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RESEARCH ARTICLE

HUMAN ELEPHANT CONFLICT ISSUES IN THE FRAGMENTED O'VALLEY FOREST RANGE, GUDALUR FOREST DIVISION, THE NILGIRIS, TAMILNADU

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ABSTRACT

Human Elephant Conflict (HEC) issues on O'valley Forest Range, Gudalur Forest Division, Tamil Nadu (11º 27'17 ''N, 76º 28'43'' E) was carried out from December 2016 to February 2017. It is an important landscape for Conflict issues to compare other forest ranges in Gudalur Division. The results of human deaths due to elephants found that totally 11 deaths were recorded during past 10 years. Of which, 2014 and 2015 attributed highest deaths (54%). The month wise human casualities showed that deaths were in peak between December and July. Most of the human death incidences were occured between 08:00 hrs and 10:00 hrs (27 %). The sex and location of human deaths result showed that men were more severely affected than the women. Among the males (n=4) about 80 % of deaths were recorded. The results of age category of victims showed that 40 to 50 years were affected 55 % followed by 50 to 60 years age category (36 %) irrespective of sex . Totally 5 elephant deaths were recorded from 2008 to 2016. The main almost all deaths, were due to diseases and natural death. The highest percentage of deaths were recorded in 2012 to 2014 as 80 %. An average of only 0.56 % elephant deaths per year , of which 80 % of the elephants were male, and most of them adult category 16 to 40 years old and totally Rs. 277272.727/- was paid as ex-gratia for human deaths and injury caused by the elephants. Totally 23 houses were damaged by elephant from 2008 to 2016, 2.88 houses per year.

Key words: Human elephant conflict, Gudalur, O'Valley, The Nilgiris.

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INTRODUCTION

Asian elephant (*Elephas maximus*) is an endangered species (IUCN Red List, 2006), about 6000 years ago enjoyed a much wider geographic distribution and higher number than it does today. The elephant population estimation in India shows that 27,694 elephant and (ranges from 27669 to 27719) with largest population are regionally seen in southern India (Project elephant, 2009). HEC refers to the negative interactions between humans and elephants. Some of the negative effects of elephants to humans include crop-raiding and deaths and injuries to humans and livestock. Across Southeast Asia, tropical deforestation continues at alarming rates (Santiapillai and Jackson, 1990; Achard *et al*., 2007; Hansen *et al*., 2009bf). Large-bodied mammals, depending on the large areas of suitable habitat to meet their dietary demands, are considered to be particularly vulnerable to the effects of habitat transformation (Shannon *et al*., 2009). The elephant is one of the most conflicts – prone wildlife species in India causing large scale damage to crops and human lives. Each year, nearly 400 people and 100 elephants are killed in conflict related instances in India, and nearly 500,000 families are affected by crop damage (MoEF, 2010). HEC is the major challenge to the conservation of Asian elephant, resolving HEC is the major concern among the conservation community (Tchamba, 1996; Hedges, 2006). The present levels of high conflict contribute to developing negative attitude towards elephants, particularly where they exist outside protected areas (Fernando *et al,* 2005).The HEC includes crop damage, human casualities, house and other infrastructure damage by elephants and elephant mortality by human (Barua and Bist, 1995; Sukumar, 1989; Zhang and Wang, 2003). The growing human population with its increasing demands for land for agricultural and development has reduced the once vast natural habitats in to small habitat islands. These habitats continue to be exposed to further fragmentation and degradation, leading to an increase in the level of conflict between animals and human. It is especially intense where the animals concerned are in a position to cause several damages to human life and property. Human death by elephant are being large animals they range over large area to meet their requirement of food, water and shelter, and this brings them in to greater contact with human settlement thus increasing the probability of crop raiding or human death by elephants. Sukumar (1990) has suggested that feeding on crop is related to its optimal foraging strategy crops as a part of their feeding strategy then it had mean that all

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elephant in population would raid so this concern the highly fragmented O'Valley Forest Range was selected with the following objectives to document the Human causalities and elephant's deaths due to conflict, to assess the various Human elephant conflict issues in the study area.

Study area

O'Valley Forest Range (500 Sq.M) located (11º 27'17 ''N, 76º 28'43'' E) in southern Western Ghats of Gudalur Forest Division, Nilgiri district, Tamilnadu, south India. The Gudalur Forest Division is located 51 Km west of Udhagamandalam City and is on the boundary of Tamilnadu, Kerala and Karnataka State. It is a protected Area under (Section 17) 1976. The O'Valley Forest Range consisting a different habitat types viz., Southern Dry Deciduous Forest (SDDF), Evergreen Forest (EF), Grassland Forest (GF) and Plantation (PL) (Tea, Coffee, Cardamom, Arecanut, Cocount, Clove). Most of these studies were concentrated on the various elephant ranges across the country. However, the Gudalur Forest Division particularly O'Valley Forest Range gets less attention in terms of scientific study except few studies and no detailed information is available on these aspects.

MATERIALS AND METHODS

Assessment of HEC issues

The data base was collected over the year from 2008 – 2016 from O'Valley Forest Range. The details included human deaths caused by elephants, Elephant deaths due to conflict and Property damage caused by elephants due to conflict. The variables such as number of deaths (human and elephants), year of incident, month of incident, timing of incident, and age class, sex category of victims, occurrence of death inside and outside forest, type of the property were extracted from the official records and pooled together on yearly basis.

RESULTS

Human deaths caused by elephants

Totally eleven human deaths were recorded due to elephants for the past nine years from 2008 to 2016, the result showed that the years between (1.1deaths / year) Of which years 2014 and 2015 attributed highest deaths (n=6, 54.54%). It is important to note that any human deaths were not reported during the years between 2010 and 2011. Similarly part of the victims were recorded inside the forest areas (50%) and outside forest (50%). The regression value was r= 0.17 between the number of deaths per year (Table. 1 and Fig. 1.).

Table 1. Human causality caused by elephants between 2008 to 2017 (n=11) in and around O'valley Forest Range

Age	Number of human deaths	Location of human death	
		Inside Forest	Outside Forest
1 to 10	0	0	0
11 to 20	0	0	0
21 to 30	0	0	0
31 to 40	0	0	0
41 to 50	6	3	3
51 to 60	4	1	3
61 to 70	1	1	0

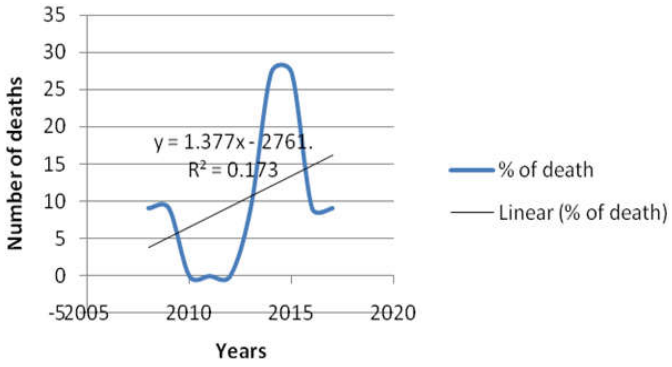

Figure 1. Number of human deaths occurred the years between 2008 and 2017

The month wise human casualities are represented in The result revealed that peak human casualties were recorded in the month of December (n=4, 36.36%) followed by July (n=2, 18 %). It is important to note that none of the human deaths were not reported during the months of January, June, August September and October in and around O'Valley Forest Range (Fig. 2).

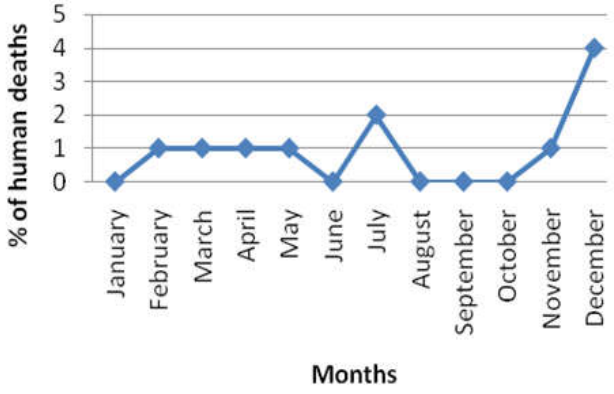

Figure 2. Month wise occurrences of human deaths caused by elephants from 2008 to 2017 (n=11) in and around O'Valley Forest Range

The time of the human deaths caused by elephants recorded for the eleven causes, the result revealed that most of the causes recorded that the timing between 8:00 hrs to 10:00 hrs (n=3, 27.28%) as well as 18:00 hrs and 20:00 hrs (n=2, 18.18%) (Fig. 3).

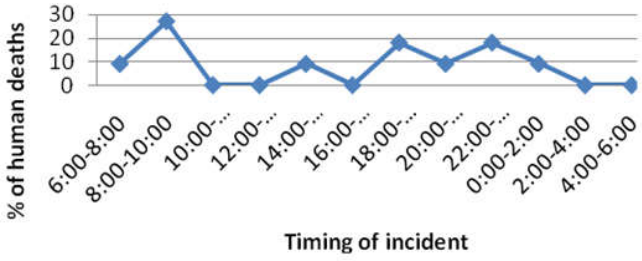

Figure 3. Time of human deaths caused by elephants in and around O'Valley Forest Range

The sex and location of human deaths caused by elephants result showed that men were more severely affected than the women. No significant diffrencewas noticed on the deaths recorded between out side and inside forest areas. Among the males (n=5) about 50 % of deaths were occurred in outside and 50 % of the death occurred inside forest. On the contrary no

female death were noticed inside forest and only one insident was recored out side the forest areas (Fig. 4).

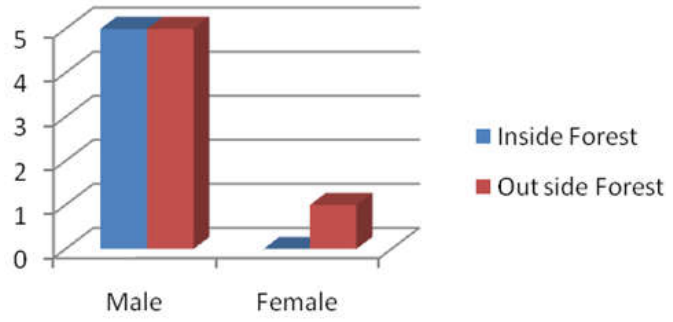

Figure 4. Sex category of human victims caused by elephant attacks from 2008 to 2017 in and around O'Valley Forest range

The age category of victims caused by elephants showed that the age category between 40 and 50 years old age category was severly affcted with the highest propotionate (n=6, 54.55 %) followed by 50 to 60 years age category (n=4, 36.36 %) irrespective of sex between 2008 and 2017, On the contrary none of the human deaths were recorded the age class between 10 and 40 years and more than 70 years old category (Fig. 5).

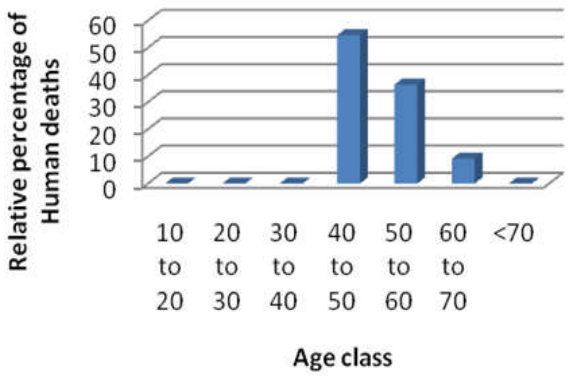

Figure 5. Relative percentage of different age classes of victims by elephants from 2008 to 2017 (n=11) Causes of elephant deaths

The elephants death due to conflict in and arround O'Valley forest range in the years between 2008 and 2017 result revealed that totally five elephants (0.56 per year) were died. Of which male elephants were contributed highest numbers (n=4) to compare females (n=1). Similarly the years 2012 and 2014 (n=4, 80%) attributed more number of deaths then any years (Fig. 6.).

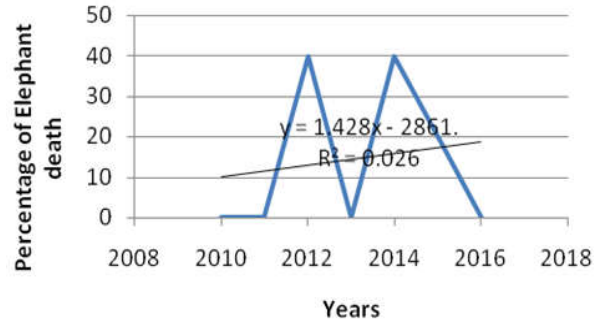

Figure 6. Percentage of elephants death due to conflict in the years between 2008 to 2017 (n=5) in and arround O'Valley Forest range

The month wise elephant deaths due to conflict, the result revealed that the months between January and March attributed more number of deaths (n=3, 60%) when compared to other months (Fig. 7.).

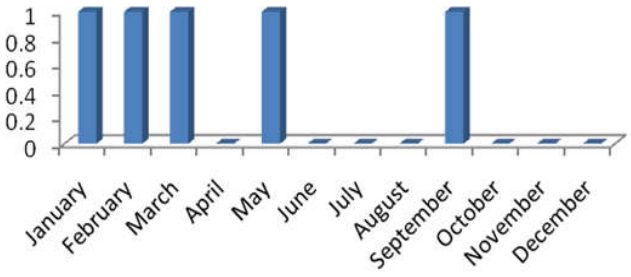

Figure 7. Months wise occurrences of elephant death due to conflict from 2008 to 2016 (n=5)

Table 2. Age and sex class of elephants death due to conflict from 2008 to 2017 (n=5) in and around O'Valley Forest Range

S.No	Age class	Male	Female
1	Calf (Age > 1 years old)	0	0
2	Juvenile (Age 1 - 5 years old)	0	0
3	Sub adult (Age 6 - 15 years old	0	0
4	Adult (16 - 40 years old	4	1
5	Old < 65 years old	0	0

The age and sex class of elephant's death from 2008 to 2017 results showed that the Adult age (16 – 40 years old) category was recorded highest numbers than other age class of elephants in the O'Valley Forest Range (Table. 2).

Property damaged by elephants

Property damaged by elephants was recorded in the O'Valley Forest Range from 2008 to 2016 the results revealed that totally twenty three properties (Houses) were damaged by elephants (Mean and SE= 2.88±0.29). Of which in the year 2012 (n=6, 26.09 %) and 2010 (n=6, 26.09 %) attributed more numbers and, which was followed by in the year of 2011 (n=21.74 %) and 2009 (n=3, 13.04 %). On the contrary no damages were recorded in the years 2014 and 2016. The Regression value is significant by year to year ($R^2 = 0.56$) (Fig. 8). Month wise property damage was taken in the study area. The results showing that June (n=7, 30.43%) and July (n=3, 14.04%) months were attributed more number of damages to compared to other months,

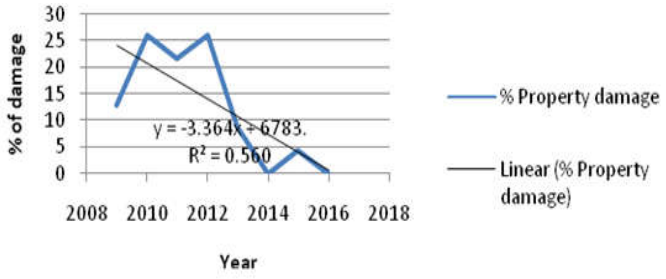

Figure 8. Percentage of properties was damaged by elephants from 2008 to 2017 in and around the O'Valley Forest range

February (n=2, 8.69%), April (n=2, 8.69%),) and October (n=2, 8.69%) months had moderate percentage of property damage caused by elephants. Property damage due to HEC is significantly differ between the years and months ($ch^2 = 1.07$, P> 0.83). On the contrary the months between January and November had no none of properties damaged (Fig. 9).

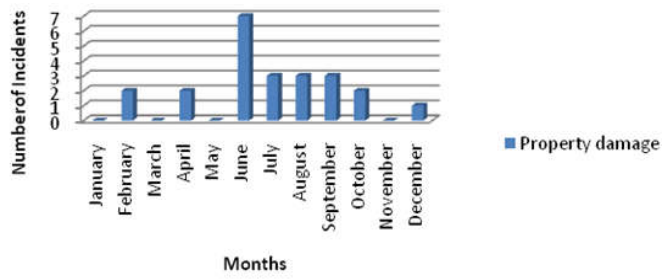

Figure 9. Month wise property damage caused by elephants in the study area

Season wise property damage caused by elephants was recorded in the O'Valley Forest range, The result revealed that Wet season (June to December) (n=19, 83%) contributed more number of property damage than Dry season (January to May) (n= 4, 17 %). (Fig. 10).

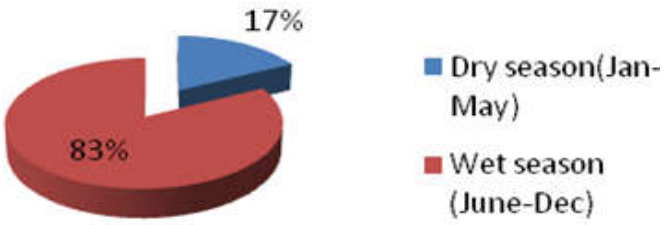

Figure 10. Season wise property damage caused by elephants in the study area

DISCUSSION

Humans and human activities are the ultimate cause of this rapid biodiversity loss, as unprecedented numbers of people compete with other species to meet the growing per capita demands for land and resources. Loss of human life and the property damage were the most serious form of human-elephant conflict according to the ranking by local communities (Sitati and Ipara, 2007). Crop damage accounts for major type of conflict followed by human deaths in Asia (Zhang and Wang, 2003; Bandara and Tisdell, 2003) and Africa (Tchamba, 1996, O'Connell-Rodwell *et al*., 2000; Sitati *et al*., 2003; Smith and Kasiki, 2000). Human deaths and injuries are a major form of conflict in elephant ranges, yet these have only been simply described in most of the studies (Sukumar, 2003) or totally avoided. In India 22 % of elephant habitats falling under protected areas. Since the rest of their range lies in areas of increasing human density where there is intense competition for the same resources, the conflict is inevitable. The estimated 28,000 wild elephants in India are distributed over an area of about 109,500 sq. km., about three per cent of the country's geographical area. In some of these tracts, a segment of the elephant population killed an average of 350 people annually over the last five years (2005-2010) (Lenin and Sukumar 2011). The present study in the O'Valley Forest Range on HEC found that totally eleven persons were killed by elephants between 2008 to 2017. On the contrary human deaths were not reported during 2010 and 2011. This could be due to blockage of elephant migratory route and adjoining areas during 1990s by severe land use changes in the Gudalur Forest division. Rama krishnan (2007) pointed out that the indiscriminate growth in the construction of buildings in the forms of resorts, educational institutions, ashrams and amusement parks in the fringes of the corridors considerably affects the movement of elephants which becomes a cause for the human-elephant conflict.

On the contrary there are none of the huge construction were build in the O'Valley Forest range because this range lying in the section 17 category. But due to the highly fragmented landscape the elephant corridor was totally destructed in the landscape. The human causalities between 2014 and 2015 alone attributed to 54 % of overall deaths. This drastic increase in case of human deaths by elephants could be as a result of recent creation of Elephant Proof Trench (EPT), which gives the people overconfidence to move freely in the forest fringe villages and roam around during nights, increase the probability of more encounter with elephants. Even though EPT has been created in majority of the area in the Gudalur forest division, still elephants are straying out into the villages through the rocks and Nullahs were crossing, which leftover between the EPTs. It is suggested that an early warning system about the presence of the elephant, in addition to EPTs, may be required for the villagers who live close vicinity to the elephant range areas that will ensure more protection. The present study showing that the timing of human casulities revealed that 55% of incidences occurred during day time between 08:00 hrs and 20:00 hrs, and the rest (45.46 %) during night time between 20:00 hrs and 06:00 hrs irrespective of locations.

Timing of human casualities with respective to location revealed that more incidences occurred during day time in forests (50 %) and the rest in night. This findings coroborated with the Datye and Bhagwat (1995) that 96% of people killed by elephants in Dalma Wildlife Sanctuary during the day time within the forest. Sukumar (1989) pointed out that out of 123 human mortality cases reported in the Biligirirangans, 55% occurred in forests during the day time and 45% in settlements at night. In the present study it was found that two peak elephant attack months in this range as July 36 % and December 18 %, and the season was wet season June to December. The highest peak season of human casualty coincide with the elephant migratory season (October – February). It was also found that 50 % of the human casualities (n=11) occurred in outside the forests and the rest in forest areas between 2008 to 2017. Similar findings were also recorded by Sukumar *et al.,* (2003) in north Bengal (Buxa Tiger Reserve and Jaldapara Wildlife Sanctuary), that 75% occurred in crop lands and villages and the rest in forests during 2002-2003. The possible reason for the cause of more human deaths in outside forests could be due to the fact that only few villages or settlements located nearby the forest areas in this range also most of the tea estates were located nearby Reserve Forests and those villagers are well aware about elephants as well. In our present study totally 23 houses were damaged by elephants of which years 2010 and 2012 contributed more number of damages 52 %, the possible reason for this issue correlated with since this range located between the main elephant corridor between Nilambur-Mudumalai- Naduvattam (Right of Passage, 2011). The age category of victims revealed that 40- 60 age class people were highly affected in outside forests (90%), to compare rest of the people (10 %). In terms of sex category, more men (80%) were killed by elephant irrespective of location. A total of 5 elephants died in the O'Valley Forest Range between 2008 to 2016. Of which 80 % were male and 20 % were female. Bist (2002) recorded that an average of 41 elephants died annually due to human–elephant conflict with poisoning taking the major share (61%) followed by electrocution (39%). The intensity increased during 2002–03 as 53 elephants died due to electrocution and poisoning across India (Project Elephant, 2009) accounting for 36% of total elephant mortality recorded

during that period. On the the contrary all five elephants died naturally in the O'Valley Forest Range.Human deaths caused by elephants increased drastically in last three years in the O'Valley Forest Range. This negative experiences and fear of the elephant is likely to create a negative attitude among the people. If this negative trend continues further, elephant conservation in this region would be a very tough challenge for the managers, elephant scientists and conservationists in the forthcoming years. A recent study of Ramkumar *et al*., (2013) on people's perception on HEC revealed that even though HEC is in increasing trend over the years near forest areas in the Coimbatore Forest Division, still most of the people showed positive attitude towards elephant conservation. On the contrary in O'Valley Forest range most of them showed negative attitude on elephants because of the section 17 issue.

This is not a good sign to conserve Asian elephants from decrease and control HEC in this region. The growth of the human population has led to encroachment on elephant habitat, forcing elephants to move into agricultural fields to forage (Gubbi and Lahiri choudhury, 2000), particularly during the harvest period, when raiding by elephants is most common (Gurung, 2006). Overall, survivorship is low: more so for adult males than females, and the recently assessed sex ratios of adults is still skewed towards females, a legacy of the ivory poaching in the past. The proportion of illegal killings (0.22) is higher than that reported for Asian Elephants. (Burn *et al.,* 2011), which might increase further if the causes for the majority of recent deaths could be established. The adult females in the population despite facing less threat from humans have lower survivorship than female timber elephants in Myanmar (Clubb *et al.,* 2008). The Nilgiris-Eastern Ghats region holds the largest population of Asian Elephants in the wild, and is critical for the long term survival of the species. This range lies within a matrix of human dominated landscapes where high human densities, expansion of settlements and intensive agriculture are serious threats. Maintaining the viability of this population in the midst of inhospitable landscapes is a challenge for conservation. These forests which connect the Western and Eastern Ghats, and provide a passage to higher elevation ecosystems, are important range lands for elephants (Davidar *et al.,* 2012). Particularly the range O'Valley is the one of the huge fragmented and conflicted landscape in the Gudalur Forest Division, the reason was elephants movement between Mudumalai Tiger Reserve and Nilambur Forest Division via O'Valley adjoin as a major passage route for elephants. Which indicating the movements of elephants from Mudumalai Tiger Reserve to Nilambur Forest Division is possible only through the encroachments in O'Valley.

The important elephant movement path from Nilambur to Mudumalai TR is Periasholai, Amblimalai, Shanthi Estate, Seaforth, Yellamalai, and New hope, Barathinagar, Marapalam and Gudalur Ginger Traders Estate. Apart from this, elephants are also using the following areas for their regular movements Gudalurmalai, Balmadi, Suffolk- Lauriston, Athur, Guynd, Gandinagar, Kelly, Barwood, Glenvance, Moolakad-Polikundha within the O'Valley. Therefore O'Valley Forest Range comprises human-elephant conflict is higher level compared to other Forest Ranges in Gudalur Forest Division. The main reasons for the HEC in the O' valley range is the EPT and other preventive methods can be considered as only short term, which may provide some immediate relief. In addition to EPT, modern tools using mobile communications such as mobile alerts and alarms and early warning systems about elephant presence can be tried. As long term measure, intensive management of elephant migratory routes is needed (Ramkumar *et al.,* 2014a). Also management strategies in this division should be aimed at regulating land use changes in private lands at least 2 km from forest boundary, habitat improvement in foothill forests and detailed research on factors of human – elephant conflict and new techniques on control measures. Private lands located at least 200m from forest should be freed from all sort of physical barriers. In case of electric fencing, where ever it is an absolute need, fuse system should be made mandatory to avoid usage of high voltage in electric fences. The fuse system, if high voltage is used, will make the fence dysfunctional and also the data recorded in the fuse monitor can be used as evidence in case of need. Water sources could be provided along every 5 km in the forest foothills during summer, to negate the need for elephants to move further inlands into human areas.

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