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Editor

Charles Santiapillai
Department of Zoology
University of Peradeniya
Sri Lanka
e-mail: csantiapillai@gmail.com

Editorial Board

Richard F. W. Barnes
Department of Biology 0116
University of California at San Diego
La Jolla, CA 92093-0116
USA
e-mail: rbarnes@ucsd.edu

Jayantha Jayewardene
Biodiversity & Elephant Conservation Trust
615/32, Rajagiriya Gardens
Nawala Road, Rajagiriya
Sri Lanka
e-mail: romalijj@eureka.lk

M. Philip Kahl
100 Mountain Road
Pine Valley
Sedona, Arizona 86351
USA
e-mail: musthbull@sedona.net

D.K. Lahiri-Choudhury
45 Suhasini Ganguly Sarani
Calcutta 700 025
India
e-mail: dklc@cal.vsnl.net.in

Heidi S. Riddle
Riddle's Elephant and Wildlife Sanctuary,
Post Office Box 715,
Greenbrier,
Arkansas 72058, USA
e-mail: gajah@alltel.net

Raman Sukumar
Centre for Ecological Sciences
Indian Institute of Science
Bangalore
India
e-mail: rsuku@ces.iisc.ernet.in

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COMMENT

"The universe, Human Stupidity, are infinite" – Albert Einstein

There is a growing concern among the educated public of the need to care for animals, especially such large, charismatic ones such as elephants, rhinos, tigers etc in captive facilities. One of the issues is the limitation to animal movement imposed by space in zoos. This is understandable, given that most zoos are in urban areas where space is limited. Nevertheless, there are facilities and institutions in a number of captive facilities in the world, especially the USA, where elephants are indeed very well looked after and cared for. There is therefore a need to identify such institutions and facilities and recognize their contributions to the conservation of elephants and provide a balanced assessment of their activities to the general public. These agencies recognize the importance of a well informed public. A knowledgeable and concerned public will then remain a source of support and constructive enquiry to the conservation of elephants both in the wild and in captivity.

It is in this context that a well meaning but ill conceived new legislation AB 3027, is being proposed in the State of California in the USA, which will come into force on January 1, 2008, according to which, "*it shall be unlawful for any person, within the state, who houses, possesses, is in contact with, or travels with any elephant to use or be in possession of any of the following while present around the elephants: (1) ankus, bullhook, or similar device (2)any chain that is used to retrain an elephant, except if utilized for the shortest amount of time necessary to provide actual medical treatment*".

The law further states that *"On or after January 1, 2009, each person who possesses, keeps, or maintains elephants at a stationary facility shall make an outdoor space with a minimum of five acres available to those elephants, provided that no more than three elephants shall inhabit any five acres and that an additional half acre shall be made available for each additional elephant".*

"On or after January 1, 2008, each person who possesses, keeps, or maintain any elephant on traveling display shall provide the following: (1) an indoor climate-controlled space that is, at a minimum, 1800 square feet for a single elephant and an additional 900 square feet for each additional elephant (2) an outdoor space that is, at a minimum, 1800 square feet for a single elephant and an additional 900 square feet for each additional elephant".

Such legislation, however well meant it may have been, will make it almost impossible for many zoos in the USA to maintain elephants in captivity, given the space limitations. This is where a degree of calm and impartial reflection is needed before the legislation actually becomes a law.

But are these stipulations really necessary vis-à-vis what is being done extremely well here in Sri Lanka, where the art of managing elephants in captivity dates back to more than 2,000 years? Since 1980, elephants rescued from the wild are being maintained at the Elephant Orphanage in Pinnawala – a facility run by the Government of Sri Lanka. Here in a 9 ha (22.2 acres) coconut estate, some 66 elephants of all sizes are being maintained, almost all of them in excellent health and well cared for by experienced and dedicated mahouts (elephant keepers) and veterinarians. This translates into a density of 7.3 elephants per ha (or 3 elephants per acre). The National Zoological Gardens in Dehiwela (Sri Lanka) too maintains elephants in captivity in a much smaller enclosure, given the limitations of space. But the animals are well looked after and are in very good health.

Some conservationists have pointed out that elephants in captivity tend to be aggressive, neurotic and prone to a variety of diseases and suffer from infertility. But they fail to realize that life in the wild is not a bed of roses either for elephants. In Sri Lanka, one can see wild elephants with gunshot injuries and suppurating wounds. Elephants are routinely shot, maimed, poisoned or killed by irate farmers as they interfere with agriculture. Currently, over 100 elephants are slaughtered in the wild annually in Sri Lanka as a consequence of the escalating human-elephant conflict. Although this is a tragedy, yet a peasant farmer whose crops are consumed by elephants would welcome the elimination of animals, which are considered serious and dangerous pests. [In the United Kingdom, farmers benefited from the extinction of the wolf and the bear]. Wild elephants also kill between 30-50 people every year in Sri Lanka. Poor health is not peculiar to animals in captivity; even in the wild, one can see elephants in poor body condition as a result of prolonged drought or through competition for grazing with domestic cattle. As far as infertility in captivity is concerned, evidence from Sri Lanka points to the opposite: elephants are breeding well in captivity, without the need for artificial insemination.

In the USA there are a number of facilities (such as zoo, sanctuary, safari park and circus) in which elephants are managed in captivity. The level of care given to the elephants in places such as Center for Elephant Conservation at Polk City (Florida), Annheuser-Busch Adventure Park in Tampa (Florida), Disney's Animal Kingdom at Lake Buena Vista (Florida), The Ringling Bros. & Barnum & Bailey Circus at Corpus Christi (Texas), and the Riddle's Elephant & Wildlife Sanctuary at Greenbrier (Arkansas) is second to none. In all these facilities, the elephants are managed extremely well and looked after with great care by experienced and dedicated keepers. The level of veterinary care given to the animals

is excellent and veterinarians are on call 24 hours a day.

None of the elephants in these facilities are overworked, undernourished, abused or obese. None of them show any foot disease or exhibit neurotic behavior. The Center for Elephant Conservation in Florida has over 100 acres of land for its elephants to range freely, while the Riddle's Elephant & Wildlife Sanctuary has over 300 acres of land. There are excellent facilities to monitor the elephants' body weight and physical condition. The "protected contact" approach practiced in these facilities ensures the safety of the elephant keepers, and helps minimize risks. The bond between the elephant and its keeper is so good that there is no need to use excessive disciplinary action. The animals are well trained to obey basic commands.

The proposed legislation in the State of California is too restrictive and unrealistic. Items such as ropes, chains, ankus etc are needed in the management of elephants in captivity by mahouts (elephant keepers), who unlike biologists studying elephants in the wild from the comfort and safety of their air-conditioned-4WD vehicles, need to interact at close range with elephants. Instead of banning items such as ropes, chains or hooks, we need to promote their use judiciously with great care and sensitivity. Such restrictive laws and regulations are the result of agitation by a minority of highly vocal, wealthy and influential animal rights activists. People who look after elephants and other animals in zoos, circuses and other captive facilities are far more humane than some of the animal rights activists, who can be deluded, deranged and even dangerous at times.

Animal rights activists are totally against keeping elephants and other wildlife in captive facilities, arguing that they are being denied freedom. Their criticisms are based on anthropomorphism, or the attributing of human reactions to non-human beings. Given the chance they would rather set free all the elephants currently kept in captivity back into the wild, to face an almost certain extinction. Freedom is a peculiar word – freedom to do what? It is better to relieve boredom among animals in zoos than discuss freedom. In the wild, an animal needs to stay alive, which means that it needs to find food, water, shelter, and escape from predators and/or poachers. It also needs to find a mate. Despite the limitations of space, many zoological gardens all over the world, try their very best to provide the basic necessities to elephants in captivity.

Today, the world is preoccupied with too many "rights" – gay rights, lesbian rights, children's rights, human rights, animal rights etc. It is therefore a pity that an increasingly vociferous and influential group of animal rights activists is unable to separate the lasting wheat from the fading chaff. While everyone working for the conservation of elephants must fight for animal welfare, no one should allow people's emotions to be exploited by animal rights activists. As Dr Graham Child (Zimbabwe) argues, they play on people's sensitivity against cruelty to animals, and in the process have "gained prominence as a form of remote political coercion". They have power without responsibility. As the US Senator James Inhofe (Republican, Oklahoma) argues, "Appeasing these groups only validates the effectiveness of their tactics and inspires them to replicate their model of activism in some other venue".

The matter is serious, and an editorial in *Nature* some time ago, highlighted the need for scientists to speak up against the unreasonable stand of the animal rights activists. "The reluctance to talk to the public about their research merely plays into the hands of the extremists who would be delighted to see scientists stay silent".

The US legislators should study how well elephants are managed in Asia, both in the wild and in captivity. There will always be elephants in captivity in Asia given their religious and social significance. No amount of protest or agitation from the animal rights activists will ever stop pageants such as the Perahera in Sri Lanka at which numerous elephants take part. Elephant management and conservation should be based on science and not on sentiment. The animal rights movement, like the Taliban, is a form of extremism and it is time that scientists spoke up in defence of facilities where elephants (and other wildlife) are managed with great care. Remaining silent would only spur the animal rights activists to venture into even more hare-brained schemes, such as banning the keeping of dogs in captivity.

Charles Santiapillai

An overview of the status of the Asian elephant

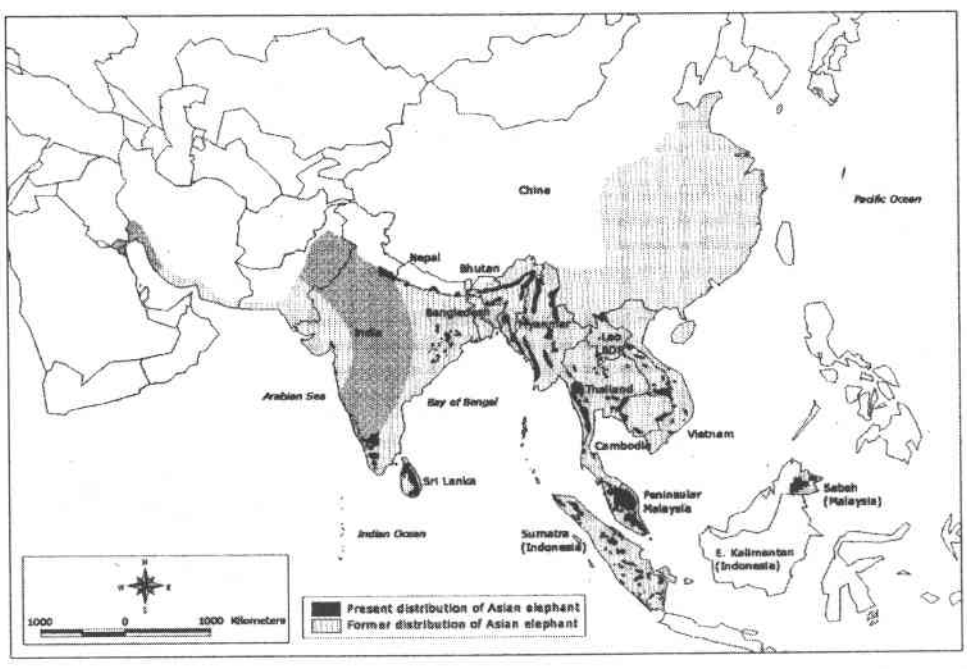
Charles Santiapillai and Raman Sukumar

About 6,000 years ago, at the dawn of human civilization, the Asian elephant (*Elephas maximus*) enjoyed a much wider geographic distribution and higher numbers than it does today. Its range then extended from Mesopotamia in the west across the Indian subcontinent to Southeast Asia and China, as far north at least as the Yangtze-Kiang. Today, as indicated in Fig. 1, the Asian elephant is distributed discontinuously in India, Nepal, Bhutan, Bangladesh, Myanmar, Thailand, Peninsular Malaysia, Sabah (Malaysian part of Borneo), Kalimantan (Indonesian part of Borneo), Cambodia, Laos, Vietnam, south-eastern China, and the islands of Sumatra (Indonesia) and Sri Lanka (Santiapillai and Jackson 1990; Kemf and Santiapillai 2000). A small feral population occurs in the Andaman Islands (India). IUCN lists the Asian elephant as an endangered species, while CITES places it on Appendix 1.

Until recently, three subspecies of the Asian elephant were recognized by zoologists as valid: *Elephas maximus maximus* from Sri Lanka, *E. m. indicus* from the Asian mainland, and *E. m. sumatranus* from the island of Sumatra (Indonesia). From our present understanding of the molecular genetics of Asian elephants though, there is no support for the subspecies status of the Sri Lankan elephant population (*E. m. maximus*) and its differentiation from those in the Asian mainland (*E. m. indicus*) (Fernando *et al.* 2000; Sukumar 2003). However, DNA analysis carried out by Fernando *et al.* (2003) indicates that elephants in Borneo, on the basis of their genetic distinctiveness and evolutionary history, may constitute a separate subspecies, *E. m. borneensis*, thereby extending the natural range of the Asian elephant by 1,300km. More recent studies of elephant genetics (Fernando *et al.* 2000, 2003; Vidya *et al.* 2004) are beginning to provide a much better understanding of the evolutionary history and population genetic structure of the species across its range; such information provides a firmer basis for conservation priorities and management decisions.

The total population of Asian elephant in the wild is estimated between about 36,000 and 52,000 (Table 1). Country populations vary from perhaps less than 100 in Vietnam to well over 24,500 in India. Although there are only about one tenth as many Asian as African elephants (*Loxodonta africana*), much more international attention has been focused on the latter in recent years. While the African elephant's misfortune is its tusk for which it is being killed in large numbers, as far as the Asian elephant is concerned, given that some males and all females lack tusks, ivory poaching cannot be the terminal threat it is in Africa (Dawson and Blackburn 1991). Nevertheless, the lust for 'white gold' has a serious impact, for when tuskers are killed before they have bred, their valuable genes are lost forever and, as such, tusklessness could ultimately become the norm (Santiapillai and Jackson 1990). Regional variation in the number or proportion of tuskers in the male segment may reflect the intensity of past hunting for ivory or selective capture of tusked males, a process that has been going on for thousands of years. The Roman chronicler, Pliny commented in AD 77: "Large elephant teeth are now rarely found, except in India, the demands of luxury having exhausted

Fig. 1 Former and present distribution of the Asian elephant



all those in our part of the world". He was referring to the Mediterranean basin where both African and Asian elephants were found, for sub-Saharan Africa with its innumerable elephants, was then unknown. Thus, the predominantly tuskless bull populations of Sri Lanka and the considerable numbers or proportions of tuskless bulls in north-eastern India and Myanmar may reflect this historical process of human selection against tuskers (Tiedemann and Kurt 1995; Sukumar 2003).

In recent decades, ivory poaching in southern India has progressively skewed the adult male:female sex ratio in several populations, in some instances such as the Periyar Tiger Reserve, to extreme values (Sukumar 1989; Ramakrishnan *et al.* 1998). At the same time, large-scale hunting of elephants for not just ivory but also meat, hide, and other products has reduced their populations significantly over a wide area from Myanmar to Vietnam in Southeast Asia (Menon 2002). Thus, the elephant population of Vietnam has plummeted to perhaps below 100 individuals at present while that of Cambodia is believed to be only a few hundred.

Table 1.. Estimated minimum and maximum number of elephants in the wild in Asia.

Country		Area (km²)	Elephant range (km²)	Minimum - Maximum
Bangladesh		147,570	1,800	190-230
Bhutan		46,600	1,500	250-500
Cambodia		181,035	c. 40,000	400-600
China		9,579,000	2,500	170-200
India		3,287,590	110,000	22,800-32,400
	South		(39,500)	(10,300-17,400)
	Central		(23,500)	(2,400-2,700)
	North-east		(41,000)	(9,200-11,300)
	North-west		(5,500)	(900-1,000)
Indonesia		1,919,440	105,000	1,180-1,500
	Kalimantan	(550,200)	(c. 5,000)	?-?
	Sumatra	(524,100)	(c. 100,000)	1,180-1,557
Laos		236,800	c. 20,000	780-1,200
Malaysia		329,750	c. 45,000	2,250-3,000
	Peninsular		(c. 20,000)	1,251-1,466
	Sabah		(c. 25,000)	1,100-1,600
Myanmar		678,000	115,000	4,000-5,300
Nepal		141,400	c. 2,500	100-130
Sri Lanka		65,610	c. 15,000	2,100-3,000
Thailand		513,115	25,000	2,500-3,000
Vietnam		340,000	c. 3,000	70-100
Total		17,465,910	486,800	36,790-51,160

Most important in parts of Asia are habitat loss and fragmentation, and the pressures of an expanding human population, which in turn leads to increasing conflict between man and elephant. Competition for living space and natural resources has resulted in a dramatic loss of forest cover, reduced elephant numbers in the wild, and increased human suffering through conflict with elephants. The absence of good data, and the difficulty of counting elephants that live in dense tropical forests, mean that it is almost impossible to precisely quantify the decline in Asian elephant numbers, but it can be safely assumed on the basis of available information, that there has been a substantial reduction in elephant populations in many Range States in recent decades. In many Asian countries, elephants are being destroyed simply because they interfere with agriculture. The long-term future of elephants outside the Protected Areas (PA) is inextricably linked to the tolerance of humans. Asian elephants live in the region of the world with the densest human population, growing at a rate of between 1-3% per year. Clearance of forests for settlement and agriculture is disrupting traditional elephant movement paths and leading to violent clashes between humans and animals when elephants raid crops, especially along the boundaries of PAs (Kemf and Santiapillai 2000). Because the elephant requires much larger areas of natural range than any other terrestrial mammal in Asia, it is often the first species to suffer the consequences of habitat fragmentation and destruction (Santiapillai and Jackson 1990). In some places, agriculture and human settlement are resulting in continuous contraction of its habitat. Because of its great size and intemperate appetite, the elephant cannot co-exist with people in areas where agriculture is the dominant form of land-use, and the conversion of forested areas for agriculture has had serious consequences. In extreme cases, elephants have been confined as so called 'pocketed herds' in small patches of forest in landscapes dominated by man. Such 'pocketed herds' represent an extreme stage in the human-elephant conflict (Olivier 1978).

Hundreds of people and elephants are killed annually in the conflict between man and elephant. The human-elephant conflict has emerged as one of the biggest conservation issues in Asia, an urgent challenge facing governments today. People living in elephant areas should be assisted in protecting their homes so that they do not turn hostile towards elephants. In some situations, compensation should be paid to the villagers for loss of crops (Kemf and Santiapillai 2000). As Ferrar (1983) argues, there is a relationship between tolerance of wildlife and human population density, for at any but the lowest density, large wild animals and humans are fundamentally incompatible. This incompatibility increases rapidly as both animal and human densities increase. Elephants are incompatible with peasant agriculture unless the damage they cause is compensated (Child 1995). This is the crux of the human-elephant conflict in Asia, and it is leading in just one direction: the destruction and eventual elimination of elephants from agricultural areas, unless innovative measures are adopted to address the concerns of the farmers. Ways to minimize the human-elephant conflict need to be devised as 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 instead of an agricultural pest, then they will tolerate it in their neighbourhood (Child 1995). Unless people value living with elephants, the slaughter will go on. Given that the human-elephant conflict is already bad today, it may become worse tomorrow. Even if we cannot eliminate the conflict altogether, we need to reduce it to tolerable levels. The rapidly changing socio-economic and cultural contours of South and Southeast Asia are also bound to change the human-animal relationship and hence it is imperative that steps are taken to mitigate the conflict.

Changes in land-use patterns are resulting in continuous contraction of habitat available to the elephant, whose range has already declined from over 9 million km^2 in the distant past to less than 500,000km^2 at present (Sukumar 2003), and continues to fragment and isolate elephant populations through the 13 countries in which they still live. Asian elephants are forest animals that require shade, unlike the 'bush' elephants of Africa, which are able to better tolerate the sun. Therefore, conservation of forests is crucial to saving the Asian elephant (Santiapillai and Jackson 1990). Elephants also need access to areas with permanent water and which provide adequate browse and grass, both important components of their mixed diet.

The Asian elephant is one of the last few megaherbivores (i.e., those plant-eating mammals that reach an adult body weight in excess of 1,000kg) still extant on earth (Owen-Smith 1988). The two sexes initially grow at the same rate but in males, after puberty there is a marked acceleration in the growth - the post-pubertal growth spurt - leading to great differences in the size of mature males and females. Hence, adult bulls are taller and twice as heavy as adult cows; a 50-year old bull in healthy condition could reach 6,000kg in some regions.

The basic social unit among elephants is the family, consisting of an adult cow and her immature offspring. Elephant society is multi-layered, ranging from the mother-calf or nursery unit, through the family unit, the 'kin' or bond group (2-5 family units which associate frequently), the clan (a number of family units and bond groups in an area that coordinate their movements), the subpopulation (a number of clans using a particular part of the range), to the whole population as with the African species (Moss and Poole 1983; Moss 1988; Sukumar 1989; Baskaran *et al.* 1995). Females remain in the cow herds of their birth, which are essentially a matriarchy being led and coordinated by the oldest reproducing cow, who is also probably the mother, aunt or grandmother to most of the rest of the herd members. Such a female-centred or matriarchal nature of Asian elephant society was known

to some astute naturalists of the 19th century (Sanderson 1878). Using molecular genetics, Fernando and Lande (2000) have confirmed that elephants constituting a group could be related to one another. Larger herds with older, more experienced matriarchs are more successful in exploiting high quality habitats, and thus ensure better survival of young. Herd size ranges from 8-20 animals. The matriarch's presence is crucial to the survival of the herd, for she is the repository of knowledge.

While females become sexually active between 9-12 years, males reach sexual maturity between 12-15 years, at which time they disperse from their natal herds to prevent inbreeding. Adult bulls live alone, or in small temporary groups ('bull herds') with weak social bonds. The composition of the bull groups changes both in space and time. Bull elephants exhibit the phenomenon of *musth*, analogous to the rut in deer, during which testosterone levels in blood soar to much higher levels than usual. Although the secretions of the temporal glands are associated with heightened sexual activity and aggressiveness among bulls, males can successfully mate with females even in the absence of musth. Elephants are extraordinarily vocal animals; their auditory communication extends down into the infrasound range that is not audible to humans (Payne *et al.* 1986). Females are in estrus only for a short time every 14-16 weeks, and they announce their brief receptive periods through chemical, auditory and behavioural signals increasing the likelihood that multiple males will be available as mates to choose from. Older males and those in musth generally have higher chances of mating; Females have a long reproductive period, from about 12 to 60 years, during which time they could produce as many as 12 calves. From the moment a calf is born, after a gestation period of nearly two years, it becomes the centre of attention of the herd, fussed over and cared for by the herd members (Moss 1988). Female helpers known as 'allomothers' are important in the rearing of calves (Gadgill and Nair 1984). A calf that is born into a large family with several allomothers has a better chance of surviving than one born into a small family with few or no allomothers (Poole 1994).

Elephants are less discriminating than other herbivores in what they eat. They browse and graze on a variety of plants but their proportions vary both in time and space. During the dry season, 70% of an elephant's diet is browse, while in the wet season, grasses make up the major part of the diet when available (Sukumar 1989). Elephants may feed on over a hundred plant species in an area but plants from just a few botanical families may account for most of their total intake (McKay 1973; Sukumar 1989). Fruits are an important component of their diet in rainforests (Olivier 1978). Elephants may also include bark, which contains minerals such as calcium and also provides roughage. As the elephant does not have a rumen, cellulose is digested in the large caecum and the colon, with the help of symbiotic microorganisms. The passage of food through the gut is fast, and the ingested food is only partially digested, with about 40-50% ending up as waste. Elephants may spend 12-18 hours a day feeding, during which they may consume up to 10% of their body weight as fresh weight fodder (Vancuylenberg 1977; Sukumar 1989). They also defecate about 16-18 times a day, producing large quantities of dung. The recycling of dung is very important for nutrient cycling of the ecosystem and also helps disperse seeds.

Asian elephants do not seem to make long distance migrations as their cousins do in semi-arid Africa. While home ranges of individual African bush elephants (*Loxodonta africana*) may stretch across thousands of square kilometres, those in Asia tend to be rather smaller. Radio-telemetric studies carried out in India (e.g., Baskaran *et al.* 1995; Sukumar *et al.* 2003) and in Sri Lanka (e.g. McKay 1973; Fernando and Lande 2000) indicate home range sizes of 250-1,000km^2 for family herds in Indian populations but a much more restricted 50-150km^2 in Sri Lanka. The area over which elephants move is dependent on the availability of food and water. Where both are plentiful throughout the year, elephants may move over relatively small distances, but elsewhere they may move over much larger areas to find nourishment. Regional information on home range sizes and elephant movement is thus important for conservation planning.

The relationship between man and elephant in Asia is so unique that the animal has become a sacred and beloved symbol to millions of people. The association of the Asian elephant with man began in the misty past, thousands of years ago. Perhaps baby elephants, isolated from their herds, were tamed by forest people, who found they could be ridden and taught to obey commands. Ancient Hindu works refer frequently to elephants, and one of the most popular gods to this day is the elephant-headed Ganesh, son of Siva, one of the most important deities of the Hindu Pantheon, and his consort Parvati.

White elephants are believed by man to be the reincarnation of Lord Buddha and wars have been fought over them (Kemf and Santiapillai 2000). As Lahiri-Choudhury (1988) points out, it is difficult to imagine India without elephants, for they are so much a part of its history, myths, culture and religion. In Sri Lanka, elephants continue to figure in pageantry and religious festivals. A caparisoned tusker, escorted by other richly-decorated elephants, carries the reputed tooth of Lord Buddha in stately procession at the annual Esala Perahera in Kandy. Many Hindu temples in south India maintain captive elephants in stables for ceremonial occasions. Thailand reveres the sacred white elephant. But the species that once adorned flags and ancient temple grounds of royal kingdoms is in grave danger today. A pragmatic synergy of scientific knowledge, cultural pride and political will is needed today to ensure that the elephant, among the last of the megafauna, survives in the coming decades and centuries.

Given the broad habitat requirements and the present distributional range of the species across the rich tropical

forests of Asia, including several so-called 'hot spots' of biodiversity such as the Western Ghats/Sri Lanka, Indo-Burma and Sundaland, it is often regarded as an 'umbrella' species; hence, any conservation programme for the elephant will also confer protection for a number of other species living with the elephant. The Asian elephant is also one of the world's most important charismatic 'flagship' species. The elephant is also known as a 'keystone' species, to emphasize the vital role it plays in the structuring of natural communities (Dublin *et al.* 1997). Thus, the conservation of the elephant will ensure the maintenance of biological diversity across a much larger area.

The conservation of the elephant in Asia is of international significance, but linked inextricably to the welfare of the people with whom the animal shares the land and resources. Reconciling conservation of the Asian elephant with human interests has to be given the highest priority. This is the aim of this Action Plan.

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Photo: Heidi Riddle for International Elephant Foundation (IEF)

Planning for Asian elephant conservation

Raman Sukumar and Charles Santiapillai

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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Photo: Heidi Riddle for International Elephant Foundation (IEF)

Conservation of the Asian elephant in Bangladesh

Md. Anwarul Islam

Introduction

Bangladesh – the Land of Bengal – was once a part of Pakistan, but became independent in 1971. The country has a total land area of 147,570km^2 and stretches between 20°34'N and 26°33'N, and between 80°1'E and 92°41'E. It is surrounded by India on the west, north and east, and by Myanmar on the south-east. To the south lies the Bay of Bengal. With a human population of about 130 million, Bangladesh is also one of the most densely populated countries on earth. Average population density is about 880 people per km^2. The country is rich in culture, history and natural resources. The Ganges-Brahmaputra River systems flow through the country and form the largest delta in the world, extending over some 40,225km^2 (Rashid 1991). The monsoonal climate of Bangladesh is characterized by high temperatures and heavy rainfall. Cyclones and floods are frequent. Bangladesh has lost much of its forest, through agricultural development in an effort to feed its huge human population. Less than 6% of the country is forested.

Elephants in Bangladesh: a historical sketch

The elephant is a part of the cultural heritage of Bangladesh (Chakraborty 1996). Only about a hundred years ago, elephants were abundant in most of the forests of Bangladesh. Places such as the Madhupur Forests near Dhaka were also known to have had elephants. They were captured and trained for use for a variety of purposes. A road in Dhaka (Elephant Road) was used by captive, trained elephants, which were brought from Peelkhana (a Royal elephant stable, and a locality in Dhaka to the north-west of Azimpur). Elephants were brought in from various parts of the then 'Bengal' for necessary training before sending for duty to different parts of British India. The mahouts of Peelkhana lived in a locality in old Dhaka called Mahouttuli. During Mughal days, private *zamindars* also kept their elephants in Peelkhana on payment of fees. Demonstration of *kheda* (elephant-trapping enclosure) operations used to take place here even towards the end of the 19th century. The British army needed elephants for its guns and its commissariat. They had to transfer their regular elephant-catching establishment from Dhaka to Myanmar in 1900 because of the depletion of herds in the Garo Hills as a result of excessive capture. Elephants disappeared from the area a few years before the creation of Pakistan in 1947. The principal functions of elephants were the removal of logs cut from deep inside the forest.

The number of elephants captured for domestication or eliminated through shooting during the 19th and 20th centuries in Bangladesh far exceeds the size of the present wild population. The documented sources indicate that between 1868 and 1985, some 1,534 wild elephants were captured (Table 1).

Kheda (capture in stockade) operation was first practised in Bangladesh in 1868. The Forest Department started it from 1915-1916. The competent authority called for sealed tenders from the intending contractors for quoting the royalties they could offer for each elephant to be caught in the proposed *kheda*. The rate of royalties for capturing elephant by *kheda* sometimes went up to Rs.750 for each elephant. The *kheda* operation was stopped in Bangladesh in 1965.

In former days, a large number of elephants were annually captured and handed over to the Government in payment of the land revenue by certain *zamindars* (landlords). They were then sold by the Collector, and sometimes brought prices averaging only about UK£5 each. This practice, however, has long been discontinued, and the revenue was then invariably paid in money. Some paid their tributes to the Company in elephants. There was very high mortality among these elephants given as tribute.

Current status of wild elephants

The elephant is now a critically endangered species in Bangladesh. Some information on the status and distribution of wild elephants was given by Ranjitsinh (1978), Olivier (1978), Khan (1980), and Gittins and Akonda (1982). Chakraborty (1996) carried out an extensive field study of the elephant in Bangladesh. Islam and Al-Zabed (1992), Islam *et al.* (1999) and Chakraborty *et al.* 2000 have studied human-elephant interactions in the wild. Today the stronghold of wild elephants of Bangladesh is those areas which are relatively less accessible to humans, i.e., Chittagong and the Chittagong Hill Tracts in the south-east. Some herds come down from the neighbouring Indian states of Meghalaya and Assam. These non-resident herds stray into the New Samanbag area of Maulvibazar District under Sylhet Forest Division in the north-east, some of which come from Karimganj of neighbouring Indian State of Assam. The other non-resident elephants, found in Durgapur of Netrokona District in the north, come from the Tura Reserve of Meghalaya, in India. The presence of non-resident elephants coincides with paddy harvesting seasons, i.e., February-May and September-December. The resident herds that live in Teknaf area (south-east) frequent the neighbouring forested areas of Arakan of Myanmar; the Sangu and Matamuhuri (south-east) herds frequent the forests of Mizoram State of India.

Today there are about 200 wild elephants in the country, confined largely to the south-east. The largest number of elephants occurs in the Chittagong Hill Tracts, while the rest distributed in the Chittagong and Cox's Bazar forest divisions. About 30 elephants frequent from the neighbouring Districts of Myanmar. A non-resident herd (about 10 animals) sometimes enters New Samanbag area of Maulvibazar District. Three herds comprising about 30 elephants visit the north-central Districts from Meghalaya of India. An IUCN-Bangladesh team in 2003 recorded 40-45 elephants at Nalitabari of Sherpur District (northern Bangladesh; herds come down from Meghalaya, India), and 8-10 elephants at Rajibpur of Kurigram District (neighbouring district of Sherpur, situated on the north-west of Sherpur).

On the basis of dung count method (indirect method) the mean elephant density was recorded by IUCN-Bangladesh in 2003 as 0.11/km^2 in its natural habitat and the total number of wild resident elephants was estimated to be 178. However, from discussion with the local people, FD staff and direct field observations the population size was mentioned in the same report to range from 196 and 227. In the early 1990s, the number of wild elephants was estimated to be between 195-234 (Chakraborty 1996). The migratory population has been estimated to number between 83 and 100 animals.

Status of captive elephants

Captive elephants (n=94) are mostly used in the timber industry for hauling logs, and in circuses. Some of these elephants are the descendants of a single female in captivity. Most of the captive elephants are found in Maulvibazar District in the north-east; the owners rent these elephants out for hauling timber, and to circus parties. Elephants that are not used in circuses are mostly log haulers. Of the 94 captive elephants, 74 (79%) are log haulers (of the 17 government owned elephants, 13 are log haulers), 17 (18%) are circus elephants, 3 are zoo elephants, and one is owned by Betbunia Police Station, Rangamati. 56 of these elephants are females and 38 are males; 57 (27 males and 30 females) are under 30 years of age and 22 (15 males and 7 females) are less than 10 years old (Table 2). People hire log haulers at the rate of Tk.1,200 (US$20) for the whole day. Circus elephants are rented out for *c.* Tk.100,000 (US$1,600) for one year. Price of a log hauler varies from US$5,000-6,000, whereas a circus elephant may cost up to US$10,000.

Threats to wild populations

Habitat loss and fragmentation have had a severe impact on the wild elephant population in Bangladesh. Over the past two decades, forested areas within Bangladesh that served as prime elephant habitat have undergone drastic reduction (Gain 1998). Generally, habitat loss and fragmentation is attributed to the increasing human population and its need for fuel wood and timber. However, illegal timber extraction plays a significant role in deforestation and habitat degradation (Gain 1998; Geisen 2001).

As a result of the shrinking habitat, elephants have become more and more prone to coming into direct conflict with humans. With reduced forest land, crop depredation by elephants are on the increase, during which people also get killed. In 2000, 17 people were killed and 15 injured by elephants. On the other hand, three elephants were killed by irate people in September and November 2001. A recent survey conducted by IUCN-Bangladesh showes that such human-elephant conflict is commonplace in

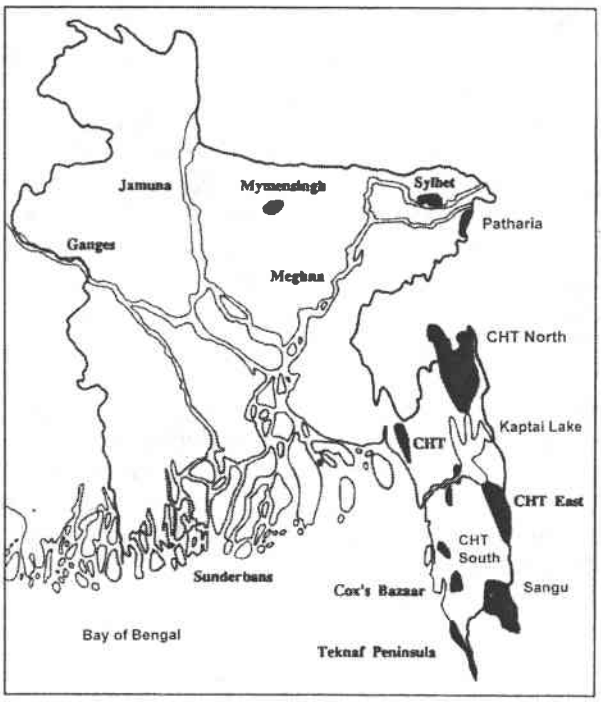


Figure 1. Forested areas in Bangladesh inhabited by elephants. CHT = Chittagong Hill Tracts

some north-eastern villages, where large herds seem to be attracted to croplands on a regular basis (Fernando 2002). In 1997 a total of 21 human deaths were recorded and the economic loss caused by elephants through feeding and trampling of crops amounted to about Tk.4.6 million (US$102,000) in about 30 incidents of the conflict (Islam *et al.* 1999). In the same year 2 elephants were killed.

Huge areas of forestland have been illegally converted into croplands. It is estimated that the forest cover has been reduced by more than 50% since the 1970s. Estimates in 1990 revealed that Bangladesh had less than 0.02ha of forest land per person; one of the lowest forests to population ratios in the world. Throughout the 1980s, the introduction of advanced technologies, such as high yield varieties of rice, altered the traditional cropping patterns. This made it possible to expand the crop yields without utilising more land. This vertical expansion (more crop yield on the same area of land) has almost reached its limit. Horizontal expansion (aerial expansion of cropped area) into forests and increasingly into wetlands is on the increase.

Conservation needs

A total of sixteen areas have been brought under protection through government initiatives covering about 2% of the country's total area. Teknaf Game Reserve and Chunati Wildlife Sanctuary in the south-east are forested areas that were set up to protect elephants. However, simply declaring an area as protected alone does not ensure protection in the absence of guards to protect the area. Manpower is expensive to hire in Bangladesh. Even within the protected areas, the issue of human-elephant conflict is of importance and people from surrounding villages are often responsible for persecuting elephants (Chakrabarti *et al.* 2000). Protected Areas (PAs) in Bangladesh need to be brought under a centralized management system with appropriate funds and manpower being allocated to solve local problems with benefits to both man and wildlife. Corridors should be built by planting trees to facilitate elephant movement.

An important way by which this could be achieved is by launching public awareness programmes. A survey of people in the Chunati Wildlife Sanctuary showed that 49% were willing to conserve the elephant, and 16% had mixed feelings, whereas the remaining 35% were against conservation. Appropriate education and public awareness programmes are required to facilitate elephant conservation in these areas. People affected by elephant raids should be compensated for their losses as incentives to assist in conservation. Eco-tourism should be developed to meet the needs of local people to relieve pressure on forests.

Some elephant herds, living primarily within the forested areas of India, both along the south-eastern and north-eastern regions, regularly move into Bangladesh territory and raid crops. Management guidelines dealing with transboundary issues should be developed by

Table 1. Partial record of elephants captured in Bangladesh during the 19th and 20th centuries

Location	Number of elephants captured	Period of capture
Dhaka Hill (Madhupur)	413	1868-76
Chittagong	85	1875-76
Dhaka Hill	503	1876-80
Jayalla (Chunati, Chittagong)	36	1938
Sylhet	3	1947-1962
Chittagong	151	1947-1962
Chittagong Hill Tracts	320	1947-1962
Ukhia (Cox's Bazar)	10	1965
Ramgar (Chittagong)	2	1984
Matiranga (Khagrachari, Chittagong Hill Tracts)	3	1985
Kaptai (Chittagong Hill Tracts)	3	1985
Ramgar (Chittagong Hill Tracts)	3	1985
Edgaho (Cox's Bazar)	1	1985
Kaptai (Chittagong Hill Tracts)	1	1985
Total	1534	

both nations to provide a safer place for the remaining elephants that frequently cross borders. Above all, there should be a strong political commitment for elephant conservation in the country.

Legal conservation measures

Elephants received some protection under The Elephant Preservation Act of 1879, known as Bengal Act of 1879 VI, which has been repealed. All wild elephants are now protected under the Third Schedule of the Bangladesh Wildlife (Preservation) (Amendment) Act of 1974. All reptiles, birds, and mammals under this schedule are protected animals, i.e., animals which shall not be hunted, killed or captured. The rogue elephants, listed under Part II of the First Schedule, could only be hunted with a special permit in places as declared by the Chief Wildlife Warden. There is no clause in the Act for the protection of domesticated elephants. However, Article 9 states: "(i) Any person having the control, custody or possession of any wild animal or meat or trophy of any wild animal shall, within such period as the Government may by notification in the official Gazette, declare to an officer of the number and description of such wild animal, meat or trophy and the place where it is kept; (ii) On receipt of such declaration, the officer shall enter upon the premises of such person in the prescribed manner and such person shall produce the declared wild animal, meat or trophy for inspection and verification before such officer; and if the declaration is found correct, the officer shall fix upon or put such mark of registration on such wild animal, meat or trophy as may be prescribed as lawful possession; (iii) No person shall counterfeit exchange or in any way interfere with any mark of registration fixed or put on by the officer on any wild animal, meat or trophy; (iv) The officer shall, on being satisfied that the requirements of clauses (i) and (ii) have been fulfilled, issues, in the prescribed manner, a Certificate of Lawful Possession of such wild animal, meat or trophy; (v) The authorized officer may, pending legal action, seize any wild animal meat or trophy which has not been legally acquired or imported under this Act."

Regarding trade, Article 15 states: "(1) No person shall, with a view to carrying on a profession, trade or business, buy, sell, or otherwise deal in wild animals, trophies or meat or process or manufacture goods or articles from such trophies or meat unless he is in possession of a valid permit, hereinafter called a Dealer's Permit, issued for the purpose by an officer authorized in this behalf; (2) An officer may grant, or refuse to grant without assigning any reason a Dealer's Permit to any person to deal in any wild animal, trophy or meat, or any class of wild animals, trophies, or meat specified in such permit. (3) A Dealer's Permit shall be issued on payment of the prescribed fee and shall remain valid for a period of one year from the date of its issue unless earlier cancelled; (4) (i) The holder of a Dealer's Permit shall maintain such register or record of his dealings as may be prescribed and shall produce it for inspection at any reasonable time when called upon to do so. (ii) The officer may suspend or cancel Dealer's Permit at any time and if he suspends or cancels it, he shall record in writing the reason therefore; (5) Nothing in this Article shall be construed to exempt the holder of a dealer's permit from complying with the provisions of Articles 8, 9, 11, 12, and 13."

All the circus parties are registered with the District Commissioner's office. The mahouts and the owners are ignorant of the legal status of their elephants; they are even ignorant of the necessary daily diet for a captive elephant; proper veterinary care is also absent. Only the government-owned elephants receive good veterinary care. Some elephant owners admit that their elephants are registered with the local administration. However, under the existing law the registration of the captive elephants is the jurisdiction of the forest department.

Recommendations

Domesticated elephants

(a) There should be a compulsory nationwide central registry for captive elephants;
(b) Information on births, deaths, and transfers (including trade) of all the domesticated elephants should be recorded;
(c) All the *mahouts* and elephant owners need to be registered;
(d) An Elephant Managers' Association needs to be established in order to foster better communication among mahouts so that they could share their experiences; and
(e) Necessary education and training materials should be prepared for those who manage elephants in captivity.

As Bangladesh's forest areas continue to diminish, lack of occupation in the timber trade has meant that many owners are now even prepared to give up the idea of keeping elephants. These elephants could be used in tourism, ceremonial processions, etc. Therefore a management plan is needed to provide the necessary guidelines.

Wild elephants

(a) Forest Department staff should regularly monitor the movement of elephant populations. They should also assess the habitat conditions and the ecological requirements of elephants, and help identify the causes of human-elephant conflict so that appropriate measures could be taken to mitigate it;

(b) Isolated elephant populations need to be linked through the establishment of forest corridors through which animals could move and mix, and thereby bring in greater diversity into the gene pool and improve the viability of such populations;

(c) The Wildlife and Nature Conservation Circle (WNCC) of the Forest Department should be

strengthened through the provision of training to its personnel;

(d) Since the territorial District Forest Officers (DFOs) are in charge of the Protected Areas in Bangladesh, a much closer coordination between the WNCC and other Sectors should be developed. Ideally, the management of Protected Areas should come under the auspices of the WNCC; and

(e) The WNCC should establish a research unit to oversee the management-oriented research on the elephant and other wildlife in Bangladesh.

Conclusions

The present elephant population in Bangladesh is just a fraction of what used to be in the past. Over the decades, habitat loss and increase in human population have led to the extirpation of the elephant from much of its former range, and today, the species is represented as a fragmented population confined largely to the southeast of the country. There is an urgent need to launch a Project Elephant in Bangladesh to promote the conservation and management of the species, both in the wild and in captivity. In addition, given the scale of the human-elephant conflict, the future of many elephant sub-populations can only be assured, if adequate compensation can be paid to people who bear the brunt of elephant depredations.

Isolated elephant populations need to be linked through the establishment of forest corridors, thereby bring in greater diversity into the gene pool and increased viability. In addition, outside the system of PAs, the survival of the elephant will depend on the adoption of appropriate land-use practices that do not come into conflict with elephant conservation. Some elephants in Bangladesh are seasonal migrants from neighbouring India and Myanmar, and hence the management of such a migratory species needs closer cooperation between the three Range States.

Bangladesh is one of the most densely populated countries in the world, where competition for resources between man and wildlife is likely to get worse in the years to come. The combination of increasing numbers of human beings, their depletion of natural resources and their increasing expectations for improved living standards will exacerbate the problem. The fact that a megaherbivore such as the elephant still survives in such a densely populated country is a testament to the people's tolerance and willingness to share the land with wildlife. This offers hope for the future of the elephant and wildlife in Bangladesh.

Table 2. Age-sex groups of the captive elephants of Bangladesh (ages of six males and eight females could not be ascertained).

Age	Male	Female
01 – 10	15	7
11 – 20	7	13
21 – 30	5	10
31 – 40	3	8
41 – 50	1	3
51 – 60	0	6
61 – 70	0	1
71 – 80	1	
Total	32	48

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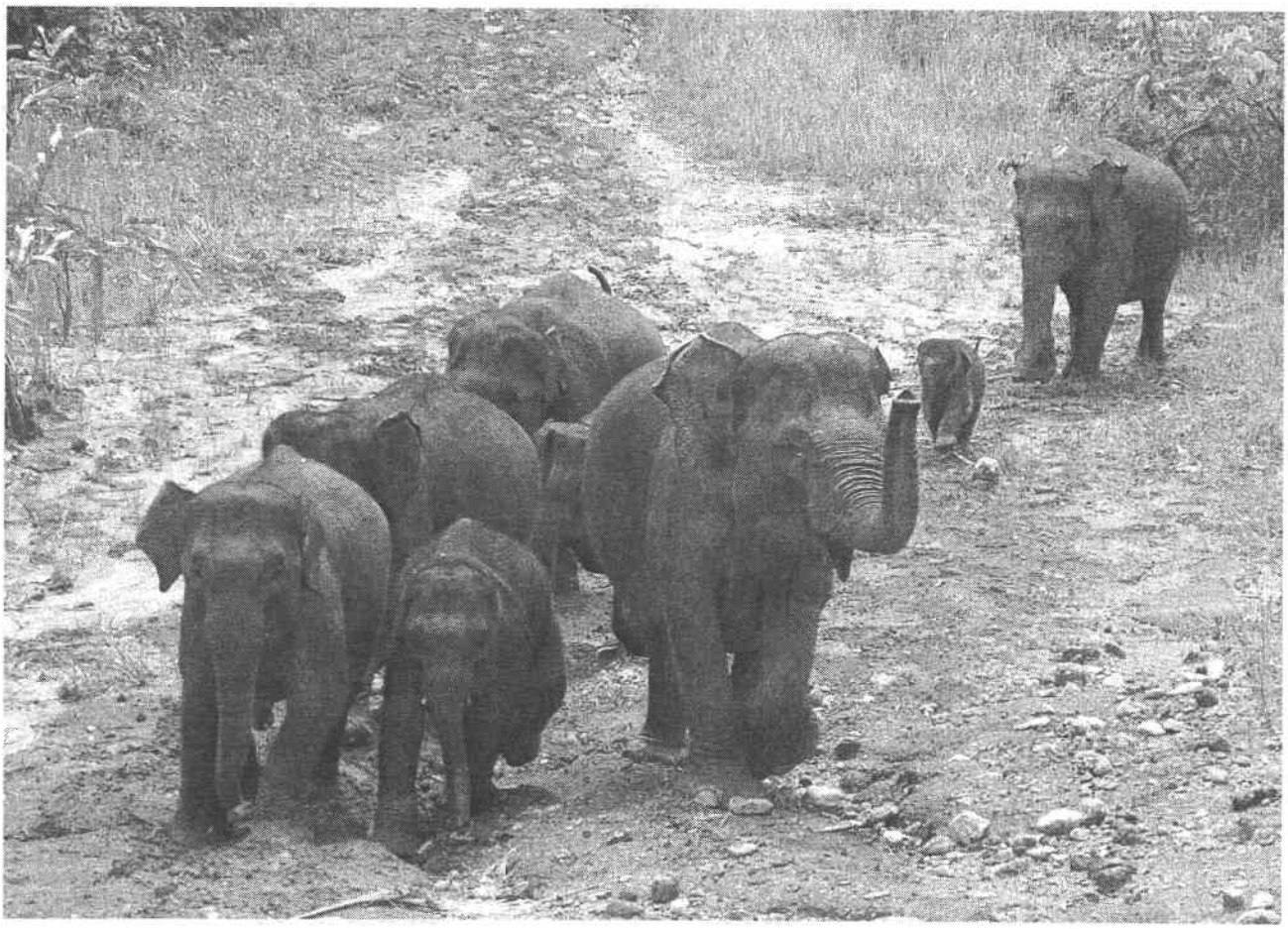


Photo: Heidi Riddle for International Elephant Foundation (IEF)

Elephant conservation in India – an overview

S.S. Bist

Introduction

The Republic of India is a union of 27 States and seven Territories. With a total land area of 3.28 million km^2, India is the seventh largest country in the world, with about 2.4% of the Earth's total land surface. India's frontier bordered by six countries is over 16,000km long of which about 7,500km is coastline (including those of its islands). India includes (a) portions of the Himalaya and sub-Himalaya regions; (b) extensive Indo-Gangetic Plains together with the Brahmaputra Valley of Assam; and (c) the Deccan Plateau to the south which constitutes the Peninsular India. The Himalaya (Sanskrit: *him*, 'snow', and *alaya*, 'abode') in the far north include some of the highest peaks in the world, the highest in India being Kangchenjunga (8,586m). Major rivers include the Ganges, Brahmaputra, Mahanadi, Narmada, Godavari, Krishna and Cauvery.

The climate in India is dominated by the monsoons, most importantly by rains from the south-west monsoon between June and October.

Forest types include evergreen tropical rain forests in the Andaman and Nicobar Islands, the Western Ghats, and the north-eastern States, to dry alpine scrub in the Himalaya to the north. Between these extremes lie forest types such as semi-evergreen rain forests, deciduous monsoon forests, thorn scrub, subtropical broad-leafed and subtropical pine forests. The total forest cover of the country assessed through satellite imagery interpretation is about 20% of the land area.

With more than a billion people, India is the world's second most populous country. Very little of India's land is uninhabited; more than three-quarters of India's human population inhabits the fertile alluvial soils of the Indo-Gangetic Plain and the deltaic regions of the eastern coast, and along the western coast. Population densities may exceed 800 per km^2 in agriculturally productive areas.

Historical background to conservation efforts

There are historical records, such as the *Kautilya Arthasastra*, that indicate legal protection for elephants by rulers of the sub-continent about 2,000 years before present (Rangarajan 1992). In more recent times, efforts for the conservation of the elephant in British India were initiated with the promulgation of the Madras Wild Elephant Preservation Act of 1873. Soon after, the Indian Government enacted the Elephant Preservation Act of 1879, that applied to the entire country. This Act, along with the Indian Forest Act of 1927 (IFA-1927) and certain other State Acts, remained a major legal tool for protecting elephants in most parts of the country until 1972. But all these Acts were quite liberal as regards capturing of elephants and permitted their killing under the pretext of protecting crops and public property. Ivory trade was kept outside the purview of law and there was no serious attempt to protect the habitat of elephants. As a result, the elephant population in the country continued to decline over the years.

The Wildlife (Protection) Act of 1972 (WPA-1972), which superseded all other wildlife legislation in the country, initially including the elephant under Schedule-II of the Act. This implied that elephant was 'Special Game' which could be killed or captured on the basis of a licence issued by the Chief Wildlife Warden (CWLW) of the State or any other authorized officer. The trade in ivory continued to be outside legal control. The recognition that the Asian elephant was an endangered species and needed special protection, came after the inclusion of this species in Appendix I of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) in 1975, and the formation of the IUCN/SSC Asian Elephant Specialist Group in 1976. Consequently, the elephant was transferred to Schedule I of the WPA-1972 on 5 October 1977. This implied a ban on hunting and capturing of elephants except for some specified purpose.

The Forest (Conservation) Act of 1980 (FCA-1980), brought the process of deforestation of elephant habitats under control. As a result of the revision in the Import-Export Policy of Government of India in 1978, 1987 and 1990, and amendments to the WPA-1972 in 1986 and 1991, the domestic and international trade in ivory was totally prohibited, thereby plugging a major legal loophole in the protection of elephants.

In February 1992, the Government of India launched Project Elephant, a major initiative for the conservation of elephants in the country. This project is meant to provide financial and technical assistance to elephant-bearing States. Until 31 March 2004 the Government of India had spent an amount of Rs.747 million (equivalent to US$16.2 million at current 2004 prices) on this project. A number of measures have been taken under the Project Elephant for strengthening of enforcement machinery, protection and improvement of habitats and corridors of elephants, reducing human-elephant conflict, capacity building of the field staff and veterinarians, care of captive elephants, sensitisation of public, and various other matters relating to elephant conservation. As a result, elephants in India now enjoy better protection and management than ever before.

Present distribution of elephants

Census operations carried out during 2001-2002 indicate the presence of over 27,000 elephants in 16 States and one Union Territory in the country (Table 1). Elephants are found in five distinct geographical zones, *viz.*, north-eastern India (*c.* 9,200), eastern India (*c.* 2,600), northern India (*c.* 1,600), southern India (*c.* 13,800) and the Islands of Andaman and Nicobar (*c.* 40) (Fig. 1). The elephant population of Andaman and Nicobar is derived from captive elephants that escaped into the wild in the 1960s. In recent decades Several states that were devoid of wild elephants for centuries have witnessed the influx of elephants from neighbouring States. The elephant population of Andhra Pradesh in southern India is derived from elephants that came into the state from Tamilnadu and Karnataka in late 1983 and thereafter. In central India elephant herds from Orissa and Jharkhand have been visiting Chhattisgarh since 1999, but there is no evidence so far that these elephants have permanently settled there. The total elephant habitat in the country is about 110,000km^2: 41,000km^2 in the north-eastern India; 23,500km^2 in the eastern India; 5,500km^2 in the northern India; 39,500km^2 in the southern India; and 500km^2 in the Andaman and Nicobar Islands.

Current population trends

The population of wild elephants has apparently increased in the country since 1980 when the first estimates were made by the Asian Elephant Specialist Group (Chart 1). Increase in elephant population is not uniform throughout the country. A negative trend is seen in the elephant populations in the north-east and Orissa. The population of elephants in Assam has gone down from 5,524 (year 1993) to 5,246 (2002); Arunachal Pradesh from 2,102 (1993) to 1,607 (2001); Meghalaya from 2,872 (1993) to 1,868 (2002); Nagaland from 256 (1980) to 145 (2002); and Orissa from 2,044 (1979) to 1,841 (2002). Some of the variation may be on account of refinement in census techniques in the recent years. In fact, during the recent enumeration in 2003, population estimates of Kerala and Uttaranchal had to be 'technically corrected' and brought down.

Threats to elephants

Poaching of elephants for ivory continues to be a serious problem in the country, though the average number of cases of poaching of tuskers has come down from 64 per year (during 1991-2000) to 44 per year (during 2000-2004) (Chart 7.2). However, there is reason to believe that not all the cases of poaching are brought on record. This is particularly true in the north-eastern States, where insurgency is a major problem.

A matter of serious concern in recent years has been the deliberate killing of elephants by villagers through

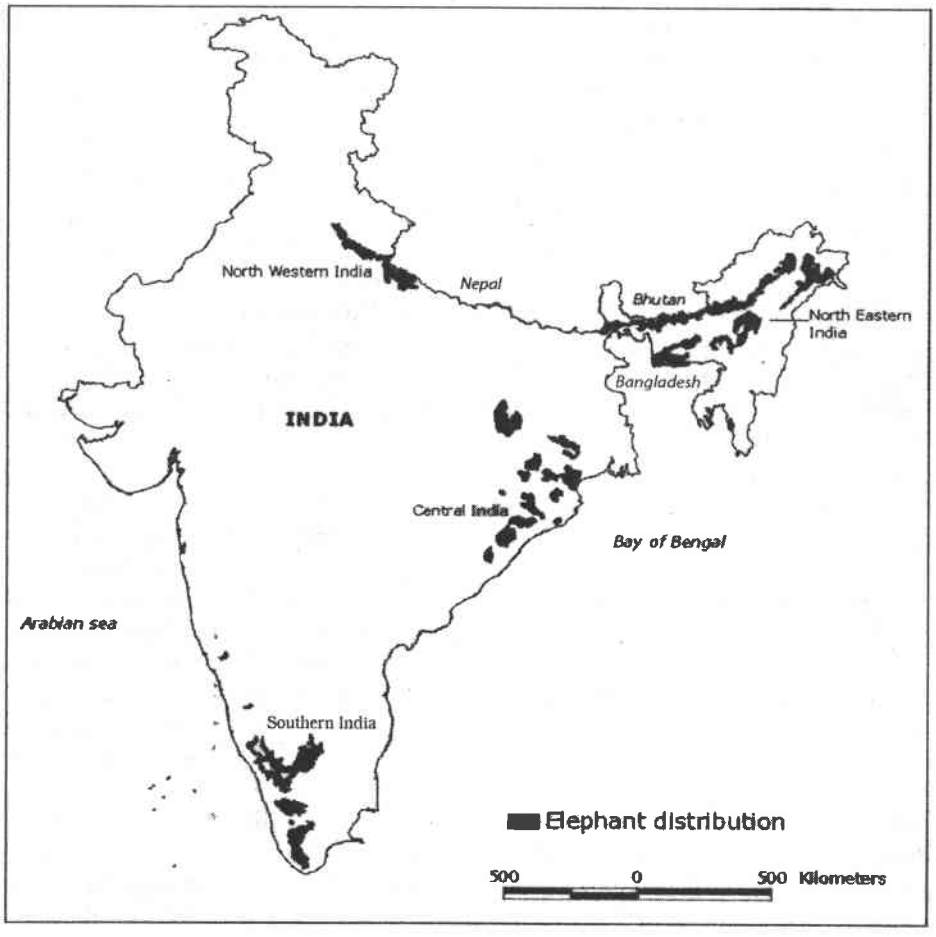


Fig 1 Distribution of the Asian elephant in India

poisoning or electrocution in retaliation against crop depredation by elephants. At least 21 elephants were killed by poisoning in Assam alone during 2001-2002. There were, fortunately, only two cases of elephant deaths in the country by poisoning during 2003-2004. On average, however, 35 elephants died of electrocution per year between 1998-2004, most of the reports coming from Karnataka, Kerala, Tamilnadu, Orissa and Assam. Cattle-borne diseases (e.g., anthrax, haemorrhagic septicaemia, trypanosomiasis, etc.) also account for about 20 elephant deaths every year. Ironically, expansion of railways, the indicator of country's economic growth, has proved to be a bane for elephants. During 1998-2004, reports of 74 elephants getting killed by trains were received — about 88% cases being reported from Assam, Jharkhand, West Bengal and Uttaranchal. Project Elephant has initiated coordinated efforts with the State Electricity Boards, Veterinary Department, the Railways and other relevant agencies to deal with these problems. As only the bulls among the Asian elephants carry tusks, they are selectively killed by ivory poachers. This has resulted in abnormally low proportion of adult bulls and highly skewed sex ratios in certain areas. Some examples of highly skewed adult male to female ratios are between 1:100 and 1:122 in Periyar Tiger Reserve in Kerala during the 1980s and 1990s [Chandran 1990; Ramakrishnan *et al.* 1998; but also see Easa (2001) who reports adult male to female ratio of 1:10 for the same reserve]; 1:29 in Mudumalai Sanctuary in Tamilnadu (Baskaran and Desai 2000); 1:9 in Coimbatore Division in Tamilnadu (Sivaganesan 1998); 1:12 in Bandipur National Park (Menon *et al.* 1997); and 1:7 in Nagaland (Lotha 1999). On the other hand, Meghalaya with a sex-ratio of 1:1.8 (Marak 1999), and northern West Bengal, with a sex-ratio of 1:1.3 (Bist 2000), have reported a very high proportion of adult bulls — probably due to large scale capturing of cow elephants in the past. Monitoring of adult sex-ratio has now been accepted as a useful indicator of the protection status of tuskers in India.

Threats to elephant habitats

Despite the provisions of the FCA-1980, elephant habitats are under threat in many States. The Forest Survey of India (FSI) has recorded a decrease in forest cover by 1,800km^2 between the 1991 and 1999 assessments in the north-eastern States of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram and Nagaland (Anon 2000). Most of the loss of forest cover is over elephant habitats and caused by encroachment and deforestation. But the actual loss of elephant habitats may be much more. About 1,500-1,800km^2 of prime elephant habitat on the north bank of the Brahmaputra in Assam is estimated to be under encroachment. Loss of elephant habitat has also been observed in Orissa and Jharkhand due to encroachment and mining activities. Large chunks of elephant habitats in Meghalaya, Nagaland and Orissa are under the control of either the local communities or the district administration and hence the State Forest Departments do not have much say in their management.

Yet another problem concerning elephant habitat is that of *jhum* (shifting cultivation). The FSI has assessed the cumulative area affected by shifting cultivation in the seven States in the north-east during the period between 1987 and 1997 as 17,300km^2 (Anon 2000) or at least 50% of this area forming the elephant habitat. Strictly speaking, *jhum* with longer cycles may not be detrimental to elephants as the secondary growth in the abandoned fields is greatly favoured by elephants. But human demographic pressures and diminishing soil fertility have resulted in a considerable shortening of the *jhum* cycle in most parts in the north-east and elephants are virtually on the run everywhere. In Garo Hills (Meghalaya), *jhum* areas experience the maximum human-elephant conflict.

Proliferation of weeds and monocultures of teak and eucalyptus have reduced the carrying capacity of forests for elephants in many areas. Forest fires and livestock grazing also affect the quality of elephant habitats. The Project Elephant supports activities for protection and improvement of elephant habitats.

Threats to elephant corridors

Corridors facilitate movement of elephants between two larger habitats, reduce the impact of fragmentation and enhance the viability of elephant landscapes. Therefore, protection and maintenance of corridors is essential for elephant conservation. Unfortunately, with a few exceptions in the south, no serious attempt to inventorize, demarcate and protect corridors has been made. Provisional estimates suggest that there are over 100 potential elephant corridors in the country. The proportion of corridors *vis-à-vis* elephant habitats

Table 1. Regional estimates of the number of elephants in the wild in India (2002).

Region	State/Union Territory	Population size
North-east	Arunachal	1,607
	Assam	5,246
	Meghalaya	1,868
	Nagaland	145
	Mizoram	33
	Manipur	12
	Tripura	40
	West Bengal (north)	292
Total for north-east		**9,243**
East	West Bengal (south)	36
	Jharkhand	772
	Orissa	1,841
Total for east		**2,649**
North	Uttaranchal	1,582
	Uttar Pradesh	85
Total for north		**1,667**
South	Tamilnadu	3,052
	Karnataka	5,838
	Kerala	3,850
	Andhra Pradesh	74
Total for south		**12,814**
Islands	Andaman and Nicobars	40
Grand total		**26,463**

is greater in the eastern region than in the rest of India – indicating the high level of fragmentation of habitats in this region. About one-fifth of the known corridors are inter-State in extent, making their management much more complicated. Available information indicates that at least one-third of the land in corridors belongs to private companies (mostly tea and coffee estates), individuals and communities. Management of these corridors without active support of the land-owners is a difficult proposition. The corridors under the control of the government agencies are generally affected by grazing, trespass, encroachment, mining, commercial forestry practices, and other kinds of biotic pressures. Project Elephant has provided financial support to the State Governments of Kerala, Karnataka and Meghalaya for procurement of land for consolidating and securing some important corridors.

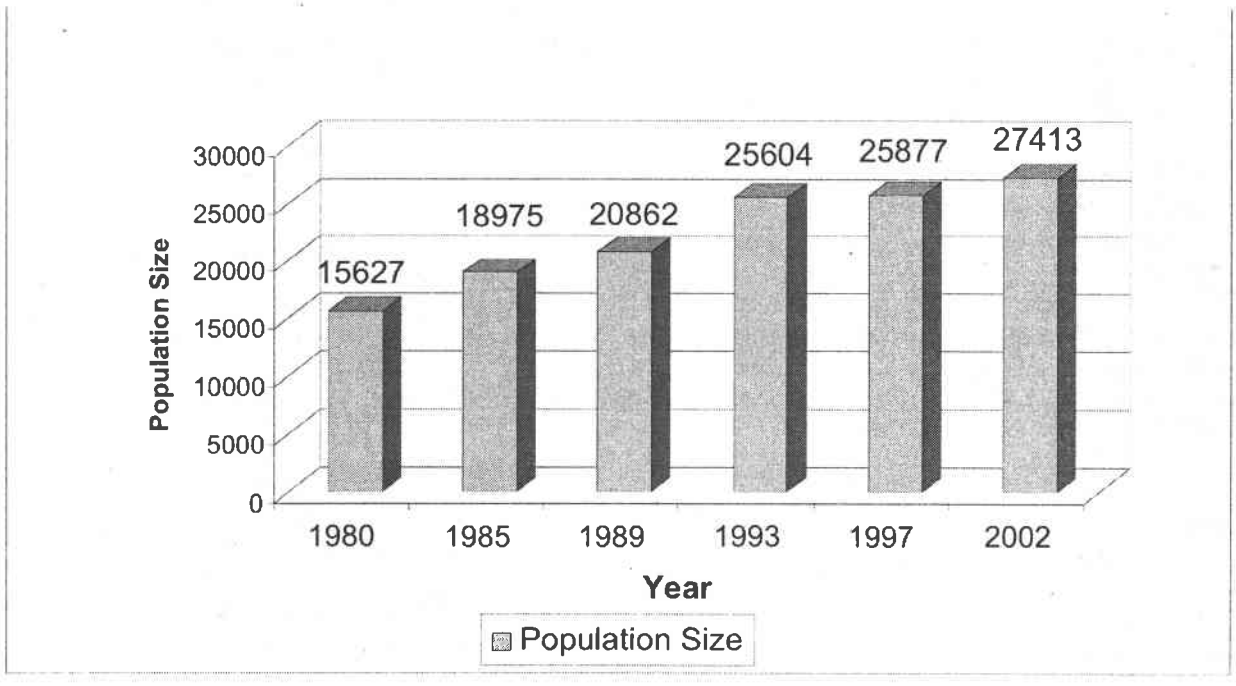
Human-elephant conflict

Human-elephant conflict continues to be a serious issue in India. On average, 240 people have lost their lives in encounters with elephants every year since April 1991 (Chart 3). Ironically, the eastern region, which harbours only 10% elephants of the country, contributes over 60% of the human casualties. It is estimated that elephants annually damage 10,000 – 15,000 houses and 0.8 to 1 million hectares of crops. As stated earlier, incidents of villagers killing elephants by poisoning and electrocution are increasing. The Central and the State Governments spend Rs.100-150 million (equivalent to US$2.2-3.3 million at current 2004 prices) every year on measures for controlling elephant depredation and payment of *ex-gratia* relief to the victims of depredation. The Project Elephant has been sponsoring a medley of conflict-mitigation measures varying from such modern methods as the use of energized fences and chemical immobilization of elephants to traditional methods like *Mela Shikar* (i.e., chase and capture) using *kunkis* (trained elephants). People's participation has been identified as the key to gain maximum benefit from any conflict-mitigation measure.

Captive elephants

Capturing elephants for taming and use is an age-old practice in India. The Project Elephant directorate carried out a rapid survey in December 2000 and estimated that there were 3,400-3,600 elephants in captivity in 21 States and three Union Territories in the country (Bist *et al.* 2001). There is no evidence to suggest any significant increase or decrease in population of captive elephants in recent years. There is, however, some regional shift in their distribution. For example, the number of captive elephants has increased in Kerala from 250 in 1983 to about 800 in 2002. Jaipur (Rajasthan) with about 90 captive elephants has presently become a major elephant centre. As a result of the restriction on logging operations in the north-eastern States and Andaman and Nicobar Islands imposed by India's Supreme Court in the 1990s, there has been an exodus of captive elephants from these areas to other parts of the country, particularly Kerala. The WPA-1972 stipulates that all the captive elephants, except those in recognised zoos, should be declared to the State Chief Wildlife Wardens (CWLW) who should register these elephants by issuing ownership certificates. But only about 2,000 captive elephants are registered with the State Forest Departments. Project Elephant has now undertaken a programme for registration of captive elephants by using microchips.

Chart 1. Trend in the growth of elephant population in India from 1980 - 2002



The survey by the Project Elephant directorate revealed that 75% of the captive elephants are owned by private individuals, 6% by temples, 3% by circuses 2% by zoos, and 14% by the State Forest Departments. The survey has also revealed that 43% of the elephants are primarily used for logging, 12% for ceremonial purposes, 10% for transportation, 7% for begging, 6% for tourism, 5% for entertainment (circus and zoo), 4% for elephant capturing (as *Kunkis*), and 2% for agriculture (mostly in Arunachal Pradesh). The remaining 11% elephants (mostly calves, sub-adults and old ones) are not put to any work. There is not much demand for captive elephants in the country at present.

Veterinary support

Veterinary support is needed for treatment of sick and injured elephants, immunization of livestock on the forest fringes to protect elephants against communicable diseases, control of problem-elephants (e.g., elephants in *musth*) and for post-mortem and forensic requirements. Not all captive elephants in India get proper veterinary support. Elephants owned by the zoos and State Forest Departments have better facilities. All major zoos in India have one or more full-time veterinarians. Major National Parks and Sanctuaries also have full-time veterinarians. The Protected Area (PA) authorities generally receive help from the State Veterinary Officers in arranging immunization of livestock – a legal requirement under the WPA-1972. In some PAs, NGOs also arrange veterinary support. A large number of captive elephants, particularly under private possession, do not have access to modern veterinary care and the elephant keepers depend on *Kaviraj* (practitioners of traditional medicine), or their own knowledge. Most of the veterinary doctors called upon to treat a wild or a captive elephant, lack necessary knowledge, experience and laboratory support. There have been instances when a problem elephant had to be destroyed in the absence of tranquillizing equipment. In a large number of cases of post-mortem of elephants, the reports are either defective or inconclusive. Project Elephant has initiated regular training programmes for veterinary doctors at Guwahati (Assam) and Trichur (Kerala) with help of the local agricultural universities.

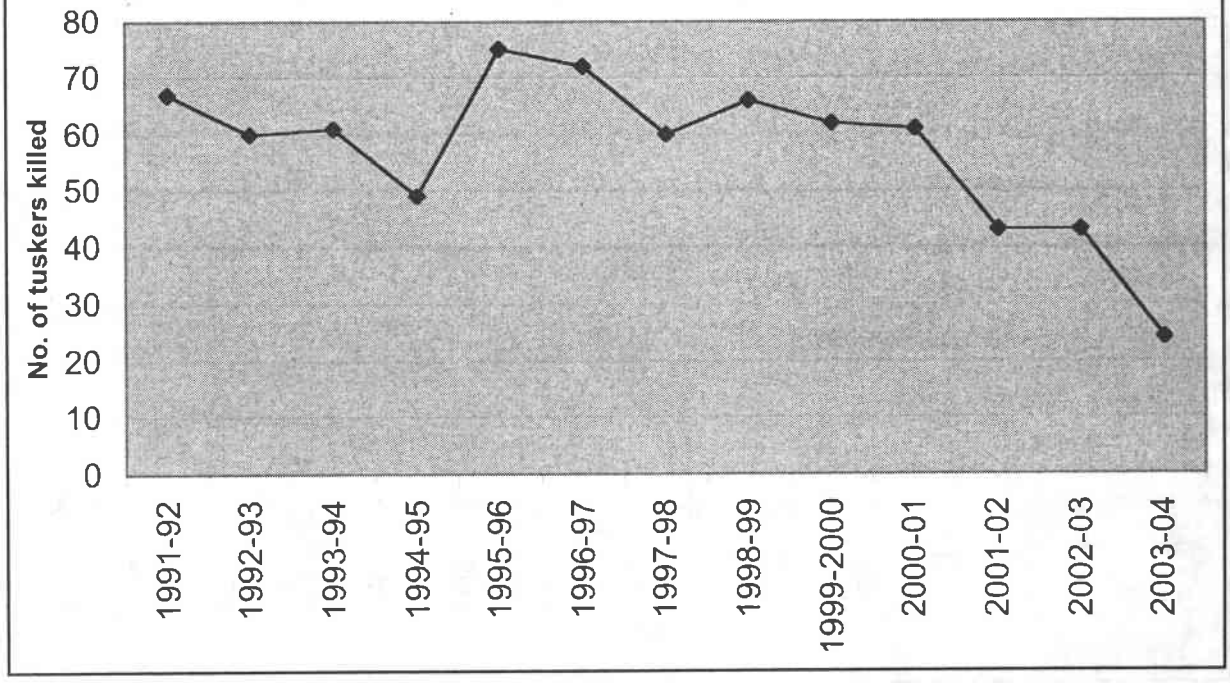
Legal support

The IFA-1927 and various other State Forest Acts recognize elephants as 'forest produce' and require a transit permit for their movement from one place to another. The FCA-1980 prohibits the diversion of any forestland for non-forestry purposes without concurrence of Government of India. This Act, as stated earlier, has prevented the destruction of elephant habitats in many areas.

As already stated, there is a ban on hunting and capturing of elephants as well as on ivory trade (both domestic and international) in India. The CWLW can however, proclaim a rogue elephant that has become dangerous to human life, and permit it to be hunted. The CWLW may also, with the prior permission of the Central Government, permit capturing of elephants for scientific research or population management.

As stated earlier, no person can keep, possess or acquire an elephant without an ownership certificate issued by

Chart 2. Number of tuskers killed in India between 1991 and 2004



the CWLW or any other authorized officer. Ironically, as a consequence of an amendment carried out in 2002 in Section 43(1) of the WPA-1972, the persons possessing ownership certificates for elephants have been forbidden from selling or transferring their elephants by any mode of consideration of commercial nature. This has created a serious problem for the owners who cannot afford to keep elephant as well as for the persons and government agencies desirous of procuring elephants. Government of India is now contemplating another amendment in the WPA-1972 to sort out this problem.

Zoos, recognized by the Central Zoo Authority, are exempted from the requirement of ownership certificates, but they are required to follow the standards and norms prescribed under the Recognition of Zoos Rules (1992) for keeping elephants.

Offences relating to elephants and ivory under the WPA-1972 can not be compounded and invite a term of imprisonment varying from three to seven years along with a fine which shall not be less than Rs.10,000 (equivalent to US$220). Any elephant captured or kept in violation of the WPA-1972 becomes government property and is liable for confiscation.

Domesticated elephants are also subject to the provisions of the Prevention of Cruelty to Animals Act of 1960, (PCA-1960) and the rules framed thereunder, *viz.* Prevention of Cruelty to Draught and Pack Animals Rules of 1965; Performing Animals Rules of 1973; and Prevention of Cruelty (Capturing of Animals) Rules of 1972. 'Cruelty' has not been defined in the Act. However, certain acts of omissions and commissions described in the Act constitute cruelty punishable under the Act. The Government of Kerala has also enacted 'The Kerala Captive Elephants (Management and Maintenance) Rules, 2003' for the welfare of captive elephants.

The Import-Export Policy of the Government of India does not normally permit import and export of live elephants. Zoological parks, recognized scientific institutes, circus companies and private individuals can import elephants subject to recommendation of the CWLW and the provisions of the CITES. Non-commercial export of elephants for scientific, zoological or educational purposes is permitted subject to recommendation of the Ministry of Environment and Forests.

Elephant Reserves

The conventional strategy in India to protect wildlife is through setting up PAs, i.e., National Parks and Wildlife Sanctuaries. There are 64 PAs in the country spread over an area of 24,580km^2 which harbour elephants (Anon 1998). However, for long-ranging animals like elephant, the existing PAs are inadequate. In fact, PAs protect less than 23% of the elephant habitat. The PAs are also not uniformly distributed over the elephant territories. It is evident that the strategy of PAs alone does not serve the purpose of elephant management and it is required to conserve elephants all over their range. Thus, Project Elephant has identified 11 viable 'Elephant Ranges' in

Chart 3. Human deaths caused by elephants

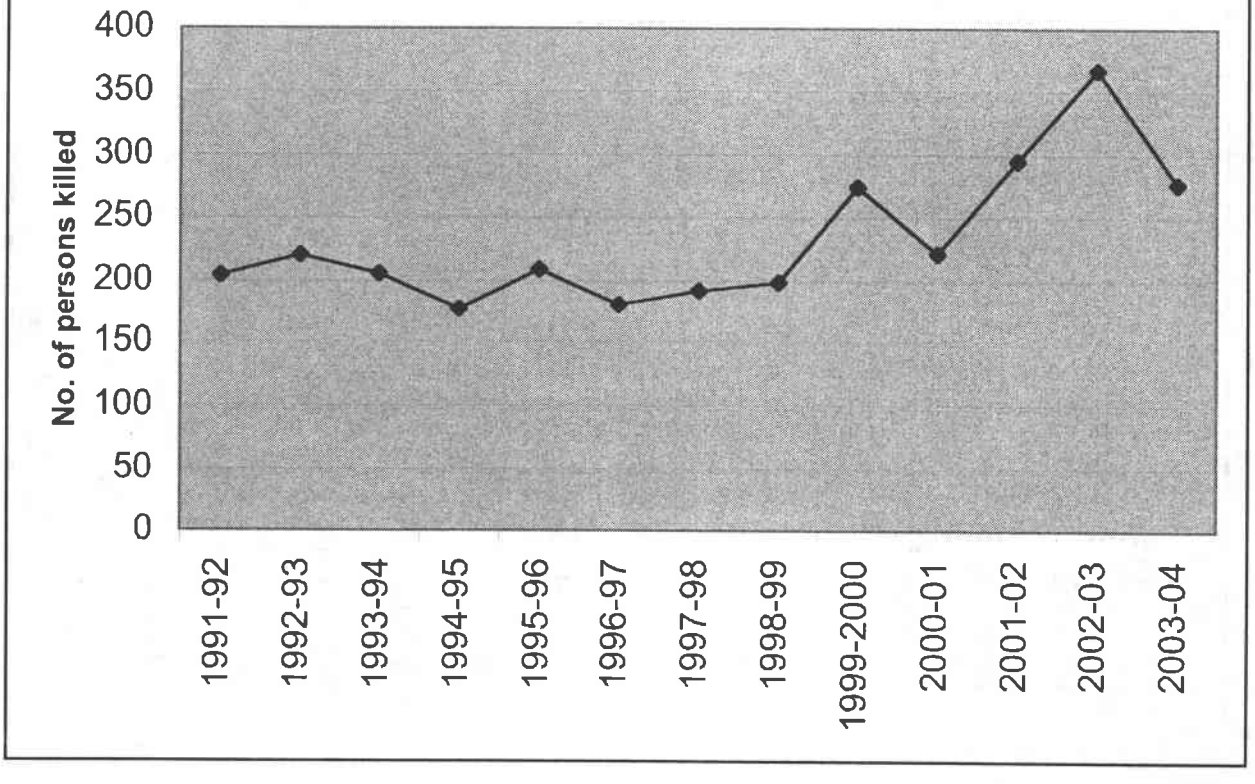


Table 2. Number of elephants in captivity in India (December 2000).

Region	State /U.T.	Number
North-eastern	Assam	1,253-1,290
	Arunachal Pradesh	564-580
	Meghalaya	45-54
	Nagaland	6
	Tripura	35-40
Sub-Total		**1,903-1,970**
Eastern	Bihar	76-92
	Jharkhand	15-20
	Orissa	8
	West Bengal	110-120
Sub-Total		**209-240**
Northern	Uttar Pradesh	115-140
	Uttaranchal	18-22
	Delhi	31
	Punjab	17
	Rajasthan	90
Sub-Total		**271-300**
Western	Gujarat	2
	Maharashtra	20-26
	Madhya Pradesh	53-60
	Goa	2
	Dadra – Nagar Haveli	2
Sub-Total		**79-92**
Southern	Andhra Pradesh	20-25
	Karnataka	101-115
	Kerala	612-635
	Tamilnadu	127-145
Sub-Total		**860-920**
Islands	Andaman & Nicobar	145
Sub-Total		**145**
Total		**3,467 – 3,667**

the country and advised the State Governments to notify their respective portions of these Ranges as 'Elephant Reserves'. There are presently 26 identified Elephant Reserves (ERs) extending over 58,000km² and harbouring over 20,000 elephants (Table 3). Of these, 24 ERs have been formally notified so far. A few more ERs are likely to be notified in the near future. As envisaged by Project Elephant, each ER will have a Field Coordinator, a Stakeholders Advisory Committee and a 10-year Perspective Plan.

Future of elephant conservation in India

Conservation of elephants in a developing and a highly populated country like India is bound to be a big challenge. There are problems on account of organized poachers of tuskers, mounting pressures on elephant habitats and corridors, and increasing human-elephant conflict. But despite all these problems, India has been able to maintain a reasonably good population of elephants with the help of a comprehensive legal and administrative system. India's commitment to elephant conservation is reflected in Project Elephant which ensures that sufficient financial and technical support is available to the elephant managers and enforcement staff. Establishment of Elephant Reserves is a step towards scientific management of elephants and rational utilization of resources. Project Elephant has invested heavily in capacity building programmes for the field staff, mahouts and veterinarians, which are likely to improve the quality of elephant management in India. Project Elephant has also been implementing the MIKE (Monitoring of Illegal Killing of Elephants) Programme of CITES. The Project has also focussed on improving research support for mitigation of human-elephant conflict and welfare of domesticated elephants. Project Elephant fundamentally provides a sound basis for elephant conservation in India. But a much more secure and reliable foundation is provided by the common people of India, who have tremendous love and sympathy for elephants because of their cultural and religious values. These values must be nurtured and encouraged as an essential ingredient of the conservation strategy for elephants in the coming years.

Table 3. Elephant Reserves in India (August 2004).

Sl. No.	Elephant Range	Elephant Reerve (Date of notification)	State	Total area (km²)	Elephant numbers
I	Eastern India (south West Bengal-Jharkhand-Orissa)	1. Mayurjharna ER(24 October 2002)	W. Bengal	414	56
		2. Singhbhum ER (26 September 2001)	Jharkhand	4,530	300
		3. Mayurbhanj ER (29 September 2001)	Orissa	3,214	512
		4. Mahanadi ER (20 July 2002)	Orissa	1,038	204
		5. Sambalpur ER (27 March 2002)	Orissa	427	284
	Sub-total			**9,623**	**1,356**
II	North Brahmaputra (Arunachal-Assam)	6. Kameng ER (19 June 2002)	Arunachal	1,892	377
		7. Sonitpur ER (6 March 2003)	Assam	1,420	577
	Sub-total			**3,312**	**954**
III	South Brahmaputra (Assam-Arunachal)	8. Dihing-Patkai ER (17April 2003)	Assam	937	457
		9. Deomali ER*	Arunachal	900+	150+
	Sub-Total			**1,837+**	**600+**
IV	Kaziranga (Assam-Nagaland)	10. Kaziranga - karbi Anglong ER (17 April 2003)	Assam	3,270	1,000
		11. Dhansiri-Lungding ER (19 April 2003)	Assam	2,740	430
		12. Intanki ER#	Nagaland	202	28
	Sub-Total			**6,212**	**1,458**
V	Eastern Dooars (Assam-W. Bengal0	13. Chirang-Ripu ER (7March 2003)	Assam	2,600	807
		14. Eastern Dooars ER (28 August 2002)	W. Bengal	978	165
	Sub-Total			**3,578**	**972**
VI	Garo Hills (Meghalaya)	15. Garo Hills ER (31 October 20010	Meghalaya	3,500	878
VII	Nilgiri-Eastern Ghats (Karnataka-kerala-Tamilnandu-Andhra)	16. Mysore ER (25 November 2002)	Karnataka	6,724	5,838
		17. Wayanad ER (2 April 2002)	Kerala	1,200	961
		18. Nilgiri ER (19 September 2003)	Tamilnadu	4,663	1,938
		19. Rayala ER (9 December 2003)	Andhra	766	74
	Sub-Total			**13,335**	**8,818**
VIII	South Nilgiri (Kerala-Tamilnadu)	20. Nilambur ER (2 April 2002)	Kerala	1,419	886
		21. Coimbatore ER (19 September 2003)	Tamilnadu	566	132
	Sub-Total			1,985	1,018
IX	Western Ghats (Tamilnadu-Kerala)	22. Anamalai ER (19 September 2003)	Tamilnadu	1,457	680
		23. Anamudi ER (2 April 2002)	Kerala	3,723	750
	Sub-Total			5,185	1,430
X	Periyar (kerala-Tamilnadu)	24. Periyar (2 April 2002)	Kerala	3,742	1,268
		25. Srivilliputtur ER (19 September 2003)	Tamilnadu	1,249	223
	Sub-Total			**4,994**	**1,491**
XI	Northern India (Uttaranchal)	26. Shivalik ER (28 October 2002)	Uttaranchal	5,405	1,391
	Total			**58,900+**	**20,150+**

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* Under process.

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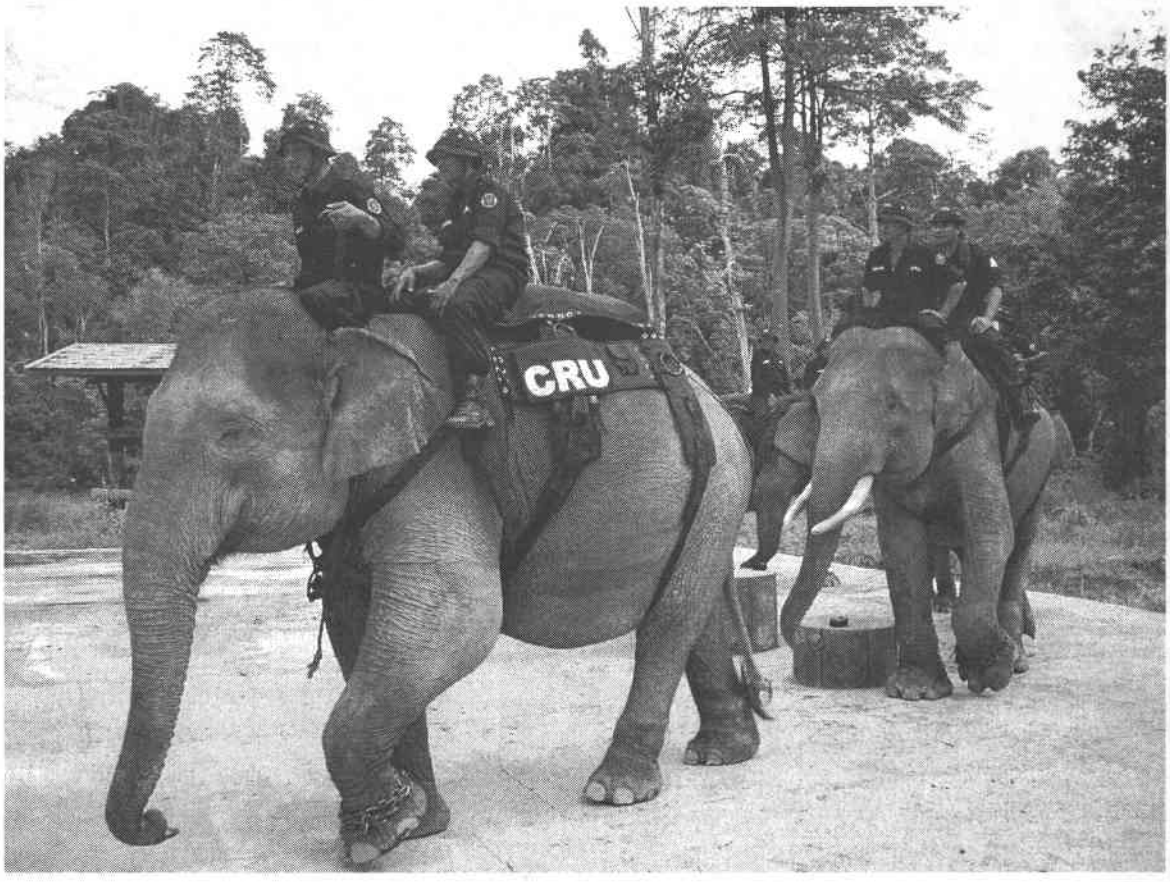


Photo: Heidi Riddle for International Elephant Foundation (IEF)



Photo: Heidi Riddle for International Elephant Foundation (IEF)

Conservation of the Asian elephant in Central India

Sushant Chowdhury

Introduction

In central India, elephants are found in the States of Orissa, Jharkhand (part of the erstwhile Bihar), and southern part of West Bengal. In all three States elephants occupy a habitat of approximately 17,000km^2 constituted by Orissa (57%), Jharkhand (36%) and southern West Bengal (7%). A large number of elephant habitats in this region are small, degraded and isolated. Land fragmentation, encroachment, shifting cultivation and mining activities are the major threats to the habitats. The small fragmented habitats, with interspersed agriculture land use in and around, influence the range extension of elephants during the wet season, and have become a cause of concern for human-elephant conflicts. Long distance elephant excursions from Singhbhum and Dalbhum forests of the Jharkhand State to the adjoining States of Chattisgarh (part of erstwhile Madhya Pradesh) and West Bengal respectively, have been a serious conservation problem since 1990. While there was no earlier record of elephant presence in Chattisgarh, yet from West Bengal they were once displaced following forest losses.

Biogeographically, the elephant habitats in the region fall in two major biotic provinces (Rodgers and Panwar 1985), namely Chotanagpur Plateau in the Northern and Eastern Ghats in the south. The former Province comprises the forests of Jharkhand tapering through Dalbhum tract to western border of southern West Bengal and north-western portion of Orissa. The majority of the forests are deciduous in nature but hill ranges have greater diversity value. The major elephant habitats in the Chotanagpur biotic province are Palamau, Singhbhum and Dalbhum Forests. On the north of the Mahanadi River, lie the separate hill ranges of Simlipal and Keonjhar Plateau. These hill ranges have relics of many archaic landmasses with elevated ridges and densely forested valleys. Topography of this area is very rugged comprising hill and peneplains. The highest peaks of those hill ranges are Mankarcha (1,117m) and Malayagiri (1,187m) in Keonjhar Plateau and Meghasani (1,165m) in Simlipal. Forest Divisions having elephant in these ranges are Baripada, Karanjia, Keonjhar, Bamra, Rairakhol, Angul, Dhenkenal, Athamalik and Athgarh. The Eastern Ghats extending from south of the Mahanadi River to Mahendragiri forms the elephant habitat in the southern region with areas falling only in Orissa State. The Forest Divisions containing elephant habitat are: Boudh, Nayagarh, Phulbani, Baliguda, Kalahandi, Raygada, Parilakhmundi and Ghumsur North. The average elevation of this tract is 1,100m a.s.l., and the highest point in the Eastern Ghats is Mahendragiri (1,501m). The habitat of Chandaka Elephant Reserve in the Khurda upland of coastal plains is beyond the limits of Eastern Ghats.

Forests lying in Orissa constitute the major habitats of elephant in the central India and are distributed across over 22 out of the 27 Forest Divisions. Total elephant habitat extends over an area of nearly 10,000km^2, which is about 21% of 47,033km^2 State Forest available, assessed through satellite data (FSI 1999). Dense forest accounts for 26,073km^2, open forest for 20,745km^2 and mangrove for 215km^2. While the northern part of Orissa beyond the Mahanadi River is plagued by severe mining activities, the southern part suffers from shifting cultivation. FSI (1999) data reports that the four Districts of Orissa, namely, Sundergarh, Keonjhar, Jajpur and Dhenkenal, have 164 mining leases of iron, manganese and chromate over 376.6km^2 which include 192.6km^2 of forest. About 5,030km^2 (or 8.8% of total forest area) is affected by shifting cultivation, most of which is on the southern part. Human population density is 236 persons/km^2. Nearly 53% of the elephant habitat is currently networked through 11 Protected Areas (PA) out of total 18 found in the State. The PAs of value to elephant conservation are: Simlipal National Park or NP (845.7km^2), Simlipal Wildlife Sanctuary or WLS (1924.3km^2), Hadgarh WLS (191km^2), Kuldiha WLS (116km^2), Satkosia Gorge WLS (795.5km^2), Baisipali WLS (168.3km^2), Chandaka-Dampara WLS (175.8km^2), Kotgarh WLS (399km^2), Lakhari valley WLS (185.5km^2), Khalasuni WLS (116km^2) and Badarma WLS (304km^2). The Simlipal Tiger Reserve that covers the areas of Simlipal NP and Simlipal WLS enjoys better protection under the umbrella of the Project Tiger. The majority of PAs, except for Simlipal Tiger Reserve and Satkosia Gorge Sanctuary, do not have management plans. Recently, under Project Elephant, the following three Elephant Reserves (ERs) were declared in Orissa: Mayurbhanj ER (7,044km^2; 500 elephants); Mahanadi ER (1,000km^2; 550 elephants); and Sambalpur ER (500km^2; 100 elephants)

Elephant habitat in Jharkhand covers an area of approximately 6,000km^2, which is 28% of 21,644km^2 forests assessed through satellite data in the State (FSI 1999). Singhbhum forests are the only major elephant habitat affected by mining of iron, manganese and copper. Total leased area of the District is 115.4km^2, which includes 31.9km^2 of forest. A study conducted by Singh and Chowdhury (1999) reports operation of 12 mines in Saranda Forest Division where 17km^2 of forest area have been opened up out of the lease area of 81km^2. Plamau District does have bauxite mining in a smaller area. The human population density of the State is 880 persons/km^2. There are two PAs: Palamau Tiger Reserve (1,920km^2) and Dalma WLS (193.2km^2), both of which lack a management plan. Unfortunately, the Singhbhum Forests, with their sizable elephant habitat

and population, did not have any PAs until recently. In 2001 this area was brought under the category of Elephant Reserve (ER), with an area of 4,350km² for about 350 elephants.

The elephant habitat in southern West Bengal includes Districts of Midnapore, Bankura and Purulia where elephant range expansion takes place from adjoining Dalma WLS, Jharkhand. Nearly 50-60 elephants enter southern West Bengal annually during the wet season from September to February. However there are about 26 resident elephants remain localized in the southern West Bengal habitat (Chowdhury *et al.* 1997). This habitat has fragmented forests mostly in protected and unclassed categories. The major land use in the area is agriculture, which over the decade has boosted due to better water harvesting regime developed through dams and lift irrigation (Chowdhury *et al.* 1997). According to the human census data 2001, the human density in the State is 904 per km². To date, there is no PA here. Mayurjharna ER has recently been created to conserve 60 elephants in an area of 450km².

The general vegetation types in the region are mainly tropical moist deciduous forests interspersed with tropical dry deciduous forests available through the influences of dry climatic factors. The moist deciduous forests having sal (*Shorea robusta*) as predominant tree in association with various other species such as: *Terminalia* spp., *Adina cordifolia*, *Anogeissus latifolia*, etc. occur in large extent. In the deeper valleys where soil and moisture condition are better, tropical semi-evergreen forests occur in patches. The tree species associations are: *Macaranga peltata*, *Bischofia javanica*, *Pongamia pinnata*, etc. The tree ferns *Alsophila glabra* and *Cyathea spinulosa* occur in lower reaches of the semi-evergreen forests. However, at higher elevations, the plant associations are *Alstonia scholaris*, several *Ficus* spp., *Anthrocephalus cadamba*, *Michelia champaca*, *Toona ciliata*, *Mesua ferra*, *Mangifer indica*, etc.

The elephant habitat immediately adjacent to the north of Mahanadi River and beyond to south has plenty of bamboo available. *Bamboosa arundinacea* occurs at places where soil condition and moisture remain good. *Dendrocalamus strictus* occurs extensively in dry and deficient soils, along with *Sal* understory. In northern half of Orissa, *Dendrocalamus* occurs sporadically.

The tropical dry deciduous forests occur in interspersion mostly in the southern part of Orissa and north-eastern part of Jharkhand. The important species associated with sal are *Anogeissus latifolia, Terminalia tomentosa, Mitragyna parviflora, Ougenia dalbergoides, Cassia fistula, Bauhinia racemosa, B. purpurea, B. retusa, Adina cordifolia,* etc.

Status and distribution of wild elephants

Population estimates of elephants in this region have varied according to the available sources of information as summarized in Table 1. The figure for Central India may range between 2,400 and 2,700 including Orissa (1,800-2,000); Jharkhand (600-700) and southern West Bengal (25-35). Elephants migrating into southern West Bengal have been enumerated with those in Jharkhand. Elephant numbers in Jharkhand were estimated regularly by the Forest Department in Palamau, Dalma WLS, but in other areas they were carried out only occasionally. In some selected habitats in Orissa, such as Simlipal Tiger Reserve, Kuldiha WLS Hadgarh WLS, Satkosia Gorge WLS and Chandka-Dampara WLS, elephant numbers were estimated methodically on the basis of direct sighting. For other areas such estimations were based on rapid local inquiries as well as educated guesses.

Table 1. Estimation of elephants in Orissa, Jharkhand and southern West Bengal.

S. No.	State	Reporting year	Elephant estimation	Source
1.	Orissa	1985	1,351	Chowdhury *et al.* 1985
		1989	1,600 –2,000	Orissa Forest Department in 1989 Elephant Action Plan Workshop, Dehradun, India.
		1989	1,692 – 1,947	Singh 1989
		1993	1,500 – 2,000	National Elephant Conservation Action Plan
		1999	1,827	Orissa Forest Department quoted in PE review committee report 2001
Orissa			1,800-2,000	
2.	Bihar	1985	300 – 360	Chowdhury *et al.* 1985
		1989	750	Bihar Forest Department in 1989 Elephant Action Plan Workshop, Dehradun, India
		2001	655 –700	Bihar Forest Department Report quoted in PE review Committee Report 2001
Bihar			600-700	
3.	Southern West Bengal	1997	24-26 localized and 35-40 migratory from Dalma WLS	Chowdhury *et al.* 1997
		2000	35 localized and 55 migratory	West Bengal Forest Department
Southern West Bengal			25-35	
Total			2,400-2,700	

There are four large zones in Orissa and two in Jharkhand, where habitat integration is possible to make them viable for elephant range and number. The six zones so identified collectively make up about 87% of conservation coverage available to the elephant population in the region. These zones need to be managed on an enhanced priority for elephant conservation, where other priorities such as forestry, non-forestry land-use activities should be subservient and made compatible with the overall objectives of elephant conservation. A large number of isolated elephant populations (see Fig. 1) that are medium to small in size, are described below:

ORISSA

Large habitats

Simlipal-Kuldiha-Hadgarh (Zone 1): This zone comprising an area of approximately 3,200km² has three PAs – Simlipal Tiger Reserve (2,770km²), Kuldiha Sanctuary (116km²) and Hadgarh Sanctuary (191km²). Furthermore, this zone is also contiguous to the Reserve Forests (RFs) of Noto (63km²) and Gadsahi (40km²), which can be integrated to make it more effective for long-term elephant conservation. Estimation of elephant numbers based on direct counts was first attempted by AsESG, Central India Task Force in May/June 1983 and came out with an estimate of 375 elephants (Chowdhury *et al.* 1985). Subsequently, in 1989, transects studies during the monsoon indicated a population of 500 elephants (Singh 1989). A comprehensive block count in 1994 estimated 491 elephants in the zone including 432 in Simlipal Tiger Reserve, 31 in Kuldiha WLS and 25 in Nato and Satkoshia RFs and 3 in Gorumahisani (Prusty and Singh 1994). This zone, if integrated, could provide protection to 550-600 elephants with a crude density of 1 elephant/5.3-5.8 km². This zone is remarkably well known for its biodiversity attributes available within the tropical semi-evergreen forests and moist deciduous forests. The well-wooded rolling plateau with deep folds of hills, interlaced with a network of perennial streams and rivers provide ideal habitat for elephants. The immediate management actions required in this zone are the reduction of hunting by the locals, eliminating ivory poaching, maintaining the corridor links with the Kuldiha and Hadgarh Sanctuaries with the South Simlipal Tiger Reserve, relocation of a few small hamlets from South Simlipal, and monitoring ferro-alloy mining activities in Hadgarh Sanctuary.

Satkosia-Baisipalli Complex (Zone 2): This zone is situated in the central part of Orissa covering two PAs – Satkosia Gorge Sanctuary (795.5km²) on the north of the Mahanadi River and Baisipalli Sanctuary (168.3km²) on the south of the Mahanadi River. An 800km² contiguous RF area available to the south of Baisipalli Sanctuary makes it possible to integrate the entire area into a larger landscape zone (comprehensively 1,763km²) for elephant conservation. A summer water hole count revealed a population of 100 elephants in Satkosia Gorge WLS by the Central India Task Force, AsESG (Chowdhury *et al.* 1985). Singh (1989) reports a population of 300-400 elephants both in Satkosia and Basipali WLS. The estimated population in this zone could be between

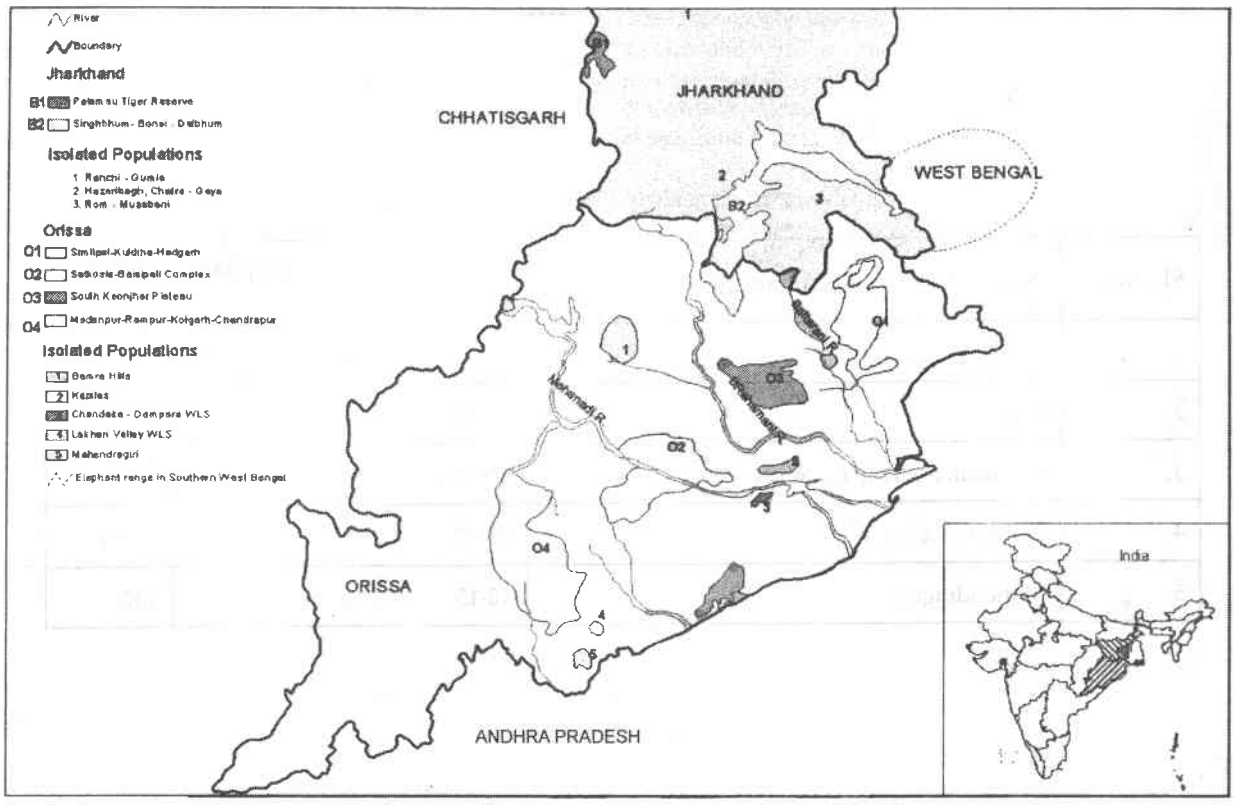


Figure 1 Elephanbt habitats in central India (Orissa, Jharkhand and southern West Bengal).

400-500 elephants with a crude density of 1 elephant/3.5-4.4km^2. Sal, in association with bamboo (*Dendrocalamus strictus*), in the northern tropical dry deciduous forest is the major component of elephant habitat. Water management in this dry deciduous habitat, making forestry operations more wildlife oriented, controlling cattle grazing and forest fire, and attention to cattle-borne diseases are the major issues for management. Habitat conversions of dense mixed forests with commercial monoculture plantations need to be reviewed for developing management priorities and actions.

South Keonjhar Plateau (Zone 3): This zone, with an area of about 2,600 km^2 includes Deogan, Ghatgan and Telkoi Ranges of the Keonjhar Forest Division (or FD) and Kamkhya east and west ranges of Dhenkenal FD in Orissa. No systematic estimation of elephant population has been made here. There could be 200–250 elephant in this zone, giving a crude density of one per 10-13 km^2. This zone does not have any PAs at present to enhance elephant conservation. Elephant habitat is mostly constituted with northern tropical moist deciduous forests. Land encroachment, mining and shifting cultivation practices are the major conservation problems in this zone.

Madanpur-Rampur-Kotgarh-Chandrapur (Zone 4): This zone in the Eastern Ghats covers the Civil Districts of Phulbani, Kalahandi, Koraput and Ganjam. Although a vast stretch of area (approximately 8,000km^2) is available in the three elephant bearing FDs of Balliguda, Kalahandi and Raigada, about 70–80 % area is under shifting cultivation that has badly fragmented the entire landscape. At present the Kotgarh Sanctuary is the only PA in this zone, covering an area of 399km^2. No systematic estimation of elephant population has ever been carried out here. Proposed status of two more Sanctuaries - Belghar and Subrnagiri is unclear. This zone could have 300-400 elephants. The crude density of elephant per unit area is very low, i.e., one per 27-36km^2. Elephant habitat in this zone is represented by northern tropical moist and dry deciduous forest. The northern portion of the elephant habitat is drier compared to the southern portion.

Isolated elephant habitats

Besides the above-mentioned four large habitats, there are five isolated, medium to small sized elephant populations in Orissa. The Bamra Hills contain a habitat constituted by two PAs, i.e., Khalasuni (116km^2) and Badrma (304km^2). Recently this area was identified as an Elephant Reserve for protecting some 100 elephants over an area of 500km^2. Other small and isolated elephant populations include, Kapilas, Chandaka-Dampara WLS, Lakhari Valley WLS and Mahendragiri (see Table 2). All these habitats need to be managed separately with stronger objectives of elephant population management.

Table 2. Isolated elephant populations in Orissa.

Sl. No.	Name of isolated elephant populations	Estimated elephant population	Habitat (km^2)
1.	Bamra Hills, (Kalhasuni and Badarma WLS	100-110	500
2.	Kapilas	40-50	129
3.	Chandaka-Dampara WLS	50-60	175.8
4.	Lakhari Valley WLS	50-60	185.5
5.	Mahendragiri	10-15	130

JHARKHAND

Large habitats

Palamau Tiger Reserve (Zone B_1): This zone has an area of nearly 1,250km² most of which comes under the umbrella of the Project Tiger. Population estimates of elephants through direct counts are an annual feature of Forest Department census in Palamau Tiger Reserve. This zone has an elephant population numbering between 100-125 animals giving a crude density of one per 10-12.5km². Threats to elephant population are few. However, people's antagonism towards the elephant for crop depredation, dealing with an occasional straggler group of elephants straying into adjoining areas, and the management of water in the habitat are the important issues for elephant conservation.

Singhbhum–Dalbhum–Bonai (Zone B_2): This zone includes three FDs – Saranda, Kolhan and Porahat of Singhbhum District of Bihar. Contiguous with this on the south are the Joda and Koira Ranges of Bonai FD of Orissa, and on the north, the Dalma WLS. At present there is only one PA in the zone, namely the Dalma WLS (193.2km²) where elephant numbers are estimated annually through waterhole counts by the Forest Department (Chowdhury *et al.* 1985). Datye (1995) estimated the population to be about 66 elephants in Dalma WLS. The comprehensive elephant habitat in this zone amounts to 2,900km² that could support a population of 350-450 elephants. Major management problems in this zone are: pollution and habitat degradation due to iron-ore mining; illegal forest felling; fragmentation of habitat; and tribal hunts. Shifting cultivation occurs in the Bonai Forest Division, Orissa. Replacing dense mixed forests with teak plantations needs to be reviewed. Among the recent developments, the canal layout of the Subernarekha Multipurpose Project might pose a barrier to the movement of elephants from Porahat in Singhbhum Forests to Dalma WLS which needs to be reinvestigated to mitigate the problem.

Isolated habitat/problem populations

There are two problem populations and one small population in the Rom-Musabani Forests south of the Subrnarekha River (see Table 3). The Hazaribagh–Chatra and Ranchi-Gumla are the stressed populations, which do not have any clearly discernible movement range. Habitat fragmentations in both these ranges are severe with extensive human population and biotic pressures. A national policy document for managing such dislocated populations on sub-optimum habitat needs to be developed.

Table 3. Isolated small and problem populations in Jharkhand.

S. No.	Name of isolated elephant populations	Estimated elephant population	Habitat (km²)
1.	Hazaribagh, Chatra and Gaya	43	>2,412
2.	Ranchi and Gumla	11	>1,510
3.	Rom-Musabani Forests (South of the Subernarekha River)	20-30	60

Southern West Bengal

The elephant population in southern West Bengal is made up by about 35-40 elephants migrating annually from Dalma WLS, Jharkhand, and 26 localized elephants in four sub-groups (Chowdhury *et al.* 1997). The habitat here is altered agriculture-dominated interspersed with revived forests through community efforts. The *Zamindari* land tenure system was major cause of forest destruction during pre-independent India.

Status of captive elephants

The status of captive elephants in the region has been documented and compiled by the Ministry of Environment and Forests. According to the information available, there are 15-20 elephants in captivity in Jharkhand, and eight in Orissa. In West Bengal, although there is a much larger number (110-120) of elephants in captivity, most of them are Government-owned and confined to northern West Bengal. In southern West Bengal they are brought if and when domestic elephants are required for tackling the marauding wild elephants, and in elephant captures. As in West Bengal, almost all the elephants in captivity in Orissa also belong to the State Forest Department. However, in Jharkhand, there are quite a number of privately-owned elephants. The registration process of all the privately-owned elephants has not been completed. Captive elephants belonging to the State Forest Department are relatively well looked after in all the three States. The Forest Department provides veterinary care to the elephants as and when it is needed.

Legal status of elephants and their habitat

As in other parts of India, elephants in this region are legally protected under the Wildlife (Protection) Act of 1972. However illegal poaching, electrocution and cases of poisoning need to be monitored. Annually about 14 elephants are being killed for ivory in Orissa, while in West Bengal about three elephants are killed per year and one per year in Jharkhand (Project Elephant 2001). Mohanty (2001) reports the death of 48 elephants between 1991-2000 from the Simlipal Tiger Reserve alone, of which 22 were confirmed cases of poaching. Furthermore, he points to the activity of an international gang of ivory poachers in Simlipal in 1993. The major vulnerable areas are the northern and central part of Orissa including Simlipal, Kapilas and Satkosia WLS. There is a single report of an elephant by the locals for meat in the Chandaka-Dampara Reserve in Orissa (Dash 1983). Cases of elephant killing by electrocution, based on the data from 1997-2001, indicate an average of 1-2 elephants/year in Orissa, followed by Jharkhand and West Bengal (Project Elephant 2001). Poisoning of elephants in the same reporting years has been known only from West Bengal at average rate of 1 elephant/ year. Most of the cases of electrocution and poisoning are retaliatory actions by people affected by elephant depredation.

Addressing elephant conservation policy issues for several small and fragmented elephant populations as described above remains a top priority. The current laws and regulations permit the capture of such isolated individuals. However, under these circumstances, there must be clear strategies to deal with the animals captured. There is a need to consider the demand for domesticated elephants elsewhere in the country. This needs to be integrated into the overall national planning.

Conservation problems and issues

Habitat fragmentation

Habitat fragmentation has been a major threat for the conservation of elephants in central India. In broader terms, the agents of forest fragmentation in northern part of the region are mines and mining activity, encroachments and conversion of lands for cultivation, human settlements and commercial forestry operations. In contrast to the situation in the north, the southern part of the region beyond the Mahanadi River has suffered largely from indiscriminate shifting cultivation (*jhum*), which has led to the fragmentation of forests in Phulbani, Balliguda, Raygada, Kalahandi, Paralakamedi, Koraput and Ghumsur south of Eastern Ghat where elephants occur. Repeated short cycle *jhumming* on the steep hill slopes, has washed away the topsoil and at many places, exposing the parent rocks. Both the reserve and protected forests are harmed in this way. Aggressive weeds such as *Eupatorium* and *Lantana* have taken over the elephant habitat, following repeated fires. In addition, the practice of growing teak on a commercial scale has also led to the replacement of the dense mixed forests containing several fodder plants for elephants. The affected areas are Kuldiha, Satkosia Gorge, Kapilas and Lakhari Valley Sanctuaries in Orissa, and Singhbhum Forests in Jharkhand.

Mines and mining

The northern region is important for mining. Large tracts of land in Keonjhar, Angul, Dhenkenaland, Jajpur Districts, Orissa, and Singhbhum District, Jharkhand, are under mining activity related to the extraction of iron-ore, copper, manganese, ferro-alloy, coal etc. An environment impact assessment (EIA) is very much needed in such areas where elephants also occur. A study carried out by the Wildlife Institute of India in Singhbhum forests has clearly shown the impacts of iron-ore mine discharges in polluting the Koina River. The high turbidity and TSS (total suspended solids) from an unregulated mine was one of the major reasons for the altered water quality of the Koina River resulting low utilization of the riverine forests (Singh and Chowdhury 1999). This suggests the need for a stronger monitoring of mining activities and their discharges to avoid ecosystem degradation and health impairment.

Tribal hunts

The entire Chotanagpur Belt and its adjoining areas including Simlipal Tiger Reserve has a major impact on the decline of wildlife due to annual tribal hunts prevailing in this region. However, elephant killing and poaching in particular is not known in any of the areas except for Simlipal Tiger Reserve. There were few cases of elephants being killed with bows and arrows or through poisoning and the subsequent removal of tusks in Simlipal Tiger Reserve.

Straying of elephants

During 1988 and 1989, long distance movements of 18 elephants were recorded from the Porahat FD to the adjoining of Gumla in Ranchi District, Jharkhand, from where they moved to Basia, Palcot, Raidih and entered in neighbouring State in Chattisgarh via the Jaspur Forests. After their rampages, the elephants reached the north Sarguja Forest Division via Kurog. From the Bihar border these elephants traveled 50-60km in Madhya Pradesh. Managing such straying herds of elephants is an issue that needs serious attention.

Human-elephant conflict

The human-elephant conflicts in agricultural areas are widespread and serious in the region. On the whole, crop depredations, property losses and human kills in a year are much more severe in West Bengal than Jharkhand and Orissa. Annual manslaughter by elephants, based on 10-year data in Orissa, is 17 per year (Project Elephant 2001). Sar and Choudhury (2001) studied the human-elephant conflict in Nyagarh FD and estimated crop and property losses. Other sensitive areas for such conflicts in Orissa are, Chandaka, Kapilas, Lakhari-valley, and Satkosia Gorge Sanctuaries and their adjoining areas. The major human-elephant conflict occurs in southern West Bengal where a group of 45-40 migratory elephants enters every year from Dalma WLS through Kankrajhore of West Midnapore FD. This phenomenon has been going on since 1987 with the revival of forest cover in south West Bengal due to Joint Forest Management activities.

During the stay of elephants for 5-6 months from September to February, they utilize the forest ranges of Hoomgarh, Garbeta, Goaltore, Nayabasat, Arabari, Lalgarh, Bankada, Joyapur, and Bishnupur in eastern Midnapore, Rupnarayan and Bishnupur Divisions. Besides the migratory elephants from Dalma WLS, there are four resident sub-populations, which remain throughout the year in southern West Bengal. The study carried out by Wildlife Institute of India under the West Bengal Forestry Project revealed that the majority of human kills occurred during the post paddy harvest season and with the advent of potato crops (Chowdhury *et al.* 1997). The bulk of human kills was the result of the resident populations (mostly constituted by males) rather than migratory ones. In Jharkhand, on average about 24 people are killed annually (Project Elephant 2001). This problem is on the increase mainly with the two problem populations mentioned above.

Past and present conservation measures

In 1969, an expert committee of Indian Board of Wildlife recognized the threat of ivory poaching as a factor for decimating elephant populations. With the advent of Wildlife (Protection) Act of 1972, elephants were included in the category of game under the Schedule II. The first recognition of endangered category of elephant came through CITES listing the species on Appendix I. The Asian Elephant Specialist Group (AsESG) was constituted in 1976 with four task forces to look into the status and distribution of elephants (Daniel 1980). Subsequently, in 1977 the Asian elephant was brought under the Endangered category of Schedule I of the Wildlife Act of 1972.

The Central India Task Force of the AsESG took up a detailed survey of elephants in Orissa, Jharkhand and in southern West Bengal. In 1985, a complete status survey of the elephants in Central India was carried out (Chowdhury *et al.* 1985). A national workshop on elephant management issues was organized in 1989 at the Wildlife Institute of India to consolidate the actions required for elephant conservation in the country. Authorities of all elephant-bearing States also participated in this meeting. In 1992 Project Elephant came into force with the objectives of protecting elephants, improvement of habitats and corridors, welfare of domestic elephants, public cooperation and support services. Within a decade, the Project provided assistance of 738 Lakh Indian Rupees to the three States of the region, which was 23% of total National contribution (Project Elephant 2001). This enabled the concerned States to strengthen their activities for habitat protection and management, corridors, anti-poaching, *ex-gratia* relief for conflicts, publicity, training and eco-development. With the support of Project Elephant, the States were able to declare five Elephant Reserves in central India, of which one was in Jharkhand, three in Orissa and one in southern West Bengal. All these reserves amount to a total area of 9,694km^2 of elephant habitat for the protection of 1,560 elephants in the region. Given the enormity of the task, the present investment of 500-600 Indian Rupees per km^2 is inadequate. Out of this investment, only a third is set aside for settling compensation claims in human-elephant conflicts.

Recommendations

Priorities for elephant conservation in this region include: linking and maintaining habitat contiguity through effective protection; removal of illegal settlements and creating conservation corridors; controlling and curbing tribal hunts; relocation of a few small settlements to other developed areas; habitat improvements through enriched plantations; minimizing human-elephant conflicts through tactical methods of erecting barriers; developing better monitoring and control on mining and pollution

activities; and developing a better land-use planning and coordination and eliciting people's participation for various programmes and activities.

The zone-wise recommendations are given below:

Zone O_1

The corridor between Kuldiha and Simlipal Tiger Reserve has to be restored by eliminating encroachments for marginal cultivation in the chicken neck. The Reserve Forests of Noto (63km²) and Gadsahi (40km²) have to be added to Hadgarh Sanctuary for increasing the effectiveness and integration with Simlipal Tiger Reserve.

Two villages, Jenabil and Barhakamra in southern Simlipal, should be relocated in the command area of the Kalo and Subernarekha Projects. With the available irrigation facilities, the tribal economic conditions will improve.

The annual tribal hunts which last for five months (January to May) need to monitored and controlled. There should also be an awareness campaign to highlight the plight of the elephants in this area.

The ferro-alloy mining inside the Hadgarh Sanctuary needs to be investigated and reviewed.

Forest management practices for fire suppression need to be intensified.

Zone O_2

The 800km² RF lying to the south of the Baisipali Sanctuary, needs to be integrated towards wildlife-oriented management by developing a comprehensive management plan.

No commercial plantations should be allowed at the expense of the indigenous flora.

Well-distributed water management needs to be developed in the entire zone.

An investigation for outbreaks of diseases among wildlife should be undertaken to improve the health of wildlife populations in the zone.

The Wildlife (Protection) Act of 1972 must be strictly enforced for controlling the use of fire arms within the prescribed radius of the Sanctuary boundary.

Silviculture practices for bamboo extraction must be made wildlife-oriented.

Zone O_3

There is a need for identifying a PA within this zone, as there is none at present.
People-oriented programmes need to be initiated for tackling land encroachments by marginal cultivators.

Existing mining activities need to be appraised and evaluated.

Zone O_4

The proposed Belghar and Subarnagiri Sanctuaries must be declared and established as has been suggested by the AsESG Central India Task Force.

People-oriented programmes need to be initiated to wean the local tribals away from their present practice of shifting cultivation.

Zone B_1

Priority to be given for controlling crop depredation and manslaughter by wild elephants in Betla and its adjoining areas. Effective barriers to deter the elephants entering croplands should be established.

Research on human-elephant conflict should be undertaken with the view to mitigating it.

Sensible policies for the use of water during the dry season needs to be adopted.

Zone B_2

There is a need for protecting and maintaining the corridor between Saranda FD on the south and the forest of Bonai in Orissa.

The forest corridor between the Porahat FD on the north and the Chandil Forest of Dalbhum FD should be protected and maintained.

The mining activities and their impact on the air, water, and soil need to be monitored. For aquatic ecosystem monitoring, TSS and turbidity as key parameters, must be determined regularly.

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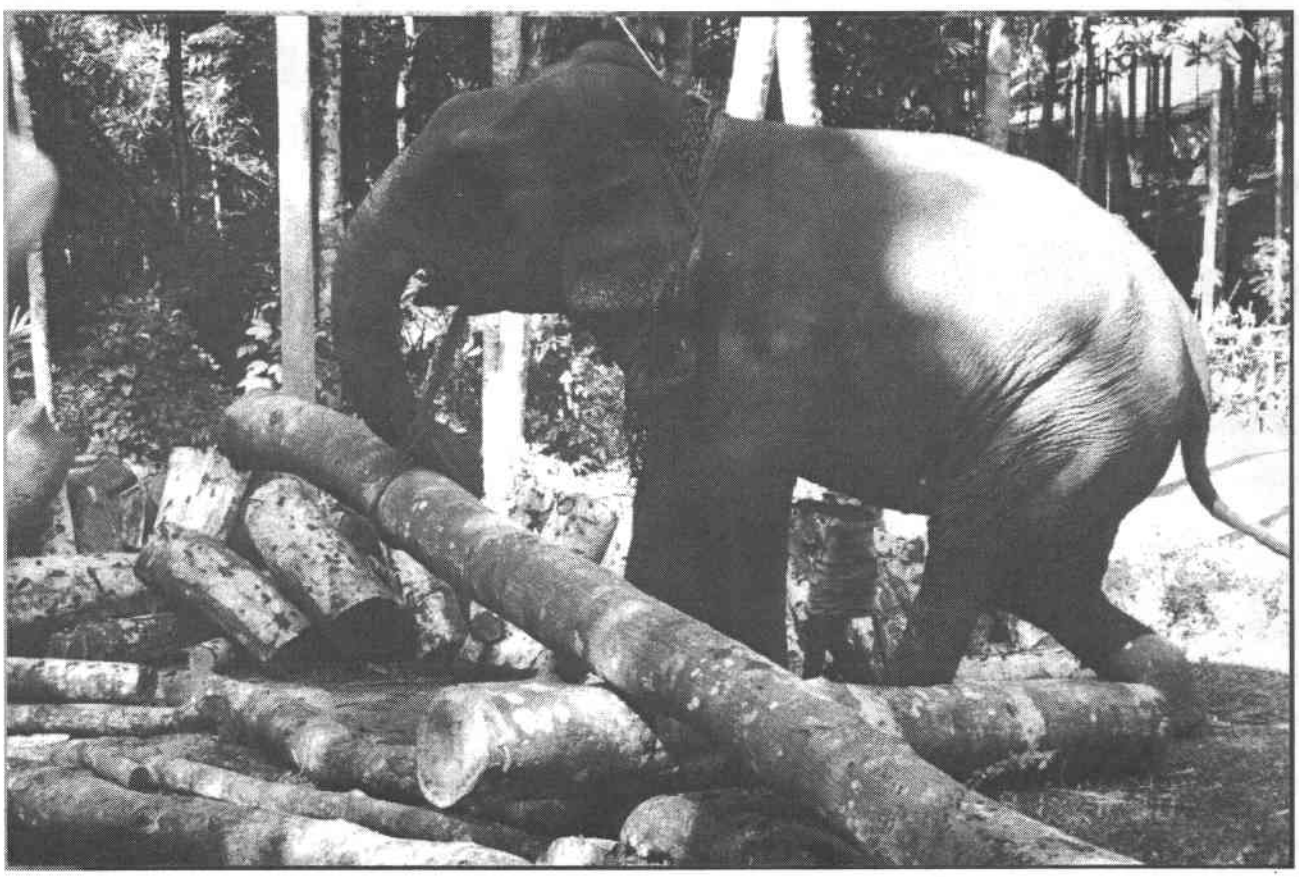
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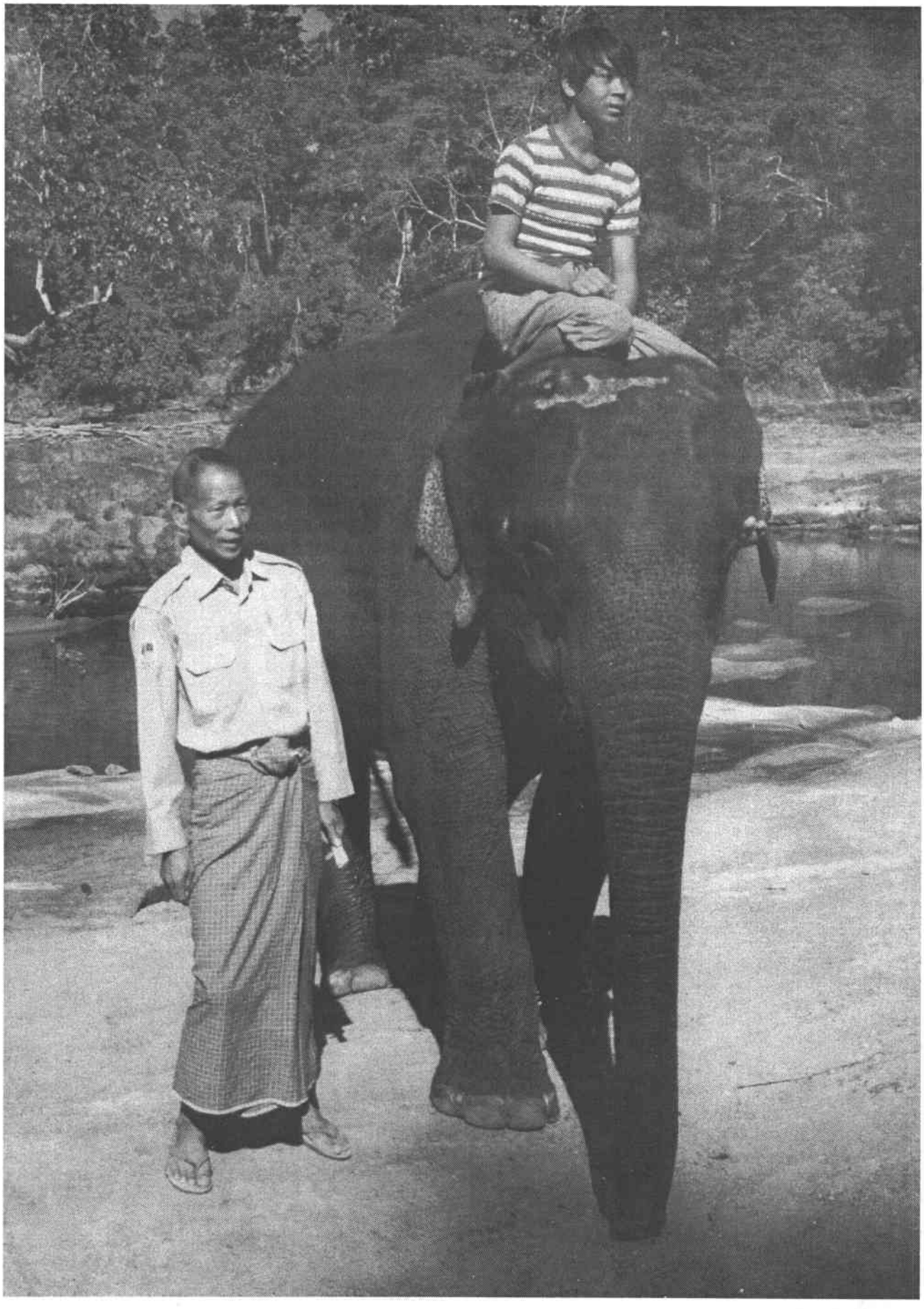


Photo: Richard Lair (Thailand)

Conservation of the Asian elephant in North-East India

Anwaruddin Choudhury and Vivek Menon

Introduction

North-east (NE) India comprises the States of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura (21°58'N to 29°27'N, 89°42'E to 97°24'E). The total area of this region is about 255,083km². The elephant habitat in NE India is contiguous with those in Bangladesh, Bhutan, Myanmar and Nepal. For the purposes of this description we should also add the three northern Districts (Darjeeling, Jalpaiguri and Cooch Behar) of the State of West Bengal whose elephant habitat is contiguous with the above region.

About a fifth of the known world population of the Asian elephant (*Elephas maximus)* occurs in this region. Although the general extent of its occurrence has remained almost the same for the past 35-40 years, expansion of human settlements and the consequent destruction of habitat, and poaching for ivory and wild meat have resulted in the decline of the wild population besides severely fragmenting the habitat.

Historical information on the elephant in NE India including capture and training is found in Gee (1964), Shebbeare (1958), Stracey (1963), and Barua and Bist (1995), while information on its status is found in Lahiri-Choudhury (1980), Jackson (1985), and Santiapillai and Jackson (1990). There is an interesting Assamese historical treatise on the elephants, titled *Hastividyarnava* – the manuscript of which was prepared in 1734 AD under the patronage of the Ahom King Siva Singha and Queen Ambika Devi. Brief accounts on a few specific areas of Assam, Arunachal Pradesh and Manipur are found in Choudhury (1991, 1992a,b, 1993a,b, 1995) and Meghalaya in Williams and Johnsingh (1996a,b). Some information is also found in synoptic works such as Sukumar (1989), Menon *et al.* (1997) and Menon and Kumar (1998). The distribution of the elephant in Assam has been mapped by Choudhury (1994, 1997a) while its status in Meghalaya has been dealt with by Lahiri-Choudhury (1980). A detailed account of its distribution, habitat and status in NE India with maps was published recently (Choudhury 1999a).

Physiographically, the region can be divided into five main components: the Himalaya in the north; the hill ranges of the east and south; the Meghalaya Plateau; the plains of the Brahmaputra River; and the Barak Valley. The climate of the region [except for the Himalaya, which may be termed as 'mountain' type (Singh 1976)] is of a tropical monsoon type with a hot wet summer and a cool dry winter. About 75% of the rain falls during the monsoon (May-September). Winter rains are not uncommon all over the elephant-country. The annual rainfall of the region varies from less than 1,000mm to more than 12,000mm. The south-facing slopes of the Meghalaya Plateau receive very heavy rainfall, often recording the highest in the world. Temperature generally ranges from 0°C in winter (minimum) in the high mountains of Arunachal Pradesh to 35°C in summer (maximum) in the plains of Assam.

NE India has diverse habitat ranging from tropical wet evergreen forests to snow-capped mountains. Tropical wet evergreen forests occur mainly in eastern and southern Assam, eastern Arunachal Pradesh, and in small patches in Nagaland, Manipur and Mizoram (up to 900m a.s.l. in the Himalaya, and 1,500m a.s.l. in southern areas). Tropical semi-evergreen forests are widespread in the region especially in the *bhabar* tract of central Assam. A large part of the lower Brahmaputra Valley, the *duars* of northern Bengal and foothills of Meghalaya Plateau is covered by tropical moist deciduous forest. The higher altitudes of the Himalaya, Mishmi Hills, and other hill ranges and the top of Meghalaya Plateau have subtropical forest. Broad-leaf forests generally occur between 800 and 1,900m elevation while conifers are found usually between 1,000 and 1,800m a.s.l. in the Himalaya. In the Barail Range and Manipur subtropical broadleaf forest occurs above 1,200m a.s.l. while in Mizoram it is found slightly higher up to an elevation of above 1,500m. Farther up the Himalaya, and Mishmi Hills occur the temperate forest, both broadleaf (between 1,800 and 2,800m a.s.l.) and conifers (between 2,800 and 3,500m a.s.l.). The latter forms the highest known habitat for elephants in NE India (Choudhury 1999a).

Riparian fringing forest occurs along the banks of most of the larger hilly rivers and streams while mixed secondary jungles are man-made and are found everywhere. Swamp forest and wet savannah grasslands form an important habitat type with the bulk in the floodplains of the Brahmaputra River and its major tributaries, and in the *terai* belt. The major grasslands are in the Protected Areas (PAs) of Jaldapara in West Bengal, Kaziranga, Manas, Dibru-Saikhowa and Orang in Assam, D'Ering memorial and in Dibang Reserved Forests in Arunachal Pradesh (Choudhury 2000).

The human population in NE India is over 42 million, with 26.6 million in Assam alone. The density varies from 340 persons per km² in Assam to 13 per km² in Arunachal Pradesh. About 80% of this population lives in rural areas with agriculture as its main occupation. The population was about 19.5 million in 1971, and has almost doubled in three decades. In case of Nagaland, the increase was phenomenal, from 0.5 million in 1971 to almost 2 million in 2001.

Dense forest cover varies significantly between the states, from 69% in Arunachal Pradesh to 18.5% in Assam. Overall, 95,285km^2 or 37.3% of the total geographical area of the region is under dense forest while 68,514km^2 or 26.8% was open and degraded forest (FSI 1999). In addition, about 3,050km^2 of the northern districts of West Bengal, or about 24% of the geographical area of these districts, is also under forest cover. The position of forest cover in individual states is listed in Table 1.

There are at least 64 notified national parks and wildlife sanctuaries (WLS) in the region covering about 6% of the total geographical area of the region. The Asian elephant occurs in 40 PAs. However, only about a fourth of the known elephant habitat is under these PAs (Choudhury 1999a).

Table 1. Forest cover in different States of NE India (FSI 1999).

State / Region	Dense forest (km^2)	% of dense forest to total geographical area	Open forest (km^2)	% of open forest to total geographical area
Arunachal Pradesh	57,756	69.0	11,091	13.2
Assam	14,517	18.5	9,171	11.7
Manipur	5,936	26.6	11,448	51.3
Meghalaya	5,925	26.4	9,708	43.3
Mizoram	3,786	18.0	14,552	69.0
Nagaland	5,137	31.0	9,027	54.4
Tripura	2,228	21.2	3,517	33.5
West Bengal	3,051*	24.0*	n/a	n/a
TOTAL*	**98,336***	**37.3**	**68,514**	**26.8**

*The figures for West Bengal refer to total forest cover for three northern districts (see text). Total area under dense forest and its percentage are thus slightly over-estimated.

Status and distribution of elephants

The elephants in NE India together with those in Bhutan, Bangladesh, Myanmar and Nepal had an almost continuous distribution at the turn of the century. Currently, the elephant is discontinuously distributed in about 16 discrete populations/sub-populations (Choudhury 1999a; Choudhury in press) although ecologically many of these may be considered splinter groups. Six elephant groupings are large enough and distinct enough to be referred to as populations.

Currently, the elephant range extends from the eastern border of Nepal in northern West Bengal through western Assam along the Himalaya foothills up to the Mishmi Hills and eastern Brahmaputra plains of Assam and Arunachal Pradesh (Fig. 1). Then it extends into the eastern Arunachal Pradesh, the plains of upper Assam and the foothills of Nagaland. Further west, it extends up to the Garo Hills of Meghalaya through the Khasi Hills, parts of the Brahmaputra plains and Karbi Plateau. Elsewhere in the south, only scattered populations survive.

The major populations and their splinter sub-populations

Northern West Bengal [WEST BENGAL]

The distribution of elephants in the northern West Bengal region begins close to the border with Nepal along the Mechi River, and extends eastward along the Himalaya foothills in the *duars* to the border with Assam State along the Rydak River (Barua and Bist 1995). The habitat is dissected in a north-south direction by several rivers, chief of them being the Teesta and Torsa, and human settlements, cultivation and tea estates; the result is a highly fragmented landscape. From west to east the important Forest Divisions (FDs) and PAs for elephants are the Kurseong Division, Mahananda Sanctuary, Baikanthapur Division, Kalimpong Division, Chapramari Sanctuary, Gorumara National Park,

Cooch Behar Division, Jaldapara Sanctuary and the Buxa Tiger Reserve. The last mentioned reserve is the largest and most compact block of forested habitat in this region, and hence vital for the survival of elephants (Sukumar *et al.* 2003). The distribution of elephants covers about 2,000km² of this region. Overall, there has been a noticeable increase in the elephant population of this region since 1980. The most recent estimates of the elephant population here range from 292 (census figures of West Bengal Forest Department) to about 450-500 based on indirect count (dung density) estimates (Sukumar *et al.* 2003).

North bank of the Brahmaputra [ASSAM and ARUNACHAL PRADESH]

This is a large population extending from western Assam through the Himalaya foothills and the *bhabar-terai* or *duar* tract touching southern Bhutan, northern Assam and Arunachal Pradesh. In eastern Assam, the range also covers part of the floodplains of the Brahmaputra and the Lohit Rivers. This long range (about 600km) is almost continuous; the elephants are able to move across the few gaps easily. Towards the west, this population is contiguous with those of northern West Bengal. Although largely restricted to the north bank of the Brahmaputra in the easternmost part, the pachyderms regularly cross over to the Dibru-Saikhowa National Park on the south bank. This population was separated from the nearest population (South bank-eastern areas) only in the 1970s due to clearing of a strip of land (about 20km wide) for cultivation and habitation in Dibang Valley District of Arunachal Pradesh (Choudhury 1995).

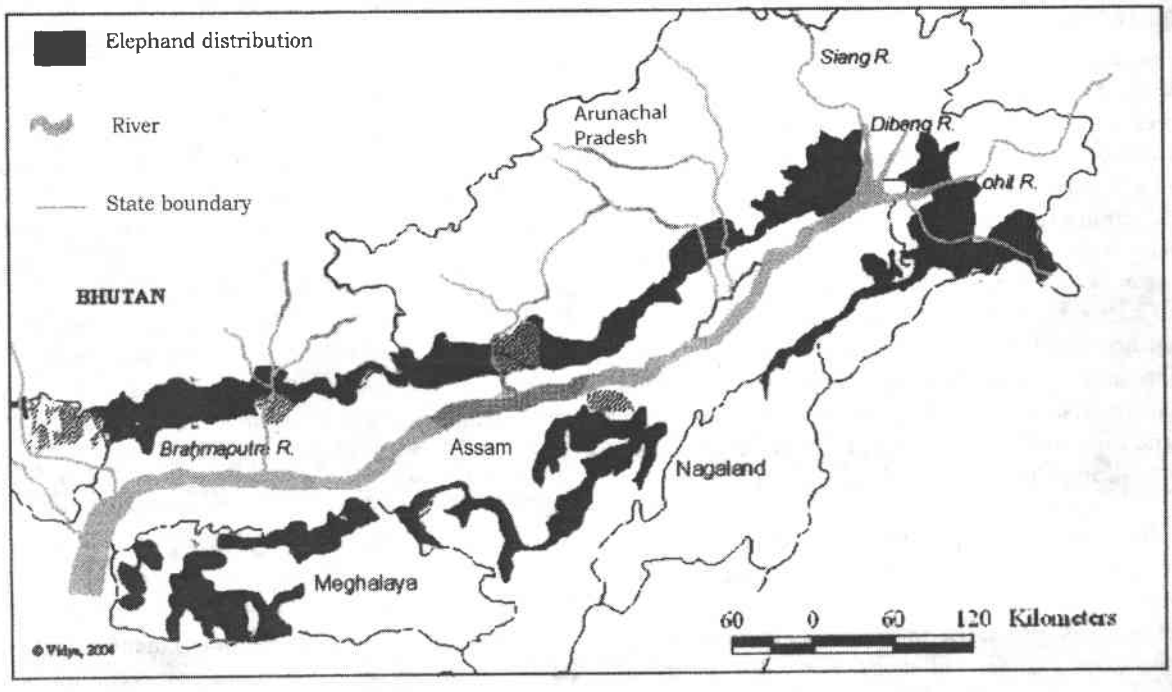
The area covered by this population includes parts of Kokrajhar, Bongaigaon, Barpeta, Nalbari, Kamrup (northern areas), Darrang, Sonitpur, Lakhimpur, Dhemaji, Dibrugarh and Tinsukia Districts of Assam; and West Kameng, East Kameng, Papum Pare, Lower Subansiri, West Siang, East Siang and Lower Dibang Valley Districts of Arunachal Pradesh.

Tropical wet evergreen forest covers the eastern areas as a narrow strip, especially along the foothills of the Himalaya from near the tri-junction of Assam, Arunachal Pradesh and Bhutan to near Pasighat and at the foot of Mishmi Hills. Tropical moist deciduous sal (*Shorea robusta*) forest occurs in parts of western Assam. Tropical semi-evergreen habitat and small pockets of marshy areas with *Alpinia allughas* herbs are found all over the range. Wet savannah grassland with various species of elephant-grass (height up to 5m), a favored and critical habitat of the elephant occurs in patches largely within the PA network, the largest being in Manas National Park of Assam (about 250km²). Other such grassland pockets are found in Barnadi Sanctuary, Kobo Chapori and parts of Dibru-Saikhowa National Park (Assam) and D'Ering Memorial Sanctuary and Dibang Reserved Forest (Arunachal Pradesh). In parts of Dibru-Saikhowa and in Jamjing Reserved Forest, swamps dominated by *Salix tetrasperma*, reed beds dominated by *Arundo donax* and seasonal marshes form an important elephant habitat.

The approximate total habitat available for this population is about 7,900km², the break-up being: Assam 3,400 km², and Arunachal Pradesh 4,500 km². The contiguous habitat in northern West Bengal is about 1,500 km² and Bhutan is about 1,600 km². The estimated number of elephants in this population is 2,700–3,000 (for details and source, see Table 2).

South bank of the Brahmaputra - eastern areas [ASSAM,

Fig. 1. Elephant distribution in North - East India



ARUNACHAL PRADESH and NAGALAND]

This population extends from the base of the Mishmi Hills through Lohit Valley, Dapha Bam Range, plains of upper Assam to the foothills of the Naga-Patkai Ranges. This population became separated from the north bank during the seventies (Choudhury 1995) and from the south bank-central area in the early 1980s (Choudhury 1999a).

District-wise, this population covers Lower Dibang Valley, Lohit, Changlang and Tirap in Arunachal Pradesh, Tinsukia, Dibrugarh, Sivasagar (Sibsagar), Jorhat and Golaghat in Assam, and Mon, Tuensang, Mokokchung and Wokha in Nagaland.

A large part of the range of this population is covered by tropical wet evergreen rain forest, while tropical semi-evergreen (partly degraded) occurs in patches towards west, along Naga foothills. *Dipterocarpus macrocarpus*, a tall dipterocarp, dominates the vegetation type. Some of the finest remnants of rain forest areas of the Indian sub-continent are found in this area, especially in Namdapha National Park of Arunachal Pradesh and Upper Dihing (west block) and Joypur Reserved Forests of Assam.

The approximate total habitat of this population is 4,500km^2, the break-up being: Assam *c.* 1,100km^2, Arunachal Pradesh *c.* 2,900km^2, and Nagaland *c.* 500km^2. The estimated number of elephants in this population is 1,100-1,200.

South bank of the Brahmaputra - central areas [ASSAM and MEGHALAYA]

This important elephant population extends from Kaziranga National Park through the Karbi Plateau, parts of the central Brahmaputra Plains, basin of the Diyung River to the foot of the Meghalaya Plateau in Assam and Meghalaya. Wide gaps have already been formed in this population although somehow, the elephants have maintained their traditional movement. The population has become separated from the south bank-western population due to expansion of Guwahati City, the capital of Assam, clearing of forest for *jhum* and increased human habitation along the National Highway No. 40 connecting the two State capitals, Shillong (Meghalaya) and Guwahati (Assam). District-wise, this population occurs in Golaghat, Karbi Anglong, Nagaon, North Cachar Hills, Morigaon and Kamrup in Assam, and Ri-Bhoi and Jaintia Hills of Meghalaya. However, stragglers and even herds often wander into Sonitpur District of Assam (usually from Kaziranga National Park) and once to East Khasi Hills District (almost at the edge of Shillong City) of Meghalaya.

The habitat in this range is tropical semi-evergreen in its eastern extremities and moist deciduous (mainly sal) in the southern and western parts. Evergreen forest occurs in patches, especially along the streams. Various species of bamboos are abundant all over the area. Large patches in the deciduous biotope have been converted into teak (*Tectona grandis*) plantations.

In Kaziranga National Park, which supports a very dense elephant population, especially in winter, the habitat is mostly tropical wet savannah grassland with scattered patches of light woodland. The savannah contains tall elephant grass including *Arundo donax*, *Erianthus ravennae*, *Imperata cylindrica*, *Phragmites karka*, *Saccharum arundinaceum*, *S. procerum*, *S. spontaneum*, *Themeda arundinacea*, etc.

The approximate total habitat in this range is 5,000km^2, the break-up being: Assam *c.* 4,500km^2 and Meghalaya *c.* 500km^2. The estimated number of elephants in this population is 2,900-3,000.

South bank of the Brahmaputra - western areas [MEGHALAYA and ASSAM]

A significant elephant population exists in the western areas of the south bank of the Brahmaputra River covering Meghalaya and a small part of Assam. This population extends from near Guwahati, the capital city of Assam, through the foot of the Meghalaya Plateau covering the Garo and Khasi Hills. District-wise, it covers Kamrup (southern areas) and Goalpara in Assam, and Ri-Bhoi, West Khasi Hills, East Garo Hills, West Garo Hills and South Garo Hills, all in Meghalaya (Marak 2002). Occasional seasonal range of this population also covers small areas of Bangladesh (northernmost areas of undivided Mymensingh District) (Choudhury 1999a).

Most of the habitat of this population is tropical moist deciduous (towards the north) and tropical semi-evergreen (towards the south). Tropical wet evergreen forest occurs along the narrow river-valleys especially in the south-facing canyons. The deciduous forests of the northern slopes are dominated by *Shorea robusta*. Small and scattered patches of grassland occur in different areas of Meghalaya Plateau, especially in the Balphakram National Park, the most important of the existing Protected Areas here. Protected Areas constitute only 1.4% of the geographical area of Meghalaya. A large area of forest in Meghalaya designated as Unclassed Forests rests with the Autonomous District Councils of Khasi, Garo and Jaintia Hills. These are mostly under *jhum* or shifting cultivation.

The approximate total habitat available for this population is about 6,700km^2, the break-up being: Assam 700km^2 and Meghalaya 6,000km^2. The estimated number of elephants in this population is 2,800-3,000.

Dhansiri-Intanki [ASSAM, NAGALAND and MANIPUR]

This isolated but viable population covers part of Karbi Anglong District of Assam and Dimapur and Kohima Districts of Nagaland. In Karbi Anglong, the elephants of this population are distributed in Dhansiri and Daldali Reserved Forests while in Nagaland; it is confined chiefly

to the Intanki WLS. In Manipur, a small number of elephants occasionally, but almost annually, cross over from Nagaland to Senapati District. This population was separated from the South Bank - Central Population by the Diphu-Lumding road and subsequent settlements, *jhum* and teak plantations. The habitat in this range is tropical semi-evergreen in eastern areas and tropical moist deciduous in western areas. Large stretches of bamboo breaks are found in Daldali Reserved Forest. Patches of Teak plantations and secondary scrub are also found. The habitat used by this population is about 1,050km^2, the break-up being: Assam, *c.* 800 km^2 and Nagaland, *c.* 250 km^2. The estimated number of elephants in this population is 300 – 350.

The minor populations and their splinter sub-populations

Barail - Jaintia Hills [ASSAM and MEGHALAYA]

About 35-40 elephants, now scattered, occur in the southern faces of the Barail Range of Assam and Jaintia Hills of Meghalaya. The Barail population in Cachar was extirpated in late 1998 (Choudhury 2001) and now only animals on the Jaintia Hills are surviving with only an occasional straggler in Cachar near its border with former. The link between Jaintia Hills with that of the south bank-western population ceased at least four and half decades back due to clearing of forests for settlement and cultivation in the northern areas of Sylhet (Bangladesh) while very steep slopes made it difficult for the animals to move through southern Khasi Hills. The main habitat type of this population's range is tropical wet evergreen and semi-evergreen forest with bamboo breaks.

Karimganj [ASSAM and TRIPURA]

A small herd of nine elephants occurs in Tilbhum, Longai and Patharia Hill Reserved Forests of southern Assam, adjoining area of Tripura and Bangladesh (Sylhet area). The link with the nearest group (Hailakandi) ceased around the mid-1970s (Choudhury 1991). The habitat in the range is mostly semi-evergreen with patches of teak plantations and stretches of bamboo. The total area of the habitat is *c.* 140km^2, the break-up being, Assam *c.* 80km^2, Tripura *c.* 20km^2 and Bangladesh *c.* 40km^2.

Hailakandi [ASSAM]

Only two individuals, a mother and her grown-up calf were left in the Katakhal Reserved Forest of Hailakandi District in southern Assam in 1996-1997. However, a small group of 3-4 joined them in late 1997 from an unknown destination only to disappear again (A. Majid Choudhury pers. comm.).

The habitat type is mostly tropical evergreen and semi-evergreen with abundant bamboo.

Laokhowa-Burhachapori [ASSAM]

A small population of 10-15, which increases to >20 during the paddy season, ranges in two adjacent reserves, Laokhowa WLS of Nagaon District and Burhachapori WLS of Sonitpur District in central Assam. The main link of this population was with those of Kaziranga National Park and Bagser-Kukurakata Reserved Forests, however, due to clearance for cultivation and habitation, and development of a major road with a long bridge across the Brahmaputra River, the movement has virtually ceased except for some during the paddy season. The habitat type is wet savannah grassland with deciduous and semi-evergreen woodland.

Orang [ASSAM]

An interesting all-male group of 6-7 elephants occurs in this small park of Darrang and Sonitpur Districts of central Assam. These elephants move about singly or as *maljurias* (bachelor duos) and breed freely with the captive female elephants stationed at the national park. The habitat type is wet savannah grassland with tall elephant grass and patches of deciduous woodland and some marshy areas. The total area of the range is *c.* 80km^2.

Amcheng [ASSAM]

About 30-40 elephants are found in Amcheng Hill Reserved Forest and adjacent areas of Kamrup District, very close to Guwahati City. These elephants were part of the larger south bank-central population but are cut off by National Highway 37 and clearance of forest and subsequent settlements on both sides of the highway (Choudhury 1985). The habitat type is tropical semi-evergreen and moist deciduous with bamboo.

Hollongapar (Gibbon Sanctuary) [ASSAM]

A group of 10-15 elephants is pocketed in the 19km^2 Gibbon [Hollangapar] Sanctuary of Jorhat District. This population was part of the larger south bank - eastern areas population but habitat loss between it and Desoi Valley forests near the Assam-Nagaland border has isolated it. The habitat type is largely semi-evergreen with evergreen trees.

East Manipur [MANIPUR]

A group of around 50 elephants occurs in the Anko Range on the Indo-Myanmarese border in Manipur. District-wise, this range falls in Ukhrul and Chandel. This population is continuous with those of the Somra Tract of Myanmar (Burma). Within India, this population occurs in two disjunctive parts; however, the habitat in Myanmar is contiguous and hence, are treated as one population. The habitat type is tropical semi-evergreen and moist deciduous. The total area of the habitat, i.e., potential elephant range is about 250km^2.

Tripura and northwest Mizoram [TRIPURA and MIZORAM]

Another group of around 50 elephants occurs in the forests of Tripura and north-west Mizoram. This population was continuous with those of the Chittagong Hill Tracts of Bangladesh. These elephants are now concentrating mostly in the PAs such as Gumti WLS in Tripura and Dampa Tiger Reserve in Mizoram. The forest type is of tropical semi-evergreen with large stretches of bamboo. The area of the total elephant range is *c.* 2,100km^2, the break-up being: Tripura *c.* 1,600km^2 and Mizoram *c.* 500km^2.

South Mizoram [MIZORAM]

Recent surveys have confirmed the presence of two small splinter groups of eight animals in the Ngengpui WLS of the Lawngtlai District and two to three in the Palak Dil area of Saiha District of Mizoram (Choudhury in press). The forest type is tropical evergreen with some fine tracts of mature primary forest dominated by *Dipterocarpus turbinatus*. The area of the total elephant range is *c.* 300km^2.

Table 2 Habitat availability and populations/sub-populations of wild elephants in NE India.

Table 9.2. Habitat availability and populations/sub-populations of wild elephants in NE India.

Name of the population/ sub-population	Approx. potential habitat in km^2	Notified Protected Area in km^2	Estimated number of elephants	Remarks
Northern West Bengal	2,000	1,276	300 - 500	The lower estimates of elephant population are from the census of the forest department in 2002, while the higer estimates are based on Sukumar *et al.* (2003). Some of the differences could be possibly due to in flux of elephants into northern Bengal from western Assam.
North bank of the Brahmaputra	7,900	3,137	2,7000 - 3,000	2,799 estimated during joint census by the Forest Departments in Assam and Arunachal Pradesh in 1993; c.280 in north Bengal; additional 1,600km^2 of habitat in Bhutan (Choudhury 1999a).
South bank - eastern areas	4,500	2,270	1,100 - 1,200	1,150 estimated during joint census by the Forest Departments in Assam and Arunachal Pradesh in 1993; >50 in Nagaland (Choudhury 1999a).
South bank - central areas	5,000	835 [+376*]	2,900 - 3,000	2,950 estimated during joint cernsus by the Forest Departments in Assam and Meghalaya in 1993 (Choudhury 1990a).
South bank - western areas	6,700	418	2,800 - 3,000	3,001 estimated during joint census by the Forest Departments in Assam and Meghalaya in 1993 (Choudhury 1990a).
Dhansiri-Intanki	1,050	207	300 - 350	232 estimated during census by the Forest Department in Assam in 1993; 141 counted during a census by the Forest Department in Nagaland in 1978; maximum possible in the entire Dhansiri-Intanki area is 4100 elephants (Choudhury 1999a).
Barail-Jainta Hills	150	0	35 - 40	37 estimate d during joint census by the Forest Departments of Assam and Meghalaya in 1993 (Choudhury 1999a). Barail populaiton extirpate; only Jaintia Hills survice.
Karimganj	140	0	9	8 counted during census by the Forest Department of Assam in 1993 (Choudhury 1999a).
Hailakandi	80	0	1 - 2	2+ in Choudhury (1999a).
Laokhowa-Burhachapori	110	114	10 - 15	13 estimated during census by the forest Department of Assam in 1993 9Choudhury 1999a).
Orang	80	79	6 - 7	10 estimated including Singri Hills RF during census by the Forest Department of Assam in 1993 (Choudhury 1999a).
Amcheng Hill	80	0	30 - 40	36 estimsyrf during census by the Forest Department of Assam in 1993 (Choudhury 1999a).
Hollongapar (Gibbon Sanctuary)	20	21	10 - 15	12 estimated during census by the Forest Department of Assam in 1993 (Choudhury 1999a).
Eastern Manipur	500	185	<50	Choudhury 1999a.
Tripura-NW Mizoram	2,100	870	<50	194 estimated in Choudhury (1999a).
South Mizoram	300	110	11+	Forest Department of Mizoram
Total	31,600	9,948	10,300 - 11,300	Figures have been rounded.

* 376km^2 have been added to Kazirang as the 6th addition but a case has been filed in Gauhati High Court against it.
# In many Protected Areas only a part is suitable for elephants.

NB:The census of 1993 jointly undertaken by the Forest Deparments of Assam, Arunachal Pradesh and Meghalaya has been taken although there were subsequent estimates. This census was done elaborately and many of the ex-ahouts and phaandis were also involved besides NGOs. The later exercises were not done jointly and also not in the same year. A similar joint exercise was conducted in March 2002.

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9.3 Conservation problems and issues

The following is a summary of the conservation problems and issues that pose a threat to the survival of the elephant populations of NE India.

Habitat destruction

Habitat destruction through logging, encroachment, *jhum*, and monoculture forest plantation is a major threat to the survival of the elephants. The forest cover in NE India is disappearing at an alarming rate. More than 1,000km² of forest were destroyed annually in the 1970s and 1980s (derived from data from the National Remote Sensing Agency). The alarming decrease in forest cover is evident from examples such as Meghalaya where the dense forest cover has declined from 33.1% in 1980-1982 (National Remote Sensing Agency, Hyderabad) to 18% in 1993 (FSI 1997). In just two years, from 1989-1990 to 1991-1992, Arunachal Pradesh has lost 334km² of dense forest (FSI 1993, 1995). In the latter half of the 20th century, more than 2,200km² of prime elephant habitat in Assam have been cleared for tea plantations alone (Choudhury 1999a). Some of the important reasons were:

Logging

Both legal and illegal logging has affected the elephant habitat all over the region. There are extreme examples such as Disoi Valley, Tiru Hill and Geleky RFs in eastern Assam where virtually no forest of any significance is left.

Expansion of *jhum*

In the hilly areas, *jhum* (shifting or slash-and-burn cultivation) is an important cause for loss of elephant habitat. In Manipur, *jhum* covers more than 1,800km² or 8.2% of the total geographical area. Even in the hilly areas of Assam, the area under current *jhum* is more than 2,600km².

Unplanned clearance for human settlements

The ultimate cause of habitat destruction is the very rapid growth of the human population; more than 500,000 people are added annually to NE India. As a very high percentage of population (*c.* 84.5%) lives in rural areas with farming as the main occupation, the large-scale destruction of forest and wetland seems inevitable.

Encroachment

Three Reserved Forests (RFs) in Sonitpur District of Assam illustrate the problem of encroachment in elephant habitats. In Balipara RF more than 100km² of 188km² is under encroachment and forest villages. There is also an extreme case, in Gohpur RF, where almost the entire forested area of 133km² in under encroachment and forest villages. Almost the entire 900km² of rainforest, comprising Nambor (south block), Diphu, and Rengma RFs in Golaghat District (Assam), is badly degraded due to the border problem with Nagaland, and subsequent felling and encroachment (Choudhury 1999b); this happened in the 1970s and 1980s.

Developmental projects

Construction of roads and railways through forests has caused the death of many elephants. As recently as November 2001, at least seven elephants died in collision with a train in Tinsukia District of upper Assam. Large-scale, unplanned bamboo harvesting for two large paper mills (Jagiroad in Morigaon District, and Panchgram in Hailakandi District of Assam), and oil mining and exploration in upper Assam and adjoining areas of Arunachal Pradesh, have also opened up large forested areas.

Poaching and trade

Elephants are poached in NE India for tusk and meat. Adult and sub-adult males are targeted for meat irrespective of sex or age. Although the exact number of elephants poached in the region is not known, available records show that at least 150 animals were killed between 1987 and 1997. The worst record in a single year was 30 elephants killed in Meghalaya in 1995.

At present, poaching of tuskers is serious along the Assam-Arunachal Pradesh border (especially Lakhimpur-Dhemaji and Papum Pare, Lower Subansiri-West Siang sectors), the Assam-Nagaland border, eastern Karbi Anglong, and the Garo Hills (see Table 3).

Although the ivory trade is the main motivation of poachers, for many hill tribes elephant meat is a delicacy. While some wait for natural and accidental death of elephants, others kill them deliberately for food. Major tribes fond of elephant meat are, the Nagas (all tribes), Kukis (all tribes including the Hmars), Mizos (or Lushais), Nishis (or Dafflas), Adis (or Abors), Chakmas and Dimasa Kacharis. There are also instances when Assamese settlers have been known to eat meat, such as that in February 1993 when an immature elephant that died due to accidental electrocution in Upper Dihing (west block) RF of Assam was eaten. Poaching has played a key role in decimating the elephant population in parts of North Central Hills, almost all of Mizoram,

the bulk of Manipur, parts of Nagaland, and the southern Assam Districts of Cachar, Hailakandi and Karimganj (Choudhury 1999a).

Methods of poaching

Shooting with rifles and automatic guns is the most widely-used method although occasionally, muzzle-loaders are also used. Killing elephant with poisoned arrows and spears is still practiced, although with the easy availability of modern firearms such primitive methods survive only in some areas. Traps made of spears including 100mm galvanized pipes filled with sand (for weight) and pointed at one end are in use in Garo Hills and western Khasi Hills of Meghalaya. These 'spears' are hung high (4-6m) so as to penetrate deeper resulting in death of the elephant. Often, tips of such spears are poisoned. Pits are also used in different areas, where pits 2m deep are dug where some spears or pointed bamboo are struck at the bottom. Such pits are usually dug along known elephant-trails and are covered with vegetation. In 1987, the Dimasa Kacharis of N.C. Hills killed one elephant in this way. Such killings have also been reported from southern Garo Hills area.

Quite a few elephants have died of electrocution that includes both accidental as well as deliberate, i.e., poaching. In Kaziranga National Park and Pabitora WLS, this method is occasionally used by the poachers to kill rhinos. The only case where deliberate electrocution of elephants was suspected was in Garo Hills of Meghalaya where an entire group of seven animals was electrocuted in 1995.

Trade in elephant parts

Trade in elephant products is largely centered on ivory, although wild meat and other parts often form an insignificant amount. Ivory craft is an age-old practice and originally thrived mainly on the raw materials from naturally dead animals or captive elephants. In India the main use of ivory was for the making of ornaments such as bangles, rings, ear-rings and bracelets, artifacts such as toys, statues, sculpture, chess pieces, combs, etc. Recently, the ivory trade has been fuelled by the demand in the Far East for *hankos* (signature seals) and *netsukes* (small carved figurines). Most of the ivory is smuggled out and domestic trade in ivory is negligible in the NE India. In parts of NE India, elephant meat also forms part of the trade. However, it is mostly for domestic consumption. There are recent instances of dried meat being taken in trucks from Garo Hills, West Khasi Hills and Ri-Bhoi areas of Meghalaya to Mizoram. Unreported local trade is prevalent in parts of Nagaland and Arunachal Pradesh. Other uses of elephant products include legs, which are made into sitting stools.

The main trade routes of elephant products inside the north-east and those leaving the region are listed in Table 4.

Table 3. Main recorded areas of poaching.

Name of Area	State
Balpakram NP, Siju WS and adjacent areas of South Garo Hills and West Khasi Hills	Meghalaya
Manas NP and adjacent forests of Bongaigaon and Kokrajhar Districts	Assam
Nambor (north and west blocks) RFs of Karbi Anglong and Golaghat Districts	Assam
Barnadi WS, Nanoi Range and adjacent areas of northern part of Darrang District	Assam
Dulung, Kakoi and Ranga RFs of Lakhimpur District and Panir RF and Doimukh proposed RF of Papum Pare District	Assam and Arunachal Pradesh
Gandachara Sub-division of South Tripur District	Tripura
Abhoypur, Dilli and Geleky RFs of Sibsagar District and adjacent areas of Tirap, Mon and Mokokchung Districts	Assam, Arunachal Pradesh and Nagaland
Northern parts of Karbi Anglong District	Assam
Wokha District	Nagaland
Intanki WS of Kohima District	Nagaland

Illegal capture

Although not common, elephants are illegally captured in the region. There were two recorded cases of single individuals captured in 1987 and 1993 from a small herd in Katakhal RF of Hailakandi District. More audaciously, in 1992 a herd of 16 elephants was captured by Nagas close to the Assam-Nagaland border. Although difficult to prove a number of calves are captured in Arunachal Pradesh to supply the captive elephant trade in southern India, particularly Kerala.

Disease

Outburst of bacterial diseases, such as *anthrax*, occasionally affects elephant populations, although most cases go unreported. One reason is that the carcasses are usually located after a few days of death and a post-mortem becomes difficult. Moreover, in most of the interior areas veterinary facilities to diagnose the diseases are not available. *Anthrax* is normally transmitted by domestic animals that graze in or near the forests. In the mid-1940s, two outbreaks of *anthrax* in epidemic form devastated the elephant population of N.C. Hills (Choudhury 1991).

Elephants also occasionally catch foot-and-mouth disease from cattle.

Human-elephant conflict

Conflict between elephant and people is a major conservation problem throughout this region. With the decrease in forest cover due to ever-increasing human population, the conflict is becoming more serious daily. Raiding of crops by wild elephants is a familiar phenomenon all over the area. Elephant depredation in human settlements is another cause for conflict. However, most such cases occur near small and disturbed forest pockets (e.g., near Hollongapar RF), within encroached areas in prime elephant habitat (northern Sonitpur), along migratory paths, and where lone bulls go in search of granaries and stored liquor. The worst case of depredation ever recorded was in northern areas of Darrang District (Dimakusi area, Bornadi-Nonoi tract) of Assam in October 1992 when about 4,000 people (900 families) had to flee their villages and take shelter in relief camps set up by the government. A recent study carried out in parts of Assam found that a hamlet between Karbi Anglong and Kaziranga National Park looses a third of its annual paddy production to

Table 4. Main trade routes (The main destinations for ivory are the Far East, Southeast Asia, and Middle East).

Centre of Poaching	Route
(a) Ivory	
E and S Garo Hills, W Khasi Hills	Guwahati-Joygaon-Phuntsholing (Bhutan)
E and S Garo Hills, W Khasi Hills	Guwahati-Siliguri-Dhulabari (Nepal)
E and S Garo Hills, W Khasi Hills	Guwahati-Siliguri-Calcutta
E and S Garo Hills, W Khasi Hills	Mahadeo/Rongara/Baghmara/Ranikor-Mymensingh-Dhaka (Bangladesh)
W Garo Hills	Phulbari-Dhubri-Siliguri-Calcutta
W Garo Hills	Phulbari-Dhubri-Siliguri-Dhulabari (Nepal)
W Garo Hills	Phulbari-Dhubri-Joygaon-Phuntsholing (Bhutan)
Karbi Anglong, Golaghat, Kohima	Dimapur-Imphal-Moreh-Tamu (Myanmar)
Lakhimpur, Papum Pare	Guwahati-Joygaon/Siliguri-Phuntsholing/ Dhulabari (Bhutan/ Nepal)
Lakhimpur, Papum Pare	Bhalukpong-Bomdila-Tawang-Lhasa (Tibet)
E Siang, Dibang Valley	Dibrugarh-Guwahati-Joygaon/Siliguri-Phuntsholing/ Dhulabari (Bhutan/ Nepal)
N Bengal	Joygaon/Siliguri-Phuntsholing/Dhulabari (Bhutan/Nepal)
Jaintia Hills, Cachar	Silchar/Badarpur-Imphal-Moreh-Tamu (Myanmar)
Jaintia Hills, Cachar	Silchar/Badarpur-Karimganj-Sylhet (Bangladesh)
Jaintia Hills, Cachar, Karimganj	Silchar/Badarpur-Aizawl-Myanmar / Bangladesh
North-eastern India (as a whole)	Mumbai (Bombay)- Middle-East (mainly Dubai)
(b) Meat	
Garo Hills, W Khasi Hills, Ri-Bhoi	Shillong-Jowai-Silchar-Mizoram
Lower Assam	Guwahati-Shillong-Silchar-Mizoram
Karbi Anglong, Golaghat and Central Assam	Dimapur-Kohima/Imphal

wild elephants (Choudhury 1997b). The northern Bengal region, especially the western part, is also one of serious elephant-human conflict. On average about 50 people are killed each year by elephants, mostly within settlements or crop fields, in northern Bengal.

Elephants also cause several human deaths in Assam. In just one week at least 50 people were killed, more than half of which were by a lone 'rogue' bull near Burhachapori and Laokhowa Sanctuaries of Assam in August 1993. From 1980 to 2001, more than 900 people had been killed by elephants in the entire Assam. The figures speak of the magnitude of the problem. Affected persons/families are usually paid relief money by the governments but lack of adequate funds, delay in processing, and the tendency among many villagers to submit false claims, exacerbate the problem.

Preventive measures against elephant depredation include beating of tins, shouting, brandishing fires and bursting of crackers; however, these may not work in certain places. Capture of live elephants was also considered a mode to decrease depredation. For instance, 1,298 elephants were captured in Meghalaya between 1960 and 1981. Large-scale capture programmes would certainly decrease the population size of the elephants in the wild. Twelve elephants were captured in Assam in 1994-1995 after obtaining special permission from the Government of India. All elephants were captured by traditional *mela shikar* (capture through noosing from the back of trained elephants) method.

Villagers often retaliate by killing elephants; usually elephants are either shot or electrocuted, but most of them are poisoned. Four animals were poisoned near Barnadi WLS in 1993 and a lone *mukhna* (tuskless bull) in Nanoi Range, both in Assam's Darrang District (Choudhury 1999a). However, the worst case was recorded in Sonitpur District of Assam and adjacent areas of Arunachal Pradesh when at least 27 elephants were poisoned, 20 in July-August 2001, and seven in October of the same year.

Other problems

Pollution of water bodies by pesticides such as Dieldrin, Thiodan and DDT, occasional poisoning for fishing, opencast coal mining in eastern Assam and Meghalaya, and by industrial effluents (paper mills, oil installations, etc.), are serious problems. Power lines passing through forest also cause accidental deaths of elephants by electrocution, especially when high velocity wind or fallen trees damage the lines. Digging of ditches inside forests for oil exploration and by the electricity departments often become death traps for many elephant-calves.

Table 5. Recommended Protected Areas for elephants in NE India.

Name of area	State	Area in km² (Core area in km²)
Amcheng Hill	Assam	53 (40)
Dhansiri #	Assam	1454 (800)
Lumding-Kaki	Assam	350 (100)
Nambor-Daigrung	Assam	100 (60)
Patharia Hill	Assam	75 (40)
Ripu-Chirang #	Assam	750 (400)
South Kamrup	Assam	160 (100)
Upper Dihing #	Assam	440 (267)
Dibang River #	Arunachal Pradesh	202 (100)
Manabum-Tengapani #	Arunachal Pradesh	650 (200)
Papum #	Arunachal Pradesh	450 (250)
Dadengiri-Damalgre #	Meghalaya	550 (00)
Narpuh-Saipung	Meghalaya	300 (80)
Anko Range #	Manipur	400 (250)

(# = high priority areas)

Legal status and past and present conservation measures

The wild elephant is protected under Schedule I of the Indian Wildlife (Protection) Act of 1972, which prohibits its killing or capture. This is in fact the highest level of protection accorded to any species in the country. Most of the villagers, including the hill tribes of remote areas, are aware of its protected status. However, it is often difficult to enforce the Act in remote areas due to delayed information, inaccessibility and problems of insurgency. In cases of arrests of poacher and seizure of ivory/meat, the lengthy judicial process often makes it difficult to convict the accused persons. This is mainly due to slow process in the courts, rather easy bail to the accused, lack of sufficient evidence and subsequent lack of perusal on the part of prosecution side.

Habitat protection

Sixteen notified PAs in Assam, nine in Arunachal Pradesh and four in Meghalaya, two each in Nagaland and Mizoram, and one each in Tripura and Manipur have either permanent or temporary elephant populations. Although the measures taken by the respective State governments offer some degree of protection to elephant habitat, the total forest cover available within the PA system in most States is still inadequate.

Under the Government of India's Project Elephant (launched in 1991-1992; Anon 1993), five Elephant Ranges have been declared in NE India. However, this project has yet to make its impact in the region. The reserves have not yet been notified nor is there any clear boundary demarcation. In one such reserve (Kameng-Sonitpur) large-scale encroachment has taken place over the past five years (1999-2003), thereby indicating the ground reality.

Between 1999 and 2003, wild elephants and their habitats benefited to some extent by the conservation efforts by some NGOs. These included provision of infrastructure for better management and enforcement, awareness and motivation and lobbying. At least 15 vehicles, six motorcycles, three motorboats, a large number of wireless sets, clothing for the patrolling staff, torch lights for night patrolling, etc., have been donated by NGOs since 1995 to different PAs of Assam, all important elephant habitat. In addition, more than 20 anti-poaching camps were also constructed with support from NGOs and U.S. Fish and Wildlife Service. The NGOs which made these donations included The Rhino Foundation for Nature in NE India, WWF-India's Tiger Conservation Programme, Fauna and Flora International, US Wildlife Foundation (through Ranthambore Foundation), Environmental Investigation Agency, Rhino Rescue, UNESCO (only to Manas and Kaziranga as World Heritage Sites) and Aaranyak. Another NGO, Early Birds, conducted a series of veterinary care camps in the border areas, while The Wildlife Trust of India, with funding from Ministry of Social Justice, has set up a rescue center near Kaziranga.

Recommendations

Creation of new Protected Areas

With only about a fourth of elephant habitat in NE India included in the network of PAs, there is an urgent need to bring more areas under the system. The areas recommended for PA status are listed in Table 5.

Extension of existing Protected Areas

Balpakram–Siju [Meghalaya]

This very important elephant habitat of Garo Hills needs to be enlarged significantly to cover Baghmara, Rewak and Emangiri RFs, the corridor between Nokrek National Park and Siju Sanctuary, and the unclassed forests of West Khasi Hills. The total area will should be *c.* 750km^2.

Nongkhyllem Wildlife Sanctuary [Meghalaya]

This small sanctuary of 29km^2 should be extended to cover the adjacent RF areas totaling 149km^2. Since this is the only PA in the entire northern slopes of Meghalaya, its extension is very important.

Dibru-Saikhowa National Park [Assam]

An area of 196km^2 of Kobo *chapori* and Poba RF of Dhemaji District is recommended for addition to Dibru-Saikhowa. This is a vital route for the elephant between eastern Siang and western Dibang Valley of Arunachal Pradesh and Dibru-Saikhowa.

Barnadi Wildlife Sanctuary [Assam]
This small sanctuary should be extended towards east to include Khalingduar RF (70km^2). The presence of the 273km^2 Khaling Sanctuary across the international boundary in Bhutan is an added advantage.

Legal protection and augmentation of corridors

Besides protecting elephant habitat, corridors, which are regularly used by the elephants, need to be given some legal protection and in many cases further strengthened through land acquisition. It is therefore recommended that provisions for 'Protected Elephant Movement Corridors' be incorporated in the Indian Wildlife (Protection) Act of 1972 by suitably amending it. In case of tea estates, cultivations and *jhums*, the land will continue to be with the private owners but the Act would make sure that no changes in the land-use pattern take place within the narrow corridors (as has been done in case of oil pipelines and power lines). At places, the governments can also acquire such strips under the Land Acquisition Acts prevalent in different states and pay suitable compensation. A list of some of the important corridors used by elephants in the north-eastern region is given below.

Northern Bengal corridors

Several corridors have been identified across northern West Bengal that need protection as well as possible augmentation (Chowdhury *et al.* 1997; Sukumar *et al.* 2003). Mahananda Sanctuary in the west is connected to the Apalchand RF further east across the Teesta Chaur. Several human settlements and an army firing range are the present threats to the movement of elephants across the Teesta. The Apalchand RF is itself connected to the Gorumara NP through the Damdim and Baradighi tea estates. The Apalchand RF is also connected to the Kalimpong Division in the north through a tenuous corridor straddled by settlements, tea estates and an army camp. Several elephant routes connect this division to Jaldapara Sanctuary; these pass mainly through tea estates and include the Bhuttabari-Chapramari, Rethi-Central Diana, Rethi-Moraghat, Rethi-Dumchi, and Titi-Dumchi. Between Jaldapara Sanctuary and Buxa Tiger Reserve the two important corridors used by elephants are through Beech/Barnabadi tea estates and across the Torsa River. Buxa Tiger Reserve is itself connected to Kochugaon FD of Assam across the Sankosh River. These corridors have been described in more detail in the above cited publications.

North Bank of the Brahmaputra corridors

The contiguity of the landscape for elephants along the Himalaya foothills to the north of the Brahmaputra (between Sankosh and the Brahmaputra itself) is poorly understood. A large number of potential corridor-like situations have been mentioned in several reports but a detailed survey and documentation of these corridors is urgently needed before priorities are set.

Kaziranga- Karbi Anglong corridor

To the south of the Brahmaputra, the Kaziranga National Park located on the floodplains of this river maintains only tenuous links with the Karbi Anglong Hills to the south. These links are essential for the very survival of not only elephants but also a host of other species including rhino during the monsoon period because of flooding of Kaziranga and the movement of animals to safer ground in the hills. The national highway running along this stretch, tea estates and cultivation are the main obstructions. Three crossing points have been identified – Amaguri, Kanchanguri and Panbari. The strengthening of corridors for the movement of elephants and other animals between Kaziranga and Karbi Anglong is essential.

Meghalaya corridors

Only a small fraction of the elephant habitat in Meghalaya is under the PA system. Thus, maintaining existing links between these and possibly strengthening these corridors would be important for the long term survival of elephants in this region. The important links include the Siju-Rewak, Baghmara-Balphakram, and Imangiri-Nokrek corridors.

Controlling poaching

Poaching of elephants for ivory and meat and occasional illegal capture should be checked immediately. Anti-poaching staff should be well trained and better equipped in all the PAs (Kaziranga National Park could be a model). Areas that have poaching problems should have anti-poaching plans in place as part of their management plans. Special courts to deal with wildlife offences should be set up in the north-east for speedy justice. All unlicensed arms should be confiscated.

Control of jhum cultivation

While it is not possible to completely stop *jhum* cultivation as it is a way of life and deeply imbedded in culture, some effective measures should be taken to control it especially near the prime elephant habitats and movement routes. Schemes such as IJDP (Integrated Jhumiya Development Programme) and WDPSCA (Watershed Development Projects for Shifting Cultivation Areas), both funded by the Government of India, may be implemented with greater commitment and areas where human-elephant conflict is severe should be given high priority.

Check on encroachment and clearing of encroachers

No new encroachments should be allowed to take place in the RFs. Fresh encroachments, especially those inside the important elephant habitats such as Nambor (northern block), Charduar, Balipara, Naduar, Behali and Biswanath RFs of Assam should be stopped.

Ban on commercial felling

Considering the poor tree cover left in different parts of the north-east, commercial felling in the remaining natural patches should not be allowed. Uncontrolled cutting of grass in the grasslands (e.g., Kobo *chapori*) should also be checked.

Modification of Project Elephant

This centrally-sponsored scheme now needs to be modified slightly to suit the ground reality in the NE India. Instead of the present system of 'loose' reserves, compact areas as in the case of Project Tiger should be taken up in conjunction with recommended protection for elephant corridors (see Recommendation 9.5.3). It is a well-known fact that unless a compact and viable area is administered as a single unit from a single headquarters, enforcement will never be effective, and even management will be difficult. However, joint committees may oversee inter-state reserves.

Effective protection and management of the existing Protected Areas

All areas already under the PA network should be

adequately protected. Communication system should be improved with the introduction of wireless in all the important reserves. Fund flows to the park must be better managed so that management decisions taken can be implemented.

Review and rectification of some of existing development projects in elephant habitats

To avoid accidental electrocution, technical persons should regularly check power lines passing through the forests. At places these should be diverted outside the forest.

All the ditches and trenches dug by the electricity departments and oil miners should be filled up immediately. A large number of such features, usually concealed under vegetation, are found abandoned inside forests, which virtually become death traps for many elephant calves. The severely polluted ponds near existing oilrigs should be treated by the oil industry.

Two roads, 15km of Highway Number 39 between Silonijan and Thorajan, and 10km between Barlangpher and Lumding, need to be diverted. The former passes through Garampani and Nambor Wildlife Sanctuaries and Nambor (northern block) RF while the latter through Lumding RF. Both these stretches have created serious human-elephant conflict. Uncontrolled and unscientific harvesting of bamboo for the paper mills should be checked effectively.

Other measures

Conservation education is needed among locals, including the hill tribes of remote areas, with the active involvement of local NGOs.

Concrete measures should be taken to reduce depredation; expeditious relief to be given for loss of life and property.

Steps should be taken to reduce the dependency of fringe villagers on the forest. One method is large-scale installation of bio-gas (the Deenbandhu Model is recommended) that will greatly reduce pressure on firewood.

Capture and translocation of elephants may be necessary at places; however, these should be given low priority.

Further research on ecology, behavior and movement in different habitat types of NE India is needed.

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Photo: Charles Santiapillai (Thailand)

Conservation of the Asian elephant in North-West India

A.J.T. Johnsingh, Qamar Qureshi, Dhananjai Mohan and Christy A. Williams

Introduction

The north-western elephant population in India once had a continuous range in Uttar Pradesh (UP), from Katerniaghat Wildlife Sanctuary (WLS) in Bahraich Forest Division (FD) in the east, to the Yamuna River in the west (Singh 1978). Over time, this continuity has been broken, and now the total population of about 1,000 elephants occurs in six isolated sub-populations. From east to west, these populations are in Katerniaghat Wildlife Division (WLD), 10-20 animals migrating to and from Nepal's Bardia National Park (NP), in and around Dudhwa Tiger Reserve (TR, 880km^2, *c.* 40 elephants) (Javed 1996), between Sharda River and Haldwani town, Haldwani and Khoh River, Khoh River and Ganga River, and between Ganga River and Yamuna River. Bulls, however, still cross Khoh and Ganga Rivers. The major breaks in this elephant range are along the Ganga River, along the Gola River that runs to the west of Kathgodam-Haldwani-Lalkuan Highway, across Khatima Range of Terai East FD and between Dudhwa NP and Katerniaghat WLD. Although isolated, Katerniaghat WLD is identified as an area to be managed along with Dudhwa TR. The Khatima Range has become unsuitable for elephants and other large mammals as a result of the construction of Sharda Main Canal, Tanakpur-Khatima Highway and enormous increasing biotic disturbances, from the human settlements in and around. Steep terrain and biotic disturbances deter the movements of elephant groups across Gwalgod *sot* in the hilly terrain of Rajaji-Corbett corridor (Sunderraj *et al.* 1995). Nevertheless, elephants use the stretch of forests south of Rajaji-Corbett corridor (parts of Haridwar and Bijnor Plantation Division, *c.* 300km^2) as a corridor between Rajaji NP and Corbett TR. But this forest belt is also under enormous biotic pressures. Sand and boulder mining started in the riverbeds of this area, in the recent years, have added to the pressures.

From east to west, the Protected Areas (PAs) and forest divisions in this elephant range are: Katerniaghat WLD, Dudhwa NP, Kishanpur WLS, North Kheri FD, Pilibhit FD, Haldwani FD, Champawat FD (South Pithoragargh), East Terai FD, Central Terai FD, West Terai FD, Ramnagar FD, Corbett TR (including Sonanadhi WLS), Bijnor FD, Lansdowne FD, Bijnor Plantation DIivision, Haridwar FD, Rajaji NP, Dehra Dun FD, Narendra Nagar FD (part), Shivalik FD and Kalsi FD. The elephant range here is about 500km long and narrow in most places.

Altitude varies between 200 and 1,000m a.s.l., and Kanda, which is situated on the northern boundary of Corbett TR, is the highest point. The total elephant habitat available is around 10,000km^2. The Outer Himalaya and the Shivaliks are the mountain and hill ranges that run through this tract.

West of Sharda River, the fertile water-rich *terai* tract has been lost to cultivation and monoculture plantations, and the elephant habitat is largely confined to the *bhabar* tract, which is full of boulders and has a low water table. *Terai* habitat is still available east of the Sharda River, in Pilibhit and North Kheri FD, Dudhwa TR and Katerniaghat WLD. Major rivers in this range are the Yamuna, Ganga, Ramganga, Sharda, Suheli and Geruwa. Besides these, there are numerous streams and ephemeral water courses known as *raus*, which in the *bhabar* tract remain dry during most parts of the year. See Johnsingh *et al.* (2004) for more details of this area.

Vegetation types

The vegetation in this tract is dominated by moist and dry sal (*Shorea robusta*) forests, interspersed with northern tropical dry deciduous forests, Northern tropical moist deciduous forests, and bamboo (*Dendrocalamus strictus*) clumps. Himalaya sub-tropical forests dominated by chir pine (*Pinus roxburghii*) occur on the peaks of the Shivaliks. Cane (*Calamus tenuis)* brakes, seasonal swamp forests dominated by *Syzygium*, riparian fringing forests dominated by *Trewia nudiflora*, *Ficus hispida* and *Putranjiva roxburghii* also occur at mesic sites. The *terai* grasslands east of the Sharda River are dominated by *Phragmites karka*, *Saccharum spontaneum*, *S. bengalensis*, *S. munja*, *Narenga porphyrocoma*, *Sclerostachya fusca*, *Themeda arundinaceae* and *Vetiveria zizanoides*. Several parts of this range, particularly the remaining *terai* belt, are planted with exotics like teak (*Tectona grandis*), gum (*Eucalyptus*), poplar (*Populus deltoides*), *Haplophragma heterophylla* and *Ailanthus excelsa*. The area is classified into six broad natural vegetation classes, Moist Sal Forest, Dry Sal Mixed Forest, Mixed Forest, Acacia-Dalbergia Forest, Open Woodland/Plantation and Open scrub and Grassland (Figure10.1).

Legal and management status

At present, there are six PAs in this range: Corbett NP (core of Corbett TR), Rajaji NP (still proposed), Sona Nadi WLS (part of Corbett TR), Dudhwa NP, Kishanpur WLS, and Katerniaghat WLD (the last three from the Dudhwa TR).

(a) Corbett NP (*c.* 521km^2), which forms the core area of the 1,288km^2 Corbett TR, has had a chequered

history. In 1936, it became India's first National Park under the United Provinces National Parks Act. Originally called Hailey NP, it became the Ramganga NP after independence. Finally, it was named Corbett NP in honour of late Jim Corbett, legendary hunter and author, and later a consultant to demarcate the limits of the proposed national park. On 1 April 1973, India's laudable conservation programme, Project Tiger, was inaugurated at the park headquarters in Dhikala.

(b) Rajaji NP, which encompasses three former wildlife sanctuaries – Rajaji, Chilla and Motichur – as well as parts of the Shivalik and Dehra Dun FDs, also has a history. In 1966, 90km^2 of the Dehra Dun FD was upgraded as Motichur WLS. An area of 247km^2 of the Shivalik FD and an area of 249km^2 of the Lansdowne FD were upgraded as Rajaji and Chilla WLSs in 1967 and 1974, respectively. In 1984, these three sanctuaries, and parts of the above mentioned FDs, were intentionally notified as Rajaji NP.

(c) Sonanadi WLS is contiguous to the Corbett NP, and along with it and some adjoining reserved forests (RFs), forms the Corbett TR. The Sanctuary was established in 1987 over an area of 301.76km^2. Lying between the Corbett NP and Rajaji NP, the Sanctuary is a part of the link between the two.

(d) In the *terai* region of Lakhimpur Kheri in UP, Dudhwa WLS, spread over an area of 212km^2, was created in the year 1958, to protect a population of swamp deer (*Cervus duvauceli duvauceli*). This was upgraded to National Park in 1977, and enlarged to an area of 490 km^2, along with a buffer of 124km^2.

(e) South of Dudhwa, on the southern bank of Sharda River, another PA, Kishanpur WLS, was established in 1972, over an area of 204km^2. In 1987, these two PAs of the UP *terai* were brought under the umbrella of Project Tiger. The Dudhwa TR so formed was further enlarged in 1994, by adding some buffer areas to the south, and extending the area of the reserve to 884km^2.

(f) Katerniaghat WLS was created in the forests of Bahraich FD in the year 1976. This Sanctuary had an area of 400km^2 on the eastern bank of the Ghaghra River. In 1997, along with 150km^2 of contiguous buffer, this Sanctuary was reorganized administratively as the Katerniaghat WLD, and in 2001, it was merged with Dudhwa TR.

The rest of the areas within this elephant range come under the category of Reserved Forests.

10.4 Density and status of elephant population

The elephant population in this range, from Yamuna to Katerniaghat, could be around 1,000 animals, giving a crude density of one animal per 10km^2. Area-wise population estimation is as follows: 150 to 200 elephants west of River Ganga (*c.* 1500km^2), 650 to 700 between Ganga and Gola River (Haldwani) (*c.* 4,000km^2), 50 between Gola and Sharda (*c.* 1,800km^2) which still a few years ago was reported to range into Nepal, may be into Sukhlaphanta Reserve, and 50 between Khatima Range and Katerniaghat (*c.* 2,500km^2) which moves between India and Nepal (Figure 10.2). Until recently, the population between Yamuna River and Haldwani had the best reported sex ratio in the entire Asian elephant range. Studies conducted by the Wildlife Institute of India in Rajaji NP and Corbett TR, have shown that the existing adult male:female sex ratio was 1:2-2.5, due largely to the absence of poaching for ivory. As a result, the effective population size of elephants in the forest patch between Yamuna River and Haldwani was higher than that of the southern Indian populations, despite their having a much larger number of individuals (Williams 2002). Recent poaching incidents (10 tuskers were poached in the Corbett-Rajaji area from December 2000 to December 2001) and the death of males (of the 11 elephants that died in December 2001 and January-February 2002 in the Rajaji area, including two bulls that were poached, eight were males) indicate that this healthy sex ratio can be drastically altered within a few years, if habitat degradation, deaths due to electrocution, poisoning and poaching are not brought under control.

Conservation problems

Since the steep Himalaya and Shivaliks bound this elephant range on the north, and the fertile *terai* on the south, fragmentation as a result of human habitations and associated developments, is the most serious problem. Equally serious is the problem of habitat disturbance and degradation due to overgrazing by domestic livestock, lopping of trees to feed the *Gujjar* buffaloes, and collection of *bhabar* grass (*Eulaliopsis binata*) for rope making. Overgrazing leads to proliferation of weeds and lack of regeneration of palatable plant species (Dabadghao and Shankarnarayan 1973; Johnsingh *et al.* 1990). Since October 2002, Uttaranchal Government has permitted large-scale sand and boulder mining in the river beds within the RFs. This mining brings in nearly 25,000 poor labourers from Eastern Uttar Pradesh and Bihar who camp on the riverbed for nine months (October to June) and their firewood needs combined with that of local people, cause enormous loss and disturbance to the elephant habitat.

Habitat fragmentation and threats to habitat connectivity

The once continuous elephant range is now fragmented in four places (along the Ganga and Gola Rivers, across Khatima Range and between Dudhwa NP and Katerniaghat WLD). There is a fragile connectivity between Dudhwa NP and Katernighat WLD along Bardia NP. In several other places the threats to habitat connectivity are increasing.

Kansrau-Barkote corridor

The connectivity between Kansrau Range of Rajaji NP and Barkote-Rishikesh Ranges (*c.* 120km^2 of elephant habitat) is a 2km-wide patch of disturbed forests, which is under enormous pressure, particularly wood-cutting from the adjacent villages (Lal Thapar and Chhidarwala). The corridor is being degraded at present. The Dehra Dun–Haridwar National Highway, passing through this corridor, is an additional source of disturbance. Bulls and groups occasionally use this corridor.

On the banks of Ganga River (Chilla-Motichur corridor)

As stated earlier, the habitat is almost completely fragmented for elephant groups, between Chilla and Motichur Ranges of Rajaji NP, on the banks of Ganga River. The factors that have led to fragmentation on the right bank of Ganga River are the expanding Haridwar Township, the Raiwala Army Camp, and the settlements of Tehri Dam oustees (Khand Gaon I, II and III) between Raiwala and Motichur *rau*. On the left bank of Ganga River, the 14km-long Kunaun-Chilla power channel has blocked the movement of elephants between Chilla and the river. All these developments occurred in the late 1960s and early 1970s. Now only a few bulls move at night between Chilla and Motichur, along the Motichur *rau* and through the army camp and the Khand Gaon III. The bridge on the channel near Suni *sot*, and the aqueduct built below the channel for the passage of water in Dogudda *rau*, are also occasionally used by the bulls (Johnsingh *et al.* 1990).

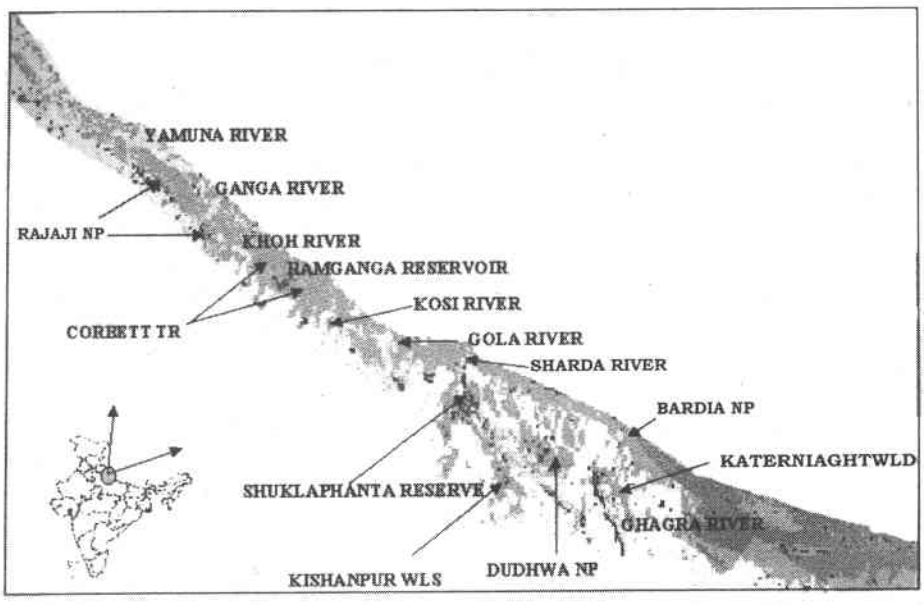
Between Rajaji NP and Corbett TR

In the past, there was a continuous stretch of forest south of the hilly tract that extends between Khoh River (west of Corbett TR) and the eastern end of Rajaji NP (Rawason River). In due course, forests closer to Khoh River were lost to cultivation and human settlements, forcing elephants to move across the hilly terrain in the eastern part of the corridor. Over the years, this narrow hilly corridor has come under immense biotic pressures from the *Gujjar* camps and villages situated on the northern and southern boundary. As a result of the growing biotic disturbances and the steep terrain, elephants have stopped using the habitat between Gwalgod *sot*, which is about 10 km west of Khoh River, and Khoh River (Sunderraj *et al.* 1995).The forests south of this hilly area, Haridwar and Bijnor Plantation Division, though under increasing biotic pressures, are still being used by elephants.

On the southern boundary of Corbett TR

The construction of a reservoir across the Ramganga River, and the building of the Kalagarh Township on the south-western boundary of Corbett TR in the early 1970s, has put an end to the movement of elephant groups across the Ramganga River, from Corbett NP to Kalagarh FD (Sona Nadi WLS and now part of Corbett TR). Only a few bulls occasionally cross the river along the southern boundary. Fortunately, the hilly habitat north of the Ramganga Reservoir is disturbance-free, and is used even by groups to move between the Park and the Sona Nadi WLS. The Kalagarh Project and associated township was built on 90km^2 of forest land and according to an agreement between the Irrigation and Forest Departments, 3.5km^2 of this area should have been vacated and returned to the Forest Department soon after the completion of the construction of the reservoir. After much persuasion 3.1km^2 were returned by the Irrigation Department. The remaining area (0.4km^2) has colonies with about 4,000-5,000 encroachers. Now Forest Department, supported by NGOs, has filed cases against 724 individuals for evicting them and their families and the case is in the court of Sub-Divisional Magistrate, Kotdwar.

Fig. 1 The North - West elephant range, India



Kosi River corridor

The Kosi River flows between Corbett TR and Ramnagar FD, and although there are human habitations along the river, the connectivity is good in the following four places: (a) about 5km between Mohan and Kumaria; (b) 1.5km between Dhangari Gate and Sunder Khal; (c) 100m between the two blocks of Sunder Khal; and (d) 6km between Infinity Resorts and Bijrani. The growing problems of Sunder Khal, an encroachment since 1974, now 3.5km long, along the right bank of Kosi River, pose the most serious threat to this corridor.

Boar River corridor

This is the forest connectivity around Kaladhungi, in Ramnagar FD.

Nihal-Bhakhra corridor

The 4km-wide Nihal-Bhakhra corridor is between Boar River and Gola River connecting the Ramnagar FD with Terai Central FD, a plantation division. There are seven villages – Bedrampur, Pratappur, Kharakpur, Lachchampur, Rampur, Sakatpur and Sherpur – with about 700 families, and a human and cattle population of 4,000 and 3,000, respectively. However, the major threat to the corridor comes from the powerful landlords who have large land-holdings on lease. Large-scale farming means not only more biotic pressure on the corridor, but a direct threat to the forest – clear-felling for agricultural purposes, besides legal and illegal commercial felling.

Gola River corridor

The major break in the elephant range has occurred as a result of the growth of Haldwani Town situated at the base of the steep Shivalik Hills, and the various developments that have occurred south of Haldwani. Notable among them is the Lal Kuan Industrial Complex. Heavy traffic along Haldwani–Lal Kuan Road throughout the day and night, and large-scale sand and boulder mining from October-June by hundreds of labourers along the Gola River have also contributed to this fragmentation. The firewood demands of these labourers, who camp on the river bed, are eroding the forests in the Tanda Range of Terai Central FD and Doli Range of Terai East FD (Johnsingh *et al.* 2004).

Kilpura-Khatima corridor

The Haldwani-Sharda population of about 50 elephants range mostly in the Haldwani FD and in the Jaulasal and Kilpura Ranges of Terai East FD. During rains, some of these elephants from the Kilpura Range cross the Sharda Canal 2km upstream of Lalkhoti in the Navakhal block of Khatima Range. Beyond Khatima Range the status of forest in Nepal is unknown. There may be some connectivity with the Sukhlaphanta Reserve. The inhabitants of Devipura Majgaun in Khatima Range, an area encroached for about 20 years, report of occasional crop raiding by elephants during the rains. They also reported that the elephants, until recently, during the rains, used to migrate to Nepal, possibly to Sukhlaphanta Reserve. The Kilpura-Khatima corridor is severely threatened by enormous wood cutting and fodder collection by the inhabitants of Khatima Township, the encroached villages such as Devipura Majgaun, Pachoria and Patta and Nepali villages north of Khatima Range (Kanchanpur *teshil*, Mahendra Nagar District).

Lagga Bagga–Haripur–Belha–Kishanpur–Dudhwa corridor

Lagga Bagga lies in the Barahi Range of Pilibhit FD. It is a corridor of *c.* 6km^2, connecting the Pilibhit Forests with those of Royal Suklaphanta Reserve in Nepal. It is thus an important link in the movement of animals from Dudhwa and Kishanpur to Nepal, via Haripur range of Pilibhit FD, which is contiguous to Kishanpur WLS. While Lagga Bagga has the status of Reserved Forest, the forests of Belha (a stretch of forest bordering Pilibhit and South Kheri FD) are still in the process of being acquired by Government. Both these areas have serious problems of encroachment and other biotic pressures such as illegal felling, grazing (mainly by feral cattle), and poaching, which occur at a larger scale due to the proximity to the international border. The Bhira and Mailani Ranges of South Kheri FD, and the Khutar Range of Shahjahanpur FD, are also contiguous to Kishanpur WLS on the south and south-western side, and help provide a corridor to Pilibhit FD further west.

There is another break in this forested continuum, in the *terai* between Kishanpur WLS and Dudhwa NP. While the Kishanpur WLS extends to the southern bank of the Sharda River, the northern bank is devoid of forests. It is only after travelling 5-10km north of the river that one reaches the forests of Dudhwa NP. The area in between consists mainly of agricultural crops such as sugarcane, wheat and paddy, and small patches of forests/plantations and reed-covered water courses and ox-bow lakes. In early winter, from October-November, elephants are known to use these water courses and lakes while moving between the two PAs.

Dudhwa-Katerniaghat corridor

There is hardly any contiguity between these two PAs at present, except that of riverine corridors along Mohana and Suheli Rivers. Even the much better connectivity along the Mohana River is broken for about 5km. Both riverine corridors are quite patchy, nonetheless they provide some cover in the otherwise agricultural landscape. The distance and area between these two Protected Areas are between 15-20km^2 and 200km^2 respectively. Nearly 5% of this 200 km^2 has patches of RFs belonging to the North Kheri FD which are largely under *terai* marshes. The remaining area is under agriculture (mainly sugarcane) tenanted by nearly 20,000 people. Recreating a corridor here for elephants capable of causing enormous damage to crops in a landscape dominated by sugarcane, is difficult, as it would require

decades of dedicated conservation effort.

There exists a weak corridor between the Katerniaghat WLD and Royal Bardia NP of Nepal, which is a very narrow strip of riverine vegetation along the Geruwa River (the eastern branch of Karnali/Ghagara) and has been used by rhinos and elephants in moving into Katerniaghat WLD in recent years. This Division has enormous problems due to settlements inside and around the periphery.

Encroachments

These forests have suffered in many places as a result of large-scale Government-sponsored encroachment that took place in the early 1970s. Two examples are worth recording: one is Sunder Khal, and other in the Terai East FD.

In 1974, about 400 people, prompted by Parvati Shilpkar Samiti–Sunderkhal, encroached into the Western Kunkhet Beat, Dhulwa Block 5, 9 and 11, an area of 73.84ha in the Kosi Range of Ramnagar FD. The Forest Department filed cases in the Kashipur Court to evict these encroachers: 24 cases in 1974-75, 114 in 1989 and 131 in 1990, a total of 269. The Kashipur Court gave a verdict in 1992 that 172 families should leave, but no decision was made on the other 97 families. The 172 families refused to leave as they were not given alternative sites in one area for resettlement. According to the 1999 census, there are some 300 families with 1,500 individuals and they have built 100 *pucca* houses and 200 temporary huts. This entire population gets its fuel, fodder and timber from the surrounding elephant habitat. Resettlement of this entire population should be a priority to secure the future of this corridor.

The Terai East FD has an area of 820km^2 and of which 60km^2 are encroached. The Ranges affected are: Barkoli (encroached area 22.40ha), Doli (138.44), Gaula (4312.63), Khatima (373.9), Kishanpur (84.1), Ranshali (250.71), South Jaulasal (159.57 and Surai (497). Encroachment has occurred in other forest divisions, gradually growing in size as well. An early solution to mitigate this problem is urgently needed.

Habitat degradation

With the exception of the Corbett NP and parts of the Rajaji and Dudhwa NPs, all other forest areas in this tract are used by people for livestock grazing, and firewood and grass collection. Timber, bamboo, minor forest produce and cane are also extracted in some forest divisions. One major factor that has drastically reduced the habitat quality of this tract for elephants is the conversion of natural vegetation into monoculture plantations of eucalyptus, teak and *Haplophragma heterophylla*. The Divisions that have come under this conversion are: East *Terai*, Central *Terai*, West *Terai*, Bijnor, and Haridwar. Plantations are also common in Pilibhit, Kheri and Katerniaghat Divisions. Kalagarh FD (Sona Nadi WLS), Lansdowne FD, Rajaji NP, Shivalik FD and Terai East FD have the problem of pastoral *Gujjars* and their buffaloes. Lopping by the *Gujjars* and grazing by the buffaloes have contributed to habitat degradation resulting in the spread of weeds such as *Parthenium hysterophorus*, *Lantana camara* and *Adhatoda vasica*, and lack of regeneration of palatable tree species. *Gujjar* buffaloes urinate and defecate in waterholes making them unfit for use by elephants (Johnsingh and Joshua 1994).

Elephant mortality due to train accidents

One of the major problems of Rajaji NP is the death of elephants due to train accidents along 19km-stretch of railway track passing through the Park. The track extends 4 km into Haridwar Range, 7km into Motichur Range and 8km into Kansrau Range. Between 1987 and May 2002, 20 elephants were killed, of which 10 were adult females, one adult male, two sub-adult males, two sub-adult females, four juvenile males and one female calf. The length of track where the elephants are vulnerable to accidents is 1.5km in Haridwar Range, 5km in Motichur Range and the entire 8km in Kansrau Range. Comparatively more elephants died in Haridwar Range (8) than in Motichur (7) and Kansrau (5). Records for different months show that 16 animals died during the dry season, from January to June, with a peak in May (5). This dry season mortality is correlated with the water-induced movement of elephants. All accidents occurred between 1830 and 0530hrs. Trains responsible for accidents are the Doon Express, Mussoorie Express, Janta Express, Ujjain Express, Haridwar-Rishikesh Passenger, Sahranpur-Dehra Dun Passenger and goods trains (A. K. Singh pers. comm.).

Recommendations

Priorities for elephant conservation for this Range include the following:

(a) Maintenance of habitat continuity, by establishing and strengthening corridors, consolidation of habitat through translocation of *Gujjars* and several other human settlements including encroachments;
(b) Reducing biotic pressures through eco-development measures and conservation education;
(c) Total ban on sand and boulder mining in river beds crucial for establishing corridors;
(d) Creation of mini core areas;
(e) Converting plantations into better elephant habitats, by planting patches of browse species;
(f) Control of poaching; and
(g) Reducing mortality caused by trains.

Establishing and strengthening corridors

The first two corridors that need to be established and strengthened are the Chilla-Motichur corridor and Gola River corridor. Priority should go to the Chilla-Motichur corridor, which will help consolidate habitat

integrity from Yamuna to Gola River (Haldwani), an area of about 8,000km^2.

Chilla-Motichur corridor

Chilla-Motichur corridor across the Ganga River needs the immediate attention of the Government of Uttaranchal and the Government of India. Over the last 20 years, several discussions took place, and numerous reports submitted, but the corridor has not yet been established. Two major problems in this corridor area are due to the presence of the army ammunition dump and the settlements of the Tehri Dam oustees. What is urgently needed is the resettlement of Khand Gaon III of the oustees. Land has already been identified for resettlement in Bibiwala near Rishikesh, and the oustees are willing to move there as it is closer to a perennial spring, to the Haridwar-Rishikesh Road and to Rishikesh, where employment and educational opportunities are better. Bibiwala is in the north-western corner of the much-disturbed Elephant Range (Barkote and Rishikesh Range), and sacrificing this land for creating the corridor would go a long way in strengthening elephant conservation in its north-western range. This corridor will be beneficial for several other large mammals, particularly tiger.

It has often been suggested to build big bridges across the Kunaun-Chilla power channel, which runs parallel to the left bank of the Ganga — this is not necessary. What is urgently needed is to make the adjacent Suni *sot* and Dogudda *sot* totally free of *Gujjar* settlements. If this is done, even groups of elephants will start using the aqueduct built below the power channel for the flow of water from Dogudda, and the bridge across the channel near Suni *sot*. At present only the bulls use the bridge, and the aqueduct is only used when *Gujjars* do not camp in the *rau* near the aqueduct entry. Other measures for strengthening this corridor are the banning of further development around the place of worship between the army camp and Ganga River, banning of construction of an all-weather road to this place of worship and night traffic along Chilla-Rishikesh Road, keeping the islands on the Ganga River free of disturbances, and if possible, shifting the Gangabhagpur Thalla and Malla villages. More suggestions are given in Johnsingh *et al.* (2004).

Gola River corridor

There is a good possibility of restoring the continuity between East and Central *Terai* FD, which is broken due to development activities between Haldwani and Lal Kuan. This may be possible by translocating the timber depot of Uttaranchal Government just north of Lal Kuan, acquiring an equal amount of land east of the Haldwani-Lal Kuan Road and west of Gola River, which is fortunately only sparsely populated by illegal settlers of boulder collectors in Gola River. It will be crucial to ban sand and boulder mining along the entire stretch of Gola River. Intensive management of forests on either side of this corridor, particularly of Doli Range, by planting of suitable fodder tree species and bamboo, and protection from grazing and cutting should also be carried out.

Rajaji-Corbett corridor

The corridor forests between Rajaji NP and Khoh River (west of Corbett TR) need immediate attention to control growing biotic disturbances that emanate from the villages south of the corridor and Kotdwar Township. Through appropriate eco-development measures, villages along the northern boundary should be made ecologically self-sufficient in terms of their fodder and fuel requirements, or alternate fodder and fuel provided, so that the growth of their impact on the corridor forests can be minimized. *Gujjars* from this area should be resettled on a priority basis.

Kosi River corridor

In the Kosi River corridor, the forests between Mohan and Kumaria Villages should be kept free of disturbance, by shifting the Indian Medicines Pharmaceutical Corporation Limited from its present location, closer to Ramnagar Town, as most of the 200 or so employees come from this town, which is about 15km away. Gargia Chemicals, where less than 10 people work, should be immediately closed. There is a colony of 15-20 huts, *c.* 75m north of Mohan, on the way to Kumaria. The people in this colony depend on cutting firewood and transporting them to Ramnagar. Immediate attention is needed to address this problem. The encroachers at Sunder Khal could be resettled in Gabua forest patch (13km^2), between Ramnagar and Kaladhungi, in Terai West Forest Division. Gabua, surrounded by human habitations, may eventually be encroached or used by Government for some other purpose. Before this happens the encroachers should be settled in Gabua forest patch so that the elephant habitat can be protected. The connectivity between Infinity Resorts and Bijrani can be strengthened further if people in the two small villages, Ringora and Amdanda, are resettled.

One important habitat alteration immediately needed in the corridor patches identified (Kumaria-Mohan, Dhangari and the western block of Sunder Khal, and between Infinity Resorts and Bijrani) is the planting of the existing teak plantation with cover-giving and fodder species including bamboo (*Bambusa arundinacea* and *Dendrocalamus strictus*) and browse species including *Zizyphus mauritiana*. It is known that these species are heavily browsed by ungulates, but their survival could be improved by planting grown-up saplings in the beginning of the rainy season.

Boar River corridor

This corridor needs total protection from development, particularly from excess tourism. The buildings of Sterling Resorts, the construction of which was stopped by Supreme Court intervention, should be dismantled and taken away from the forest area. Uttaranchal

Government should acquire other private holdings in this corridor area.

Nihal-Bhakhra corridor

This area needs intense management input in the form of eco-development measures in the surrounding villages to control further degradation. If this corridor forest is lost, the connectivity between Ramnagar FD and Central Terai FD would go as well, and there will not be any opportunity to restore the Gola River corridor.

The corridors between Dudhwa NP and Kishanpur WLS, and between Katerniaghat WLD and Dudhwa NP, may be difficult to recreate, owing to large-scale private ownership of highly productive agricultural land there. Restoration of a 100-200m wide riverine corridor along Mohana River, with the involvement of local people, should be attempted. The patches of Government-owned forest land between Dudhwa NP and Katerniaghat WLD, including the marshy areas, should be intensively planted and managed with cover-giving species such as bamboo, *jamun*, cane and *Ficus hispida*. The fragile connectivity between Dudhwa NP–Bardia NP–Katerniaghat WLD is a hope.

Relocation of human settlements

Resettling of *Gujjars*

It is vital that the forests of this elephant range should be made as disturbance-free as possible. In this regard, relocation of pastoral *Gujjars* who live in the Shivalik FD, Rajaji NP, Lansdowne FD (including Rajaji-Corbett corridor), the western portion of Corbett TR (former Kalagarh FD or Sona Nadi WLS) and Terai East FD is a must. The presence of *Gujjars* within the forest has become incompatible with the conservation of the elephant, an endangered species, which needs enormous amounts of forage, clean water, and disturbance-free cool forests for resting during the day. *Gujjars* should be involved in every step in the resettlement process. Resettlement should be done following the model of Ghaindikatha where *Gujjars* have been resettled in fringe forest areas and are given incentives to build and live in their traditional huts.

Relocation of villages

It is imperative to translocate several villages and encroachments which will strengthen the corridors, habitat integrity and reduce biotic disturbances.

Chilla-Motichur corridor area

People in two villages (Khand Gaon III, and Ganga Bhagpur Thalla village between Ganga River and the power channel on the left bank of the river), in the Chilla-Motichur corridor area, have to be resettled. This latter village of about 30 families is close to the only patch of riverine forest about 2.5km long, along the entire length (2,500km) of the Ganga River that is still being used by elephants. If people from this village are not translocated, the riverine forest will eventually disappear, as a result of the firewood and timber needs of the village people. Translocation of this village would create at least 1km^2 of flood plain grassland habitat. Land for the resettlement of Ganga Bhagpur Thalla village can be found in Bibiwala, where Khand Gaon III is to be resettled. Johnsingh *et al.* (2004) even recommend the shifting of Ganga Bhagpur Malla and Kunaun *goth* villages to Barkote Range which has lost all the large mammal values because of the firewood needs of the Rishikesh population.

Corbett Tiger Reserve

Three villages from Corbett TR have to be shifted as soon as possible. These are Ringora between Dhangari and Bijrani, Amdanda near Bijrani, and Laldhang on the southern boundary. Ringora and Amdanda were once cattle camps but have now become established villages. They can both grow further, disturbing and destroying the contiguity between the reserve and Ramnagar FD. The villagers of Laldhang are willing to move out, and the Government of India has already approved their proposal for resettlement. The proposed relocation site in West *Terai* FD has already been clear-felled. The encroachers in the Kalagarh Colony should be evicted. This is possible only when the Government of India, the Government of Uttaranchal, Government of Uttar Pradesh and NGOs interested in the conservation of Corbett TR work together.

Ramnagar FD

Tedha Village near Bangajhala Valley (Ramnagar FD), which has about 50 families and 600 cattle, causing immense damage to the habitat, also needs translocation.

It is urged that all the above-mentioned villages be translocated as soon as possible. The successful resettlement of Jhirna, Dhara and Kothi Rau Villages, which was done in 1994, stands as an excellent model to be emulated. For the relocation of Ringora, Amdanda, and Tedha Villages, sufficient fertile land is available in Gabua forest patch of West *Terai* FD.

Terai East FD

There are numerous encroachments, *Gujjar* camps and Bengali villages in Terai East FD. Efforts should be made to resettle all these people in patches of forests along the southern boundary of the FD. Priority should be given to resettle the encroachments from Khatima Range (e.g., Devipura Majgaun, Pachoria and Patta) as the Range has to play a crucial role in corridor connectivity.

From Pilibhit and Katerniaghat FDs

The encroachments from Belha in Pilibhit FD need to be removed. In the Katerniaghat WLD, only one village, Bharthapur, is located in the very important trans-Girwa area of the Sanctuary. If this village could be removed,

the entire biodiversity-rich trans-Girwa area, which is of great importance for large mammals like rhino and elephant, would be free from permanent human inhabitation. No scheme, however, has been proposed to date.

Total ban on sand and boulder mining in crucial wildlife areas

Presently Uttaranchal Government may get Indian Rupees 30-50 crores annually from sand mining and this source of income may be important for this young State formed in November 1999. But the Government has to weigh its options whether to allow mining to totally degrade its reserve forests, or to stop mining to enable the reserve forests to contribute to the overall biodiversity conservation in the State which plans to carve out a future based on ecotourism. The Government of India could assist Uttaranchal by giving a special annual conservation subsidy of Indian Rupees 50 crores for several years with the agreement that no mining be allowed and Uttaranchal meanwhile will consolidate its revenue generation through other means such as ecotourism, sale of mineral water, etc.

Creation of mini core areas

As a result of the inability to create large tracts of undisturbed habitats, the establishment of 30-100km^2 mini core areas is suggested, which should be free from all forms of disturbance. The following areas are suggested to be managed as mini core areas:

(a) The Dholkhand, Malawali, Andheri, Ganjerban and Lakarkot forest blocks south of Shivalik Ridge in Rajaji NP

(b) The Motichur, Koelpura (east) and Koelpura (west), Danda and Behereda forest blocks on the northern side of the Shivalik ridge in Rajaji NP is an important area for elephants in summer, due to the availability of water.

The above forest blocks should be cleared of *Gujjars* and managed as a mini core.

(c) A few elephants use the forest blocks around Bulindwala and Phandowala areas in Ramgarh Range of Rajaji NP. There are few *Gujjars* in this area, and it will be fairly easy to clear this area of human presence and manage it as a mini core.

(d) The Dogudda, Suni and Mundal *sot* areas in Chilla, if cleared of human use by *Gujjars* and the people from Gangabagpur Thalla and Malla Villages, will form an excellent habitat for elephants on the east bank of River Ganga in Rajaji NP. Present resettlement of *Gujjars* being carried out by Uttaranchal FD may eventually create the mini-core areas mentioned here.

(e) The Rawasan catchment area, with its perennial water, can form the nucleus of another mini core. *Gujjars* from this area need to be relocated, and disturbances arising from the nearby Laldhang Village, including poaching, should be controlled.

(f) The forests on either side of Malin River in Rajaji-Corbett corridor should be made into a mini core, by controlling human use of this area.

(g) There are 20 to 30 *Gujjar* families in Koluchaur, Lansdowne FD, and they are willing to move if a proper resettlement package is offered. The main reason cited for their willingness to move is the difficulty in transporting milk over 20km to the nearest market (Kotdwar). Their ordeal becomes even more difficult during the rainy season. Steps should be taken to resettle these *Gujjars* to secure what is possibly one of the finest habitats not only for elephants, but also for other wildlife. Logging in this area should be banned and the revenue lost by this can be gained through the promotion of ecotourism in this wildlife-rich area.

(h) The Bangajhala Valley in Ramnagar FD can be another excellent mini core area which will necessitate shifting of Tedha Village with about 50 families and 600 cattle which cause enormous damage to the habitat.

(i) In Haldwani FD, the Nandaur Valley including the Durga-Pipal area, is suitable for forming a mini core. It is possible to create either a 300-400km^2 National Park or Wildlife Sanctuary in this area.

(j) The Lagga Bagga area of Pilibhit FD needs to be developed as a mini core because of its crucial value as a corridor between the Royal Sukhlaphanta Reserve and the Pilibhit FD. Intensive protection and participatory management with the villagers living on the right bank of Sharda River, who depend on Lagga Bagga for firewood and thatch grass, will be required to help the area recover.

(k) In Katerniaghat WLD, the entire trans-Girwa and Katerniaghat Ranges, along with the adjoining areas of Nishangarha Range, are well suited to be managed as a mini core area.

(l) The forests on the west bank of Sharda River, belonging to Champawat FD (South Pithoragarh FD), require special attention for conservation. Large mammals can move from this area to Nepal across Sharda River.

Planting monoculture plantations with species suitable for elephant

Presently, the monoculture plantations seen in and around the elephant range, offer very little to elephants in terms of forage and cover. This shortcoming of plantations as elephant habitat can be overcome through

the planting of other tree species in patches. It is suggested that, for example, for every square kilometre of eucalyptus plantation, one hectare be clear-felled, and planted with a patch of unpalatable species such as *Holoptelia integrifolia* and *Pongamia pinnata*. Once these patches establish themselves, then species such as bamboo can be planted in their cover. There will also be the growth of several other palatable species such as *Mallotus philippensis* from the original rootstock. This will benefit not only elephants but also several other ungulate species like sambar (*Cervus unicolor*), leopard (*Panthera pardus*) and tiger (*P. tigris*). The forest divisions that need this attention are Haridwar, Bijnor, West Terai, Central Terai, East Terai, Pilibhit, Dudhwa TR and Katerniaghat WLD. In the *terai* region of UP, the moist grasslands were planted with eucalyptus and teak in the past. These plantations should be gradually removed from these grasslands and care needs to be taken that weeds do not take over, once the overwood is removed. The grasslands, which are important habitats for species like the hispid hare (*Caprolagus hispidus*), Bengal florican (*Eupodotis bengalensis*) and swamp partridge (*Francolinus gularis*).

Eco-development and conservation education

Along its boundaries, this tract has a long interface with human settlements. An enormous number of people are dependent on the forests of this Elephant Range for their fuel and fodder requirements. To conserve and manage elephants in this area, such pressures need to be reduced. Therefore, eco-development activities in cooperation with the villagers need to be launched as early as possible. These should include fuel and fodder plantations, popularizing smokeless *chula* and solar cookers, and reduction of scrub cattle by the promotion of hybrid cattle. The corridor areas identified above, the villages along the northern boundary of Dudhwa NP, and the large enclave of Tharu Village in the Katerniaghat Range would need immediate attention. Conservation education emphasizing the importance of forests and wildlife should be an integral part of this eco-development programme (Johnsingh *et al.* 2004).

Anti-poaching measures

Poaching of tuskers for ivory needs the attention of the Government throughout this range. Vigilant anti-poaching measures are urgently required. Poaching has been a problem in the forests east of Haldwani (Haldwani, South Pithoragarh and East Terai forest divisions). As this forest tract is adjacent to Nepal, poachers have found it easy to poach in this area. Special efforts will be needed to protect this population, and enable young bulls to mature to create a genetic linkage with the elephants of Sukhlaphanta Reserve and Kheri FDs. Control of poaching should be the concerted efforts of the Uttaranchal and Uttar Pradesh forest and police departments.

Reducing mortality caused by trains

This can be achieved by the following:

(a) Build a mechanical steel barrier between Haridwar and Motichur *rau* on the western side of the railway track. There is no need for elephants to cross the railway track and come to the eastern side which is full of human habitation. The mechanical barrier should also prevent domestic livestock from entering the forests. This will lead to habitat recovery, enabling elephants to find sufficient forage in the forest. This would also reduce the pollution of waterholes by buffaloes, which is a major conservation problem in Rajaji NP (Johnsingh and Joshua 1994).

(b) As elephants often get killed in locations where the terrain on either side of the railway track is in the form of steep banks, efforts should be made to flatten these banks. This would enable elephants to move away when trains speed along the track.

(c) As elephants have the habit of feeding on the edible household wastes discarded by people, sustained efforts should be made to educate the public and railway employees not to leave garbage along the railway track.

(d) It has often been recommended to realign the railway track from Haridwar to Rishikesh, and then to Dehra Dun, bypassing Motichur and Kansrau Ranges. This is an expensive recommendation, involving nearly Indian Rupees 100 crores (US$20 million), and the track would go through Rishikesh and Barkot Ranges, which are also occasionally used by elephants. Therefore, this expensive option should be carefully considered.

Research

Although wildlife populations in the Rajaji NP have been well researched over the last two decades, much research needs to be carried out in other parts of this elephant range. Future research should focus on elephant use of corridors, human-elephant conflict, population dynamics of elephant food trees, and monitoring the habitat, population and population structure of elephants. In this regard, long-term monitoring of the elephant population dynamics in Corbett NP, and in the forest tract between Haldwani and Sharda River, should be taken up. A satellite-telemetry study of elephants in Dudhwa-Kishanpur-Suklaphanta and Katerniaghat-Bardia should also be a priority to understand the ranging patterns of elephants.

Training

The forest staff in this Elephant Range need training in assessing and monitoring the status of habitat and elephants. The methods taught should be simple, reliable, and consistent over time. The staff should also

be equipped and trained in anti-poaching measures.

Domestic elephant management

There are 18-20 domestic elephants in Uttaranchal, largely in the custody of the Forest Department, and 115-140 in Uttar Pradesh with the Forest Department and private ownership (Bist 2002).

Shivalik–Terai Elephant Range

This entire Elephant Range should be designated as the Shivalik–Terai Elephant Range, and managed by one senior-level forest officer in the rank of Chief Conservator of Forests (CCF), whose focus should be to solve the problems related to the corridors, and resettlement of *Gujjars* and villages. The CCF should also be entrusted with the task of converting the monoculture plantations to habitats suitable for elephant, strengthening protection across this elephant range, and ensuring the proper care of domestic elephants. Conservation of this elephant range should be combined with the planning of the Terai Arc Tiger Conservation Landscape (WWF 2000; Johnsingh *et al.* 2004).

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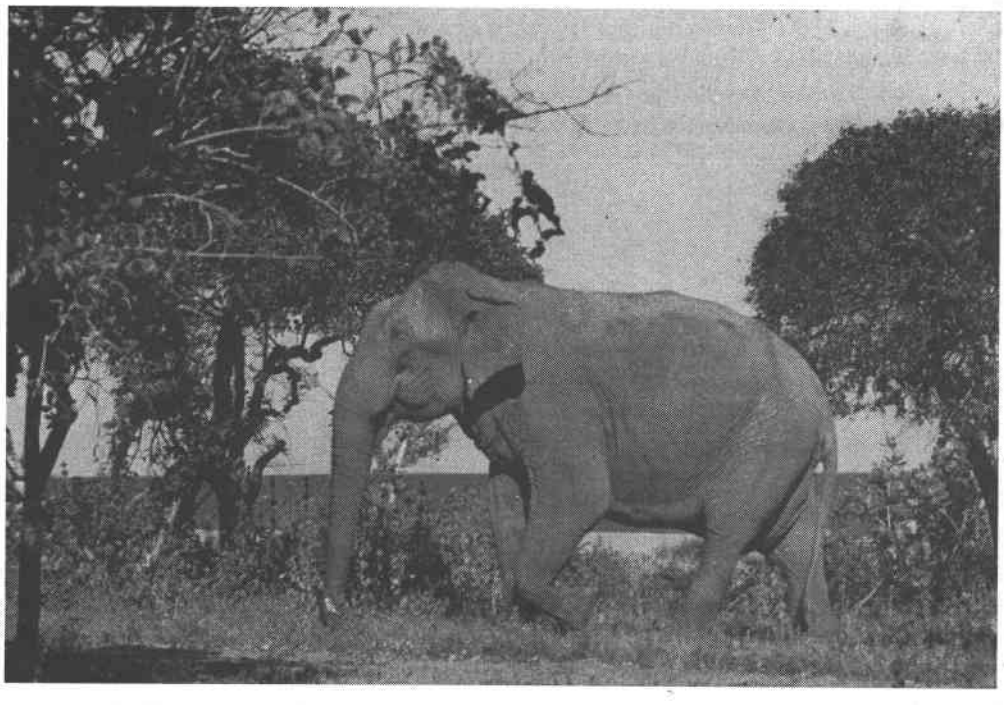


Photo: Dr. H. I. E. Katugaha

Elephant Conservation in South India: issues and recommendtions

R. Sukumar and P.S. Easa

Contributing authors: Surendra Varma, Arun Venkataraman, N. Baskaran, N. Sivaganesan

Status and distribution of wild elephants

The elephant is distributed over hilly terrain of the Western Ghats and a part of the Eastern Ghats in the southern Indian States of Karnataka, Kerala, Tamilnadu and, relatively recently, Andhra Pradesh. Its range lies between 8°15'N and 15°30'N and 74°15'E and 78°E, and is characterized by a diversity of vegetation types including medium elevation tropical evergreen forest, montane stunted evergreen forest and grassland, semi-evergreen forest, moist deciduous forest interspersed with grasslands, dry decidous forest and dry thorn forest, in addition to planted forests. Over this range of habitat types elephants are seen from an elevation of 100m a.s.l. to over 2000m a.s.l. (Nair *et al.* 1980; Sukumar 1985, 1989; Anon 1993; Easa 2001; AERCC 1998).

The distribution of the elephant can be considered under the following major population categories for the sake of convenience. This is modified from the earlier categories used by Sukumar (1989) based on new information on habitat connectivity:

(a) Northern Karnataka
(b) Crestline of Karnataka Western Ghats
(c) Bhadra–Malnad
(d) Brahmagiri–Nilgiris–Eastern Ghats (Elephant Range 7)
(e) Nilambur–Silent Valley–Coimbatore (Elephant Range 8)
(f) Anamalais–Parambikulam (Elephant Range 9)
(g) Periyar–Srivilliputhur (Elephant Range 10)
(h) Agasthyamalais

Of these, the following four populations (Sections 11.2 to 11.5) have been designated Elephant Reserves by Project Elephant, a conservation endeavour funded by the Indian government.

(a) Northern Karnataka

The elephants of northern Karnataka represent the northern limit of distribution of the species in southern India. They range over the Uttara Kannada and Belgaum Districts of Karnataka state mainly in moist and dry deciduous forests. The estimated population is about 40-60 elephants, completely isolated from populations further south along the Western Ghats. The only Protected Area (PA) for elephants here is the Dandeli Wildlife Sanctuary (WLS), whose area has now 475km^2 from the earlier 5,729km^2. A proper survey of status and distribution of this population is needed.

(b) Crestline of Karnataka Western Ghats

The status of the elephants ranging as small, scattered groups across the evergreen forests and montane grasslands in the Districts of South Kanara, Mangalore, Shimoga and Chickmagalur is poorly understood. It is however clear that the population numbers across this range is very low, not more than about 60 elephants.

(c) Bhadra Sanctuary–Malnad

The Malnad Plateau lying east of the Ghats is separated from them by a tract of coffee plantations and cultivation. The Bhadra WLS (827km^2) is the major habitat for elephants that range over moist deciduous forest. The latest estimate for this region is 500 elephants. A major ongoing resettlement scheme for villages within the reserve is completed and is expected to improve the overall viabilty of the habitat for the elephant population here. This region also maintains tenuous links with the Pushpagiri/Brahamagiri Range further south, but the precise nature of these links is yet to be explored.

(d) Brahmagiri-Nilgiri-Eastern Ghats (Elephant Range 7)

The largest single population of elephants in Asia today is found in this range, which extends from the Brahmagiri Hills, south through the Nilgiri Hills and east through the Eastern Ghats within the States of Karnataka, Tamilnadu and Kerala (with a splinter group in Andhra Pradesh). Covering an area of over 12,000km^2 and a minimum population of 6,300 elephants (Table 11.1), this range still maintains tenuous links with Elephant Range No. 8 (Nilambur-Silent Valley-Coimbatore), with a few elephants moving between these two ranges and possibly maintaining some gene flow.There are four important zones with relatively intact habitat and/or large elephant populations within this range. These are:

(i) Brahmagiri Hills covering parts of Karnataka (Brahmagiri Sanctuary) and Kerala (Wynad North Division), with good evergreen forest, montane shola forest and grassland and elephants at a low density.

(ii) Nagarhole, Bandipur, Wynad, Mudumalai PAs and the Nilgiri North Division with moist deciduous and dry deciduous forests and a very high elephant density and population.

(iii) Biligiriranganswamy Temple (BRT) Sanctuary (within the Chamrajnagar

Division) and eastern portions of the Satyamangalam Division with a diversity of vegetation types, including dry thorn forest, deciduous forest, montane shola forests and grassland and a medium to high density of elephants.

(iv) A 100km tract along the Cauvery River in Karnataka (Cauvery Sanctuary, Kollegal Division) and Tamilnadu (Hosur and Dharmapuri Divisions) with dry deciduous and dry thorn forest and a medium density of elephants.

The priority should be to maintain these habitats and the interconnections between them. With a moderately unequal sex ratio, the effective population size of elephants in this reserve is much less than its potential size. Nevertheless, this population is demographically and genetically viable from a long-term perspective, with a largely protected habitat and should thus be maintained as the key population for the long-term conservation of the species.

Geography of the Elephant Range

This elephant range is situated in the States of Karnataka, Tamil Nadu and Kerala. The terrain of the range is mostly undulating with low hills varying from 400-2,207m a.s.l. (the highest altitude being in the Nilgiri North Division). To the northwest of this range, the Brahmagiri Hills in Karnataka rise to 1,607m a.s.l., and are a part of the Western Ghats. South-east and south of the Brahmagiris, the range extends through the Wynad Plateau, the northern Nilgiri Hill slopes, the Mysore Plateau, to the Sigur Plateau and down to 250m a.s.l. in the Moyar River Valley which is the eastern limit of the Western Ghats. To the north-east, the Moyar Valley rises up the steep slopes of the Eastern Ghats to the Talamalai Plateau (750m a.s.l.) and then through a series of hills to

Fig. 1 Elephant distribution in Southern India

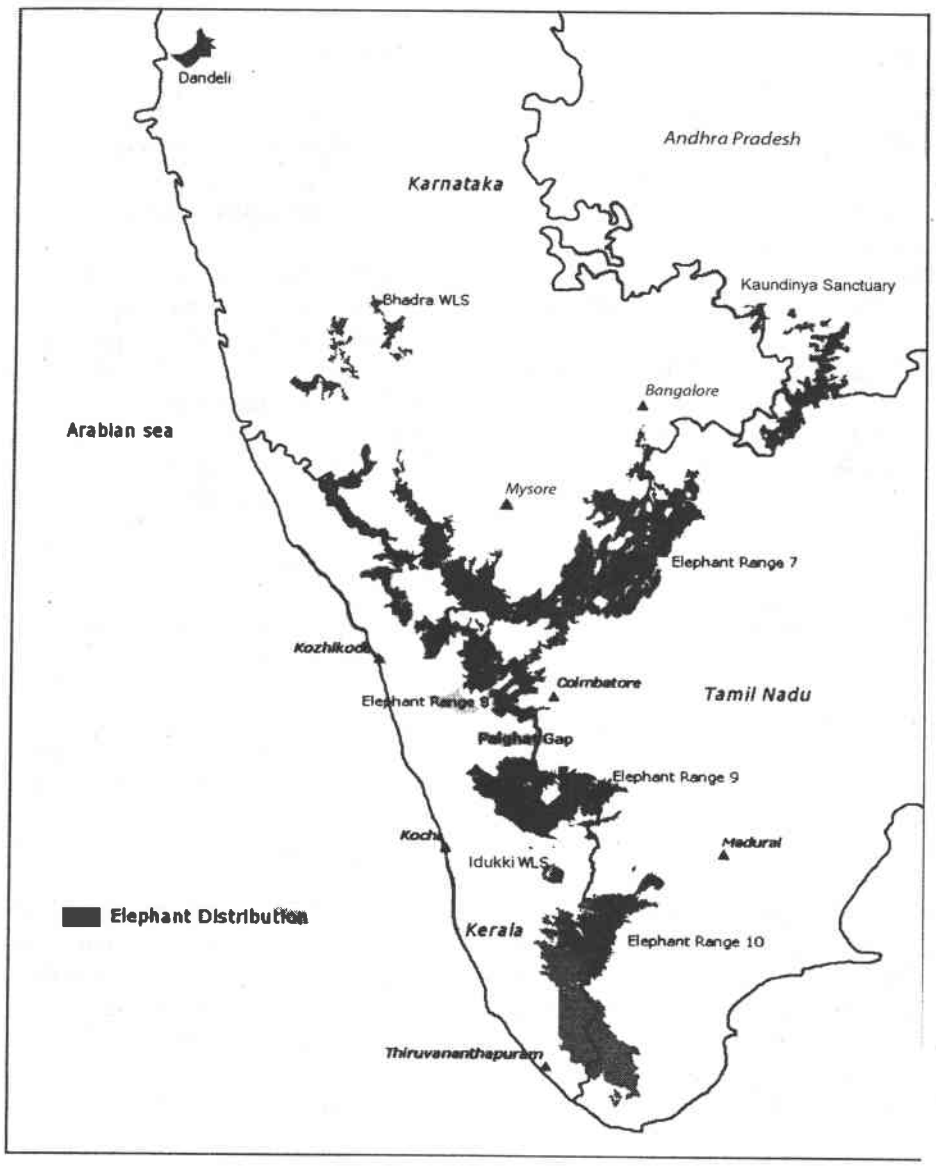


Table 1. The estimated number of elephants in southern India (TN = Tamil Nadu; KA = Karnataka; KE = Kerala).

Name of Division	Area (km^2)	Elephant Population	
		Minimum	Maximum
Brahmagiri Sanctuary (KA)	181	50	184
Virajpet (KA)	*336*	33	68
Madikeri (KA)	*373*	64	105
Rajiv Gandhi NP (KA)	*644*	842	1439
Bandipur PTR (KA)	*874*	1469	2484
Nugu Sanctuary * (KA)	*32*	12	41
Chamrajnagar Sanctuary (KA)	*560*	411	*774*
Kollegal (KA)	*1145*	190	518
Cauvery Sanctuary (KA)	*511*	509	1109
Mandya * (KA)	*194*	14	14
Bangalore Rural * (KA)	317	?	?
Bannerghata NP (KA)	*104*	21	121
Wynad North (KE)	214	138	?
Wynad South (KE)	323	58	?
Wynad Sanctuary (KE)	344	700	?
Kozhikode * (KE)	324	65	?
Mudumalai Sanctuary (TN)	*321*	647	*761*
Gudalur (part) (TN)	93	?	?
Nilgiri North (TN)	*854*	525	558
Nilgiri South (TN)	150	23	?
Satyamangalam (TN)	*1360*	556	1193
Erode (TN)	*782*	154	181
Dharmapuri (TN)	*529*	81	100
Hosur (TN)	*907*	251	296
Total	**11,472**	**6,813**	**9,946**

The estimates are based on total counts (made during 1979 and 1983) and sample block counts (1993) by the forest departments, direct line transect counts and indirect dung counts (Karanth and Sunquist 1992) at Nagarhole, IISc and AERCC at Mudumalai, Bandipur and Wyanad (Sukumar *et al.* 1991; Varman and Sukumar 1995) and KFRI (Anon 1993) at Wynad. Repeated estimates by rigorous statistical methods consistently return density figures of 2-4 elephants/km^2 in this tract. For other areas, the estimates are more tentative at present. On the whole, the population estimates for this range are probably among the most reliable, in statistical terms. The figures in italics are the results of the 2002 South India Synchronised Elephant Census.

Conservation problems and issues

Habitat fragmentation

As this range extends over a large area of the Western and the Eastern Ghats, and covers four States (including the sub-population in Andhra Pradesh), the problems are also specific to different regions. Broadly, the threat of further fragmentation of habitat still exists for this range. There are numerous enclaves of human settlement and cultivation in the various divisions of the Eastern Ghats (primarily in Bannerghatta NP, Kollegal, Chamarajnagar, Hosur, Dharmapuri, Erode, Satyamangalam), the Nilgiris (Nilgiri North, western part of Mudumalai and Wynad Sanctuaries and Wynad North Division) and in Kodagu District, particularly in the Madikeri Division. Some of these settlements, such as those in the *vyals* or swamps of the Wynad and Mudumalai keep elephants away from their traditional dry season feeding grounds. Coffee plantations in the Kodagu Region have already cut off direct access between Nagarhole and Brahmagiris in Karnataka. North of the Cauvery River in the Madikeri Division, the elephant habitat is highly fragmented and separated by a long belt of settlements (along the

the Biligirirangan Range (highest peak 1,816m). East of the Biligirirangans, the lower hills of Satyamangalam, Bargur and Madeshwaramalai extend to the Cauvery River. The terrain along the Cauvery is rugged, and to its north the Melagiri Hills represent the northern limit of elephant distribution, although some herds are now found further north in the Chittoor Hills of Andhra Pradesh.

The mean annual rainfall varies from 625-5,500mm. The Nugu and the Kabini Rivers flow in the Bandipur Project Tiger Reserve and are the main sources of water during the dry season. The Cauvery River is a major water source within the Cauvery Sanctuary and the Hosur and Dharmapuri Divisions. Some important reservoirs in the range are the Nugu and the Kabini.

The range includes the entire spectrum of vegetation types of Peninsular India and is dominated by deciduous forest. The other forest types found within the range are dry thorn, evergreen and semi-evergreen forests, montane-shola grassland and man made forests. Apart from these forest types, micro-habitats such as swampy grasslands, are also found in the range.

Status, density and distribution of elephants

The population estimates for the various divisions in this range are given in Table 1. With a minimum estimate of 6,813 elephants (and an upper limit of over 9,946) this range has the largest known population of elephants in the country. Indeed, even taking the lower limit, this range has more elephants than any other Asian country, with the possible exception of Myanmar.

Table 2. Estimates of elephant numbers from Tamil Nadu, Karnataka and Kerala States, India. (TN = Tamil Nadu; KA = Karnataka; KE = Kerala)

Name of Division	Area (km²)	Elephant Population	
		Minimum	Maximum
Nilambur North (KE)	325	315	n/a
Nilambur South (KE)	100	210	n/a
Mannarghat (KE)	665	193	n/a
Silent Valley NP (KE)	90	100	227
*Palghat (KE)	239	68	83
Mukurthi NP (TN)	78	n/a	38
Nilgiri South (TN)	150	23	n/a
Coimbatore (TN)	*738*	*125*	*231*
Total	**2,385**	**1,034**	**?**

The estimates are based on total counts made during 1979 and 1983 and sample block counts done in 1993 by the forest departments,) and KFRI (Anon 1993). The figures in italics are the results of the 2002 South India Synchronised Elephant Census.

northern banks) from the forests to areas south of the Cauvery.

Pressures from developmental projects (Pykara Ultimate Stage Hydro-Electric Project and the proposed hydroelectric projects such as Mekkadatu along the Cauvery in Karnataka), also threaten to contribute to habitat fragmentation. A proposed railway link between Chamarajnagar (Karnataka) and Mettupalayam (Tamil Nadu) through the Moyar Valley and the steep slopes of the Eastern Ghats near Talamalai, if implemented, would effectively separate the elephant populations of the Western and Eastern Ghats.

In the Wynad North Division, small areas under contiguous elephant habitat are under tremendous pressure from tea and coffee cultivation. Complete loss of contiguity between the Brahmagiris and the rest of the Division within the Periya Range occurs because of tea cultivation. The dry deciduous tracts are comparatively less disturbed, but have been characterized by an almost complete transformation of natural vegetation into teak plantations.

Isolated elephant herds

During 1983-1984 several elephant herds dispersed from the Hosur and Anekal area northwards into the Chittoor District of Andhra Pradesh. A sanctuary (Kaundinya Sanctuary) was set up for these elephants and about 20-30 elephants are isolated within this reserve. Splinter herds or individuals have wandered further north into the Tirupati Hills and into the Cuddapah and Ananthpur districts of Andhra Pradesh. One splinter herd of 6-7 elephants is also isolated in the Tirupattur Division of Tamilnadu.

Table 3. Estimates of elephant numbers from southern India. (TN=Tamil nadu; KA=Karnataka; KE = Kerala)

Name of Division	Area (km2)	Elephant population Minimum	Maximum
Thrissur (KE)	210	36	98
Nemmara (KE)	352	42	152
Chalakudy (KE)	477	32	93
kothamangalam (KE)	317	32	90
Malayattur (KE)	617	124	194
Vazhachal (KE)	414	312	619
Munnar Division and Sanctuary (KE)	1,185	161	365
Parambikulam Sanctuary (KE)	274	146	217
Anamalai (Indira Gandhi) Sanctuary (TN)	959	470	623
Kodaikanal (TN)	407	10	?
Dindigul (TN)*	400	70	91
Theni (part) (TN)	450	103	140
Total	**6,062**	**1,538**	**2,692**

* indicates estimates from block counts (all other estimates are based on the indirect dung count method). the estimates are based on census carried out during 2002 using sample block counts and indirect (dung) count by the forest departments in collaboration with the Asian Elephant Reserch and Conservation Centre (AERCC 2002a, b) for Tamil Nadu and karnataka, and by Kerala Forest Reserch insitute for Kerala reassessed by AERCC and Project Elephant directorate. Repeated estimates by rigorous statistical methods such as line transect direct counts consistently return density figures of 1- 4 elephants/km2 in this tract for the Nagrahole-Mudumalai-Bandipur Wynad tract (Karanth and Sunquist 1992; Sukumar et al. 1991; Varman and Sukumar 1995; Centre for Ecological Sciences unpubl). For other areas, the estimates are more tentative at present. On the whole, the populaiton estimates for this range are probably among the most reliable, in statistical terms.

Table 4. Estimates of elephant numbers in Kerala and Tamil Nadu, southern India (TN = Tamil Nadu; KE = Kerala)

Name of Division	Area (km^2)	Elephant population Minimum	Maximum
Theni (part) (TN)	272	62	84
Srivilliputur Sanctuary (TN)	380	133	179
Periyar PTR (KE)	777	1,065	1,717
Konni (KE)	332	31	74
Achenkoil (KE)	264	47	98
Ranni (KE)	1,059	175	297
Punalur (KE)	280	12	30
Total	**3,364**	**1,526**	**2,479**

The estimates are based on census carried out out during 2002 using sample block counts and indirect (dung) count by the forest department in collaboration with the Asian Elephant Research and Conservation Centre (AERCC 2002a. b) for Tamil Nadu and karnataka, and by Kerala Forest Research Institute for Kerala reassessed by AERCC and Project Elephant directorate. Repeated estimates by rigorous statistical methods such as line transect direct counts consistently return density figures of 1-4 elephants/km^2 in this tract for the Nagarahole-Mudumalai-Bandipur-Wynad tract (Karanth and Sunquist 1992; Sukumar *et al.* 1991; Varman and Sukumar 1995; Centre for Ecological Sciences unpubl.). For other areas, the estimates are more tentativeat present.On the whole, the population estimates for this range are probably among the most reliable, in statistical terms.

Anthropogenic pressures on habitat

The large human population both within and along the periphery of the range has made substantial impact on the vegetation in some regions, especially outside the PAs. The causes include extraction of fuel wood, collection of NTFPs (non-timber forest products), grazing by domestic livestock and collection and export of dung as manure. FDs and areas most affected by this include Hosur, Dharmapuri, Erode, Satyamangalam, Nilgiris North, Masinagudi Range of Mudumalai (Tamilnadu), Kanakapura Range, Kollegal, a part of Chamarajnagar (Karnataka) and Wynad (in Kerala).

Human-elephant conflict

Given the extent of cultivation and the abundance of elephants, this range has serious problems of elephant-human conflict. Crop depredation by elephants is common in practically all forest divisions, both in cultivated enclaves and along the outer boundary of forest and settlement. Cases of manslaughter by elephants, often associated with crop depredation, are also widespread in the range. Most sanctuaries, national parks and divisions in this range are surrounded by human settlements. Although no particular division can be singled out, the high degree of fragmentation in places such as Kodagu, Wynad and Bannerghatta does seem to result in greater conflict. During the dry season when major areas of Mudumalai and Bandipur are burnt, elephants migrate westwards towards Nulpuzha, the only water source in the whole area. The high concentration of elephants bring them into conflict with the settlements. Crop-

raiding reaches high levels in areas of Madikeri Division where the habitat is highly fragmented and cultivation pressure is very high.

In Bannerghatta National Park, around five kilometres away from the north-west corner of the park, there is a distillery which maintains around 250ha of eucalyptus plantation and scrub-jungle along with a large tank of water. Elephants are reported to use this as a base from which they conduct nightly raids on surrounding crop fields and then return to it during the day. Effluents discharged from the distillery into the streams and/or illicit distilling within the premises may be attracting the elephants to this area. A dramatic manifestation of this in Bannerghatta has been the dispersal of over 50 elephants from here to Andhra Pradesh during 1983-1984, and what seems to have been a similar effort during 1995 by a herd of about 80 elephants.

Poaching

The large population of elephants with over 90% of the males being tuskers has also led to widespread poaching during the past two decades. No Division has been completely free of this menace, although the levels seem to have been the lowest at Nagarahole NP. During this period, poaching has been noticeable in Hosur, Dharmapuri, Erode, Satyamangalam, Nilgiris North, Mudumalai, Kollegal, Chamarajanagar, Bandipur and Wyanad. Consequently, the sex ratios in this region are becoming increasingly skewed with time. Objective data on population structure and sex ratio are available only for some areas. During 1981-1983, the Chamrajanagar and Satyamangalam Divisions had an adult (>15 years) male: female ratio of 1:5. This widened here and in the adjoining Nilgiri North, Mudumalai and southern Bandipur tract to about 1:8 by 1987. Monitoring of sex ratio in the Mudumalai and Nilgiris North populations indicates that the sex ratio had widened to about 1:30 by 2001.

Recommended actions

Elephant conservation priorities for this range include maintaining habitat contiguity through protection, acquisition and creation of corridors, consolidation of habitat through translocation of some settlements, habitat improvement through promotion of regeneration and afforestation, minimizing elephant-human conflicts through setting up of barriers and population management and control of ivory poaching.

Restoration and preservation of crucial elephant corridors

Brahmagiri-Tirunelli corridor (Karnataka; Brahmagiri Sanctuary, Kerala; Wynad North Division): The elephant populations in the Western Ghats of northern Karnataka along the Brahmagiris are connected to those in the Coorg Plateau only through the northern Wynad Region of Kerala. The southern tip of the Brahmagiris extends into Kerala's Wynad North Division, where the Tirunelli RF and Kudrakote RF provide a narrow connection eastwards to the Tholpatty Range of Wynad Sanctuary. There are eucalyptus and teak plantations in this corridor and also some settlements (Edayurvayal and Panayankolli). This is an extremely important corridor to maintain habitat contiguity for elephant populations in the Western Ghats, and should be accorded a very high priority. Resettlement of villages should be carried out and strict protection against habitat degradation ensured.

Singara-Masinagudi corridor (Tamil Nadu; Mudumalai Sanctuary, Nilgiri North Division): The contiguity between the elephant habitats in the Nilgiris and the Eastern Ghats is today maintained entirely by movement through private lands and forest land leased to the Tamil nadu Electricity Board. Penstock pipes between Glenmorgan and the Singara power station obstruct any elephant crossing along the Nilgiri slopes. Further north between Singara and Masinagudi Villages, elephants move in an east-west direction through a private forest belonging to Singara (coffee) estate. New developments connected with the Pykara Ultimate Stage Hydro-Electric Project are increasingly threatening the existence of this crucial corridor utilized by several elephant clans as revealed by a BNHS study (Desai 1991; Desai and Baskaran 1996). At least a portion of this forest should be acquired and maintained for the elephant movement to continue.

Masinagudi-Moyar corridor (Tamil Nadu; Mudumalai Sanctuary): Further north, between Masinagudi and Moyar Villages, the 7km-long flume channel carrying water from Maravakandy Reservoir to the Moyar Power Station passes through the Mudumalai Sanctuary. A small strip of land on either side of the channel has been leased out to the Tamilnadu Electricity Board. Elephants at present cross the channel at certain points. The Tamilnadu Electricity Board proposes to widen the canal and line the sides with concrete to increase water flow as part of the Pykara Ultimate Stage Hydro-Electric Project. The preservation of this corridor should be strictly ensured, and no development activity be allowed to disrupt the movement of elephants.

Kaniyanpura corridor (Karnataka; Bandipur Project Tiger Reserve): This corridor connects the western parts of the Bandipur National Park with its eastern extremeties. This area maintains a contiguity to habitats within the Sathyamangalam and Chamrajnagar Divisions. The corridor is extremely narrow (20m wide) and is bordered on one side by an elephant-proof trench running through private land and on the other, by the steep slopes of the Moyar Gorge. Private lands need to be purchased to widen this corridor.

Punjur - Kolipalya corridor (Karnataka; Chamarajnagar Division): A 1.5km-wide strip of RF between the villages of Punjur and Kolipalya in Chamarajnagar Division (BRT Sanctuary) was traditionally used by

over 100-200 elephants moving between the Punjur Range (Chamarajnagar Division) and the Satyamangalam Division (Tamil Nadu). During 1990 tribals from the Biligirirangan Hills were rehabilitated on this corridor by the forest department, and the forest was cleared for cultivation. This has completely obstructed the movement of elephants along this tract. To the east of Punjur village, there is insignificant movement along the steep hill slopes, while to the west of Kolipalya, there are other settlements and cultivation. The restoration of this corridor by resettling the tribals on the forest periphery, and providing elephant-proof barriers around the villages of Punjur and Kolipalya is necessary.

Talavadi-Mudahalli corridor (Karnataka; Chamarajnagar Division, Tamil Nadu; Sathyamangalam Division): Elephants going to the small Suvarnavati Reservoir often use the corridor between the villages of Talavadi and Mudahalli. This corridor connects the Chamrajnagar (Karnataka) and Sathyamangalam (Tamil Nadu) Divisions. Survey of the corridor, its strict protection and provision of appropriate barriers in the villages to prevent crop depredation are priority actions.

Sujalkottai-Bannari corridor (Tamil Nadu; Sathyamangalam Division): Located in the Sathyamangalam Division, connecting the Moyar valley to Guttiyalattur RF, this corridor is extensively used by elephants during the dry season. The habitat is highly degraded due to fuelwood collection, cattle grazing, NTFP collection, human habitations and agricultural lands which border the corridor (Sivaganesan and Sukumar 2000).

Bekkatur - Arabikere corridor (Karnataka; Chamrajnagar and Kollegal Divisions): This corridor located in the Chamrajnagar Division, connects the habitats of Chamrajnagar and Kollegal Divisions. The elephant range to the east of the Biligirirangan Hills has been divided by a long strip of cultivation, extending from the town of Kollegal, south to the Tibetan settlement at Byloor, a distance of 50km, with the Doddasampige RF (in the BRT Sanctuary) being nearly cut off from the Ramapuram Range in Kollegal Division. Only a narrow one kilomete corridor now exists between the villages of Bekkatur and Arabikere along the Kollegal-Satyamangalam highway. Strict protection of this corridor is essential.

Chattiramdoddi-Hunsanhalli corridor (Bangalore Division, Karnataka; Hosur Division, Tamilnadu): The Bannerghatta National Park, parts of Bangalore Division in the Kanakapura Range and the northern part of Hosur Division (Thalli RF) are at present practically cut off from the Cauvery Sanctuary and southern part of Hosur Division through intrusion of cultivation between Chattiramdoddi and Hunsanhalli Villages. Elephants move through cultivated fields and small patches of jungle between these two regions. If the northern portion comprising Bannerghatta National Park and adjacent ranges has to maintain its viability as elephant habitat, it is essential to maintain a forested corridor in this region. Some acquisition of land may be needed to establish this corridor. A proper survey to explore the feasibility of this corridor is needed.

Periya corridor (Kerala; Wynad North Division): In the Wynad North Division, a narrow corridor connects the Kottiyur RF with the Kannoth RF within the Periya Range. This corridor cuts the Mananthavadi-Tellicherry road (north) and is essentially a strip of jungle less than 100m wide. The corridor has semi-evergreen vegetation and is not under great pressure. The terrain in other areas where the forest reaches both sides of the road precludes crossing.

Pakranthalam corridor (Kerala; Wayanad North Division): This is another narrow corridor located in Wyanad North Division, connecting the northern and southern portions of the Periya RF along the Mananthavadi-Kuttayadi-Tellicherry Road (south) at Pakranthalam. Highly degraded scrub-jungle characterize this corridor, which is once again situated on a steep Ghat road. The lower reaches of this corridor actually pass through fallow estate land.

Sampaje corridor (Karnataka; Madikeri Division): The range of the elephant population in the Brahmagiris extends further north to the Pushpagiris and beyond. The exact distribution and habitat connections have to be determined through surveys. There are several places where habitat contiguity has been or could be broken. One of these is along the Madikeri-Mangalore Highway. This highway through the Ghats has steep sides for a major part and is flanked by coffee, cardamom, coconut and arecanut plantations. Only a three kilometre stretch between the Glencoorg Estate and the Sampaje Range Office is used for crossing by elephants. The elephants actually move through the Glencoorg Estate to reach the road. A proper survey and protection of this corridor is essential to maintain north-south movement along the Western Ghats.

Nanjarayapatna corridor (Karnataka; Madikeri Division): The Cauvery River defines the western edge of Dubare RF (45km^2) and separates it from Anekad RF (30km^2) situated about 0.5-3.5km further west. The area between the river and Anekad RF is completely cultivated with paddy, coffee, coconut and other crops, restricting free movement of elephants between the two forests. There is no contiguity between the forests at any point. However, Dubare and Anekad adjoin other forests to their south and north respectively. Movement of elephants between the two forest patches is widespread and regular, increasing in frequency during the paddy growing season. Almost all the crossing occurs after dark as the region is well populated by humans.

Pallivayal-Tattur corridor: (Kerala; Wynad Sanctuary): This corridor connects Kuppadi RF with Kurichiat RF of the Kurichiat Range of Wynad Sanctuary. It is two kilometres wide, with plantation (mainly pepper and banana) along the edge. Most of these plantations are

protected from elephants using electric fences. There is a proposal to construct a road through this crucial corridor, which runs from Sultan's Battery to Pallivayal. Once this road comes into use, the connection between Kuppadi and Kurichiat would be lost.

Control of poaching

Given the large elephant population in this range, it would always be an attractive target for ivory poachers. In the past, poaching was widespread throughout this range. In recent years, however, poachers have been operating mainly in the high density areas of Nagarhole, Bandipur, Wynad, Mudumalai, Nilgiri North and Satyamangalam. Inter-state coordination for patrolling the border areas and intelligence gathering and exchange has to be strengthened. In these Divisions, in remote and sensitive areas, permanent or temporary (depending on the situation) and patrolling camps with wireless communication systems should be established to make species and forest protection more effective.

Minimizing elephant-human conflict

High priority has to be given to controlling crop depredation and manslaughter by elephants. Elephant-proof trenches have been dug along the periphery of Nagarahole NP. There are, however, a large number of gaps at places where streams and gullies emerge. Some of these are being plugged with solid walls which are very expensive. Alternative designs, including use of discarded steel railway lines (rolling stock), may be tried here and at other places on an experimental basis. Electric fencing has been used quite successfully around settlements in the Wyanad Sanctuary and this has to be strengthened here and in other areas.

In addition to measures such as elephant-proof barriers, *ex-gratia* payments, crop insurance, relocation of settlements, etc. there is also a need for population management in Madikeri Division and other places where forests are highly fragmented and conflict is severe. Some capturing of elephants which have been identified as a threat to human life and notorious crop raiders may have to be undertaken in such areas. This should be preceded by a population survey to quantify population structure, sex ratio, population size, etc. in order to ensure that capture does not disrupt the normal demographic processes. Translocation of some elephants into small, fragmented forests may also be tried out in conjunction with barriers to prevent them from going back to their original home. Systematic monitoring of crop-raiding intensities is however never done to determine the efficacy of different methods used. However, any method of preventing elephant visitations to human habitation requires more experimentation and the results should be monitored more scientifically.

Relocation of human settlements

It is important to begin the process of habitat consolidation in this range through gradual relocation of some settlements from highly fragmented areas which adjoin contiguous forested tracts. Apart from relocation of settlements from the corridors mentioned above, the settlements in the western portion of Wynad Sanctuary and Mudumalai Sanctuary should be given priority.

The Wynad Sanctuary is a critical area for conservation of the Asian elephant. It forms a refugium for wildlife from the adjacent sanctuaries during the dry period from January to June. Extensive fires in the adjacent sanctuaries further complement the need for migration to the Nulpuzha in the Wynad Sanctuary. The human settlements are scattered within the sanctuary. To provide a contiguous forest, some settlements should be relocated or moved to a single location.

(e) Nilambur-Silent Valley-Coimbatire (Elephant Range No. 8)

With an estimated minimum of a few hundred elephants (Table 2), the elephant population in this range is certainly viable in the short term from the standpoint of demography and genetics. The herds comprising the population are, however relatively dispersed due to the considerable degree of habitat fragmentation. If action is not taken to prevent further fragmentation, this relatively low density elephant population is in danger of splitting into several, completely isolated populations. The only large contiguous tract within this range is the New Amarambalam - Silent Valley RFs along with a small part of Attapadi RF. Protection of corridors and habitat consolidation should thus be a high priority in this range. Existing links with Elephant Range No. 7 should also be maintained and strengthened where possible.

Geography of the elephant range

The geography of the range is influenced by the Nilgiri Mountains. From the Nilambur Plains at 100 m a.s.l., the elephant range rises steeply to Kollari Betta situated at 2,594 m a.s.l. Most of the range therefore, consists of steep hills, cliffs and valleys, with very little flat land. Separated from the Nilgiris, and situated in the north of the range is another knot of mountains comprising the Nilambur and Manjeri Kovilagams. The terrain within this range extends in a south-eastern direction encompassing the western (New Amarambalam RF), south-western (Silent Valley RF) and southern (Attapadi RF) escarpments of the Nilgiris. To the south of the Nilgiris, the Attapadi valley separates the former from the Palghat Hills which extend to the Palghat Gap.

Given the great variation in elevation, rainfall too varies across the entire range. In the northern portion of the range comprising the Nilambur North and South Divisions, in the Kovilagams, Silent Valley and the New Amarambalam RF, the rainfall varies between 2,000–5,000mm. Moving eastward along the Attapadi Valley towards Agali, the rainfall steadily decreases and reaches a low of 900mm. In the Coimbatore Division the average

rainfall varies from 750mm in the plains and along the foothills to about 2,000mm on the hills.

The major rivers in the range are the Chaliyar flowing south-west and draining the Nilambur and Manjeri Kovilagams, the Karimpuzha flowing west through the New Amarambalam RF, the Kuntipuzha flowing south through the Silent Valley RF and the Bhawani with its source in the Upper Nilgiris and draining eastwards into the Cauvery.

Vegetation types within the range

This elephant range contains a diversity of vegetation types as a consequence of its varying climatic and geographical regimes. The vegetation types and the areas where they are found are given below.

Wet evergreen forest:

This vegetation type occurs in the high rainfall areas along the western slopes of the Nilgiris in the New Amarambalam RF (Nilambur South Division) and the Silent Valley National Park. Parts of the Silent Valley National Park were once thought to have had the best examples of this vegetation type, but have been highly disturbed due to excessive conversion to plantations. This vegetation type is also found in the Attapadi RF Block 6 and to a lesser extent in Blocks 1-5 (Mannarghat Division). Patches of forest still exist in the northern parts of the Nilambur Kovilagam (Nilambur North Division) and along the Nilambur-Gudalur road in the north-east of the Nilambur North Division. Small forest patches occur on the upper slopes of the Boolavampatti RF in the Coimbatore Division.

Semi-evergreen forest:

This type is found in portions of the Nilambur Kovilagam, along the Karimpuzha River in the New Amarambalam RF and in the Attapadi RF Block 1. Transitional stages are found along the Bhawani River in the eastern forests of the Attapadi RF. It is also found at elevations of 1,200m a.s.l. on the Nilgiri slopes of the Coimbatore Division and at 1,500m a.s.l. in the Boolavampatti.

RF.Moist deciduous forest:

This type is found in many areas within the Nilambur Kovilagam. Most of the plains of the Nilambur South Division, west of the New Amarambalam RF, contain this forest type. This vegetation is also found along the Bhawani River in the Attapadi Valley and in the Walayar RF in the south-east tip of the Mannarghat Division.

Dry deciduous forests:

In all the divisions, this vegetation type is primarily represented in dry teak plantations found at foothills.The drier eastern portions of the Attapadi Valley and the Walayar RF at the south-western tip of the Mannarghat Division have some examples of this vegetation. Eastwards into the Coimbatore Division, along the lower slopes of the Nilgiris, this is the dominant vegetation type. It is also found in the Boolavampatti RF within the valleys.

Shola forest and grasslands:

This is found in the upper reaches of the Nilgiris, from 1,250-2,000m a.s.l. above the New Amarambalam RF and the Silent Valley National Park where the average rainfall is above 2,500mm. It also occurs in the upper reaches of the Attapadi RF. The best tract of this vegetation type is found in the Mukurthi National Park and portions of the Nilgiri South Division.

Dry thorn and scrub forest:

This type is found up to an elevation of 1,000m a.s.l. along the slopes of the Nilgiris. It also occurs in the Anaikatti areas and in the eastern reaches of the Boolavampatti RF in the Coimbatore Division.

Status, density and distribution of elephants

The elephant density and population sizes for divisions in the range are given in Table 2. The density estimates are based on the dung count method used by the Kerala Forest Research Institute for Kerala and forest department censuses using direct counts in Tamil Nadu.

The population within the range could be considered distributed in three distinct areas. The first area comprises the Nilambur and Manjeri Kovilagams situated within the Nilambur North Division. The second major distribution occurs in the New Amarambalam RF in the Nilambur South Division, the Silent Valley National Park and the Attapadi RF Blocks 1-5 in the Mannarghat Division. Migratory paths also lead from here to the Mukurthi National Park and the Nilgiri South Division. A small number of elephants regularly migrate up the steep slopes to the Nilgiri Plateau. The third distribution occurs to the south of Attapadi, in the Siruvani Hills, comprising the Coimbatore Division in Tamilnadu and Attapadi RF Block 6 in the Mannarghat Division of Kerala. Contiguity does exist between the three areas, through narrow corridors.

Corridors

Kallar corridor (Tamil Nadu; Coimbatore Division): The Kallar corridor is a narrow strip starting at Gandhapallayam (near the Jackkanare Mountains) and bisects the Mettupalayam-Kotagiri highway. This corridor is constricted between the steep escarpment of Nilgiri Mountains and the agricultural lands at the base of these mountains. The habitat here is contiguous to the Pillur RF and Attapadi Valley (Kerala State). The corridor is narrow with the steep terrain of the Nilgiris eastern slopes on the east and an expansion of the cultivation on the west. The approximate length of the corridor is seven kilometres and the average width ranges

from 0.5-3km. The link between the Sathyamangalam and Coimbatore Divisions is maintained through this corridor. Movement of elephants from Nilgiri North Division to Coimbatore and Mannarghat Divisions is also reported through this corridor.

The Anaikatti corridor (Tamil Nadu; Coimbatore Division): Elephants along the slopes of the Nilgiris occasionally move south into the Boolavampatti RF in the Coimbatore Division and from there further west into the Attapadi RF Block 6. This corridor situated along the Anaikatti-Coimbatore Road is only five kilometres wide and consists of dry thorn forests. It is an extremely critical corridor as its loss would isolate elephants within the Boolavampatti RF and the Attapadi RF Block 6 from the rest of the range. Cattle grazing and fuel extraction are serious threats to the vegetation of this corridor.

The Vazhikadavu corridor (Kerala; Nilambur North Division): Current status of the movement of elephants through this corridor is unknown. The corridor is situated on the Gudalur-Nilambur Ghat road. A stretch of forest exists on both sides of the road. However, the slopes are too steep for easy crossing. Most of the crossing is supposed to occur about five kilometres ahead of the village of Vazhikadavu which is on fairly level ground. A major tract of this forest has been converted to areca-nut, coconut and banana plantations. This corridor effectively connects habitats within the Nilambur and Manjeri Kovilagams with those in New Amarambalam RF in Nilambur North Division.

The Mannarghat–Mukali road corridor (Kerala; Mannarghat Division): The road between Mannarghat and Mukali has a strip of forest which is approximately four kilometres long. In the lower reaches the vegetation comprises dry thorn forest but gets increasingly wetter, attaining a mixture of moist-deciduous and semi-evergreen, on reaching higher elevations. Elephants seem to use this corridor quite regularly to move between the eastern and western portions of the division. However, the significance of this corridor in maintaining genetic contiguity across the population in this range is largely unknown.

Conservation problems within the range

The Tamil Nadu Electricity Board (TNEB) has occupied a large area of RF in the Nilgiri South Division and the Mukurthi National Park regions, in connection with the execution of various hydroelectric projects. These projects have fragmented the forest and caused much disturbance. There are many wood based industries located here and their demands are met by Nilgiri South Division. Most of the areas in this division fall under tea and potato cultivation. Conversion of grassland into varying types of plantations in the Mukurthi National Park and Nilgiri South Division, in the past, has made the quality of the habitat unsuitable for elephants.

The Nilambur and Manjeri Kovilagams, within the Nilambur North Division, once excellent elephant habitat and containing patches of excellent wet evergreen and semi-evergreen forests, have suffered from the lack of effective surveillance. Considerable fragmentation has already occurred due to the establishment of plantation estates such as those of the Gwalior Rayon Corporation and a number of other cardamom, coffee and rubber estates. Recent encroachments have fragmented the available habitats. The actual area under estates and encroachments is still unknown.

The Attapadi RF is a striking example of how human encroachment can transform pristine wet evergreen forests to near desert in a strikingly short time. The road from Mukali to Anaikatti in Tamil Nadu (via Agali), along the Attapadi Valley and parallel to the Bhawani River, has dense settlements which have completely curtailed elephant movement between the two portions of the Attapadi RF. It is only in the western and southern portions of the RF some forest remains. Compensation claims for crop-damage by elephants is minimal, though there is some conflict in the Agali area.

Repeated fire and human encroachment, on the western and southern peripheries of the Silent Valley National Park, seem to be major problems. Even though these convert natural vegetation to grasslands, which may actually be preferred by elephants, their negative impact on the biodiversity of the area is to be seriously considered. A notable feature of the elephants in the park is that they virtually never raid crops even though they have ample opportunity to do so in the periphery. This may be due to the abundance of grasses and reeds the park has to offer.

The dry thorn and deciduous forests of the Coimbatore Division have been degraded in the past due to fire, cattle grazing and fuel extraction. Being relatively arid compared to the rest of the range, agriculture is of the subsistence variety putting a great deal of stress on the forest.

Recommended actions

Protection of corridors

1. The Kallar corridor has to be preserved as it connects the elephant populations of Elephant Ranges 7 and 8. The activity of the residential school and other developmental activities within the corridor area should be monitored.

2. Increased protection of Vazhikadavu corridor, in the forests around Vazhikadavu, through legislation would prevent further encroachment into this narrow corridor. This would also maintain valuable evergreen tracts.

3. Increased protection of the Anaikatti corridor through legislation and surveillance is necessary. Elephants regularly use the fields that lie between Anaikatti and the start of the corridor. Farmers have complained of great

economic losses through crop-raiding by elephants and may be easily convinced to sell their lands. This would effectively increase the width of the corridor by three kilometres bringing it to a total of eight kilometres.

Relocation of settlements or acquisition of land

The proposal made by the Kerala Forest Department to acquire 120ha of the Mandanmutti Estate bordering the Silent Valley National Park should be given serious consideration. Most of the forests around the National Park are in private hands, blocking the movement of elephants from the park into habitats within the Attapadi RF. Acquisition of this tract of land will facilitate this movement.

Illegal encroachment into the Attapadi RF and Nilambur FDs should be immediately stopped as a priority. Demarcation of boundaries by the construction of cairns to protect RF and boundaries is essential.

The evergreen forests of Silent Valley NP are being degraded, often into grasslands, because of high incidence of fire. Protection against fire and promoting natural regeneration and forest succession should be taken up through a scientifically designed programme. To protect the buffer land, a proposal exists to include another 200km^2 from the Attapadi RF in the park. This would not only increase the available protected elephant habitat but would also preserve the rich, though highly threatened forest type.

The proposal to bring some of the area of Nilgiri South Division under the Mukurthi National Park has to be given priority.

(f) Anamalai-Parambikulam (Elephant Range No. 9)

This range extends over a relatively large area and has a sizeable population of elephants. The elephant population seems demographically and genetically viable from a long term perspective, although this has to be verified from field data. The habitat is, however, under threat of multiple fragmentation due to a variety of causes — numerous hydro-electric projects (dams, canals, penstock pipes and a power house), tea estates and cultivation and development along major roads. This population is completely cut off from the one further south in Range No. 10. Management priorities would include the maintenance of corridors, habitat restoration, control of ivory poaching and minimizing elephant-human conflict.

Geography of the range

This range is situated south of the Palghat Gap, in the states of Kerala and Tamilnadu. Topographically, the range comprises portions of three major hill ranges of the Western Ghats. The central range comprises the Anamalai Hills (*anai* = elephant), rising from the Palghat Gap to a peak of 2,690m a.s.l. at Anaimudi (the highest peak in southern India), while to the west the Nelliampathis extend as a spur into the Malabar Plains, and to the east, the Palani Hills descend to the Coimbatore Plains. The rainfall varies between 900mm on the eastern side, within the Chinnar Wildlife Sanctuary to 5,000mm on the western side. The range has several perennial and semi-perennial river systems and man-made reservoirs. Notable among them are, the Periyar River forming the southern boundary of the range, the Chalakudy river north of the Periyar, the Kallar River, the Pambar River, Kudaraiyar River within the Chinnar Wildlife Sanctuary and Porandalar River, forming the approximate eastern boundary of the range. The important reservoirs in this range are Parambikulam and Thunakadavu, in the Parambikulam Sanctuary, Sholiyar in the Vazhachal Division, Aliyar, Amaravathi, Thirumurthy in the Indira Gandhi Sanctuary and Mattupatti and Anairangal Reservoirs in the Munnar Division.

Vegetation types The complex topography and rainfall gradient contribute to a striking diversity in vegetation. The forest types in this range include:

Wet evergreen forest

Fairly intact patches of wet evergreen forests exist in the western or windward side of the Western Ghats, especially in areas where the precipitation exceeds 2,500mm. Vazhachal Division, Parambikulam Sanctuary and Nemmara Divisions probably contain the most intact of these patches.

Semi-evergreen forest

This vegetation type is found where some degradation of wet evergreen forests occur. It also occurs in portions of Malayattur Division, Vazhachal Division, Nemmara Division and Parambikulam Sanctuary.

Moist deciduous forest

Areas within the Chalakudy Division were once covered with wet evergreen and semi-evergreen forests. As a result of human induced deterioration of these forests most of this forest type has been converted to moist deciduous type. Some parts of the Nemmara Division, Indira Gandhi Sanctuary and high altitude areas of Theni Division display this vegetation type.

Dry deciduous forest

The drier eastern reaches of the Indira Gandhi Sanctuary and the Theni Division are largely covered with this vegetation type.

Teak and other plantation species

A large percentage of natural vegetation in all divisions especially in the Indira Gandhi Sanctuary and the Parambikulam Sanctuary have been converted to extensive teak plantations. Kodaikanal Division has

an extensive area under eucalyptus, wattle and pine plantations.

Moist bamboo brakes

These brakes along with patches of cane, are found in all divisions on the windward side of the Western Ghats.

Shola forest and grasslands

The Eravikulam National Park, situated north of the Munnar Division has some excellent examples of this vegetation type. It is also found at high elevations in the Indira Gandhi and Parambikulam Sanctuaries and the Kodaikanal Division.

In some of the divisions, this natural vegetation has disappeared because of extensive tea cultivation. Between these vast commercial tea estates, patches of shola-grassland type of forest can be observed. In some reserves the natural vegetation has now been converted to extensive teak, wattle, bluegum, and pine plantations.

Status, density and distribution of elephants

Population estimates for the range vary from a minimum of about 1,600 to a maximum of 3,475 elephants (Table 11.3). Population estimates are based on direct count censuses by the forest department of Tamil Nadu and the indirect dung count made by KFRI (Anon 1993).

The figures in itlics are the results of the 2002 South India synchronised elephant census.

There are considerable differences in elephant distribution and densities across this range. A relatively high density (>1 elephant/sq.km) of elephants occurs in parts of Parambikulam, Indira Gandhi Sanctuary and possibly Vazhachal, while medium(0.2 to 1.0 per sq.km) to low <0.2 per sq.km) densities are seen in most other divisions. The populations are basically divided between the western and eastern portions ofthe range, with severaal other small populations or herds being practically isolated, especially in Kodaikanal and Theni Divisions. The former herds are believed to be moving in from Munnar Division while those in Theni Division are confined to a narrow strip of jungle along the eastern slopes of the hills overlooking the Cumbum Valley.

Conservation problems within the range

Threat of habitat fragmentation

Even though there is relatively large habitat area available for this population, the numerous hydroelectric projects, combined with large-scale plantations of tea and cardamom, roads and towns, have fractured the habitat considerably. The elephant population in the range is thus, partially isolated, probably as several sub-populations.

(a) Hydro-electric and irrigation projects: A series of dams, canals, penstock pipes and power stations in recent decades within the range have disrupted the traditional movement of elephants, and in some cases have directly led to their deaths. The reservoirs within the elephant habitat include the Peechi, Poringalkuttu, Sholayar, Parambikulam, Thunakadavu, Peruvaripallam, Aliyar and Amaravathi. The Parambikulam-Aliyar Project has been the main deterrent. Obstacles to elephant movement occur at many places. Penstock pipes along steep slopes from the Sholayar reservoir to a power house completely obstruct elephant movement. The canal leading from the Thunakadavu Reservoir to the Sirkarapathy Power Station is open along four stretches. Elephants and other animals have been washed away by the swift current and sometimes drowned. The last stretch of the penstock canal, down the hill slopes, cannot be traversed by elephants.

(b) Tea and cardamom estates: The central portion of the range (primarily the Valparai and Munnar areas) has been taken up by a number of tea, coffee and cardamom estates. More than 20,000ha is under these plantations. Only in a few places are narrow paths available for elephants to move in an east-west direction. To the south of the range, the extensive cardamom and other plantations in the Devikulam-Periyar Region have completely eliminated the elephant, thus isolating the population of the Anamalais with that of Periyar.

(c) Other cultivations and settlements: There has been an increase in the number and size of settlements on the road, running from Chalakudy to Adirapally Falls 30km away. These settlements have virtually stopped elephants from moving between the northern and southern portions of the division.

Threat of isolated elephant herds

There are several parts in this range where the constriction of habitat has led to virtual isolation of small elephant herds. The viability of these herds and the habitat is in serious doubt. These include the following:

a) Elephants have been visiting the Kodaikanal Region in Palani Hills in recent years. This area mostly contains monoculture plantations of pine and wattle, and small patches of shola forest and grasslands. The narrow belt through which the elephants move on the eastern fringe of the range does not have any long-term prospects of sheltering elephants.

b) In the Theni Division, in the area adjoining Kottamalai (which is the southern limit for elephant movement in the range), the distribution is confined to a very narrow belt of forest along the steep eastern slopes which is also degraded by dense human settlements and cultivation on both flanks. Suranganar Reserve Forest located in the Gudalur

Range in Theni Division, forms the eastern slopes of the Western Ghats along the border of Kerala State. The records reveal that, starting from the foothills of Suranganar RF as well as along the border, there had been planned encroachment both by the people of Gudalur and adjacent Kerala with encroachment slowly increasing during 1985 and 1989. The total area under encroachment in 1976 was reported to be 650ha. in the linear stretches along the border. Due to this encroachment, the entire habitat in the northern portion of the division is confined to a narrow belt of forest on the hill slopes and the elephant movement has stopped in the Kottamalai area itself. The western side of this narrow belt is connected to the Devikulam Range of the Munnar Division, which has extensive plantations of cardamom and tea.

c) Elephants which visit Mathikettan shola forests from the Munnar Division are also trapped between the Bodinayakkanur and Kottamalai areas. This is due to private establishments on the northern side of Mathikettan, as well as degraded forests and human settlements on the southern side (areas of Chinnamanur Forest beat in Gudalur Range).

Habitat degradation

In Malayattur Division, large tracts of forests seem to have been cleared for the illegal cultivation of ganja (*Cannabis indica*). The dimensions of this problem is unclear because of inadequate surveillance.
Extensive transformation of natural vegetation to softwood plantations (chiefly eucalyptus) on the southern banks of the Chalakudy River has destroyed what was once good elephant habitat. At least two time-share resorts have been established on the banks of the river. This may cause an increase in the vehicular traffic, which is already high, as the Adirapalli Waterfalls forms a major tourist attraction. Large tracts of land, cleared in the past, currently with good grass growth, have been earmarked for the establishment of soft-wood plantations.

Large areas of forest in Parambikulam and Indira Gandhi Sanctuaries have been converted to teak plantations. These are often infested with weeds such as *Lantana* and *Eupatorium*. In Vazhachal and Pooyamkutty, there is large-scale extraction of reeds.

Poaching for Ivory

The extent of poaching for ivory is not clear in the range. The limited surveys by KFRI (Easa 2001) reveal an overall male to female ratio of 1:9, which indicates that adult sex ratios may be even more unequal. Ivory poaching thus seems to be a serious problem in the range.

Human-elephant conflict

Conflict is largely confined to the central portion of the range, around the Valparai area, where elephants regularly move across tea plantations. Cases of manslaughter are known every year. Crop depredation in other parts of the range is marginal.

Recommended actions

Preservation of elephant corridors
There are three corridors within this range used by elephants to move between the western and eastern parts, all of which are located in the Indira Gandhi Sanctuary in Tamilnadu. However, the usage pattern of elephants is not well known.

Attakati-Upper Aliyar corridor: This is located in the western part of the Indira Gandhi WLS. Using this corridor along the steep hill slopes, elephants move between Attakati and Kadamparai. This corridor is well used and has undisturbed forest cover. However, constant vehicular movement on the Valparai-Pollachi Road hinder movement.

Ayerpadi-Waterfalls Estate Corridor: This is the second corridor along the Pollachi-alparai Road, located between Ayerpadi and Waterfalls Estates within the Anamalais. There is a very narrow stretch of forest available in this gap. Elephants are reported to cross here during the dry season.

Siluvaimedu-Kadamparai Corridor: This corridor has very steep slopes and a narrow patch of forest between Siluvaimedu and Kadamparai estates. There is very little information on the usage of this corridor.
In addition, the elephants often move through tea plantations as well. The Madupatty Tea Division of the Tata Tea Company is one such example. There is a need for proper survey and documentation of such corridors through the estates.

There is also a need for the survey of elephant movement along the road from Chalakudy to Sholayar. The numerous settlements and cultivation along the road have disrupted elephant movement and existing crossing points have to be identified, protected and strengthened.

Translocation of settlements

People in the Churulipatti enclosure (32ha) of Chinnar Wildlife Sanctuary (Kerala) have expressed a willingness to be relocated outside the reserve. This would establish a contiguous stretch of forest along the border with the Indira Gandhi Sanctuary in Tamilnadu.

Habitat restoration

In areas such as Vazhachal and Chalakudy Divisions the habitat has to be improved for elephants through phasing out of softwood plantations and promoting natural regeneration.

The encroachment, starting from the foothills of Suranganar RF in Theni Division and along the State

border, had resulted in denudation of forest and stopped elephant movement to the Periyar Region. In 1976, eviction of encroachments was initiated. However, the encroachers subsequently entered forest areas and re-encroachment has increased. In August 1994, a fresh eviction operation was started and a total of 275ha was reclaimed. If the entire area occupied by encroachers is reclaimed and habitat improvement operations are initiated, the area would provide additional habitat for elephants with the possibility of restoring the contiguity of the Periyar and Anamalai populations.

Creation of Protected Areas

The status of the Vazhachal Division needs to be upgraded to that of a Wildlife Sanctuary given its excellent diversity of vegetation, high elephant density and abundance of forage species. This may also lead to a better control of extraction of reeds within the Division and possible acquisition of tea estates which have sprung up recently. There is a proposal to declare Kodaikanal Division as a Sanctuary. If that happens, the Sanctuary would promote free movement of elephants and other mammals within the division and from adjoining divisions.

Control of poaching

In most of the divisions within this range, increased surveillance of the interior reaches and interstate coordination in controlling poaching is essential. Communication may be improved by the use of modern high-range wireless systems. The areas currently under *ganja* cultivation need to be mapped and an assessment as to whether they pose an impediment to movement of elephants across the divisions should be made.

(g) Periyar-Srivilliputhur (Elephant Range 10)

This range probably represents the most compact block of elephant habitat in the south, with least fragmentation. Although it harbours a relatively large population of more than 1,500 elephants, the long-term genetic and demographic viability is compromised because of a very distorted adult male to female sex-ratio and age structure. High priority must, therefore, be accorded to the protection from further poaching of male elephants, and to the examination of the demographic and genetic viability of the population. Habitat links with the smaller population further south in the Agasthyamalai-Mahendragiri range (comprising Kalakkad-Mundanthurai and Neyyar Protected Areas) has to be studied and consolidated.

Geography of the range

The range is located in the states of Tamil Nadu and Kerala and covers an area of over 3,300km^2. It lies between 9°-9°45'N and 76°45'-77°45'E with an altitudinal variation from near sea level to 2,000m. The range geographically comprises the southern part of the Periyar Plateau and its eastern spur, the Varshunad Hills. From the west, the Periyar Plateau rises relatively gradually through a series of hills to its highest point (1,830m), while on the east it falls steeply to the Madurai Plains. South of Periyar the Achenkovil valley lies on either side of the Achenkovil River, bounded by high rugged and undulating hills on all the sides, giving the appearance of an oval basin in the hills.

Mean annual rainfall is about 2,000mm in the western part, and lower in the eastern rain shadow. The area is drained by the Periyar River which has been harnessed for irrigation and hydroelectric power by a dam, whose reservoir is the central feature of the Periyar Project Tiger Reserve (PTR). The Vaigai River, draining east flows through the Cumbum Valley bordered by the Varushanad Hills to the southeast. Achenkovil, Pambiyar, Chittar and Kallar are other important rivers which flow in the FDs south of the Periyar Reserve. These divisions have the Kakki and Pamba Reservoirs.

As in other parts of the Western Ghats, there is a strong west to east gradient in rainfall. Tropical wet evergreen and semi-evergreen forests are seen over much of the range including Periyar PTR, Achenkovil, Konni, Ranni and Punalur Divisions, and the ridge of Srivilliputhur Division. Moist deciduous forest and grasslands predominate in the part of the Periyar PTR around the reservoir and portions of Srivilliputhur Division. Theni Division has mixed deciduous on the Varshunad Hills, and dry thorn forest along the foothills. There are also extensive plantations of *Eucalyptus* and to a lesser extent teak in parts of the range.

Status, density and distribution of elephants

There is a distinct difference in elephant density between the Periyar PTR and other divisions of the range. Periyar PTR has a density of 1.1-1.5 elephants/km^2, with a higher concentration around the reservoir and lower abundance away from it. Other divisions in the range have by contrast a low density of between 0.1-0.3 elephant/km^2. The population estimates are summarized in Table 11.4. In total, a minimum of about 1,500 elephants and an upper limit of 1,900 elephants may be taken for this range.

In 1993, the Kerala Forest Research Institute made estimates of elephant density using the indirect method of dung density (Anon 1993) for all the divisions within Kerala. We also have a density estimate for Periyar PTR from the dung count method carried out by Indian Institute of Science in 1994 (Ramakrishnan *et al.* 1998). Outside Periyar PTR, there is need for refining the population estimates through more intensive work.

Conservation problems within the range

Human-elephant conflict

Relatively, there is not much depredation of crops or manslaughter by elephants in this range. Kallar and

Pellavakkalmedu within the Srivilliputur Sanctuary have irrigation dams which promote cultivation at the foothills. Elephants visit these crop lands during the rainy season, resulting in some conflict.

Anthropogenic pressures on habitat

Cattle grazing occurs in the Kotamalai Region and foothills of Srivilliputhur. Illegal cultivation of *ganja* occurs in the interior forests of Srivilliputhur, Theni, Periyar and other Divisions. The *ganja* cultivators cause considerable disturbance to the forests. For the ganja cultivation, prime reed areas, highly favoured as food by elephants, are selected and the area is cleared for the cultivation. There is also illegal exploitation of forest products such as bark of cinnamon (*Cinnamomum zeylanicum*), reeds, etc. within the range.

Sabarimalai Temple, located in the south-western part of Periyar PTR's buffer zone, is an important Hindu pilgrimage site and receives millions of visitors annually, the main season being November to January. The area around Sabarimalai is severely degraded and wild animals move away during the peak tourist season. There are demands for expansion of the Sabarimalai Township to accommodate the increasing rush of pilgrims. During Sabarimala season, millions of people use the roads in Ranni, Konni, Punalur and Achenkovil Divisions for three months and it becomes difficult for the elephants to cross the road, thus affecting their movement. Widening of the road from Ranni-Pamba, with steep slopes on one side and cutting on to the other, has impeded the elephants from crossing the road. During the same season several thousand pilgrims visit the Achenkovil Temple located inside the Division. Forest fires associated with anthropogenic pressures have degraded evergreen forests in many areas.

The ruins of another ancient temple are found at Mangaladevi, 14km to the north-east of Thekkady and bordering Tamil Nadu. Access to Mangaladevi is restricted and requires special permission. However, there is a proposal to construct a road from the Tamil Nadu side, which may cause severe disturbance and damage to the habitat.

In Konni Division the total area under plantations extends up to 8,300ha, the largest in the State for a single Division. A large portion of the deciduous forest has been converted into plantation. In Punalur Division, most of the forest land is cleared for oil palm cultivation and for raising plantations for wood-based industries. Ranni Division was a major supplier of sleepers for the Southern Railways. The Achenkovil Division was earlier under the Kallar Valley Teak Plantation Division and suffered heavily due to uncontrolled extraction. The timber extraction started in the 1960s and continued until the 1980s. Reed extraction and extraction of other forest products for basket and newsprint activities are a major source of disturbance. The habitat is degraded due to fire, extraction of natural resources, weeds and dependence of the people on the forest.

Michaenia weed infestation is another major problem in these divisions. It has spread over an area of 40km^2 in Goodrikkal Range alone.

In Punalur Division, there were 80 enclosures with marginal encroachment. The absence of permanent demarcation of the forest land has led to large-scale encroachment. In Punalur division 29ha of forest land was leased to a mica mine. Now the area is occupied by people who have raised valuable plantations. There are two estates within Achenkovil Division and the Division has three *pandaras* (tribal colonies) along the road in the encroached forest lands. In Ranni Division, seven settlements exist within the reserve. Crop raiding is reported in Angamali and Goodrikkal. Cattle from Tamil Nadu visit the Pasukadatheri Hillocks adjoining the Tamil Nadu border in Achenkovil.
Inaccessibility of the forests in these forest divisions makes it an ideal ground for illegal activities such as poaching, illicit felling, etc.

Poaching for ivory

Historically, this has been the most serious conservation problem within this reserve. Poaching for ivory in Periyar and adjoining areas has been severe during the 1970s and 1980s, but has declined in recent years due to the reduction in the number of tuskers. However, the past rate of poaching has resulted in a highly skewed sex ratio in elephants. Earlier observations by Chandran (Chandran 1990) and by IISc researchers (Ramakrishnan *et al.* 1998) indicated an adult male to female ratio in excess of 1:100, but a more recent survey by KFRI (Easa 2001) over a wider area than the Periyar Reserve has come up with a less skewed adult sex ratio. However, this study still came up with a sub-adult sex ratio of 1:64 that indicates that adult sex ratios in coming years would continue to be very unequal. Most of the historical poaching in Periyar is believed to have been carried out by gangs coming from the adjoining areas of Tamilnadu (Srivilliputhur). It can thus be expected that ivory poaching has also affected the elephant population in the latter region.

Recommended actions

Population management

In the Periyar Tiger Reserve, the elephant population showed a lower birth rate and a negative population growth rate during the 1990s because of the highly skewed sex ratio. This seems to have changed to a certain extent in recent years with a higher birth rate, possibly through the growth of some sub-adult bulls into the adult age class. The possible management of this population through the translocation of bulls should be examined from demographic and genetic viewpoints.

Control of ivory poaching

Because this range has suffered the most from ivory poaching in the past two decades, it is obvious that

curbing poaching should be the high priority here. Coordination between Kerala and Tamilnadu is essential in addition to strengthening anti-poaching infrastructure, intelligence gathering and enforcement.

Habitat management

Planting fodder plants in extracted areas where weeds are coming up is essential. There exists a proposal to purchase the Achenkovil estate through the Vamanapuram Irrigation Project and Compensatory Afforestation Programme. The proposal should be given priority. Demarcating the forest boundary to prevent further encroachment and habitat improvement programmes through soil conservation measures should also be carried out.

(h) Agasthyamalais

A population of between 100 and 150 elephants is thought to range over the evergreen forests of the Agasthyalamalais, cheifly in the Kalakkad-Mundanthurai Tiger Reserve and the Neyyar Wildlife Sanctuary. A few elephants are also found in the Tirunelveli and Kaniyakumari Forest Divisions. The population size, structure and viability here have to more objectively studied before firm recommendations for conservation can be made.

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Efforts to conserve the Asian elephant in Nepal

Shiv Raj Bhatta

Introduction

The land-locked kingdom of Nepal is situated along the southern Himalaya slopes, on the north-eastern frontier of India, between 80°15'E and 88°10'E and 26°20'N and 30°10'N. It is bounded on the north by Tibet (China), on the east by Sikkim and West Bengal (India), and on the south and west by the Indian States of Bihar and Uttar Pradesh. From east to west, Nepal is about 800km long, and has an area of 147,181km^2.

Nepal contains some of the most rugged terrain in the world, 75% of which is mountainous. From south to north the country can be divided into four natural physical belts: (i) the *Terai* (the northern extension of the Gangetic Plains); (ii) the forested Churia foothills; (iii) mid-mountainous region; and (iv) the Great Himalaya Range, up to 8,848m.

Nepal has lost much of its forest and today, less than 15% of the land area is forested. The population is about 19 million, with an average density of 129 people/km^2, but the fertile valleys support human populations at much higher densities. Nepal being an agricultural country, more than 90% of the population is engaged in agriculture, especially in the *Terai*. Nepal experiences a monsoonal climate, which varies with altitude. Major rivers such as Kosi, Gandak and Karnali flow southwards, and offer immense potential for hydroelectric power.

Vegetation and animal life varies with altitude. In the Terai, the most important tree is the sal (*Shorea robusta*), which provides hard and durable timber. Much of the central mountainous area is cultivated, but chir pine (*Pinus roxburghii*) is grown in patches. At higher elevations, the forest is dominated by oaks such as *Quercus lanuginose*, *Q. semecarpifolia* and *Q. lameelosa* and rhododendrons. The Terai is rich in wildlife and is home to the Asian elephant (*Elephas maximus*), Great Indian one-horned rhinoceros (*Rhinoceros unicornis*), tiger (*Panthera tigris*), leopard (*Panthera pardus*), sloth bear (*Melursus ursinus*), gaur (*Bos gaurus*), water buffalo (*Bubalus bubalis*), spotted deer (*Axis axis*), sambar (*Cervus unicolor*) and swamp deer (*Cervus duvauceli*). The Government has set aside conservation areas for the protection of the country's rich and diverse fauna and flora. The Royal Chitwan National Park represents one of the last bastions of the Great Indian one-horned rhinoceros.

Status of the elephant

As Olivier (1978) points out, it is likely that Nepal once had a population of elephants quite distinct from those in northern India. Elephants were once widely distributed in the lowland Terai of Nepal along the Indian border, from Jhapa in the east and Mahakali in the west. They were particularly numerous in the area centred today on the Royal Chitwan National Park (Oldfield 1880). By the 20th century, the elephant population in Nepal began to decline gradually. Its present distribution represents just a fraction of its former extensive range (Fig. 1). About 50 years ago, much of the area known as the Terai at the foothills of the Himalaya in southern Nepal was covered by jungles unsuitable for human habitation due to malaria. These jungles were then home to such large mammals as elephant, rhinoceros, tiger, etc. However, the eradication of malaria in the 1950s resulted in a rapid influx of people from the hills and marked the beginning of the large-scale agricultural development (Santiapillai and Jackson 1990). The arrival of settlers from the north meant the destruction of over 80% of the natural habitat of the elephant and other large mammals (Mishra 1980). After 1950, forests were cleared to export logs to India, to increase food production, and to provide employment to the increasing human population. In the Chitwan Valley (one of the best habitats for elephant) alone, 65% of forest areas were converted for agricultural extension, between 1961 and 1977. One of the reasons for the decline of the elephant population in Nepal has been the use of elephants in Royal hunts. Up to 315 elephants were used for a single Royal hunt in Chitwan Valley in 1930.

Today, as a result of fragmentation of forests, the elephants are restricted to a few Protected Areas (PAs) namely, Royal Chitwan National Park, Parsa Wildlife Reserve, Royal Bardia National Park and Royal Suklaphanta Wildlife Reserve (Figure 18.1). However, elephants frequently move along the Siwalik corridor, Suklaphanta (Nepal)-Kisanpur (India) corridor, and Bardia (Nepal)-Katerniai (India) Corridor. Recently a herd elephants visited the Basanta corridor of Kailali (D. Rai pers. comm.). This is another corridor linked to the Dudhwa National Park, India. Similarly the Bardia elephant population has moved up to the Dang (proposed Royal Bardia National Park extension area). Today, between 106 and 172 elephants are estimated to occur in the wild in Nepal (Table 1), which represents almost a doubling of the number estimated in the 1980s by Santiapillai and Jackson (1990).

Figure 1. Distribution of elephants in Nepal

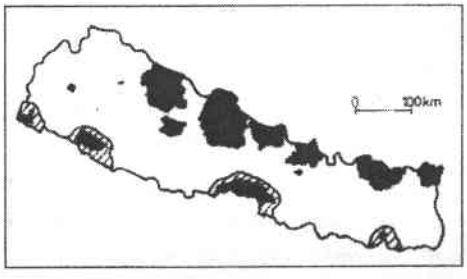


Table 1. Number and distribution of elephants in Nepal.

Population	Estimates		Remarks
	1990	2002	
Eastern	3	10-60	(1 in Koshi-Tappu WLR and 2 in Sunsari-Jhapa area). Today animals appear seasonally from West Bengal.
Central			
Royal Chitwan NP (=Thori-Sikaribas area)	10-15		
Parsa Wildlife Reserve NP	8-12	25	Parsa WLR NP is continuous with Chitwan. Elephants are residential.
Western	7-12	60+	Royal Bardia NP (residential)
Far western	5-30	11-27	Royal Suklaphanta WR (3 resident, rest migratory)
Total	33-72	106-172	

Conservation efforts

Establishment of a network of Protected Areas

In order to conserve Nepal's rich biodiversity, His Majesty's Government (HMG) established the Department of National Parks and Wildlife Conservation (DNPWC) and created a network of PAs, covering 18% of the total area of the country. Of the 16 PAs, four are located within the elephant range. For the long-term goal of preserving Nepal's biological diversity, His Majesty's Government has established the Department of National Parks and Wildlife Conservation (DNPWC). The DNPWC has created a network of Protected Areas (PAs) that include eight national parks, four wildlife reserves, one hunting reserve, and three conservation areas, covering about 18% of the total area of the country. PAs located in lowland Terai are inhabited by several species of large mammals including the elephant.

Habitat extension

Even after the creation of PAs, adjoining potential habitats of endangered species were included in PAs by area extension of the Royal Chitwan National Park, the Royal Bardia National Park, and the Royal Suklaphanta Wildlife Reserve. The major PAs supporting elephants were extended in area. The area of Royal Bardia National Park was increased from 340km^2 to 932km^2 in 1984. It has been proposed to further extend the area of this park by about 900km^2 to the east. Similarly the area of the Suklaphanta Wildlife Reserve was increased from 155km^2 to 305 km^2 in 1997.

Buffer zone

The concept of buffer zone has been adopted in order to manage the peripheral resources to meet the daily needs of the local communities and channel back 50% of the revenue accrued from the PAs to improve the socio-economic conditions of the local people. This provision has highlighted the direct benefit of the PA to the local community and a long-term conservation of biodiversity resources through government-community partnership. These initiatives have been taken as indirect compensation for the negative impacts of PAs. Buffer zone programmes have helped minimize park-people conflict, improve the resource base in the surroundings, create alternative sources of energy, provide several livelihood options, and create conservation awareness (Budhathoki 2004).

Local communities have been involved in the protection, use, and management of forest resources in the buffer zone. As a result, the status of many forested areas in the buffer zone has improved, thereby providing additional habitat for many species including the elephant.

Forest corridors

In areas where forests are fragmented, a system of forest corridors will help establish connectivity between isolated elephant populations (Sukumar 2003). The Department of National Parks and Wildlife Conservation (DNPWC) with the support of its conservation partners, such as the WWF-Nepal Program, GEF/UNDP is committed to the establishment of such forest corridors in order to enhance the passage of elephants across a fragmented landscape. The Terai Arc Landscape (TAL) is a new initiative undertaken by HMG, with support of WWF, to conserve and manage the entire ecosystem of Terai. The TAL area is endowed with rich and varied biodiversity. The TAL area includes most of the elephant range in the country. Conservation and management of this area will greatly help the elephant and other large mammals. The necessity for a trans-border cooperation

between Nepal and India has been recognized and dialogues have been initiated for the conservation of migratory megaherbivores.

Minimizing wildlife damage

Physical barriers: Wildlife watchtowers, trenches, fences, electric fences and scaring devices are being promoted in PAs. This includes technical support to promote traditional methods used by the local communities as well.

Relief schemes: In order to compensate local people for their losses and thereby enlist their support in wildlife conservation, a few schemes have been initiated. There are emergency funds to provide immediate medical support to people attacked by wildlife, relief schemes to provide support to the injured or family members of a victim. Stipend schemes have also been initiated to support women of the family of a victim.

Tourism in Protected Areas

Tourism is one of the major sources of foreign exchange in Nepal. A growing alliance has developed between the tourist sector and PAs. Approximately 27.4% tourists (80,410 out of 293,567) in 1993 and 45.5 % (191,617 out of 421,181) in 1999 visited PAs in Nepal. The tourism industry provides employment opportunities for many people and also functions as a local market for people living in the neighbourhood of PAs to sell their products. This also justifies the benefit of conservation, given that almost 50% of the revenue from the PAs is being channeled back for the development of the buffer zone community.

Human-elephant conflict

Human-elephant conflict is not a new phenomenon in Nepal. It is believed that the conflict is as old as agriculture. Human-elephant conflict intensified by the spread of agriculture into previously unoccupied wildlife habitat. The conversion of forested land to agriculture has lead to serious conflict between man and elephant. Conflicts arise when elephants pass through human settlements, specially cultivated areas. The human-elephant conflict for crop damage is quite widespread and serious in the elephant range countries (Sukumar 1991). Fragmented habitats, small PAs, and degraded corridors have all contributed to the increase in crop degradation, property losses and human fatalities.

Annually, wilderness areas become smaller as forests are opened up for other purposes, thereby forcing elephants to feed on cultivated crops. In extreme situations, the human-elephant conflict has led to the killing of elephants by irate farmers.

The human-elephant conflict in Nepal is expected to be severe in the Royal Bardia National Park, where more than 60 elephants resident in the park move into the Karnali flood plains and the Babai Valley. The human casualties by elephants were few when the population of wild elephant was small. But the situation may have changed today in the light of the increase in the size of the elephant population in the wild.

Recommendations

A detailed assessment of the human-elephant conflict in Nepal needs to be carried out. Such an assessment must include the nature and extent of crop damage caused by wild elephants, and suggest measures towards its mitigation. Damages caused by wild elephants must be compensated adequately and promptly in order to win the support of the local communities. Help must be given to the communities in their efforts to reduce elephant depredations. These may include suggestions for an alternative cropping/livelihood along the periphery of the PAs.

Detailed information concerning the distribution, number and home range, and movement pattern of elephants should be determined. Such scientific information must form the basis for the long-term management of elephants in Nepal.

Nepal and India need to strengthen their efforts in conserving the species across their national borders. Regular exchange of information on the movement and activities of ivory poachers would greatly help combat the problem of ivory trade.

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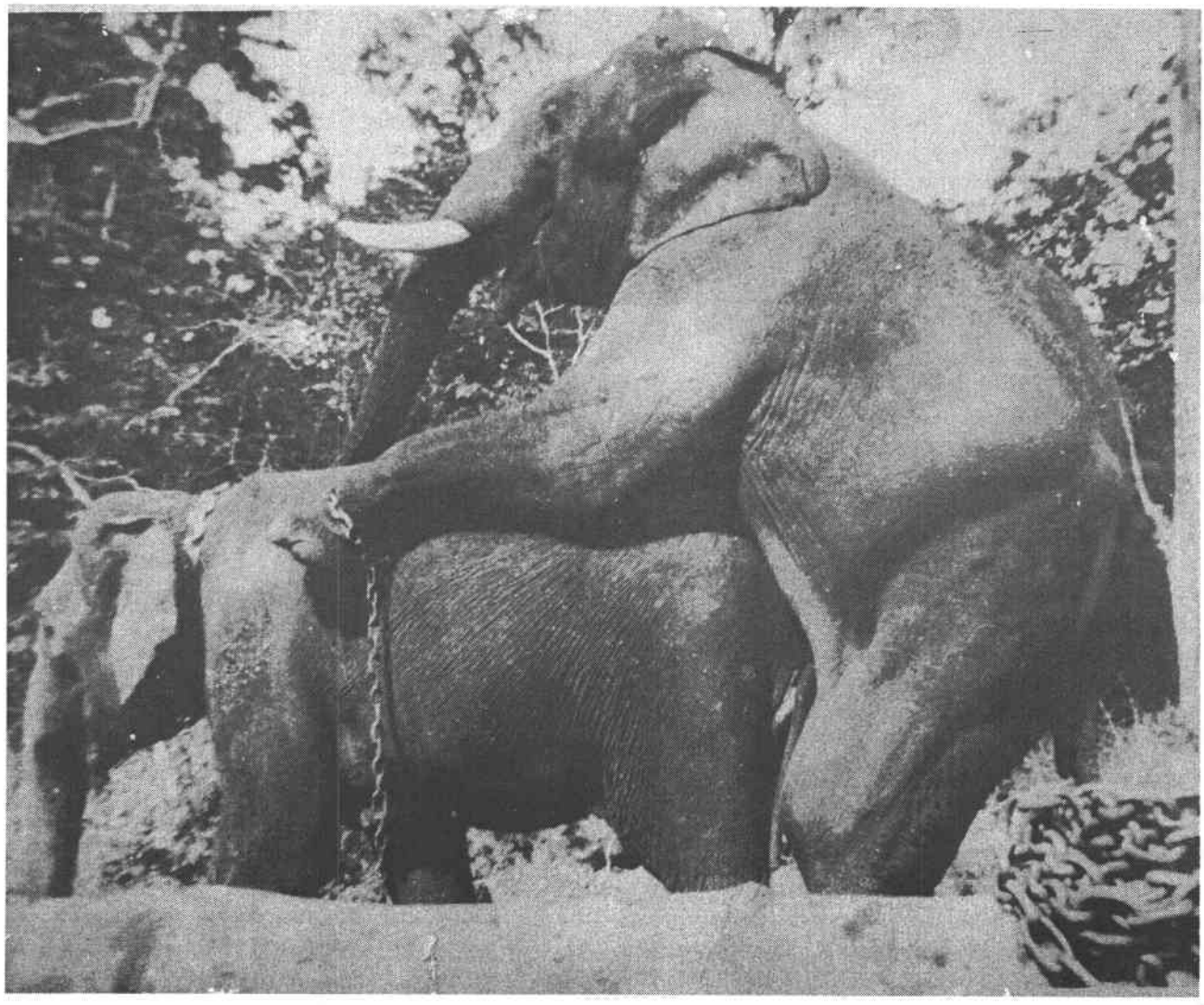


Photo: Dr. John F. Eisenberg (1968)

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

Charles Santiapillai, Prithiviraj Fernando and Manori Gunewardene

Introduction

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

The elephant has been so closely associated with Sri Lanka's history, culture, religions, mythology and even politics that it would be difficult to imagine the island without it. Besides its dominant role in the ecosystem, the elephant also highlights many of the ecological, economical and philosophical issues underlying wildlife management as a whole in the island. Given the small size of the island and the high human population density of 300 people/km^2, elephants are finding it increasingly difficult to move about and adjust their densities to the changing vegetation patterns. Expansion of agriculture and human settlements is leading to continuous contraction of habitat available to the elephant, resulting in the pocketing of elephant herds. Such pocketed elephants have no long-term future (Seidensticker 1984). Child (1995) argues that wild elephants are fundamentally incompatible with peasant agriculture unless the damage they cause can be compensated. However, the situation is somewhat different in Sri Lanka, where elephant presence was found to be incompatible with irrigated agriculture, but compatible with traditional slash-and-burn agriculture (Fernando *et al.* in press). The human-elephant conflict in Sri Lanka has reached alarmingly high levels during the recent past, and is the major cause of elephant mortality. Unless the problem is resolved or mitigated, it will ultimately lead to the elimination of most elephants that range outside the system of Protected Areas (PAs), which amounts to a significant proportion of the elephant population. Wild elephants also often kill people and destroy property. Therefore, as Child (1995) points out, if elephants and PAs are to survive on a significant scale, they must be "socio-politically acceptable, economically viable and ecologically sustainable". Today, the growing conflict between humans and elephants has become the major conservation problem facing the Department of Wildlife Conservation (DWC) in Sri Lanka. For elephant conservation to succeed in Sri Lanka, conservation efforts should be tied to the welfare of the people who bear the brunt of elephant depredations. Elephant conservation in Sri Lanka should not simply be a matter of protecting the charismatic species; it should also be about the well being and survival of the people who share their land with elephants.

Forest cover

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

Protected Areas

Conservation of nature and culture are ancient traditions in Sri Lanka. The tradition of setting aside areas for the express purpose of protecting wildlife goes back to the 2nd century BC. One of the world's first wildlife sanctuaries was established in the island during the 3rd century BC by King Devanampiyatissa under whose reign Buddhism was introduced into the island (IUCN 1990). But it was not until 1885, however, with the enactment of the Forest Ordinance No.10, that legal provision was made to protect wildlife through the establishment of sanctuaries, first at Yala in 1900 and then Wilpattu in 1905 (Hoffmann 1969; Crusz 1973). Today, Sri Lanka's commitment to wildlife conservation is underscored by the amount of land allocated to that purpose. This amounts to a total of 8,579km^2, or nearly 13% of the land area of the island spread across a system of PAs (Figure 19.2), which number 73 (Table 19.1). But while most habitats are represented within the existing PAs, the coverage of tropical wet evergreen and hill forests is still far from adequate (MacKinnon and MacKinnon 1986). Almost all the major conservation areas lie within the dry zone (IUCN 1990), however not all of them support elephants. Given the small size of the country, and that a large fraction of elephant range occurs in non-conservation areas, PAs by themselves are not large enough to accommodate the entire current elephant population. The continued presence of elephants in non-conservation areas will inevitably result in some level of conflict, and management and mitigation of conflict is critical to elephant conservation. Therefore, as Child (1995) points out, the maximum number of elephants that a PA and its surrounding region can support depends not only on the carrying capacity of the land but also on the people's tolerance of the species.

Table 1. Protected Areas in Sri Lanka.

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

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

Elephants in Sri Lanka

Status

To Buddhists and Hindus alike in Sri Lanka, the elephant has an enormous cultural and religious significance. No other animal has had such a close relationship with people as the Asian elephant and still remained wild (Kemf and Santiapillai 2000). *Elephas maximus maximus* that is found in Sri Lanka is the *forma typica* of Linnaeus (Crusz 1986). It was thought to be distinct from the Indian subspecies, *Elephas maximus indicus*, on grounds of genetic divergence based on allozyme variation (Shotake *et al.* 1986). In addition, the flood plains of Mahaweli Ganga were known for some remarkably large animals, which were once thought to belong to a separate subspecies, *Elephas maximus vilaliya* (Deraniyagala 1951; de Alwis 1982), and were referred to as the marsh elephant or swamp elephant. But Ellerman and Morrison-Scott (1951) equate this with the nominate form as the subspecies of elephant inhabiting most of the island (McKay 1973). Recent genetic studies have not supported the case for a separate subspecies status for the Sri Lankan elephant (*Elephas m. maximus*) and its differentiation from those in mainland Asia (*E. m. indicus*). The Sri Lankan population shares several mitochondrial haplotypes with those in the mainland (Fernando 2000; Fernando *et al.* 2000, Fleischer *et al.* 2001). However, Sri Lanka has perhaps the highest genetic diversity of any of the 13 Asian elephant Range States; hence its elephant population is very important in terms of overall Asian elephant conservation.

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

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

Distribution

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

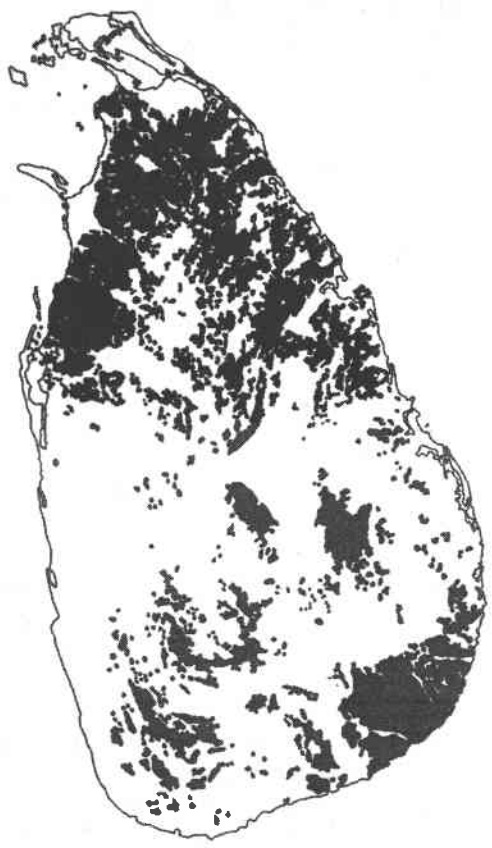


Figure 1. The extent of forest in Sri Lanka.



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

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

Number

The number of elephants in Sri Lanka today is but a fraction of what existed about a hundred years ago (Santiapillai and Jackson 1990). How numerous elephants were at one time can be appreciated by a reference to the numbers captured or killed. Until 1830, elephants were so plentiful that their destruction was encouraged by the Government (Storey 1907), and rewards were paid for any that was killed (Baker, 1853). More than 5,000 elephants were eliminated systematically within a period of just 10 years (Tennent 1867). Major Rogers is credited with the slaughter of no less than 1,400 elephants (Storey 1907), while Captain Galway killed half that number and Major Skinner almost as many (Tennent 1867). In addition to sport hunting, large numbers were also captured for use both locally and abroad. Between 1863 and 1899, a total of 2,190 elephants were exported to zoos in the USA and Europe (Clark 1901), while large numbers went to princely courts in India (Marshall 1846). During the period of British rule, the population of elephants in the wild dropped from an estimated 10,000 to 2,000 animals (Schultz 1984), due partly to excessive hunting, but probably even more because of the loss of habitat when vast areas of forests in the hill country were clear-felled to make way for the establishment of coffee and, later, tea plantations. As a result, the elephant was eliminated from the hill country and the lowland wet zone, and at present survives only in the low country dry zone.

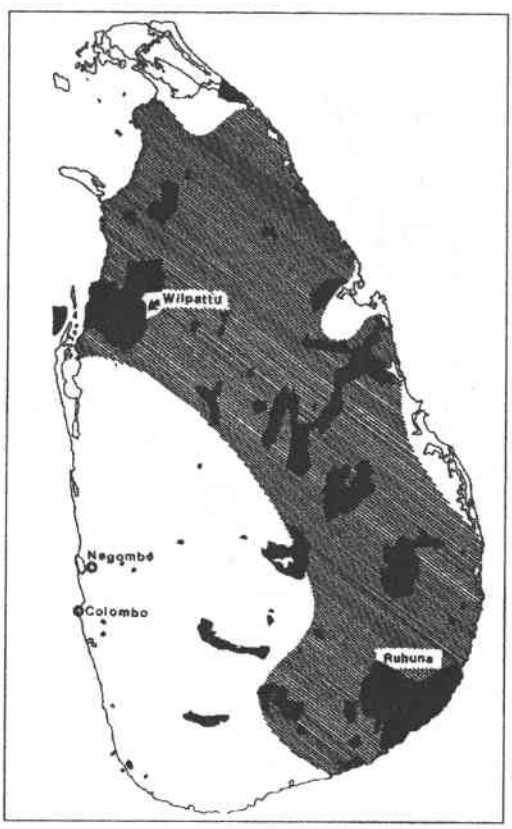


Figure 3 The approximate range of the Asian elephant in Sri Lanka.

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

Conservation issues

Human-elephant conflict

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

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

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

Limitations of the system of Protected Areas

Conservation measures to date have mainly depended on legislative protection of the species and reservation of habitat – essentially keeping people and elephants apart. To its credit, Sri Lanka has set aside 8,577km^2 of the land as PAs for conservation of wildlife: this amounts to almost 13% of the land area. But most of the reserves are established on marginal lands to balance intensive land use in surrounding areas. This approach has led to the establishment of a number of small reserves as islands in an intensively managed landscape. However, the system of PAs is not large enough to accommodate the entire current population of elephants. Of the 14 National Parks that cover an area of 4,987km^2, only two – Wilpattu and Ruhuna – are more than 1,000km^2 in size, while 11 are less than 500km^2. Most of the conservation areas are small with low area:perimeter ratios and many elephants that use them depend on non-conservation areas for their resource requirements in the dry season (Fernando *et al.* in press). The elephant is an 'edge species' preferring secondary habitat (Mueller-Dombois 1971). The main limiting factor for elephants in Sri Lanka is food, and food resources are abundant in regenerating forests, but at low density in mature forests. While traditional slash-and-burn agriculture creates optimum habitat for elephants, through promoting successional vegetation, the lack of habitat management in PAs, leads them to become mature secondary climaxes hence sub-optimal for elephants. The strategy of the DWC has mainly been directed towards limiting elephants to PAs by translocation and erection of electric fences. There is no reason to assume that the elephant populations in the PAs are at anything but the long-term carrying capacity of those areas, and in the absence of massive habitat management, translocation of large numbers of elephants into PAs may result in exceeding their carrying capacity, and hence be detrimental to elephant conservation (Fernando 1997). Thus, PAs alone as viable self-containing oases are poor bets for the long-term survival of the elephant given that almost 65% of the elephant range lies outside the system of PAs. If the elephant is to survive, there must be healthy populations living both within and outside PAs and a landscape approach integrating conservation areas and non-conservation area elephant ranges is required Thus there is a need to recognize that humans are a part of and not apart from nature. Accommodation, rather than protection would be the key to conservation success. This, as Bengtsson *et al.* (2003) point out, implies that conservation of biodiversity and preservation of ecosystem services is of concern for all land use.

Deforestation

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

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

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

Forest conversion

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

Human encroachment

In the Flood Plains National Park, official permits were granted for the establishment of 200 tobacco plots of 1.2ha each. In all, 430 such plots have been established, of which 230 were illegal. An increasing number of unauthorized tobacco cultivations along the riverbanks, and the establishment of brick kilns, which are affecting elephant movement, threaten the Somawathiya National Park. The manufacture of bricks goes on inside the National Park (Anon 1985), presumably using timber from the forest as firewood. In the Wasgomuwa National Park disused pits dug to excavate gemstones have proved a hazard to elephants and other wildlife (Anon 1985). Some elephants have fallen into the disused pits. A vast majority (94% of the population) of Sri Lankans still depend on firewood and animal residues for cooking. Each family requires about 2 tonnes of firewood per year. There is also a substantial increase in the demand for industrial logs, which is expected to grow from 980,000m^3 to 1.4 million m^3. The Forest Department has been unable to curb widespread illegal felling outside the wildlife reserves and, based on current trends, it is only a matter of time before such activities spread into the reserves.

National Elephant Conservation Strategy

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

Recommendations

Mitigation of human-elephant conflict

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

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

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

Establishment of Managed Elephant Reserves (MERs)

One of the significant developments favouring wildlife conservation in general and elephant conservation in particular was the coming together of the Forest Department and the Department of Wildlife Conservation under the single Ministry of Environment and Natural Resources. Such a move has led to greater cooperation between the two departments and enabled the Department of Wildlife Conservation to acquire buffer zones and thereby extend the extent of the PAs. However, where buffer zone areas have been managed under traditional slash-and-burn agriculture, unless such areas are managed to the benefit of elephants through habitat management, paradoxically the increase in PA may result in the decrease in the number of elephants that can be supported by the area (Fernando *et al.* in press). The linking up of conservation areas such as Wasgomuwa, Flood Plains, Somawathiya and Trikonamadu resulted in the formation of an extensive area (1,110km^2) for elephants. This represents the first attempt in Sri Lanka to incorporate the existing national parks and PAs into an overall development plan (Jansen 1986).

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

Recent research, using radio-telemetry, has shown that these assumptions are untenable, and that a landscape approach is essential for the conservation of elephants. Such an approach, based on Managed Elephant Reserves, offers perhaps the best potential to ensure elephant conservation in Sri Lanka and, as such, they need to be implemented. Of the four areas Desai (1998) identified, the southern cluster comprises eight reserves totaling an area of 206km^2. It can be further expanded to 1,323km^2 by linking it to: (a) the Kumbukkan Forest Reserve (376km^2), which extends up to the Lahugala-Kitulana National Park in the east; and (b) other Government Forest Lands (741km^2). Integration of non-conservation areas such as Mattala, Kuda Oya, Yala buffer zone, area north of Ruhunu National Park, etc. in a landscape management approach, will more than double the area available to manage elephants. The north-western cluster is based around the Wilpattu National Park. Although Wilpattu is not an ideal elephant reserve (C. Wickremasinghe pers. comm.), it does support a small population and hence linking it to the Giant's Tank and Madhu Road Sanctuaries in the north would ensure the free movement of elephants to and from the north. It would also increase the conservation area to 1,590km^2.

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

Establishment of elephant corridors

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

Habitat enrichment

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

Determining the status of populations

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

Controlling ivory poaching

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

Improving the effectiveness of electric fencing

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

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

Enhancing ex-situ conservation

Although the Elephant Orphanage at Pinnawala was established for the purpose of caring for displaced, orphaned or injured elephants, from its inception, the authorities concerned were keen to exploit the facility and promote the *ex-situ* conservation of the elephant through a carefully planned breeding programme, in which at least 18 calves were born between 1982 and 2000 (Tilakaretne and Santiapillai 2002). Today about 66 elephants are being kept in a 9ha abandoned coconut plantation. The close bonds between people and elephants in Sri Lanka that has enabled a few thousand elephants to co-exist with 20 million people in a land area only about 65,000km^2 is due to the close association between people and captive elephants. Therefore, continuation of such close ties is an important aspect of conservation, and the captive breeding facility at Pinnawela, can provide an important conservation service in this manner.

Integrating elephant conservation with economic development

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

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

Conclusion

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

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

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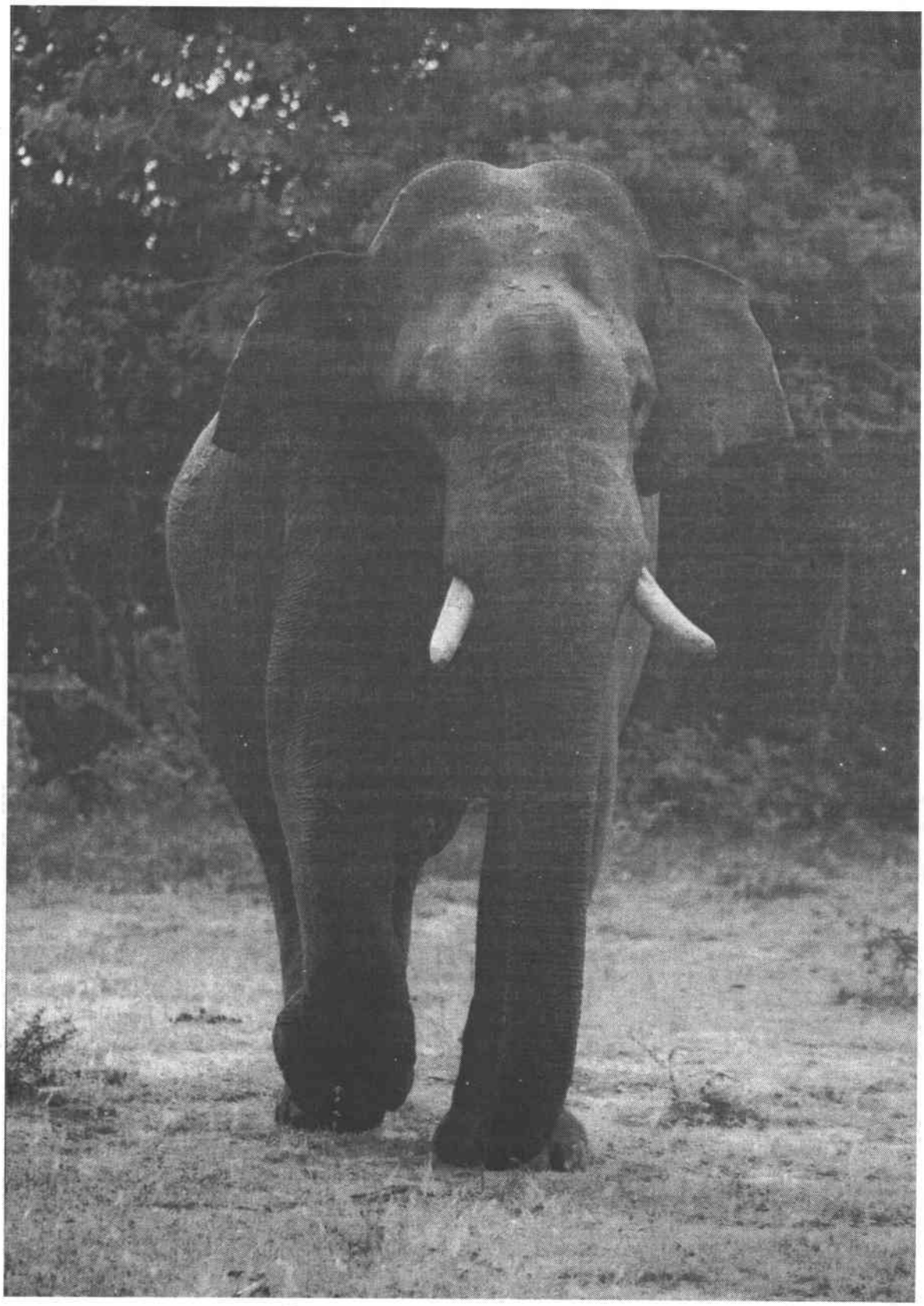


Photo: Dr. H. I. E. Katugaha

Epilogue

With the publication of issue # 25, the future of GAJAH as the Journal of the Asian Elephant Specialist Group (AsESG) remains uncertain. A number of options for the future of GAJAH are being considered and they include its continued publication as the journal of the AsESG, or a possible merger with PACHYDERM, the journal of the African Elephant, African Rhino and Asian Rhino Specialist Groups; or possible extinction of the journal itself, if there are no funds to continue its publication.

Asian elephant, given its special cultural and religious significance to the Asian people, deserves a separate journal to promote its identity, conservation and management. But in the end, it is the AsESG membership that must decide what would be the best option. The success of any journal will depend on the quality of the papers and their impact on society.

The publication of GAJAH traces its origin to the time when the second Chairman of the IUCN/SSC Asian Elephant Specialist Group, Mr. Lyn de Alwis felt the need for a medium of communication in the form of an annual Newsletter. The first issue of the AsESG NEWSLETTER was published on May 1, 1986. The 2nd NEWSLETTER was named HASTHI and was published on July 2, 1987. Both issues were edited by Mr. de Alwis. From 1993, I took the initiative in improving the quality and distribution of the NEWSLETTER and changed its name to GAJAH (after the Sanskrit word for Elephant).

I take this opportunity to thank Mr. Lyn de Alwis, who as the Chairman of the AsESG, not only started the newsletter, but more importantly, gathered together some of the most deserving people to become members of the Group. During his time, there were civilized debates and discourses at meetings. It was through his personal charm and patient diplomacy that the AsESG was able to work with the Governments in countries such as Burma, Cambodia, Indonesia, Malaysia, and Thailand. He took the AsESG into Burma and Cambodia when these countries were virtually closed to outsiders. He also ensured the active participation of the international zoo community. In all his efforts he was greatly supported by the then Head of the Species Survival Commission (SSC), Dr. Simon N. Stuart. GAJAH in the initial stages, owed its survival to the funds provided by WWF-International. Subsequently, the US Fish and Wildlife Service (USF&WS) continued providing the funds for the publication of GAJAH. I owe a great debt of gratitude to Dr. Karl Stromayer (USF&WS) for his constant support and encouragement. I consider myself privileged to have worked with the former Chairman of the AsESG, Prof. Raman Sukumar – an internationally well known and respected wildlife biologist and elephant conservationist, and Mr. Widodo Sukohadi Ramono the Deputy Chairman from Indonesia - in developing GAJAH. The moment of revelation is a little different for every person who experiences it and for me, the road to Damascus came in the form of Prof. Lahiri-Choudhury, who with his inimitable wit, erudition and boundless enthusiasm for elephants, contributed much to the success of GAJAH and enlivened the AsESG, especially at meetings.

The long-term survival of the Asian elephant both in the wild and in captivity must remain the main focus of interest of the AsESG. Our concern must be more on enhancing the survival of viable populations of the elephant than counting carcasses. Resolving elephant conservation problems in Asia needs ideally Asian solutions that give due recognition to the people's perception of the elephant in terms of culture, mythology, and religion. It is therefore encouraging to note the initiative of the Sri Lankan Government in formulating a National Policy for Elephant Conservation and Management. The Task Force convened by the Government to prepare the national policy included six AsESG members. This is one way in which the AsESG can re-establish its position as an authority on elephant conservation, providing advice and assistance to Government agencies.

Unfortunately, there had been a few instances when outsiders working in Asian countries have highlighted the shortcomings and inadequacies of the national conservation agencies vis-à-vis elephant management, at international symposia and meetings, much to the dismay of the host nations. Asians do not like to lose face, especially at international forums. Such individuals and institutions are mercifully rare, and they seem to work on the principle that a squeaky wheel gets the oil. The oil in this instance is money. Some have criticized even the practice of maintaining elephants in captivity in Sri Lanka – a tradition that dates back to more than 2000 years. They have questioned the use of elephants in the annual religious pageant – the Perahera – in Sri Lanka, citing cruelty to elephants. They forget or choose to ignore fox hunting in England or bull fighting in Spain, practices that are far more distressing to watch than caring for elephants in captivity. Such critical individuals and institutions remain inflexible in the application of common sense, and their opposition to the manner in which elephants are managed in Asia is often motivated by the ease with which such a stand could be used to raise funds from the emotional western communities.

There are however, many individuals and international institutions that continue to assist elephant conservation and management in Asia. They are able to match their counsel with the necessary funds to implement their advice. We need to collaborate with them in our efforts to conserve and manage the elephant both in the wild and in captivity.

Charles Santiapillai

Instructions for Contributors

GAJAH is the official journal of the Asian Elephant Specialist Group (AsESG) of the Species Survival Commission (SSC) of the World Conservation Union (IUCN). The journal is intended as a medium for communication and discussion by the members of the AsESG of important issues that concern the conservation and management of the Asian Elephant (Elephas maximus) both in the wild and in captivity. GAJAH welcomes communications and research papers on all aspects of the Asian elephant with the focus on its conservation and management. GAJAH is aimed at professionals, biologists and academics carrying out research on Asian elephant, government and non-government organizations involved in its conservation, and interested members of the general public. All articles published in GAJAH, are deemed to reflect the individual views of the authors and not the official points of view, either of the Asian Elephant Specialist Group (AsESG) or the Species Survival Commission (SSC). GAJAH is a non-profit publication that is supported by financial assistance from the U.S. Fish and Wildlife Service.

Categories of manuscripts

Research articles report research results, and should include a short abstract, introductory paragraph, brief subheads, and references.

Short communications must contain important new findings that are of general interest.

Notes from the field: GAJAH welcomes notes from the field.

Historical notes concern interesting aspects of personalities and events in elephant conservation and management

Miscellaneous includes letters, book reviews and announcements of forthcoming meetings related to elephant conservation.

Preparation of manuscripts

Manuscripts should be in British English. They should be typed double-spaced on A4 paper. Electronic submission (in MS Word) is also acceptable. The manuscript should have an abstract. References should be cited in the text as, for example, Eisenberg & Lockhart (1972) or (Sukumar, 1989). For three or more authors, use the first author's surname followed by *et al.* Multiple references should be in chronological order. The reference list should be in alphabetical order following the Harvard author-date system. Write out journal titles in full. Acknowledgements should be as brief as possible. In the reference list, cite the publications as follows.

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All manuscripts must be addressed to Dr. Charles Santiapillai, Editor, GAJAH, Department of Zoology, University of Peradeniya, Sri Lanka. e-mail: csantiapillai@gmail.com

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