THE SURVEY OF ELEPHANTS IN SRI LANKA

A report prepared for the Department of Wildlife Conservation by

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ABSTRACT

A survey of the elephants in parts of the Southern, Eastern, North Western, Central and Mahaweli regions of Sri Lanka was carried out for six days from 23 to 28 June 1993 in order to assess the structure and composition of the elephant populations. It was also designed to train the field staff in monitoring elephants in the wild. Some 800 personnel, including volunteers from NGOs spent more than 57,000 man hours recording the elephants in the five regions.

The population structure of the elephants appears to be biased in favour of the adult animals. The proportions of the adults, subadults, juveniles and calves on an average were 51.9%, 21.8%, 15.7% and 10.6% respectively. The highest proportion of the calves (21.1%) was seen in the Southern population. The adult sex-ratio varied from 1:1 in the small population of elephants in the Central region (n=30) to 1:2.9 in the Southern population. In the four large populations, the number of bulls per 100 cows ranged from 73 in the North Western to 34.8 in the Southern regions. No tuskers were seen among the adult bulls in the Central population but the proportion of the adult bulls with tusks in the rest varied from 15.3% in the North Western to 2.8% in the Mahaweli regions. It is significant to note that although the elephant population in the Mahaweli region makes up 34.2% of the estimated population size (minimum estimate) in the five regions, yet it accounts for the lowest percentage of tuskers (0.9%). The national average for the percentage of tuskers among the adult bulls, appears to be 7.3. In Sri Lanka, even though only a small proportion of the males have tusks, yet more bulls are being killed in conflicts with man.

The most frequent grouping consisted of 3-6 animals. In addition, larger groupings consisting of 10-20 animals were also observed. The largest grouping consisted of 124 animals. The most permanent social grouping appears to be related to cows and their offspring. Both solitary bulls and groups showed a bimodal pattern of activity, with activity reaching a peak during the late evenings.

While it is impossible to be certain about the actual population size of elephants in the five regions, it is clear that there are at least a minimum of 1,967 animals. Recommendations for logn-term conservation of elephants in Sri Lanka need not depend on precise quantification of its populations across the island. It is usually sufficient to know if they exist in significant numbers and thereafter, it is necessary to establish whether the populations are declining, increasing or remaining stable. The elephant is a "flagship species" whose conservation will result in the maintenance of biological diversity and ecological integrity across a large area of Sri Lanka.



Elephants in Ruhuna National Park, Sri Lanka (Photo: Charles Santiapillai)

Introduction

The Asian elephant (Elephas maximus) is one of the most seriously endangered species of large mammals in the world. Given its enormous size and body mass, it is also one of the few species of terrestrial megaherbivores still extant. Its present geographic distribution extends from the Indian subcontinent in the west to Indo-China in the east across 13 countries including islands such as Sri Lanka, Sumatra and Borneo. The entire population in the wild is estimated to be between 35,000 and 55,000 (Santiapillai & Jackson, 1990). Even optimistic figures indicate that there are only about one tenth as many Asian as African elephants.

Throughout its rage, the Asian elephant is in decline. Increasing human populations and increasing agricultural land use have considerably reduced the area available to the elephants since the turn of the century. The obvious corollary to a decrease in a species' range, is a decrease in its resource base, and for such a wide-ranging species as the elephant, this means that the animal's flexibility to buffer the effects of local resource depletion by moving out is lost (Croze, et al., 1981).

In Sri Lanka, changes in land use patterns are resulting in continuous contraction of the habitat available to the elephant, and over large areas of its range, there is no longer room for the animals to roam about and adjust their densities. The situation, as pointed out by Laws (1981) in the case of the African elephant, has reversed in Sri Lanka too from one in which "human islands existed in a sea of elephants, to a sea of people with elephant islands". The problem is further compounded by development programmes that have squeezed the elephants out of their former ranges and pushed them into a few refugia. The concentration of elephants into protected areas has led to a build up in their densities within these areas, even though absolute population size might be decreasing throughout the Island.

Erosion of habitats also forces the elephants into agricultural areas, where they destroy crops and at times kill people and in turn are themselves killed by irate farmers who have borne the brunt of elephant depredations. The elephants have lost so much of their former habitat, that they are now forced to invade the communities that have displaced them. This is the crux of the elephant-human conflicts in Sri Lanka (de Alwis & Santiapillai, 1993). Depredation by elephants has become a way of life!

It is now becoming increasingly clear that if the long-term survival of the elephant in Sri Lanka is to be enhanced, then some sort of a accommodation must be reached between man and elephant. Both have to live together by mutual adjustment. Furthermore, for elephant conservation to succeed, it should have the support of the local people. The local communities that bear the brunt of elephant depredations must be properly compensated for their losses. They must also be given the opportunity to participate fully in decisions affecting their land and resources.

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Elephants In Ruhuna National Park (Photo: Charles Santiapillai)

Rationale for the Survey

A sound scientific understanding of a natural resource is fundamental to any well planned management of that resource (Sale, 1985). In accepting the need for systematic research as the basis for improved management of elephants in Sri Lanka, the Director of Wildlife Conservation, Mr W. A. Jayasinghe embarked on implementing the plan to make an assessment of the current status of the elephants in the wild and in captivity, as recommended in the country's Five Year Development Plan.

An update on the status of the wild elephants in Sri Lanka was long overdue. The last comprehensive survey of the elephants in Sri Lanka was carried out more than 20 years ago, between 1967 and 1969 jointly by the Smithsonian Institution (USA) and the Department of Wildlife Conservation (Sri Lanka). On the basis of this survey, McKay (1973) estimated the *minimum* size of the total population of wild elephants in Sri Lanka at that time to be between 1,600 and 2,200. This estimate agrees closely with that of Norris (1959) who was very familiar with Sri Lankan wildlife. McKay (1973) based his estimate on the numbers known to be present in certain areas, and later extrapolated them to cover the entire island.

A more recent estimate by A.B. Fernando, who is very knowledgeable about wild elephants in Sri Lanka puts the figure as anything between 2,800 and 3,250 (Santiapillai & Jackson, 1990). These two estimates of abundance underline the difficulty involved in estimating the size of the population in the wild of even the largest terrestrial herbivore.

A considerable part of any study of wildlife populations relates to determining the number of individuals in population. But as Caughley (1977) points out, "estimates of abundance have no intrinsic value and they should never be considered ends in themselves. Many biological problems require no estimate of abundance. The majority of ecological problems can be tackled with the help of indices of density, absolute estimates of densities being unnecessary luxuries".

Objectives of the Survey

The main objective of the survey was to initiate a programme to monitor seasonally the changes in the structure of the local elephant populations across as large an area as is feasible. Obtaining information on the population size was incidental to the main study which was designed to understand the factors that mould population structure by affecting the survival of individuals.

The survey was also initiated with the view to providing the necessary training to the field staff of the Department of Wildlife Conservation so that they could regularly observe and monitor the changes in the structure (such as group size, composition, sex ratio, proportion of calves and tuskers) of the local elephants.

It was hoped that such a study would ultimately lead to an understanding of how elephants utilize their habitats, what times of day are favoured for feeding, how much time is spent in foraging, and how this activity varies seasonally.

In particular, much emphasis was placed on the need to monitor the proportion of calves and tuskers - two of the most vulnerable categories - in the local populations. The proportion of calves in any population is a good indicator of the habitat quality. The work of Corfield (1973) and Laws (1969) in Africa point to the selective mortality of calves, mature females with calves, and old animals among elephants.

It was not intended to carry out a census of the elephant population across the island. The entire island cannot be surveyed at present given the volatile ethnic situation currently prevailing in the country and hence an island-wide census of elephants is well nigh impossible. Estimation of elephant numbers was therefore incidental to the main objective of study of population structure of the elephants and it refers to the minimum number of elephants living in five regions.

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Methods and Materials

While it may be possible at times, to record all the elephants in a small area such as Lahugala or Handapanagala, it is a much more daunting task to record all the elephants in such an enormous area in Sri Lanka as that incorporating the Southern, Eastern, North Western, Central and Mahaweli regions! In general, the larger the area to be searched, the more difficult it is to search the area effectively (Rodgers, 1991). A large area requires a greater amount of time or large number of people. This is the reason why, the survey was carried out for six days from 23 to 28 June 1993 and involved some 800 personnel, including volunteers from NGOs and villagers who spent a total of 57,600 man hours looking for elephants.

Such an exercise raises the problems of over counting due to movement of elephants (and observers too) during the survey period and to different observers recording the same animal. Attention to this bias was pointed out prior to the survey to the Senior Staff from the Department of Wildlife Conservation when they were given preliminary training at Pinnawala Elephant Orphanage and Ruhuna National Park.

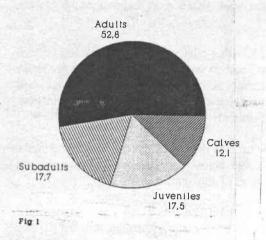
The first training programme was held in Pinnawala under the auspices of the Director of Wildlife Conservation, on 13 and 14 March 1993. During this period, the domestic elephants provided the basis for the determination of the appropriate age and sex categories. This was followed by a more intensive field training given to the same staff from 26 to 31 March in Blocks I and II of Ruhuna National Park and at Handapanagala. On their return to their field stations, the Senior Rangers and the Regional Assistant Directors in turn trained their staff in the technique of monitoring and recording elephants in readiness to the proposed survey in June.

The problem with such an exercise is that it is often difficult to interpret the results. We have only the data sheets of the observers to rely on and there is thus no real way of telling how accurate or precise these results are. But the method, despite its inherent short comings, would be useful in that it is *repeatable*. It is particularly useful in studying the trends in the population, if it is repeated year after year in the same way, with the same bias occurring throughout. In successive total counts in an area, the highest total was taken to compute the minimum number of elephants in that area.

A total of 153 locations (listed in Tables 1-5) were surveyed during the six days and at every location, a group of five observers was given the task of monitoring elephants, Each group was led by a member of the Department of Wildlife Conservation. All observations were carried out from 0600 to 1900 hrs, from vehicles or on foot. Whenever elephants were encountered, the time, location, number of animals, size of groups, and activity were noted on maps and data sheets. Any special distinguishing marks (such as kinky tails, ear nicks, tusks, pigmentation, etc) were noted in order to help identify individuals and thereby reduce the possibility of double counting. All observations were made either with the naked eye or using a pair of binoculars. Each survey team covered as much of the study area as possible.

Population Structure Southern Region

Population Structure Eastern Region



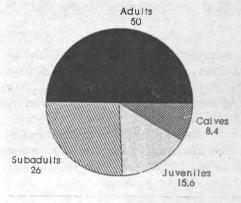
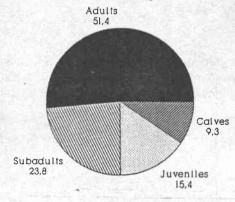


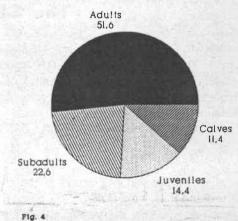
Fig. 2

Population Structure North Western Region

Population Structure Mahaweli Region







Sex and Age Criteria

Sexing elephants in the field is not easy. It is particularly difficult in young animals. Tuskers present no problem but these are rare as only a small proportion of the males have tusks while the females are tuskless. The most reliable indicators of sex are the genitalia but these are not always easily observed in the wild. Often more indirect characters are used in sexing elephants in the wild.

The female in general is more box-shaped, with a relatively straight back and vertical hindquarters, whole the male tends to have a more convex back, which curves more gradually into the hindquarters (McKay, 1973). Reproductively active females could be distinguished by their tumescent mammary glands. Genitalia become become visible during urination, and this is about the only time when young animals may be sexed.

The relative size of the head can also be used to determine the sex of adult animals. Adult males usually have a very prominent bulge below and in front of the eyes, and a second bulge above the eyes which is lacking in the females.

For the purpose of censusing work, we distinguished four classes of animals based on age: adult, subadult, juvenile and calf. The calf can be easily distinguished by its long hair and its small size. It can easily walk under its mother. It is usually less than 1.2 m at shoulder height. The distinction between juveniles and subadults is not easy. Juveniles in general are between 1.2 and 1.5 m in height and tend to remain with the herd, forming play-groups (McKay, 1973). Subadult females tend to remain with the adults, while subadult males are often seen away from the herds (McKay, 1973). Males are considered to be in the subadult category from approximately four to nine years (Eisenberg & Lockhart, 1972).

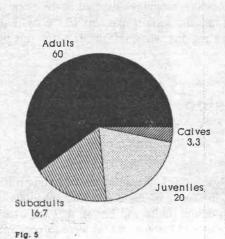
The Study Area

The survey discussed in this report was carried out in five regions in Sri Lanka, namely the Southern, Eastern, Central, North Western and Mahaweli. The Padawiya tank represents the northern-most area surveyed. Observations were carried out in 153 separate locations in the five regions.

Results

The population structure of the elephants in the five regions are given in Tables 1 to 5 and Figs. 1 to 5, while Table 6 and Fig. 17 provide an overall picture of the population structure based on the total number of elephants (N=1,967). In addition, the population

Population Structure Central Region



Group Size Eastern Region

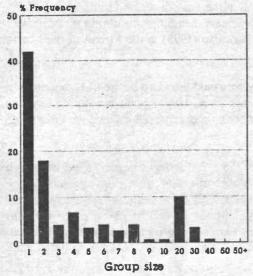


Fig. 7

Group Size Southern Region

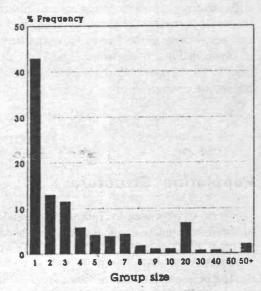


Fig. 6

Group Size North Western Region

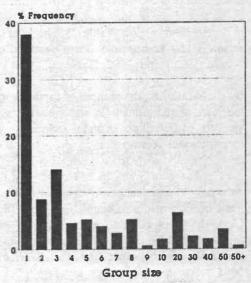


Fig. 8

structure of the classified animals is given in Table 7 and is based on a slightly lesser number of animals (N=1,611) as it refers only to those that were classified. The age and sex ratios of the elephants (Table 8) were based on the animals that were classified and not on the total number of animals counted. Table 9 refers to the proportion of tuskers in the five regions. The percentages of tuskers and the maknas (tuskless bulls) are based on the adult males. On the other hand, Fig. 16 refers to the proportion of tuskers in the total populations in the five regions. The frequency of groupings observed in the elephants is shown in Figs. 6-10, while Figs. 11-15 illustrate the activity patterns of the bulls and groups. The approximate boundaries of the five regions where elephants were surveyed are shown in Fig. 18.

Discussion

Population Structure:

As can be seen in Tables 1 to 5 and Figs. 1 to 5, the structure and composition of the five populations of elephants are biased in favour of the adults and subadults. Of the total 1,967 animals, 1,020 (or 51.9%) were adults (bulls and cows), 429 (or 21.8%) were subadults, white 309 (or 15.7%) were juveniles and 209 (or 10.6%) were calves (Table 6). The percentage of calves varies from 3.3 in the Central Region to 12.1 in the Southern Region (Figs. 1 & 5). This pattern is broadly similar to those of Eisenberg & Lockhart (1972) and Santiapillai et al., (1984).

As far as the proportion of calves in each of the five regions is concerned, except in the case of the Central region where there was only 1 calf scored in a total of 30 animals, in the rest of the regions, it varies between 8.4% in the Eastern region (Table 2) and 12.1% in the Southern region (Table 1). The % of calves (less than 6 months old) in the Mahaweli region is 11.4 comparable to that observed by Ishwaran (1993) in the Mahaweli river basin between 1980 and 1982 (Table 3).

Monitoring the number of calves every year would therefore be useful in determining the rates of recruitment in elephants for as Laws *et al.* (1975) point out during any one year, the pattern of peaks and troughs in the lower age classes would indicate the differences in the annual recruitment.

Studies in South India indicate that from the 5-7 year age category, there was sharp reduction in the number of males owing to higher mortality from poaching, and hence adult males constituted only about 7.5% (Sukumar, 1989). Results from this survey in Sri Lanka however point to a much higher % of bulls as far as the *classified populations* are concerned (Table 7). The proportions of adult bulls in the Eastern, Southern, Mahaweli and North Western were 10.8, 11.2, 12.9 and 17.4 (in the aberrant Central population adult bulls make up 25% of the total).

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Group Size Mahaweli Region

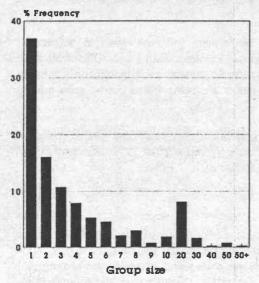
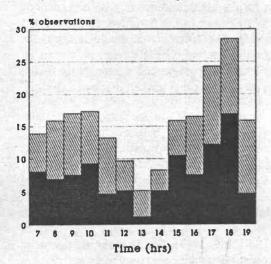


Fig. 9

Activity Pattern Southern Region



Bulls COUPS

Fig. 11

Group Size Central Region

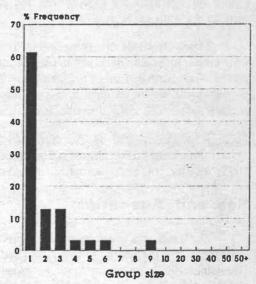


Fig. 10

Activity Pattern Eastern Region

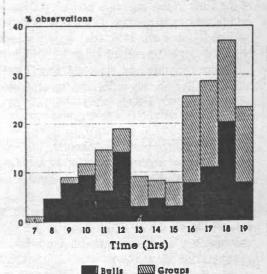


Fig. 12

It is likely that much mortality among elephants in Sri Lanka as a result of escalating human-elephant conflicts could be directed to the subadult males, especially when individuals move from away from herds, as they mature in search of the oestrus females. Future surveys must try to determine the proportions of the two sexes in both adult as well as subadult categories.

Many elephants are being killed today by farmers and pastoralists in defence of their crops. In South India, about 18% of all female elephant deaths and 70% of all male deaths were attributed to man (Sukumar, 1989). In Sri Lanka, even though only a small proportion of the males have tusks, yet many males are being killed during crop raiding as they take more risks than the females, especially those with calves.

Adult-dominanted age structure and female-biased sex ratios are characteristic of several populations of elephants in Sri Lanka (Eisenberg & Lockhart 1972; Ishwaran, 1981; 1993; McKay, 1973; Nettasinghe, 1973; Santiapillai et al., 1984).

Sex and Age-ratios:

Sex ratio is a measure of the reproductive performance of any population and a knowledge of it is essential to understand and interpret other vital statistics of the population (Downing, 1980). In general, the sex ratios among calves and juveniles are roughly 1:1 but they vary in the adults. Table 8 shows the sex ratios of adults from the four Regions. The 1:1 adult sex ratio of the elephant population in the central Region cannot be considered realistic of the area on account of the small sample size (only 24 animals). However, as far as the other three regional populations are concerned, the North Western population has the most number of bulls (Table 8) with 73 bulls per 100 cows. This high percentage of the bulls in this region is perhaps the reason for the high incidence of crop depredations in this area by elephants. The ratios of bulls to 100 cows in the Southern, Mahaweli and Eastern Regions are 34.8, 46.0 & 54.5 respectively. The difference in the adult sex ratios observed might be caused either by a high mortality among subadult males or dispersion of animals in this age class (McKay, 1973). The lower proportion of the bulls in the Mahaweli Region may reflect the fact that this is the category that is often shot by cultivators.

The elephant is a polygynous species, where one bull can successfully mate with a number of cows in oestrus. Thus there is always some "surplus" bulls available for mating with cows. Furthermore, as Sukumar (1989) points out, a certain proportion of adult females would also be either pregnant or in lactational anoestrus, and therefore not available for conception, in which case, the operational sex ratio would not be as disparate as the observed sex ratio in the population.

But at some ratio of adult male to adult female, there will be too few males to ensure that all the available females are successfully mated, resulting in a lower rate of conception and a longer inter-calving interval (Sukumar, 1989). For elephant management, the important question is at what adult sex ratio will this factor come into operation? Except in the case of the Central (aberrant) and North Western populations, in the other 3 Regional populations, the adult male: adult female ratio was between 1:1.8 and 1:2.9 (Table 8). Despite

the low proportion of adult males, as long as the female mortality remains very low, the populations will increase or remain stable even in the face of a decrease in fertility due to higher male mortality.

Age-ratios too are an important source of information for management of elephant populations. They are a measure of the mortality and rearing success of the population (Downing, 1980). On an average, the population of elephants in Sri Lanka is composed of 51.8% adults, 21.8% subadults, 15.7% juveniles and 10.6% calves (Table 6).

Social Organization:

A total of 1,189 observations of elephants were made during the survey period but quite a number of these observations in fact referred to the same animals and/or groups and so the total number of elephants that were observed on 1,189 occasions (about 6,000 animals) should not be confused with the population size of the five Regions. However, these observations were used to work out the frequency of groupings seen among elephants during the survey (Figs. 6 to 10)

The overall pattern of the frequency of grouping is similar in all five Regions, with solitary animals being the most frequently observed category. In the Central Region, solitary animals make up 61.3% of all the observations, while in the North Western and the Mahaweli Regions, solitary animals make up 38 and 37%; and the % of solitary animals in the Eastern and Southern Regions are also similar (42.0 and 42.9 respectively). Almost 90% of the solitary animals are usually adult bulls (Santiapillai et al., 1984). Groupings of 2 individuals were invariably either an adult male / adult female or adult female /calf combination. For the most part of their lives, adult males lead a semi-solitary existence, joining the herds mainly for breeding.

Group Size:

The group size of elephant was found to vary from count to count and also between the different regions. If we ignore the solitary and paired animals, the most frequently observed grouping consisted of 3-6 animals, recorded 104 times out of 406 observations in the Southern Region (26%); 27 times out of 150 observations in the Eastern Region (18%); 48 times out of 171 observations in the North Western Region (28%); and 123 times out of 431 observations in the Mahaweli Region (29%). In addition to this grouping, a larger grouping of between 10 to 20 animals was also observed in all but the Central Region (Figs. 6-10). The average subgroup of 3-6 animals presumably contains a matriarch and/or 1 or 2 adult daughters. In Africa, Douglas-Hamilton (1972) has observed the repeated recombination of individual family units. Laws et al. (1975) refer to such a repeatedly recombining group as an "extended family".

Groups of more than 50 animals were seen on ten occasions in the Southern, North Western and Mahaweli Regions. The largest grouping seen consisted of 124 animals in

the Handapanagala area. Such large groupings have no long term cohesion and are composed of several smaller subunits (Ishwaran, 1981). It was found that in Africa, regions with the highest group sizes were the ones in which poaching was prevalent, while those areas most secure from poaching had the lowest group sizes (Eltringham, 1977).

Elephants occur in discrete groupings of two types - the family unit, consisting of closely related adult females and their immature offspring, and the bull herd, which is a loose association of males of all ages above puberty (Eltringham, 1977). Such bull units were also observed during the survey. The largest bull group with nine animals was recorded in Handapanagala indicating a high level of disturbance in the area. These all-male groups have a rapidly changing composition of individuals and are usually associated with disturbed areas. Croze (1974) reports bull herds in Seronera bordering on heavy cultivation outside the Serengeti National Park. Laws (1974) has postulated that group size is a measure of the ecological health of an elephant population, since aggregation of family units and bull herds is the result of stressful conditions. This was also borne out by the study of Ishwaran (1981) who found the mean group size of an elephant population in an area interspersed with human settlements to be larger than that of a similar population living within a nearby national park.

Diurnal Activity:

The diurnal activity patterns of both solitary adult bulls and the mixed groups are illustrated in Figs. 11-15. In all but the Central Region, both bulls and groups clearly show a bimodal pattern of activity, with activity reaching a higher peak during the late evenings about 1700-1800 hrs and a less pronounced peak in mid-mornings. Much of the activity observed refers to feeding. Elephants spend a long time feeding in their habitats as a result of their large body size, intemperate appetite and the relatively inefficient digestives system. Elephants may abruptly disappear from an area, suggesting that they may at least undertake extensive movements within a large home rage (Wyatt & Eltringham, 1974).

Number of Tuskers:

The proportion of male elephants possessing tusks varies enormously among different Asian elephant populations (Sukumar, 1989). In Sri Lanka, Deraniyagala (1955) found that 324 bulls out of a sample of 364 were tuskless (or 89%). McKay (1973) in a much smaller sample of 25 captured bull elephants, found 23 (or 92%) animals to be tuskless.

As can be seen from Table 9, the proportion of tuskers among adult bulls varies from 15.3% in the North Western Region to zero in the Central Region. In other words, the percentage of the tuskless males (maknas) among the adult bulls varies from 100% in Central to about 84.7% in North Western Region.



Elephants in Handapanagala, Srl Lanka (Photo: Anouk Ilangakoon)

The number of tuskers as a proportion of the overall population size in the five regions is given in Fig. 16 Mahaweli Region has the lowest proportion of tuskers (0.89%) relative to the total population size. It is in this Region that several tuskers have been killed in the recent past as a result of escalating human-elephant conflicts, brought about by elephant depredations on cultivated crops. The National average of the percentage of tuskers among the adult bulls, appears to be about 7.3 (Table 9), and the two populations in the Southern and North Western Regions have higher proportion of tuskers (10.2% and 15.3% respectively) and thus need greater protection against poaching.

Number of Elephants:

In a survey of this nature, covering enormous areas and involving several hundred people, the data need to be checked rigorously in order to minimize the error due to over counting of animals. The same individual elephant can be counted by several observers placed along its path of movement over several days. The dense and tangled nature of the vegetation also makes it difficult to observe the entire groups moving through the forest and hence many observations will not represent the true size of the groups.

In this analysis, we have tried to reduce the error due to repeated counting of the same individuals by removing as may doubtful observations as possible from the total. In this, we relied heavily on the notes the observers had supplied, especially with reference to the number of calves in the groups seen and any other distinguishing features found on the animals. We recognize that this method is far from perfect but we hope that by providing a minimum estimate for the number of elephants in the five regions, such errors could be reduced. By being too critical, we may have pruned down the total to less than the true population size of elephants. But there is no way of checking this on the basis of just one survey. In future surveys, some areas could be cross-checked through indirect methods based on dung deposition and decay, in particular that of Barnes & Jensen (1987), which has been successfully used in tropical Africa and Asia to estimate the elephant numbers and densities.

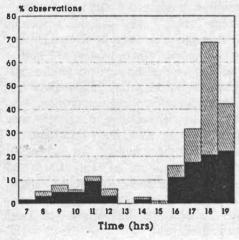
The survey indicates that there are at least a minimum of 1,967 elephants in the five regions. The largest number of elephants are to be found in the Mahaweli region (34.2%) and the lowest number in the Central region (1.5%), as can be seen in Fig. 17. It is however interesting to note that although the Mahaweli region has the highest number of elephants, it has the smallest proportion of tuskers (Fig. 16). While it is impossible to be certain what the upper limit of the size of the elephant population in the five regions is, it is clear that there are at least a minimum of about 2,000 animals in the five regions surveyed. This estimate in itself is interesting in the light of the diminishing forest cover and increasing human population in Sri Lanka. The island of Sumatra which is more than 7 times the size of Sri Lanka is estimated to have only between 2,800 and 4,800 elephants (Santiapillai & Widodo, 1993).

Conclusion

The preliminary survey of elephants carried out in June 1993, represents an attempt on the part of the Department of Wildlife Conservation to update the status of the elephants in the wild. It recognizes the fact that the current political situation prevailing in the country does not permit an island-wide survey of the elephants, as many areas in the North and East are in the North and East are inaccessible and/or dangerous. Information on the changes in the structure of the elephant population on a yearly basis would be useful if measures aimed at its conservation in Sri Lanka are to be appropriate and effective.

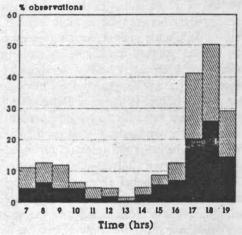
Any real understanding of what is happening to the wild elephant populations in Sri Lanka depends on several factors such as the size of the population, its rate of reproduction, its natural mortality rates, and the number and ages of elephants that are being slaughtered these days by poachers and pastoralists alike. Such information is necessary to predict the fate of the elephant populations. But to obtain such reliable information, scientific research must be carried out at regular intervals. The present survey, carried out by a large number of people represents a scientific basis for the long term monitoring of the elephants in Sri Lanka.

Activity Pattern Northwestern Region



MIN Groups

Activity Pattern Mahaweli Region



Bulls A Groups

FIg. 14

Activity Pattern Central Region

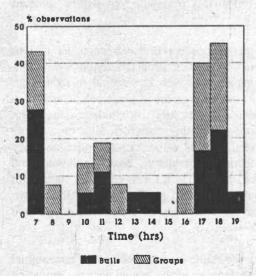


Fig. 15

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% of Tuskers Regions

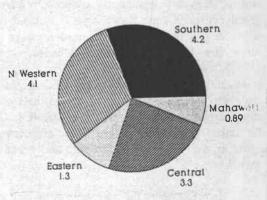


Fig. 16

The objective of elephant conservation is to protect as many individuals of the species as possible in as wide a rage of its habitats as is practical by preventing or minimizing the spatial competition with man and by preventing or controlling predation of elephants by man. The attainment of this objective will be subject to constraints that will determine the boundary between the possible and the impossible (Parker, 1981). Sri Lanka's vigorous human population growth, which generates land hunger shows no signs of slackening; and the island's political turbulence compromises law enforcement. Time, money, and trained manpower often act as brakes on what can be done to minimize the problem of elephanthuman conflicts. The root cause of elephant depredations in Sri Lanka is deforestation and conversion of forests to monoculture plantations. Although human population pressure, land hunger and a need for fuelwood have all helped to cause deforestation, it has also been encouraged enormously by bad economics and poor planning. Even the World Bank has realized at last that the forest is far more productive than the scrubland that succeeds it once it is cleared. It is a fallacy to believe that fragile forests can be easily cleared and farmed. Such a belief ignores the ecological costs of deforestation: soil erodes, rainfall diminishes, water supplies become less reliable, rivers silt up, dams get clogged, humanwildlife conflicts escalate and such extinction-prone species as the elephant and other large mammals are often the first to become seriously endangered.

Sri Lanka is rapidly approaching a stage when all the remnants of natural environment will be contained in a patchwork of parks and reserves. Containing elephants within small patches of forest surrounded by dense and at times hostile human populations will inevitably lead to an escalation of contacts between man and elephant. Many of the protected areas in Sri Lanka are not large enough to accommodate the entire annual home ranges of herds of elephants. Ishwaran (1993) recommends the management of elephant habitat within the reserves to improve grazing opportunities for the elephants, otherwise they will be attracted by the cultivated land outside.

Currently there is considerable interest in the concept of forest corridors to link isolated elephant populations to secure reserves. Corridors, if properly established, would greatly enhance gene flow between isolated populations, which is essential to reduce the inbreeding depression. Inbreeding depression is more of a threat to small populations than large ones. But corridors can also cause problems. Unfortunately, as Simberloff and Cox (1987) point out, much of the current literature concerning corridors fails to consider potential disadvantages and often assumes potential benefits without catastrophes, and they may also increase exposure of the animals concerned to predators, domestic animals and more importantly to poachers (Simberloff & Cox, 1987). Thus, forest corridors should not be looked upon as a panacea to the elephant problems in Sri Lanka. Such corridors have costs as well as potential benefits and hence every case must be considered on its own merits.

In areas where the climate is stable and unpredictable natural disasters are rare, animal populations will reach a level close to the carrying capacity of the habitat near the saturation

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density K. The elephant is an extreme example of a K-selected species, with about 22-month gestation period and a large parental investment and therefore as Laws (1981) argues, reproduction is the actual regulatory process, limiting the size of elephant populations. Hence, regular monitoring of the elephant populations will provide the much needed information on recruitment rates.

The June 1993 survey of wild elephants in Sri Lanka carried out by the Department of Wildlife Conservation, despite its short comings, has provided considerable information on the structure, composition; age and sex ratios. It has also indicated areas where more detailed observations would be useful. Future surveys will have to be modified and standardized to be carried out in much shorter time interval in order to minimize the bias of over counting. There is however a danger in becoming over-cerebral in relation to elephant conservation. While basic knowledge clearly has its place, much needs to be done in the field to minimize the human-elephant conflicts.

Recommendations for long-term conservation of the elephant in Sri Lanka need not depend on precise quantification of its populations across the island. It is usually sufficient to know whether they exist in significant numbers within their range and thereafter, it is necessary to establish whether the populations are expanding, declining or remaining stable. The elephant in Sri Lanka must have somewhere to live and something to eat. Both requirements are likely to be in ever shorter supply in the years ahead, given the current trends in human population growth and economic development. On the one hand, people are tempted to have more and more consumer goods and on the other, they are asked to preserve natural resources: the two are incompatible. A population of 125 elephants in a particularly area today is of little significance, if the habitat is to be converted to sugarcane plantations in a few years' time! Popular support for conserving the elephants must be built by communicating the problems confronting elephants, and the role they play in Sri Lanka. Elephant conservation policies, however well rooted they may be in science, can succeed only if they are intelligible to the people concerned.

Conservation of elephants in Sri Lanka should not be viewed as a preoccupation of a few with a single species. It provides a practical means for enhancing the island's overall conservation capacity. As a super keystone species, the elephant plays a large role in structuring habitats and thus maintaining biological diversity. It is also a "flagship species" and its conservation will result in the maintenance of biological diversity and ecological integrity on a very large scale in Sri Lanka.

Distribution of Elephants N = 1,967

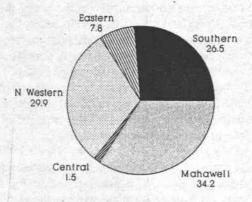
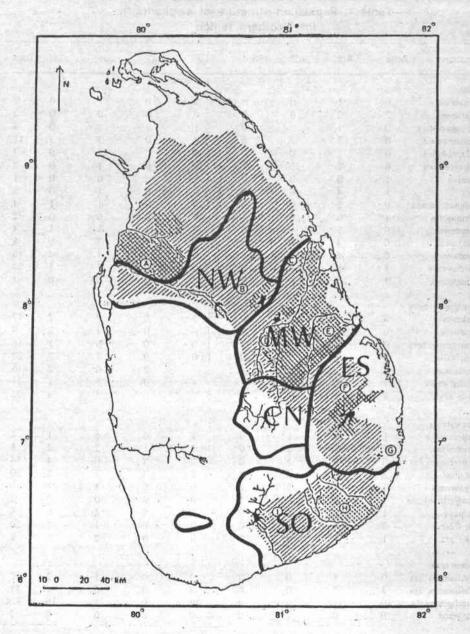


Fig. 17



The approximate boundaries of the four regions (NW=North Western; MW=Mahawell; ES=Eastern; CN=Central and SO=Southern) within which the elephant survey was carried out. The small area west of the Southern region refers to the Sinharaja forest. The hatched areas represent the approximate range of the elephant in Sri Lanka

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Table 1. Population structure of elephants in the Southern region

	Location	Adm	Adf	Ad?	SaM	SaF	Sa?	Juv	Cal	Tota
	Yala		EW N						4	
1	Nimalawa	0	1	0	0	0	0	1	0	
2	Palatupana	2	0	0	0	0	0	0	0	
3	Debragaswewa	0	1	0	0	1	0	1	0	
4	Meynetwewa	0	5	0	0	0	0	3	3	1
5	Wilapalwewa	0	1	0	0	0	0	2	0	
6	Mahaseelawa	0	2	0	1	0	0	1	0	
7	Uraniya	1	0	0	0	0	0	0	0	
8	Yala	1	4	0	0	0	0	1	0	
9	Kosgasmankada	0	2	0	0	0	0	1	1	
0	Rakinawala	1	0	0	1	0	0	0	0	
1	Pilinnawa	Ô	1	0	0	0	1	1	1	
2	Bambawa	0	4	0	0	0	1	3	0	
3	Heenwewa	0	6	2	0	0	0	4	4	1
4	Banduwewa	2	10	9	0	0	0	2	1	2
		1	0	Ó	0	0	0	0	0	Ob.
5	Sithupauwa					•				
	Lunugamwehera				0	3	0	0	2	
6	Paskema	3	5	4		. 0	0	1	2	313
7	Karawila	0	0	6	0					100
8	Lunugam wehera		6	0	3	0	0	6	1	
9	Tanamalwila	2	4	7	0	0	0	7	2	
0	Kitulkotte	0	9	1	2	2	0	0	2	1
1	Ratmalwewa	1	5	6	1	4	0	7	1	2
2	Kuda Oya	0	0	17	0	0	6	5	4	3
	Udawalawa									
3	Kaltota	1	2	1	0	1	0	1	- 1	
4	Kaudeliara	1	2	0	0	0	1	2	2	
5	Veheremankada	110-110-110-0	4		0	0	5	0	4	TE I
6	7th Post	3	6	0	4	2	0	3	2	1
7	Diyawinna	1	0	2	2	0	0	1	1	T.
8	Pinagasmankada		0	0		0	0	0	0	
19	Galpaya		2	0	o	1	0	2	0	1
10	5th Post	2	0	16	0	o	0	1	1	Table .
1	Mau ara	1	3	0	1	Ö	Ö	2	2	
	Moneragala									
12	Walliamma ara	0	4	0	0	0	0	1	2	
3	Walliamma ara		7	0	0	0	0	Ö	1	
34		10	32	0	9	29	0	28	16	1
15	Handapanagala Tunkema	0	0	2	ó	0	o	0	0	
	Kataragama									
16		0	1	0	0	1	0	0	1	
36	Kataragama Deiyanne Kem		0	0	4	0	0	1	2	
37		2 11	and the second second		4		U			

continued.....

Table 1. Population structure of elephants in the Southern region (continued)

	Location	Adm	Adf	Ad?	SaM	SaF	Sa?	Juv	Cal	Total
39	Pilimigala	0	0	0	2	0	0	0	0.	2
40	Katagamuwa	1	0	0	0	0	0	0	0	1
41	Uralu wewa	0	2	2	0	0	0	0	0	4
42	Unamula	1	0	0	0	0	0	0	0	1
	Bundala									
43	Bundala	. 0	0	2	0	0	0	0	0	2
44	Metigattewewa	4	3	0	0	0	0	0	0	7
45	Mattala	1	3	2	0	0	0	0	1	7
46	Weerawila	3	0	0	0	0	0	0	0	3
47.	Ridiyagama	0	2	3	0	0	- 3	2	2	12
	Sinharaja									
48	Sinharaja	1	0	1	0	0	0	0	0	2
	Total	49	141	85	31	44	17	91	63	521
	%	9.4	27.1	16.3	6.0	8.4	3.3	17.5	12.1	100
	%	ads	52.8%	sad	17.7%					

Legend: AdM = Adult Males; AdF = adult Females; Ad? = adults (unclassified); SaM = Subadult Males; SaF = Subadult Females; Sa? = Subadults (unclassified); Juv = Juveniles; Cal = Calves; ads = adults; sad = subadults

Table 2. Population structure of elephants in the Eastern region

	Location Ad	ME	AdF	Ad?	SaM	SaF	Sa?	Juv	Cal	Total
49	Ingeniaygala	0	0	2	0	0	0	0	0	2
50	Lahugala	0	2	12	0	0	11	4	2	31
51	Athimale	4	5	0	0	0	5	1	0	15
52	Mullegama	1	3	0	2	2	1	2	2	13
53	Ekgala ara	2	2	0	0	0	0	1	1	6
54	Nilgala	1	0	21	0	0	0	6	2	30
55	Kahatiyangwel	a 1	1	0	1	1	0	0	0	4
56	Ampara	0	0	0	0	0	5	1	0	6
57	Baduluwela	2	4	3 .	2	3	3	6	1	24
58	Pallan oya	1	5	5	0	0	4	3	5	23
	Total	12	22	43	5	6	29	24	13	154
	%	7.8	14.3	27.9	3.2	3.9	18.8	15.6	8.4	100
	%	ads	50%	sad	26%					

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Table 3. Population structure of elephants in the Mahawell region

Ī	Location	AdM	AdF	Ad?	SaM	SaF	Sa?	Juv	Cal	Total
59	Kaudulla wewa	2	0	6	0	0	3	2	0	13
60	Tummodera	4	3	0	0	0	3	4	0	14
51	Manampitiya	3	2	0	0	0	0	0	0	5
52	Hatareskotuwa	3	3	0	0	1	0	0	1	8
53	Sungawila	0	0	6	0	0	4	3	0	13
54	Gal oya Jct	4	5	0	0	2	1	0	1	13
	Minneriya									
55	Minneriwewa	2	9	0	5	0	0	0	1	17
56	Badepanwila	0	0	1	0	0	0	0	0	1
57	Katukaliyawa	0	0	0	1	0	0	0	0	1
58	Pubbiliya	2	2	0	0	σ	0	0	0	4
59	Elehara	0	1	2	0	0	1	1	0	5
70	Alikanda	0	1	0	1	0	0	0	1	3
71	Raja Bamma I	0	0	1	0	0	0	0	0	1
72	Siyambalapitia	0	0	7	0	0	5	3	1	16
73	Dastota	1	6	0	5	6	3	3	i	25
74	Raja Bamma II	i	0	0	0	0	ő	- 0	Ö	1
75		1	1	0	0	Ö	0	0	0	2
76		3	2	0	i	Ö	0	Ö	0	6
	Wasgomuwa									
77	Kiri ebbey	1	0	0	0	0	0	0	0	1
78	Kadurupitia	4	6	0	4	5	0	4	3	26
79	Wilmitiya	0	5	0	1	3	- 0	5	3	17
30	Namini oya	2	2	0	0	0	0	0	0	4
81	Kiri oya	2	2	0	. 0	1.0	0	0	2	7
32	Digannawa	2	1	0	0	0	0	1	2	4
33	Laggala	1	2	0	0	0	0	- 1	1	5
84	M'weliganga	5	6	2	0	0	0	7	6	26
85		1	2	0	0	0	0	0	2	5
	Sigiriya									
86	Ambagaswewa	1	1	0	0	0	0	0	, 0	2
87	Eerige oya	0	1	0	0	0	4	0	1	6
88	Minneriwewa	6	17	5	1	3	12	14	10	68
89	Dehiyatawala	0	4	0	1	0	0	1	0	6
90	Alakolawewa	2	4	2	2	- 3	2	3	2	20
91	Mailattewa	2	0	0	0	2	0	-0	1	5
92	Kosgahaella	0	0	0	0	0	- 1	1	0	2
93	Pahal Talkot	0	1	0	0	0	0	0	1	2
	Pimburettawa									
94	Yakkure	1	3	0	0	1	0	-1	0	6
95	Weeralanda	2	1	4	0	0	0	0	- 1	8
26	Kandegama	0	o	20	0	0	13	6	4	43
7	Veheragama	1	0	0	0	0	0	0	0	1
98	Palatiyawa	1	1	0	0	0	0	1	0	3
,0	Lauryawa	B. 1		U	3 1	U		tinued	_	,

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Table 3. Population structure of elephants in the Mahaweli region (continued)

	Location	AdM	AdF	Ad?	SaM	SaF	Sa?	Juv	Cal	Total
	Ulhitiya									
99	Ulhitiya	0	0	36	0	0	0	3	0	39
100	Kandeganwila	0	0	6	0	0	0	0	4	10
101	Gurukumbura	0	3	0	0	0	2	2	- al	8
102	Thimbirana	1	6	0	2	4	0	3	4	20
103	Rathkinda	1	1	0	0	0	0	0	0	2
104	Puwakpale	1	8	0	0	6	1	3	2	21
105	Iddapola	1	3	0	0	0	0	0	0	4
106	Rotalawela	2	0	0	0	0	0	0	0	2
	Maduru oya									
107	Maduru oya	1	12	6	0	0	5	8	12	44
108	Karagammana	0	6	0	0	2	0	1	0	9
109	Henanigala I	0	4	0	3	7	4	6	4	28
110	Henanigala II	0	2	0	0	0	0	1	0	3
111	Kadupara ella	3	2	0	1	1	1	2	2	12
112	Damanewela I	0	4	0	0	0	0	1	1	6
113	Damanewela II	0	10	17	0	0	11	6	4	48
114	Damanewela III	1	0	0	1	0	0	0	0	2
	Total	71	155	121	29	47	76	97	77	673
	%	10.5	23.0	18.0	4.3	7.0	11.3	14.4	11.4	100
	%	ads	51.6		sad	22.6				

Table 4. Population structure of elephants in the North Western region

	Location	AdM	AdF	Ad?	SaM	SaF	Sa?	Juv	Cal	Total
115	Kala oya	2	1.	18	0	0	9	8	4	42
116	Katupathewa	0	0	4	0	0	2	1	0	7
117	Galkiriyagama	5	7	10	0	0	7	9	4	42
118	Jayaganga	0	1	0	0	1000	0	0	1	3
119	Giribawa	10	11	0	9	5	0	6	7	48
120	Rambewa	0	0	3	0	0	0	0	0	3
121	Medawachiya	10	13	0	8	6	5	3	1	46
122	Ritigala	2	3	0	3	8	0	5	3	24
123	Kebitigollawe	2	2	1	0	0	0	2	1	. 8
124	Aliwadiya	2	4	0	2	5	0	5	3	21
125	Mihintale	4	4	1	1	2	2	1	3	18
126	Mahawilachiya	4	2	0	0	0	4	1	0	11
127	Kahallepallek	3	0	6	0	12	0	10	6	37
128	Kekirawe	15	10	20	0	0	0	8	5	58
				THE	Real of		COF	tinued		

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Table 4. Population structure of elephants in the North Western region (continued)

	Location	AdM	AdF	Ad?	SaM	SaF	Sa?	Juv	Cal	Total
129	Thirappane I	2	3	6	0	0	0	4	1	16
130	Thirappane II	4	1	1	1	1	0	2	0	10
131	Galengb'wewa	2	3	0	0	0	0	1	1	7
132	Tantirimale	6	12	0	0	0	0	2	3	23
133	Hakwtunawa	2	4	10	0	0	14	4	0	34
134	Hunuwilagama	0	0	0	1	0	5	1	1	8
135	Herathgama	0	0	2	0	0	0	0	0	2
136	Galgamuwa	0	0	- 11	0	0	6	1	0	18
137	Kokkawidawewa	0	1	0	1	1	0	1	0	4
138	Wilpattu I	2	1 .	0-	1	T	1	ê 0	0	6
139	Wilpattu II	1	0	0	0	0	0	0	0	1
140	wilpattu III	1	3	1	0	0	0	0	1	6
141	Wilpattu IV	0	4	2	1	1	0	0	0	8
142	Nawagathgama	3	6	0	2	4	0	5	3	23
143	Puttalam	0	0	3	0	0	0	0	0	3
144	tabbowa	1	1	0	0	0	0	0	1	3
145	Karuwelagasw	2	20	2	3	0	5	11	6	49
	total	85	117	101	33	47	60	91	55	589
	%	14.4	19.9	17.1	5.6	8.0	10.2	15.4	9.3	100
	%	ads	51.4		sad	23.8				

Table 5. Population structure of elephants in the Central region

	Location	AdM	AdF	Ad?	SaM	SaF	Sa?	Juv	Cal	Total
146	Minipe	. 2	3	0	0	1	0	2		9
147	Kirthibanda	1	0	0	0	0	. 0	0	0	1
148	Unagolla	1	0	0	0	0	0	0	0	1
149	Bolaganthawela	0	0	4	0	0	1	1	9	6
150	Bandaraketiya	0	-1	2	0 .	0	0	1	0	4
151	Heenganga	1	0	0	0	0	0	0	0	0.00
152	Uwaparanagama	0	2	0	0 .	1	0	2	0	5
	Haldumulla	1	0	0	0	2	0	0	0	3
	Total	6	6	6	0	4	1	6	1	30
	%	20	20	20	0	13.3	3.3	20	3.3	100
	%	ads	60		sad	16.7		PYPE PIEE		TO 1811

Table 6. Population structure of elephants In the five regions

25.		AdM	AdF	Ad?	SaM	SaF	Sa?	Juv	Cal	Total
5	Regions	223	441	356	98	148	183	309	209	1,967
	%	11.3	22.4	18.1	5.0	7.5	9.3	15.7	10.6	100

Table 7. Population structure of the classified elephants

Region	AdM	AdF	Sad	Juv	Cal	Total
Southern	49	141	92	91	63	436
Eastern	12	22	40	24	13	111
Mahaweli	71	155	152	97	77	552
N Western	85	117	140	91	55	488
Central	6	6	5	6	1	24
Total	223	441	429	309	209	1611
%	13.8	27.4	26.6	19.2	13.0	100

Table 8. Age and Sex ratios of the classified elephants

Region	Number	Bulls	Cows	Calves	Sex ratio
Southern	436	34.8	100	44.7	1:2.9
Eastern	111	54.5	100	59.1	1:1.8
Mahaweli	552	46.0	100	50.0	1:2.2
N Western	488	73.0	100	47.0	1:1.4
Central	24	100.0	100	17.0	1:1.0

Table 9. Proportion of tuskers among the elephants

Region	Tusker	No. adm	% Tusker	% Maknas	SadT	JuvT	Total
Southern	5	49	10.2	89.8	12	5	22
Eastern	1	12	8.3	91.7	1	0 .	2
Mahaweli	2	71	2.8	87.2	0	4	6
N Western	13	85	15.3	84.7	4	7	24
Central	0	6	0	100.0	0	1	1
Total	21	223			17	17	55
ачетаде			7.3	90.7		89.	

Note: adm = adult male; SadT = Subadult Tusker, JuvT = Juvenile Tusker

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Elephants in the Ruhuna National Park, Sri Lanka.
(Photo: Chries Santiapillai)