THE HUMAN-ELEPHANT CONFLICT IN SRI LANKA: LESSONS FOR MITIGATION, MANAGEMENT, AND CONSERVATION FROM TRADITIONAL LAND-USE PATTERNS

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Abstract

With almost twenty million people and three to four thousand elephants sharing and competing for land in Sri Lanka, conflicts are inevitable. Due to close cultural and historical ties between people and elephants these conflicts have become an important socio-economic and conservation issue. We studied the human-elephant conflict in two areas where differences in settlement histories and agricultural practices provide contrasting scenarios of levels of conflict; Kahalle-Pallekele in the northcentral area where the conflict is intensive, and Yala in the south where it is less. In Kahalle-Pallekele the landscape is a mosaic of settlements, agriculture, and small forest patches. This region is within the Mahaweli River Diversion Project area, where forests were cleared for settlement and agriculture. Settlers grow crops year-round because irrigation water is available during the dry season. The elephants that lived in the vast forests are now pocketed in the small patches and constantly raid crops. These new settlers are intolerant of elephant depredations and place the onus of mitigation on the government. In contrast, Yala is dominated by a large (>1000 km^2) protected areas complex. The main agricultural methods are a form of shifting cultivation known as *chena*, and traditional rain-fed paddy cultivation. Due to lack of water the fields lie fallow during the dry season. The farmers are from ancient villages and are used to the presence of elephants, thus more tolerant of depredations. Our research indicated that the large protected area and other fallow, secondary forests in the mosaic have adequate food for the elephants during the rainy season, when the single annual crop is grown in the surrounding 'buffer zone'. But during the dry season food in the park was limiting. The elephants would then move to the 'buffer zone' and feed on the pioneer vegetation in fallow fields. Thus, the traditional agricultural methods and attitudes allow humans and elephants to partition food during the year, reducing conflict. These traditional land-use practices, with appropriate regulation, can be a useful strategy for managing landscapes for elephant conservation.

Introduction

Elephants and people have had a long history of coexistence in Sri Lanka, where religious and socio-cultural traditions have advocated a remarkably benevolent attitude towards wildlife. Elephants have figured prominently in the country's economy, culture, and religion and continue to be central to the Sri Lankan way of life. However, today close to twenty million people and three to four thousand elephants (Santiapillai and Jackson 1990, Jayewardene 1994) vie for land in this country of 65,000 km^2. A population growth rate of 1.2% (Department of Census and Statistics 1986) adds over 750 persons per day to the current population, necessitating increasing clearing of land occupied by elephants to provide for basic human needs. The resulting habitat loss and fragmentation has led to increased interaction and conflict between humans and elephants. While positive conservation attitudes and the significance of elephants in Sri Lanka have made the human-elephant conflict (HEC) an important socio-economic and conservation issue (Fernando 1993, Jayewardene 1996, Santiapillai, 1996), its current escalation threatens to erode traditional values of tolerance and benevolence towards elephants and wildlife.

Since the 19th century, elephants have been mostly restricted to the dry zone of Sri Lanka (Jayewardene 1994, Ishwaran 1993, Fernando 2000). The dry zone was extensively forested prior to the Accelerated Mahaweli hydro-project, initiated in 1978 to dam and divert water from Sri Lanka's largest river, Mahaweli, to irrigate the northcentral and northeastern part of the country. Until then, people in the dry zone were largely limited to scattered hamlets and practiced slash and burn agriculture, known locally as *chena*, and small-scale paddy farming using water from rain-fed reservoirs. Under the Mahaweli project, large areas of forests were cleared, low-lying land irrigated and cultivated with paddy, and higher areas settled or utilized for *chena* agriculture. A 'trans-migration' program brought in people from other parts of the country to settle and cultivate the newly opened up areas. Consequently, most of the elephant habitat was converted to agricultural lands and settlements within a very short time period (see also Jayawardene this Volume).

A system of linked protected areas, using elephants as a focal species, was included within the Mahaweli project design. As part of the project plan, the elephants in the Mahaweli project areas were to be driven and confined within this protected areas system. However, the Department of Wildlife Conservation failed to secure and manage several protected areas. It was also unable to find, drive, and confine all elephants from the developed areas into these reserves (Jayawardene this Volume). The development plans of the Mahaweli project included small areas of natural vegetation demarcated as reservoir catchments, community forests, wind belts, and tree cover along streams and waterways. The result has been a landscape mosaic of forest patches that harbor elephants, agriculture, and settlements, a configuration that has enhanced the human-elephant habitat interface. Consequently, the HEC has become an overbearing influence on people's lives in many areas developed under the Mahaweli project. In contrast, people in ancient settlements in

southern Sri Lanka have been farming amidst elephants for centuries.

The areas are climatically similar. The terrain is flat with scattered granitic Inselbergs rising to 100 m. There are distinct wet and dry seasons. The primary wet-season rainfall peak is from October to January, during the northeast monsoon, with a secondary peak from March to April due to inter-monsoon rains. The drought becomes severe from May to September when the southwest monsoon, after releasing its moisture in the wet zone, sweeps across the dry zone as a desiccating wind.

Methods

We determined land use patterns by ground-truthing and updating 1:50,000 scale topography and land-use maps (Survey Department, Sri Lanka 1988). Data on elephant depredation and agricultural practices in each area were collected through village interviews and from records kept by appointed villagers. A questionnaire survey was administered to 10% of households in KP (n=162) and YA (n=122), by sampling every 10th house on householder lists obtained from local administrative offices.

Recently damaged fields were inspected to identify crop-raiding patterns and to verify depredation reports. Elephant dung samples were examined macroscopically to identify recognizable crop material as an independent estimator of the prevalence of crop depredation.
Ranging patterns and behavioral information were collected from five (four females, one male) radio-collared elephants in YA (GEF-DWLC 1999) and from 8 elephants (five females, three males) radio-collared in the northcentral region (Weerakoon 1999).

Results

Land-use Patterns

In KP, past and current agricultural practices dominated landuse, and resulted in a patchy heterogenous landscape.. In the 8,300 ha study area, 17% was irrigated paddy cultivation, 9% rain-fed paddy cultivation, 31% home gardens, 2% *chena* cultivation, 35% scrub forest, and 6% freshwater reservoirs. There were no large protected areas or extensive (i.e., >100 km^2) natural forest areas; instead, patches of forest and scrub were interspersed with human-use areas throughout the landscape; thus human and elephant use areas were not clearly defined.

elephant habitat' in the center comprised of *chena* lands, small-scale paddy land, and scrub forests in a mosaic of secondary forest and scrub under various successional stages. This 'buffer zone' was uninhabited by people. Most farmers who cultivated in this zone lived in the towns, but built and occupied small temporary huts in the area during the growing season. The 'elephant habitat' zone to the east was a protected areas complex that exceeded 1,000 km^2 and consisted of several contiguous national parks, sanctuaries and nature reserves The vegetation in this complex was dominated by dry monsoon forest and mature scrub with patches of scattered short-grass plains, especially near the coast. A number of seasonal and perennial man-made reservoirs provided ample water for elephants and other wildlife.

Agricultural Practices

In KP, the main agricultural practice was irrigated agriculture, where two crops were grown annually. The primary cultivation season was from October to January, dependant mainly on the Northeast monsoon rains and supplemented by irrigation water. The secondary season was from April to July and depended mainly on irrigation water. During the primary season, the main crop was paddy, and paddy or vegetables in the secondary season. The period between the primary and secondary growing seasons was inadequate to permit scrub growth in fallow fields and vegetative cover was absent or limited to grass.

A small area in KP and most of the YA study area were cultivated under the *chena* regime. *Chena* cultivation was entirely dependent on rain, hence limited to the northeast monsoon period. *Chena* cultivation comprised of clearing a patch of scrub, burning the cleared vegetation, and cultivating with the arrival of rains. The same plot was cultivated for a period of 2-3 years, then abandoned for a period of 5-10 years. The main crops cultivated were vegetables and cereals. Since cultivation was limited to the rainy season, the long fallow period between February to September allowed *chena* plots to be colonized by short grasses and scrub such as *Dichrostachys cinerea*, *Acacia* sp., and *Memecyclon* sp. Succession during the 5-10 year period between cultivation cycles created a vegetation mosaic across the landscape, from scrub in early colonization stages to mature scrub forest.

A small area in YA was also cultivated from irrigation through small rain-fed reservoirs. The main crop cultivated was paddy. These plots were cultivated repeatedly with no rotation as in *chena*, but cultivation was limited to four months of the year, again as in *chena*. Human activity in both *chena* and areas cultivated from rain-fed reservoirs was limited to four months of the growing season during the monsoon.

Elephant Behaviour and Habitat Use

Radio-tracking and other observational data from YA showed that elephants frequently entered post-harvest *chena* and single-crop fields during the dry season

(Figure 2), when fields were fallow. They fed on plant material left over from the harvest and colonizing pioneer vegetation. Sprouting stumps of *Limonia* sp. and *Bauhinia* sp. provided additional fodder in *chena* fields. During the wet season, when fields were cultivated, most of these elephants moved back into the protected areas complex or other uncultivated patches of late secondary scrub.

When in the protected area, elephants were active during the day and fed in open areas. However, when outside the protected area, they remained in scrub refuges during the day
In KP, the activity pattern of elephants was similar to that observed outside the protected area in YA; i.e., animals took refuge in small forest patches during the day, venturing at night to raid crops in surrounding agricultural fields. This pattern of activity was evident throughout the year. Most elephants observed during the dry season were in better body condition compared to elephants in YA and all observed herds in the area had calves.

Crop Depredation
In KP, crop depredation occurred throughout the year. Elephants also raided stored grain, home gardens and perennial crops. When elephants raided crop fields, trampling caused the most damage, which greatly exceeded the quantity actually consumed. Single males, male groups, and female herds with juveniles raided crops. Of 412 elephant dung piles examined, 19% had crop material representing 24 crop species. Crop material was found in the dung of both adults and juveniles confirming the pattern of raiding.

In YA, crop depredation was mostly by single males and male groups. There were very few instances of crop raiding by female herds (Figure 2). The pattern in YA was confirmed by radio-tracking data (GEF-DWLC 1999), where the male which was tracked raided crops four times during 1996-1997, but none of the four radio-collared females raided crops.

Human Mortality and Injury
Elephants killed three people in KP during the period 1994 to 1996. The first was a young boy in a fishing hut that was destroyed during the night by an elephant, the second an old woman who was walking on a street and the third, an intoxicated man. The first occurred outside a village area and the latter two within. In YA, an elephant injured a single person during the period 1995-1997.

Elephant Mortality
During the same three-year period, 14 carcasses of elephants (seven adults, three juveniles and four infants) were found within the KP study area. Four of the adults and possibly one juvenile died of gunshot injuries, and one female died of gangrene and sepsis after stepping on a nail-embedded plank used to prevent crop-raiding. The causes of death of the others were unknown. All the adult elephants were of reproductive age as judged by tooth-wear. All the adult carcasses carried pieces of metal embedded in the skin; evidence of past injuries from muzzle loading guns.

In YA, the carcasses of six elephants (two adults, three sub-adults, and one juvenile) were observed between the three year period from 1995 to 1997, and one adult female disappeared from her group in late pregnancy and was presumed dead. As far as could be ascertained, none of these deaths were anthropogenic, and at least three were attributed to aggression between elephants.

Perception of Depredation
In both KP and YA, farming was the main source of income (76% of sampled families in KP and 63% in YA). In KP, 97% of the families interviewed considered elephants to be a significant source of economic loss and threat to their safety, compared to 80% in YA. While 93% of respondents from KP considered elephants to be the primary cause of crop losses, only 42% in YA expressed such an opinion with 31% considering domestic cattle and water buffalo to be more significant sources of crop damage.

In KP, 90% of the respondents insisted that the onus of mitigating the HEC lay with the Department of Wildlife Conservation, compared to 45% in YA. Moreover, 7% in KP and 64% in YA said that HEC mitigation should be a joint effort between the Department of Wildlife Conservation and villagers, while a further 3% in KP and 13% in YA indicated that the responsibility lies with the villagers themselves.

In KP, the preferred method of dealing with HEC was translocation, while in YA over half the respondents preferred electric fences (Table 1). While 20% of the respondents from YA affirmed that organized crop protection would work, only 7% from KP suggested it. None from YA suggested killing elephants, although a few from KP did.

Discussion
Our study showed that the incidence of human-elephant conflict in KP was high. Almost all the families in the area have suffered some economic losses due to elephants. The heterogeneous landscape in KP does not clearly demarcate elephant and human use areas, and both vie for the same space creating an intense conflict. The elephants have also found that the abundant crops surrounding their small forest and scrub refuges represented a resource they can utilize, and both adult males and female groups with calves raided crops. In India's West Bengal state (Bist 1998), and in parts of Africa (Hoare 1995), similar anthropogenic landscape mosaics intensified human-elephant conflicts.

Because irrigated agriculture allowed for two annual crops, this food source was available throughout the year. Crops represent a far superior, nutritious resource than forage in natural systems (Sukumar 1990). Therefore, despite being subjected to stress, these elephants were able to maintain good body condition and reproduce. However, this reproduction and recruitment are likely to be offset by the high mortality

as a result of hostile actions taken by the farmers whose crops were raided. The number of elephant deaths due to anthropogenic causes and the attitudes of the farmers are evidence of these actions. Paradoxically, since the elephants in KP seem dependent on the crops as an important part of their food requirements, successful mitigation to prevent crop raiding will also likely threaten their survival unless they are provided large refuges with adequate food.

Many of the residents in KP are recent settlers originating from areas without elephants. Thus, they lacked the experience, attitude, and fortitude to successfully defend their crops from elephants. Most of the people blamed the elephants for crop losses. Community-based crop protection was not well organized and fields were protected mostly on an individual basis. Although many families were sympathetic towards the elephants' plight and acknowledged that the elephants also have a right to exist, the economic realities and dependence on a successful harvest made them intolerant of any depredations. Crop losses and damage were commonly seen by recent settlers as failures on the part of authorities to provide sufficient protective measures, and elephants were seen as a deterrent to successful farming in the area.

In contrast, the large protected area complex in YA served as a refuge for many elephants in the area. Others were able to find refuge and food in the late successional scrub in the 'buffer zone'. During the wet season, when the *chena* were cultivated, the protected area and the patches of scrub in the buffer zone provided adequate food for elephants. But during the dry season, when food was limiting in the protected area, the elephants moved into the *chena* fields to feed on the regenerating scrub. Since these fields were left fallow during the dry season, there was no conflict with farmers.

The villagers in YA have farmed for generations amidst elephants and readily organized communal crop protection measures against the few crop-raiding elephants during the wet season. They were also less quick to blame elephants and retaliate against crop depredations; in fact, many people did not consider elephants to be the primary cause of crop losses. Livestock such as cattle and buffalo were considered a bigger source of crop loss.

Thus, in YA, the buffer zone that separated the large protected area from the densely populated townships provided clear spatial partitioning between people and elephants. Moreover, the traditional rain-fed agricultural practices in this buffer zone provided temporal resource partitioning in resource use between people and elephants, allowing for co-existence with relatively little conflict.

Implications for Elephant Conservation

The extent of land that can be set aside for elephants is crucial in determining the viability of populations (Armbruster and Lande 1993). However, it is apparent that with the increasing demand for land due to a rapidly increasing human population in Sri Lanka, contact and conflict between people and elephants will continue to increase. Therefore, a long-term strategy for elephant conservation is essential and the urgency is great.

For the past several decades, Sri Lanka's approach to elephant conservation was based on the premise that elephants undertake long-distance seasonal migrations. In fact, long before wildlife corridors became accepted as part of wildlife conservation planning and management, a system of corridors had been proposed expressly for elephant conservation in Sri Lanka (Sessional Paper 1959). Although visionary for that time, recent studies on the ecology and ranging behavior of elephants indicate that in Sri Lanka, elephants do not undertake long-range migrations, but instead have relatively small home ranges (GEF-DWLC 1999, Weerakoon 1999). Most movements are seasonal and occur over short distances, unlike the long-distance migrations by elephants in India, where elephant home ranges can exceed exceed 500 km^2 (Baskaran *et al.* 1993, Datye & Bhagwat 1995). Whereas protecting migration corridors are essential in India to capture the full extent of the elephants' home ranges (Desai 1991, Johnsingh and Joshua 1994, Johnsingh and Williams 1999), in Sri Lanka, an elephant conservation strategy should be based on conservation landscapes that provide for short-distance movements, rather than a system of long-distance migration corridors.

Our research shows that the traditional *chena* practice, which has evolved in the midst of elephants, is an appropriate form of landuse in these conservation landscapes,or Managed Elephant Ranges (see Fernando et al., this volume). The secondary vegetation that *chena* creates actually represents a form of habitat enrichment for elephants.

However, as currently practiced, *chena* creates a fine-grained landscape mosaic, where small patches are scattered across the landscape. We propose that the practice be regulated to create a coarse-grained landscape mosaic. Such a landscape will have several advantages. Elephants are large animals, and can respond better to a coarse-grained landscape where specific habitat types and food are available in larger patches. If the patches of *chena* are clustered together and rotated together, as illustrated conceptually in Figure 3, the resulting coarse-grained landscape will be better for elephants. Moreover, the clusters of larger *chena* patches can be better and more efficiently protected by erecting temporary electric fences or other early warning systems around them, and through communal vigilance committees. Community-based ecotourism programs centered on elephants in these landscapes can bring additional revenue to the local communities.

However, such strategies require thoughtful land-use planning and a departure from ad-hoc development based largely on political impulse and expediency. Land use and conservation planners should identify

priority elephant populations and work with policy-makers to agree on land-use within these landscapes. Areas that are to be developed for large settlements and intense agricultural practices should be cleared of all small forest patches that can provide temporary refuge for elephants, from where they can raid crops. Similarly, intense land-uses and large settlements should not be permitted in the elephant conservation areas and around protected areas (see Hoare 1995, Desai and Baskaran 1996). Other revenue generation mechanisms that are compatible with conservation should be promoted.

The human-elephant conflict is not a recent development. It has been present throughout history whenever and wherever humans and elephants have coexisted. But with a burgeoning human population has heightened the demand for land. As land in elephant areas are cleared for agriculture and settlements, the conflicts intensify. The historical respect and reverence for elephants that Asian cultures and societies have had is rapidly eroding. Elephants are now increasingly being perceived as a despicable agricultural pest by the people who have to contend with them almost on a daily basis.

The stock solution of confining wide-ranging megavertebrates such as elephants in small protected areas is not viable.

Unless conservationists can develop new management strategies to reverse this trend, and unless policy-makers have the will to implement these measures, the survival of Asia's largest land mammal in the wild is not assured. However, this study indicates that certain land-use practices, especially those traditional practices that have evolved in the presence of elephants, are well suited to allow people and humans to coexist. Such land-use practices can be used to manage large landscapes for elephant conservation and for human uses (Fernando et al. this Volume). As we search for innovative ways to conserve elephants into the future, some solutions may lie in the practices of the past.

Dedication

We dedicate this study to G. V. Gunawardena, of the Department of Wildlife Conservation, Sri Lanka, himself a victim of the 'human-elephant conflict'. Gunawardene was tragically killed by a disoriented elephant he was helping to rescue after it had fallen into a well. He was a friend and colleague who never lacked a sense of humor even under the most trying conditions and hardships. Gunawardene loved and cherished the wildlife to which he was devoted and sacrificed his life to protect.

Acknowledgements

We have to thank: Dhanasiri Dharmawardene, Yasaratne Wanninayake, Mahendra Siriwardene, Harin Corea and Dharmapala with fieldwork in KP; G.V. Gunawardene, Nimal Kaluarachchi, and V.U. Weeratunga for assistance in Yala. The Asia Foundation funded the KP study and the Global Environmental Facility (GEF), DWLC, supported the Yala study.

We would also like to thank Karl Stromayer, Mary Pearl, Fred Koontz, Julie Hughes, Robyn Cashwell, Susan Elbin and Jayantha Jayewardene for encouragement and logistic support, and the US Fish and Wildlife Service, Liz Clairborne and Art Ortenberg Foundation, and Wildlife Trust for funding the Sri Lanka Elephant Research Project.

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Endangered Elephants
Past present and future
Proceedings of the Symposium for Human-Elephant Relationships and Conflicts
Colombo, August 2003

Editor
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Cover Design
Wasantha Siriwardena

CITATION: (Name, Initial). 2004. (title of paper). In (ed.)
Jayewardene, Jayantha. Endangered elephants, past present & future.
Proceedings of the Symposium on Human Elephant Relationships and Conflicts, Sri Lanka, September 2003. Biodiversity & Elephant Conservation Trust, Colombo. Pages 228.

Front cover depicts a stylized version of the '*Sandakadapahana*' or moonstone, an essential element of ancient Sri Lankan architecture. The moonstone is a form of stone sculpture unique to Sri Lanka. It was placed at the foot of steps leading to important royal and religious buildings. The level and intricacy of decoration on this half-moon shaped step depended on the era and the kingdom. The moonstone, archeologists say, symbolizes the endless cycle of birth and death and the path to nirvana.

Back cover carries an image of the elephant stone carving found at the entrance to the Temple of the Tooth in Kandy, Sri Lanka's last capital before the British colonized the entire country in 1815. Sri Lankans believe that a tooth relic of Lord Buddha is enshrined in the 400-year old temple, which has preserved its medieval rituals and carried them on even today. The temple is best known for the colourful pageant it holds during the full moon of August, where hundreds of heavily caparisoned elephants parade in the narrow streets of Kandy. The tooth relic is carried by an especially trained tusker.

ISBN NO: 955-1108-00-0

Publisher
Biodiversity and Elephant Conservation Trust
615/ 32 Rajagiriya Gardens
Nawala Road
Rajagiriya
E-mail: romalijj@eureka.lk

Date of Publishing: November, 2004

Printer:
Karunaratne & Sons
67, UDA Industrial Estate
Katuwana Road
Homagama

Funded by The International Elephant Foundation, USA
and the Biodiversity & Elephant Conservation Trust, Sri Lanka