A strategy for the conservation of the Asian elephant in Sri Lanka

Charles Santiapillai, Prithiviraj Fernando and Manori Gunewardene

Introduction

The island of Sri Lanka is situated in the Indian Ocean between 5°54'N and 9°52'N and 79°39'E and 81°53'E, off the southern tip of Peninsular India. It is 434km long and 225km at its widest and has an area of 65,610km². The island shares much of its fauna and flora with India with which it was once a part, as is evidenced by its continental shelf and rock formations (Crusz 1973). A highland massif situated in the southern central part dominates the topography of the island. The highest peak is the Pidurutalagala Mountain (2,524m). Rivers in Sri Lanka are noted for their number rather than for their size, and radiate from the highlands like the spokes of a wheel. The island's longest river, the Mahaweli Ganga, is only about 330km long. The climate is strongly influenced by the monsoons. Despite its small size, Sri Lanka is the epitome of tropical fecundity in its plants, animals and people. It is biologically one of the richest and most diverse countries in Asia. With almost 20 million people it is also one of the most densely populated countries in the world, where a rapidly expanding human population is being maintained essentially by an agriculture-based economy.

The elephant has been so closely associated with Sri Lanka's history, culture, religions, mythology and even politics that it would be difficult to imagine the island without it. Besides its dominant role in the ecosystem, the elephant also highlights many of the ecological, economical and philosophical issues underlying wildlife management as a whole in the island. Given the small size of the island and the high human population density of 300 people/km², elephants are finding it increasingly difficult to move about and adjust their densities to the changing vegetation patterns. Expansion of agriculture and human settlements is leading to continuous contraction of habitat available to the elephant, resulting in the pocketing of elephant herds. Such pocketed elephants have no long-term future (Seidensticker 1984). Child (1995) argues that wild elephants are fundamentally incompatible with peasant agriculture unless the damage they cause can be compensated. However, the situation is somewhat different in Sri Lanka, where elephant presence was found to be incompatible with irrigated agriculture, but compatible with traditional slash-and-burn agriculture (Fernando et al. in press). The human-elephant conflict in Sri Lanka has reached alarmingly high levels during the recent past, and is the major cause of elephant mortality. Unless the problem is resolved or mitigated, it will ultimately lead to the elimination of most elephants that range outside the system of Protected Areas (PAs), which amounts to a significant proportion of the elephant population. Wild elephants also often kill people and destroy property. Therefore, as Child (1995) points out, if elephants and PAs are to survive on a significant scale, they must be "socio-politically acceptable, economically viable and ecologically sustainable". Today, the growing conflict between humans and elephants has become the major conservation problem facing the Department of Wildlife Conservation (DWC) in Sri Lanka. For elephant conservation to succeed in Sri Lanka, conservation efforts should be tied to the welfare of the people who bear the brunt of elephant depredations. Elephant conservation in Sri Lanka should not simply be a matter of protecting the charismatic species; it should also be about the well being and survival of the people who share their land with elephants.

Forest cover

Humans have occupied Sri Lanka for millennia, with the result that the natural forest cover has been greatly altered. The open grasslands (*patanas*) in the eastern highlands are said to have resulted from the destruction of the forests. But until relatively recent times, the island had a substantial forest cover. In 1880, about 83% of the island was forested, but over the years the forest cover began declining steadily. In 1956, it was estimated to be 2,900,810ha, comprising 44% of the land area (Andrews 1961). By 1981, it had declined further to 24.9% (Geiser and Sommer 1982). Between 1956 and 1983, the area of natural high forest declined at an average annual rate of 42,000ha from 2.9 to 1.75 million hectares (Anon 1986). According to Somasekaram (1988), natural forest cover has further reduced to about 22% (Figure 19.1). Much of the intact dry forests occur today within the PAs, in the drier parts of the island (Figure 19.1). Major causes of deforestation and forest degradation are permanent agriculture, fuel wood collection, tree plantations, forest fires, mining for gemstones, timber extraction, and urbanization (Collins et al. 1991). However, the current landscape of the dry zone is essentially a 'man-made' one. Sri Lanka has few natural standing freshwater bodies, but has tens of thousands of artificial reservoirs, known as *tanks*, that dot the dry zone landscape. In addition, most areas of the dry zone of Sri Lanka have come under cultivation at some time in the past. Consequently, with a few notable exceptions such as some areas in Wilpattu, Wasgomuwa and Yala, where mature high forests still exist, many of the forests in the dry zone are secondary climaxes consequent to historical cultivation or slash-and-burn agriculture. These two factors, i.e., ready availability of fresh water and secondary forests, both due to human alteration of the landscape, are perhaps the main reasons that Sri Lanka has a very high density of elephants (Fernando 2000).

Protected Areas

Conservation of nature and culture are ancient traditions in Sri Lanka. The tradition of setting aside areas for the express purpose of protecting wildlife goes back to the 2nd century BC. One of the world's first wildlife sanctuaries was established in the island during the 3rd century BC by King Devanampiyatissa under whose reign Buddhism was introduced into the island (IUCN 1990). But it was not until 1885, however, with the enactment of the Forest Ordinance No.10, that legal provision was made to protect wildlife through the establishment of sanctuaries, first at Yala in 1900 and then Wilpattu in 1905 (Hoffmann 1969; Crusz 1973). Today, Sri Lanka's commitment to wildlife conservation is underscored by the amount of land allocated to that purpose. This amounts to a total of 8,579km², or nearly 13% of the land area of the island spread across a system of PAs

(Figure 19.2), which number 73 (Table 19.1). But while most habitats are represented within the existing PAs, the coverage of tropical wet evergreen and hill forests is still far from adequate (MacKinnon and MacKinnon 1986). Almost all the major conservation areas lie within the dry zone (IUCN 1990), however not all of them support elephants. Given the small size of the country, and that a large fraction of elephant range occurs in non-conservation areas, PAs by themselves are not large enough to accommodate the entire current elephant population. The continued presence of elephants in non-conservation areas will inevitably result in some level of conflict, and management and mitigation of conflict is critical to elephant conservation. Therefore, as Child (1995) points out, the maximum number of elephants that a PA and its surrounding region can support depends not only on the carrying capacity of the land but also on the people's tolerance of the species.

Table 1. Protected Areas in Sri Lanka.

Category	Number	Area (km²)
National Park	14	4,968
Strict Nature Reserve	3	315
Nature Sanctuary	2	479
Sanctuary	54	2,815
Total	73	8,577

The Department of Wildlife Conservation (DWC) has always subscribed to the view that conserving biodiversity within PAs is an important part of sustainable development. The aim of the DWC is to develop an integrated system of parks, reserves and sanctuaries to achieve the objectives of wildlife conservation. PAs alone will not solve Sri Lanka's conservation problems, but they will certainly go a long way towards achieving them. Given the small size of the island, and the scarcity of land, establishment of new conservation areas has to be justified on ecological as well as economic terms. It is therefore significant that the DWC has established three new national parks: (i) Lunugamvehera in 1995; (ii) Minneriya in 1998; and (iii) Kaudulla in 2003; for the sole purpose of safeguarding the large number of elephants that regularly move in and out of these areas in response to changes in the availability of water and grazing grounds. Protection of these areas would greatly enhance elephant conservation.

Elephants in Sri Lanka

Status

To Buddhists and Hindus alike in Sri Lanka, the elephant has an enormous cultural and religious significance. No other animal has had such a close relationship with people

as the Asian elephant and still remained wild (Kemf and Santiapillai 2000). *Elephas maximus maximus* that is found in Sri Lanka is the *forma typica* of Linnaeus (Crusz 1986). It was thought to be distinct from the Indian subspecies, *Elephas maximus indicus*, on grounds of genetic divergence based on allozyme variation (Shotake *et al.* 1986). In addition, the flood plains of Mahaweli Ganga were known for some remarkably large animals, which were once thought to belong to a separate subspecies, *Elephas maximus vilaliya* (Deraniyagala 1951; de Alwis 1982), and were referred to as the marsh elephant or swamp elephant. But Ellerman and Morrison-Scott (1951) equate this with the nominate form as the subspecies of elephant inhabiting most of the island (McKay 1973). Recent genetic studies have not supported the case for a separate subspecies status for the Sri Lankan elephant (*Elephas m. maximus*) and its differentiation from those in mainland Asia (*E. m. indicus*). The Sri Lankan population shares several mitochondrial haplotypes with those in the mainland (Fernando 2000; Fernando *et al.* 2000, Fleischer *et al.* 2001). However, Sri Lanka has perhaps the highest genetic diversity of any of the 13 Asian elephant Range States; hence its elephant population is very important in terms of overall Asian elephant conservation.

The elephant has been protected in Sri Lanka since the 12th century AD (Wikramasinghe 1928). Wild elephants

in the Sinhalese Kingdom were the king's property and so they could not be captured or killed without his permission (Nicholas 1954b). Elephants were captured and tamed on behalf of the king for religious and ceremonial purposes, for use in war, as draught animals to haul timber, and for export. The hunting of elephants for sport was totally unknown (Nicholas 1954b). The systematic slaughter of elephants in general and the tuskers in particular, began with the arrival of the colonial powers and the introduction of firearms. The situation was exploited to such an extent that a Government Ordinance in 1891 banned the wanton destruction of elephants (Olivier 1978). The elephant was given full legal protection in Sri Lanka as early as 1937. However, legislation alone could not prevent the decline in its number and range across the island as a result of sport hunting (in the past), poaching for ivory, human encroachment, and the current escalation in the human-elephant conflict. While the African elephant's misfortune is its tusks, the elephant in Sri Lanka is being threatened more by habitat loss and fragmentation as a result of escalating human population than by poaching for ivory; given that today only about 7.3% of the bulls have tusks (Hendavitharana *et al.* 1994), in contrast to the situation in southern India where about 90% of the bulls are tuskers (Sukumar 1989). Elephant numbers have declined in recent times, largely due to the attrition of the animal's habitat. Therefore the long-term survival of the elephant in Sri Lanka is almost certain to be limited to PAs (Santiapillai *et al.* 1984). Today, the Asian elephant is listed in the Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), to which Sri Lanka is a signatory.

Distribution

In the historical past, elephants were found in the dry zone, the lowland wet zone, as well as in the cold damp forests of the mountains in the island. They enjoyed wide distribution and good numbers from sea level to the highest mountain ranges. They were reported from such present-day urban areas as Colombo, Kandy, and Ratnapura between 1669 and 1744 (McKay 1973). Their disappearance from the montane zone, according to Nicholas (1954b) began with the large-scale clearance of forests for the planting of coffee, and afterwards tea, during the first half of the 19th century. Even by the turn of the 20th century, elephants were distributed over much of the island (Phillips 1935). Today, except for a small remnant population in the Peak Wilderness area, elephants are restricted mostly to the lowlands in the dry zone (Figure 3). Over the past 200 years, changing human land-use patterns have extirpated elephants from the wet and fertile regions of the south-west of the island, during which time, according to Olivier (1978) the elephant population in Sri Lanka may have declined by over 65%.

Figure   1. The extent of forest in Sri Lanka.

Figure   2. Distribution of some of the Important protected areas in Sri Lanka.

With the exception of Wilpattu and Ruhuna National Parks, all other PAs are less than 1,000km² in extent. Many areas are less than 50km² and hence, not large enough to accommodate the entire home ranges of elephants that use them. Furthermore, the existing national parks and nature reserves are unlikely to incorporate the long-term ·and large-scale dynamics of ecosystems (Bengtsson *et al.* 2003). This problem was overcome to a certain extent in the Mahaweli Development Area, by linking PAs such as Wasgomuwa, Flood Plains, Somawathiya, and Trikonamadu resulting in an overall area of 1,172km² of contiguous habitat for elephants. Nevertheless, about 65% of the elephants' range extends outside the PAs.

Number

The number of elephants in Sri Lanka today is but a fraction of what existed about a hundred years ago (Santiapillai and Jackson 1990). How numerous elephants were at one time can be appreciated by a reference to the numbers captured or killed. Until 1830, elephants were so plentiful that their destruction was encouraged by the Government (Storey 1907), and rewards were paid for any that was killed (Baker, 1853). More than 5,000 elephants were eliminated systematically within a period of just 10 years (Tennent 1867). Major Rogers is credited with the slaughter of no less than 1,400 elephants (Storey 1907), while Captain Galway killed half that number and Major Skinner almost as many (Tennent 1867). In addition to sport hunting, large numbers were also captured for use both locally and abroad. Between 1863 and 1899, a total of 2,190 elephants were exported to zoos in the USA

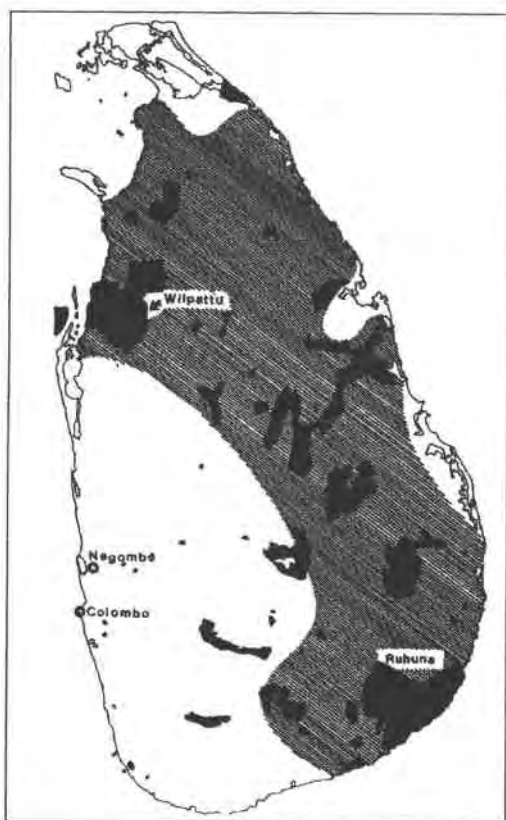**Figure   3 The approximate range of the Asian elephant in Sri Lanka.**

and Europe (Clark 1901), while large numbers went to princely courts in India (Marshall 1846). During the period of British rule, the population of elephants in the wild dropped from an estimated 10,000 to 2,000 animals (Schultz 1984), due partly to excessive hunting, but probably even more because of the loss of habitat when vast areas of forests in the hill country were clear-felled to make way for the establishment of coffee and, later, tea plantations. As a result, the elephant was eliminated from the hill country and the lowland wet zone, and at present survives only in the low country dry zone.

During the first half of the 20th century, Sri Lanka had some of the best, and probably the most wildlife conservation areas in Asia (Hoffmann 1983). Most of them were located in the low country dry zone, where human pressure was not serious enough to prevent the recovery of elephant numbers. McKay (1973) estimated a minimum population size of between 1,600 and 2,200 animals, while Hoffmann (1977) suggested a much higher total of 4,000. Since then, conversion of wild lands may have resulted in a decline. Estimates of elephant numbers in the wild in Sri Lanka vary and they underline the difficulty of counting even such large animals in the dense and tangled vegetation. The Department of Wildlife Conservation carried out a survey of elephants in much of the safe areas of the island in June 1993, and arrived at a minimum estimate of 2,000 elephants in the wild in the north-western, Mahaweli, central, eastern and southern regions (Hendavitharana *et al.* 1994). Today between 3,160 and 4,400 elephants are estimated to be present in Sri Lanka (Kemf and Santiapillai 2000) of which between 2,100 and 3,000 may entirely or partly use the PAs. All these estimates may turn out to be underestimates, given the difficulty of counting elephants in the scrub forest. The carrying capacity of elephant range in the island is high enough to maintain a population in excess of 4,000 elephants. The number of elephants in captivity has also declined from about 670 in 1955 (Deraniyagala 1955) to 317 by 1995 (Chin *et al.* 1998). The distribution of domesticated elephants is quite distinctive and does not overlap with that of the wild elephants. They appear to be confined to 14 smaller Districts out of a total of 22, in the south-west quarter of the island (Lair 1997).

Conservation issues

Human-elephant conflict

Wild elephants are unwelcome neighbours in agricultural areas. With their large size and intemperate appetite, elephants can easily destroy the entire cultivation of a peasant farmer in a single night. Therefore farmers view the elephant as a dangerous pest, and would rarely regret its disappearance from their area. Thus the conflict between man and elephant has become the most serious conservation problem facing the Department of Wildlife Conservation (DWC) in Sri Lanka today, where a combination of deforestation, agricultural expansion, and human population growth has substantially reduced the habitat that was once available to the elephant. The

ecological and social costs of clearing forests to resettle farmers have proved to be very high. Wild elephants have lost so much of their range in Sri Lanka that they are now being forced to prey upon the communities that have displaced them, and this has often been viewed as the crux of the human-elephant conflict. Since 1950, a minimum of 4,200 elephants may have perished in the wild as a result of the conflict between man and elephant in Sri Lanka. The conflict has escalated in the recent past: during the last decade alone, a total of 1,369 elephants were killed of which the largest numbers (526 animals or 38.4%) perished in the north-west (Hendavitharana et al. 2004). Gunshot injuries account for 56% of the elephants killed in the wild. Other causes of elephant mortality include electrocution (by being entangled with exposed naked wires left by farmers to protect their goods and chattels), poisoning, land mines, accidental falling into wells and abandoned gem pits, collision with vehicles (such as trains), and natural causes. As Hendavitharana et al. (2004) point out, the highest number of elephants (164) was killed in 1997, followed by 162 in the year 2001, which translates into a rate of over 3.1 animals per week. Such a high rate of elephant mortality is unsustainable, given the relatively small population of wild elephants in the island. Of the 1,369 elephants that died in the conflict, 925 (or 67.6%) were bulls while 321 (or 23.4%) were females from family units. Such directed slaughter can greatly affect the sex ratio. In addition to the loss of elephants, a total of 536 people were killed by wild elephants in Sri Lanka between 1992 and 2001, of which 400 (or 74.6%) were males, 70 (or 13%) females and 66 (or 12.3%) were children (Hendavitharana et al. 2004). The north-west accounted for many of the human fatalities, with 231 deaths (or 43%).

In most mammal populations, as Sukumar (1989) points out, the adult sex ratio is biased in favour of the females as a result of the observed higher natural mortality rate in males, and it is especially so in such a polygynous species as the elephant, where there is often a surplus of males, given that one male alone can mate with several females. In such instances, the observed adult sex ratio is unlikely to be parity. In Sri Lanka, the average overall adult male to female sex ratio was found to be 1:3 (Hendavitharana et al. 1994). But in certain areas in the north-west, as a result of the human-elephant conflict, the adult male to female sex ratio is 1:7, indicating a greater loss of bull elephants. What is worrying is that in addition to the bulls, even cows and calves have also been killed in the conflict.

Limitations of the system of Protected Areas

Conservation measures to date have mainly depended on legislative protection of the species and reservation of habitat – essentially keeping people and elephants apart. To its credit, Sri Lanka has set aside 8,577km² of the land as PAs for conservation of wildlife: this amounts to almost 13% of the land area. But most of the reserves are established on marginal lands to balance intensive land use in surrounding areas. This approach has led

to the establishment of a number of small reserves as islands in an intensively managed landscape. However, the system of PAs is not large enough to accommodate the entire current population of elephants. Of the 14 National Parks that cover an area of 4,987km², only two – Wilpattu and Ruhuna – are more than 1,000km² in size, while 11 are less than 500km². Most of the conservation areas are small with low area:perimeter ratios and many elephants that use them depend on non-conservation areas for their resource requirements in the dry season (Fernando et al. in press). The elephant is an 'edge species' preferring secondary habitat (Mueller-Dombois 1971). The main limiting factor for elephants in Sri Lanka is food, and food resources are abundant in regenerating forests, but at low density in mature forests. While traditional slash-and-burn agriculture creates optimum habitat for elephants, through promoting successional vegetation, the lack of habitat management in PAs, leads them to become mature secondary climaxes hence sub-optimal for elephants. The strategy of the DWC has mainly been directed towards limiting elephants to PAs by translocation and erection of electric fences. There is no reason to assume that the elephant populations in the PAs are at anything but the long-term carrying capacity of those areas, and in the absence of massive habitat management, translocation of large numbers of elephants into PAs may result in exceeding their carrying capacity, and hence be detrimental to elephant conservation (Fernando 1997). Thus, PAs alone as viable self-containing oases are poor bets for the long-term survival of the elephant given that almost 65% of the elephant range lies outside the system of PAs. If the elephant is to survive, there must be healthy populations living both within and outside PAs and a landscape approach integrating conservation areas and non-conservation area elephant ranges is required Thus there is a need to recognize that humans are a part of and not apart from nature. Accommodation, rather than protection would be the key to conservation success. This, as Bengtsson et al. (2003) point out, implies that conservation of biodiversity and preservation of ecosystem services is of concern for all land use.

Deforestation

The core of the elephant conservation problem in Sri Lanka today stems from the rapid loss of prime elephant habitat. In the wake of the Accelerated Mahaweli Development Programme (AMDP), thousands of hectares of lowland forest in the dry zone were lost. Of the total area of 364,200ha that were earmarked for irrigation, 260,000ha were new land, which overlapped known elephant ranges (Ishwaran and Punchi Banda 1982). The elimination of natural habitat on such a large scale was one of the most serious problems facing elephant conservation in recent times. The elimination and fragmentation of vast areas of natural habitat in the lower reaches of the Mahaweli Ganga under the AMDP was the single most serious setback to Sri Lanka's elephants in recent times. The greatest threat to elephants comes from an expanding human population

and its demand for land. Loss of significant extents of elephant range to development continues currently, with a number of irrigation and development projects leading to the conversion of more elephant ranges to irrigated agriculture and settlements.

Sri Lanka has already lost almost 80% of its original forest cover. The elephant is running out of space among almost 20 million people now living in Sri Lanka. In 1870 when the human population was 2.4 million, the land:man ratio was 2.7ha. Today, with a population of 20 million, the land:man ratio is 0.35ha. The ratio reduces even further to 0.15 if *chena*, pasture and *patanas* are excluded. Over much of the island, there is no longer room for elephants to move about and adjust their densities to changing vegetation patterns. Changes in land-use patterns are resulting in a continuous contraction of habitat available to the elephant. Conservation areas have shrunk as the number of people dependent on the land increases. As Laws (1981) observed in Africa, the situation in Sri Lanka too "has reversed from one in which human islands existed in a sea of elephants, to a sea of people with elephant islands". The day is rapidly approaching when the remnants of natural environment will be contained in a patchwork of parks and reserves. When elephants lose their range, they die (Parker and Amin 1980). The concentration of elephants in limited areas may lead to a buildup in their numbers, even though absolute population size may be decreasing (Laws 1981).

Forest conversion

Desai (1998) identified the loss and fragmentation of habitat as the major threat to the Asian elephant. In the Moneragala District, large areas of forest close to Yala (North), Gal Oya and Uda Walawe National Parks were converted to sugarcane plantations, despite the known appetite of elephants for sugarcane. Predictably the crops have been attacked by elephants resulting in massive economic losses to the sugarcane industry. The problem has been particularly severe in and around the Pelwatte Sugar Company plantation. Electrified fencing was established, but the elephant depredations go on, and both elephants and human beings are killed (Fernando 1987).

Human encroachment

In the Flood Plains National Park, official permits were granted for the establishment of 200 tobacco plots of 1.2ha each. In all, 430 such plots have been established, of which 230 were illegal. An increasing number of unauthorized tobacco cultivations along the riverbanks, and the establishment of brick kilns, which are affecting elephant movement, threaten the Somawathiya National Park. The manufacture of bricks goes on inside the National Park (Anon 1985), presumably using timber from the forest as firewood. In the Wasgomuwa National Park disused pits dug to excavate gemstones have proved a hazard to elephants and other wildlife (Anon 1985). Some elephants have fallen into the disused pits. A vast

majority (94% of the population) of Sri Lankans still depend on firewood and animal residues for cooking. Each family requires about 2 tonnes of firewood per year. There is also a substantial increase in the demand for industrial logs, which is expected to grow from 980,000m³ to 1.4 million m³. The Forest Department has been unable to curb widespread illegal felling outside the wildlife reserves and, based on current trends, it is only a matter of time before such activities spread into the reserves.

National Elephant Conservation Strategy

The strategy of the Department of Wildlife Conservation, as far as the elephant in concerned, is to conserve as many viable populations of the species as possible in as wide a range of its habitats as is feasible. This should mean protecting elephants both within the system of PAs and as many animals outside these areas that the land can support and landholders will accept (Child 1995), and not restricting elephants to the PA network alone.

Recommendations

Mitigation of human-elephant conflict

Despite the growing concern over the escalation of human-elephant conflict, the problem is far from being resolved satisfactorily. There is simply no all-encompassing solution for the problem, and each situation appears to warrant a unique approach (Dublin *et al.* 1997). Many techniques have been adopted by the villagers to prevent crop raiding, such as the use of thunder flashes, crackers, and noise to ward off elephants, but they soon learn to ignore them as bluffs. Given the serious increase in the incidence of the human-elephant conflict in agricultural areas, the DWC has identified three areas namely, the north-west, Mahaweli and the south for appropriate action. A National Workshop on Mitigating Human-Elephant Conflict was held in the north-west in which areas where the elephant-human conflict has been serious were identified. These include Kotavehera, Kalegama, Navagattegama, Galgamuwa, Giribawa, Kahalle-Pallekele, Galewela, Pibidunugama, Galkiriyagama and Karuwalagaswewa in the north-west, Heen Ganga to Dumbara valley in the vicinity of Wasgomuwa National Park; Sigiriya-Habarana area in the Mahaweli area and Ritigala-Kalawewa area; and Haldummulla, Uma Oya; the area between Lunungamvehera, Udawalawe and Bundala; Haltota-Haldummulla area north of Udawalawe National Park in the south.

The human-elephant conflict in Sri Lanka is a stark reality, and it is leading in just one direction: the destruction and eventual elimination of elephants from non-conservation areas, unless innovative measures are adopted to address the concerns of the farmers. The management of human-elephant conflict has to be integrated into a proper land-use policy and also must make the elephant an economic asset to the community. If people do not

derive economic benefit but only bear a cost by sharing resources with elephants, they cannot value living with elephants. If the local people could perceive the elephant as an economic asset instead of as an agricultural pest, then they will tolerate it on their land. One way that local people can benefit from the elephant in their midst is from the tourist revenues it generates, whether through community-based eco-tourism or through the manufacture of paper from dung, production of biogas from dung, or the promotion of organic farming using dung. The debate over elephants is an emotional one, between the preservationists and the pragmatists. The problem with wildlife is that the those who wish to preserve it, are rarely those who have to bear the cost. Given that the human-elephant conflict is already bad today, it may become worse tomorrow: therefore, even if we cannot eliminate the conflict altogether, we need to reduce it to tolerable levels.

Establishment of Managed Elephant Reserves (MERs)

One of the significant developments favouring wildlife conservation in general and elephant conservation in particular was the coming together of the Forest Department and the Department of Wildlife Conservation under the single Ministry of Environment and Natural Resources. Such a move has led to greater cooperation between the two departments and enabled the Department of Wildlife Conservation to acquire buffer zones and thereby extend the extent of the PAs. However, where buffer zone areas have been managed under traditional slash-and-burn agriculture, unless such areas are managed to the benefit of elephants through habitat management, paradoxically the increase in PA may result in the decrease in the number of elephants that can be supported by the area (Fernando et al. in press). The linking up of conservation areas such as Wasgomuwa, Flood Plains, Somawathiya and Trikonamadu resulted in the formation of an extensive area (1,110km²) for elephants. This represents the first attempt in Sri Lanka to incorporate the existing national parks and PAs into an overall development plan (Jansen 1986).

Conservation of elephants requires large areas: but setting aside sufficient habitat to preserve the current population of elephants which are large, highly mobile animals, with home ranges covering hundreds of square kilometres, and daily consuming > 100kg of fodder each, is almost impossible in Sri Lanka given its small size. Furthermore, given that almost 65% of current elephant range lies outside the PAs, it is inevitable that lands other than PAs need to be integrated, if elephant conservation is to succeed. They should be, as Santiapillai and Jackson (1990) point out, part of larger Managed Elephant Ranges (MERs) to provide sufficient space for elephant movements. Desai (1998) has suggested four substantially large key elephant conservation areas to be established in the north-western, Mahaweli, eastern and southern parts of Sri Lanka. These areas incorporate the forest reserves that lie adjacent to the PAs, and their role is to provide supplementary habitat. In view of the positive effects of traditional *chena* cultivation in creating elephant habitat (Fernando et al. in press), such areas are an important aspect of MERs and provide a mechanism for managing non-conservation area components of MERs. In many cases, integration of traditional agriculture areas with PAs, will allow elephants to range across a much larger landscape, where the PAs will support elephants at lower densities and represent elephant refuges, while the outside areas will continue to support high densities of elephants. Linking of PAs by significant blocks of traditional agriculture lands to form contiguous elephant habitat, rather than attempting to link PAs through narrow forest corridors, would represent a shift from previous management strategy, which was based on the idea that elephants lived in PAs and came out to raid crops and that they migrated long distances.

Recent research, using radio-telemetry, has shown that these assumptions are untenable, and that a landscape approach is essential for the conservation of elephants. Such an approach, based on Managed Elephant Reserves, offers perhaps the best potential to ensure elephant conservation in Sri Lanka and, as such, they need to be implemented. Of the four areas Desai (1998) identified, the southern cluster comprises eight reserves totaling an area of 206km². It can be further expanded to 1,323km² by linking it to: (a) the Kumbukkan Forest Reserve (376km²), which extends up to the Lahugala-Kitulana National Park in the east; and (b) other Government Forest Lands (741km²). Integration of non-conservation areas such as Mattala, Kuda Oya, Yala buffer zone, area north of Ruhunu National Park, etc. in a landscape management approach, will more than double the area available to manage elephants. The north-western cluster is based around the Wilpattu National Park. Although Wilpattu is not an ideal elephant reserve (C. Wickremasinghe pers. comm.), it does support a small population and hence linking it to the Giant's Tank and Madhu Road Sanctuaries in the north would ensure the free movement of elephants to and from the north. It would also increase the conservation area to 1,590km².

The eastern cluster covering a total area of about 2,788km² of which PAs and the rest by the Forest Reserves. Despite its large size, the eastern cluster is weak in design as the PAs occur in three distinct blocks separated by forests that are fragmented (Desai 1998). The Mahaweli cluster consists of 10 PAs totaling 1,704km² but has a large perimeter of nearly 580km (Desai 1998). The size of the conservation area can be increased to 4,132km², if Forest Reserves (1,521km²) and other forest lands (907km²) could be included. In creating MERs, it has to be realized that previous *ad hoc* development and historical location of villages, do not allow the creation of completely homogenous elephant habitat on a landscape scale. Permanent settlements and cultivations are incompatible with elephant presence, and those situated within MERs need to be fenced, so that conflict is minimized.

Establishment of elephant corridors

The idea of a corridor to promote the movement of wild elephants from one area to another was first put forward in Sri Lanka in the 1950s based on the assumption that elephants migrated long distances. However, current research has shown that elephants in Sri Lanka have well-circumscribed small home ranges of 50-150km^2 and that they do not have seasonal long distance migrations. In addition, the existence of a corridor many kilometres in length and a few kilometres wide, through cultivation areas, is likely to exacerbate the conflict with humans as elephants use such areas as refuges from which to raid crops. What has been observed through radio tracking 18 elephants in Sri Lanka is that many groups as well as males, have home ranges entirely outside PAs. Therefore, rather than proposing narrow corridors linking PAs, a strategy of managing these outside areas to form contiguous elephant habitat between PAs, would be a more desirable approach.

Habitat enrichment

The DWC has begun improving habitat conditions in a number of conservation areas with the view to enhancing their elephant carrying capacity. Furthermore, as Ishwaran (1993) recommends, fallow lands could become important grazing sites for elephants in the dry season. Research conducted in southern Sri Lanka has also shown that elephants use fallow *chena* lands intensively in the dry season, and that such areas provide critical food resources during the dry season (Fernando *et al.* in press). Elephants in the African savannah are known to extend their range into agricultural lands as soon as the intensity of farming activity is reduced (Lewis 1989). Ishwaran (1993) found that although most of the forests in the Mahaweli River Basin provide optimum habitats for elephants to rest and move through, did not in fact contain sufficient food on a year-round basis. Thus as Bengtsson *et al.* (2003) point out, such "static reserves should be complemented with dynamic reserves, such as ecological fallows and dynamic successional reserves, that are part of ecosystem management mimicking natural disturbance regimes at the landscape level". The Lahugala-Kitulana National Park, although small in extent (1,554ha) is an important grazing area for a large number of elephants (between 100-150 animals) that annually move to this area from outside to feed on beru (*Sacciolepis interrupta*), a tall reedy grass that covers the tank extensively. Considering the fact that a single elephant requires over 100kg of food every single day, growing food for elephants in the PAs is not a practical option. While it would be possible to manage PAs for elephants by intensive habitat management through practices similar to slash-and-burn agriculture, such management would be detrimental to many other species that require undisturbed mature forest. In addition, habitat management within the PAs to support high elephant densities would need to be conducted indefinitely, and would require immense long-term allocations of funds. The use of traditional agriculture practices to manage outside areas for elephants has the advantage that there is no expenditure incurred by the government and that both elephants and people benefit from it.

Determining the status of populations

Given the two decades of armed conflict in Sri Lanka, it was not possible to carry out any evaluation of the status of the elephants in the north and east. The armed conflict has created complex challenges for elephant conservation. In many areas in the north and east, it has had a profound impact on the environment, natural resources and biodiversity. An unknown number of elephants were maimed or killed by land mines. Thus, there is an need to carry out field studies in the extensive, hitherto unsurveyed areas of the north and east in order to identify elephant populations, estimate their number, and set aside land to safeguard as many populations as possible in order to minimize future conflict with man. The size and scale of the present conservation areas in the north are woefully inadequate to ensure the long-term survival of the elephant and other wildlife. Continued data collection on such populations will allow for the determination of long-term trends.

Controlling ivory poaching

Ivory carving in Sri Lanka is a very ancient craft (Nicholas 1954a) where master carvers enjoyed great prestige in the society and were accorded privileges by the kings. Tushes as well as tusks were used in ivory carving. Although the proportion of tuskers in Sri Lanka is the lowest among Asian elephants, at a time when elephants were so numerous, tuskers would not have been a rarity. According to Nicholas (1954b), in 1707 the King of Kandy was reported to possess 300 tuskers. Today, given the rarity of tuskers in Sri Lanka, ivory poaching is not a major conservation issue. Nevertheless, some trade in ivory still goes on. Sri Lanka being a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), has ordered that all elephant tusks and ivory carvings be registered with the Department of Wildlife Conservation (Santiapillai *et al.* 1999). Only registered ivory can be sold domestically. In a recent survey carried out by Martin and Stiles (2002), it was found that 22 out of 113 antique/craft outlets sold ivory, even though vendors knew that it was illegal to sell it. Kandy has been identified as the centre for such illegal trade. As Martin and Stiles (2002) argue, "this trend may give satisfaction to wildlife conservationists, but in another sense it is regrettable to see the end of a centuries' old tradition of producing fine art".

Improving the effectiveness of electric fencing

The use of electric fences as a psychological barrier against wild elephants was first tried out in Sri Lanka in 1966 (Jayewardene 1994). Today it has become a common management tool in mitigating elephant depredations in

agricultural and plantation areas. The Pelwatte Sugar Corporation has built about 280km of electric fence to protect its sugar plantations. The fence has could prove effective in reducing elephant depredations if it is constructed and maintained well. To date, over 500km of electric fence has been constructed in several parts of the island both by DWC as well as private companies and NGOs, and the DWC plans to extend its construction in several new areas in the north-west where the human-elephant conflict is most intense. However, with the exception of Uda Walawe and to some extent, Maduru Oya, electric fences have major flaws in strategy, design, structure and maintenance, making them ineffective (Desai 1998). It is therefore essential that the network of electric fencing be kept in good working order at all times. Elephants often test a fence to see whether it is working, and if it is not, they will break through (Osborn and Welford 1997).

Enhancing ex-situ conservation

Although the Elephant Orphanage at Pinnawala was established for the purpose of caring for displaced, orphaned or injured elephants, from its inception, the authorities concerned were keen to exploit the facility and promote the *ex-situ* conservation of the elephant through a carefully planned breeding programme, in which at least 18 calves were born between 1982 and 2000 (Tilakaretne and Santiapillai 2002). Today about 66 elephants are being kept in a 9ha abandoned coconut plantation. The close bonds between people and elephants in Sri Lanka that has enabled a few thousand elephants to co-exist with 20 million people in a land area only about 65,000km² is due to the close association between people and captive elephants. Therefore, continuation of such close ties is an important aspect of conservation, and the captive breeding facility at Pinnawela, can provide an important conservation service in this manner.

Integrating elephant conservation with economic development

As the decline of the elephant in the wild in Sri Lanka has been largely the result of socio-economic and political forces, it is important that its management and conservation should take into consideration human preferences and values. As White *et al.* (2001) argue, given the limited monetary resources available for nature conservation; policy makers need to be able to prioritize conservation objectives. The mitigation of the human-elephant conflict is high on the list of priorities of the Department of Wildlife Conservation (DWC) in Sri Lanka, which recognizes it as the most serious conservation problem in the island. According to Dublin *et al.* (1997), "Most wildlife managers in Africa now believe that the key to finding a long-term solution to the elephant problem is two-fold: to encourage national land-use strategies to minimize the occurrence of conflict situations, and to ensure that in areas here humans and elephants do overlap, that people derive some benefit from their presence."

The DWC plans to promote economic activities that would enable the local communities to derive some tangible benefits from the presence of elephants in their neighbourhood, e.g., manufacture of paper from elephant dung, organic farming using elephant dung, and production of biogas using a combination of elephant and cattle dung. As Shambaugh *et al.* (2001) point out, incentives for local communities to conserve resources and species decrease when economic benefits from them decline.

Conclusion

The prospects for long-term survival for the elephant in Sri Lanka are good. There is already a well-established PA network, which supports a significant proportion of the elephant population, and ensuring the future of the segment of elephants that range entirely inside PAs is both central and crucial to the conservation of elephants in Sri Lanka. Sri Lanka has an educated and enlightened public, which supports the conservation of wildlife and abhors wanton destruction of all forms of life. This is partly due to the influence of Buddhism and its pacific philosophy. But given the small size of the island, land is at a premium, and it is shrinking under the onslaught of a growing human population. Elephants and people are basically incompatible at any but the lowest densities. As their densities increase, people become more and more intolerant of wildlife that threatens their livelihoods. No amount of legislation and law enforcement will ensure the survival of the elephant outside the PAs, if measures are not adopted to compensate for the losses farmers suffer from elephant depredations.

Today, wild elephants are being killed at the rate of three animals per week. These are killed not for their meat, nor hide, nor tusks; they are being slaughtered simply because they interfere with agriculture and threaten the livelihood of people. The core problem here is the perception of the worth of an elephant by the rural people. They bear the total cost of sharing resources with elephants and gain no benefit, leading them to perceive elephants as an unwelcome burden and a dangerous pest. Elephant conservation, if it is to succeed in Sri Lanka, needs to exercise flexibility in the application of common sense and see that the cost is somehow converted into an asset to the people. As Child (1995) argues, if wildlife is permitted to contribute meaningfully to their life, people will not be able to afford to lose it in their battle for survival. If wildlife does not contribute significantly to their well-being, people will not be able to afford to preserve it, except as a tourist curiosity in a few PAs.

References

Andrews, J.R.T. 1961. *A forest inventory of Ceylon. A Canada-Ceylon Colombo plan project.* Government Press, Colombo, Sri Lanka. 116 pp.

Anon. 1985. Animals dumb witness in national parks. *The Island*. 11 August 1985.

Anon. 1986. *Forestry master plan for Sri Lanka*. Main report. Ministry of Lands and Land Development, Forest Resources Development Project. Jaakko Pyory, Helsinki, Finland. No. 1168. 79 pp.

Baker, S. 1853. *The rifle and the hound in Ceylon*. Tisara Prakasakyo Press, Dehiwela, Sri Lanka.

Bengtsson, J., Angelstam, P., Elmqvist, T., Emanuelsson, U., Folke, C., Ihse, M., Moberg, F. and Nystrom, M. 2003. Reserves, resilience and dynamic landscapes. *Ambio* 32: 389-396

Child, G. 1995. *Wildlife and people: the Zimbabwean success*. Wisdom Foundation, Harare, Zimbabwe and New York, USA.

Chin, H., Kumara, P., Piyadasa, W., Ganegoda, G. and Perera, V. 1998. *Domesticated working elephants in Sri Lanka*. Paper presented at the First National Symposium of Elephant Management and Conservation, 29-30 May 1998. Colombo, Sri Lanka.

Clark, A. 1901. *Sport in the low-country in Ceylon*. Tisara Prakasakyo Press, Dehiwela, Sri Lanka.

Collins, N.M., Sayer, J.A. and Whitmore, T.C. 1991. *The conservation atlas of tropical forests of Asia and the Pacific*. Macmillan Press, London, U.K.

Crusz, H. 1973. Nature conservation in Sri Lanka (Ceylon). *Biological Conservation* 5: 199-208.

Crusz, H. 1986. The vertebrates of Sri Lanka: endemism and other aspects. *Rep. Soc. Res. Native Livestock* 11: 65-80.

De Alwis, L. 1982. *River basin development and protected areas: a case study*. Session IIIA (Indomalayan). World Parks Congress, Bali, Indonesia.

Deraniyagala, P.E.P. 1951. Elephas maximus, *the elephant of Ceylon*. Vol. 1. National Museum of Ceylon, Colombo, Ceylon.

Deraniyagala, P.E.P. 1955. *Some extinct elephants, their relatives and the two living species*. Ceylon National Museum Publication, Colombo, Ceylon.

Desai, A. A. 1998. *Management strategies for conservation of elephants and mitigation of human-elephant conflict*. Technical Report under the GEF Project. Department of Wildlife Conservation, Colombo, Sri Lanka.

Dublin, H. T., McShane, T.O. and Newby, J. 1997. *Conserving Africa's elephant. Current issues and priorities for action*. WWF, Gland, Switzerland.

Ellerman, J.R. and Morrison-Scott, T.C.S. 1951. *Checklist of palaearctic and Indian mammals*. British Museum (Nat. Hist.), London, U.K.

Fernando, A.B. 1987. *Elephant conservation and management work programme - 1987/88*. Unpublished report, Dept. of Wildlife Conservation, Colombo, Sri Lanka.

Fernando P. 1997. Keeping jumbo afloat - is translocation the answer to the human-elephant conflict? *Sri Lanka Nature* 1: 4-12.

Fernando P. 2000. Elephants in Sri Lanka: past, present, and future. *Loris* 22: 38-44.

Fernando, P. and Lande, R. 2000. Molecular genetic and behavioral analysis of social organization in the Asian elephant (*Elephas maximus*). *Behavioural Ecology and Sociobiology* 48: 84-91.

Fernando, P., Pfrender, M.E., Enclada, S.E. and Lande, R. 2000. Mitochondrial DNA variation, phylogeography and population structure of the Asian elephant. *Heredity* 84: 362-372.

Fernando, P., Wikramanayake, E., Weerakoon D., Jayasinghe, L.K.A., Gunawardene, M. and Janaka, H.K. Perceptions and patterns of human-elephant conflict in old and new settlements in Sri Lanka: insights for mitigation and management. *Biodiversity and Conservation* (in press).

Fleischer, R.C., Perry, E.A., Muralidharan, K., Stevens, E.E. and Wemmer, C.M. 2001. Phylogeography of the Asian elephant (*Elephas maximus*) based on mitochondrial DNA. *Evolution* 55: 1882-1892.

Geiser, U. and Sommer, M. 1982. Up-to-date information on Sri Lanka's forest cover. *Loris* 16: 66-69.

Hednavitharana, W., Dissanayake, S., de Silva, M. and Santiapillai, C. 1994. The survey of elephants in Sri Lanka. *Gajah* 12: 1-30.

Hendavitharana, W., Amararathne, M. and Santiapillai, C. 2004. An assessment of the human-elephant conflict in Sri Lanka. *Current Science* (under review)

Hoffmann, T.W. 1969. The Wildlife Protection Society of Ceylon: some historical reflections on the occasion of its 75th anniversary. *Loris* 11: 1-13.

Hoffmann, T.W. 1977. Major threats to oldest wildlife reserve. *Loris* 14: 133-137.

Hoffmann, T.W. 1983. *Wildlife conservation in Sri Lanka: a brief summary of the present status*. Bomb. Nat. Hist. Soc. Centenary Seminar, Powai, Bomaby, India. 6-10 December 1983.

Ishwaran, N. and Punchi Banda, A. 1982. *Conservation of Sri Lankan elephant - planning and management of the Wasgomuwa-Maduru Oya-Gal Oya complex of reserves.* IUCN/WWF Project 1783. Final Report. 48 pp.

Ishwaran, N. 1993. Ecology of the Asian elephant in lowland dry zone habitats of the Mahaweli river basin, Sri Lanka. *Journal of Tropical Ecology* 9: 169-182.

IUCN. 1990. *IUCN directory of South Asian Protected Areas.* IUCN – The World Conservation Union, Gland, Switzerland.

Jansen, M. 1986. Conservation and development in Sri Lanka's Mahaweli River Basin Project. *Parks* 11: 4-7.

Jeyawardene, J. 1994. *The elephant in Sri Lanka.* Mortlake Press Ltd., Colombo, Sri Lanka.

Kemf, E. and Santiapillai, C. 2000. *Asian elephants in the wild. 2000 a WWF species status report.* WWF, Gland, Switzerland.

Lair, R. C. 1997. *Gone astray: the care and management of the Asian elephant in domesticity.* RAP Publication 1997/16. FAO, Bangkok, Thailand.

Lewis, D.M. 1989. Disturbance effect on elephant feeding: evidence for compression in Luangwa Valley, Zambia. *African Journal of Ecology* 24: 227-241.

MacKinnon, J. and MacKinnon, K. 1986. *Review of the Protected Area system in the Indomalayan Realm.* IUCN – The World Conservation Union, Gland, Switzerland.

Marshall, H. 1846. *Ceylon: a general description of the island and its inhabitants.* Tisara Prakasakyo Press, Dehiwela, Sri Lanka.

Martin, E. and Stiles, D. 2002. *The South and South East Asian Ivory Markets.* Save the Elephants, London, U.K.

McKay, G.M. 1973. Behavior and ecology of the Asiatic elephant in southeastern Ceylon. *Smithsonian Contributions to Zoology* 125: 1-113.

Mueller-Dombois, D. 1971. Crown distortion and elephant distribution in the woody vegetations of Ruhuna National Park, Ceylon. *Ecology* 53: 208-226.

Nicholas, C.W. 1954a The Ceylon elephant in antiquity. I. The Sinhalese period. *The Ceylon Forester* 1: 52-58.

Nicholas, C.W. 1954b. The Ceylon elephant in antiquity. Ii. The Portuguese, Dutch and British periods. *The Ceylon Forester* 1: 103-111.

Olivier, R.C.D. 1978. *On the ecology of the Asian elephant.* Ph.D thesis, University of Cambridge, U.K.

Osborn, F.V. and Welford, L.A. 1997. *Living with elephants: a manual for wildlife managers in the SADC region.* A USAID-funded publication.

Phillips, W.W.A. 1935. *Manual of the mammals of Ceylon.* Dulau and Co., London, U.K.

Santiapillai, C., Chambers, M.R. and Ishwaran, N. 1984. Aspects of the ecology of the Asian elephant *Elephas maximus* L. in the Ruhuna National Park, Sri Lanka. *Biological Conservation* 29: 47-61.

Santiapillai, C. and Jackson, P. 1990. *The Asian elephant: an Action Plan for its conservation.* IUCN – The World Conservation Union, Gland, Switzerland.

Santiapillai, C., Silva, A., Karyawasam, C., Esufali, S., Jayaniththi, S., Basnayake, M., Unantenne, V and Wijeyamohan, S. 1999. Trade in Asian elephant ivory in Sri Lanka. *Oryx* 33: 176-180.

Schultz, D. 1984. Another river dammed. *Journey, Australasia Geographic Magazine.* Pp.68-79.

Seidensticker, J. 1984. *Managing elephant depredation in agricultural and forestry projects.* A World Bank Technical Paper, Washington D.C., USA.

Shambaugh, J., Ogelthorpe, J. and Ham, R. (with contributions from Sylvia Tognetti). 2001. *The trampled grass: mitigating the impacts of armed conflict on the environment.* Biodiversity Support Program, Washington D.C., USA.

Shotake, T., Nozawa, K., Singh, M., Cyril, H.W. and Crusz, H. 1986. Genetic variabilities within and between Sri Lankan and Indian subspecies of the tamed Asian elephants, *Elephas maximus. Rep. Soc. Res. Native Livestock* 11: 215-221.

Somasekaram, T. (Ed.). 1988. *The national atlas of Sri Lanka.* Survey Department, Colombo, Sri Lanka.

Storey, H. 1907. *Hunting and shooting in Ceylon.* Tisara Prakasakyo Press, Dehiwela, Sri Lanka.

Sukumar, R. 1989. *The Asian elephant: ecology and management.* Cambridge University Press, Cambridge, U.K.

Sukumar, R. 2003. *The living elephants: evolutionary ecology, behavior, and conservation.* Oxford University Press, Oxford, U.K.

Tennent, J. E. 1867. *The wild elephant and the method of capture and taming it in Ceylon.* Longmans, Green and Co., London, UK.

Tilakaretna, N. and Santiapillai, C. 2002. The status of domesticated elephants at the Pinnawala Elephant Orphanage, Sri Lanka. *Gajah* 21: 43-52.

White, P.C.L., Bennett, A.C. and Hays, E.J. 2001. The use of willingness-to-pay approaches in mammal conservation. *Mammal Review* 31: 151-167.

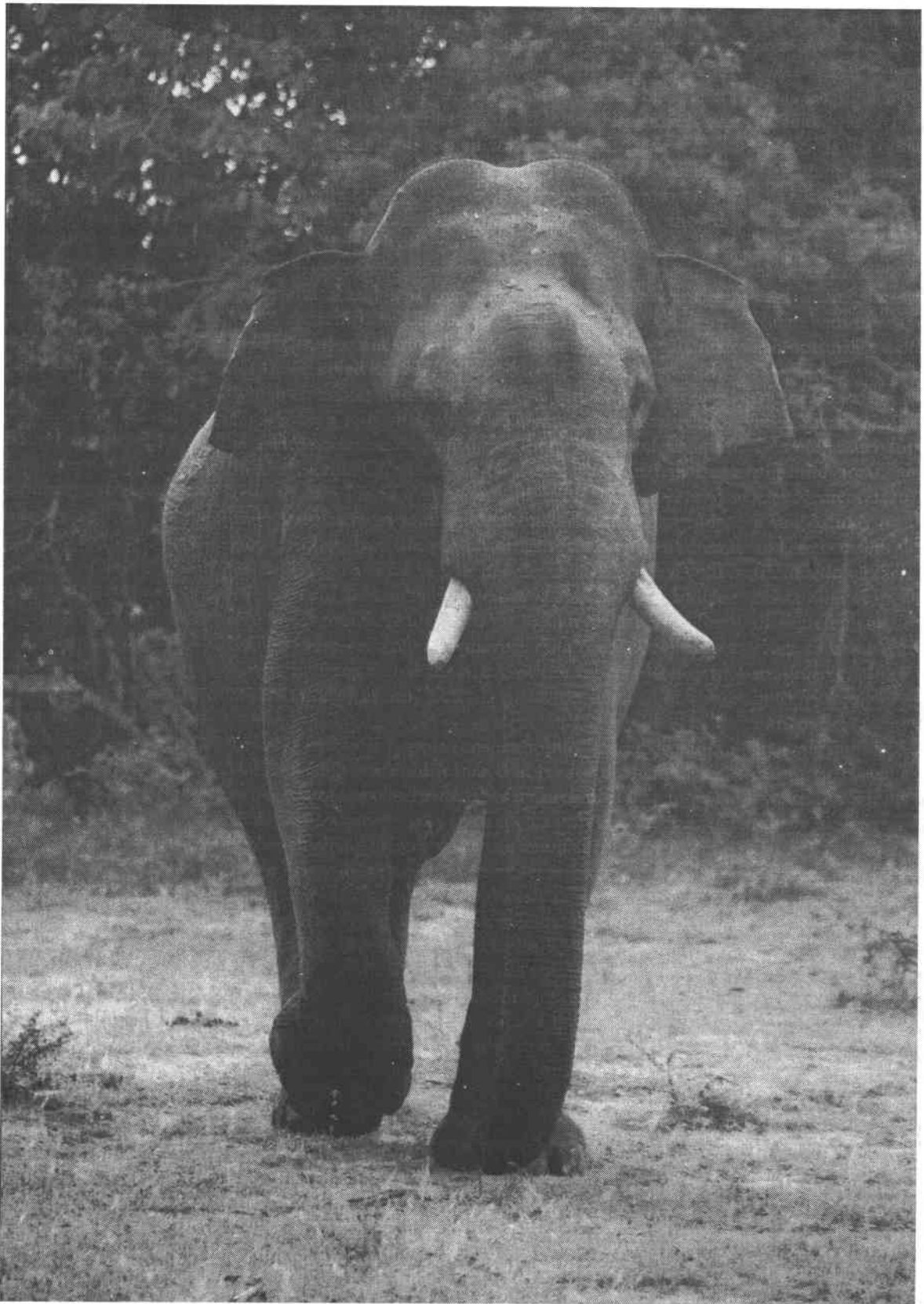Wikramasinghe, D.M. de Z. 1928. The slab inscription of Kirti Nissanka Malla (1187 to 1196 A.D) at Ruvanvali Dagaba, Anuradhapura. *Epigrapia Zeylanica* 2: 82-83.

Photo: Dr. H. I. E. Katugaha