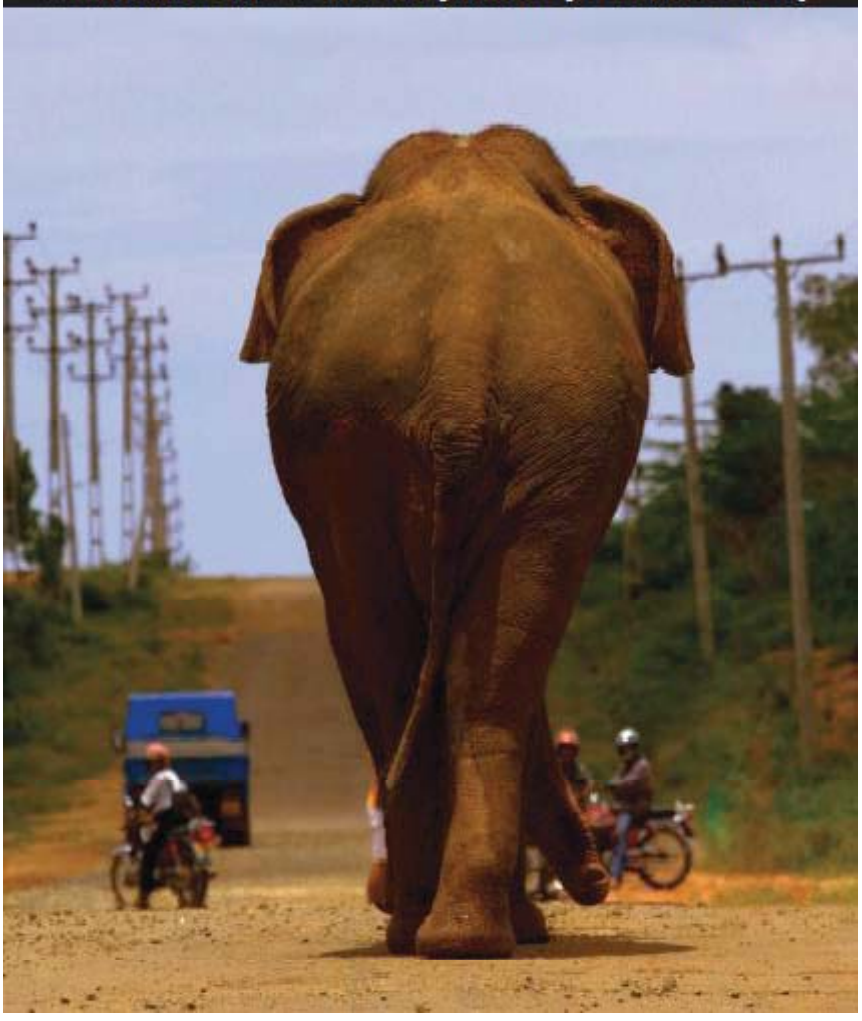
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# Editorial

Jayantha Jayewardene (Editor)

People living with wildlife are important players in any strategy to conserve wildlife. This becomes more important where there are conflicts between man and wildlife. The importance of the involvement of the local people in wildlife conservation is because these people share resources with wildlife and the interaction of people and wildlife affect each other both positively and negatively. Therefore one cannot isolate local people from the conservation of wildlife. It is also equally important to look at conservation issues from both the point of view of conserving wildlife per se and its socio-economic aspects.

Human-elephant conflict (HEC) is one such issue that requires a greater consideration of its socio economic aspects, if any mitigation measures are to be successful. These conflicts impact on the livelihoods of people. The declaration of protected areas takes away land that could be used by increasing human populations for cultivation. Agriculture in elephant habitats disrupts elephant home ranges, and reduces the resources available to the elephants. The loss of human lives and damage to houses and cultivations affects the livelihood of families. It creates animosity with the elephants. Therefore if one does not tackle these issues directly, it would be difficult to find long term solutions to the ever increasing HEC.

Initially, when planning elephant conservation and HEC mitigation strategies, it is necessary to meet and get the input of the communities that are affected. The necessity for those affected by these conflicts to take an active part in the solution of HEC in their areas cannot be over emphasized. Without the initial input of the people the actual situation on the ground cannot be ascertained accurately. It is also necessary to look at these problems from their point of view instead of making conservation decisions based on the perceptions and theories of managers and conservationists alone.

When an elephant is killed the carcass is buried or burnt. No further thought is given to the effect that the death of this elephant has on the herd. However, if a human is killed by an elephant there is an immediate effect on the family of the deceased. Apart from the pall of grief that descends on the family and friends of the victim, there is an immediate negative effect on the economic status of the family, especially if the victim was the bread winner. A source of income, in many instances the only source, is cut off. With this loss many changes to the life style of the family, with regard to food, schooling, plans for the construction of a house etc., have to be made.

The payment of compensation for the loss of human lives and loss of property is the only action that the authorities take. In most of these instances this compensation schemes do not meet their objectives. Charitable schemes, which have no compensatory effect on the families of the victims, will only ease the conscience of the authorities and show the world that a compensation scheme is in place. What is needed is a compensation scheme that would gradually alter the pathway of the lives of the victimized families towards a better life.



Elephant on a road in Riau, Sumatra
Photo by Ajay A. Desai

In Sri Lanka, for instance the compensation scheme for a family where one member has been killed by a wild elephant is the payment of Rs. 50,000 (~ $ 500) to the spouse. Another Rs. 50,000 is divided amongst all children under the age of 18 years. The irony of this is that each child has to wait till he/she is over 18 years to get the due share of money.

Another important aspect of HEC mitigation is to have accurate data and information to go on. This becomes more important since the cause of con icts in one area may not be the cause for con icts in another. Data and the information owing from this data, is important for decision making, in order to evaluate the status of a problem and also for post implementation evaluations. HEC attracts quite a number of individuals and various organizations who contribute to the socio economic development of poor families including those victimized by elephants.

There are also researchers who work on different aspects of these con icts. However, there are large gaps in the data or information that is available all over Asia. Not only is there a paucity of data and information to plan conservation strategies but this also effects post implementation evaluations when measuring the actual impact of conservation and mitigation strategies.

It is absolutely necessary for research personnel and the decision makers to join forces and coordinate their activities. This not only strengthens the conservation plans but also makes it possible to focus on the gaps in the data available. It is imperative that we make use of the good work that has been done so far. With research priorities in place the limited funds available for research could be put to the best possible use.

Since the governments of most Asian countries are involved in elephant conservation, each of them should not only develop a policy for elephant conservation but also ensure that this policy is implemented. Sri Lanka has a policy for elephant management and conservation, which has been approved by the highest legislature in the island, which is a good rst step. However even in Sri Lanka much needs to be done to translate policy into action on the ground.

Policy implementation needs to involve not only stakeholders in elephant conservation but also all those that contribute to genesis of HEC such as government and non-government agencies that undertake development in and around elephant habitat, the general public and politicians, who should also be stakeholders in its mitigation. If the wild elephants in Asia are to be conserved effectively, there has to be a concerted effort, by all concerned, to plan realistically, implement these plans ef ciently and evaluate them at the end to ensure that there has been a positive impact.



Elephant on a road in the Bandipur Tiger Reserve, India
Photo by Ajay A. Desai

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# Notes from the Co-chairs IUCN/SSC Asian Elephant Specialist Group

Ajay A. Desai and Simon Hedges

Recently the Indian Judiciary was involved in three interesting cases related to elephant conservation. One related to a decision on the need for a  yover that would facilitate elephant movement under a road that cuts through elephant habitat. The second related to the closure of a road at night – again to facilitate wildlife (including elephants) movement across a road that cuts through a protected area. The third related to establishing a corridor for elephant movement in an area that was gradually being broken up by private development (resorts and holiday homes). In all cases the courts ruled in favour of elephants. Good news, but throughout the elephant range in Asia corridors are becoming increasingly important. Corridors may be important conservation tools but they are basically indicators of a far more serious problem – habitat fragmentation and consequently a reduction in the conservation potential of a habitat patch or population. Where corridors cannot be secured and maintained, habitat is broken into two or more smaller patches with exclusive human use areas in the intervening area.

Linear development in elephant habitat, such as roads, railways and canals are major reasons for habitat fragmentation. Planned or unplanned development of human settlements along such infrastructure is routine. Human settlements also tend to occur along rivers and along the foothills of mountain/hill ranges. Such development and settlements break up elephant habitat into smaller and less viable patches for conservation. Such fragmentation also increases con ict by bring human use areas into elephant habitat and by disrupting normal ranging patterns and cutting home ranges into smaller patches. Unlike habitat loss, which has always been a major conservation concern, habitat fragmentation brought about by linear development apparently seems to have attracted less attention. Possibly because such development generally appears to be relatively small in size and the remaining habitat appears to be large (although now broken into two patches). Further the initial crossing of elephants across such breakages appears to lessen our worries. However, with time human settlements and activities get entrenched and before long elephants can no longer cross. For example we have all seen elephants crossing roads and in the past roads were not major obstacles for elephant movement. However multilane highways or heavily used roads today have become impassable barriers. This is now being observed in India, home to thousands of elephants and even in China with a few hundred elephants, multilane highways pose similar problems. Elephant habitat in North-western Sri Lanka is fragmented by numerous roads, many with human settlements along them. Elephants are forced to intrude into human use areas. Roads are not the only problem; all development that fragments habitat is a problem.

Other than the obvious increase in human-elephant con ict due to increased fragmentation of habitat there are other more serious problems. Recently one of us (AAD) was involved in an assessment of two fragmented areas one with 20 odd elephants and the other with 50 odd elephants and both these patches were totally unsuitable for elephant conservation with no real opportunities for reviving connectivity. The assessment indicated that these two populations did not have long-term viability unless managed in a zoo like situation in the remaining habitat fragments – all purpose of conserving these animals would then be lost. Certainly conserving the genetic diversity contained in these populations would be useful but there are other means of doing that. These two are not the only cases there are many more, not only in India but across the entire elephant range in Asia.

We are creating smaller and less suitable habitat patches that are really not suitable for elephant conservation. We are creating doomed populations. Their management requires extremely high levels of inputs in terms of efforts

and resources, inputs that are well beyond the reach of most countries. And even if such efforts were to be made the long-term viability would remain doubtful in many cases.

While assessing the status of Asian elephants we take into account the entire population and the extent of remaining habitat. We neglect separating doomed populations and consequently come up with figures that are erroneous and optimistic, indicating a far more secure status than what is really there. Such doomed populations will eventually die out due to retaliatory killings as they are usually in serious conflict with people or due to increased stress and other factors associated with small isolated populations. Another deceptive factor is the longevity of elephants and their ability to persist in sub-optimum habitats. Any population with a few young sub-adults will certainly outlive most of us and can persist in sub-optimal habitats. But in the long run (over several generations) it will eventually decline and die out. Their gradual decline and disappearance does not attract the attention that other issues like poaching and HEC do and as such their loss goes largely un-noticed. More and more populations are being gradually driven into the doomed category because the process attracts little attention and is rarely highlighted.

There are three basic problems that arise from not identifying and accounting for doomed populations. First the status of the Asian elephant appears to be far more optimistic than it actually is. We continue to believe that we have significantly large populations of elephants and habitat. Second, the process of fragmentation and reduction in the conservation potential of the remaining populations (habitat) continues because it is not given the significance it deserve. And third, we do not face up to the reality of managing these doomed populations. We mention them but we do not act or do anything about them. Not enough attention is being given to the long-term implications of declining habitat patch sizes, confined populations and the management of doomed populations. We limit our efforts to HEC mitigation which is largely symptomatic treatment and does not in any way resolve the problem.

If we start to identify such doomed populations it will highlight the true status of the Asian elephant and bring about greater focus on their conservation. It will also make us aware of populations we stand to lose and the processes that brought about such situations. This will make governments and people recognize and accept responsibility for the situation they have created, which in turn will ensure that there are greater efforts made to stop and reverse such processes. We will hopefully stop the slow and largely unseen and unrecognized erosion of the conservation potential that the remaining elephant populations have.

To address issues related to doomed populations we need to ask basic questions about how much habitat is required for a viable population – even for one managed as a part of a meta-population? How to contain such populations in the limited habitat that is available (minimize or eliminate HEC)? What impact will the confined population have on its habitat and consequently on bio-diversity? We should not forget that elephant conservation is ultimately a part of biodiversity conservation. What is to be done with the excess population once numbers build beyond the carrying capacity (that is if we can estimate it)? How do we manage population sizes? What are the resources and information needed for managing such population? What resources and knowledge do we need for effective meta-population management? We appear to lack the basic data and information needed to answer such questions as we have not really looked at such issues in any depth. There is an urgent need to gather data related to such issues. We need to evaluate populations based on the long term habitat and population requirements rather than just on numbers. We need to identify doomed populations and come up with pragmatic solutions to addressing such populations. This will be the real challenge in the near future.

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# The Human-Elephant Conflict in Southeastern Sri Lanka: Type of Damage, Seasonal Patterns, and Sexual Differences in the Raiding Behavior of Elephants

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## Introduction

The conflicts between humans and large fauna for the use of resources have become a major concern in conservation biology (Sukumar 1991; Barnes 1996; Hill 1998; Naughton-Treves 1998; Osborn & Parker 2003; Treves & Karanth 2003). These conflicts are increasing as landscapes continue to be transformed, depleting the amount and quality of resources left for wildlife. Local communities affected by these conflicts bear disproportionate costs in the global enterprise of wildlife conservation and develop negative attitudes towards conservation policies (Newmark *et al.* 1994; de Boer *et al.* 1998). On the other hand, human-wildlife conflicts can be a precursor to the local extinction of the problematic species (Hoare 2000). The Asian elephant (*Elephas maximus*) is a clear case in point.

Asian elephants are endangered (Choudhury *et al*. 2008) due to the rapid decline of their populations in recent decades as a consequence of habitat loss, fragmentation, and the subsequent increase in human-elephant conflict (HEC) incidents (Sukumar 1989). This is particularly true for elephant populations in South Asia, where elephants often live in human-dominated landscapes in close contact with human populations (Leimgruber *et al.* 2003). Elephants have survived in large numbers in these conditions because of their special status in the South Asian culture, where people respect and care for elephants (Erdelen 1988; Bandara & Tisdell 2003; Sukumar 2003). However, these attitudes are eroding under the present levels of HEC (Fernando *et al.* 2005), and further developments are known to impact negatively on these elephant populations (Sukumar 1991; Williams *et al.* 2001; Fernando *et al.* 2005).

Conservation of elephant populations in South Asia needs thus to emphasize the reduction of HEC (Leimgruber *et al.* 2003), but this is a spiny problem that remains unabated (Barnes 1996; Hoare 2000; Osborn & Parker 2003; Fernando *et al.* 2005). Mitigation management requires sound scientific studies to understand the underlying patterns and processes operating in HEC (Sitati *et al*. 2003) at population level, which are scarce in Asia.

Sri Lanka provides ideal conditions to study HEC. During the 20th century, human population increased dramatically (from four to twenty million people), leading to abrupt losses of forests (from 70 to 20% of the land; Legg & Jewell 1992). Nevertheless, the elephant population is still as high as 2000-4000 individuals (Santiapillai & Jackson 1990; Jayewardene 1994; but see also Blake & Hedges 2004). Many of these animals range outside protected areas, where HEC has escalated in the form of crop raiding and attacks on houses and people. Between 30-50 people and more than 150 elephants die annually in HEC incidents, posing serious problems for the Sri Lankan society. Since poaching for ivory is almost negligible (at difference to other Asian elephant populations, only 7% of males bear tusks; Jayawardene 1994), the HEC is the single main threat for Sri Lankan elephants (Fernando *et al.* 2005).

The official policy in Sri Lanka to reduce the HEC is to confine the elephants within the network of protected areas. For this purpose many elephants have been translocated or driven from confl ictive areas into national parks, where electric fences have been erected (Fernando 1993). However, these policies have been rather unsuccessful (Erdelen 1988; Fernando 1993, 1997) and new, scientifi cally sound, strategies must be considered. Since no systematical study on the characteristics and patterns of the HEC has yet been conducted, we studied HEC incidents in the southeast of Sri Lanka for one year in order to describe the following basic patterns. First, we described the characteristics of the damage produced by elephants. Second, we addressed the temporal distribution of HEC incidents and its causes. The southeast of Sri Lanka is a tropical dry zone with marked seasonality in rainfall and therefore we focused especially on the relation of HEC with rainfall, water availability and the agriculture calendar. Finally, we looked at sexual differences in the raiding behavior of elephants, as pointed out for other populations (Sukumar & Gadgil 1988).

*Study area*

The southeastern region of Sri Lanka (6°45'-21'N, 81°7'-31'E) is part of the dry zone of the country with a bimodal rainfall pattern. The main rainy season comes with the northeast monsoon from September to December. The dry season runs from June to mid-September, with the maximum drought occurring in August and early September. In April and May there is a shorter period of rains (Fig. 2a). The average annual precipitation ranges from 1000 to 2000 mm. The terrain is largely level and natural vegetation is dominated by scrubs and semi-evergreen dry monsoon forests. Water is limited during the dry season and the main sources of water are a few rivers and a series of seasonal and permanent "tanks" (water reservoirs for irrigation purposes).

An extensive complex of national parks, including Yala, Lunugamvehera, and Bundala (Fig. 1), covers an area of more than 1500 km$^2$ and constitutes important habitat for elephants in the region. Elephants are abundant both inside and outside the parks. Outside the park complex

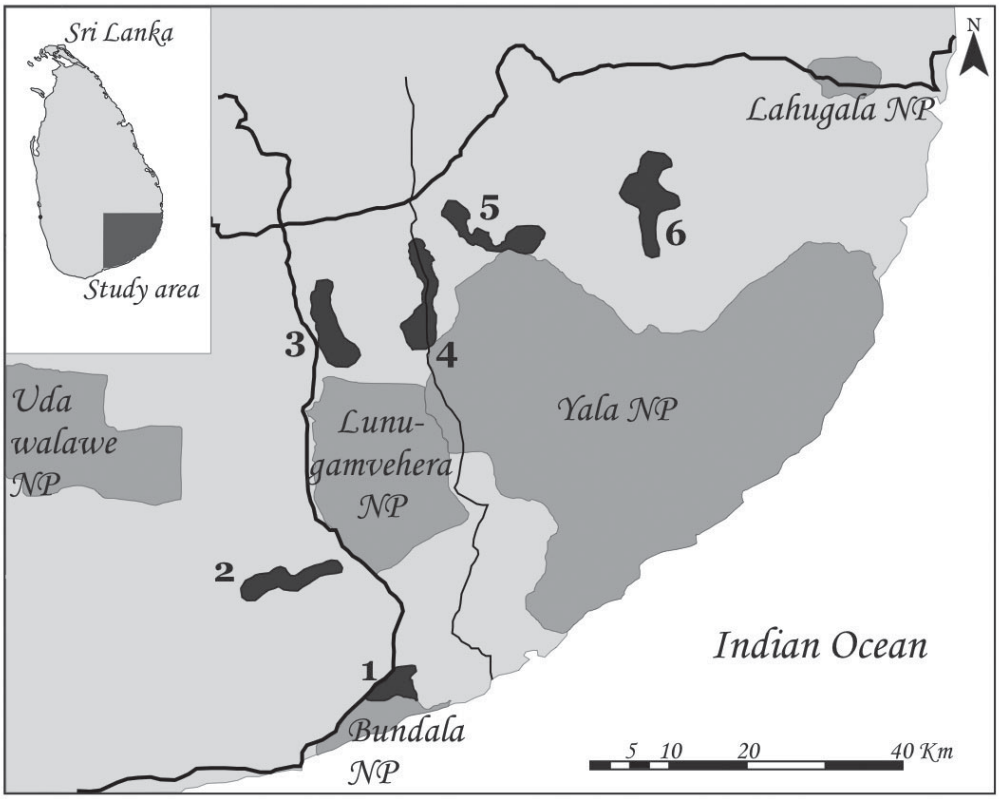



**Figure 1.** Study area in the southeastern region of Sri Lanka. 1-6 = HEC monitoring areas, NP = National Park, lines = main roads.

human population is rapidly increasing, and elephant habitats are being lost.

Small-scale agriculture is the main economic activity in the region. Banana (*Musa* spp), coconut (*Cocus nucifera*), and sugarcane (*Saccharum officinarum*) as well as some other tree-crops like mango (*Mangifera indica*), jack (*Artocarpus heterophylla*), and tamarind (*Tamarindus indica*) are grown through the year. Seasonal crops are cultivated during the rainy season, including paddy (*Oryza sativa*), maize (*Zea mays*), and several seasonal vegetables (*Phaseolus aureus*, *Vigna catjang*, and others). "Chena", the local variety of shifting cultivation, is practiced during the rainy season in the forests near villages. This practice creates a mosaic of vegetation of different successional stages inside the forests. Some irrigated paddy fields can produce rice twice in a year.

In order to address the general trends of HEC in this region, we selected six areas located around the park complex (Fig. 1). These areas are old settlements that are currently expanding their limits by forest encroachment for agriculture and settlement. The mean size of our study areas was 43.7 (±15.6 SD; range 33-72) $km^2$. One large-scale sugarcane plantation occurred in the proximity of two of the study areas. There is no detailed information on the elephant population existing in these areas, but during a preliminary survey we could assess the presence of elephants and HEC incidents in them.

## Methods

### *Data collection*

We collected data on the agriculture calendar, the water availability, and the occurrence of HEC incidents in the six study areas from June 2004 to May 2005. During the first month only four areas were studied and therefore June was excluded from the temporal analyses.) Six local people (enumerators) were trained and hired on a permanent basis to collect these data. This system allowed us to establish a reliable and independent system to report the HEC (Hoare 1999a; Sitati *et al.* 2003), avoiding the problem of overexaggeration by farmers (Tcamba 1996; Siex & Struhsaker 1999; Hedges *et al.* 2005).

The enumerators recorded the availability of water and the agriculture calendar in their respective areas. This information was qualitative, subjective (based on their field observations), and recorded on a fortnight basis. Water availability was recorded according to six categories (0 = no water available, 1 = water is available only in permanent tanks or rivers, 2 = low water in seasonal tanks, no flow in streams, 3 = low flow in streams, 4 = medium to high level in seasonal tanks and streams, and 5 = streams and seasonal tanks are at full capacity). A general monthly water availability index was derived as the mean of the monthly water availability in each study area (which was itself the mean of the values for both fortnights). The temporal availability of seasonal crops (rice, maize, and seasonal vegetables) was recorded as "planted", "early", "intermediate", "mature", and "harvested". Information about the agriculture calendar was collected for informative purposes and was not included in any analysis.

The enumerators visited the study areas at least twice a week. They were supported by key people at every village who collected information on the occurrence of incidents. The objectives of our study were explained to local communities and their collaboration was requested.

HEC incidents were defined as any incident involving crop damage, house damage, and human threat or injury caused by a single elephant or group of them (Hoare 1999b). All the HEC incidents were visited for verification purposes. Collection of data at each incident was largely based on Hoare (1999b). Data included:

1) Time and location: date, time, and GPS location of HEC incidents.

2) Characteristics of damage: damage was categorized into: crop, house, and human damages. These categories do not mutually exclude each other within one HEC incident. For crop damages, we recorded crop type(s), growth stage(s), size(s) of the plot

**Table 1.** Crop damage by elephants.

| Crop | No. of attacks | Consumption* | Consumed parts | Growth stage** | | |
|---|---|---|---|---|---|---|
| | | | | E | I | M |
| Banana | 318 | 100 | Pith, tender leaves, and rarely fruit | 7 | 38 | 55 |
| Paddy | 176 | 97 | All plant | 10 | 16 | 74 |
| Coconut | 128 | 100 | Leaves and secondarily rachis | 22 | 38 | 40 |
| Sugarcane | 106 | 82 | Culm | 16 | 45 | 39 |
| Maize | 87 | 91 | Cobs and secondarily leaves | 6 | 14 | 80 |
| Manioc | 85 | 100 | Rhizome | 9 | 28 | 73 |
| Seasonal vegetables | 62 | 93 | All plant | 7 | 10 | 83 |
| Papaya | 52 | 85 | Fruit | 4 | 17 | 79 |
| Tree | 41 | 97 | Fruit, bark and leaves | 3 | 14 | 83 |
| Sesame | 27 | 0 | - | 11 | 33 | 56 |

* percentage of cases in which damage was caused for consumption as opposed to trampling.
**E = early, I = intermediate; M = mature.

and damage, and plant parts consumed by elephants. For house damages, we recorded the degree of destruction, the materials of the houses, whether people were inside during the attack, and the reasons for the attack. For human attacks, we recorded physical injuries of the victims and the severity. Attacks on humans were also considered to include those cases in which elephants charged or chased people (without physical injury) in incidents isolated from crop raiding or house attacks.

3) Elephants: because of the difficulties for farmers to identify correctly sex and age classes during HEC incidents (tuskless males, incidents happening at night) we recorded only the group size of the offender elephants.

*Analyses*

The relationships between the temporal distribution of incidents, the temporal patterns of rainfall, and water availability were analyzed by the nonparametric Spearman's rank-order correlation. The group size of elephants was compared according to two different factors, type of damage (crop, house, and human) and season (dry, rainy, and post-rainy), using the Kruskal-Wallis test.

## Results

*Description of HEC incidents*

From June 2004 to May 2005, we recorded 975 HEC incidents. Crop damage was the most common form of HEC, present in 92% of the incidents. Elephants damaged more than 30 different types of cultivated plants of which banana, paddy, and coconut were the most common (Table 1). Consumption was the main cause of damage, and elephants were selective in the parts of crop they consumed (Table 1). Damage due to trampling alone (without any consumption) was less frequent (but see sesame).

Seasonal crops were raided mainly when they were ripe (Table 1). House damage accounted for 10.9% of the HEC incidents (118 houses were attacked). Elephants attacked houses to consume stored foods (mainly paddy), to drink from water deposits (e.g. home wells or water barrels), or — as claimed by some house owners' — to consume salt from kitchens. Several houses were completely destroyed (22.0%) and many more suffered serious damages that could be repaired (49.2%; Table 2). Damages were more frequent on houses made of clay (52.8%) than those of cement (14.2%) or other materials (Table 2). Although elephants attacked houses more frequently when no person was inside (68.6%), attacks with people present inside the house

**Table 2.** House damages by elephants.

| House damage | | N | % |
|---|---|---|---|
| Destruction | complete | 26 | 22.0 |
| | partial | 58 | 49.2 |
| | low | 22 | 18.6 |
| | others* | 12 | 10.2 |
| Material | cement | 15 | 14.2 |
| | clay | 56 | 52.8 |
| | other | 35 | 33.0 |
| People inside | yes | 37 | 31.4 |
| | no | 81 | 68.6 |

*Others include damage on toilets and other external elements.

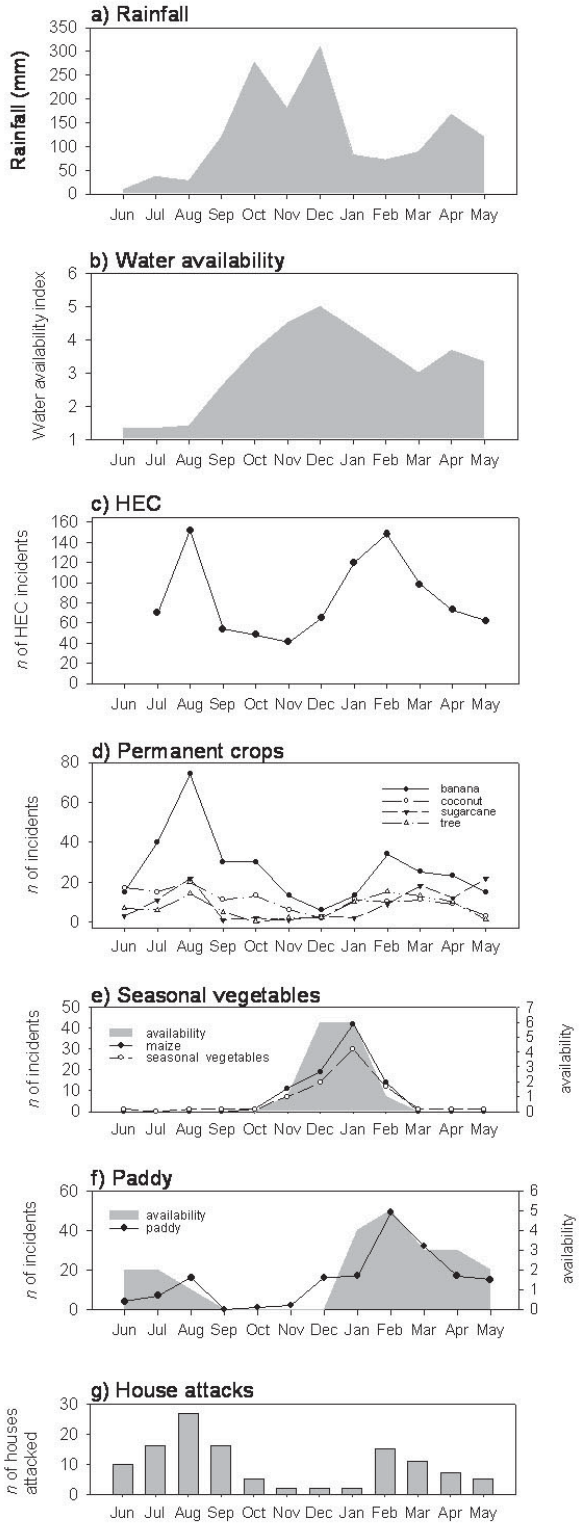



**Figure 2.** Temporal patterns of HEC incidents in relation to rainfall, water availability, and crop availability. Gray area in (e) and (f) represents the number of areas (0-6) in which a type of crop was recorded as ripe by enumerators. See text for explanation of water availability index.

were also frequent (31.4%; Table 2). Twenty-two (2.3% of total incidents) attacks on humans were recorded, including one death, one permanent disability and 18 charges with no physical injury. These attacks were commonly result of incidental encounters.

*Temporal patterns*

There was a strong positive correlation between our water availability index and the rainfall ($r_s$=0.741, $P$=0.006, N=12), although in January and February the lack of rain didn't translate in an immediate lack of water from rivers and tanks (Fig. 2a, b). HEC incidents occurred year-round but were more frequent during two periods (Fig. 2c): August (in the dry season) and January/ February (after the rainy season). The monthly distribution of incidents was strongly negatively correlated with rainfall, but not with the availability of water (Table 3).

Damages on permanent crops were very high during the dry season, especially on banana, low during the rainy season, and relatively high in February (Fig. 2d). The damage frequencies on banana, coconut, and trees were better explained by water availability than by rainfall (Table 3). In contrast, damages on seasonal crops (Fig. 2e) and paddy (Fig. 2f) occurred after the rainy season. Cultivation of these crops started in October, they ripened in December and January, and were harvested before March (Fig. 2e). Paddy ripened mainly from January and remained longer than other seasonal crops (Fig. 2f). The temporal distribution of damage on paddy, maize, and seasonal vegetables followed their availability as ripe crops (Fig. 2e, f).

**Table 3.** Spearman's rank-order correlation between raiding frequency and rainfall, water and crop availability.

| Incident type | Rainfall | Water |
|---|---|---|
| All incidents | -0.745** | -0.257 |
| Banana (permanent) | -0.667* | -0.816* |
| Coconut (permanent) | -0.606** | -0.694* |
| Tree (permanent) | -0.626* | -0.755** |
| Paddy (seasonal) | -0.374 | 0.161 |
| Maize (seasonal) | 0.283 | 0.820** |
| Vegetables (seasonal) | 0.253 | 0.830** |
| House damage | -0.645* | -0.796** |

*signi cant at $p$ = 0.05; ** $p$<0.01.

**Table 4.** Group size of raiding elephants according to type of damage and season.

| Group size | | Mean | SD | N | Kruskal-Wallis *p* | d.f. |
|---|---|---|---|---|---|---|
| General | | 2.37 | 2.85 | 915 | | |
| Type damage | crop raid | 2.46 | 2.94 | 845 | | |
| | house attack | 1.55 | 0.98 | 38 | 0.000 | 2 |
| | human attack (threats and injuries) | 1.05 | 0.21 | 22 | | |
| Season | dry (July/August) | 2.46 | 2.60 | 212 | | |
| | rainy (October/November) | 2.46 | 3.09 | 76 | 0.567 | 2 |
| | post-rainy (January/February) | 2.43 | 3.22 | 265 | | |

House attacks showed a bimodal distribution (Fig. 2g). Frequencies of house damages were higher in the dry season than in the post-rainy season (Fig. 2g). Houses were attacked less frequently from Nov. to January, but it is noteworthy that crop raiding was frequent in January (Fig. 2c).

*Raiding behavior of elephants*

HEC incidents occurred almost exclusively during nighttime (98.3%; Fig. 3). The group sizes of raiding elephants were highly biased to small groups, and 57.4% of incidents were caused by lone elephants (Fig. 4). The group size of raiding elephants did not vary seasonally, but according to the type of HEC incident: average group size was smaller in attacks on humans and houses than in crop raiding incidents (Table 4).

## Discussion

*Description of HEC incidents*

This is one of the first studies to describe systematically the characteristics of HEC in Sri Lanka. In our study area, crop raiding was the most common type of HEC incident, as in other populations in India (Sukumar 1990; Williams *et al*. 2001), Sumatra (Nyhus *et al*. 2000; Hedges *et al*. 2005), South China (Zhang & Wang 2003) and Africa (Hoare 1999a; Sitati *et al.* 2003; among others). Elephants consume crops as part of their optimal foraging strategy, and the proximate causes that lead to crop (or house) raiding have been well explained by Sukumar (1989, 1990). Attacks on houses and people were frequent in our study area; especially the attacks on houses seem to be much higher than in other populations (but see Hedges *et al*. 2005). It is common to keep rice sacs in the same rooms where people sleep because, to some extent, it reduces the risk of attack by elephants. Elephants probably detect rice and other goods stored inside the houses with their sensitive smell sense and knock down the walls to feed on them. Some farmers suggested that a few elephants might have become accustomed to raiding houses and do it repeatedly. Attacks on houses and people have a high social impact, since they produce high costs on the victims and are highly publicized

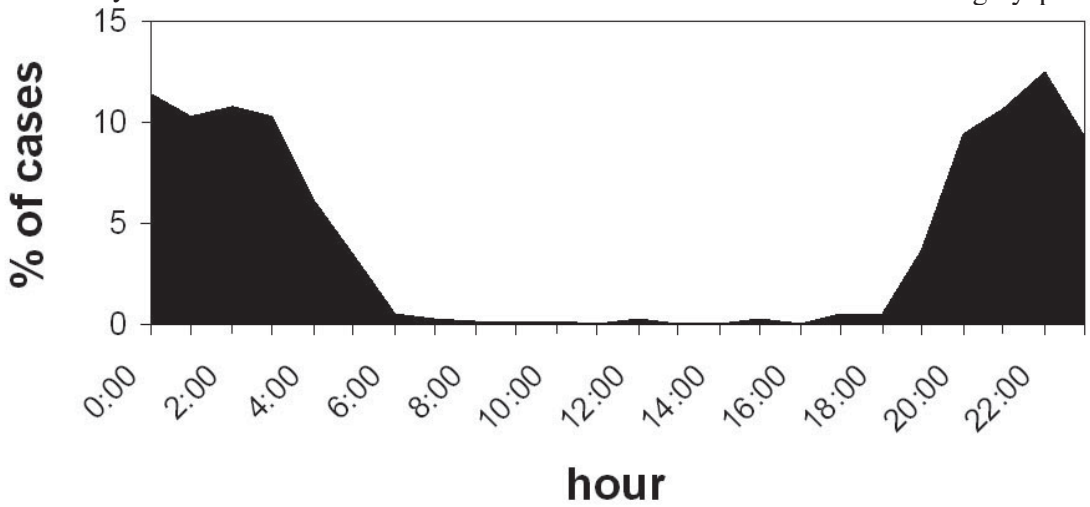



**Figure 3.** Time distribution of HEC incidents.

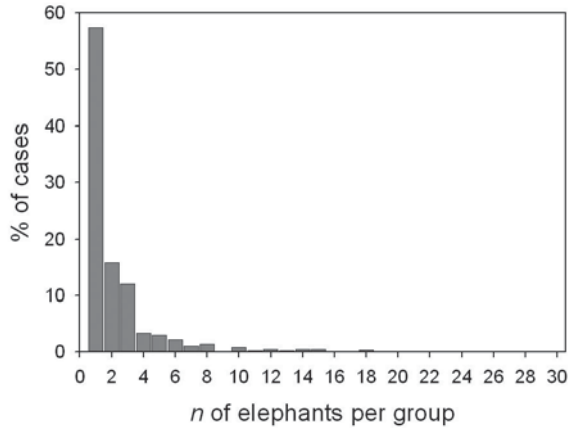



**Figure 4.** Group size of raiding elephants.

by media. Although farmers in southeast Sri Lanka are mostly Buddhist and very tolerant to crop losses by elephants, tolerance to attacks on houses and people is probably lower. High levels of these incidents may change local people's attitude toward elephants.

*Temporal patterns*

We have shown that HEC in the southeast of Sri Lanka is a seasonal phenomenon in which rainfall is the main driver for the temporal distribution of HEC incidents. According to the raiding frequency of elephants, the year can be divided into four seasons: the dry season with high damage, the rainy season with low damage, the post-rainy season with high damage, and the transitory season with low damage. These seasons largely correspond with the rainfall patterns.

In order to understand the seasonal patterns of damage by elephants, the attractiveness of crops in relation to wild forage in a particular season, the extent of availability of crops, and the presence of elephants near cultivated areas should be considered (Sukumar 2003). When the attractiveness of crops in relation to wild forage crosses certain threshold — caused either by a decrease in the quality of wild fodder or by an increase in the quantity and quality of crops — we can expect peaks of high con ict like those observed in our study area during the dry and post-rainy seasons. In our study area, the severe drought during the dry season probably led to a drop in the quality of wild forage. In these conditions, the few available crops, as well as other resources such as food and water stored in houses, would become relatively more attractive to elephants and hence the increase in HEC incidents. With the onset of rains, natural vegetation recovers and damage on crops and houses decreased drastically. The abundant rain from September to December determined local agricultural practices and by January and February (the post-rainy season) most of seasonal crops became ripe. Although rainfall was low in this period, drought was not as severe as during the dry season (e.g. relatively high levels of water ow in streams and tanks; Fig. 2b). We think that the increased attractiveness of crops relative to wild forage in this season was caused by an increase in the abundance and quality of crops, rather than by a drop in the quality of wild fodder. This corresponds with the peaks of damage described for other elephant populations in Asia (Sukumar 1990) and Africa (Bhima 1998; Osborn 2004; Chiyo *et al.* 2005).

Sri Lankan elephants do not undergo seasonal migrations (Fernando, pers. com.), and therefore this factor cannot explain any seasonal variation in HEC as found in other populations (Tchamba 1996). However, we detected some seasonal differences in their local spatial distribution. Particularly, we think that chena cultivation exerted some in uence in the distribution of elephants because from October to the end of January the forests around villages were occupied by chena farmers working on and guarding their crops, acting as a barrier for elephant movements toward villages. Once chena was harvested, the result was a mosaic of forest and open patches with low human presence that elephants used extensively, moving closer to villages. From February, there was a sharp increase in the number of raids on paddy, banana, and especially on houses, which we think was partially due to the end of chena activities.

Further investigation is necessary to clarify the details of the relations between the cycles of abundance and quality in natural foods and crops (based on objective and quantitative measurements rather than qualitative data presented here), and their effects on the seasonal changes in crop raiding by elephants in this

region. However, it seems very likely that the mechanisms determining an increase of damage are different in the dry and the post-rainy seasons, which is relevant for the design of mitigation management.

*Raiding behavior*

Most of the HEC incidents were caused by small groups of elephants, mainly one to three individuals. It is known that elephant males tend to move alone or in small temporal groups (up to ve individuals; McKay 1973), whereas females move in family-based larger groups (McKay 1973; Fernando & Lande 2000). Thus, it is plausible that most of the problematic elephants in this region are bulls. Our results coincide with previous studies in the region (Fernando *et al*. 2005), in southern India (Sukumar 1989), nothern India (Williams *et al.* 2001), or in African savanna (Bhima 1998; Osborne 1998; Hoare 1999a; but see Sitati *et al.* 2003). These results indicate different behavioral strategies between adult males and female-led herds, with males more ready to assume the risks of crop raiding and attacks to houses and humans than females in a "high risk-high gain" behavior related to their reproductive strategies (Sukumar & Gadgil 1988). The fact that most of the HEC incidents happened at night also supports this. Elephants are active during daytime (McKay 1973). Exclusive nocturnal raiding behavior therefore indicates that elephants do recognize the risk associated to incurring in HEC accidents. Sexual differences were even more accused in attacks to houses and people, involving higher risk than crop raiding. Sexual differences in HEC have consequences for the management of con ictive populations (Sukumar 1991).

Since female herds managed to obtain their resources without frequently feeding on crops, it can be said that crops are not a necessary component of the diet of elephants in the region. It has been suggested that females, initially less prone to assume the risks of con icts with farmers, might become obligate crop raiders when living in highly fragmented habitats, where resources are more limited and scattered in the human-dominated landscape (Sukumar 2003; Fernando *et al.* 2005). This means that the level of HEC in the southeast of Sri Lanka is likely to increase in coming years, as further developments and loss of habitats are ongoing. If such threshold exists, in which elephants become obligate rather than "optional" raiders, conservation of elephants would become much harder once it is crossed, and therefore habitat management should be oriented to avoid these levels of habitat fragmentation and impoverishment.

In the long run, the large extension of the park complex will guarantee the survival of elephants in the southeast of Sri Lanka. However, the elephants ranging outside parks will continue to raid crops and incur into HEC. In order to maintain the peaceful attitude of people toward elephants, as has been done for the last 2000 years or longer (Erdelen 1988), more effective HEC mitigation policies are needed. We encourage the use of (evidence-based) adaptive management strategies that integrate information about the periods and locations in which particular subsets of the elephant population are likely to incur in particular forms of HEC incidents. These management strategies need to be designed at landscape-level and considering the requirements of elephants and local agricultural societies (e.g. Fernando *et al.* 2006).

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# Elephant Health Status in Thailand: The Role of Mobile Elephant Clinic and Elephant Hospital

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## Background

In the beginning of the 20th century there were about 100,000 domesticated elephants in Thailand (Langka 2000). Elephants were originally found throughout the country (Oliver 1978; Lair 1997), especially in the north of Thailand where there were abundant teak forests. At present there are 3456 domesticated elephants in Thailand (P. Churplaivech, pers.comm.) and the population seems to be stable.

In 1884 British companies started the teak logging business in Thailand and founded the Forest Industry Organization (FIO) in 1947. In 1969 FIO established the Young Elephant Training Center in Lampang as the first school for training elephants for logging.

The status of domesticated elephants in Thailand turned into a crisis when the government banned logging in 1989. Elephants all over the country suddenly became unemployed. The owners had to find other jobs for their elephants to earn a living. Some were used in the tourist business, moving to the big cities for street – wandering. They earned an income by selling elephant food, for the tourists to feed the elephants.

In 1992, FIO established the Thai Elephant Conservation Center (TECC). Currently it consists of an elephant hospital, a Mobile Elephant Clinic (MEC), elephant reintroduction project, plantations of elephant food, 'Last Home for Elephants' (rehabilitation center) and an Elephant Camp for tourism.

The MEC started in 1999, and the Elephant Hospital officially opened in 2000, both offering free treatment to domesticated elephants from all over Thailand. The budget for treatment was supported by the Ministry of Natural Resources and Environment and public donations. Elephants in remote areas in the case of short term treatment are serviced via the MEC which logs in approximately 70,000 km a year. It was supported by the Royal Society for the Prevention of Cruelty to Animals (RSPCA) and the World Society for the Protection of Animals (WSPA) in 1999-2001 and 2005-2008, respectively.

The former Young Elephant Training Center was closed, and developed into the Elephant Rehabilitation Center in 2000, where elephants are living in the Last Home for Elephants. These include old, disabled, blind, unwanted or dangerous elephants as well as elephants confiscated during illegal logging (Fig. 1).



**Figure 1.** Elephant at the Rehabilitation Center (The Last Home for Elephants).




**Figure 2.** Map of Thailand showing the placement of elephant hospitals.
NEI = National Elephant Institute
DLD = Department of Live stock Development

In 2002, TECC became the National Elephant Institute (NEI) with the purpose of enlarging the scope of elephant conservation and relieving the various problems. The main reason for establishing the NEI was to develop elephant conservation in a sustainable way and to preserve the local traditions including local wisdom and knowledge associated with elephants. Her Royal Highness Princess Galayani Vadhana accepted the NEI under her patronage. The NEI has collaborated with other government and non-government organizations for improving elephant conservation in Thailand in terms of consulting, and exchanging data, skills and knowledge. At present there are four government elephant hospitals in Thailand:

1. Lampang (Northern region), TECC/NEI.
2. Surin (North Eastern region), the Department of Livestock Development.
3. Nakhonpathom (Central region), Faculty of Veterinary Medicine, Kasetsart University.
4. Kanchanaburi (Western region), Faculty of Veterinary Medicine, Mahidol University.

Further there are a few private hospitals for elephants and four organizations are running mobile elephant clinics, which collaborate with each other (Fig. 2).

**Materials and methods**

The diagnosis, treatment and outcome of treatment in NEI hospital and MEC were recorded from 2005-2008. For elephants treated more than once, a treatment for new disease/symptoms was recorded as a new case. The age of the elephants was given by the mahout, or if unknown, was estimated by veterinarians based on size of the elephant. The body condition of elephants was estimated based on a scoring system based on six parts of the elephant body with total scores ranging from 1=poor to 5=fat.

The MEC has provided health check, prophylactic and curative treatment to 3129 domesticated elephants (Fig. 3).

**Results**

During the study period, 3129 elephant treatments were recorded by the MEC. Of these 2210 were of females and 919 were of males. The cases according to working conditions were; tourist camps (2032), logging industry (464), and other jobs including living in zoo, staying with some elephant projects or jobless (633). The 3129 elephant treatments were of 1386 elephants, representing approximately 40% of the domestic elephant population in Thailand. Of these 154 (11.1%) were so affected that they were transferred to the NEI hospital. In addition, there is a tradition for de-worming twice a year by oral application, which is simple and safe. The annual number of cases treated is given in Table 1.

Eight of the elephants, which were attended in the  eld died:

- Two females died after having dystocia for a week. Dystocia was dangerous and very

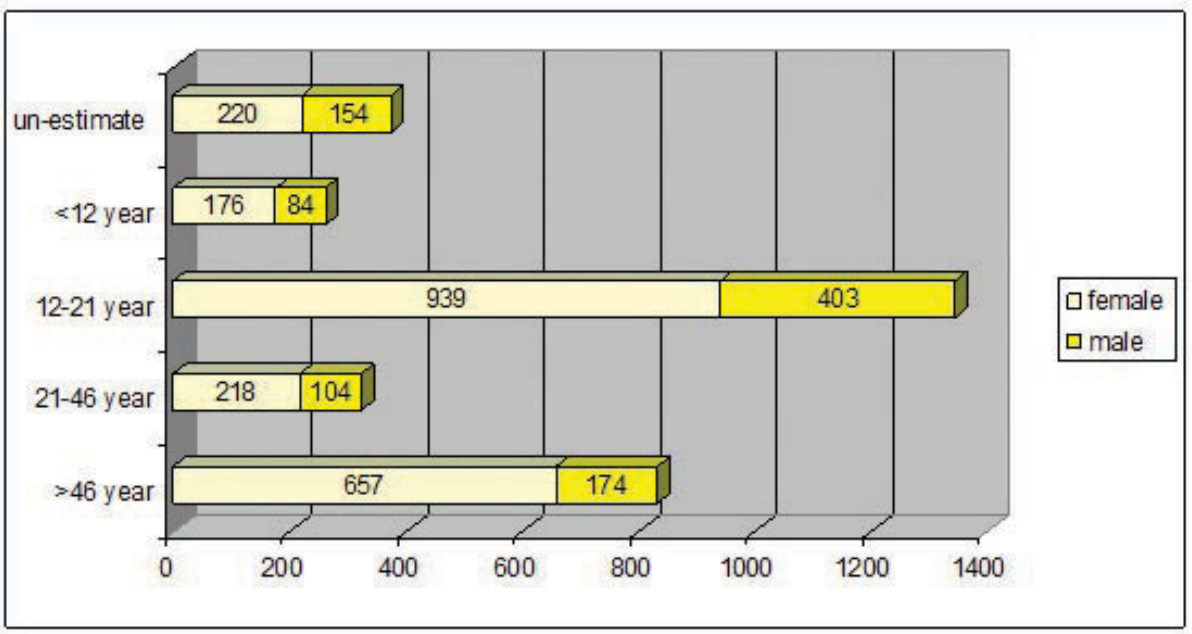



**Figure 3.** Age and sex distribution of 3129 cases treated by the MEC.

difficult to treat. In one female the amniotic sac was visible for a few days with bad smell and the calf was sometimes visible. The female tried but could not expel the calf. The other female was similar but the calf was not visible.

- A baby died a few hours after birth of unknown causes.
- One female died because another female attacked her. Cause of death was shock from internal bleeding with broken ribs and neck.
- A three year old female got diarrhea and died within a few days.
- Three males in the tourist camp were treated for dyspepsia, but finally died. At necropsy impaction of colon was observed.

Most commonly seen ailments were wounds and abscesses, such as shoulder abscesses caused by harnesses, wounds around the ears and feet caused by controlling equipment such as hooks, ear halters, hobbles, chains, ropes, wire ropes, knifes and other special equipment, and tail wounds from bites by other elephants. However, the wounds were not problematical to manage as gastro-intestinal and reproductive problems.

**Table 1.** Comparison of elephant cases treated by MEC and NEI hospital.

| Year | MEC | Hospital |
|---|---|---|
| 2005 | 363 | 94 |
| 2006 | 362 | 67 |
| 2007 | 296 | 62 |
| 2008 | 365 | 60 |
| Total | 1386 | 283 |

Gastro-intestinal problems were associated with feeding. Elephant food was often contaminated with the insecticide and fertilizer. If elephants are fed with such contaminated food, fermented food, or too much food, they developed dyspepsia and constipation. One baby died from *E.coli* infection in the small intestine, established by necropsy and culture.



**Figure 4.** Eye dysfunctions are seen frequently.

**Table 2.** Diagnosed conditions in the current study and previously (Phaungkam *et al.* 2002).

| Diagnosis | 2005-2008 | | 1999-2001 | |
|---|---|---|---|---|
| | # | % | # | % |
| 1.Wounds and abscesses | 265 | 19.1 | 89 | 19.2 |
| 2. Poor condition (weak, dehydration ,body condition score <2) | 244 | 17.6 | 107 | 23.1 |
| 3. Ecto-parasites | 207 | 14.9 | 151 | 32.5 |
| 4. Eye (conjunctivitis, corneal ulcer, opacity, uveitis, cataract) | 196 | 14.1 | 35 | 7.6 |
| 5. Musculoskeletal problems (lameness, bone fracture) | 136 | 9.8 | 0 | 0 |
| 6. Gastro-intestinal (dyspepsia, constipation, colic, diarrhea) | 108 | 7.8 | 26 | 5.6 |
| 7. Tusk problems (osteodendritis, pulpitis) | 58 | 4.1 | 11 | 2.4 |
| 8. Skin problems (fungus, allergy) | 51 | 3.6 | 0 | 0 |
| 9. Reproductive (musth, dystocia, abortion, vaginitis, neonatal) | 49 | 3.5 | 12 | 2.6 |
| 10. Foot problems (cracked nail, nail overgrowth, foot-pad cracking) | 44 | 3.1 | 17 | 3.7 |
| 11.Other causes | 28 | 2.1 | 0 | 0 |
| Total | 1368 | 100 | 464 | 100 |

Nutritional problems were often seen among elephants in poor condition, and were often associated with parasites, wounds or infectious diseases.

Elephants with eye problems (Fig. 4) were difficult to treat because they did not easily accept introduction of medicine into the eyes except well controlled elephants or under sedation. Although these problems never killed elephants, they may become blind. Table 2 provides the percentage of various diseases recorded by the MEC during the first two years of work from 1999-2001, which consisted of 464 elephants (slightly modified from Phaungkum *et al*. 2002) and the study period.

**Hospital**

During 2005-2008, 283 elephant treatments were recorded at the NEI hospital with 239 cases of recovery (84.5%). Seventeen elephants died and 27 elephants were still under treatment at the end of the study period. On average the elephants spent 2 months at the hospital. Of the 283 elephants 154 were sent to the NEI hospital via the MEC and the rest were referred by other veterinarians from all over Thailand.

Gastro-intestinal problems were the most serious and the major cause of death (Table 3). Sixty eight elephants presented with symptoms of dyspepsia, constipation, diarrhea and anorexia. In one case of diarrhea caused by protozoan infection (*Balantidium* sp.), the elephant had bloody diarrhea for 36 hours before it died.

Wounds and abscesses (Fig. 5) were often seen but the elephants usually recovered well on treatment. One male elephant with open wounds from gunshot died from septicemia.

It was found that elephants in poor condition with malnutrition had lower recovery rates. A common reason was old age, as when their last teeth were worn out they could not digest food and became weak. Infectious diseases such as *Mycobacterium bovis* were seen twice, diagnosed by necropsy and culture.

Hard work may cause musculo-skeletal problems. One elephant died from a fracture of the femur caused during work at a logging camp and died a few months later from septicemia.

Reproductive problems including dystocia also caused elephant deaths (recovery rate around

**Table 3.** Diagnoses of elephants treated in NEI hospital (2005 -2008).

| Diagnosis | 2005 | 2006 | 2007 | 2008 | Total | |
|---|---|---|---|---|---|---|
| | | | | | N | % |
| 1. Gastro-intestinal problems | 32 | 17 | 8 | 11 | 68 | 24.0 |
| 2. Wounds and abscesses | 19 | 13 | 15 | 13 | 60 | 21.2 |
| 3. Poor condition | 10 | 9 | 12 | 9 | 40 | 14.1 |
| 4. Musculoskeletal problems | 10 | 7 | 12 | 10 | 39 | 13.8 |
| 5. Reproductive problems | 5 | 5 | 5 | 1 | 16 | 5.7 |
| 6. Eye problems | 5 | 4 | 4 | 3 | 16 | 5.7 |
| 7. Tusk problems | 5 | 3 | 1 | 2 | 11 | 3.9 |
| 8. Ecto-parasites | 3 | 3 | 2 | 2 | 10 | 3.5 |
| 9. Foot problems | 0 | 3 | 0 | 6 | 9 | 3.2 |
| 10. Skin problems | 3 | 1 | 0 | 3 | 7 | 2.5 |
| 11. Growths etc. (cysts, fibromas, papilloma) | 1 | 2 | 2 | 0 | 5 | 1.8 |
| 12. Urinary problems (renal failure, bloody urine) | 1 | 0 | 1 | 0 | 2 | 0.7 |
| Total | 94 | 67 | 62 | 60 | 283 | 100 |



**Figure 5.** Wound-abscess in Thai elephant.

73%). The sex, age and cause of death of 17 elephants are given in Table 4.

## Discussion

Most ailments among domesticated elephants were work related. The 1386 elephants treated by the MEC represented about 40% of the population of domesticated elephants in Thailand. Therefore the records from MEC provide a representative picture of the health problems among domesticated elephants in the country. This statement is further supported by the problems recorded in the first 2 years of work in the MEC as the types and proportions of problems were similar to what was recorded during the current study.

**Table 4.** Causes of elephant deaths in NEI hospital (2005-2008).

| # | Sex | Age | Cause of death |
|---|---|---|---|
| 1 | Male | 35 | Septicemia from chronic wounds |
| 2 | Female | 40 | Neurologic problems |
| 3 | Female | 45 | Dystocia |
| 4 | Male | 5 | Colic |
| 5 | Female | 40 | Colic |
| 6 | Female | 47 | Aging disease |
| 7 | Male | 3 | Septicemia |
| 8 | Female | 35 | Septicemia and infectious disease |
| 9 | Female | 50 | Septicemia from wound and infectious disease |
| 10 | Female | 5 | Enteritis |
| 11 | Male | 30 | Colic |
| 12 | Male | 38 | Colic |
| 13 | Male | 41 | Colic |
| 14 | Female | 52 | Esophageal obstruction |
| 15 | Female | 30 | Neurologic problems |
| 16 | Female | 70 | Septicemia,aging disease |
| 17 | Male | 48 | Broken leg |

The common occurrence of various problems related to work gives a strong indication of the need to educate people working with elephants on the causation and prevention of such problems, and the immediate treatment of problems preventing their worsening. Therefore education of people working with elephants is essential if conditions for the domesticated elephants in Thailand are to be improved.

In efforts to address this, NEI veterinary staff provides advice and instructions. The NEI has also written a mahout care manual (Phaungkham *et al*. 2005) where the mahouts can read about elephant care in the Thai language. To increase immediate care of minor problems, a first aid kit has been developed. The "mahout box" is given to mahouts working in the tourist camps or in the forest. It contains first aid medicine (antiseptic, local antibiotic, boric acid for eye washing, eye ointment and eye drops), soap, vet number contact and medicine manual used for basic treatment.

A training program (sponsored by the East Asian Company, Denmark) has been initiated. The program includes a three day workshop for approximately 40 mahouts. Four workshops including mahouts from all over Thailand are planned in the future.

We conclude that a Mobile Elephant Clinic which can quickly come out to the site of an ailing elephant, in combination with a hospital for more serious cases, provide an ideal system for the treatment of domestic elephants (Figs. 6 & 7).

## Acknowledgement

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**Figure 6.** Working with the MEC in the field.

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**Figure 7.** Working with the MEC in the field.

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# Elephant Movement in Karra C.D. Block – A Spatio-Temporal Analysis

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## Introduction

An increasing number of large mammal studies have used species distribution maps and related analysis to convey their message about conservation priorities (e.g. Hatough-Bouran & Disi 1991; Smith & Mishra 1992) and elephants are those important large mammal species which are subject of, a concern for conservationists world-wide.

Globe over, elephant habitat is rapidly getting fragmented and eroded by various factors including competing land uses, which needs to be taken into consideration to gain a long term perspective on elephant movement patterns and their management.

In this paper, GIS has been used to systematize, standardize and manage the enormous amounts of spatial data generated by the movement of elephant in the background of disturbance to the landscape. Real time habitat use information by elephant along with the spatial distribution of habitat and temporal changes has been analysed for habitat evaluation. Limitations of conventional methods of physical survey have been avoided by using remote sensing and G.I.S. technology.

The study area has been a hotbed of intense con ict between elephants and men for many years, forcing wildlife managers to have a relook at their approach and strategy.

The main objective of this study was to nd out, how elephants in study area were distributed and further their utilization pattern of different areas in different seasons to assess management implications.

## Study area

The study area forms part of Singhbhum Elephant Reserve (84°55'E and 85° 15'E, 22° 55'N and 23° 20'N), and comprises a forested area of 567 km$^2$, (though honeycombed) and its part is spread over the Karra Community Development (CD) Block of Ranchi district, as shown in Figures 1 & 2. The average elevation of the tract is 600 m; the general slope of the tract is from northeast to southwest. The area presents a vista of grassland and forest vegetation interspersed with agriculture. The major geological formations of the area are recent, tertiary to recent, upper cretaceous and dharwar. The region has one major drainage system: the Karo river. Given the general northwards aspect in this area, most of the streams ultimately reach the river Karo, which ows in a southward direction.

The study area has little variation in climate, due to minimal change in relief and topography.



**Figure 1.** Cadastral map of Karra CD Block.

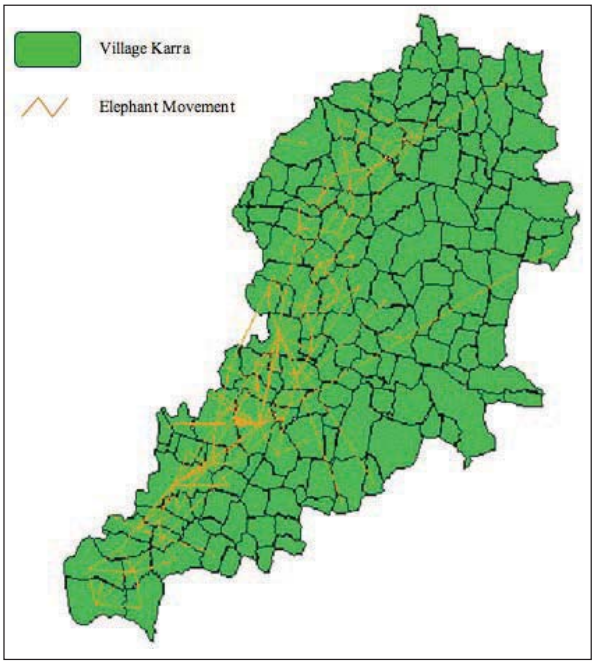



**Figure 2.** Elephant movement in different villages in Karra CD Block.

Temperatures begin to drop rapidly from November. December is the coldest month. After February the temperatures rise steadily till May. With the end of the south-west monsoon by the end of September, temperatures begin to drop.

The study area is comparatively flatter than other parts of the district and is honey combed with cultivation, chiefly of paddy. Besides this, the villages also have groves of fruit bearing trees, mainly of jackfruit and mango. The basic vegetation type, as defined by Champion & Seth is (3b/c $B_2$a) Northern tropical moist deciduous forest' containing mainly Sal. In addition, many plantation forests of acacia and eucalypts etc. are present in scattered manner. Human impact has converted most of the primary forest into secondary forms, degrading into scrub in the vicinity of settlements.

The fauna in the study area includes the elephant, the dominant wild mammal in terms of biomass. Besides elephants, chital (*Axis axis*). barking deer (*Muntiacus muntjac*) leopard (*Panthera pardus*), wild pig (*Sus scrofa*), sloth bear (*Melursus ursinus*), macaque (*Macaca mulatta*) and the common langur (*Presbytis entellus*) etc. are also present.

## Methods

Twenty-four hour trackers were employed for monitoring the movements of elephants, starting from April 1998. The trackers moved to villages frequented by the elephants in the study area and noted down the details of elephants, movement; description and size of the herd and from which village they came; their stay, and departure destination on day to day basis. This movement data was compiled for the period April 1998 to December 2000. Later this movement pattern was overlaid on the map of study area, with the village boundaries, using ARCVIEW. The length of movement (distance covered and as measured on map) - falling in each village boundary was considered important parameter, which was observed in the field and then transferred to the map. This length of movement also has a time attribute, hence it also helped in seasonal analysis of movement. This relatively simple approach was adopted, taking into consideration the constraints faced in the field for such type of research.

The factors, which most closely correlated with elephant distribution were tested and used to predict their distribution, by using GIS for integration and analysis of environmental elements associated with elephants. Thus without a long history of previous survey work idea of habitat distribution could be had. However, limitations in collecting comprehensive elephant data made trend analysis difficult.

The Environmental Systems Research Institute's (ESRI) ARCVIEW3.1 was used for the current analysis exercise. Karra C.D. block map along with the village boundaries at a scale 1:50,000 were digitized. Spatial information within the study area was stored in vector format in which features are represented by points, lines and polygons.

## Results and discussion

The null hypothesis ($H_o$) was that the dependent variable ($Y_1$) "elephant" movement in a village" is affected by independent variables i.e. the "population density", "area available

for agriculture in the village", "forest density", "temperature", "relative humidity", and "rainfall". The alternative hypothesis ($H_1$) was that elephant movement is not affected by the above said independent variables. The village wise movement data of elephants were recorded for the different villages of Karra C.D. block of Ranchi District.

The correlation coefficient between the dependent variable and each independent variable was calculated separately (Table1).

The significance of the above correlation coefficients was tested by applying the t-test. The calculated values of |t| for all the correlation coefficients did not exceed their corresponding tabulated values. Hence the correlation coefficients tested were not significant and the null hypothesis ($H_o$) was accepted.

The importance of rainfall and temperature together was tested using multiple correlation coefficients. The calculated value of "F", where sum of square of deviation from the mean of elephant movement and s=sum of square of deviation from the "mean of rainfall" and "mean of temperature" was less than the tabulated value of F at 5% of level of significance. Hence the rainfall and "temperature" were not taken into consideration for multiple correlations.

Multiple regression equations for the dependent variable, i.e. elephant movement and the two independent variables "area available for agriculture" and "forest density" were developed, on the basis of data for summer season 1998, winter season 1998, and rainy season 1998 and complete Year 1998 as follows:

(I) $Y = 35.22 - 0.28X_1 - 0.25X_2$
(on the basis of data of summer season 1998)

(II) $Y = (-)\ 1.72 + 0.23X_1 - 0.25X_2$
(on the basis of data of winter season 1998)

(III) $Y = (-)\ 58.8 + 2.7X_1 - 0.91X_2$
(on the basis of data of rainy season 1998)

(IV) $Y = (-)\ 2.7 + 0.28X_1 + 0.25X_2$
(on the basis of data of winter season 1998)

Where Y = Elephant's movement in the block
$X_1$ = Area available for agriculture
$X_2$ = Forest density
= [Forest area] / [Village area]

To validate it, by applying the above equation, the predicted values of elephant's movement for year 1999 and 2000 were calculated and the difference of averages of actual value and predicted values was tested by applying the t-test. The difference of mean of actual movement and predicted value for the year "1999" and "2000", "winter season" were not significant. But the average differences in "summer season" and "rainy season" were significant.

The calculated value of F (1.18) was less than the critical (tabulated) value of F (3.13, 3.63) for 5% and 10% levels of significance respectively with $n_1 = 2$ and $n_2 = 69$ d.f. Hence the null hypothesis ($H_0$) was accepted. Therefore, it could be said that independent variables 'area available for agriculture' and 'forest density', taken together have an effect on elephant movement.

## Conclusion

The results about elephant movement intensity and seasonal distribution patterns are useful to the wildlife managers in following way-From G.I.S. analysis, it appears that during summer, winter and rainy seasons, elephants have preference for certain areas, demonstrated by the frequency of visit to these areas in particular seasons (Figs. 2 & 3), where the intensity of movement has been obtained using "surface-contour" module.

**Table 1.** Correlation co-efficient between dependent and independent variables.

| Sl. No. | Dependant variable | Independent variable | Correlation coefficient |
|---|---|---|---|
| 1. | Elephant's movement | Population density | 0.08 |
| 2. | Elephant's movement | Area available for agriculture | 0.1 |
| 3. | Elephant's movement | Forest density | 0.05 |
| 4. | Elephant's movement | Mean monthly temperature | 0.2 |
| 5. | Elephant's movement | Relative humidity | 0.06 |
| 6. | Elephant's movement | Mean monthly rainfall | 0.1 |

Figure 3 shows the spatial distribution patterns during summer season (March-May), rainy season (July-September) and winter season (October-February).

The concentration of elephant movements in the summer season was found to be high inLapa, Bakaspur, Nagra and Gosa, in rainy season Barwadag, Dehkela, and Limra, and in winter Nagra, ChotkaRegre, Barwadag and Limra villages of Karra C.D. Block.

In these villages special wildlife management practices should be adopted for elephants and at the some time the people should be trained and equipped to protect crops and live with the elephants with minimum damage to each other.

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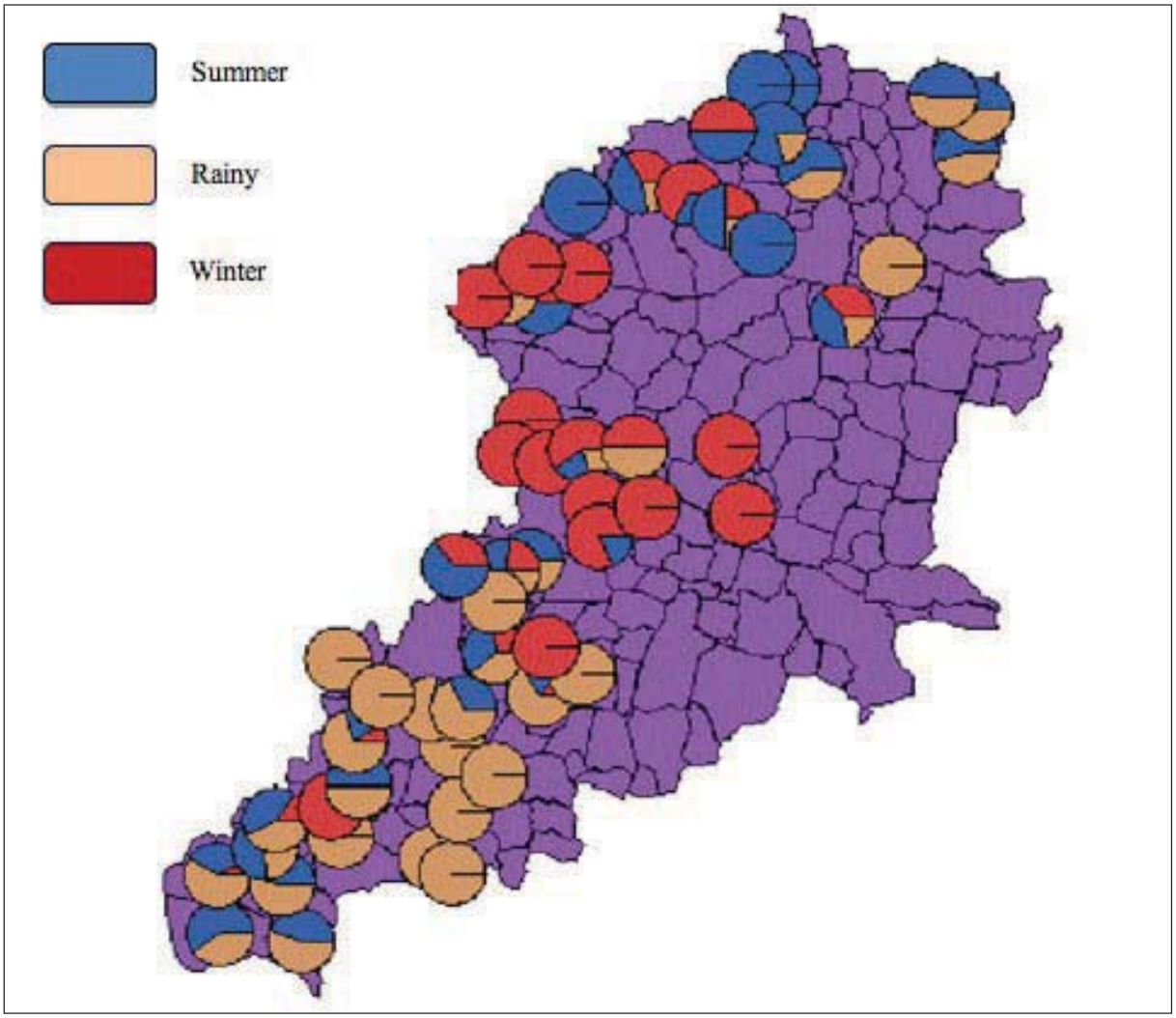




**Figure 3.** Elephant movement in different seasons in Karra CD Block.

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# Captive Elephant Medicine: Recent Developments

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Several new challenges in elephant medicine have emerged over the past several years. Arguably the most critical is elephant endotheliotropic herpesvirus (EEHV), now recognized as a significant threat to captive Asian elephant populations in range countries, Europe and Asia (Cracknell *et al*. 2007; Reid *et al*. 2007; Richman 2007). Characterized by high mortality as well as stillbirth and abortion, the disease primarily affects juveniles between the ages of 1 and 4 years. Affected animals typically present with mild signs of lethargy which progress within hours or days to cranial and respiratory edema, facial cyanosis, and ultimately death, caused by myocardial failure and damage to the endothelial lining of the microvasculature leading to severe internal hemorrhage. Diagnosis is achieved via PCR testing of whole blood samples from actively viremic animals (Richman *et al*. 1999; Richman 2007). Current treatment recommendations include large doses of the antiviral drug famcyclovir, along with supportive care (Schmitt *et al*. 2000). However, in several cases, elephants have died despite early and aggressive treatment for reasons that remain unclear.

EEHV is a member of the genus Proboscivirus, and little is known about its epidemiology, modes of transmission, or patterns of shedding and latency. Three distinct strains were initially classified: EEHV 1a, found in both Asian and African elephants, EEHV 1b, which is apparently specific to Asian elephants, and EEHV 2, documented both in healthy wild African elephants and in two African elephants in North America who succumbed to hemorrhagic disease. Recently, however, several new strains of EEHV have been recognized, of which some are associated with disease and others are not (Garner *et al.* 2009). The relationships between the new strains are under investigation, and it is still unclear whether they are infective and/or pathologic to both elephant species.

Efforts to establish a databank of elephant serum from North American animals are being performed by several institutions in conjunction with the EEHV laboratory at the National Zoo in Washington, DC in order to identify epidemiological patterns of transmission, seroconversion, and shedding. A recently developed ELISA test from the National Zoo against EEHV1a antibodies allows identification of at least some of animals that have been exposed to the disease. Current estimates indicate that more than 10% of North American elephants are seropositive for EEHV suggesting that seroconversion occurs with subclinical disease (Latimer 2007). It is hoped that measurement of viral titers will eventually help identify animals most likely to shed disease -- information that could be used in managing the movement of captive animals between institutions. A similar databank documenting EEHV titers elephants in Europe and in range countries is planned (Cracknell *et al*. 2007; Reid *et al.* 2006).

Another area of intense research in elephant medicine is tuberculosis (*Mycobacterium tuberculosis*), due, in part to the growing need for better and more reliable methods of diagnosis. Trunk washes, while 100% specific and still the gold standard for diagnosis, have less than ideal sensitivity because elephants only shed mycobacterial organisms intermittently. Diagnostic techniques useful in other species including chest radiographs, skin testing, and interferon gamma levels are either not feasible or not reliable in elephants. (Miller 2007) Although several new serological tests have appeared on the market, their validity remains unproven, and the possibility of false positives using these tests in animals exposed to atypical mycobacteria or even non-mycobacterial cross-reacting antigens

is concerning. (Cousins & Florisson 2005) Because treatment of a positive animal is a signi cant endeavor, and because legislation in several European countries requires euthanasia of any zoo animal with even a suspicion of tuberculosis (*M. tb*), false positives have grave consequences.

Treatment of *M. tb* in elephants still continues to be a conundrum as well. In the United States, treatment requirements are based on older guidelines developed for human with *M. tb*, and evidence now exists indicating that several of these drugs when dosed to produce human serum levels, cause severe toxicity in elephants. The options of utilizing alternative treatment regimes now standard in human *M. tb* therapy, including shorter duration of treatment, intermittent dosing schedules, and the use of other, less toxic drugs, are currently being investigated in elephants (Wiedner & Schmitt 2007).

With several demographic models forecasting the inevitable loss of elephants in captivity due to aging populations and a low birth rate (Wiese and Willis 2004), ongoing research in assisted reproductive technologies has continued unabated (Hermes *et al.* 2007). Reproductive ultrasound of both male and female elephants, used to identify reproductive tract pathology, monitor developing pregnancies, and provide information about breeding soundness and infertility, has become an invaluable technique for institutions committed to breeding their animals (Hildebrandt *et al*. 1998, 2000, 2006).

Improvements in endocrine monitoring now permit tracking of the elephant's estrus cycle (Brown 2000). Elephants are unique in having two surges of luteinizing hormone (LH) during the follicular phase of the estrous cycle, the  rst is non-ovulatory and second LH surge induces ovulation. Newer assays for LH and progesterone enable veterinarians and elephant managers to accurately predict the occurrence of this second LH peak and facilitate better planning of both natural and arti cial inseminations. (Dahl *et al*. 2004) A current limitation to using arti cial insemination in Asian elephants is the dif culty of routinely freezing and storing semen for later use, spurring research on sperm physiology, the use of extenders and freezing protocols.

Ironically, the development of an elephant contraceptive vaccine has also been an important recent development (Barber *et al*. 2001; Fayrer-Hoskins *et al*. 2000). Tests of a recently developed zona pellucida vaccine in Africa indicate that use of this immuno-contraceptive may be an alternative to permanent removal from the reproductive pool in areas where elephant populations need to be controlled (Barber *et al.* 2001; Fayrer-Hoskins *et al*. 2000).

A  nal area of active investigation is basic anatomy. Gross imaging techniques such as MRI and CT have enabled researchers to produce detailed anatomic maps of elephant joints, limbs, and muscle as well as document locomotion (Tsaopoulous 2008; Hakeem *et al.* 2008). Sophisticated camera recording techniques have unlocked clues about elephant gait and locomotion (Hutchinson *et al*. 2003, 2006; Ren & Hutchinson 2007). Microscopic techniques including histology and scanning electron microscopy have been used to analyze the placenta, the nervous system, and the cushions of the feet (Hoffman *et al.* 2005; Shoshani *et al*. 2006; Weissengruber *et al*. 2006; Witter *et al.* 2007). The potential clinical value of this type of information is high, since anatomic studies that delineate the ranges of normal help in both the recognition and understanding of pathology. As conservation of elephants takes on ever greater urgency, the ability of veterinarians to keep captive populations healthy becomes more important as well.

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Sundara with her mother
Photo courtesy of Feld Entertainment

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# A Simple Method for Assessing Elephant Body Condition

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## Introduction

Human-elephant con ict (HEC) is widespread across Asian elephant range (Sukumar 1989; Santhiapillai & Jackson 1990). The threat to elephants from HEC makes it a serious conservation problem. Loss of human life and limb, and economic losses due to crop raiding and property damage by elephants, makes it a major socio-economic and political issue (Fernando 2006). Rapidly expanding human populations result in ever greater conversion of elephant habitats and increased interaction between humans and elephants, leading to escalation of HEC. 'Development' and wide media coverage of the effects of HEC on people change perceptions and expectations, causing decreased tolerance of damage caused by elephants.

Across the 13 south and south-east Asian countries with free ranging elephants, their management and HEC mitigation is largely focused on relieving the human consequences of HEC, albeit within a framework of elephant conservation. HEC mitigation is one of the main functions of wildlife conservation authorities in these countries. A wide range of activities and tools have been developed to mitigate HEC (for review see Fernando *et al*. 2008). The 'successes' of HEC mitigation is almost exclusively assessed from the standpoint of decreased human impact. The effects of HEC mitigation activities on elephants are rarely assessed and largely unknown. Recent studies suggest that tools such as translocation and barriers can have severe detrimental impacts on elephants in some situations (Fernando 2006).

In longitudinal studies to assess the impact of management actions on elephants, monitoring effected elephants should commence pre-implementation to provide baseline data, and continued after till a clear conclusion on impact can be reached. Another approach is to do cross sectional studies, comparing elephants subject to an intervention and those that are not. Monitoring methods range from individual based ones such as radio tracking and behavioral observations, to population based ones such as demographic evaluation. Body condition assessment is individual based, but is most meaningful when applied to a population. It can be used for both longitudinal and cross sectional studies, is comparatively inexpensive and does not require a high technical capacity. It can also be used as an early indicator of the impact of management actions on elephants, in contrast to demographic evaluation, which tracks parameters that take long to manifest.

The method developed by Wemmer *et al*. (2006) has been used to assess body condition in captive (Thitaram *et al.* 2008) and free ranging elephants (Pinter-Wollman 2009) and is recommended by the Asian Elephant Specialist Group (http://asesg.org/PDF les/2009/Asian Elephant Body Condition Index.pdf). It is based on subjective scoring of the prominence of bony characters, to assess body fat stores and muscle mass. Seven characters are commonly used and an additional 3 characters with palpation are used in the case of elephants that can be handled.

Here we present a new method of body condition assessment which is simpler, can be conducted more rapidly and can be more easily applied to free ranging elephants.

## Method

The method is based on the comparison of the target animal to be scored, with a scale of




5 reference photographs (Fig. 1). The scale photographs are assigned scores of 1, 3, 5, 7 and 9, with numerically higher values corresponding to better body condition. The photographs are of free ranging individuals observed in Sri Lanka and represent almost the entire spectrum of body condition encountered in free ranging elephants. However in order to accommodate the possibility of greater variation, the range of scores extend from 0 to 10.

The method is primarily based on direct comparison with the photographic scale, and appraisal of being emaciated, wiry or plump. In order to facilitate scoring and emphasize important landmarks, a rough indicator of characters corresponding to the given scores is provided in non-technical terms (Table 1) and indicated by arrows in Figure 1. However this is only supplementary to the photographic scale and not meant as a scoring system by itself.

The pro le of the elephant is used in scoring. By visually comparing the test animal to the scale, a score is directly assigned. If the elephant in question exactly matches one of the body conditions in the scale, it is assigned that score. If it is dif cult to decide between two points on the scale, as the scale is composed of odd numbers, the score represented by the intervening even number is assigned. An elephant in worse body condition than 1 would be assigned 0 and one in better condition than 9 would be assigned 10.

The method has been eld tested with both free ranging and captive elephants and with photographs of both, and found to be equally applicable in all situations. When tried out with mahouts, Wildlife Department game guards and researchers, all were able to use the method consistently and with ease, after a few minutes instruction and a few trial scores. As the method is a subjective assessment based on visual appraisal and comparison, there is bound to be variation caused by lighting, posture and

**Figure 1.** Photographic body condition scale. The numeral in the white circle denotes the 'body condition score' of each elephant. Arrows indicate the characters referred to in Table 1.

**Table 1.** Diagnostic characters pertaining to scores in photographic scale.

| Score | Characters |
|---|---|
| 1 | All ribs (shoulder to pelvis) visible, some ribs prominent (spaces in between sunken in) |
| 3 | Some ribs visible (spaces in between not sunken in), shoulder and pelvic girdles prominent |
| 5 | Ribs not visible, shoulder and pelvic girdles visible |
| 7 | Backbone visible as a ridge, shoulder and pelvic girdles not visible |
| 9 | Back rounded, thick rolls of fat under neck |

observer. However, the error was found to be comparatively small and usually ±1 the assigned score. When scoring photographs, preferably a series should be used for each elephant.

It is hoped that the method's rapidity and ease of use will facilitate scoring free ranging elephants across the range by managers, researchers and students, promoting the assessment of HEC mitigation impact on elephants, and providing feedback for management.

**Acknowledgements**

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**Figure 2.** Explaining the method to mahouts.

*Gajah 31 (2009) 32-35*

# Wild Elephant Counting Weeks in the King's Project Area, Kui Buri National Park, Southwestern Thailand

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## Introduction

Crop raiding by elephants is the most important problem in the conservation and management of wild elephants in Thailand. Elephants have special status due to their role in Thai national history, and are under the patronage of the Thai Royal Family, which plays a very important role in solving the problem of crop raiding by elephants (Srikrachang 2003). In the case of Kui Buri National Park (KBNP), before 1998 a large forest area was encroached for growing agro-industrial crops (pineapple), causing habitat degradation. When the value of pineapple became very high in 1997-1998, four elephants were killed in the area. Consequently, solutions for human-elephant conflict were formulated as a part of His Majesty's Project "Conservation and Restoration of Kui Buri Forest" and were implemented since May 1998.

The 'Elephant Counting Weeks' was a novel program organized by the first author to obtain information on the elephants. It was conducted with cooperation of the Wild Elephant Lover Club (WELC), and financially supported by the Biological Diversity Management in Kaeng Krachan Forest Complex Program, Department of National Parks, and Elephant Reintroduction Foundation. This program was part of the effort at providing "Long-term Solution of Human-Elephant Conflict at Kui Buri National Park by Participation of Local Communities", which proposes to use ecotourism, especially elephant watching for solving the conflict between the elephant and people.

## Methods

*Study area*

The King's Project area with a total extent of about 1,600 hectares, is adjacent to the Kui Buri National Park, lying within 11° 40' – 12° 10' N and 99° 20' – 99° 50' E in Prachuap Khiri Khan Province, southwestern Thailand (Fig. 1). The degraded cropland was permanently handed over to the project for reforestation, soil and water conservation and elephant habitat improvement.

Because the Kui canal and its tributaries had become dry or stopped flowing after long-term crop growing in the area, 12 small reservoirs, many ponds and hundreds of check dams were built to keep water all year round (Srikrachang & Srikosamatara 2005). About 30 artificial mineral licks were also created (Fig. 2). In addition, two ranger stations were established in 1998 and 2004 in both Kui canal valleys to provide safety for the elephants.

Consequently this area has become a preferred habitat for elephants and is now composed of a mosaic of secondary forest, natural grassland, and forest plantations.

In addition, more grassland patches were made in April 2008 and 2009 by removing plants that elephants did not consume, especially *Chromolaena odorata* (bitter bush) and *Lantana camara*. After removal of these plants the grasses grew back, providing an important food supply for elephants and other ungulates such as gaur and deer.

*Activities*

Trained members of Wild Elephant Lover Club, rangers and 25 volunteers of various ages and occupations such as students, wildlife photographers and media participated (Fig. 3). Extensive surveys were conducted during late wet season and early dry season (5-10th Dec. 2008) and dry season (13-18th March 2009). In the evening (15.00-18.30 pm) of 5-7 days each month, observations were made from 17 platforms (Fig. 4) that were built at small reservoirs, grassland patches as well as elephant trails.

To identify individuals and groups, we noted marks of individuals and took photographs using a digital SLR camera with a 100-300 mm lens. Each elephant was individually identified with descriptions of the age, sex, social formation, and unique marks. Age classes were categorized to adult (>15 years old), sub-adult (5-15 years old), juvenile (1-5 years old) and calf (<1 year old) based on either the relative height of the elephant to the largest individual in the herd, see Figure 3 (Wanghongsa 2004) or the degree of ear folding, and behaviour. Other individual marks such as tusk characteristics in males, depigmentation patterns, ear contour, and holes in the ears were identified from photographs. The date and location of observation were added to the database for the analysis of home range.

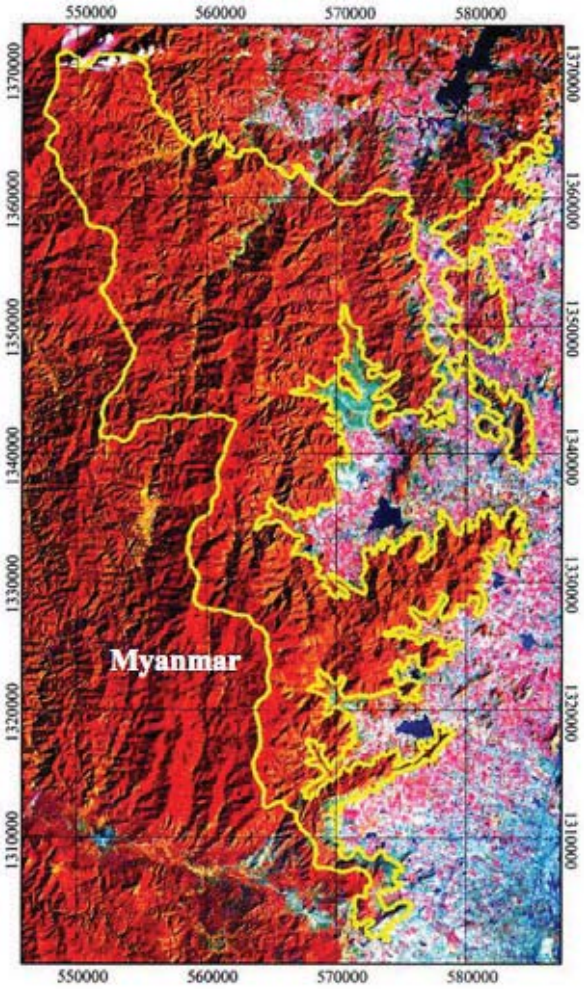



**Figure 1.** Satellite imagery map of Kui Buri National Park showing its landscape and location of HM the King's Project Area.
/ = park boundary; O = forest park; O = pineapple plantations; O = water sources; O = the King's Project area (grassland and secondary forest).

## Results and discussion

We identified a minimum of 168 elephants in the King's Project area. This should be close to the population in the Kuiburi National Park, which was estimated to be approximately 150-200 individuals (Wildlife Research Division 2005). This elephant population should be enough to maintain as a viable population without inbreeding depression as suggested in Sukumar & Santiapillai (1993) as there were few threatening

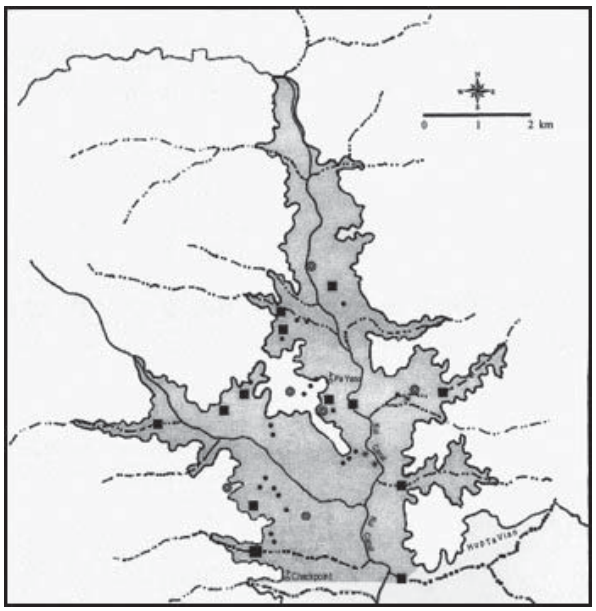



**Figure 2.** A map of the King's Project area showing the locations of small reservoirs where platforms were set up on trees to observe elephants. ■ = small reservoir; ● = man-made ponds, *N* = streams; ✳ = mineral licks; ◎ = known resting areas of the elephants.



**Figure 3.** Looking for elephants.

activities from humans in the secured area.

The data showed that 34.5 % were adult, 25% were sub-adult, 24.5% were juveniles, and 16% were calves. The population was more likely stationary due to the high number of juveniles and sub-adults. However, more calves should be recruited in the next few years because there were more sub-adults and juveniles, and the area has abundant food and there is low mortality.

The ratio of adult male:adult female was 1:7. In another wild population in Thailand in Huai Kha Khaeng Wildlife Sanctuary the sex ratio was 1:5.8 (Sukmasuang, 1993). Comparing to that of captive elephants, where male:female ratio of the country was 1:2 (Srikrachang 2003), the sex ratio in the wild population was approximately three times less. There was a higher sex ratio in the domesticated elephants because the males, which were previously used in the logging industry were brought into tourism. However, in many elephant camps in Thailand, female elephants are preferred because of their tame behavior and easiness to control when they are working with man (Lair 2003). In addition, the female-biased sex ratio is common in the promiscuous elephant population (Romano 1991).

The proportion of tuskers (Fig. 5) in all age classes was 37% of the male population, which is higher than observed in Sri Lanka (Anon 1993). There is no evidence of poaching for ivory in the area. However, the population size and sex ratio might be underestimated because the surveys conducted were of a short duration.

The King's project area represents the advantages of habitat improvement to elephants. The main elephant population in the Kui Buri National Park is concentrated in and around the study area. There were no signs of elephants in the western part of the national park, which is adjacent to the Union of Myanmar (Steinmetz *et al*. 2006). Moreover, fighting among ethnic groups along the boundaries of Myanmar might impede the movement of elephants between Thailand and Myanmar (Steinmetz *et al.* 2006). It is suggested that the King's project area which provides elephants basic requirements has become a preferred habitat for the elephants (Fig. 6).

The activity encourages the appreciation and conservation of wild elephant to general public. There were 26 volunteers of various ages, religions, and careers participating in the activity. Furthermore, it received attention from public media, especially newspaper and television, helping increase awareness of elephants and their conservation. The information and pictures obtained enabled identification and classification of elephants in the area, which will help the long-term study of the elephant population. This project promotes ecotourism as a man and elephant conflict mitigation tool in the future.

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**Figure 4.** Elephant watch tower.



**Figure 5.** Tusker in the King's Project area.


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**Figure 6.** Female with her calf.

*Gajaha 31 (2009) 36-39*

# The Death of Jumbos on Railway Tracks in Northern West Bengal

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## Introduction

Elephant habitat in northern West Bengal, India, is part of the Eastern Himalaya biodiversity hotspot and the western-most extension of the north-eastern elephant population (Roy *et al.* 2006). The habitat is characterized by a high degree of fragmentation and intense human-elephant con□ ict, resulting not only in loss of agricultural crops and properties but also of human lives, ~50 annually (Lahiri-Choudhury 1975, Choudhury *et al.* 1997, Sukumar *et al*. 2003). The total geographic range of the elephants in northern Bengal is 3051 km$^2$ and covers about 24% of the total area of northern Bengal (Barua & Bist 1996). The gross forest area forming the elephant zone is about 1954 km$^2$ (Lahiri-Chouddhury 1980 and Barua and Bist 1996).

On average, 20 elephant deaths take place every year due to various causes, out of a population believed to be less than 500 individuals (Sukumar *et al.* 2003; Mangave 2004). The elephant population inhabiting the region is spread across the districts of Darjeeling and Jalpaiguri comprising nine forest divisions of Kurseong, Wildlife-1, Baikunthapur, Kalimpong, Wildlife-2, Jalpaiguri, Cooch-Behar, Buxa Tiger Reserve (West), and Buxa Tiger Reserve (East) in a forest area of 1954 km$^2$ (Baura and Bist 1996). There is a 161-km railway track between Siliguri and Alipurdaurs of which 74 km passes through various forest divisions of northern West Bengal (Table 1).

In recent times, elephant conservation in northern West Bengal has been setback due to high-levels of human–elephant con□ ict and mortality owing to railway accidents. The British constructed the Siliguri–Alipurduar Junction, meter gauge railway line (less than standard railway line of 4' 8½") during 1910–1911. Major areas of the forest were cleared off to establish the railway line. Railway sleepers were supplied from cutting off trees in the prime natural forests, which supported the elephant population.

The railway stretch is a major threat for free movement of the elephant population in the fragmented present habitat. The railway also acts as a conduit for illegal transportation of fuel and wood from northern Bengal forest areas. The Siliguri–Alipurduar (SGUJ –APDJ) meter gauge (MG) route was the only main route prior to the construction of the New Jalpaiguri–Bonagaigaon (NJP-NBQ) broad gauge (BG) line linking the North East Frontier region with the rest of India. The 161-km-long Siliguri–Alipurduar junction was converted from MG to BG in 2003 and the BG train movement started in 2004. Every single day 20 trains run on this track (5 pairs of passenger trains and 5 pairs of goods trains). There is thus a high possibility of accidents involving wild animals on this track. Before gauge conversion, the trains that ran on this track had limited speed, but after it the speeds are so high that many times elephants dash against the trains while passing through from one forest patch to another or during crop raiding season while passing through tea garden to villages, and die.

**Table 1.** Railway stretches in forest areas of various forest divisions of northern Bengal.

| Existing railway track | Length (km) |
|---|---|
| Buxa Tiger Reserve | 18 |
| Jaldapara WLS | 12 |
| Jalpaiguri Division | 6 |
| Chapramari WLS | 12 |
| Kalimpong Division | 8 |
| Baikunthapur Division | 6 |
| Mahananda WLS | 12 |
| Total | 74 |

## Methods

Data on elephant mortality for the period 1958–2008 was collected from various sources like forest department records, newspaper cuttings, railway divisional manager's of ces and personal eld visits. The data on elephant deaths before and after gauge conversion were compared.

## Results

*Mortality over the years in northern Bengal*

A total of 39 elephant deaths were reported during the period of 1958–2008. Twenty-nine deaths took place during the operation of meter gauge over a period of 44 years from 1958–2002 (0.6 incidents/year). Ten deaths were reported after gauge conversion in a time span of just 4 years from 2004–2008 (2.5 incidents/year). Overall the deaths of 14 adult males, 8 adult females, 2 sub-adult males, 5 juveniles/calves, and 10 of unknown sex were recorded over the time period (Table 2).

Figure 1 shows the increasing trend of occurrence of accidents on railway tracks in recent years. Over the period 1958–2008, 11 cases have been reported from Gulma (Mahananda sanctuary stretch), 9 deaths from Panjhora (Chapramari Wildlife Sanctuary stretch), 2 on Goodhope TE stretch, 4 from the Mongpong stretch (Kalimpong division, Fig. 2), 3 in Jaldapara stretch and 7 from the Rajabhatkhawa stretch (Buxa Tiger Reserve, Fig. 3) (details in Appendix1).

The elephants are sighted more frequently in Gulma-Sevoke, Rajabhatkhwa- Alipuduar, Madarihat–Hasimara, Hasimara–Kalchini area (Table 3).

**Table 2.** Details of elephant deaths from 1958–2008.

| Age class | | Number |
|---|---|---|
| Adult male | tusker | 9 |
| | makna | 5 |
| Subadult male | tusker | 1 |
| | makna | 1 |
| Adult female | | 8 |
| Juvenile/calf | | 5 |
| Unknown | | 10 |
| Total | | 39 |

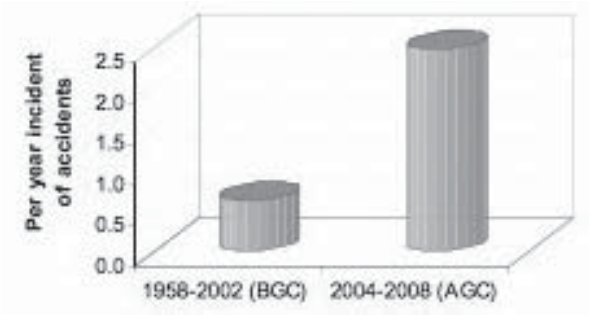



**Figure 1.** Annual frequency of accidents before (BGC) and after (AGC) gauge conversion.

At the time of gauge conversion, an expert committee reviewed the situation and suggested cautious driving in the four stretches of forest areas:

- Buxa Tiger Reserve at km post 140/2-141/3 (Kalchini–Hasimara section)
- Jaldapara Wildlife Sanctuary km 128/1-130/8 (Hasimara–Madarihat section)
- Chapramari Wildlife Sanctuary km 66/6-70/0 (Chalsa-Nagrakata section)
- Mahananda Wildlife Sanctuary km 24/8-26/0 (Sevove-Gulma section)

## Recommendations

1) The driver should negotiate curves skillfully and at a low speed on the tracks where elephants pass through frequently. If possible night driving should be avoided.
2) The driver should have a full view of the frontal side. If possible, two or more drivers should be engaged on trains passing through the forest areas.
3) There should be good communication network in the moving train so that forest staff and railway patrolling staff can pass on information prior to the trains passing through forest areas.
4) Strong barriers be established on both sides of the track except a few passages where the elephants pass through frequently.
5) Inspection trolley can be sent prior to trains passing through forest areas in order to ascertain information on elephant movement close to railway track.
6) Frequent counselling should be given to drivers for cautious driving on this stretch.

**Table 3.** Number of elephant sightings on railway tracks (Sep. 2007– Feb. 2008)*

| Railway section | Herd | Solitary | Unknown | Total |
|---|---|---|---|---|
| Gulma–Sevoke | 29 | 6 | 4 | 39 |
| Sevoke–Bagrakote | 2 | 0 | 2 | 4 |
| Damdim–New Mal | 1 | 0 | 0 | 1 |
| Chalsa–Nagrakata | 3 | 2 | 2 | 7 |
| Banarhat–Binnaguri | 0 | 1 | 0 | 1 |
| Dalgaon-–Mujnai | 0 | 1 | 0 | 1 |
| Madarihat–Hasimara | 5 | 3 | 1 | 9 |
| Hasimara–Kalchini | 6 | 2 | 2 | 10 |
| Kalchini–Rajabhatkwa | 1 | 3 | 1 | 5 |
| Rajabhatkhawa–Alipurduar JN | 7 | 2 | 2 | 11 |
| Total | 54 | 20 | 14 | 88 |

*Source: Railway record, Alipurduar Sub divisional Railway office

**Acknowledgements**

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**Figure 2.** Elephant death at Sevoke-Mongpong stretch (18. Nov. 2006).

## Appendix 1

Elephant mortality on railway tracks in northern Bengal (1958-2008).

| #* | Date | Year | Place of occurrence | Forest division | Animal | Sex |
|---|---|---|---|---|---|---|
| 1 | Feb | 1958 | Mahananda WLS | Wildlife-1 | Calf/Juv. | Female |
| 2 | Feb 23 | 1974 | North Sevoke,MWLS | Wildlife-1 | Adult | Female |
| 3 | Jun 12 | 1977 | North Sevoke,MWLS | Wildlife-1 | Adult | Male/makna |
| 4 | Feb 7 | 1979 | Gulma ,MWLS | Wildlife-1 | Subadullt | nil |
| 5 | Oct 15 | 1980 | Oodlabari -Bagracote | Kalimpong (G&Sp) | Adult | Female |
| 6 | NA | 1979-1982 | Gulma ,MWLS | Wildlife-1 | 4 Adults | nil |
| 7 | NA | 1979-1983 | Gulma ,MWLS | Wildlife-2 | Subadullt | nil |
| 8 | Oct 15 | 1986 | North Cabin , MWLS | Wildlife-1 | Calf/Juv. | nil |
| 9 | Jan 8 | 1992 | Chapramari WLS | Wildlife-2 | Adult | Male/tusker |
| 10 | Jul 1 | 1992 | Madarihat | Coochbehar Div | Adult | Male/tusker |
| 11 | 17-Jun | 1993 | Gulma ,MWLS | Wildlife-1 | Adult | Male/tusker |
| 12 | NA | 1993 | Jaldapara WLS | Coochbehar Div | Adult | Male/tusker |
| 13 | Oct 12 | 1995 | Mongpong | Kalimpong (G&Sp) | Adult | Female |
| 14 | Oct 12 | 1995 | Mongpong | Kalimpong (G&Sp) | Adult | Male |
| 15 | Jun 4 | 1996 | Hamiltonganj | Buxa Tiger Res. (W) | Adult | Female |
| 16 | Sep 25 | 1999 | Chapramari WLS | Wildlife-2 | Adult | nil |
| 17 | Aug 8 | 2000 | Jaldapara WLS | Coochbehar Div | Calf/Juv. | nil |
| 18 | Aug 22 | 2000 | Chapramari WLS | Wildlife-2 | Adult | Male/tusker |
| 19 | Sep 24 | 2000 | Majiaghat ,Jalpaiguri | Jalpaiguri | Adult | Male |
| 20 | Oct 11 | 2000 | Chapramari WLS | wildlife-2 | Adult | Female |
| 21 | Jun 9 | 2001 | Rajabhatkhawa | Buxa Tiger Res. (W) | Adult | Female |
| 22 | Oct 4 | 2001 | Mongpong | Kalimpong (G&Sp) | Calf/Juv. | nil |
| 23 | Feb 7 | 2002 | Chapramari WLS | Wildlife-2 | Adult | Male/tusker |
| 24 | Feb 7 | 2002 | Chapramari WLS | Wildlife-2 | Subadullt | Male/tusker |
| 25 | Feb 7 | 2002 | Chapramari WLS | Wildlife-3 | Subadullt | male/makna |
| 26 | Oct 10 | 2002 | Chapramari WLS | Wildlife-2 | Adult | Female |
| 27 | May 28 | 2006 | Good hope TG | Kalimpong (G&Sp) | Calf/Juv. | nil |
| 28 | May 28 | 2006 | Near Damanpur | Buxa Tiger Res. (W) | Adult | Male/tusker |
| 29 | May 29 | 2006 | Good hope TG | Wildlife-2 | Adult | Female |
| 30 | Nov 13 | 2006 | Madarihat -Hasimara | Coochbehar Div | Adult | Male/makna |
| 31 | Nov 18 | 2006 | Bagrakote-Sevoke | Kalimpong (G&Sp) | Adult | Male/tusker |
| 32 | Apr 11 | 2007 | Rajabhatkhawa | Buxa Tiger Res. (W) | Adult | Male/makna |
| 33 | Jul 25 | 2007 | Gulma -sevoke | Widlife-1 | Adult | Male/tusker |
| 34 | Nov 9 | 2007 | Rajabhatkhawa | Buxa Tiger Res. (W) | Adult | Male/makna |
| 35 | Jan 15 | 2008 | Rajabhatkhawa | Buxa Tiger Res. (W) | Calf/Juv. | Male |
| 36 | Oct 4 | 2008 | Rajabhatkhawa | Buxa Tiger Res. (W) | Adult | Male/makna |

* 1-26: before gauge conversion, 27-36: after gauge conversion



**Figure 3.** Elephant death at Rajabhatkhawa area (28. May 2006).

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# The Occurrence of Micro laria and the Response of Micro laria and Gut Nematodes to Ivermectin Therapy in Myanmar Timber Elephants

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## Introduction

Filariasis is a parasitic nematode infestation characterized by the presence of micro laria, an embryonic stage between the eggs and the larvae (Haleem *et al.* 2002). They occur in all orders of vertebrates and are obviously of considerable antiquity, but have no close relations among the other parasitic nematodes. Little is known about their evolutionary history. They live within the body tissues of host animals. The micro lariae are removed from the body by blood-sucking insects. In some species there is a peculiar and as yet unexplained periodicity of their appearance in the peripheral blood-vessels of the host. In some cases, they appear during the hour of darkness, in others during daylight (Cameron 1965). The appearance of micro laria is thought to be in uenced by environmental conditions such as sunlight, temperature and humidity (Oishi 1975).

Filariasis denotes the presence of micro laria in the blood and tissue of the host. Filarial parasites of African elephants are; *Dipetalonema loxodontis*, *Dipetalonema asiatica*, and *Stephano laria* sp. the latter two being also found in Asian elephants. Micro laria vary from 0.137-0.255 mm, and 0.007-0.011 mm in diameter. Micro laria are concentrated in the blood oozing from nodules that form in the skin of infected elephants. Presumably blood-sucking insects transmit the parasite in elephants also. The life cycle in the insect is unknown (Fowler and Mikota 2006).
Filariasis causes a chronic progressive dermatitis in elephants and is prevalent among Myanmar timber elephants. In Myanmar, larial infestation has been found in about 50-55% of Myanmar Timber Enterprise owned elephants before 1986. Mortality is negligible, but there is signi cant economic loss from decreased working capacity.

The objectives of this study were to investigate the occurrence, density, and periodicity of micro laria, and the effectiveness of ivermectin in treating micro laria infection and in gut nematodes of elephants.

## Materials and Methods

Sixty elephants owned by Myanmar Timber Enterprise with ages ranging from 9 to 54 years were used in the study.

We employed two methods for examination of blood samples for micro laria:

1. Direct examination of micro laria from wet blood lms: Blood samples were dropped directly onto glass slides, a wet-smear made, and the slide searched for micro laria under the microscope at 100x magni cation.
2. Examination by staining: A sample of venous blood was collected and was processed promptly, not allowing it to clot. One milliliter of whole blood was placed in 10 ml, 2% formalin and was mixed gently by inverting the closed tube twice and centrifuging ve to eight minutes at 1500 rpm. The supernatant uid was discarded by careful inversion of tube and the sediment stained with an equal amount of 1:1000 methylene blue. The mixture was pipetted onto two glass microscope slides; a cover slip placed, and examined at 100X. Blue stained, elongated micro lariae were readily visible, and length and width was measured using a micrometer (Embert 1967).

### *Experimental design*

Sixty elephants from Pyinmana North and Pyinmana South Timber Extraction agency were tested for micro laria. From those found to be infected with micro laria, ten were selected

randomly and divided into two groups of five: $I_1$ and $I_2$; Five elephants were randomly selected from the elephants not detected as being infected with microfilaria, which formed a control group - C. Group $I_1$ was treated with ivermectin at day 0 and group $I_2$ was treated at day 0 and day 15. The group C did not receive treatment.

*Ivermectin treatment*

Ivermectin 10mg/ml (1% w/v) was administered subcutaneously to elephants naturally infected with microfilaria in a dosage of 1 ml/100 kg of body weight. The body weight of treated elephants was assessed by using the formula described by Hile *et al.* (1997):

Body weight [kg] = 18.00 x HG [cm] - 3336
(HG = heart girth)

*Testing effectiveness of treatment*

Blood samples were collected from the 15 experimental animals on days 0, 15, 30, 60, 90 and 120 to determine microfilaria titers and to assess blood parameters; Packed Cell Volume (PCV), Haemoglobin (Hb), Total Protein (TP), erythrocytes (RBC) and leukocytes count (WBC), Mean Corpuscular Volume (MCV) and Mean Corpuscular Haemoglobin Concentration (MCHC). Four or 5 ml of blood were collected from the ear vein of each elephant by using a 5 ml disposable syringe and 18 gauge needle and put into labeled bottles containing 1 mg EDTA powder per 1 ml of blood (Chakrabarti 2002).

*Counting of microfilaria*

With the help of a haemoglobinometer pipette 20 $mm^3$ of blood was placed on a clean glass slide, dried as a thick film, dehaemoglobinised and stained in the usual manner. The total number of microfilaria in the thick smear multiplied by 50 was taken as the number per milliliter of blood (Chatterjee 1976).

*Quantitative examination of faeces*
*Modified McMaster technique*

Twenty-eight ml of flotation fluid (saturated common salt- NaCl, solution) was added to 2 g of feces. The feces and fluid were mixed until all lumps were broken down and the mixture sieved with a coarse sieve (tea strainer). The sieve containing coarser material was then removed leaving the flotation fluid and smaller fecal material. The mixture was then thoroughly stirred and each chamber of a McMaster counting-slide filled using a pipette. The counting-slide was covered with a coverslip and left aside.

After 5-8 minutes, parasite eggs rise in the solution and come to lie against the under surface of the glass coverslip covering the top of the counting chamber. The slide was then examined under a microscope using 100x magnification. The total number of eggs were counted and multiplied by 50 to give a count of eggs per gram of faeces (Pomroy 2000). Faecal egg counts of all 15 elephants were done at days 0, 15, 30, 60, 90 and 120.

*Statistical analysis*

The data were analyzed by one-way analysis of variance (ANOVA) and differences between means were tested for significance by Tukey test using SPSS version 11.00 (Coakes & Steed 2003).

**Results**

*Morphology of microfilaria*

The length of the microfilaria observed was 182.00±37.96 µm, tail length was 17.92±4.13 µm and width 5.12±1.28 µm. The head of the microfilaria were prolonged and the tail was curved and pointed. Nuclei were seen in the body of microfilaria (Figs. 1-3).

*Examination of microfilariae*

Microfilaria were detected in 46.6% (n=28) of the 60 elephants screened in daytime, 51.66% (n=31) of those screened in early-night and 53.33% (n=32) of those screened at midnight. There was no significant difference in the occurrence during early night and midnight but a significant difference between day and night time.

*Response to treatment*

The density of micro laria in groups $I_1$ and $I_2$ were 152 and 184 per ml of blood before the treatment period at day 0. Group C remained free of micro laria infestations on days 0-90. After treatment, micro laria disappeared in both groups $I_1$ and $I_2$ by day 15 and were not detected at days 30 and 60. On day 90, micro laria were observed in $I_1$ group and on day 120 in the $I_1$, $I_2$ and C groups. On day 120, the densities of micro laria were 52 mf/ml of blood in $I_1$, and 12 mf/ml of blood in $I_2$ and C.

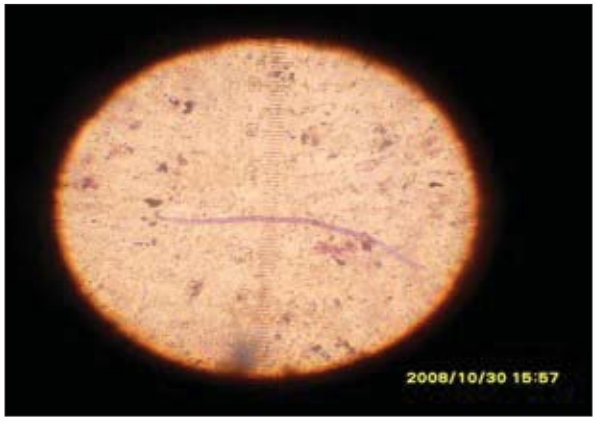



**Figure 1.** Micro laria in elephant blood.




**Figure 2.** Tail of micro laria: methylene blue stain.

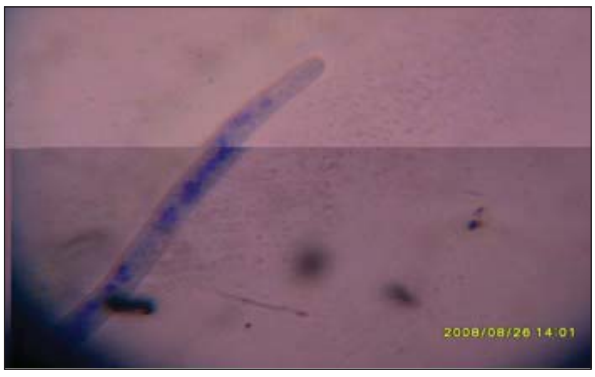



**Figure 3.** Head of micro laria: methylene blue stain.

*Faecal worm egg counts*

The mean±SE of epg for the 3 groups on day 0 was 1256±123.7. On day 15, 30, 60, 90 and 120 were 684±283.67, 370±122.23, 95±35.41, 70±31.22 and 330±123.76 respectively. The mean value of faecal worm egg counts (epg) between group $I_1$ and group C were not signi cant, but the mean values of epg in group C were signi cantly ($p$<0.05) higher than that of group $I_2$ at day 0. At day 15, group C was signi cantly ($p$<0.05) higher than that of mean (epg) of group $I_1$. From day 30 to day 120, mean values of (epg) in C group were signi cantly ($p$<0.05) higher than that of groups $I_1$ and $I_2$ (Figs. 4 & 5).

## Discussion

The occurrence of micro laria using the direct wet blood  lm and staining methods, showed that more than half the elephants were naturally infected with micro laria. This result is consistent with what has been observed previously for MTE elephants.

The appearance of micro laria in the peripheral blood of elephants was observed to be somewhat higher nocturnally in this study, consistent with a daily periodicity. Rhee, Yang and Kim (1998) from a study of species other than elephants in Korea, stated that periodicity of micro laria depended on geographic location. They also stated that the maximal counts of micro laria were found at 21:00 hrs and minimal counts at 11:00 hrs. Euzeby & Laine (1951) postulated that the lowest counts of micro laria occurred at 08:00 hrs and the highest counts at 20:00 hrs in France. Webber & Hawking (1995) stated that the

**Table 1.** Observation of micro larial infection in 60 elephants.

| Observation period | Micro lariae status | | | |
|---|---|---|---|---|
| | Mf (+) | | Mf (-) | |
| | m* | f* | m* | f* |
| daytime (12 - 14) | 14 | 14 | 8 | 24 |
| early night (20 - 22) | 13 | 18 | 9 | 20 |
| midnight (00 - 02) | 14 | 18 | 8 | 20 |

* m = male, f = female

**Table 2.** Haematological pro le of the experimental groups.

| Parameter | Observed values | | | | | | | | | | | | *Normal values |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Groups $I_1$ and $I_2$ (n=10) | | | | | | Group C (n=5) | | | | | | |
| Day # | 0 | 15 | 30 | 60 | 90 | 120 | 0 | 15 | 30 | 60 | 90 | 120 | |
| Total RBC counts ($x10^{12}$/l) | 2.3 | 2.3 | 2.6 | 2.9 | 3.0 | 3.3 | 2.3 | 2.7 | 3.1 | 2.6 | 3.4 | 3.2 | 2.5-5.0 |
| Total leukocyte counts ($x10^{9}$/l) | 14.4 | 12.4 | 5.5 | 5.7 | 8.3 | 10.5 | 12.7 | 8.1 | 8.5 | 7.1 | 15.8 | 17.5 | 10-18 |
| PCV (%) | 34.0 | 34.5 | 27.5 | 28.5 | 33.9 | 27.2 | 33.0 | 28.0 | 26.4 | 29.8 | 30.4 | 28.0 | 30-40 |
| Hb (g %) | 10.6 | 10.0 | 11.4 | 12.1 | 13.9 | 14.5 | 13.2 | 9.2 | 9.3 | 11.2 | 12.8 | 13.9 | 12-14 |
| Total plasma protein (g/dl) | 7.3 | 7.3 | 6.5 | 6.2 | 7.0 | 5.9 | 7.5 | 7.1 | 6.6 | 6.2 | 7.5 | 6.6 | 6-12 |
| MCV ( l) | 174.6 | 159.6 | 108.5 | 101.0 | 101.0 | 114.8 | 148.1 | 105.8 | 91.4 | 124.1 | 124.6 | 89.9 | 80-160 |
| MCHC (g/dl) | 34.2 | 33.9 | 41.7 | 43.2 | 43.2 | 43.5 | 36.7 | 32.3 | 44.7 | 38.1 | 38.1 | 42.4 | 25-40 |
| Lymphocytes (%) | 55.4 | 46.9 | 49.2 | 51.8 | 51.0 | 42.5 | 58.4 | 53.2 | 48.6 | 49.0 | 54.5 | 39.4 | 40-60 |
| Neutrophils (%) | 34.8 | 30.2 | 33.1 | 29.0 | 35.8 | 36.6 | 29.8 | 34.2 | 29.4 | 34.4 | 35.0 | 36.6 | 22-50 |
| Eosinophils (%) | 5.6 | 11.3 | 8.6 | 5.4 | 4.2 | 6.1 | 6.0 | 6.6 | 4.4 | 6.8 | 4.6 | 7.2 | 6-15 |
| Monocytes (%) | 3.2 | 11.8 | 12.1 | 12.3 | 9.0 | 15.7 | 5.0 | 7.0 | 17.6 | 9.8 | 7.8 | 16.8 | 1-3 |

*Source: K.K. Sarma (2004)

minimum parasitemia occurred at 06:00 hrs and the maximum at 18:00 hrs in China. Therefore the results from previous studies are consistent with our nding that the occurrence of micro laria was higher in early night and midnight than in daytime.

The dosage of ivermectin used by us was half the usually recommended dosage. The results of this study showed that all micro lariae were cleared off in the peripheral blood of experimental animals after treatment at day 15. Thereafter, micro lariae infestation was not observed in the treatd groups until day 90. On day 120, both treatment groups were re-infected with micro laria. Thoung Nyunt *et al*. (1987) described that all treated elephants were free from micro laria at the 12th day after treatment and that reinfection occurred eight months after treatment. So, the results of Thoung Nyunt *et al*. (1987) did not agree with the ndings of the present study. Gaysorn *et al*. (2005) reported that after a single oral dosage of ivermectin (200 µg/kg) and diethylcarbamazine, rapid suppression of micro laria was achieved within 30 days. The authors also stated that ivermectin is effective in clearing micro laria within 30-60 minutes, but cannot eliminate adult worms, and therefore, micro laria can recur within 1-2 months. The haematological values did not show any clear differences between the treated and untreated groups during the period of examination.

Mean values of epg signi cantly ($p<0.05$) decreased after injection of ivermectin in the treatment groups (Fig. 4). Burkholder *et al.* (2004) reported that ivermectin, a broad spectrum endo- and ectoparasitic antihelminthic, is recommended as a preventive for meningeal worm in cattle at a dosage of 200 µg/kg subcutaneously administered once in 3 weeks. Soulsby (1968) stated that in equines, 500 epg was observed in mild infection, 800-1000 epg in moderate infection and 1500-2000 epg in severe infection. The gastrointestinal tract of elephants is similar to that of horses. Therefore, using the values given by Soulsby (1968) in the present study, the mean values of epg were severe at the start of the study and then decreased to moderate and mild infection with ivermectin treatment.

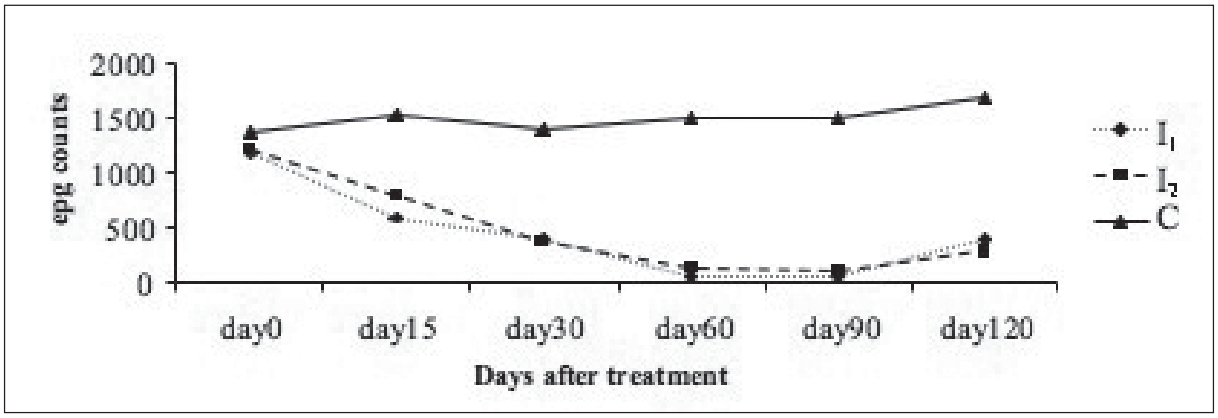



**Figure 4.** Faecal worm egg counts of experimental elephants.

## Conclusions

According to the results obtained from this study, it can be concluded that;

1. The diagnosis of microfilariae can be performed anytime of the day.
2. A single dose of ivermectin (1%) administered subcutaneously, not only reduced the density of microfilariae in elephant's peripheral blood but also significantly ($p$<0.05) decreased gastrointestinal nematodes.
3. A single dose of ivermectin (1%) in half recommended dose is effective for the clearance of microfilaria for up to 3 months. Therefore the drug should be administered four times per year to elephants.

## Acknowledgements

We would like to express our sincere gratitude to Professor Dr. Myint Thein, Rector of University of Veterinary Science, Yezin, Professor Dr. Tin Tin Myaing, Pro-rector (Academic), University of Veterinary Science, Yezin, and Professor Dr. Khin Ma Ma, Pro-rector (Admin;), University of Veterinary Science, Yezin for their kindness permission, invaluable advice and facilitating the completion of work. The authors also would like to acknowledge U Win Htun, Managing Director and U Khin Maung Yi, General Manager, Ministry of Forestry, Myanmar Timber Enterprise for their financial support and encouragement of this research.

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**Figure 5.** Strongyloides egg in elephant faeces.

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Burnese veterinarian doing elephant inspection in a camp
Photo by Peter Leimgruber

# Government and WWF Brighten the Future of Lao Wild Elephants

Noy Promsouvanh

*WWF Greater Mekong - Laos Country Programme, Chanthabouly District, Vientiane Capital, Laos*

The wild elephant population of Laos has declined 60% within two decades from 1500 in 1988 to 600 in 2009. Illegal poaching, land conversion, infrastructure, and mining have been the main causes of the decline.

On June 29 –30th 2009, the Division of Forest Resources Conservation and WWF organized a workshop on wild elephants in Laos. Provincial and central representatives of the government, National University of Laos, Ministry of Foreign Affairs, National Agriculture and Forestry Institute, Water Resources and Environment Agency, Department of Forestry, Department of Forest Inspection, National Tourism Authority, Wildlife Conservation Society, IUCN, and UNDP participated in the workshop.

The workshop identified a priority landscape map for elephant conservation, which identified areas that can link the known populations, and areas where it may be possible to restore the species in the future.

The workshop identified a goal, objectives, and activities to be undertaken. The activities identified included patrolling (Fig. 1), local capacity building, and law enforcement, which will help maintain the number of wild elephants in the country.

"Elephants are one of the most important natural resources and a source of cultural pride for our people", said Mr. Bouaphanh Phanthavong, the Head of Division of Forest Resources Conservation, Department of Forestry. "Our country used to be named *Lane Xang*, the land of a million elephants, therefore we have to ensure that elephants can survive in the wild".

The out put from the workshop that hopefully brightens the future of wild elephants of Laos became an Elephant Action Plan, which addressed the government and WWF's efforts to reduce illegal poaching and conflict, to reduce the impacts from commercial plantation, infrastructure development and mining, and to identify the critical habitats and populations to develop and implement spatially based management and conservation measures.

"Still a heavily forested Southeast Asian nation, Laos is coming under increasing pressure to exploit its abundant natural resources, particularly the large forest areas on the borders with Cambodia, Thailand, China, and Vietnam. It is no surprise then, that species such as the elephants are facing a future where there is less habitat available and a greater chance of human conflict" said Khamkhoune Khounboline, manager of WWF's species program in Laos,

WWF is working with local government authorities and communities in Xekong Province and Xe Pian National Park to raise awareness of the importance of elephants, patrolling in order to decrease poaching, and to increase understanding of the 'Aquatic and Wildlife Law'.

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**Figure 1.** Rangers on patrol training in Xepian National Park.

*Gajah 31 (2009) 47-48*

# A Gathering of Experts for Asian Elephants

Ravi Corea

*Sri Lanka Wildlife Conservation Society, Dehiwala, Sri Lanka*

On July 10th and 11th an unprecedented event took place in the Jiuhua Resort & Convention Center in Beijing China. For the first time in the annals of Asian elephant conservation an impressive group of Asian elephant experts convened to discuss, deliberate and assess the methods that have been applied to mitigate human elephant conflicts for the long term conservation of the Asian elephant and how successful these methods have been. Human elephant conflict is perhaps one of the most pressing issues impacting Asian elephant conservation in the new millennium. Never had there been before a similar international forum solely organized to assess the mitigation methods and their effectiveness to resolve human elephant conflicts in Asia.

The Human Elephant Conflict Workshop was an idea that evolved and was developed by the Human-elephant Conflict Task Force of the IUCN/SSC Asian Elephant Specialist Group. It took two years to plan and the main objective of the workshop was to conduct a review of the causes of human–elephant conflicts and the methods that had been used to mitigate such conflicts in Asia and how effective these methods have been in resolving human elephant conflicts.

The workshop was funded by the Asian Elephant Conservation Fund of the U.S. Fish and Wildlife Service and organized by the Sri Lanka Wildlife Conservation Society on behalf of the IUCN/SSC Asian Elephant Specialist Group (AsESG) in coordination with the Institute of Zoology of the Chinese Academy of Sciences and the Institute of Ecology of the Beijing Normal University. All the participants who were finally selected to participate in the workshop were provided with a travel grant that covered their airfare, ground transportation, incidental expenses, hotel accommodations, and meals.

Fifty participants representing 12 of the 13 Asian elephant range countries participated in the workshop. The participants included field researchers, university faculty members and students, government officials from range countries, wildlife managers, and officers of national and international non-governmental organizations. Due to the incredible interest shown by a large number of individuals who wanted to participate and due to the financial and logistical constraints a selection process had to be conducted. All potential participants were invited to submit a report on their current and past HEC mitigation efforts. A rigorous review of the reports was conducted by the organizing committee based on a set of 12 pre-agreed criteria and a scoring system so that selection was unbiased.

By holding the workshop the IUCN/SSC AsESG Human–elephant Conflict Task Force's main goal was to bring together a group of people (including but not restricted to the Task Force members) with practical experience of human elephant conflict (HEC) mitigation work in Asia to:

- Review the causes for HEC.
- Identify processes and actions that could stop or minimize the creation of new HEC situations.
- Identify and review processes and actions



that can stop the escalation of existing HEC situations and possibly reverse some of the factors that contribute to HEC.

- Review and list the types of HEC situations (i.e. dispersal, pocketed populations, etc.) and mitigation measures in place.

- Compile a list of mitigation methods used across Asia.
- Review and compile a summary of what has worked and what has not, where, and why (if known), thus facilitating an evidence-based approach to HEC mitigation.

- Develop a document listing best management practices and keep that current on the IUCN/SSC Asian Elephant Specialist Group's website as 'a living document.'

The workshop was a great success and it achieved its goal by producing a document that encompasses practically almost all the information pertaining to human elephant con□ icts in the Asian elephant range countries and an assessment of mitigation methods, their suitability and effectiveness to resolve HEC.

This document will be circulated to all the workshop participants, members of the Asian Elephant Specialist Group as well as other non-members who are involved in HEC mitigation in Asia for reviewing and editing. Once the document has been extensively reviewed and edited the information would be disseminated via a dedicated online elephant Geo-Portal that will be linked with the IUCN/SSC AsESG website and other websites dedicated to elephant conservation and research. The document will be maintained as a "living document" to ensure that it will continue to be updated with the most current efforts to mitigate human elephant con□ icts in the Asian elephant range countries.

For those who would like to know more about these efforts of the IUCN/SSC AsESG Human-elephant Con□ ict Task Force please go to the following link <www.AsianElephant.info> and register yourselves to receive current updates.

*Author's e-mail: ravi@slwcs.org*



# DO's & DONT's of Human Elephant Conflict Mitigation




**AREAS-India, North Bank Landscape / Kaziranga-Karbi Angiong Landscape Elephant Conservation Programmes**

*The posters are in Assamese. The above are translations*

# Recent Publications on Asian Elephants

Compiled by Jennifer Pastorini

*Anthropologisches Institut, Universität Zürich, Zürich, Switzerland and*
*Centre for Conservation and Research, Rajagiriya, Sri Lanka*

S.L. Bartlett, N. Abou-Madi, M.S. Kraus, E.B. Wiedner, S.R. Starkey & G.V. Kollias
**Electrocardiography of the Asian elephant (*Elephas maximus*)**
*Journal of Zoo and Wildlife Medicine 40 (2009) 466-473*

**Abstract.** Electrocardiograms (ECGs) are infrequently performed on Asian elephants (*Elephas maximus*), and few studies have been reported in the literature. The aim of this study was to determine reference ranges of ECG parameters in Asian elephants and to ascertain if age, body weight, and position of the elephant signi cantly affected the ECG. Electrocardiograms were obtained from 27 captive, nonsedated apparently healthy Asian elephants while they were standing (ST), in right lateral recumbency (RL), and/or in left lateral recumbency (LL). Six-lead ECGs were obtained using novel clamps and long ECG cables (71 cm). From lead I, standard waveforms and intervals were analyzed, including PR interval, QT interval, ST segment, P, QRS, T, and U waves if they were present. One animal was determined to have a previously undiagnosed conduction abnormality and was not included in the study. Most elephants had a sinus arrhythmia in at least one position. With increasing age, there was a trend toward a slower heart rate and signi cantly longer P waves. Increasing body weight was signi cantly correlated with longer QT intervals and T waves with lower amplitude. Compared with measurements in ST, LL resulted in P waves and QRS complexes with shorter amplitude, U waves with greater amplitude, PR intervals with shorter duration, and an increased heart rate. Compared with measurements in LL, RL resulted in larger QRS complexes. U waves were most commonly detected in RL and LL. Mean electrical axis calculated in the frontal plane were as follows: standing range -125 to +141°, mean -5°; left lateral range -15 to +104°, mean 27°; right lateral range -16 to +78°, mean 9°. Position-speci c reference ranges should be used when interpreting ECGs, and clinicians must be aware of how age and body weight may affect the ECG. © 2009 American Association of Zoo Veterinarians.

A. Benz, W. Zenker, T.B. Hildebrandt, G. Weissengruber, K. Eulenberger & H. Geyer
**Microscopic morphology of the elephant's hoof**
*J. of Zoo and Wildlife Med. 40 (2009) 711-725*

**Abstract.** As a result of the lack of basic microscopic anatomy of the elephants' foot, this study deals with the normal microscopic morphology of both the Asian (*Elephas maximus*) and African (*Loxodonta africana*) elephant foot with consideration of pathologic changes. A total of 727 histologic samples from de ned locations of 24 hooves of both species (17 Asian and seven African species) were studied, measured, and evaluated. Minor differences between the feet and species are seen histologically. Poor horn quality in captive elephants' hooves and loci of minor resistance in captive and wild animals are detected. The thickness of the weight-bearing surface of the captive elephants' hooves is histologically measured as "very thin" (about 10 mm). The normal histologic ndings provide a basis for assessing histopathologic changes and especially horn quality. The histologic ndings might explain some of the foot problems, but they also give rise to questions about the quality and correctness of current husbandry techniques. © 2009 American Association of Zoo Veterinarians.

R.W. Byrne, L.A. Bates, & C.J. Moss
**Elephant cognition in primate perspective**
*Comparative Cognition & Behavior Reviews 4 (2009) 65-79*

**Abstract.** On many of the staple measures of comparative psychology, elephants show no

obvious differences from other mammals, such as primates: discrimination learning, memory, spontaneous tool use, etc. However, a range of more naturalistic measures have recently suggested that elephant cognition may be rather different. Wild elephants sub-categorize humans into groups, independently making this classi cation on the basis of scent or colour. In number discrimination, elephants show no effects of absolute magnitude or relative size disparity in making number judgements. In the social realm, elephants show empathy into the problems faced by others, and give hints of special abilities in cooperation, vocal imitation and perhaps teaching. Field data suggest that the elephant's vaunted reputation for memory may have a factual basis, in two ways. Elephants' ability to remember large-scale space over long periods suggests good cognitive mapping skills. Elephants' skill in keeping track of the current locations of many family members implies that working memory may be unusually developed, consistent with the laboratory nding that their quantity judgements do not show the usual magnitude effects. © 2009 Byrne.

A. Campos-Arceiz

**Shit happens (to be useful)! Use of elephant dung as habitat by amphibians**

*Biotropica 41 (2009) 406–407*

**Abstract.** Although elephants are commonly cited as an example of ecosystem engineering, cases involving Asian elephants are missing in the literature. In a dry environment of southeastern Sri Lanka, I examined 290 elephant dung piles and found a total of six frogs from three different species in 1.7 percent (N= 5) of the dung piles. This suggests a facilitative role of elephants by providing habitat for amphibians. © 2009 The Author.

R. Clubb, M. Rowcliffe, P. Lee, K.U. Mar, C. Moss & G.J. Mason

**Fecundity and population viability in female zoo elephants: problems and possible solutions**

*Animal Welfare 18 (2009) 237-247*

**Abstract.** We previously reported that African (*Loxodonta africana*) and Asian (*Elephas maximus*) female elephants in European zoos have shorter adult lifespans than protected conspeci cs in range countries. This effect was the cause of greatest concern in Asian elephants, and risk factors within this species included being zoo-born, transferred between zoos, and possibly removed early from the mother. Here, we investigate these risk factors further; assess fecundity and sustainability in European zoos; and propose testable hypotheses as to the causes of these animals' problems. Although imported wild-born Asian elephants live longer than zoo-born conspeci cs, being imported when juvenile or adult appears no more protective than being imported in infancy, suggesting that the bene ts of being wild- rather than zoo-born are conferred early in life. Zoo-born Asian neonates are signi cantly heavier than those born to working animals in range countries, with a possible tendency to be fatter. In zoos, African elephants have tended to be removed from their mothers at older ages than young Asians, and were also transferred between zoos signi cantly less often: factors that could possibly underlie this species' lower calf losses and improving adult survivorship in Europe. Both species have low fecundity in European zoos compared to in situ populations, and are not self-sustaining, declining at approximately 10% per annum if reliant on captive-bred females under historically prevailing conditions. Data from other species suggest that stress and/or obesity are parsimonious explanations for the suite of problems seen. We recommend speci c screens for testing these hypotheses, and for potentially identifying vulnerable individuals within the extant zoo populations. © 2009 Universities Federation for Animal Welfare.

A. Datta-Roy, N. Ved & A.C. Williams

**Participatory elephant monitoring in South Garo Hills: ef cacy and utility in a human-animal con ict scenario**

*Tropical Ecology 50 (2009) 163-171*

**Abstract.** We evaluate the ef cacy of community based elephant monitoring programme in South Garo Hills, Meghalaya (India). Major objectives of the programme are to understand the ranging and habitat utilization patterns of free ranging Asian elephants in a human interspersed habitat with frequent human - elephant con icts. We collected information on elephant presence in

the landscape through participatory wildlife monitoring techniques by modifying an existing model for African elephants from six 'akings' or clan villages which are worst affected by human-elephant con ict (HEC). A total of 201 visits were recorded in six 'akings' during June 2005 to July 2006, of which solitary elephants accounted for 100 visits. The visits were found to peak during the two main harvesting periods in the Garo hills indicating a de nite seasonality pattern in the visits. Information from individual 'akings' also indicate that some 'akings' were particularly prone to visits by solitary animals indicating the complexity in the dynamics of elephant ranging patterns within the landscape. We note that participatory elephant monitoring can be a useful tool to collect basic data on elephant presence in tropical ecosystems where traditional line transect method is restricted by considerations of terrain, access and resources. Other advantages, limitations and conservation implications are discussed. © 2009 International Society for Tropical Ecology.

G. Iossa, C.D. Soulsbury & S. Harris

**Are wild animals suited to a travelling circus life?**

*Animal Welfare 18 (2009) 129-140*

**Abstract.** A comprehensive synopsis of the welfare of captive, wild (ie non-domesticated) animals in travelling circuses is missing. We examined circus animal welfare and, speci cally, behaviour, health, living and travelling conditions. We compared the conditions of non-domesticated animals in circuses with their counterparts kept in zoos. Data on circus animals were very scarce; where data were absent, we inferred likely welfare implications based on zoo data. Circus animals spent the majority of the day con ned, about 1–9% of the day performing/training and the remaining time in exercise pens. Exercise pens were signi cantly smaller than minimum zoo standards for outdoor enclosures. Behavioural budgets were restricted, with circus animals spending a great amount of time performing stereotypies, especially when shackled or con ned in beast wagons. A higher degree of stereotyping in circuses may be indicative of poorer welfare. Inadequate diet and housing conditions, and the effects of repeated performances, can lead to signi cant health problems. Circus animals travel frequently and the associated forced movement, human handling, noise, trailer movement and con nement are important stressors. Although there is no conclusive evidence as to whether animals habituate to travel, con nement in beast wagons for long timeperiods is a de nite welfare concern. Circuses have a limited ability to make improvements, such as increased space, environmental enrichment and appropriate social housing. Consequently, we argue that non-domesticated animals, suitable for circus life, should exhibit low space requirements, simple social structures, low cognitive function, non-specialist ecological requirements and an ability to be transported without adverse welfare effects. None of the commonest species exhibited by circuses, such as elephants and large felids, currently meet these criteria. We conclude that the species of non-domesticated animals commonly kept in circuses appear the least suited to a circus life. © 2009 Universities Federation for Animal Welfare.

R. Joshi

**Asian elephant's *Elephas maximus* behaviour in the Rajaji National Park, north-west India: Eight years with Asian elephant**

*Nature and Science 7 (2009) 49-77*

**Abstract.** In order to generate scienti c knowledge on behaviour of wild Asian elephant *Elephas maximus*, eld study was conducted from 1999 to 2007. The data were derived from a novel combination of self eld observations (direct and indirect methods), traditional knowledge of various local communities, and available literature on elephant studies. During the course of study 19 different behaviours of elephant were documented from Rajaji National Park, north-west India. Despite, the status, movement pattern, habitat utilization, feeding behaviour and human-elephant con ict of Asian elephant, extremely rare research work has been carried out on its behaviour in the wild. My review of available evidences suggested that wild elephants also used to perform various usual and unusual behaviours, which are directly linked with their management and conservation. The elephants in Rajaji are emerge out in the open areas in evening hours. The movement of elephants was entirely seasonal

and they also utilize the adjoining protected habitats. Fodder requirements are quite variable in groups and bulls and breeding season seems maximum to extent from May to November. Locomotion, social organization, drinking and bathing, resting and sleeping, defecation and urination, recognition, male-male aggression, syampathy and cooperation, play behaviour, association with other wild animals, parental care and elephant communication were another major behaviours observed in elephants. Besides, four unusual behaviours were also studied during this period. This is the first documented study, which could be helpful in generating more biological information about the activities of wild Asian elephants. All of these findings may have wider implications for developing predictive models of human – elephant interactions.

R. Joshi & R. Singh

**Gujjar community rehabilitation from Rajaji National Park: Moving towards an integrated Approach for Asian elephant (*Elephas maximus*) conservation**

*Journal of Human Ecology 28 (2009) 199-206*

**Abstract.** Rehabilitation of Gujjar community from the Rajaji National Park area is a persistent and better effort in the direction of wildlife conservation in India. On one hand it has provided the better opportunity for livelihood to pastoral Gujjars and on the other hand it has promoted the regeneration of forest wealth along with movement related activities of wildlife. The major objectives of the study are to generate the database of impact of Gujjar rehabilitation on frequent movement of wildlife. Eight forest ranges were surveyed for about seven years before and after the resettlement of Gujjar and all the data on animal sighting, movement and vegetation component were recorded. Currently wild animals are utilizing whole of the forest area frequently for their routine activities whereas before the resettlement of Gujjars wild animals generally used the water points after sunset. The undisturbed conditions created as a result of the resettling of the pastoral Gujjars, have had a noticeable effect on the elephant and tiger population of the forest area. As per the records of 1998 a total of 1390 families were existing in the park area and after the commencement of the programme 512 families were resettled at Pathri area and 613 were relocated at Gaindikhatta area. Presently 265 families are to be relocated who are residing inside the national park area. After the establishment of state Uttarakhand the rehabilitation programme has conducted very rapidly and over the past six years five forest ranges of the park are freed from the Gujjars. © 2009 Kamla-Raj Enterprises, Delhi, India.

N. Kontogeorgopoulos

**Wildlife tourism in semi-captive settings: a case study of elephant camps in northern Thailand**

*Current Issues in Tourism 12 (2009) 429-449*

**Abstract:** Due to improved transportation and communication technology, changing social attitudes towards nature and wildlife, and the physiological benefits of interaction with animals, tourism centred on wildlife in captive and semi-captive settings is becoming increasingly popular. One example of wildlife tourism in a semi-captive setting is the proliferation of 'elephant camps' in Thailand, where tourists interact in a variety of ways with domesticated elephants. Though work in elephant camps can be difficult for elephants, tourism provides the only viable legal option for elephant owners and handlers to earn income. This study examines the characteristics, preferences, and values of the visitors of three elephant camps in the vicinity of Chiang Mai in northern Thailand and argues that despite reflecting divergent worldviews on, and practical approaches to, animal rights, each type of camp makes significant contributions to the overall welfare of Thailand's domesticated elephants. © 2009 Taylor & Francis.

J.A. Landolfi, S.A. Schultz, S.K. Mikota & K.A. Terio

**Development and validation of cytokine quantitative, real time RT-PCR assays for characterization of Asian elephant immune responses**

*Veterinary Immunology and Immunopathology 131 (2009) 73-78*

**Abstract.** Infectious disease is an important factor in Asian elephant health and long-term species survival. In studying disease pathogenesis, it is important to consider not only

the pathogen, but also the effectiveness of the host immune response. Currently, there is a paucity of information available on elephant immune function. Measurement of cytokine levels within clinical samples can provide valuable information regarding immune function during health and disease that may elucidate disease susceptibility. To develop tools for assessment of elephant immune function, Asian elephant partial mRNA sequences for interleukin (IL)-2, IL-4, IL-10, IL-12, interferon (IFN)-γ, tumor necrosis factor (TNF)-α, transforming growth factor (TGF)-β, glyceraldehyde 3-phosphate dehydrogenase (GAPDH), and β-actin were determined. Sequence information was then utilized to design elephant-specific primers and probes for quantitative, real time, RT-PCR assays for the measurement of cytokine mRNA. Greater than 300 bps of Asian elephant mRNA sequence were determined for each cytokine of interest. Consistent and reproducible, real time, RT-PCR assays with efficiencies of greater than 93% were also developed. Assay sensitivities ranged from less than 1 to 5000 DNA copies with the exception of IL-12, which had a sensitivity of 42,200 copies. Employment of molecular techniques utilizing mRNA-based detection systems, such as real time, RT-PCR, facilitate sensitive and specific cytokine detection and measurement in samples from species for which commercial reagents are not available. Future studies utilizing these techniques to compare elephant immune function during health and in the face of infection will be useful for characterizing the contribution of the elephant immune system to disease. © 2009 with permission from Elsevier.

W.A. Lindsay, E. Wiedner, R. Isaza, H.G.G. Townsend, M. Boleslawski & D.P. Lunn

**Immune responses of Asian elephants (*Elephas maximus*) to commercial tetanus toxoid vaccine**

*Veterinary Immunology and Immunopathology 133 (2010) 287-289*

**Abstract.** Although captive elephants are commonly vaccinated annually against tetanus using commercially available tetanus toxoid vaccines marketed for use in horses and livestock, no data exists to prove that tetanus toxoid vaccination produces measurable antibody titers in elephants. An ELISA test was created to measure antibody responses to tetanus toxoid vaccinations in 22 Asian elephants ranging in age from 24 to 56 years (mean age 39 years) over a 7-month period. All animals had been previously vaccinated with tetanus toxoid vaccine, with the last booster administered 4 years before the start of the study. The great majority of elephants had titers prior to booster vaccination, and following revaccination all elephants demonstrated anamnestic increases in titers, indicating that this species does respond to tetanus vaccination. Surprisingly older animals mounted a significantly higher response to revaccination than did younger animals. © 2009 with permission from Elsevier.

J. Lorimer & S. Whatmore

**After the 'king of beasts': Samuel Baker and the embodied historical geographies of elephant hunting in mid-nineteenth-century Ceylon**

*J. of Historical Geography 35 (2009) 668-689*

**Abstract.** This paper draws on and develops a range of concepts and methodologies from 'more-than-human' and animal geographies to map some embodied historical geographies of elephant hunting in mid-nineteenth-century Ceylon. It focuses in particular on the exploits of Samuel Baker and some of his contemporaries. The paper attends to the attachments, crossings and ethics that passed between hunted and hunting bodies to flesh out the colonial visions of these 'seeing men' of empire. It critically engages with existing work on hunting and colonial natural history by examining interwoven human and nonhuman experiences, exploring elephant hunting as a collection of embodied and co-evolutionary processes with complex material histories. Drawing out the importance of embodiment, affect and intercorporeal exchange the paper then reflects on the performance, epistemology and ethics of hunting practice and traces the role played by a code of sportsmanship in orientating and legitimating the ethical sensibility of hunting. In conclusion the paper details what is gained from this style of embodied historical analysis which unsettles any simple spatio-temporal territorialisation of (post-) colonial historical geographies. © 2008 with permission from Elsevier.

A. Mallapur & A. Ramanathan

**Differences in husbandry and management systems across ten facilities housing Asian elephants *Elephas maximas* in India**

*International Zoo Yearbook 43 (2009) 189-197*

**Abstract.** A face-to-face questionnaire survey was conducted to document the husbandry and management systems followed by ten facilities housing Asian elephants *Elephas maximas* in India. Eighty-two Asian elephants at these ten facilities were surveyed between November 2004 and February 2005. A signi cantly greater percentage of the elephants managed by zoos (n=4 zoos; 13 elephants surveyed) and the forest elephant camp (n=1 forest elephant camp; ve elephants surveyed) were housed in pairs or groups; whereas animals maintained by tourist camps (n=2 tourist camps; 40 elephants surveyed) and temples (n=3 temples; 24 elephants surveyed) were permanently restrained with minimal social contact (physical contact with other elephants). A considerably larger proportion of elephants from tourist camps and temples were housed in environments devoid of natural features, such as trees, shrubs and water bodies. Forest elephant camp and zoo elephants, on the other hand, were housed in complex species-speci c environments, which included water bodies, trees/shrubs and a substrate of compacted mud. From this paper, it is evident that the husbandry and management protocols vary signi cantly across the degrees of captivity, with some facilities (e.g. zoos and a forest elephant camp) being more conducive for housing elephants than others (e.g. temples and tourist camps). © 2009 The Zoological Society of London.

P. Matson, Wendy Kappelle & I. Malecki

**The use of a hypo-osmotic swelling (HOS) test on sperm of the pig (*Sus scrofa domesticus*), emu (*Dromaius novaehollandiae*), Asian elephant (*Elephas maximus*), hamadryas baboon (*Papio hamadryas hamadryas*), and central rock rat (*Zyzomys pedunculatus*)**

*Reproductive Biology 9 (2009) 181-187*

**Abstract.** A hypo-osmotic swelling test using TALP-HEPES medium over a range of 50 to 300 mOsm/kg was applied to sperm from domestic and endangered species. Maximal responses of curling of the sperm tails were seen over a range of osmolalities for epididymal sperm from the pig (100 mOsm/kg), hamadryas baboon (range 50-125 mOsm/kg), and central rock rat (range 50-100 mOsm/kg), and the ejaculated sperm from the emu (50 mOsm/kg) and the Asian elephant (range 75-150 mOsm/kg). A solution of TALP-HEPES medium at 100 mOsm/kg would be suitable to obtain the maximal response in this range of mammals tested, though it would need to be diluted to at least 50 mOsm/kg when testing the viability of the emu sperm. © 2009 Society for Biology of Reproduction.

***http://www.repbiol.pan.olsztyn.pl/jul2009.htm***

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N.K. Nath, B.P. Lahkar, N. Brahma, S. Dey, J.P. Das, P.K. Sarma & B.K. Talukdar

**An assessment of human-elephant con ict in Manas National Park, Assam, India**

*Journal of Threatened Taxa 1 (2009) 309-316*

**Abstract:** An assessment of human-elephant con ict was carried out in the fringe villages around Manas National Park, Assam during 2005-06. The available forest department con ict records since 1991 onwards were also incorporated during analysis. Con ict was intense in the months of July-August and was mostly concentrated along the forest boundary areas, decreasing with distance from the Park. Crop damage occurred during two seasons; paddy (the major crop) suffered the most due to raiding. Crop maturity and frequency of raiding were positively correlated. Single bull elephants were involved in con icts more frequently (59%) than female herds (41%), while herds were involved in majority of crop raiding cases. Of the single elephants, 88% were *makhnas* and 11.9% were tuskers. The average herd size recorded was 8 individuals, with group size ranging up to 16. Mitigation measures presently adopted involve traditional drive-away techniques including making noise by shouting, drum beating, bursting re crackers and ring gun shots into the air, and using torch light, pelting stones and throwing burning torches. *Kunkis* have been used in severe cases. Machans are used for guarding the crops. Combinations of methods are most effective. Family herds were easily de ected, while single bulls were dif cult to ward off. Affected villagers have suggested methods like regular patrolling (39%) by the Forest Department of cials along

the Park boundary, erection of a concrete wall (18%) along the Park boundary, electric fencing (13%), simply drive away (13%), culling (11%) and lighting the Park boundary during night hours (6%). Attempts to reduce con ict by changing the traditional cropping pattern by introducing some elephant-repellent alternative cash crops (e.g. lemon and chilli) are under experiment. © 2009 The Authors.

W. Pan, L. Lin, A. Luo, & L. Zhang
**Corridor use by Asian elephants**
*Integrative Zoology 4 (2009) 220–231*
**Abstract.** There are 18 km of Kunming–Bangkok Highway passing through the Mengyang Nature Reserve of Xishuangbanna National Nature Reserve in Yunnan Province, China. From September 2005 to September 2006 the impact of this highway on movement of wild Asian elephants between the eastern and western part of the nature reserve was studied using track transecting, rural surveys and direct monitoring. Our results showed that the number of crossroad corridors used by Asian elephants diminished from 28 to 23 following the construction of the highway. In some areas, the elephant activity diminished or even disappeared, which indicated a change in their home ranges. The utilization rate of arti cial corridors was 44%. We also found that elephants prefered arti cial corridors that were placed along their original corridors. During the research, wild elephants revealed their adaptation to the highway. They were found walking across the highway road surface many times and for different reasons. We suggest that the highway management bureau should revise their management strategies to mitigate the potential risks caused by elephants on the road for the safety of the public and to protect this endangered species from harm. It is also very important to protect and maintain current Asian elephants corridors in this region. © 2009 ISZS, Blackwell Publishing and IOZ/CAS

G. Paul
**The nearly columnar limbs of elephants are very different from the more exed, spring action limbs of running mammals and birds**
*J. of Experimental Biology 212 (2009) 152-154*
No abstract. This is correspondence to the recently published article: "Ren, L., Butler, M., Miller, C., Paxton, H., Schwerda, D., Fischer, M.S. & Hutchinson, J.R. (2008) The movement of limb segments and joints during locomotion in African and Asian elephants. Journal of Experimental Biology 211: 2735-2751." There is also a reply included from J.R. Hutchinson: "Response: Of ideas, dichotomies, methods, and data – how much do elephant kinematics differ from those of other large animals?"

P.A. Rees
**Activity budgets and the relationship between feeding and stereotypic behaviors in Asian elephants (*Elephas maximus*) in a zoo**
*Zoo Biology 28 (2009) 79-97*
**Abstract.** Activity budgets were studied in eight Asian elephants (*Elephas maximus*) at Chester Zoo (UK) for 35 days, between January and November 1999. Recordings were made between 10:00 and 16:00 hr (with most behavior frequencies calculated between 10:00 and 14:00 hr). The elephants exhibited variation in activity depending on their age, sex, the time of day and the time of year. Only the ve adult cows exhibited stereotypic behavior, with frequencies ranging from 3.9 to 29.4%, of all observations. These elephants exhibited individual, diurnal and seasonal variation ill stereotypic behavior. This has implications for studies that use short sampling periods and may make comparisons of data collected at different times of the day or year invalid. The six adult elephants spent 27.4-41.4% of the time feeding (between 10:00 and 14:00 hr), 22.9-42.0% standing still, 6.1-19.2% walking and 3.9-9.6% dusting. The hypothesis that the frequency of stereotypic behavior in adult cow elephants was negatively co-related with the frequency of feeding behavior was tested and was found to be true. Stereotypic behavior increased with frequency toward the end of the day-while waiting to return to the elephant house for food-and elephants spent more time stereotyping during the winter months than during the summer months. Elephants were inactive (i.e. exhibited behaviors other than locomotion) for between 70.1 and 93.9% of the time. Creating more opportunities for elephants to exhibit foraging behavior and the introduction of greater unpredictability into management

regimes, especially feeding times, may reduce the frequency of stereotypic behavior and increase general activity levels. © 2009 Wiley-Liss, Inc.

Y. Ren, M.T. Johnson, P.J. Clemins, M. Darre, S. Stuart Glaeser, T.S. Osiejuk & E. Out-Nyarko

**A framework for bioacoustic vocalization analysis using hidden Markov models**

*Algorithms 2 (2009) 1410-1428*

**Abstract.** Using Hidden Markov Models (HMMs) as a recognition framework for automatic classi cation of animal vocalizations has a number of bene ts, including the ability to handle duration variability through nonlinear time alignment, the ability to incorporate complex language or recognition constraints, and easy extendibility to continuous recognition and detection domains. In this work, we apply HMMs to several different species and bioacoustic tasks using generalized spectral features that can be easily adjusted across species and HMM network topologies suited to each task. This experimental work includes a simple call type classi cation task using one HMM per vocalization for repertoire analysis of Asian elephants, a language-constrained song recognition task using syllable models as base units for ortolan bunting vocalizations, and a stress stimulus differentiation task in poultry vocalizations using a non-sequential model via a one-state HMM with Gaussian mixtures. Results show strong performance across all tasks and illustrate the  exibility of the HMM framework for a variety of species, vocalization types, and analysis tasks. © 2009 by the authors.

A.L. Roca, Y. Ishida, N. Nikolaidis, S.O. Kolokotronis, S. Fratpietro, K. Stewardson, S. Hensley, M. Tisdale, G. Boeskorov & A.D. Greenwood

**Genetic variation at hair length candidate genes in elephants and the extinct woolly mammoth**

*BMC Evolutionary Biology 9 (2009) 232*

**Abstract.** Background: Like humans, the living elephants are unusual among mammals in being sparsely covered with hair. Relative to extant elephants, the extinct woolly mammoth, *Mammuthus primigenius*, had a dense hair cover and extremely long hair, which likely were adaptations to its subarctic habitat. The  broblast growth factor 5 (*FGF5*) gene affects hair length in a diverse set of mammalian species. Mutations in *FGF5* lead to recessive long hair phenotypes in mice, dogs, and cats; and the gene has been implicated in hair length variation in rabbits. Thus, *FGF5* represents a leading candidate gene for the phenotypic differences in hair length notable between extant elephants and the woolly mammoth. We therefore sequenced the three exons (except for the 3' UTR) and a portion of the promoter of *FGF5* from the living elephantid species (Asian, African savanna and African forest elephants) and, using protocols for ancient DNA, from a woolly mammoth. Results: Between the extant elephants and the mammoth, two single base substitutions were observed in *FGF5*, neither of which alters the amino acid sequence. Modeling of the protein structure suggests that the elephantid proteins fold similarly to the human FGF5 protein. Bioinformatics analyses and DNA sequencing of another locus that has been implicated in hair cover in humans, type I hair keratin pseudogene (*KRTHAP1*), also yielded negative results. Interestingly, *KRTHAP1* is a pseudogene in elephantids as in humans (although fully functional in non-human primates). Conclusion: The data suggest that the coding sequence of the FGF5 gene is not the critical determinant of hair length differences among elephantids. The results are discussed in the context of hairlessness among mammals and in terms of the potential impact of large body size, subarctic conditions, and an aquatic ancestor on hair cover in the Proboscidea.© 2009 Roca et al.

J. Saragusty, R. Hermes, F. Göritz, D.L. Schmitt & T.B. Hildebrandt

**Skewed birth sex ratio and premature mortality in elephants**

*Animal Reprod. Science 115 (2009) 247–254*

**Abstract.** Sex allocation theories predict equal offspring number of both sexes unless differential investment is required or some competition exists. Left undisturbed, elephants reproduce well and in approximately even numbers in the wild. We report an excess of males are born and substantial juvenile mortality occurs, perinatally, in captivity. Studbook data on captive births (CB, n=487) and premature deaths (PD, <5 years of age; n=164) in Asian and African elephants in

Europe and North America were compared with data on Myanmar timber (Asian) elephants (CB, n=3070; PD, n=738). Growth in CB was found in three of the captive populations. A signi cant excess of male births occurred in European Asian elephants (ratio: 0.61, P = 0.044) and in births following arti cial insemination (0.83, P=0.003), and a numerical inclination in North American African elephants (0.6). While juvenile mortality in European African and Myanmar populations was 21–23%, it was almost double (40–45%) in all other captive populations. In zoo populations, 68–91% of PD were within 1 month of birth with stillbirth and infanticide being major causes. In Myanmar, 62% of juvenile deaths were at >6 months with maternal insuf cient milk production, natural hazards and accidents being the main causes. European Asian and Myanmar elephants PD was biased towards males (0.71, P=0.024 and 0.56, P<0.001, respectively). The skewed birth sex ratio and high juvenile mortality hinder efforts to help captive populations become self-sustaining. Efforts should be invested to identify the mechanism behind these trends and seek solutions for them. © 2008 with permission from Elsevier.

J. Saragusty, T.B. Hildebrandt, B. Behr, A. Knieriem, J. Kruse & R. Hermes

**Successful cryopreservation of Asian elephant (*Elephas maximus*) spermatozoa**

*Animal Reprod. Science 115 (2009) 255-266*

**Abstract.** Reproduction in captive elephants is low and infant mortality is high, collectively leading to possible population extinction. Arti cial insemination was developed a decade ago; however, it relies on fresh-chilled semen from just a handful of bulls with inconsistent sperm quality. Arti cial insemination with frozen-thawed sperm has never been described, probably, in part, due to low semen quality after cryopreservation. The present study was designed with the aim of  nding a reliable semen freezing protocol. Screening tests included freezing semen with varying concentrations of ethylene glycol, propylene glycol, trehalose, dimethyl sulfoxide and glycerol as cryoprotectants and assessing cushioned centrifugation, rapid chilling to suprazero temperatures, freezing extender osmolarity, egg yolk concentration, post-thaw dilution with cryoprotectant-free BC solution and the addition of 10% (v/v) of autologous seminal plasma. The resulting optimal freezing protocol uses cushioned centrifugation, two-step dilution with isothermal 285 m Osm/kg Berliner Cryomedium (BC) with  nal glycerol concentration of 7% and 16% egg yolk, and freezing in large volume by the directional freezing technique. After thawing, samples are diluted 1:1 with BC solution. Using this protocol, post-thaw evaluations results were: motility upon thawing: 57.2 +/- 5.4%, motility following 30 min incubation at 37 degrees C: 58.5 +/- 6.0% and following 3 h incubation: 21.7 +/- 7.6%, intact acrosome: 57.1 +/- 5.2%, normal morphology: 52.0 +/- 5.8% and viability: 67.3 +/- 6.1%. With this protocol, good quality semen can be accumulated for future use in arti cial inseminations when and where needed. © 2008 with permission from Elsevier.

B.E. Slade-Cain, L.E.L. Rasmussen & B.A. Schulte

**Estrous state in uences on investigative, aggressive, and tail  icking behavior in captive female Asian elephants**

*Zoo Biology 27 (2008) 167-180*

**Abstract.** Females of species that live in matrilineal hierarchies may compete for temporally limited resources, yet maintain social harmony to facilitate cohesion. The relative degree of aggressive and nonaggressive interactions may depend on the reproductive condition of sender and receiver. Individuals can bene t by clearly signaling and detecting reproductive condition. Asian elephants (*Elephas maximus*) live in social matrilineal herds. Females have long estrous cycles (14–16 weeks) composed of luteal (8–12 weeks) and follicular (4–8 weeks) phases. In this study, we observed the behavior of four captive Asian elephant females during multiple estrous cycles over 2 years. We evaluated whether investigative, aggressive, and tail  icking behaviors were related to reproductive condition. Investigative trunk tip contacts showed no distinct pattern by senders, but were more prevalent toward female elephants that were in their follicular compared with their luteal phase. The genital area was the most frequently contacted region and may release reproductively related chemosignals. Aggression

did not differ signi cantly with estrus; however, rates of aggression were elevated when senders were approaching ovulation and receivers were in the luteal phase. © 2008 Wiley-Liss, Inc.

C. Thitaram, S. Chansitthiwet, P. Pongsopawijit, J.L. Brown, W. Wongkalasin, P. Daram, R. Roongsri, A. Kalmapijit, S. Mahasawangkul, S. Rojanasthien, B. Colenbrander, G.C. van der Weijden & F.J.C.M. van Eerdenburg

**Use of genital inspection and female urine tests to detect oestrus in captive Asian elephants**

*Animal Reprod. Science 115 (2009) 267–278*

Captive Asian elephant (*Elephas maximus*) populations are decreasing due to low birth rates compared to wild elephants. Improving oestrous detection in female elephants is required to ensure successful mating in captive and semi-captive herds. Responsive behaviours of eight semi-captive bull elephants to the uro-genital area (genital inspection test) or urinary pheromones (urine test) of 14 female elephants throughout the oestrous cycle were evaluated. Weekly blood samples were collected for 27 consecutive months (14 months for the genital inspection test and 13 months for the urine test) from female elephants to characterize the patterns of circulating progestagen. Responsive behaviours of bulls were compared between females in the follicular versus the luteal phase of the cycle. The sensitivity and speci city of the genital inspection test were 65% and 68%, while those of the urine test were 52% and 61%, respectively. The bulls showed signi cantly higher "genital inspection", " ehmen from genital area" and "trunk on back" behaviours during the genital inspection test, and " ehmen" behaviours during the urine test in oestrous than in non-oestrous females. In sum, this study showed that monitoring sexual behaviours of Asian elephant bulls towards females or their urine can be used to detect the oestrous period. Although the sensitivity and speci city of both tests were not as high as expected, still, these methods appear to be more ef cient at detecting oestrous than traditional methods based on mahout estimations of female receptivity. The use of genital inspection and urine testsmay lead to more successful matings and thus to creating self-sustaining populations of captive elephants in range countries. © 2008 with permission from Elsevier.

C. Thitaram, P. Pongsopawijit, S. Chansitthiwet, J.L. Brown, K. Nimtragul, K. Boonprasert, P. Homkong, S. Mahasawangkul, S. Rojanasthien, B. Colenbrander, G.C. van der Weijden & F.J.C.M. van Eerdenburg

**Induction of the ovulatory LH surge in Asian elephants (*Elephas maximus*): a novel aid in captive breeding management of an endangered species**

*Reproduction, Fertility and Development 21 (2009) 672-678*

A unique feature of the reproductive physiology of Asian elephants (*Elephas maximus*) is the occurrence of two LH surges before ovulation, instead of one. An anovulatory LH (anLH) surge, the function of which is unknown, occurs consistently 3 weeks before the ovulatory LH (ovLH) surge that induces ovulation. Thus, the ability to induce an ovLH surge would be useful for scheduling natural mating or arti cial insemination. The present study tested the ef cacy of a gonadotrophin-releasing hormone agonist (GnRH-Ag) to induce LH surges during the follicular phase of the oestrous cycle, which resulted in varied LH responses, but generally none were as high as previously documented natural surges. Thus, for the ovulation-induction trials, nine females were administered 80μg GnRH-Ag intravenously at three time periods during the oestrous cycle, namely the anovulatory follicular phase, the ovulatory follicular phase and the luteal phase. During the late anovulatory follicular phase, nine of 10 females (90%) responded with an immediate LH surge followed 15–22 days later by an ovLH surge or a post-ovulatory increase in progestagens. In contrast, despite responding to the GnRH-Ag with an immediate increase in LH, none of the females treated during other periods of the oestrous cycle exhibited subsequent ovLH surges. One cow got pregnant from natural mating following the induced ovLH surge. In conclusion, ovLH induction is possible using a GnRH-Ag, but only during a speci c time of the anovulatory follicular phase. © 2009 CSIRO, www.publish.csiro.au.

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P. Pongsopavijitr, K. Kornkaewrat, A. Pinyopummin, T. Angkawanish, S. Jansittiwate, R. Rungsri, K. Boonprasert, W. Wongkalasinh, P. Homkong, S. Dejchaisri, W. Wajjwalku & K. Saikhun

**Successful artificial insemination in the Asian elephant (*Elephas maximus*) using chilled and frozen-thawed semen.**

*Reproductive Biology and Endocrinology 7 (2009) 75*

**Abstract.** Background: Artificial insemination (AI) using frozen-thawed semen is well established and routinely used for breeding in various mammalian species. However, there is no report of the birth of elephant calves following AI with frozen-thawed semen. The objective of the present study was to investigate the fertilizing ability of chilled and frozen-thawed semen in the Asian elephant following artificial insemination (AI). Methods: Semen samples were collected by from 8 bulls (age range, 12-to 42-years) by manual stimulation. Semen with high quality were either cooled to 4°C or frozen in liquid nitrogen (-196°C) before being used for AI. Blood samples collected from ten elephant females (age range, 12-to 52-years) were assessed for estrus cycle and elephants with normal cycling were used for AI. Artificial insemination series were conducted during 2003 to 2008; 55 and 2 AI trials were conducted using frozen-thawed and chilled semen, respectively. Pregnancy was detected using transrectal ultrasonography and serum progestagen measurement. Results: One female (Khod) inseminated with chilled semen became pregnant and gave birth in 2007. The gestation length was 663 days and the sex of the elephant calf was male. One female (Sao) inseminated with frozen-thawed semen showed signs of pregnancy by increasing progestagen levels and a fetus was observed for 5 months by transrectal ultrasonography. © 2009 Thongtip et al.

E. Wiedner, A.R. Alleman & R. Isaza

**Urinalysis in Asian elephants (*Elephas maximus*)**

*J. of Zoo and Wildlife Med. 40 (2009) 659-666*

**Abstract.** Urine was collected from 22 healthy female adult Asian elephants (*Elephas maximus*) and analyzed for the purpose of determining normal biochemical and microscopic parameters. Findings included urine that was less concentrated compared to other mammals, predominantly alkaline pH, crystalluria of varying types in all samples, and minimal cellularity. Glucose and urobilinogen were not detected in any samples. Trace ketones and trace bilirubin occurred in two different samples. Trace blood was identified in another sample. Three samples tested positive for protein via dipstick but were confirmed negative through the sulfosalicylic acid test. Two samples contained mucus threads. Bacteria were seen microscopically in four samples, and could be cultured from six others, but, because of the lack of an associated inflammatory response and the heterogeneous populations of organisms observed, were considered to be contaminants from the distal urethra, the vestibulovulva, or the environment. Because of the variability in elephant urine, baseline values for elephants within captive herds should be obtained and regular assessments should be performed over time to allow trending of data. Establishment of normal urine values provides an important tool in elephant health care. © 2009 American Association of Zoo Veterinarians.

If you need additional information on any of the articles in the above section, please feel free to contact me. You can also let me know about new (2009-2010) publications on Asian elephants.

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Collared elephant "Tzu Chi", Sri Lanka
Photo by Jennifer Pastorini

# News Briefs

*Compiled by the Editor*

## 1. Rescue centre for elephants near Tiruchi (India)

*The Hindu*
*July 1, 2009*

TIRUCHIRAPPALLI - Ailing and old elephants in the wild and those in temples will get a place to rest with nutritious diet on hand if a proposal to set up a rehabilitation centre for jumbos at a zoological park near here gets the green signal. A proposal in this regard has been sent to Tamil Nadu government to segregate an area of about 50 acres within a 300 acre zoological park coming up in the reserved forests of M R Palayam near Tiruchirappalli Chennai National Highways.

The centre would maintain natural ambience with flora and fauna and adequate water resources for bathing elephants would be created by digging a large pond within the designated area. The centre could house about ten animals at any given time and the jumbos could be imparted intensive health care along with nutritious diet. Facilities would be created to impart appropriate training to mahouts on health care nuances of the animal, the officials said.

A jungle stream, sugarcane cultivation and planting coconut saplings within the area would also supplement the healthy ambience for the Jumbos. There were about 4,000 wild elephants in forest ranges like Mudumalai and Anaimalai.

Although rejuvenating camps are held every year in Mudumalai sanctuary, domestic elephants require regular care and maintenance which individual owners would not be able to provide. The proposed park, to be jointly developed by the state forest department and Central Zoo Authority, will house about 500 animals of 35 species that include spotted deer, hyena, Indian gaur, jackal, panther, lion, jaguar, peacock, aquatic birds, swamp birds, marine birds, monkey, fox, sloth bear and reptiles.

## 2. Indonesia's elephanticide: 15 endangered elephants killed by poachers with cyanide-laced fruit (Indonesia)

*The Associated Press*
*June 24, 2009*

Five wild elephants lie on the jungle floor after they were found poisoned to death in 2006. Elephant poaching has increased dramatically in 2009, an Indonesian official said Wednesday.

At least 15 endangered Sumatran elephants have been shot or poisoned to death with cyanide-laced fruit this year, marking a sharp rise in the rate of killing from 2008, a government conservationist said Wednesday. The giant mammals were mostly killed by poachers for their ivory. The number killed in the past six months is equal to the total for the whole of 2008, he said.

Indonesia's endangered elephants, tigers, rhinos and orangutans are increasingly threatened by their shrinking habitat in the jungle, which is commonly cleared for commercial farming or felled for lumber. Only 3,000 Sumatran elephants are believed to remain in the wild. They sometimes venture into inhabited areas searching for food and destroy crops or attack humans, making them unpopular with locals.

## 3. Forest Department drives elephants away from poisoned water (India)

*Indian Express*
*June 29, 2009*

Officials of the forest department on Saturday prevented seven elephants from drinking the contaminated water of the Kho river in Kotdwar. The contamination had killed thousands of fish.

Chief Wildlife Warden SK Chandola told The Indian Express, "When we came to know of thousands of fish having died in the Kho river.

We rushed to the area as it is a corridor for the movement of elephants." He said the officials reached just in time to find seven elephants ready to get into the river. "We resorted to continuous firing and had to explode strong crackers to scare them away into the jungle," said Chandola. He added the exercise continued for three hours.

Chandola said the forest department found an empty bottle of an insecticide that may have been emptied into the river. "It was after three hours that we saw fresh fish moving in the river. We later allowed the elephants to drink water from the river,"

**4. Rs 78 crore plan for jumbo home (India)**

*The Telegraph*
*August 5, 2009*

RANCHI - The state forest department is chalking out an action plan for managing the habitat of elephants in the state to prevent them from straying, thus checking man-animal conflicts. Rs 78 crore will be required for the programme, a part of the Project Elephant Scheme started by the Union government.

Under the programme, the department will take a number of measures to restrict the jumbos in their habitat. These include water harvesting, stocking of bamboos, solar electric fencing, solar power fencing, digging of trenches and radio-collaring system to detect movement of elephants in Dalma, Koderma, Sareikela, Khunti and Ranchi.

Besides, anti-depredation teams will be deployed in the village areas. The teams, comprising five to 10 members, will keep a tab on straying elephants. Armed with dragon torches and crackers, they will chase away pachyderms.

Talking to The Telegraph, chief life warden of the state forest department S. K. Sharma said: "Elephants stray as there are not enough provision for food and water in the forests. Hence we have decided to undertake water harvesting and plantations to improve the living conditions. If the habitat are improved, the population of elephants will also increase."

**5. Nepal probes elephant 'attacks'**

*BBC News*
*July 24, 2009*

Nepalese officials are visiting an area in the far east of the country to investigate attacks by elephants migrating from neighbouring India. More than 200 elephants are believed to have entered the region and have been blamed for destroying crops and killing villagers in border villages. With the onset of the annual monsoon, herds of wild elephants have crossed into Nepal from the forests of India. They are following traditional migratory routes. These routes lead them to rich paddy fields and fruit trees that lie over the border.

After Nepalis began shooting at the animals, the situation threatened to turn into an international incident. Last week the chief minister of the Indian state of West Bengal - which shares a border with Nepal - described the shooting as a crime. The Nepalese government say they will now pay compensation to villagers who have lost family members or been injured in attacks.



Elephants in southern Sri Lanka
Photo by Prithiviraj Fernando

**6. Underage elephant's pregnancy baf es vets at TATR (India)**

*Times of India*
*August 1, 2009*

CHANDRAPUR - The case of a minor elephant giving birth to a stillborn calf couple of weeks ago at Tadoba Andhari Tiger Reserve (TATR) has shocked the forest authorities as well as the veterinary doctors. It is a unique case and probably the rst in history of the species, when an elephant conceived at an age when she is still a calf. The senior vets who examined the stillborn calf and its minor mother have decided to report this unique case to wildlife magazine with the consent of forest department.

According to the TATR record Laxmi was born in 2001 and had not attended the maturity for mating. Last year she was brought from Sironcha forest range in Gadchiroli district to the TATR. "According to forest authorities Laxmi was mere 8 years. Generally it is between 9 and 13 years that a female elephant comes into estrus phase. After entering this stage the elephant becomes ready to conceive (and is called a cow elephant).

**7. Elephant found dead, suspected poisoned (Indonesia)**

*The Jakarta Post*
*August 11, 2009*

A male elephant has been found dead at the Way Kambas National Park in Lampung with both its trunks missing, kompas.com reported Tuesday. The park's director, John Kenedie, said Tuesday the two-year-old elephant may have been poisoned. Park of cials found him dead at his cage at about 2 a.m. on last Friday. The trunks weigh close to 70 kilograms and are valued at tens of millions of rupiah.

"The thieves might have fed him with food that was laced with rodenticide," John said; adding that the thieves were probably familiar with the park. Wildlife Conservation Society (WCS) activist M. Gio said trunk hunters are now targeting elephants bred in national parks due to the dwindling population of wild elephants. The Way Kambas park covers 125,000 hectares of land and is home to 250 elephants.

**8. Indonesian elephant fossil opens window to past (Indonesia)**

*The Associated Press*
*June 23, 2009*

BANDUNG (AP) – Indonesian scientists are reconstructing the largest, most complete skeleton of a prehistoric giant elephant ever found in the tropics, a nding that may offer new clues into the largely mysterious origins of its modern Asian cousin.

The prehistoric elephant is believed to have been submerged in quicksand shortly after dying on a riverbed in Java around 200,000 years ago. Its bones — almost perfectly preserved — were discovered by chance in March when an old sand quarry collapsed during monsoon rains.

The animal stood four meters (13-feet) tall, ve meters (16-feet) long and weighed more than 10 tons — closer in size to the woolly mammoth of the same period than to the great Asian mammals now on Earth. Animal fossils are rare in the humid, hot climate of the equator because decomposition occurs extremely quickly.

"We believe from the shape of its teeth that it was a very primitive elephant," but little else has been veri ed, said paleontologist Fachroel Aziz, who



Tea elephant in Assam, India
Photo by WWF India

is heading a 12-strong skeletal reconstruction team. Scientists agree it is the first time an entire prehistoric elephant skeleton has been unearthed since vertebrate fossil findings began to be recorded in Indonesia in 1863.

**9. Tusker kills cow elephant in Rajaji Park (India)**

*Press Trust of India*
*September 17, 2009*

HARIDWAR (PTI) - A cow elephant was gored to death by a tusker in Dhaulkhand range of Rajaji Park in Uttarakhand, officials said today. The incident took place yesterday after the two elephants fought over mating and the pachyderm pierced its tusks into the stomach of cow elephant resulting in latter's death. The postmortem report confirmed its death as a result of a violent struggle, they said.

**10. State bid to end ban on wild jumbo-trapping (India)**

*Times of India*
*August 20, 2009*

GUWAHATI - Assam has asked the Centre to lift a 1982 ban on mela 'shikar', a traditional way of trapping wild jumbos with the help of domesticated elephants. "We want the Centre to withdraw the ban so that we can acquire wild elephants and domesticate them for government duties," said state forest minister Rockybul Hussain on Thursday. The jumbos are needed for carrying guards and tourists in wildlife sanctuaries, transporting EVMs and polling officials to remote areas.

The mela shikar' method involves noosing a wild elephant from the back of a trained tusker. The capture of wild pachyderms was banned in India in 1982 after they were brought under the Schedule I species of the Wildlife Protection Act, 1972. Prior to this, the Indian elephant was included in Schedule-II (Part I) of the Act under which they were granted the status of "Special Game" and could be killed or captured under licence as well as traded commercially.

According to the 2008 census, there are 5,281 wild elephants in the state. In 2002, the census counted the population at 5,246. On the other hand, there are about 1,290 domesticated and trained elephants owned by individuals across the state. But, after the Supreme Court ban on timber felling in 1994, the jumbos employed for the purpose were rendered jobless.

**11. Police arrest ivory smugglers (Vietnam)**

*Saigon Giai Phong*
*August 21, 2009*

Thanh Hoa Police detained two men who are suspected to smuggling 17 elephant tusks Thursday morning. The police stopped a car carrying 17 elephant tusks, weighing 94 kilos in total. The car was driving on Ho Chi Minh Road, the section running through Luan Thanh Commune, Truong Xuan District.

The car was driven by Cao Xuan Vinh, 20, resident of Dien Lam Commune, Dien Chau District, Nghe An Province. Police originally stopped the driver for a traffic violation. While checking the driver's papers, the police came upon an elephant tusk lying next to his seat.

Commander Le Minh Tam, head of the police unit, decided to search the entire car. The team then found a further 11 tusks under the hood and five others on the floor of the car.

Also in the car was Le Van Chien, 37, owner of the car, living at the same address as Xuan. Chien said that he was transporting the tusks from Nghe An to Hanoi.

**12. 105 pachyderms killed in seven months (Sri Lanka)**

*Sunday Island*
*September 13, 2009*

Under the government funded 300 million rupee 'Gaja Mithuro' elephant conservation program in 2009, plans had been drawn for setting up solar powered electric fences, elephant control units and elephant drives as solutions to reduce the

elephant– human con ict. Action had been taken to curtail the elephant-human con icts which had caused the loss of many lives.

The electric fences have a voltage of 8000 volts and an elephant would get thrown when the animal comes into contact with it, but it won't die. Eleven elephant control units have been set up in Kotavehera, Kekirawa, Kebetogollawe, Karuwalagaswewa, kanthalai, Pimburuwawewa, Wilgamuwa, Wellawaya and Baduluwewa and each unit has an driver with a vehicle and eight persons functioning under the direction of the respective District Secretary and Divisional Secretariat.

**13. Elephant poaching racket busted (India)**

*Times of India*
*September 15, 2009*

MADIKERI - Forest of cials have busted an elephant poaching racket and arrested four persons from Kodagu at Hunsur recently, trying to sell ivory worth Rs 75,000. The gang is involved in poaching and selling ivory and wildlife skins in Kodagu, Bandipur and Chamrajnagar. Ivory and other materials worth rupees Rs 3.5 crore have been seized.

Forest SP Krishnamurthy disguised himself as a buyer and went to Hunsur to track the criminals. As the gang sat for a deal, the sleuths rounded them up and arrested Raju, a gram panchayat member from Nagarahole Tribal colony, Appanna from Kumbarakatte Tribal colony, Ravikumar from Bommadu Tribal colony and national forest sanctuary watcher Shankara. Shankara owns four tempovehicles and a motor bike. The arrested were handed over to Hunsur police on Sep. 11.

**14. Rogue elephant captured (Malaysia)**

*New Straits Times*
*October 9, 2009*

JERITH - A rogue elephant that has been causing havoc in Pelagat for almost a week was nally captured by wildlife authorities on Wednesday. The 12-year-old wild elephant walked into a trap set up three days ago by the State Wildlife department with the help of locals. For almost seven days before that, the elephant had caused havoc in three villages — Pelagat, Paroh and Padang Tapung — by destroying their crops. The rampage took place especially at nights, causing widespread fear among villagers for their safety.

The operation involved 21 members from Terengganu and Pahang wildlife departments, said Besut Perhilitan chief Edley A Jailium. The Pelagat area is notorious for rampages by wild elephant, Many of them come from the Terengganu-Kelantan border.Villagers are constantly living in fear, and there have been reports of elephant herds, some as many as 10-12, roaming the plains where their crops are cultivated. However, there have been no attacks on the villagers so far.

**15. Cambodia villagers save elephants**

*BBC News*
*October 13, 2009*

Elephants are losing their natural habitats, becoming a tourist attraction. Conservationists in Cambodia have brokered an agreement which should see elephants living more peacefully alongside their human neighbours. Villagers living near elephant habitats have promised not to harm the animals - or disturb their environment. In return the local farmers are receiving help to keep the elephants away from their crops.

Human-elephant con icts can develop wherever the animals live close to people. As villagers develop and expand their land, elephants lose their habitat. At the same time, they become more likely to wander into elds - destroying crops and occasionally attacking humans and livestock.
Wild alternatives

This situation has put wild elephant populations in danger in a number of countries.
Conservationists are keen to prevent the same thing happening in Cambodia.
Elephant numbers are nally on the rise here - after decades of war and deforestation.

The organisation Fauna and Flora International is helping to keep the peace between people and pachyderms. It is giving villagers funding to develop small businesses like chicken-farming - as an alternative to clearing the forests the elephants call home.

They are also giving advice on how to keep the elephants away from crops. “Growing different types of crops is one line of defence, such as chilli fences around the boundaries of their fields. Elephants don’t like chillies, so they will naturally turn the other way. If that doesn’t work, or if chillies aren’t available, then we can deploy solar-powered electric fences.

**16. Fossils of ancient elephants found in Yunnan (China)**

*Global Times*
*November 5, 2009*

Fossils of ancient elephants were found in Shuitangba community, in Taiping Village, Zhaoyang District, in Zhaotong City, Yunnan Province recently when local farmers were digging for coal. Archeologists say this is the largest site of fossils of ancient elephants in South China.

In the Zhaotong Basin of Yunnan where the fossil was found, over 10 new types of fossils of ancient elephants have been unearthed since the 1950s. Archeologists estimate that the fossil discovered in Shuitangba community lived 3 million to 7 million years ago. The restored fossils can form three skeletons of the ancient elephants, one of which has a tusk 2.6 meters long and weighed 150 kilograms.

According to Jiang Nina, an archaeologist from the University of Pennsylvania who participated in the excavation, the Zhaotong Basin was a swamp filled with water birds, lizards, tortoises and elephants millions of years ago, where old animals died and new ones came into being.

Moreover, Asia’s earliest primate tooth was also discovered at the site. Fossils of ancient apes living 3 million to 7 million years ago will be a significant contribution into the research on the origin of humans.

**17. Elephants in Vietnam: Just 80 left**

*VC International News, quoting VietNews*
*December 3, 2009*

At the rate it’s going, Vietnam will kill off all their wild elephants within two years. In 1975, Vietnam’s Ministry of Agriculture and Rural Development estimated that the nation’s elephant population numbered about 2,000 individuals. Today, there are only 80 left.

Illegal poaching and loss of habitat through deforestation are the primary killers. Though trade in ivory was outlawed in 1992, a loophole in the ban -- that sellers can continue to sell ivory obtained before the band, makes enforcement nearly impossible. Traders can simply claim that new ivory is really old ivory. There is little that officials can do. Tusks can fetch up to $1,500 in the black market. Every year, around 4,000 tons of illegal wildlife products pass through Vietnam, according to a report by TRAFFIC, an international wildlife trade monitoring group.

Elephants have the largest brains of any land animal and exhibit a remarkable array of advanced behaviors associated with rituals, grief, music, art, altruism, play, use of tools, compassion and self-awareness.



Photo by Prithiviraj Fernando