

Observations on Elephants in the Maduru Oya National Park, Sri Lanka (Mammalia, Elephantidae)

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ABSTRACT *Maduru Oya National Park (58,850 ha) was established as a new conservation area in the Accelerated Mahaweli Development Programme, mainly to accommodate some of the estimated 800 elephants that were displaced by the development activities. Prior to the development, the area was inhabited by elephants belonging to the subspecies *Elephas maximus vilaliya* referred to as the Marsh elephant. A preliminary study was carried out to determine the status of the elephants in the park from June to December 1989 in which a total of 1,162 animals were recorded in 87 observations. The population was characterized by female-biased sex ratios and adult-dominated age structures. The overall average adult male:female ratio was 1:2.4, but among the herds and bond groups it was 1:6. Tuskers were few and represented just 0.5% of the total population but made up 3.2% of the adult males. The population was characterized by both large group sizes and herd sizes. The largest group size observed was 65, while the largest herd observed had 52 animals. Stressful conditions brought about by the presence of human settlements and the reduction of habitat may have led to the formation of such large groupings. Both bulls and groups showed the highest activity during the late evenings. The population appears to be breeding well. Although calves were seen regularly during the study period, yet the calving intensity was not constant. More calves were observed in the wet season than during the dry season. The limited data points to an average calving interval of 5.6 years. The poor quality of food resources available to the elephants within the park could be one of the reasons for the movement of elephants into cultivated areas which offer more energy rich food. Given this situation, containing elephants within the boundaries of the park is difficult. Although the population is not yet adversely affected by poaching (given the inherently low numbers of tuskers in the area), the mitigation of human-elephant conflict remains the key to the long-term survival of the elephants in the park.*

Introduction

The Government of Sri Lanka embarked on an ambitious hydro-electric scheme in 1970 to harness the resources of the island's longest river, the Mahaweli Ganga to provide irrigation to boost agriculture and human settlement. The scheme known as the Accelerated Mahaweli Development Programme, called for the development of some 360,000 ha of land (of which 260,000 ha represented forests that had been cleared for agriculture) and the construction of a number of storage reservoirs. The Mahaweli basin was the home

of a population of the so called Marsh elephant (*Elephas maximus vilaliya*) estimated at that time to number about 800 animals (Anon, 1981; Jansen, 1986), and the planned development activities in the area were considered to pose a direct threat to these and other wildlife in the area. Therefore, in order to safeguard their long-term survival, a system of protected areas totalling some 218,000 ha was designed in and around the project sites (Fig.1). This network of protected areas included some reserves that were already in existence, and some new ones especially created to accommodate the elephants displaced from

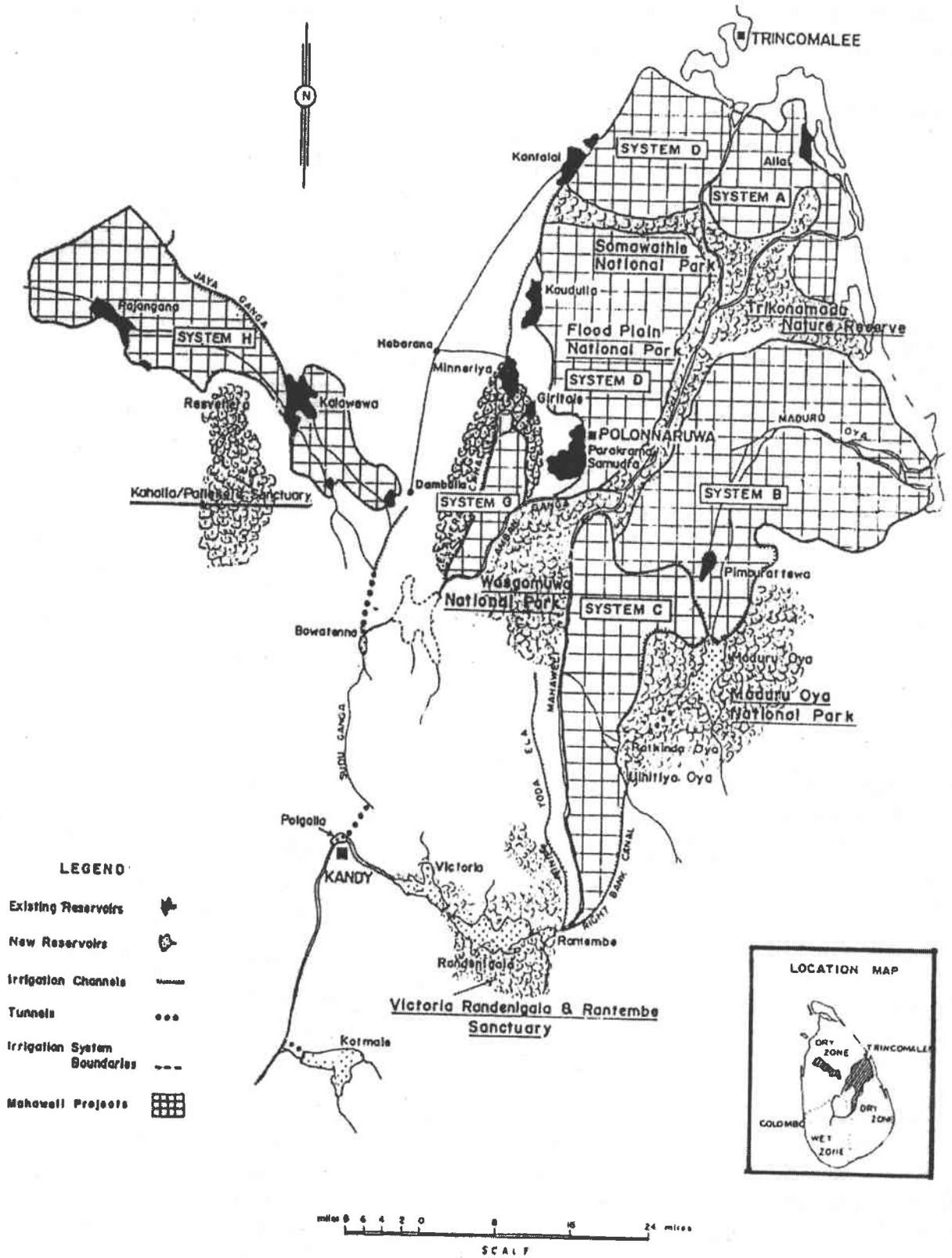


Fig. 1 Map of the Accelerated Mahaweli Development Programme Area, Sri Lanka

their original habitat. Maduru Oya National Park represents one of the new conservation areas added to the system of protected areas in Sri Lanka as a result of the Accelerated Mahaweli Development Programme. The original plan called for the linkage of Maduru Oya National Park with the Gal Oya National Park to the south through a forest corridor (Anon, 1981). By 1995, the Mahaweli Development Programme had settled a total of 20,653 families (or about 117,446 people) in System C, which adjoins the Maduru Oya National Park. This paper deals with a short study that was carried out in order to assess the status of the elephants in the Maduru Oya National Park, in the light of the changes in the demography of the area.

Study Area

Maduru Oya National Park (Fig. 2) with an area of 58,850 ha lies east of System C in the Dry Zone between the Polonnaruwa-Batticaloa road and Mahiyangana-Padiyatalawa road in the districts of Ampara, Badulla and Polonnaruwa, spanning the border between Eastern and Uva provinces ((IUCN, 1990). It was established in 1983 under the Fauna and Flora Protection Ordinance. The most conspicuous topographic feature is the 8 km-long range of rocky mountains in the south-west of the park. Wetlands constitute about 15% of the park and they include the Maduru Oya (6,100 ha), Ulhitiya (2,300ha), Ratkinda (1,000 ha), NDK (800ha), Henanegala (700 ha) reservoirs and tributaries of the Mahaweli and Maduru Oya river systems (MEP/DWLC, 1985;1987). The vegetation is tropical dry mixed evergreen forest characterized by tree species such as *Drypetes sepiaria* (weera), *Chloroxylon sweitenia* (satin), *Manilkara hexandra* (palu), *Limonia acidissima* (wood apple), *Pterospermum canescens* (velang), and *Cassia fistula* (ehela). Much of the park is dominated by grasses such as *Imperata cylindrica* (illuk), *Panicum maximum* (guinea grass), and *Pennisetum sp.* A rare and endemic tree *Vatica obscura*, the only species of the Dipterocarpaceae to occur in the Dry Zone, is found in some areas along the banks of the Maduru Oya and Gallodai Aru (IUCN, 1990). In addition to the population of el-

phants (*Elephas maximus*), the park also supports a number of threatened or endangered species of mammals such as leopard (*Panthera pardus*), sloth bear (*Ursus ursinus*), and water buffalo (*Bubalus bubalis*). Endemic species include the Ceylon jungle fowl (*Gallus lafayetti*), Broad-billed roller (*Eurystomus orientalis*) and the Toque macaque (*Macaca sinica*). The park's wetlands support a rich avifauna. In the past, some parts of the park were inhabited by veddhas - aboriginal people- who were traditionally hunters and gatherers. According to Urugoda (1969) the veddha families living at Dambana have retained a traditional lifestyle to some extent.

Methods

The study was undertaken as a part of the faunal survey of Maduru Oya National Park, under the Mahaweli Environment Project. One of the basic objectives was to obtain information on the status and ecology of the elephants in the area. Elephants were observed in Maduru Oya National Park for a total of 45 days from June to December 1989, between noon and 1900 hrs. Most of the observations were made in the north-western part of the park, where elephant activity was high. Special attention was paid to the north and north-western parts of the park, since areas adjoining them were already being developed. For the purpose of classification, the following categories based on Eisenberg & Lockhart (1972) were adopted: adult male, adult female, subadult, juvenile and calf. In addition, all the tuskers encountered, were identified. Whenever possible, every time elephants were encountered; their number, composition, location, time and activity were recorded. When such classification was not possible, a total count of the number seen was recorded under the category of "unclassified". All observations were made on foot and from a Jeep using a pair of 8x40 binoculars. In this study, a group refers to three or more animals of any age or sex moving together in a coordinated manner. Therefore, it excludes solitary and paired animals. A family unit or herd consists of a matriarch (oldest female) and her offspring excluding adult males. (Adult males could

however join such herds from time to time for the purpose of breeding but they are not an integral part of them). A bond group refers to an aggregation of two or more (usually related) family units. Most of the park lies between 30 and 150 m altitude. The park receives 1,650 mm of rain annually, during the north-east monsoon which lasts from October to January. Mean annual temperature is about 27° C.

Results and Discussion

Population structure

A total of 1,162 elephants were recorded in 87 observations (Table 1). On average, 25.8 animals were seen

per day (range: 15.0-37.9). Of the 434 animals that were classified, 240 (55.3%) were adults (males and females), 84 subadults (19.4%), 80 juveniles (18.4%) and 30 calves (6.9%) (Table 2). Such adult-dominated structure is characteristic of many elephant populations in Sri Lanka (Eisenberg & Lockhart; Ishwaran, 1981; McKay, 1973; Nettasinghe, 1973; Santiapillai *et al.*, 1984), including those in the Mahaweli region (Hendavitharana *et al.*, 1994). Such an age-ratio is not unusual in a species characterized by long life-span, gestation period and calving intervals. Of the total number of groups sighted, 25 (28.7%) were of family unit or herds and 35 (40.2%) were either lone males or male groups. Males were found singly (29% of the

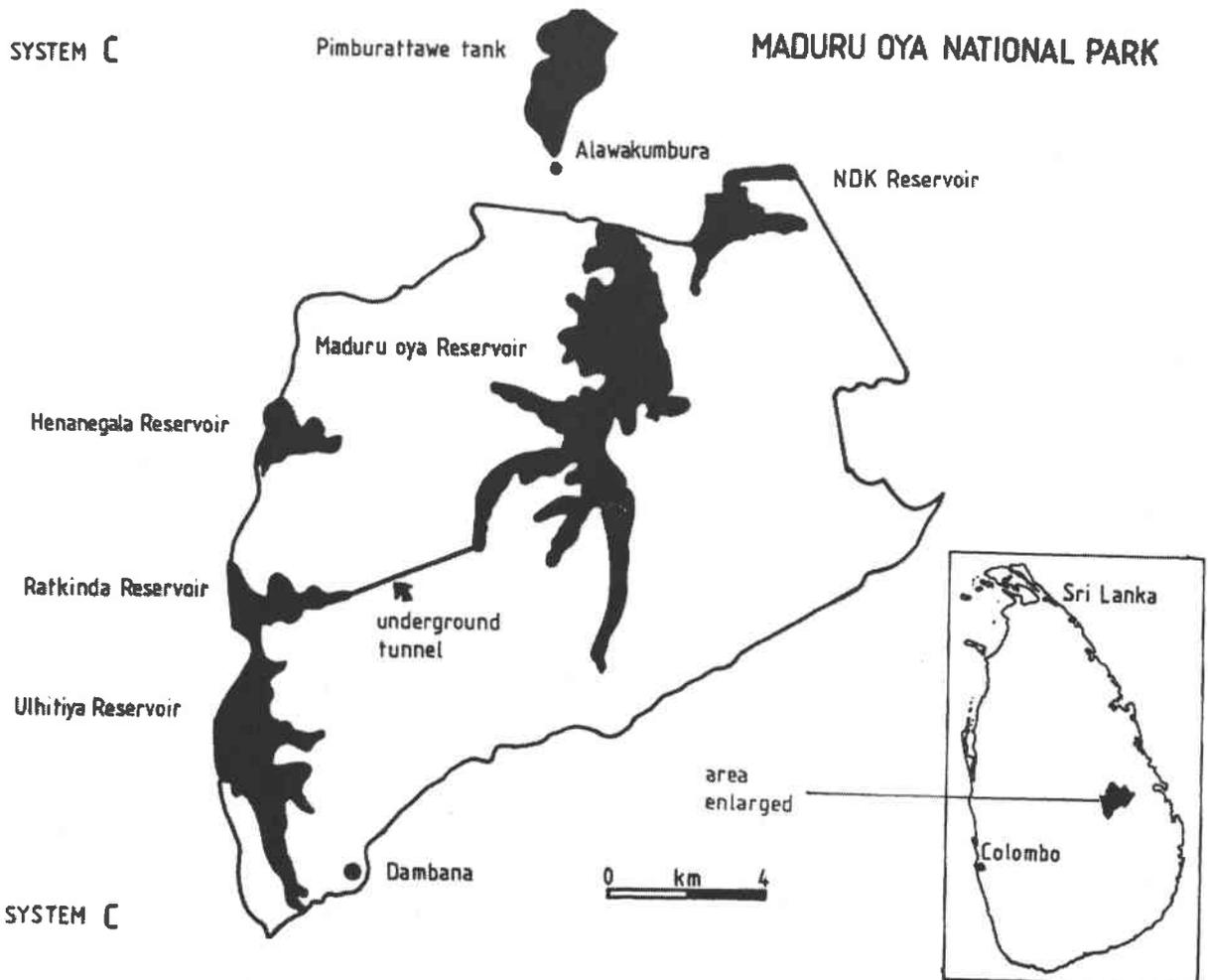


Fig. 2 Map of Maduru Oya National Park

sightings), in temporary all-male groups (range 2-3), or in association with females. There were only 6 tuskers, and they comprised just 0.55 % of the total population and 3.2% of the total number of bulls (n = about 190, obtained from 71 classified bulls and 119 estimated from the unclassified animals). By 1993, the proportion of tuskers among the bulls had declined to 2.8% in the Mahaweli area (Hendaavitharana *et al.*, 1994).

Sex-ratio

Elephant being a polygynous mammal, the 'natural' adult sex ratio is unlikely to be parity. However, there is evidence that the sex ratio in elephants does not vary from the expected ratio of 1:1 up to the subadult stage (Sukumar, 1989). In Sri Lanka, where most of the male elephants are makhnas (tuskless bulls), the ratio of male to female elephants is about 1:3 (McKay, 1973; Kurt, 1974). In Maduru Oya National Park, the observed average adult male:female ratio was 1:2.4 (Table 2), less skewed than the national average. In a

subsequent survey carried out in June 1993 too, the average adult sex-ratio was found to be similar (Hendavitharana *et al.*, 1994). This may indicate a low level of poaching in the area. According to Deraniyagala (1955) the lower Mahaweli River basin is the home of the subspecies, *Elephas maximus vilaliya* or the Marsh elephant, characterized by the lack of tusks among the bulls. The observed tusker:makhna (tuskless bull) ratio was 1:30. Although this may explain the low level of poaching on the few tuskers in and around Maduru Oya National Park, even tuskless elephants (makhnas) are killed when they come into conflict with farmers. Intense poaching on elephants can distort their age structure considerably and thereby have a major impact upon elephant population dynamics (Barnes & Kapela, 1991). But poaching in Sri Lanka is nowhere as serious as in some parts of South India. Indiscriminate poaching of the tuskers in the Periyar Tiger Reserve in South India has led to a bizarre sex-ratio of 1:101 in favour of the females (Ramakrishna *et al.* 1998)

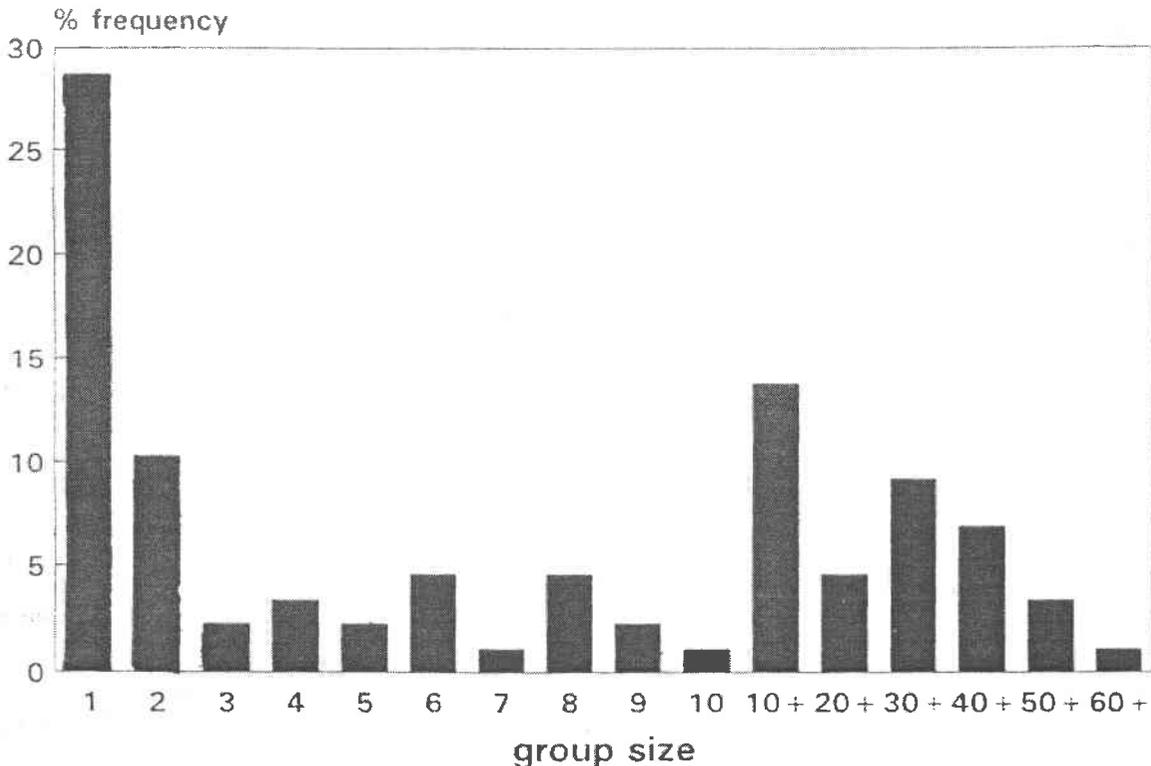


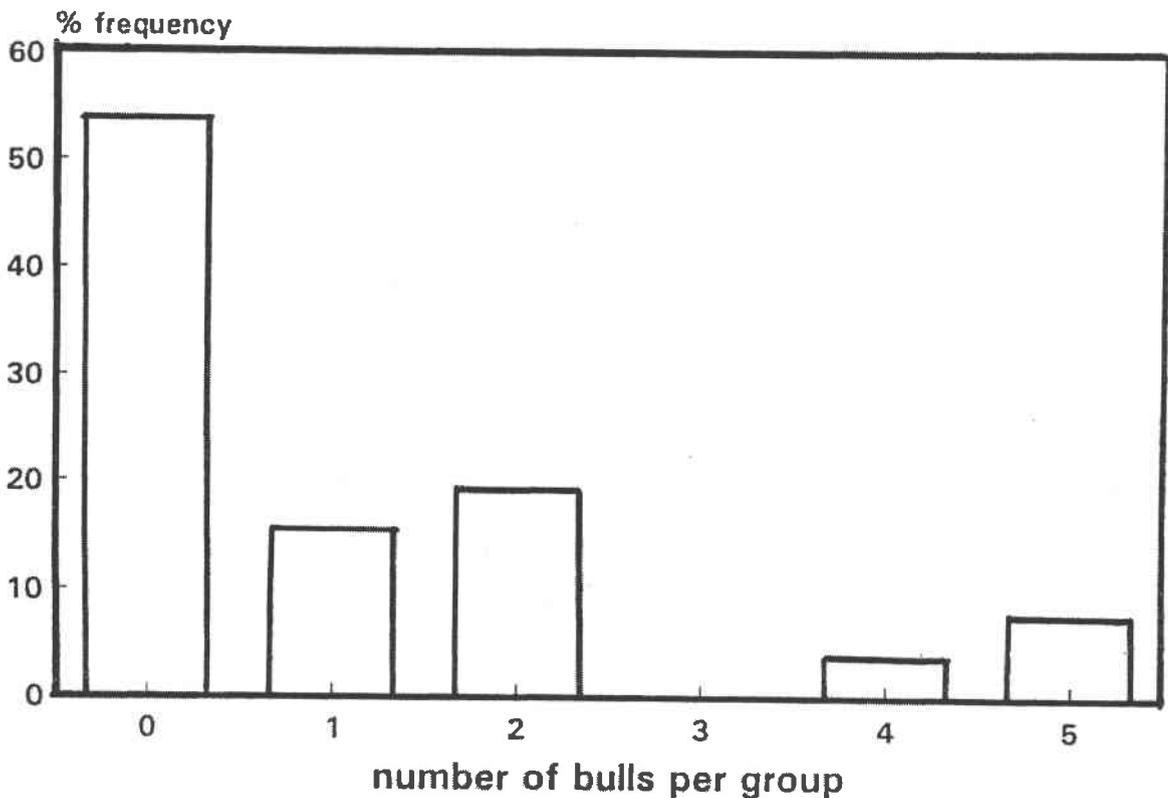
Fig. 3 Frequency of sightings for elephant groupings of various sizes

Table 1 Number and group sizes of the elephants seen in Maduru Oya National Park

| time | # of days | # of sightings | # of tuskers | largest group | total | # of animals observed/day |
|-------------|-----------|----------------|--------------|---------------|-------|---------------------------|
| June | 5 | 9 | 3 | 46 | 95 | 19 |
| July | 17 | 44 | 1 | 65 | 644 | 37.9 |
| August | 9 | 12 | 0 | 44 | 152 | 16.9 |
| September | 6 | 10 | 2 | 38 | 90 | 15 |
| October | 6 | 7 | 0 | 50 | 116 | 19.3 |
| November | 1 | 4 | 0 | 31 | 31 | 31 |
| December | 1 | 4 | 0 | 12 | 34 | 34 |
| Total (av.) | 45 | 87 | 6 | (409) | 1162 | (25.8) |

Table 2 Monthly changes in the composition of elephants

| | Adult male | tusker | adult female | subadult | juvenile | calf | total | not classified |
|-----------|------------|--------|--------------|----------|--------------|------|----------|----------------|
| June | 6 | 3 | 59 | 9 | 15 | 3 | 95 | |
| July | 35 | 1 | 58 | 41 | 33 | 9 | 177 | (467) |
| August | 10 | 0 | 17 | 5 | 15 | 4 | 51 | (101) |
| September | 3 | 2 | 13 | 4 | 8 | 3 | 33 | (57) |
| October | | 0 | 16 | 19 | 6 | 7 | 56 | (60) |
| November | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (31) |
| December | 3 | 0 | 6 | 6 | 3 | 4 | 22 | (12) |
| Total | 65 | 6 | 169 | 84 | 80 | 30 | 434 | (728) |
| | adult 240% | | subadult 84% | | juvenile 80% | | calf 30% | |
| | 55.3 | | 19.4 | | 18.4 | | 6.9 | |

**Fig. 4** The proportion of adult bulls seen in elephant groupings

Group size

Of the 87 observations made on elephants, 25 (28.7%) were of solitary animals, all of them being bulls (Fig.3). Paired animals composed of bulls, made up 10.3% of the observations. Besides the solitaries and pairs, group sizes of 11-20 animals were the most frequently observed. The largest group size observed was 65 (Table 1). It is interesting to note that of the 53 observations of elephant groupings (excluding solitaries and pairs), 34 (64.2%) were of large size having more than 10 animals, while only 19 observations (35.8%) were characterised by small size of between 3-10 animals. Thus elephants frequent Maduru Oya National Park in large groups of about 40 animals (Table 1). Furthermore, the larger groups were seen mostly during the dry season (between June and October). In general, animals living on open ground are found in large groups than those living in forests (Dasman & Taber, 1956; Peek *et al.*, 1974; Franklin *et al.*, 1975). There could be several reasons for the formation of large groups in Maduru Oya National Park.

Table 3 Monthly changes in the proportion of calves per 100 females

| | % males | 100 females | % subadults | % juveniles | % calves |
|-----------|---------|-------------|-------------|-------------|----------|
| June | 10.2 | 100 | 15.3 | 25.4 | 5.1 |
| July | 62.1 | 100 | 70.7 | 56.9 | 15.5 |
| August | 58.8 | 100 | 29.4 | 88.2 | 23.5 |
| September | 38.5 | 100 | 30.8 | 61.5 | 23.1 |
| October | 50.0 | 100 | 118.8 | 37.5 | 43.8 |
| November | - | - | - | - | - |
| December | 50.0 | 100 | 100.0 | 50.0 | 66.7 |
| Total N | 71 | 69 | 84 | 80 | 30 |
| /100 cows | 42.9 | 100 | 49.7 | 47.3 | 17.8 |

Much of the forest has been already degraded and vast areas of grasslands dominate the landscape. Such habitat topography can promote the formation of large groups. Large group size may give more protection from disturbance in open areas (Jarman, 1974). On the other hand, the large groupings seen in Maduru Oya National Park may reflect stressful conditions brought about by the human settlements in the vicinity

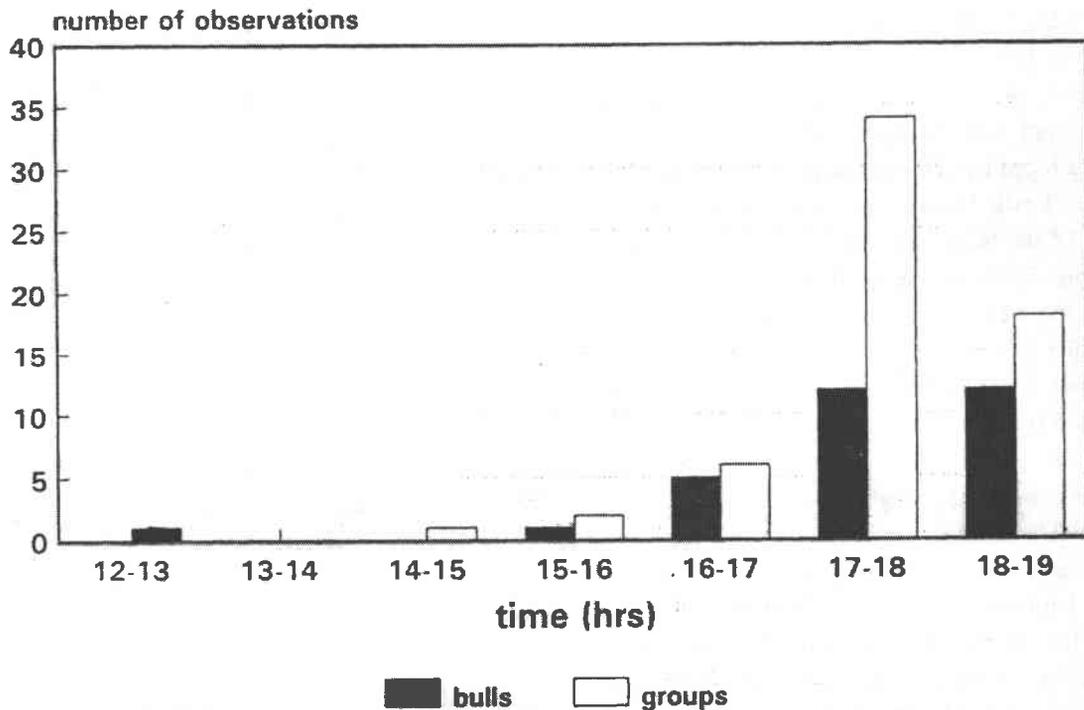


Fig. 5 Diurnal activity patterns of the elephant bulls and groups

of the 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 groups is the result of stressful conditions. It is likely that social factors in the area are responsible for the increase in group size. The stress may arise from the reduction of the habitat available to elephants as a result of conversion of forests in the area and the establishment of human settlements and agriculture. As Ishwaran (1998) points out, frequent random aggregations among elephants in Sri Lanka could be directly related to losses in their home range as a result of human encroachment. Moss (1988) has suggested that there are social and reproductive benefits to be gained from formation of large aggregations in the case of African elephant (*Loxodonta africana*). About 53.8% of the groups had no adult males, while 15.4% had only one male, and 19.2% had 2 males (Fig.4). The largest number of males seen in any group was 5.

Herd size

During the study 26 separate herds (including some bond groups) were identified (Table 4). The herds represent fairly stable associations of elephants characterized always by the presence of at least one matriarch (the oldest female), and a number of adult females (allomothers), and young. Adult bulls are not an integral part of the herd, but they are known to associate from time to time with the herds for the purpose of breeding. This is indicated by the observed average adult male:female sex-ratio of 1:6 biased largely in favour of the females (Table 4). Adult males represented only 7.2% of the total. Of the 26 herds recorded in the area, 14 (53.8%) were without any adult males, while 4 herds (15.4%) had only a single male. The highest number of adult males seen with the herds was 5 (Fig. 4). It is interesting to note that the herd size ranged from 3 to 52, and the average herd size of 15 is one of the highest recorded anywhere in Sri Lanka. The average herd size recorded in Ruhuna National Park, was 5.9 (Santiapillai *et al.*, 1984). All the large herds in Maduru Oya National Park were observed late in the evening, after 1700 hrs, and so could represent bond groups. Small related herds are known to join with other herds in the evenings, while feeding on grasslands or drinking from river or water

holes. The large herd size may reflect stressful conditions in the area as a result of the human settlements. On the other hand, the large herd sizes observed may refer to the bond groups which are formed by the aggregations of a number of usually related family units. Calves represent 7.7%, which translates into a inter-caving interval of 5.6 years.

Table 4 Herd composition of elephants in Maduru Oya National Park

| herds | adult males | adult females | subadults | juveniles | calves | total |
|-------|----------------|------------------|-----------|-----------|--------|-------|
| 1. | 1 | 4 | 3 | - | - | 8 |
| 2. | - | 34 | - | 9 | 3 | 46 |
| 3. | 1 | 21 | 6 | 6 | + | 34* |
| 4. | - | 24 | 12 | 15 | 1 | 52 |
| 5. | - | 5 | 3 | 3 | - | 11 |
| 6. | - | 4 | 6 | 1 | 1 | 12 |
| 7. | - | 1 | 1 | 3 | 1 | 6 |
| 8. | - | 1 | 4 | - | - | 5 |
| 9. | - | 2 | 4 | - | - | 6 |
| 10. | - | 4 | 2 | 1 | 1 | 8 |
| 11. | 2 | 3 | - | - | 1 | 6 |
| 12. | 2 | 3 | - | - | 1 | 6 |
| 13. | 2 | 6 | 6 | 10 | 3 | 25 |
| 14. | 4 | 5 | 2 | - | - | 11 |
| 15. | 5 | 5 | 2 | 4 | - | 16 |
| 16. | 2 | 4 | 1 | 5 | 2 | 14 |
| 17. | - | 2 | - | 1 | - | 12 |
| 18. | - | 6 | 2 | 5 | 2 | 15 |
| 19. | 1 | 7 | 3 | 1 | - | 12 |
| 20. | - | 2 | 1 | - | 2 | 8 |
| 21. | - | 4 | 1 | 3 | 1 | 9 |
| 22. | 2 | 1 | - | 2 | - | 5 |
| 23. | 5 | 15 | 19 | 4 | 7 | 50 |
| 24. | 1 | 2 | 2 | 2 | - | 7 |
| 25. | - | 1 | 2 | - | 1 | 4 |
| 26. | 2 | 3 | 2 | 1 | 3 | 11 |
| Total | 28 | 169 | 83 | 80 | 30+ | 390 |
| % | 7.2 | 43.3 | 21.2 | 20.5 | 7.7 | 100 |

*It is likely that calves present in this herd were missed during the observation.

Feeding activity

Fig. 5 summarises the diurnal feeding activity patterns of the bulls and groups. It is interesting to note that the mixed groups of elephants show a pronounced peak in activity about 1700 hrs, followed by a decline in activity at 1800 hrs, and the bulls continue their activities at the same level from 1700 to 1900 hrs. This is related to the feeding behaviour of the elephants in areas close to human settlements and agriculture. Most of the solitary elephants were observed crossing into the adjoining settlements to the west in System C, which is heavily populated. The fact is that mixed groups of elephants made up of matriarchs, allomothers and young ones, do not take great risks in moving into cultivated areas. They raid crops during the nights and move back into the safety of the forest. By contrast, the males appear to take more risks into moving out of their natal area into cultivated land for raiding crops which have a high nutritive content. Relatively more adult and sub adult males were seen moving into cultivated areas in the late evenings. As Sukumar & Gadgil (1988) argue, this high level of crop raiding by male elephants is a consequence of the "high-risk, high-gain" strategy to enhance their reproductive success. The cultivated crops provide more crude protein than do the wild plants. Bull elephants not only raid more frequently they also consume more per capita compared to members of the family units.

Recruitment of young

The population of elephants seems to be breeding well. The proportion of calves per 100 females showed a steady increase from a low of 5.1 in the dry season month of June to a high of 66.7 in the peak rainy month of December, but the overall population of calves per 100 females was about 17.8 (Tables 3 & 4). This gives an average calving interval of 5.6 years. This slightly extended calving interval points to poor habitat quality within the park. Much of the area has been invaded by *Imperata cylindrica* and *Panicum maximum*, which are eaten by elephants only during their early stages of regeneration following burning

(Ishwaran, 1993). Although many previous research workers have concluded that there was no seasonal pattern of breeding among elephants in Sri Lanka, the limited observations made in Maduru Oya National Park appear to indicate that although breeding may go on throughout the year, the calving intensity could vary according to season. In Maduru Oya National Park, it appears that slightly more calves were produced during the wet season than in the dry season. The average number of calves per 100 females during dry season was 12.9 compared to 50.0 in the wet season. The production of most of the young during the optimal time for their survival to coincide with the onset of the rains will ensure the availability of high quality food rich in protein but low in fibre (Barnes, 1983). The key to the reproductive success of the elephants in Maduru Oya National Park, despite the poor habitat quality may be associated with the structure and composition of the family units. 87% of the herds classified had more than one adult female. Calf survival is affected by many factors, including the age of the mother, size of the family, number of allomothers, sex of the calf and environmental conditions (Moss, 1988)

Conclusions

Although a system of protected areas was established in the Accelerated Mahaweli Development Area in order to accommodate the elephants displaced from their original habitat, yet in practice containment of these elephants within the confines of the protected areas has proved almost impossible. The reason is two-fold: on the one hand, much of the habitat within the protected areas, such as Maduru Oya National Park is of poor quality, and on the other, the cultivations around these protected areas offer well irrigated, nutritionally richer food resources for the elephants almost year round. These two factors have resulted in the movement of elephants into cultivated areas, and increased incidents of crop depredation by the elephants. The original Master Plan recommended the establishment of forest corridors linking the Maduru Oya with the Wasgomuwa National Park to the north and the Gal Oya National Park to the south - east.

However, these recommendations were rejected as they were not economically feasible (TAMS, 1980) In the absence of such safeguards, elephants from Maduru Oya often utilize the fallow lands as grazing grounds during the dry season. Although mean group size of elephants usually decrease in poorer habitats (Leuthold, 1976), the observed large group sizes in the Maduru Oya National Park point to the presence of stressful conditions following range contraction. The Department of Wildlife Conservation has stationed two teams to drive the marauding elephants away from the development areas, but these units are ineffective as they are poorly equipped to deal with the problem. They have not even been provided with thunder flashes to drive the elephants away (Jayawardene, 1989). At the time of the study, the elephant population in Maduru Oya was not seriously affected by poaching, given the low number of tuskers in the area. But today even tuskless elephants (makhnas) are being killed in defence of crops by irate farmers. The human-elephant conflict has become a serious conservation problem that needs to be resolved or mitigated if elephants are to survive in the area. The reality is that nowhere in Sri Lanka can the entire home range of an elephant population be insulated from the disturbances by man. Containing elephants within small reserves that are surrounded by densely populated human settlements and perennial agriculture is becoming increasingly difficult in Sri Lanka and it calls for not only changes in the land use pattern and the establishment of a buffer zone outside the reserves but also for improved management of the grazing grounds within the reserves.

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