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HUMAN-ELEPHANT CONFLICT ISSUES WITH SPECIAL REFERENCE TO CROP DAMAGE AND PEOPLE'S PERCEPTION IN AND AROUND COIMBATORE FOREST DIVISION, SOUTHERN INDIA

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ABSTRACT

The Human-Elephant Conflict (HEC) assessment study was carried out from May 2013 to August 2014 in Coimbatore Forest Division, Tamilnadu, South India. Totally 438 persons were interviewed from the forest fringe villages of six forest ranges of the Coimbatore Forest Division. This study revealed that 6 Forest Ranges were affected by elephant crop raids. Total frequency of elephant's attempt to raid the crop fields (n=409) were recorded as 2070. Crop raiding attempts and success was highest in Boluvampatti Range. Lowest attempts were recorded in Sirumugai Range. Totally 31 crop species were recorded during the study period, of which 24 species were raided by elephants at various intensities. Banana (*Musa paradisia*) (139.49 acres), Sorghum (*Sorghum vulgare*) (122.35 acres), Areca nut (*Areca catechu*) (18993 trees), Coconut (*Cocus nucifera*) (4701 trees) were the most raided crops by elephants. The study recorded 96 human casualties caused by elephants over the last 16 years. The result showed that drastic increase in human death was in the last five years. 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 in the year. Most of the human deaths were occurred 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%).

Key words: Asian elephant, Human-elephant conflict, Coimbatore forest Division.

Introduction

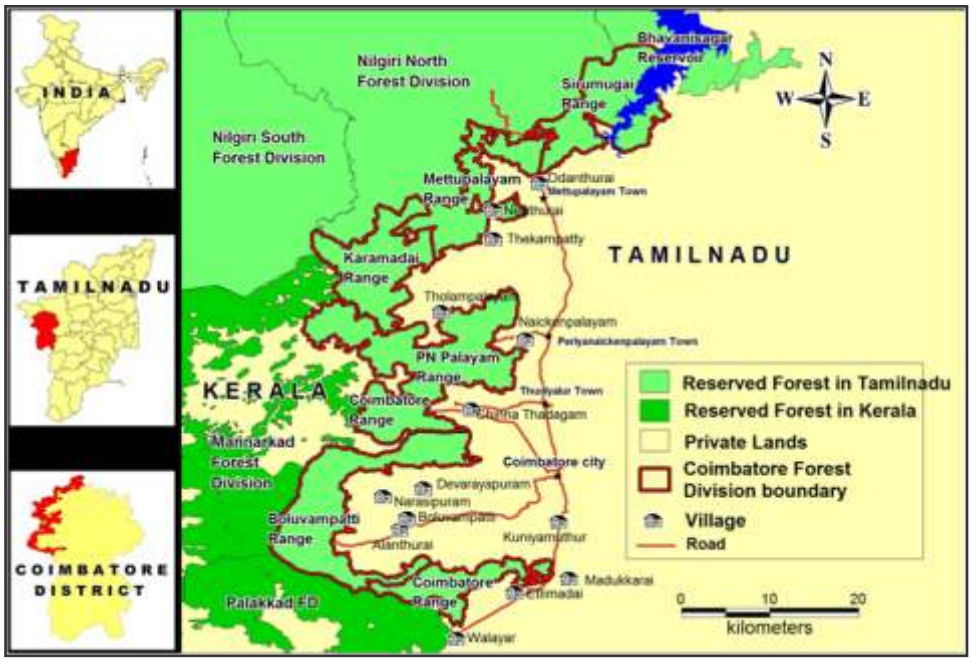
The Asian elephant (*Elephas maximus*) is a highly endangered and keystone species categorized under Schedule I and Part I of the Indian Wildlife (Protection) Act, 1972 (Ramakrishnan and Saravabamuthu, 2010). The Asian elephant is once found throughout the Asia and is now restricted to few localities in the Indian Subcontinent due to various reasons. Of late, management of Human–Elephant Conflict (HEC) is one of the important challenges to the wildlife researchers, conservationists and forest managers. The major reason for HEC could be due to invasion of agriculture fields on the forest fringe areas and various developmental activities in forest region (Ramakrishnan, 2008). Across its home range various anthropogenic pressures led to loss of habitat quality, which forced elephants to extend their traditional range and raid crops to meet out their daily requirements. During such forays elephants invade into human properties and confrontations become inevitable. Fragmentation of habitat due to loss of corridors leading to trapping of elephants in isolated patches with cultivation all around are mentioned as the factors responsible for crop raiding in South India (Sukumar, 1985). Further, factors such as degradation of habitat, competition for water, movement pattern, palatability and nutritive value of crops also led to crop depredation (Sukumar, 1985; Sukumar, 1990).

The Coimbatore Forest Division has a sizeable elephant population and viable habitat for elephants. More than 20% of the area of the reserve forest serving 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). Apart from ecological factors there are several developmental activities reasoned for HEC issues in and around the Coimbatore Forest Division. Due to these obstacles the HEC incidents are notably on increasing trend. Over the past few decades many developmental and destructive activities of human beings have severely fragmented the forests. Of which, the elephants, as they require large areas of natural range than other mammalian species in tropical Asia, are one of the main animal to suffer the consequences of developmental activities

There is a big question arises now that in future how best elephant and human beings can live in a human induced environment like Coimbatore Forest Division. Unlike the wildlife sanctuaries and national parks in the Western Ghats the Coimbatore Forest Division gets less attention in dealing with the HEC issues though it is part of

Thirty one (31) crops raided by elephants during May 2013 to August 2014; 96 human casualties and 133 elephant death (during last 16 years) are described.

the Nilgiri Biosphere Reserve (NBR) and is also part of the Elephant Reserve No.8. The Coimbatore Forest Division shares its boundary at the length of about 350 km between human habitations and farm lands. Therefore the villages adjoining the reserve forest boundary are more prone to elephants' visits. The movement of elephants in this division is mostly restricted to foot hills due to escarpment of steep slope on the west and human habitations on the east. Therefore HEC is higher level compared to other largely populated elephant habitats in South India. Earlier elephants used to visit only forest fringe villages, attracted by standing crops. Nowadays 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.



Map 1: Location of Coimbatore Forest Division

However the Coimbatore Forest Division gets less attention in terms of scientific study except Ramakrishnan (2008) and no detailed information is available on these aspects. Therefore this study was initiated to assess the overall pattern of crop damage by elephants with the objectives of survey and quantify the crop damage by elephants on agriculture crops and also 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.

Material and Methods

The Coimbatore Forest Division covers an area of 694 km² and is situated in the Coimbatore district of Tamilnadu, Southern India. The Coimbatore Forest Division is also part of Nilgiris and Eastern Ghats Landscape, which is holding single largest Asian elephant population in the world. This forest division has six forest ranges namely Sirumugai, Mettupalayam, Karamadai, Perianaickenpalayam (PN Palayam), Coimbatore and Boluvampatti, (map 1). This division lies between latitude 10°51' and 11°27' and longitude 76° 39' and 77° 4'. This forest division has wide range of altitude from 450m to 1450m (msl). Innumerable streams originate and drain the plateau. This network of streams resolves itself into Bhavani and Noyyal river. The vegetation types range from tropical thorn forest at the foothills to evergreen relation to terrain, altitude and rainfall. Carried out in the villages located all along the foot hills of six forest ranges.

Assessment of crop damage

The Coimbatore district has divided in 6 Forest ranges. To study the HEC issues, selected panchyaths which are located adjoining to the forest fringe areas were visited. Questionnaire method was followed to assess the crop damage by elephants. Elephant raided crop fields were visited in all villages and thereby information was gathered through "broad and open ended" questions giving the respondent an opportunity to express their views freely (Ramakrishnan *et al*., 1997). The questionnaire survey was conducted from May 2013 to August 2014. Totally 438 persons were interviewed from the six forest ranges of the Coimbatore Forest Division. Information such as number of elephant visits and raids, economic loss caused by elephants and intensity of crop damages were collected. These data were pooled together to quantify HEC status.

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 August 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 1999 to August 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 were extracted from the records and pooled together on yearly basis.

Resuts

Crop raiding attempts and success of elephants

This study was conducted in 409 crop fields belonged to 6 Ranges in Coimbatore Forest Division Among 6 Ranges, highest number of crop fields were affected in Boluvampatti Range (n=127). Conversely, the least was recorded in Sirumugai Range (n=21). Total frequency of elephant's attempt to raid the crop fields (n=409) were recorded as 2070. Of which crop raiding success was calculated as 41% includes family herds accounted for 68.66% and solitary males 31.34%. An average elephant's attempt for crop raiding calculated as 4.85/crop field (Table 1).

Economic loss of crops

Sugarcane (*Saccaram officinarum*) was the only crop accounted for highest ($27598.67 per year in 59.14 acres) damage with an economic loss followed by Banana (*Musa paradisia*) ($34872.50 per year in 139.49 acres) and Maize (*Zea mays*) ($6416.67 per year in 38.5 acres) On the contrary, Teak (*Tectona grandis*) was the only crop accounted for lowest ($25.00 per year in 50 acres) damage with an economic loss followed by Finger Millet (*Eleusine coracana*) (($8.33per year in 1 acres) and Eucalyptus (*Eucalyptus sp*) ($16.27 per year in 0.25 acres) (Table 2).

Table 1: Frequency of crop raids by elephants

S.No	Range name	Total No. of agricultural fields encountered by elephants	Total No. of attempts	Successful Raids (%)	Category of elephants responsible for the successful crop raid	
					Family herds (%)	Solitary male (%)
1	Boluvampatti	127	641	37.33	67.33	32.67
2	Coimbatore	53	253	24.00	67.50	32.50
3	Karamadai	33	152	31.00	68.33	31.67
4	Mettupalayam	52	256	77.00	65.50	34.50
5	P.N.Palayam	123	672	48.77	67.30	32.67
6	Sirumugai	21	96	32.50	76.00	24.00
	Total	409	2070	41.77	68.66	31.34

Table 2: Crop economic loss caused by elephants

SI.No	Crop Name	Scientific name of crops	Total damaged crops (acres)	Total economic loss (US $)
1		*Areca nut*		
		Areca catechu	18993 (trees)	5826.10
2	Ash Guard	*Benincasa hispida*	2	416.66
3	Banana	*Musa paradisia*	139.49	34872.50
4	Black Gram	*Vigna mungo (L.) Hepper*	4.75	633.33
5	Coconut	*cocus nucifera*	3946.21 (tress)	3918.33
6	Cotton	*Gossypium sp.*	1.5	87.50
7	Eucalyptus	*Eucalyptus sp*	0.25	16.27
8	Finger Millet	*Eleusine coracana*	1	8.33
9	Fodder Grass	*Pennisetum purpureum*	0.04	0.67
10	Grapes	*Vitis vinefer*	2	183.33
11	Ground Nut	*Arachis hypoea*	9	166.66
12	Lablab	*Lab lab purpureus*	3	150.00
13	Lady's Finger	*Anthyllis vulneraria*	1	116.67
14	Maize	*Zea mays*	38.5	6416.67
15	Mango	*Mangifera indica*	1	106.67
16	Paddy	*Oryza sativam*	12.75	3187.50
17	Pigeon pea	*Cajanus cajan*	3.75	500.00
18	Samai	*Panicum miliare*	1	83.33
19	Sorghum	*Sorghum vulgare*	122.35	8156.67
20	Sugarcane	*Saccaram officinarum*	59.14	27598.67
21	Tapioca	*Berghia major*	1	133.33
22	Teak	*Tectona grandis*	50	25.00
23	Tomato	*Lycopersicon esculentum*	22.25	1483.33
24	Turmeric	*Curcuma longa*	1	41.67

Human deaths caused by elephants

Totally 96 human deaths due to elephants were recorded during the past sixteen years. Of which, in 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 areas (human habitations, farm lands, villages, barren lands and any sort of lands located outside the boundary of reserved forest) since 2010 onwards (Table. 3).

The month wise human causalities are represented in Fig. 4. The result showed that peak human casualties were recorded in the months between December and February. It is not worthy that the second highest casualty has been recorded in the months between July and September (Fig. 2).

Table 3: 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	4	0.0	100.0

Fig. 2: Month wise occurrences of human deaths caused by elephants from 1999 to 2014 (N=96)

Although two peak durations have been found, January (16.0%) and August (10.0%) months were 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 occurred 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 3).

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 outside 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 4).

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 causality categories caused by elephants outside of the forest areas (Table 4).

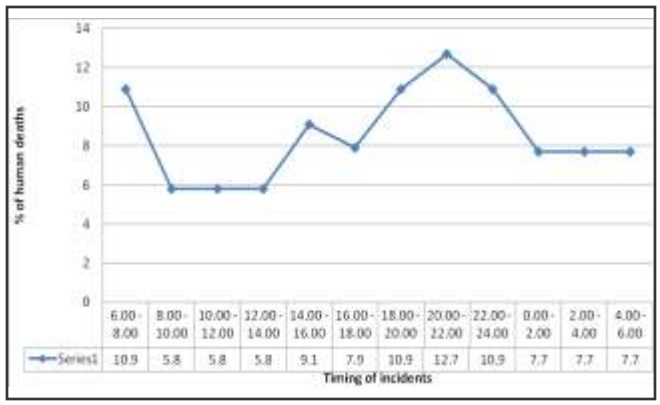


Fig. 3: Timing of occurrence of human death from 1999 to 2014 (N=55)

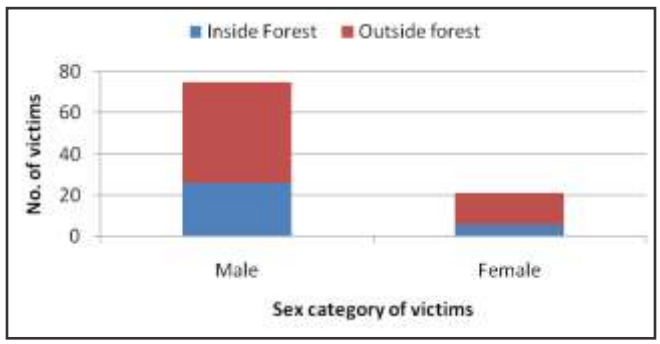


Fig. 4: Sex category of victims caused by elephant attacks from 1999 to 2014

Table 4: 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

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 5).

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 6). Sex categories of elephant deaths due to electrocution revealed that male was affected high (67%) rather than female (33%).

Discussion

Crop raiding by elephants has been reported from almost all elephant ranges in Asia as well as Africa, where elephants survive in fragmented and disturbed habitats. India has a long history of HEC. Competition over space and resources by ever growing human population has made the problem severe. In many places, exploitation of forest resources beyond its safe use capacity has led to habitat degradation and altered the habitat quality drastically. Depleted resources across its home range have forced elephants to forage outside the protected areas thus finding themselves in human dominated landscapes.

Crop depredation by elephants is one of the crucial issues in HEC. During the study 6 Forest Ranges were visited, of which Boluvampatti experienced high crop damage incidences (127 crop fields). This could be attributed due to constructional developments such as Sachidananda Jothi Nikethan International School, Black thunder water theme park and others considerably reducing the width of the corridor coupled with two linear developments such as road and railway track passing through the Kallar corridor which located in the Odanthurai causing serious impediment to elephant movement. Incidentally Sachithanandha school and Black thunder recorded the second highest (61) crop damage incidences around them. Joel *et al.* (2005), pointed out crop damage also occurs when elephants move from one area to another in search of water or food.

Least crop damage was recorded in the Sirumugai Forest Range due to the extent of area under cultivation is very less and also more lands were fallow due to lack of interest in farming caused by more profitable opportunities in the nearby mining industry. A herd of elephants frequently cause havoc in Madukarai by venturing far into human settlements. Eventually the problem ended on 4th February, 2008 when a tragic train collision caused the death of three elephants of that herd. The reason for such long distance wandering also could be ascribed to the non availability of foraging opportunities, even in the crop fields.

Highest crop raiding incidences were recorded in the Boluvampatti range with 137 affected crop fields spread along the 10 'grama panchayats'. This could be attributed to (i) the presence of six constructional development activities, (ii) topography of the forest area is hilly and suitable elephant habitat only exists along the

Table 5: Causes of elephant death from 1999 to 2014

Causes of elephant death	No. of elephant deaths	Demography (%)		
		Adult male	Adult female	Unidentified
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	28	64.3	35.7	0.0
Poaching	5	100.0	0.0	0.0
Natural	36	36.1	41.7	22.2
Unknown	7	14.3	71.4	14.3

Table 6: Temporal pattern of elephant death 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

foot hills, (iii) family herds with calf usually prefer to use the less gradient foot hills in which the developments cause a hindrance and sometimes leads them in to crop fields, (iv) sorghum is cultivated in more area, which is an elephant attracting crop. The third argument is supported by the fact that, more number of successful family herd raids (n=308) than solitary males (n=153) in the total successful raids (461). Even though the crop raiding successes was more (n=231), Still most farmlands (n=209) were using traditional mitigating measures. As modern mitigating measures requires a high initial implementation cost, affordability of economically backward farmers is very less.

Twenty four species of crops were prone to elephant damage. According Ramesh kumar and Sathyanarayana (1993) Raggi and paddy were major crop items raided by elephants in the forests of Karnataka and Nilgiris. Jayson (1999) pointed out that Coconut palm, Sugarcane, Cocoa, Aareca nut and Paddy were the main crops raided by elephants in Kerala. But our present study found that areca nut, coconut, banana, sorghum and sugarcane were the major crops raided by elephants in Coimbatore Forest Division. The elephant preferable crops were cultivated in large extent, along all the forest ranges which inevitably attracts more conflicts. Banana (139.49 acres), was the widely cultivated crop across all ranges, it accounted for more economic loss. The presence of large rain fed areas resulted in wider cultivation of Sorghum. Even though the cultivated area of Sugarcane (59.14 acres) is comparatively less than Sorghum (122.35), due to high market value, it accounted for more economic loss. Crops like Marigold, Sappota, Jatropha etc. were found to be avoided by elephants. Joel *et al*. (2005), pointed out that more or less all elephants indulge on crop raiding whenever they get an opportunity. It is not entirely understood as to why wild animals raid crops but it is believed they prefer the taste of cultivated plants rather than the wild plants. Crops are higher in sugars and lower in fibre and secondary defense chemicals than their wild counter parts.

This study revealed that 59% of the attempts were ended as successful raids irrespective of the age and sex of the elephants in all 'panchayaths'. Family herds were frequently attacked the crop fields rather than solitary males (tusker and makhna) irrespective of ranges. The availability of perennial crops, water in the adjoining areas throughout the year as well as the blockage of elephant corridors due to construction reasoned for the unusual crop raiding strategy in (age and sex) the elephants. Blockage of elephant migratory routes due to constructions coupled with cultivation of elephant highly preferred crops such as areca nut, coconut, banana, sorghum and sugarcane in large extent along the all forest ranges and availability of water in the villages throughout the year inevitably attracts more human elephant conflicts in the Coimbatore Forest Division.

Loss of human life is the most serious form of human-elephant conflict according to the ranking by local communities. Crop damage accounts for major type of conflict followed by human deaths in Asia (Lahiri–Chowdhury, 1980; Sukumar, 1985; Balasubramanian *et al*., 1995; 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 HEC. 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 same resources, conflict is inevitable. The estimated 28,000 wild elephants in India are distributed over an area of about 109,500 km^2, 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 casualties 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 causalities 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 causalities 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

Examining elephant feeding sign in wild plants

Conducting questionnaire survey in the fringe villages

An adult tusker invaded into human habitation

Electrocution of an adult tusker near agriculture field

Herd of elephants crop raiding in Maize field

incidences occurred during night time (57%) and day time (43%) almost equal. This findings corroborated 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 of 123 human mortality cases reported in the Biligirirangan Temple Sanctuary, 55% occurred in forests during the day and 45% in settlements at night. The present study also found that 67% of human causalities (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 findings of Datye and Bhagwat (1995) showed that 24 out of 25 human deaths occurred within the forest in Dalma Wildlife Sanctuary. An another study by Nath and 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 produces passing through forest and bush and often intoxicated unaware of proximity of elephants. 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 location.

A total of 133 elephants died due to various causes such as train hit, slipped from slopes, disease, natural and electrocution in the 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 Tamil Nadu and Karnataka between 1975-87. Bist (2002) recorded that an average of 41 elephants died annually due to HEC 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.

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कोयम्बटूर वन प्रभाग, दक्षिणी भारत में और इसके चारों ओर फसल क्षति और लोगों की धारणा के विशेष संदर्भ में मानव-हाथी संघर्ष मुद्दे

एस. कार्थिक, बी. रामाकृष्णनन और एम. इल्लाकिया

सारांश

कोयम्बटूर वन प्रभाग, तमिलनाडु, दक्षिण भारत में मई, 2013 से अगस्त 2014 तक मानव–हाथी संघर्ष मूल्यांकन अध्ययन किया गया। कोयम्बटूर वन प्रभाग के छः वन रेंजों के वन सीमावर्ती गाँवों से कुल 438 लोगों का साक्षात्कार लिया गया। इस अध्ययन ने दर्शाया कि 6 वन रेंजें हाथी की फसल छापामारी से प्रभावित थी। फसल खेतों (n= 409) में छापामारी हेतु हाथी के प्रयास की कुल बारम्बारता 2070 के रूप में अभिलिखित की गई। फसल छापामारी प्रयास और सफलता बोलूवामपट्टी रेंज में उच्चतम थी। निम्नतम प्रयास सिरूमुगाई रेंज में अभिलिखित की गई। अध्ययन अवधि के दौरान कुल 31 फसल प्रजातियां अभिलिखित की गई, जिनमें से 24 प्रजातियों में विभिन्न तीव्रताओं पर हाथियों द्वारा छापामारी की गई। केला (*मूसा पाराडिसिया*) (139.49एकड़), शोरघम (*शोरघम वुल्गेरी*) (122.35 एकड़), सुपारी (*एरीका कटैचू*) (18993 वृक्ष), नारियल (*कोकस नूसिफेरा*)(4701 वृक्ष) फसलों में हाथियों द्वारा सबसे ज्यादा छापामारी की गई। अध्ययन में गत 16 सालों में हाथियों द्वारा उत्पन्न 96 मानव दुर्घटनाएं अभिलिखित की गई। परिणामों ने दर्शाया कि गत पांच सालों में मानव मृत्यु में भारी वृद्धि थी। अकेले 2010 और 2014 के बीच मानव दुर्घटना कुल मृत्यु की 59 प्रतिशत थी। अधिकांश मानव मृत्यु (67 प्रतिशत)वन क्षेत्रों के बाहर अभिलिखित की गई। जनवरी (16.0 प्रतिशत) और अगस्त (10.0प्रतिशत) महिने वर्ष में हाथियों द्वारा उत्पन्न उच्चतम मानव मृत्यु के रूप में पाए गए। अधिकांश मानव मृत्यु 1800 बजे और 2200 बजे के मध्य हुई। 1999 से 2014 तक कुल 133 हाथी मृत्यु अभिलिखित की गई। हाथी मृत्यु के कारणों में रोग (37.6 प्रतिशत), इसके बाद प्राकृतिक (27.1 प्रतिशत), विद्युतमारण (18 प्रतिशत) और ढलान से फिसलकर (6 प्रतिशत) है।

REFERENCES

Balasubrmanian M., Baskaran N., Swaminathan S. and Desai A.A. (1995) Crop raiding by Asian elephant (*Elephas maximus*) in the Nilgiri Biosphere Reserve, South India. In: *A Week with Elephants* (J.C. Daniel and H.S. Datye, eds.), *Bombay Natural History Society*/Oxford University Press, Bombay, 350-367.

Bandara R. and Tisdell C. (2003). The economic value of conserving Asian elephant: Contingent valuation estimation for Sri Lanka. *Gajah*, 22: 22-29.

Bist S.S. (2002). An overview of elephant conservation in India. *Indian Forester*, 128: 121-136.

Datye H.S. and Bhagawat A.M. (1995). Man-Elephant conflict: A case study of human deaths caused by elephants in parts of central India. In: *A Week with Elephants* (J.C. Daniel and H.S. Datye, eds.), *Bombay Natural History Society*/Oxford University Press, Bombay, 340-367.

Joel M., Edward A., Doreen R. and Biryahwaho B. (2005). Management of conservation based conflicts in South Western Uganda.

Jayson E.A. (1999). Studies on crop damage by wild animals in kerala and evaluation of control measures, Kerala Forest Research Institute, Research Report, 169.

Lahiri Choudhury D. (1980). An interim report on the status and distribution of elephants in north-east India. In The status of the Asian elephant in the Indian sub-continent (ed. J. India. *Tiger Paper*, 30: 3-6.

Lenin J. and Sukumar R. (2011). Action Plan for the Mitigation of Elephant-Human Conflict in India. Final Report to the U.S. Fish and Wildlife Service. Asian Nature Conservation Foundation, Bangalore.

Nath C.D. and Sukumar R. (1998). Elephant-human conflict in Kodagu: Southern India. Asian Elephant Research and Conservation Centre, Bangalore.

Ramakrishnan B. and Saravanamuthu R. (2010). Elephant – the key stone species, Published by Tamilnadu State Council for Science and Technology and Indo American Wildlife Society, Chennai.

Ramakrishnan B. (2008) Status of wildlife Corridors and their use by selected endangered mammals in the Nilgiri Biosphere Reserve, India, Ph.D thesis submitted to Bharathidhasan University, Tamilnadu.

Rameshkumar S. and Sathyanarayana M.C. (1993). Crop raiding patterns in Hosur and Dharmapuri Forest Divisions, Dharmapuri District, Tamil Nadu, A week with elephants, Proceedings of the international seminar on asian elephants, *Bombay Natural History Society*, 533-534.

Ramakrishnan B., Sivaganesan N. and Srivastava, R.K. (1997). Human interference and its impact on the elephant corridors in Sathyamangalam and Coimbatore forest divisions, Tamil Nadu, Southern India, *Indian Journal of Forestry*, 20(1), 8-19.

Ramkumar K. (2014). People's perception on elephant depredation and conservation. THEFLAGPOST, Monthly magazine, may, 6-9.

Sivaganesan N., Ajithkumar and Ramakrishnan B. (2000). "Status of the corridors and their use by mammals with special reference to selected endangered mammals in the Nilgiri Biosphere Reserve, Southern India," Technical Report, Salim Ali Centre for Ornithology and Natural History, Coimbatore.

Sukumar R. (1985). Ecology of Asian Elephant (*Elephas maximus*) and its Interaction with Man in South India. Ph.D., thesis, Indian Institute of Science, Bangalore, India.

Sukumar R. (1989). *The Asian Elephant: Ecology and Management.* Cambridge University Press, Cambridge.

Sukumar R. (1990). Ecology of the Asian elephant in southern India, II. Feeding habits and crop raiding patterns. *Journal of Tropical Ecology*, 6, 33-53.

Sukumar R. (2003). *The Living Elephants: evolutionary ecology, behavior and conservation.* Oxford University Press, New York.

Sukumar R. (2003). Male-female differences in foraging on crops by asian elephants, *Anim. Behav*., 36, 1233-1235.

Sukumar R., Baskaran N., Dharmrajan G., Roy M., Suresh H.S. and Narendran K. (2003). Study of the Elephants in Buxa Tiger Reserve and Adjoining Areas in Northern West Bengal and Preparation of Conservation Action Plan. Final Report, Centre for Ecological Sciences, Indian Institute of Science, Bangalore.

Thouless C.R. (1994). Conflict between humans and elephants on private land in northern Kenya. *Oryx.*, 28(2), Pp- 119-127.