MONITORING THE EFFICIENCY OF THE ELECTRIC FENCE IN UDAWALAWE NATIONAL PARK

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DECLARATION

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MY PARENTS & TEACHERS

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Abstract

Human Elephant Conflicts (HEC) is a major ecological problem in most of Asian and African countries. Overlapping of human and elephant needs causes this HEC. Number of methods using FOR minimise HEC. Electric fences, bio-briars, elephant drives, transelocation, capture and elephant corridors are some of the methods that are using to minimise the HEC. In Sri Lanka this HEC occurring most of the dry zone, where the elephant population comparably higher than the wet zone. In the year 1989-1992 HEC was increased in Udawalawe (UW) area. Sevanagala Sugar Cooperation (SSCo) croplands are very close to UW Protected Area (PA). Because of the elephant have been entered to the cropland, SSCo was established the Electric Fence (EF) in the year 1992. As a result of this Elephant entrance was decreased according to PA authorities and SSCo data files. But still there was no scientific study about the efficiency of this EF. This study aimed to monitoring the efficiency of the electric fence. Identify the breaching patterns of the elephants and financial loss to the SSCo. The study area is located the south side of the UW NP and there are 298 families living in this area and they are permanent sugar cane growers. During the rainy season they are growing crash crops. The electric fence is locating in between Colombo Monaragala B-427 road and the PA. Total length of the fence is 15Km and the power supplying to the fence with the help of two batteries. Power range is 12V and 1.5A. During the study period (6th of September to 10th of December) there were three elephants was identified that breached the fence according to their foot print perimeters. Single elephant damage to the fence along and two elephant's damage to the fence at once. According to result most of the times elephants breach pleases, where the average distances between the two houses over 500m and the bare lands in the inside of PA, the sugar cane very close to the EF and no current supplied areas. The single elephant used it head and front legs and the two elephants used their back legs. Elephants have mostly damage to the sugar cane and also damage to the crash crops. Total lost for SSCo was Rs.801600.00.

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Abbreviation

NP- National Park

PA- Protected Area

SSCo- Sevanagala Sugar Co-operation

UW- Udawalawe

DWLC- Department of Wildlife Conservation

EF- Electric Fence

HEC- Human Elephant Conflicts

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CHAPTER 1

1 INTRODUCTION.

Human Elephant Conflict (HEC) is a main ecological problem in most of Asian and African countries where elephants usually occur outside the protected areas. Expanding agricultural areas in Africa's and Asia has increases elephant densities and intensified the elephant human interface (Caitlin et al, 2000). As a result of heightened conflicts many elephants have habituated to elephant crop raiding deterrents. Main causes for HEC are reducing and fragmentation of habitats, lack of natural resources overlapping of land use of elephant and human hindering of free migration. As a result of human elephant conflicts there are many out comes. Some of that is destruction of houses and properties, crop depredation, loss of human lives and deaths of elephants.

Elephant in Sri Lanka is a serious public concern of the farmers in the dry zone. Human population of Sri Lanka in early 19th century was 3.6 millions, but now it is over 18 millions. In the early 19th century there was 80% of forest cover and now it has decreases to less than 20%. Land problems a caused by the increase of human population, which is now equivalent to 275 perkm^2 in comparison to 55 perkm^2 in the early of the last century. (Santiapillai, 1997). In the period where the English ruled the country they killed many elephants, not only for ivory but also as a game. They introduced tea and coffee to our land and because of that elephant habitats decreased in the wet zone and elephants moved to the dry zone, but limited numbers of pocket herds are in the peak wilderness and the upper part of Baddulla (Thouless, 1994). Because of some large-scale plantation and development activities, lots of protected areas were fragmented and elephant corridors were disturbed by the human activities.

Conflict normal occurs between farmers and elephant living in the same area. This affects both human and elephants. In the entire dry zone the crop raiding by the elephants increased in last few decade. The elephant raids not only home garden but also sugar cane and perennial crops. The elephant raid paddy before and after the harvesting and also damage the forest plantation in the dry zone. They highly damage

to Teak plantation especially in Udawalawe and Handapanagala areas (Munaweera and Kuruvita, 1995; Thouless, 1994). Most of the time's elephants attack houses to get stored rice or foodstuff inside. Galoya, Handapanagala, Laggala and Wasgamuwa are the places that elephant damages to the Houses (Fenando, 1994; Munaweera and Kuruvita, 1995; Ranasinghe, 1997; Thouless, 1994). A numbers of human are killed each year by elephants in Sri Lanka. Majority of deaths occurs in the Mahawali region (Jayawardane, 1997; Thouless, 1994; Santiapillai, 1997).

Table: 1. -Elephant deaths, human deaths and elephant's damages:
Mahawell system B, C and G

	ELEPHANTS KILLED			HUMANS KILLED			COMPLIMENTS OF ELEPHANT DAMAGE.		
Year	B	C	G	B	C	G	B	C	G
1990	8	2	-	1	0	-	204	19	-
1991	6	2	4	-	0	3	160	13	36
1992	9	6	2	4	1	2	190	2	75
1993	10	2	5	3	1	7	171	14	82
1994	5	4	7	1	1	2	95	27	148
1995	3	-	2	12	-	2	86	46	107
1996	7	3	-	12	-	3	83	32	43
1997	10	4	2	8	3	-	149	82	102
1998	17	5	-	8	-	-	-	-	-
Total	75	28	22	49	49	19	1138	235	593

Source-Sri Lanka Nature vol.I (Santiapillai, 1997).

Because of HEC in each year lot of damages and injuries occur to elephant. The gunshots, trap guns, poisoning are the major method that people using to kill the elephants. Accidents are the other major way that elephant deaths occur.

Table: 2. No of elephant deaths in past years

Year	No of elephant deaths
1950-1970	1163
1990-2000	1400
2000	156+war area death

Source: web search: Environmental. lk.

The civil war in the north and the north-eastern province has caused the major proportion of the elephant death and injuries (Wanigasundara, 1990; Thouless, 1994). Because of the increase of HEC and the huge publicity inside the country, the Department of Wild Life Conservation (DWLC), Mahawali authority and many other stakeholders have introduced a number of methods to minimise the HEC.

1.) Translocation.

In this method the trouble making elephant is captured and translocated to another area.

2.) Elephant drive.

In this method the elephant group that cause HEC are identified and driven to a well-protected area.

3.) Electric fences.

This method is to establish a physical barrier to the elephant to prevent entering cultivated land.

4.) Habitat enrichment.

Improving the habitat of the elephants.

5.) Bio barriers.

Establish the human settlement as a line or establish plant line as a fence.

The farmers who live in the HEC areas are also using some techniques to minimise crop raiding and settlement damage by the elephants. The farmers normally light

crackers, oil lanterns make noises in the nights, spend all nights in the watch towers and burn fires at the edge of the crop land to protect there crop land.

Although the farmers, DWLC and other organisation try to minimise or overcome HEC, still the conflicts are increasing day by day and the human and elephant death increase every year. None of above techniques has been fully successful. Many believe that the electric fence is the most successful method that used to solve HEC. But still there is no detailed study about existing electric fences, and how successful that it is in solving HEC.

There are many types of fences used all over the world for minimise HEC. Electric fences, Human settlement as fences, Plant species (Agave, Pepper) are some of the methods used to minimise HEC. Some countries like South Africa, Zimbabwe, and Kenya are using Pepper and Chillies as the fences (Whitfield, 2002). The other countries including Sri Lanka use Agave, Boganvila as the major plants for the fence.

Electric fence is known to be the most successful techniques that are used to minimise HEC. Kenya, South Africa, Zimbabwe, India and Nepal are the countries that use electric fences to minimise HEC (Santiapillai, 1991; Thouless, 1994). Electric fences were introduced to Sri Lanka as an experimental basis in Block I of Ruhuna National Park on 1956(Jayewardene, 1994; Santhipilli, 1997). Now in Sri Lanka this method is used in most of the Protected Areas (PA) especially in the dry zone.

Sewanagala Sugar Co-operation Ltd built the fence in the study area, which is the Udawalawa park boundary, in 1992. The fence is in the boundary of the Udawalawe national park along the Colombo –Monaragala B-427 road. The fence is in between the Udawalawa reservoir and Mow-Ara Bridge. The length of the fence is 15km, and the power is generated in two Sevanagala checkpoints. GPS Locations are 06.25.81^{N} ,080 53.68^{E} and06 25.18^{N} ,08 5588^{E} .The Udawalawa fence was believed to be most efficient electric fence in Sri Lanka, but no recent studies have been done to evaluate it's efficiency. There for it was decided to evaluate the efficiency of the fence to control HEC during the period of 06th of September to 06th of December of 2002.

1.2 STUDY AREA.

1.2.1 Udawalawe National Park

Udawalawe National Park is one of the main national parks in Sri Lanka. It is popular because of not only elephant but also water birds. This Protected Area (PA) is above 200km from the Colombo near to the Colombo Monaragala main road. UWNP is located within the lower catchment area of the UW reservoir in the lowest peniplane. These whole areas are in the two administrative districts. The Right Bank of the Walawe Ganga within Ratnapura district and the left bank fall within the Monaragala district. The total area of the park is 32315ha.It include about 308km^2 of dry land and the reservoir. The annual average temperature is about 290^{0}C with the maximum rainfall is about 750 to 1000mm. The wind spread are relatively low in the rainy season May, June and July the wind speed are high normally May to September is the dry season and the December and January highest rain fall recorded.

In the reservoir there are three major types of habitats

i. The reservoir water and the immediate marshy fringes.

ii. The Walawe Ganga and major tributaries within the Park and lower reaches within the lowland plain.

iii. The National Park surrounding the reservoir.

The three-major habitat types fall in to distinctive ecosystem and vegetation type of the UWNP (CEA, 1995).

1.2.1.1 Flora.

The park includes forested land in various stages of succession, along with extensive grassland. The forested lands have largely been cleared in 1960's prior to the declaration of UWNP. The grassland communities appear to be largely anthroprogenic, and are the result of past slash and the burn. The dominant species in most of this area are the grasses *Panicu maximum* and *Imperata cylindrical*. Totally

ninety-four plant species recorded in side Park, three are endemic. These are Mandora, *Hopea cordifoliaca*, *Memecylon petiolatum* and Jasminium angustifolium. Mandera is also the only threatened species in UWNP (Lourie & Mithapal, 1994)

1.2.1.2 Fauna.

UWNP is popular among visitor since elephants can usually be observed, even at midday. It is estimated that a 350 elephants roam in the park, both resident and migratory (Elephant census, 1993). Availability of water in the reservoir, even during the driest periods, provides good habitats for the animals. Most of the information available on the fauna of the park stems from the DWLC records.

Rich hemiptera fauna was noted in the reservoir There were 21 species of fishes recorded from the park (Karunaratne, 1990). Out of this only one is endemic (*Garra ceylonensis*) twelve amphibian's species have been recorded from the Park of which three species are endemic. In total thirty-three reptiles species have been recorded from the park: eighteen-serpentoid reptile (Snakes) and fifteen tetrapode reptiles two of the former and six of the later are endemic. (IUCN, 1988). Around one hundred and eighty four birds sepsis have been recorded from the park, 8 of them are endemic and at least twelve are recorded as threaten (IUCN, 1993). During the IWRB waterfowl census 1988-1992, a thirty-three migrant species were recorded from the park. Elephant, wild population of Samba, Spotted Deer and Wild Boar are the major mammal's species in the PA.

1.2.1.3 Social interacts with the park

Lot of people works in the UWNP as guides, safari jeep renters, and the people whom near to the A-5 road, earning money from selling vegetables and fruits to the visitors. On the other hand some are earning money in illegal ways. They are releasing their cattle in to the PA, fish in the lake in side the park and some hunt in the park.

1.3 Relative study area.

The Relative study area is located in the south side of the UWNP where the GPS locations are 06 26.12^{N}, 080 51.34^{E} and 06 24.21^{N}, 080 57,23^{E}. The Colombo Monaragala A-5 road is divided the Park boundary and the settlements. Out side of the protected area, there are 298 families are living near to the main road in between those GPS locations. The majority of those families are the farmers of the Sevanagala sugar plantation. They have ¼ acres land for home gardens and those lands in between main road and the sugar plantation. Houses and other small structures like wells, water tanks, cover the most home gardens. The Mango or Neem trees mostly cover other part of the garden. Sugar cane period normally take place in the November to following October. Cash crops are cultivated in the presence of the rain in the October and harvested in January, February. Normally they farming these crops in between the main road and house fences.

The electric fence is located near to the B-427 road. The mean distance between roads to electric fence is 3m. That three-meter normally covered by the seasonal grasses and some perennial trees. Those perennial trees were planted by Sevanagala sugar Factory. Sevanagal sugar factory established the electric fence in year 1995 and it is 15km long.

1.4 OBJECTIVES:

1,) To determine the efficiency of electric fence in solving human elephant conflicts.

2,) To determine the financial lost incurred to farmers from the elephant and to calculate the maintenance charges of electric fence.

3.) To determine the breaching patterns of the fence by elephant.

4.) What action should be taken to increase the efficiency of electric fence.

CHAPTER 2

2 LITERATURE REVIEW.

2.1 Human elephant Conflict.

The growing human population with its increasing demands for land for agriculture and development has reduced the once vast natural habitats in to small habitats of islands. These habitats continue to be exposed to further fragmentation and degradation leading to an increasing the level of conflicts between animal and man. It is special intense where the animal's concerned are in a position to cause severe damage to human lives and property (mostly crop damage.). (Balasubramania et al, 1993).

HEC is mainly due to people encroaching on to the elephants' habitat without considering the ecological needs of the elephants. Struggling to survive in the face of the increasing cost of living, villages clear jungle areas for cultivation, many of these clearing are situated in the habitats paths used by elephants and hence led to conflict. (Fernando, 1995).

HEC is a problem in most Asian and African countries where elephants occur outside PA (Bell and Meschane-Caluzi, 1984; Blan and Noor, 1979; Dey, 1991; Tayler, 1993; Thouless, 1994). In both continents there is a perception that the problem has got worse in recent years (Thouless, 1994).

2.1.1 Human elephant conflict in African Continent.

Crop raiding is a huge problem anywhere farmer and elephants come together. Entire fields can be destroyed over night. Botsswana one of the few African countries to compensation farmers for elephant damage pays out more than US $ 1 million each year (web search: www.news1.com). While Canadian farmers curse rabbits and gophers for wrecking their crops, farmers in Zimbabwe in Southeast Africa have a much bigger pass to worry about –elephants. In recent years, the pachyderms have

been wandering out of the forest and grasslands on moonless night to snack on crops or corn, bananas and coconut (McCormick, 2000). The problem of HEC around perimeters of the Mount Kenya forest has been in exertions for as long as there have been local people cultivating the areas adjacent to the forest reserve (WEB search: WWW.Problem of HWC.com)

2.1.2 HEC in other Asian Countries

HEC in Asia is a long time problem to Asian countries India, Nepal, Sri Lanka are the some of countries that suffering from this problem. The behaviours of wild elephant in crop raiding well studied by Sukumar in Southern India to revel crop preferences seasonal fluctuations and the more destructive raiding patterns of males than females (Sukumar and Gadil 1998; Sukumar, 1991).

2.1.3 Human elephant conflict in Sri Lanka.

Human has affected elephant population and their distribution in Sri Lanka many centuries. The great irrigation dependent civilizations of Sri Lanka developed in the low lying dry zone, and many areas that are now considered prime elephant habitat than supported intensive agriculture. Presumably most lived in the wet zone and the British shot large numbers of elephants in the country during the nineteenth century. (Gunaratne, 1978; Thouless, 1994), while most of the mountain forests were cleared for tea plantation. In response to concern about the level of slaughter being carried out, game laws were promulgated and hunting reserves, which late became national parks, where established chiefly in the dry zone where the majority of remaining elephants lived (Thouless, 1994).

Following independence, a number of large-scale irrigation schemes were developed in the dry zone in order to overpopulation in the wet zone. New large reservoirs were built, rivers were diverted, and large areas of jungle cleared for paddy cultivation. The Mahaweli scheme, based on Sri Lanka's largest river, was the largest. Although environmental consideration were included in the planning for the Mahaweli scheme (Tippets-Abette-McCarthyStratton (TAMS), 1980; Tippets-Abette-McCarthyStratton (TAMS), 1981; Thouless, 1994) and several new NP were declared, many new problems of HEC resulted from the Mahaweli scheme and other large scale

agricultural developments in the GalOya, Menik Ganga and Walawe Ganga basin (Cox,1988;Hoffmann,1978; Jayawrdene,1989; Jayawardana,1990; Jayawardana,1992; Jones,1975; Thouless, 1994).

2.1.3.1 Southern Region.

There are several protected areas in Southern Regain with high elephant populations, including Yala Complex. Between these PA human population density is relatively low because it is the driest part of Sri Lanka, but there are a number of recent large-scale agricultural developments, which have precipitated much HEC. These include the irrigated developments schemes fed by the Udawalawe and Lunugamwehera reservoirs, and large-scale sugar plantation at Pelwatte and Udawalawe. Between these schemes are older villages, many making use of chena cultivation. As well as growing paddy from irrigation from village tanks and there are still considerable areas of more or less disturbed jungles and small patches of a banded teak plantation. Elephant occur through out this regions and are responsible for wide spread crop damage. The in and around Pelwatte sugar plantation has been given much publicity. However the overall level of conflicts as measured by human and elephant mortality is less severe in Southern Region than in the North-western and the Mahaweli Regions. (Thouless, 1994). To the south west of the Udawalawe lies the Sevanagala sugar plantation. Damage to the sugar cane by elephants was once a serious problem, but following the erection of an electric fence by the sugar co-operation along the southern boundary of the park, this problem has been almost eliminated. There are still problems with HEC along the eastern boundary of the reservoir (Thouless, 1994).

During dry seasons over the past years due to over grazing by large herds, the carrying capacity of the teak forest is over exceeded and this forest is also under threat since there are sever de-barking and even up rooting of trees. The incidence of crop raiding is highest during the dry season and includes whatever crop cultivated by the villagers. Acute scarcity of foods some times forces the matriarchs to bring young calves into human settlement areas knowing the risks that they might face. This type of crop raiding was apparent in Nelluwagala and Pubudugama and part of Buduruwagala villages. There have been a number of incidents where calves have received gun shot injuries and some have died by falling into pits or unprotected wells

and in some instances there have been cases of sudden death following acute diarrhoea which is suggestive of poisoning (Thouless, 1994).

2.1.3.2 Mahaweli region.

The Mahaweli River and the irrigation areas of the Mahaweli Development program dominate this region. Clearing of large areas of forest has created several herds of pocketed elephants. Although several national park were created preserve the area along the Mahaweli River and to act as corridors for elephant movement, this has resulted in the creation of an extremely long interface between elephant habitat and settle areas, and human-elephant problems are a serious concern (Jayewardene. 1984: Jayewardene, 1986: Jayewardene, 1989: Jayewardene, 1990: Jayewardene, 1992)

There are problems with crop raiding in Mahaweli system B and C from pocketed elephants, and those from Wasgomuwa and Maduruoya. A corridor between these national parks was planned, but the idea has now been abandoned. The Mahaweli Agencies is now building electric fence along the boundaries of the parks, so the problem should be reduced. However, there is some uncertainty about the effectiveness of the electric fence. (Thouless, 1994)

2.1.3.3 Central region

There are only a small numbers of elephants in Central region. The number is believed to be between 50-65 in the Victoria Randenigala Sanctuary, which raid crops go along the Uma oya, and 10-14 in the Peak Wilderness area. In the Passara Badulla there is a small-pocketed herd of 4 animals in forest patches (Thouless, 1994)

2.1.3.4 North-western region

North-western Region suffers from particularly server human/elephant conflict, although it receives less attention from the media and the NGOs than Southern Region. The only large protected area is Willpattu NP, but because of the security situation DWLC does not operate inside the park. Elephant are scattered through out the region, in small patches in jungle, from which they come to raid crops. It appears that many of the elephant in the region are true' pocketed populations', confined in

the small areas in jungle that have been left after clearing for agriculture, especially for Mahaweli System, H, suffering high levels of mortality and wounding of farmers defending there crops.(Thouless,1994)

Groups from Wilpattu are believed to move as far as Daduru-Oya over 50km from the south, where they do a subsubstaintiol amount of damage to banana and coconut plantation. (Fernando, pers. com.; Tholess, 1994). The most series problems have been reported from the Mihinthale, Nawegattema, Galgamuwa, Rasvehera and Kahalle-Pallekele areas (Thouless, 1994).

2.2 PROBLEMS OCCURRING IN HUMAN ELEPHANT CONFLICTS.

2.2.1 Loss of life and injury to human.

In 1990, there was a death rate about 0.13 per thousand people per year in Sri Lanka. Out of the all the cases since 1990 for which the information is available, 71 were men and 119 were women. People are also injured, and in some cases crippled, by elephants. (Thouless, 1994)

Table :3 Circumstances of human deaths caused by elephants

Circumstances	No. Cases
Walking at night	9
Walking (time un specified)	8
Out side house	6
Protecting crops	3
Fishing	3
Sleeping in house	2
Taking cattle in through jungle in day time	2
Bathing in tank	1
Bicycling	1
Walking in field	1

Source-Preliminary Technical Report for GEF Project (Thouless,1994)

2.2.2 Damage to crops.

Elephants raid paddy fields even when the stems have just started growing, but the main problem is just before and during and the harvesting time. Elephant also eat paddy after harvesting, when it is stored in fields or houses. Elephants also raid crops grown in the chena system. These include Cowpea, Kurakkan, and Groundnuts. Mung bean, Maize, Vegetables, Golden melon, Millet, Manioc roots sesame, Pumpkins and Chilli, which are also grown in paddy fields during the Yala season in area where irrigation water is not available (Santiapilia, 1998).

Banana and coconut trees are particularly affected and they also eat roots of the groundnuts, plantations and vegetables (Thouless, 1994).

2.2.3. Damage to forestry plantation.

Elephant damage is a major problem in the establishment of forestry plantation in the dry zone, with teak plantation is particularly badly affected. Bark is stripped from mature trees in some cases leading to death of the tree, while damaging to young trees may result in coppicing. (Thouless, 1994)

Table. 4. Area of forestry plantation destroyed by elephants, from 1984-1986 forestry planning unit survey.

Forestry Division	Ha. Destroyed	Total ha.	% Distraction
Anuradhapura	383	3556	10.8
Puttalam	239	7732	3.1
Ampara	1170	21449	5.5
Monaragala	312	1756	17.8
Kurunagala	216	6334	3.4
Polonnaruwa	410	2614	15.7
Matale	100	2249	4.4
Nothern	90	2343	3.8

Source-Preliminary Technical Report for GEF Project (Thouless,1994).

2.2.4 Damage to houses.

Elephant attack houses, mostly to get access to stored rice, or other foodstuff inside. In one case an elephant appeared to break in to a house to get access to salt, an in another elephant was reported as having died after eating a sack of flour, which swell up inside its stomach. Elephant will break in to even quiet substantial brick built houses using there heads to batter down the walls, and in some cases, where houses are on regular movement routes, will attack the same house several times. All cases of house breaking appear to be caused by solitary bulls (Thouless, 1994).

The main factor affecting house damage appears to be whether or not houses lie on a regular movement route. Some houses have been broken in to repeatedly by elephants. This is particularly noticeable in the area near Elahera. (Thouless, 1994).

2.2.5 Damage to Elephant.

Publicity about human-elephant conflict tends to be one-sided-concentrating on damage suffered by humans. However, elephant suffer more in the long tern. Clearing of jungle to areas once used by elephant usually largely causes the conflict. This disrupts their movement patterns and reduces the amount of natural food available to them. Farmers often defend their crops using shot-guns or home made guns, both of which are more likely to injure elephants severely, then to kill them immediately, condemning them to a considerable period of suffering.(Thouless,1994)

Table: 5 Recorded causes of elephant deaths (1993-1994).

Cause	N	%
Gunshot	246	57
Unknown	81	19
Natural	55	13
Accident	50	11

Source-Preliminary Technical Report for GEF Project (Thouless,1994)

2.3 HUMAN ELEPHANT CONFLICT MANAGEMENT TECHNIQUES.

As a result of increasing of human elephant conflicts, there are wide varieties of techniques used in the world. Farmers according to their traditional knowledge take some management techniques.

2.3.1 Traditional methods.

2.3.1.1 Self defence by farmers in the world.

Elephant avoid chilli plants and burning peppers keeps animals away from other crops. In Zimbabwe over the past two years elephant damage were cut by three quarters using noise making, burning chillies and warning system such as bells strung of fences. The farmers in Uganda use thorn fences trench and stonewall to keep out of their fields (McCormick, 2000). In Namibia farmers use strategies such as drum beating, fire and shooting in the air, Elephant have sometimes become aggressive towards farmers who try to prevent them from entering fields, leaving the farmers afraid to chaise problem elephants. In the southern Africa, Cafrive region of Namibia, under traditional tribal low, a hunter would have been appointed from the community to kill problem elephants (Web search: WWW.HEC/Africa.com.). In Zimbabwe the farmers farming multi-layered defence that not only include pepper, but also involve the design of the farm itself. Farmers clear a path between farming land and forest and field, creating a well-defined border elephants could recognise. Then farmers' plant hot papers and dense thorny plants around the perimeters of the farm, something does not usually enjoy trekking through. Next comes the crash crop, usually cotton, which elephants eat but do not enjoy as corn or banana. Then the farmers plant the good stuff deepest in the field. The pepper is the last line of the defence. In the moon less nights that elephants prefer farmers set small firs around their fields. When they hear an elephant, they put the briquettes (elephant dung and ground hot chillies) in to the fires and the smoke created from the burning chillies irritate elephant trunk and make them returned back to the forest (McCormick, 2000).

2.3.1.2 Self defence by farmers in Sri Lanka.

The resources of the Department of wildlife conservation (DWLC) are so limited; most attempts in management of HEC are carried out, not by department staff, but by local farmers themselves. During the period before the harvest, paddy farmers in affected areas usually spend whole night in or close to their fields, watching for the approach of elephants. They construct watchtowers, preferably in the branches of trees, and may build fires around the edge of the cultivated areas to deter the elephant. When elephants raid the fields, the farmers make use of firecrackers, torches, and gangs to try to deter the raiders. In the case of family groups, these techniques are often effective, but bulls may not respond, and may even act aggressively. Because of the failure of these methods, and the failing that DWLC has been unable to solve problems of HEC, farmers have taken to using guns to deter elephants. These are mostly homemade shotguns, filled with a variety of projectiles, although trap guns are also used, and in some instance police have issued farmers with shotguns and immunisation. The impact of this can be seen in the large number of elephants killed by gun shot, and the numbers of injured elephants that have had to be treated by the veterinary consultant (Thouless, 1994)

2.3.2 Method used by DWLC to minimise HEC.

2.3.2.1 Drives.

The method that has been used on a large scale in Indonesia and Sri Lanka, an on smaller scale in other Asian and African countries, to move elephant out of and a area, is the drive. Elephants are moved slowly in a particular direction by large group of beaters, who shout, beat gongs, and throw thunder flashes, and so on. At night fires are set in a line to prevent the elephant from breaking back. In some cases helicopters have been used as well. If the drive is well planed and stop lined are affectively maintained, it is possible to drive larger group of elephants over distance of 100km in a few week (Thouless, 1994).

The DWLC initiated driving elephant in masse early as 1974, when two elephants were driven from Angunukolapalassa to forest in Gonnoruwa, in which operation, none of the animals returned.(Jayawardana,1994; Santiapillai,1998)

2.3.2.2 Capture.

A widely used management technique for removing problem animals, either particularly trouble some individuals, or pocketed herds, involves capture followed by translocation to new areas, or by domestication (Thoules, 1994).

2.3.2.3Trnnslocation.

Captured of solitary crop-raiding elephants (mostly bulls) began in 1990 when the department initiated a translocation programme as a means of mitigating the elephant damage (Santiapillai, 1998).

2.3.2.4Electric fences.

The used of electric fence as a deterrent to elephants was tried as early as 1956 on an experimental basis in block 1 of Ruhuna National Park (Jayewardene, 1994; Santhiapillai, 1997). Electric fences were first constructed in Sri Lanka in 1966(Jayewardene, 1994; Thouless, 1994), but have only comes to be used on large-scale against elephant movements in the last few years.

In 1986 Pelwatte sugar co-operation started to build fences. These have proved effective in reducing the depredation elephant on a sugar plantation. In 1992 fence was erected along the southern boundary of Udawalawe NP by the Sevanagala sugar cooperation. A short fence of 13km was built in 1992 by DWLC along the southern boundary of Wasgamuwa National Park. The eastern end of this fence is at the Mahaweli River. On the other bank is section of fence built by the Mahawali authority. The fence on the West Bank of the river has been extended north. The Mahaweli authority has also constructed a fence along the western boundary of Maduru Oya NP during 1994. Although this is built along the far bank of an irrigation channel across from the park. In Southern Region fence have been constructed by DWLC along part of the western boundary of the Lunugamwehera Proposed National Park, and on the Southern boundary of Yala Block IV (Thouless, 1994).

Table: 6 Electric fences in Sri Lanka

Location	Region	Length	Year Built	Organization
Pelwatte	Southern	280	1986	Pelwatte sugar
Kataragama	Southern	10	1992	DWLC
Udawalawe	Southern	15	1992	Sugar company
Ridiyagama	Southern	25	1991	State farm
Lunugamwehera	Southern	10	1992	DWLC
Maduruoya	Mahaweli	40	1994	Mahaweli
Wasgamuwa Flodplains	Mahaweli	65	1994	Mahaweli
Wasgamuwa southern	Mahaweli	13	1992	DWLC
Ekgala Oya	Eastern	6	1970s	Sugar company

Source-Preliminary Technical Report for GEF Project (Thouless, 1994).

CHAPTER 3

3 METHODOLOGY.

3.1 METHOD OF STUDY.

Two basic methods used to conduct the study.

1. Identification of fence breaking.
2. Damage assessment.

3.1.1 Identification of fence breaking.

In the study period there were morning and night field visit to identify the fence breaking. In the morning session, the full 15km was covered. This was done in most of the days during the project period (6th of September to 10th December), but the night field visits were done in one or two days for the each week. The morning field visit was done in between 7.00am to 12 noon The night field visits were done in around 5.30pm to11.30pm.

In morning sessions, if the elephants have broken the electric fence in the previous night, then the following data were collected.

If there were any elephant footprints there in the previous night, then that could be used to identify whether the elephants have gone in to the PA or gone out from the PA.The nails of the foot print showed to which way they have gone. If there were good completed footprints there, then the perimeters of the footprint was measured with the help of a tape. If there were any dung sample of elephants, that also were collected to sampling tubes and filled from buffer solution. The date, Location, time of the sample was recorded in the sample bottle.

If there were no elephant footprints, then the elephant movement direction were identified by the help of the electric wire broken patterns. If the wire was broken towards the out side of the fence, then that meant the elephant that has breached the

fence out from the PA. If that have happened in opposite direction that mean the elephants have gone in to the PA.

If the elephant have breach out or in to the PA then the following data were collected with the help of living near by farmers.

i. At what time the elephant have breach out or in to the PA.

ii. How many elephants have breach in or out from PA.

After identifying the damaged place in the fence, the data sheet given in annex I was completed.

3.1.2 Damage Assesment.

If the elephant has gone out of the PA, then they have gone to the home gardens or sugar plantation. The damage assessment was done in the following two ways.

i. Identification of the location of damage and, assessment.

ii. Interview the farmers who own the damaged land.

3.1.2.1 Visits to the location of damage.

The elephant's footprint shows the direction that elephant have gone to damage the crops. If there were any possibility to visit that site then the data sheets was filled. (Refer Annex 1)

3.1.2.2 Interview the farmers who own the damaged land.

With the help of the farmers, the quantity of the damage was identified. If the damage taken place in the sugar cane, then it was questioned from the landowner the type of damage done by the elephants. Whether the sugar plants were eaten or crushed how much of sugar plants broken or eaten, and estimated the elephant damage (Refer

annex II). If the elephants damaged the home gardens that also was handaled in the same way.

In both these cases, there were some assumptions made.

i. If the damage site was mature sugar cane, it was assumed that a bull elephant damage ¼ Acres overnight.

ii. If the damaged site was immature sugar cane, it was assumed that a bull elephant damage one Acres overnight.

These two assumptions were made accordingly with the experience of Sevanagala field officers.

Counting the damaged plants and crushed areas identified damage to the home gardens. In home gardens, the damage was estimated with the aid of annex II.

If single elephant damage to sugar cane and home garden then both set of data was taken into single sheet and estimated both damages together.

CHAPTER 4

4 RESULTS

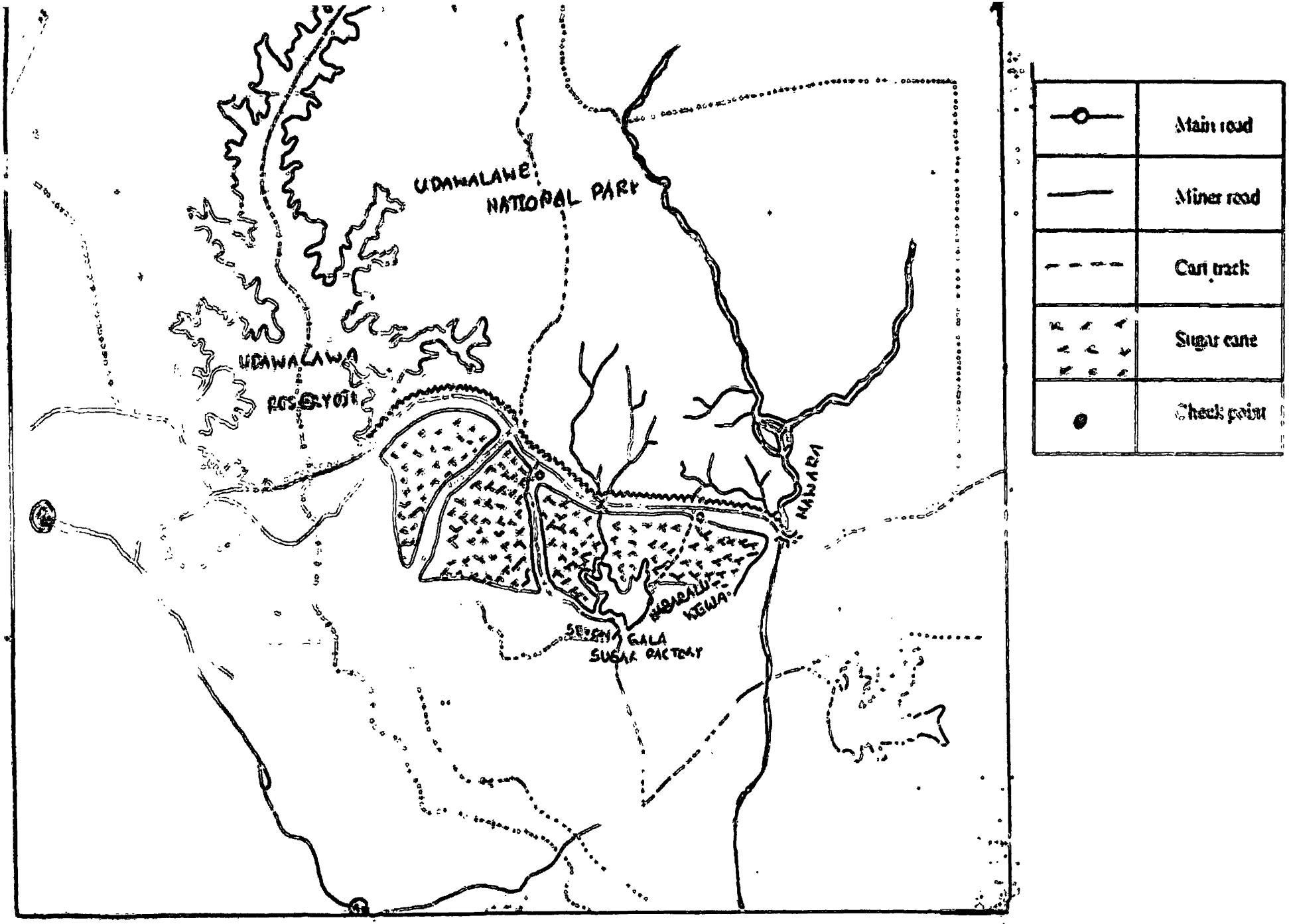
4.1 DESCRIPTION OF THE FENCE.

Sewanagala Sugar Corporation constructed the Udawalawe electric fence in 1992. The length of that is 15 km and other it is in between over spill of Udawalawe Reservoir and Mow- ara bridge. Other part of the fence was constructed by the DWLC in same year and it is in between Maw-ara to check point ad recently it was constructed to 10th post checkpoint.

Normal distance between the two posts is five point one meter. Height of a concrete post is one point five-meter. There was two live wire and one earth wire. Gap between the two wires is one feet. Middle wire is the earth wire. The wire is carrying 12V and 1.5A. The power is supplied to the fence by two-check point of Sewanagala Sugar Corporation. Two GPS locations are 06 25 80N, 80 53 69E and 06 25 18N, 80 55 88E. The power is generated with the help of solar panels in those two checkpoints. The generated power is stored in the two batteries in both places until at six pm. Current is supplied to the fence at 6pm.to 6.00am. in the morning. If the power is not enough to the fence then the controlled AC current is supplied to the fence using controlled meters.

Figure: 1. control meter

Figure: 2. Power supply batteries



MAP OF STUDY AREA

4.2 NUMBERS OF BREACHING IN EACH MONTH.

During the study period there were ninety-two morning field visits was completed and out of that ninety-two days, in forty days elephants have been gone in to the PA and forty two times there have gone out from the PA, to the data table is given bellow.

Table: 7. Numbers of breaching in each month.

Month	Numbers of Field visits.	In to PA	Out from PA	Total
September	25	17	16	33
October	29	15	18	33
November	28	4	4	9
December	10	4	4	8

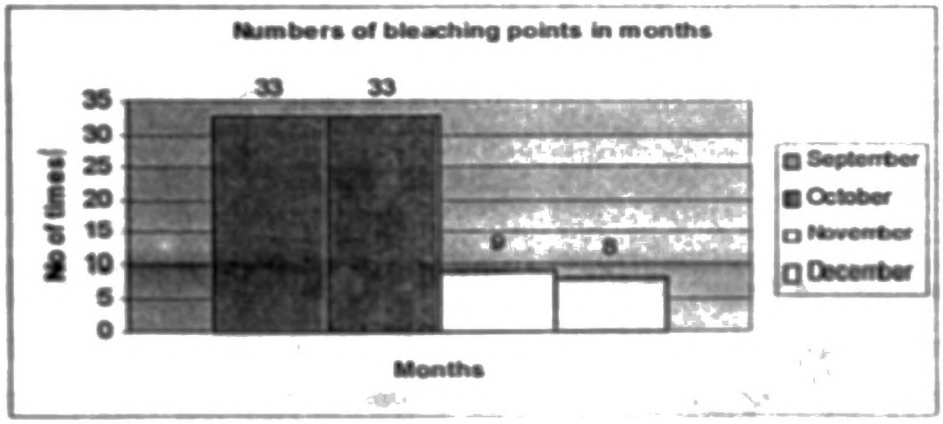


Figure 3. No: of breaking points per month.

In the month of September and October there was maximum number of breached occurred. There were 33 each time in both these months.

4.3 IDENTIFICATION OF THE NUMBER OF DAMAGE CAUSING ELEPHANTS AT A TIME.

Elephants who broken the fence were identified from their foot print measurements. A pattern was identified for the elephants that broke the fence most of the times. There was one elephant that broke the fence alone (front foot perimeter-54', back foot perimeter- 48'). And two elephants who were together in breaking (FFP-55', BFP-49 and FFP-59', BFP-51'). In additions there were few occasions where another unknown elephant broke the fence.

1-Single elephant. 2- Two elephant. Un- Unknown numbers of elephants.

Table: 8 Damage causing elephants at a time

Mont.	September			October.			November.			December.		
No. Of elephants	1	2	Un	1	2	Un	1	2	Un	1	2	Un
In.	4	8	5	14	1	-	4	-	-	4	-	-
Out.	6	7	3	15	3	-	5	-	-	4	-	-
Total	10	15	8	29	4	-	9	-	-	8	-	-

In the month of September there was maximum number of times where the two elephants broke the electric fence. The maximum number of damage caused by single elephant was in October. The damage causes by the two elephant decreased when the rainfall increased. In the month of November and December those two elephants did not damaged to the fence.

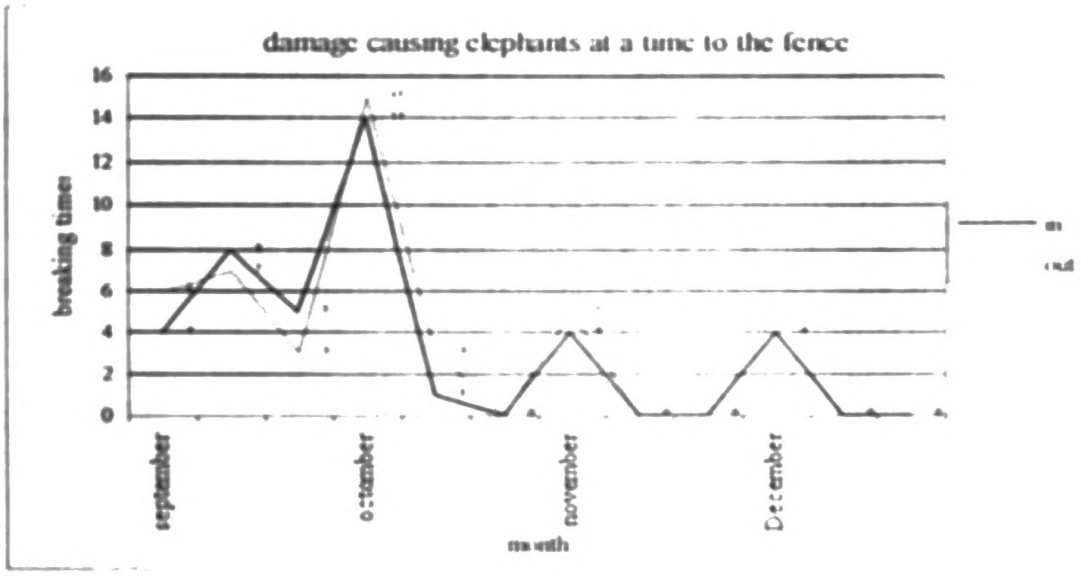


Figure: 4. Damage causing elephant at a time to the fence.

4.4 BREACHED PATTERNS IN RELATION WITH RAINFALL.

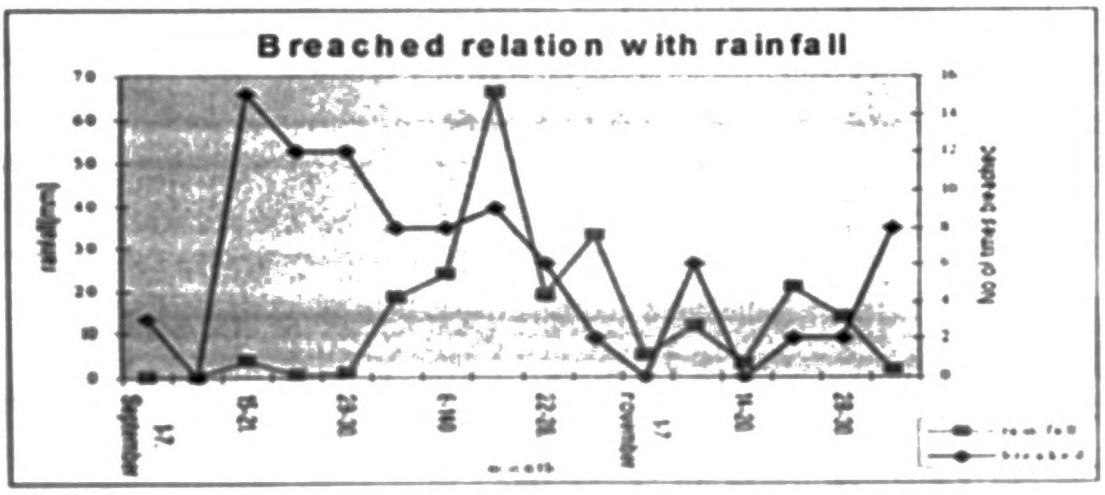


Figure: 5. Breached patterns in relation with rainfall.

Regression

Hypothesis

Ho=There is no linear relationship between Rainfall and Elephant breached

H1=There is a linear relationship between Rainfall and Elephant breached

P=0.597

P>0.05 So Ho is not rejected but accepted.

There is no linear relationship between Rainfall and Elephant breached at 95% confidence level.

When rain fall increase then the fence damage was decreased. Highest rainfall reported in November then the fences damage was minimum too in November.

4.5 NUMBER OF BREACHING IN EACH KM GAP.

4.5.1 September.

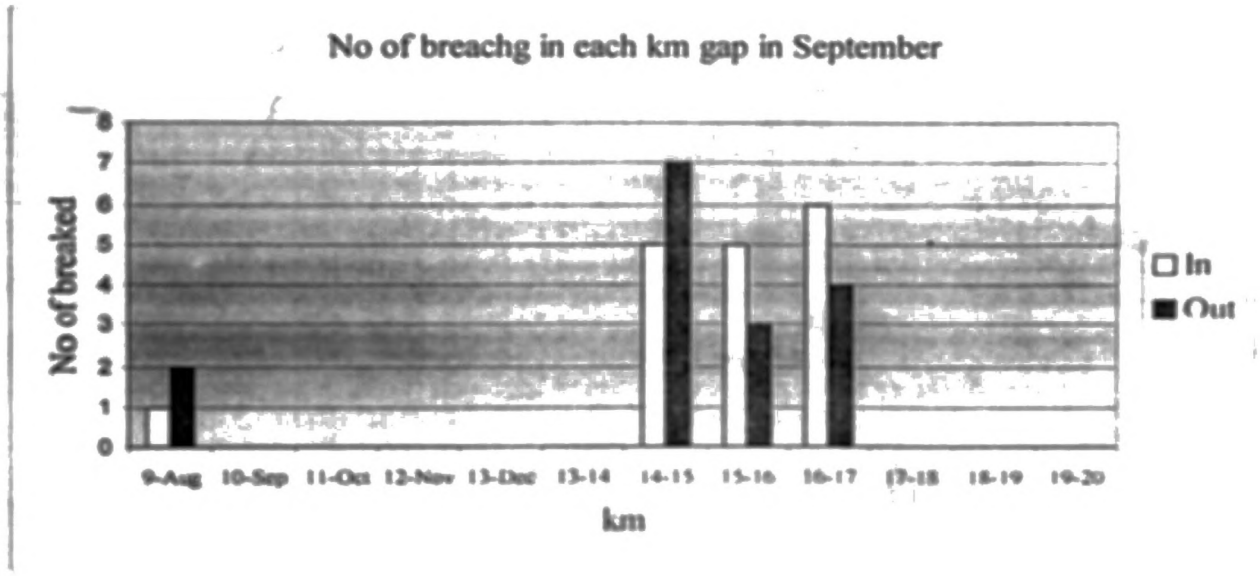


Figure: 6. No of damage in each km gap in September

There was maximum beaked in between 14-15 km gap.

4.5.2 October.

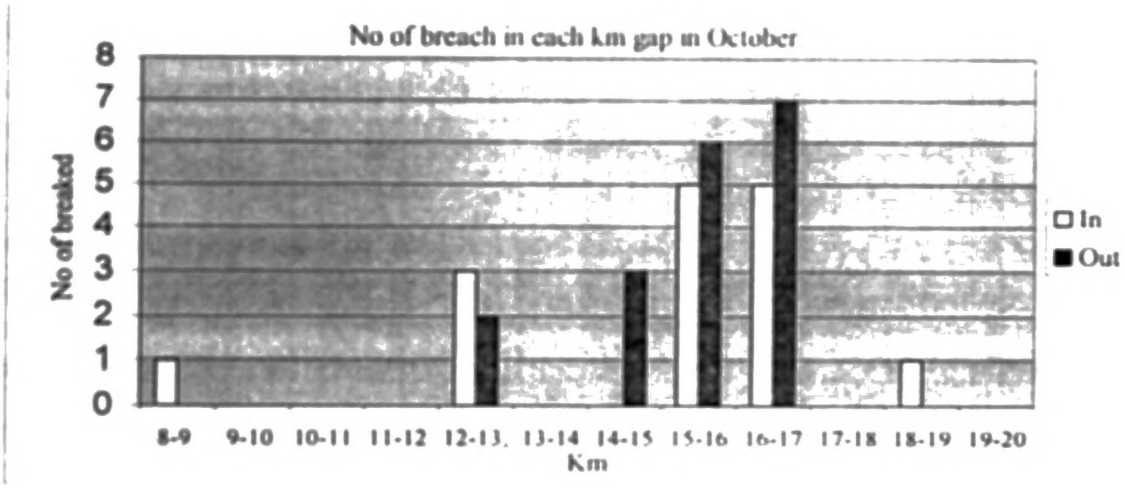


Figure: 7. No of damage in each Km gap in October.

There was maximum breach points (12) in between 17-18 km gap and one breaching point in between 17-18 and 7-8kms, there were no anywhere else.

4.5.3 November.

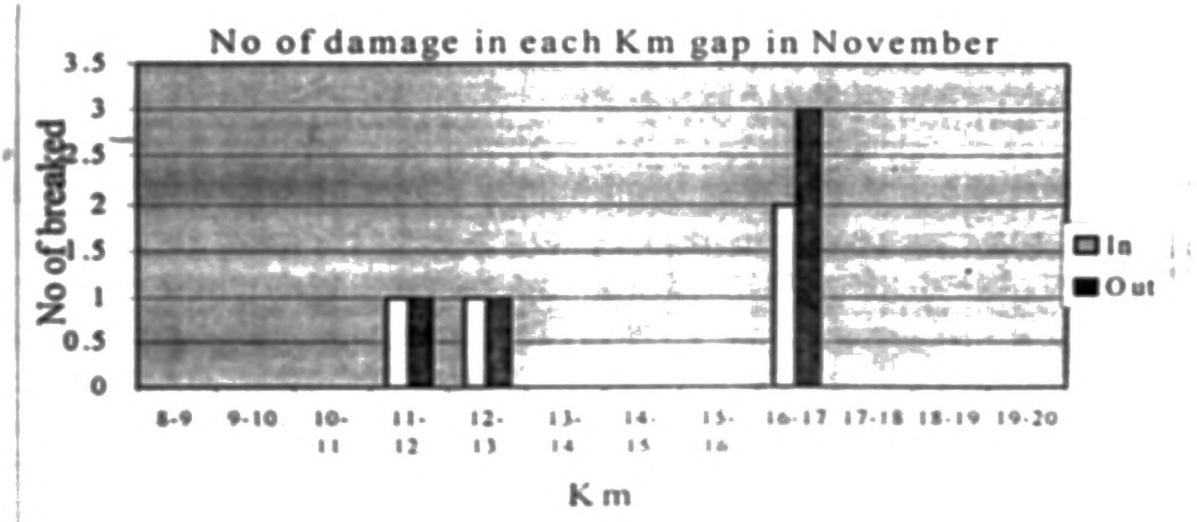


Figure: 8. No of damage in each Km gap in November.

There was maximum number of break points in between 16-17km gaps. In this month single elephant was injured in 16-17km gap.

4.5.4 December.

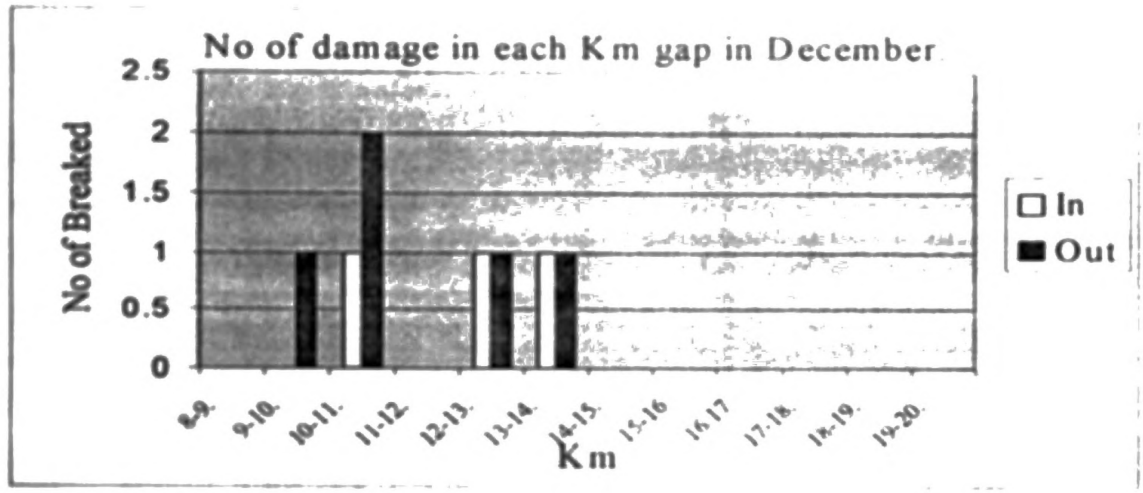


Figure: 9.No of damage in each Km gap in December.

In this month maximum breach points occurred in 10-11km gap.

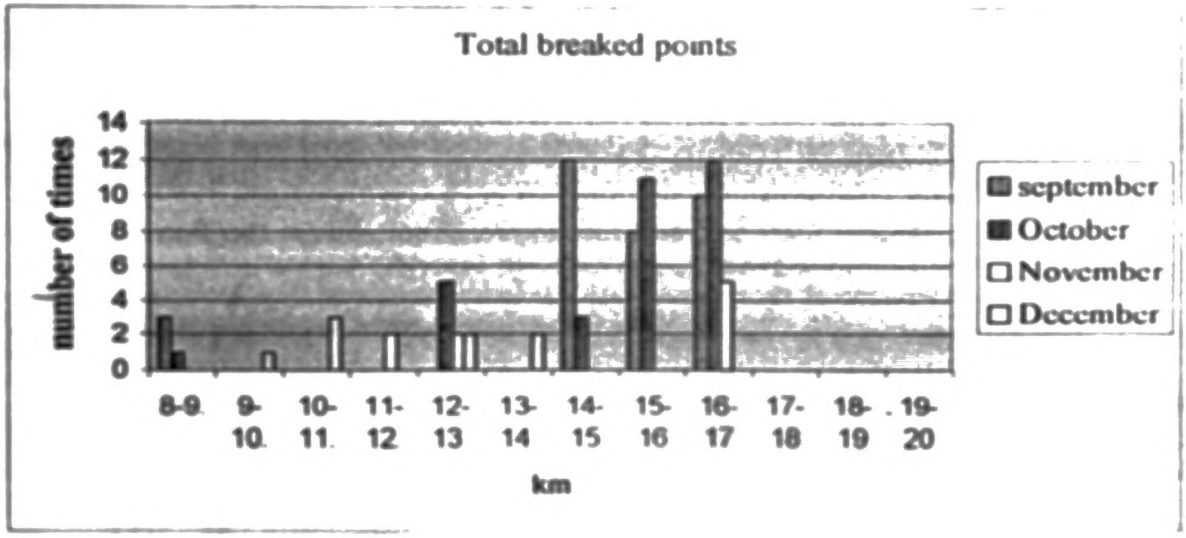


Figure: 10. Total No of beaked point in each km gaps.

According to these results there was maximum-breached points in between16-17kms.

4.6 DISTANCE BETWEEN FOREST COVERS FROM ELECTRIC FENCE (INSIDE THE PA/ OUT SIDE THE PA).

Table: 9 Distance between forest cover and the electric fence

Elephant moved direction	Distance to tree lines	No of times break in each distance gaps.			
		0-9	10-49	50-100	>100
In	In: T:	9	9	6	15
	Out; T:	7	17	5	6
	Cul.	8	4	2	25
Out	In: T:	5	5	7	29
	Out: T:	4	22	8	4
	Cul.	1	4	1	8

In: T: Inside tree line from the electric fence.

Out: T: Outside tree line from the electric fence.

Cul: Cultivated land from the electric fence.

Chi-Square Test: When elephant went out from the PA

Chi-Square = 47.351, DF = 6, P-Value = 0.000

Hypothesis:

H0=There is no relationship between tree line distance and elephant movement (Out PA)

H1=There is a relation between tree line distance and elephant movement (Out PA)

P=0.000 which is less than 0.05

So Ho should be rejected

So H1 is accepted

There is a relationship between tree line distance and elephant movement (Out from PA) at 95% confidence level.

Chi-Square Test: When elephant went in to the PA

Chi-Square = 22.758, DF = 6, P-Value = 0.001

Hypothesis:

H0=There is no relationship between tree line distance and elephant movement (in to from PA)

H1=There is a relation between tree line distance and elephant movement (in to PA)

P=0.000 which is less than 0.05

So Ho should be rejected.

So H1 is accepted.

There is a relationship between Distance and Out PA, at 95% confidence level.

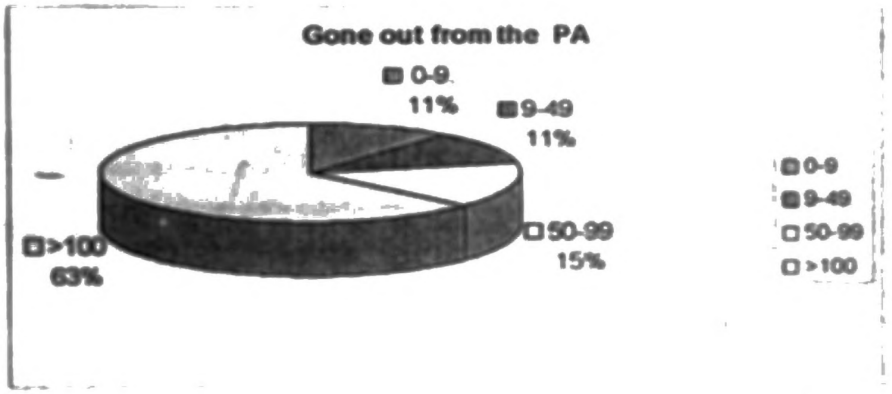


Figure: 11. Percentage of breached in relation to the distance to the tree line from the fence-gone out of the PA

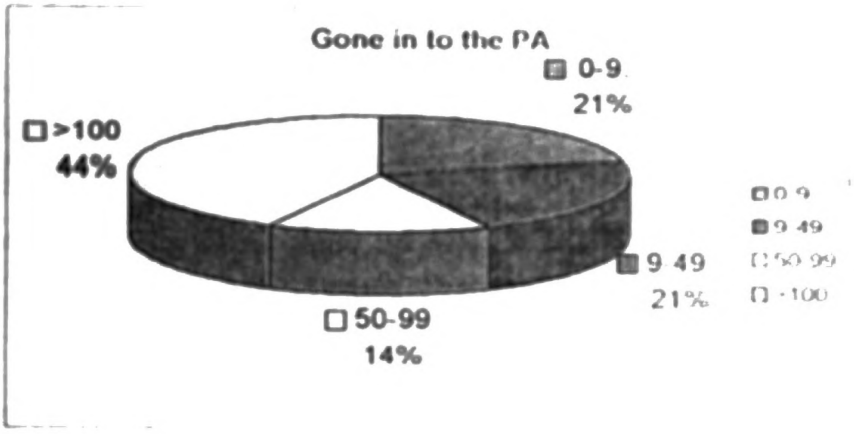


Figure12. Percentage of breached in relation to the distance to the tree line from the fence-gone in to PA.

When the elephants try to go out from the PA, most of times they choose points which has over 100m distances between inside tree line and electric fence. That percentage was 63%. When the distance between inside tree line and electric fence is less than 9m, then the damage was 15%. But when they coming in to the PA, there were 44% of times they choose points with distance between inside tree line to fence more than 100.when the in side tree line located less than 9m, time increased 11 to 21%

4.7 DAMAGE CAUSED TO THE CABLE.

Table: 10 Damage caused to the cable.

	In to PA			Out To PA		
No of cables Damage / No of elephants	1	2	3	1	2	3
1	16	4	6	20	8	2
2	0	2	6	2	1	5
3	1	1	1	1	1	1

4.7.1 Damage caused by bull elephant to the cable.

When the single elephant breached out from the PA they mostly damage a single cable. Only two times they damaged all three cabals. When gone out of the PA most of the time they broke single cable.

4.7.2 Damage caused by two elephant to the cable.

Most of times they damage all cables when they are going out of the PA. When they came in they use the same way.

4.8 MAINTENANCE COSTS OF ELECTRIC FENCE TO SEVENAGALA SUGAR CO-OPERATION.

Numbers of permanent labours for one year	=03
Number of days.	= 540
For one day.	= Rs.275.44
Total	= Rs. 446212.80

Number of minimum post for year	20
Cost for one post.	= Rs.475
Cost for post for one year.	Rs. 9500
Total cost of maintenance for electrical fence in One year	= Rs. 455712.8

- There were no estimated documents for wires.
- End of the rainy season the Sugar Company was cleared the grasses in both side of the electric fence by using a one bacco.

4.9 INCOME LOSS TO THE FARMERS.

Table: 10 Income loss to the farmers.

Damage / Month	Sugar		Coconut (Rs.)	Banana (Rs.)	Home gardens		Houses (Rs.)
	Immature (Rs.)	Mature (Rs.)			Manioc (Rs.)	Other (Rs.)	
September	100800	151200	5500	41500	840	0	0
October	268800	168000	2400	80000	0	0	0
November	230400	0	0	0	0	1912	600
December	201600	0	0	0	0	1100	0

In the month of September there was maximum effect the farmers income, in that month the elephant damage was very high because elephants have gone out to the PA 17 times, out of that 7 times two elephants have gone out from the PA. In the end of October there were no well-grown sugar cane and also home garden were grown and elephant started damage that with the beginning of November.

According to above table, most of times elephant damage sugar cane. The cost of damage was Rs.1120800.00. And also they damage coconut and other cash crops. They also damage to two houses. Total damage to crops and house was Rs1,182,652.00

Figure: 13 Damaged house.

Figure: 14. Damaged coconut trees.

Figure:15. Death elephant.

CHAPTER 5

5 DISCUSSION.

The study was conducted to evaluate the efficiency of the electric fence in Uda walawe national Park. The study was carried out in between 05th of September to 10th of December.

During the study period there were ninety-two field visits. The field visits started on the 05th of September 2002 went on to 10th of December 2002. In the month of September and October, there were maximum numbers of breached points in the electric fence. In first few days of November there were few numbers of breached points in the fence.

Elephants who broken the fence were identified from there foot print measurements. A pattern was identified for the elephants that broke the fence most of the times. There was one elephant that broke the fence alone (front foot perimeter-54', back foot perimeter- 48'). And two elephants who were together in breaking (FFP-55', BFP-49 and FFP-59', BFP-51'). In additions there were few occasions another unknown elephant broke the fence.

The study aimed to locate the points along the fence where the fence where breaking takes place, and identify the cause in each case. In the first week of the study period (in month of September), the elephants had damaged the fence in between the 8-9 km gap.

At end of the first week of this month farmers harvested sugar cane in that area and after that the breached patterns appeared between 14-17 km areas of the fence in order to reach the sugar cane plantation. In the end of the 15th of November the farmers harvested the all sugar cane and there after the elephant's entered in between 9th to 13th km areas. That area in those periods was fully covered with the cash crops. Because of that elephants entered to these areas and damage the crop.

The rainfall began on the 29th of September and it increased in December. Usually, when it starts raining, elephants cease to attack home gardens, since the food starts

getting abundant within the park. Though the rainfall increased the 54', 48' elephant continually damage the home garden and the immature sugar cane. While the rain started the bleached times of the two elephants (FFP-55', BFP-49 and FFP-59', BFP-51') decreased. In the month of November and December no damaged was done by those two elephants, since there was enough food available in side the PA, but the54', 48' elephants crop raiding had not stopped. In between 15-16km gaps, in the cultivate land, the single elephant (front foot perimeter FFP-54 inches, back foot perimeter BFP-48inches) was injured by a tarp gun. The injured elephant used the same path to enter the home gardens in previous two nights. Because of the injury, there was no damage for ten days of period. In the month of September two elephants caused most of the damaged. In other months most of times the fence was broken by 54', 48' elephant.

In the first two-month of the study period the elephants mostly damage, in between 13-16km. In the month of September, elephants mostly damage in between 13 - 14 km gaps. But they never broke in between 9-12 and 17-20 km gaps. In the month of October in most of the occasion the elephants have damaged in between 14-15km gaps and in the month of November they have mostly damaged in between 15-16 km gaps. In the month of December they have mostly damaged in between 10-11km gaps, because in these period the people have cultivated home gardens in these area. In most occasions the elephants have damaged to 16-17 km gaps. In the area between, the tree line to inside PA from the electric fence, the mean distance was 25-50 m and to out side-cultivated land, Over 100m and there are no actual tree line out side gardens to provide cover. In the area of 16-17 km the average gap between two settlements was about 500m. In those places the elephants could have easily gone to the sugar cane because were no real barrier exists for the entrance. And also in most occasions elephants breached near "Habaralu Ara" bridge. They have damaged this place sixteen times during the study period. In some occasions the elephants have gone through the "Habaralu Ara" bridge. In that area there was no Electric fence. The cattle owners have broken the fence to let the cattle in to the PA. In few occasions the elephants use same break path to go out from the PA and to return, but in most occasions they have used new path to enter the PA and that path was very close to the one or two electric fence post near to previous break point in the electric fence.

According to table 4.4 when the elephants were going out of the PA, they mostly used points which has over six meter distance between inside tree line and the electric fence. If the tree line was very close to the electric fence (less than 10m), then in fewer occasions they have damaged the electric fence. When the elephants were going in to the PA in most occasions they used the points, which have over 100m distances between inside forest line to electric fence. In 8- 9 and 17-19 km gaps the inside tree line to the fence was less than 10m, and there were no damage to electric fence in that areas in the study period. In most occasions the elephants have broken the electric fence when there were no out side forest line or settlement.

When the elephants have damage the electric fence the, 54', 48' elephant and the two elephants (FFP-55', BFP-49 and FFP-59', BFP-51') always damage the cables, they never damaged the posts. When two elephants (FFP-55', BFP-49 and FFP-59', BFP-51') have gone in or out from the PA, most of times they have damaged all cables. But the single elephant (54'48') most of the times break single cable to go in or out of the PA. When two elephants damage the fence, by the use of the footprints, it could be identified easily that they have broken the fence by using of there back side. Because near to fence if there were any footprint there, it could be identified that they have come out of PA back to back. The two occasion elephants have broken two post and in both these cases, the foot print measurement was 59'51'. It suggests that that it could be one of the two elephants, but since they are not known to break post, it can be a new elephant.

In one occasion in the month of September, the single elephant (54'48') had damaged over 100 banana plants in one night. In between 15-16 km gaps a house and a garden were damaged in several occasions. The elephant has damaged this house, the first time it came out of the park after injury. The elephant was injured near this house and according to the footprints it was the same elephant that has got injured that has attacked the house. That elephant has damaged that house twice, but in both occasions there were no settlers in side the house.

In the beginning of September the elephants have broken in between 7-8 km gaps. But in that area human disturbances were very high. Sevanagala sugar patrol tractor also go up and down along this area, because of high disturbances from the farmers,

elephants have changed their breaching path from 7-8 to 14-16km gaps. In between 15-16 km the farmer disturbances to the elephant are very less compare to other areas.

According to the farmers in the vicinity the elephants had damaged the fence in between 5.30 to 8.30 pm, But if the new elephant had damaged to the fence, that had occurred after 8.30pm. The farmers in most occasions failed to tell actual breached time. Although farmers said that the breaking time is between 5.30-8.30pm, not a single of the 25-night field visits at that time uncounted a break during the study period.

When coming in to the PA the elephants enter between 5.30-6.30am. But in this occasion the farmers also failed to gave actual time. Because of this reason there are no correct data about breaking time.

When two elephants (FFP-55', BFP-49 and FFP-59', BFP-51') go out from the PA, normally they stay two days in the sugar cane. When the elephants try to break the fence, if there were big disturbances from the farmers, then they change the path and break somewhere else close by.

The farmers who lives near the electric fence in some occasions never know that elephants have gone through their gardens, but some farmers most of days guard the electric fence in most of the months. The farmers normally burn fire pots near the electric fence. If the elephants were close to the fence in the evening then the farmers fire the crackers and make noise to protect the electric fence from the elephants.

In this area there are some farmers association. In these associations they do some work to minimize HEC. According to their rules two members in the society should help the Sevanagala guards to protect the electric fence from the elephants. But these methods were not efficient, since two farmers do not come every day to this work.

During the estimation of the damage the farmers always tried to overestimate their damage, they never revealed real damage. In some occasion even if the buffalo damage the sugar cane, they said that elephants did the damage.

In dry days there were no elephants foot prints, and some occasions elephant have chosen the same path to breached out or in to PA. Then that time there were some possibilities to unidentified the path.

Most of times, two elephants (Range and Rambo) hover the electric fence, especially in the dry season. The small stalls owners throw foods to elephants to keep them close to their stalls, because then they could sell their goods to visitors when they stop to see elephants. This may cause the elephants not too afraid of the electric fence any more.

With beginning of the rainy season the farmers grow the cash crops in front of their gardens, because of the reduced distance, elephants always try to enter these gardens to get foods and as a result of that they have broken fence near these gardens.

In every week, three in the Sewanagala sugar cooperation maintain, the electric fence. Every breaking points of the fence is renewed in each day by single labour. With the beginning of the rainy period the workers of the Sevanagala Company cut the grass near to the electric fence.

Maintenance of the electric fence is doing every day in between 3-5 pm. A labour searches the braked point of the fence and if there are any break points then that would construct. Every day this is handling before power is switch on. The maximum voltage of the fence is12V and the 1.5A the power generated by the two Sewanagala checkpoints. The power generated with the help of the two solar panels and it is stored in the two batteries. However, no one monitor this stored electric power before it is given to the electric fence. The power is given to the fence in between 6.00pm-6.00am.the current is not supplying continuously. It is breaking every 3 seconds. The sugar cooperation fixes batteries every two years.

Maintains of the fence was very bad in the rainy season. The grasses normally grow over cables and that will cause the discharge of the battery. The maintenance cost is normally going over Rs451327.80 each year. The price for wire should add for this. DWLC gives crackers to the farmers to protect their land from crop raiding by the elephants and this was not continuously working. They are never patrolling the

electric fence in nights. If there were any elephants in the sugarcane they chase them in the morning, but that would not happened regularly.

CHAPTER 6

6 CONCLUSION.

In the study area there were three identified elephants damaging the fence. Out of them there is one solitary elephant that damage the fence. That elephant is identified by foot print perimeters which are front foot perimeter-54', back foot perimeter- 48'. The other two elephants damage to the fence in together. Their foot print perimeters are: FFP-55', BFP-49 and FFP-59', BFP-51'.

In most occasions the elephants damage to the fence in between 14-17km gaps. In those areas there are no power supplies in houses as a result of that after 7.30.pm there are no any lights in those areas. Also farmers in those areas are not trying hard to protecting the electric fence in front of them and also sugar cane patrol not going on regularly in those areas. There are plenty of gaps between two houses. There for elephants can easily enter to the cultivated land.

The current supply to the fence is not monitoring by Sevanagala Sugar Co-operation or DWLC. The current is supply to the fens with the help of two batteries. The normal average supplies is 12V and 1.5A and it is may not effect to elephants. The damaging cabals are not reaffixed in nights, because of that if damage occurred in any places in the fence then the power was discharge immediately and that cause the power failure in hall fence. In night reaffix fence weir helps the increase of efficiency of the electric fence. According to results out of 92 days there was 83 bleached times in the fence. Sevanagala Sugar Co-operation spends Rs.461212.80 for monitoring the electric fence. For three months they spends Rs. 38434.40 and their income lost was Rs.801600.00.

Though there are any foods inside the PA, the one elephant damage tote fence and enter to the cultivated land. If in the dry period if those elephants need water they have enough thank in side PA.

Udawalawe fence may hold back the herds from the reaching the cultivation in that since it is effective, but is not fully efficient because once one elephant get used to breaking, there is no way to stop it from constancy. So it is continues process of breaking and mending.

The maintaining efficiency is not sufficient, especially when it comes to the power supply and the repairing. Also the authorities are not concerned about the other factors that might help to prevent breaking.

Recommendation

Increasing the monitoring efficiency.
Establish biological fence inside the PA.
Electric current supply to the settlements along the park boundary, where still there is no electric current.

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Appendix I

Date: .....

Date fence was broken: .....

Time: .....

Location:.....

Elephant movement:.....

i. in to PA -01

ii. Out of PA –02

No of elephants: .....

Distance between :

Fence to tree line inside the PA :.....

Fence to tree line out side the PA:.....

Closet cultivated land:.....

To main road: .....

Damage causes to fence:

No of post:

01

02

03

No of were:

01

02

03

Elephant foot print

Front:

01.....

02.....

03.....

Back

01.....

02.....

03.....

Appendix II

Date:.....

Location: .....

Type of crop damage .....

1-Mature sugar

2-Imature sugar.

3-Ccount.

4-Banana.

5-Cash crops.

No of acres damage:.....

Quantity of damage:.....

Appendix III

Regression

The regression equation is

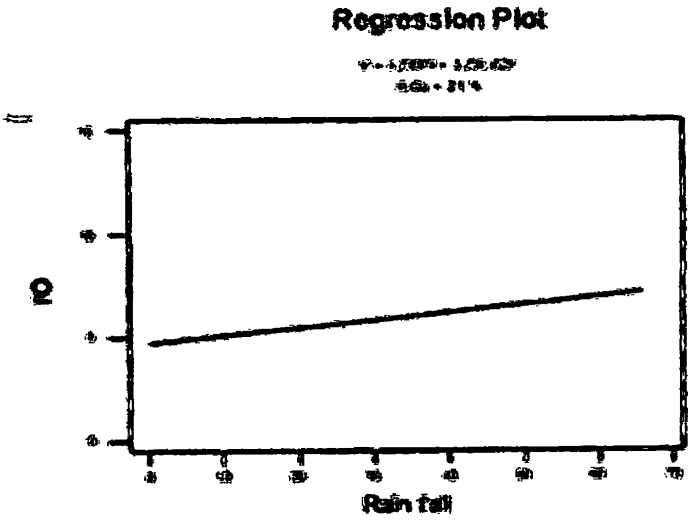
$y = 4.73 + 0.0373\ x$

Predictor	Coef	StDev	T	P
Constant	4.734	1.494	3.17	0.007
x	0.03732	0.06890	0.54	0.597

S = 4.604 R-Sq = 2.1% R-Sq(adj) = 0.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	6.22	6.22	0.29	0.597
Residual Error	14	296.78	21.20		
Total	15	303.00			



Appendix IV

Chi-Square Test

Rows: Distance Columns: Out PA

	1	2	3	All
1	5	4	1	10
2	5	22	4	31
3	7	8	1	16
4	29	4	28	61
All	46	38	34	118

Chi-Square = 47.351, DF = 6, P-Value = 0.000

Appendix V

Chi-Square Test

Rows: Distance Columns: In to PA

	1	2	3	All
1	9	7	8	24
2	9	17	4	30
3	6	5	2	13
4	15	6	25	46
All	39	35	39	113

Chi-Square = 22.758, DF = 6, P-Value = 0.001

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