# Planning for Asian elephant conservation

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## Objective

The objective of an Action Plan is to provide governments, national and international conservation agencies, researchers and conservationists with concise, up-to-date information on the status of *Elephas maximus,* as well as an objective and practical management framework for ensuring the survival of as many viable populations of the elephant as possible in as wide a range of its habitats as is feasible. This objective has to be achieved in the context of continued increase in human population in South and Southeast Asia, rising living standards in many Range States, the imperatives of opening up new land for agriculture and settlement, and the need to minimize human-elephant conflict. The Action Plan thus aims to promote the conservation of as many healthy populations of the elephant both within Protected Areas (PAs) and as many animals outside these areas as the land can support and the landholders will accept.

Throughout its range, the Asian elephant is increasingly being confronted by socio-economic and political pressures that threaten to destroy the very habitats set aside for its long-term survival in the wild. For wildlife, such as the elephant, and PAs to survive on a significant scale, they must be "socio-politically acceptable, economically viable, and ecologically sustainable" whether it be in Africa or Asia (Child 1995). Conservation of the elephant in Asia therefore depends on the political will and concrete actions of the governments involved. Without political will and commitment, the implementation of many of the conservation recommendations outlined here will be impossible. Government commitment and action must be obviously based on sound ecological, economic, and cultural arguments for conservation of the elephant in the light of its positive values and negative impacts on the environment.

Strict protection of habitat and its denizens is perhaps the best way of ensuring the long-term survival of elephants in the wild. But setting aside sufficient habitat large enough to accommodate the home ranges of such long-ranging animals in Asia, where people and elephants compete for the same resources, is practically impossible. Most wildlife sanctuaries, national parks or other categories of nature reserves in Asia are not large enough individually to support elephant populations, and farmers or villagers living along the periphery of such reserves or in enclaves within are highly vulnerable to what happens when such large herbivores do not stay inside their boundaries (Sugal 1997). It will not be possible to save all of Asia's wild elephants, but losses can be kept to a minimum if economic development plans take into account the needs of the elephant, and planning for elephant conservation takes into consideration the needs of local people as well. The number of elephants that are to be protected must be equivalent to or above the minimum required to ensure the survival of the species.

As Ferrar (1983) rightly argues, at any but the lowest density, large wild animals and people are fundamentally incompatible. This incompatibility increases rapidly as both elephant and human densities increase. Thus, the maximum number of elephants that a system of PAs and their surrounding regions can support depends on the neighbours' tolerance of the species (Child 1995). The present rate of human population growth, the constant land hunger, and increasing expectations for improved living standards, exacerbate the problem for habitat conservation. More often, legitimate aspirations for better living conditions cause greater pressure on elephant habitat than sheer growth in human numbers. The attitudes of local communities are strongly influenced by whether the high cost of having the elephant in their neighbourhood can be offset by the revenues it generates through other means such as small-scale ecotourism. The future of the elephant in Asia is inextricably linked to the welfare of the rural people with whom the animal shares the land. Conservation programmes that ignore human interest are doomed to failure. As Sugal (1997) succinctly puts it, the hard lesson in ecology as in economics is that "there are no free rides; in one way or another, everything pays its way".

Thus, the most practical and appropriate strategy of conserving elephants in the long term is the landscape approach that incorporates PAs within a matrix of other forms of land use including logging areas, non-timber product extraction areas, grazing land for livestock, and even some agricultural activity. Such an integral landscape has been termed the *Managed Elephant Range* (MER) (McNeely 1978; Santiapillai and Jackson 1990) and is the approach taken by India in implementing its elephant conservation project namely, the Project Elephant.

The success of the Action Plan will depend on how effectively each government implements the key recommendations. An action plan that is not implemented is little more than an interesting academic exercise. It is most desirable that each country develop its own National Action Plan for elephant management and conservation. Each country should identify its national priorities and seek the necessary resources to put the strategy into action. The cost of implementing the recommendations given in this Action Plan may be high, and therefore calls for increased financial allocations from Range State governments and international donor agencies for elephant conservation in most

Asian countries. Governments can also receive financial assistance from the Congress of the United States of America through its Asian Elephant Conservation Act of 1997 (AsECA), which was enacted to "assist the conservation of Asian elephants by supporting and providing financial resources for the conservation programs of nations within the range of Asian elephants" (Stromayer 2003). Elephants are part of the heritage of all mankind, and hence even other governments and conservation agencies should contribute funds and expertise towards their continued survival in the wild.

**Recommended actions**

The following set of prescriptions provides the broad conceptual framework for the more specific planning for elephant conservation and management. These are based on our current scientific knowledge of elephant biology and ecology, and many of these have been outlined in earlier publications as well (Santiapillai and Jackson 1990; Sukumar 2003).

*Viable elephant populations*

A small or fluctuating population is more prone to extinction than a large or more stable population, due to chance factors; these include demographic, environmental and genetic stochasticity, and catastrophes (Shaffer 1981; Gilpin and Soulé 1986). The risks associated with demographic and environmental stochasticity are inversely proportional to population size (Caughley 1994). Modern theory of conservation biology recommends the maintenance of effective population sizes $N_e$ of 50 and 500 adult reproductive individuals for short-term and long-term conservation, respectively (Franklin 1980). However, these are merely 'rule of thumb' estimates, and the specific needs would vary with the species, its population and the circumstances of its environment. The effective size of a population in genetic terms is the number of individuals that would lose genetic diversity (or become inbred) at the same rate as an ideal, constant population with an equal ratio of adult male to female, random mating and random distribution of offspring among parents (Frankham *et al.* 2004). In the short-term, the most serious genetic consequence of a small population is inbreeding depression (Ralls *et al.* 1979), as it leads to reductions in heterozygosity, reduced reproduction and survival, and increased risk of extinction. Fragmentation of a widely distributed species into many small populations increases the risk of losing a high degree of genetic variation in subsequent generations (Gilpin 1991). It must be noted that a given effective population size translates into a higher total population size (including sub-adults and juveniles) by a factor of at least two or three for elephants under normal conditions.

The term *minimum viable population* (MVP) according to Gilpin and Soulé (1986) may have come into vogue in 1976 because of an injunction from the U.S. Congress to the U.S. Forest Service to maintain 'viable populations' of all native species. But the concept, in fact, can be traced to an enlightened Sri Lankan Wildlife Warden, Mr. C.W. Nicholas, who in his Administration Report (1953) stated that "there is a biological minimum for every species of animal; if the population falls below that minimum, breeding ceases and extinction follows". Based on modeling the MVP for Asian elephants it has been suggested that managers should aim at maintaining a total population of 100-300 elephants for short-term survival in the face of demographic and environmental stochasticity as well as genetic erosion (Sukumar 1995, 2003). If small populations continue to lose habitat and come into conflict with people, their viability would be further compromised (Sukumar 1995). It is also important that the adult male: female sex ratio in the population is not skewed too drastically as this reduces the effective population size. For maintaining the long-term evolutionary potential of a population about 10 times the above number of elephants may be needed. There are fewer than about 10 Asian elephant populations today that attain these sizes. Most of these larger populations are in India and Sri Lanka.

*Viable elephant habitats*

The key to maintaining an elephant population in the long term is to provide it habitat of sufficient size and quality. All Range States, on their own and in cooperation with neighbouring Range States, need to develop a comprehensive network of PAs for elephant conservation. These areas are critical for the long-term survival of the species. They need to be of sufficient size and ecological diversity to accommodate viable elephant populations. The minimum viable habitat area is related to the minimum viable population and the carrying capacity of the habitat (Sukumar 2003). In many dry habitats in Asia, elephants occur at an equilibrium density of 0.5/km$^2$, which would translate into minimum habitat areas of 200-600km$^2$ for short term survival and 2,000-6,000km$^2$ for long-term persistence of a population. Tropical rainforest habitats with a lower elephant carrying capacity of one elephant per 5-10km$^2$ need correspondingly much larger areas to sustain viable elephant populations. The maintenance of the integrity of the overall landscape for an elephant population should be the most overriding consideration for long-term conservation.

PAs that provide necessary sanctuaries for elephants from human activities should be part of larger MERs to provide sufficient space for elephant movements (Santiapillai and Jackson 1990). In a MER, priority is given to the requirements of elephants, but compatible human activities such as sustained-yield forestry, slow rotation shifting cultivation, controlled livestock grazing, and subsistence hunting are permitted. Controlled logging too can contribute to making good habitats for elephants, as regrowth and secondary vegetation often provide excellent food resources and can maintain higher elephant densities than primary forest. MERs are complementary to, and not a substitute

for, PAs. Nevertheless, as Lahiri-Choudhury (1991) argues, the main problem of elephant preservation is one of preserving the geographical extent as well as the quality of wildlife habitat. Therefore, in contrast to the conservation of a species such as the tiger, the simple core-buffer concept for a management unit will not hold in the case of the elephant. However, according to Lahiri-Choudhury (1991), the principle of total protection will continue to apply to crucial habitat pockets, such as areas where elephants take shelter during the 'pinch period' (usually dry season); cover used as daytime refuge for nocturnal foraging; salt-licks to which elephants must return periodically for trace elements, and corridors linking different parts of an elephant range.

*Corridors to facilitate elephant movement*

One of the major threats to the elephant in Asia is degradation and fragmentation of habitat. As traditional seasonal migratory routes are blocked, elephant populations will become genetically isolated from other populations and may become vulnerable to genetic impoverishment and stochastic extinction. This problem could be resolved by establishing forest corridors or strengthening existing ones linking two or more elephant habitats (Kemf and Santiapillai 2000). Where it is not possible to establish sufficiently large individual PAs for an elephant population, forest corridors should be maintained to facilitate movement of elephants between PAs. When landscapes are threatened with fragmentation, a system of corridors may be one practical way to ensure connectivity for elephant movement (Sukumar 2003), and to expand elephant habitats to a reasonable size. Corridors need not be established in prime elephant habitats; even degraded forests facilitate elephant movement so long as they provide some cover. The proper design and management of such forest corridors will help minimize conflicts between elephants and people. It will also prevent the isolation of herds, and improve the genetic and demographic viability of the overall population. However, such corridors, to be effective, should be at least about 1km wide; however, as the Project Elephant document asserts, if the distance between two habitats is too long, then the width has to be much more. But longer corridors may enable the elephants to spill over into the adjacent human settlements, and thereby exacerbate the conflict between man and elephant. Therefore, it is important that the boundary of the corridor be protected (Sukumar 2003).

International cooperation is required where migration routes cross frontiers. The elephant migration routes along the foothills of the eastern Himalaya from northern Bengal to Assam and Arunachal Pradesh through Bhutan need national and international actions for their preservation. It is particularly important that migration routes are not disrupted, or very serious conflicts between people and elephants may result, involving some of the largest remaining Asian elephant populations. Potential elephant corridor areas need to be identified, surveyed, and set aside (in some instances, even purchased outright) to ensure the free movement of elephants (Kemf and Santiapillai 2000).

*Management of human-elephant conflict*

Despite the special esteem in which the elephant is held in Asia, the relationship between humans and elephants has undergone a drastic change; contraction and loss of habitat, as Lahiri-Choudhury (1988) points out, have made it antagonistic. People encroach on the elephant's land; elephants eat the crops cultivated on the occupied land; people strike out at elephants for doing this; elephants retaliate. This is the crux of the human-elephant conflict in Asia (Lahiri-Choudhury 1988). Understanding the relationship between human settlement patterns and elephant abundance is fundamental to predicting the viability of elephant populations (Hoare and Du Toit 1999).

Elephants kill over 200 people each year in India alone. The human-elephant conflict in many parts of north-eastern India has become so critical that it is often a political issue of the first magnitude (Lahiri-Choudhury 1988). In Sri Lanka, between 1950 and 1970, a total of 1,163 elephants were lost in the wild, of which 639 were killed by farmers in defence of their crops and in some cases by poachers for ivory (Santiapillai 1994). In the year 2001 alone, wild elephants were killed at a rate of three per week in the conflict, which also claimed the lives of 44 people. In Sri Lanka, human-elephant conflict seems to have replaced poaching as the major threat to wild elephants. People and elephants seek the same resources: fertile soils and water (Parker and Graham 1989). The crop-raiding problem is particularly acute in Sri Lanka, where dense human populations surround elephant refuges. Elephants are killed in Sri Lanka simply because they interfere with agriculture. Even in countries such as Vietnam with very few wild elephants, the conflict is acute because of the 'pocketed herd' phenomenon.

In many parts of the range of the elephant in Asia, the human-elephant conflict has escalated for a variety of reasons. The resolution of the conflict between elephants and sedentary, agriculturally-based people is a priority issue in the conservation of the species (Hoare 2001). If unresolved, the conflict may lead to the eventual destruction and elimination of elephants from agricultural areas. Ways to minimize the human-elephant conflict remains one of Asia's highest conservation priorities (Kemf and Santiapillai 2000). The management of human-elephant conflict has to be integrated into a proper land-use policy and it must also recognize the elephant as an economic asset. If local people could perceive the elephant as an economic asset rather than an agricultural pest, they will tolerate it in their neighbourhood (Child 1995).

Ideally, reserves should be designed to provide for elephant needs so that the stimulus to move elsewhere is minimized. However, in present conditions, elephants are likely to clash with human interests in many places.

Depredation of crops (such as oil palm, rubber, cereals, millets, and sugarcane) causes losses of millions of dollars every year in some countries, and manslaughter by elephants is a serious problem. In Malaysia, losses due to elephant depredation in oil palm and rubber estates alone were estimated to be about US$20 million per year during the 1970s (Blair *et al.* 1979).

Ratnam (1984) recognized three major categories in the conflict between man and elephant in agricultural areas:

(a) Obligate crop depredation - where a group of elephants has been marooned by development into a tiny pocket of forest which, being unable to meet the food requirements of the herd, forces the animals to raid the surrounding agricultural crops. Such pocketed herds can be extremely dangerous and so need to be captured and translocated to larger habitats (Seidensticker 1984).

(b) Semi-obligate crop destruction - where a group of elephants with sufficient usable habitat, for various reasons, still raids large adjacent development area with a broad but unified boundary with the forest. The problem cannot be resolved by capture and translocation of such semi-obligate crop raiders. Ratnam (1984) found that the use of electric fence as a barrier reduced elephant damage by more than 95% in Peninsular Malaysia.

(c) Occasional crop destruction - where a group of elephants with sufficient usable habitat raids a patchwork of villages, farms, orchards or smallholdings with no clear-cut or unified boundary between the forest and the developed area. Occasional crop raiders are the most difficult to control, because the targets of their attacks are so patchy, small and widespread.

Elephant movements can be controlled by the use of barriers of various kinds to exclude them from areas used by people or to keep them in reserves. Natural barriers are to be preferred, such as belts around PAs or MERs, where crops that would attract elephants are not grown. There should be no water sources, which elephants would use, within cultivated areas close to natural habitat. A belt of land at least 1km wide, with zero appeal and inhospitable to elephants, should be maintained in order to minimize conflict with people (Seidensticker 1984). Crops such as tea and oil seeds are suitable for planting, as they are not attractive to elephants.

Being very intelligent, elephants soon learn that traditional methods of deterring elephants – banging drums, firing shots in the air, flashing lights, lighting fires, and thunder flashes – are non-fatal and so such methods are not effective in the long-term (Sukumar 1989; Barnes 1999). Barriers of various designs have been used to keep elephants away from humans in agricultural areas, and the African experience shows that the elephants are capable of going through the most sophisticated barriers, including highly electrified fences (Kangwana 1995a). Among the more exotic experiments carried out to deter elephant depredations were one with tear gas (Lahiri-Choudhury 1988), and the other using swarms of the African honeybee (*Apis mellifera*) by farmers in Kenya to ward off wild elephants (Vollarth and Douglas-Hamilton 2002).

Other measures used to deter wild elephants in agricultural areas include the following:

*Trenches*

The trench or ditch is the traditional elephant-proof barrier, and masonry-sided trenches are still used widely in India (Lahiri-Choudhury 1988). They are expensive to build and maintain. To be effective a trench has to be at least 2m deep, 2m across at the top and 1.5m across at the base (Sukumar 1989). They would be useful provided they are dug in solid soils and well maintained. Otherwise, elephants will soon make breaches in the trench and get across. However, in many areas, trenches rarely survive rainy seasons, and maintenance costs remain high. In Peninsular Malaysia, although trenches did reduce the extent of elephant damage to oil palm, they were not economical to maintain. Besides, in the generally wet and humid conditions of Peninsular Malaysia, the erosion caused by elephants can reduce the effective depth of the trench, thereby making it easy for elephants to get across (Blair *et al.* 1979). Moats in conjunction with electric fences have worked well if the moat and the fence are well maintained (Osborn and Welford 1998). Elephant-proof steep-sided canals can be effective in preventing entry of elephants into agricultural areas. Crossing for elephants can be constructed at carefully selected points, bearing in mind known elephant movements and preferences.

*High-voltage electric fences*

Electric fencing for elephants has been used successfully in Africa and Asia to separate agricultural activity from the elephant range, and is perceived as the most permanent solution to problem elephants (Hoare 1995). Electric fences in Asia appear to have been more effective than those in Africa. This may be largely due to the fact that in African elephants both sexes carry tusks, and they make considerable use of their tusks for fence breaking. Furthermore, the higher soil moisture in the range of Asian elephants than in African savannah areas, makes electric shocks more effective (Thouless and Sakwa 1995). An electric fence provides a sharp, non-lethal but memorable shock to elephants. Although the shock is painful, it does not injure or disable the elephant (Osborn and Welford 1998). This has been very effective (Ratnam 1984) and relatively cheap compared with other methods. Several thousand kilometers of fencing have been erected in Malaysia and it has been calculated that, over a period of five years, they may save crops valued at as much as 70 times the cost of installation (Santiapillai and Jackson

1990). For elephants the electric fence should consist at least two strands of high-tensile galvanized steel wires at heights of about 1m and 2m above ground, powered by an 'energizer' (transformer) giving an electric pulse of over 5000V and 1/3000 second duration every second (Sukumar 1989). The capital costs of erecting electric fences can be very high, and so beyond the budgets of many Asian countries. Such fences need to be located strategically, maintained assiduously, and monitored regularly to ensure that they are in working order. The fence design needs to be modified once elephants have learnt to deal with each new modification (Rice 1990). Elephants are known to pull tree trunks onto the wires to break the electric fences. Therefore, when erecting electric fences, it is important that we consider ecological and behavioural factors in addition to the technical considerations (Thouless and Sakwa 1995).

*Acoustic deterrents*

It may be possible to manipulate the behaviour of elephants with playbacks of vocalizations (Osborn and Welford 1998). In agricultural areas, the use of high-frequency 'bleepers' along with an electric fence may have potential in repelling elephants (Piesse 1982). The playback of post-copulatory rumbles is known to attract bull elephants, while playbacks using the musth repel non-musth males but not musth males or females (Osborn and Welford 1998). When recordings of Masai-associated cattle bells and bellowing were played back to groups of elephants, they forced the elephants to retreat as they associated the sound with the danger posed by the Masai who used to spear them on occasion (Kangwana 1995b). In Namibia, O'Connell-Rodwell *et al.* (2000) used recordings of distress calls of elephants to herds and bulls in the Etosha National Park, with mixed results: in one instance the herds bolted, while in other trials they responded aggressively by surrounding the source of sound. The distress calls had no impact on the bulls.

*Chemical repellents*

Given the elephant's highly developed sense of smell, there have been some attempts to use chemicals as a deterrent to elephants. In India, even tiger urine was used against wild elephants (Lahiri-Choudhury 1988), a practice that was earlier tried out by the Dutch in Sumatra, while in Zimbabwe, Osborn and Rasmussen (1995) successfully demonstrated the use of capsicum-resin aerosol (chilli-pepper spray) as a deterrent against wild elephants. Their experiments demonstrated that capsicum possesses short-term repellency towards elephants, but more tests are needed to see if animals can be adversely conditioned to avoid crop fields by this method (Sukumar 2003). In Asia, most of the notorious crop raiders are male elephants. During musth, the bulls are known to broadcast odoriferous, behaviorally-influential messages from secretions of the temporal gland (Jainudeen *et al.* 1972; McKay 1973). Studies on chemical communication in elephants by Rasmussen *et al.* (2002), indicate that it may be possible in the future to chemically modulate male behaviour in conflict areas.

*Removal of problem elephants*

Elephants may have to be translocated from areas which are being developed or where they have become pests. Advance planning is necessary to route the elephants through suitable forest corridors and to make barriers to prevent their return (Santiapillai and Jackson 1990). Pocketed elephant herds and notorious crop-raiding bulls that often come into conflict with people could be captured and translocated to safer areas or tamed rather than killed. Elephants may be captured for taming or for zoos, but in both cases, the number that can be absorbed is very small. In areas where the adult sex ratio is not very disparate, the elimination of some bulls will not have any adverse effect on the population demography (Sukumar 1989). But as Lahiri-Choudhury (1993) cautions, it may not be possible to identify correctly the problem elephants in the field, and furthermore, those that are translocated could return to their capture site. They may also cause new problems in the relocated site, in which case the exercise would be tantamount to transfer of a problem from one area to another, as has happened in Sri Lanka many times. As Sukumar (1989) argues, there may be no alternative to eliminating adult male elephants that have turned 'rogues' and are dangerous and difficult to maintain in captivity. But Hoare (2001) now believes that when an offending elephant is removed, it could be replaced by another problem animal from within the same population, and recommends that to adequately control the effect of an agricultural pest, it should be denied food or a place to live nearby.

Trained domestic elephants have been used successfully in West Bengal (India) to drive away herds of raiding elephants. This kind of chase without capture is referred to as anchored *mela-shikar*. Wild elephants have been driven across long distances from sugarcane plantations into PAs in Sumatra (Santiapillai and Suprahman 1985). The Department of Wildlife and National Parks in Peninsular Malaysia has translocated 285 wild elephants over 20 years from fragmented habitats, using trained or *koonki* elephants (Daim 1995). In Sri Lanka, although large groups of elephants have been successfully driven from areas of conflict to PAs, often through areas of human settlements, elephant drives have become progressively more difficult and impracticable (Jayewardene 1994). Furthermore, in the absence of post-relocation monitoring, it is unclear whether any of these elephants subsequently came into conflict with people. Translocation of elephants, either bulls or herds, must be accompanied by monitoring through radiotelemetry to decide on the future course of management (Sukumar 2003). Chemical immobilization and transport is possible under strict veterinary supervision, but even so entails risks for the elephants and people involved.

Doomed elephants are those which have no future because they are too few in number, have poor or no breeding potential, or will lose their habitat to

development projects. Doomed elephants can be translocated to suitable habitat where there are elephant populations well below the carrying capacity, or they can be removed for taming.

*Adopt sound land-use planning strategies*

The key to resolving human-elephant conflict in Asia, is first and foremost, to encourage the adoption of sound land-use strategies that would make it more difficult for elephants to stray into human settlements. It will be important to develop mechanisms to predict where human-elephant conflicts are likely to occur, and to enlist the support of governments and local communities to undertake land-use planning in order to minimize the likelihood of such conflicts occurring. In areas where people and elephants do overlap, people must derive tangible benefits from the presence of elephants as through tourism (Dublin *et al.* 1997). Master plans which detail elephant reserves in overall countrywide planning are needed, so that future development projects do not fragment elephant habitat. Similarly the environmental impact of development projects in elephant range should be evaluated well in advance so that the interests of elephants and people are provided for (Kemf and Santiapillai 2000). Incentives for changes in cropping pattern or even forms of land use should be should be provided. Land use planning should of necessity be a long-term strategy; short-term results cannot be expected in solving conflict.

*Control of poaching*

Poaching for ivory is primarily a threat to tuskers, and thereby to the genetic health of elephant populations. Although it has been argued that elephant poaching could be a relatively minor problem in Asia, in view of the fact that some males and all females lack tusks (Dawson and Blackburn 1991), ivory poaching combined with poaching for a variety of other elephant products has indeed become a threat to the long-term survival of some elephant populations (Menon 2002). Elephant numbers declined in Cambodia, Lao PDR and Vietnam from 1988 to 2000 by over 80% from an estimated total of 6,250 to 1,510, while Myanmar lost over a thousand elephants from an estimated population of 4,820 animals, largely due to the trade in ivory and other elephant products (Martin and Stiles 2002). The demand for ivory has resulted in the elimination of tuskers from some populations in Asia, while the recently developed industries in China using hide for bags, shoes, belts and other items represent a grave threat to elephants of all ages and sexes. The threat to Asian elephant from poaching, not only for ivory but also a variety of other products including meat and hide, has been grossly underestimated at the international level in relation to its African cousin (Menon *et al.* 1997).

The 1989 elephant ivory ban adopted by Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) helped greatly reduce the illegal trade in ivory, and led to the increase in many elephant populations in Africa. While ivory poaching is not the terminal threat to the elephants in Sri Lanka, as it is in Africa, given the low percentage of tuskers (less than 7%) left in the former, it is extremely serious in parts of southern India where almost 95% of the bulls are tuskers. In Periyar Tiger Reserve in the State of Kerala – one of the strongholds of the elephant in India – only five or six adult bulls, some of these tuskless, were left in 1994 in a population of about 1,000 elephants (Menon *et al.* 1997). Unfortunately, despite the CITES ban, the demand for ivory has remained steady, thereby stimulating elephant poaching. Ivory poaching has drastically skewed adult sex ratios: during the 20-year period from 1969 to 1989 in Periyar, the adult male:female sex ratio changed from 1: 6 to 1:122 (Chandran 1990), and subsequently reached 1: 101 in 1994 (Ramakrishnan *et al.* 1998). At such levels of poaching, even the loss of one male is very serious.

The main factors responsible for elephant poaching in some Asian countries, according to Martin and Stiles (2002) include the large economic returns from selling tusks, poverty, unemployment, and widespread corruption by the military and other government staff in poaching elephants and trading in their tusks. While ivory poaching has reduced the number of bulls in populations, the elephant population itself has been increasing in some region over several decades, leading to local over abundance and associated adverse impact on vegetation, and hence, on habitat quality as well (Desai 2001).

The following actions are essential to the control of ivory trade in Asia:

(a) The Governments of the Range States should enforce CITES regulations concerning the trade in Asian elephant products. All Parties to CITES should ensure that they have domestic legislation to implement the convention. There is no point in having laws if they cannot be implemented. Governments of the Range States need to strengthen and improve their domestic laws and regulations, and enforce them, as has been done with partial success in countries such as India; otherwise global ivory markets will continue to claim the lives of hundreds of elephants every year (Martin and Stiles 2002).

(b) It may not be possible to prevent tuskers being occasionally killed by ivory poachers, but it is certainly possible to control the marketing of tusks. Thus, shutting down the illegal ivory trade must become a higher national priority in all member states, but particularly in the major importing countries which provide the market demand that drives the ivory trade. Through public awareness programmes, it may even be possible to dissuade affluent western tourists from buying ivory products in souvenir shops.

(c) Education campaigns on the value of elephants should be carried out to win the support of all sections of the community for suppression of illegal ivory and hide trade. This is an appropriate activity for non-government organizations (NGOs).

(d) Adequate funds, staff, and facilities should be made available to enforce CITES regulations. To combat ivory poaching, the Range States need to draw up specific anti-poaching plans and equip the anti-poaching squads with vehicles, arms, ammunition, and communication equipment. As Menon *et al.* (1997) point out, intelligence gathering being the most cost-effective way to combat poaching, it should be accorded top priority.

(e) Customs and wildlife staff should be trained to administer CITES regulations and to recognize ivory, hide, and other elephant products.

(f) Stocks of ivory with traders should be registered and frequently inspected to ensure that they are not used as a cover for illegal trade.

(g) Countries with ivory and hide should conduct detailed studies of the industries and trade in raw ivory and hide and artifacts. They should develop and implement policies that will eliminate illegal trade in ivory and hide and enforce adequate controls on legal trade. The traditional craft of ivory carving should be kept within acceptable limits. Controls on domestic ivory and hide commerce should be enacted and enforced to match CITES international provisions.

(h) Countries, which still use African ivory for local carvers, should ensure that it is not used as a cover for illegal trade in local ivory from poached Asian tuskers.

(i) Creation of paramilitary units for protection of elephants in the field should be considered. Intelligence units should be established to uncover poaching networks, and cooperation with police and other civil authorities should be ensured.

(j) Research should be intensified to find practical methods of differentiating between African and Asian ivory. Decisions on ivory trade regulations must be based on objective science and not political or commercial expedience, nor emotion.

(k) Range States should cooperate with and begin implementing the CITES coordinated programme on Monitoring the Illegal Killing of Elephants (MIKE) that was mandated during the Conference of Parties (CoP10) in June 1997 at Harare, Zimbabwe. Apart from providing objective data on elephant populations and their mortality from poaching or other causes, MIKE would also help build capacity among Range States for monitoring and managing elephant populations.

*Social security schemes*

For the rural poor, whose life is a daily battle for economic survival, elephants can be a dangerous nuisance. Therefore, it is inevitable that elephants and other wildlife will decline and eventually disappear from agricultural areas in Asia, unless the damage they cause is adequately and promptly compensated for (Child 1995; Kemf and Santiapillai 2000). In the absence of relief, farmers will not regret the disappearance of such large and dangerous pests from their neighbourhood. Compensation payment in Asia varies from country to country. In Sri Lanka compensation payments cover less than 10% of the actual damage caused by elephants (Bandara and Tisdell 2002). Farmers in most states in India are eligible to receive *ex gratia* relief from the government for damage to their crops by elephants. Such schemes are sometimes abused: in north-eastern India, for example, 30% of claims were found to be false (Williams and Johnsingh 1996). Although farmers in general tend to exaggerate their losses, they need to be provided adequate relief. In some instances, farmers in Sri Lanka have abandoned their farms in high conflict areas, because of the sheer futility of raising crops to their maturity in the presence of elephants. Crop insurance schemes can also be tried out. In Sri Lanka, Bandara and Tisdell (2002) find that appropriate compensation schemes for farmers are potentially more effective for conserving elephants in the wild than legal prohibitions on the killing of elephants. Compensation payments, to be effective, should be adequate and prompt. Bandara and Tisdell (2002) found that farmers in Sri Lanka are willing to contribute towards a self-financed compensation scheme. Compensation and insurance for crop damage can be organized on a limited basis. Despite numerous practical problems in paying compensation, including inflated claims for damages, until more permanent solutions to the problem of elephant depredation are implemented, social security schemes are necessary to prevent farmers from shooting or poisoning elephants that raid their crops.

*Management of elephants in captivity*

With an estimated 16,000 Asian elephants (or about 30% of the species' total) in captivity, the healthcare, welfare and management of captive animals is obviously of great importance. Captive elephants are kept in logging camps, tourist camps in nature reserves, temples, zoos and safari parks, circuses, or by individuals. Management systems thus vary tremendously across this spectrum. A broad goal of captive elephant management on a regional or even a global scale would be to ensure that captive

populations do not contribute to further depletion of wild elephant populations but rather help augment the latter's conservation. At the same time we must recognize that some elephants will continue to be transferred from the wild to captive stocks because of elephant-human conflicts or the pocketed herd phenomenon.

The Captive Elephant Task Force of the AsESG has come up with several tentative recommendations (see Kurt and Mar 2003) for captive elephant management. While the work of the task force is yet to be completed, the key recommendations along with other important considerations are summarized below.

(a) Governments should encourage collection and analysis of data on their captive elephants. For instance, registration of elephants (Lair 1997) through microchips that can be read electronically, as is being done in India, could be one means of a database on captive elephants for monitoring. Countries with captive elephants should establish databases on their domestic elephants. This would be an important step in planning for their management.
(b) In countries where elephant recruits are customarily sourced from the wild, serious attempts should be made to encourage reproduction amongst the captive stock so as to eliminate the need to capture wild elephants.
(c) DNA and molecular genetic analysis of captive elephants of known wild provenance may facilitate the exploration of sub-speciation and unique racial strains in elephants. This information will be essential for setting conservation action priorities, and when examining questions of future trade and breeding, as well as for its purely scientific value.
(d) Elephants being highly social animals are best kept captive in 'extensive systems' that simulate their natural social order. When kept in 'intensive systems' they are far more prone to serious health problems, behavioural aberrations including infanticide, reproductive failure, and lower longevity. There has to be serious dialogue among various captive elephant facilities, whether these are in the Asian Range States or in zoos and circuses outside, about developing and enforcing standards for maintaining elephants.
(e) Every Asian Range State should be encouraged to develop its own standards for the welfare and management of elephants in captivity, keeping in mind both traditional systems as well as international standards (see, for instance, Bist 1996). Captive elephant facilities outside the Range States, such as in Europe, North America and Australasia, are encouraged to conform to standards being developed regionally by zoological associations (e.g., see Dorresteyn 2001; Stevenson 2002).
(f) A veterinary consultancy group with an international character should be set up to provide free advice and medical care in the Range States.
(g) In Range States the welfare and training of elephant handlers (*mahouts*) also needs serious attention; some of the abuse of elephants can be traced to poorly trained mahouts.

We can do no better to conclude this section than by quoting from Kurt and Mar (2003): "The adequate management of captive Asian elephants can only be reached by coming together of people with varied talents such as wildlife experts, veterinarians, elephant owners, and managers and every effort must be made to ensure that all captive elephants meet the maximum welfare standards".

### *Research*

Elephant management, both in the wild and in captivity, should be based on scientific principles. Some elephant populations in India, Sri Lanka, and Sumatra (Indonesia) have been the subject of considerable research. Research and monitoring of these populations should continue in order to provide a basis for improved management of other wild populations. Much research is needed into the implications of MVP size and imbalanced sex ratios and their effects on fertility. Poaching and habitat loss have reduced the size of elephant populations to critical sizes in several areas and so the minimum viable unit for an elephant population needs to be established in relation to the area and quality of the remaining habitat. At the same time, one of the critical challenges that would face the conservation of the Asian elephant would be the management for recovery of small, isolated populations in conflict with people. Other research issues that merit high priority are:

#### *Establishing standardized elephant census techniques*

Current efforts to develop a rigorous, yet practical census methodology for elephants should be completed and then introduced into each Asian country, thus ensuring that future data are standardized. Being very large and conspicuous, elephants have been successfully counted in the open savannahs of Africa from the air. Such aerial counts are often impractical in the dense and tangled vegetation inhabited by elephants in Asia. Therefore, lately dung counts have become the most common type of indirect method for estimating elephant numbers in forested areas in Africa and Asia (Dawson 1990; Dawson and Dekker 1992; Barnes and Jensen 1987). Such estimates based on dung counts can then be used to improve the reliability of the methodology as a tool for the management and conservation of Asian elephants. In this connection, it is recommended that linkages between Asian elephant survey experts and African elephant survey experts be established to review and improve the methods for estimating elephant numbers.

*Practical methods of distinguishing African and Asian ivory*

Practical means are required to distinguish ivory from African and Asian elephants. Research studies by Van der Merwe *et al.* (1990) and Vogel *et al.* (1990) based on the ratios of stable isotopes of elements such as carbon, nitrogen, strontium, and lead in elephant bone/ivory have shown promise in identifying the geographical source of tusks in Africa. Research should also be carried out on the possibility of determining the geographic origins of tusks using genetic and mineralogical analytic techniques. Forensic research on ivory is already under way to build a reference library of DNA profiles from both nuclear and mitochondrial genes of elephant populations (Sukumar 2003).

*The effectiveness of elephant corridors*

Reliable data on the usefulness of jungle/forest corridors as conduits for elephant movement is needed. If these corridors do in fact aid the dispersal of elephants and function as a bolt-hole for the animals to move from a disturbed area into a less disturbed one, then they would be beneficial in areas where timber harvesting is the dominant form of land use. Such corridors could also reduce the effects of inbreeding among small populations. Research should look into the effectiveness of corridors in permitting the movement of animals from one area to another.

*Habitat evaluation*

Research is needed to assess more accurately the area of habitat required by viable elephant populations, and also the quality of the habitat that the elephants need. In particular, it is important to know what constitutes serious habitat degradation for elephants, what causes such degradation and how it can be avoided.

*The effect of translocation on elephant populations*

Techniques of elephant translocation have been developed, but there is little information on how or whether translocated animals integrate with the local population. This information is fundamental if translocations are to be used as a means of maintaining the demographic and genetic viability of small populations. Some observations suggest that translocated animals tend to move away from the release area in the direction of their place of capture. Translocated elephants should be radio-collared and tracked to establish whether translocation is a solution to saving small problem herds.

***Benefit to local communities***

Communities living in proximity to elephants should benefit from their presence. Long-term residents around PAs can be hired as trackers, rangers, elephant keepers (mahouts), and trainers, at fair wage scales comparable to employees hired from outside the region (Kemf and Santiapillai 2000). Furthermore, long-term residents could also be trained and employed in PA management, thus seizing the opportunity for combining traditional knowledge with sound modern conservation approaches. Revenues from tourism could be shared with communities through a direct percentage of return, or through employment in the tourist industry. Ecotourism or other small-scaled businesses could provide some revenues, but realistically speaking, probably not enough to meet all the communities' needs (Kemf Santiapillai 2000).

***Public awareness***

Increased awareness of the seriously endangered status of the Asian elephant is urgently needed at all levels of society. Education can also help persuade people to change their attitudes and behaviour towards wildlife, and it is important that local communities are made aware of the tangible benefits of elephant conservation. Conserving elephants would provide employment in anti-poaching activities, fire control measures, and census operations, and would help develop more cordial relations between the public and wildlife authorities (Kemf and Santiapillai 2000). Programmes should be carried out to educate the public regarding the plight of the Asian elephant. Publicity should be given to agricultural, resettlement and hydroelectric projects where elephant habitat would be affected, so that possible impacts can be evaluated before their implementation. This activity is well suited to non-governmental agencies (NGOs).

## Conclusions

There are powerful reasons for conserving elephants in Asia: they have strong cultural affinities to Asian peoples, arouse strong public emotion and are therefore ideal animals to attract strong support for conservation. They may be economically important, as in Myanmar, where they are the backbone of the timber industry. They play a major role in natural ecosystems that are rich in biodiversity across vast areas. If such a high profile species, that is as ecologically dominant, economically important, and culturally significant as the elephant cannot be protected in Asia, what hope is there for less prominent species?

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