

LEAD ARTICLE

Managing Elephants in Sri Lanka: Where We Are and Where We Need to Be

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ABSTRACT

Asian elephants are 'endangered' but come into significant conflict with humans. Sri Lanka holds an important position in relation to Asian elephants, both in terms of species conservation and human-elephant conflict mitigation. Historical aspects of the two main conservation agencies in Sri Lanka and difficulty of coordination between them has prevented a landscape level holistic approach to conservation in general and elephants in particular. The primary objective of elephant management is human-elephant conflict mitigation and secondarily elephant conservation. Many human-elephant conflict mitigation activities are ineffective and in some cases cause its escalation and wider spread. Others are extremely detrimental to elephant conservation. Effective human-elephant conflict mitigation and elephant conservation requires a paradigm change. Elephant management needs to be based on science and evidence rather than outdated beliefs and false assumptions. Unless immediate and effective remedial measures are taken, human-elephant conflict will continue to escalate and the elephant population continue to decline.

Keywords: Asian elephant, human-elephant conflict, conservation

INTRODUCTION

Asian elephants (*Elephas maximus*) once existed across south and south-east Asia from Iraq in the west, Himalayan foothills in the north and China in the east, together with four island populations in Sri Lanka, Java, Sumatra and Borneo (Fernando & Leimgruber 2011). They are now extinct in over 80% of this range and are limited to a number of fragmented and isolated populations in Sri Lanka, India, Nepal, Bhutan, Bangladesh, Myanmar, Thailand, Laos, Cambodia, Vietnam, Malaysia, Indonesia and China (Fernando & Pastorini 2011). The global population of Asian elephants is around 40,000 (Fernando & Pastorini 2011) numbering less than 10% of African elephants (*Loxodonta africana* and *L. cyclotis*) (Blanc *et al.* 2007). Current Asian elephant populations in Bhutan, Nepal, Vietnam and China all number less than 200 individuals (Fernando & Pastorini 2011). Given its decline in range and numbers and the on-going threats to the species, Asian elephants have been listed as 'Endangered' under IUCN red listing criteria (IUCN 2015). The population in Sumatra has undergone sharp decline in numbers and range in the recent past (Azmi & Gunaryadi 2011) and are now categorized as 'Critically Endangered' (Gopala *et al.* 2011).

While many subspecies of the Asian elephant were described in the past (Deraniyagala 1955), subsequently most of them including the Bornean *E. m. borneansis* were synonymized under *E. m. indicus*, while the Sri Lankan *E. m. maximus* and Sumatran *E. m. sumatranus* were held to be valid subspecies taxa (Choudhury *et al.* 2008). Genetic analysis recognized the Bornean population as a separate Evolutionarily Significant Unit, suggesting that it is a valid subspecies (Fernando *et al.* 2003). Therefore, currently four subspecies are recognized. The Sri Lankan elephant is the *forma typica* as the original scientific description of the elephant in 1758 by Linnaeus was based on material thought to originate from Sri Lanka. Recent examination of the source material found that the foetus used by Linnaeus was in fact that of an African elephant (Cappellini *et al.* 2013). This would indicate that the name *Elephas maximus* should refer to the African and not the Asian elephant. However among the material cited by Linnaeus was a description of a skeleton, which was traced to a museum in Florence and found to be of an Asian elephant (Cappellini *et al.* 2013). Genetic analysis of the skeleton found consistency with a putative Sri Lankan origin, and it has now been designated as a lectotype (Cappellini *et al.* 2013). Thus, the nomenclature of the species and the *forma typica* status of the Sri Lankan elephant remain unchanged.

As one of three island populations, as a population at one extreme of the species' range, as the population with the highest genetic diversity (Fernando *et al.* 2000; 2013; Vidya *et al.* 2005a, b), and as a population consisting of a distinctive subspecies (Choudhury *et al.* 2008), the Sri Lankan population of Asian elephants holds a unique and very important position in the conservation of the species. Additionally, although having only 1-2% of global Asian elephant range (Fernando *et al.* 2011), Sri Lanka holds 10-20% of the global Asian elephant population, at a density of around ten times that of any other range state (Fernando & Pastorini 2011). Of the 13 range states, Sri Lanka has the third highest human density and the highest level of human-elephant conflict (HEC). Given that the main threat to Asian elephants across the range is HEC (Fernando & Pastorini 2011), the conservation of elephants and mitigation of HEC in Sri Lanka and its successes and failures are of great relevance to the management of elephants worldwide.

ECOLOGICAL ASPECTS RELEVANT TO HEC AND ELEPHANT MANAGEMENT

Morphology

Elephants, with an adult weight of 1,000-5,000 kg are the biggest terrestrial animals. As a result, through evolutionary time they have been immune to physical challenge by other species. When challenged, animals respond by 'fight or flight' reaction. With repeated challenge, animals are more likely to respond with 'fight' as indicated by the proverb 'even the worm will turn'. Given their evolutionary history, elephants are far more likely to 'turn' and respond with aggression to challenge or confrontation than other species.

Feeding behaviour

One of the main problems for plants is consumption by animals. Plants have evolved to address this issue in a number of ways. Grasses develop very rapidly and grow from the proximal end of the blade so that grazing damage is limited. Many shrubs and small trees have evolved mechanical defences such as thorns. Others invest in secondary compounds that are poisonous. Plants that colonize open spaces are called 'pioneer species' and tend to adopt rapid growth and mechanical defences. Plants that grow in shade cannot grow fast and tend to invest in secondary compounds. Elephants are mega-herbivores, with a daily food requirement of about 10% of their body weight (Sukumar 1989). Thus they have to find a large quantity of food, which means they cannot be specialized feeders selecting a narrow range of plants or the choicest plant parts. Consequently elephants have evolved to be generalist herbivores consuming a wide cross

section of vegetation of well over a hundred species (Vancuylenberg 1977; Sukumar 1990; Somasiri & Weerakoon 2007). They tend to prefer grasses as they grow in abundance, hence are easy to gather and have few secondary compounds. However in most Asian elephant habitats, grasses are available only seasonally. The next choice of elephants is pioneer species as they too grow in abundance, can be repeatedly harvested and persist through the dry season. Elephants have overcome the thorny defences of such vegetation by developing thick and tough skin and tolerant digestive tract lining, so can devour them in quantity. Elephants also consume shade tolerant species, but only in small amounts due to the issues caused by ingestion of secondary compounds.

Habitat preferences

Asian elephants are an 'edge species' dependent on forest-edges or eco-tones (Fernando 2006; Fernando & Leimgruber 2011). While they prefer grasslands, such habitat is not a prominent feature of the tropical areas they occupy. Over much of Asian elephant range the climax vegetation is tall/mature forest where most of the productivity is in the canopy, out of elephant reach. Saplings and other vegetation that comprise the sparse undergrowth in such forests are mostly unpalatable shade tolerant species. However, in locations where light levels are high as in tree fall gaps and along river courses, pioneer species and grasses proliferate. Elephants mainly use such restricted, ephemeral and seasonal habitats corresponding to 'forest edge' in tall/mature forests. In such forests, elephants occur at low densities of about 0.2 elephants/km² (Sukumar 2003). Where forest is cut and burnt, and allowed to regenerate, as in slash-and-burn or shifting cultivation, the entire area becomes 'edge habitat' (Fernando 2006; Fernando & Leimgruber 2011; Pastorini *et al.* 2013). Areas under an intermediate disturbance regime support elephant densities of around 3 elephants/km² (Sukumar 2003), a magnitude higher than tall/mature forests.

A larger proportion of high elephant density habitats are administered under the Forest Department and come under the designation of 'Other State Forests'. Most lands under the Department of Wildlife Conservation are mature forests or in succession and will revert to mature forests, leading to decreasing elephant densities (Fernando 2015). The only exceptions are reservoir bed grasslands such as Minneriya and Kaudulla where the agent of disturbance is annual flooding.

Home ranges

There is a common perception that elephants are a migratory species. Studies done in Africa have suggested that particular populations of elephants are migratory, some are composed of both

migratory and non-migratory herds and others non-migratory (Thouless 1996; Grainger *et al.* 2005; Galanti *et al.* 2006). Some studies on the ranging patterns of Asian elephants have suggested that Indian elephants migrate (Sukumar 1989; Baskaran *et al.* 1993; Datye & Bhagwat 1995) and others that they do not (Easa 1988; Joshua & Johnsingh 1993). Radio tracking studies in Sri Lanka have conclusively proven that Sri Lankan elephants do not migrate, but instead have circumscribed ranges to which they show high fidelity (Fernando *et al.*, 2008a). However they may show seasonal movement in response to agricultural patterns, moving out of areas when they are seasonally cultivated and moving back after harvest (Pastorini *et al.*, 2013). Elephants have a strong attachment to their home ranges as it is related to their fitness (Fernando *et al.* 2008). The forcible removal of elephants from their home ranges greatly jeopardizes their survival.

The home range size of African elephants varies from over 15,000 km² in the Namib Desert to about 15 km² in the highly productive Lake Manyara system (Douglas-Hamilton 1973; Lindeque & Lindeque 1991). Home ranges of Asian elephants also show wide variation with ranges of over 4,000 km² being reported from North-east India and 30-50 km² from North-central India and Malaysia (Olivier 1978; Joshua & Johnsingh 1993). The home ranges of Sri Lankan elephants vary from about 50 to 400 km² (Fernando *et al.*, 2008a). Therefore, elephant conservation and management has to be of an appropriate scale and requires a landscape approach.

Social organization

Elephants have a sexually dimorphic social organization with largely solitary adult males and herds composed of adult females and young (Fernando & Lande 2000). Male offspring remain close to their mothers till about 2-3 years of age and then become progressively independent. From about 5-8 years they spend more time on the fringes of the natal herd and gradually drift away. By about 10 years they are mostly independent of the natal herd. The spatial dispersal of males has been confirmed by genetic analysis (Vidya & Sukumar 2005). However, it is possible that some elephants employ an alternate strategy of social but not spatial dispersal, with young males leaving the herd but remaining in the same area. Much of what a male knows is learnt through association with the natal herd in his formative years and such knowledge is likely to have a major impact on its behaviour as an adult. So for example if a herd is regularly subjected to aggression by people, adult males originating from that herd are very likely to be very aggressive 'problem males'.

Reproduction

Asian elephants have a gestation period of 22 months and suckle the young for about 2-3 years. Therefore a female comes into oestrus or mating condition once every 4-5 years (Eisenberg *et al.* 1971; Rasmussen & Schulte 1998). As a result it is not advantageous for a male to develop a strong pair bond and associate with a female throughout. Nor does it facilitate developing a harem system as in many ungulate species, especially in view of the considerable costs of group living. Instead, a receptive female broadcasts her condition through pheromones secreted in the excreta and males in the surrounding area are attracted to her at ovulation (Hess *et al.*, 1983). A competition for mating ensues among the males, with the victor mating with the female and possibly guarding her over the fertile period (Eisenberg *et al.*, 1971; Rasmussen & Schulte 1998). The biggest and the strongest males win the mating rights and this has led to marked sexual dimorphism with males being up to three times heavier than females. Thus, it is advantageous for a male elephant to become bigger and stronger which requires nutritious food. The easiest way to obtain better food is by raiding crops, which grow in concentrated lots and have been enhanced by people to be more nutritious and energy rich over thousands of years (Sukumar 1989). Thus there is a strong innate drive in male elephants to raid crops (Sukumar & Gadgil 1998). Crop raiding by male elephants far outstrips any raiding by females (Ekanayake *et al.* 2011; Thaufeek *et al.* 2014) and males rather than herds are responsible for all house breaking and most HEC incidents.

Elephant numbers, densities and distribution

There is a misconception that elephant numbers in Sri Lanka have been increasing over the past few decades. Past estimates have ranged from 1,600-2,200 in 1969 (McKay 1973) 2,000-4,000 (Olivier 1978), 5,000 (Hoffmann 1978), 2,700-3,200 (Santiapillai & Jackson 1990), 1,967 – excluding the North (Hendavitharana *et al.* 1994) and 5,825 in 2011 (Anon. 2013). The argument for increased numbers is based on selective use of past estimates. If all estimates are considered, rather than an increase, wide fluctuation beyond plausible limits is observed. All past estimates have been based on 'expert opinion', except (Hendavitharana *et al.* 1994) and (Anon. 2013) which were based on direct counts by the Department of Wildlife Conservation. It is widely accepted that Asian elephants cannot be accurately counted by direct methods, necessitating technical, complex and logistically intensive methods of estimation (Jachmann 1991; Barnes *et al.* 1997; Fernando 2008). Therefore rather than estimates, the currently available numbers should be treated as 'guesstimates'. Additionally there are no management decisions that can be made on

elephant numbers other than to cull the population upon perceived 'excess', which is irrelevant to the Sri Lankan situation (Fernando 2008). In contrast, mapping of elephant presence/absence at an appropriate scale provides repeatable objective assessment of elephant distribution and is of much relevance for management (Fernando 2008). Such assessment shows that elephant range has been continuously decreasing, indicating that elephant numbers are in fact declining in Sri Lanka.

WILDLIFE MANAGEMENT IN SRI LANKA

Historical aspects

The beginning of modern wildlife management in Sri Lanka can be traced to the late 19th century, upon the establishment of the Forest Department in 1885. In 1889 the then Conservator of Forests Colonel Clark R.A., brought to the notice of the government the 'disastrous effects of commercial exploitation of wildlife', mainly that of deer and sambur that were being killed for export of hides (Anon. 1959). One of the first items of legislature dealing specifically with wildlife was enacted in 1891 entitled 'An Ordinance to prevent the wanton destruction of elephants, buffalo and other game' (Anon. 1959). The Game Protection Society of Ceylon was set up in 1894 to fight against widespread commercial exploitation. In early 1900s the government on the advice of the Conservator of Forests declared the Yala and Wilpattu areas as Reserves under the Forest Ordinance. The Fauna and Flora Ordinance No. 1 was enacted in 1909, which consolidated the existing laws pertaining to wildlife protection (de Silva & de Silva 2007).

Large-scale land clearing for 'agricultural development' in the dry zone began in early 20th century and firearms proliferated, leading to massive destruction of fauna and its commercial exploitation, engendering fear of rapid decline and extinction of elephants and other species (Anon. 1959). In 1930 the administration of forests came under the newly set up Ministry of Agriculture and Lands, which appointed a Fauna and Flora Protection Committee. The recommendations of this committee resulted in the Fauna and Flora Protection Ordinance No.2 of 1937 and the setting up of a number of protected areas for wildlife conservation.

The conservation branch of the Forest Department was made into an independent department in 1950 as the Wildlife Department. This action divested conservation responsibility from the Forest Department and created a formal distinction between conservation, which was the responsibility of the Wildlife Department and that of forest

utilization which was the remit of the Forest Department. Since then, the vision of wildlife conservation in Sri Lanka has been blinkered by this dichotomy.

A Committee on Preservation of Wildlife appointed by the Ministry of Lands and Land Development submitted a report in 1959, which included a map of 'elephant corridors'. Permanent corridors linked the protected areas set aside for wildlife conservation, so that elephants could migrate from one to another. Temporary corridors were identified so that "when development takes place the herds of elephants can be driven into permanent corridors and National Reserves and Sanctuaries". It further stated that "these temporary corridors should therefore be the last to be developed" (Anon. 1959), envisaging a future where all land other than that administered under the Wildlife Department is converted to exclusively human habitats.

Current situation

Protected areas were originally set up to preserve wildlife, safeguarding them from indiscriminate slaughter and commercial exploitation. In effect, to provide safe havens from the dangers posed by humans. However with time the flipside, the idea that wildlife should not be outside protected areas, became dominant. This is especially so in the case of elephants but is increasingly applied to other 'dangerous species' such as leopards, crocodiles and snakes; and 'nuisance species' such as monkeys. Increasingly, protected areas are viewed as bottomless pits where all wildlife can and should be deposited.

In the latter part of the 20th century the Forest Department changed tack and charted a more conservation oriented course. A moratorium on logging of natural forests was imposed in 1990 and 'Other State Forests' - forested lands administered by Government Agents, were brought under the Forest Department in 2001, thus strengthening the conservation focus of the Forest Department. Currently, the Department of Wildlife Conservation and the Forest Department are the main administrators of natural areas with Wildlife being responsible for around 40% of natural habitats and Forest around 55%. Consequently, the limitation of wildlife in general and elephants in particular to Department of Wildlife Conservation areas has lost all relevance. Unfortunately this fact is yet to be accepted and the management of elephants continues to be largely based on limiting them to Wildlife Department areas.

In terms of conservation in general and elephant management in particular, the wisdom of having two independent departments managing different areas, with little coordination and collaboration has

to be questioned. Modern conservation concepts focus on landscapes rather than isolated protected areas. Having two independent departments, often with divergent institutional issues, administrative structures, management objectives, views and expertise, makes it difficult to undertake landscape level conservation. One possibility out of this conundrum would be to revert to the original prescription and amalgamate the two departments. Such a merging would enable the smoother functioning and adoption of a holistic approach to conservation.

Would such amalgamation result in any detriment to conservation? Given the historical background of the two Departments, there remains a feeling among environmentalists that Forest Department areas are more readily handed over or taken over for development. Current conservation areas under the Forest Department are designated as Forest Reserves, Proposed Forest Reserves and Other State Forests. 'Forest Reserves' are areas that have been identified as having a high conservation value and are usually not divested. They mostly consist of mature forests. Proposed Reserves are areas that are in the process of being declared as Forest Reserves. However, it is a slow process and such areas are more liable to be divested. They consist of mature and secondary forests. 'Other State Forests' are mostly areas that were formerly designated as 'Government Agent Forests' and consist of secondary forests, scrublands, chenals and non-forest habitats such as grasslands and bare lands. The historical leanings of the Forest Department towards forest utilization and the identity with 'forests' *per-se* leads to a lower value being assigned to 'Other State Forests'. Consequently they are more likely to be divested and given over for development, and subject to land alienation. Thus the lands most likely to be divested and developed are the ones that support the highest densities of elephants hence the most important in terms of elephant conservation.

Lands under the Wildlife Department are also not immune to being divested and encroached. For example the larger area of Hakgala Strict Nature Reserve, which is the highest conservation designation under the Department of Wildlife Conservation, currently consists of villages and a semi-government livestock farm. Areas in Lunugamvehera, Somawathiya and Wasgomuwa National Parks have come under development/encroachment. Sanctuaries such as Weerawila, Anawilundawa and Attidiya are largely encroached or now exist only on paper.

The loss of conservation areas to development is not unique to either department but a larger conservation issue. While the alienation of natural habitat for development attracts the attention of

environmentalists on and off, by far the biggest loss of habitat is from encroachment and government development projects. As long as the practice of periodic legalization of encroachments persists, such losses will continue to mount.

Other concerns in amalgamating the two departments are mostly administrative in nature. For most of their existence the two departments have also been under different ministries. To provide a meaningful foundation for conservation, at a minimum they should be under the same ministry. In addition, putting in place a mechanism for active coordination between the Forest Department and the Wildlife Department in all conservation activities is a must and is critical for elephant conservation and HEC mitigation.

ELEPHANT MANAGEMENT IN SRI LANKA

HEC and its mitigation

Asian elephants are one of a very few species that are endangered yet come into considerable conflict with humans. Elephants suffer from a plethora of human inflicted maladies such as getting trunks and legs cut by wire nooses, jaws being shattered by 'jaw-bombs', poisoning, falling into wells, electrocution, and being shot. Across the range, HEC has become a major, conservation, socio-economic and political issue (Fernando & Pastorini 2011). Consequently, management of Asian elephants has largely been shaped by the need to mitigate HEC. Major initiatives are undertaken to mitigate damage to crops and property by elephants and considerable funds are expended on electric fences and other elephant barriers, other methods of crop protection, insurance and compensation. In Sri Lanka HEC annually kills around 250 elephants and 70 people (Fernando *et al.* 2011). While penal action against offenders for elephant killings are a handful, the number of elephants translocated in response to human killings, by capture transport and elephant drives are commensurate with the number of such cases. 'HEC mitigation' is almost entirely from the point of view of mitigating the impact of elephant depredation on people. This state of affairs is not unique to Sri Lanka but also common to the other range countries and holds true for 'mitigation' of human-wildlife conflict in general.

Management actions

The management of elephants has two major objectives, HEC mitigation and elephant conservation, with the former taking priority in practice. In Sri Lanka as across the range, the main approach to elephant management has been the restriction of elephants to protected areas. The rationale being that development outside protected

areas can then occur without incurring damage from elephants and that the elephants will be able to live contentedly within the protected areas without harm from people. The main activities conducted for HEC mitigation and elephant conservation in Sri Lanka are translocation by capture-transport, elephant drives, distribution of elephant thunder crackers, construction of electric fences and law enforcement.

Translocation by capture-transport

Translocation through capture-transport has been the main approach taken to managing ‘problem elephants’ in Sri Lanka (Fernando 2011; Fernando *et al.* 2012). Such action is most often taken as a result of human deaths caused by an elephant or frequent damage to houses by elephants searching for stored grain. In translocation by capture-transport, the animal is immobilized by injecting an anaesthetic drug, tied up using ropes and transported by vehicle to a remote site and released. The main objective of translocation is removing the elephant from a conflict area and secondarily its continued existence in the wild (Fernando *et al.* 2012). Such action is driven by pressurizing the Department of Wildlife Conservation (DWC) through protests, public outcry, media and politicians.

Translocation as a management tool needs to fulfil several conditions. Firstly it should eliminate the problem causing elephant from the site of conflict. In view of the known extents over which elephants range, their translocation over distances of a few kilometres is likely to result in their release close to or within their home range. This inevitably results in their return to former haunts. The practicality of removing elephants beyond their home range needs to be considered in the light of the extent of ranging, which for a male, may be up to 400 km². However, even this cannot guarantee the non-return of animals. Studies done in Sri Lanka through GPS satellite radio-tracking of 16 translocated ‘problem elephants’ found that all of them left the National Park they were translocated to (Fernando *et al.* 2012). Some returned to the site of capture, from distances as far as 100 km. Some wandered over extensive areas over ten times their normal home ranges, sometimes walking into highly populated areas and creating chaos. Others left the park but settled down in nearby Forest Department areas and most of these created new HEC in adjacent areas. The percentage of people killed by translocated elephants far exceeds that by non-translocated elephants and translocated elephants have a higher mortality rate (Fernando *et al.* 2012). Therefore, translocating ‘problem elephants’ does not help mitigate HEC and in many cases causes its intensification and wider spread. It is also detrimental to elephant conservation. In 2010, the Department of Wildlife Conservation

took a decision to minimize translocations and to radio collar all translocated elephants so that remedial action could be taken where translocation fails. However, both the decisions were later reversed. Translocations of ‘problem elephants’ without collaring continues to be undertaken by the Wildlife Department, mainly as a means of pacifying communities protesting against human deaths or property damage.

Elephant prisons

In 2010 the Department of Wildlife Conservation set up an ‘Elephant Rehabilitation Center’. The idea was based on the ‘holding-ground’ concept identified in the National Policy, which envisaged a fenced-in area into which problem elephants could be translocated. A 20 km² area inside the Lunugamvehera National Park was surrounded by a high specification electric fence and an elephant ditch constructed along part of it. However of around 15 elephants translocated to it, none remained and it was soon abandoned. Subsequently a second ‘holding ground’ was constructed in Horowpatana. It consists of a physical fence consisting of nail studded concrete columns and steel cables, with an outer and inner electric fence, encircling an area 10 km² in extent. Constructed at a cost of over Rs. 300 million, it has not been tested as yet.

Elephant drives

Elephant drives are a carryover from the ‘game drives’ of colonial hunting, where ‘beaters’ drove elephants and other wildlife into ‘sportsmen’s’ guns. Elephant drives are conducted in forests where the elephants take refuge. The drivers enter the forest from one side and shout, light flares and elephant thunder crackers, and attempt to panic the elephants into running. Where the elephants do not run, or turn towards the drivers, shooting at them with shotguns using live SG cartridges (pellets) is resorted to.

Three forms of elephant drives are undertaken by the Department of Wildlife Conservation. The first is where individual males are chased from a particular location due to public complaint, often following house breaking, human injury or death, or an elephant entering a developed area and taking refuge in a patch of forest. The objective is to chase the elephant from the immediate vicinity of the incident. Such drives are conducted by a few Wildlife personnel and are very common in all areas with elephants, occurring on a daily basis in areas such as the north-west. They take a few hours and cease once the elephant moves away from the location. Usually elephant thunder crackers are used. If it fails to put the elephant to flight or if the elephant reacts aggressively, it is shot at with SG cartridges.

The second form of drive is to chase away elephants from a locality where they are causing issues such as crop raiding. These drives may last from a few hours to a few days and are regularly conducted throughout elephant areas in Sri Lanka in response to public protest. They are conducted by Wildlife personnel, sometimes with assistance from villagers and aim to provide temporary relief by chasing away elephants from an area. However, in regions such as the north-west where such drives are conducted regularly, the areas they are chased into are no different to the areas they are chased from, as the elephants and people live in a heterogeneous habitat mosaic.

In both above types of drives the elephants are chased around within their home range. The decision to conduct both above types of drives are taken at field level and represent a 'first response' to public complaints and protests.

The third type of drives are undertaken to permanently remove elephants from a large area. They require advance planning and allocation of specific funds. They are most often conducted in relation to large irrigation development projects, where the line agency provides funds to the Department of Wildlife Conservation for drives, as a 'HEC mitigation measure'. The heyday of such mega drives was during the Mahaweli development period in the 1970s (Jayewardene 1996). However in all these drives some elephants did not leave while other returned (Jayewardene 1994). The last such mega drive was conducted in 2005-2006 over a period of one and a half years, in the Walawe Left Bank Development area. It removed around 225 elephants, but left behind over 400 in the drive area.

Drives of one to a few months duration have been conducted in the north-west, north-central and Uva areas in the past year or so. Such drives aim to remove elephants from their home ranges and relocate them to another area, usually a Department of Wildlife Conservation protected area. They may employ hundreds of people including both Wildlife Department personnel and villagers who are remunerated. In recent times such drives have been combined with temporary electric fencing erected along strips cleared through forest, dividing it into blocks. Once the elephants are driven during the day, the electric fences are erected to prevent them coming back to the 'cleared area' in the night. Additionally, water sources are guarded to prevent elephants' access to drinking water so that they are forced to keep marching.

Impact of drives on HEC

All drives subject elephants to intense conflict and in the case of mega-drives, for sustained periods of many months. Although drives have been conducted for many decades all over Sri Lanka,

there is not one area where elephants have been completely eliminated as a result (Fernando 1993; Jayewardene 1994). Radio telemetry and observational studies have shown that the only elephants that can be 'successfully' driven are the innocent herds and not the problem causing males. However, not even all herds can be removed by drives. The methods employed for driving elephants – creating disturbance, shouting, lighting firecrackers and flares, are all confrontational and are the same as used for crop protection. By intense and sustained subjecting of elephants to the same methods, drives make elephants non-responsive to them, refractory to being chased and increase their aggression towards humans. Driving of innocent herds turns them into problem-causing herds with increased likelihood of raiding. Shooting at aggressive males with SG cartridges turns them into killer elephants who charge on sight. The history of elephant drives and their continuance is one of the main factors responsible for the very high levels of HEC in Sri Lanka.

Impact of drives on elephants

All drives are conducted in elephant habitat and not in developed areas, most often in Forest Department areas. Sometimes elephants are also driven from Department of Wildlife Conservation areas as from the Nimalawa Sanctuary (close to Yala National Park) in 2004 and Bundala National Park in 2006. Monitoring of elephant herds that lost part or the entirety of their home range due to drives has shown that herds do not adapt to new areas easily and suffer very high morbidity and mortality. Exceeding the carrying capacity of protected areas by driving large numbers of elephants into them and restricting them there by electric fences leads to starvation and death of elephants. These impacts are not limited to the elephants that are driven in and equally impact those that were in the park previously, due to increased competition for limited resources.

From both HEC mitigation and elephant conservation points of view, drives are extremely detrimental. Therefore suspension of elephant drives should be a priority.

Distribution of elephant thunder crackers

Annually over Rs. 50 million is spent in purchasing elephant thunder crackers (Fernando *et al.* 2011). They are distributed free of charge to villagers by the Department of Wildlife Conservation and through the Divisional Secretariats. The supply of elephant thunder crackers encourages confrontation of elephants and aggression towards them. Similar to drives, the indiscriminate and wide spread use of thunder crackers by the public results in habituation and increased aggression by elephants. When the Wildlife Department is called upon to chase such elephants in an emergency

situation, there is little recourse other than to shoot at them, which in turn increases aggression many fold.

Phasing out the distribution of elephant thunder crackers and replacement by non-confrontational protection methods would prevent continued escalation of HEC. In the interim, two strengths of elephant firecrackers could be produced with a lower explosive strength to be given to the public and the current full strength ones reserved for the exclusive use of the Wildlife Department in emergency situations.

Electric fencing

Electric fences are arguably the most effective tool for preventing crop depredation by elephants (Fernando *et al.* 2008b). More than 2500 km of electric fencing has been constructed by the Department of Wildlife Conservation for HEC mitigation. The majority of these fences are on the boundary of protected areas of the Wildlife Department (Fernando *et al.* 2011). In most cases the area adjacent is forest land under the Forest Department, where also there are elephants. Consequently elephants are found on both sides of the majority of electric fences built by the Wildlife Department. In such instances the fences prevent elephants in the Forest Department areas from utilizing the resources in the Wildlife Department areas, forcing them to look for new resources. As then there are no fences between the Forest Department areas and developed areas, elephants increasingly venture into villages and cultivated fields, causing increased HEC.

Fences inside forests are difficult to maintain and a couple of years after construction, become non-functional. Additionally, such fences are much more likely to be challenged and broken by elephants as they are free to spend time next to them and try out various methods of overcoming them. Electric fencing is only a psychological barrier (Fernando *et al.* 2008b). Once elephants learn to break them, fences become useless. Electric fences are constructed solely for protecting human habitations, cultivations and lives. Therefore, to be effective they need to be on the boundary of developed areas with elephant habitat, and not inside forests. If fences are located on the boundary of settlements and cultivations it is a simple matter for communities to maintain them as they live and work right next to them. Such community electric fences have been very successfully implemented in areas such as Ehetuwewa in the north-west, formerly an area with the highest level of HEC. Community electric fences that protect villages are permanent and ones that protect paddy fields, deployed seasonally.

For effective HEC mitigation, electric fences should be used solely to prevent elephant depredation and not as boundary markers. Thus, fences inside forests, fences with elephants on both sides and non-functional fences should be relocated to forest-developed area boundaries. To be effective, a paradigm change in the approach to electric fencing is needed. Electric fences are constructed entirely for the benefit of people. Therefore, instead of the conservation sector, communities that are protected by electric fences need to take the lead in construction and maintenance of electric fences. Institutions, whose primary mandate is people's welfare and development, need to provide funding and play a major role in technical assistance, monitoring and ensuring the proper function of fences.

Other elephant barriers

Other elephant barriers such as physical fences (barbed wire, razor wire, concrete, stone) elephant ditches, bio-fences, bee-hive fences and chilli fences are largely unsuccessful in preventing elephant depredation as there are major issues with cost, logistics and the effort needed for their implementation (Fernando *et al.* 2008b). Various stakeholders have tried out elephant ditches and bio-fences as elephant barriers but they have been complete failures. Similarly, methods such as alternative crops and livelihoods, supplementary feeding and habitat management have little relevance to HEC mitigation at an appropriate scale.

Law enforcement

The elephant is given special protection under the Fauna and Flora Protection Ordinance, which provides for the protection and conservation of all fauna and flora in Sri Lanka and under which the Department of Wildlife Conservation functions. Under the laws enacted therein the harming or killing of an elephant carries a penalty of a fine of Rs. 150,000 – 500,000 or imprisonment of 2-5 years or both fine and imprisonment. However, prosecution of people for causing elephant morbidity and mortality is very poor. For example, in Sri Lanka around 250 elephants are killed by people every year but the number of prosecutions are only a handful due to the difficulty of identifying and apprehending the culprits.

Management planning

A National Policy for the Conservation and Management of Wild Elephants in Sri Lanka' was developed in 2006 and ratified by the Cabinet of Ministers. A National Action Plan based on the policy was developed in 2010 and presented to the then President who approved its implementation. Both the Policy and Action Plan were developed with wide stakeholder participation with the Wildlife and Forest Departments playing a leading

role. However, to date both documents have largely been ignored in the planning and implementation of elephant management.

To be effective, management needs to be based on actual data on elephants rather than beliefs and traditional practices. Radio tracking data is invaluable in assessing the effectiveness of management actions and their impact on elephants (Fernando *et al.* 2003), and in guiding development to prevent creating HEC and its escalation (Fernando *et al.* 2015). Radio-tracking around 250 elephants outside protected areas in the next few years would provide a definitive map of elephant-use areas and movement patterns. Such data could effectively guide development and management, thus minimizing genesis of HEC and its escalation and ensuring the conservation of elephants.

CONCLUSION

Elephant management requires major revamping, if HEC mitigation and elephant conservation is to be effective. Irrational acts such as removing elephants from Forest Department areas and construction of electric fences between Wildlife Department and Forest Department lands, as well as actions detrimental to HEC mitigation and elephant conservation such as elephant drives need to be stopped. Close coordination between the Wildlife and Forest Departments is a must for elephant management in particular and conservation in general. A science based management approach with decisions based on actual data rather than outdated beliefs and false assumptions needs to be put in place. Elephant management should have clear and appropriate objectives with impacts of management actions monitored in an adaptive-management approach. Failure to act immediately and continuance of 'business as usual' will further escalate HEC and hasten the decline of the Sri Lankan elephant.

ACKNOWLEDGEMENTS

Much of the material this paper is based on is derived from research conducted by the Centre for Conservation and Research (CCR). Therefore I would like to thank those that have supported our work, including the Abraham Foundation, United States Fish and Wildlife Service, Whitley Fund for Nature, Zoological Society of London, Auckland Zoo, Mario-Hoedemaker Foundation and the Eco-Health Alliance. I would also like to thank those who have collaborated with us, especially the Department of Wildlife Conservation Sri Lanka and the Smithsonian Institution USA. Finally my thanks to the CCR team and the officers of the

Department of Wildlife Conservation for their support and dedication to conservation.

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