GAJAH

Newsletter of the Asian Elephant Specialist Group



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Newsletter of the Asian Elephant Specialist Group
Number 10 **Spring 1993**

WWF World Wide Fund For Nature

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The Asian Elephant Specialist Group Newsletter is published with the following aims:-
- to highlight the plight of the Asian Elephant
- to promote the conservation of the Asian Elephant
- to provide a forum for communication amongst all the members

Newsworthy articles are invited for consideration for publication and should be sent to Dr Charles Santiapillai at 110 Wattarantenne Road, Kandy, Sri Lanka. All articles may be reprinted. Reprinted articles should give credit to the Newsletter. The editors would appreciate receiving a copy of any article so used. The opinions expressed by the authors do not necessarily reflect the policies of either WWF or IUCN.

Cover : One of the many *makhnas* (tuskless bull elephants) in the Ruhuna National Park, Sri Lanka.

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COMMENT

It is a truism that, at any but the lowest density, large wild animals and human beings are fundamentally incompatible. As the densities of both large mammals and man increase, this incompatibility increases as well. Throughout Asia, increasing human population and increasing agricultural land use have substantially reduced the area once available to the elephants. The situation has reversed from one in which man lived in small settlements in areas dominated by elephants to one in which the elephants find themselves confined to small patches of habitat, surrounded by a man-dominated landscape. The elephants and other wildlife have lost so much of their former habitat, that they are often forced to invade the communities that have displaced them. This is the crux of the elephant-human conflicts in Asia. Depredation by elephants has become a way of life.

There is a relationship between tolerance of wildlife and human population density. In countries where the human population densities are low, there is generally an acceptance and tolerance of such large mammals as the elephant. Religious sentiments too reinforce this attitude to keep poaching, wanton killing and cruelty to animals to a minimum. However, when the human population becomes too numerous and too sophisticated, this relationship progresses through time from acceptance to intolerance. When this happens, even religion is powerless in preventing the slaughter of wildlife.

In Sri Lanka, despite a strong Buddhist culture a number of wild elephants had been killed in the recent past by irate farmers who had borne the brunt of elephant depredations. In some instances, the killings were carried out by poachers in order to supply tusks to a few carvers, who despite the international ban on ivory, continue to produce pendants and other trinkets from elephant ivory for sale to the tourists who seem to have re-discovered Sri Lanka. In a desperate effort to resolve the human-elephant conflicts in Sri Lanka, a consultant from abroad recommended the capture of some 500 wild elephants for domestication and subsequent sale through public auction! Such a harebrained scheme, if implemented, would adversely affect the long-term survival of the elephants in the wild. In most instances, much of the crop depredations are the result of lone bulls wandering in search of oestrous females to mate. The capture and removal of such animals will seriously undermine reproduction and recruitment in the wild. It would also lead to a significant reduction in the genetic variation in the population. Removal of chronic crop raiding elephants from an area of high human population makes sense if it involves only a few animals. But to recommend the capture and removal of almost 20 percent of the island's elephant population for domestication and sale to the public will only help accelerate the demise of the island's wild elephant population. There are no instant solutions to the complex problem of human-wildlife conflicts in Asia. Time, money and trained manpower act in many cases as brakes on what can be done to resolve the problem. The root cause of elephant depredations throughout Asia is deforestation and conversion of forests to agriculture. Although human population pressure, land hunger and a need for fuel wood have all helped to cause deforestation, it has also been encouraged enormously by bad economics. Even the World Bank has realised that a tropical forest may be far more productive than the scrubland which often succeeds. But governments throughout Asia frequently assume that fragile forests can easily be cleared and farmed. They also frequently ignore the ecological costs of deforestation: soil erodes, rain fall diminishes, water supplies become less reliable, rivers silt up, dams get clogged, human-wildlife conflicts escalate and such extinction-prone species as the elephant and other large mammals often disappear.

It is now becoming increasingly clear that if we want to enhance the long-term survival of the elephants in Asia, some sort of accommodation between man and elephant must be reached. Man and elephant will have to live together by mutual adjustment. Furthermore, management policies must be designed to persuade people to change their attitudes, from intolerance to tolerance or from mere tolerance to acceptance. How can this be achieved? One way is through proper zoning of the conservation areas and their adjacent lands for types of use that integrate conservation needs with those of adjacent human populations. Another possibility is by improving the incentives for local communities to participate in the conservation of wildlife resources. The communities that bear the brunt of elephant depredations must be properly compensated for their losses. Such compensation could be provided through sensible insurance schemes or from revenues from nature tourism. Unfortunately, in many Asian countries, the local communities receive little or no benefit from tourism, whereas the true beneficiaries of tourism are the local tour operators and their international sponsors. Outdoor recreation is valued by a small segment of the more affluent section of the society while the poor remain alienated or indifferent. The local communities must participate fully in decisions affecting their land and resources. International efforts to protect and safeguard the Asian elephant populations throughout their range must include projects and programmes that involve the cooperation and participation of the local communities. Finally, conservation education must be given high priority. Conservation policies, however well-rooted they may be in science, can succeed only if they are intelligible to the people concerned.

by Lyn de Alwis & Charles Santiapillai

Feature Articles

COMMUNITY ECOLOGY OF THE ASIATIC ELEPHANT

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In prehistoric times the Asiatic elephant *(Elephas maximus)* occupied a large terrestrial generalist-herbivore niche within the alluvial plain, savanna, and gallery forest ecosystems of southern Asia. Currently wild Asiatic elephant populations are largely restricted to relict lowland forest fragments and upland forest areas of Southeast Asia, whereas formerly this species occupied a much larger range and a greater variety of habitats.

Asiatic elephants were known in historical times to have lived throughout much of southern Asia from the montane regions of the Himalayas to the coastal lowlands of Southeast Asia. Asiatic elephants ranged from the Tigris-Euphrates valley of Asia Minor in the west across the Indian sub-continent to the Huang He (Yellow River) valley of China in the north and east; and south through the Malay penninsula to the island of Sumatra. The modern population of Asiatic elephants on Borneo is thought to have been derived from introduced domesticated stock. (Altevogt and Kurt, 1972; Olivier, 1978b).

The Asiatic elephant is able to utilize a wide variety of habitats provided that basic requirements for water, shade, and forage can be met. Freezing temperatures and daily access to fresh water are major limiting factors. Savanna, forest-scrub, secondary forest, and grassland-forest mosaics are the preferred habitat types (Eisenberg, 1980a). The availability of grasses (Graminae, Poaceae) is an important factor, since grasses typically constitute at least 50% of the Asian elephant's diet (Vancuylenberg, 1977). Closed-canopy forests can thus support only limited elephant populations unless clearings or alluvial corridors are available to provide grasses for forage. Seasonal variations in the availability of water and forage may result in regular migrations of 40 km or more, and formerly aggregations of elephants containing thousands of individuals occurred in some areas as the result of seasonal migrations to areas of exceptional resource abundance.

The surviving Asiatic elephant populations are for the most part small, isolated, and declining rapidly. The alienation of habitat to agriculture, plantation forestry, wholesale clearcutting of forests, competition from domestic livestock, and direct human predation (for food, ivory, or crop protection) are constant threats to the few remaining wild elephant populations. Until fairly recently the human-elephant relationship in Southeast Asia was a relatively benevolent character with losses of alluvial plain habitats to stable agriculture balanced by increases in the availability of suitable forest habitat as a result of human-induced fires, low-intensity selective logging, and traditional patterns of shifting cultivation.

The impact of explosive human population increases in the past century and concurrent demands for greater agriculture and forestry production have steadily eroded the limited remaining areas of wild elephant habitat. Most surviving wild populations of Asiatic elephants are small and isolated among relict forest fragments widely scattered across human-dominated landscapes, a situation which offers little hope for long-term survival (Soule, 1980; Allendorf *et al*, 1986). The Asiatic elephant is now extinct throughout most of its former range and excluded from many preferred habitats (Olivier, 1978b). This trend appears unlikely to change in the forseeable future, and the pressure on relict populations is increasing steadily with the passage of time.

Elephants are the largest living terrestrial mammals. The Asiatic elephant is somewhat smaller than the African bush elephant *(Loxodonta africana africana)* and similar in size to the African forest elephant (*L. a. cyclotis).* Mature Asiatic elephant bulls attain weights of 5400 kg. and shoulder heights of 3.2 m. Females average about one-third smaller than males. Large tusks are found only in the male Asiatic elephant, and the proportion of tusked and untusked males varies among populations. In Sri Lanka tusked males are rare (<10%), and this phenomenon may be due to centuries of selective removal of tuskers from the breeding population by man, either through killing for ivory or by capture for domestication (Eisenberg, personal communication). In the nearby mainland populations of south India 90% of males are tusked (Sukumar, 1986). The elongate proboscis or trunk functions effectively as a fifth limb, and enables the elephant to extend its feeding range to a height of five meters or more vertically, enabling efficient use of scrub and low canopy forest habitats (Eisenberg and Mckay, 1974; Grzimek, 1972; Shoshani and Eisenberg, 1982).

Man has been an important predator of elephants since at least the late Pleistocene. Only the largest of the great cats, tiger and lion, can be considered with man as a significant predator of elephants.

Formerly tigers were a major predator of young elephants, and Williams (1950) estimated that tigers killed about one fourth of all elephant calves during their first few years of life. While healthy adult and sub-adult elephants are for the most part immune to predation by big cats, a few instances of tigers killing adult elephants are known (Shoshani and Eisenberg, 1982). Elephants are hosts for various internal and external parasites including various species of roundworms, flukes, lice, ticks, bacteria, and protozoans (Benedict, 1936; Eltringham, 1982).

The Asiatic elephant typically assumes a role as the ecologically dominant mammalian species within its habitat (Eisenberg, 1981; McKay, 1973; Seidensticker, 1984). Elephant foraging activities may have profound impact on the diversity, distribution, and abundance of numerous components of the biotic community (Janzen, 1983; Ishwaran, 1983; Mueller-Dumbois, 1972; Laws *et al*, 1975; Mulkey *et al*, 1984; Wing and Buss, 1970). Studies on the feeding habits of *E. maximus maximus* in Sri Lanka have assessed the impact of elephant foraging behavior on the physiognomy and species composition of forest vegetation (Ishwaran, 1983; Vancuylenberg, 1977; Muller-Dumbois, 1972). Food preferences in general are highest for open scrub species of plants and lowest for forest species. Among woody vegetation species consumed, early seral species are prefered over later seral or climax species (McKay and Eisenberg, 1974).

Although Asiatic elephant foraging behavior has significant effects on the plant communities within their habitats, major changes in habitat characteristics have not been correlated with feeding activity by *E. maximus* populations. In contrast to the radical landscape-altering impacts attributed to African elephants *(Loxodonta africana)* in various East African ecosystems (Laws *et al*, 1975; Mulkey *et al* 1984; Wing and Buss, 1970), the influence of *E. maximus maximus* populations on their habitats has been found to be of a more subtle character. Among study populations of the Asiatic elephant in Sri Lanka the principle effect of elephant activity has been to maintain existing successional community characteristics without inducing major changes in existing habitat structure or species composition (Ishwaran, 1983; Vancuylenberg, 1977; Mueller-Dumbois, 1972). However, this difference may be due in part to the lower densities of Asiatic elephant populations and not entirely to differences in feeding habits (Mueller-Dombois, 1972).

Elephants are generalist herbivores which utilize a broad range of herbaceous and woody vegetation, fruits, roots, tubes - virtually any form of plant material may be consumed. Grasses are a prefered food source and comprise a high proportion of the diet when conditions permit (McKay, 1971; Vancuylenberg, 1977). Bamboo may be an important food source in heavily forested habitats where the availability of other grasses is limited, and other monocots such as palms and rattans may be of importance in the diet in rain forest communities (Olivier, 1978a; Blower, 1985). Forbs, shrubs, and trees are incorporated in the diet to varying degrees according to site and season. Forbs, seedlings, and smaller trees may be consumed entirely, but leaf and/or bark may be selectively eaten in foraging on woody vegetation.

Feeding activity may be highly destructive in certain instances. Grasses are often ripped up and eaten root, culm, and leaf while trees may be pushed over or broken down in order to gain access to fruit or leaves which are out of reach (Mueller-Dombois, 1972; Kurt, 1974; Lekagul and McNeely, 1977). In selective feeding on bark or leaves up to 80% of the biomass removed in foraging may be discarded (Ishwaran, 1983; Lekagul and McNeely, 1977). Seeds frequently pass unharmed through the digestive tract and may subsequently germinate or be eaten by other animals (McKay, 1973).

Elephants are hindgut fermenters with a fairly rapid gut transit time and relatively low digestive efficiency (Benedict, 1936). Nonetheless, adequate nutrition can be maintained on a relatively poor quality (low protien/high cellulose) diet provided sufficient quantities of forage are available (Janis, 1976; Eltringham, 1982). Elephants can utilize coarse and highly lignified mature grasses which are unpalatable to other ungulates. Mature elephants consume 150-200 kg per day of green vegetation (Lekagul and McNeely, 1977; Seidensticker, 1984; Vancuylenberg, 1977). Wild elephants may need to spend 70% to 80% of their waking time in foraging in order to maintain an adequate nutritional plane (Eisenberg, 1981; McKay, 1973; Altevogt and Kurt, 1972; Vancuylenberg, 1977).

In Sri Lanka, elephants typically forage in small groups of one to ten individuals which feed for a few days in the vicinity of a particular water source and then move on. Feeding areas are shifted several times daily and in Sri Lanka elephants feed on grasses in open areas during the cooler morning and evening periods, and browse in shaded areas during the heat of the day (McKay, 1971). Although up to 70% of the plant species in a given habitat may be eaten, elephants tend to drift and spot-feed upon only a small percentage of individuals of any one species at a given site (Vancuylenberg, 1977; Eisenberg and Lockhart, 1972; Mueller-Dombois, 1972; McKay, 1971).

Mortality of large trees due to browsing by the Asiatic elephant is very low, perhaps attributable in part to the limited distribution of elephants with large tusks among the population as a whole. Browsing activity focuses on woody plants in the 2.0 - 32.0 cm size class, and observations indicate that less than 9% of feeding on trees or shrubs involves the pushing over or breaking down of the individuals fed upon (Ishwaran, 1983).

Mueller-Dombois (1972) has identified crown-distortion as the primary impact of Asiatic elephant browsing activity on woody vegetation. The physiognomy and growth patterns of trees and shrubs are altered as a result of injuries caused by elephants when browsing on bark, leaves, or fruits. Crown distortion is characterized by abnormal crown shapes and growth patterns, and the long term effect is to create reductions in the rates and extent of canopy closure in browsed stands. Canopy species often show high levels of crown distortion, apparently, caused by elephant predation, and this may affect canopy regeneration in areas with high elephant densities (Mueller-Dombois, 1972).

Elephant induced tree mortality also occurs outside of a foraging context. Male elephants sometimes knock down trees without any associated feeding activity, often within a localized area (Eisenberg and Lockhart, 1972). While the low levels of tree mortality associated with browsing by Asiatic elephants apparently has little direct effect on the species composition of forest stands, the selective browsing of early seral canopy species tends to inhibit regeneration of shade-adapted climax forest species by reducing canopy closure. Reduced canopy closure benefits the elephant by increasing the availability of prefered early seral vegetation forms, especially grasses.

Elephant feeding habits show extensive overlaps with those of other sympatric herbivores. Virtually all species of plants, browse and herbs, eaten by other ungulates are also consumed by elephants. In areas with high herbivore densities, elephants may compete with bovids, deer, swine, rhinoceros, porcupines, and hares for available forage. Competition with domestic or feral livestock for access to water and grazing is a significant problem in many areas (Altevogt and Kurt, 1972). Although the potential for exploitative competition clearly exists, other factors tend to ameliorate the negative impact of elephant populations on various other sympatric herbivores.

The mobility and generally low population densities of Asiatic elephants tend to reduce the effects of elephant competition for forage on most endemic wild herbivores, and behavioural facilitation phenomena arising from elephant activity may provide benefits to numerous other species. Although the elephant competes directly with other herbivore species for access to some plant resources, elephants also graze on the tall, lignified stems of mature grasses which cannot be effectively utilized by most other ungulates (McKay and Eisenberg, 1974; Vancuylenberg, 1977). This removal of mature grass stems by elephants can stimulate new growth, increase primary productivity, and improve the accessibility of the underlying herbage to other herbivores (McNaughton, 1979). Young leaves discarded by elephants during browsing and bark feeding may be eaten by deer or other animals which otherwise would be unable to obtain access to these resources (Lekagul and McNeely, 1977).

Elephants dig deep holes in dry watercourses to create seeps when surface water is unavailable, and these are used by other animals when the elephants depart (Eisenberg and Lockhart, 1972). Numerous animals use elephant paths in traversing areas of dense undergrowth (McKay, 1971; Altevogt and Kurt, 1972; Lekagul and McNeely, 1977), and these paths may thereby function as corridors in promoting the movement of species between habitat patches. The opening up of dense understory and lower canopy vegetation promotes growth of grasses and forbs favoured by other ungulates and various other herbivores. Elephant foraging activities thus can benefit various other mammalian species, especially grazing ungulates, by maintaining earlier successional plant communities and ecotone areas at the expense of closed canopy forest species.

Elephant foraging activity can be beneficial to various species in other ways. Mynahs *(Acridotheres tristis),* cattle egrets *(Bubulcus ibis),* and egrets (*Egretta* spp.) feed on insects disturbed by elephants in feeding, and these birds may be allowed to perch unmolested on the heads or backs of elephants (McKay, 1971).

The role of elephants in biomass transport and redistribution within ecosystems has been frequently overlooked. In conjuntion with a food intake of some 150kg/day, elephants produce about 80 kg/day of dung (Vancuylenberg, 1977). My own experience with captive elephants indicates this latter figure may be somewhat conservative, and Benedict (1936) records fecal deposition rate in a large captive female at up to 137 kg/day. Nonetheless, using Vancuylenberg's data for estimation, an elephant produces some 15 metric tons of fecal material each year. Two elephant herds in Sri Lanka were estimated by Vancuylenberg (1977) to deposit, respectively, 7507 kg and 9075 kg of dung daily. Asiatic elephant population densities vary widely among different habitats, and densities of 1.0 /km² (Eisenberg, 1980a), 0.27/km² (Olivier, 1978), 0.19/km² (McKay, 1971) have been reported. At a population density of 0.20/km², the elephant fecal deposition rate would be about 5000 kg/km²/year. At a density of 1.0 /km² (which is near the maximum record for Asiatic elephant populations), annual fecal deposition rates would be 30,000 kg/km²/year. Elephant feeding and defecation thus contribute substantially to the recycling and redistribution of plant biomass within their habitats (Eisenberg, 1972; Vancuylenberg, 1977).

When undisturbed, elephants typically defecate while standing in a single spot. Defecation and urination are frequently simultaneous. Excreta are often concentrated in an area approximately one meter square. In captive Asiatic elephants a single defecation typically consists of 6-8 fecal boluses weighing from 0.5-1.5 kg each (on a diet of grass hay with supplemental grain and occasional fresh fruit and vegetables). A single urination may result in the localized deposition of ten liters of nutrient-rich fluid to the soil (Benedict, 1936). Elephant excreta form localized and patchily distributed

nutrient sources which are utilized by numerous members of the biotic community (Eisenberg, 1972; McKay, 1971; Anderson and Coe, 1974).

Elephant excreta provide rich nutrient sources for a wide range of both plant and animal species. The relative inefficiency of the elephant digestive tract ensures that the overall nutrient content of the dung remains higher than that of most other ungulates (Benedict, 1936; Shoshani and Eisenberg, 1982). Elephant excreta provide a rich organic nutrient source for soil bacteria and various other detritivores, which in turn make these resources available for plant use (Anderson and Coe, 1974).

Seeds and tough-skinned fruits eaten by elephants frequently pass through the digestive tract intact. Birds and small mammals are known to seek out dung piles to feed on undigested seeds, fruit, or plant material and various coprophilic invertebrates (Eisenberg, 1972; McKay, 1971; Rood, 1975; Vancuylenberg, 1977). Fungi frequently grow in elephant dung, and undigested seeds may germinate if not subsequently eaten by other animals (Eisenberg, 1972; McKay, 1971). The importance of the Asiatic elephant in the seed dispersal of tropical forest plants is as yet poorly documented. Given the high vagility and extraordinary consumption potential inherent to this species, Asiatic elephants should provide excellent vehicles for redistributing seeds of many plant species employing animal seed dispersal strategies (Janzen, 1983).

Elephant dung is a prime food source for numerous invertebrates such as termites, scarabid beetles, worms, and flies. Termites feed on elephant dung and refuse from elephant foraging activities. New mound and colonies of some termite species are frequently initiated under piles of elephant dung (Eisenberg and Lockhart, 1972). Termites are extremly important members of the biotic community, and the role of termites in the nutrient cycles of tropical ecosystems is frequently underestimated (Eisenberg, 1972).

Termite mounds serve to concentrate resources by forming high nutrient patches in nutrient-poor tropical soils (Golley, 1983; Salick *et al*, 1983). The indirect effects of termite mound building activities include increased levels of soil turnover and soil aeration, aspects of great importance to maintaining optimal growing conditions for plants in tropical soils. The elephant dung/ termite relationship has far reaching implications when viewed in terms of a keystone symbiosis in the biogeochemical nutrient cycles of tropical forest and savanna ecosystems (Eisenberg, personal communication).

Elephants also contribute to soil turnover in other contexts. In feeding on short prostrate grasses elephants scrape the ground with the nails of the forefeet, 'scalping' the grasses and parts of the roots from the upper layer of the soil. When using this feeding method elephants kick up large quantities of soil, and erosion may occur subsequently on these sites (Kurt, 1974; Vancuylenberg, 1977). The mud-bathing or dust-bathing activities of elephants create soil turnover and enable the transport of large quantities of soil between different habitat patches (Vancuylenberg, 1977).

Elephants and other herbivores have high sodium requirements and in many areas mineral licks are of great importance to resident elephant populations (Seidensticker, 1984; Lekagul and McNeely, 1977). Salt soils or friable rock are dug out with tusks or the toenails of the forefeet and then collected with the trunk and ingested. The unused remainder is frequently utilized by other herbivore species (Lekagul and McNeely, 1977). The distribution of mineral licks may have marked effects on the movement patterns of elephant populations in some areas and can be manipulated as a means for regulating movements in some wild elephant populations (Seidensticker, 1984).

Elephants need daily access to drinking water. Thirty gallons (120 liters) of water or more may be ingested over a short period of time by a large adult. Water is important not only for drinking and bathing but also as a means for avoiding heat stress. Access to water and shade are important for thermoregulation at high ambient temperatures. The elephant's low surface area to mass ratio predispose it to problems of overheating at high temperatures or in direct sunlight (Eisenberg, 1983). African elephants apparently have greater tolerance for exposure to direct sunlight at higher temperatures than do Asiatic elephants (Seidensticker, 1984). The author has observed instances of sunburn on the skin of the forehead in captive Asiatic elephants in temperate North America (Maryland, U.S.A.) following extended exposure to direct sunlight in the spring after a several month period of limited outdoor activity during winter.

Elephants possess both physiological and behavioral mechanism for avoiding problems due to overheating. Physiological adaptations to heat stress include a convection cooling mechanism associated with high vascularization of the large, flattened ear pinnae. Increased blood flow in the ears when coupled with fanning movements permits rapid heat dissipation from the surface of the ears (Shoshani and Eisenberg, 1982; Eisenberg, 1983). The wrinkling and folding of the skin serves to increase skin surface area and promote heat dissipation,. The sparse pelage permits free air movement over the skin surface, while tending to trap soil and vegetation thrown onto the body to form an insulating cover against sun and insects. Behavioral adaptations for reducing heat stress include bathing with water or mud and seeking shade during the heat of the day. When access to drinking water is not limiting, water consumed early in the day may be retained in the stomach, and then hours later regurgitated into the throat, drawn into the trunk, and then sprayed on the body to promote heat loss through evaporation from the skin.

In their daily and seasonal movements elephants will cross large areas, and home ranges of 60 km² or more have been reported for elephant herds in Sri Lanka (McKay, 1973). Olivier (1978a) has estimated the home range for an elephant herd in Malaysian rain forest at over 166 km². Seasonal movements of 30-40 km are known from both south India and Sri Lanka (Eisenberg and Lockhart, 1972). The Asiatic elephant frequently shifts activities between alluvial grasslands, savanna-scrub, grassy ecotone areas and forest interiors in daily foraging activities (McKay, 1971; Vancuylenberg, 1977); feeding bouts are interspersed with visits to drinking, bathing, and wallowing sites.

Considering the capacity of the elephant for both mineral and biomass redistribution between different activity sites in the home range, the elephant may be said to function as a mobile link between the various plant communities within its environment. While elephants are never the numerically dominant mammal species in their habitats, they are nonetheless frequently an ecological dominant in terms of biomass and materials cycling parameters (McKay, 1973; Seidensticker, 1984). Both directly and indirectly elephants contribute substantially to the cycling of mineral and organic components of the ecosystems they inhabit.

Elephant foraging activities affect the configuration and species composition of plant communities within their habitats. Elephants impose landscape-level impacts upon their habitats by maintaining earlier seral stages of plant succession, with far-reaching effects upon the plant and animal species therein. The physical modifications imposed by elephants upon their environments such as pathways, water seeps, and opening up of understory vegetation may tend to offset competition for forage between elephants and other sympatric ungulate species. Herbivores favouring ecotone and forest-grassland mosaic habitats can benefit from the presence of elephants, whose activities tend to maintain these communities at the expense of closed-canopy forest habitats. Species prefering closed-canopy habitats, such as arboreal primates, may be adversely affected for these same reasons (Eisenberg, 1980b).

The actual role of the Asiatic elephant in structuring its environment remains but poorly understood. Although various studies have provided regional insights regarding general trends and the potential mechanisms involved, as yet only a few more obvious aspects of this phenomenon have been investigated. The nature and scope of the known ecological interaction between the Asiatic elephant and its environment as reviewed above probably represent a small fraction of the functional interrelationships actually present.

Unfortunately, the keystone function of the Asiatic elephant has already, been lost to ecosystems throughout most of the species original range. The Asiatic elephant may well become extinct before comprehensive ecological studies can assess the full significance of the elephant's role in the tropical forest ecosystems of Southeast Asia. These forests form the final refuge for this once ubiquitous species of southern Aisa, and provide the sole remaining opportunity for determining the ecological interaction of the Asiatic elephant in its native habitat. These forest systems themselves are in great jeopardy due to human exploitation, and given the present situation, as the forest goes so must the elephant.

The potential exists for maintaining viable population of Asiatic elephants within multiple-use forest reserves (Olivier, 1978c; Dudley, ms). Elephant populations can respond favourably to certain forms of habitat perturbation associated with forest resource harvesting activity. The development of multiple-use forest areas ('Elephant Ranges') has been proposed by Olivier (1978c), McNeely (1980), and others as a potential means for ensuring the survival of the wild Asiatic elephant. The Elephant Range model resembles that of the Biosphere Reserve (MAB, 1979; see also Harris, 1984).

The Elephant Range concept envisions a multiple-use forest reserve comprised of one or more inviolate core preserve areas enveloped by one or more concentric designated-use areas (buffer-zones), managed in such a way as to enable the maintenance of wild elephant populations in concert with development of compatible renewable resource forestry techniques. Buffer-zones should be managed under sustainable-yield resource harvest regimes appropriate to the goal of maintaining critical genetic resources contained in endemic plant and animal species, and would function in protecting core preserve areas from the detrimental impacts of the surrounding human-dominated landscape (and vice-versa).

The Elephant Range concept represents a potential framework for the establishment of forest reserves integrating wildlife conservation and sustainable-yield agroforestry methods. Such a system might ultimately provide a means whereby the coexistance of elephant and man in Asia could be maintained in the face of inexorable human pressures on the forest communities which are the last refuge of the Asiatic elephant.

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ELEPHANTS UNDER THREAT IN LAOS

CHARLES SANTIAPILLAI

Laos was known as **Muong Lan Xang Hom Khao** or the "Land of the Million Elephants and the White Parasol" in the fourteenth century when it was founded. It was first called "Laos" by the French when they annexed it to their Far Eastern Empire in the last century. Today Laos, with a total land area of about 236,800 km² is estimated to have not more than 4,000 elephants in the wild and about 850 animals in captivity. One of the legacies of the Indo-China war is the ready availability of guns and firearms. Today, it is estimated that there are nearly 1.2 guns per mile in this strategic, land-locked, innocuous, little Buddhist country of 4 million people (Martin, 1992). Between 1990 and 1992, about 50 elephants had been killed by poachers for their tusks, skin and meat (Vientiane Mai, 1992). These killings occurred mostly in the Nam Theun area in the Khammouane province in central Laos. The killings of elephants were attributed to some poachers who crossed into Laos from neighbouring Vietnam (Vientiane, Mai, 1992). (Some of the poachers who were caught red-handed by the Laotian authorities turned out to be Vietnamese nationals!). At over 400,000 ha Nakai Plataeu/Nam Theun is by far the largest proposed protected area in Laos with Vietnam as its eastern boundary (Salter *et al.*, 1991). This area has a known resident population of elephants, and is inhabited largely by Lao Loum and Lao Theung ethnic groups who practise slash and burn agriculture. Price of unworked raw ivory is about US$ 50 per kg. Ivory carvers in Vientiane and Luang Prabang using hand tools carve out small souvenirs such as Buddha pendants from ivory for sale to tourists (Martin, 1992). Most of the tourists are form Thailand and the problem will only be exacerbated if the proposed plan to build a bridge (with Australian aid) across the Mekong river, linking Thailand to Laos goes ahead! Laos needs international assistance (mainly funds and equipment) to improve the protection of almost all the proposed conservation areas. Arresting the illegal trade in wildlife across its border with China, Burma, Thailand, Cambodia and Vietnam will not be easy. It is recommended that Laos becomes a party to CITES (Convention on International Trade in Endangered Species). A British historian once casually remarked that "Laos is like the Cheshire cat. One minute it's there, the next it has disappeared; and sometimes, while you're watching, it begins to fade, until there's nothing left but the smile - the Lao smile" (Field, 1965). If poachers are allowed to ply their trade with impunity in Laos, then only the White Parasol will be left!

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Reconciling Elephant Conservation with Economic Development in Sumatra

by

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1.0 Introduction

The Sumatran elephant (Elephas maximus sumatranus) is the smallest of the three subspecies of the Asian elephant. Its numbers are estimated to be anything between 2,800 and 4,800 (Blouch & Haryanto 1984; Blouch & Simbolon 1985). Once widely distributed throughout the eight provinces of Sumatra, the animal has almost disappeared from two provinces and is under threat in the rest of the island from a host of development programmes such as logging, human re-settlement, establishment of large-scale plantation estates, oil exploration, mining, irrigation and agriculture. The conversion of primary forest into agricultural holdings has been one of the causes of conservation problems in Sumatra and the elephant has been among the large mammals most seriously affected by it. Development programmes have led to the annual elimination of tens of thousands of hectares of elephant habitat.

As their traditional migratory routes are blocked, habitats fragmented, the elephants are becoming increasingly confined to patches of forests that are surrounded by cultivated land. As Laws (1981) points out in the situation in East Africa, the situation in Sumatra too is reversing gradually "from one in which human islands existed in a sea of elephants, to a sea of people with elephant islands". These conditions have led to a dramatic increase in the scale of elephant depredations in Sumatra. In some cases the success of the development programmes has been threatened as a result of which, there has been a change in attitude by the planners in recognizing the need to take into consideration the ecological requirements of the elephant during the planning stage of any development programme. In return, the Directorate of Forest Protection and Nature Conservation (PHPA) which is primarily responsible for the conservation of elephant must match this recognition by the planners with realistic proposals to ensure the conservation of the species without leading to unacceptable conflicts. This paper is an attempt to reconcile elephant conservation with economic development in Sumatra.

2.0 Conservation of Elephant.

The human population of Indonesia currently estimated to be 170 million and concentrated in Java and Bali is growing at an annual rate of 2.1%, with no controlling mechanism in sight, and with a forecast which must be at best optimistic, of ultimately stabilizing at 400 million. In an effort to relieve the population pressure on the already over-crowded island of Java, the Government of Indonesia is currently resettling the surplus population on the so called "Outer Islands" of Sumatra, Sulawesi, Kalimantan and Irian Jaya. Such population over-spill into Sumatra would imply an even greater competition for land that is currently inhabited by the elephants. The population pressure is and will always be a real constraint on any attempt to find a rational solution to the long-term conservation of the elephant in Sumatra. Hence PHPA must adopt a realistic policy to ensure the long-term survival of the elephant in Sumatra by aiming to keep the elephant populations and human settlements as far apart as possible.

Given that our objectives is to ensure the long-term survival of the elephant in Sumatra, we must adopt a strategy that can achieve this objective. Parker (1984) recommended the protection of as many individuals as possible in as wide a range of habitats as is practical. This implies the fact that not all the elephants in Sumatra can be actively protected. Before such a strategy can be adopted, the PHPA must have clear information on the following:-

1. An approximate idea of the total number of elephants in Sumatra.
2. The number and size of discrete populations.
3. How such populations are distributed in space.
4. How many of these populations do in fact inhabit protected areas, and so can be actively protected.
5. What should be done with the populations that occur outside the protected areas?
6. What is the total extent of the protected areas in Sumatra.
7. How many of these areas are in fact large enough to hold viable elephant populations?

8. What can be done to enhance the survival prospects of the elephants inhabiting small areas?
9. What land-use practices can be accommodated along the periphery of the protected areas, without leading to unacceptable levels in elephant-human conflicts?
10. What is expected from other Government Departments, whose development programmes have been responsible in the past, for at least part of the current human-elephant problems in Sumatra?

2.1 Number of Elephants in Sumatra

On the basis of the surveys carried out by Blouch & Haryanto (1984) and Blouch & Simbolon (1985), between 2,800 and 4,800+ elephants are estimated to be present in Sumatra today, distributed mostly in six of the eight provinces (Table 1).

Table 1. The minimum and maximum number of elephants in Sumatra

Province	Minimum	Maximum
1. Aceh	600	850
2. North Sumatra	a few	a few
3. Riau	1,100	1,700
4. West Sumatra	a few	a few
5. Jambi	200	500
6. Bengkula	100	200
7. South Sumatra	250	650
8. Lampung	550	900
Total	2,800+	4,800+

Source: Blouch & Haryanto (1984); Blouch & Simbolon (1985).

2.2 Number and size of discrete populations

The surveys of Blouch & Haryanto (1984) and Blouch & Simbolon (1985) have identified at least 44 discrete elephant populations (Fig. 1) whose size ranges from less than 50 to 400 (Table 2). The largest populations with up to 400 elephants are found in Riau and Aceh provinces, which are important areas for economic development and so have been identified with chronic elephant depredations in the past. Some of the elephant populations in the heavily populated Lampung province are very small, consisting at times less than ten animals, and so have no long term viability.

Table 2. The number and size of the discrete elephant populations in Sumatra in 1985

name	province	number
1. Gunung Sulah*	Lampung	<50
2. Gunung Tanggang*	Lampung	<50
3. Gunung Betung*	Lampung	<50
4. Way Kambas	Lampung	100-200
5. Way terusan	Lampung	50-100
6. North Barisan Selatan	Lampung/Bengkulu	50-100
7. South Barisan Selatan	Lampung	>100
8. Gunung Raya	Lampung	50-100
9. Gunung Rindingan	Lampung	50-100
10. Block 42	Lampung	<50
11. Block 46	Lampung	50-100
12. Block 44	Lampung	50-100
13. Block 45 (Mesuji)	Lampung	>100
14. Tunggal Buta	South Sumatra	<50
15. Subanjeriji	South Sumatra	<50
16. Air Semangus	South Sumatra	50-100
17. Padang Sugihan	South Sumatra	>100
18. Sungai Pasir	South Sumatra	<50
19. Bentayan	South Sumatra	50-100
20. Air Medak	South Sumatra	>100
21. Air Kepas	South Sumatra/Jambi	>100
22. Intan Hepta	Jambi	50-100
23. Mendahara Ulu	Jambi	50-100
24. Suban	Jambi	50-100
25. Gunung Sumbing	Jambi	>100
26. Batang Tebo	Jambi	50-100
27. Sungai Ipuh	Bengkulu	>100
28. Bukit Hitam	Bengkulu	<50
29. Torgamba	Riau/North Sumatra	100-200
30. Tanjung Medan	Riau	>50
31. North Central Riau	Riau	200-300
32. Koto Panjang	Riau	50-100
33. Lipat Kain	Riau	50-100
34. Langgam	Riau	>50
35. South Central Riau	Riau	100
36. Southern Riau	Riau	300-400
37. Buantan	Riau	>50
38. Siak Kecil	Riau	100-200
39. Lower Rokkan	Riau	50-100
40. Sinkinjang	West Sumatra	>50
41. Singkil	Aceh	<50
42. Western Gunung Leuser	Aceh	50-100
43. Western Aceh	Aceh	200-300
44. Eastern Aceh	Aceh	300-400

(* extinct by 1990)

2.3 Distribution of elephant populations

The distribution of elephant populations in Sumatra is discontinuous (Fig. 1). The establishment of large scale oil palm and rubber estates have almost squeezed the elephant out of North Sumatra province. Heavy human pressure has also pushed the animal out of West Sumatra province. The elephant populations in Aceh still enjoy a wide distribution and good numbers. But in Riau, they are scattered and are under heavy pressure from development activities. Protected areas are woefully

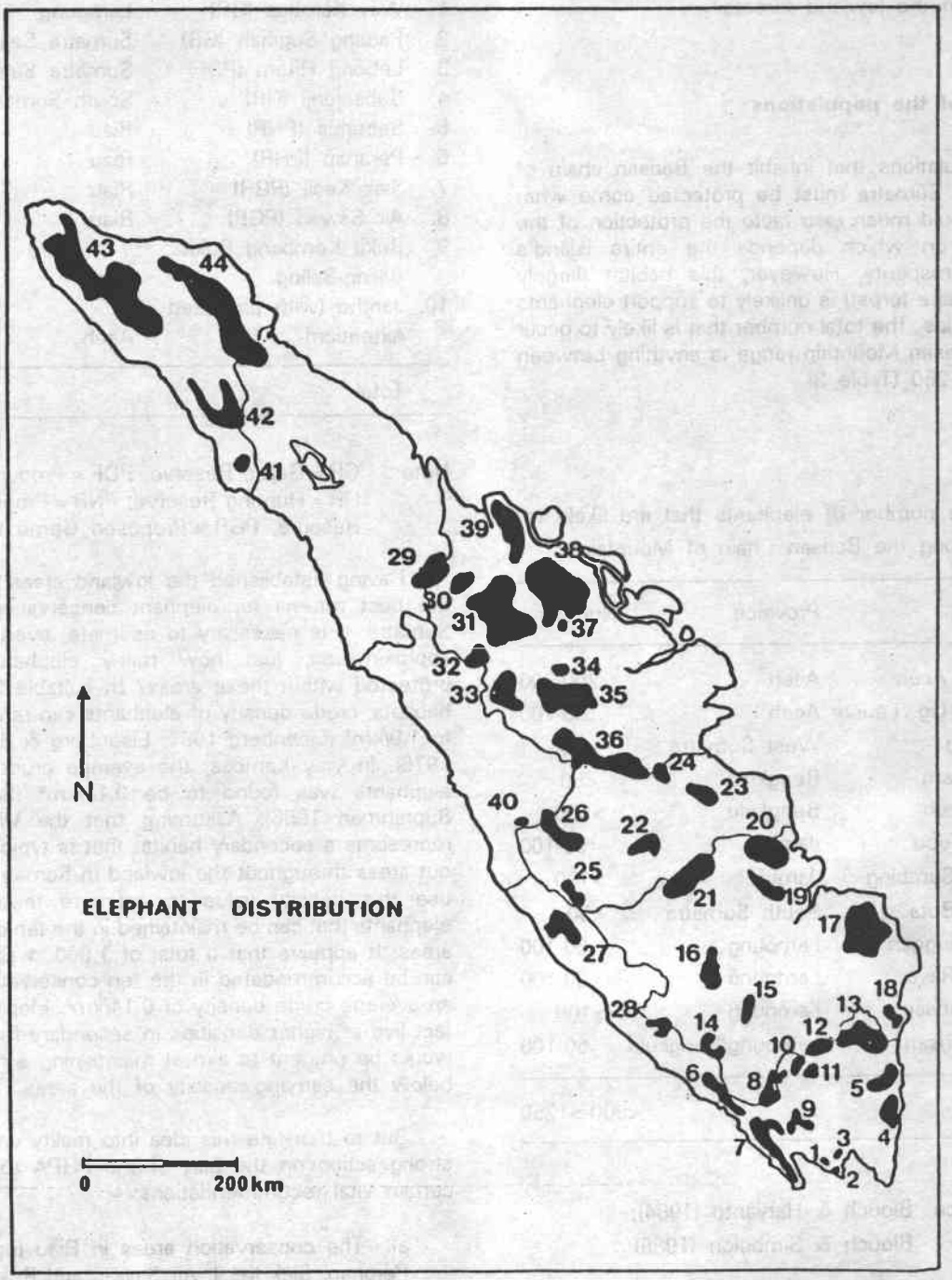


Fig. 1. Distribution of Elephant Populations in Sumatra, Indonesia

inadequate to accommodate all the populations in Riau. The situation in Lampung too is serious in that the animals are scattered in a man-dominated environment. The Barisan range of mountains that run along the spine of Sumatra support elephants but at much lower densities than the lowland forests.

2.4 Status of the populations

The populations that inhabit the Barisan chain of mountains in Sumatra must be protected come what may as it would mean *ipso facto* the protection of the watersheds, on which depends the entire island's agricultural prosperity. However, this habitat (largely primary montane forest) is unlikely to support elephants at high densities. The total number that is likely to occur along the Barisan Mountain range is anything between <900 and >1250 (Table 3).

Table 3. The number of elephants that are likely to occur along the Barisan Chain of Mountains

Name	Province	Number
43. Western Aceh	Aceh	200-300
42. Western Gg. Leuser	Aceh	50-100
40. Sinkinjang	West Sumatra	<50
28. Bukit Hitam	Bengkulu	<50
27. Sungai Ipuh	Bengkulu	>100
26. Batang Tebo	Jambi	50-100
25. Gunung Sumbing	Jambi	>100
14. Tunggal Buta	South Sumatra	<50
9. Gg. Rindinggan	Lampung	50-100
8. Gunung Raya	Lampung	50-100
7. South Barisan	Lampung	>100
6. North Barisan	Lampung/Bengkulu	50-100
Total		<900->1250

Source: Blouch & Haryanto (1984);
Blouch & Simbolon (1985).

In contrast to the montane areas, the lowland forest habitates can maintain relatively higher elephant densities on account of the high productivity. Ten areas in the lowlands offer the best hopes for the long-term survival of elephants in Sumatra (Table 4).

Table 4. Lowland areas with the best potential for elephant conservation.

name	province	areas (km²)
1. Way Kambas (GR)	Lampung	1,235
2. Padang Sugihan (GR)	Sumatra Selatan	750
3. Lebong Hitam (PDF)	Sumatra Selatan	3,000
4. Subanjeriji (HR)	South Sumatra	650
5. Seberida (PNR)	Riau	1,200
6. Peranap (PHR)	Riau	1,200
7. Siak Kecil (PGR)	Riau	1,000
8. Air Sawan (PGR)	Riau	1,400
9. Bukit Kembang Bukit Baling-Baling	Riau	1,460
10. Jantho (with proposed extention)	Aceh	1,880
Total		13,775

Note: GR = Game Reserve; PDF = Production Forest; HR = Hunting Reserve; PNR = Proposed Nature Reserve; PGR = Proposed Geme Reserve

Having established the lowland areas which offer the best returns for elephant conservation efforts in Sumatra, it is necessary to estimate, even as a rough approximation, just how many elephants can be protected within these areas? In suitable South Asian habitats, crude density of elephants can range from 0.1 to 1.0/km² (Eisenberg 1981; Eisenberg & Seidensticker 1976). In way Kambas, the average crude density of elephants was found to be 0.14/km² (Santiapillai & Suprahman 1986). Assuming that the Way Kambas represents a secondary habitat that is typical of logged out areas throughout the lowland in Sumatra, we could use this density value to estimate the number of elephants that can be maintained in the ten conservation areas. It appears that a total of 1,900 is about all that can be accommodated in the ten conservation areas at an average crude density of 0.14/km². Elephants can in fact live at higher densities in secondary forests, but it would be prudent to aim at maintaining a number well below the carrying capacity of the areas.

But to translate this idea into reality would require strong action on the part of the PHPA to implement certain vital recommendations:-

a). The conservation areas in Riau (eg: Seberida, Peranap, Siak Kecil, Air Sawan and Bukit Kembang Bukit Baling-Baling) should be given legal status (At present they are designated simply as "prposed" and therefore amount to little more than "paper parks".)

b). These areas must be surveyed and properly demarcated and separated preferably from human settlements by suitable buffer zones.

c). The proposed nature reserve Jantho (80 km²) in Aceh is inadequate as an elephant reserve. However it could be much enlarged by incorporating the surrounding 1,200 km² block of protection forest and the 600 km² block of protection forest (Blouch & Simbolon 1985). The new reserve would then have a total areas of 1,880 km² and thus would be adequate to maintain a viable elephant population.

d). The Padang Sugihan Game Reserve is only 750 km² but it supports about 240 elephants, giving a crude density of 0.32/km² (Nash & Nash 1985; Nash 1987), which is one of the highest elephant densities known in South-East Asia. The Padang Sugihan elephants are about the maximum the reserve can support. Already there have been reports that some of the elephants have raided crops in the adjoining transmigration settlements. The problem is further compounded by the fact that forest fires within the reserve have also driven some animals out, leading to more conflicts with the human settlers nearby. The elephants are in turn threatened by harrassment and habitat degradation (Nash & Nash 1985; Nash 1987) within the reserve. Illegal logging takes place despite the fact it is a protected area. Loggers operate with impunity within the reserve, cutting trees well below the officially permitted diameter of 50 cm. In one sample study of 450 logs that were felled illicitly in the reserve, the average diameter was 33 cm, and some as small as 19 cm (Nash & Nash 1985; Nash 1987).

Given the high elephant density observed in Padang Sugihan reserve, it would be a fail safe measure if this reserve could be linked with the larger (3,000 km²) Lebong Hitam production forest to its east. Such a move would greatly increase the area for elephants from 750 km2 to 3,750 km² and will relieve the current pressures on the Padang Sugihan reserve as well.

But there are currently disturbing reports of forest fires even within the Lebong Hitam production forest that have destroyed up to 10,000 ha of peat swamp forest! Unless strong measures are taken now to prevent the recurrence of forest fires, even such an extensive area as Lebong Hitam would be useless as a refuge for the surplus elephants from the Padang Sugihan Game Reserve.

So, with the best of efforts and will, it might just be possible to protect between 2,800 and 3,000 elephants in Sumatra, one third of which inhabit the Barisan mountain range, while two thirds occur in the lowlands.

2.5 Elephants outside protected areas.

A decision must be made as to what should be done with the elephants that occur outside the protected areas. The home range of elephants do in fact overlap with the production forests in Sumatra. If such substantial areas do in fact accommodate the entire annual home range of a population, then the area is best managed as a multiple-use forest where elephants can co-exist with man and might even benefit from "limited human use of forested uplands, including selective logging for local consumption, traditional hunting, bamboo extraction and slash and burn agriculture" (McNeely 1978). The " Managed Elephant Range " concept was put forward by Olivier (1978) and offers a great potential to reconcile economic development and elephant conservation and so ought to be at least given a try.

If a population of elephants is causing unacceptable levels of depredations, then a decision must be made if the animals have to translocated to another reserve or captured for domestication and training. The PHPA have staff who are well experienced in both operations. They have successfully driven whole herds of elephants in 1982 and 1984 in Southern Sumatra and Lampung provinces, away from problem areas. If the number of elephants that are causing the problem is small (less than ten animals), then it would be more economical to capture them using chemical immobilization for either release into another reserve or for domestication and training.

In areas where elephants have become a problem as a direct result of economic development (eg: establishment of oil palm, rubber, sugar cane plantations), the onus of establishing elephant barriers (eg: electric fence, ditch etc.) must be on the development agency and not on the PHPA. At present all elephant problems, irrespective of their source of origin, are brought to the PHPA's "doorstep" to be resolved. Given the low budget on which the PHPA operates, it would be grossly unfair to expect the PHPA alone to solve all the elephant problems.

2.6 Protected areas in Sumatra

With a total area of 47.7 million ha, Sumatra is the second largest island in the Indonesian archipelago. 64.3% of the land area is officially designated as forest land (Anon 1984). The primary forest cover amounts to 42% (UNDP/FAO 1982). Protected areas (i. e: National Parks, Nature Reserves, Game Reserves, Recreation Parks, Hunting Reserves and Protection Forests) account for 17.2% of the total land area. As far as the elephant conservation is concerned, there are 28 areas in Sumatra whose total area is 48,448 km2 (Santiapillai 1987). But 50% of the areas are still in the "proposed" category and so do not have the full legal protection they deserve. However not all of them represent prime elephant habitat. About 65% of the areas is mountainous. The home ranges of at least 17 out of 44 elephant populations are within these protected areas, and they account for a maximum of 2,500 animals

2.7 Areas with potentially viable elephant populations

There are 13 areas in Sumatra (actual and proposed) which are over 1,000 km² in extent and so might be adequate to accommodate viable populations. However, size of a reserve alone is no guarantee for the viability of an elephant population. What is important is to determine the productivity of the area. Small areas can in fact support high densities of elephants in comparison to large areas. A good example is the Padang Sugihan Game Reserve which despite its small size (750 km²) supports a much higher elephant density than the largest conservation area in Sumatra, the Kerinci-Seblat National Park (14,846 km²).

2.8 Small areas

If resources are limiting, small areas are poor bets for long term conservation programmes. However, if it is indeed possible, every effort must be made to link small reserves with a nearby large reserve by forest corridors. For such corridors to be really effective, they should be broad (at least a minimum of 5 km wide), and established along the banks of the river.

2.9 Compatible land-use practices

Ideally, all protected areas where elephants occur, should be established as far away as possible from human settlements. If this is not possible, then a suitable buffer zone should be established in between the reserve and the human settlements. Elephants respond to edges, the transition zone between forest and grasslands in a positive way (Seidensticker 1984). Much of the elephant depredations in Sumatra is due to the establishament of crop lands by the side of the reserve, thereby creating a diversity of habitats for the elephant. The patch of land that lies between human settlements and elephant reserve should have "zero appeal" to the elephants to deter them from leaving the forest. This could be achieved by maintaining heavily grazed areas along the periphery of the reserve, establishing plantations that are not preferred by elephants (eg: Eucalyptus), or livestock husbandry instead of cash crop plantations.

2.10 Other Government Department assistance

The elephant problem must be looked upon as the collective responsibility of a number of Government Sectors that include Transmigration, Forestry (logging), plantations (oil palm, rubber, coconut, sugar cane etc.), Swidden agriculture, Mining, and power (hydro-electric and oil explorations) etc. Transmigration has been identified as an agent of forest desruction and much of the blame for the previous appalling failures of transmigration schemes is due to the scant attention the planners paid to site selection. A careful assessment of each forest block set aside for transmigration should be made before it is cut. Despitethe ambitious, well meaning efforts of the Government, the transmigration programme cannot possibly solve the demographic problems of Indonesia when human population growth in Java alone adds 2 million a year. The target for resettlement during 1984-1989 was 800,000 families (Ross 1984). The answer must lie in increased literacy, enhanced standard of living and the acceptance of the virtue of having small families. Transmigration is a fact of life in Indonesia, but it is a policy that cannot go on forever. As Ross (1984) points out, if the programme continues at the present rates of settlement untill all arable land is used, it would require an additional 5-10 million ha of land every five years, which must come from the forests.

The tropical rainforests of Sumatra contain a very high proportion of commercially valuable timber species. On an average, these forests contain as much as 200 m³/ha of commercial sizes trees (GOI/IIED 1985). In Sumatra, timber production means harvesting of old growth timber from natural forests. The commercially valuable dipterocarp species take about 70 years to attain the 60-70 cm dbh (diameter at breast height).

The Department of Forestry has laid down strict limits to the exploitation of commercial timber species. The regulations stipulate that a minimum diameter of 50 cm dbh and a cutting cycle of 35 years, leaving more than 25 trees per ha of commercial species of dbh 20 cm or greater (GOH/IIED 1985). As long as timber extraction is carried out selectively and within strict limits, it can enhance the carrying capacity for elephants (Santiapillai 1987). In practice however, given the economics of timber extraction, logging companies often cut trees well below the official limit of 50 cm dbh. Selective logging in Indonesia entails the removal of up to 20 trees/ha which can cause up to 40% damage to the residual stand (Kartawinate et al., 1981). There is also profligate waste of timber at the point of extraction. Loggers often extract lower number but exploit larger areas. The rate of overall timber exploitation far exceeds any attempts of reforestation and rehabilitation. As far as the elephants are concerned, they do not have any escape routes to move from a disturbed area to another less distributed area. Shelton (1985) offers a practical solution to this problem which is to maintain unlogged buffer strips along the water courses to link a concession area with corridors of mature forest.

An ingenious way to maintaining areas of older forests as wildlife habitats within a logging concession is to cut it in a checkerboard pattren (Shelton 1985). It is worth quoting in full: "In a forest reserve managed on a 50-year rotation, which is fairly typical in Malaysia today, a block amounting to one fiftieth of the reserve would be logged each year. If alternate blocks were left unlogged until the second 25 yaers, there would always be at least 25 blocks of 25 to 49 year-old logged forest distributed evenly throughout the reserve. These blocks would be adjacent to more recently logged blocks, which would thus have a nearby refuge and source of seeds and animal colonizers". Such a system provides the best opportunity for the management and conservation of elephant outside the protected areas in Sumatra.

The need to control the current rates of deforestation in Sumatra cannot be overstated. Logging operations *per se* are not responsible for large scale conservation of forests. These actions however expose the forest by providing access to many people along the logging roads, to the interior (Ross 1984). Roads in a normal logging operation in the high forests of Sarawak represent 4% of the total area logged (Hong 1987).

The department of Forestry must explore the possibility of using trained elephants in timber extraction within production forests, as is the case in Thailand and Burma. The Elephant Training Centres in Sumatra cannot hope to provide trained elephants to replace modern machinery but could assist in some way the extraction of timber from say, swampy areas where no machinery can function economically.

Soil erosion is perhaps the most serious environmental impact of logging (Hong 1987). The use of trained elephants in timber extraction within production forests can greatly reduce the negative impact of logging.

Plantation estates such as oil palm, rubber, sugar cane, coconut etc. have reaped enormous profits in the past but have not responded substantially to mitigating the current spate of elephant-human conflicts in areas where their activities have displaced the elephants. Proper environmental impact analysis must precede any new establishment of oil palm or other plantations. The oil palm is a much preferred food item of the elephant and so in the absence of effective elephant barriers, enormous elephant damage to oil palm trees will be inevitable. Appropriate electric fencing in Peninsular Malaysia could reduce elephant damage by more than 95% (Ratnam 1984). Electric fencing provides the most cost effective way of reducing elephant depredation under conditions prevailing in humid tropics (Blair & Noor 1981).

Shifting cultivation is often accused of causing much forest destruction. However, much of the damage to the forests is caused by the so called "Shifted cultivators" rather than by traditional slash and burn cultivators. As Ross (1984) points out, shifting cultivation in its classical form is the only self sustainable system of agriculture in the tropical rainforest. It becomes destructive only when their numbers exceed the carrying capacity of the forest. Compared to the amount of forest logged commercially, the primary forest opened by swidden farmers in Sarawak is only a small fraction (Hong 1987).

3.0 Conclusion

Elephant problems in Sumatra can never be completely eradicated. They can however be reduced substantially if much thought is given to the elephant in the planning stage of many of the island's development programmes. The PHPA alone cannot deal effectively with the elephant depredations. It would need the active support and generous financial assistance from both Governmental Departments and International Organizations. International philanthropy to date has paid more attention to helping with extraction of timber rather than reforestation and rehabilitation of degrarded areas.

The conservation of elephants in the face of growing economic development and increased human population growth calls for a provincial approach. Each province should establish a Task Force to deal with the elephant problems in that province on a respond-to-crisis basis. Each Elephant Task Force (ETF) should include a veterinarian trained in the use of cap-chur gun to tranquilize problem elephants if they need to be captured and translocated elsewhere.

The provincial ETFs should be under the control of a Director of Elephant Conservation whose Department would be responsible for the control, management and conservation of elephants in Sumatra.

The elephant Training Centres should provide trained elephants for use in forestry, wildlife and tourism. Trained elephants should be seen as an asset to economic development. Incentives must be given to individuals or companies that use trained elephants in hauling logs to using heavy machinery. Trained elephants performed a number of useful jobs during the Dutch colonial period; they ranged from hauling artillery during the war to hauling telegraph posts during peace. Capturing "problem elephants" and training them for useful service to man seems to be more humane and meaningful than shooting them as pests. The Elephant Training Centres in Sumatra should incorporate programmes to start breeding elephants in captivity. Elephants are slow breeders no doubt, but that should not prevent the PHPA in making a start in this direction. If elephants are to be trained for use in forestry operations, then they should be self-sustainable. Otherwise, there is a hidden danger that these training centres would simply become the raison d'etre for more captures from the wild.

The PHPA should base its policies on sound ecological research. This can only come about if increasing number of its staff are trained in wildlife management, and such trained personnel are in fact based in the field to address the problems and provide the appropriate solution. Unless and until this happens, wildlife conservation in Sumatra would be nothing more than an art of the possible.

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RECENT ELEPHANT CONSERVATION EFFORTS IN SRI LANKA
A Tragic Story

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Elephas maximus was once present in all the forest tracts, both in the central hill region as well as in the lowland parts of Sri Lanka. During the British occupation of the country, elephants got progressively eliminated from the wet and fertile regions mainly due to large scale forest clearance, at first for cultivation of coffee and later for tea, and uncontrolled shooting. Since gaining independence in 1948, despite the authorities taking some meaningful steps to give special protection to the elephant, the situation has not improved to any appreciable degree. The total elephant population in Sri Lanka today is estimated to be about 2,500 elephants. They are found scattered in disjointed ranges in the north, north central, north western, east and south eastern parts of the country. This drastic decline in the elephant ranges is basically due to habitat loss through:

(a) major irrigation - settlement schemes embracing river valley basins;
(b) cultivation - both legal and illegal encroachment;
(c) change in forest composition by silvicultural practices, and
(d) loss of habitat through man-made construction.

In unfamiliar surroundings, the movement and behaviour of elephants change drastically. Such elephants are compelled either to wander aimlessly for a few years until they find a new route back to their old haunts, or to remain confined to the new areas. Man-made barriers, habitat discontinuity and deterioration can lead to a group becoming isolated from the original population and finally ending up in an unexpected area. In either situation, the result is increased frequency of human-elephant interaction.

It is common knowledge that the Asian Elephant has drastically declined in numbers in almost all the countries it is still found during the past two hundred years, and today the total population is estimated to be not more than 56,000 elephants in the whole of Asia. The problems connected with the preservation of the elephant are common to all these countries and in that context an Action Plan for the preservation of the Asian Elephant was prepared in 1990 and was commended to the respective Governments by the Asian Elephant Specialist Group (AESG). The chapter on the Sri Lankan elephant in the Action Plan gives a fair and comprehensive assessment of the present status of the Sri Lankan elephant, and with over 3 decades of experience as a field worker in the Department of Wildlife Conservation, I may venture to say that the recommendations made there in are sound and practical and form a scientific basis for guiding and developing the future elephant conservation plans and programmes. It is in this context that I am making an attempt in this paper to evaluate and assess the ongoing elephant conservation efforts since 1990, by the Sri Lankan authorities vis-a-vis the recommendations made by the AESG in its Asian Elephant Action Plan.

It has been long accepted in Sri Lanka that all management decisions should be based on scientifically sound, but practical data and guidelines, and there is no gainsaying that in the past several decades, the Government policy was directed towards that end, though funds and manpower requirements provided to the department were minimal. During the past two or three years, however, sufficient funds have been provided.

The Smithosonian Elephant Survey activities carried out between 1966 and 1972 and the short term studies carried out by the local Universities over the years, on the biology and ecology of the elephant, have contributed in no small measure to help and guide the department to plan and develop practical elephant management strategies.

One of the main recommendations made in the Action Plan is the necessity to undertake a long-term monitoring programme to assess numbers, population trends, ecological requirements, movements and human/elephant conflicts to provide a scientific basis for all management decisions. Regrettably, the department does not seem to have taken up this recommendation seriously. The authorities however, have done away with the separate elephant conservation unit which existed from 1980 and which had overall responsibility for Elephant conservation activities, as well as the elephant control units that functioned fairly effectively by responding promptly, among other things, to the complaints of farmers. Today, that responsibility has devolved on the 5 Regional Assistant Directors, whose decisions and recommendations are undoubtedly influenced by the regional interests and requirements, rather than those of the country as a whole.

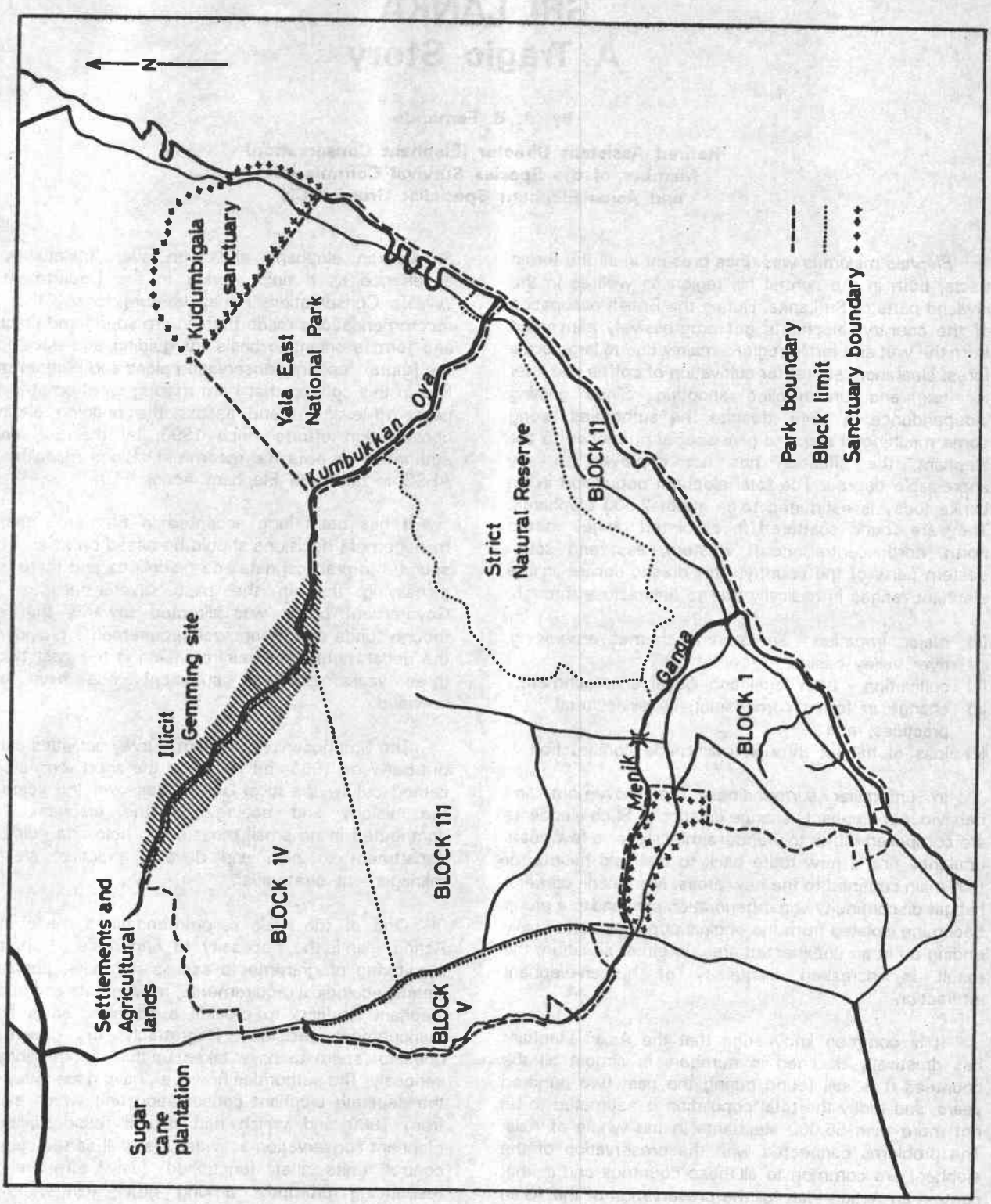


Fig. 1. Map of Ruhuna National Park, Sri Lanka, showing Blocks I - V.

In this situation, it is surprising that the present administration has embarked on an *ad-hoc* and haphazard elephant capture/translocation programme to remove from conflict areas, single male elephants, which are alleged to be crop-raiders and mankillers. Which elephant that is displaced from its traditional habitat and forced to live in inhospitable pockets surrounded by cultivations and human habitations, is not a crop raider? one may ask. It is however, ironical that the department's target is to capture and translocate into safe areas (National Parks) 500 such males said to be roaming about in conflict areas in the country! Even this programme is being carried out by fits and starts in far flung regions and since 1990 some 30 odd adult males have been captured and removed from the Mahaweli Scheme area and from Northern and Southern Regions. At the start, the captives were transferred to a holding centre at Kurunegala for taming before disposal by public auction. The department's statistics indicate that out of 11 elephants captured between January and March 1991, 5 animals had died of severe rope cut wounds. In reply to a question raised by a member at a meeting of the Provincial Council, the Chief Minister had said that out of 10 elephants brought to the holding centre, 4 animals died due to deep wounds on the legs, massive internal haemorrage and weak hearts. While one adult male still remains at the holding centre, the others were sold to the public post-haste. It is not known as to how many of them have survived. It is understood that His Excellency and his Cabinet of Ministers had viewed this exercise with alarm and stopped the scale of any captives in future. Since then, the Department is translocating, or I may say just releasing the captives, in any convenient location in any National Park. Regrettably no action is being taken to monitor these releases in their new homes.

That there is no method or consistency in this exercise is obvious from the following cases:-

i Initially 5 or 6 adult males were captured in Dimbulagala area, close to Maduru Oya National Park, in the Mahaweli Scheme Region; and 4 or 5 adult males were captured in several locations in the Northern Region and were removed to Kurunegala in 1990/91 for taming. According to the Department's press release, it proposes to capture and remove 20 adult males from Maduru Oya area.

ii Two young male elephants were captured in February 1991, at Sela Kataragama in the south on the immediate southern border of Yala NP Block III, and they were released in Block II. Incidentally a photograph of one of these animals taken in Yala Block I, 30 days after its release by a wildlife enthusiast, shows its pathetic condition.

iii In April 1991 capture operations were shifted to the 'H' area of the Mahaweli scheme in the Northern Region, and 3 or 4 adult males were captured in different locations from the pocketed elephants there. The captives were released in Wilpattu NP, which is closed since 1988 due to security reasons. It is therefore, doubtful whether they were released well into the interior in Wilpattu NP away from cultivations and human habitations or near its borders.

iv In July-August 1991 capture activities again shifted to the South. Ten adult males including a tusker were captured in Pelwatte Sugar Cane Plantation and its environs, claiming that they were causing problems to the plantations. The Pelwatte sugar cane plantation is located in the immediate southern borders of Yala NP Blocks III, IV and V and at any given time over 100 elephants concentrate around there. The tusker was taken and released in Yala NP Block I. The other 9 elephants were taken and released at Uralawewa in Yala NP Block III, which is not more than 10-12 miles away as the crow flies, from the place of capture. Their movements were not monitored. It is generally known now that these elephants have returned to Pelwatte soon after they were translocated in Block III. The criteria on which this area was selected for the translocation of Pelwatte captives is not known. However, it is to be noted that no elephant, whether resident, migrant or 'translocatee' would have stayed in Yala NP Block III, as the Sri Lanka Army, with the permission of the Department, was conducting Jungle Training camps there for their recruits. The Army had held several such training camps in Block III and in the adjoining Katagamuwa Sanctuary in July, August and September 1991.

v In September 1991, the Department captured 5 adult males in Bundala Sanctuary in the South and also 3 or 4 males in areas outside Bundala. Two of them were captured at a place called Galwakkada close to Hambantota. One of them is known to have died at the site before retrieval. All these captives too were taken and released at Uralawewa in Block IV. Why the 5 loners that were claimed to be harmless and very popular with tourists to Bundala Sanctuary, were removed from there, while one or two really troublesome males in the periphery were allowed to remain, is a mystery!

vi Late in 1991 another 2 or 3 males were captured at different locations in H2 area (Mahaweli II). One of them was taken and released in Maduru Oya NP, where the human-elephant conflict is said to be serious. Others were released in Wilpattu NP.

vii One adult male that was captured in January 1992 in Resvehera area (H2) was also taken and released in Maduru Oya NP.

viii In March '91, a subadult tusker was captured in Resvehera (H2) and removed all the way to Yala NP in the south, and was released there. Incidentally, it is understood that the Capture Team was on a mission to capture a crop raiding adult tusker in Resvehera,

when it captured the young tusker. The adult tusker which is claimed to be a crop raider is at large there even today.

ix In March 1992, an adult male in Resvehera jungle pocket which was on a crop raiding spree in a village 4 miles away accidentally fell into a home garden well. Police and villagers promptly contacted the Capture Team which was on a capture mission close by, and requested the animal to be removed. The Capture Team for some reason or other, did not remove it, but released it to go free back to Resvehera over settlements and continue its ravages.

x It is understood the Capture Team is presently engaged in a mission to capture an adult tusker carrying only one tusk in Puttalam District. This Particular tusker was one that was moved out along with 70 odd other elephants by driving on foot in 1982 from Resvehera to the southern part of Wilpattu NP. This animal is known to move between the southern boundary of Wilpattu NP (Kala Oya) and Resvehera regularly.

The adult male elephants that are being captured by the Department claiming to be crop raiders and mankillers, are not all from pocketed herds. If they are habitual crop-raiders and mankillers, is it advisable to translocate them to the National Parks? Would these crop-raiders settle down in the National Parks without coming out to the cultivations and habitations that surround them? Would they integrate with the local elephants? Would they not be subjected to some degree of stress in the new area, in the absence of their related and known associates? What would be the long term effects of such arbitrary removal of dominant breeding males from scattered small elephant populations or herds? These are some questions that are being posed by the conservationists, scientists, and even by a large segment of the educated public, for which reasonable answers are not forthcoming from an insensitive administration.

Past experiences show that adult captives suffer serious rope cut wounds when bull-dozers and other machinery are used to tether, move and load them for transport. In the ongoing operations however, the department is using bulldozers to handle captives, and it is suspected that most captives suffer serious leg wounds due to the manila ropes constricting and damaging the muscles and flesh. People with experience have, for a long time advocated the use of tame elephants instead of bulldozers and other heavy machinery in handling captives.

The use of bulldozers and other mechanical equipment in the handling of animals is not possible without cruelty and damage to the beasts. Machinery is unfeeling and unyielding, and it is unlikely that machines of this type are used anywhere in the world either in the capture or movement of animals, whether wild or domesticated. Tame elephants are always preferable to heavy machinery for handling of captives and they are not unavailable in Sri Lanka.

In 1979 when the Department captured and translocated the Deduru Oya herd in Wilpattu NP, tame elephants were used instead of bulldozers, with success. The Committee on Translocation of Elephants in its report dated 1st February, 1985 had also recommended the use of domesticated elephants for movement of immobilized elephants after re-mobilization, instead of bulldozers.

The press statements made by the Department indicate that the elephants targeted for capture were mankillers and crop-raiders. One animal captured in Maduru Oya area was claimed to have killed 18 people, while another captured in Puttalam District was claimed to have killed 13 people. Yet another animal captured was claimed to be a lone female mankiller!

It is generally known that some solitary males which live away from the herds for most of the time become persistent crop raiders. The herds which comprise of adult females, subadults and calves, unless when pocketed, are not known to enter human habitations for crop raiding. But single males become habitual mankillers very rarely. In my 30 odd years of service, the Department had declared as mankillers not more than 4 or 5 males. The last one which was declared in 1988 and destroyed, had a record of having killed 13 people. It had a file dating from 1983, and some of the killings apparently were mere accidents. At the time of my retirement in mid 1990, there was no record of any mankillers at large in the country. While on the subject of mankillers, I may say that generally per year not more than 10 to 15 human deaths in the country are attributed to elephants, and majority of them occur due to chance meetings and other similar reasons, where the people involved are to be blamed more than the elephant.

For 1992, the department had targeted to capture 30 male elephants as follows:

12 elephants in the North Western Province
8 elephants in the North Central Province
5 elephants in Monaragala and
5 elephants in Buttala in the Southeast

Strangely neither the identity and location of the elephants, nor where they are to be translocated after capture, has been made available even to the Ministry. This capture/translocation activity appears to be more a 'conservation gimmick' adopted to bluff the public and the authorities, than a genuine effort to save the endangered elephant.

Crop damage in some elephant infested developed areas may have increased in the recent past. It could be attributed partly to the former elephant control units

not functioning, and partly to the increasing number of exaggerated complaints being made by the farmers and developers with the ulterior motive of obtaining their guns back or to activate the department to capture and remove elephants. Whilst on the subject of crop damage by wild elephants, let me quote the late R. S. V. Poulier CBE., a former civil servant. In a talk delivered at a symposium at the Natural History Society in 1953 he had said:

> "In this matter of crops and wild elephants I fear I see too much of both sides of the question; as an Assistant Government Agent for 6 years in the Mannar, Vavuniya and Mullaitivu districts, I saw at first hand the damage done to cultivations and the problems of fencing and watching; I held numerous inquiries into the shooting of elephants both lawfully and unlawfully. There were ten fantastic stories of damage for each genuine one. Since those far off days the number of elephants has diminished so rapidly that we are all anxious to save some in the wild state"

My experiences of complaints of crop damage in every elephant infested part of the country were not different to those of Poulier, and I may add that is largely true even today.

According to information released by the Department, its target is to capture 500 elephants, and that the decision was taken to capture all troublesome elephants to ensure the safety of human life and property, as well as to save an endangered species from extinction. This is a very interesting statement, since the country has an elephant population estimated to be between 2500 and 3000 elephants, which live in scattered groups. According to Dr Kurt (Smithsonian Elephant Survey) who studied the elephant populations in Yala and Lahugala areas in the South eastern part of the country: 11-20 years age class has 7% males and 12% females, and 21 years and above age class has 6% males and 23% females. Since most troublesome adult males fall into 21 years and above age class, one is not certain as to how the Department has arrived at the figure of 500 troublesome males in the country for capture. Even if the Department is to include the younger animals in the 11-20 years age class as well, it is not possible to find 500 troublesome males. This clearly shows this figure of 500 troublesome elephants is not accurate, and not based on any informative field data. In the course of his survey Kurt also had examined for age, some 49 skulls collected from dead elephants in the field, and interestingly he had concluded that they all had died before reaching 40 years of age.

It has to be noted that generally over 90% of the 60 odd elephants that die annually due to various causes, are adult males, and majority of them are recorded from isolated populations living in and around cultivated areas. In such populations, rate of recruitment to adult male class cannot keep pace with the annual loss. In this situation in most areas today, animals over 25-30 years have got eliminated, and the sex ratios in scattered populations have already become heavily biased in favour of females. Therefore, it could be concluded that the Department's on-going programme of capturing the so called troublesome adult males is likely to accelerate the demise of Sri Lanka's small elephant populations.

Another important recommendation made in the Action Plan is the creation of Jungle corridors over the elephants' traditional migratory routes to interlink the isolated National Parks. The concept of Jungle Corridors, which had even been recommended by the Committee on Wildlife Preservation in Sessional Paper XIX of 1959, does not appear to have received any favourable consideration of the authorities. The need for the elephant to move from one feeding ground to another according to change of seasons has been known to the peasant-cultivator for thousands of years, though scientific study of this phenomeon is of recent origin. Sri Lanka is recognized as the pioneer in the establishment of Jungle Corridors. In 1970 it created the first Jungle Corridor to ensure the safe passage of elephants from Omunagala F. R. to Kandakadu (Somawathiya Sanctuary) in the lower Mahaweli river basin and back seasonally. Since then, this Jungle Corridor has been taken over from development under Systems B and C of the Accelerated Mahaweli Programme (AMP). In 1984 under the Mahaweli Environment Programme (MEP), which was funded by the USAID and GSL, Flood Plains N. P. was legally created to interlink Wasgamuwa N. P. and Somawathiya N. P. and ensure free movement of elephant herds. But from the inception, the authorities allowed this National Park to be invaded by hordes of tobacco cultivators, brick makers and other encroachers. As the removal of the tobacco cultivators and other sundry pests is being delayed day by day, by the authorities, the Flood Plains N. P. is losing its identity and integrity, including the purpose for which it was created.

Interlinking of Maduru Oya NP and Galoya NP; Galoya NP and Lahugala NP; and Yala NP and Uda Walawe NP in the south-east, and Wilpattu NP and Madhu Road Sanctuary in the north with Jungle Corridors have been on the cards for the past 10-15 years. They have been investigated, plans prepared and amended several times, but nothing is being done to give them the necessary legislative protection, while encroachers continue to ravage them daily. Plans for the establishment of the Lunugamvehera NP and the Lunugamvehera-Uda Walawe Jungle Corridor were completed in 1989. The plan and Gazette notification were approved by the Survey General and by the Legal Draftsman. The ADB released funds under Phase II of the KOISP, for the survey of the boundaries. But so far, this National Park has not been legally established.

Surprisingly the authorities think that to ensure their future survival, all free-ranging elephants should be confined in small, but isolated National Parks with habitat enrichment and by putting up electric fences right round them. Since approximately 70% of the total elephant

population of 2500+ is presently free-ranging in developed areas outside the National Parks consequences of such an arbitrary exercise can be detrimental to the very survival of the National Parks. In the absence of proper long-term studies on population dynamics, carrying capacity and influence and effects of large scale habitat enrichment on the natural vegetation and on other animal communities in the isolated National Parks, this policy of keeping elephants restricted to National Parks in the future cannot be accepted to be based on any scientific data and therefore as practical.

It is understood that already funds have been allocated for the construction of some 160 km of electric fences around the National Parks and Sanctuaries during the current year. The plan is to collect all elephants now free-ranging in the peripheral areas into the National Parks and Sanctuaries and keep them boxed in them with the help of electric fences. In the south the Department proposes to construct electric fences along Wellawaya-Wirawila road and along Hambantota-Tissamaharama road to seal off the western boundary of the proposed Lunugamvehera National Park and the northern boundary of the Bundala Sanctuary. In the north-west it proposed to seal off a part of the southern boundary (Kala Oya) of Wilpattu N. P., and also Resvehera jungle pocket from Kahal-Balaluwewa area. It is preposterous to expect the Department to collect all free-ranging elephants and herd them in the National Parks closeby, in one clean sweep. In the last abortive elephant drive in the south in 1991, the department was not able to collect and drive to Lunugamvehera more than 50% of the elephants free-ranging in village areas situated between Walawe and Kirindi Oya lower basins. But they returned to the former haunts within weeks, despite the valiant efforts of the staff to hold them in Lunugamvehera proposed N. P.

The proposed electric fence along the southern boundary (Kala Oya), of Wilpattu NP will cover only the section of the boundary from Nadunawila to Aliwadiya, a distance of some 10 miles. The sections of the boundary from Nadunawila to the sea-coast (Eluwankulama) and from Aliwadiya to Thunmodera (Pannikkankulama) are being kept open. The Department expects to collect and bring all elephants now free-ranging in the forests south of Kala Oya which include Mi Oya and Nanneri Oya basins, and keep them boxed in the southern sector of Wilpattu NP. This section of Wilpattu NP has not been provided with fresh water holes large enough to meet the needs of large numbers of elephants. Besides, Wilpattu NP is subjected to one short and one long, severe drought periods annually. So if the plan is carried out, the elephants will be compelled to concentrate along Kala Oya, resulting in them escaping back to their old haunts, either through the gaps kept open or by breaking the electric fence itself. It is naive to expect them to stay in Wilpattu NP to destroy the vegetation there!

The electric fence is not a 100% elephant proof barrier. Its effectiveness depends on its ability to bluff elephants. By and large, its success depends on night patrolling round the clock, and regular maintenance by staff. Electric fence of the magnitude proposed by the department needs large numbers of staff for daily patrolling and maintenance, in addition to hard to get funds. The resources available to the department for this grandiose programme could be better utilized to maintain 4 or 5 Elephant Control Units effectively in problem areas. Furthermore, such a move will be not only helpful and acceptable to the peasant-cultivator, but also will be beneficial to the survival of the much harassed elephant.

Another matter that needs to be discussed in this paper is the propriety of the development of Yala NP Block IV undertaken by the department with NORAD aid, without first developing Block III, which is situated more to the interior. Yala Block III is bordered by Block IV and V on the west. They act as buffer zones to Block III, and they are surrounded right round by village settlements, cultivations and by the Pelwatte Sugar cane fields. Development of edges without first developing core areas of reserves is countrary to all principles of conservation practices. Such activities like restoration or construction of tanks, roadways and pasture development attracts wild animals, particularly the elephants from the core areas to the edges and to the adjoining cultivations and settlements. This results in increased human-elephant interaction.

The proposal for development of Block IV was no doubt prepared and recommended by the Monaragala District Environmental Committee. But it was not subjected to any critical examination at a workshop by the department, before submitting it to NORAD for funding. The result is the development of the wrong place in Yala NP, which in the not too distant future, would lead to serve elephant problems. Probably the authorities may be compelled to submit another proposal to NORAD for funds to erect electric fences round Yala Blocks IV and V as well!

A long felt need in the conservation of the elephant in Sri Lanka was the creation of the necessary Regulations for the registration of elephants in captivity, and for the registration of tusks and tushes of elephants. While regulations for the registration of tusks and tushes have yet to be created, the Regulations for the registration of elephants in captivity were passed by Parliament in 1990. However, so far no action appears to have been taken to get the elephants in captivity registered.

From the foregoing recent elephant conservation efforts, it is apparent that the policies being followed by the department, though grandiose, are neither scientifically sound nor practical. For this situation it is incorrect to totally blame the department. The Director who is qualified and knowledgeable in wildlife conservation matters, is being compelled to work under severe political and bureaucratic pressure in finding instant solutions to elephant problems in the country. Further, almost all senior hands with field experience have in recent years, left the department on retirement.

Since the government is committed to the preservation of the elephant, the present tragic situation can be largely corrected by the Fauna and Flora Advisory Committee. For this conservationists, scientists and NGOs should come forward with practical suggestions and support. The department has honest and dedicated staff yet, and also the necessary funds. They only need correct motivation and direction, and also some unobtrusive supervision.

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SOME OBSERVATIONS ON ELEPHANTS IN THE RUHUNA NATIONAL PARK, SRI LANKA

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INTRODUCTION

The Ruhuna National Park (RNP) is situated in the southeastern corner of Sri Lanka. Elephants have been its main attraction, though many other large mammals such as the Leopard, Sloth Bear, Spotted Deer, Sambar, Water Buffalo, Wild Boar and a host of other smaller mammals, reptiles, plus over 100 species of birds have been recorded in the park. It has been my good fortune to have been able to pay periodic visits to RNP since 1950. I have carefully recorded the sightings of elephants since 1960. I make these observations as a result of personal sight records of elephants in RNP over a period of 40 years.

ELEPHANT POPULATION

Block 1 (Fig. 1) of RNP where observations were made covers an area of 140 km² and has been justly famous for its population of elephants. During the 1950's, the elephants moved out of the park during the drier months. Such localised migrations took place in three directions; (a) along the west coast, (b) to the east of Block II, and (c) to the north. Then the elephants were reasonably free to move in and out of the park. But today, owing to human population pressures and the clearing of forests, the elephants in Block I can only move eastwards into Block II without coming into conflict with man. As the RNP developed, a major attempt was made to provide water throughout the year. This was achieved by enlarging the existing water holes and by creating larger reservoirs to assure a year-round supply of water to wildlife. This in turn, attracted elephants from outside the park and more importantly, made it possible for the animals to remain within the park. A reference to Table 1 clearly shows that the number of elephant groups sighted in 1976-1991 (239) was almost double that seen during 1960-1976 (396).

There are several reasons for this apparent increase in the number of groups encountered in Block I of RNP, such as:-

1. natural increase in the population.
2. an influx of elephants from outside.
3. improved opportunities to observe elephants.

In the early 50's, we were obliged to walk to most parts of the park. As the park developed, better roads and the use of four-wheeled drive vehicles provided access to more extensive and remote areas. This made it possible for us to observe much more of the wildlife including the elephant.

Given my observations dating from 1950, I feel that the Block I of RNP supports a resident population of about 80-100 elephants, with numbers reaching a maximum of 140 from December to April. The best time to observe elephants is February for the elephant numbers appear to reach a peak between February and March (Fig. 2). Since the park is usually closed to the public from September to October, my visits have been minimal and will not provide a reliable estimate of the elephant number and density for this period.

ACTIVITY PATTERN

It has been the usual practice of visitors to the RNP to do two tours into the park during the day, between 0600-0900 hrs and 1500-1800 hrs. Most published reports on animals in the park refer to these periods as being the times of peak activity even for the elephants.

This was the pattern of activity for the elephants during 1960-1975 period. Of course, herds of elephants do visit the water holes during the hottest period of the day, especially if there were calves present. A tour round the reputed water holes between 1130 and 1330 hrs always brought results depending on the availability of water in the park. During the rainy season, we did not see the herds utilizing these water holes as there was plenty of water throughout the park.

But when considering the period from 1975-1991, another factor must be taken into account. It was the tremendous increase in the number of tourists visiting RNP, leading to a great disturbance of the elephant herds. The elephants in Block I of RNP soon found that they could come to drink from the water holes in relative peace between 1130 and 1330 hrs. As time went on, we began observe more elephants during the mid-afternoon period. It is my belief that the herds changed their activity pattern, so that we now have an additional peak during mid-day.

Period	Time of mid-day activity	Number of elephants
1960-1975	1130-1330 hrs	144
1975-1991	1130-1330 hrs	347

This of course does not apply to the activity pattern of solitary bulls, and we must consider the increase of elephants in the park.

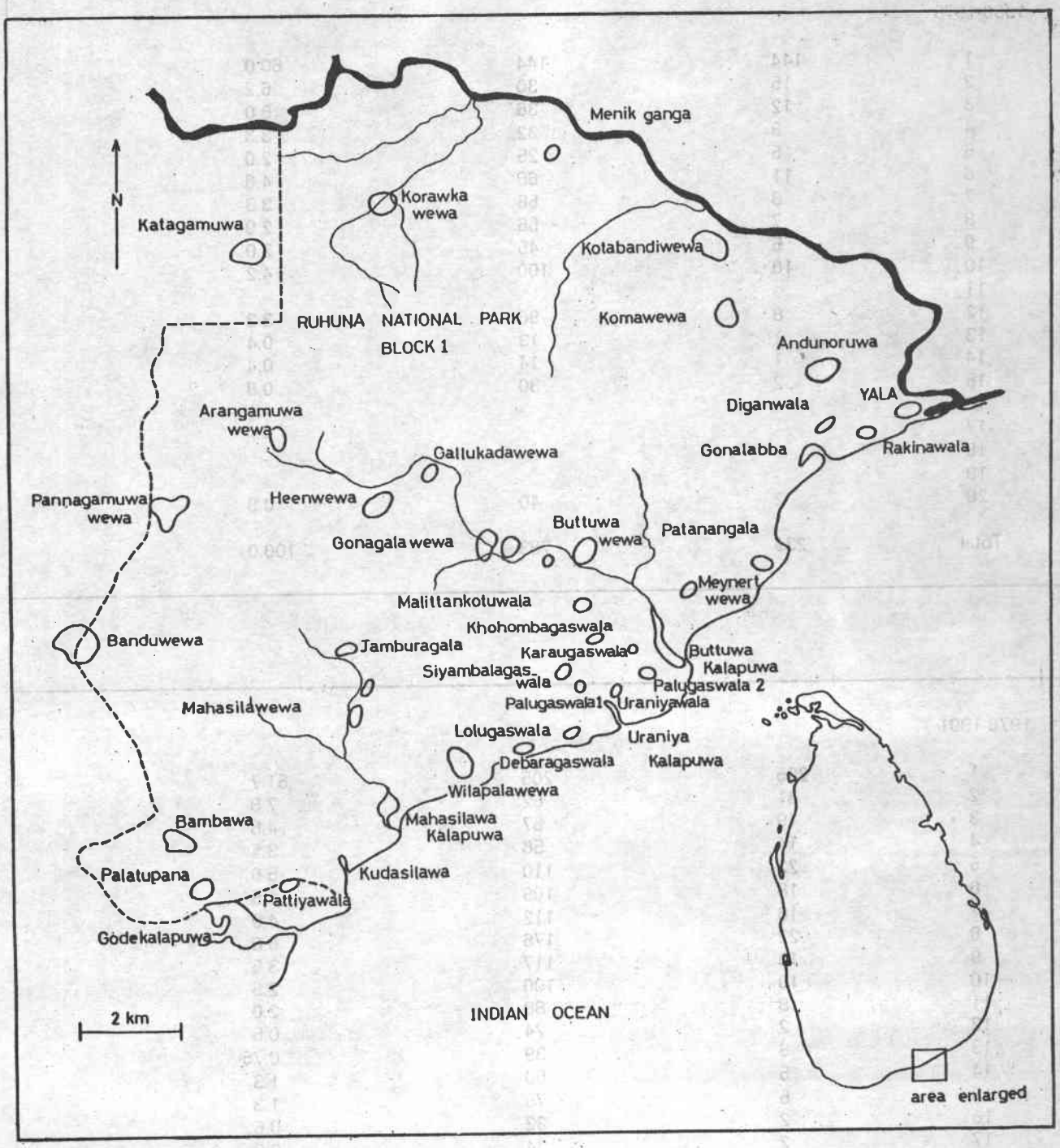


Fig. 1. Map of Block I of Ruhuna National Park, Sri Lanka, showing the location of the main waterholes.

Table 1. Frequency & Group Size of Elephants in RNP.

Group Size	No. of Groups	Total Number	Frequency of Groups
1960-1975			
1	144	144	60.0
2	15	30	6.2
3	12	36	5.0
4	8	32	3.3
5	5	25	2.0
6	11	66	4.6
7	8	56	3.3
8	7	56	2.9
9	5	45	2.0
10	10	100	4.2
11	-	-	-
12	8	96	3.3
13	1	13	0.4
14	1	14	0.4
15	2	30	0.8
16	-	-	-
17	-	-	-
18	-	-	-
19	-	-	-
20	2	40	0.8
Total	239	783	100.0
1976-1991			
1	205	205	51.7
2	31	62	7.8
3	19	57	4.8
4	14	56	3.5
5	22	110	5.6
6	18	108	4.5
7	16	112	4.0
8	22	176	5.6
9	13	117	3.5
10	10	100	2.5
11	8	88	2.0
12	2	24	0.5
13	3	39	0.75
14	5	60	1.3
15	5	75	1.3
16	2	32	0.5
17	2	34	0.5
Total	396	1455	100.0

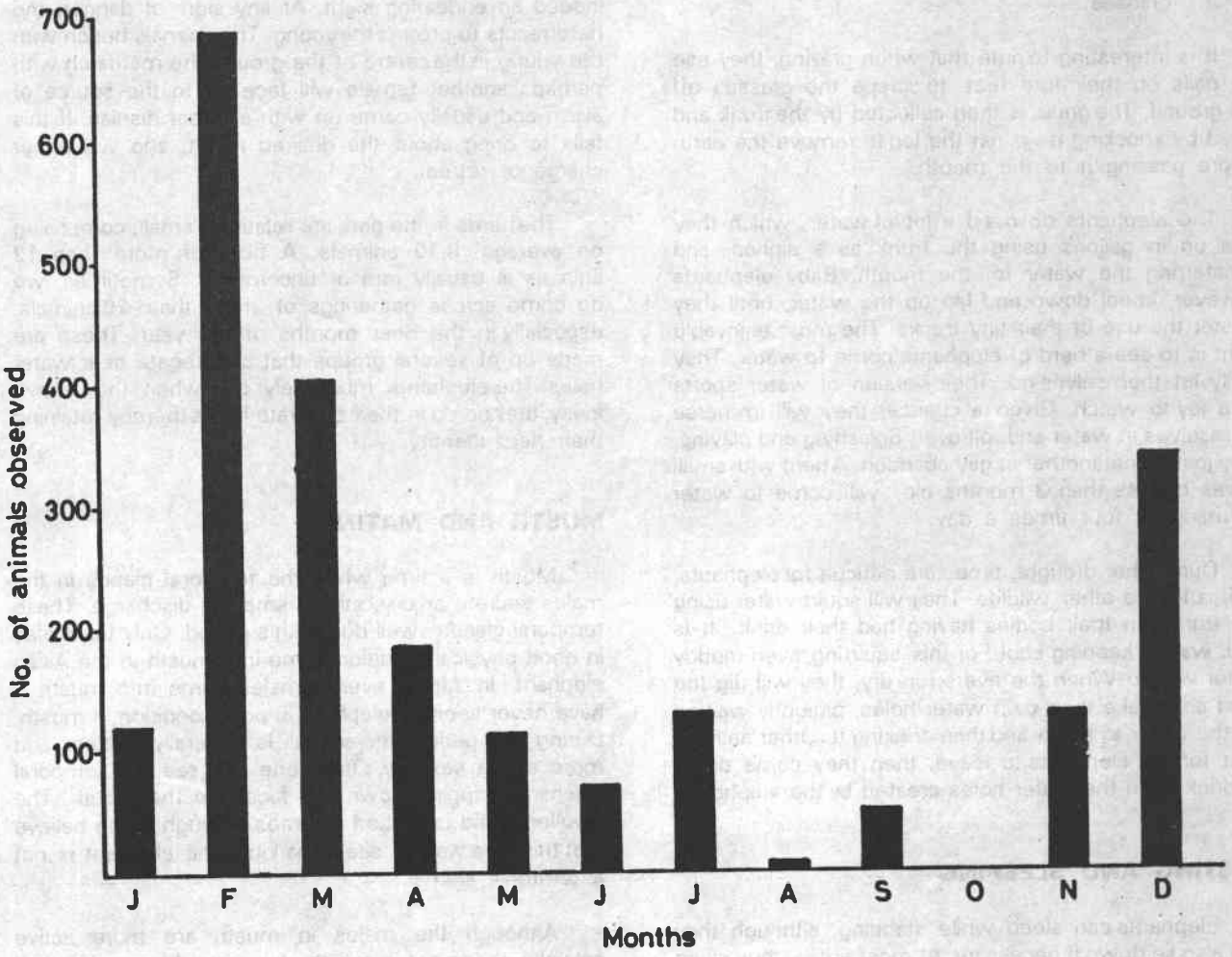


Fig. 2. Monthly totals of elephants seen in Block I of Ruhuna National Park.

FEEDING AND DRINKING

Elephants can and do travel several kilometers in a day. When actively on the move, they do not feed much but take a few branches as they go along. It is amazing that a herd of such large animals can travel so silently. Only an occasional squeal of a calf gives them away. When not on the move, most of the elephants spend time feeding, usually about 150 kg of wet food per day. Consuming such an enormous amount of vegetation in a day is no mean task. Elephants are known to spend between 17-19 hrs per day feeding on more than 100 species of plants. Feeding occurs at different levels:-

1. branches of trees
2. shrubs
3. grasses

It is interesting to note that when grazing, they use the nails on their fore feet to scrape the grasses off the ground. The grass is then collected by the trunk and sifted by knocking it against the leg to remove the earth before passing it to the mouth.

The elephants do need a lot of water, which they take up in gallons using the trunk as a siphon, and transferring the water to the mouth. Baby elephants however, kneel down and lap up the water, until they master the use of their tiny trunks. The most enjoyable sight is to see a herd of elephants come to water. They really let themselves go. Their version of water sports is a joy to watch. Given a chance, they will immerse themselves in water and roll over. Splashing and playing, they jostle one another in gay abandon. A herd with small calves of less than 3 months old, will come to water as many as four times a day.

During the drought, times are difficult for elephants, as it is for the other wildlife. They will squirt water using the trunk, on their bodies having had their drink. It is their way of keeping cool. For this squirting, even muddy water will do. When the rivers run dry, they will dig the sand and make their own water holes, patiently waiting for the water to fill up and then drinking it. Other animals wait for the elephants to leave, then they come down to drink from the water holes created by the elephants.

RESTING AND SLEEPING

Elephants can sleep while standing, although they can also lie down if necessary. At most times, they sleep standing leaning on a tree. They do sleep lying down and they do snore! Calves usually sleep lying down in front of the mothers' forelegs. and once they are bigger, under the mothers' belly. A herd of elephants will not move away until the tiny baby wakes up. They show a great deal of tolerance. Periodic stops are made when on the move, to allow the little ones to feed and rest.

HERD STRUCTURE

A herd of elephants is essentially a family unit, consisting of an elderly female (or the matriarch) and her related offspring. The males leave the herd when they are about 8-10 years old. They may linger close to the parent herd for a year or more, until finally going off on their own. I have never come across sub-adult male groups in RNP as those described in the African parks. But we do see associations between 2 or 3 adult bulls. Generally, lone bulls are the rule and are often encountered in the park.

Calves enjoy a special place in the herd. They are cared for by the "nursery unit" of the herd. A baby elephant is suckled by more than one adult female. To watch a female let another female's calf to feed is indeed an endearing sight. At any sign of danger, the herd reacts to protect the young. The animals bunch with the young in the centre of the group. The matriarch with perhaps another female will face up to the source of alarm and usually come up with a threat display. If this fails to bring about the desired result, she will either charge or retreat.

The herds in the park are relatively small, comprising on average, 8-10 animals. A herd of more than 12 animals is usually rare or uncommon. Sometimes, we do come across gatherings of more than 20 animals, especially in the drier months of the year. These are made up of several groups that congregate near water holes. The elephants mix freely but when they move away, they do so in their separate herds thereby retaining their herd identity.

MUSTH AND MATING

Musth is a time when the temporal glands in the males secrete an oily, strong smelling discharge. These temporal glands swell during this period. Only the males in good physical condition come into musth in the Asian elephant. In Africa, even females come into musth. I have never seen an elephant in poor condition in musth. During this period, the animal is generally restless and more active sexually. Often one can see the temporal discharge dripping down the face into the mouth. The swollen gland is rubbed on trees. Though some believe that this is a way of scent-marking, the elephant is not a territorial animal.

Although the males in musth are more active sexually, those not in musth also mate. I have observed that the largest number of males in musth was seen during February-March. Mating takes place in typical quadruped manner and the act of mating takes only a minute or two at the most. It is interesting to note that the other females in the herd show some degree of excitement during the mating, which usually culminates in a bout of trumpetting.

Elephantine pregnancy lasts about 22-24 months and the birth of a calf is quite an event for the rest of the herd. The movement of the herd becomes restricted and the herd becomes more apprehensive. The youngest calf seen by me in RNP was two weeks old. Unfortunately, this calf died during the severe drought in 1976.

TUSKERS

Tuskers were a very rare sight during the early period. The first Administration Report of the Department of Wild Life in 1950 states that only 2 tuskers were observed in the park. More tuskers were seen in the 60's and now there are quite a few in the park. I can personally identify 16 tuskers and the Department estimates the number to be about 22. It is indeed a good sign to have so many tuskers but they must be driven into the park whenever they are seen close to the park boundaries. This is imperative if the tuskers are to have any chance of survival.

CHANGES IN BEHAVIOUR

The most dramatic change that I have observed has been the change in the behaviour of elephants. Forty years ago, the lone bulls in the park were an aggressive lot. Almost always, they gave us anxious moments when seen at close quarters. At least a threat display or the mock charge was the order of the day. The herds reacted in the expected manner, to get away from man as soon as possible.

The "Stay In Your Vehicle" rule was enforced in the 1950's and the animals were quick to realise that vehicles were harmless mobile objects. It was not long before that lone bulls began to take no notice of parked vehicles. Today, they walk right up to the vehicle and walk past the parked vehicle only a few feet away from the thrilled visitors. If the vehicle is moving, they may sometimes give chase.

The herds took a longer time to change, but change they did. During the earlier phase, the matriarch with another female or two began to give chase to vehicles. The protective instinct with threat display became the rule. As years went by, the herds became more and more accustomed to the vehicles as long as they did not move. Today it is a common sight to see tourist vehicles surrounded by a herd of elephants. One could observe the family life of these animals with impunity. If you leave the elephants in RNP alone, they will most certainly leave you alone and go their way. This change from aggressive behaviour to acceptance has been the most dramatic change over the years.

FUTURE PROSPECTS

The elephants in RNP face few dangers as long as they remain within the park. The tuskers must be driven into the park if they are observed along the periphery. This will reduce the conflicts with man and thus enhance the long term survival prospects of the tuskers. The herds too will come into conflict with man if they move out of the park into the cultivated areas. The greatest threat to the elephants will be the loss of habitat. Thus, the RNP must never be allowed to be reduced in size.

Today, RNP being one of the few parks that are open to the public, over visitation poses another danger to the elephants in the park. The herds are disturbed especially when they come to the water holes; sometimes they are even denied access to these crucial areas by the visitors. This has a drastic effect especially on the calves during the drier months. The fouling up of water holes by buffalo may also pose a threat to the elephants during the drought.

The introduction of translocated elephants poses yet another problem. Most of the translocated elephants are adult bulls that had come into conflict with man. Nearly all are aggressive and some are even known to be man killers. The introduction of such potentially dangerous animals into the park may not only pose a threat to the visiting public but may well have a bad effect on the non-aggressive lone bulls in the park. A change in the behaviour pattern could be disastrous. It is my hope that if these loners must be translocated into the RNP, they be released instead into either Block II or III but not into Block I.

There had been only one fatal accident in the park over the last 50 years. Let us not harass our elephants in the park by deliberately provoking them for the sake of taking a few photographs or films. Today, a few tourist jeeps do the most damage for a Few Dollars More! If this is not checked, an accident is bound to happen and that too very soon. There must be some sort of control, if we are to avoid a calamity. As I mentioned earlier, the elephants in the park are a peaceful lot. Let us therefore keep them that way.

SHORT COMMUNICATIONS

MARKING OR TAGGING ELEPHANTS FOR INDIVIDUAL IDENTIFICATION

By
Richard C. Lair

The privately-owned domesticated elephant population is greatly in need of management programs such as biodata collection, veterinary care, economic analysis, enforcement of work regulations, breeding programs, etc. Any such management programs at scale can only proceed after strict licensing (or, at very least, registration) programs: licensing at scale can proceed only after elephants can be marked and numbered as individuals (Lair. 1986). Developing a safe and simple method for marking individual elephants should be a high priority. (One reason that such a method has never been developed is that the men most able to develop such a method, forest department veterinarians and their Western counterparts, have the least need; their elephants are well guarded and well known as individuals).

Theft of elephants is probably nearly as old as the art of elephant keeping. Branding has a long history as a theft prevention measure. The Moghul Emperor Akbar required that the elephants of his noblemen be branded with a particular mark. "Branding with a hot iron was replaced in colonial times by use of a caustic or corrosive paste (the active ingredient often being phosphoric acid) applied with a stamp or painted through a stencil. Both Evans (1910) and Ferrier (1947) give similar descriptions of chemical branding which includes washing (and sometimes shaving) the skin, tying the elephant's tail under its belly, applying the paste and then leaving the elephant in the sun for 20 minutes before washing the paste off. Both the literature and people who have done it or seen it done disagree on the amount of pain inflicted but it must be considerable, for some animals at least.

But, beyond any question of cruelty, there are at least three disadvantages to chemical branding. First, such brands need to be large (probably a four-digit number) and obviously require some skill in application. (Who would apply such a brand, the owner or a government specialist?) Second, chemical brands are not permanent but must be re-done or re-touched periodically as normal skin wear occurs. Third, brands are susceptible to intentional defacement, obliteration or alteration. (A fourth disadvantage, that of possible infection or abscess after over-exposure to the paste, is probably at an acceptable level of risk.) All in all, chemical branding is a useable but awkward and imperfect tool for making individual elephants. It is suitable enough for a careful and conscientious owner trying to protect his own elephants from theft but much less suitable for making and numbering many thousands of privately-owned animals in regional or national programs.

Veterinarians and other specialists should begin to research new techniques for marking or tagging. The ideal technique would be easy to apply, painless, safe and permanent. Cyrobranding (freeze branding) has been more durable than other techniques on domestic water buffalo but apparently has not been tested on elephants. Tatooing is another conventional option but tattooing (whether on the lip or perhaps even the ear) poses many of the same problems as chemical branding, requiring considerable skill, time and restraint. (The low visibility of a lip tattoo, while no problem for specialists, might hamper law enforcement officials).

But research efforts should not stop with such conventional techniques at a conceptual level every conceivable option should be considered. Perhaps an expandable tail ring could work or even a durable tag glued or pinned to a tusk. (One obvious objection to a tusk disc, that there are many tuskless cows and bulls, is not as strong as one would think since even tuskless elephants often have enough tusk to bear a small disc, such discs might need to be replaced often, which would be a disadvantage.)

Perhaps the most exciting approach would be a method to pierce the ear and affix a unique numbered tag. This tag should be difficult to remove and impossible to reuse, much like a customs seal. (Owners would have little motive to remove tags, since their animals would then be liable to confiscation, but they might try to *swap* tags.) While there are obvious problems associated with an ear tag (e.g., making allowance for growth, preventing abscess or infection, making the tag snag-proof and trunk-proof, etc.) it would seem to offer the best hope for a quick, clear and failsafe result. Ear tags could be very visible and thus easy to examine. So long as a tag *which posed no health hazards* could be developed, this would seem the best way of marking elephants.

Developing an ear tag which is non-irritating and which allows for growth will require much thought and

possibly even the invention of a simple mechanical device to pierce the ear. The ideal tag would require minimal specialist training, minimal physical restraint and minimal amount of time to apply. (Such an ear tag might also be used on elephants immobilized for other reasons.)

Development of a safe ear tag (or any other marking technique as yet not thought of) will take much time and ingenuity but is surely within the competence of an age capable of inventing an artificial heart. Marking for individual identification is the *sine qua non* for any effective registration or licensing program. Marking, though it will always pose a degree of pain and medical risk, is the best protection an elephant has against abuse. Marshall (1959) describes one incidence of chemical branding and writes. "The pain must have been considerable but, since a good brand would be their greatest safeguard against theft and ill-treatment in years to come, they were made to last out a full twenty minutes."

It will be a sad day when every last domesticated Asian elephant is registered and tagged but, given their rate of decline, tagging is both inevitable and desirable.

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INSURING AGAINST ELEPHANT DEPREDATIONS IN SRI LANKA

In recent years, the conflicts between elephants and human beings have increased substantially in Sri Lanka. Newspapers constantly refer to elephants being shot or killed by irate farmers who often bear the burnt of elephant depredations. The Department of Wildlife Conservation in association with the Insurance Corporation of Sri Lanka has come out with a novel idea of providing insurance cover to poor villagers living in remote areas where elephant depredations are chronic and serve.

In this scheme, the Department of Wildlife Conservation will meet the insurance premia cost for the families concerned. The compensation of Rs. 50.000 (about US$ 1,250) will be paid to the families if wild elephants either kill or permanently disable their breadwinner. Other family members will receive Rs. 30,000 (or US$ 750) and children below 18 years, Rs. 20.000 (or US$ 500). Property damage will be covered to the extent of Rs. 10,000 (or US$ 250).

Initially, the scheme will cover people at risk in 8 provinces outside the Western Province. About 700 families will be covered by this elephnat risk insurance policy.

Such an enlightened policy will no doubt bring some relief to the poor villageres. It will also help create a climate of public opinion, especially in the remote villages, that is conducive to the overall conservation of elephants and other wildlife in Sri Lanka.

(Source: *The Daily News* 27 August, 1992. Sri Lanka.)

BOOK REVIEW

THE ILLUSTRATED ENCYCLOPEDIA OF ELEPHANTS

From their origins and evolution to their ceremonial and working relationship with man.
Consultant Editor: Dr. S. K. Eltringham
Salamander Book, London 1991. ISBN 0 86101 556 8 UK price £ 18.95

The elephants are the largest land mammals and the best known among all wild animals. Even today, they are popularly known as pachyderms on account of their thick skin. In fact they were once grouped with such unlikely animals as walruses, tapirs, rhinoceroses and hippopotamuses under the term Pachydermata. However their thick skin is in fact a minor feature: what sets the elephants apart from most other extant herbivorous mammals is their relatively large body size and huge weight. Norman Owen-Smith of the University of Witwatersrand in South Africa designates the elephant, rhinoceros, hippopotamus (and marginally the giraffe too) as Megaherbivores - a term that encompasses those terrestrial herbivorous mammals that typically attain an adult body mass in excess of 1000 kg or one metric tonne. By the end of the Pleistocene, many genera of large mammals had become extinct. This disappearence has been related not only to changes in climate and habitat but to the predatory nature of man as well. Human predation is thought to be the main agent for the elimination of several species of megaherbivores. Elephants however, have managed to survive. Two features of the elephants provide the key to their survival: one is their ability to adapt to widely different habitats, from the dry savannahs in Africa to the dense tropical rainforests of Asia at altitudes ranging from sea level up to almost 3,000 m, and the other is their generalised feeding habit.

The Illustrated Encyclopedia of Elephants is the work of Lyn de Alwis (Sri Lanka), James Barnett (UK), Dhriti K. Lahiri-Choudhury (India), Phyllis C. Lee (UK), Richard Luxmore (UK), Jeheskel Shoshani (USA) and R. Sukumar (India), all are considered experts on elephants. This book should be read by everyone who is interested in elephants and their long term survival prospects and, more importantly, should be studied carefully by conservationists and wildlife managers.

Jeheskel Shoshani deals with the elephants' origins, evolution, anatomy and physiology. Elephants, the only surviving proboscideans, belong to two genera, *Elephas*, the Asian elephant, and *Loxodonta*, the African elephant. Although certain superficial features distinguish them, these two forms are very much alike in basic structure, habits and behaviour. The name 'Proboscidea' was coined by the naturalist Carl D. Illiger from the Greek words *Pro* ('forward' or 'in front of') and *boskein* ('to feed' or 'mouth') and refers to the expansion of the nose and upper lip as a long, grasping or prehensile trunk or proboscis containing the nasal passages of the elephant. This is the strangest and most useful part of the animal, being far more versatile than the limbs of other mammals, including the human hand. It is one of the most remarkable structures ever developed by a vertebrate, and is typically invertebrate in its structure and mechanics. The proboscis has played a significant role in the evolution of the elephants. It allows the animals to reach a height of 6 m or more and occupy very dry areas by making it possible for them to dig for water under dried up river beds.

The elephants belong to the order Proboscidea, which can be traced back to the genus *Moeritherium*, found in the Eocene deposits of Egypt about 50-55 million years ago. Their closest modern relatives are the Sirenians (manatees and dugongs) and the hyraxes or conies. The modern day elephants are descended from gomphothere ancestors. The earliest recognised elephant, *Primelephas* was known in Africa during the late Miocene and was the ancestor of both the African elephant (*Loxodonta africana*) and the Asian Elephant (*Elephas maximus*) as well as the mammoth (*Mammuthus*). Thus the modern genera of elephants are the end results of over 50 million years of evolution. While the African elephant evolved and roamed within the African continent, the Asian elephant after its evolution in Africa migrated to Eurasia.

The African elephant (*Loxodonta africana*) is the largest living mammalian herbivore. The largest recorded African elephant was shot in Angola and measured 4.0 m at the shoulder and weighed 10,000 kg. In general however, African elephants are about 3.2 m in height and weigh between 5,500 to 6,000 kg. Females are usually smaller, weighing up to 2,500 to 2,800 kg. There are 2 subspecies: the bush elephant (*L. a. africana*) and the forest elephant (*L. a. cyclotis*). The forest elephant is somewhat smaller than the bush elephant and is distinguished by its downward pointing tusks and smaller ears. The Asian elephant (*Elephas maximus*) is smaller than the African species with bulls reaching a shoulder height of 2.7 m (average) and females somewhat smaller (2.35 m), and weighing between 3 to 5 tonnes. Although many subspecies of the Asian elephant have been described in the past, only three have been recognised as valid today. They are *Elephas maximus maximus* in Sri Lanka, *E. m. sumatranus* in Sumatra (Indonesia), and *E. m. indicus* elsewhere in Asia from the Indian subcontinent in the west to Indo-china in the east.

The most important atribute of the elephant is its possession of a large, slow-growing brain. In most newly-born mammals, the brain weighs 90% of the mature brain weight. In elephants, the brain weight at birth is 35%, while in man it is 26%. The initial slow growth of the brain in elephants, as in man, is probably responsible for the remarkable learning ability of young elephants.

The tusks, which have become the bane of modern elephants' existence, are enormously enlarged upper incisor teeth. While in the African elephant both bulls and cows have tusks, in the Asian elephant by contrast, only some males have tusks and they are absent in the females. According to Richard Laws, the tusks do not appear in the calves until they are about 2 years old, but grow in length at a constant rate (11 cm a year in African bull elephants, and 8.5 cm a year in females) throughout life. The proportion of Asian bull elephants with tusks varies from country to country. While in southern India, over 90% of the bulls are tuskers, in Sri Lanka and Sumatra (Indonesia) only about 7-10% of the bulls carry tusks. Large tuskers are becoming increasingly rare as a result of trophy hunting in the past and poaching at present, despite a ban on ivory trade. Even bulls with moderately small tusks are being killed for the ivory.

The molar teeth are also unique. Unlike most other mammals, including man, the molars in elephants replace one another in succession, as in a conveyor-belt system, where new and bigger teeth push and replace the old ones six times during their lifetime. The enamel of the molar teeth are folded into numerous plates to enable the animals to grind grass as well as herbaceous browse that they consume in such large quantities. The age of an elephant can be fairly precisely determined by the examination of its teeth. When the sixth set of molar teeth are wasted, then it is time for the elephant to die.

In Asian elephant, the phenomenon of 'musth' has attracted a great deal of attention and is associated with the activities of the temporal gland, situated between the eye and the ear. During the musth, the bull elephants exhibit heightened sexual and aggressive activity. Musth usually lasts for about 2-3 months once a year. Bulls tend to show non-overlapping musth periods, so that it is rare for two males to be in musth at the same time. When this happens, either one male moves away or comes out of musth. African bull elephants too exhibit a similar condition. But it is not confined to the bulls alone. Even cow elephants show seasonal temporal gland activity. Mature bulls in musth range over larger areas, displacing equally large bulls that are not in musth.

The function of the temporal gland in the elephant is not well understood. M. R. Jainudeen, George M. McKay and John F. Eisenberg who investigated the phenomenon of musth in domestic elephants in Sri Lanka, consider musth to be a post-pubertal phenomenon. From a management point of view early recognition of musth will be useful, as musth in a working elephant is an economic loss as well as a very dangerous period. More recent studies by Michael Schmidt at the Washington Park Zoo in Portland, Oregon, USA indicate that musth is not a rutting period in the classic sense of the term. Musth may enable a bull elephant to challenge established dominance hierarchy.

The large body size of the elephant is an advantage against other mammalian predators (except modern man). On the other hand, because it is so huge, it has a relatively small surface area compared to its volume. This creates problems when it comes to losing heat. Since elephants do not sweat, how do they manage? The answer lines in the peculiar sculpturing of the skin. According to Harvey B. Lillywhite and Barbara Stein of the University of Kansas, USA the skin of the African elephant is wrinklier that that of the Asian elephant. The wrinkles are there as the animals need to keep their bodies cool and their skin moist. African elephant skin can hold between 5 and 10 times more water than a flat surface. The wrinklier skin of African elephant can hold roughly half as much again as the skin of Asian elephant. The elephants spray themselves with water at least once a day, and also wallow in mud. The sculpturing of the skin enables the elephants to retain water and delay the drying of mud. This means that the elephants can keep themselves cool with less water. The largest African bush elephant inhabits dry, open environments where heat and loss of moisture are severe problems. The properties of the skin are probably vital to the survival of elephants. Asian elephants, with less wrinkly skin, solve the problem of heat loss by retreating into the forests during the hottest time of the day.

Phyllis Lee considers the social life and the reproductive behaviour of the elephants. Among the elephants, the basic population unit is the family consisting of an integrated group of closely related animals of all classes excluding adult males. The units are led by the oldest female or the matriarch. In Africa, the family units may number 8-10 animals, while Asian elephants tend to occur in smaller units of 4-8 animals. While large aggregations of elephants numbering 100-1300 animals are known in Africa, these usually do not number more than 150 animals in Asia. The other population unit is the loose association of mature bulls, the bull herd averaging only 2 to 3 animals. Lager bull groups containing more than 30 animals are not unknown in Africa but are either very rare or unknown in Asia. Females reach sexual maturity in about 8-10 years while the males become sexually active in about 12-15 years. Puberty can be delayed. In areas of poor nutrition, the growth and maturation of elephants can be retarded. According to John Eisenberg, the young male Asian elephant does not begin to achieve adult stature until he is approximately 17 years of age. The males once they reach sexual maturity, leave the herd and roam over large areas in search of cows in oestrus. It is also during such wanderings that farmers and cultivators experience much depredations to their crops from elephants.

females reach puberty is very plastic and could vary from 12 to 23 years, and can be deferred in unfavourable conditions. These according to Richard Laws are density dependent as well as habitat related, since habitat changes occur at the higher densities. Mean calving intervals varied from 3 years in a very productive population to 9 years in least productive population. The elephant represents an extreme example of a k-selected species, with 22 months gestation period and a large parental investment. Laws argues that reproduction is the actual regulatory process. Elephant populations tend to reach saturation densities at which nutritional limitations restrict further increase. The major regulatory responses, according to Norman Owen-Smith, occur through changes in fecundity, i.e. in birth intervals and in age at sexual maturity. These may be sufficient to arrest population growth without much increase in mortality.

The number of elephants in the 35 African countries in 1979 was estimated to be 1,343,340 animals by Iain Douglas-Hamilton. Some eight years later, a similar but less comprehensive survey carried out by him indicated they there were only 410,235 elephants in 32 countries. But there is some doubt about the accuracy of the first census and so it is difficult to assess the rate of decline. To add to the confusion, the number of elephants in Africa is now estimated to be about 650,000 animals! In Asia, it is estimated that between 35,000 and 55,000 elephants occur in the wild, in 13 countries with another 15,000 animals in captivity. The entire range covers a total areas of 500,000 km² (or about the size of Thailand).

In the absence of detailed surveys, these estimates of the Asian elephant numbers too must be viewed with caution. In many instances, the estimates do not represent much more than informed guesses, based on little in the way of detailed evidence but depending much more on extrapolation from one area to another. Recommendations for long-term conservation of the elephants do not depend on precise quantification of populations. It is usually sufficient to know whether they can exist in significant numbers. Thereafter it is necessary to establish whether the populations are expanding in numbers, declining or remaining stable.

Over large regions of Africa and Asia, there is no longer room for elephants to move about and adjust their densities to changing vegetation patterns. Increasing human population and increasing agricultural land use have considerably reduced the area available to the elephants since the turn of the century. The key to the long term survival is a reduction in the human population growth. Mankind cannot go on expanding in an exponential manner and at the same time, expect to conserve the natural resources. In Africa, the most serious threat to the elephants is poaching while in Asia, forest conversion appears to be a far more serious threat than poaching. But on both continents, the poverty of the people and their legitimate aspirations to a better life will ultimately decide the future of much of the wildlife including the elephants.

Many Asian elephant populations are small , fragmented and are distributed discontinuously. Small populations are more extinction prone than larger ones. What is the minimum size of the population that is viable? For elephants, the Minimum Viable Population (MVP) appears to be over 100 animals. From a theoretical point of view, a population of 500 breeding individuals (or a total population of 1,000 animals) is necessary to halt genetic erosion. In practice however, only very few Asian countries have the habitat extensive enough to support populations of 1,000+ elephants. The solutions given in the book to manage small populations of elephants include the improvement of habitat, translocation of the small populations to more secure habitats and the establishment of corridors to maintain habitat continuity and to ensure genetic exchange between small populations.

Despite their size and seeming invincibility, elephants are still vulnerable to natural causes of mortality, such as disease and malnutrition, and cannot avoid the effects of habitat destruction and mass slaughter by man. James Barnett elaborates these aspects in the chapter on Dissease and Mortality. Both African and Asian elephants may be infested with the same parasites, but many parasites appear to be species specific. The Fluke, *Fasciola jaksoni* is found only in the Asian elephants and is known to cause disease and mortality in working elephants. A protozoan parasite, *Trypanosoma* occurs in both African and Asian elephants and is thought to be responsible for disease causing anaemia and intermittent fever. The elephant is also parasitized by a variety of forms, perhaps the most unusual of which is a botfly, the larva of which is found only in the sole of the elephant's foot. The incidence of infectious diseases appears to be low.

The most vulnerable stage in an elephant's life is its first year, when mortality rates may exceed 30%. The elephant is one of the few species in which ageing occurs in the wild. Like man, they suffer from a variety of degenerative conditions linked to age. Elephants suffer from arteriosclerosis, which increases throughout life as in man. The major cause of mortality in both African and Asian elephants however, is man. Man has been slaughtering elephants from time immemorial for their ivory, skin and meat. In recent times, poaching for ivory (despite a total ban on ivory trade by CITES), has almost decimated elephant populations in a few East African National Parks (e.g. Uganda and Kenya). On the other hand, in southern African states (e.g. Zimbabwe, Botswana and South Africa) where strict anti-poaching measurers have ensured the steady increase in elephant numbers, the management authorities have to regularly cull excess elephants to prevent over exploitation of the habitat. In such instances, the culling is the major cause of elephant mortality.

Lyn de Alwis discusses the role of trained elephants in forestry, agriculture and tourism. It is about 4000 years since the elephant was tamed in India. Since that distant beginning, the elephant has maintained its supreme

position in the cultural, religious and social life of Indians. Contrary to the popularly held belief that African elephants cannot be trained, it appears that they were domesticated as early as the Asian elephants. Today, the trained elephant is the backbone of the timber industry in Burma. Elephants are captured for domestication in many ways: the *keddah:* where entire family herds are captured by driving them into a stockade. *Mela-shikar:* where selected wild elephants are noosed from the back of tame elephants (or *koonkies*). *Pit-method:* where an unsuspecting elephant falls into a well camouflaged pit set along the trail. *Chemical - immobilization:* where an immobilizing chemical such as Immobilon (which is a combination of etorphine and acepromazine) loaded into a special gun (Cap-Chur gun) and 'fired' on the targetted elephant. Chemical immobilization has been used in Africa since 1959 and is now a routine practice in Asia in translocating problem elephants.

Trained elephants have been used in war and peace. They are invaluable in forestry operations especially in marshy areas and along steep hills where machinery cannot be operated. The elephant's advantage in forestry operations - both economic and environmental - are many and well-proven:-

1. A fully trained elephant is an investment for a lifetime. In Thailand, it costs US$ 6,000 to US$ 10,000 to buy a 20-year old timber elephant, whose working life after purchase may continue another 30 years. Compare this with the US$ 100,000 to 140,000 price of a crawler tractor, with a working life of only six years and the requirement of a continuous supply of air polluting diesel fuel.

2. Using elephants does not require construction of expensive logging roads. Such roads not only destroy a great deal of the forest, but open the interior to slash-and-burn farmers and poachers. Elephant based logging eliminates this danger.

3. Unlike machinery, elephants do not rust, corrode or pollute the environment. They also do not need expensive spare parts.

4. Their dung acts as fertilizer as well as an agent of seed dispersal in the forest, automatically reforesting even as they remove trees!

5. Elephants' staple food include grass and bamboo, which are part of the undergrowth in forests. Their feeding thins the undergrowth thus enhancing the germination and growth of many tree seeds, thereby further fostering reforestation.

6. Elephants cause less damage to the land than heavy machines, whose wheel and tread ruts create corrosion channels and whose weight causes soil compaction.

7. Trained elephants (except bulls when they are in musth and pregnant females) can work throughout the year under weather conditions, even in rain and mud that stop machines.

8. In some terrains, such as freshwater swamp forests or on very steep hills, elephants are the most cost-efficient means of timber extraction, if not the only means.

Trained elephants are ideal vehicles for transporting tourists in National Parks. In Asia, the Indians, Nepales, Thais and to some extent the Indonesians have exploited this with great success in their national parks. If more countries were to use elephants seriously in this way and prove that they have a tremendous economic value in a non-extractive industry (e.g. nature tourism), it might provide another incentive to protect them in the wild.

Richard Luxmore analyses the ivory trade which has become a controversial issue. Ivory has been valued as an article of adornment since the dawn of mankind. In October 1989, however, most governments voted to outlaw the trade in ivory through fears that ivory poaching was directly responsible for the decline in the number of African elephants. The African elephant was thus transferred to the Appendix I from Appendix II at the October meeting of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The Asian elephant was already in Appendix I. At this Convention, a few important countries (Zimbabwe, Malawi, Botswana, Zambia and South Africa) refused to support the ban, arguing that controlled trade regulated by an "ivory exchange" will do more to safeguard the African elephant.

Despite a low per capita income, an expanding human population and the existence of an ivory industry, elephant numbers have remained stable in India. Does India's experience have any relevance to Africa? But India too has tightened its regulations lately. It has banned the import of ivory and sale of articles made from imported ivory with effect from 2 April, 1992. The ban has not been able to eliminate ivory poaching from either Africa or Asia. The exploitation of elephants is an economic problem. A total ban on ivory trade alone cannot ensure the survival of tuskers in Africa and Asia. What is more urgently needed is action to improve the incentives for the local communities to participate in the conservation of wildlife resources. They must also participate fully in decisions affecting land and resources.

Dhriti Lahiri-Choudhury traces the references to the elephant in 5,000 years of Indian history and mythology. It is a fascinating story. The earliest Veda-Rigveda- already refers to the elephant and by 800 BC, an elephant *(hastin)* is recommended as a gift. This seems to indicate that the elephants might have already been tamed by that time. Elephant ownership conferred status on the owners *(hastipa)* then as it does today. By 650-600 BC, the Vedic texts refer to a gift of 10,000 elephants (plus

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an equal number of slave girls). One can imagine the number of elephants extant in India at that time! The Jataka stories (in Buddhism) refer to the white state elephant that defeated the King Kosala who was attacking Varanasi. In those days, the King went to war riding the elephant and not the horse. The Jataka stories also refer to several elephant festivals in the north. The main concentration of elephants referred to in the stories was in the Himalayas, from where they have almost disappeared today. It was during the reign of Emperor Asoka (grandson of Chandragupta Mauriya) that the elephant become a symbol of Buddhism. The two great Indian epics, the *Ramayana* and the *Mahabharata* refer to the elephant as the royal mount and provide more detailed and acute observations on the elephant behaviour than given in the Jataka stories. Alexander the Great was told that during 327-325 BC in India elephants were as numerous as cattle, east of Beas. More than 1,800 years later, Babur, the founder of the Mughal Empire in India (1526-1530), noted that as one moved east, elephants become more numerous. The ambassador of Seleukos to the court of Chandragupta Mauriya, Megasthenes provides the first datable report of using the keddah method of capturing elephants. The comprehensive account of Indian politics and government organization given in the Arthashastra (300 BC - 300 AD) also deals with the training of elephants. Teasing an elephant is set down as a legal offence!

The ancient Tamil literature of the Sangam period (1st to 3rd century AD) offers a wealth of information and shows that elephants were a part of the culture and way of life of the ancient Tamils. *Nigandu* the old poetical lexicon has 44 names for the elephant species, four seperate names for female elephants and five for calves. *Raghuvamsham* (Kalidasa's poem in 400 AD) refers to elephants debarking trees! (one of the current management problems in many parts of Asia and Africa). The beginning of Islamic period in India, saw an increasing reference to the use of elephants in warfare.

The use of elephants in war reached its highest level of sophistication under the British in India and the Dutch in Indonesia. The value of using trained elephants in military operations especially in mountainous regions in India was appreciated by General Sir Sydney Cotton who disarmed the mutinous Sepoys of Peshawar in the rebellion of 1857. Lahiri-Choudhury concludes that the "elephant still survives in India despite all odds: respected, worshipped and loved in captivity; deferentially treated and feared in the wild; still in demand by man, its market price higher than ever before, symbol of eternal India". It would indeed be difficult to imagine India without elephants.

The book has three short, very useful addtional chapters on "(1) Keeping Wild Elephants at Bay" in which Dhriti Lahiri-Choudhury identifies the human-elephant conflicts and provides a number of practical measures to resolve them; (2) "Tourism and National Parks" where Lyn de Alwis using his ample experience in the past as the Director of Wildlife Conservation in Sri Lanka, discusses the role of national parks and the economic potential of these recreational areas in Asia. He also acknowledges the role played by the Asian Elephant Specialist Group of which he is the Chairman; and (3) "How to Photograph Wild Elephants".

Given the excellent text, the wealth of information contained, and lavish colour illustrations, the book at 18.95 pounds sterling is indeed good value for money. The book could have given more atention to the present status of the African forest elephant *(Loxodonta africana cyclotis)* and the Sumatran elephant *(Elephas maximus sumatranus),* and the current on-going efforts to ensure their long term survival in the wild. But this is a small oversight in what is otherwise a very succinct and comprehensive account of the elephants.

Charles Santiapillai

DIARY

1. WORKSHOP ON THE BIOLOGY OF FOREST ELEPHANTS

This workshop will be held during the Sixth International Theriological Congress, at the University of New South Wales, Sydney, Australia (4 - 10 July 1993).

Those interested in presenting a paper at the Workshop, should write to either of the following two convenors:-

1. Dr Jeheskel Shoshani
   Cranbrook Institute of Science
   106 East Hickory Grove Road
   Bloomfield Hills, MA, USA.

2. Dr Colin Groves
   Dept. of Prehistory & Anthropology
   Australian National University
   GPO Box 4, Canberra, ACT 2601
   Australia.

The deadline for submission of abstracts is 31 March 1993 and any abstract postmarked later than this will not be accepted for printing.

2. INTERNATIONAL SEMINAR ON THE CONSERVATION OF THE ASIAN ELEPHANT

J. C. Daniel
Bombay Natural History Society
Hornbill House,
Shaheed Bhagat Singh Road,
Bombay 400 023, India.

The Bombay Natural History Society has been involved in the conservation of the Indian Elephant for the past two decades. In the late seventies when I was the Chairman of the Asian Elephant Specialist Group of the Species Survival Commission of the IUCN, the group undertook a status survey of the elephant populations in various regions of the sub-continent. The basic data obtained indicated the perilous status of the species and the possible areas of conflict with man. It was established that with a continually shrinking habitat, the status of the elephant in India and elsewhere in its distribution would continue to deteriorate unless urgent conservation measures were undertaken.

This period also saw the commencement of extensive scientific research into the ecology of the elephant, initiated by Dr R Sukumar of the Centre for Ecological Sciences, Indian Institute of Science, Bangalore. and later on a long term basis by the scientists of the BNHS with funds and collaboration provided by the Fish and Wildlife Service, USA, and sponsored by the Ministry of Environment and Forests, Government of India and the Forest Department, Government of Tamil Nadu.

This project of continuous study over a period of nine years ended in September 1992 and voluminous data on the ecology of the Indian elephant and the problems facing it has been obtained from populations in Mudumalai Wildlife Sanctuary, peripheral populations in the border areas of Tamil Nadu, Karnataka and Andhra Pradesh and a population inhabitating a degraded habitat in the Dalma Sanctuary in Bihar. During this period, research on elephant ecology has also been undertaken by the Wildlife Institute of India and the Kerala Forest Research Institute.

It was therefore felt by the Society that at this point of time when the Project Elephant of the Govt. of India is to come into operation, it would be useful to review the status of the elephant on the basis of available information through an international seminar.

We feel that the conservation of the species would be best served by holding a seminar where status of the species throughout its present range and the problems faced by it can be examined and discussed in detail. Presently the following organisations have agreed to sponsoring or collaborating with the Bombay Natural History Society in the organisation of the seminar: (1) Forest Department of Tamil Nadu (2) Forest Department of Karnataka (3) Salim Ali Centre for Ornithology and Natural History (4) Centre for Ecological Sciences, Indian Institute of Science (5) Kerala Agricultural University (6) Kerala Forest Research Institute.

The Bombay Natural History Society is planning to organise an International Seminar at Mudumalai Wildlife Sanctuary in Tamil Nadu, India in June 1993 on the theme "The Asian Elephant - Present Status, Problems and Future Prospects"

It is felt that there should be an interaction between the Asian Elephant Specialist Group, Wildlife Managers and Scientific community. It is hoped that such an interaction will also include members of the African Elephant Specialist Group.

The tentative programme is as follows:-

1st day:	National Status Reports
2nd day:	State-wise Status Reports (India)
3rd day:	Elephant Research in Asia
4th day:	Elephant Research in Asia (continued)
5th day:	Management Problems:-
	a) Man-elephant conflicts
	b) Habitat conservation
	c) Project elephant, India
	d) Translocation
6th day:	e) Elephant and human economy
	f) Recommendations

Those interested in attending this International Seminar on Asian Elephants, should write to:

Mr J. C. Daniel
Bombay Natural History Society
Hornbill House,
Shaheed Bhagat Singh Road
Bombay 400 023, India.



WWF World Wide Fund
for Nature

Please send your articles to :

Dr. Charles Santiapillai
Executive Officer, AESG
110 Wattarantenne Road, Kandy, Sri Lanka.