# GAJAH

NUMBER 32
2010

## Journal of the Asian Elephant Specialist Group



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Number 32 (2010)

The journal is intended as a medium of communication on issues that concern the management and conservation of Asian elephants (*Elephas maximus*) both in the wild and in captivity. It is a means by which members of the AsESG and others can communicate their experiences, ideas and perceptions freely, so that the conservation of Asian elephants can benefit. All articles published in *Gajah* reflect the individual views of the authors and not necessarily that of the editorial board or the AsESG.

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GAJAH
Journal of the Asian Elephant Specialist Group
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## Contents

Gajah 32 (2010)

Editorial 1-2
*Prithiviraj Fernando*

Notes from the Co-chairs IUCN/SSC Asian Elephant Specialist Group 3-5
*Ajay A. Desai and Simon Hedges*

Status of the Asian Elephant Population in Mudumalai Wildlife Sanctuary, Southern India 6-13
*N. Baskaran, A. Udhayan and Ajay A. Desai*

Human-Elephant Conflict—What Can We Learn from the News? 14-20
*S. Doyle, M. Groo, C. Sampson, M. Songer, M. Jones and P. Leimgruber*

The Veterinary Care of Domesticated Elephants in Laos by a Mobile Veterinary Unit 21-26
*Florence Labatut and Ingrid Suter*

Group Size and Age-Sex Composition of Asian Elephant and Gaur in Mudumalai Tiger Reserve, Southern India 27-34
*M. Ashokkumar. R. Nagarajan and Ajay A. Desai*

Estimating Asian Elephant Population in Dindugul, Kodaikanal and Theni Forest Divisions, Western Ghats Tamil Nadu 35-39
*A. Kumaraguru, K. Karunanithi, S. Asokan and N. Baskaran*

Solitary Behaviour of Female Elephants in Idukki Wildlife Sanctuary, Kerala 40-41
*Kannan Govindaraj*

Supporting Wild Elephant Conservation, Sustaining Laos' Pride and Culture 42
*Noy Promsouvanh*

Human Aspects of Human-Elephant Conflicts 43-44
*Jayantha Jayewardene*

The Last Few Minutes of an Asian Elephant 45-46
*T. Murugavel*

CITES Alone Cannot Solve the Elephant Crisis 47-49
*David M. Lavigne*

Report from EU-Asia Link Training Course on "Asian Elephant Breeding and Health Management in South East Asia" 50-51
*C. Thitaram, S. Mahasawangkul and A. Silva-Fletcher*

Recent Publications on Asian Elephants 52-65

News Briefs 66-71

*Gajah 32 (2010) 1-2*

# Editorial

Prithiviraj Fernando (Member Editorial Board)

**Whose responsibility is it?**

Today human-elephant conflict (HEC) has become a major socio-economic and political issue in many Asian elephant range countries. In spite of much effort at mitigating the conflict, it seems to be escalating over most of elephant range. On the one hand the number of incidents of HEC has steadily increased and on the other, the tolerance of people has decreased. With 'development' and changing attitudes, people are less willing to accept any losses due to wildlife in general and elephants in particular.

Where people traditionally considered part of their harvest was for the birds of the air and beasts of the ground, the farmer of today has little empathy with those who would partake of his harvest uninvited. Media, which frequently sensationalizes the damages and deaths caused by elephants drives the reducing tolerance. Currently it is becoming more common in Sri Lanka to stage public protests, burn tires, block roads and carry the mortal remains of persons killed by elephants to Wildlife Department offices, and to manhandle officials whenever an 'elephant incident' occurs.

It is not only the people who have changed but also the elephants. Where elephants of the past took flight at the mere sound of a human voice and generally kept away from anything 'human', elephants of today are more and more coming to accept conflict as the norm and responding to it in kind. In many areas elephants are increasingly raiding crops in the face of heightened efforts at confronting them as they are willing to accept ever greater levels of conflict. Attempted chasing of crop raiding bulls is increasingly met with violent responses from them that result in injury and death of farmers. Throw stones at a sleeping dog every day and he will jump on you even before you throw a stone one day. What we have with the elephants of today is the same situation. The HEC we have to deal with today is a monster of our own creation.

The response of most authorities to the increasing HEC is to up the ante. The Wildlife Department in Sri Lanka currently distributes tens of thousands of 'elephant crackers' (firecracker that is about a foot long and an inch in diameter, practically a small bomb) annually to farmers for battling elephants. A doubling of the amount is on the cards. Greater numbers of elephant crackers and shooting with 'repeater' shotguns are used for periodic 'elephant drives' undertaken by the Wildlife Department to move elephants to protected areas. People confront elephants with everything ranging from stones and sticks to home-made shot guns and throwing lighted fuel soaked ash on elephants that sticks and burns. The end result is over 220 elephant deaths and 50 human deaths in Sri Lanka in 2009 alone.

Is there no alternative to this escalating spiral of confrontation? What about passive barriers? Of the multitude of elephant barriers that have been tried and found wanting, electric fences stand out as the one method that has failed the least. The problem with electric fences is expense and maintenance. Currently electric fences cost around $ 5000 per km. Who should bear this cost? Maintenance on electric fences consists mainly of clearing vegetation that would touch the fence and repairing any breakages. Someone needs to walk along the fence every few days and attend to it. Who should be responsible for such maintenance?

One school of thought would say that the need for a fence is because elephants are being conserved hence it is the responsibility of the conservation establishment. Such an argument would hold water if elephants were introduced to an area for the purpose of conservation and were subsequently causing problems. A parallel would be your neighbor acquiring some cows which then jump over the hedge into your backyard and eat the prize flowers. However the reality is that HEC is caused not by the introduction of elephants into what was originally human habitat but

development and settling of areas with elephants. If a person decides to build a house in an area with elephants, should he not take measures to safe guard his house or at the least lend a hand protect his house from elephants? If I cultivate in an area with elephants is it someone else's duty to guard my cultivation so that I can reap the benefit? As discussed in the note by the co-chairs in this issue, if a development agency undertakes a development project in an area with elephants that results in HEC, whose responsibility is it to institute preventive measures and take adequate safe guards to protect the development? If the development causes escalation of HEC in surrounding villages is it someone else who should take care of the problem?

Why we are faced with an escalating HEC that is rapidly becoming unmanageable in some areas is that in most cases those who settle, cultivate and conduct developmental activities in areas with elephants, undertake such activities irresponsibly, expecting someone else to solve the HEC that are born out of their deeds. This has gone so far in Sri Lanka for example that now there are millions of people, houses, paddy fields and other cultivations in areas with elephants, and the Department of Wildlife Conservation which has a thousand personnel in total is expected to 'guard' all of them. Billions of dollars are spent in development projects such as infrastructure, irrigation and commercial plantations, in areas with elephants. The budget for conservation agencies in most range countries are a few paltry millions at best with which they are supposed to address the problems created by the billions in investments. This mismatch in problem creation and solving is too lopsided in the case of HEC for there to be any meaningful results.

Take the case of human deaths and injuries caused by elephants. Unlike a man-eating tiger or lion there is no gain for an elephant in killing a person. No elephant goes around looking for people to kill. In Asia especially, elephants living as they are in a sea of people, have to actively avoid people all the time. In most instances of human deaths and injury there is something the person could have done different that would have prevented the incident. Many such incidents are caused by drunkenness, walking alone or going on a bicycle or motorbike after dark in areas with elephants. Most instances of house breaking are due to storage of paddy harvest in the house. Elephant pushes wall, wall topples on those sleeping under it. People living in areas with elephants traditionally took many safeguards. They went to their fields in the evening while it was still light. They had a tree hut in the field, which afforded them protection from elephants, but today people are less and less willing to accept the fact that they are living in areas with elephants and to take necessary safeguards.

If we are to effectively address the HEC and prevent its escalation a change in paradigm is needed. We need to move away from the spiral of escalating conflict. Those in areas with elephants and those conducting developments in areas with elephants as well as funding agencies that support such developments need to realize that doing business in areas with elephants has consequences. They need to take responsibility for preventing, mitigating and managing HEC that arise out of their doings. Development and funding agencies investing in areas with elephants need to integrate HEC prevention and mitigation plans for the development and areas of increased conflict into project design and implementation. The costs of such activities have to be part of the project cost and mechanisms and funding for management of HEC have to be in place for the duration of the conflict and not just the project implementation period.

Finally, it is not to say that the conservation establishment does not have any responsibility for mitigating HEC, they need to come up with better ways to manage and mitigate HEC with least detriment to elephant conservation. However HEC is so complex, extensive and pervasive, that it is a battle they alone cannot even begin to fight. The precious and paltry sums of money that are represented by conservation dollars are less than a drop in the bucket that we are trying to douse a raging fire with. If we are serious about effectively mitigating HEC and elephant conservation, we need to think in terms of development scale investments in time, funds and effort to address the problem.

*Gajah 32 (2010) 3-5*

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

Ajay A. Desai and Simon Hedges

Recently there was a discussion on developing a 'tiger filter' – this was about identifying 'no go' and 'go' areas for development in and around tiger habitat. Two important doubts or worries were expressed. First, do we actually need an analytical tool to identify such areas? And second are we then, by default telling developers to do what they want in the 'no go' areas? Will we then not be identifying certain areas as being 'unimportant' and sending the wrong message?

Tiger conservation, claimed a retired Director of Project Elephant in India, had one drawback. It created 'elitist' tigers, i.e. those living in Tiger Reserves. The apparent neglect and the subsequent loss of tigers living outside the Tiger Reserves (actually the bulk of the tigers) possibly led to the decline of tiger populations. He warned that elephant conservation should not follow a similar path.

Elephant conservation has not really had elephant specific Protected Areas (PAs) as in the case of Project Tiger in India. People involved in elephant conservation (governments, conservationists, scientists, etc.) have always recognized the need to deal with all elephants. This may have to do with the fact that elephants, wherever disturbed by man, cause conflict that is very visible. They are probably the only species that brings the fight back to people whenever their habitat is lost or degraded. Thus highlighting their problem and setting off warning bells.

Back in the 1980's AsESG members and several elephant conservationists spoke about 'Managed Elephant Ranges' (MERs) outside the PAs as being a complete solution to conserving elephants. It was recognized that range states would find it difficult to set aside large areas that would meet the conservation requirements of the species in standalone PAs. It was also not possible to declare all elephant habitat as PAs. So MERs were critical for elephant conservation especially since the bulk of the population (> 60%) ranges outside PAs. Unlike PAs, MERs would have multiple uses allowing resource use by man but in a manner that was not detrimental for elephants. MERs would provide connectivity between PAs or provide additional habitat outside PAs and thus address the spatial requirements of elephants. It would also address the need to secure habitat for populations living outside PAs.

Most Asian elephant range states are currently facing problems related to protecting forests, due to rapid development. Growth in Asia has hit exponential levels and with communication (via TV and printed media) reaching even the most remote areas, economic aspirations of the people have risen very sharply. Everyone wants to be a part of the rapid economic growth. The bulk of development unfortunately is based on using or exploiting forested areas. Forests and conservation are therefore a low priority on most governments' or publics' mind. In India it is mining, agriculture and infrastructure development. In Sri Lanka it is agriculture and infrastructure development. In Malaysia and Indonesia it is agro-forestry and logging. In other parts of Asia similar developmental pressures exist.

Habitat across the elephant range is being lost rapidly and elephants are being rendered homeless. Human-elephant conflict is naturally increasing because of this. Governments unable to resolve existing HEC effectively are actually pursuing or allowing land use practices that are creating new HEC situations or are exacerbating existing ones. Consequently retaliatory killing is emerging as a major cause for elephant deaths and it is exceeding poaching in countries like India. So where does this leave elephant conservation? Are we headed towards what some AsESG members pessimistically felt in the 1980's – that elephants will be conserved only in PAs in future? Or will there be MERs as envisaged by them, covering large areas and making elephant conservation meaningful?

Elephant habitat is far from secure; loss, fragmentation and degradation have been the biggest and least addressed part of the elephant conservation problem so far. The focus, internationally, has been on the illegal killing of elephants for ivory and other elephant products. While poaching may pose an extinction threat in some range states, it is not an immediate threat in others. Habitat loss on the other hand is a range wide problem but it rarely gets the kind of international or national attention that poaching does. We also need to note that PAs too are far from secure; they too are threatened by habitat loss and degradation in many areas. This is not to deny that poaching is a serious threat that needs to be addressed urgently, but rather to suggest that there is a clear need to focus on habitat conservation on an equally serious and urgent basis.

Currently development is eating into elephant habitat in an *ad hoc* manner. This results in fragmentation of habitat, creation of pocketed populations or creation of poorly structured habitat patches that escalate HEC. Effective and functional MERs can be created only if there are suitable, adequate and connected habitat patches. We are currently running out of time to create MERs as *ad hoc* development is undermining the conservation potential of most remaining habitat patches.

There are several steps we need to take urgently to implement MERs. First there is a need for a focused and sustained effort to make governments accept MERs as a means to conserve elephants. Second there is a need to identify all elephant habitats that are currently suitable for such actions including those which can be restored without major resettlement of people or infrastructure. We need to map and analyze elephant habitat to identify MERs. To do this we would need to know and understand what the spatial requirements of elephants are in different habitat types. We would also need to take into account elephant behaviour, genetic requirements, carrying capacity and population size. The various aspects of HEC, ranging from size and shape of the MER to the intensity of conflict would have to be taken into consideration. It would also require the development of acceptable model(s) for MERs and their management. We would need to define which human activities/uses of elephant habitat would be compatible (to an extent) with elephant conservation. And how those activities or uses would need to be regulated and their adverse impacts (if any) mitigated.

The creation of MERs will not completely stop habitat loss brought about by unavoidable or essential development. This is where a tool (like the tiger filter) that helps identify ‘go’ and ‘no go’ areas for development will be important. Development will continue with or without such tools or even MERs. The absence of these has in fact facilitated unplanned development causing far more damage. This unplanned development has severely undermined the conservation potential of whole areas. A GIS based analytical tool that helps assess if the planned development is acceptable or not will be a great help. Where acceptable or where habitat loss is unavoidable it will give us the ability to identify areas whose loss (or disturbance) will cause the least damage. However such planned development can only happen if there is integrated development planning. Such planning should involve the development and conservation agencies at all levels of planning in and around elephant habitat. In addition it would require a dedicated elephant specific ‘Environmental Impact Assessment’ (EIA). Such an EIA would use the GIS tools coupled with existing knowledge of elephant behaviour, ecology and HEC to determine the impact of any planned development. An EIA assessment is ultimately an assumption based on our limited knowledge of elephants about their likely responses to development or loss of habitat. We need to go beyond that with systematic and sustained monitoring of elephants in and around the developed area to assess actual impacts. Such monitoring would be able to identify all the impacts and consequently hold the concerned development agency responsible for all adverse impact. The costs of elephant conservation and HEC mitigation originating from development should be borne directly by the concerned development agency. Only then will unplanned and unnecessary development by government and private agencies be regulated.

Talking of costs, we need to recognize that there will not be enough room for all elephants even when MERs are created. What to do with elephants living outside MERs for whom there may be no hope for conservation (doomed populations)? This is a difficult question that we need to answer collectively. But more importantly we need to make sure that the government and private agencies that cause habitat loss are made aware of and held responsible for creating doomed populations. The general public also needs to be made aware of how unplanned and unregulated development is condemning many populations to the 'doomed population' category.

At present all development in elephant habitat is seen as having no direct cost in terms of elephant lives. This is a fallacy, whenever elephant habitat is lost or fragmented a part of the population is destined to die out eventually due to resource crunch. This is little understood and rarely highlighted or even thought about. It's time that everyone is made aware of this so that we place a higher price on elephant habitat and on elephants. Recent studies by Prithiviraj Fernando and his team in Sri Lanka are giving us new insights on such impacts and the impacts are very serious – elephants are dying when habitat is lost.

Elephant habitat in most countries represents the few large tracts of forests remaining. The ecosystem services that these forests provide are critical to the ecological security of man. Elephants through HEC are not only making us aware of their plight but are also reminding us of our own bleak future. Habitat loss directly equates with the loss of elephants eventually and also with high levels of HEC. So we need to make the development agencies take direct responsibility for this. Only that may stop or minimize our onslaught on elephant habitats in future. Aside from our site specific conservation work we need to rapidly move towards targeting elephant conservation at the national level because elephants require that urgently.

We would also like to thank Ravi Corea and his team for putting out the HECTF document online. We also thank Jayantha Jayewardene and his team for their efforts in publishing the *Gajah* and Hank Hammatt for hosting the AsESG website.

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Elephants in the Nilgiri North Forest Division, India
Photo by Jennifer Pastorini

*Gajah 32 (2010) 6-13*

# Status of the Asian Elephant Population in Mudumalai Wildlife Sanctuary, Southern India

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## Introduction

The elephant population in Mudumalai Wildlife Sanctuary has been estimated using various methods in the past. Total count method was used extensively by the Forest Department from the 1970 until 1980. Ratio method based on individually identified elephants was used by Daniel *et al*. (1987). In addition, line transect indirect method (dung count) was tested by Dawson (1990) and direct sighting method by Varman & Sukumar (1995). The Tamil Nadu Forest Department has been using the line transect (direct count) method to estimate the population of larger mammals since 1995. However, these efforts have been hampered by lack of equipment and trained personnel needed to ensure precision of measurements.

The results of these studies have varied widely and it is difficult for the managers to make realistic use of these widely varying figures. Additionally, focusing largely on estimating the elephant densities alone, recent studies have failed to account for other important aspects of elephant population demography like the age structure, sex ratio, etc. There has also been no attempt to compare the past and present population density or the age structure and sex ratio of the elephant population. Knowledge of the age structure of population is essential for investigating trends in recruitment, mortality and reproductive status of the population (Lindeque 1991; Stearns 1992). Needless to say that estimating elephant densities with reasonable accuracy and precision is the very first step in this direction, which is merely a gathering of data. Interpreting the results beyond this point has more implications for management.

The present study was done primarily to address this shortcoming. Taking the baseline study done in the mid-1980 (Daniel *et al*. 1987) as a starting point, the present study attempts to record the cumulative changes that have taken place in the elephant population in Mudumalai Wildlife Sanctuary over the past 12 years. The study by Daniel *et al*. (1987) used a reasonably accurate but time-consuming method of estimating the population using the ratio between known and unknown elephants encountered during the study. Elephants were individually identified using natural markings like tusk/tush size and shape, cuts and holes in the ears and tail length and hair pattern (Douglas-Hamilton 1972). The differences in the methods used to estimate population, minor differences in the area sampled and the inability to attribute absolute accuracy and the precision to the past and the present density estimates rule out estimating absolute changes in the densities. However, considering the time interval between the two studies and also management requirements of knowing gross changes and trends in the population, the present comparison and results should be more than adequate for management purposes. The limitations, as can be expected in any study, have been highlighted in the beginning itself not to detract from the merits of the study but to ensure that readers' focus and debate are channelled towards management implications of the results rather than remaining fixed totally and unproductively on the academic merits of the study. The study was carried out between January 1999 and February 2000 with three major objectives of estimating population density, the age–sex structure and determining the accumulated changes in the population over the past 12 years using the earlier study (Daniel *et al*. 1987) as baseline.

## Methods

*Study area*

The study area, Mudumalai Wildlife Sanctuary, is located at the tri-junction of three southern states of India, namely Tamil Nadu, Karnataka and Kerala (Fig. 1). It lies between 11º 32' and 11º 45' N and 76º 20' and 76º 45' E and is a part of the Nilgiri Biosphere Reserve. The sanctuary is spread over 321 km$^2$ and bounded to the north by Bandipur Tiger Reserve and to the west by Wayanad Wildlife Sanctuary and to the south and east by Nilgiri North Forest Division. Mudumalai Wildlife Sanctuary is a part of Elephant Range 7, which is one of the 11 elephant ranges, declared by the Project Elephant, Govt. of India (Project Elephant: *Gajatme* 1993). This range extends over 12,900 km$^2$ of forest in the Western and Eastern Ghats. It has tenuous link with Elephant Range 8, which covers an area of 2385 km$^2$ and there is movement of elephants between Elephant Ranges 7 and 8 (Baskaran *et al*. 1995). These Ranges together cover an area of 15,000 km$^2$ and support a population of 8572 elephants (Project Elephant 2005). The large contiguous area and the large elephant population together represent the largest single Asian elephant population in Asia.

*Population size*

The elephant population density was estimated using the line transect method (Burnham *et al.* 1980). Mudumalai Wildlife Sanctuary has fairly good visibility and high elephant density that makes line transect a suitable method. Sampling was done using randomly located transects as follows. First, 2  2-km grid overlaid on 1:50,000 topographic maps of Mudumalai Sanctuary; all the grids were numbered. A total of 58 grids (blocks) were selected using systematic random sampling method. Within the selected grid, a transect of 2 km length was randomly laid but were aligned to ensure that they ran across altitudinal gradients or drainage patterns. Out of 58 transects, 50 were covered twice and eight were covered thrice (with one covered partially (1 km) in one of the survey). On transects, whenever elephants were sighted, sighting angle (using a compass), sighting distance (using a range finder), group size and age–sex classification were recorded.




**Figure 1.** Map showing the Mudumalai Wildlife Sanctuary (study area) and its adjoining forest divisions in different states of southern India.

Mean group (cluster) size (G) and its SE was estimated based on data where complete counts of individuals were obtained on transects. Grouping the data into 20 m perpendicular intervals, elephant cluster density (C) and its SE was estimated using the "*Fourier Series Estimator*" implemented in *'Transect'* programme. Individual elephant density (D) was arrived at by multiplying the mean group size (G) by the elephant cluster density (C). Standard error of individual elephant density (seD) was calculated using standard error of cluster density (seC) and standard error of mean group size (seG) using Goodman's (1960) formula: (seD) = C (seG) + G (seC) – (seC) (seG) and used the same to workout the 95% confidence limit of individual elephant density.

*Population structure*

In addition to data gathered during the transect work, data on age–sex structure of the population was gathered on an *ad hoc* basis whenever elephants were encountered in the study area. Elephants were classed into four age classes, i.e., calf (<1-year old), juvenile (>1 year to 5 years), sub-adult (for females > 5 years to <16 years and for males >5 years to 20 years) and adults (for females ≥16 years and for males ≥20 years).

The differentially structured age groups for male and female were adopted to allow comparison with the earlier study (Daniel *et al.* 1987), which used these criteria. During the 1985–1987 period females of 16 years and above were breeding, while males below 20 years (even though sexually mature) were being excluded from breeding by the older bulls. Currently, the lack of older bulls (due to selective poaching) allows the younger bulls to breed. Applying the old criteria may not represent the effective sex ratio but we feel that given the gross negative trend in the sex ratios, the marginal change of a corrected age classification would not bring any change in the outcome.

Sex classification was simple in the adult and sub-adult age classes as males have tusks (Fig. 2), which are clearly visible in these age classes. However, a small percentage of males (*makhnas*) do not have tusks but their identification (especially older sub-adults and adults) is fairly easy considering characteristic features such as the presence of penis sheath and the bulge of the penis below the anal region (in older males), slanting back, broad musculature of trunk base and the social context of the individual (a sub-adult or adult solitary elephant without tusks was suspected to be a *makhna* and an effort was made to confirm this). Though younger sub-adults may pose some problems, proper observations allow their identification. In the case of juveniles, differentiating a *makhna* from a female at this stage was not always possible, as the younger animals are short and the presence of tall grass makes identification a difficult task in some areas. In the case of calves, sex identification is very difficult (can be done only when the calf is clearly visible while urinating) and thus sex ratio was assumed as 1:1 for calves.



**Figure 2.** An adult bull in musth at Mudumalai.

Data was used for the analysis only when the entire herd could be classified into different age-sex categories. Solitary animals and herds were encountered on 142 occasions and data on the age structure could be obtained for all herd members only in 112 cases. The other 30 cases, where data on age structure could be obtained only for partial herd members were excluded from the analysis. However, a comparison made between the age structure estimated with and without them showed no significant difference between the two estimates indicating that the eliminated 30 cases are very similar to the 112 cases retained for the analysis. In the 112 cases, a total of 586 elephants were classified into the different age classes. All adults seen were classified and out of a total of 141 sub-adults recorded, the sex of only four individuals could not be determined. Sexing juveniles was difficult; especially those below two years of age, and 11% of the juveniles that could not be classified into sex classes were excluded from the analysis.

## Results and discussion

### *Population size*

From 247 km of walking along 58 line transects, 25 groups of elephants were recorded and the estimated results are presented in Table 1. The coefficient of variation estimated for the cluster density is 25% and this indicates that greater sampling effort would be needed to derive a more precise estimate. Taking the estimated cluster density of 0.45 (± SE 0.11) per $km^2$ and the mean group size of 5.32 (± SE 0.37) elephants, population estimated for Mudumalai Wildlife Sanctuary (area = 321$km^2$) is 768 (95% lower and upper confidence interval = 536–1001). The

**Table 1.** Population density (elephants/km$^2$) estimated based on line-transects in 1999–2000.

| Parameter | Density | SE | 95% CI | |
|---|---|---|---|---|
| | | | lower | upper |
| Cluster | 0.450 | 0.113 | 0.229 | 0.671 |
| Individual | 2.39 | 0.723 | 1.67 | 3.12 |

present estimate (2.39 elephants/km$^2$) is much lower than the 3.58 elephants/km$^2$ estimated by Varman & Sukumar (1995). The study by Varman & Sukumar (1995) covered only part of the Mudumalai Wildlife Sanctuary and also relied more on temporal replicates of a few (5 transects) longer transects unlike the present study that extensively relied on spatial replicates using 58 transects across the Sanctuary with a minimum of two-time sampling of all the transects over a period of one year. The elephant density estimated by the present study is comparable with the density estimated earlier in 1999 by the Forest Department using line transect direct sighting method (2.46 elephants/km$^2$) using a similar layout of transects as the present study.

This estimate, however, cannot be viewed in isolation, as Mudumalai Wildlife Sanctuary is part of a larger elephant range that includes Elephant Ranges 7 and 8 and covers an area of over 15,000 km$^2$. Desai (1991) and Baskaran *et al*. (1995) have shown that elephants using Mudumalai Wildlife Sanctuary also range across into Bandipur National Park (Karnataka), Wayanad Wildlife Sanctuary (Kerala) and Nilgiris North Division (Tamil Nadu). Elephants from Mudumalai Wildlife Sanctuary have been shown to have home ranges of over 600 km$^2$ (Baskaran *et al.* 1995), which is nearly twice the size of Mudumalai Wildlife Sanctuary. Considering these facts, the population estimate should be viewed as an estimate of the average number of elephants using the Mudumalai Wildlife Sanctuary during the sampling period rather than as a fixed resident population.

The present population estimate is much higher than the earlier estimate of approximately 350 elephants (Daniel *et al.* 1987). The earlier study estimated the population size using the ratio method based on the ratio of known (individually identified elephants): unknown elephants in the population (Douglas-Hamilton 1972; Sukumar 1985). Though there is a possibility that the study of Daniel *et al*. (1987) could have underestimated the population to some extent, it is unlikely that there was gross underestimation. While differences in sampling methods and efforts could be responsible for some of the differences in the estimates, they are unlikely to account for such major changes. Therefore, the increase in population indicated by the present study can be considered significant even though the two sampling efforts cannot be compared directly. The earlier study (Daniel *et al.* 1987) had coarsely estimated growth rate at approximately 1~2% per year, despite the heavy male mortality due to poaching. The present population estimate indicates a significant growth over the past 12 years. Data on recruitment and mortality for different age classes could not be gathered in this study and hence it is not possible to ascertain if the present population is still growing. But managers should take into consideration the fact that the population was estimated to be growing even when there was heavy poaching during 1985–87 period (Daniel *et al*. 1987); therefore, it is likely that the current population will also be growing rather than stabilizing or declining.

The effect of male-biased poaching on the overall elephant population size would have been more severe in the initial stages when the sex ratios were closer to even, rather than, when they are heavily skewed in favour of females. For example, in a population of 25 males and 25 females, 20 males need to be killed to bring down the sex ratio from 1:1 to 1:5, but it requires only four additional males to be killed to further reduce the sex ratio from 1:5 to 1:25. With the highly reduced adult male population, the impact of poaching of adult males would not have a significant numerical impact on the elephant population size. Nevertheless, there is reason to believe that the declining sub-adult male population over the past 12 years, where the sex ratio has gone down from 1:1 to 1:2.9 (see below), would still have had an impact on the overall elephant population size. The contribution of adult and sub-adult males to the overall growth of the elephant population size would be limited due to poaching. However, there have been no real checks on the growth of female population

**Table 2.** Age structure and sex ratio of the elephants during 1985–87 (Daniel *et al*. 1987) and 1999–2000 (present study).

| Age class | 1985–1987 ($n$ = 1449) | | 1999–2000 ($n$ = 566) | |
|---|---|---|---|---|
| | Age structure (%) | Sex ratio (M:F) | Age structure (%) | Sex ratio (M:F) |
| Adult | 39.3 | 1 : 4.9 | 41.5 | 1 : 29.4 |
| Sub-adult | 21.1 | 1 : 1.1 | 24.1 | 1 : 2.9 |
| Juvenile | 25.8 | 1 : 0.8 | 24.9 | 1 : 1.5 |
| Calf | 13.8 | 1 : 1* | 9.5 | 1 : 1* |

* assumed

and this would have contributed to the population growth. All these arguments lend support to the assessment that there is a high probability that the population is growing.

*Population structure*

Taking into consideration only the age structure of the population, there appears to be very little difference in the overall population age structure between 1985–87 and 1999–2000 (Table 2). However, major changes can be detected when we take into consideration both the age structure and sex ratios (Table 2). Number of males in the adult class is very poor (Fig. 3) and no adult males over 40 years of age were recorded during the study. The adult class has increased from 39.3 to 41.5% in the past 12 years. However, considering that the adult male population has declined from 1: 4.9 (male to female sex ratio) in 1985–87 to 1: 29.4 in 1999–2000, it is evident that the adult class is composed predominantly of females indicating a significant increase in the adult female population. This would be the result of continuous recruitment of sub-adult females into the adult class coupled with low adult female mortality. In the case of males, there would have been reduction of the adult class due to poaching as well as reduced recruitment from the sub-adult class due to the decline in the sub-adult males, which is again due to poaching.

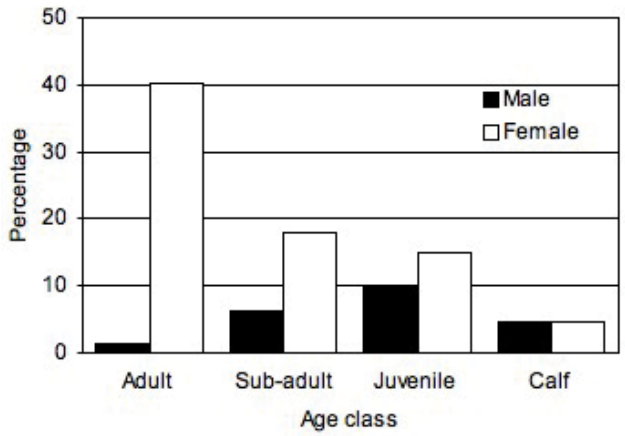



**Figure 3.** Percentage of various age and sex classes of elephants during 1999–2000.

In the case of sub-adults also, there was an increase from 21.1% in 1985–87 to 24.1% in 1999–2000. Here too, the proportion of males has declined from 1:1.1 recorded in the earlier study to 1:2.9 in the present study. This again indicates a large increase in the sub-adult female population. Additionally this situation also points to an increased recruitment into adult female class in the future. The increased sub-adult population recorded in the present study also indicates that breeding was not hampered in the 80s and early 90s despite the reduction in the adult males.

The juvenile class shows a marginal decline from 25.8% in 1985–87 to 24.9% recorded in the present study. As this class covers a four-year interval (>1 year to 5 years), which is less than the inter-calving interval of 4.7 years recorded in the earlier study (Daniel *et al*. 1987), changes of this magnitude can be natural as a result of variation in the number of females breeding in any given year described below in detail. Without long-term monitoring, it is difficult to attribute these changes to any specific cause. What is however evident is that despite the declining male population, the breeding does not appear to have declined at least until the mid-90s. This could be due to the polygamous nature of the males, which allows them to mate with multiple females. This should not be a reason for complacency as the situation is very serious as far as poaching of males is concerned.

The percentage of calves, though lower than the earlier study, may not be cause for worry, if it is

occurring naturally. The long inter-calving interval in elephants results in only a small and varying percentage of females calving in any given year. A high calving rate in any year is usually followed by lower calving rate in subsequent years, as there will be fewer females remaining to calve in the population (Douglas-Hamilton 1972; Daniel *et al.* 1987). However, reduction in the number of calves can be a cause for serious concern, if it is the result of reduced breeding due to lack of adult bulls. The highly skewed sex ratio in the present study points in this direction. However, a short-term study cannot really pinpoint the cause of lower calf numbers, as there is no data from the previous years for comparison. This highlights the need for systematic and long-term monitoring of elephant populations especially in the light of the adverse condition (poaching and anthropogenic pressures) the population is undergoing. Reduced breeding due to a decline in the male population could result in reduced recruitment into the population in future. Although this may appear to address the problem of growing elephant population, it cannot be considered as a management or conservation tool. The problem of declining male number (due to poaching) and the growing elephant population need to be addressed separately.

The adult male to adult female ratio has deteriorated from 1: 4.9 in 1985–87 to a very poor and alarming 1: 29.4 in 1999–2000. Daniel *et al*. (1987) had recorded a high level of poaching and reported 90% of the adult male and 100% of the sub-adult deaths were caused by humans. There is little doubt that poaching and other human-related causes of deaths are the main reason for the continued decline of the male population. What is even more worrying is the fact that the sex ratio in the sub-adult age class also shows a significant decline from 1: 1.1 in 1985–87 to 1: 2.9 in 1999–2000. This is especially alarming as it indicates that males are being eliminated even before they join the breeding pool. It also points to a very slow recovery of the adult male population in future due to reduced recruitment.

As discussed earlier the sharp deterioration in the adult sex ratios could result from a few adult males being killed. But the change in the sub-adult sex ratios, even though small, would be a consequence of higher level of killings as here the figures deviate from an initial 1: 1.1 ratio to the current 1: 2.9 indicating that large numbers would need to be killed to change the ratio from this level. The juvenile class also shows changes. A part of this could be due to natural reasons (random effect) as the ratio estimated earlier by Daniel *et al*. (1987) was 1: 0.8 in favour of males. Poaching of juvenile males has been recorded earlier on rare occasions but it is largely opportunistic; but the threat of juvenile males becoming targets of poachers cannot be ruled out. Even the marginal money derived from opportunistic poaching of such animals would significantly supplement a poacher's income, especially when larger males are becoming increasingly scarce and difficult to locate.

What is apparent from the analysis is that poaching has adversely affected the male population and now in a male-depleted population even low intensity poaching poses a serious threat to the population of Mudumalai Wildlife Sanctuary and adjoining areas. There is an urgent need to re-assess the status of the elephant population in the Elephant Ranges 7 and 8, not just densities alone but by focusing more on other demographic data that are of greater relevance for future management. These two Elephant Ranges form one of the best in Asia, both in terms of habitat and elephant population and their effective management and conservation should take the highest priority.

**Conclusions and recommendations**

Mudumalai Wildlife Sanctuary is too small an area to be viewed in isolation, as its elephant population (Fig. 4) is not restricted to the sanctuary. This population is affected by threats within Mudumalai and also from threats well outside the administrative boundary of the sanctuary. Two major issues emerge from the present study: first, the male-biased poaching, which is leading to a skewed sex ratio and the second is that the population is growing while habitat size in the area remains the same or declines due to loss, degradation and fragmentation. Mudumalai Wildlife Sanctuary represents a sub-sample of

the population in the Elephant Range 7; lessons learnt here are also broadly applicable to the Elephant Ranges 7 and 8. Needless to say, that over such large areas conditions and situations will vary and managers should take that into account.

Poaching remains the most urgent and immediate threat. Managers should recognize that elephants range outside their individual PAs due to their large home range sizes and the areas outside the PAs are more vulnerable to poaching because of their poor infrastructures and staff strength. Desai (1991) and Baskaran *et al*. (1995) have highlighted this problem. There is a need for greater focus on and support to these vital but often-neglected areas outside the PAs.

Managers should note that the skewed sex ratio means that very few males remain in the population. Under such circumstances, the poaching of even a single male will have a disproportionately large and adverse impact on the population. Therefore, what is seen as low intensity poaching at this stage still poses a serious threat. Current anti-poaching activities should be sustained and strengthened further.

The lower proportion of calves and juveniles in the population could be cause for worry, if it is due to reduced breeding as a consequence of the highly skewed sex ratio. This vital aspect points to the need for monitoring of all demographic parameters on a systematic basis in the future.

The elephant population of the sanctuary and its adjoining areas has grown significantly, while their habitats remain the same or in reality might have declined in both extent and quality due to anthropogenic pressures. Daniel *et al*. (1987) and Sivaganesan & Sathyanarayana (1995) have noted that elephants (and forest fire) were having an adverse impact on tree species in Mudumalai Wildlife Sanctuary. Daniel *et al*. (1987) suggested that while addressing the immediate threat of poaching, managers should take into consideration the problem of growing elephant populations and their impact on habitats. This aspect has all but been forgotten with all the action being focused on containing poaching. The impact that elephants have on their own habitat and how that in turn affects biodiversity is not clearly known in the Asian situation. The decline in preferred tree species recorded by Sivaganesan & Sathyanarayana (1995) and the recent proliferation of exotic weeds in the elephant habitats point to a worrying future. A study of this aspect is urgent especially, because elephants are keystone species and their overabundance could be more adverse than beneficial. Without a study that produces tangible results to give directions to management on how to deal with local overabundance, the debate can go on endlessly and fruitlessly.

It is not within the scope of this work to suggest management action required to meet this emerging (if not already serious) problem of local overabundance. There is an urgent need for further research, planning and action to tackle it.

There is a need to standardize data collection (on population) using robust methods. Capacity building by training and developing a core team of Forest Department staff and others (NGOs) is essential to systematically monitor elephant populations in the future. There is also a need to monitor the other aspects of elephant population and shift focus from primarily determining the densities.

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**Figure 4.** An elephant herd having a dust bath in Mudumalai Wildlife Sanctuary.

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# Human-Elephant Conflict—What Can We Learn from the News?

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## Introduction

Human-elephant conflict (HEC) poses the single greatest threat to the survival of wild Asian elephants. HEC is not a new phenomenon. Humans and elephants have been utilizing the same space for thousands of years (Sukumar 1989, 2003; Fernando *et al.* 2005; Fernando & Leimgruber in press). However, human populations in Asia elephant range countries now constitute ~26% of the world's population (1.79 billion excluding China. Source: U.S. Census Bureau 2009) and there is fierce competition for space and resources between people and elephants. HEC results in injury and death to humans, crop raiding, damage to villages and huts, and an increased resentment of elephants (Hedges *et al.* 2005; Fernando *et al.* 2005, 2008a). Despite widespread reverence for wild elephants, poisoning and electrocution of elephants are increasing as local people attempt to protect their livelihoods (Uryu *et al.* 2008; Perera 2009). In the last two decades, the situation has worsened because elephant habitat is not only lost to small-scale subsistence agriculture but also to broad-scale conversion of vast natural areas into industrial plantations for sugar, tea, paddy, and palm oil (Flint 1994; Sodhi *et al.* 2004; Koh & Wilcove 2008; Uryu *et al.* 2008).

Relatively, little hard data is available on extent, contributing factors, spatial patterns, and consequences of HEC across Asia (Hedges *et al.* 2005; Fernando *et al.* 2005). A recent review (Perera 2009) and an IUCN workshop at the 2009 annual meeting of the Society for Conservation Biology in Beijing, indicate HEC usually is only recorded at local but not at national or regional levels. Yet, HEC is widely recognized as the main driver for the continued decline of the species (Santiapillai & Jackson 1990; Leimgruber *et al.* 2003; Sukumar 2003; Hedges 2006; Choudhury *et al.* 2008). The little data that exist are not standardized and difficult to locate and access because they are deemed too sensitive to be shared widely. Meanwhile, news outlets throughout Asia are continually reporting on HEC and this information is readily available via the Internet. The Kenya-based organization Save the Elephant (STE) is compiling news items on elephants and providing them to a wide audience via a listserv news service. We used the STE listserv archive to compile and analyze HEC reports from the news media and to address three questions:

1. What level of HEC is reported in the news media across the Asian elephant range?
2. What are the causes of conflict based on the information from news media?
3. Can reports in the news media be used to monitor HEC across Asia?

## Methods

STE has been providing a free email news service on Asian and African elephants since 2000 (http://www.savetheelephants.org/elephant-news-service.html). The service has >1,000 subscribers and disseminates daily news stories, publications, and other information. Using STF's archive, we extracted 193 news stories on HEC in Asia for the period from August 18, 2003 to July 29, 2009. We augmented this information by including 13 news items that we found in the Elephant News Listserv (http://www.elephant-news.com/) for the period from November 2, 2006 to March 2, 2008. We included news reports on HEC and elephant poaching. Almost all of the poaching reported in the news, occurred close to conflict areas. In these poaching reports,

**Table 1.** Classification of HEC outcomes and causes of elephant mortality.

| Outcomes/Causes | Definition |
|---|---|
| Crop raiding | Elephants raiding agricultural fields |
| Village attack | Elephants entering village and raiding crops, destroying huts or other property, or killing people |
| Huts destroyed | Number of live-in structures destroyed during crop raiding or village attack |
| Human mortality | Number of people killed |
| Elephant mortality | Number of elephants killed |
| Poaching | All elephant deaths attributed to poaching by local authorities. In all cases tusks or body parts were removed. However, all poaching in the news reports we included, occurred in or close to HEC areas. |
| Culling | All elephant deaths in which government officers shot an elephant perceived to cause problems |
| Conflict | All elephant deaths that resulted from direct or indirect conflict with local people. Includes intentional shooting, poisoning, and electrocution, as well as unintentional electrocution or accidents. |
| Trains | Elephants killed by trains |

often the motives for killing elephants seem to be both, a response to HEC and the intent to acquire and sell ivory or elephant body parts. Thus, for the purpose of our analysis we regarded all news reports on poaching as conflict. We did not include HEC involving working, temple, or zoo elephants. Using Google Earth (http://earth.google.com/), we mapped HEC locations for all news articles that provided a geographic reference (town, village, district, etc.).

To assess HEC patterns reported in news media across Asia, we summarized the type of HEC, people and elephants killed, causes of elephant deaths, and methods used to kill elephants (Table 1). Countries with large wild populations might be expected to experience more HEC, and countries with more HEC may have higher human and elephant mortalities. To test for these patterns we calculated Spearman rank correlation coefficients between elephant population size and HEC, and between HEC and human and elephant mortality respectively. We also tested whether a country's human population size was significantly correlated with the number of HEC incidents.

## Results

We found 206 incidents of HEC throughout Asia, resulting in the deaths of 226 people and 87 elephants. More than half of the HEC incidents (n=118, 57%) were located outside of the geographic elephant ranges provided by the IUCN (Fig. 1). Crop raiding was the most common HEC type (36%), followed by village attacks (26 %) and the destruction of human habitations (27%; Table 2).

India had the highest number of HECs (n=110), and the highest mortalities for humans and elephants (Table 2). Agricultural-related conflicts (38%) were the most common type of HEC. In

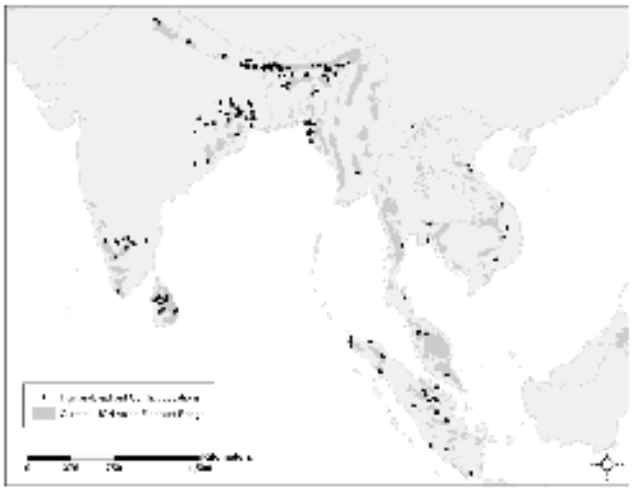


**Figure 1.** HEC locations (black points) in Asia relative to geographic range of Asian elephant range (gray polygons). Source: <http://www.iucnredlist.org/apps/redlist/details/7140/0/rangemap> accessed Oct. 2009.

**Table 2.** HEC incidents reported in the news media and their consequences.

| Country | # HEC Reports | Crop raiding | Village attacks | Huts destroyed | # people killed | # elephants killed | Wild population rank[1] |
|---|---|---|---|---|---|---|---|
| Bangladesh | 18 | 4 | 12 | 13 | 41 | 1 | 4 |
| Bhutan | 1 | 1 | 0 | 0 | 0 | 0 | 5 |
| Cambodia | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| China | 1 | 0 | 1 | 0 | 0 | 0 | 3 |
| India | 110 | 42 | 32 | 29 | 113 | 49 | 13 |
| Indonesia | 23 | 13 | 3 | 3 | 16 | 20 | 10 |
| Laos | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Malaysia | 4 | 3 | 0 | 1 | 0 | 1 | 8 |
| Myanmar | 1 | 0 | 0 | 1 | 1 | 0 | 11 |
| Nepal | 22 | 3 | 7 | 5 | 45 | 4 | 2 |
| Sri Lanka | 16 | 4 | 1 | 1 | 8 | 11 | 12 |
| Thailand | 4 | 0 | 0 | 0 | 2 | 1 | 9 |
| Vietnam | 6 | 5 | 0 | 2 | 0 | 0 | 1 |
| Total | 206 | 75 | 56 | 55 | 226 | 87 | |

[1]Populations were ranked by relative size with 13 being the largest remaining wild population. Rankings were developed by adjusting estimates in Sukumar (2003) based on other published work (Blake & Hedges 2004; Choudhury *et al.* 2008; Leimgruber *et al.* 2008; Perera 2009).

Bangladesh, HEC most commonly resulted attacks on villages and huts. In Indonesia, 57% of HEC stems from agricultural crop raids by elephants. We found no news reports on HEC for Cambodia and Laos.

Human mortalities from HEC were highest in Bangladesh, Nepal and India (18%, 20% and 50%, respectively; Table 2). Indonesia overall has very little HEC, but the country's elephant mortality from HEC constitutes 23% of all reported HEC-related elephant deaths in Asia. All of these elephant mortality results from poaching and conflict with villagers. Bangladesh had only one reported case of elephant mortality, but all HEC for Bangladesh involved the death of a person.

Primary causes for killing elephants in HEC included, poaching (22%), culling by government officers (8%), killed during crop raiding (43%), or killed in train accidents (29%; Table 3). Poaching and conflict killing of elephants were highest in India and Indonesia. Elephant mortality from train accidents were reported only from India, Sri Lanka, and Malaysia.

Poached elephants usually were shot (58%, Table 4), but we found three cases in which elephants were poisoned before tusks and body parts were removed. In three additional killings, poachers used explosives that were packaged inside food and were probably intended for the killing of smaller animals. All three elephants died slow deaths from the wounds inflicted inside their mouths.

Poison was the most frequently used method for killing elephants in agricultural conflict (62%), followed by electrocution (19%) and shooting (16%). Poisoning and shooting is always intentional. Electrocution may sometimes be accidental.

Countries with higher levels of HEC had significantly higher human and elephant

**Table 3**. Causes of elephant deaths reported in news media.

| Country | Poaching | Culling | Conflict | Trains | Total |
|---|---|---|---|---|---|
| Bangladesh | - | 1 | - | - | 1 |
| India | 11 | 4 | 20 | 14 | 49 |
| Indonesia | 6 | - | 14 | - | 20 |
| Malaysia | - | - | - | 1 | 1 |
| Nepal | 1 | 2 | 1 | - | 4 |
| Sri Lanka | 1 | - | 1 | 9 | 11 |
| Thailand | - | - | 1 | - | 1 |
| Total | 19 | 7 | 37 | 25 | 87 |

**Table 4.** Methods used to kill for elephant deaths from poaching and human-elephant conflict.

| | Poaching | | | | Conflict | | | |
|---|---|---|---|---|---|---|---|---|
| Country | Shot | Poisoned | Electro-cuted | Explosives | Shot | Poisoned | Electro-cuted | Other |
| India | 8 | 1 | - | 2 | 4 | 9 | 6 | 1 |
| Indonesia | 4 | 2 | - | - | - | 14 | - | - |
| Others | 1 | - | - | 1 | 2 | - | 1 | - |
| Total | 11 | 3 | - | 3 | 6 | 23 | 7 | 1 |

mortalities. (r=0.84, DF=11, p=0.003; r=0.88, DF=11, p=0.002; respectively). The estimated size of wild elephant populations did not affect the number of HEC incidents (r=0.20, DF=11, p=0.471). However, countries with large human populations have significantly higher levels of HEC (r=0.56, DF=11, p=0.05).

## Discussion

Overall numbers of HEC detected in the news media via online news services are lower than numbers reported from other sources (Sukumar 1990; Nyhus *et al.* 2000; Hedges *et al.* 2005; Perera 2009). In India alone, HEC may cause ~300 human deaths and ~200 elephant deaths each year (Bist 2002) and in Sri Lanka ~50-70 human deaths and ~150 elephant deaths (Perera 2009)! In a recent summary of HEC patterns based on published data and expert information, Perera (2009) showed higher levels of HEC based on estimates of human fatalities for India (~300 vs. 113 in our study), Sri Lanka (50-70 vs. 8), Nepal (66 vs. 45), Vietnam (26 vs. 0) and lower levels for Bangladesh (38 vs. 41) and Indonesia (3 vs. 16). Remarkably, while news media coverage represents an underestimate, the relative patterns are very similar to the ones described by Perera (2009). HEC incidents, as well as human and elephant mortality, highest in two hotspots: South Asian and Sumatra. India has the highest overall HEC numbers. News media coverage of HEC, thus, cannot be used to determine actual levels of HEC, but may indicate ongoing patterns.

Despite obvious biases, news media information also provides some potential new insights. Sumatra has much higher HEC incidents than described by Perera (2009). Partly, this is explained by the fact that Perera (2009) relied on published information from localized studies (e.g. Hedges *et al.* 2005), rather than information covering all of Sumatra. Also, news media information indicates significant differences in HEC patterns between the two hotspots, with many more *human fatalities/HEC event* in South Asia and many more *elephant fatalities/HEC event* in Sumatra.

South Asian countries have the highest human population densities in the region and also support some of the largest elephant populations remaining in the wild (Leimgruber *et al.* 2003; Sukumar 2003; Choudhury *et al.* 2008). The combination of these factors increases the probability for negative interactions between people and elephants and the probability for human fatalities. The comparatively low number of elephant deaths is probably the result of a combination of religious and cultural inhibitors to killing animals, a deep-rooted appreciation of the species by people, and the existence of comparatively well-functioning protection systems. HEC in South Asia has been high for a long time and also may be accepted as a natural condition by farmers.

Our results along with other publications indicate increases in HEC in Sumatra during the last 2-3 decades that resulted in unparalleled numbers of elephant killings (Hegdes *et al.* 2005; Uryu *et al.* 2008). Uryu *et al.* (2008) found that >200 elephants disappeared or were killed during conflict from expanding palm oil plantations between 2000 and 2006 in Riau alone. An additional 224 elephants were removed from conflict areas by elephant capture teams. Elephant populations declined from 1342 in 1984 to 210 in 2007 (Uryu *et al.* 2008). Poaching or poisoning were among the most common causes of elephant deaths and these deaths were often located near or around an agricultural area. Many of the news sources indicate that villagers have been frustrated with the lack of compensation for crops lost to elephant

raiding. As frustration is increasing, farmers are retaliating against the presence of elephants and escalating HEC by laying out fruit laden with poison, such as cyanide-laced pineapples, to kill raiding elephants (The Times of India 2009).

Ultimately, the HEC increase in Sumatra can be attributed to the explosive and rapid land cover and land use changes that have been occurring since the 1980s. The region has experienced some of the highest deforestation rates globally due to logging and agricultural conversion (Kinnaird *et al.* 2003; Uryu *et al.* 2008; Hansen *et al.* 2009). For example, in only 25 years Riau province has lost 65% of its forests (Uryu *et al.* 2008). Similarly, 40% of all lowland forest in Sumatra and Kalimantan was cleared between 1990 and 2005 (Hansen *et al.* 2009). Such forest loss rates are only paralleled by deforestation rates in the Brazilian Amazon (Hansen *et al.* 2009). The major driving force behind this environmental and conservation catastrophe is the conversion of forest ecosystems to oil palm plantations. The consequences of dramatic forest loss for mammals in Indonesia, and elephants especially, are well-documented (Kinnaird *et al.* 2003; Hedges *et al.* 2005; Uryu *et al.* 2008).

In addition to the deforestation patterns and increased frustration levels, lack of previous experience in HEC by the local population, as well as the absence of cultural or religious inhibitors to killing animals, may have contributed to the incomparably high number of elephants poisoned and shot from HEC in Sumatra. With historically much lower HEC rates, there may also be a conspicuous lack of traditional mitigation knowledge and techniques for HEC.

Notably missing from the news reports about HEC in Sumatra is the removal of "problem" elephants into Elephant Training Centers (Lair 1997; Nyhus *et al.* 2000; Mikota *et al.* 2006). Created by the Indonesian government in 1986, these camps were intended to manage and train elephants removed from HEC areas with the intension of later using them for logging or ecotourism. The camps have received hundreds of elephants despite significant problems in their management and care (Mikota *et al.* 2006).

Generally, HEC throughout Asia is driven by expanding human populations and agricultural development. Not surprisingly, we found a significant relationship between human population size and HEC. Countries with high human population densities had the highest number of HEC incidents. Some of these countries, especially India and Sri Lanka, also have the largest remaining populations of wild elephants. Together these two countries may hold as much as 45-54% of all living wild Asian elephants (based on Sukumar 1989). However, we did not find a significant correlation between HEC and estimated elephant population sizes at the country level, suggesting that human overpopulation and overexploitation of land plays a more important role in determining HEC intensity than elephant abundance.

Much of the HEC (57%) reported by newspapers is found outside the geographic range for Asian elephants (Fig. 1). This is a surprising finding and we have three possible explanations: 1) HEC may be more common in places where remnant elephant populations or even individuals are living in human-dominated landscapes well away from currently mapped wild elephant populations; 2) the recently established range map by IUCN AESG is incomplete and is omitting several elephant areas; 3) the current range map is based on habitat and population assumptions that are not correct for elephants; and 4) the news reports did not include accurate spatial information or our mapping technique was too coarse. All four explanations probably play a role in explaining the spatial pattern and it is difficult to assess their relative importance. However, if these assessments are correct there may be significant numbers of elephants outside the currently mapped geographic range.

The prevalence of elephant deaths from railroad accidents in new media reports was surprising. Likely these events attract more media attention, resulting in over-emphasize of this problem. Overall train and traffic accidents probably are much less of a threat to wild elephant populations than death during crop raiding and poaching (see Perera 2009).

## Conclusion

The lack of information on the extent of and patterns in HEC throughout Asia is a serious problem that impedes development of region-wide conservation strategies for Asian elephants. It also reduces the ability of the conservation community as well as national and international agencies to monitor Asian elephant declines effectively. This is further exacerbated by the fact that conservation organizations and agencies have invested large sums of money to collect and synthesize existing information, and to monitor illegal killing of elephants throughout the region via the CITES MIKE Asia program. Recent IUCN workshops on the current status of Asian elephants in Cambodia (November 2008) and HEC in Beijing (August 2009) have attempted to collate some of this information and to provide guidance on how to systematically collect this data in the future. The judgment on the efficacy of these workshops is still out as we are awaiting reports of the results.

A fundamental problem may be that the responsibilities for monitoring and reporting HEC have not been assigned. Maintaining such a monitoring effort is expensive and requires long-term commitment, institutional capacity, infrastructure, and support from local and national governments. As a consequence the responsibility should probably reside with the appropriate natural resource agency in the different countries. However, which agency likes to report the frequency of management problems? Unfortunately, conservation NGOs lack many of the requirements for the effective long-term monitoring of HEC, specifically long-term persistence and institutional capacity.

Information gleaned from news media, i.e. civil society, may be one tool to use to try and capture changes and increases in the patterns of HEC. As is obvious from our research, such data has significant biases but it may be used to initiate discussions and additional research and monitoring to reduce HEC and conserve Asian elephants. However, based on the current experience it seems that the best strategy to monitor further elephant losses to HEC might be a strategy that involves civil society; i.e. citizens in elephant range countries that take it upon themselves to collect information on the problem.

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# The Veterinary Care of Domesticated Elephants in Laos by a Mobile Veterinary Unit

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## Introduction

Once a commonly occurring species, it is now estimated that only 1200 elephants remain in Laos, compared to tens of thousands at the beginning of the 1900's (Chadwick 1991). Of this about 480 or 40% are domesticated (Maurer & Duffillot 2009).

The legal status of elephants in Lao is dependent on the elephant's classification as "wild" or "domestic". Domesticated elephants are viewed as livestock and are managed by the national Department of Livestock and Fisheries. Wild elephant -management is undertaken by the Department of Wildlife and Forestry. The Lao PDR became signatory to the CITES convention in 2004, therefore trade and international sale of this globally endangered species is subject to regulation. The government of Laos banned the capture of elephants from the wild for domestication in the late 1970s.

Domesticated elephants in Lao PDR are mainly employed in the logging industry in the north, and tourism in the south (Maurer & Duffillot 2009). The traditional use of elephants for transportation still occurs in small remote villages providing employment for immature and unemployed logging elephants. Elephants tend to be used only in areas where the terrain is steep and roads are few, creating access problems. The development of logging industry for the last 30 years created a new opportunity for elephant owners who were used to use them for local transportation. This has led to an intensification of workload, which can threaten an elephant's health.

Tourism is a growing industry in Laos, with 1.7 million visitors in 2008, up from 500,000 a decade ago (LNTA, 2009). Though new camps are established each year, elephant trekking is still in its infancy. For the moment no more tourism activities are available, but a sanctuary, sponsored by ElefantAsia, is about to see the light. Employment opportunities in tourism for domesticated elephants are currently low but could become significant in the future. Currently some elephants are employed in both logging and tourism.

Several ethnic groups such as the *Tai Leu* tribe in northern Laos and the *Kui* tribe in southern Laos possess traditional knowledge of elephant care and breeding. However as the image of a mahout is not highly regarded by younger generations, widespread loss of knowledge regarding traditional medicine and elephant care has occurred.

To rectify this situation, ElefantAsia, an International Non Government Organisation (www.elefantasia.org) working for the protection and conservation of Asian elephants in the Lao PDR, initiated a domesticated elephant conservation project in 2002. Consultations with mahout regarding their socio-economic needs showed they were interested in improving the health of their elephants and increasing their knowledge regarding veterinary medicines. , This led to the initiation of the country's first Mobile Veterinary Unit (MVU) in 2006.

## Materials and methods

The MVU is based on a model used at the Lampang Elephant Sanctuary in Thailand. Information on traditional elephant care and knowledge was translated from Thailand and elephant medical needs recommended from Fowler & Mikota (2006) and Evans (1910). The MVU is an all-terrain vehicle, fully fitted

and equipped with veterinary medication. It is based in Sayaboury Province, in the north-west of Lao PDR, which contains approximately 80% of the domesticated elephants in Laos (Maurer & Duffillot 2009). Though most field missions occurred in Sayaboury, the provinces of Champassak, Saravane, Luang Prabang, Oudomxay and Vientiane were also visited.

The MVU team consisted of one Lao government official from the relevant province and officials from the specific district visited. Officials were responsible for planning each mission and informing mahouts of the MVU's intended visit. ElefantAsia employed a multi-lingual mahout liaison officer to gauge the needs and requirements of mahouts, and to act as a translator between officials, mahouts and any foreign veterinarians joining the mission. Free elephant care training and first aid kits were given to mahouts. The mahout liaison officer trained mahouts in the proper administration and application of supplies, with all instructions listed in a free booklet written in the Lao language. At the beginning of 2008, a short study on the digestive parasites was undertaken using faecal samples collected during field missions and analysed by microscope after sedimentation.

Proactive annual missions were organized to different villages and districts at prearranged meetings. Reactive emergency missions were initiated when needed. All medical treatment and supplies were given for free, but to install a sense of ownership mahouts must purchase their own drugs for use when the MVU is not present. Most mahouts/owners can afford veterinary expenses. An adult domesticated elephant is worth approxiamately 10,625 and can earn up to 1667 for two months work in the logging industry (Labatut 2009a). A two-day course of antibiotics for an average elephanst costs approximately 7, with owners recommended to buy 10 rounds of antibiotics if long-term therapy is required. While these can be considered expensive purchases in a least-developed nation, the MVU shows elephant owners that the price of medicine is relatively small when compared to the animal's value.

Data on elephants was collected between December 2007 and July 2009 from field mission medical reports detailing all medical problems observed and treated. Domesticated elephants were registered using a standardised registration form which contains a unique elephant registration number and documents details including the elephant's name, sex, origin, weight, gait and any medical history and care received. The deaths or births of elephants were generally recorded during the field missions by interviewing the mahout, or officials informed MVU staff of these events. All the registration data were entered into a national domesticated elephant database, including information regarding the elephant's owner, mahout and location.

## Results and discussion

### *Details of treated elephants*

From the period December 2007 to July 2009 medical care was administered to 347 individual domesticated elephants, 55% female, 45% male. Employment varied with 78% working in the logging industry, 10% in tourism and 12% undertaking village work or unemployed at the time of treatment.

### *Mortality*

Deaths vastly outweigh births, with approximately one birth recorded for every 10 deaths. From January 2009 – July 2009, 10 domesticated elephant deaths were recorded in the Sayaboury Province. Causes given for these deaths included tusk fractures, diarrhoea, overworking, old age, poaching and septicaemia. The reasons given for an elephant's death were unreliable as post-mortems rarely occur and mahouts fear repercussions for the occurrence of possibly preventable deaths. Additionally, the death of a domesticated elephant was previously only notified to the Department of Livestock and Fisheries when annual livestock taxes were due, making disease diagnosis impossible. However the notification of deaths is slowly being reported more frequently.

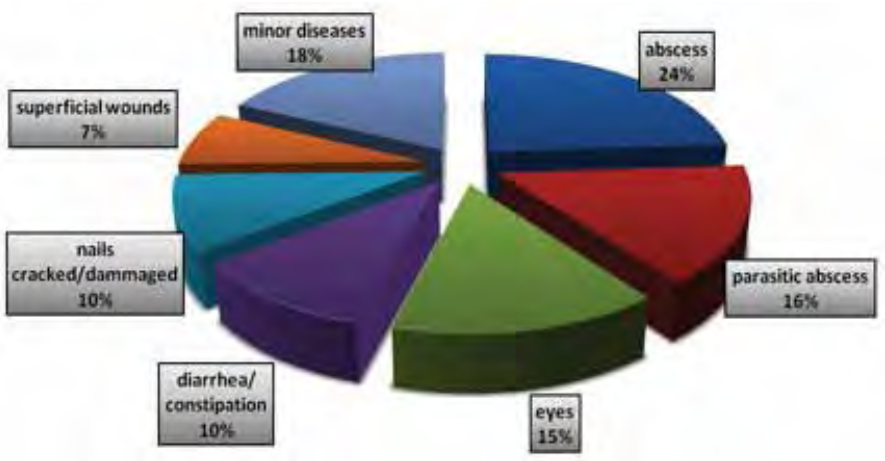



**Figure 1.** Commonly-occurring disorders of domesticated elephants.

*Diseases and their treatment*

Figure 1 indicates the most commonly occurring disorders observed. Figure 2 is a breakdown of the less frequently found disorders. Percentages are calculated from a total of 315 elephants with 422 medical conditions recorded and analysed.

Disorders such as abcesses were caused by the prolonged chaffing of chains. Superficial wounds, and eye problems due to chronic irritation are associated with work in the logging industry due to the harsh contidtions of logging work and contiuned exposure to dusty environments.

Given geographical and infrastructure constraints, surgery or minor operations were not possible. The only big pathological conditions which could be successfully treated and cured onsite were the treatement of severe abcesses. Veterinarins with the MVU could open abscesses with a scalpel but this was done only if the mahout agreed to allow the elephant to rest and not work for several days after the procedure. The abscess wound was cleaned and flushed with 1% povidone iodine (betadine) as an antispectic solution. Once clean an antibiotic spray containing oxytetracyclin was applied. Oxyblue Spray was ususallly used for this purpose. Negasunt (Table 1), an insecticidal powder was also applied to protect the open wound from flies. Intra muscular broad-spectrum antibiotics such as penicillin-streptomycin (20/20) 50 ml per elephant was provided to animals which have an abscess greater than 10 cm. The freshness, consistency and location on the body of the abcsess was also a consideration for antibiotic use.

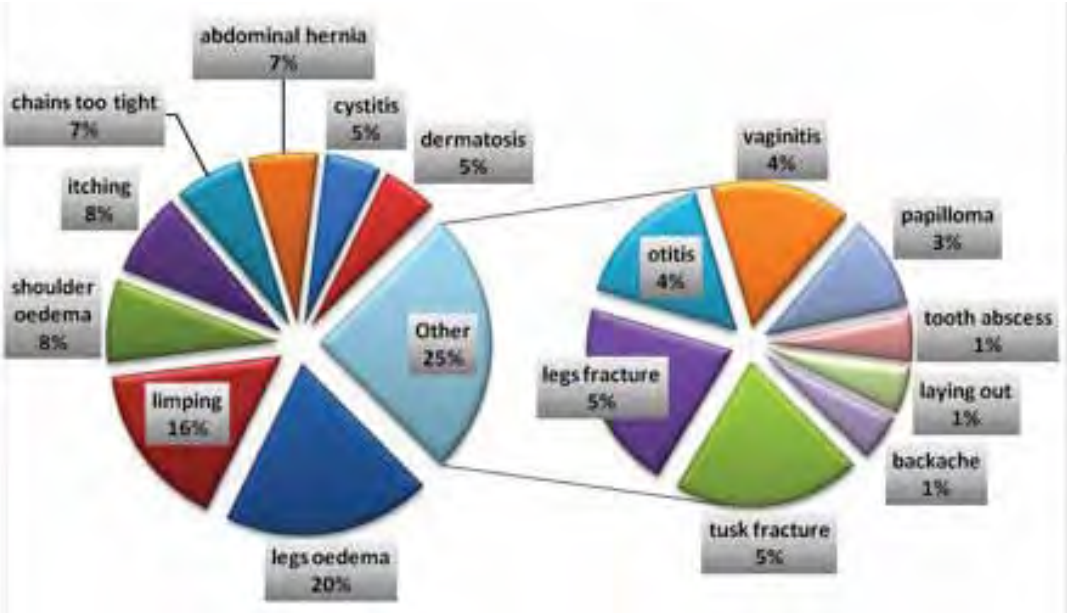



**Figure 2.** Less common disorders.

**Table 1.** Commonly used drugs in the MVU.

| Drugs | Dosage | Treatment intervals |
|---|---|---|
| Betadine | Diluted 70 % | Twice a day |
| Oxytetracycline | 20 mg/kg IM | 48 hours |
| Negasunt | Cover the wounds | Twice a day minimum |
| Penicillin-streptomycin | 4-2 IU/kg IM | 24 hours |
| Mebendazol | 3 mg/kg PO | 6 months to 1 year |
| Dufamec | 0.07 mg/kg SC | 6 months to 1 year |
| Opsar | 2 ml per eye | Twice a day |
| Archifen | 0.5 ml per eye | Twice a day |

The duration of a course of antibiotics for treating an abcess was dependant on the size and age of the abscess. Vitamin therapy (ADE, B12, B4,) was occasionally administered in the instances of weightloss or marked apathy in the elephant. Recovery was determined on whether post-treatment advice was adhered to by the mahout.

Eye discharge was common (15% of all cases treated) due to the extremedust conditions. Eye discharge only became a cause for concern when the eye discharge changed colour, consistency or frequency. A low to moderate eye discharge was common in 90% of all domesticated elephants observed in Laos. Eye problems observed in domesticated elephants could be seperated into two catagories: Chronic diseases such as cataracts, corneal opacity, blindness, and acute diseases associated with red eyes and continual running fluid. An eye flush with physiological fluid such as Opsar was advised when running eye fluid was moderate. In the cases of red eyes or signs of eye infections an antibiotic eyedrop containing chloramphenical like Archifen was applied. Without proper diagnostic tools available in the Lao PDR, the use of eyedrops containing corticoids was not possible.

Disgestive disorders such as diarrhoea and constipation accounted for 10% of cases observed. These were observed more frequently in elephants living in southern Laos where the weather is drier and sources of clean drinking water fewer.

Instances of foot diseases in domesticated elephants were minor (10% of cases) when compared to those of captive elephants in zoos (Culti *et al.* 2001). In most cases no pain or discomfort was shown by the elephant. Foot infections occured mainly from working accidents, UXO (unexploded ordinance), or damage from foreign objects. In severe cases treatment and care for these problems was often very prolonged as no artifical support such as plaster casts are available in Laos. Unfortunately this means any elephant that cannot physically support itself is destined to die.

Foot care treatment in Laos was very simple and worked on the "maximum restraint" technique. Mahouts were advised to put their elephant in an area of the forest where there was sufficient food and water within a very small spatial area. Two baths per day were also advised to prevent imflammation, after which an analgesic balm such as Counterpain should be applied in the instance of a fracture or chronic limping.

Other diseases observed infrequently included dermatitis and genital infections. Dermatitis was generally treated by improving skin health. The best remedies in the Lao PDR for this was to ensure the elephant had an increased number of baths, were dewormed and disinfected on a regular basis. Diagnosis of dermatalogical etiology was not currently possible in the Lao PDR. Genital disorders were diagnosed by changes in the colour and smell of urine. Usually problems observed were at a chronic stage. Urinary infections were treated with antiboitics such as enrofloxacin with courses reccommended for at least 15 days.

Endo and ecto parasites were the second most common disorders and were also common in Sumatra (Stremme *et al.* 2007). Digestives strongles were the most common parasite in Laos (Fig. 3). A good deworming programme could decrease parasites by nearly 95% after using drugs. For the MVU, two drugs were used: Mebendazol (3 mg/kg) for elephants without symptoms of externals parasitises and Dufamec

1% (0.07 mg/kg) for elephants showing external symptoms. The ventral oedema, a typical sign of strongles, is rare.

Dufamec was successful in treating external parasitises. However it is an irritant and can cause numerous abscesses at the site of injection. This can unfortunately make mahouts distrustful about modern medicine. For this reason, Mebendazol was used 84 % of the time.

Complaints from mahouts were more commonly occurring in districts where elephant breeding was a new activity or mahouts were young and professionally inexperienced. These mahouts did not posses a strong knowledge of elephant sanitary requirments or the detrimental impacts of overworking elephants. . Domesticated elephants in logging camps were often observed in very poor conditions with chronic and long-lasting medical conditions. These districts also possess higher indicences of inexperienced mahouts being killed by their elephants.

*Musth*

Incidences of uncontrolled musth have increased due to the decline in traditional knowledge and musth management. The musth starts normally when the elephants have 20 or 25 years old and occurred once or twice a year (Labatut 2009a). The MVU observed that some elephants are still working rather than being seperated and isolated in remote areas as recommended in Gale (1966). Since the implementation of this study, five emergency visits were undertaken to logging camps to tranquelize uncontrolable bulls and in 2008 one bull in musth was shot and killed by his mahout to prevent personal injury.

*The developing role of the MVU*

The MVU plays an essential role in supplying much-needed veterinary treatment to domesticated elephants. Visiting 73% of the population, the MVU reaches a high percentage of domesticated elephants, owners and mahouts. However, there are a number of factors that limits elephant veterinary work in Laos.

In 2010 a veterinary curriculum is beginning in the Lao PDR, but is still very basic. The majority of the 80 Lao national veterinarians were trained decades ago. The country lacks laboratories capable of detecting major infectious diseases such as EEHV, pox fever or turberculosis. Only three labarotories have begun to cultivate human turberculosis diagnonsis,. A a result veterinary treatment is reliant on symptomatic observations rather than etoligical diagnosis. The MVU has no labaratory equipment to perform pathology. This also limits treatment of digestive disorders so after animals are dewormed, traditional dietary changes are given such as feeding sticky rice, coconut leaves and tamarind for diarrhoea. If still persisting, antibiotics such as oxytetracyclin are reommneded for a period of five days. Constipation in domesticated elephants is treated by feeding Chinese watermelons or palm leaves.

The remoteness of logging camps makes access to certain areas difficult. Acquiring medical supplies in such areas is also difficult and most drugs used are imported from Thailand directly

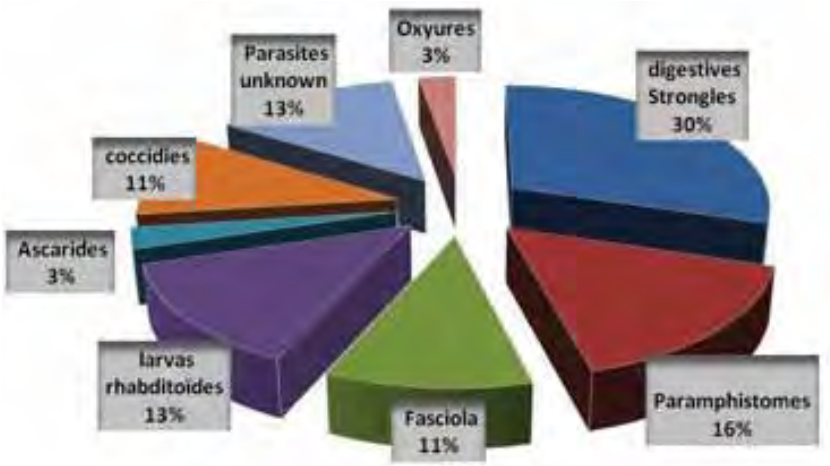



**Figure 3.** Digestive parasites recorded in a study of 13 elephants in 2008.

to ElefantAsia headquarters in Vientiane. As rural areas do not carry most medicines required for elephant healthcare and there is a risk of spillage when medical supplies are transported by MVU. It would be greatly assisted if medicines were readily available at provincial or district pharmacies.

As it is the elephant owners and mahouts that care for domesticated elephants on a daily basis, and post-treatment rehabiliation is reliant on the mahout, it is essential that they are provided with basic medical and product training. Local education about the animal's conservation status and the need for reproduction is also critical if the elephant population is to recover. To improve veterinary skills, a short educational booklet witten in Lao has being distributed. This gives practical information regarding elephant care, product use and dosage rates. The Elephant Care Manual (2005) from Thailand will also be translated and given free to all elephant owners, mahouts and tourist camps working with domesticated elephants.

Currently domesticated elephants in Laos are not vaccinated against preventable diseases. This is due to a fear amongst mahouts about vaccines, and a lack of understanding about the need for preventative medicine. One of the MVU's current projects is to provide mahouts with a clear understanding of preventative medicine techniques and benefits. Once mahouts and elephant owners are educated, a vaccine program can be implemented within field missions.

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# Group Size and Age-Sex Composition of Asian Elephant and Gaur in Mudumalai Tiger Reserve, Southern India

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## Introduction

Asian elephant *Elephas maximus* and Indian gaur *Bos gaurus* are listed as endangered species (IUCN 2009). Both species are mega-herbivores, and live in forested habitats. There is little detailed information on population structure and social organization available for the elephant across much of its range and even lesser data on gaur. Therefore age-sex composition and even population status is uncertain for many populations. This is basic information required to formulate proper management and conservation strategies.

While disease is regarded to be the greatest threat to gaur populations (Arrendaran 2000), elephants are susceptible to the effects of habitat fragmentation and degradation (Daniel *et al.* 1987; Riddle *et al*. 2010). Both species are threatened by poaching, which affects gaur by reducing their numbers while selective poaching of males for ivory leads to a highly skewed sex ratio in elephants (Daniel *et al*. 1987). Studies on group composition would yield useful information on population characteristics and trends. A comparison of the population structure of elephant (highly skewed sex ratio) and gaur (less skewed sex ratio) could enable us to understand differences in their group structure and social organization.

The Asian elephant population is estimated to be 30,000 – 50,000 with approximately 60% of the population being present in India (Riddle *et al*. 2010). Mudumalai Tiger Reserve (hereafter termed 'MTR') forms a part of a contiguous forest tract of about 5520 km$^2$ known as the Nilgiri Biosphere Reserve (NBR). It is an important area in terms of elephant conservation since it provides habitat contiguity, allowing wide ranging elephants access to the Eastern Ghat forests (Desai 1991). This area also supports the highest gaur population in India (Choudhury 2002). Davidar (1997) has reported that the gaur population had recovered significantly since the outbreak of Rinderpest epidemic in the mid 1960s, which nearly wiped out the MTR population.

The present study provides baseline data on age-sex composition of gaur. This investigation compares the group size of elephants that has a highly social hierarchical pattern of grouping, long distance seasonal migrations, and long gestation and inter-calving periods with gaur, which is less cohesive and has a relatively smaller inter-calving interval. It also compares the population composition of elephants, which have been affected by poaching that has created a skewed sex ratio with a normally growing gaur population.

### *Study area*

MTR is located in the Nilgiri District of Tamil Nadu (11º 32´ and 11º 42´ N and 76º 20´ and 76º 45´ E). It extends over an area of 321 km$^2$ and forms a part of the Nilgiri Biosphere Reserve (Fig. 1). The sanctuary is located in the Western Ghats, which is one of the 25 biodiversity hotspots of the world (Myers *et al*. 2000). The altitude varies from 485 m to 1226 m above MSL with a general elevation of about 900 m to 1000 m. There are densely populated human settlements on its south-eastern boundary and also some smaller settlements inside the reserve. The study area has three major forest types namely Tropical Moist Deciduous (here after termed MDF), Tropical Dry Deciduous (DDF) and Southern Tropical Thorn forest (TF) (Champion and Seth, 1968). Rainfall varies from 600 mm in the eastern part




**Figure 1.** Map of Mudumalai Tiger Reserve.

to 2000 mm in the western part of the sanctuary. Corresponding to the gradient in rainfall, the vegetation varies from tropical thorn forest in the east to tropical moist deciduous forest in the west. In between these two lies a dry deciduous forest.

The large herbivores include elephant and gaur, three species of cervids *viz*., chital (*Axis axis*), sambar deer (*Cervus unicolor*) and barking deer (*Muntiacus muntjak*) and two species of antelopes *i.e*. the four-horned antelope (*Tetracerus quadricornis*) and the blackbuck (*Antilope cervicapra*). Predators such as tiger (*Panthera tigiris*), leopard (*Panthera pardus*) and wild dog (*Cuon alpinus*) also can be seen. Elephant and gaur are threatened by habitat degradation from weed invasion, overgrazing, poaching and human disturbance.

## Methods

Group size and age-sex composition was determined based on direct sighting of elephants and gaur in the field. Data was collected systematically across the entire study area to ensure that all strata were well sampled. The tiger reserve area was covered on foot every month from May 2003 to August 2004. Data on group size and composition was collected while monitoring line transects and on road strip counts, conducted to estimate ungulate densities (Ashokkumar *et al*. 2004). Forty-two line transects, 2 km in length and placed in a stratified random fashion were marked for all three vegetation types. The line transects were monitored on a seasonal basis for two seasons (wet and dry). Transects were walked twice during the dry season, and three times in the wet season, adding up to a total of 504 km distance walked. In addition, road-strip counts were conducted every month in different vegetation types. Each road transect was monitored during both morning and evening hours. A total distance of 829, 308 and 124.5 km was covered by foot in DDF, MDF and TF areas respectively. The time spent in each habitat was in proportion to its size.

Elephants were classified into various age-sex categories based on relative height and morphological characteristics (McKay 1973; Daniel *et al.* 1987; Sukumar 1989). Younger elephants (<15 years) were classified by comparing their height to the oldest adult female in the group. Elephants were placed in broad age groups such as calves (<1 year), juveniles (1-5 years), sub-adults (5-15 years) and adults (>15 years; Fig. 2). Gaur was classified into different age and sex classes such as calves (<6 months), juveniles (1), sub-adult (2.5) and adults (<3) based on height, body colour, size and shape of horn, criteria prescribed by Schaller (1967) and Krishnan (1972; Fig. 3).



**Figure 2.** Elephant herd feeding in saltlick of MTR.

The sighting data was pooled for both the years to derive frequency distributions of group size, sex ratios, mean group size (MGS), median group size (MDG), and typical group size (TGS) following Barrette (1991). TGS is an animal-centred measure of group size, reflecting the experience of an average individual in a group and is better, compared to MGS and MDG, which are observer-centred estimates of group size. Proportions of age and sex classes in the populations were derived from complete classified groups during the study period. Solitary males were not considered in mean group size calculations as males of both species spend part of their lives as solitary animals and only join female herds for breeding. Males do form social groups but such groups lack social cohesion.

One-way analysis of variance (ANOVA) was used to test the significance of differences in MGS values among seasons and habitats (thorn forest area was excluded as there were only very few sightings). Statistical analyses were performed by using Windows based statistical packages viz. Microsoft Excel and SPSS (Nie *et al*. 1975). Statistical inferences were made following Sokal and Rohlf (1995).

## Results

*Group size*

During the study a total of 423 and 209 sightings of gaur and elephants respectively were recorded; of these bulls (male groups and solitary males) constitutes 26% (n=108) and 7% (n=14) of the sighting for gaur and elephant respectively. Of 195 elephant groups sighted, 99% of sightings were completely classified into different age-sex classes. Of 315 sightings of gaur groups only 46% (n=146) were completely classified into different age-sex classes.

The group size ranged from 1 to 26 individuals for elephants and 1 to 47 individuals for gaur. Both species showed positively skewed group size with smaller group sizes being more common than larger groups. In probability theory, positive skew indicates that the tail on the right side is longer than the left side and the bulk of values lie to the left of the mean. The group size frequency of sightings was higher for smaller group size than larger group sizes.

The mean group size of elephants was (4.32±3.2) while gaur had a mean group size of (9.76±7.6). The other group size measures such as median group size and the most frequented group size (mode) also showed that elephants had smaller



**Figure 3.** Herd of gaur feeding in tropical dry deciduous forest of MTR..

**Table 1.** Mean group size (±SD) of gaur and elephant in different habitats and seasons at MTR.

| Habitat | Species | N | Dry | I wet | II wet | Overall |
|---|---|---|---|---|---|---|
| Dry deciduous forest | elephant | 128 | 3.5±1.6 | 3.9±2.6 | 5.9±3.9 | 4.1±2.7 |
| | gaur | 214 | 7.9±5.4 | 10.4±8.4 | 10.9±8.7 | 10.1±8.1 |
| Moist deciduous forest | elephant | 61 | 4.8±3.4 | 4.3±2.7 | 6.0±7.5 | 4.8±4.0 |
| | gaur | 79 | 9.3±6.6 | 8.2±7.3 | 9.9±7.4 | 9.3±6.9 |
| Overall | elephant | 195 | 4.1±2.7 | 4.0±2.7 | 5.6±5.0 | 4.3±3.2 |
| | gaur | 315 | 8.7±6.2 | 10.1±8.1 | 10.2±7.9 | 9.8±7.6 |

group sizes than gaur. The median group size for elephants was 3 and the mode was 2, while for the same measures it was 8 and 5 for gaur. TGS value was higher than MGS for both species (elephant 6.4±3.3; gaur 13.54±3.69).

*Grouping characteristics*

More solitary individuals were sighted in elephants (11%) than in gaur (2%). Smaller groups were more frequently seen than larger groups (Fig. 4). The group sizes from two to six animals, collectively constitutes 68% and 40% of all sightings for gaur and elephants respectively.

Mean group size did not vary significantly among habitats and seasons for elephant ($F=0.06$; $p>0.05$) and gaur ($F=0.92$; $p>0.05$). Elephants had lower group size in the dry season and the first wet season, the highest mean group size being recorded in the second wet season in both DDF (5.9±3.9) and MDF (6.0±7.5). Gaur group size was lower in dry season (8.7±6.2) in the dry deciduous forests than both the wet seasons (Table 1).

*Age-sex composition*

The proportion of adults, sub-adults, juveniles and calves in the population were calculated from sightings of 859 and 993 individuals in 209 and 143 groups of elephant and gaur respectively. The bulk of the population was composed of adults, 48% in elephant and 60% in gaur. The other age classes such as sub-adults, juveniles and calves constituted 17%, 14% and 21% respectively in elephants and 16%, 15% and 9% in gaur.

The age-sex composition of the elephant and gaur in MTR is given in Figure 5. The proportion of adult males was higher in gaur (11%) than elephant (2.3%). The proportion of sub-adult and juvenile age-sex classes between elephant and gaur did not vary. The proportion of calves was more in elephants than in gaur.

*Sex ratio*

The sex ratio appears to vary significantly from the expected ratio of 1:1 in sub-adult and adult age classes of both species (Table 2). In adults a highly skewed sex ratio (1:21; $^2$=361.8; df =1; p<0.00) was recorded for elephants and (1:5; $^2$=280; df =1; p<0.00) for gaur.

**Discussion**

*Group size*

The social organization of elephant and gaur are based around the family unit or the herd consisting of one or more related adult females and their offspring (Daniel *et al*. 1987; Sukumar 1989; Schaller 1967). In elephants the most cohesive unit is the family unit and it represents a tightly knit unit both socially and structurally (Moss 1988). At puberty, young females remain with the natal group, while the males leave the herd and they tend to form temporary groups with weak social bonds (Laws *et al*. 1975). Little

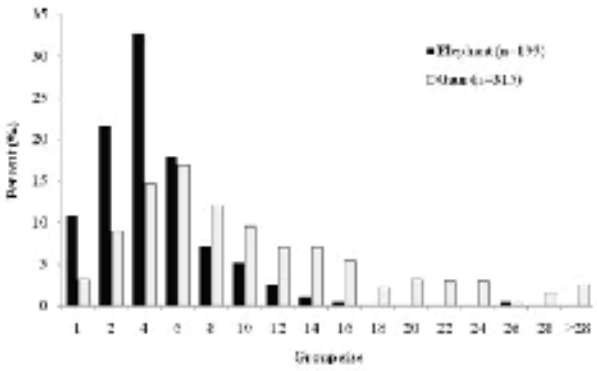


**Figure 4.** Frequency distribution of elephant and gaur group size in MTR from May 2003 to August 2004.

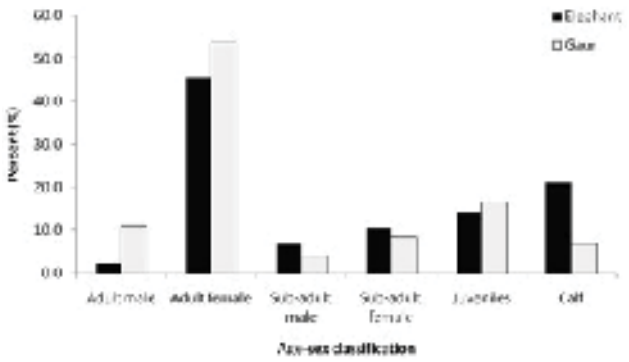



**Figure 5.** Proportion of different age-sex classes of elephant (n=209) and gaur (n=146) in MTR.

however is known about gaur social structure or about male dispersals.

Of the total number of sightings, the solitary bulls constituted 7% and 21% in elephant and gaur respectively. Adult males associated only transiently with the family units. Bulls remain together only a day or two. Bull groups were not recorded for elephants whereas 5% of sightings constituted bull groups for gaur. An earlier study in this area (Daniel, *et al.* 1987) had reported bull groups in elephants. However during that period the adult male to female ratios were far less skewed (1:4.7) than the current ratio of 1:21. This indicates that the adult male population has declined significantly from the mid 1980's and this could be the reason for non-sighting of bull groups during the present study; there are too few males to form groups. This decline in adult male population in elephants is largely due to poaching of males for their tusks (Daniel *et al*. 2008).

Association of adult males is considered an anti-predatory strategy in African buffalo (Prins 1996) and it is conjectured to be related to the establishment of dominance ranks among young adult male elephants (Vidya & Sukumar 2005). It is possible that male gaur also show antipredatory strategy. However the formation of bull groups in gaur seemed to be opportunistic when two bull gaurs met and they remained together only for a few hours to a few days. The differential foraging of males (Sinclair 1977) and male mating strategy (Clutton-Brock 1982) may influence the formation of male groups and further studies on these aspects are needed in both species we studied. More elephants (11%) were seen in the solitary group size class (females) than gaur (3%). Most sightings of solitary females were of older adult females. It is possible that a lack of dependent calves or close siblings or inability to move fast along with the herd resulted in them lagging behind and remaining solitary.

Group formation and sizes can be influenced by foraging behaviour (Jarman 1974) and predation (Geist 1998). Both the range of group size and mean group size was lower for elephant (4.32) than for gaur (9.76). Apparently, gaurs tend to forage and live in larger groups than elephants. As individual elephants have greater resource requirements, there might be a need for smaller groups to avoid competition within the clan/kin group. So breaking up into smaller groups during foraging would be a good strategy to avoid competition, especially when food resources are highly patchy or foraging conditions are not optimal.

Predation pressure increases the probability of formation of larger group as it reduces individual risk and increases vigilance. However, predation is not a serious threat to elephants although elephant calves are occasionally killed by tigers. Large carnivore diet profile studies suggest that gaur in the diet composition of tiger ranges from 1.87 to 30.4% (17.4%- Karanth & Sunquist 1995 in Nagarahole; 1.87%- Swaminathan *et al*. 2002 in Mudumalai; 30.4%- Kumaraguru 2006 in Indira Gandhi Wildlife Sanctuary; 23.9%- Andheria *et al*. 2007 in Bandipur Tiger Reserve). Schaller (1967) reported that 50% of calf mortality was due to predation. Carnivore studies in Nagarahole based on scat and kills has shown that among different age-sex classes of gaur preyed up on by tiger, young ones (calves and juveniles) constituted a greater proportion

**Table 2.** Age-sex ratio of elephant and gaur in MTR.

| Age-sex classes | Elephant (n=859) | Gaur (n=993) |
|---|---|---|
| Adult (male : female) | 1:21 ($\chi^2$=361.8; df=1; p<0.00) | 1:5 ($\chi^2$=280; df=1; p<0.00) |
| Sub-adult (male : female) | 1:2.5 ($\chi^2$=28.96; df=1; p<0.00) | 1:2 ($\chi^2$=15.9; df=1; p<0.00) |

(58.8%), than adult females (22.6%) and adult males (14.6%). Thus tigers selectively preyed upon young gaur and the variation in population age-structure could influence prey selection.

When the population age structure of gaur in Nagarahole (Karnath & Sunquist, 1995) and Mudumalai (Ashokkumar *et al.* 2004) were compared, there was no difference in the proportion of different age-sex classes. Thus the variation in the proportion of young and adult males could be due to predation. Thus for gaur, predation remain a serious threat and it could have a far more significant influence on group size than it does in elephants. Additionally individual resource needs of gaur are far less than those of elephants possibly allowing for larger group sizes in similar habitats.

Mean group size of elephant and gaur did not vary significantly across habitats and seasons. Social organization of a species has been considered as one factor governing seasonal variation in group sizes, it can cause the group sizes to vary in some ungulates and not in others (Rodgers, 1977). The group size in certain species exhibit open membership of social structure (e.g. chital, swamp deer) and may show temporal variation not only on a seasonal basis but also during different times of the day (Sharatchandra & Gadgil 1975; Barrette 1991). However, the group size of gaur and elephant appears to be based on strong social bonds, with influences from factors like avoiding competition for food and predation risk. The fact that elephant group sizes were highest in the second wet season when the entire habitat is at its richest in terms of food resources indicates that there is some seasonal impact and that competition avoidance could be the cause for smaller groups sizes in this species. Similarly gaur in the dry deciduous forest showed the smallest group sizes relative to the wet seasons, again indicating that competition was at play in determining group size and that there were seasonal influences.

The comparison of age-sex composition between elephant and gaur did not show any significant variation in sub-adult and juvenile age classes. However the adult age class shows that 60% of the gaur population is in the adult age class whereas only 48% of elephants are in the adult age class. This is possibly due the severe poaching that has eliminated a significant proportion of males from the population. The present adult male to female sex ratio of 1:21 is a strong indicator of that. A normal male to female ratio for elephants would be 1:1.87 and 1:1.85 as reported for Rajaji National Park (Williams 2007) and Ruhuna National Park, Sri Lanka (Katugaha *et al*. 1999) respectively. If a normal 1:2 male to female ratio existed in the study area then the proportion of adults would be nearly 57% or more, which is close to that seen in gaur. Thus poaching has significantly affected the age structure of the elephant population.

In the 1960s the gaur population was affected by Rinderpest and foot and mouth disease (Davidar 1997). In the total population of Mudumalai and Bandipur only a few hundred survived. We did not have any data in the mid 90s to show how the population recovered. However the current population estimate is 7/km2 (Ashokkumar 2007). In 1990 the outbreak of Rinderpest killed about 3000 gaurs in Bhadra Sanctuary located in Karnataka state of Southern India (Raju & Heggde 1995). All age-sex classes are vulnerable to epidemics and there is no specific age-sex classes affected due to epidemics. Poaching is mainly on adult gaur for meat, one or two individuals being poached every year. As a management measure the Forest Department established anti-poaching camps to control poaching. We do not know the impact of poaching on group size of gaur.

In conclusion we can say that gaur have larger group sizes than elephants. The age-sex structure of the elephant is strongly influenced by selective poaching of males where many of the older males have been killed. At present gaur have a larger proportion of their population in the adult age class than elephants. However, if a normal adult male to female sex ratio is assumed then the percentage of elephants in the adult age class would be similar to that of gaur. It is important to establish and systematically monitor population age-sex structure to detect impacts of poaching and also to monitor the long term well being of these populations.

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*Gajah 32 (2010) 35-39*

# Estimating Asian Elephant Population in Dindugul, Kodaikanal and Theni Forest Divisions, Western Ghats Tamil Nadu

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## Introduction

The Asian elephant (*Elephas maximus*), an endangered species today, being a wide-ranging animal mainly affected by loss of habitat throughout Asia (Daniel 1987), is in great conflict with humans. Population estimation of elephants in southern India has been carried out extensively using the 'total count' method by the Forest Department since 1970. However, due to several shortcomings like poor visibility in the forested areas, observer fatigue (while covering larger areas like 5 to 10 km$^2$ blocks), intense labour requirements and several other inherent problems like double counting, the total count method is considered an inappropriate method for obtaining reliable estimates of elephant numbers.

The method proposed by Burnham *et al.* (1980) has been used satisfactorily for estimating elephant densities in Asia through direct counting (Varman & Sukumar 1995; Baskaran & Desai 2000) in areas with high elephant density and enumeration of indirect evidence e.g. dung (Varman *et al*. 1995) in areas with low elephant density and poor visibility.

The Western Ghats hill ranges in southern India are one of the unique biological regions in the world (Myers *et al.* 2000). Elephant Range 9 situated in the Western Ghats, extends over 5700 km$^2$ located to the south of Palghat gap. Despite the high potential of this region, work on elephants in this proposed area is meagre and hence the present work was undertaken with the following objectives:

- To estimate the population density of elephants in three territorial forest divisions of elephant range 9 in Tamil Nadu.
- To analyse the spatial distribution pattern or abundance of elephants in different vegetation types of the study area and provide recommendations for the future studies of elephants in this landscape.

## Methods

### *Study area*

The present study was carried out in three territorial forest divisions, Dindugul, Kodaikanal and Theni, that are located in the Western Ghats of Tamil Nadu, and are a part of Elephant Range 9 declared by Project Elephant, Government of India for the conservation of elephants, situated between $9^0$ 31' and $10^0$ 10' N lat. and $77^0$ 18' and $77^0$ 46' E long (Fig. 1). The wide variation in rainfall and topography in the study area has resulted in significant diversity of vegetation types (Table 1) that supports a rich floral and faunal diversity.

### *Estimation of elephant population*

Transects were laid across the forest areas covering all the habitats. The sample area was selected by random sampling method, 1:50,000 survey of India topographic map of Dindigul, Kodaikanal and Theni forest divisions with grids of 2.5 x 2.5 km and all grids were numbered and each grid represented a 5 km$^2$ block. A total of 60 blocks were selected for sampling out of 180 blocks of the study area after excluding blocks that came under human settlements and border areas. A total of 41 transects were laid with a total length of 52.9 km. Within each selected block, a straight 1 km long transect was laid randomly across altitudinal gradients, drainage pattern and human disturbance gradient and transects were surveyed one time.

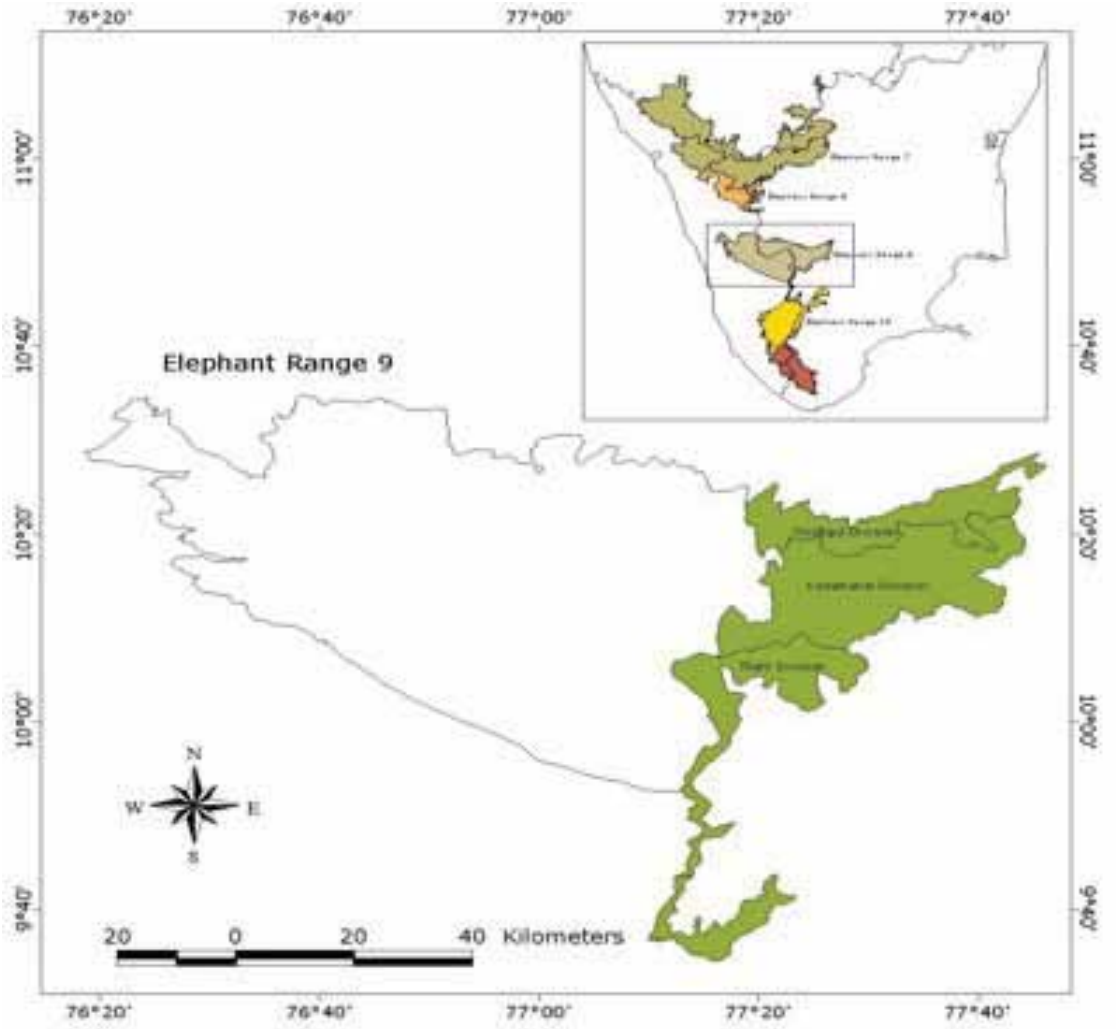



**Figure 1.** Map of study area showing the various forest divisions surveyed.

The method of Dawson (1991) and Varman *et. al*. (1995) was employed in the present study for estimating the density of elephants and the following formula was used:

$$E = (Y \times r) / D$$

Where, E = density of elephants, Y = density of dung, r = daily rate of decomposition and D = the number of dung piles deposited per elephant per day.

**Table 1.** Extent [km$^2$] of various landscape elements in 3 different forest divisions.*

| Landscape | Koda-ikanal | Dind-ugul | Theni | Total |
|---|---|---|---|---|
| Evergreen | 69.3 | 174.3 | 74.1 | 317.6 |
| Grassland | 70.3 | 214.8 | 99.4 | 384.4 |
| Deciduous | 62.2 | 116.0 | 47.2 | 225.4 |
| Scrub | 109.5 | 196.9 | 86.7 | 393.1 |
| Tea | 3.0 | 0.3 | 8.9 | 12.2 |
| Cultivation | 6.0 | 17.8 | 116.2 | 139.9 |
| Total | 320.3 | 720.1 | 432.5 | 1472.6 |

*Source: Tamil Nadu Forest Dept. website.

Dung defection rate (16.16±0.80) calculated in captive elephants of Mudumalai Wildlife Sanctuary was used to convert dung density into elephant density (Watve 1992; Varman *et. al*. 1995). Similarly, a decay rate of 0.0097±0.002 was estimated in similar dry deciduous forest of Mudumalai Wildlife Sanctuary by Varman *et al*. (1995). It is assumed that there will be no variation in defecation and decay rates between Dindigul and Theni forest divisions used in the present study.

Data collected from line transects was first used to calculate the dung density, and incorporating the dung decay rate and defecation rate, the dung density was converted into elephant density. Dung piles that were visible from lines were counted, for each dung pile; perpendicular distance from line to centre of dung piles was measured using measuring tape, with (±1 cm) accuracy. All the analyses were performed using computer software *GAJAHA ver.1.0* – a Monte

**Table 2.** Elephant density and population size estimated using line transect dung count method in three different forest divisions.

| Forest Division | Transect length [km] | # dung piles | Dung density [dung/km$^2$] | Elephant density [elephants/km$^2$] | | Elephant habitat* [km$^2$] | Esti-mated pop. |
|---|---|---|---|---|---|---|---|
| | | | | Mean±SD | 95% CI | | |
| Theni | 14.30 | 90 | 539±58.54 | 0.32±0.05 | 0.26-0.37 | 132 | 42 |
| Dindugul | 19.00 | 310 | 1266±77.76 | 0.76±0.11 | 0.64-0.87 | 108 | 82 |
| Theni & Dindugul | 33.30 | 400 | 957±50.97 | 0.57±0.32 | 0.49-0.65 | 240 | 137 |
| Overall** | 52.95 | 402 | 603±32.10 | 0.36±0.16 | 0.31-0.42 | 300 | 108 |

*From Tamil Nadu Forest Department website.

**Including Kodaikanal Forest Division, density for Kodaikanal was estimated separately due to very low sample size (n=2) in nearly 20 km of transect.

Carlo simulation method developed by Santosh and Sukumar (1995).

The density or abundance of elephants in each habitat type was evaluated using dung count data collected for population estimation. The transect lines were laid in different habitat types in proportion to their availability. The dung density was calculated to find out its abundance in different vegetation types.

## Results

*Overall elephant population*

A total of 402 dung piles were recorded from a transect of 52.75 km length. This works out to about 8 dung piles per kilometre of transect.

The analysis was carried out using a cut-off point of 15 m, as distribution of dung piles from the line transect appeared normal (Fig. 2) up to this distance. The pooled data of three transects indicated a mean density of 0.36 elephants/km$^2$ with a narrow confidence interval of 0.31 to 0.42 elephants/km$^2$. The pooled data of the three forest divisions may be considered more appropriate as the standard error was 32.10. Thus the present study indicated the density of elephants is 140 elephants/km$^2$. However, the present study report on elephant density needs further confirmations.

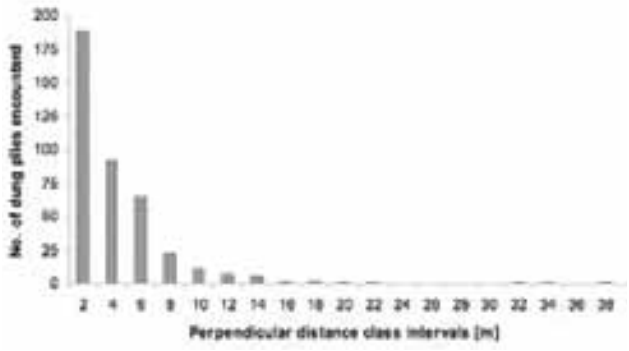



**Figure 2.** Distribution of perpendicular distances of elephant dung piles into 2 m class intervals.

*Elephant density in different forest divisions*

The results of the density analysis showed a considerable variation with Dindugul forest division (0.76 elephants/km$^2$) having more than double the density of Theni forest division (0.26 elephants/km$^2$). On the whole, 82 elephants were estimated in Dindugul forest division and 42 elephants in Theni division (Table 2).

*Eelephant density in different vegetation types*

To examine distribution pattern of elephants in different vegetation types, the vegetation used by the elephants in Theni and Dindugul forest divisions was classified broadly into the following four major types Viz., Teak Plantation, Grassland, Dry deciduous forest of Thorn forest. Considering sample size (number of dung piles required for reliable estimate) and elephant ecology. The data from Kodaikanal was not included in the analysis as sample size obtained for this division was very low (n =2) and also the forest type (wattle "*Acacia mearnsii*" plantation) in which these two dung piles were recorded was not found in the other two forest divisions surveyed.

The analysis revealed that among the four vegetation types studied, elephant spatial distribution or abundance appeared to be more in grassland followed by teak plantation, dry deciduous and thorn forests (Table 3, Fig. 3).

**Table 3.** Elephant density in various forest types at Theni and Dindugul.

| Forest type | Transect length [km] | # dung piles | Dung density [dung/km$^2$] | Elephant density [elephants/km$^2$] | |
|---|---|---|---|---|---|
| | | | | Mean | 95% CI |
| Teak plantation | 1.30 | 19 | 1355±394.10 | 0.82 | 0.61-1.01 |
| Grassland | 2.75 | 45 | 1275±210.24 | 0.77 | 0.62-0.90 |
| Dry deciduous forest | 14.10 | 197 | 1033±61.35 | 0.61 | 0.52-0.70 |
| Thorn forest | 14.30 | 134 | 795±70.84 | 0.48 | 0.40-0.54 |
| Overall | 32.45 | 395 | 1114.5±184.1 | 0.67 | 0.54-0.79 |

However, encounter rates of elephant dung piles is a function of visibility that varies widely between forest types (given the equal distribution of elephants in various habitats). Encounter rate is related to the transect width.

The results of density analysis showed that elephant abundance varied considerably (0.48 to 0.82 elephants/km$^2$) across the four different habitats with highest in teak plantation forest and lowest in thorn forest (Table 3).

## Discussion

*Elephant population*

The results of the present investigation suggest that there is an unequal spatial distribution or abundance of elephants across the four vegetation types during the study period. Such unequal distribution could be attributed to the uneven distribution of various resources like food, water, shelter etc. *Sivaganesan* (1991) also reported seasonal movement changes in elephant density in different vegetation types.

Using the line transect dung count method, the present study estimated a mean density of 0.36 elephants/km$^2$ and a total population of 108 elephants. The accuracy and precision of population estimates in line transect sampling method depends on the sampling area distribution, sampling intensity and sample size. The narrow difference between the lower (0.31 elephants/km$^2$) and upper (0.42 elephants/km$^2$) densities at 95% confidence interval indicates a high precision of the present estimate. The results obtained using three division data would be more appropriate to consider instead of overall estimate arrived at using two division data excluding Kodaikanal, as the standard error of dung density estimated in the analysis of three divisions together was smaller (32.10) as compared to two divisions (50.97).

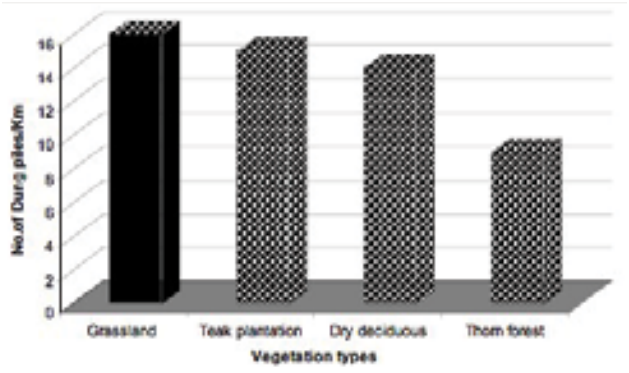



**Figure 3.** Encounter rate of elephant dung piles in various forest types in Theni and Dindugul.

On the whole, in the present study area (~1470 km$^2$) 108 elephants were estimated (with three divisions together). The present estimate of 0.36 elephants/km$^2$ or 108 elephants for the three divisions together is comparable with the estimate of 112 elephants made by Forest Department during 2002 synchronized elephant census (using block count method) or 85 elephants (65 from dung count average of Dindugul and Theni division and 20 from block count in Kodaikanal division) conducted during the study period.

The small variation in the population size estimates using dung count method between the present study and earlier estimates by the Forest Department could be due to any one or a combination of following reasons. The field surveys for the current study were carried out during January to April unlike the earlier estimate during 2002 that was done in early May. It has been well documented that elephants tend to move between habitats according to seasons both in Asia (Baskaran & Desai 2000; Kumaraguru 2006) and in Africa (Field 1971).

*Spatial distribution of elephants in different vegetation types*

Based on the results of the present investigation, it can be concluded that the dry deciduous forest with higher sampling area (14.1 km) and sample size (197 dung piles) are supporting a high elephant density (0.61 elephants/km$^2$). Thus the present study results are similar to that of Sivaganesan (1991). The reason for the dry deciduous forest to have high density could be due to the availability of grass resources coupled with shade and water during the dry season. Studies on feeding behaviour on elephants in Asia (Sivaganesan 1991) also showed that grass is the major diet of elephants. Abundant availability of such grass resources in the dry deciduous forest could have resulted in the higher concentrations of elephants.

**Acknowledgements**

We are thankful to the Tamil Nadu Forest Department, Dr. J.C. Daniel, BNHS, andProf. Dr. R. Sukumar, IISc-Bangalore and A.V.C. College, Mayiladuthurai for their support in many ways.

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# Solitary Behaviour of Female Elephants in Idukki Wildlife Sanctuary, Kerala

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Solitary female elephants were observed in Idukki Wildlife Sanctuary Kerala, during our elephant population and habitat survey 2005-2006. The Idukki Wildlife Sanctuary in Idukki district of Kerala covers an area of 130 $km^2$ of which approximately 25 $km^2$ of forest area is submerged by the reservoir. The elephant population of Idukki is about 76 (Sivaram *et al.* 2006) estimated by direct sighting. Elephant density is 0.8 elephants/$km^2$ (Baskaran *et al.* 2007) by dung count method. The sanctuary is separated from elephant range number 9 by the Idukki reservoir but elephants regularly swim across to Thodupuzha range of Kothamangalam division. On the southern side human settlements completely curtails elephant movement into elephant reserve 10. Kottayam territorial division abuts the sanctuary on the eastern side.

During our population survey of elephants, on five instances we observed solitary females, 3 of them were adults and 2 of them were sub-adults. Female elephants live in groups of closely related individuals while only males disperse from their natal herd on social and sexual maturity to lead a solitary life (Hamilton 1972; Moss 2002; Sukumar 2003). Normally unhealthy or old females that may not be able to move along with the herd would be seen alone. Sometimes due to scarcity of food resources female elephants may split from the rest of the herd temporarily. But in Idukki Wildlife Sanctuary, the solitary behavior of both healthy adult and sub adult female elephants is peculiar. The number of breeding males is fewer in Idukki Wildlife Sanctuary compared to other protected areas in Kerala.



**Figure 1.** Solitary female in Idukki Wildlife Sanctuary.

We speculate that one possible motivation for an elephant female to temporarily leave its herd could be to search for a mate during her oestrus. The oestrus cycle of female elephants is approximately 16 weeks long but with a very brief ovulatory receptive period of 2 to 7 days (Moss 1983). During this brief period a female has to locate and attract a suite of potential mates and choose the best bull to mate with. In fairly undisturbed populations where potential mates are not scarce, eccentric behavior such as temporary separation from the herd by a female is not warranted. In disturbed populations, with highly skewed male-female sex ratios, there is possibility of behavior modifications in female elephants. Thus, the solitary behavior of females in Idukki Wildlife Sanctuary is highly unusual and therefore warrants an investigation.

**Acknowledgements**

I thank Prof. Raman Sukumar, Chairman, Centre for Ecological Sciences, Indian Institute of Science for giving the opportunity to work in elephant project. I also thank Thomas Mathew (Executive Director, ANCF), my colleague Karpagam Chellaiah and Joshua David for her valuable comments on an earlier version of the note. I also thank the Kerala Forest Department for permission.

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Elders blessing elephants at the Elephant Baci Ceremony during the Elephant Festival in Xayabouly Province, Laos, 2009 (see next article on page 42)
Photo by Noy Promsouvanh

# Supporting Wild Elephant Conservation, Sustaining Laos' Pride and Culture

Noy Promsouvanh

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Xayabouly Province once again hosted the Elephant Festival on the 14. and 15. of February 2009, which drew thousands of visitors from many places around the country and from other counties across the region.

The Elephant Festival is an event that brings together domestic elephants from five districts in Xayabouly Province. This year there were 60 elephants. The festival consists of a number of events such as the "Xayabouly Cultural Procession"; "Baci Ceremony" – which is a ceremony to celebrate a special event, whether a marriage, a homecoming, a welcome, a birth, or one of the annual festivals; and "Elephant of the Year Procession" – which included the healthy and good looking elephant contest.

The festival aims to raise awareness of Asian elephants, which are recognized as an endangered species globally, their important role in the history and culture of Laos, and to promote national tourism that can generate income and help conserve domestic elephants.

In Laos domestic elephants have been used in the logging industry for decades. Even though today logging is not dependant on elephants as much as it was in the past, elephants are still needed in places that machinery cannot access.

Today the Lao government tries to shift elephants from hazardous work to tourism industry. Xayabouly Province has been selected to conduct activities that need continuous promotion and accommodate a number of domestic elephants from around the country.

"Asian elephants are under threat," said Dr. Lien Thikeo the Governer of Xayabouly Province in his opening speech at the festival. "This festival helps explain to Lao people and the new generation why we need to conserve elephants and allow them to live with us forever," he said.

WWF participated in the Elephant Festival to address the important link between wild elephants and domestic elephants. "There are less healthy bulls in captivity, they need to breed with wild bulls," said Khamkhoun Khounboline, National Species Coordinator.

Nowadays domestic elephant populations mostly rely on wild elephants for breeding. Generally domestic elephants are worked hard and receive poor health care, resulting in poor condition. As a result, there are few healthy domestic bulls, reducing the chances to breed amongst domestic elephants. "Whenever wild populations are disturbed it is absolutely going to effect domestic populations," he added.

"Domestic elephants are separately used in different working areas so I have to leave my female elephant in the jungle and let her breed with wild elephants" said a 54 years old mahout from Thongmixay District. She will come back to her owner within a month or so depending on how soon she can find a wild bull, the mahout explained.

The festival was also a good opportunity for WWF to provide information on the human-elephant conflict to people. Protecting wild elephants is not only about survival of the wild population and conserving biodiversity, but also about sustaining the domestic ones, securing local livelihoods, and preserving the culture of Laos, the National Species Coordinator added.

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*Gajah 32 (2010) 43-44*

# Human Aspects of Human-Elephant Conflicts

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Many lives, both human and elephant, are lost as a result of the human-elephant conflicts that are prevalent in most parts of the country. 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 it belonged to.

However, if a human is killed by an elephant there is an immediate effect on the family of the deceased. There is a pall of grief that descends on the family and friends of the victim. With time this grief is reduced in intensity. If, on the other hand, the victim was the breadwinner, there is an immediate change in the position of the family. 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 have to be made. Adjustments have to be made with regard to food, schooling, clothing, plans for the construction of a house etc. Life for that family will never be the same again.

The majority of those killed by elephants are men. This is mainly because men move about more at night than the women do. This is also the time that the wild elephants also become active in their search for food. The men move about at night, going to their fields to protect their crops, returning from a bout of drinking or starting off or returning from a trip.

I have identified 74 families where one parent has been killed by a wild elephant. I assist 134 children from amongst these families, and assist them with the donation of schoolbooks sufficient for one year. This has been done for the last three years. I also assist in the construction of a house for those in dire need of a house.

In the course of my visits to these effected families over the last three ears, I have found three instances where there is great doubt as to whether it was an elephant that actually killed the victim. One instance is where the man living in Opanaike went to Madunagala to work in a stone quarry. Later his wife was told that he had been killed by a wild elephant. She has grave doubts that this was what actually happened. In another instance in Galewela the husband took his wife, in the late evening, to the forest purportedly to gather firewood. It was known that there were elephants in that forest. He came back after a while and said that the wife had been killed by an elephant. Strangely there have been no subsequent reports of elephant attacks in that area. The third instance is from Etaweeragolla off Medawachchiya where the victim was a home guard, who was on duty with three other home guards, at a security point on the edge of the village. Late at night the other three home guards had come and told the wife and others in the village, that an elephant had attacked them and that her husband Nimal Jayakody had been killed by a wild elephant. They said that they had managed to escape with great difficulty. The wife, however says that none of them had any injuries nor was there any damage to the bunker in which they were.

The attitudes of most children of the victims undergo many changes after the death of the parent. Most of the boys become difficult for their mothers to manage. They are disobedient, rarely at home, refuse to go to school, refuse to help the mother in anyway etc. The changes in the attitude of the girls are different. There is a lot of sadness reflected in the face of some girls. They become quieter, less inclined to study even though they go to school. Some children, both boys and girls, have stopped going to school because of the changed economic situation at home. They seek employment, however menial, just to supplement the family income. With their lack of a completed education the jobs they are able to get do not pay much.

In one instance a boy from Mahawewa off Galgamuwa had gone off to Colombo and found employment. He has come home, for a visit, sporting new clothes, a watch and a mobile telephone. However, the mother laments that he did not give her anything even though the family is living in abject poverty. In some instances it was found that the sudden state of poverty was an embarrassment to the child and he/she refused to go to school.

Poverty and the resultant inability of the surviving parent to support all the children, has pushed them to send some of their sons to temples to serve as acolytes and maybe later to be ordained as priests. From amongst the 76 families that we assist, there are 8 boys who have been sent to temples. In all these cases it has been the mother, driven by poverty, who has sent them. This move, even though it may not be the best for the child, has its advantages. The child gets an education, food and a comfortable place to stay. His education at the temple could go up to the level that the child is interested in learning. The child is always free to come back home.

In a number of instances when the mother is killed the father leaves the children and goes off. This may be because he cannot mange to look after the children by himself or because he wants to marry again. The children are invariably left with ageing grandparents, who themselves are not in a position to bring up these children properly due to their financial situation. There are also instances where the children have been left with an aunt or uncle.

Some wives of victims of elephant attacks have found employment in the Middle East. Though the children are deprived of the presence and love of either parent, they are financially stable because of the money that is sent for them. This at least ensures the children of some security.

The Department of Wildlife Conservation has a compensation scheme for families affected by the death of a member. They make a once and for all payment of Rs. 100,000. Of this Rs. 50,000 is given to the spouse. The balance Rs. 50,000 is distributed among the children who are under 18 years of age. However this money is placed in a Pass Book by the department and is available to the children only on their reaching the age of 18. If there is only one child he/she gets the whole amount. If there is more than one child the Rs. 50,000 is divided equally between the children.

The Department of Wildlife Conservation takes a long time to pay this compensation to the families of the victims. In most instances it is over a year before the money is received. The family of a recent victim in Medawachchiya was paid in June 2009 when the man was killed in March 2008.

Not all families of those killed by elephants are poor. A few of them are financially stable. These people are able to adjust more easily to the sudden drop in family income.

In our efforts to conserve our wild elephants, we must always be conscious of the damage that these elephants cause to humans. We must make every effort to alleviate, as much as possible, their hardships and difficulties so that their future would be a little better in spite of the major setback that they have had.

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Hut destroyed by an elephant (Sri Lanka)
Photo by Jennifer Pastorini

*Gajah 32 (2010) 45-46*

# The Last Few Minutes of an Asian Elephant

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It was noon when we reached Kudiraivetti—part of the Kalakadu Mundanthurai Tiger Reserve, which lies between 8º25' and 8º53' north latitude and 77º10' and 77º35' east longitude and has an area of 895 km$^2$. In fact, this was not part of our itinerary but then we learnt that an elephant (*Elephas maximus*) had been sighted in a hamlet close to Maanjcholai Estate (a tea estate), so we changed gears.

We obtained permission for stay at Kudiravetti. The guard, who had already been informed of our visit, was waiting for us. We asked him for details about the elephant. He said it was an old female elephant and had been sighted around Kudiravetti. The villagers, who worked in the tea estate, did not worry too much about the elephant's presence, as it didn't pose any threat. But they maintained a safe distance.

As there was hope, we went in search of the elephant. We scanned the area from the watchtower with our binoculars but the elephant was not to be seen. As we settled down at our resthouse for dinner, a few villagers came to inform us that the elephant had been sighted in the village. They took us to the spot. Some villagers had already gathered there, watching the animal. The elephant was standing under a big tree in the clearing of a slope. As it was dark, we could see the animal only with the aid of a torch. I went down the slope, cautiously, for a closer look. Yet, I could not see its profile in detail, to judge its age. The elephant kept on feeding itself in a languid manner. After a little while, we left requesting the villagers to let us know as soon as they sighted the elephant during the day.

We retired for the day. I woke up early and went out in search of the elephant; it was around 8 am when a villager informed us that the elephant was right behind our resthouse. We rushed out. The elephant was there, standing at the fringes of the wood that was behind the rest house. Yes, it was an old female elephant. We used the binoculars and watched the old giant. Her skin was loose and was a network of wrinkles, particularly around her ankles. It was easy to see her bones jutting. Her large ears were tattered.

Though we waded through the tall grass and moved closer to the animal with care she did not show any sign of discomfort. We inched our way towards her and stopped at about a hundred meters. She just stood there, making small circling movements on the grass, with her trunk, as if to grab tufts of grass (Fig. 1). However, she did not attempt to eat anything. Her actions, it seemed, were more idle than purposeful.



**Figure 1.** Old female.

The villagers shared their experiences—one of them, indicating the white smudge on her body, said that the smudge resulted from her leaning to rest on the walls of the houses. Another said she had never bothered anybody; she only made mock charges, that too only when they tried to chase her away.

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We stood there watching her for almost twenty minutes. Then my friends wanted to move. Respecting my wish to stay for a little more time, they left. I moved a little closer. I was so close that my telezoom lens at 170 mm did not fit the elephant in its frame. I sat down on the ground observing the old female. She just stood there motionless. The only movements were her trunk's churnings and her ears' slow back and forth action. At times, she was also shifting her legs as if to transform her body weight from one to another. It seemed she didn't mind my presence. She was looking at me as I settled down. As I looked at her, she seemed to want to communicate something to me. I could see the pain she was enduring—may be due to some internal ailment or old age; I wasn't sure.

I felt sorry for her. To me, she looked like an elderly woman tarnished by age. As I was watching her, I realized that she continued her gaze on me. Then she moved a little forward and stayed in that posture for a while.

It was then the most unexpected thing happened. As she lifted her left front leg as if to move, her left hind leg went backward and it buckled. She raised her right front leg, may be in an attempt to steady herself. Then all of a sudden, she fell down on to her left. Her whole frame collapsed with a thud. Even in the grass-covered ground, her huge body created a dust storm as it reached the ground. She attempted to get up by lifting her right hind limb but without success. As the dust settled the elephant's movements stopped (Fig. 2).

A villager seeing the elephant fall informed my friends who rushed to the spot. Briefing them in haste what had happened, I moved towards the fallen giant. As we reached the spot, she was still breathing. Just as we got to her, she let out



**Figure 2.** Collapsed female.

a huge sigh. My friend, Jayachandran called his friend, a wildlife veterinary doctor, to find out if we could do anything to save the elephant. But the doctor said that it was only a matter of time before she breathed her last. In the mean time, the Forest Department staff and inmates of the village arrived. It was a sad sight to see such a magnificent animal lying on the ground (Fig. 3). I felt awful for our helplessness. We wished her no more agony and a quick, peaceful death. It wasn't long before (just 45 min.) she breathed her last.

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**Figure 3.** Female lying on the ground.

*Gajaha 32 (2010) 47-49*

# CITES Alone Cannot Solve the Elephant Crisis

David M. Lavigne

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Renewed concerns about the status of elephant populations in parts of Africa and Asia have re-energized the debate over whether international trade bans, implemented under the Convention on International Trade in Endangered Species (CITES), have the desired effect (e.g. Anon 2008; Lemieux & Clarke 2009; Lovett 2009; Styles 2008; Milliken *et al.* 2009). That debate is largely a distraction, however, because it ignores the ultimate problem: the existence of *any* legal markets for elephant ivory, whether international or national.

If the goal of conservation today is to protect elephants from the threats posed by legal and illegal hunting (poaching) for the marketplace, and to promote the recovery of depleted populations, then the only possible solution – actually one of three options suggested by Styles (2008) – is to remove elephant ivory not just from international trade, but entirely from the global marketplace. If ivory had no commercial value, there would be little incentive for anyone to kill elephants for their tusks and one of the major threats to their survival would disappear. In the absence of effective legislation banning all trade and sale of elephant ivory, combined with adequate enforcement and compliance, the poaching of elephants for their ivory will surely continue.

It is now more than 20 years since African elephants (*Loxidonta africanus*) joined Asian elephants (*Elephas maximus*) on Appendix I of CITES, effectively banning (on paper, at least) the international trade in all elephant products, including ivory. At the time, two species of elephants were recognized and listed, the African elephant, *Loxodonta africanus*, and the Asian elephant, *Elephas maximus*. Now twenty years later, at least three and, possibly, more species, are recognized (Eggert et al 2002, Niskanen 2004, Roca et al. 2001). The existence of newly recognized elephant species – all of which would seemingly qualify as "look-alike species" under CITES, has conservation implications that have yet to be formally acknowledged by CITES. In the current text, the generic term "elephants" applies equally to all recognized species.

Since then, however, there have been a number of "one-off" sales of African elephant ivory from populations subsequently downlisted to Appendix II, the first of which occurred in 1999 (Milliken et al. 2009). Following the most recent round of auctions of stockpiled ivory in 2008, there is now a restricted 9-year moratorium on *international* ivory sales (Wasser *et al*. 2010). The moratorium applies only to the four countries whose elephant populations are listed in Appendix II and who were allowed to sell their ivory in 2008: Botswana, Namibia, South Africa and Zimbabwe. The moratorium has not, however, dampened enthusiasm in some quarters for further legal ivory sales. For example, two proposals to downlist additional African elephant populations from Appendix I to Appendix II of CITES, and associated requests for further one-off sales, were considered at the 2010 CITES Conference of the Parties (CoP15) in Doha, Qatar. While they failed to receive the necessary two-thirds majority to be adopted, the two downlisting proposals were supported by a majority of Parties casting votes.

Meanwhile, the poaching of African elephants throughout parts of their range is on the rise and once again depleted elephant populations are in further decline (Styles 2009; Wasser *et al*. 2007, 2008, 2009, 2010; Milliken *et al*. 2009). The conclusion offered by some proponents of the ivory trade is that the current situation provides further evidence that trade bans do not protect elephants. Such conclusions ring hollow because elephant ivory has *never* been removed from the marketplace. There is actually no basis, therefore, for testing the hypothesis that a total

ban on trade *and sale* of ivory would virtually end the poaching of elephants. Perhaps the only real surprise is that the original CITES ban in 1989 appeared to reduce poaching, at least for a while (e.g. Douglas-Hamilton 2009).

Why is poaching and illicit ivory trading (Milliken *et al*. 2009) apparently on the increase again? One suggestion is that as long as the debate over the effectiveness of trade bans continues, the mere possibility that additional elephant populations will be downlisted in the not-too-distant future, and that the current moratorium is time limited, maintains the prospect of renewed markets and international trade in the future. These two factors, plus the continued existence of legal national markets for elephant ivory, provide incentives for commodity speculators (see Wasser *et al*. 2009) and organized crime syndicates (Wasser *et al.* 2008; Milliken *et al*. 2009) to continue poaching, even if some of the ivory must be stockpiled for a while in anticipation of a future payoff.

Another possibility is that those involved in the illegal ivory trade understand their need to demonstrate that putative trade bans do not work. This possibility provides another incentive (from their perspective, merely an investment in the future) to ensure that poaching continues, or even escalates, as it now appears to be doing, despite the existence of the current CITES moratorium on international ivory sales.

Of course, there remain other economic reasons for over-exploiting large, valuable, but slowly reproducing organisms like elephants, as well as great whales and old growth forests. As Clark (1973a, 1973b, 1989) and Caughley (1993) pointed out years ago, it makes more economic sense to deplete such "resources" as quickly as possible and to invest the profits elsewhere than it does to "harvest" (a conservation euphemism) them in a biologically sustainable manner. Viewed in this light, there is really no economic incentive for ivory traders (nor for the whaling and forestry industries) to conserve stocks in the wild. And there will always be sufficient local inhabitants willing to risk life and limb to put food on the table by selling poached elephant tusks to unscrupulous middlemen.

Those who promote continued trade in elephant ivory are also denying the long established lesson of history (see, for example, Geist 1988; Lavigne *et al*. 1996; Lavigne 2006) that, "Species that people use as commodities are inherently at risk of population reduction or elimination" (Norse 1993, p. 81). And, they are ignoring the undeniable human behaviour, so aptly described by Vreeland (1916, p. 97) that, "As long as there are dealers in wild game you will find men who will kill it in spite of anything you may do to the contrary".

Failure to close *all* commercial markets to elephant products virtually guarantees that the poaching of elephants and the illegal trade in ivory will continue. And, no doubt, the tangential and unproductive debate over the pros and cons of international trade bans will continue unabated, further jeopardizing the status of elephant populations in many parts of Africa and Asia.

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*Gajah 32 (2010) 50-51*

# Report from EU-Asia Link Training Course on "Asian Elephant Breeding and Health Management in South East Asia"

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This training course was the fourth in a series of four training courses planned under the framework of the European Union Asia Link Program on "Managing the health and reproduction of elephant populations in Asia". It was organized by the Faculty of Veterinary Medicine, Chiang Mai University (FVM-CMU), the National Elephant Institute (NEI), the Elephant Reintroduction Foundation, Thailand, and the Royal Veterinary College (RVC), London University, UK, with support from the Faculty of Veterinary and Animal Science (FVMAS) of the University of Peradeniya (UP), Sri Lanka, and the Faculty of Veterinary Medicine at Kasetsart University (KU), Thailand.

The course was started with internet based learning during 26. April – 10. May 2010 in home countries, followed by practical training from 24.-28. May 2010 at FVM-CMU, with practical training and field work at NEI and the Elephant Reintroduction Foundation, Thailand. It was attended by 11 international participants from India, Sri Lanka, Indonesia, Laos, Japan and Germany and 9 national participants from both non-governmental and governmental organizations in Thailand (Fig. 1).



**Figure 1.** Group at the opening ceremony.

The objective of the course was to provide veterinarians, biologists, scientists, zoo and wildlife personnel engaged in the management, conservation, health and breeding of elephants with knowledge and skills on 1) reproductive functions of both male and female elephants; 2) management of breeding animals and methods for natural and artificial breeding; 3) assessment of health status and management procedures for maintaining captive elephants in optimum health.

The internet based training comprised of four units; 1) an overview of reproductive anatomy, physiology and endocrinology; 2) tools for monitoring reproduction: semen evaluation, ultrasonography, hormone assays; 3) breeding and conservation; and 4) health assessment. The aim was to ensure that all participants have a basic knowledge about elephant reproduction and health management before starting the practical training and interactive discussion. Furthermore, the internet based part of the course gave an opportunity for all participants and tutors to meet 'online' introduce themselves and discuss relevant issues before travelling to Thailand to attend the practical course. The tasks during this internet course involved a pre-test and mid course self-assessment tests for the participants to self-evaluate themselves and identify their own learning needs.

The lecture and practical part started 2 weeks after finishing the online course. The topics during the first day included elephant health care and management in Thailand and Sri Lanka, neonatal care, molecular tools for conservation, clinical pathology and wild elephant management. This was followed by the practical part at the elephant hospital at the NEI, Lampang on the second day.



**Figure 2.** Clinical examination of an elephant.

Trunk wash for diagnosis of tuberculosis was performed with a discussion of other diagnostic procedures, advantages and disadvantages of each method. Later on, the participants were divided in to 3 groups to practice on physical examination and health assessment of 3 elephants (Fig. 2). A demonstration with some participation on wound management, tusk problems, eye problems etc. was performed. The second day ended with a discussion on health management, neonatal care, routine disease monitoring and the treatment of disorders.

The third day comprised of lectures on male and female reproduction, breeding management in Thailand and Sri Lanka and reproductive control, followed by a discussion on reproduction and breeding management. The practical part on male and female reproduction was carried out on the fourth day at NEI. On male reproduction, semen collection and evaluation were performed (Fig. 3), with use of ultrasonography to assess the male reproductive organs. Furthermore, semen quality was assessed by the computer assisted sperm analysis (CASA) machine. On female reproduction, estrus detection by genital inspection test and urine test was performed. Females with known reproductive cycle status were used for endocrine monitoring. The ultrasonography on female reproductive organs was assessed on both specimens and on live animals per rectum. Discussions on male and female reproduction, and breeding management were performed at the end of the day involving all participants.

A field trip to observe the released elephants of the elephant reintroduction project at the Doi Pha Muang Wildlife Sanctuary, Lampang was conducted on the last day. All participants were given information on the background of the wildlife sanctuary, aims and process of elephant reintroduction. Participants were divided in to 2 groups and led into the forest to observe the elephants. The behaviours of individual and social animals were recorded and analyzed to see the overall behavior and migration pattern of these elephants. This course ended with an understanding of health management, captive breeding program and elephant release to the wild.

The training course was a success. The model of delivery, which included an online component prior to the practical course gave participants and tutors an opportunity to prepare well ahead for the valuable practical components and time was utilized in a productive manner. We hope the training course resulted in a greater understanding and skill on the reproductive functions of elephants among the veterinarians and wildlife personnel in Asian and other regions. The course was also an opportunity to develop long-term linkages and networking between the participants and the partner institutes of this EU-Asia Link project. This will inevitably, lead to greater collaboration in elephant management, conservation and breeding activities in Asia and other regions in the world. This course will be arranged again in Chiang Mai, Thailand in June 2011. For more information please visit our website: <http://www.asianelephantresearch.com>

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**Figure 3.** **S**emen collection and evaluation.

# Recent Publications on Asian Elephants

*Compiled by Jennifer Pastorini*

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E.A. Archie, T. Henry, J.E. Maldonado, C.J. Moss, J.H. Poole, V.R. Pearson, S. Murray, S.C. Alberts & R.C. Fleischer

**Major histocompatibility complex variation and evolution at a single, expressed DQA locus in two genera of elephants**

*Immunogenetics January 07, 2010*

**Abstract.** Genes of the vertebrate major histocompatibility complex (MHC) are crucial to defense against infectious disease, provide an important measure of functional genetic diversity, and have been implicated in mate choice and kin recognition. As a result, MHC loci have been characterized for a number of vertebrate species, especially mammals; however, elephants are a notable exception. Our study is the first to characterize patterns of genetic diversity and natural selection in the elephant MHC. We did so using DNA sequences from a single, expressed DQA locus in elephants. We characterized six alleles in 30 African elephants (*Loxodonta africana*) and four alleles in three Asian elephants (*Elephas maximus*). In addition, for two of the African alleles and three of the Asian alleles, we characterized complete coding sequences (exons 1–5) and nearly complete non-coding sequences (introns 2–4) for the class II DQA loci. Compared to DQA in other wild mammals, we found moderate polymorphism and allelic diversity and similar patterns of selection; patterns of non-synonymous and synonymous substitutions were consistent with balancing selection acting on the peptides involved in antigen binding in the second exon. In addition, balancing selection has led to strong trans-species allelism that has maintained multiple allelic lineages across both genera of extant elephants for at least 6 million years. We discuss our results in the context of MHC diversity in other mammals and patterns of evolution in elephants. © 2010 with kind permission from Springer Science+Business Media.

M. Barua

**Whose issue? Representations of human-elephant conflict in Indian and international media**

*Science Communication 32 (2010) 55-75*

**Abstract.** The media play a key role in communicating conservation issues such as human-wildlife conflict, but corresponding literature on how issues are represented is limited. This article traces the depiction of human-elephant conflict in the media by examining (a) how conflicts are framed and (b) how ultimate and proximate causes are communicated in Indian and international newspapers. Issues were often polarized or framed in dramatic terms, and consonance in reporting causes was lacking. Active engagement with the media is needed to produce a nuanced debate on conflict, for which recognizing the role of different actors and working closely with individual journalists are vital. © 2010 SAGE Publications.

M. Barua, J. Tamuly & R.A. Ahmed

**Mutiny or clear sailing? Examining the role of the Asian elephant as a flagship species**

*Human Dimensions of Wildlife 15 (2010) 145-160*

**Abstract.** Flagship species are used to leverage public support for conservation. The success of a flagship is potentially determined by its popularity and ability to foster conservation intentions among a target audience. When flagships come into conflict with people, however, it is likely that conservation intentions get negatively affected. By examining peoples' exposures to the Asian elephant—a global conservation flagship—this study sought to (a) identify exposures that enable conservation intentions and (b) test whether human-elephant conflict undermines them. Survey results showed that exposure to wild elephants negatively affected intentions to conserve elephants, while specific concern for the

elephant and direct involvement in conservation activities led to positive intentions. These results suggest that the effective use of the Asian elephant as a flagship may be contingent on mitigating human-elephant conflict, for which engagement with concerned local actors and initiation of participatory conservation frameworks need to be considered. © 2010 Taylor & Francis Group, LLC.

G. Boschian & D. Sacca

**Ambiguities in human and elephant interactions? Stories of bones, sand and water from Castel di Guido (Italy)**

*Quaternary International 214 (2010) 3-16*

**Abstract.** Geoarchaeological and taphonomical studies have been carried out on the sequence and on the faunal remains of Castel di Guido (Central Italy), a Middle Pleistocene site with Acheulean industry and faunas including *Elephas* (*Palaeoloxodon*) *antiquus*, *Bos primigenius*, *Equus ferus* and other taxa. Investigation focused on remains accumulated on the bottom of a depressed area, probably an ephemeral stream channel sometimes acting as a seep. The assemblage resulted prevalently from human activity, as shown by the selection of the faunas, by the thorough fracturing of the bones, and by the occurrence of abundant chipped stone industry and bone bifaces. It is still a matter of debate whether the animals were hunted or scavenged. The present-day distribution of the remains does not represent exactly their original configuration, as in most sites of this type and age. More likely, the objects are partly in their original position and partly reworked, and lie within a complex palimpsest of several phases of fluvial transport and human activity, with the addition of external inputs of reworked bones and artefacts. © 2009 with permission from Elsevier and INQUA.

J.L. Brown, D.C. Kersey, E.W. Freeman & T. Wagener

**Assessment of diurnal urinary cortisol excretion in Asian and African elephants using different endocrine methods**

*Zoo Biology 29 (2010) 274-283*

**Abstract.** Longitudinal urine samples were collected from Asian and African elephants to assess sample processing and immunoassay techniques for monitoring adrenal activity. Temporal profiles of urinary cortisol measured by RIA and EIA, with and without dichloromethane extraction, were similar; all correlation coefficients were >0.90. However, based on regression analyses, cortisol immunoactivity in extracted samples was only 72-81% of that of unextracted values. Within assay technique, RIA values were only 74-81% of EIA values. Collection of 24-hr urine samples demonstrated a clear diurnal pattern of glucocorticoid excretion, with the lowest concentrations observed just before midnight and peak concentrations occurring around 0600-0800 hr. These results indicate that elephants fit the pattern of a diurnal species, and that glucocorticoid production is affected by a sleep-wake cycle similar to that described for other terrestrial mammals. Cortisol can be measured in both extracted and unextracted urine using RIA and EIA methodologies. However, unexplained differences in quantitative results suggest there may be sample matrix effects and that data generated using different techniques may not be directly comparable or interchangeable. © 2009 Wiley-Liss, Inc.

R. Clements, D.M. Rayan, A.W.A. Zafir, A. Venkataraman, R. Alfred, J. Payne, L. Ambu & D.S.K. Sharma

**Trio under threat: can we secure the future of rhinos, elephants and tigers in Malaysia?**

*Biodiversity and Conserv. 19 (2010) 1115-1136*

**Abstract.** Three of Malaysia's endangered large mammal species are experiencing contrasting futures. Populations of the Sumatran rhino (*Dicerorhinus sumatrensis*) have dwindled to critically low numbers in Peninsular Malaysia (current estimates need to be revised) and the state of Sabah (less than 40 individuals estimated). In the latter region, a bold intervention involving the translocation of isolated rhinos is being developed to concentrate them into a protected area to improve reproduction success rates. For the Asian elephant (*Elephas maximus*), recently established baselines for Peninsular Malaysia (0.09 elephants/km$^2$ estimated from one site) and Sabah (between 0.56 and 2.15 elephants/km$^2$ estimated from four sites) seem to indicate globally significant populations based on dung count surveys. Similar surveys are required

to monitor elephant population trends at these sites and to determine baselines elsewhere. The population status of the Malayan tiger (*Panthera tigris jacksoni*) in Peninsular Malaysia, however, remains uncertain as only a couple of scientifically defensible camera- trapping surveys (1.66 and 2.59 tigers/100 km$^2$ estimated from two sites) have been conducted to date. As conservation resources are limited, it may be prudent to focus tiger monitoring and protection efforts in priority areas identified by the National Tiger Action Plan for Malaysia. Apart from reviewing the conservation status of rhinos, elephants and tigers and threats facing them, we highlight existing and novel conservation initiatives, policies and frameworks that can help secure the long-term future of these iconic species in Malaysia. © 2010 with kind permission from Springer Science+Business Media.

R.H.I. Dale

**Birth statistics for African (*Loxodonta africana*) and Asian (*Elephas maximus*) elephants in human care: history and implications for elephant welfare**

*Zoo Biology 29 (2010) 87-103*

**Abstract.** African (*Loxodonta africana*) and Asian elephants (*Elephas maximus*) have lived in the care of humans for many years, yet there is no consensus concerning some basic parameters describing their newborn calves. This study provides a broad empirical basis for generalizations about the birth heights, birth weights, birth times and gestation periods of elephant calves born in captivity. I obtained data concerning at least one of these four characteristics for 218 newborn calves from 74 institutions. Over the past 30 years, newborn Asian elephants have been taller and heavier than newborn African elephants. Neonatal African elephants exhibited sex differences in both weight and height, whereas neonatal Asian elephants have exhibited sex differences only in height. Primiparous dams ex situ are at least as old as their in situ counterparts, whereas ex situ sires appear to be younger than sires in range countries. Confirming earlier anecdotal evidence, both African [N=47] and Asian [N=91] dams gave birth most often at night. © 2009 Wiley-Liss, Inc.

S. de Silva

**Acoustic communication in the Asian elephant, *Elephas maximus maximus***

*Behaviour 147 (2010) 825-852*

**Abstract.** Existing knowledge of acoustic communication in elephants is based primarily on African species (*Loxodonta africana* and *Loxodonta cyclotis*). There has been comparatively less study of communication in Asian elephants (*Elephas maximus*). In order to provide a basis for understanding the evolution and function of acoustic communication in proboscideans, I present a quantitative description of vocal communication in wild Asian elephants. I classify calls by acoustic features into 8 'single' calls, 5 'combination' calls and one possibly unique male call for a total of at least 14 distinct call types. Some of these vocalizations have never before been described. Certain low-frequency calls are individually distinct. Acoustic signals occur in a wide range of social contexts, with some differences in call production among age and sex classes. © 2010 Koninklijke Brill NV, Leiden.

R. Duffy & L. Moore

**Neoliberalising nature? Elephant-back tourism in Thailand and Botswana**

*Antipode 42 (2010) 742-766*

**Abstract.** This paper examines the case of elephant-back safaris in Thailand and Botswana; it argues that tourism has extended and deepened neoliberalism by targeting and opening up new frontiers in nature. In essence tourism redesigns and repackages nature for global consumption. Through a cross comparison of the same product (the use of captive/trained elephants) in two very different contexts (Thailand and Botswana) this paper analyses the variations in "actually existing neoliberalisms" (Brenner and Theodore 2002) and demonstrates that the effects are not unremittingly negative (Castree 2008b). It also draws out the ways that neoliberalism is challenged and reshaped by context specific processes and so it does not completely displace existing ways of approaching nature. Instead, existing approaches mix with neoliberalism to create new ways of valuing and conserving elephants. © 2010 Editorial Board of Antipode.

C. Gaucherel, M. Balasubramanian, P.V. Karunakaran, B.R. Ramesh, G. Muthusankar, C. Hély & P. Couteron

**At which scales does landscape structure influence the spatial distribution of elephants in the Western Ghats (India)?**

*Journal of Zoology 280 (2010) 185-194*

**Abstract.** In spatial ecology, detailed covariance analyses are useful for investigating the influences of landscape properties on fauna and/or flora species. Such ecological influences usually operate at multiple scales, involving biological levels from individual to group, population or community and spatial units from field to farms and regions. The aim of this work was to analyze possible multiscale influences of some landscape properties on elephant distribution in the Western Ghats, India, by applying a recent and simple mathematical method to quantify such ecological relationships across space and scales. This method combines a moving window with various correlation indices to investigate the relationship between two mapped variables. Maps of landscape heterogeneity (quantified here at all locations of the landscape with a modified Shannon index) and Asian elephant presence (a two-dimensional presence probability) were significantly correlated. This correlation systematically decreased with increasing scales (i.e. sizes of the reference moving window). Yet, this global relationship includes both positive and negative correlations located at distinct places. We documented a positive feedback (reinforcement) because elephants appeared to seek greater habitat heterogeneity, in heterogeneous areas, such as along the interface between natural and a human-disturbed habitat or in the natural part of the studied landscape. In parallel, we observed a negative feedback (compensation) making elephants seeking more homogeneous places in some relatively heterogeneous zones. Such negative feedbacks corresponded to higher than average probabilities of elephant presence. Finally, when elephant density varied according to landscape heterogeneity (corresponding to significant correlations), it pointed towards swamps and grasslands, but not towards semi-evergreen or secondary forests (as it may have been expected). Land cover information appeared to be less relevant than an integrated heterogeneity index computed at all scales. © 2009 The Zoological Society of London.

J.J. Genin, P.A. Willems, G.A. Cavagna, R. Lair & N.C. Heglund

**Biomechanics of locomotion in Asian elephants**

*J. of Experimental Biology 213 (2010) 694-706*

**Abstract.** Elephants are the biggest living terrestrial animal, weighing up to five tons and measuring up to three metres at the withers. These exceptional dimensions provide certain advantages (e.g. the mass-specific energetic cost of locomotion is decreased) but also disadvantages (e.g. forces are proportional to body volume while supportive tissue strength depends on their cross-sectional area, which makes elephants relatively more fragile than smaller animals). In order to understand better how body size affects gait mechanics the movement of the centre of mass (COM) of 34 Asian elephants (*Elephas maximus*) was studied over their entire speed range of 0.4-5.0 m $s^{-1}$ with force platforms. The mass-specific mechanical work required to maintain the movements of the COM per unit distance is ~0.2 J $kg^{-1}$ m–1 (about 1/3 of the average of other animals ranging in size from a 35 g kangaroo rat to a 70 kg human). At low speeds this work is reduced by a pendulum-like exchange between the kinetic and potential energies of the COM, with a maximum energy exchange of ~60% at 1.4 m $s^{-1}$. At high speeds, elephants use a bouncing mechanism with little exchange between kinetic and potential energies of the COM, although without an aerial phase. Elephants increase speed while reducing the vertical oscillation of the COM from about 3 cm to 1 cm. © 2010 reproduced with permission from The Company of Biologists Ltd.

R. Ghosal, R. Sukumar & P.B. Seshagiri

**Prediction of estrus cyclicity in Asian elephants (*Elephas maximus*) through estimation of fecal progesterone metabolite: development of an enzyme-linked immuno-sorbent assay**

*Theriogenology 73 (2010) 1051-1060*

**Abstract.** Asian elephants (*Elephas maximus*), prominent "flagship species", are listed under the category of endangered species (EN – A2c, ver. 3.1; IUCN Red List 2009) and there is a need for

their conservation. This requires understanding demographic and reproductive dynamics of the species. Monitoring reproductive status of any species is traditionally being carried out through invasive blood sampling and this is restrictive for large animals such as wild or semi-captive elephants due to legal, ethical, and practical reasons. Hence, there is a need for a non-invasive technique to assess reproductive cyclicity profiles of elephants, which will help in the species' conservation strategies. In this study, we developed an indirect competitive enzyme linked immuno-sorbent assay (ELISA) to estimate the concentration of one of the progesterone-metabolites i.e., allopregnanolone (5 -P-3OH) in fecal samples of Asian elephants. We validated the assay which had a sensitivity of 0.25 μM at 90% binding with an EC50 value of 1.37 μM. Using female elephants, kept under semi-captive conditions in the forest camps of Mudumalai Wildlife Sanctuary, Tamil Nadu and Bandipur National Park, Karnataka, India, we measured fecal progesterone-metabolite (5 -P-3OH) concentrations in six animals and showed their clear correlation with those of serum progesterone, measured by a standard radio-immuno assay. Statistical analyses using a Linear Mixed Effect model showed a positive correlation ($P < 0.1$) between the profiles of fecal 5 -P-3OH (range: 0.5–10 μg/g) and serum progesterone (range: 0.1–1.8 ng/mL). Therefore, our studies show, for the first time, that the fecal progesterone-metabolite assay could be exploited to predict estrus cyclicity and to potentially assess the reproductive status of captive and free-ranging female Asian elephants, thereby helping to plan their breeding strategy. © 2010 with permission from Elsevier Inc.

C. Gómez-Centurión

**Treasures fit for a king. King Charles III of Spain's Indian elephants**

*J. of the History of Collections 22 (2010) 29-44*

**Abstract.** The practice of collecting exotic animals saw an unprecedented rise at the Spanish court in the eighteenth century, particularly during the reign of Charles III. His most prized specimens were three Indian elephants, regarded as genuine crown jewels and symbolizing the power, wealth and prestige of a great sovereign more eloquently than any other animal. They gave a clear sign of the breadth and strength of his diplomacy, the influence of which extended as far away as India. The interest aroused by their acquisition and the diplomatic procedures involved are examined here, together with the problems encountered in bringing these animals to the Iberian Peninsula and maintaining them in the unusual conditions of the Aranjuez Palace. © 2009 by permission of Oxford University Press.

B.R. Harish, B.M. Shivaraj, B.M. Chandranaik, M.D. Venkatesh & C. Renukaprasad

**Hemorrhagic septicemia in Asian elephants *Elephas maximus* in Karnataka state, India**

*Journal of Threatened Taxa 1(2009) 194-195*

**Abstract.** none

S. Hedges & D. Gunaryadi

**Reducing human–elephant conflict: do chillies help deter elephants from entering crop fields?**

*Oryx 44 (2010) 139-146*

**Abstract.** Crop raiding by elephants is the most prevalent form of human–elephant conflict and can result in devastating economic losses for farmers, loss of human lives and the killing or capture of elephants. Chilli (capsaicin)-based elephant deterrents have been promoted as tools for reducing such conflict but have been little tested. From October 2005 to April 2006 we tested crop-guarding systems around Way Kambas National Park in Indonesia. We evaluated the effectiveness of community-based guarding using traditional tools (e.g. noise-makers) at one site and community-based guarding plus chilli-grease-covered fences and tripwire-triggered sirens at another site. We monitored human–elephant conflict rates around the Park to assess the effectiveness of our mitigation trials. Over the trial period there were 34 attempts by elephants to enter crop fields at the chilli and sirens site and 57 attempts to enter fields at the conventional site but 91.2% of attempts were repelled successfully at both sites. Over the same period there were 401 crop-raiding incidents elsewhere around the Park. In 2007 farmers at both our former sites voluntarily adopted the methods that had been used at the conventional site, but not at the chilli and sirens site, and were able to repel 156

of 178 (87.6%) attempted elephant raids. We conclude that community-based guarding using conventional tools is the key to keeping elephants out of crops and that chilli-grease fences (and sirens) do not add any significant deterrent effect but do add expense and create additional work. However, other chilli-based deterrents may be effective and chillies have value as elephant-resistant cash crops. © 2009 Fauna & Flora International, Cambridge University Press.

N. Irie & T. Hasegawa

**Elephant psychology: What we know and what we would like to know**

*Japanese Psychol.Research 51(2009) 177-181*

**Abstract.** Although elephants are well-known and one of the most popular species among people, their behavior and cognitive abilities have not been studied very extensively. But recently, more and more researchers are becoming interested in studying their cognition, particularly their general intelligence, including causal reasoning and mirror self recognition, memory, and numerical cognition. Although genetically elephants are more closely related to the small-brained aardvarks and manatees than to primates, they hold enormous potential in their cognitive skills. Also, studying their cognition is important from the point of view of animal welfare in captivity. © 2009 Japanese Psychological Association.

D. Jayantha, P.N. Dayawansa, U.K.G.K. Padmalal & W.D. Ratnasooriya

**Social relationships of wild juvenile Asian Elephants *Elephas maximus* in the Udawalawa National Park, Sri Lanka**

*Journal of Threatened Taxa 1 (2009) 211-214*

**Abstract.** Social relationships of juvenile wild elephants (3-6 years old) in the Udawalawa National Park were studied. Focal animal sampling was employed to quantify behaviour of juveniles encountered on 450 different occasions. Nearest neighbour (NN) and nearest neighbour distance (NND) were considered for proximity analysis and the social relationships of focal animals. Adult females and juveniles were the NN of the study group during 50.8% and 37.6% of the total observed time respectively. The mean NND was 1.62m (SD±2.8), and it was less than 5m 98% of the time while 33% of the time the study group was touching (NND<1m) the NN. There was a significant difference between NND categories ($p<0.05$). Eighty percent of the NN infants stayed at a touching distance and were cared or allo-mothered by the juveniles under discussion. Time allocated for different behaviour patterns by the study group varied with the NN. When the study animals were accompanied by age-mates, they spent 17% of time in social playing and another 3% in non-play social contacts, but only 1% in each behaviour pattern when the adult females were in close proximity. Maximum social contacts were observed between study animals and infants. The findings suggest that juvenile elephants associate more frequently with adult females and near-age mates while they show social relationships in a varying degree with different associates. Play and social contacts of juveniles with conspecifics, especially with peers, provides opportunity to develop skills and social confidence necessary in adulthood. © 2009 The Author.

M.A. Kumar, D. Mudappa & T.R.S. Raman

**Asian elephant *Elephas maximus* habitat use and ranging in fragmented rainforest and plantations in the Anamalai Hills, India**

*Tropical Conserv. Science 3 (2010) 143-158*

**Abstract.** The persistence of wide-ranging mammals such as Asian elephants in fragmented landscapes requires extending conservation efforts into human-dominated landscapes around protected areas. Understanding how elephants use such landscapes may help facilitate their movements and reduce conflict incidence. We studied elephants' use of fragmented habitats and ranging patterns of focal herds in a landscape of rainforest fragments embedded in tea, coffee, and Eucalyptus plantations in the Anamalai Hills. Elephant herds entering this landscape were tracked daily between April 2002 and March 2006, resulting in 985 GPS locations of herds obtained across six major habitats. Natural vegetation in rainforest fragments and riparian habitats, despite low coverage in the landscape, was preferred by elephants during the day. At night, elephants preferred riparian vegetation, avoided other habitats such as swamps and settlements, while the remaining habitats were used proportional to availability. Use of rainforest fragments and

riparian vegetation increased over three years of study with a corresponding decline in the use of tea monoculture. Among plantation habitats, coffee, and Eucalyptus were used significantly more during wet and dry seasons, respectively. The concentration of elephants along a major riparian system in the center of the landscape emphasized the role of water and food availability in habitat use during the dry season. Protection of rainforest fragments, secondary vegetation along rivers, and regulated and sequential felling (instead of clear-felling) of Eucalyptus along elephant movement routes will help retain forage, cover, and passage routes of elephant herds and may reduce direct human-elephant encounters in such fragmented landscapes. © 2010 The Authors.

K.D. Lewis, D.J. Shepherdson, T.M. Owens & M. Keele

**A survey of elephant husbandry and foot health in North American zoos**

*Zoo Biology 29 (2010) 221-236*

**Abstract.** The foot health of elephants in human care is a longstanding concern. In 2001, the AZA Standards for Elephant Management and Care were published recommending husbandry to improve foot health. This article reports the results of a 2006 survey: basic statistics describing facility, husbandry, and foot health attributes are reported and relationships among variables are investigated. Median area available to elephants exceeded standard recommendations (755 $ft^2$ per elephant indoor and 10,000 $ft^2$ outdoor). Concrete makes up 69% of indoor area and natural substrates account for 85% of outdoor area. Elephants in AZA facilities received an average of 45.5 min/day of exercise, and facilities with a structured exercise plan provided significantly more exercise than did facilities without a structured exercise plan ($z=-2.522$, $P=0.012$). Enrichment is important to psychological health and may also stimulate activity beneficial to foot health; 95% of institutions had a structured enrichment program. Preventative foot care was nearly universal, and 100% of facilities performed routine nail and pad trimming. However, foot pathology has not been eradicated; 33% of institutions reported at least one pathology in the previous year. This study found a strong inverse relationship between foot pathology and exercise ($2(3)=24.34$, $P<0.001$). Younger herds were less likely to have a member diagnosed with arthritis ($2(1)=8.90$, $P=0.003$). Lameness was unrelated to age or pathology, and only the presence of arthritis explained lameness ($z=-7.81$, $P<0.001$). African elephants seemed to experience lower rates of foot pathology and arthritis than Asian elephants; however, this was explained by differences in age. © 2009 Wiley-Liss, Inc.

G.J. Mason & J.S. Veasey

**How should the psychological well-being of zoo elephants be objectively investigated?**

*Zoo Biology 29 (2010) 237-255*

**Abstract.** Animal welfare (sometimes termed well-being) is about feelings - states such as suffering or contentment that we can infer but cannot measure directly. Welfare indices have been developed from two main sources: studies of suffering humans, and of research animals deliberately subjected to challenges known to affect emotional state. We briefly review the resulting indices here, and discuss how well they are understood for elephants, since objective welfare assessment should play a central role in evidence-based elephant management. We cover behavioral and cognitive responses (approach/avoidance; intention, redirected and displacement activities; vigilance/startle; warning signals; cognitive biases, apathy and depression-like changes; stereotypic behavior); physiological responses (sympathetic responses; corticosteroid output - often assayed non-invasively via urine, feces or even hair; other aspects of HPA function, e.g. adrenal hypertrophy); and the potential negative effects of prolonged stress on reproduction (e.g. reduced gametogenesis; low libido; elevated still-birth rates; poor maternal care) and health (e.g. poor wound-healing; enhanced disease rates; shortened lifespans). The best validated, most used welfare indices for elephants are corticosteroid outputs and stereotypic behavior. Indices suggested as valid, partially validated, and/or validated but not yet applied within zoos include: measures of preference/avoidance; displacement movements; vocal/postural signals of affective (emotional) state; startle/vigilance; apathy; salivary and urinary epinephrine; female acyclity; infant mortality rates; skin/foot infections; cardio-vascular disease; and

premature adult death. Potentially useful indices that have not yet attracted any validation work in elephants include: operant responding and place preference tests; intention and vacuum movements; fear/stress pheromone release; cognitive biases; heart rate, pupil dilation and blood pressure; corticosteroid assay from hair, especially tail-hairs (to access endocrine events up to a year ago); adrenal hypertrophy; male infertility; prolactinemia; and immunological changes. © 2009 Wiley-Liss, Inc.

G.J. Mason & J.S. Veasey

**What do population-level welfare indices suggest about the well-being of zoo elephants?**

*Zoo Biology 29 (2010) 256-273*

**Abstract.** To assess zoo elephants' welfare using objective population-level indices, we sought data from zoos and other protected populations (potential benchmarks) on variables affected by poor well-being. Such data were available on fecundity, potential fertility, stillbirths, infant mortality, adult survivorship, and stereotypic behavior. Most of these can also be affected by factors unrelated to well-being; therefore, for each, we analyzed the potential role of these other factors. Population-level comparisons generally indicate poor reproduction, and poor infant and adult survivorship in zoos compared with benchmark populations (with some differences between zoo regions and over time). Stereotypic behavior also occurs in c. 60% of zoo elephants; as the population-level welfare index least open to alternative interpretations, this represents the strongest evidence that well-being is/has been widely compromised. Poor well-being is a parsimonious explanation for the diverse range of population-level effects seen, but to test this hypothesis properly, data are now needed on, for example, potential confounds that can affect these indices (to partition out effects of factors unrelated to well-being), and causes of the observed temporal effects, and differences between species and zoo regions. Regardless of whether such additional data implicate poor well-being, our findings suggest that elephant management has generally been sub-optimal. We also discuss the selection and utilization of benchmark data, as a useful future approach for evaluating such issues. © 2010 Wiley-Liss, Inc.



Elephant relief at the Kesava temple in Somnathpur, India built in 1268

S. Nair, R. Balakrishnan, C.S. Seelamantula & R. Sukumar

**Vocalizations of wild Asian elephants (*Elephas maximus*): structural classification and social context**

*Journal of the Acoustical Society of America 126 (2009) 2768-2778*

**Abstract.** Elephants use vocalizations for both long and short distance communication. Whereas the acoustic repertoire of the African elephant (*Loxodonta africana*) has been extensively studied in its savannah habitat, very little is known about the structure and social context of the vocalizations of the Asian elephant (*Elephas maximus*), which is mostly found in forests. In this study, the vocal repertoire of wild Asian elephants in southern India was examined. The calls could be classified into four mutually exclusive categories, namely, trumpets, chirps, roars, and rumbles, based on quantitative analyses of their spectral and temporal features. One of the call types, the rumble, exhibited high structural diversity, particularly in the direction and extent of frequency modulation of calls. Juveniles produced three of the four call types, including

trumpets, roars, and rumbles, in the context of play and distress. Adults produced trumpets and roars in the context of disturbance, aggression, and play. Chirps were typically produced in situations of confusion and alarm. Rumbles were used for contact calling within and among herds, by matriarchs to assemble the herd, in close-range social interactions, and during disturbance and aggression. Spectral and temporal features of the four call types were similar between Asian and African elephants. © 2009 Acoustical Society of America. Reprinted with permission.

C. Neto de Carvalho

**Vertebrate tracksites from the Mid-Late Pleistocene eolianites of Portugal: the first record of elephant tracks in Europe**

*Geological Quarterly 53 (2009) 407-414*

**Abstract.** This study describes the palaeoichnology of the Malhao Dune Field (Pleistocene), the first report of vertebrate tracksites from all the Cenozoic front Portugal. At least 14 stratigraphic horizons with mammal and bird footprints and trackways occur, including those of elephants. Footprints produced by elephants show four feet with four toes imprints on each foot and heteropody in a narrow gauge. The presence of three possibly parallel trackways points to gregarious behavior of sub-adults/females of *Elephas antiquus*. The ichnospecies *Proboscipeda panfamilia*, found in the Malhão and Pessegueiro sectors, represents possibly the first Pleistocene elephant trackways, and record one of the latest occurrences of *E. antiquus* in Europe. The new ichnogenus and ichnospecies *Leporidichnites malhaoi*, interpreted as lagomorph tracks, are also described. © 2009 The Author.

J.M. Plotnik, F.B.M. de Waal, D. Moore III & D. Reiss

**Self-recognition in the Asian elephant and future directions for cognitive research with elephants in zoological settings**

*Zoo Biology 29 (2010) 179-191*

**Abstract.** The field of animal cognition has grown steadily for nearly four decades, but the primary focus has centered on easily kept lab animals of varying cognitive capacity, including rodents, birds and primates. Elephants (animals not easily kept in a laboratory) are generally thought of as highly social, cooperative, intelligent animals, yet few studies - with the exception of long-term behavioral field studies - have been conducted to directly support this assumption. In fact, there has been remarkably little cognitive research conducted on Asian (*Elephas maximus*) or African (*Loxodonta africana* or *L. cyclotis*) elephants. Here, we discuss the opportunity and rationale for conducting such research on elephants in zoological facilities, and review some of the recent developments in the field of elephant cognition, including our recent study on mirror self-recognition in *E. maximus*. © 2009 Wiley-Liss, Inc.

C.M. Proctor, E.W. Freeman & J.L. Brown

**Results of a second survey to assess the reproductive status of female Asian and African elephants in North America**

*Zoo Biology 29 (2010) 127-139*

**Abstract.** Surveys are being conducted to monitor the reproductive health of elephants managed by the TAG/SSP. This study summarizes results of a 2005 survey and compares data to one conducted in 2002. Surveys were returned for 100% and 79.0% of Asian and African elephants, respectively. Of those, 79.3% of Asian and 92.1% of African elephants had weekly progestagen data to assess ovarian cyclicity. For Asian elephants, acyclicity rates were similar between the 2002 and 2005 surveys (13.3% versus 10.9%), whereas irregular cycling increased in 2005 (2.6% versus 7.6%), respectively. For African elephants, the percentages of both acyclicity (22.0% versus 31.2%) and irregular cycling females (5.2% versus 11.8%) increased. In both species, ovarian inactivity was more prevalent in the older age categories (>30 years of age), but for African elephants also occurred in the reproductive aged groups. Reproductive tract pathologies did not account for the majority of acyclicity problems. Several females changed cyclicity status between the two surveys, including from noncycling to cycling, suggesting this is not an irreversible condition. However, seven African females went from cycling to abnormal or no cyclic activity. In summary, the incidence of ovarian acyclicity in Asian elephants is low and stable, but appears to be increasing in African females. These findings reinforce the need for

long-term reproductive monitoring programs and continuous reproductive surveys, even for females not being considered for breeding. With more data we hope to determine what factors are related to changes in ovarian status and how to reverse the trend towards acyclicity. © 2009 Wiley-Liss, Inc.

L. Ren, C.E. Miller, R. Lair & J.R. Hutchinson
**Integration of biomechanical compliance, leverage, and power in elephant limbs**
*PNAS 107 (2010) 7078–7082*
**Abstract.** The structure and motion of elephant limbs are unusual compared with those of other animals. Elephants stand and move with straighter limbs (at least when walking), and have limited speed and gait. We devised novel experiments to examine how the limbs of elephants support and propel their mass and to explore the factors that may constrain locomotor performance in these largest of living land animals. We demonstrate that elephant limbs are remarkably compliant even in walking, which maintains low peak forces. Dogma defines elephant limbs as extremely "columnar" for effective weight support, but we demonstrate that limb effective mechanical advantage (EMA) is roughly one-third of that predicted for their size. EMA in elephants is actually smaller than that in horses, which are only one-tenth their mass; it is comparable to human limb values. EMA drops sharply with speed in elephants, as it does in humans. Muscle forces therefore must increase as the limbs become more flexed, and we show how this flexion translates to greater volumes of muscle recruited for locomotion and hence metabolic cost. Surprisingly, elephants use their forelimbs and hindlimbs in similar braking and propulsive roles, not dividing these functions among limbs as was previously assumed or as in other quadrupeds. Thus, their limb function is analogous to four-wheel-drive vehicles. To achieve the observed limb compliance and low peak forces, elephants synchronize their limb dynamics in the vertical direction, but incur considerable mechanical costs from limbs working against each other horizontally. © 2010 National Academy of Sciences.

H.S. Riddle, B.A. Schulte, A.A. Desai & L. van der Meer
**Elephants - a conservation overview**
*Journal of Threatened Taxa 2 (2010) 653-661*
**Abstract.** Loss of habitat is one of the most significant problems facing elephants worldwide, leading to clashes over resources between wildlife and humans where elephants receive the largest part of blame – defined as Human Elephant Conflict (HEC). The sub-Saharan region of Africa contains an approximate population of 500,000 elephants that occupy 37 range countries. The African Elephant (*Loxodonta africana*) is categorized as Vulnerable in the Red List of Threatened Species; they are listed there as two distinct subspecies: the Savanna Elephant (*L. a. africana*) and the Forest Elephant (*L. a. cyclotis*). The Red List of Threatened Species categorizes the Asian Elephant (*Elephas maximus*) as endangered, and today they are found in 13 range states. The Asian Elephant population is estimated to be 30,000 to 50,000 with approximately 60% of the population being present in India. Due to threats of poaching, the elephant ivory debate has been an important part of recent meetings of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) as Parties have debated proposals for one-time sales of legal government stockpiles of elephant tusks. To maintain elephant populations into the future, long-term and large-scale planning is necessary to ensure adequate space and protection for elephants and people living in elephant habitats. © 2010 The Authors.

M. Sa-ardrit, N. Thongtip, K. Kornkaewrat, T. Faisaikarm, Y. Kitiyanant, S. Mahasawangkul, A. Pinyopummin & K. Saikhun
**Assessment of viability and acrosomal status of Asian elephant (*Elephas maximus*) sperm after treatment with calcium ionophore and heparin**
*Journal of the South African Veterinary Association 80 (2009) 146-150*
**Abstract.** Knowledge about the acrosomal status of Asian elephant (*Elephas maximus*) sperm is extremely limited. The objective of this study was to evaluate the viability and acrosomal status of Asian elephant sperm following induction by

calcium ionophore and heparin using propidium iodide (PI) and fluorescein isothiocyanate conjugated peanut agglutinin (FITC-PNA). Semen samples were collected from elephant bulls by manual stimulation. Semen was diluted with extender, cooled to 4 C and transported to a laboratory for the experiment. Sperm cells were incubated in modified Tyrode's medium containing either 1mM calcium ionophore or 10 mg/ml heparin for 5 h at 39 C. Sperm recovered at the onset (0 h), 1, 2, 3, 4 and 5 h of incubation were simultaneously assessed for the viability and acrosomal status using dual staining of FITC-PNA and PI. Results were confirmed by transmission electron microscopy. A progressive increase in the proportion of live-acrosome reacted sperm was observed within 3 h of incubation in both treatment groups which slightly decreased at 4 to5 h of incubation. At 1 to 3 h of incubation, the percentage of live-acrosome reacted sperm induced by calcium ionophore was higher ($P < 0.05$) than those induced by heparin and the control. However, there were no statistical differences at 4 to 5 h of incubation. A progressive reduction of the percentage of motile sperm was observed in the control as well as both treatment groups. Sperm motility decreased sharply when they were incubated in calcium ionophore compared with incubation in heparin and control groups. These results indicate that the occurrence of live-acrosome reacted sperm in the Asian elephant was induced by calcium ionophore at a rate higher than that induced by heparin.

R.C. Sidle & A.D. Ziegler

**Elephant trail runoff and sediment dynamics in northern Thailand**

*J.of Environmental Quality 39 (2010) 871-881*

**Abstract.** Although elephants may exert various impacts on the environment, no data are available on the effects of elephant trails on runoff, soil erosion, and sediment transport to streams during storms. We monitored water and sediment fluxes from an elephant trail in northern Thailand during seven monsoon storms representing a wide range of rainfall energies. Runoff varied from trivial amounts to 353 mm and increased rapidly in tandem with expanding contributing areas once a threshold of wetting occurred. Runoff coefficients during the two largest storms were much higher than could be generated from the trail itself, implying a 4.5- to 7.9-fold increase in the drainage areas contributing to storm runoff. Clockwise hysteresis patterns of suspended sediment observed during most storms was amplified by a "first flush" of sediment early on the hydrograph in which easily entrained sediment was transported. As runoff areas expanded during the latter part of large storms, discharge increased but sediment concentrations declined. Thus, sediment flux was better correlated to kinetic energy of rainfall on the falling limbs of most storm hydrographs compared to rising limbs. Based on a power function relationship between sediment flux and storm kinetic energy, the estimated annual sediment yield from the trail for 135 storms in 2005 was 308 to 375 Mg $ha^{-1}$ $yr^{-1}$, higher than from most disturbed land surfaces in the tropics. The eight largest storms (30% of total storm energy) in 2005 transported half of the total annual sediment. These measurements together with site investigations reveal that highly interconnected elephant trails, together with other source areas, directly link runoff and sediment to streams. © 2010 American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America

M. Techakumphu, R. Rungsiwiwut, P. Numchaisrika & A. Thongphakdee

**Cloned Asian elephant (*Elephas maximus*) embryos reconstructed from rabbit recipient oocytes**

*Thai Journal of Vet. Medicine 40 (2010) 63-68*

**Abstract.** The information about reproductive biology, especially embryo development of Asian elephant (*Elephas maximus*) generated from naturally fertilization is lacking. In the present study, somatic cell nuclear transfer (SCNT) was applied as an alternative way to produce the elephant embryos. The fibroblasts derived from ear skin of Asian elephant and rabbit were used as the donor cells and rabbit oocytes were used as the recipient cytoplasm. The objectives of the study were 1) to find the optimal conditions for fusion and activation by using electrical pulses (experiment I) and 2) to investigate the *in vitro* development of cloned Asian elephant in comparison to clone rabbit embryos (experiment

II). Enucleation was accomplished by aspiration of the first polar body and the metaphase II plate together with a small amount of cytoplasm. The donor cells were transferred into the perivitelline space of the enucleated oocytes. In experiment I, sixty-one of elephant-rabbit reconstructed units were fused by electrical pulses E1 (3.2 kV/cm, 3 pulses, 20 μs) and sixty-nine units were fused by E2 (2.0 kV/cm, 2 pulses, 20 μs) in 0.3 M mannitol with 0.1 mM $Ca^{2+}$ and $Mg^{2+}$. The fused units were activated by using the same electrical pulses and incubated in activation medium for 1 h. Subsequently, the activated embryos were cultured in B2 medium containing 2.5% fetal calf serum and the developmental rate was observed daily for 7 days. The results showed that the fusion and cleavage rates of elephant-rabbit cloned embryos fused and activated by E1 were significantly higher than E2 ($p<0.05$). Electrical pluses program E1 was selected for further investigation in experiment II. The fusion and activation rated of elephant-rabbit units displayed significantly higher than rabbit-rabbit units ($p<0.05$). However, by comparison of cloned embryo development between elephant- and rabbit-rabbit units, the development from cleavage throughout the blastocyst stage of elephant-rabbit cloned units was similar to those of rabbit-rabbit units. In conclusion, fusion and activation protocol of E1 is suitable for elephant-rabbit SCNT and the elephant nuclei could be reprogrammed and developed to blastocyst stage in enucleated rabbit oocytes. The present study provides the fundamental knowledge for further investigation of conservation and therapeutic aims, including cloned elephant embryo development *in vivo* after transfer, rescuing valuable elephant and establishment of elephant embryonic stem cells.

H. Telkänranta

**Conditioning or cognition? Understanding interspecific communication as a way of improving animal training (a case study with elephants in Nepal**

*Sign Systems Studies 37 (2009) 542-557*

**Abstract.** When animals are trained to function in a human society (for example, pet dogs, police dogs, or sports horses), different trainers and training cultures vary widely in their ability to understand how the animal perceives the communication efforts of the trainer. This variation has considerable impact on the resulting performance and welfare of the animals. There are many trainers who frequently resort to physical punishment or other pain-inflicting methods when the attempts to communicate have failed or when the trainer is unaware of the full range of the potential forms of human-animal communication. Negative consequences of this include animal suffering, imperfect performance of the animals, and sometimes risks to humans, as repeated pain increases aggression in some animals. The field of animal training is also interesting from a semiotic point of view, as it effectively illustrates the differences between the distinct forms of interaction that are included in the concept of communication in the zoosemiotic discourse. The distinctions with the largest potential in improving human-animal communication in animal training, is understanding the difference between verbal communication of the kind that requires rather high cognitive capabilities of the animal, and communication based on conditioning, which is a form of animal learning that does not require high cognitive ability. The differences and potentials of various types of human-animal communication are discussed in the form of a case study of a novel project run by a NGO called Working Elephant Programme of Asia (WEPA), which introduces humane, science-based training and handling methods as an alternative to the widespread use of pain and fear that is the basis of most existing elephant training methods.

C. Thitaram, C. Somgird, S. Mahasawangkul, T. Angkavanich, R. Roongsri, N. Thongtip, B. Colenbrander, F.G. van Steenbeek & J.A. Lenstra

**Genetic assessment of captive elephant (*Elephas maximus*) populations in Thailand**

*Conservation Genetics 11 (2010) 325-330*

**Abstract.** The genetic diversity and population structure of 136 captive Thai elephants (*Elephas maximus*) with known region of origin were investigated by analysis of 14 highly polymorphic microsatellite loci. We did not detect significant indications of inbreeding and only a low differentiation of elephants from

different regions. This is probably explained by the combined effects of isolation by distance and exchange between different regions or between captive and wild elephant populations. Estimates of effective population sizes were in the range of 90-240 individuals, which emphasizes the necessity to guard against inbreeding as caused by the current use of a restricted number of breeding bulls. © 2009 with kind permission from Springer Science+Business Media.

N.E. Todd

**New phylogenetic analysis of the family Elephantidae based on cranial-dental morphology**

*The Anatomical Record 293 (2010) 74-90*

**Abstract.** In 1973, Vincent Maglio published a seminal monograph on the evolution of the Elephantidae, in which he revised and condensed the 100+ species named by Henry Fairfield Osborn in 1931. Michel Beden further revised the African Elephantidae in 1979, but little systematic work has been done on the family since this publication. With addition of new specimens and species and revisions of chronology, a new analysis of the phylogeny and systematics of this family is warranted. A new, descriptive character dataset was generated from studies of modern elephants for use with fossil species. Parallel evolution in cranial and dental characters in all three lineages of elephants creates homoplastic noise in cladistic analysis, but new inferences about evolutionary relationships are possible. In this analysis, early *Loxodonta* and early African *Mammuthus* are virtually indistinguishable in dental morphology. The *Elephas* lineage is not monophyletic, and results from this analysis suggest multiple migration events out of Africa into Eurasia, and possibly back into Africa. New insight into the origin of the three lineages is also proposed, with *Stegotetrabelodon* leading to the *Mammuthus* lineage, and *Primelephas* as the ancestor of *Loxodonta* and *Elephas*. These new results suggest a much more complex picture of elephantid origins, evolution, and paleogeography. © 2009 Wiley-Liss, Inc.

N.E. Todd

**Qualitative comparison of the cranio-dental osteology of the extant elephants, *Elephas maximus* (Asian elephant) and *Loxodonta africana* (African elephant)**

*The Anatomical Record 293 (2010) 62-73*

**Abstract.** Few osteological descriptions of the extant elephants and no detailed morphological comparison of the two genera, *Elephas* and *Loxodonta*, have been done in recent years. In this study, 786 specimens of extant elephants (crania, mandibles, and molars) were examined for characters unique to each species. Differences between sexes in each species were described, as well as differences between subspecies of each species. Striking differences in morphology were noted between sexes of both elephants and between subspecies, which may complement current genetic studies, the focus of which is to determine division at the subspecies or species level, particularly differences between the savanna elephant (*Loxodonta africana africana*) and the forest elephant (*Loxodonta africana cyclotis*). In addition, examination of the two living elephants provides an excellent dataset for identifying phylogenetic characters for use in examining evolutionary relationships within and between fossil lineages of elephantids. © 2009 Wiley-Liss, Inc.

N.M. Weissenböck, F. Schober, G. Fluch, C. Weiss, T. Paumann, C. Schwarz & W. Arnold

**Reusable biotelemetric capsules: A convenient and reliable method for measuring core body temperature in large mammals during gut passage**

*Journal of Thermal Biology 35 (2010) 147-153*

**Abstract.** It is still not fully understood how megaherbivores regulate their body temperature (Tb), particularly with respect to their unfavourable surface to volume ratio. The paucity of information is probably owing to the difficulty obtaining physiological parameters from such animals. We developed a precise and reliable non-invasive method for determining the Tb of large-bodied mammals. We used this method on African and Asian elephants. Small capsules (30 g) containing a temperature-sensitive transmitter and a memory for onboard data storage were hand-fed 71 times to elephants (N=21) and Tb was measured during gut passage. In 64 cases, sensors were successfully retrieved. The operation and reliability of our data loggers

was sufficient and compared favourably with any other published method. © 2010 with permission from Elsevier.

L. Yon, B. Faulkner, S. Kanchanapangka, N. Chaiyabutr, S. Meepan & B. Lasley

**A safer method for studying hormone metabolism in an Asian elephant (*Elephas maximus*): accelerator mass spectrometry**

*Zoo Biology 28 (2010) 1-7*

**Abstract.** Noninvasive hormone assays provide a way to determine an animal's health or reproductive status without the need for physical or chemical restraint, both of which create unnecessary stress for the animal, and can potentially alter the hormones being measured. Because hormone metabolism is highly species-specific, each assay must be validated for use in the species of interest. Validation of noninvasive steroid hormone assays has traditionally required the administration of relatively high doses of radiolabelled compounds (100 μCi or more of $^{14}C$ labeled hormone) to permit subsequent detection of the excreted metabolites in the urine and feces. Accelerator mass spectrometry (AMS) is sensitive to extremely low levels of rare isotopes such as $^{14}C$, and provides a way to validate hormone assays using much lower levels of radioactivity than those traditionally employed. A captive Asian bull elephant was given 1 μCi of $^{14}C$-testosterone intravenously, and an opportunistic urine sample was collected 2 hr after the injection. The sample was separated by HPLC and the $^{14}C$ in the fractions was detected by AMS to characterize the metabolites present in the urine. A previously established HPLC protocol was used, which permitted the identification of fractions into which testosterone sulfate, testosterone glucuronide, and the parent compound testosterone elute. Results from this study indicate that the majority of testosterone excreted in the urine of the Asian bull elephant is in the form of testosterone sulfate. A small amount of testosterone glucuronide is also excreted, but there is no parent compound present in the urine at all. These results underscore the need for enzymatic hydrolysis to prepare urine samples for hormone assay measurement. Furthermore, they highlight the importance of proper hormone assay validation in order to ensure accurate measurement of the desired hormone. Although this study demonstrated the utility of AMS for safer validation of noninvasive hormone assays in nondomestic species, this methodology could also be applied to studies of nutrient metabolism and drug pharmakokinetics, both areas in great need of further study in wildlife species. © 2010 Wiley-Liss, Inc.

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 (2010) publications on Asian elephants.

*E-mail: jenny@aim.uzh.ch*



Wanamali (collared elephant on the very right) and her herd in southern Sri Lanka

# News Briefs

*Compiled by the Editor*

**1. Unwise to chase away marauding elephants on your own, villagers told (Malaysia)**

*Bernama.com*
*January 4, 2010*

JELI - It is unwise for villagers to, on their own, chase away marauding elephants which destroy their crops as this can endanger their own lives. The advice came from Kelantan Department of Wildlife and National Parks director Pazil Abdul Patah after a resident of Kampung Pendok and five friends almost got killed by a wild elephant which they were trying to chase away for destroying their crops.

Pazil said he understood the anger and frustration of villagers when their crops were destroyed by wild elephants, but they should not act on their own based on emotions and instead think of safety and get help from the department. Pazil said the residents and others in nearby villages, who were constantly under threat from wild elephants, should be more careful and know the risk involved. He said, the department always deployed its officers to monitor the area and to chase away wild elephants which threatened villagers' crops.

**2. Elephant rampage makes people wary (Indonesia)**

*The Jakarta Post*
*January 27, 2010*

LABUHAN RATU - The residents at 22 villages near the Way Kambas National Park have become wary about rampaging elephants, which have damaged their ready-to-harvest plantations. They say the elephants cannot be shooed away by torches, bamboo drum rattles or gun shots. They complained they had their paddy, corn, cassava and coffee plantations disrupted by the rampaging elephants. A herd of up to 20 elephants can damage between 4 and 6 hectares of land. Sayuti, a villager, said the elephant-human conflict had been ongoing for 30 years with no solution in the horizon.

**3. Rampaging elephant and calf safely caught (Malaysia)**

*The Star*
*February 9, 2010*

IPOH - A female elephant that had been on a rampage near Grik was finally captured by the Perak Wildlife and National Parks Department (Perhilitan). Department Director Shabrina Shariff said the elephant was part of a herd of 15 to 20 elephants that had destroyed crops of villagers around Kampung Chepor in Lenggong, near Gerik.

"Since 2008, we received over 40 complaints from villagers regarding the animal which destroyed oil palm and rubber crops," she said "The elephants", she added, "were believed to be from the Piah Forest Reserve near the village". Shabrina said her officers managed to tranquilise the female elephant at 12.30pm and had it chained. "The two elephants will be relocated to the Piah Forest Reserve soon with help from Kuala Gandah Elephant Sanctuary officials," she added.

**4. Four Bali parks hope to draw tourists with imported elephants (Indonesia)**

*Jakarta Globe*
*February 9, 2010*

DENPASAR - After last year's failed attempt to ship in Komodo dragons, Bali now is looking at getting elephants from Sumatra to attract more tourists. Four conservation institutions in Bali on Tuesday requested 59 elephants from Way Kambas National Park in Lampung: 10 for the Elephant Safari Park in Taro, Gianyar district; 14 for Bali Zoo Park, also in Gianyar; 15 for Kasian

in Badung; and 20 for Bakas Zoo in Klungkung district.

The request was made at a meeting in Sanur, Bali, on elephants and other wild animals in conservation institutions. "We hope that this could be a new breakthrough for Bali tourism," said Anak Agung Gede Putra, an official with Bali Zoo Park, explaining that the elephants would be used as ride attractions.

Nyoman Suweta, a representative from Bakas Zoo, said the elephants would not disrupt the environment as the province had about 402,000 hectares of idle land, some of which could be used to boost tourism.

Conservation institutions in Bali already have 93 elephants, including 33 at Taman Safari Indonesia, while the Elephant Safari Park in Taro has 32, Kasiana has 18 and Bakas Zoo has 10. There are about 200 wild elephants in Way Kambas National Park, and 61 more in the park's elephant training center.

The Sumatran elephant is an endangered species. A 2000 survey estimated at most 2,700 living in the wild. The biggest threat to the elephant is habitat loss due to forest conversion.

**5. Novel way to check man-animal conflict (India)**

*The Hindu*
*February 8, 2010*

MYSORE - Even as the Forest Department is planning to erect elephant-proof barricades to a length of 547 km in different wildlife sanctuaries in Karnataka to reduce man-animal conflict, forest officials of Chamarajanagar have succeeded in containing the conflict to some extent by adopting a novel strategy.

As a result of efforts of the forest officials and support extended by the local community, no elephant was electrocuted in Chamarajanagar district in the last 18 months, according to Deputy Conservator of Forests (DCF), Chamarajanagar, Biswajit Mishra. On an average, five to six elephants were dying of electrocution every year. This was because of the frustration of farmers, who were losing their standing crop and not getting proper compensation in time. To address the issue, the department adopted a "three-pronged strategy." Besides saving the lives of pachyderms, the eco-friendly approach has helped in protecting standing crops too.

Mr. Mishra told 'The Hindu' that the staff rushed to the help of villagers and extended all support in scaring away the elephants that strayed into agricultural fields. Officials visited the spot immediately and submitted a report on the damage to life and crops for immediate release of compensation. "We have cleared compensation due to the farmers for the past eight years, and so far compensation to the tune of Rs. 54 lakh has been paid to them. This has helped in winning the hearts of farmers to some extent," he said.

Mr. Mishra said that recently it was decided to hand over the responsibility of erecting and maintaining solar fences to EDCs by extending them technical training and paying them Rs. 1500 a month as maintenance allowance.

**6. Ministry has mammoth plans for jumbos - Project Elephant (India)**

*The Pioneer*
*February 13, 2010*

Home to 60 per cent of the global wild Asian elephants, India has now woken up to the cause of its pachyderms with a "fresh impetus" and decided to set up an institutional framework" on par with its flagship Project Tiger scheme.

In view of the cultural and ecological significance of the species, accorded the highest protection by being listed in Schedule I of the Wildlife (Protection) Act, 1972, the Government has decided to develop an "institutional framework" at the Central and State level, which is not only on par with its flagship scheme Project Tiger but enjoys the same stature.

On Friday, the Ministry set up a high-level Task Force to draft the roadmap for strengthening

elephant conservation in India. The Task Force, which is required to submit its report in May this year, has also been asked to recommend measures and strategies for the suitable use of captive elephants, an issue which has been neglected over the years leading to gross violation of laid down existing norms in this regard.

As things stand, India's wild elephant population is pegged at 27,694 as per the last census carried out in 2007. This is an increase of over 12,000 in the last three decades. However, India doesn't have an inkling of the present strength of captive elephants. For, the last survey was done way back in 2000, and which put their numbers at 3,567.

**7. Fruitful study on wild elephants' movement (Malaysia)**

*The Star*
*February 20, 2010*

KINABATANGAN - Age and gender have been found to dictate the movement of Bornean elephants roaming in the wild of the Lower Kinabatangan Wildlife Sanctuary (LKWS). These were among the initial findings of a study being conducted on three elephants that were fitted with satellite collars two years ago. The move is an effort by experts to help minimise elephant and human conflicts.

"The data we have obtained so far shows that Bornean elephant movements in the wild varied between male and females," according to researcher Nurzhafarina Othman, who is carrying out studies on the social behaviour of the elephants.

The elephants were fitted with the satellite collars in a joint project carried out by Sabah Wildlife Department, Danau Girang Field Centre (DGFC) and French non-governmental organisation, HUTAN. "We placed one collar on a male bull, and another on a female which was the matriarch. The final collar was put on a younger female, that had been collared previously by WWF-Malaysia, " said Nurzhafarina.

DGFC director Dr. Benoit Goossens said the data obtained was vital in helping to understand how elephant movement varied within its population based on gender and age. "It is crucial to know if there is any traditional or common route used by the elephants at LKWS as it will help wildlife managers identify important areas within the sanctuary to establish wildlife corridors for the elephants," he added.

**8. Bangladesh's elephant trails grow faint**

*bdnews24.com*
*February 21, 2010*

DHAKA - Bangladesh's elephant trails, the centuries-old natural pathways made and used by the Asian pachyderms are being gradually whittled away as humans encroach across them. As these magnificent animals see their foraging grounds shrinking, elephant attacks on humans become more frequent. This further threatens the endangered mammal's dwindling numbers.

At present the number of elephants is between 250 to 350 in 11 forests of the country, forest conservator (wildlife and nature conservation circle) Tapan Kumar Dey says. Also, another 83 to 100 elephants move across the borders from Myanmar's Arakan and India's Assam, Meghalaya, Mizoram and Tripura states. There are another 94 to 100 captive elephants in zoos and circuses.

Dey says elephants have suffered serious loss of habitation because of human encroachment inside the forest over the last few decades. Loss of their long-used trails also disorients the animals. "The elephant trails are disappearing because of human habitation and road construction. There is a shortage of their food and water," Dey told.

In Chittagong, Khagrachhari, Cox's Bazar, Bandarban, Mymensingh and Sylhet the ages-old elephant corridors have shrunk. The forests of Mymensingh, Sylhet, Chittagong and the hill tracts CHT were elephant sanctuaries once upon a time. Now these endangered mammals are found only in the forests of Chittagong and the hill districts.
"The sanctuary of our elephants is shrinking day

by day. Attack of wild elephants has increased because they are losing their habitats and natural trails," Ainun Nishat, adviser of IUCN,said. "The tracks that elephants used for foraging, passing through them five times a year on average, are now being taken up by humans. Now, the elephants are seen on these trails just once a year," said Nishat.

A policy will be formed to protect elephants and also to compensate those who have suffered losses, Majumdar said. Conserving forests, planting trees for elephant food, following the wildlife act and increasing public awareness can help counter elephant attacks, suggested Anwarul Islam, chairman of Bangladesh Wildlife Trust.

**9. Proposed Nilgiris elephant corridor runs into resistance (India)**

*The Times of India*
*February 26, 2010*

VAZHAITHOTTAM - Tension is simmering over a proposed elephant corridor in the Ooty foothills. While conservationists say this is essential to restore the man-nature balance, farmers and property owners are questioning the state government's decision to acquire 7000 acres of fertile land for it. The whole area from the Bandipur reserve forest in Karnataka, adjoining the Mudumalai wildlife sanctuary of Tamil Nadu and the foothills of Ooty, was once untouched "tusker territory", say wildlife activists.

Humans have now intruded into the wilderness and encroached upon the Unesco-recognised Nilgiri biosphere reserve comprising more than 5000 $km^2$ in Tamil Nadu, Kerala and Karnataka, they say. Of the around 2000 elephants in the southern peninsula, half are in the three contiguous, ecologically sensitive sanctuaries.

While officials deny that land acquisition for the elephant corridor has already been initiated, residents say under the Tamil Nadu Preservation of Private Forest Act, 1947, proceedings have begun in Masinagudi, Mavanallah, Bokkapuram, Vazhaithottam, Anaikatty and Sigur. A farmer said their main occupation had been agriculture for more than 500 years and now "more than 2000 families would be displaced".

Another farmer in the area said: "The more than 10,000 Sri Lankan refugees have not been touched by the Tamil Nadu government's move to provide the elephant corridor."

**10. Jumbos run out of space (Malaysia)**

*Daily Express*
*February 28, 2010*

KOTA KINABALU - The Sabah Wildlife Department has detected more cases of human-elephant conflicts due to lack of habitat for the State's unique wildlife. Disclosing this in a statement, its Director Laurentius Ambu said this is despite some 49% of permanent forest cover being retained and it being the second biggest State in the country. He said Sabah is blessed with wonderful wildlife from orang-utans, rhinos, elephants, sun bears, clouded leopards that are unique to this State but "we have a forest that is broken up by agriculture without corridors linking them and this leads to conflict".

He explained that such behaviour was not common among Sabah's gentle elephants but seemed to be increasing over the last three to five years due to development of the natural habitat without providing for forest corridors. He said people also need to understand that unless this is settled and private companies make real efforts to reforest corridors, things will reach the stage of having to put down this gentle creatures.

The Bornean elephant is a distinct sub-species from the Asian Elephant and is only found in Sabah, although some individuals roam in Northern Kalimantan (Indonesia), and thus makes Sabah the sole custodian of this unique sub-species of elephant.

In Sabah they are protected under the Wildlife Conservation Enactment of 1997, under which unlawful killing of an elephant carries a fine of RM 50,000 or a jail term of five years or both under Section 25 (3) (b) if proven guilty. It also allows the department to put down individuals as

it sees fit to control the population. "Today, there are fewer than 1500 individuals left in Sabah." said Laurentius.

**11. Villagers in Assam take care of an injured elephant (India)**

*Sify News*
*March 12, 2010*

Villagers of Shattergaon are taking care of a female elephant, which got hurt by a train near Deepor Beel (a freshwater lake) in Guwahati. A goods train had hit the elephant on February 28, when it was trying to cross a railway track. The injured elephant, pregnant at that time, then gave birth to a male calf in a nearby forest. But, she abandoned her calf and vanished in the Garbahanga Reserve forest in Kamrup district.

Forest officials then found the newborn calf and took him to the Assam State Zoo. The mother elephant then reached Shattergaon village, near the Garbhanga Reserve forest and is now being taken care by the villagers. To save the animal, the villagers are fetching water and banana trees to feed the ailing animal.

"The officials come to see the elephant and then go back. They are not bothered with what the elephant needs. This is such a sad situation. The elephant needs a quintal of food in a day but they bring only a kilogram of food for her. Moreover, the animal needs tons of water. How can a litre or two of water help the poor elephant?" asked Narzary.

**12. Army accused of killing elephants, selling ivory (Myanmar)**

*The Irrawaddy*
*March 8, 2010*

Burmese army units from Butheetaung and Maungdaw townships in Arakan State are reportedly capturing and killing wild elephants and illegally exporting ivory to China, according to an Arakan environmental and human rights organization. The rounding up of wild elephants is occurring in conjunction with a search for a white elephant, say environmentalists.

Khaing Htun Lin of the Bangladesh-based Arakan Environment Preservation and Human Rights Watch told The Irrawaddy that Capt Aung Thura Heing of Light Infantry Battalion (354), Captain Hein Khant of Infantry Battalion (263) and Pe Than of the Butheetaung 5 Mile Elephant Camp have worked on the project, which began in January.

"As far as we know, more than 10 wild elephants have been captured since the beginning of this year," said Khaing Htun Lin. "We estimate that at least 500 elephants has been caught this decade. The army cuts ivory from some elephants and, together with businessmen, it is exported to China."

In 2004, the regime captured a white elephant from Mayu mountain in Yathetaung Township and then Prime Minister Gen. Khin Nyunt, built a garden on Min Dhamma hill in Insein Township in Rangoon where it was kept in a compound. According to tradition, ancient Burmese kings believed they would become more powerful if they possessed a white elephant.

Environmentalists are concerned that elephants in Arakan State are in danger of extinction from hunting and also an exodus of elephants from Arakan to Bangladesh.

**13. Poachers kill another elephant for ivory (Laos)**

*Vientiane Times*
*March 4, 2010*

A 41 year old male domesticated elephant has been slaughtered for its body parts in Vientiane, with the hunt continuing for those responsible. The attack took place a short 40 minute drive from central Vientiane in Nanga village, Naxaithong district, at the end of last month and appeared to be the work of at least two poachers.

The elephant, known as Phu Thongkhoun, belonged to Mr. Somyod Phimasan, who was left distraught by the death, saying this was the third

elephant he has lost to illegal poachers, totalling a loss of about US$40,000. The two prior incidents occurred in Xieng Khuang province in 2007 and 2009, where he lived previously.

Elephant conservationists have expressed their concern about the illegal poaching, which they say is leading to a rapidly declining population. This latest attack occurred at around 2am on February 26, when villagers who live near Mr. Somyod's garden reportedly heard three gunshots, which they initially dismissed as hunters given the area's proximity to woodland.

Mr. Somyod contacted conservation group ElefantAsia to inform them of the illegal poaching and to ask for assistance in ascertaining the cause of death. The group's veterinarian, Dr Bertrand Bouchard, undertook an informal autopsy on the remaining body parts and concluded that Phu Thongkhoun died from at least three high-calibre bullets to the head and face. The elephant's ivory, tail, face and tip of the trunk were all removed, presumably for sale on the black market.

Less than 500 domesticated elephants remain in Laos, with poaching a recurrent problem. Local laws are clear regarding the killing of elephants. In 1989 the government declared a ban on the hunting and killing of protected, endangered species, and became signatories to the Convention on International Trade in Endangered Species of Wild Fauna and Flora in 2004.

**14. Timber industry threatens elephants habitat (Indonesia)**

*The Jakarta Post*
*April 7, 2010*

JAMBI - The habitat of two large groups of elephants were reported to be in danger of extinction following a plan by PT Lestari Asri Jaya, a subsidiary of PT Barito Pacifi TBK, to open an enclave of forest. The company has recently been granted an exclusive right to manage 61,500 hectares of forest area in Tebo regency, as stipulated by a Forestry Ministry letter. Arnold Sitompul, the head of the Indonesian Elephant Conservation, said the area was home to two large groups of elephants, called Semambu and Riau-Jambi. The Sumatran Forest is reported to hold only up to 2800 elephants currently.

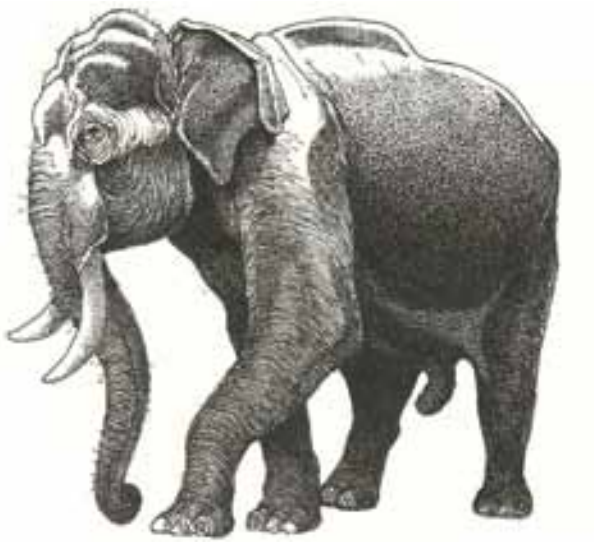
**15. Dying elephant calf rescued in Borneo (Malaysia)**

*news.com.au*
*May 24, 2010*

Malaysian wildlife authorities said they rescued an endangered Borneo pygmy elephant calf that was separated from its mother and found dying in a plantation. The six-month-old elephant was weak and dehydrated when found last week after plantation workers alerted the wildlife department in eastern Sabah state, on Borneo island, its chief veterinarian Sen Nathan said.

He said the calf was lost in the plantation for at least three days before it was rescued. "A calf relies entirely on the mother and if it is not fed for that long, this would have normally killed the elephant," he said. "Its condition was bad, and it could have died from dehydration," Mr. Nathan said, adding that an elephant was only capable of looking after itself after it turned three. Its condition has stabilized and it is recovering,"

Pygmy elephants are unique to Borneo and form a subspecies of the Asian elephant. Males stand only about 2.5 meters tall, compared to about 3 meters for mainland Asian elephants. Authorities said the elephant species is considered endangered, with about 1500 to 2000 left on Borneo island.



Drawing by Arnab Roy