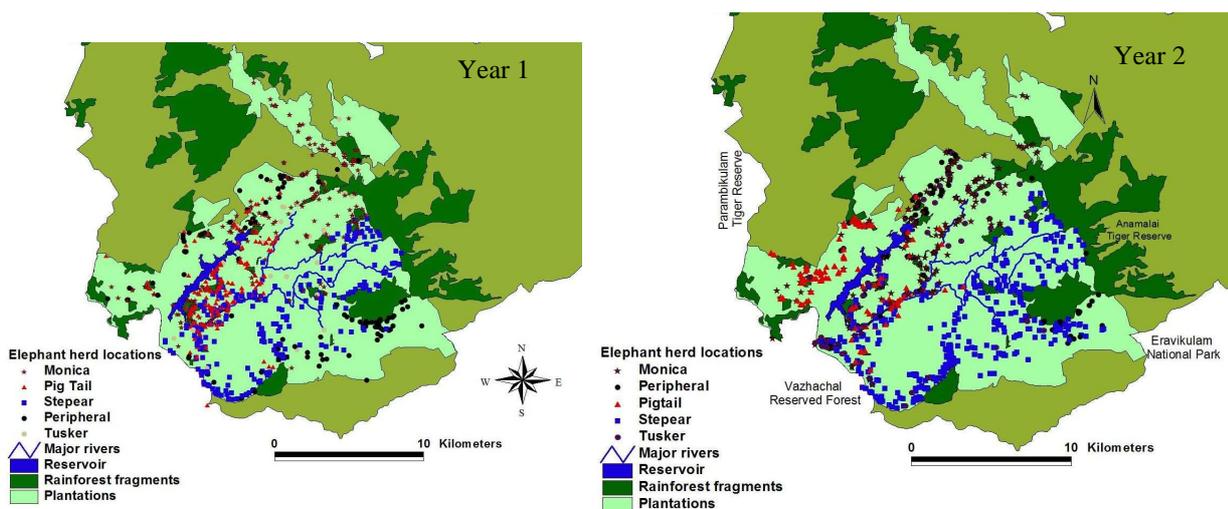

Figure 2. Map of spatial distribution of elephant herd locations over a two year period between April 2011 – March 2013 on the Valparai plateau

Spatial distribution of incidence of conflicts

Spatial distribution of incidence of damages for a two-year period revealed that property damage by elephants was distributed across the plateau in both years (Figure 3). However, incidence of property damages was densely distributed in the Year 1 than in the Year 2 on the Valparai plateau.
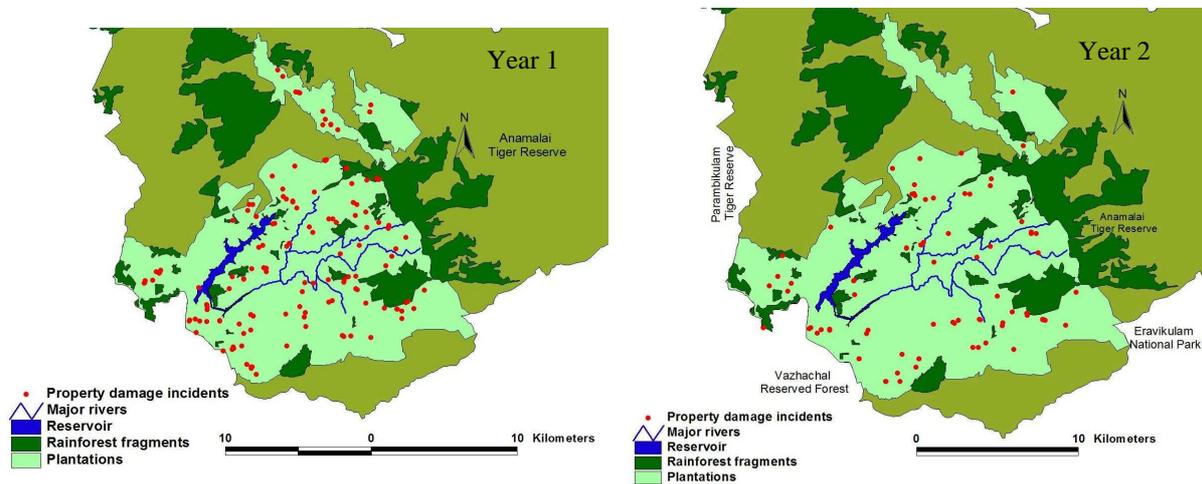

Figure 3. Spatial distribution of property damage incidents over a two year period (April 11 – March 2013) on the Valparai plateau

During the last two years, there was a significant decrease in occurrence of property damage incidents due to elephants from Year 1 (n = 150) to Year 2 (n = 88). Further analysis on places of damage revealed that number of damages to noon-meal centres, residential places and other places such as muster rolls, estate office, hospital, factory buildings, post office etc decreased but increased to rations shops from Year 1 to year 2 (Figure 4). However, percentage of damage to rations shops doubled from Year 1 to Year 2 whereas, for other places decreased substantially from Year 1 to Year 2. Number of damages to residential places and school noon-meal centres did not differ significantly. The difference in proportion of damages to ration shops and other places contributed to overall significance in occurrences of incidence of conflicts between two years (χ^2 = 22.809, df = 3, p < 0.001).
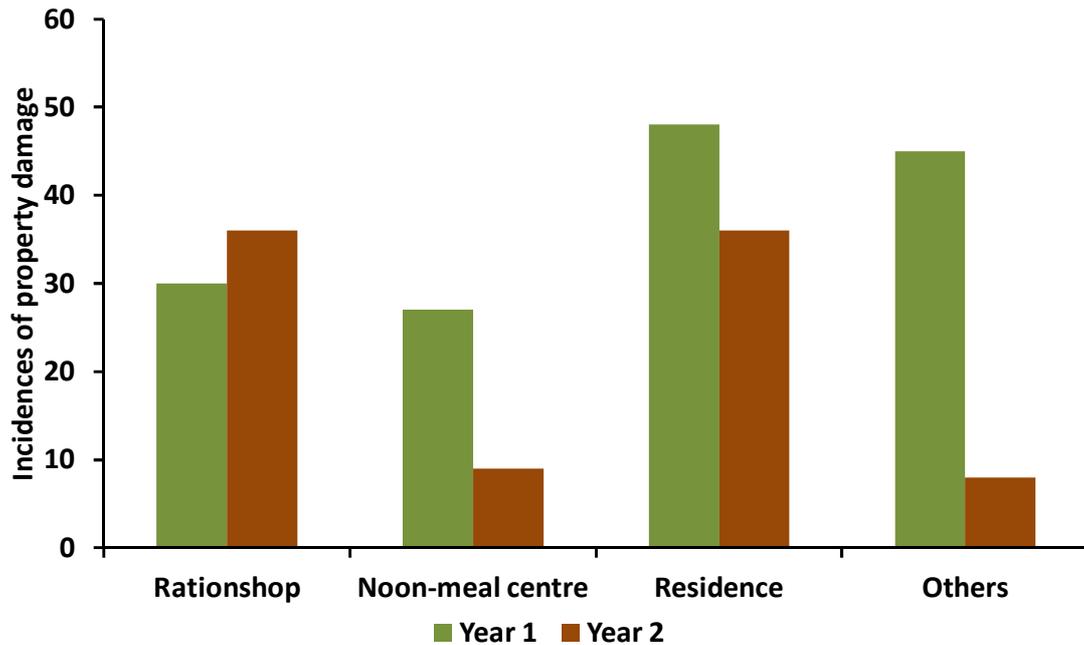
Figure 4. Distribution of property damage incidents due to elephants to different places in the Year 1 (n = 150) and Year 2 (n = 88).

Temporal distribution of property damages and elephant herd-days

Frequency of property damage incidents due to elephants ranged from a minimum of 1 to a maximum of 22 conflicts per month across years (Figure 5). Gradual increase in number of damages to property was observed from June to December in the Year 1 and October to December in the Year 2. Percentage of property damage was high during July–December in the Year 1 (68%, n = 102) and in the Year 2 (54.5%, N = 48). Number of damage incidents per month decreased in most months in Year 2 as compared to Year 1. Monthly variation in occurrence of property damage incidents had significantly differed between Year 1 and Year 2 (t = 2.62, df = 22, p < 0.05). Elephant herds stayed on the Valparai plateau throughout the year, the herd-days (presence of multiple elephant herds or a single herd split into more than one sub-herd in different locations separated more than one kilometer) ranged from 11 – 105 in the Year 1 and 28 – 114 in the Year 2. Percent number of days by different elephant herds was higher during relatively dry period of November – April in the Year 1 (n = 404 herd-days, 61.4%) and Year 2 (n = 437 herd-days, 56.5%). However, no significant difference in the number of elephant herd presence days across months between Year 1 and Year 2 (Year1 = 658 herd-days and Year 2 = 774 herd-days, t = 0.86, df = 22, p > 0.05). Though frequency of occurrence of conflicts per month was significantly positively related to elephant herd-days

(adjusted r^2 = 0.144, df = 22, p < 0.05) across 24 months, but influence of elephant herd days had explained only 14% of variation in occurrence of conflicts.
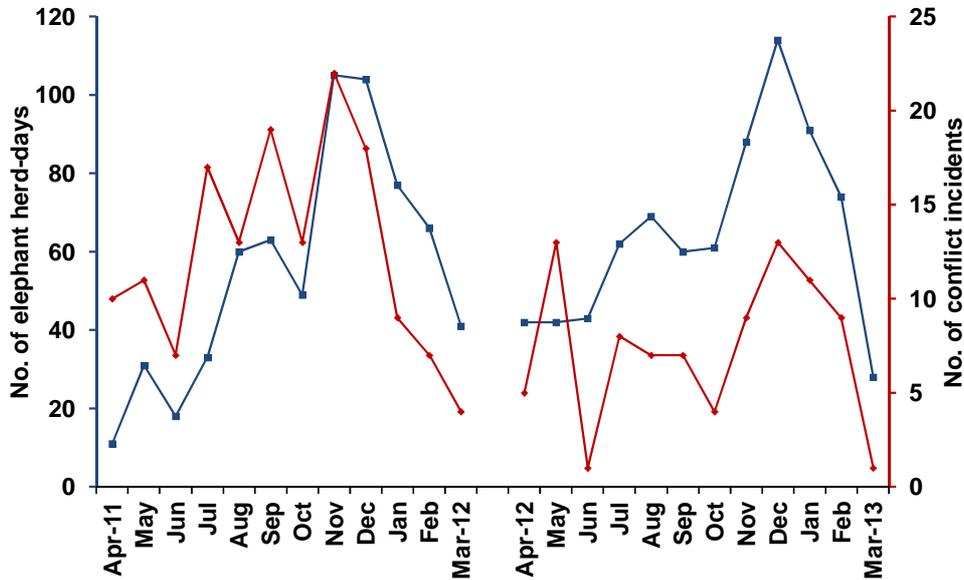

Figure 5. Monthly distribution of incidents of property damage by elephants and elephant herd-days over a two year period (April 11 – March 2013) on the Valparai plateau

Human death distribution across years

A total of 39 people lost their lives in accidental encounters with elephants between 1994 – 2012 with an average of 2 – 3 people per year on the Valparai plateau (Figure 6). Gradual decline in number of deaths between 2002 - 07 with no incidence of human death for 31 months between November 2004 and June 2007 during the previous study. Based on the efforts of prior study, new measures to deal with human-elephant conflict have been initiated in mid 2011. However, there were three incidences of human death reported in 2012. Prior to 2002 (1994 - 2001), on average number of human death was 2.8 people/year but during project period between 2002 -12, average number of human death was only 1.6 people/year.
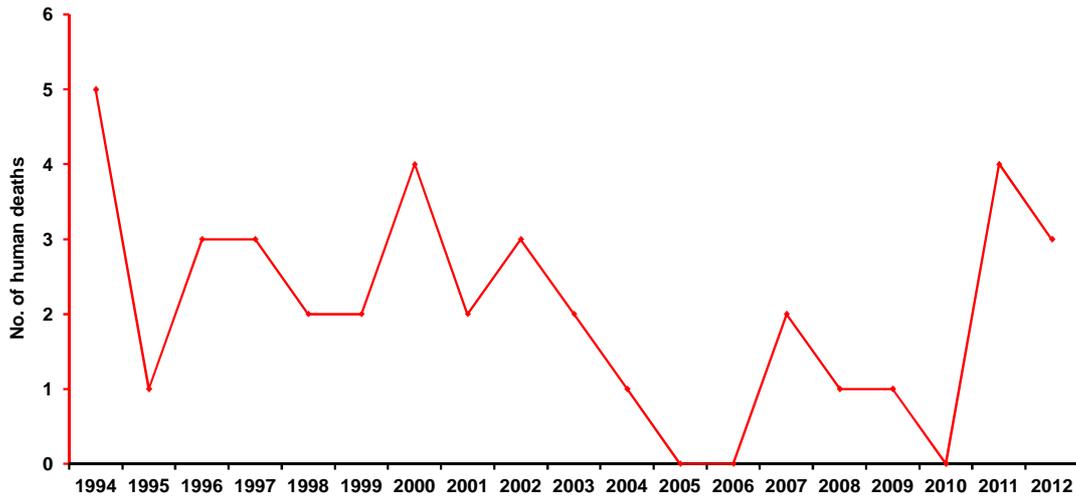
Figure 6. Temporal distribution of human deaths across years due to elephants
on the Valparai plateau (1994 - 2012)

Circumstances of death

A further analysis on circumstances of human deaths due to elephants revealed that 30
people (77%) died in unexpected accidental encounters and lack safety measures at
work place and home (Figure 7). Physical infirmities such as inadequate competent
physical and mental faculties, ignoring elephant messages, lack of conscious decision in
close encounters resulted in remaining deaths. However, in two cases substantial
circumstances were not established. In 35 of 39 cases, people were unaware of elephant
presence while in other cases, three were in inebriated condition and one person
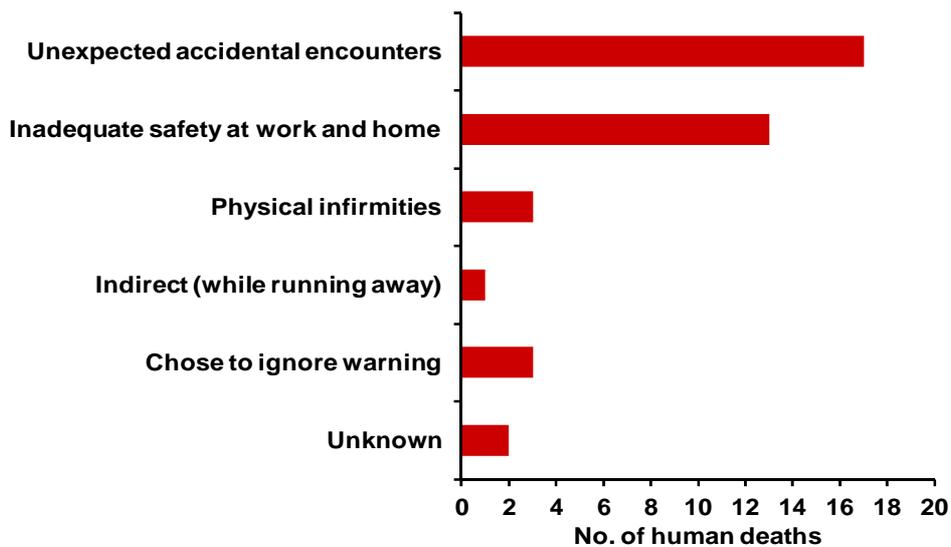misjudged elephant movements.

Figure 7. Circumstance of human deaths in fatal encounters with elephants on
the Valparai plateau (1994 - 2012)

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Responses to VTV and SMS initiatives

A total of 284 response calls for VTV network with an average of 12 calls/month (Figure 8a) in a two year period and 2441 response calls received for Bulk SMS initiative with an average of 116 calls/month in a 21–month period (Figure 8b). Number of response calls from people for VTV network declined from July 2011 and remained low during rest of months. Whereas, response calls for bulk SMS initiative remained higher than VTV network and varied across months.
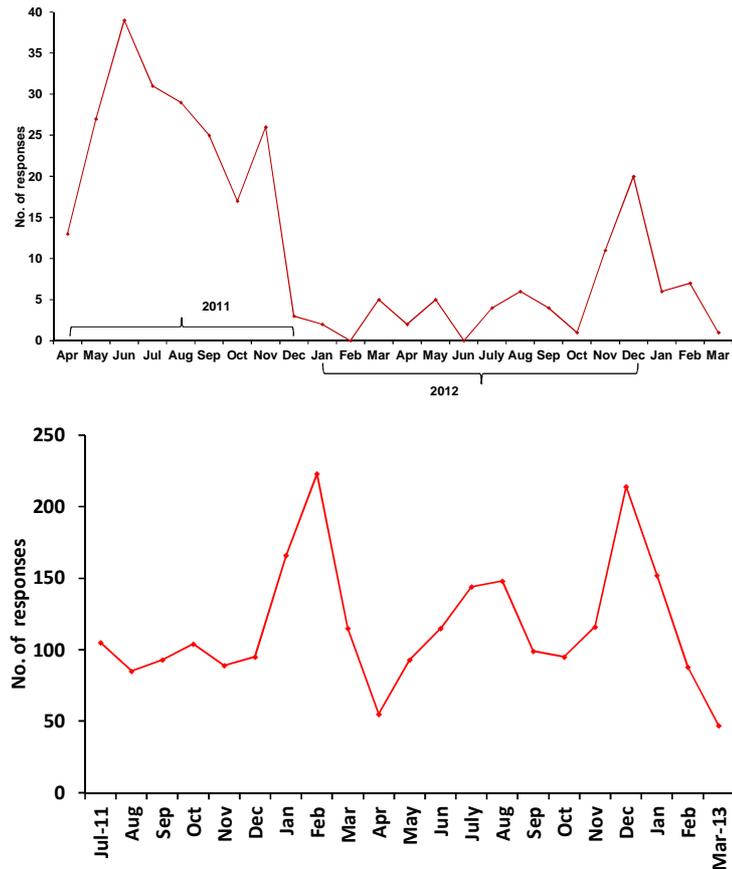

Figure 8. Response calls from people for VTV (upper panel) and bulk SMS initiative (lower panel)

Response calls from people for SMS service reached peak during January and March in 2011, June – August and November – December in 2012.

Community involvement in elephant alert indicator operations.

Percentage of elephant alert indicator operation was analyzed for 25 mobile operated early warning lights to determine community involvement in alerting local people about elephant presence in their respective localities (Figure 9). Of the 1423 light operations, number of operations per month was high between November and February, a period of high elephant movement activity on the Valparai plateau. Active involvement by local community was observed in alert indicator operations (1254 operations) than the conservation group (169 operations) during 17–month period. Except for initial period of installation of indicators (November 2011 – February 2012), an average of 97.4% of operations per month was carried out by community as compared to conservation group between March 12 – March 13. Local community and conservation group differed significantly in operations of alert light indicators (t = 4.07, df = 32, p = < 0.01).
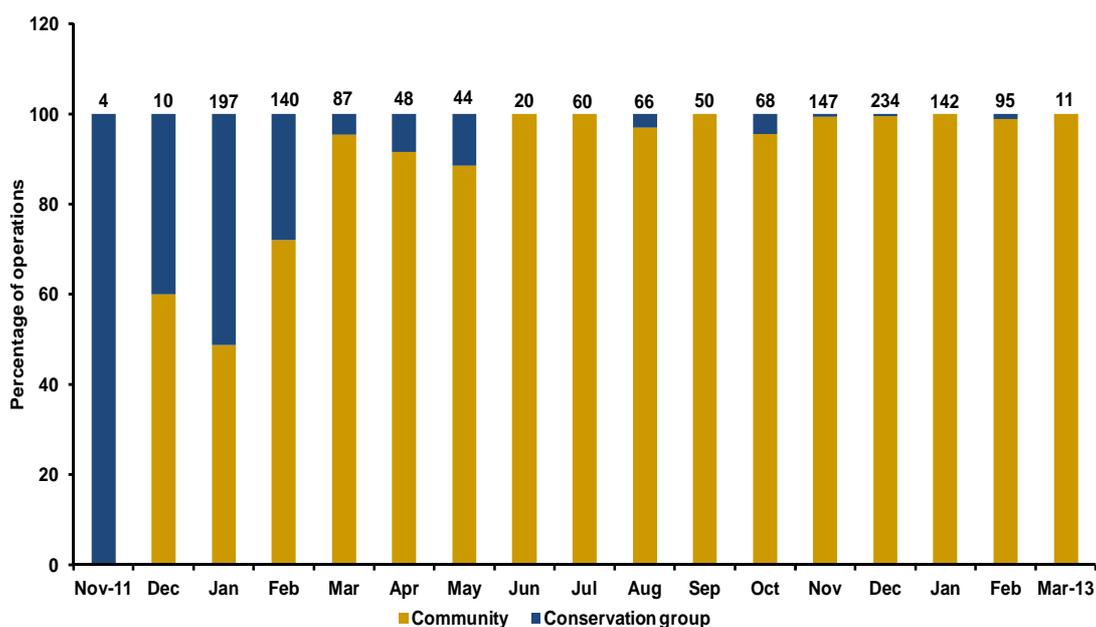
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Figure 9. Percentage of elephant alert indicator operations across months carried out by local community and conservation group. Values above bars indicate total number of operations per month

Effectiveness of alert indicator operations by local community

Effectiveness of alert indicators (n = 25) in communicating about elephant presence or absence within 1 km radius for each light for 17 months was analyzed to estimate false alarms and failed operations (Table 1). False alarms (n=33) and failed operations (n=57) represented significantly less than one percent of total number of days (χ^2 = 7285.19, df = 1, p < 0.01)

Table 1: Showing false alarms and failed operations of lights in 25 elephant alert indicators locations

	Light on (no. of days)	Light off (no. of days)	Total (no. of days)
Elephant presence within 1 km radius from alert indicators	1389	57	1446
Elephant absence within 1 km radius from alert indicators	34	6404	6438
Total	1423	6461	7884

DISCUSSION

Human-elephant conflict is a complex issue and conflict resolution based on effective and appropriate mitigation measures help promotes human-elephant coexistence in altered landscapes. The Valparai plateau with tea and coffee plantations, high human density, frequent elephant movements, and their conflicts with people poses a challenge for conservation of elephants in fragmented landscapes. Implementing conflict mitigation measures and assessing their effectiveness for their suitability and sustainability depends on active involvement of local community and adoptability of techniques in human-elephant conflict management (Osborn and Parker 2003, Hedges and Gunaryadi 2009).

On the Valparai plateau, regular elephant herds have shown consistent movement patterns over the past two years which reiterate the fact that elephants exhibit strong fidelity to their ranges (Fernando *et al* 2008). High concentration of elephant locations along rivers indicate that riverine system would play an important role in elephant use of areas and facilitate their movements across the plateau, indicate for importance of corridor development with native species along rivers (Kumar *et al* 2010).

Overall decrease in incidence of property damage incidents from Year 1 to Year 2 could be attributed to two reasons. One, communicating elephant movements and their presence in plantations over bulk SMS service has alerted people to take adequate precautions to safe guard their property and seek the help of concerned estate authorities to prevent damages to property by elephants to certain locations. Secondly, efforts by the anti depredation squad in the Forest Department have been effective in preventing damages to property. Such timely actions resulted in overall reduction of conflicts by 1.7 times (42%) in the second year as compared to first year. However exploration of data on places of damage by elephants revealed that damages to noon-meal centres in schools, residential colonies, and other places such as muster rolls, estate office, tea factory buildings etc decreased while it increased to ration shops. Increased proportion of damages to ration shop by elephants was primarily due to repeated damages to certain food grain stores to access food grains such as rice, dhal, lentils, and salt by elephants and absence of protective measures to these places. Measures such as electric fencing, deploying watchers, and arranging elephant drives using anti depredation vehicles were taken by the authorities prioritizing the protection of few human residential colonies which resulted in decrease in total number of damages. However, increase in proportion of damages to houses in the second year

indicates lack of protective strategies for remaining colonies and certain repeatedly damaged houses. Caution needs to be taken while adopting these mitigation measures that protection of few places should not result in increasing damages in surrounding areas. Measures such as elephant drives need to be used as a last resort when all other options of deflecting elephant movement away from residential areas or food grain stores failed. Such reactive measures if employed indiscriminately may cause severe stress in elephants particularly young ones and endanger people lives who operate drives. It appears that buildings such as muster rolls, office buildings etc were paid more attention to prevent damages which resulted in substantial reduction in number of conflicts in others category in the later year. No storage of food grains in school non-meal centres have also helped in reduction of number of conflict incidents in the Year 2. Property damage incidents by elephants could be minimized by adopting preventive and protective conflict mitigation measures in targeted locations. Better storage practices of food grains, mobile distribution of essential commodities, deploying physical barriers such as electric fences to identified residential places and food grain stores without blocking elephant movements, would help further reduction in elephant damages to property and increase people tolerance levels towards elephants. Chasing of elephants using trucks and bursting crackers to drive away elephants from plantations has been less in the second year (Forest Department field staff communications). No disturbance to elephants when they are away from habitations (minimum 100 m), strict avoidance of chasing, and facilitating free movement of elephants through plantations need to be strictly implemented. Better conflict management practices by concerned authorities would help promote human-elephant coexistence.

Temporally conflict incidents have been distributed in all months in both years, there was substantial decrease in occurrence of elephant damage incidents across months in the later year. It is apparent from the results that presence of elephant herds on the plateau did not significantly change in both years which indicate that time spent (number of days) by elephant herds on the plateau need not necessarily lead to occurrence of conflicts. Though the functional relationship between occurrence of conflict incidents and elephant presence days (elephant herd days) was significant but it had partial effect on number of conflicts. Much of the variation in occurrence of damages by elephants could be attributed to better communication systems about elephants initiated during the study, conflict avoidance measures taken by people, companies, and forest department, ecological and environmental factors such as rainfall, composition of

vegetation cover etc., and landscape features (Leimgruber *et al* 2003, Sitati *et al* 2003, Murwira and Skidmore 2005, Prasad *et al* 2011)

In India, an average 400 people (more than one person per day) lose their lives annually due to elephants and 100 elephants are killed by people in retaliation (Rangarajan *et al* 2010). With increasing and spreading of human-elephant conflict during the last two decades, a minimum of 50,000 families are being affected (Rangarajan *et al* 2010). Loss of human life and injuries in accidental encounters with elephants cause psycho-social impacts there by increases intolerance among local people towards elephants (Jadhav and Barua 2012). On the Valparai plateau, fatal encounters with elephants have become high priority conservation issue in human-elephant conflict resolution. Earlier studies (Kumar *et al* 2004, Kumar 2006, Kumar *et al* 2010) highlighted the importance of advance intimation about elephant presence to people which resulted in gradual decrease in number of human deaths and no fatal encounters occurred for two and half years on the plateau. Over years, since 2002, positive steps taken during intensive and continuous monitoring of elephants and communication about elephants to people has reduced human deaths from an average of 2.8 people per year prior to 2002 to 1.6/year in a 10-year period between 2002 – 2012 during which 12 people avoided fatal encounters with elephants. Over the last two years, systematic implementation of conflict mitigation initiatives which are aimed at increasing tolerance levels of people and adopt better precautionary practices to avoid direct encounters with elephants have been positive in alerting people about elephants in the Valparai region. Understanding circumstance of human deaths due to elephants is crucial to develop appropriate conflict mitigation measures and suggest precautionary steps to avoid direct encounters with elephants (Sitati and Ipara 2012). Circumstances of human deaths revealed a majority of people lost lives due to elephants were unaware of elephant presence. However, in few cases, particularly in 2012, three deaths occurred primarily due to ignoring early warning elephant message and misjudgment of elephant movements which necessitates carrying out awareness measures in local communities in dealing with human-elephant conflict.

Human-elephant conflict is determined by ecological, behavioural, environmental, and spatial and landscape correlates. However, implementation of conflict resolution measures largely depends on socio-economic costs which are associated with human-elephant conflict which outweigh actual damages by elephants. The perception of people in relation to human-wildlife conflict would influence conflict management and mitigation strategies in altered landscapes (Fernando *et al* 2005,

Dickman 2010). Instances such as human deaths due to elephants, restrictions on movement of people, fatigue due to guarding property, poor attendance of school as a result of loss of sleep or fear of travel etc., erode tolerance levels of people and negatively affect elephant conservation efforts (Hoare 2001, Madhusudan 2003, Nelson *et al* 2003). In the Valparai region, regular presence and movement of elephants in estates, dependency of people on tea and coffee plantations for livelihood compel elephants and humans to share resources. Accidental encounters with elephants have caused trauma and fear in people which warrant a need for effective elephant information network to promote human-elephant coexistence on the Valparai plateau. Advance intimation of elephant presence to local communities to prevent fatal encounters and safe guard property from elephants has been considered as an important mitigation measure in human-elephant conflict management (Sitati *et al* 2005, Hedges and Gunaryadi 2009, Graham *et al* 2011, Sugumar and Jayaparvathy 2013). Of the two measures of early warning message services, cable television network had low response calls from people as compared to bulk SMS service. Monthly variation to SMS service was primarily due to intensity of elephant activity in respective months which resulted in receipt of higher number of response calls during November to February (peak period) than in other months. Majority of response calls from local people for SMS and television network services were intimating about elephant presence for speedy communication to others and seeking help to know precautionary steps to avoid direct encounters and safeguarding property from elephants. The current conflict mitigation measures have facilitated multiple communication networks among local people which indicate positive reception of measures. During the past one and half year, the number of people willing to avail SMS service to receive elephant information on mobile phones grew from 600 to 2700 which indicates positive impact and benefits of SMS message service in the management of human-elephant conflict. Receiving elephant messages on mobile phones continued to be the most convenient and effective early warning mitigation for human-elephant conflict on the Valparai plateau.

Involvement of stakeholders in the management of human-wildlife conflict is crucial for conflict resolution (Osborn and Parker 2003, Treves *et al* 2009, Bal *et al* 2012). Elephant alert indicators installed in 25 locations were useful in communicating about elephant presence within 1 km radius from each of light when they were operated by identified people. These mobile operated indicators were also useful as early warning systems for people who failed to notice elephant news on cable television channel or unable to receive or read elephant messages on mobile phones. Sustained active

participation by local community in the use of elephant alert indicators is evident from the results that operation of indicators by people remained high (an average of 97% between March 2012 – March 2013). Gradual increase in alert indicator operations by people over months signify the positive impact of measure, seriousness and responsibility of people to convey elephant presence to others in respective localities, and non-dependency of people over conservation organizations and concerned authorities to safeguard their lives and property. Responsible operations by local community in alerting people about elephants in plantation were visible from the results that false alarms and failed operations remained less than one percent. False alarms in operation of lights were mainly due to anticipation of elephant movement in their respective localities. Failed operations were mostly due to technical faults as result of lightening, electrical failures, and network faults which are beyond the control of operators.

CONCLUSIONS

The present experimental study on human-elephant conflict mitigation measures brings out the following salient findings.

1. The Valparai plateau with frequent movement and use of natural and manmade habitats by elephants and dependency of people over tea and coffee plantations for their survival, measures that aim at promoting coexistence between people and elephants is the only solution to deal with human-elephant conflict management.

2. Early warning messages about elephants and timely action by Tamil Nadu Forest Department field staff and company management resulted in less number of property damage incidents due to elephants. However, certain identified residential places and ration shops which are repeatedly damaged by elephants would require targeted mitigation approach.

3. Better management practices adopted by stakeholders have resulted in overall reduction in conflict incidents over a period of time.

4. Elephant Information network has been critical for avoiding direct encounters with elephants. Ignoring elephant information would result in loss of life.

5. Early warning initiatives have been positively received by people, company management, and government authorities to safeguard lives and effectively

manage conflict situation. Tamil Nadu Forest Department initiative to cover other estate areas with elephant alert indicators in Valparai is a positive step and adoption of these techniques indicates the positive impact of early warning systems.

6. Active involvement by people, local companies, and forest department personnel in conflict mitigation measures and sharing responsibility of managing conflicts is a way forward towards human-elephant coexistence. Willingness to continue collective efforts by stakeholders would make these measures sustainable and decrease the burden on any single/fewer agencies.

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