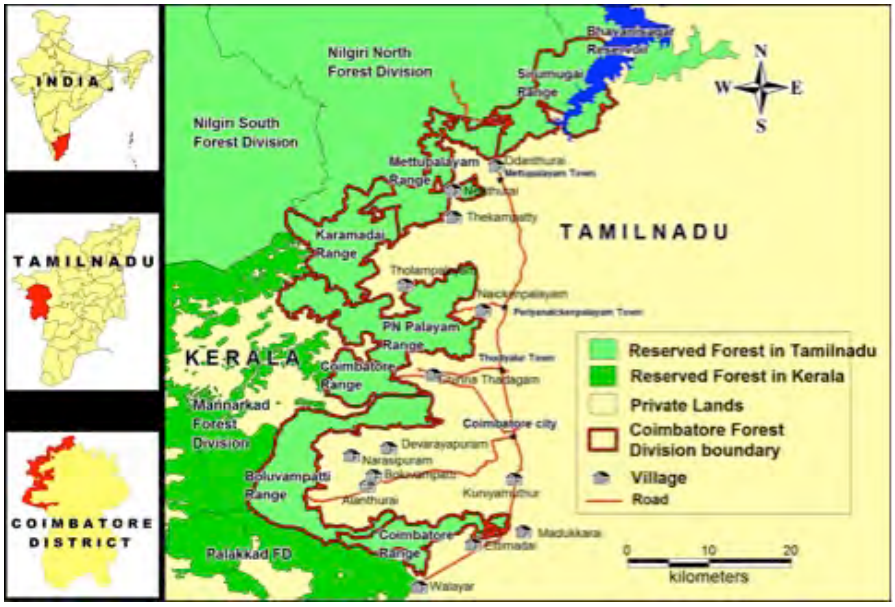
Human and Elephant *(Elephas maximus)* deaths due to conflict in Coimbatore Forest Division, Tamil Nadu, India

K. Ramkumar,[1*] B. Ramakrishnan,[2] S. Karthick[3] and R. Saravanamuthu[4]

Abstract

Human and elephant deaths due to conflict during the period 1999 to 2014 in Coimbatore Forest Division was analysed based on the secondary data collected from the forest department in order to find out the damage caused due to various conflict issues. The trend of human casualties over the last 16 years revealed a drastic increase in human death in the last five years. Ninety six human deaths due to HEC were recorded during the period. The human causalities between 2010 and 2014 alone attributed 59% of overall deaths. Most of the human deaths (67%) were recorded in outside of the forest areas. January (16.0%) and August (10.0%) months were found as highest human death caused by elephants. Most of the human deaths were occured between 1800 hrs and 2200 hrs. Totally 133 elephant deaths were recorded from 1999 to 2014. Among the causes of elephant deaths, disease attributed 37.6% followed by natural (27.1%), electrocution (18%) and slipped from slopes (6%). 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.

Key words: Asian elephant, Human death, Elephant death, HEC, Coimbatore division



Map 1. Study Area

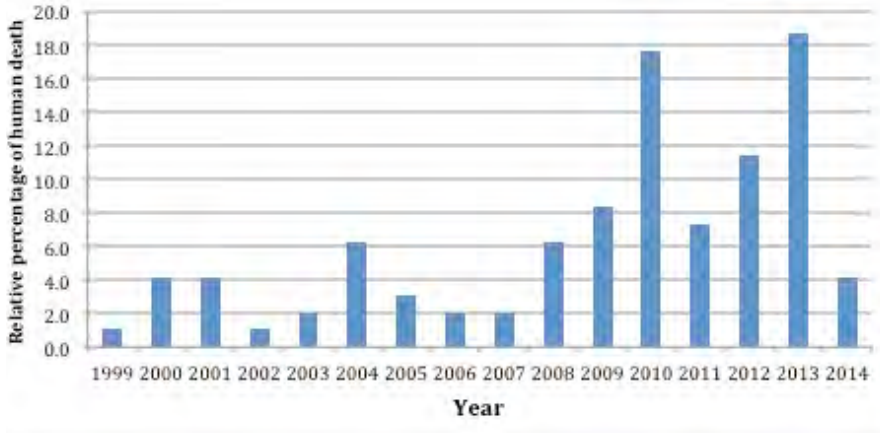


Fig 1. Relative percentage of human death caused by elephants from 1999 to 2014

Introduction

In India, Human-elephant conflict (HEC) is seen across the country in a variety of forms. The human–elephant conflict includes crop damage, human casualties, house and other infrastructure damage by elephants and elephant mortality by human (Barua and Bist 1995, Sukumar 1989, Balasubramanian *et al,* 1993, Zhang and Wang 2003).

Human-elephant conflict is dramatically on the rise and has become one of the major issues in the fight to save Asia's endangered elephants. Since the HEC is posing a major challenge to the conservation of Asian elephant, resolving human–elephant conflict is the major concern among the conservation community (Tchamba 1996, Hedges 2006). The elephant is one of the most conflict-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).

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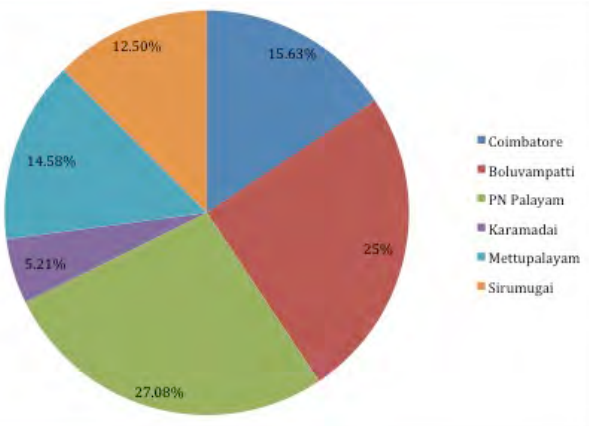

Fig 2. Human death caused by elephants in different forest ranges from 1999 to 2014 (N=96)

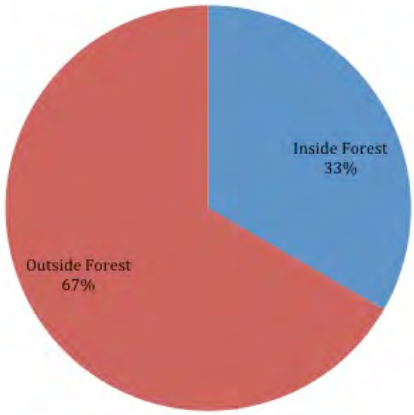

Fig 3. Location of human deaths taken place from 1999 to 2014 (N=96)

Sukumar (1989) reported killing of 30-50 people every year in southern India which has largest elephant habitat and population. Nath and Sukumar (1998) recorded an average six human deaths by elephants per year in Kodagu district of Karnataka. Dey (1991) reported human deaths ranging between 28–59 per year, from fragmented habitats of North West Bengal between 1980–90. Similar reporting by Barua and Bist (1995) from the same region accounts killing of average 47 people per year since 1981. Datye and Bhagwat (1995) reported a total of 208 human deaths between 1980 and 1991 from south Bihar (134) and south West Bengal (74) through pocketed elephants on a fragmented landscape.

Like humans, elephants do suffer due to the negative interactions inflicted on them through injury and killing. Several kinds of equipment, devices and chemicals are being used for such purposes. Conversion of elephant corridors into estates, buildings and crop cultivation sites results in crop damage and human causalities (Sukumar, 1990; Easa & Sankar, 1999).

The Coimbatore Forest Division is one of the severe HEC forest divisions in Nilgiri Biosphere Reserve of Western ghats, has a sizeable elephant population and viable habitat for the population of resident and also for the migratory elephants (Ramkumar *et al*., 2013). More than 20% of the area of the reserve forest serve as viable corridor for the movement of elephants between Silent Valley National Park (Western Ghats, Kerala) and Eastern Ghats and *vice-versa* (Sivaganesan *et al.,*2000). The movement of elephants in Coimbatore Forest Division is mostly restricted to foot hills due to escarpment of steep slope on the west and human habitations on the east. Therefore human-elephant conflict is higher level compared to other largely populated elephant habitats in South India (Ramkumar *et al*., 2014a).

Since Coimbatore Forest Division shares the eastern boundary at the length of about 350 km with human habitations and farm lands, the villages adjoining to the reserve forest boundary are highly prone to elephant depredation (Ramkumar *et al*., 2013). Earlier elephants used to visit only forest fringe villages, attracted by standing crops. These days however, elephants are coming frequently into the human habitation and crop fields located even more than five kilometers from forest boundary. It had been recorded that a herd of elephants had even 'strayed' 25 km away from forests in Coimbatore, Tamil Nadu in 2006 (Ramkumar, 2014). The elephant movements in this division are mostly restricted to very narrow paths of the foothills of the large mountains naturally near the human habitations. However, depredation is higher when compared to other largely populated elephant habitats.

Most of these studies were concentrated on various elephant ranges across the country. However the Coimbatore Forest Division gets less attention in terms of scientific study except few studies such as Ramakrishnan and Durairasu (2005), Ramakrishnan (2008) Ramakrishnan and Ramkumar (2007), Ramkumar *et al.,* (2013, 2014a) and no detailed information is available on HEC. Also HEC incidences are on the rise over the time in Coimbatore forest division. This study was attempted to assess the status of HEC in the past two decades with the objectives to record elephant and human deaths due to conflict, to find out various causes for HEC and the demography of elephant and human deaths due to conflict.

Methodology

Study Area

The Coimbatore Forest Division covers an area of 694 km² and is situated in the South-east of the Nilgiri Biosphere Reserve (NBR). The area lies between latitude 10°51' and 11°27' and longitude 76° 39' and 77° 4' (Ramkumar *et al.,* 2013). The Coimbatore Forest Division falls under the Elephant Reserve No. 8, in which Nilambur-Silent Valley of Kerala form the major portion of the tract. The Coimbatore Forest

Division is also part of Nilgiris and Eastern Ghats Landscape which is holding single largest Asian elephant population in the world. The study area covers six forest ranges (Coimbatore, Boluvampatti, PN Palayam, Karamadai, Mettupalayam and Sirumugai) of Coimbatore Forest Division (Map.1).

Methods

Assessment of human deaths

The available records on human death caused by elephant were considered to assess the conflict scenario in Coimbatore Forest Division over the years from 1990 to 2014. The variables such as number of human deaths caused by elephants, year of incident, month of incident, timing of incident, age and sex category of victims, occurrence of death inside and outside forest, name of the forest range were extracted from the official records of Forest department and pooled together on yearly basis.

Assessment of elephant deaths

The available records with the forest department on elephant deaths due to various causes were considered to assess the elephant mortality due to HEC in Coimbatore Forest Division over the years from 1990 to 2014. The variables such as name of the forest range where elephant died, sex of the elephant, month of death and various causes of death such as electrocution, poisoning, poaching, gunshot, accident (train hit, slipped from slopes and others), natural causes and disease were extracted from the records and pooled together on yearly basis.

Results

Human deaths caused by elephants

Totally 96 human deaths due to elephants were recorded during the past sixteen years. Of which, 2013 attributed highest deaths (n=18) followed by 2010 (n=17) and 2012 (n=11). From 1999 to 2009 over a period of ten years the casualty was ranged from just 1–8. On the contrary the trend has suddenly changed as 17 human deaths were occurred during 2010 and the subsequent years of 2011 to 2013 the casualty ranged from 7–18 (Table. 1). Similarly most of the victims were recorded inside the forest areas during 1999-2009, in contrast most of the victims were recorded outside the forest (human habitations, farm lands, villages, barren lands and any sort of lands located outside the boundary of reserved forest) areas since 2010 onwards (Table. 1) and (Fig. 1).

Among the forest ranges, PN Palayam range attributed highest proportion of human casualty (27.08%) caused by elephants followed by Boluvampatti (25%) and Coimbatore (15.63%) (Fig. 3). The lowest proportion of deaths was recorded in Karamadai range as 5.21%.

Fig 4. Month wise occurrences of human deaths caused by elephants from 1999 to 2014 (n=96)

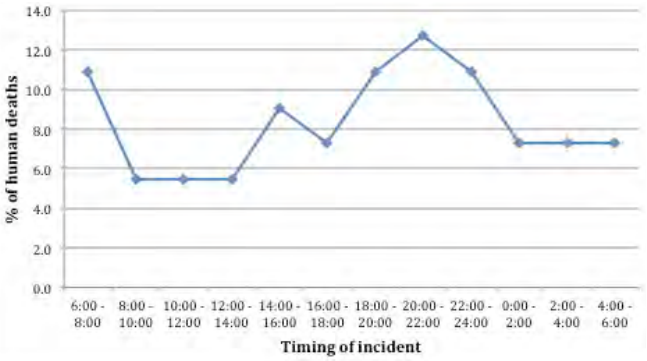

Fig 5 . Timing of occurrence of human death from 1999 to 2014 (N=55)

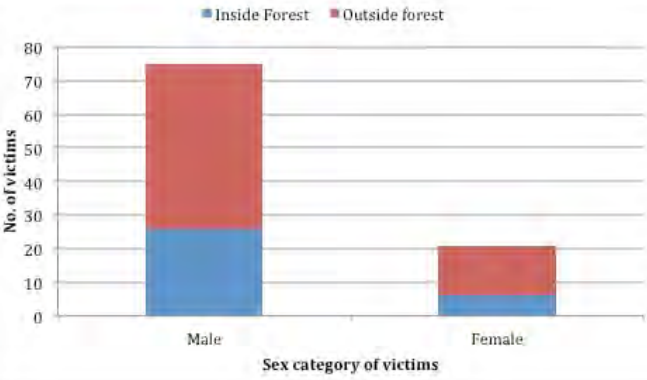

Fig 6. Sex category of victims by elephant attacks from 1999 to 2014

Totally 96 human deaths were recorded during the year between 1999 and 2014. Most of the human deaths were occurred in outside the forest areas (67%) and considerable human deaths were recorded inside forest areas (33%) (Fig. 3).

The month wise human casualities are represented in Figure 4. The result showed that peak human casualties were recorded in the months between December and February. It is noteworthy that the second highest casualty has been recorded in the months between July and September (Fig.4). Although two peak durations have been found, January (16.0%) and August (10.0%) months were

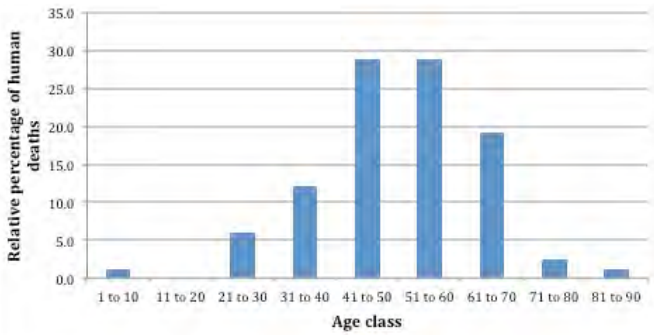

Fig 7. Relative percentage of different age classes of victims by elephants from 1999 to 2014 (N=83)

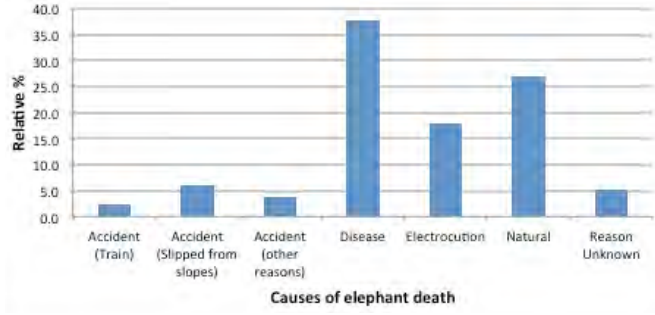

Fig 8. Relative percentage of causes of elephant deaths

found as highest peak human death months caused by elephants in the Coimbatore Forest Division.

The time of deaths caused by elephants were recorded only for 55 cases. Most of the incidences occured between 2000 hrs and 2200 hrs (12.7 %) followed by 1800 hrs and 2000 hrs (10.9%), 2200 hrs and 2400 hrs (10.9%) and 0600 hrs and 0800 hrs (10.9%) (Fig. 5).

The sex and location of human deaths caused by elephants result showed that men were severely affected than the women. Most of the deaths were recorded in the out side of the forest areas irrespective of the sex. Among the males (n=75) about 65.3 % of deaths were occurred in outside of the forest areas. Similarly the same trend was noticed for female category as well (Fig.6).

The age category of victims caused by elephants showed that the age category between 41 to 60 were affected 57.8% followed by 61 to 70 years age category (19.3%) irrespective of sex. The age category between 21 and 30 (n=5; 100%), 51 to 60 (n=24; 79.2%) and 61 to 70 years old (n=16; 75%) were recorded as highest human casuality categories caused by elephants out side of the forest areas (Table 2, Fig. 7).

Causes of elephant deaths

Totally 133 elephant deaths were recorded from 1999 to 2014. The main cause of deaths, were due to diseases (n=50) and also due to other factors such as natural deaths (n=36) and electrocution (n=24). Totally sixteen elephant deaths were due to accidents. Of which, most of the incidences were happened by slipped from slopes (n=8) followed by other reasons (n=5) and train collision (n=3). Apart from natural deaths electrocution played vital role as a man made death due to conflicts in the deaths of elephants (Table 3, Fig. 8).

Among the six forest ranges Sirumugai forest range attibuted highest proportionate of elephant deaths (n=24%) followed by PN Palayam (n=20%) and Boluvampatti (n=18 %) ranges. Very low elephant deaths were recorded in the Karamadai forest range (9%) (Fig.9).

It was interesting to note that no elephant deaths occurred in the years of 2005, 2006, 2012 and 2014 due to electrocution. On the contrary, maximum deaths were recorded in the year of 2009 (33.3%), followed by 2004 (12.5%), 2002 (12.5%) and 2013 (8.3%) (Fig. 10).

The pooled data on month wise elephant deaths due to electrocution from the year between 1999 and 2014 does not have any significant findings. But the results showed that almost every month electrocution was recorded in a year except in the month of May. More elephants were electrocuted during March (16.7%) and July (16.7%) among the months in a year. (Table 4). Sex categories of elephant deaths due to electrocution revealed that male was affected high (67%) rather than female (33%) (Fig. 11).

Discussion

Loss of human life is the most serious form of human-elephant conflict according to the ranking by local communities (Campbell *et al*., 2000; Sitati & Ipara 2007). Crop damage accounts for major type of conflict followed by human deaths in Asia (Lahiri–Chowdhury, 1980; Sumatra (Sukumar 1985; Dey 1991; Balasubramanian *et al*., 1995; Zhang and Wang 2003; Bandara and Tisdell 2003). Human deaths and injuries are a major form of conflict in elephant ranges, yet these have only been simply described in most studies (Sukumar 1989; Sukumar 2003) or totally avoided. Human deaths and injuries, although less common than crop damage, are the most severe manifestations of human-elephant conflict. In India, only 22% of elephant habitats fall within protected areas. Since the rest of their range lies in areas of increasing human density where there is intense competition for the same resources, 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 Coimbatore forest division on HEC found that totally 96 people killed by elephants between 1999 and 2014. The trend of human deaths over the last 16 years clearly revealed that drastic increase for last five years. The human causalities between 2010 and 2014 alone attributed 59% 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), as it gives people an overconfidence to move freely in the forest fringe villages and roam around during nights, increase the probability of more encounters with elephants. Even though EPT has been created in majority of the area in Coimbatore forest division, still elephants are straying out into the villages through the rocks 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 findings on timing of human casulities revealed that 55% of incidences occurred during day time between 0600 hrs and 2000 hrs, and the rest (45%) during night time between 2000 hrs and 0600 hrs irrespective of locations. Timing of human casualities with respective to location revealed that more incidences occurred during day time in forests (85%) and the rest in night (15%), but contrarily in outside of forests (n=64) the incidences occurred during night time (57%) and day time (43%) almost equal. This findings coroborated with the Datye & 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 of 123 human mortality cases reported in the Biligirirangans, 55% occurred in forests during the day and 45% in settlements at night.

The present study also found that 67% of human casualities (n=96) occurred in outside the forests and the rest in forest areas between 1999 and 2014. Similar findings 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. On contrary finding of Datye & Bhagwat (1995) shows that 24 out of 25 human deaths occurred within the forest in Dalma Wildlife Sanctuary. An another study by Nath & Sukumar (1998) in Kodagu district, Karnataka indicated that most adverse elephant-human interactions took place within the forest or along the boundary. The accounts of the circumstances in which people have been killed or injured by elephants include, farmers / dwellers attempting to defend their crop near settlements, entering forest for collection of fire wood and forest produce, passing through forest and bush and often intoxicated unaware of proximity of elephants (Thouless, 1994; Datye and Bhagwat, 1995; Sukumar, 1989).

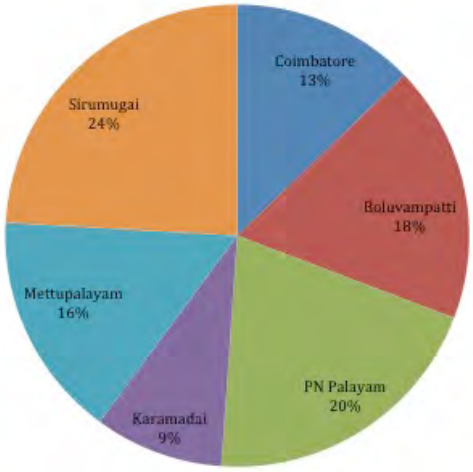

Fig 9. Abundance of elephant deaths irrespective of causes in various forest ranges of Coimbatore Division from 1998 to 2014 (N=133)

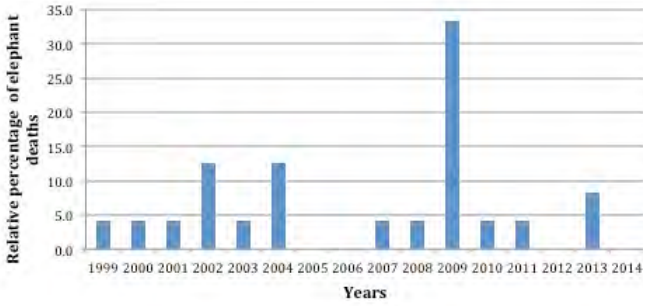

Fig 10. Relative frequency of elephant deaths due to electrocution from 1999 to 2014 (N=24)

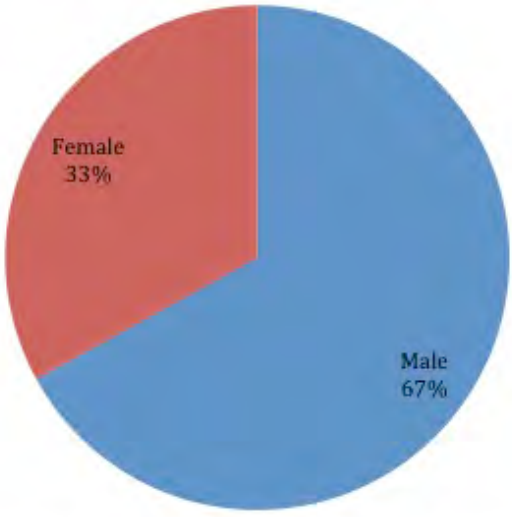

Fig 11. Sex category of elephant deaths due to electrocution from 1999 to 2014 (N=24)

Table 1. Human casualty caused by elephants from 1999 to 2014

Year	No. of human death	Location of human death	
		Inside Forest (%)	Outside Forest (%)
1999	1	0.0	100.0
2000	4	25.0	75.0
2001	4	25.0	75.0
2002	1	100.0	0.0
2003	2	100.0	0.0
2004	6	66.7	33.3
2005	3	66.7	33.3
2006	2	100.0	0.0
2007	2	100.0	0.0
2008	6	0.0	100.0
2009	8	50.0	50.0
2010	17	35.3	64.7
2011	7	14.3	85.7
2012	11	9.1	90.9
2013	18	27.8	72.2
2014 until Apr	4	0.0	100.0
Total	**96**	**33**	**67**

Table 2. Age category of victims by elephant attacks from 1999 to 2014 (N=83)

Age	No. of human deaths	Location of human death	
		Inside Forest	Outside Forest
1 to 10	1	100.0	0.0
11 to 20	0	0.0	0.0
21 to 30	5	0.0	100.0
31 to 40	10	30.0	70.0
41 to 50	24	45.8	54.2
51 to 60	24	20.8	79.2
61 to 70	16	25.0	75.0
71 to 80	2	100.0	0.0
81 to 90	1	0.0	100.0

Table. 3. Causes of elephant death from 1999 – 2014 (N=133)

Causes of elephant death	No. of elephant deaths	Demography (%)		
		Adult Male	Adult Female	Unidentified Calf
Accident (Train)	3	33.3	66.7	0.0
Accident (Slipped from slopes)	8	62.5	12.5	25.0
Accident (other reasons)	5	40.0	60.0	0.0
Disease	50	38.0	48.0	14.0
Electrocution	24	66.7	33.3	0.0
Natural	36	36.1	41.7	22.2
Unknown	7	14.3	71.4	14.3

The age category of victims revealed that 41-70 age class people were highly affected in outside forests (77%), where as 41-50 age class people were more affected inside forests (42%). In terms of sex category, more men (78%) were killed by elephant irrespective of loation.

A total of 133 elephants died due to various causes such as train hit, slipped from slopes, disease, natural and electrocution in Coimbatore Forest Division between 1999 and 2014. Of these 24 elephants died due to electrocution that accounts for 67% male and 33% female. Sukumar (1989) recorded death of at least 3-8% male and 17-19% female in various crop protection measures out of the total elephant death from state of Tamilnadu and Karnataka between 1975-87. 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.

Conclusion and management implications

Human deaths caused by elephants were increased drastically in last five years in Coimbatore Forest Division. This negative experiences and fear of the elephant is likely to create a more 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 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 Coimbatore Forest Division, still most of the

Table 4. Temporal pattern of elephant deaths due to electrocution from 1999 to 2014 (N=24)

Month	No.of elephant deaths	Relative %
January	2	8.3
February	2	8.3
March	4	16.7
April	1	4.2
May	0	0.0
June	2	8.3
July	4	16.7
August	2	8.3
September	2	8.3
October	2	8.3
November	2	8.3
December	1	4.2

people showed positive attitude towards elephant conservation. This is a good sign and time, and the authorities would do well to take these learnings into account and take these communities into confidence while preparing collaborative conservation plans to ensure long-term survival of Asian elephants in the region and country as well.

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 will be 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 forest foothill and detailed research on factors of human – elephant conflict and new techniques on control measures. Private lands located at least 200m from forest foothill 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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