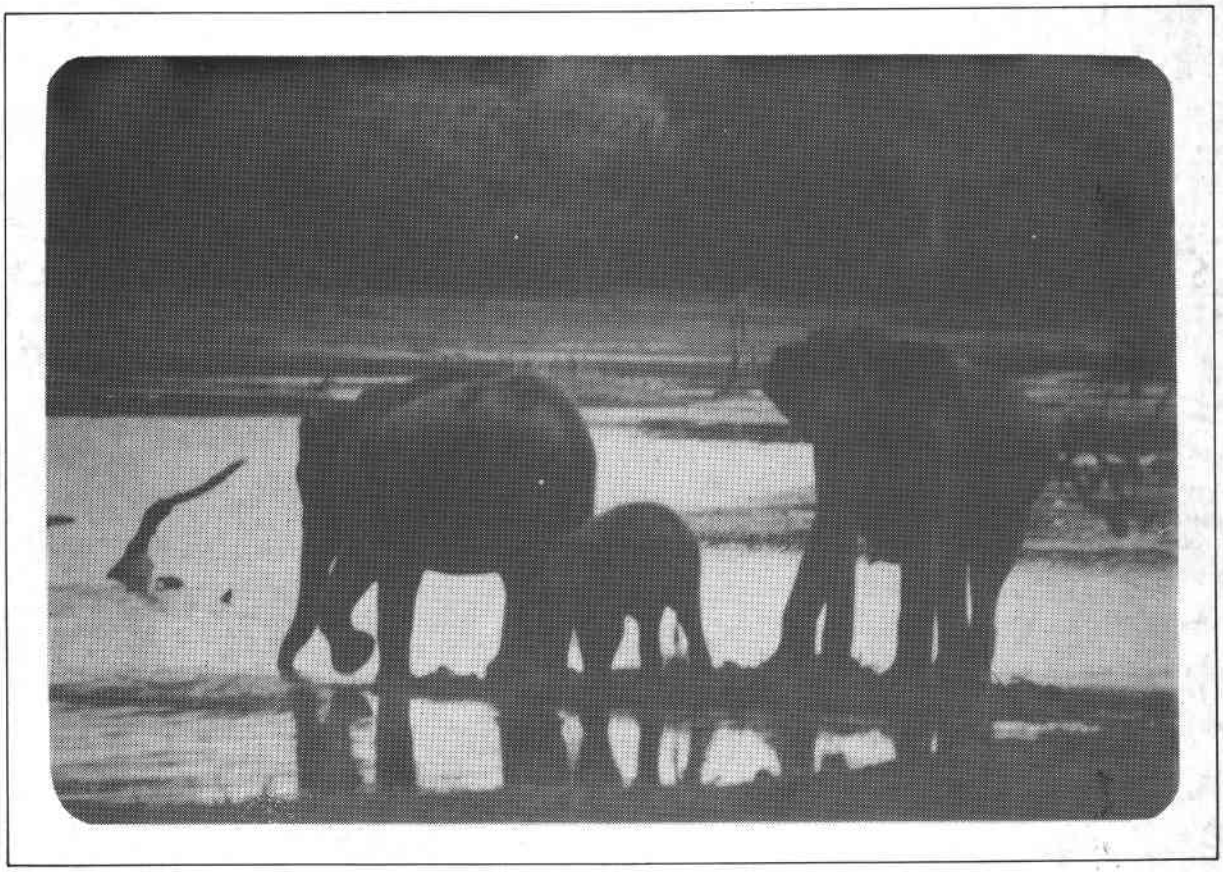
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# ASIAN ELEPHANT SPECIALIST GROUP

# NEWSLETTER



**NUMBER 8** **SPRING 1992**

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FOR CONSERVATION OF NATURE
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**Number 8** **Spring 1992**

WWF World Wide Fund For Nature

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**The Asian Elephant Specialist Group Newsletter is published with the following aims: -**

- to highlight the plight of the Asian Elephant
- to promote the conservation of the Asian Elephant
- to provide a forum for communication amongst all the members

Newsworthy articles are invited for consideration for publication and should be sent to Dr Charles Santiapillai at WWF - Asia Programme, PO Box 133, Bogor, Indonesia. All articles may be reprinted. Reprinted articles should give credit to the Newsletter. The editors would appreciate receiving a copy of any article so used. The opinions expressed by the authors do not necessarily reflect the policies of either WWF or IUCN.

Cover : A small group of two adult female elephants and one calf drinking at the Patanangala water-hole in Ruhuna National Park, Sri Lanka. (Photo: Charles Santiapillai/WWF).

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# COMMENT

The Asian elephant estimated to be between 34,000 and 56,000 exists in a number of small, scattered and discontinuous populations from India in the west to Indo-China in the east. The population size ranges from a few animals (often pocketed with little prospects of long-term survival) to over 4,000 animals. In addition there may be up to 16,000 animals in captivity throughout Asia especially in India, Thailand, Myanmar (Burma) and Sri Lanka. With few exceptions, the numbers of both elephants in the wild and in captivity are on the decline throughout Asia. The question is whether this trend could be reversed?

If we follow the enlightened policies adopted in some countries as far as wildlife conservation is concerned, then there is indeed some room for optimism. But what we see in many Asian countries leaves no cause for such euphoria. The good news is from South India where under sensible management using nothing more sophisticated than simple common sense, there had been a spectacular increase in the number of calves born to elephants in captivity. In the State of Tamil Nadu, between 1950 and 1983 about 74 calves were born to 37 adult female elephants in captivity. The Tamil Nadu foresters and wildlife managers who were responsible for the success maintained the elephants in captivity in semi-natural conditions, in the vicinity of a reserve where wild elephants occurred. Furthermore, instead of keeping the elephants tied up day and night, they let the hobbled animals to roam in the forest and graze in the nights. This enabled the wild bulls to seek out oestrus females and mate with them thus siring the calves and improving the genetic stock of the elephants in captivity. This is the way to go about if we hope to increase the number of elephants in captivity. Artificial Insemination (AI) and other high-tech methods may work but these are prohibitively expensive to carry out in many Asian countries given the meagre financial resources available for wildlife conservation.

The wild populations of Asian elephants, as Shanthini Dawson and Tim Blackburn point out in this issue (under Short communications) are being threatened more by habitat loss and fragmentation as a result of escalating human population, than poaching for ivory. Only one third of the Asian elephant habitat is in protected areas. Poaching cannot be the terminal threat in the case of the Asian elephant as it is in the African elephant where both sexes have tusks. In Asia only a proportion of the male elephants have tusks.

Many Asian countries with elephant populations face a dilemma: on the one hand, as custodians of biodiversity and charismatic megafauna they are forced to assume responsibility for their protection. Yet at the sametime, most of these countries faced with expanding human populations, collapsing economies and crippling foreign debts are in desperate need of new resources to bolster their ailing economies and thereby keep the body and soul of their human populations in communication. Therefore conservation of elephant *per se* may rank rather low in their scheme of things.

The Species Survival Commission of the International Union for Conservation of Nature and Natural Resources (IUCN) has achieved enormous success and recognition through its production of the so called Action Plans. There is also an Action Plan for the Conservation of the Asian Elephant but it remains just an achievement on paper. Sadly, it has not achieved its desired objectives. This may be due to the fact that it is already out-of-date and is therefore of little use now. This may be the case as far as the conservation of elephants in India is concerned. But in many other instances, the countries concerned have neither the financial resources or the trained manpower needed to implement the recommendations the Action Plan identified. Without money and manpower, very little indeed can be achieved in Asia.

One of the surest ways of creating public awareness of the importance of conserving the Asian elephant and its habitat is to encourage and promote the study of elephants across their range in Asia. The emphasis of such studies should be on resolving human-elephant conflicts in order to create a climate of public opinion conducive to the long-term survival of the elephant as an integral part of its ecosystem. Conservation of elephants and their habitats, perceived by the local populace to be of direct economic importance, is far more likely to be successful in the long-term than by conservation for its own sake.

**Lyn de Alwis and Charles Santiapillai**



Feature Articles

# POPULATION STRUCTURE, ACTIVITY AND DENSITY OF ELEPHANTS IN THE RUHUNA NATIONAL PARK, SRI LANKA

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**Summary**

Block I of Ruhuna National Park with an area of 140 $km^2$ can support seasonally up to 84 elephants. This gives a crude density of 0.6 elephant per $km^2$ and an average biomass of 1,086 kg per $km^2$. The recent survey carried out in June 1991 indicates that since 1978–1980, the elephant biomass may have increased by 29% in Block I. The increase may be due to the influx of animals from other Blocks. The population structure was normal with adult males and females accounting for 53% of the total. Calves formed 13.8% of the population. Of the 29 groups classified, the most frequently observed category was that of the solitary animals (48. 28%), 86% of which were adult males. Average herd size was 5.8 – excatly as it was when the survey was carried out in 1978–1980. The largest herd consisted of 10 animals. A total of the 13 herds were classified. Within the herds, the ratio of adult males to adult females was heavily biased in favour of the cows (1: 7.5). But the adult sex ratio in the total number of animals classified was 1: 2.1. The solitary animals showed a bimodal pattern of diurnal activity with peaks at 0800 and 1700 hrs while the herds activity picked up from 1500 hrs and increased up to 1800 hrs when maximum feeding activity was noted. The number of young animals observed indicate that there could be a seasonal pattern in the birth and breeding of elephants in RNP. But this needs further study before it could be confirmed.

Oddly enough there were no tuskers seen throughout the study period. In 1978–1980 there were at least 4 tuskers. The break down in law and order in the recent past in Sri Lanka as a result of guerrilla activity in the north, east, north-west, south and south-east had seriously affected the elephants and their habitat. Many of the tuskers had been killed by poachers. The proposed plan to capture 500 wild elephants in Sri Lanka for domestication is a sure recipe for disaster. The only long-term hope for the elephants in Sri Lanka may lie in the effective protection of their habitat.

## 1.0 Introduction:

The Asian elephant (*Elephas maximus* L.) represents the largest land mammal in Asia. The subspecies found in Sri Lanka (*Elephas m. maximus* L.) is the forma typica. It would be difficult to imagine Sri Lanka without elephants as they are a part of the island's history, folklore, religion, politics and cultural heritage. Elephants have been in use by man in Sri Lanka for at least

the past 2,000 years (McKay 1973). Before the large scale destruction of forests, elephants enjoyed wide distribution and good numbers in both lowlands as well as the hill country. Tennent (1867) estimated the number of elephants around the 17th century in Sri Lanka (then Ceylon) to be 1.5 million! Elephants were reported from present day urban areas as Colombo, Kandy and Ratnapura between 1669 and 1744 (McKay 1973). Even by the turn of the 19th century, elephants were distributed all over the island from sea level to about 2,500 m altitude (Fernando 1973; Phillips 1935). Today however, except for a small itinerarnt population in the Sinharaja rainforest, elephants are restricted to the low lands (Fig. 1). Over the past 150 years, human land-use has forced the animals from the wet and fertile regions of the south-west to much drier areas (Santiapillai & Jackson 1990). Olivier (1978a) argues that the elephant population in Sri Lanka may have declined by over 67% in the past 200 years.

As far as the Ruhuna National Park is concerned, it appears to have had a high concentration of elephants in the past. Norris (1959, 1967) reported as many as 300–380 elephants in an area of about 300 $km^2$ on a year-round basis.

The first serious study of the elephants in Ruhuna National Park (RNP) was carried out by the Smithsonian Institution in the late 1960's (see Kurt 1974). It was almost two decades later that Santiapillai *et al.* (1984) carried out a two year study of the elephants in Block I of RNP seasonally from May 1978 to June 1980. It was to re-assess the status of the elephants in Block I as a part of the overall large mammal management and monitoring programme (see Dissanayake *et al.* 1991) that this study was carried out in June 1991.

## 2.0 Study area:

Ruhuna National Park is one of the major conservation areas in Sri Lanka. The park with its north-adjacent reserves covers an area of about 1,200 $km^2$ and is situated in the low country dry zone in the South-eastern Sri Lanka just above the 6°N latitude. The entire National Park bounded on the south and east by the sea, consists of forest and saline flats irregularly dotted with natural water holes and man made "tanks". Two rivers Menik Ganga and the Kumbukkan Oya, and a number of seasonal streams drain the area and discharge into the sea through a shifting system of sand dunes and brackish lagoons (Woodford 1979).

Block 1 where the study was carried out is roughly triangular in outline with the Menik Ganga forming the northern boundary separating Block I from Block II (Fig. 2). The annual rainfall is about 1,000 mm of which the greatest (750 mm) falls in November, December and early January (North-east monsoon) and the balance in April and May (South-west monsoon). The dry season extends from June to September. However, rainfall can vary considerably between years.

## 3.0 Vegetation:

The main vegetation cover is woody, mostly scrub, i.e in canopy below 5-m height, but forests occur as larger and smaller islands within the scrub as a continuous cover inland from the coast (Mueller-Dombois 1972). The coastal area in Block I is characterised by numerous water holes surrounded by grazing areas frequented by the elephant and other herbivores. The grazing grounds are dominated by the halophytic grass *Sporobolous tremulus.* These flats give way, on the landward side, to light jungle dominated by *Salvadora persica, Feronia limonia* and *Cassia fistula* (Woodford 1979). The vegetation of the Park has been classified by Mueller-Dombois (1968) as falling into three physiognomic categories: - (a) forest (with at least 20% of crown biomass above 5 m in height), (b) scrub (less than 20% of crown biomass above 5 m) and (c) grassland or plains (Fig. 2). The dominant tree species are *Manilkara hexandra, Drypetes sepiaria* in well drained soil and *Feronia limonia* (Balasubramaniam *et al.* 1980). In the scrub vegetation, some of the common shrubs and treelets are *Capparis sepiaria, C. zeylanica, Dichrostachys cinerea, Flueggea virosa, Randia dumentorum* and *Cretavia religiosa.* The main components of the grassy plains are *Eragrostris viscosa, Dactylotaenium aegyptium, Sporobolous diandrus, Echinochloa colonum,*

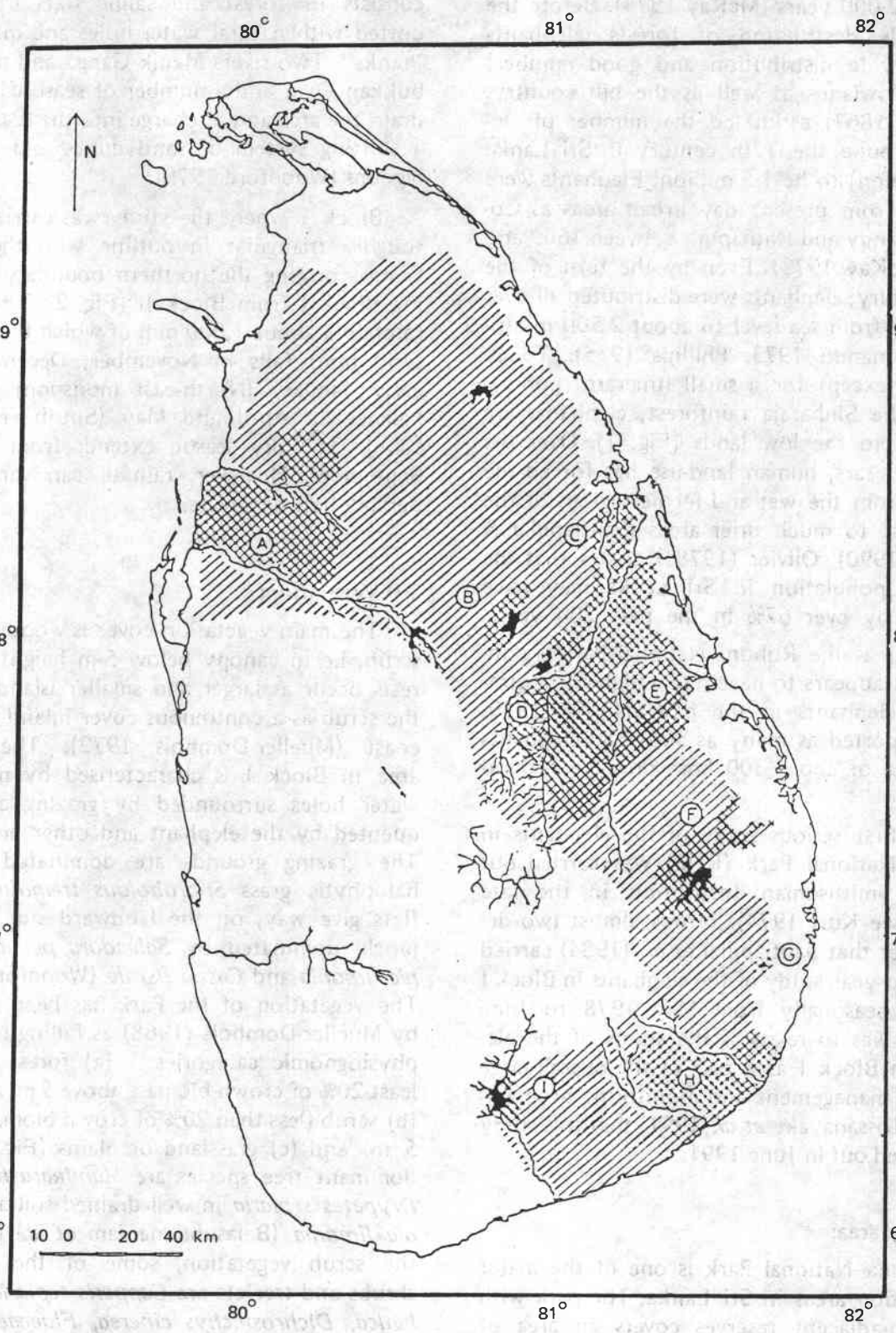



Fig. 1 Map of Sri Lanka to show the approximate maximum extent of the elephant distribution. Ruhuna National Park (H) lies in the southeastern corner.

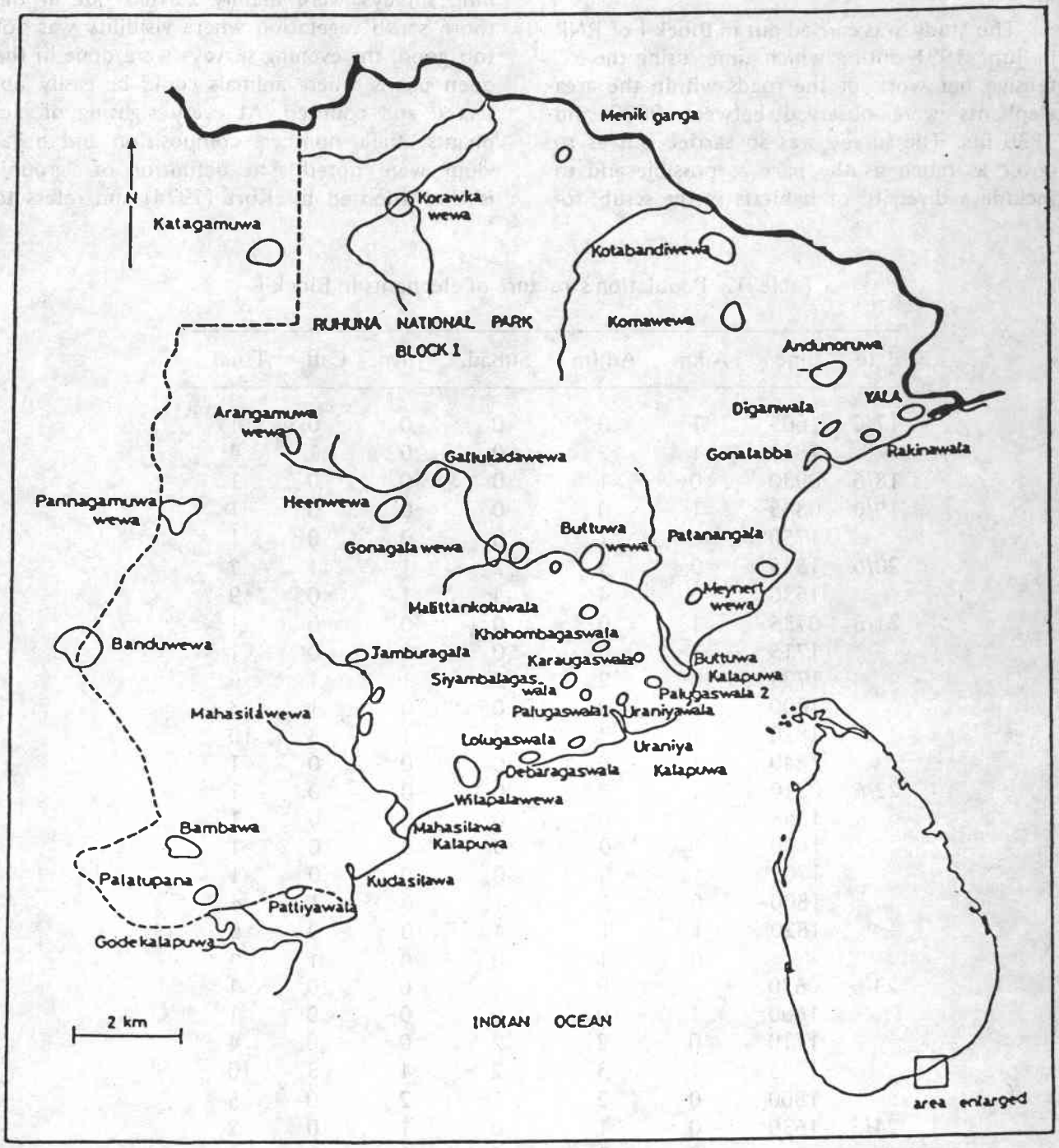



Fig. 2 Map of Block I of Ruhuna National Park, Sri Lanka showing the location of the main water holes.

*Setaria pallidifusca*. and *Alloteropsis cimicina* (Balasubramaniam *et. al.* 1980).

4.0 **Methods:**

The study was carried out in Block I of RNP in June 1991 during which time, using the extensive net work of the roads within the area elephants were observed between 0600 and 1830 hrs. The survey was so carried out as to cover as much as the park as possible and to include a diversity of habitats in the scrub, forest, grassland and the numerous water holes or villus. Each road transect was approximately 20 km long and was surveyed twice a day in the morning and in the evening. While the morning surveys were mainly carried out in the thorn scrub vegetation where visibility was not too good, the evening surveys were done in the open plains where animals could be easily observed and counted. At every sighting of elephants, their number, composition and behaviour were noted. The definition of "group" is that adopted by Kurt (1974) and refers to

Table 1. Population structure of elephants in Block I

| date | time | Ad.m | Ad.fm | Subad. | Juvn. | Calf | Total |
|---|---|---|---|---|---|---|---|
| 17/6 | 1605 | 1 | 0 | 0 | 0 | 0 | 1 |
| | 1830 | 1 | 2 | 0 | 0 | 1 | 4 |
| 18/6 | 0930 | 0 | 1 | 0 | 0 | 0 | 1 |
| 19/6 | 0845 | 1 | 0 | 0 | 0 | 0 | 1 |
| | 1750 | 0 | 1 | 0 | 0 | 0 | 1 |
| 20/6 | 1535 | 0 | 3 | 2 | 1 | 1 | 7 |
| | 1630 | 0 | 4 | 4 | 1 | 0 | 9 |
| 21/6 | 0735 | 1 | 0 | 0 | 0 | 0 | 1 |
| | 1715 | 1 | 0 | 0 | 0 | 0 | 1 |
| | 1725 | 0 | 2 | 2 | 1 | 1 | 6 |
| | 1800 | 0 | 2 | 0 | 0 | 1 | 3 |
| | 1820 | 1 | 3 | 2 | 1 | 3 | 10 |
| | 1840 | 1 | 0 | 0 | 0 | 0 | 1 |
| 22/6 | 0810 | 1 | 0 | 0 | 0 | 0 | 1 |
| | 1555 | 1 | 0 | 0 | 0 | 0 | 1 |
| | 1600 | 1 | 0 | 0 | 0 | 0 | 1 |
| | 1705 | 1 | 0 | 0 | 0 | 0 | 1 |
| | 1800 | 0 | 2 | 1 | 0 | 1 | 4 |
| | 1820 | 1 | 1 | 4 | 0 | 0 | 6 |
| | | 0 | 1 | 0 | 0 | 1 | 2 |
| 23/6 | 0630 | 1 | 0 | 0 | 0 | 0 | 1 |
| | 1600 | 1 | 0 | 0 | 0 | 0 | 1 |
| | 1710 | 0 | 2 | 2 | 0 | 0 | 4 |
| | 1745 | 1 | 3 | 2 | 1 | 3 | 10 |
| | 1800 | 0 | 2 | 1 | 2 | 0 | 5 |
| 24/6 | 1630 | 0 | 1 | 0 | 1 | 0 | 2 |
| | | 0 | 1 | 2 | 0 | 0 | 3 |
| | 1725 | 1 | 0 | 0 | 0 | 0 | 1 |
| | | 0 | 3 | 1 | 0 | 1 | 5 |
| Total | | 16 | 34 | 23 | 8 | 13 | 94 |
| % | | 17.0 | 36.2 | 24.5 | 8.5 | 13.8 | 100 |

any temporary aggregation of animals, while a herd is a more cohesive unit seen repeatedly. For the purpose of censussing, nine age-classes (McKay 1973, Ishwaran 1981) were adopted.

### 5.0 Results:

A total of 94 elephants were counted during the survey (Table 1) of which 14 were solitary animals while the groups accounted for the balance 80. A total of 76 animals were classified in 13 herds (Table 3).

### 5.1 Population Structure:

As can be seen from Table 1 the number of adult females were twice that of adult males almost identical to the situation Eisenberg & Lockhart (1972) encountered in Wilpattu National Park. The adult males and females account for 17 and 36.2% of the total number (n= 94) counted during the survey. The total number of adults (males and females) make up about 53% of the total number counted. The number of subadults, juveniles and calves account for 24.5, 8.5 and 13.8% respectively.

Out of the 16 adult males that were encountered in Block I in June, there wasn't a single tusker. This was surprising given that there had been some earlier speculation in the park that there were 11 tuskers. The absence of tuskers points to the great risks that elephants still face from poachers. In the recent past a number of tuskers had been shot by poachers as well as insurgents. On the other hand, the animals seem to be breeding well given the fact that calves accounted for 13.8% of the total number observed. By contrast, the number of calves that were encountered in the 1978–1980 survey was much less - calves accounted for only 4% of the population (Santiapillai *et al.* 1984). The high proportion of adults in the population is not unusual among elephants whose life span, gestation period and calving intervals are all long.

### 5.2 Social Groupings:

There were 29 sightings of elephants in which a total of 94 animals were counted (Table 2). 14 observations were of solitary individuals out of which 12 (86%) were adult bulls while only 2 (14%) represented cows.

Table 2. Frequency of Group Sizes in Block I

| Group size | Number of groups | Frequency |
|---|---|---|
| 1 | 14 | 48.28 |
| 2 | 2 | 6.90 |
| 3 | 2 | 6.90 |
| 4 | 3 | 10.34 |
| 5 | 2 | 6.90 |
| 6 | 2 | 6.90 |
| 7 | 1 | 3.45 |
| 8 | 0 | 0.00 |
| 9 | 1 | 3.45 |
| 10 | 2 | 6.90 |
| Total | 29 | 100.00 |

Solitary animals accounted for 48.28% of all the sightings (Fig. 4). The solitary animals that were encountered were predominantly bulls (Fig. 5). None were subadults. No bull groups were recorded. The commonest grouping was that of 4 animals. Tha largest group consisted of 10 animals. The average herd size was 5.8 exactly the same as it was almost a decade ago (Santiapillai *et al.* 1984).

### 5.3 Elephant Social Organization:

Elephants are social animals that move about in herds. The most cohesive social unit is the family unit, consisting of an integrated group of closely related elephants of all classes excluding the adult males (Laws 1970). In the Ruhuna National Park, such a unit averages about six animals and is always led by the oldest female or the matriarch (Fig. 6). The family unit is tightly knit both socially and structurally (Moss 1990). The entire unit moves as a whole led by the matriarch and the activities in a family unit are usually synchronised and coordinated by the oldest female. The other small population unit is a loose association of mature males, the bull herd. In Sumatra, the bull herd averages about 4.4 animals with a range of 2 to 9 (Santiapillai & Suprahman 1986). However, during the survey period in Sri Lanka, no bull groups were observed.

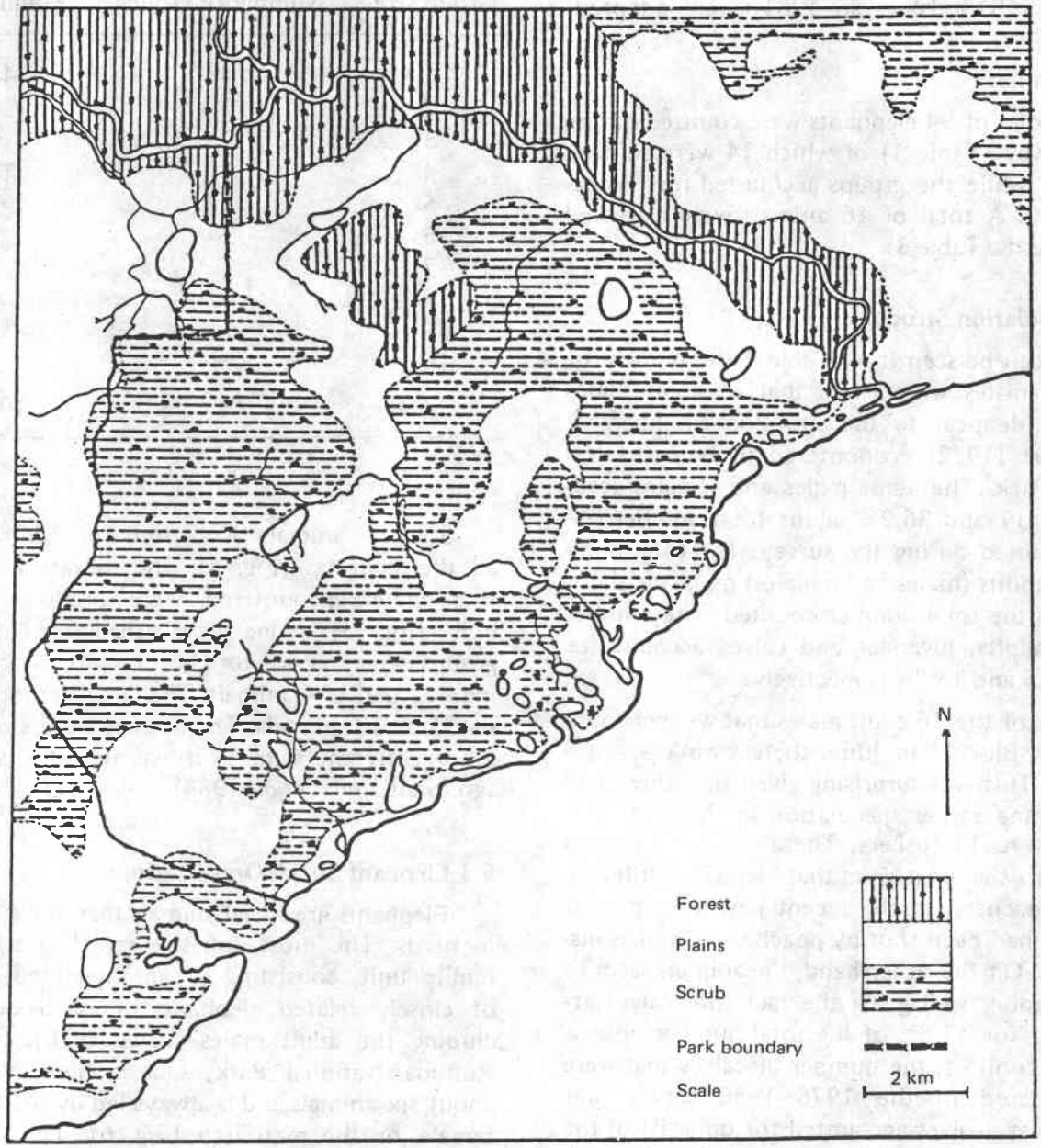



Fig. 3 Generalized vegetation map of Block I of Ruhuna National Park (adapted from Mueller-Dombois 1969).

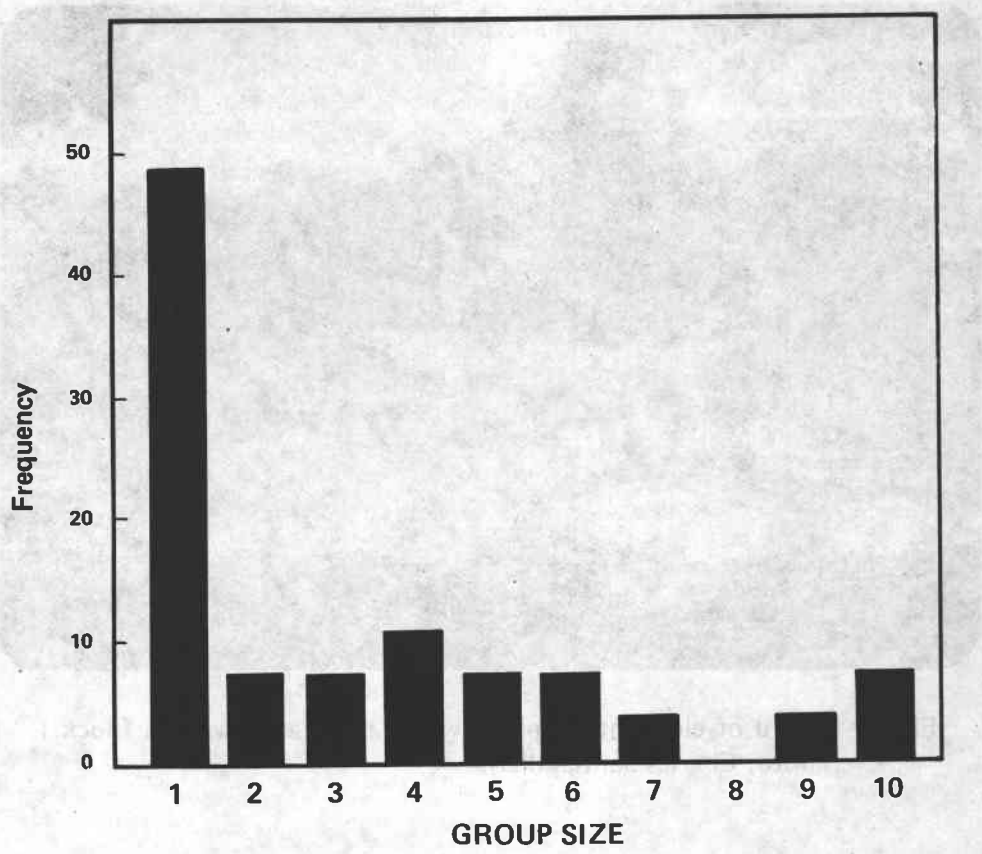



Fig. 4. Frequency of sightings for elephants groupings of various sizes.

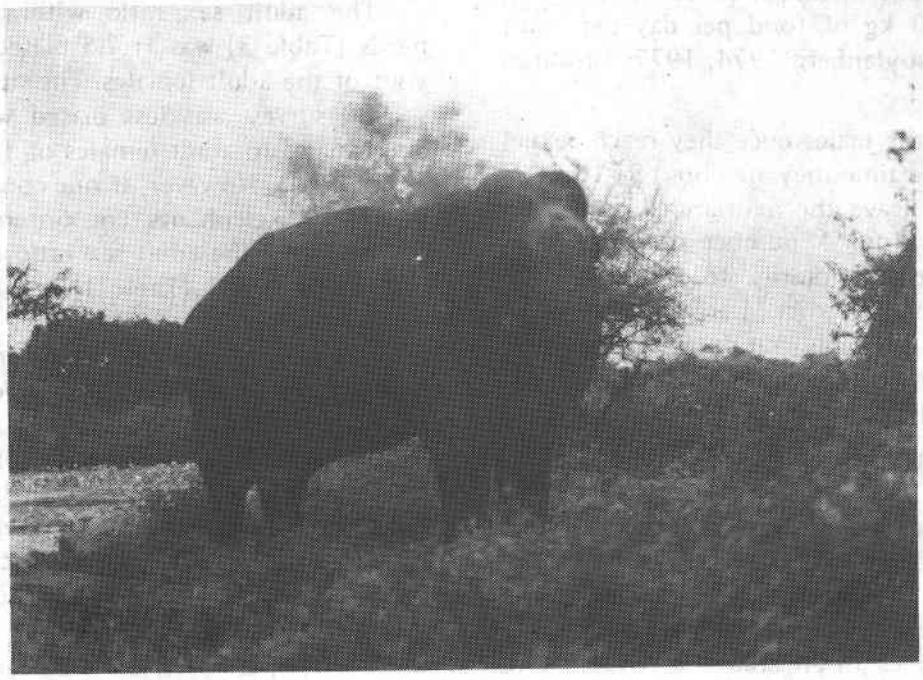


Fig. 5. Solitary adult bull elephant in Block I (Photo: Charles Santiapillai).

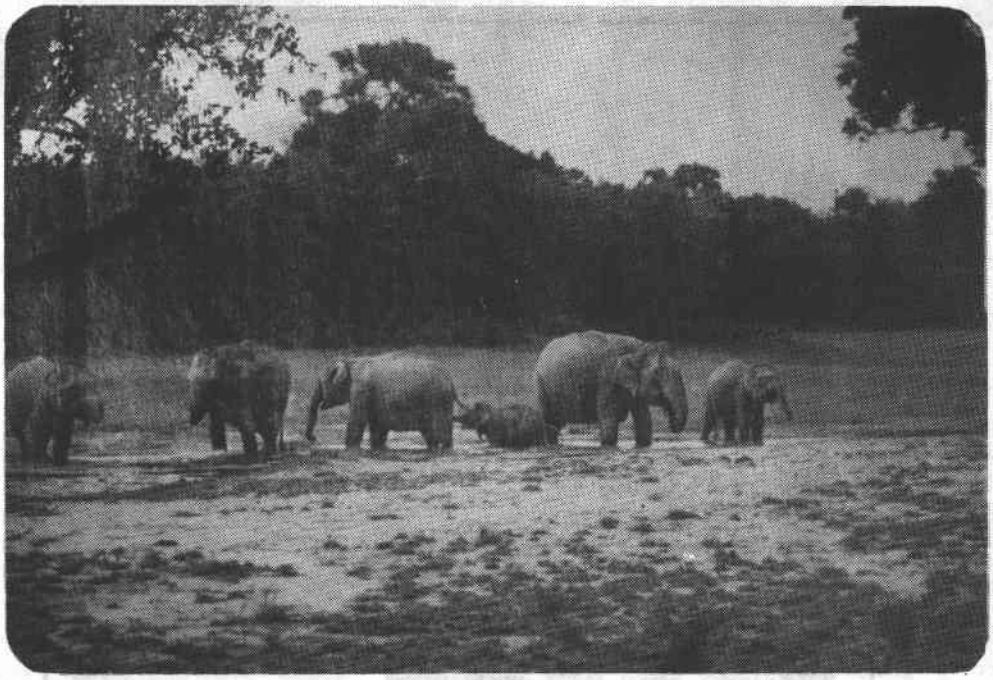


Fig. 6. A herd of elephants drinking water at Karaugaswala in Block I (Photo: Charles Santiapillai).

Matriarchal groups increase in size due to generation overlap (Eisenberg & Lockhart 1972). However the limits to group size increase would be brought about by the need to consume on an average 150 kg of food per day per adult elephant (Vancuylenberg 1974; 1977; Ishwaran 1979).

As a rule, the males once they reach sexual maturity by the time they are about 9–10 years of age, would leave the matriarchal herds and lead a solitary life. A number of such males could associate temporarily to form the bull groups referred to earlier. Large groupings of elephants are probably random aggregations, formed by chance meetings of smaller but stable groups (Ishwaran 1981).

In RNP, elephants go about in small groups during the dry season. However, with the onset of the rains and the sprouting of the short-grass community, the tendency is to form larger groups through merger of a few smaller ones. Another consequence of increased availability of food resources in an area is a reduction in the size of the home range (Olivier 1978b).

The social structure is virtually identical to the herds described for the African elephants by Laws & Parker (1968).

The adult sex ratio within the classified herds (Table 3) was 1: 7.5 biased heavily in favour of the adult females. The situation in 1978–1980 survey was less biased with a ratio of adult males to adult females of 1:4 (Santiapillai *et al.* 1984). However, if one considers the total number of elephants encountered in Block I (94 animals), the adult sex ratio of males to females was 1: 2.1 (Table 1). As far as management of elephants in the Park is concerned, the changes in adult sex ratio must be monitored. A skewed sex ratio biased in favour of the females may indicate heavy poaching pressure. The genetic consequences of a skewed sex ratio should not be overlooked. If too few bulls do all the breeding, there could be problems of inbreeding depression, especially in small populations (Sukumar 1991). The more skewed the adult sex ratio, the lower would be the effective population size. If inbreeding is to be kept below 1% per generation, then an effective

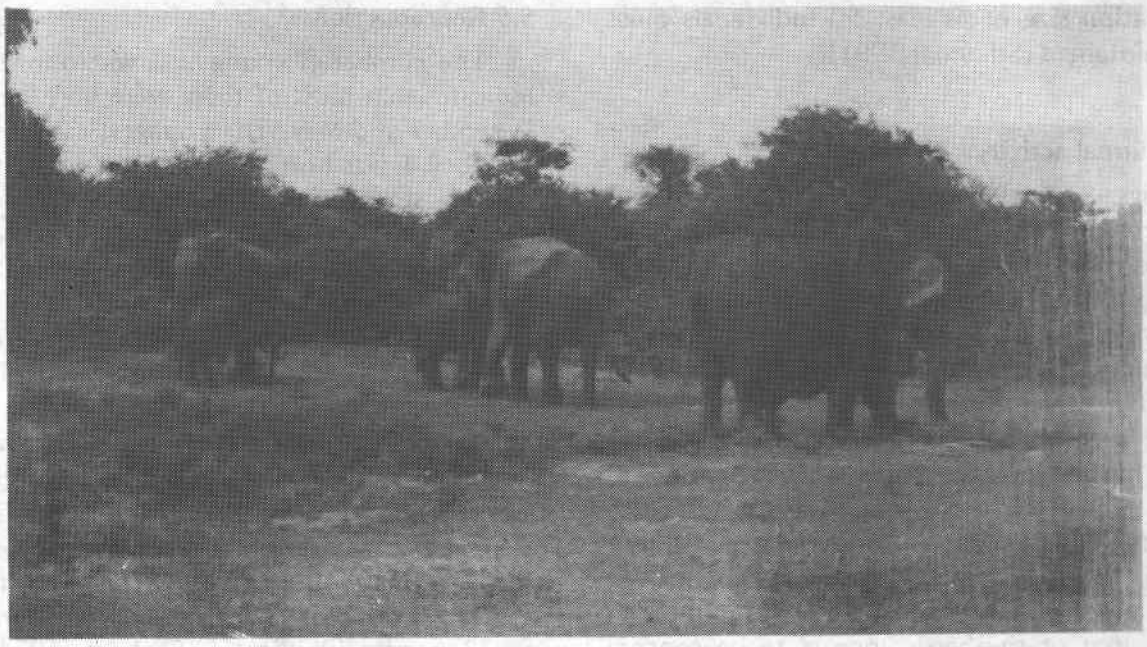


Fig. 7. A herd of three adult females and their young (Photo: Charles Santiapillai).

Table 3. Composition of the classified herds of elephants

| Herd | Ad.m | Ad.fm | Subad. | Juvn. | Calf | Total |
|---|---|---|---|---|---|---|
| A | 1 | 2 | 0 | 0 | 1 | 4 |
| B | 0 | 3 | 2 | 1 | 1 | 7 |
| C | 0 | 4 | 4 | 1 | 0 | 9 |
| D | 0 | 2 | 2 | 1 | 1 | 6 |
| E | 0 | 2 | 0 | 0 | 1 | 3 |
| F* | 1 | 3 | 2 | 1 | 3 | 10 |
| G | 0 | 2 | 1 | 0 | 1 | 4 |
| H | 1 | 1 | 4 | 0 | 0 | 6 |
| I | 0 | 2 | 2 | 0 | 0 | 4 |
| J* | 1 | 3 | 2 | 1 | 3 | 10 |
| K | 0 | 2 | 1 | 2 | 0 | 5 |
| L | 0 | 1 | 2 | 0 | 0 | 3 |
| M | 0 | 3 | 1 | 0 | 1 | 5 |
| Total | 4 | 30 | 23 | 7 | 12 | 76 |
| % | 5.3 | 39.5 | 30.2 | 9.2 | 15.8 | 100 |
| per 100 fm | 13.3 | 100 | 76.6 | 23.3 | 40.0 | |

*F and J represent the same herds.

Average herd size = 5.8 (range 3–10)
Ratio of ad. males: ad. females = 1: 7.5

population size of at least 50 individuals must be maintained (Sukumar 1991).

### 5.4 Diurnal activity:

Figs. 8 and 9 illustrate the diurnal activity patterns of both solitary animals as well as the groups respectively. These activity patterns refer to the time spent on feeding (either grazing or browsing). It is interesting to note that the solitary animals show a bi-modal pattern with peaks of activity about 0800 and 1700 hrs (Fig. 8) while the groups observed activity begins at 1500 hrs and increases steadily afterwards reaching a peak at 1800 hrs (Fig. 9). This pattern of activity is similar to that observed by McKay (1973) in the RNP. While the activity of the bulls appears to be spread throughout the diel cycle, that of the herds appears to be concentrated near dusk. One possible reason may be that the herds spend a large part of their time during the day within the thorn scrub, under shade, and are noticeable only during the late evenings when they emerge to feed on the open grasslands (Santiapillai *et al.* 1984). Another reason for the late emergence of the herds could be linked to the large number of young ones in the population. Cows with calves rarely take risks and are rather secretive and shy during the day, coming out in the open to graze or bathe in the late afternoon or at night. It is very likely that much of the feeding activity continues late into the night, given the fact that the adults consume on an average about 150 kg of food (Vancuylenberg 1974, 1977). In order to consume such a vast amount of food, the animals spend more than 16 hours in feeding activities (Eisenberg & Lockhart 1972). Feeding is intermittent throughout the 24 hr period.

Grazing occurs predominantly in the late evenings or through the dark hours. Another possible reason for the shift in activity of the herds towards late evenings could be human disturbance. The level of vehicular traffic by tourists is very high in the park vis-a-vis its small size (140 $km^2$). At the time of the survey in June, there was considerable disturbance to the animals from visitors.

### 5.5 Reproduction:

The number of young observed in the survey indicates that most of them were born between December and May. The youngest calf observed in Block I was born in May. This points to the possible seasonality in breeding in RNP by elephants. Most of the early workers have concluded that there was no seasonal pattern of breeding in elephants in Sri Lanka (Phillips 1935, Eisenberg & Lockhart 1972, McKay 1973). However both Kurt (1974) and Santiapillai *et al.* (1984) noted the presence of new born calves during the wet season (between December and May). Ishwaran (1981) also recognized a distinct late dry and early wet season birth peak among elephants in one year followed by the absence of such seasonality in the subsequent year. The gestation period in elephant varies from 18 months to 23 months (Phillips 1935). Kurt (1974) estimated it to be 21 months. Considering 20 months as the average gestation period, breeding in RNP appears to extend from March to October (i.e overlapping with the dry season).

Although there appears to be a seasonal pattern of breeding and birth in elephants in RNP, it is too premature to make any firm conclusions from the scanty information gathered during this survey. Observations must be continued for a minimum of eight years in order to establish cyclic patterns if any, in the breeding and birth among elephants (Santiapillai *et al.* 1984). Although it is clear that the females are seasonal breeders, there is yet no positive evidence for cyclical reproductive activity in the male (Hanks 1979). Jainudeen *et al.* (1972) have shown that musth occurs once a year in all adult male Asian elephants at a time when the male hormone testosterone is at a very high level. Musth should be restricted to the post-pubertal male Asian elephants, where it is characterised by aggressive behaviour and a discharge from the temporal gland. Jainudeen *et al.* (1972) hypothesize that musth in Asian elephants is a vestige of a truly seasonal rut which may have existed at some previous time in the evolutionary history of the species.

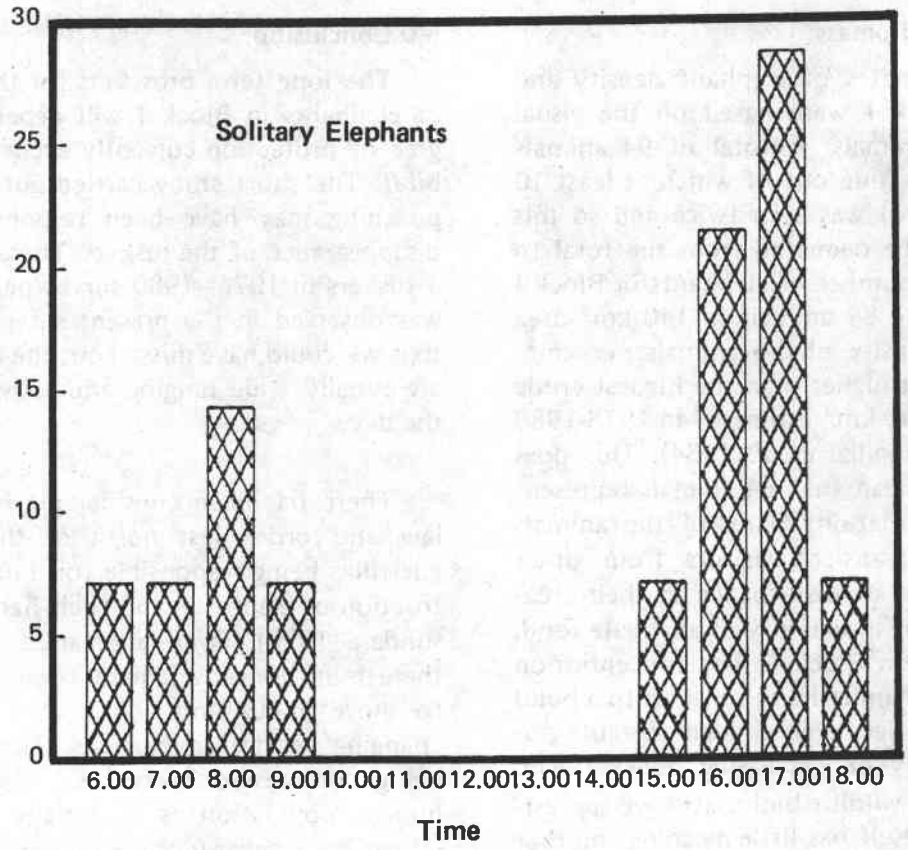



Fig. 8 Activity pattern of solitary elephants in Block I of Ruhuna National Park.

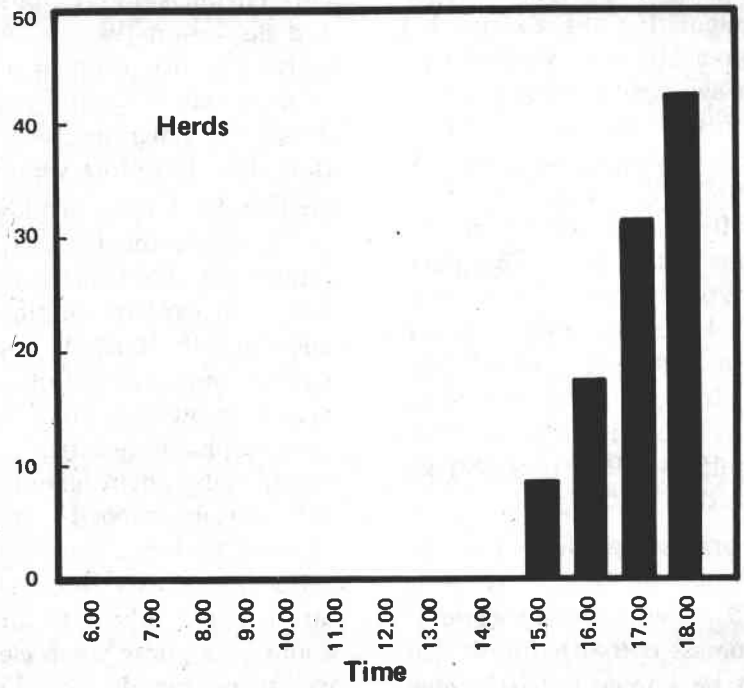



Fig. 9 Activity pattern of the groups of elephants in Block I of Ruhuna National Park.

### 5.6 Density and Biomass:

Average estimates of elephant density and biomass in Block I were based on the visual counts of the animals. A total of 94 animals were counted in June out of which at least 10 animals (one herd) was seen twice and so this number should be deducted from the total to obtain the total number of elephants in Block I in June. Thus the 84 animals in 140 $km^2$ area gives a crude density of 0.6 animals per $km^2$. This is somewhat higher than the highest crude density of 0.46 per $km^2$ estimated in 1978-1980 in Block I (Santiapillai *et al.* 1984). This does not necessarily mean that 84 animals represent the resident population. Many of the animals could well be transient visitors from other Blocks as a result of disturbance in their areas or attracted by the availability of adequate food, water and cover in Block I. The concentration of elephants in a limited area can lead to a build up in their densities, even though absolute population size may be decreasing (Laws 1981).

A number of wildlife biologists have suggested that density itself has little meaning and that it is biomass (the mass of animals) which is important to an understanding of animal-habitat interrelationships (Spinage 1982). If biomass estimates are needed then they should not be derived by simply calculating the density by adult weight. A more realistic estimate could be obtained by using an average value of the elephant's body weigt adjusted with respect to percentage of age and sex classes, as suggested by Eisenberg & Lockhart (1972). Thus using their average value of 1,810 kg the biomass of elephants in Block I works out to be 1,086 kg per $km^2$ at a peak density of 0.6/$km^2$. The estimated biomass in 1978–1980 was 840.3 kg per $km^2$ (Santiapillai *et al.* 1984). Therefore, between 1978 and 1991, it appears that there had been a 29% increase in elephant biomass (from 840.3 kg per $km^2$ in 1978–1980 to 1,086 kg per $km^2$) in Block I of RNP.

The most useful parameter with the greatest scope for comparison however is density. It is also most widely used in wildlife management. The problem with biomass is that before it can be compared, it must be known precisely how different workers have derived their estimates (Spinage 1982).

### 6.0 Conclusion:

The long term prospects for the population of elephants in Block I will depend on the degree of protection currently accorded to its habitat. The short study carried out suggests that poaching may have been responsible for the disappearance of the tuskers. There were at least 4 tuskers in 1978–1980 survey period but none was observed in the present survey. It is likely that we could have missed out the tuskers which are usually wide ranging and active throughout the day.

There has been considerable breakdown of law and order just north of the RNP with guerrillas being responsible for much of the destruction of elephants and their habitat (Wanigasundara 1990). Over large areas in Sri Lanka, there is no longer adequate room for elephants to move about and adjust their densities to changing vegetation patterns. Their ranges are being compressed every year. The expanding human population is essentially being maintained by a subsistence economy. The changes in the land-use patterns are therefore resulting in continuous contraction of habitat available to the elephant. This serves also to cut off certain channels of response such as emigration and dispersion (Watson & Bell 1969). The animals have lost so much of their original habitat to man, that emigration can no longer be considered a mechanism for regulating the population size. Therefore what is happening in many areas in Sri Lanka, including RNP is that instead of elephants moving out, most elephant populations are experiencing rapid immigration. This may well explain for the increase in density of elephants in Block I. The danger from uncontrolled immigration of elephants into a few secure protected areas comes from the fact that elephant densities can become vulnerable to changing environmental conditions. Suppose the carrying capacity of the area were to be reduced by lower rainfall or destruction of vegetation at a faster rate than the elephant population could adjust to the change, then there could be a phase when elephant densities are in excess of carrying capacity when the rate of habitat destruction would accelerate (Laws 1981).

The main reason for initiating the survey of elephants in Block I was to enable the park authorities to constantly monitor such changes in density and habitat utilization. At the present crude density of 0.6 animals per $km^2$ there is no immediate danger of elephants destroying their habitat in Block I. RNP has always sustained high elephant numbers in the past (Norris 1959, 1967). High density in itself need not become a regulatory mechanism. In Lake Manyara area is one of the highest known elephant densities in Africa with about 5 animals per $km^2$. Yet, here too the mean calving interval is about 4.5 years and the mean age at puberty is 11 years (Hanks 1979). What is more important than density in regulating elephant numbers is food supply.

Future surveys must pay special attention to the sex ratio of the adults in Block I. In small populations, the gene frequencies change randomly from generation to generation with a fixation or a loss of alleles. This process is known as genetic drift. The leakage of alleles will eventually lead to an increase in homozygosity in the population (Frankel & Soule 1981). Sukumar (1985) points out that if the male mortality rate due to both natural causes and poaching can be kept below 8% per annum, then the adult sex ratio could be pegged at 1 male to 5 females.

Despite the disparate sex ratio in the herds observed in Block I (1 male to 7.5 females), the reproductive performance of the animals appears good from the proportion of the calves (15.8%) in the population (Table 3). In any polygynous mammalian society there will always be surplus males, since one male can mate with several females. Therefore the opreational sex ratio would not be as disperate as the observed sex ratio in the elephant populations and so a normally disperate sex ratio can still ensure that most if not all the mature females in oestrus are mated (Sukumar 1989). Indiscriminate capture of crop raiding bulls (as recommended in a recent insane project proposal prepared by a consultant from abroad that calls for the capture of 500 such animals from the wild for domestication and sale as a means of reducing elephant crop depredations) can therefore seriously affect the long-term survival of especially small populations in the wild.

Another consideration for managers must be the long-term viability of small populations of elephants. In general, the smaller the population size, the greater is its vulnerability to demographic, environmental and genetic stochasticity (Shaffer 1981, Gilpin & Soule 1986). For long-term viability an effective population size of 500 has been suggested (Franklin 1980, Frankel & Soule 1981). However, not all small populations are necessarily doomed. Although the effects of inbreeding depression are real but transitory. They are minimised if numbers recover quickly from bottlenecks. The population of 40± wild cattle at Chillingham in England after 800 years (about 120 generations) of continuous inbreeding are fit and thriving (Whitehead 1953). In elephants, given their longevity, and longer generation interval, it would take much longer for any inbreeding to accumulate to an appreciable deleterious level.

A population of long-lived elephants would require a very small genetically effective population size (Ne), while a short-lived species such a field mouse may require a large one to preserve 90% heterozygosity after 200 years. The only long-term hope for the elephants in Sri Lanka may lie in the effective protection of small, isolated populations.

In the meantime, what is needed in RNP is the continuation of the monitoring programme that was started in June 1991 to warn managers when the species is in trouble. The solution that we propose will depend on how much we know about the species.

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# MANAGING ELEPHANT DEPREDATION IN PLANTATIONS IN SABAH

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## SUMMARY

Wild elephants cause enormous losses in Sabah by destroying plantation crops, notably oil palm. An ecological approach to minimising such damage, through such measures as careful siting of Reserves and plantations, offers limited prospects in the state, because bounda-

ries for Reserves have already been decided and gazetted. It is strongly recommended, however, that existing Forest and Wildlife Reserves are maintained at their present size, especially Tabin Wildlife Reserve, large enough to maintain self-contained viable breeding populations. Further excisions would produce more elephants without a home.

Data are presented to indicate that properly-maintained electrified fencing is not only effective in keeping elaphants out of plantations, but that installation of fencing at an early stage in plantation development is cheaper than the damage that is likely to be done by elephants in the absence of such fencing.

Electrified fencing may be ineffective (i) against certain solitary, adult bull elephants, which should be killed if they learn to destroy fencing at high voltage, and (ii) in flood-prone areas, where the fencing becomes ineffective when water reaches the wiring.

It is recommended that a novel physical barrier against elephants, in the form of sharp stones embedded in the ground, be considered by plantations which have not yet completely erected fencing.

## 1. INTRODUCTION

Asian elaphants *(Elephas maximus)*, once distributed throughout much of Asia, have been raiding crops for thousands of years. As a result of loss of natural habitat and of deliberate killing by Man, the elephant population has been reduced to a few scattered remnants. The rate of decline of elephant numbers has been accelerated in recent decades by sharp increases in human population growth coupled with large-scale clearance of natural forest habitat for agriculture. The cost of elephant depradations on plantations in Malaysia is enormous: FELDA and the Sabah Land Development Board alone have lost many millions of ringgits to elephants during the 1970's to 1980's (Blair *et al*, 1979, Blair and Noor, 1981, and O F Wakefield, pers. comm.).

In the past, elephants raiding crops were generally killed without question. In recent years has come the realisation that agricultural development has proceeded such that there are few areas remaining of adequate size to support even a small population of elephants. If elephants are not to go extinct, therefore, ways have to be found of minimising their damage to plantations without resorting to uncontrolled slaughter.

## 2. METHODS OF REDUCING ELEPHANT DEPRADATIONS

"As more experience is gained, and post-audit data become available, the expanding body of evidence suggests that it is more cost-effective to manage elephants in and adjacent to project areas from the beginning of the project. This requires careful pre-project planning, project designs which will prevent elephants from entering production areas, and provisions to ensure local elephants' access to critical resource areas, or to provide these through habitat enrichment and other measures." (Seidensticker, 1984). The same author claims that "fencing with electrification usually is ineffective in repelling elephants. Ivory tusks do not conduct electricity. Elephants may push over a tree on the fence or simply shove the fence". Seidensticker argues instead that agricultural and forestry development projects should be sited so as to allow local elephant populations continuing access to all their water, mineral lick and food requirements. In addition, he suggests that the boundary region between forest or wildlife reserves and the plantation should in some way be made ecologically unattractive to elephants, so that they will be unwilling to move between their reserve and plantations. Indeed, this would be ideal, but many decisions on land use have been made already without reference to elephants, and there are many cases where it seems that only the construction of physical barriers will keep elephants out of plantations.

Andau and Payne (1985) argue that the policy of the Sabah Forest Department (the government agency charged with conservation of elephants in the state) should be to: (1) encourage all larger plantations to erect and adequately maintain electrified fencing, (2) maintain Tabin Wildlife Reserve (about 123,000 ha

in area) as Sabah's major elephant reserve, and (3) chase elephants out of agricultural areas whenever called upon to do so, and destroy them only after repeated and irreconciable conflict. This paper attempts to assess the value of electrified fencing in reducing elephant depradations on plantations in Sabah, and suggests an as-yet untried method for keeping elephants out of plantations.

## 3. AN ASSESSMENT OF THE VALUE OF ELECTRIFIED FENCING

### *3.1 METHODS*

Prior to 1984, only one (oil palm) plantation in Sabah had erected electrified fencing; it has suffered no damage from elephants. In April of that year, the authors of this paper organised a one-day course on electrified fencing, in each of the towns of Sandakan and Lahad Datu in eastern Sabah (Payne, 1984), presented by a supplier of such fencing, and attended by over thirty representatives from plantations in the region. Subsequently, at least nine plantations installed electrified fencing designed to keep out elephants. Seven responded to questionnaires asking for data related to the costs and benefits of installing the fencing, and key data are summarised here (Table 1). So many variables are associated with this limited amount of data (for example, the cost of damage varies with age at which the plants are destroyed, while data from plantations where the fence does not completely encircle the boundary cannot be interpreted objectively), that we have decided to interpret it on a case-by-case basis, rather that draw and overall conclusion.

### *3.2 INTERPRETATION OF TABLE 1*

The money value of one destroyed plant varies from less than M$3 for a nursery seedling to many tens of M$ for a plant which has been growing in the field for several years. Since damage on any particular plantation either involves different age classes of plant or has not been specified by the plantation management, we assume that loss of an "average" plant represents a los of M$10 unless otherwise specified.

Plantation 1. Installation of fencing and maintenance for four years would cost about M$115,000. Instead, an estimated M$180,000 was lost in the four years preceding installation. The solitary bull elephant learned how to penetrate the fence, even with pulses at 7.5 kv, and should be destroyed. Female/young herds which had been damaging palms previously have not penetrated the plantation since installation of fencing. In any case, this plantation is well-advised to install fencing because it shares a common boundary with Tabin Wildlife Reserve, which contains many elephants.

Plantation 2. Installation of fencing and maintenance for four years would cost about M$62,000. Instead, an estimated M$300,000 was lost in two years preceeding installation. Penetration of elephants after installation was attributed to inadequate voltage. This plantation will ultimately be far from Forest Reserve, but is now in one of the highest elephant concentrations in Sabah, and installation of properly-maintained fencing is worthwhile.

Plantation 3. Installation of fencing and maintenance for four years would cost about M$33,000. Only an estimated M$2,500 was lost prior to installation, while a larger amount was lost afterwards. However, penetration occurred during flooding, when water reached the wiring, rendering the fencing ineffective (see notes on Plantation 7.). In principle, fencing would seem advisable, because elephants are fairly abundant locally, but the area is highly flood-prone in further problems are likely for this reason.

Plantation 4. Installation of fencing along the boundary with Tabin Wildlife Reserve and maintenance for four years would cost about M$220,000. The difference in elephant damage before and after installation of fencing is dramatic: an estimated M$2,850,000 before and no damage after. It is essential that fencing is maintained and extended as necessary.

Plantation 5. Total cost of installation and maintenance cannot be calculated, but the dramatic difference in elephant damage before and after installation – an estimated M$500,000 before and non after – led this plantation's

manager to comment "installation of Electric Fence is the most effective way to prevent .... elephant attack on 1 - 4 year old oil palm".

Plantation 6. The perimeter of this large plantation, which is in the middle of a high concentration of elephants far from permanent Forest Reserve, is still being fenced, but an estimated M$106,000 was lost before the first installation, while the manager has stated that subsequent elephant penetration has been through unfenced portions.

Plantation 7. Protection of this plantation from elephant damage is especially problematical. Rotan, a favoured natural food of elephants, is planted under forest cover in an area often used by elephants, and so installation of fencing would seem necessary. However, the cost of planting rotan and the expected income are low in comparison to other crops, and so the proportion of development cost incurred by electrified fencing is relatively high. Furthermore, being under forest cover contiguous with adjacent forest, fence maintenance costs are high. The whole region is highly flood-prone, as is Plantation 3. Also, there is a possibility that once the entire perimeter has been fenced, it will be found that some elephants are trapped inside.

## 4. PROPOSAL FOR A NEW FORM OF PHYSICAL BARRIER

Recently, William Xanten of the National Zoo, Washington D.C. has suggested to the authors another method which we would recommend be tried by plantations in suitable situations. A number of zoos in North America and Europe find that captive elephants will not cross a barrier of closely-spaced sharp stones embedded in the ground — because the soles of the feet are broad yet rather soft — and we can think of no reason why wild elephants should act differently. We suggest that it would be worthwhile to experiment with such a barrier at least 8 feet and preferably 10 feet wide, more than the stride of an adult bull elephant.

Several factors must be considered before embarking on this novel method. Firstly, whether crops are damaged primarily by elephants, or by a range of mammals including pigs, deer and primates. Electrified fencing can help to keep out all these animals, while sharp stones would be a barrier only to elephants. Secondly, costs will vary from place to place. In many areas where elephants are abundant, hard stone does not occur and it would have to be brought in at high cost from elsewhere. Sharpened short bamboo stakes could be a cheaper alternative but would have to be inspected and replaced from time to time. We do not have data available to estimate likely costs of laying down a chain of stones 10 feet wide, but would guess that initial costs would generally be greater, while maintenance costs over the long term would be less than that for the installation of electrified fencing. Thirdly, the realities of proper maintenance must be assessed. Electrified fencing can be well-maintained if daily inspections are made and if tree-falls are unlikely to occur, but experience has shown that maintenance of high voltage is sometimes neglected. Satisfactory fence maintenance under forest cover in seasonally-flooded areas (such as Plantation 7, Table 1), for example, is an almost-impossible task. The sharp stone barriesr requires almost no maintenance. Plantations such as this may find that a judicious combination of electrified fencing and sharp stones is most cost-effective.

## 5. ADDITIONAL METHODS FOR REDUCING ELEPHANT DAMAGE

Sections 3. and 4. indicate that physical barriers can reduce elephant damage to plantation crops, but do not touch upon the other side of the same story: welfare of the elephants and conservation of viable breeding populations. If we consider the likelihood that elephants given access to adequate water, mineral licks, food and mates inside Reserves are less likely to come out into plantations, then it is clear that the welfare and conservation of elephants should be viewed in relation to control measures.

In some areas, notably the region between the lower Kinabatangan and Segama Rivers, there are hundreds of elephants where, in the

TABLE 1. COSTS AND BENEFITS OF INSTALLING ELECTRIFIED FENCING FOR PROTECTION OF CROPS AGAINST ELEPHANTS IN SEVEN PLANTATIONS IN SABAH.

| Plantation/ size/ crops | Period of fence installation | Damage to crops (a) before (b) after fence installation | Cost per chain of (a) Installation (b) Annual Maintenance |
|---|---|---|---|
| 1. 5098 ha cocoa & oil palm | 1985 complete around planted oil palm | (a) 18,000 palms in 200 ha in 4 years, (b) 314 palms by one solitary bull (broke through fence) | (a) M$60 (b) M$5 Fence: 1440 chains |
| 2. 4856 ha oil palm | 1984 complete around planted oil palm | (a) most palms within 150 ha area destroyed 2 or 3 times within 2 years, (b) initially some; none since voltage kept high | (a) total cost M$38,347 (b) total cost M$6000 Fence length unknown |
| 3. 2023 ha oil palm | 1985 complete around planted oil palm | (a) 250 palms (b) none except one occasion during flooding, 1000 seedlings | (a) M$46.50 (b) M$4.80 Fence: 500 chains |
| 4. 80,000 ha oil palm, coconut & cocoa | 1985 only along boundary with Wildlife Reserve fenced | (a) 276,814 oil palms 7086 coconuts 1500 cocoa plants (b) none | (a) M$80 (b) unknown Fence: 2200 chains |
| 5. 19,255 ha oil palm & cocoa | 1985 only along boundary with Forest Reserve fenced | (a) 50,000 oil palms during 1982–1985 (b) none | (a) M$74 (b) M$8 |
| 6. 14,162 ha oil palm, cocoa & rotan | 1984–1986, ongoing | (a) 7075 oil palms 3491 cocoa plants 59 rotan plants (b) damage still occuring but no breakthrough of electrified fencing | (a) M$65 (b) M$5 |
| 7. 4453 ha rotan | 1985– ongoing; about half installed | (a) about 10% of all rotans planted (b) damage continues at similar rate | (a) M$55 excluding manfower (b) unknown |

future, there will be inadequate forest to support a breeding population. In such areas, it can only be recommended that forest clearance proceed in a broad front, in one direction, rather than patchily, so that elephant incursion into plantations will be less frequent and the elephants have a chance to shift their range into Forest or Wildlife Reserves.

The pattern of Reserves in Sabah now is such that only two separate areas will be able to support viable populations of elephants in the long-term: Tabin Wildlife Reserve (about 123,000 ha) and the large region of contiguous Forest Reserves covering over one million ha in the central and south-eastern part of the state. We strongly suggest that no further excisions are made from these Reserves, especially Tabin, which is already rather small in terms of elephant habitat, and contains at least seven natural mineral licks which are believed to be important regulators of elephant population density and distribution.

## 6. CONCLUSIONS

Large plantations situated in areas inhabited by elephants will almost certainly experience crop damage by this species, in the case of oil palm resulting in the loss of tens or hundreds of thousands of ringgit per year in every plantation. Available data indicates that, in most situations, the cost of installation and maintenance of electrified fencing will be less than the cost incurred by elephant damage, if total costs are averaged over several years.

The above conclusion may not apply in areas which are flood-prone, because elephants can penetrate the plantation when flood-water reaches the wiring. In certain situations, such as this, a novel physical barrier in the form of sharp stones embedded in the ground may be more effective than fencing. It is recommended that plantations which have not yet erected electrified fencing around their entire boundary seriously consider this alternative.

Two additional approaches, which integrate the need to conserve viable wild elephant populations with efforts to minimise their depradations, are (i) to clear forest for plantation development in a single, large-scale, orderly front, towards the direction of Forest or Wildlife Reserves, and (ii) to maintain existing Forest and Wildlife Reserves, especially Tabin, at their present size, adequate to support self-contained, viable elephant populations.

## ACKNOWLEDGEMENTS

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# CONSERVATION OF ELEPHANTS IN LAOS

by

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## Introduction

Lao People's Democratic Republic (Lao PDR) is a land locked country with an area of 236,800 km$^2$ in the heart of Indo-China (Fig. 1) The principal topographical feature is the Mekong river that flows from Southern China through Laos into Vietnam via Cambodia, forming much of the western boundary between Laos and Thailand. Laos is largely a mountainous country with only about 20—30% of the land area being below 200 m. The highest mountain in Laos is Phou Bia (2,817 m) located about 130 km in the Southwest of Xieng Khuang province. There are two seasons: the rainy season extends from May to October during which the country receives an average of about 1,000 mm of rain (in the Bolovens Plateau it could be much higher - about 3,600 mm) while from November to April the country experiences a much drier climate.

With a human population of about 4 million, Laos is one of the most sparsely populated countries in South-east Asia with an average density of 15 people per km$^2$. About 75% of the human population lives in the fertile lowland plains where agriculture is the principal activity and land-use (FAO/UNEP 1981).

Laos is divided into 16 provinces (khueng) plus the Vientiane municipality. There are 147 districts (muong), 900 sub-districts (tasseng) and 11,000 villages (ban) and consists of 68 ethno-linguistic groups (Kingsada 1991). Half the population lives in the lowlands and valleys and they are the ethnic Lao or the Lao Lum - descendants of the Tai people from Southern China who migrated between the 6th and 13th centuries. The rest of the population is made up of ethnic groups called Lao Theung who live in middle slopes all over Laos, with a concentration in the Bolovens Plateau (Anon 1990). The human population is currently growing at the rate of 1.9% per annum. At this rate of growth the country could double its population in 20 years.

## Forest Cover

In the distant past, much of Laos was heavily forested. About 92.5% of the country, according to Sayer (1983a) was covered with "some form of natural, unmanaged vegetation". However, the situation has changed in the recent past owing to the destruction from aerial bombardment during the war and from the exploitation of forests by loggers and shifting cultivators alike. Nevertheless, there are still substantial areas of more or less evergreen forests whose original extent was about 160,000 km$^2$ or approximately 70% of the land area (Salter and Phanthavong 1989). Lowland and montane forests covered much of the areas in the north and along the Annamite mountain chain while monsoon forests still occur in areas north and west of the Mekong river and contain valuable stands of teak (Collins *et al.* 1991). Between 1970 and 1981, the forest cover in Laos declined from 70% to 47% (or from 17,000,000 ha to 11,273,000 ha).

The commercially important species of tropical timber species are to be found below 1,000 m in centrala and southern regions and comprise species such as *Anisoptera cochinchinensis, Dalbergia* spp., *Dipterocarpus alatus, Hopea* spp. (Fidloczky 1986), *Parashorea stellata* and *Pterocarpus macrocarpus.* According to the latest

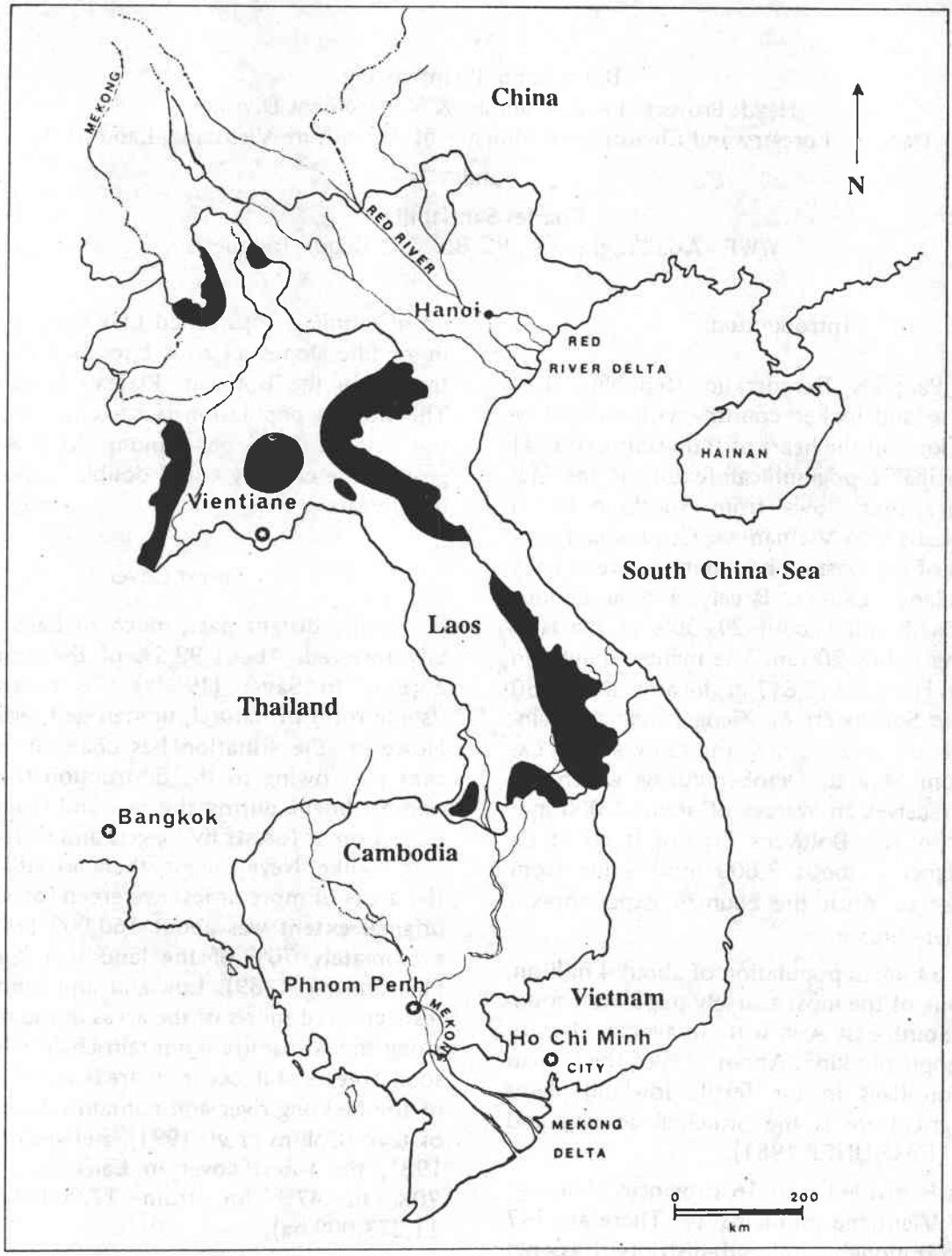



Fig. 1 Map of Indo-China showing the location of Laos. The shaded areas represent a general distribution of the Asian elephant in Laos. (Source: Santiapillai and Jackson (1990).

Table 1. Estimates of forest cover in Laos

| | |
|---|---|
| Tropical evergreen forest | 3,436,000 ha |
| Tropical semi-deciduous forest | 5,685,000 ha |
| Tropical deciduous forest | 1,664,000 ha |
| Other forests | 488,000 ha |
| Total forest cover | 11,273,000 ha |
| Fallow land | 5,000,000 ha |

Source: Kingsada (1991)

information available, about 18% of Laos (41,970 · km²) is covered by undisturbed rain forest, while monsoon forest covers 11% of the area (or 25,810 km²) and the degraded rain forest accounts for 25% of the land area (or 56,820 km²). (Collins *et al.* 1991). Grasslands cover about 8 million ha and are composed of species of *Imperata, Andropogon* and *Hyppearenia.*

**Protected Areas in Laos**

Laos is one of the few countries in Asia that has no legally established national parks, and never had any areas set aside for the protection of nature (Sayer 1984). Although about 1,280 km² of forest land was set aside in 17 forest reserves in the past, yet protective measures were never implemented (FAO/UNEP. 1981). However, today Laos is seriously considering establishing a number of protected areas that cover 20% of the total land area (Salter and Phanthavong 1989, Anon 1990) with the view to conserving its vast biological diversity.

**Status of Elephants in Laos**

Laos was once known as **Lan Xang** or the **Land of a Million Elephants** (Olivier 1978, Sayer 1984). Thus there must have been at one time substantial number of elephants both in the wild and in captivity in Laos. Just as in the neighbouring Thailand and Burma, the elephant

Table 2. Extent of forest cover in Laos

| Province | Area (ha) | % of land area |
|---|---|---|
| Phongsaly | 480,000 | 30 |
| Luang Namtha | 441,900 | 53 |
| Bokeo | 278,100 | 57 |
| Oudomsay | 230,000 | 15 |
| Houaphan | 312,000 | 17 |
| Xieng Khouang | 679,000 | 39 |
| Sayaburi | 812,000 | 50 |
| Louang Phrabang | 187,000 | 10 |
| Vientiane | 1,188,000 | 60 |
| Vientiane municip. | 104,900 | 34 |
| Bolikhamsai | 786,800 | 47 |
| Khammouane | 766,300 | 46 |
| Savannakhet | 1,598,000 | 73 |
| Saravane | 840,200 | 74 |
| Sekong | 667,800 | 87 |
| Champassack | 1,041,000 | 72 |
| Attapeu | 850,000 | 82 |

Source: TFAP. 1990.

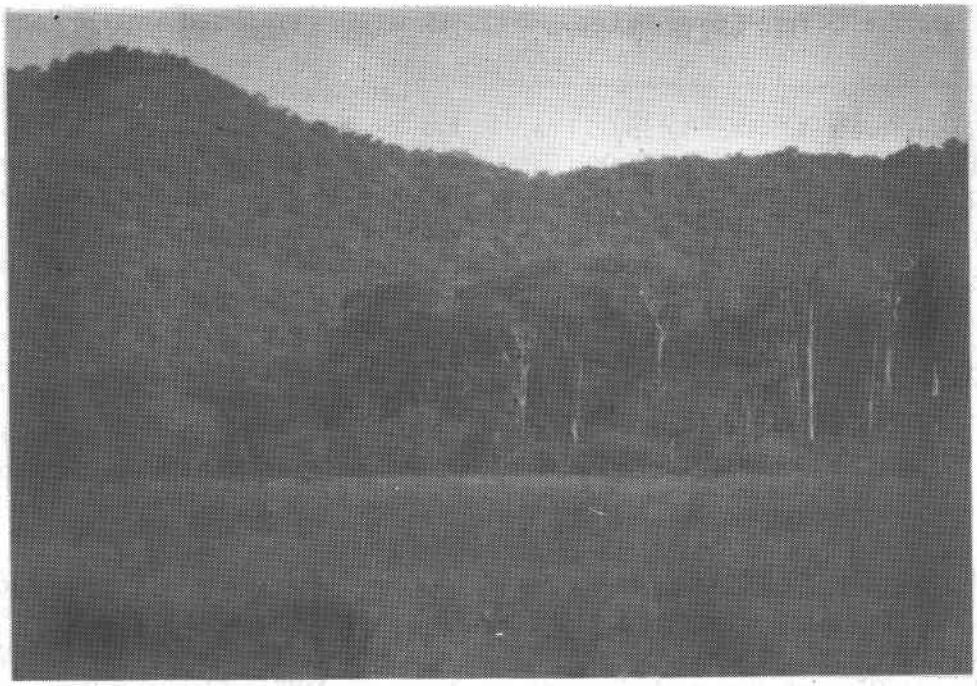


Fig. 2. Forested areas and grazing grounds utilized by elephants in Laos. (Photo: B. Phanthavong).

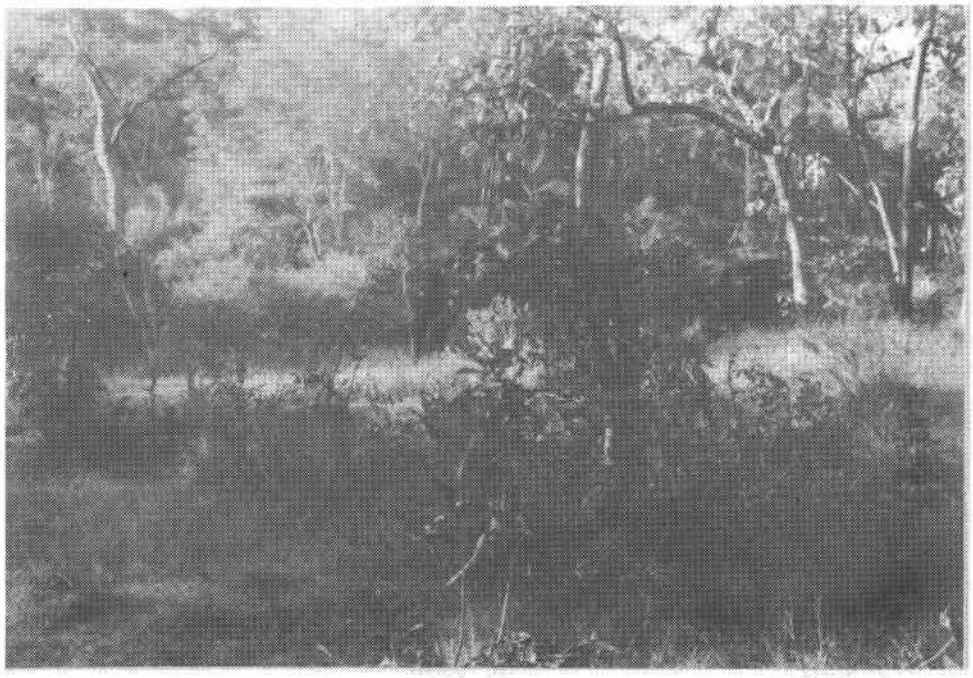


Fig. 3. Elephants in the scrub vegetation in Laos. (Photo: B. Phanthavong).

played a significant role in the country's religion and culture.

The elephant is still of great economic importance in the timber industry (Santiapillai and Jackson 1990). Viable populations of elephant still occur throughout the country and so the animal is not in imminent danger of becoming extinct in Laos (Sayer 1983a). The most serious threat faced by elephant in Laos is poaching for ivory. Many Laotians still move about in the country carrying guns and firearms looking for anything that could be killed and eaten. In Vientiane the bird life is scarce or non-existent! If hunting is allowed to go unchecked, there is a real danger that some small populations of elephants might face local extinctions.

### Distribution of Wild Elephants

There has never been a systematic survey to determine the distribution and number of elephants in the wild in Laos. Much of the information currently available has come from few site inspections and interviews with the local communities. From these alone it appears that elephants in Laos are distributed over a wide geographic area but their overall distribution remains discontinuous and patchy (Fig. 4). No doubt, with more surveys the distribution map could be substantially improved.

Elephants are particularly widely distributed in the south where there is still considerable forest cover (Sayer 1983b). In the north, where human land-use has been most intensive, elephant distribution is much less extensive. Significant populations of elephant still occur in the Sayaburi province, west of the Mekong river, in Vientiane Province and in Bolikhamsai and Khammouane Provinces and along the border with Vietnam.

According to the system of protected areas proposed by Salter and Phanthavong (1989), 4,731,887 ha of forest lands will receive some measure of protection. Of these, elephants are known to inhabit a total of 2,585,946 ha (Table 3). Thus, if the system of Protected Areas as proposed by Salter and Phanthavong (1989) is adopted and implemented by Lao PDR, then it would automatically protect 55% of the habitats inhabited by the elephants in Laos. Thus a conservation programme along the lines of the successful **Project Tiger** in India, but based on the elephant in Lao PDR alone would mean the protection of 2,585,946 ha or 11.2% of the total land area in Laos. This in itself must provide a strong impetus for launching a massive conservation programme focused on the Asian elephant in Laos.

Table 3. Proposed Protected Areas with elephant populations

| Protected area | Area (ha) |
|---|---|
| Dong Amphan | 162,465 |
| Dong Hua Sao | 70,668 |
| Dong Sithuane | 75,690 |
| Long Leng | 29,652 |
| Muang Khi | 118,740 |
| Na Kai Plateau | 161,835 |
| Nam Chuane | 207,700 |
| Nam Kading | 129,400 |
| Nam Khang (?) | 76,620 |
| Nam Kong | 122,070 |
| Nam Ma | 86,853 |
| Nam Poui | 147,820 |
| Nam Theun | 162,705 |
| Nam Yo (?) | 59,838 |
| Pa Sak Sayaburi | 124,855 |
| Phou Dene Dinh | 222,932 |
| Phou Xang He | 75,315 |
| Phou Xiang Thong | 95,355 |
| Xe Bang Fai | 102,870 |
| Xe Bang Nouane | 126,280 |
| Xe Kong Pine forest | 82,491 |
| Xe Piane | 143,792 |

### Number of Elephants in the Wild

The number of elephants in the wild in Laos is currently estimated to be in the order of 2,000–3,000 (Venevongphet 1988). The largest number - estimated to be more than half the total population - occur in the south, below the 16 N latitude. Large numbers are also believed to occur n scattered locations across Central

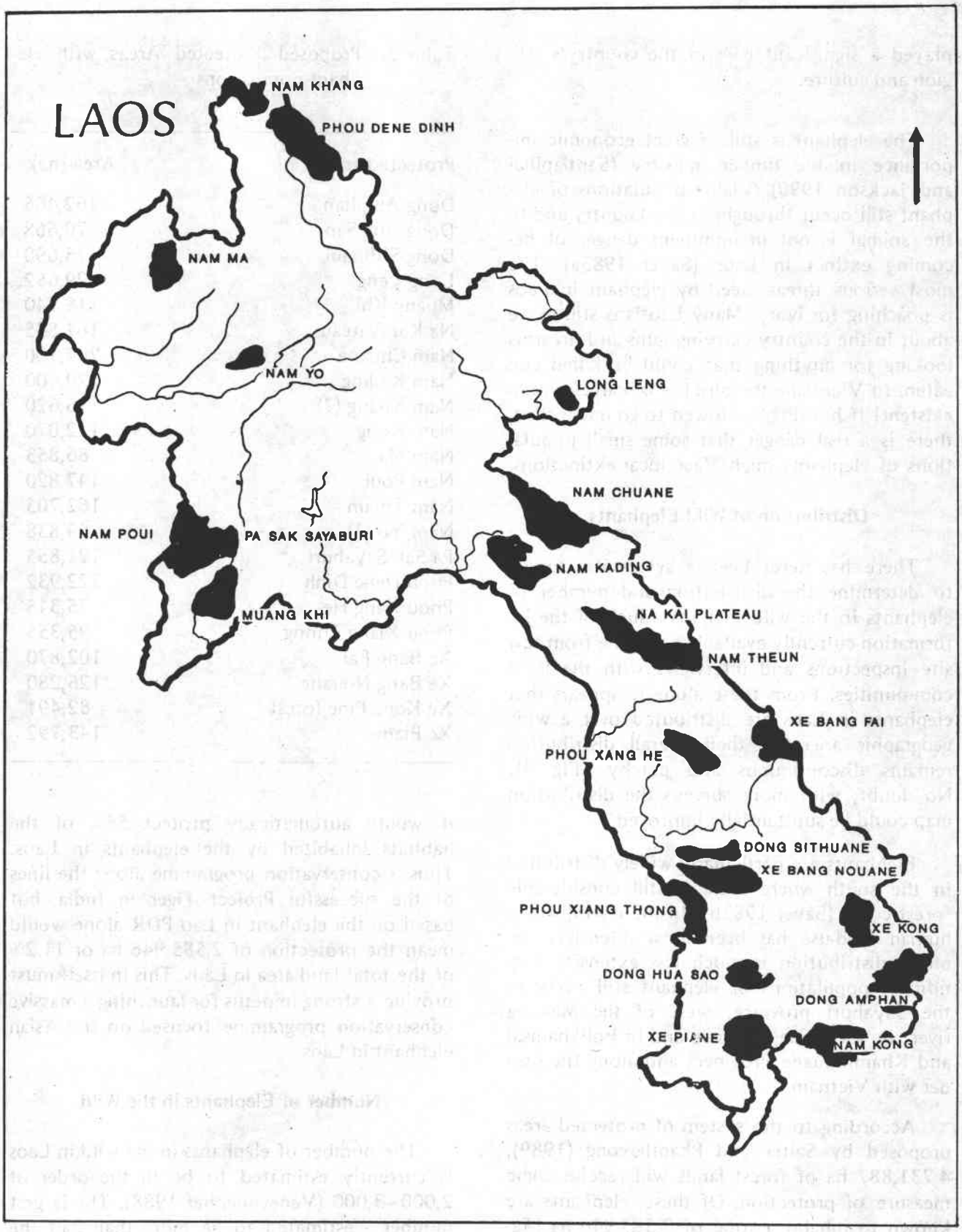



Fig. 4. Distribution of known elephant populations in Lao PDR.

Laos - perhaps 400–500 west of the Mekong river in Sayaburi Province; 200–300 in Vientiane province; and 150–300 on the Nakai Plateau (Santiapillai and Jackson 1990). Elephants although once inhabited the Phou Khao Khouay proposed protected area (200,000 ha) are now feared to have moved out owing to disturbances caused by logging in the area. These numbers are unreliable as they are not based on any serious assessments and so should be taken only as an indication.

### Conservation Problems

Although Laos is a large country with a small human population of only about 4 million, more than 60% of the population lives in the fertile Mekong plains in the Luang Phrabang, Vientiane, Bolikhamsai, Khammouane, Savannakhet and Champassack provinces. As a result the riverine grasslands which are among the most preferred elephant habitats throughout Asia have long been converted to agriculture.

Extensive areas of forest especially along the border with Vietnam were devastated by aerial bombardment by USA during the Indochina war between 1965 and 1975. It is estimated that the US Government dropped over 2 million tons of bombs on Laos, which is more than what it dropped in the World War II (White 1987). Ironically, the war may have reduced the activities of the shifting cultivators and thus allowed for the growth of secondary vegetation favoured by large herbivores (Sayer 1984).

The conversion of forst to other land-use is one of the main conservation problems facing South-east Asia in general and Laos is no exception. It is estimated that currently closed forests are being converted to grasslands, bamboo forests and savannas as a result of shifting cultivation, logging and uncontrolled forest fires in Laos at an annual rate of 100,000 to 200,000 ha (FAO/UNDP 1981).

The cause of much forest destruction in the recent past in Laos has been blamed on shifting cultivators. Shifting cultivation in its classical form is the "only self sustainable system of agriculture in the tropical rain forest" (Ross 1984). In Laos, 253,000 families are known to be engaged in shifting cultivation and about 300,000 ha of land is under this form of agriculture in any year. But in all about 1.5 million people may depend on rain-fed shifting cultivation (Salter 1989). Surprisingly, about 25% of the 1.5 million tons of rice produced annually in Laos comes from the activities of shifting cultivators!

Not all shifting cultivation is detrimental to the land. The system of shifting cultivation practiced by Lao Theung (at mid-elevations) is ecologically stable as it promotes the regeneration of trees (Collins *et al.* 1991). The Lao Loun (at lowlands) and the Lao Soung (at higher elevations) practice shifting cultivation that is basically unstable and destructive.

Two other causes of conservation problems in Laos are timber extraction and generation of hydropower, both of which are not mutually exclusive. Timber and Hydroelectric power are the nation's two top foreign exchange earners accounting for about 33% and 28% of the total earnings respectively. As such they are important for the economic propsperity of the people. But both activities if not carefully controlled, could spell ecological disaster in the years to come. Already in the Selabum power generating station, the anticipated of the halving of the life of the Nam Ngum reservoir to 60 years is a preview of what could go wrong in other proposed dams. (Poole 1991) writes, . . . "The Pa Mong multipurpose dam across the Mekong . . . . . will flood more than 6,000 $km^2$ (of land), forcing the resettlement of up to 60,000 people. The most serious and far reaching effect, however, will be the disruption of the annual flood cycle downstream, where one of the world's largest inland fisheries and some of Asia's most productive agricultural lands are dependent upon the river's yearly innundation".).

Laos has a high potential (about 22,000 MW) for hydropower but at present only 153 MW of electricity is produced of which 80% is exported to Thailand. Per capita consumption of electricity is low in Laos (about 325 KW) and 85% of it being consumed in Vientiane alone.

With the imposition of total ban on logging in Thailand on 10 January 1989 by the Thai Government, timber barons in Thailand have extended their activities into neighbouring Laos and Myanmar (Burma). Annual production of timber in Laos is estimated to be 282,000 cu. m. but illegal extraction may add another 300,000 cu. m.

Poaching is widespread and the lack of trained manpower makes law enforcement extremely difficult. Elephants are still being killed for their ivory. In the Nun Theun Nakai plateau (one of the proposed protected areas), 9 elephants were killed by poachers in June 1991. In Vientiane province eleven elephants were poached in July 1991. In the past, elephants were also smuggled out into neighbouring Thailand from Sayabouri province and sold for use in timber extraction. But this seems to have stopped after the imposition of a ban on logging in Thailand.

Human-elephant conflicts are also on the increase. In the Xam Tai district of Huaphan province, there are already reports of elephant depredations on cultivated areas. The number of elephants involved is small (perhaps about 3 animals) but their effect on the poor farmers is considerable.

Laos is not a signatory to the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES).

**Recommended Actions**

Fortunately, Laos is a late starter in economic development. This gives it an advantage to learn from and thus avoid the mistakes of other Asian countries that have suffered enormous environmental damage as a consequence of rapid economic development.

The basis of elephant conservation must be the maintenance of forest cover over large areas uninterrupted by human settlements and roads, where remoteness, difficulty of terrain and density of cover provide natural protection. This is still possible in a vast country such as Laos where the human population is small.

Restricting road building is one of the surest ways to maintain conservation areas as far away from human settlements and to contain deforestation in Laos. Particularly adverse would be the building of new roads near the proposed system of protected areas.

Elephant conservation, if it is to succeed in Laos as elsewhere in Asia, must be integrated in such a way as to confer some benefit to the people living in the vicinity of elephant reserves. It would mean resolving the conflicts between man and elephant; it would mean providing the people access to the forest and forest produce on which they had subsisted from time immemorial; it would mean recruiting local people as guards in the protected areas; it would mean provision of land tenures in the surrounding areas to landless peasants; it would mean improving the agricultural practice of the people to derive maximum benefit year round from a patch of land; it would mean the maintenance of society, tempered by tolerant Buddhist philosophy to look at nature not as something outside but as a part of being. These are difficult issues but they need to be addressed if conservation is to succeed in Laos.

International financial assistance is badly needed to implement the proposed system of protected areas in Laos. If this is not forthcoming, the international conservation community will have no strong moral ground from which it can exhort the country to protect its elephants and their habitat on meagre resources. It has been shown in Africa that the rates of decline in elephants (and rhinos) are related directly to conservation effort and spending (Leader-Williams and Albon 1990). To succeed, conservation schemes must be adequately funded, or resources must be concentrated in small parts of large reserves, if local extinctions are to be avoided. Therefore it is imperative that international conservation organizations such as World Wide Fund for Nature (WWF) and World Conservation Union (IUCN) and aid agencies focus their efforts and resources into providing much more investment in park infrastructure and its effective protection. Otherwise the excellent network of protected areas that has

been proposed by Salter and Panthavong (1989) for Laos would amount to little more than "paper parks". If the IUCN National Park requirement of 1 man for 50 km$^2$ (Parker 1984) is adhered to, then the effective policing of the 22 elephant conservation areas listed in Table 3 would call for about 500 guards. At present there is not even a tenth of this number available as guards. In Africa, the investment per guard recommended by R.H.V. Bell (in Parker 1984) is US$ 8,000 per head. Even if a sum of US$ 1,000 per head is to be taken as the basic minimum for Laos, it would mean a total investment of US$ 500,000 which must be found in the budget of the Department of Forestry and Environment. It is most unlikely that the Department of Forestry and Environment will have such a budget to provide this assistance annually. Hence the need for outside assistance.

Finally, elephant conservation as advocated here should not be seen simply as a preoccupation with a single though magnificent species. It should be regarded as a means for enhancing the country's overall conservation programme. The Asian elephant is a flagship species. As such they have an enormous appeal worldwide, and arouse strong emotions, and attract strong support from the public. They are also economically valuable and play a decisive role in structuring habitats and maintaining biological diversity. Being a large species with a wide geographic distribution in Laos, the elephant is an ideal species whose conservation alone would benefit directly millions of hectares of forest that provide the habitat to several other species of wildlife.

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(Continued on page 48)

# CAPTURE, IMMOBILIZATION AND TRANSLOCATION OF AN ELEPHANT FROM PULAU UBIN, SINGAPORE TO ENDAU-ROMPIN STATE PARK, JOHORE, MALAYSIA

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## 1. Introduction

On Friday 1st March 1991, it was reported that a wild elephant was sighted by villagers at Pulau Ubin, an island (15 $km^2$) located north-east of Singapore (Fig. 1). There were about 200 residents on the island and on the weekend there could be as many as 2,000 visitors.

The following day a team of wildlife officers and rangers from the Johore Department of Wildlife and National Parks was despatched to Pulau Ubin to carry out an investigation. On Sunday 3rd March 1991 Mr. Bernard Harrison, Executive Director of the Singapore Zoological Garden, informed us that there were sightings of a male wild elephant at Pulau Ubin, Singapore.

The animal was also reported to have attacked an old man while he was praying near à tokong (temple). Later, Mr. Harrison had officially requested assistance from the Headquarters, Department of Wildlife and National Parks (DWNP) Kuala Lumpur to enable officers and rangers from Zoo Melaka and the Elephant Management Unit to capture and relocate the solitary elephant from Singapore.

## 2. Materials and methods

### 2.1. *Personnel*

Tracking, drugging and relocation teams were from Johore DWNP, Zoo Melaka and Elephant Management Unit based in Temerloh, Pahang. Singapore Zoo, Armed Forces and Marine Police provided the support and security during the operation

### 2.2. *Monitor elephants*

Mek Bunga, Female
Che Mek, Female

### 2.3. *Drugs and Veterinary supplies*

Immobilon (1 ml = 2.45 mg Etorphine HCl and 10 mg Acepromazine)
Revivon (1 ml = 3 mg Diprenorphine HCl)
Rompun ( 1 ml = 100 mg Xylazine)
Reverzine ( 1 ml = 10 mg Yohimbine HCl)
Syringes and needles of various sizes
Disposable surgical gloves
Thermometer
Steel tape
Watch
Venoject vacuum tubes – ETDA, Heparine and plain
cotton swabs
Alcohol
KY gel
Clean towels
Ice chest

### 2.4. *Capture gear and hardware*

Palmer Cap-Chur gun
5 ml capacity barrel with collared needles
2 pcs 458 riffles
Double barrel short gun
High tensile steel chain
U-chain clips (high tensile steel)
2" diameter PVC hose (large enough to insulate the steel chain)
36 ins chain cutter
Adjustable spanners
PVC water hose
PVC water containers
Parang

2.5. *Transportation and communication*

Ten-wheeler Izuzu truck (1 DWNP & 2 hired)
Long wheel base Land Rover 110 (1 DWNP & 4 SAF)
2 units Izuzu Trooper
Suzuki 4 x 4
Outboard Marine Police patrol boat
Barge and tug (hired @ $1000/trip)
Mechanical shovel
4 units Police outriders
Hand-held telephone (Singapore Zoo)
Motorola walkie-talkie (Zoo Melaka and Marine Police)

2.6. *Documentation*

Sony video cam camera
SLR Nikon FM and FM2 cameras
Polaroid 600 camera
Agfachrome CT 100 36/135

TPR (temperature-pulse-respiration) was taken on a 15-minute interval during the duration the animal was kept sedated. A conventional mercury-glass thermometer was placed against the rectal meosa for about one minute. The pulse rate was taken by palpating the right ear vein. Respiratory rate was determined by placing the hand against the nostril and ocular observation of the chest movement.

Blood was collected into the vacuum tubes from the marginal ear vein using 21 G neddle.

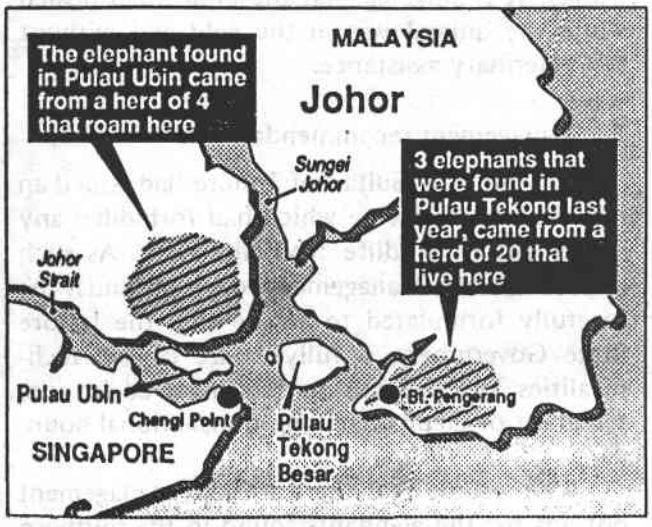



Fig. 1. Location of Pulau Ubin in Singapore.

Body measurements were taken in inches using steel tape and was later converted into metric.

**3. Immobilization, capture and relocation**

At 0842 hr, Wednesday 6th March 1991, a male free ranging elephant was immobilized using 3.5 ml of Immobilon by Dr Zainal Zahari Zainuddin near the Ubin Buddhist Meditation Centre. It was darted on the right shoulder. Six minutes later the animal was found completely sedated and recumbent on left lateral under a clump of trees near pandan and fruit trees. Policemen quickly encircled the site about 20-30 m away from the elephant and demarcated the area using plastic tape. This was done to deter the curious public from encroaching and disturbing the elephant.

A quick physical examination by Dr Zainal and Dr Shirley Llizo revealed that the animal was in excellent body condition. However, there was a long and deep scar of about 15 cm long on the right lateral of the distal end of the trunk. A wire snare could probably have caused such a scar. A circular laceration, 5 cm diameter, was located anterio-laterally on the foot pad of the right fore limb.

Morphological and physiological measurements were taken. Both fore limbs were shackled using a steel chain and secured to a tree about 38 cm diameter. The right hind limb was also leashed with steel chain which was covered with pvc hose and secured to a tree about 26 cm diameter. After about 1hr 10 mins the animal was revived using 4 ml of Revivon. At 0958.5 hr, the animal recovered, 2.5 minutes after the antidote was administered intravenously into the marginal ear vein.

After regaining full consciousness the animal made several mock charges, broke the PVC water container and was calm after about 15 minutes. Banana stems, jack fruits and banana fruits were provided for the animal to feed. It was observed that the elephant would throw banana stems when we attempted to examine its condition at a closer range. A villager was seen by Mr Vasantha Nugegoda giving water to the elephant by throwing handball-sized plastic bags containing clean water. The animal then tore the bag and used its trunk to suck the water for drinking.

An elephant loading bay measuring about 250 cm wide and 90 cm deep was prepared a few meters away from an access road along a hill ridge.

On Saturday 9th March 1991, after a brief discussion between Mohd. Shariff, Dr Zainal and Nasharuddin, the animal was darted with 80 mg of Xylazine and 30 mg of Atrophine sulphate at 0710 hr. Ten minutes later the penis was fully relaxed and at 0730 hr the elephant was fully sedated. About 35 minutes were spent to drag the wild elephant out of the estimated 60 cm deep muddy site. Before the animal was loaded on to a ten-wheeler truck at 0834 hr, its left upper ear was tattooed No. PU01.

At 1008 hr, the elephant entourage arrived at Commando Jetty on a barge (Eng Tou 175; tug, Kepah) and was escorted by police outriders to the causeway. However, the monitor elephants detoured to Singapore Zoo for a short break. Meanwhile during transportation, the wild elephant was again topped-up with 100 mg of xylazine near Kluang, Johore. At about 2000 hr the wild elephant was immobilized and unloaded near Kahang. A few minutes upon administration of Yohimbine HCl, the animal charged into its new home in Endau-Rompin state park, Johore.

## 4. Comments

4.1. This elephant capture exercise was well coordinated by the Singaporean and Malaysian parties involving some 37 personnel directly and about 15 people (policemen on a 24-hr guard; drivers and conductors of Marine Police boat, tug and barge, mechanical shovel and private trucks to transport monitor elephants) indirectly.

4.2. The presence of free ranging elephant on Pulau Ubin with an area of 15 $km^2$ and a population of about 200 is alarming and it could have endangered the lives of the residents and the weekend visitors.

4.3. Immobilization of the free ranging animal was smooth using 3.5 ml of Immobilon. Induction was 6 minutes and the animal was kept sedated for 1 hour and 10.5 minutes. Revival took only 2.5 minutes after administration of Revivon.

Under xylazine the animal was responsive to maneuvering by the monitor elephants for loading on to the 10-wheeler truck. During the long journey from Singapore to the release site (about 214 km; 4 hours 45 minutes), an additional 100 mg of xylazine was required to calm down the elephant. Another 80 mg of xylazine was administered for unloading at the release site (Sg. Emas, Kahang, Johore) and was effectively revived with 20 mg of Yohimbine HCl.

4.4. The use of PVC hose to cover the leg chain was useful to deter any damage to the limbs or skin of animal which was tied for about 72 hours. High tensile steel chain 3 mm diameter was found to be extremely strong to hold free ranging elephant of may be up to 4 metric ton weight.

4.5. A field data sheet was specially designed and used for the first time on the elephant capture work at Pulau Ubin. Unlike other capture operations, the exercise at Pulau Ubin has provided much information on the habitat, morphology, physiology and tranquilization. In this instance, data collection was made possible due to the presence of at least two experienced field officers to measure and monitor the animal as sedation progressed.

4.6. The presence of wire snares for illegal trapping of wild boar along the costal forest of Johore and Pulau Nenas had probably taken its toll on some wildlife including the large mammals. However, the Pulau Ubin elephant was rather fortunate to escape lightly (injured trunk). It is amazing that the injury had healed while the animal was in the wild and without any veterinary assistance.

## 5. Management recommendations

In 1986, the Sultan of Johore had issued an informal royal decree which had forbidden any movement of wildlife from the state. As such any long-term management decision must be carefully formulated to ensure that the Johore State Government is fully aware of the technicalities and delicate matters involved in conservation of elephants along transnational boundary.

We presume that there are four management options for the elephants found in the southern parts of Johore;

### 5.1. Relocation of all herds within 100 km radius from Singapore:

There are 6 elephant herds consisting of about 56 animals along the coastal areas from Mersing to Ulu Sedeli and the inland areas from Kota Tinggi-Kluang. Considering the capture cost to be about M$20,000/animal (M$15,000/head and M$5,000/capture in acquiring new equipment and vehicles), it would require M$1,120,000 for the relocation of elephants within 100 km radius from Singapore. This is considered costly but the operation could be financially feasible if both governments (Malaysia and Singapore), and perhaps also IUCN/SSC, agree to sponsor the relocation programme.

However, in terms of *in-situ* conservation, the operation would create immediate extinction of elephants in southern Johore and some problems may arise in determining a viable release site for such large number of animals.

### 5.2. Relocation of coastal herds in the vicinity of Singapore

There are about four herds of 24 elephants roaming from Ulu Sedeli to Penggerang region. Operational cost of capture and relocation would be about M$480,000 which could be shared between the two governments. In a short-term this might be the most realistic approach in solving the problem of wild elephants from Malaysia encroaching into international boundary and populated areas in Singapore. However, over a long period, vacuum areas left by relocated animals could be taken over by surplus animals from the inland and the situation could be self repeating.

It would be advisable to carry out detailed research on ranging patterns of the southern herds. Simultaneously, a feasibility study must be carried out on all potential release sites to determine the carrying capacity of different habitat types in Johore or other states in Peninsular Malaysia. Subsequently, after gathering all the vital information, a well-planned capture and relocation of the elephant herds could be carried out in about 24 months.

### 5.3. Transnational elephant sanctuary:

Pressure on the habitats or traditional/historical ranging routes may have motivated the elephants to swim across from Johore to Pulau Tekong and Pulau Ubin in Singapore. Enacting certain areas (within the present land use system) as a sanctuary may be a generous solution for the elephant conservation in this region. Suitable forested areas in southern Johore and Pulau Tekong could be declared as a pilot elephant sanctuary. Implementation of this project would involve all agencies affected by the elephant problem.

### 5.4. *Ad hoc* capture and relocation programme

The wait-and-see approach could be cheap in the short-term but over a long term it could be financially costly and also could run into operational and executional problems. The capture and relocation work of this nature is entirely dependent on the availability of teams of field men (trackers, capture, relocation, logistics and veterinarian) to be assembled immediately on site. For example, the Pulau Ubin exercise had taken seven days, from first sighting of animal, to assemble a full complement of the field staff. Some of the delays were inevitable as the same field men were also translocating elephants elsewhere.

## 6. Acknowledgements

We are gratefull to Encik Musa Nordin and officers of the Department of Wildlife and National Parks, Kuala Lumpur for their permission to provide immediate assistance to our Singaporean counterparts. Azmi Johor, Saharuddin Othman and Nawawi Abd Wahid of DWNP had provided much information on the recent elephant problem and distribution in Johore. The Singapore Zoo, Marine Police and Armed Forces were wonderful for their hospitality and cooperation throughout the relocation exercise. Insp. Farouk, Lpl/D Hamzah and Vijayakumar Pillai were excellent field men who provided some operational needs during odd hours. Bernard Harrison, Lyn de Alwis and Subash Chandran had initiated stimulating discussion on the future of Johore-Singapore elephant management and conservation problem. Our colleagues and field staff from the Elephant Management Unit led by Nasharuddin Othman and Johore rangers were par excellent in executing our ad *hoc capture* and relocation plan.

**From The Archives**

# ELEPHANT CATCHING IN ASSAM

[1927]

A.J.W. MILROY

Elephants are caught in Assam by two methods, *Mela Shikar* and *Kheddahs.*

The former consists of pursuing the wild herds with tame elephants carrying nooses, and this method, together with pitting (now illegal), has been practised from very ancient times.

Three or four *koonkies,* as the tame elephant are called, usually operate together at *mela shikar,* and it is considered desirable that one of the elephants should be a big male of known courage in case any of the wild elephants prove aggressive, Each *koonkie* has 3 attendants, the *phandi,* who sits on the neck and throws the *phand* (or noose), the *lohitiya,* who hangs on behind and prods the *koonkie* near the root of the tail when speed is required, and the *kumla,* who remains in camp and is responsible for feeding the *koonkie.*

The catching gear consists only of the jute *phand,* which is attached to the *koonkie's* girth.

The *koonkie* can often work their way undetected into the middle of a herd when it is feeding in open order, provided the locality has not been much hunted recently, but the wild elephants soon become exceedingly wary, and will then fly both farther and faster from the smell of a tame elephant than they will from man.

In such case there is no alternative but to pursue, and try to cut off and noose those calves, which cannot go the pace and which fall behind. The whole performance, with the screaming of the elephants and the smashing of the jungle, is very noisy and terrifying, as may be imagined, but serious accidents are uncommon, as a matter of fact, and such damage as befalls the men is usually caused by thorns and branches of trees tearing and bruising them.

Female elephants, whose calves have been noosed, will sometimes attempt a rescue, but good *koonkies* will always square up to the attacker and drive her away.

The big males of a herd seem to prefer keeping to themselves some little distance off and, when danger threatens, are among the first to seek safety in flight, provided the *koonkies* do not get in their way: an elephant in *musth* constitutes more of a problem, and the *phandis* draw off, if there is any danger of coming into conflict with a male, that is under this dangerous influence.

*Phandis* necessarily vary greatly in skill but it commonly happens, even in the case of the most expert, that the noose does not get home properly on the wild elephant's neck, and it is then necessary to call for a *phand* to be thrown from a second *koonkie.*

Quite big elephants can be caught by this method, but in the case of such the first noose scarcely serves more than to brake the headlong pace of the terrified beast, and assistance has to be summoned at once to prevent an escape.

The *phands* may be 2 inches or more in diameter, but even these ropes are not always heavy enough to take the strain, and the writer has known a big *mukhana* (tuskless male) break 7 ropes in succession before he could be finally secured.

*Mela shikar* leads to a number of the wild elephants being unavoidably strangled, and it is fortunate that this form of death is very instantaneous on account of the structure of the elephant's wind-pipe.

The *koonkie* proceeds to put on the brake as soon as the *phand* is round the wild elephant's neck, and then the tug-of-war begins, the wild animal doing all it knows to escape from the unaccustomed restraint. It is the *phandi's* concern gradually to shorten the rope until the captive is secured close alongside his own animal, and he can only do this by seizing such opportunities as occur between bouts of pulling and struggling. The noose has to be tied by a small piece of rope to prevent it slipping up and throt-

tling the elephant, and it cannot but happen occasionally that the noosed elephant gets so hopelessly wound up round trees and so on that the *phand* tightens and death ensues.

*Kheddahs* in Assam are worked on a less pretentious scale than those organized in Mysore, or formerly practised by the now defunct Kheddah Department, and no attempt is made to surround herds with a large number of men and then force them into a hastily erected stockade.

Stockades in Assam are built either across main elephant paths or else in the vicinity of salt-licks, which the elephants visit of their own accord from time to time.

The herds are bound in most districts in Assam to travel from one feeding ground to another by certain well-worn paths. Wherever the ground is favourable they can wander, may be several miles, from the main paths, but it generally happens that sooner or later steep hills or boggy ground, etc., compel them to return to their fixed paths, which follow the safest and easiest lines across country with unerring accuracy, representing, as they do, the result of the accumulated wisdom and experience of countless generations of travelling elephants.

The most favourable stockade sites are in ravines, through which the driven elephants must seek to pass, unless they have the courage to break back through the beaters.

It is necessary that a stockade should not be too obvious to the approaching animals, and so it must be built in thick tree forest, where camouflaging can be successfully practised.

Very rocky ground is avoided because of the difficulty in sinking the posts to the requisite depth, and it would obviously be impossible to build sufficiently strongly on marshy soil. Stockades vary in shape according to the locality, but are generally more or less oval or oblong, about a cricket pitch wide and a few yards more in length.

A gate at each end is necessary where elephants can be driven from either direction, and the gates have to be built across the path itself: a skilful band of hunters, who know their work thoroughly, often prefer to build their stockade across a subsidiary path, trusting to their own skilfull management to deflect the driven elephants (from whichever direction they may come), from the main on to the subsidiary path; this arrangement saves labour as it obviates the necessity of constructing more than one gate.

The best site for a gate is clearly where the path passes between two trees, because the trees can then be utilized as door-posts and, more important, because there is no artificial narrowing of the path, the elephant being accustomed to squeeze between the two trees at this spot.

Drop-gates used to be employed, but these are cumbrous to lift up, and heavy swing doors, 10 to 12 feet high, made after the pattern of an ordinary English five-barred gate, are now used.

The doors open inwards and, before a drive commences, the door, through which the herd must enter, is opened and kept in position by a long rope, leading to a machan concealed in some convenient tree outside the stockade. A slash with a knife cuts the rope and releases the gate which, apart from having been hung so as to swing to of its own accord, has its pace accelerated by means of a spring, consisting of a rope tied to the top of a bent over sapling, which tends to straighten itself as soon as the watcher in the machan has released the gate.

The old fashoned stockade consisted of stout posts, 18 or 19 feet long, sunk in the ground to a depth of 5 feet with a spacing of about 3 feet, and horizontal logs were packed in between to a height of 13 or 14 feet, but such massive structures have proved unnecessary and involve very heavy labour as the timber must be carried from some distance away in order not to disturb the forest close by.

Nowadays vertical posts, 17 or 18 feet long, are buried 5 feet in the ground, about 5 feet apart, and 3 rows of horizontal beams are tied on outside, one row near the ground level, one at breast height, and the third near the top: the whole structure is strengthened by struts from the ground to the 3 rows of horizontal beams.

The spaces between the upright posts are filled by vertical poles (3 inches in diameter are sufficient), which merely rest on the ground and are kept in position by being tied to the inside of the 3 rows of beams.

Another method is to bury rather smaller posts every foot, the interstices being filled in with poles.

A well built stockade may look extraordinarily flimsy, but there is plenty of give in it, and it is adequately protected from direct assault by a V shaped ditch, 7 feet wide and 5 feet deep.

It is not customary in Assam to tackle old and big males, which may happen to be caught because it has been found that the *koonkies* (if any can be found with sufficient courage and strength for the job) may be severely damaged in the encounter, and also because mature males often lose heart and practically refuse to live in captivity, so it is not necessary to build stockades strong enough to retain the biggest elephants.

It so happens that the masters of a herd seldom get caught, except when in *musth*, because they selfishly try to break away, when danger arises, and the beaters are only too thankful to let them through, but these *goondas*, as rogues are called, are not really very troublesome so long as they are caught with a herd; they have to be shot, not from fear that they would break out, but because they damage smaller members of the herd, and are, as has been explained, of doubtful commercial value.

Solitary rogues often wander into stockades at night, and occasionally the watcher in the gate-machan makes a mistake in the dark and underestimating the size and age of the elephant closes the door: then the fun begins. Determination on the part of the men may suffice to keep a *mukhana* in, but a tusker seeing red, is an awesome beast, and can generally walk right through a stockade at any spot he likes, despite the ditch, or, and more commonly, he just puts his tusks under the door and heaves it over his back.

V-shaped funnels or wings extend out from the gate posts so that all elephants, which are taking a course parallel to the path, may be directed to the entrance.

The final act of preparation (excluding religious observances) consists of camouflaging the stockade. Living tree-ferns and orchids are fastened onto the doors and door-posts, and branches of trees are stuck in the ground to conceal the funnel.

Care is taken during the work of construction to preserve intact the jungle growing in the middle of the enclosure, and branches and creepers are hung over the sides of the stockade to mask an otherwise too distinctive outline.

The ditch is effectively hidden by fresh branches placed across higgledy-piggledy.

A super-camouflager will sometimes take the trouble to fashion little tracks through the jungle in the middle, the idea being that the elephants, which enter first, will waste time following these tracks, and so enable the men to hustle in the laggards.

One of the outstanding advantages of the present day stockade is that the elephants can see through it. Very few herd animals are game enough to try and rush the ditch and palisade in the face of a man, armed with torch and spear, while at night, when the elephants are more restive, the encircling fires are visible and command respect.

The weak point is the gate, a moveable structure without any part buried in the ground and with no protecting ditch, and the obvious place of attack, because it bars the exit along the well known path. However, the dear old elephant is not very worldly wise, and it is found that the gate can be made to appear to the elephants to be the strongest part of the whole contraption by merely fitting it with sticks and branches, so that the beasts cannot see through it.

Driving is best done late in the afternoon and evening, when the elephants are on the move themselves, and the beaters like to time their drives so that the elephants are entrapped just before dark, when deficiencies in the concealment of the stockade may not be noticed.

Elephants like to rest in thick cover during the heat of the day, and are inclined to be pig-headed and to circle round if driven while the sun is still high; after dark they become much more aggressive and may effectively resist pursuit.

A drive may be a lengthy business extending over several days and nights but in that case the earlier stage, while the herd is still far from the stockade, consists merely in the men keeping a long way behind the elephants, so that they will move quietly in the desired direction without stampeding, any attempts to take divergent paths being frustrated by men sent forward to block the way.

The real excitement begins about 3 o'clock on the last afternoon, when pressure is first put upon the elephants.

The beaters as a rule number from 7 to 12, save in exceptional circumstances. Crowds of men and excessive noise are regarded as the signs of unskilful work.

The beaters are divided into two parties, which follow on either flank of the herd, the men keeping in single file, a formation which permits them to get through the undergrowth without straggling, and to form line if the elephants stand up to them.

The principal difficulties are caused by *goondas* trying to break out of the drive and by mothers of weary calves.

No impediment is offered to the flight of a *goonda* unless some of the smaller fry are following him, when it becomes necessary either to force back the *goonda* or to nip in behind him and head back the others, a very delicate task.

Mothers will charge back time and time again in order to let their calves get on, and they frequently spoil drives by holding back the beaters so much that the leading elephants, with no one behind to hustle them, can discover the approaches to the stockade; they will then leave the path and, if the ground permits, make a big circuit at their leisure round the stockade, all the succeeding elephants following in the footsteps of the leaders, as they know they would never have branched off like this without some very good reason.

Herds will sometimes absolutely refuse to be driven any further, and one is tempted to believe that in these cases the herd must have passed through the unfinished enclosure at night during the time when it was in course of erection, or been made wise in some other way.

Guns are only fired in the last resort and when elephants are deliberately heading in the wrong direction; the sound of a gun is so terrifying that the herd may panic and scatter pell-mell through the forest, completely beyond further control. Not even guns, however, will stop a herd that has made up its mind to break back, and the beaters are only saved from extermination by their uncanny power of distinguishing between bluff and the real thing on the elephants' part, and their amazing ability to make themselves scarce at a moment's notice as the elephants thunder through them.

Persistence on the men's part may eventually cause the elephants' determination to evaporate, if they keep on getting round in front of the herd, and the elephants will then allow themselves to be driven all the way back.

The diverging paths near the stockade are blocked by men in machans, these stops descending and joining in the passing hunt, when their work is done, and there are also stops at the ends of the wings in case the elephants come along very wide of the real path.

Once the herd has entered the funnel, a gun is fired and every one behind the elephants proceeds to make all the noise he can. The sudden irruption of sound stampedes the animals but escape should not be possible if the men running along outside the wings resist any attempt at a break through. It is not always possible to impound all the members of a herd which straggles into the stockade in extended order, because the elephants, which first enter, sooner or later realize the position and try to retreat. It is amazing, however, that they should take as long as they do to appreciate the situation: the elephants bustle in at the door and hurry across to the far side of the stockade, but the sight of the ditch with the palisade beyond seems to bemuse them, and it is only after some moments' contemplation that they slowly turn and begin to wander back.

The door must be shut, whatever elephants there may still be outside, before the animals inside make a rush for the exit. The writer has seen elephants which had been excluded because the gate could no longer be kept open, barge the gate open, before it had been tied, and join their companions within, but as a rule the excluded elephants make a mad rush for one of the wings and burst their way through.

There is a certain amount of danger to the beaters from these escaping elephants, but it is quite certain that no elephant would in such circumstances waste time in hunting a man if it could possibly get away past him.

Methods of greater finesse must be employed to catch elephants in stockades built near salt-licks.

The herds visit the salt-licks during the night-time only and at irregular intervals, so it is necessary for the men always to be on watch from the late afternoon until dawn.

Two men are stationed in the gate-machan, and the rest are distributed in high machans in the forest on the far side of the lick in such a manner that the elephants can pass by their accustomed paths without getting any scent of man.

As soon as the elephants have reached the lick and are busy taking their medicine, the beaters descend from the machans and hasten to their appointed stations by specially cut paths which are kept scrupulously clean and free from leaves.

When sufficient time has elapsed for all to reach their stations, torches are suddenly lit and the elephants driven towards the stockade: it sometimes happens that they simply rush straight into it, but more often they are less obliging, and skill and bravery are required to prevent them from escaping along any of the numerous game trails, which radiate from the lick. It is a matter of the greatest difficulty for anyone not accustomed to night work to appreciate what is happening, but a correct diagnosis of all the different crashes in the jungle must be made by the men, as it may be necessary to let small batches go rather than run the risk of frightening back the main portion of the herd.

The noise alone is sufficient to terrify the ordinary mortal and the close proximity of the big beasts is very alarming, but accidents seldom occur so long as the men use their torches boldly.

The salt-licks are very frequently visited by solitary rogues, and it is found that these are often the advance guard of a herd. There is always the chance of a herd coming early in the morning, if a *goonda* has been at the lick the previous evening, or of the herd coming the next evening after an early morning visit by a *goonda.*

It may be presumed from this that elephants pursue an ordered routine when undisturbed and that a herd will follow regular round of drinking at the accustomed places, feeding at the accustomed places and lying up in the usual retreats once it has started on one of its regular routes.

The *goondas* are, of course, not molested while at a lick, but a whiff of human smell will occasionally set a *goonda* off squealing in anger and charging aimlessly about.

The men's machans have to be built in big trees as a suspicious elephant will prospect the locality carefully, and may be bold enough to try and tear down the machans.

The writer remembers how on one splendid moonlight night a large tusker crept up noiselessly beneath his machan and stood there puzzling as to the source of this poisoning of the night air; at last his trunk reached the ladder and told him that a man had gone up it not so very long before. The ladder was soon made into mincemeat, but the tree stood firm and the huge beast rolled off in a very grumpy frame of mind. The next obstacle, which he encountered, was the outside of the stockade, which provided him with a little healthy exercise, and finally he played spillikins with one of the wings before wandering off in high dudgeon. The amazing part of the story is that the two-gate men slept through the whole performance, and were greatly astonished when dawn arrived and they saw the destruction all aroud them.

At one lick, which we stockaded, there dwelt a very old and evil-tempered *mukhana,* which soon came to learn all about the sites of the various machans, so provokingly out of his reach: one night, abandoning his accustomed path, he entered the stockade unwittingly and, being short-sighted, tumbled, into the ditch on the far side. This throughly frightened him and he essayed to retreat at his best speed, but again his sight failed him and he tumbled into the ditch by the door.

This episode was too much for his nerves and we never saw him afterwards.

Elephants will certainly do quite unaccountable things at times; a *goonda* that walked into a stockade one night, bit the cane, which was holding the gate open, and consequently imprisoned himself inside the stockade, and he had to do a lot of damage before he could punch a hole big enough to allow himself to escape through the palisade.

Elephants very seldom break out of a stockade, and when they do it is generally due to the presence of a big tusker, which unmindful

of the spears and firebrands succeeds in bursting his way through and escaping with all his herd.

It is quite clear that the elephants would have no difficulty in getting out, if only they had the sense to rush pell-mell at the stockade and use their weight against it, but that is not their way. They are exceedingly timid animals, and spend most of their time in the stockade huddled up in the centre, scrimmaging round and round, each trying to secure an inside berth. The scrimmages are painful to watch because one fears for the small beasts, but these remain safely beneath their mothers and seldom come to harm.

As an illustration of how timid elephants are may be quoted the story of a herd, which was nearly reduced to panic by the entry of two very small fowls into the stockade The religious ceremonies, which are performed on the completion of a stockade, include the releasing of two fowls, which from motives of economy are usually quite small chickens. These chickens exist in the neighbourhood of the stockade until some wild cat comes along and carries them off. On one occasion the diminutive pair sauntered into the stockade through some gap, looking for food amongst the debris on the ground, and threw the small elephants of the herd into the wildest confusion till angry charges from the bigger animals expelled them from the enclosure.

Single elephants will continually charge out from the scrum in the middle, but their charges end in precisely the same way as do the rushes which a dog will make at a cat; the brakes are put on before the ditch is reached, and after a few kicks into space with the fore-feet the elephant retires.

Elephants are more restless at night, but a shout from a man and a wave of a torch are generally sufficient to maintain discipline.

Different countries have different methods for getting the wild elephants out, in Chittagong, for example, the *koonkies* enter the stockade backwards, the *plandis* being armed with long spears to keep off any inquisitive wild elephant that comes too close with evil intent. Men descend from the *kookies* and operating beneath them dexterously manage to bind the legs of the wild elephants, which can then be taken out very easily.

More direct and spectacular methods are employed in Assam, the *koonkies* entering head first and dragging out the reluctant wild elephants without any premilinary hobbling.

The *koonkies* are arranged in single file with the biggest animal, preferably a tusker, in front. The wild elephants smell the *koonkies* from afar, and the first intimation of the *koonkies'* approach is conveyed do those watching the stockade by the up-lifted trunks and visible uneasiness of the herd. The elephants generally retreat towards the far side of the stockade and their attention is distracted there by fodder being thrown to them.

The bands tying the gate are loosed and, while men pull on ropes, the leading *koonkie* butts the gate open and stalks in with the remaining *koonkies* crowding after it.

It is advisable that the gate should be opened with reasonable speed. The writer has seen a big female charge at a gate, which stuck after being opened a little way, and she banged it shut with such force in the face of the *koonkie* on the other side that his morale was seriously affected.

It is still more advisable that the gate should shut quickly after the last *koonkie* has entered. On one occasion the leading *koonkie* swung the gate open so violently as to unhinge it and prevent it from being closed. In the subsequent confusion the men lost their heads and the *koonkies* were seized with panic, although there were only a few small females to deal with, and the whole mob, wild and tame, barged out through the open door amidst the groans and tears of the stockade men.

The wild elephants never combine to overwhelm the *koonkies;* one or two of the bigger beasts may look a little aggressive, but the *koonkies* go straight up to them and start hustling the herd round and round with the same confidence as a few disciplined men will show when dealing with an unruly but leaderless mob. No great violence is necessary and there is no excuse for damaging the wild elephants.

It used to be the custom in Assam to delay putting the *koonkies* in until the wild elephants had been weakened by thirst and hunger, but such cruelty is entirely unnecessary and has been discouraged by Government fixing a limit

of time, within which the stockade must be cleared, or else the catch set free.

After five minutes or so the animals are allowed to settle down, and the men untie their nooses and get to work. The noosing is often a tiresome job, especially in the case of small elephants, which will insist upon running under their mothers; this makes it difficult to shorten the rope and tie the noose properly to prevent it getting any tighter and unless this is done there is always the danger of strangling.

It is necessary for the *koonkies* to kneel down when the noose on a very small elephant is being tied, as otherwise the man cannot reach it.

An elephant may require one, two or even three *koonkies* to manage it; in the latter case the third noose is generally tied to a hind leg and is very effective in checking too headlong a progress.

The noosed animals resent being detached from their companions and have to be hauled to the door and there is a danger, when the *koonkies* have not sufficed to noose the whole catch, of the un-noosed elephants following the procession out, so that the biggest *koonkie* is detailed to act as rear-guard, and he turns round and looks very fierce if the rest of the herd show signs of following.

Once outside the door (and the getting outside may be a regular case of pull devil, pull baker), the pace quickens up, and the *koonkies* have to use all their strength to prevent their captives from pulling them off the track into the forest. The passage from the stockade to the camp is usually rather a rough one for all concerned.

The new elephants are tied up for the first night by the hind legs to one tree and by a long rope from the neck to another tree, and as high up one it as possible, to prevent the elephants from catching the rope and bitting through it. It is necessary to have a *koonkie* on each side, when the hind legs are being fastened, in order to obscure the elephant's view and prevent its frantic kicks from being properly aimed.

An elephant tied in this way can throw itself on the ground and exert all its weight in trying to break the ropes on the hind legs, and it is highly desirable that it should thus tire itself out as much as possible, because in the succeeding marches to the training camp the *koonkies* have to carry the men's kit, as well as lead the captives, and if the *koonkies* are few, one *koonkie* may have to take two wild elephants.

A barbaric device to keep big elephants quiet on the march was to cut the back of the neck with a knife so that the noose could be fastened into the wound and discourage struggling by the pain. Government is now taking every precaution to discourage this sort of treatment. It is not difficult to detect a neck that has been deliberately cut, but the *phandis* can obtain much the same result by springkling damp sand under the noose, which quickly eats through the skin in a more natural looking manner. The Black List now awaits the men, who cannot bring their elephants in without a clean neck.

Tying the hind legs takes considerable time, so after the first night it is customary to fasten the elephants short by the neck to a tree in such a way that they can run round and round the tree, from which the bark has been removed in order to facilitate the rope slipping round without fraying.

The training is the next episode in the elephant's career on its road to a life of domesticity and usefulness.

Keeping an elephant tied up tight by the head, and spearing it for every misdemeanour has hitherto been considered the correct way to train an elephant, but the writer has been conducting experiments, first on a small and then on a very extensive scale, for the last five years, and has been able to prove that a more rational method of treatment yields better results in every way.

In the first place the training casualties, which have been known to be as high as 48 per cent, have been reduced to less than 1 per cent., and in the second place it has been found that elephants, which are decently treated, settle down to their work in an incredibly short space of time, and are more easily and effectively trained than those which have been maltreated and have had their spirits broken.

The elephants, of course, seek every opportunity during the first few days of their captivity to attack any human being who goes near them, but their lack of success, coupled with the heartiness with which the relatiatory stick is

laid on, soon convinces them of the futility of their attempts, and their desire for a quite and inoffensive life asserts itself so strongly that they abandon further resistance.

The stick they have to get sometimes, and it is adequate punishment for these kindly beasts, though it cannot possibly hurt their thick skins.

The use of the spear is to be deprecated, not only because the wounds inflicted may set up septicaemia, but also because the fear of the pain distracts the elephant and prevents it concentrating its mind on its task and so delays the completion of its education.

An elephant has to be tied up fore and aft by its legs in the training depot, except when taken out for training; it is unnecessary to tie it up tight by the head (save during the evening performance), and it is dangerous to do so, as it may develop a bad neck wound, leading eventually to its death. Rope-harness is attached to the elephant for the benefit of the man, who has to mount it.

The "evening performance" is a great show.

Eight or ten men approach the elephant after dark, and after its neck has been tied closely to a post, a man seizes its tail and the mahout springs on to its back.

One man in front waves a torch in its face, and the others surround it, keeping well away from reach of the trunk, and proceed to scrub it with wisps of grass, and all to the accompaniment of appropriate songs.

The frightened animal bellows, shakes, throws itself on to the ground, lunges at everyone with its trunk and tries to catch the irritating torch, but all in vain, it is well lambasted with sticks and the torch proves itself to be a beastly hot thing to catch hold of.

This treatment is continued for a week or so until the elephant makes no resistance, and the men can rub its face without being attacked.

The actual training takes place morning and evening.

The elephant is taken out between two *koonkies*, to which it is attached by very short nooses.

The mahout is already on one of the *koonkies* and leaps on to the new elephant when all is ready. The animal may shake a little, in which case the mahout must hold on very tight, while the mahouts on the *koonkies* hit the elephant over the head, and the men on the ground in front and behind beat it with sticks. Shaking is a most dangerous vice and has to be stopped at all costs, and it is lucky that very few elephants take to it.

It must be remembered that an elephant has generally lost a good deal of its pep by this time. It has been through a rough and tumble in the stockade, may have had several day's march with inadequate food, has been tied on the stretch by all four legs (to prevent it getting a real good rest) and has experienced the terrifying performance at night, so, take it all round, the poor beast cannot be in its best shaking form.

The man on the ground in front is a source of much irritation to the new elephant, but it cannot get at him and he can safely prod its trunk with his stick or bamboo, while the mahout hammers it, whenever it tries to rush forward.

The man behind, who sings the whole time in a horribly strident tone, is safe from being kicked because the action of the hind legs is limited by ropes, but he punishes all attempts at kicking, and the elephant has to learn to tolerate him.

When the mahout feels securely fixed, the order to proceed is shouted out, the *koonkies* go forward and the elephant gets a prod behind each ear from a sharpened bamboo.

The order to stop is shouted, the *koonkies* stop, and the mahout leans forward and catches his beast a good clout between the eyes.

The order to go back is followed by the mahout digging the point into the elephant's forehead and pulling, while the two *koonkies* pull the captive back a few steps.

A full-grown female requires two *koonkies* for 4 or 5 days, after that one *koonkie* drops behind and, if the elephant behaves, goes about its business. The remaining *koonkie* will be needed for another 4 days, but after that a man on the ground with a leading rope will suffice until the animal can be taken out by its rider in the company of other old and new elephants.

Progress has meanwhile been made in the depot; the elephant will allow itself to be tied up without attempting to kick, and it will feed nicely from the hand.

(Continued on page 46)

**Short Communications**

# ASIAN ELEPHANT THREATENED

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SIR – Pagel and Mace[1] present a strong argument in favour of the current ban on trade in elephant products. The halving of the African elephant population in the past eight years is justly a cause for concern. But we wish to draw attention to a generally overlooked aspect of elephant conservation – that there are two species of elephants, and that the CITES ban has minimal benefits in the conservation of the Asian species, *Elephas maximus* L.

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An elephant should be ready for removal to the purchaser's home from within 14 to 21 days after the commencement of training, according to its size, though they are still far from being trained.

A full grown female should begin bringing in a few stalks of fodder after a fortnight and after 4 or 5 weeks should be fit for loading with almost a full feed.

Elephants are easiest taught to kneel down by being stretched out fore and aft, and then prodded behind the withers with a sharp bamboo, while the word of command is shouted, and men haul on the front leg ropes till the elephant has to sink down to the ground.

Runaway elephants may forget everything else, but never seem to forget how to kneel down.

All the other accomplishments are gradually taught, and the elephant should be safe to shoot from at the end of 5 or 6 months, though still by no means absolutely trustworthy.

The Asian elephant is much rarer than its African cousin. Current estimates are imprecise, but put the number of wild Asian elephants at 34,000–56,000 with a further 16,000 in captivity[2]. Even optimistic figures indicate that there are only one tenth as many Asian as African elephants[2,3]. Asian elephant numbers may not have undergone a dramatic decline in recent years, but the species faces much more intractable conservation problems.

Elephant poaching may be a relatively minor problem in Asia today and, because some males and all females lack tusks[5], poaching cannot be the terminal threat it is in Africa. Much more important for the Asian elephant are habitat loss and fragmentation as a result of escalating human population, which in turn leads to increasing conflict between man and elephant. In India, for example, which may contain half of all wild Asian elephants, the human population increased from 236 to 790 million in the period 1901–88[4]. This increase places intense pressure on undeveloped areas. Only one-third of Asian elephant habitat is in protected areas[4].

Erosion of habitat forces elephants into agricultural areas, where they destroy crops and inevitably cause human fatalities: 150–200 a year in India[4]. Most remaining populations are already small. Fragmentation of habitat leads to fragmentation of elephant populations. In Thailand, 29 protected areas hold 1,300–1,700 elephants, but only 13 of these areas hold more than 25 individuals[4]. Many Asian elephant populations in the longer term may not be viable[2,6]. It does not help that

many of the larger elephant populations are located in politically unstable areas – for example the 8,500–11,000 elephants in northeast India[2]. The destruction wrought in Manas National Park, Assam, by Bodo secessionists shows how vulnerable even protected areas are to political unrest. In the Vietnam war, US forces bombed elephants because the Viet-Cong were using them as transport[4].

None of the problems are faced by the Asian elephant can be alleviated overnight as poaching has been in Africa. Neither has much effort been expended by the international community in finding ways in which human and elephant populations can successfully co-exist (althought the individual countries involved are trying to tackle these problems). This state of affairs must be rectified, because the continued success of the CITES ban, coupled with human population growth, will result in the Asian situation being repeated in Africa in the near future. It will be in the long-term interests of both elephant species to find solutions to the Asian elephant's problems now. (Source: *Nature* 352, 1991).


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# THE DILEMMA OF SUBSPECIES


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Oliver Ryder's article[1] on the subspecies problem, which reports on issues considered at a July 1985 conference at Philadelphia on the establishment of species survival programs by the American Association of Zoological Parks and Aquariums, is most welcome and timely.

Owing to the extremisms of 'lumpers' and 'splitters' among systematists and taxonomists, and the general neglect of systematics in the wake of modern disciplines such as molecular biology, the subspecies concept has come in for a considerable bashing. Darwin's vague definitions[2] of 'species' and 'variety' may also have contributed to this, even though there are some sound modern definitions[3,4].

It is therefore heartening that he Philadelphia conference has recognized the importance of a concept of 'evolutionarily significant units or populations', that is, of subspecies within species, despite the difficulties involved in recognizing them. As Ryder remarks, these difficulties could be overcome by adopting the criterion of 'concordance between sets of data derived by different techniques'. One such modern technique is the estimation of genetic distance 'when geographical distribution data indicate the existence of discrete populations within the range of a species'.

An example from recent genetic distance studies on Sri Lankan species illustrates this well. A Japan–Sri Lanka programme has been concerned with native livestock and their wild forms, including jungle fowl, musk shrews, macaque monkeys and elephants[5]. Work on the two Asian elephant subspecies in Sri Lanka and India has given particularly promising results[6].

Genotype and gene frequencies and heterozygosity at variable protein loci, determined by electrophoretic analyses of blood samples from 29 tamed *Elephas maximus maximus* (the *forma typica*) in Sri Lanka, and from 20 tamed *E. m. indicus* in India, indicate that the genetic variability within each of the subspecies is low, as in the case of other non-domesticated large

mammalian species. Between the two subspecies there is not only a genetic distance of the same order as that between two subspecies of Japanese macaque monkeys, but also a complete allelic substitution at the tetrazolium oxidase (To) locus. This gives added support, from modern techniques, to the subspecies status of each of these two elephant populations. It also points to the possibility of confirming or refuting, by such techniques, the validity of the subspecies *E. m. vilaliya* Deraniyagala), the supposedly massive, rare and tuskless 'swamp elephant' which was 'restricted to swamps in the flood plains of a few rivers of the Eastern Province of Ceylon'[7,8].

I would like to emphasize that the potential significance for evolution of a trinomial, or subspecies, however inadequately described and named, should always be recognized. The subspecies, of variety, can after all be an expression of an incipient species, which is what Darwinian evolution is basically about.

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An adult female elephant and its calf browsing in the thorn scrub. Ruhuna National Park, Sri Lanka. (Photo: Charles Santiapillai/WWF).

# On *Elephas maximus* Palaeo-Geographical Distribution in China

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**Abstract**

From the data given in this paper of the geological and geographical distribution of *Elephas maximus* (110 localities), the writer concludes that they reached once Yangyuan County, Hebei Province, and confirms they declined from north to south in China. And at present, they exist only at few sites of south-west in Yunnan Province.
In addition, the writer discussed the problem of comprehensive causes for the decline of wild *Elephas maximus* in China. Three main points in the discussion are as follows: (1) Climatic change; (2) Mankind disturb; (3) Decline of this species itself.

# Comparative Study of Asiatic Elephant *Elephas maximus* Populations in Gal Oya, Sri Lanka

**N. Ishwaran**
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**Abstract**

Two populations of Asiatic elephants *Elephas maximus* of two different home-ranges of Sri Lanka's Gal Oya area were compared. The group-size-frequency distributions of matriarchal groups belonging to the two populations were significantly different. The population in study site B, in contrast to that in study site A, showed frequent random aggregations, and a higher mean group size. These differences are attributed to excessive range contraction in study site B. The population in the latter area also showed greater dependence on dry grass than that in study site A. Size-class structures, population numbers and adult sex ratios are discussed for the two populations. Seasonality in the birth of elephant calves was evident during the year 1975, in the population using study site A. The need to carry out similar studies over long periods of time is stressed.

Biological Conservation (1981) 21:303-313

# Elephant and Woody-Plant Relationships in Gal Oya, Sri Lanka

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**Abstract**

Two sites, having two different elephant populations with non- over-lapping home-ranges, were selected for studies on elephant and woody-plant relationships. Four woody-plant habitats, two within each site, were investigated. Woody-plant utilisation was analysed in relation to type of damage, woody-plant size-clases and species. Preferred woody-plant size-classes and species were identified. These results were used to compare trends in elephant woody-plant relationships in the two populations. The percentage of damaged woody plants, and the preference ratios for size-classes did not differ significantly between the two sites. However, the availability of woody plants in preferred size-classes, as well as in preferred species, was significantly greater in study site 1 than in site 2. The importance of these findings for the conservation and management of elephants in Sri Lanka, is briefly discussed.

Biological Conservation 26 (1983) 255-270

# The use of elephant droppings in assessing numbers, occupance and age structure: a refinement of the method

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**Summary**

Estimation of elephant numbers by means of dropping counts in the Kasungu National Park, Malawi appeared to be heavily biased in the direction of over-estimation according to a series of aerial surveys. Over-estimation errors in the counting technique were due to the boli of one dropping being spread over a considerable distance and to double counting of one defaecation by scouts counting next to each other. Under-representation of droppings from the youngest calves caused a 4.8% underestimation in dropping densities while the total correction factor was estimated to be 0.67. A complete decomposition cycle runs from the height of the wet season to the height of the following wet season and consists of three distinct phases each with a characteristic relationship between droppings accumulation and decomposition. The time of year that a survey of this kind can best be carried out and the steps that should be undertaken are briefly discussed. The dry-season defaecation rate for the Kasungu elephants was estimated to be 15.7 droppings per elephant per day with non significant difference between the sexes. The number of elephants present in 1978 was estimated from the dropping counts as being approximately 1189. An alternative method is described for determining the age structure of an elephant population by means of circumference measurements of the individual boli from a sample of droppings. Basic information on the relation between bolus circumference and bolus weight and age was obtained from various zoos. Results were compared with those from a photogrammetric method and, with the exception of calves younger than 1 year, both age structures appeared to be very similar. Slight differences are discussed and a method is given of estimating the true number of males and females in each age class above the age where growth is similar in both sexes.

Afr. J. Ecol. 1984, Volume 22, pages 127-141

# Semen of the Ceylon Elephant, *Elephas maximus*

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**Summary**

The procedure employed for the collection of semen from a captive male elephant is described. Sperm-rich and sperm-free ejaculates were obtained. Seven sperm-rich ejaculates were evaluated.
Seminal characteristics investigated in the elephant compared favourably with those of other domestic animals of normal fertility. The mean concentration of spermatozoa was 1200 x $10^6$/ml in the sperm-rich ejaculates. Individual spermatozoa measured 58.5 µ (average) in length.

J. Reprod. Fert. (1971) 24, 213-217

# Oestrous Cycle of the Asiatic Elephant, *Elephas maximus*, in Captivity

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**Summary**

During the course of a programme to breed the Asiatic elephant, *Elephas maximus*, in captivity, the oestrous cycles of eleven adult females were studied. Two methods were used for detecting oestrus: (1) daily testing with a male elephant, and (2) urogenital smear cytology.
Overt signs of oestrus were not observed but 'standing' oestrus was detected in ten animals. The duration of oestrus ranged from 2 to 8 days with a mode of 4 days. Oestrous cycles in six animals ranged from 18 to 27 days with a mean of 22 days. Urogenital smear cytology failed to indicate accurately the onset of behavioural oestrus but increases in the number of cornified cells may occur before, during and slightly after behavioural oestrus. Considerable mating activity occurred during oestrus. A description of mating behaviour is presented.
The findings are discussed in relation to breeding elephants in captivity and to the phenomenon of temporal gland activity.

J. Reprod. Fert. (1971) 27, 321-328

# Dental identification and age determination in *Elephas maximus*

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The dentition of an elephant (fossil or extant) can yield clues to the animal's age and species identity, provided the teeth are correctly identified. Identifying the serial category of elephant teeth is difficult because the size, shape and position of each tooth changes throughout life, as the teeth form, erupt, wear and move through the jaw. In the present study, teeth from over 100 museum specimens of the Asian elephant *(Elephas maximus)* were the basis for establishing size ranges for cheek teeth in six serial categories (designated by Roman numerals I to VI). Although the teeth vary greatly and overlap in their dimensions, reliable identifications (as well as estimates of an individual's age in years) can be obtained using three or more measurements. An appreciation for dental variability in *Elephas maximus* will demand a re-evaluation of frequentlycited examples of macroevolutionary patterns within the Elephantidae.

J. Zool., Lond. (1988) 214, 567-588

# Drug Immobilisation of Indian Elephant

**J. B. Sale, V. Rishi, K. N. Singh and V. K. Verma**

Critical data from the drug immobilisation of six adult wild elephants in U.P. in 1983-84, using Immobilon (etorphine/acepromazine) and Revivon (diprenorphine) are reported. A standard Distinject N60 powder rifle and accessories was used for darting, with the addition of a "radio-dart" in three cases. Complete recumbancy was achieved using doses of 3.0 to 3.5 ml Immobilon (7.4-8.6 mg etorphine, 30-35 mg acepromazine). Induction times varied between 15 and 35 minutes; "down" times between 30 and 324 minutes and revival times between 4 and 41 minutes.

Journal of Bombay Nat. Hist. Soc. 83:49-56

# The elephant populations of India - Strategies for conservation

**R. Sukumar**
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**Abstract**

Between 17 and 22 thousand elephants are found in 4 distinct regions - the northwest (525), northeast (8725-12130), central (2300) and south India (5750-7150). Elephants largely prefer the deciduous forests where both browse and grass are available. Annual home range size usually varies between 100 and 500 $km^2$. The major threats to the elephant include loss of habitat due to spread of agriculture, degradation of habitat through human impact, developmental projects such as hydroelectric dams and poaching of males for ivory. Suggestions for conservation of the elephant have been made. These include the maintenance of minimum viable populations, habitat integrity, habitat mosaic and reduction in poaching. Measures to reduce crop depredation by elephants such as the use of high-voltage electric fences are recommended.

Proc. Indian Acad. Sci. (Anim. Sci./Plant Sci.) Suppl., November 1986, pp 59-71

# Carbon isotopic evidence for different feeding patterns in an Asian elephant population

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**Abstract**

Stable carbon isotope ratios ($^{13}C/^{12}C$) in bone collagen of Asian elephants showed a variation in $\delta^{13}C$ value from - 11.1 to - 20.8 per mil. This indicates that individuals within a population vary widely in their dietary intake of $C_4$ plants (grasses) and $C_3$ plants (browse), from a predominance of either of these types through intermediate proportions. The difference in feeding pattern may be related to age, with younger elephants preferentially grazing and adults mainly browsing.

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# Growth in the Asian elephant

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**Abstract**

Records of captive Asian elephants *(Elephas maximus)* were used to derive parameters of the von Bertalanfly function for growth in height, body weight and circumference of tusks with age. There was some evidence for a post-pubertal secondary growth spurt in both male and female elephants. Domestic elephants which were born in captivity of captured at a young age also showed a reduced growth in height in both the sexes and in body weight in males compared to wild elephants. Aspects of allometric growth such as height-body weight relationship are examined. The height was twice the circumference of front foot throughout the life span, indicating an isometric relationship.

Proc. Indian Acad. Sci. (Anim. Sci.), Vol. 97, No. 6, November 1988, pp. 561 - 571.

# Ecology of the Asian elephant in southern India. I. Movement and habitat utilization patterns

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**Abstract**

The movement and habitat utilization patterns were studied in an Asian elephant population during 1981-83 within a 1130 $km^2$ area in southern India (11° 30' N to 12° 0' N and 76° 50' E to 77° 15' E). The study area encompasses a diversity of vegetation types from dry thorn forest (250-400 m) through deciduous forest (400- 1400 m) to stunted evergreen *shola* forest and grassland (1400-1800 m).

Home range sizes of some identified elephants were between 105 and 320 $km^2$. Based on the dry season distribution, five different elephant clans, each consisting of between 50 and 200 individuals and having overlapping home ranges, could be defined within the study area. Seasonal habitat preferences were related to the availability of water and the palatability of food plants. During the dry months (January-April) elephants congregated at high densities of up to five individuals $km^{-2}$ in river valleys where browse plants had a much higher protein content than the coarse tall grasses on hill slopes. With the onset of rains of the first wet season (May-August) they dispersed over a wider area at lower densities, largely into the tall grass forests, to feed on the fresh grasses, which then had a high protein value. During the second wet season (September-December), when the tall grasses became fibrous, they moved into lower elevation short grass open forests.

The normal movement pattern could be upset during years of adverse environmental conditions. However, the movement pattern of elephants in this region has not basically changed for over a century, as inferred from descriptions recorded during the nineteenth century.

Journal of Tropical Ecology (1989) 5:1-18

# Ecology of the Asian elephant in southern India. II. Feeding habits and crop raiding patterns

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**Abstract**

The Asian elephant's foraging strategy in its natural habitat and in cultivation was studied in southern India during 1981-83. Though elephants consumed at least 112 plant species in the study area, about 85% of their diet consisted of only 25 species from the order Malvales and the families Leguminosae, Palmae, Cyperaceae and Gramineae. Alteration between a predominantly browse diet during the dry season with a grass diet during the early wet season was related to the seasonally changing protein content of grasses.

Crop raiding, which was sporadic during the dry season, gradually increased with more area being cultivated with the onset of rains. Raiding frequency reached a peak during October-Desember, with some villages being raided almost every night, when finger millet *(Eleusine coracana)* was cultivated by most farmers. The monthly frequency of raiding was related to the seasonal movement of elephant herds and to the size of the enclave. Of their total annual food requirement, adult bull elephants derived an estimated 9.3% and family herds 1.7% in quantity from cultivated land. Cultivated cereal and millet crops provided significantly more protein, calcium and sodium than the wild grasses. Ultimately, crop raiding can be thought of as an extension of the elephant's optimal foraging strategy.

Journal of Tropical Ecology, (1990) 6:35-53

# The Management of Large Mammals in Relation to Male Strategies and Conflict with People

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**Abstract**

Many large mammals such as elephant, rhino and tiger often come into conflict with people by destroying agricultural crops and even killing people, thus providing a deterrent to conservation efforts. The males of these polygynous species have a greater variance in reproductive success than females, leading to selection pressures favouring a 'high risk-high gain' strategy for promoting reproductive success. This brings them into greater conflict with people. For instance, adult male elephants are far more prone than a member of a female-led family herd to raid agricultural crops and to kill people. In polygynous species, the removal of a certain proportion of 'surplus' adult males is not likely to affect the fertility and growth rate of the population. Hence, this could be a management tool which would effectively reduce animal-human conflict, and at the same time maintain the viability of the population. Selective removal of males would result in a skewed sex ratio. This would reduce the 'effective population size' (as opposed to the total population or census number), increase the rate of genetic drift and, in small populations, lead to inbreeding depression. Plans for managing destructive mammals through the culling of males will have to ensure that the appropriate minimum size in the populations is being maintained.

Biological Conservation 55 (1991) 93-102

# Characteristics of Three Populations of Elephants of the Western Ghats

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**Abstract**

Characteristics of 3 elephant populations of Peninsular India are examined and comparisons made with that of other populations. The parameters examined were distribution density sexratio and proportion of individuals in various age classes in the population Out of the 3 localities studied. Bandipur and Perivar had relatively undisturbed habitat while Idukki was disturbed. Largerherds were characteristic of Bandipur and Perivar where the adultmale to adult female ratio was 1:9 and 1.25 respectively. Both populations had a sex ratio of 1:1 in the case of subadults. Although the Perivar population had a lower proportion of adult male elephants in comparison with Bandipur the proportion of young ones was similar. The Idukki population had very few adult males where the proportion of young ones and subadults was also very low. Solitary female elephants were observed at Idukki which is indicative of a disturbed population. The major reason for the dispanly in sex ratio between subadults and adults is the poaching of tuskers for ivory. There was extensive continuous forest in Bandipur and Perivar. In the case of Idukki human habitations and construction of a hydroelectric project severely limited habitat continuity and movement.

Proc. Seminar on Ecodevelopment of Western Ghats. 1986. pp 78-83

# Feeding behaviour of the Asiatic elephant in South-East Sri Lanka in relation to conservation

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**Abstract**

This paper reports on important behavioural aspects of the Asiatic elephant *(Elephas maximus)* in South-East Sri Lanka (Ceylon), in relation to recommendations for its conservation. The activity cycle of the elephant has been investigated in relation to local or short-range movements which were found to be diurnally rhythmic. The elephant was estimated to spend about 17 to 19 h/day feeding. The feeding cycle is seen to consert of three successive phases, namely (1) rapid movement and low feeding rate, (2) little movement and high feeding rate, and (3) a certain amount of movement and relaxed feeding. During a given feeding cycle an elephant consumes about 150 kg of fresh vegetation and defecates about 80 kg of it per day. The dynamics of grass feeding were worked out for a herd of elephants in the Gal Oya National Park. The outlook for the elephant population in South-East Sri Lanka has been critically analysed with reference to its mode of habitat utilisation. The main constraints introduced into its ecosystem are discussed, namely blocking of migratory routes, burning of grassland, construction of roads, grazing of domestic cattle in its home ranges, felling of trees by villagers, and an over-population of water buffalo *(Bubalus bubalis)*. Measures for conservation are briefly dealt with.

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*Staff from the Wildlife Department (Sri Lanka) carrying out studies in Ruhuna National Park. (Photo: Charles Santiapillai)*

# LETTERS TO THE EDITOR

285/1 Talatuoya Road
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Kandy, Sri Lanka
3 August 1991

Dear Sir,

Thank you very much for your letter and the two Newsletters of the Elephant Group. Now that I have gone through Nos. 5-6, is there any possibility of obtaining the issues 1-4. Even photocopies will suffice. May I suggest that these be printed in the same size, so that fanatics like me can bind them. I hope it will not be too much of a bother to you. I will be grateful if you could kindly send me any other publications you can spare on the Asiatic Elephant.

About the electric fences used in Sri Lanka, both at Gal Oya and at the Sugar Cane Plantation at Pelwatte, I have an interesting observation. At Gal Oya, the elephants soon learnt that the wires were the problem. The herd leader however would walk up to the fence and kick the fence post. Once the post collapsed and the current earthed, the herd crossed over with impunity.

I was at the Pelwatte Plantation only for one month in August 1985. The fence had been just put up and was very effective in keeping the elephants out of the cultivation. I cannot say what the situation is just now. Perhaps the elephants have learnt another method of getting across. I have read that in some areas, the African elephants carried logs and put them on the wires so breaking the wires!

..... I am told that the Department of Wildlife is now considering having elephants in our national parks to take visitors around, as it is done with success in India. Some officers have gone across to Botswana to see how it is organised. I cannot understand why Botswana, when Periyar or Corbet National Parks would have been closer, and in my opinion better for our people to learn from. Perhaps you will know better.

In your letter you said that you helped out in Yala (Ruhuna National Park) to get a census of elephants. I am very interested, could you please let me know your opinion on the number of elephants in Yala. Are the staff members doing a proper census. I ask you this as experience has taught me, that these studies done by the Department will never be published, and if by some chance the Director changes, that will be the end of the study! Such periodical studies are very important and should be done at least once in 10 years! Some of these are never publised. My estimate (of the number of elephants) is around 300 in Yala (Ruhuna National Park) with about 80-100 mostly in Block I. I may be wrong.

The most interesting feature in Yala is the increase of the tusker population. Way back in 1950, there were said to be only 2-3 tuskers in Yala, but today there are quite a few. I can personally identify about 15 (animals), but there are said to be 20-25 tuskers in Yala. Is this estimate correct? I feel, given adequate protection the number of tuskers is bound to increase.

South India: 80% of the males are said to be tuskers (according to Dr. R. Sukumar), but back here only 6% (tuskers). Why? Is this because the tuskers were poached off for their ivory during "the British Raj" and the tuskless (males) now predominate! I am also interested very much on the effects of musth in breeding. Any literature on these, some photocopies will be most welcome.

You have requested me to write to your Newsletter. Please let me know what type of article you would like and I will gladly oblige. Thank you for inviting me to write. Wishing you all the very best.

Yours sincerely,

Dr. H.I.E. Katugaha. M.B.B.S (Cey).

***Reply***

*Thank you for your letter. Your observations on the electric fence are most welcome. Elephants being very intelligent animals, no electric fence is likely to be 100% elephant-proof. The animals are known to destroy the fence once they experience (even for a split second) the memorable shock of 5,000 volts the electric fence may carry. The usual reaction is to return and smash the fence. Bulls have one advantage in that the tusks do not conduct electricity and so can prise an insulator off the fence post. But even if an electric fence can be 80% effective, the benefit in some instances (especially in oil palm or rubber estates in Malaysia) far exceeds the cost. In Malaysia, one mile of electric fence is known to protect about 800 acres of cropland. It is therefore necessary to monitor the electric fence every day and repair any damage inflicted by the irate elephants. The grass and weeds underneath the wires must be cut regularly to prevent them coming into contact with the live wires.*

*You will be happy to note that the results of the survey of the elephant population in Ruhuna National Park, Sri Lanka carried out by the staff of the Department of Wildlife Conservation are published in this issue of the AESG Newsletter and not confined to the departmental archives! However, the disturbing observation during the survey was the lack of tuskers in the population. Although a total of 94 animals were encountered in Block I of RNP, there wasn't a single tusker among the males! One reason for the lack of tuskers could be the increase in poaching activities as a result of the breakdown of law and order in the country and the increase in guerrilla activity in the recent past. It is also possible that we had missed the few tuskers that are still around. Only further surveys would throw some light on this matter.*

*Your estimate of 80-100 elephants in Block I of RNP confirms our estimate of about 84 animals in 140 km2. The entire RNP may support 300+ elephants on a year-round basis.*

*The low percentage of tuskers in Sri Lanka could well be due to the systematic removal of tuskers during the "British Raj" by trophy hunters and also poachers. One Major Rogers is credited with the slaughter of 1,400 animals! Tusks were exported from both Ceylon and Sumatra during the Dutch Colonial rule. Between 1879 and 1883, the average export of ivory from Ceylon and Sumatra per year was 2,000 kg, half of which went from Ceylon.*

*As far as musth in elephants is concerned, I would recommend the paper entitled, "Observations on musth in the domesticated Asiatic elephant (Elephas maximus)" by M.R. Jainudeen, G.M. McKay and J.F. Eisenberg. Extrait de Mammalia Tome 36 (2): 1972. 247- 261. This should be available in the library at the Department of Zoology, University of Peradeniya, Sri Lanka.*

*I would be most grateful if you could send me any articles on Asian elephant (e.g: on its management in captivity, historical accounts of elephant management in Ceylon, traditional elephant lore, traditional methods and medicines used in treating elephant diseases, conversations with the mahouts on their experiences with elephants, the influence of elephant on the religion, society and politics of Ceylon etc). I look forward to receiving your articles. Thank you.*

*Yours sincerely,*

*Charles Santiapillai*

# DIARY

MANAGEMENT OF ELEPHANTS IN CAPTIVITY: A Training Course conducted at the Elephant Training Centre (ETC), Way Kambas National Park, Lampung, Sumatra, Indonesia by Dr V. Krishnamurthy from the Bombay Natural History Society's Elephant Project, South India (September-October 1991).

Dr V. Krishnamurthy (member of the AESG) arrived in Indonesia on 15 September to:

(1) critically assess the current management of elephants in captivity at the ETC in Way Kambas National Park, Sumatra and recommend appropriate measures for its improvement.

(2) train PHPA field staff in the management of elephants in captivity with special emphasis on the provision of a balanced diet and adequate veterinary care to the animals.

(3) initiate a programme to breed elephants in captivity along the lines of the successful programme in South India.

ASIAN ELEPHANT SPECIALIST GROUP MEETING is scheduled to be held from 20-22 May 1992 at the SEAMEO-BIOTROP (South-east Asian Regional Centre for Tropical Biology), Bogor, West Java, Indonesia. The meeting is designed to bring many of the AESG members together to assess the status of the Asian Elephant and formulate projects that would address some of the most urgent problems vis-a-vis Asian elephant conservation. Members interested in attending the meeting and presenting a paper should communicate as soon as possible with either the Chairman, Mr Lyn de Alwis or Deputy-Chairman, Dr R. Sukumar.

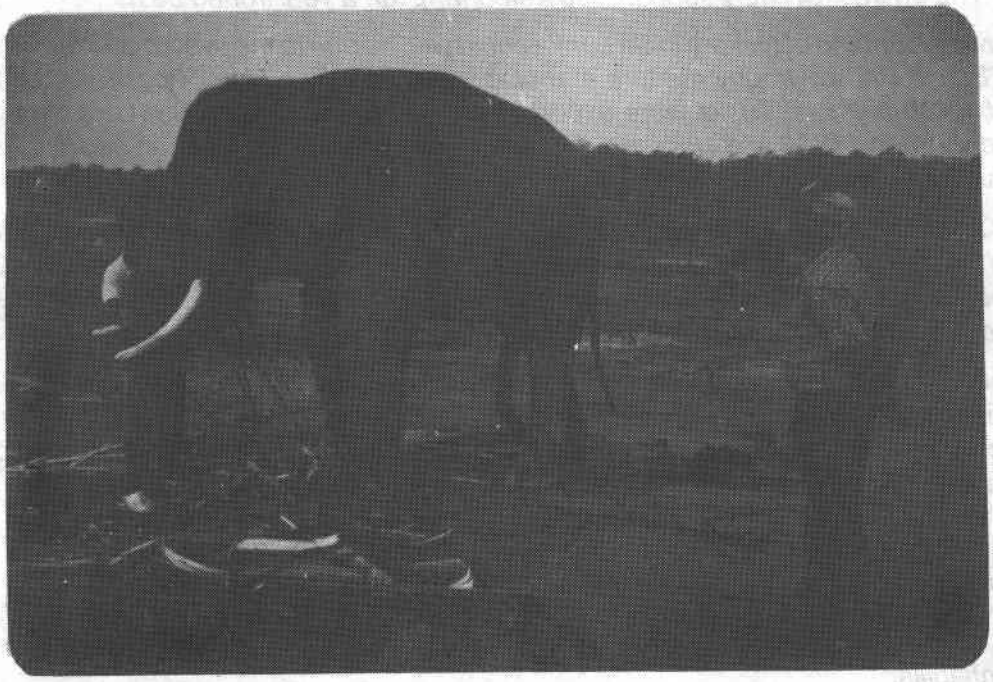


*Fig. Dr Krishnamurthy looking at one of the adult bull elephants in captivity at the Elephant Training Centre in Way Kambas National Park, Indonesia while its mahout stands behind the animal. (Photo: Charles Santiapillai/WWF)*

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# HRH Prince Bernhard of the Netherlands honours two AESG members at Soestdjik Palace



*HRH Prince Bernhard (right) talking to the recipients of the Order of the Golden Ark, Mr Widodo Sukohadi Ramono (left) and Prof. Yang Yuan Chang (centre) at the Soestdjik Palace in the Netherlands. (Photo: Charles Santiapillai/WWF).*

On the 14 th December 1991, at a ceremony held at the Soestdjik Palace in the Netherlands, HRH Prince Bernhard awarded the prestigious Order of the Golden Ark to two of the Asian Elephant Specialist Group Members, Mr Widodo Sukohadi Ramono from Indonesia and Prof. Yang Yuan Chang from China for their long and unstinted contribution to nature conservation and wildlife management.

This prestigious award is given annually by HRH Prince Bernhard to a very few outstanding conservationists whose contributions have had a significant impact on nature conservation. It is therefore not only a personal tribute to the two members of the AESG but more importantly a great honour to Indonesia and China as well.

Mr Widodo is the Chief of Species Conservation in the Directorate General of Forest Protection and Nature Conservation (PHPA) in Indonesia and has devoted more than two decades in promoting the conservation of large mammals especially the Sumatran elephant and the Javan rhino. Prof. Yang Yuan Chang has been actively involved in the promotion of elephant and other large mammal conservation in the Xishuangbanna Nature Reserve in the southern part of Yunnan Province.

The AESG is proud to congratulate Mr Widodo and Prof. Yang on their achievement. Well done and well deserved.

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**WWF** World Wide Fund
For Nature

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