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THE USE OF RADIO-TRACKING DATA TO GUIDE DEVELOPMENT AND MANAGE ELEPHANTS

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ABSTRACT - Asian elephants are difficult to observe because of habitat constraints and behavioural adaptations to avoid people. Consequently, accurate information on their movement patterns, habitat occupancy and resource use can only be obtained through radio-tracking. GPS radio telemetry is particularly useful for this purpose as it provides a wealth of high quality data. Around 60 elephants have been tracked in Sri Lanka over the past two decades using GPS collars. Here we present four case studies demonstrating the importance of such data in guiding development so as to prevent or reduce human-elephant conflict and for the effective management of elephants to ensure their conservation.

KEY WORDS : Radio-tracking data, HEC, MER, Asian Elephants

INTRODUCTION

As a species, Asian elephants (*Elephas maximus*) are unique, specially in terms of their relationship with people. They are highly endangered, a flagship species for conservation and of great socio-cultural and religious importance in range countries. At the same time elephants cause widespread and intense conflict with people, leading to significant economic losses and social disruption (Fernando, *et al*. 2008). In all 13 south and southeast Asian range countries of the Asian elephant, human-elephant conflict (HEC) is a major conservation, socio-economic and political issue. In most range countries HEC is escalating in spite of much effort and funds expended for its mitigation over the past few decades (Fernando & Pastorini, 2011). Sri Lanka is an interesting example in this context with the third highest density of people among the range countries (behind Bangladesh and India), an elephant density of almost ten times that of any other range country, and the highest level of HEC (Fernando & Pastorini, 2011).

Across the range, conservation of elephants and mitigation of HEC has largely been based on beliefs and past practices and not on scientific information. In Sri Lanka, the main approach to both these objectives has been that of limiting elephants to protected areas under the Department of Wildlife Conservation (DWC). However, after more than five decades of pursuing this goal, today over 70% of elephants remain outside DWC protected areas. HEC occurs entirely outside protected areas and annually causes the death of over 250 elephants and 70 people, significant loss of agricultural production and severe disruption of the life of villagers over a larger area of dry zone Sri Lanka.

Due to the constraints imposed by behavioural and ecological aspects of Asian elephants the only way to obtain reliable data on their movement patterns, resource utilization and habitat occupancy is through radio telemetry. Initial studies on Asian elephants used VHF telemetry where elephants were collared with a VHF transmitter and then tracked using a directional antenna and a receiver. The elephant is located by 'homing-in' where increasing signal strength is followed till the elephant is sighted or by triangulation where the direction to the transmitter is detected from a number of positions and plotted on a map, with their convergence being taken as the location of

elephant (White & Garrot 1990). However, this method involves much effort and time in the field and the number of positions that can be obtained are rather limited.

The next generation of radio telemetry now available, uses GPS-collars, which record geographic coordinates of a collared elephant at a pre-set time interval and transmit the data via satellite or mobile network. With a GPS system, once the collar is put on the elephant, the data is received remotely without need for any fieldwork. The quality and quantity of data obtained from GPS collars is magnitudes greater and more precise than possible with VHF tracking. In addition, all GPS collars also have a VHF unit that can be used to track elephants in real time for direct observation.

Here we present four case studies which illustrate the importance of radio-tracking data in guiding development to minimize negative impacts on elephants and prevent HEC, and for management of elephants in order to conserve them.

MATERIALS AND METHODS

Fiftysix elephants were collared over the last two decades as part of a collaborative study by the DWC and the Centre for Conservation and Research (CCR) to obtain baseline information to better elephant conservation and HEC mitigation. Tranquilizing of elephants for collaring was done by a DWC team of 15-20 personnel led by two DWC veterinarians according to guidelines set out by the DWC.

The collars consisted of a GPS unit, VHF transmitter beacon, satellite or GSM transmitter for data download and batteries packaged into one integrated unit. Sky orientation of the functional unit for satellite detection was achieved by a counterweight. Collars that became non-functional were not removed, as it was determined that the risk to the elephant and collaring team in tranquilization was not acceptable for the purpose of collar removal. Collar belting usually degraded and broke off within a period of 2-4 years.

Collars were programmed to collect GPS locations every 4 or 8 hours and transmit the data every 8, 24 or 48 hours. Additionally, elephants were tracked using the VHF beacon on the collar and observed opportunistically.

Data received from the collars was processed with the manufacturer's software. The GPS data output was then screened to remove erroneous locations and delete repeats. GPS locations from collars were organized in Microsoft Excel. A text file version of the data was imported into the GIS software Quantum GIS version 1.7 (QGIS) and plotted on satellite imagery or 1:50,000 topographic sheets.

RESULTS

Case Study 1 – Dole Plantation in Somāwathiya National Park

A banana plantation was commenced inside Somawathiya National Park by the multinational corporation Dole in 2011. This created an outcry from a number of concerned environmental organizations (Hance 2011a). In addition to the fact that the plantation was within the Somawathiya National Park, one of the chief concerns of the environmental lobby was that it was in an area heavily utilized by elephants. It was argued that the plantation would cause the loss of a significant extent of elephant habitat, leading to increase of HEC in surrounding villages as elephants searched for alternative resources. Additionally, as elephants are greatly attracted to banana trees, the plantation would create a major flashpointfor HEC, which would be detrimental to the development as well as the elephants.

However Dole contended that there were no elephants in the area (Hance 2011b). In addition to a number of initiatives highlighting the protests by the environmental lobby, representations were made by the environmental organizations to the US embassy in Sri Lanka to bring pressure on Dole. Consequently a meeting was called with the mediation of the US embassy where one of the main points raised was the radio tracking data which clearly demonstrated that the plantation area was heavily utilized by a tracked adult female and her herd of about 50 individuals (Figure 1). Subsequently Dole representatives accepted their error and agreed to

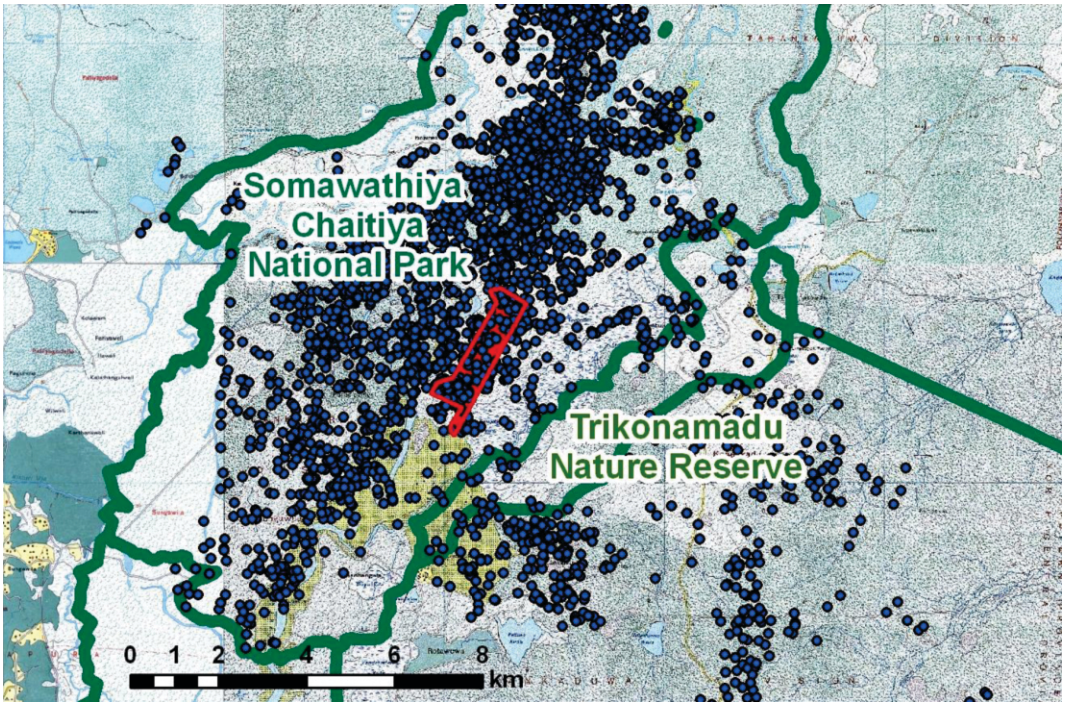

FIGURE 1: Map showing tracking data for Soma – a female in a herd of about 50 elephants, and the location of the Dole farm. Blue dots – GPS positions for Soma.

pull out (Hance, 2011c), thus preventing a non-viable development that would have been extremely detrimental to elephant conservation.

Case Study 2 – Mattala International Airport

When the Mattala International Airport was constructed, the tracking data was presented to the EIA committee demonstrating the extensive use of the site and surrounding area by elephants. As a result, the Mattala Managed Elephant Range (MER)was incorporated in the EIA report, thus highlighting the fact that the airport was entirely within elephant habitat.

Secondly, the Airport Authority was tasked with taking appropriate action to prevent HEC as a condition of project implementation by the Central Environmental Authority. Consequently one of the first activities in constructing the airport was the erection of an electric fence on its boundary by the Airport Authority under the advice of the DWC. The fence was constructed with one end bordering the Malala - Ara creek, on the premise that an elephant wading through the water and coming upto the fence would receive an amplified shock, increasing the efficiency of the fence.

However, from the tracking data it was clear that this entirely obstructed the movement of elephants from the western side of the MER to the east, hence would lead to elephants breaking the fence or suffering from range loss (Figure 2). Consequently the tracking data was presented to the Airport Authority and they were requested to pull the fence 500 m back from the Malala-Ara. After much discussion, the Airport Authority agreed to move the fence 125 m. Upon this change, the tracking data confirmed that elephants were using the corridor thus created to cross from one side to the other (Figure 2). Thus, in this instance, the tracking data enabled modifying a development activity so as to reduce the detrimental effect on elephants and prevent genesis of HEC.

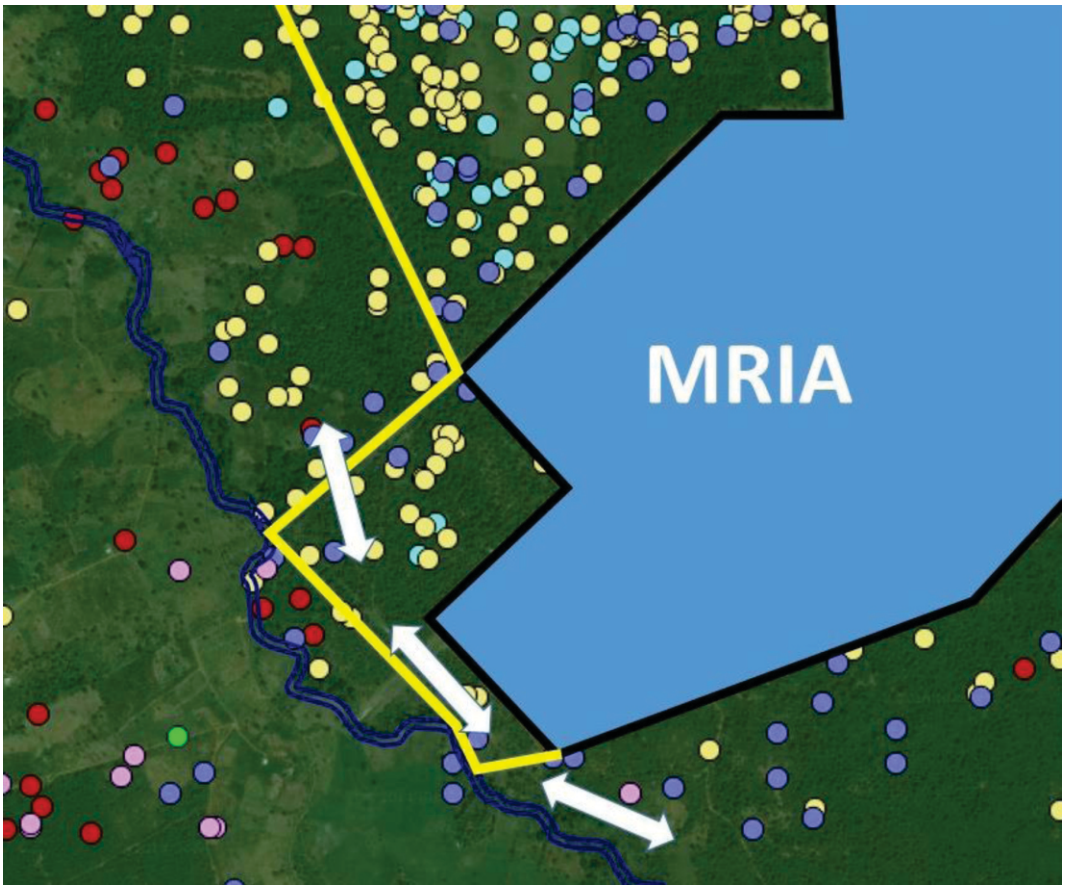

FIGURE 2: Satellite image showing the tracking data (coloured dots) and the corridor that was blocked by the airport electric fence. Yellow line – original location of electric fence. Black line- revised fence. Double blue line – Malala-Ara creek. White arrows indicate the movement pattern of elephants.

Case Study 3 – Mattala MER

An area of approximately 12,000 ha was developed in the South of Sri Lanka for irrigated agriculture under the Walawe Left Bank Development Project. The project was planned in the 1970s and even at that time it was realized that implementation of an irrigation project of this scale within elephant range would cause HEC. Therefore, one of the conditions of project implementation was the mitigation of HEC.

Workshops conducted with the participation of the DWC, Mahaweli Authority and the funding agency JBIC determined that the best course of action was to drive all the elephants in and around the area into Lunugamvehera National Park. Surveys based on water hole counts conducted by DWC and the Open University determined that there were 106 elephants in the drive area encompassing Weerawila, Bundala, Hambantota, Ridiyagama and Mattala, going up to the Udawalawe-Thanamalwila road to the North and the Thanamalwila-Weerawila road to the east.

The drive was commenced in 2005 and took 1.5 years to complete. Around 225 elephants were driven into Lunugamvehera and fenced in. However, the drive failed to reduce HEC in the development area and subsequent assessment based on photographic identification revealed that there were over 400 elephants still left in the drive area.

Monitoring of the elephants in

Lunugamvehera indicated that elephants driven out of their home ranges and confined to parks did not adapt. They as well as elephants that were previously resident in the park suffered from loss of body condition and increased morbidity and mortality as a result of exceeding the carrying capacity of the park by the elephants driven in.

In a revised elephant management plan based on traditional beliefs and the premise that the elephants in the area utilized Bundala and Lunugamvehera National Parks and migrated between them, the DWC proposed to connect the two parks with a 500 m corridor through the Mattala area. However, radio-tracking data of the herds and males showed that the elephants were resident in thearea encompassing Kadawara, Wilmanne, Bundala, Hambantota, Mirrijjawila, Keligama, Gonnoruwa, Handilla, Ketanwewa, Ellalla, Kuda-indiwewa, Badagiriya, Mattala, Bodagama and Mahagalwewa going up to the

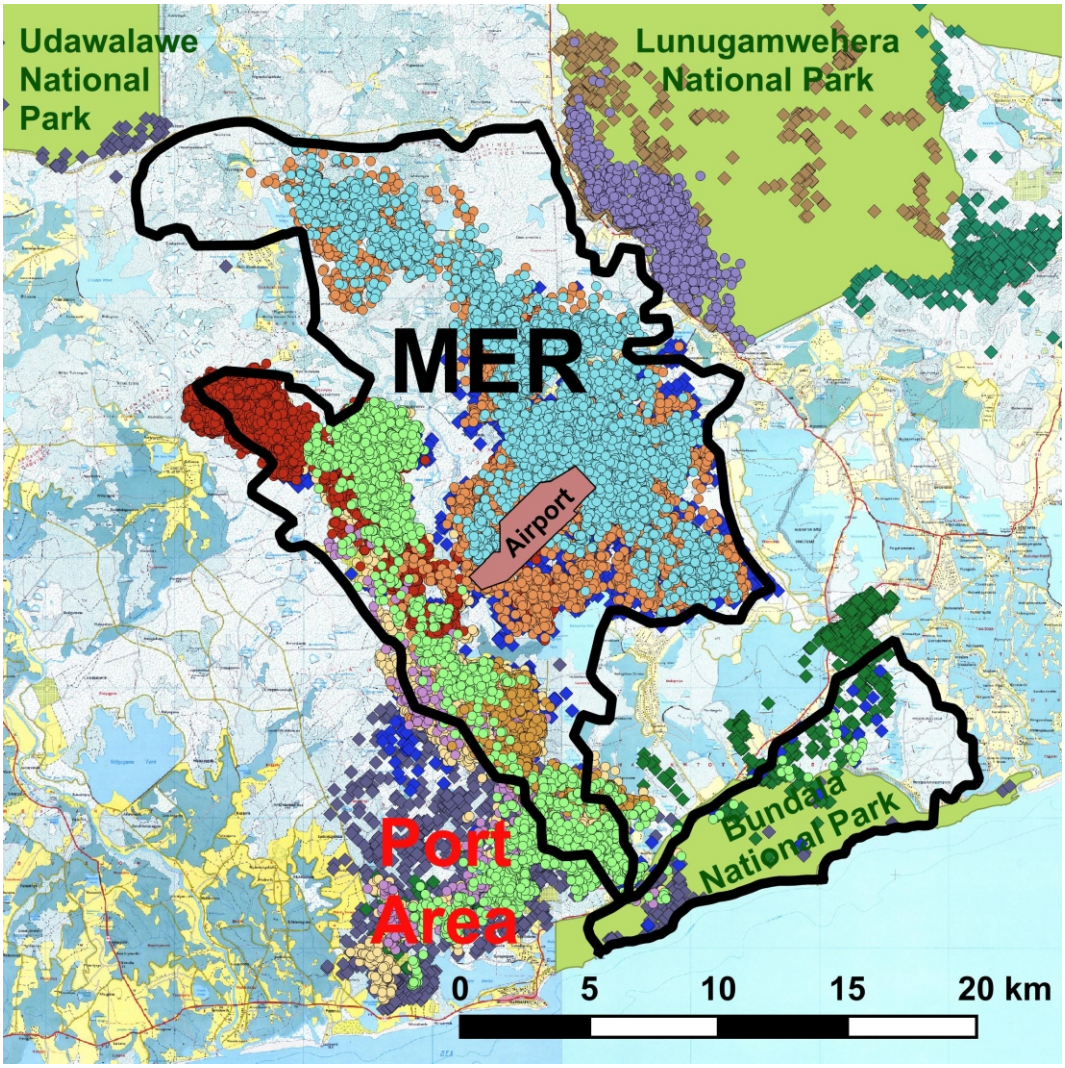

FIGURE 3: Map showing radio-tracking data for the elephants in the Mattala area and the area initially identified as a Managed Elephant Range (MER). The different coloured dots represent GPS positions for different elephants representing both herds and individual males.

Udawalawe-Thanamalwila road to the north and the Thanamalwila-Weerawila road to the east, and that they utilized the entire area (Figure 3).

At this time the entire area was zoned for development under the Greater Hambantota Development Plan by the Urban Development Authority based on a Strategic Environmental Assessmentconducted under the auspices of the Central Environmental Authority. Presentation of the tracking data to the assessment team resulted in alteration of the zoning plan to accommodate elephant needs by inclusion of a 'Managed Elephant Reserve' (MER) in the zoning plan. The area zoned as the MER covered most of the habitat heavily utilized by the herds excluding a portion in the south consisting of the port development area (Figure 3). The only major development within the zoned area was the Mattala Rajapakse International Airport.

At present, theMERhas not yet been gazetted as such. However a number of activities such as construction of a perimeter fence and protection of villages and paddy fields within the area with permanent and seasonal electric fences respectively are being implemented, and the area has been further refined according to tracking data and included in the latest elephant management plan proposed by the DWC (Peiris 2014). Most importantly, viewing of driving the elephants out of their home ranges in the MERas a management measure has ceased. Thus in this instance the tracking data was able to guide both development and management so as to prevent genesis of HEC and minimize detrimental effects on elephants, thus ensuring better conservation.

Case Study 4 – Elephant Management in the Northwest

The Northwest of Sri Lanka arguably has the highest level of HEC. Surveys of elephant distribution and radio-tracking of a number of herds and adult males over the last two decades has clearly shown that elephants utilize an extensive area in the northwest, over 90% of which is outside protected areas of the DWC (Figure 4). Therefore, the data indicate that management should focus on managing elephants where they are, by effectively mitigating HEC through community based electric fencing to protect settlements and paddy fields.

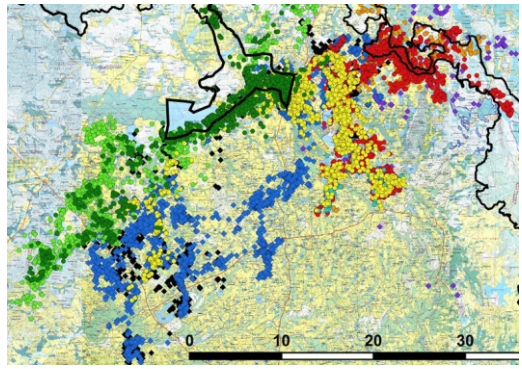

FIGURE 4: Map showing tracking data of elephants in the Northwest and the areas to which the elephants are to be confined to (areas enclosed by the heavy black line). The different coloured dots represent GPS positions for different elephants, consisting of six females representing herds and three individual males.

However,due to public and political pressure, and generally held beliefs of elephant movement, the management approach followed in the northwest has been to limit elephants to DWC protected areas. To this end, elephant drives have been conducted almost annually for decades. They have completely failed to limit elephants to the DWC protected areas. Due to the regular exposure to drives, which in effectsubject elephants to intense prolonged conflict, HEC has continued to escalate.

The most recent management plan proposed by the DWC (Peiris 2014) follows the same approach with elephants to be driven out of their home ranges and limited to two areas (Fig. 4). The radio tracking data shows that this approach will split the home range of a number of herds and cause the loss of significant extents of the home ranges of most herds (Fig. 4). If this plan is successfully implemented it will result in the death of the majority of elephant herds in the northwest. However, the practical impossibility of effectively implementing such a plan means that it is likely to only result in confining a few herds to DWC areas where they will starve to

death, and increasing the aggressiveness of all elephants left behind, leading to even more severe HEC.

DISCUSSION

The key cause of HEC is the conducting of developmental activities in areas with elephants, without any consideration of elephant resource use and movement patterns and completely devoid of appropriate safeguards to prevent elephant depredation and HEC mitigation. Such developments range from mega-scale developments like irrigation development projects, to medium scale developments such as construction of small 'tanks', to small scale developments represented by encroachments by individual farmers. One of the main reasons for this shirking of responsibility on the part of developers is the absence of actual data of elephant movements and resource use, especially outside the protected areas.

Another significant contributory factor is the widely held view that HEC mitigation is the sole responsibility of the DWC. However, this is a completely irrational and impractical expectation given the geographic and temporal scale of HEC, as well as the main cause of its genesis, which is development. On the other hand, as case studies 1 to 3 clearly demonstrate, obtaining actual information of resource use and movement patterns of elephants and providing the stakeholders of development with such information can effectively guide development activities to minimize detrimental effects on elephants as well as prevent and reduce HEC effectively.

The second reason for the failure of elephant conservation and HEC mitigation is the neglecting to take elephant behaviour and ecology into consideration when planning management activities. Unlike African savannah elephants, Asian elephants mainly occupy low visibility habitats such as thick scrub and dense secondary forests. Asian elephants are also behaviourally adapted to avoid people, largely as a result of experience of conflict with them. They are mostly nocturnal in their behaviour and can be extremely cryptic. Notions of movement patterns, resource utilization and habitat occupancy based on anecdotal evidence, cursory observations and general beliefs are often times very far from reality.

Basing management decisions on such fragmentary and unreliable information can be very harmful to elephant conservation and lead to the escalation of HEC rather than its resolution. Management actions such as translocation of problem elephants (Fernando *et al.* 2012),elephant drives and construction of electric fences on administrative boundaries, are the mainstay of traditional elephant management across Asian elephant range. However they tend to increase the conflict through disturbance of elephant behaviour, making elephants more aggressive towards people. They are also extremely detrimental to elephant conservation due to the negative effects of disruption of elephant movement and resource use patterns on the well being and survival of elephants.

The key to conducting development while minimizing and preventing HEC and conserving elephants, is obtaining data of the actual resource, habitat and landscape use patterns of elephants and using it to guide development and management. The only way of obtaining this information is through radio telemetry.

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